Identification of Factors Associated with Fume Events

Using Text Mining and Data Mining Methods"

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Identification of Factors Associated with Fume Events Using
Text Mining and Data Mining Methods

4k

Mary D. O'Connor

Vj ku'f kuugtvcvkqp'y cu'rtgrctgf 'wpfgt'vjg'fktgevkqp'qh'vjg'ecpffcvgøu'Fkuugtvcvkqp
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Eqo o kwgg'Ejckt'

Eqo o kwgg'O go dgt'	Uvgxgp'J co r vqp."Gf ÖF 0 Cuuqekcvg'F gcp."Uejqqn'qh'I tcfwcvg' Uwfkgu."Eqnkgig'qh'Cxkcvkqp'
Eqo o kwgg'O go dgt'	Cncp'L0'Uvqn| gt."Rj ÖF 0 F gcp."Eqnkgig'qh'Cxkcvkqp'
Eqo o kwgg'O go dgt'	Nqp'O qgmgt."LÖF 0' Ugpkqt'Xkeg'Rtgukfgpv'hqt'Cecfgo ke" Chhcktu'cpf 'Rtqxquv'

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November 2021

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Eqo o kwgg'O go dgt"*Gzvgtpcn+"

Uki pcwtg'Rci g'F cvg

Abstract

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Dedication

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Acknowledgments

Table of Contents

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List of Figures

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Chapter I: Introduction

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Figure 1"

Typical Basic Aircraft Bleed Air System"

Fan air

Fan

Precooler

Intermediate pressure

Compressor

High Pressure

Discharge

Combustor

High pressure bleed air

Turbine

To air conditioning packs

'""
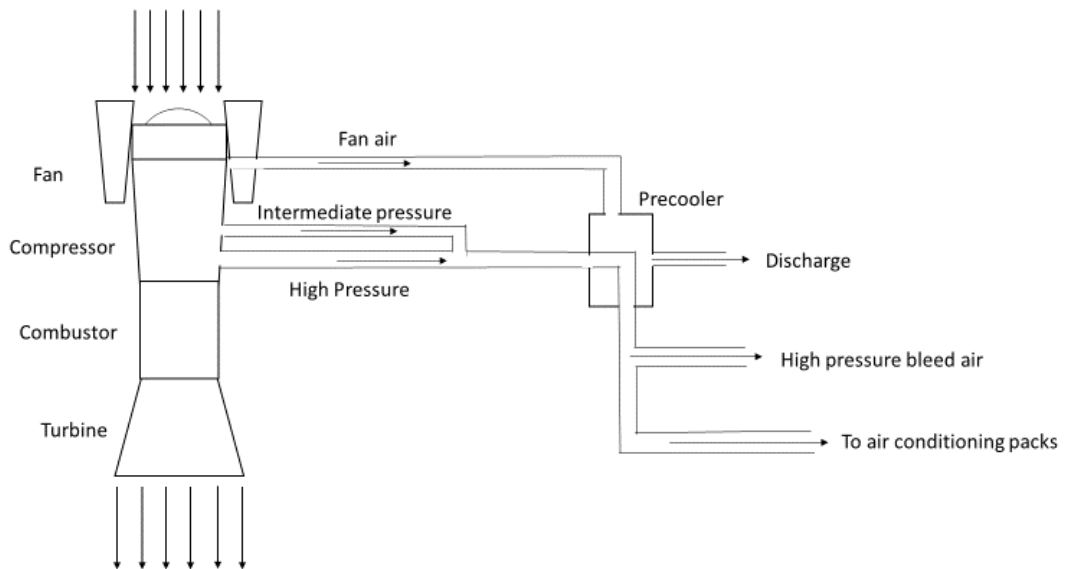
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ecp"eqpvckp"tkkuqdwv{n'rjqurjcvg"cpf "tkrjgp{n'rjqurjcvg"*P TE."4224+0'Eqo rqpgpwu"qh'

fgekpi "hnwkfu"ctg"o qtg"fkxgtug"cpf "o c{"eqpvckp"tkdwv{n'rjqurjcvg."dwv{n'fkrjgp{n'

rjqurjcvg."gyj {ngpg"i n{eqn'cpf "rtqr {ngpg"i n{eqn'*P TE."4224+0'Gyj {ngpg"i n{eqn'ecp"dg"

jki j n{"vqzke='jvwu."tgrncego gpv'ykj "gyj {ngpg"i n{eqn'ku'dgeqo kpi "eqoo qprnceg"*P TE."

4224+0"

Rtgxkqwu'gxcnwcvkqpu'qh'gzrquwtg"cpf "tgrqtvgf "jgcnvj "u{o rqo u'uwii guv'cktetchv'

etgw u"cpf "r cuugpi gtu'jcxg"dggp"gzrqugf "vq"qticpqrjqurjcvg"eqo rqwpfu'cuuqekcvgf "ykj "

r {tqn{uku'r tqfwevu'htqo "gpi kpg"qkn'qt'j {ftcwnke"hnwkfu'yj kng"vtcxgnkpi "qp"cktetchv'*Eqz"("

O kej cgnku."4224='Nk{cuqxc"gv'cn0"4234='O cemgp| kg"Tquu."422: ='O qpvi qo gt{"gv'cn0"3; 99='

Y kpfgt"gv'cn0"4224+0'U{o rqo u"gzr gtkgpegf "chvgt"gzr quwtg"vq"eqpvco kpcvgf "dngggf "ckt "

kpenwfg"j gcfcej gu."eqphwukqp."fk| | kpguu."o wueng"y gcmpguu."hcvki wg."pcwugc"cpf "xqo kvkpi ."

pgtxg"r ckp."vtgo qtu."pwo dpguu."cpf "pgwtqdgej cxkqtcn'f khhkewnkgu"*Cdqw/F qpkc."4225='

CdqwF qpkc"gv'cn0"4236='Eqz"("O kej cgnku."4224='Eqzqp."4224='J ctr gt."4228='

O cemgp| kg"Tquu'gv'cn0"4233='O kej cgnku."4225='O kej cgnku."4232='O qpvi qo gt{"gv'cn0"3; 99='

xcp'P gwgp."3; ; ; +0'Rgtukuvgpv'pgwtqnqi kecn'r tqdngo u."kpenwfkpi "j gcfcej gu."eqphwukqp."

o wueng"y gcmpguu."cpf "pgwtqdgj cxkqtcn'r tqdngo u."uwej "cu'eqi pkkkxg"f {uhwpevkqp."r quv

vtcwo cvke'uvtguu'f kuqtf gtu."f gr tguukqp."unggr ."cpf "cpzkgv{"f kuqtf gtu'o c{'cnuq'qeewt'chvgt"

gzr quwtg"*Cdqw'F qpkc"gv'cn0"4236=''J cttkuqp"gv'cn0"422; +0"""

Vj gug"u{o r vqo u'o c"kpvgthgtg"y kj "qt'eqo r tqo kug'etgy "o go dgtu')'cdkknkkgu'vq"

eqo r ngvg"vj gkt'f wkgu."kpenwf kpi "hn{kpi "vj g"cktetchv0'Gzr quwtg"vq"vqzke"fwo gu'j cu'tguwngf "

kp"etgy "o go dgtu')'r j {ukecn'ko r ckm gpv'cpf "f gi tcf gf "hnki j v'etgy "r gthqto cpeg"

*O qpvi qo gr{"gv'cn0"3; 99='UJ M."3; ; ; +."cpf "ecp"tguwnv'kp"kpecr cekcvkqp"qh'hnki j v'etgy "

*Cnkgf "Rkmqu'Cuuqekcvkqp."423: ='Dctpgw."4228='Eqo o qpy gcnj "qh'Cwvtcnkc."4222='

$Rknqv'Vwtpgf /F qevqr'Rkpu'Rgthqto cpeg'F gi tcf cvkqp"qp"Hwo gu.$"4237+0'Etgy "

kpecr cekcvkqp"o c{"dg"o qtg"eqo o qp"hj cp'tgr qtvgf ='c"uwf{"qh'kpecr cekcvkqp"co qpi "

Cwvtcnkcp'r knqu'hqwpf "vj g"ugeqpf "ngcf kpi "ecwug'qh'o gf kecn'gxgpvu"qt'kpecr cekcvkqp"y cu"

gzr quwtg"vq"vqzke"uo qmg"cpf "hwo gu'qp"vj g"ckrtetchv"*CVUD."4229+0'Ckrkpgu'o c{'j cxg"

guvcdnkuj gf "r qnkekgu'cpf "r tqegfwtgu'hqt'etgy u'wr qp"tgeqi pkvkqp"qh'c"hwo g"gxgpv."y j kej "

o c{'kpenwf g"f genctkpi "cp"go gtigpe{."cpf kpi "cu'uqqp"cu'r tcevkecdng"d{'tgwtpkpi "vq"vj g"

f gr ctwtg"ckrr qtv'qt"f kxgtvkpi "vq"cpqvj gr"ckrr qrt."qt'tghwukpi "vj g"ckrtetchv'cv'vj g"i cvg0'Vj gug"

cevkqpu'o c{'i gpgrcvg"o cpf cvqt{'tgr qrtkpi "qh'vj g"gxgpv'cpf "vj g"tgncvgf "ekrewo uvcpegu'vq"

u{uvgo u."dqvj "kpvgrcpncl'cpf "gzvgpcl'vq"vj g"eqo r cp{0'J qy gxgr."vj grg"crg"pq"kpf gr gpf gpv"

uvcpf crf ki gf "tgr qrtkpi "u{uvgo u'hqr'etgy u'vq'tgr qrt'hwo g"gxgpwu"*J cttkuqp"gv'cn0"422; +'qr"

qvj gr"gxgpwu'kpxqnxkpi "WCS ='vj wu."kphqro cvkqp"qp"gxgpv'qeewrtgpeg."ecwugu.'j gcnj "

ghhgevu."cpf "hnki j v'qwveqo gu'ku'nko kgf "cpf "pqv'eqnngevgf "kp"qpg"nqecvkqp"qr'y kj kp"qpg"

tgr qrtkpi "u{uvgo 0"

Vj g"j gcnj "ghhgevu'qh'gzr quwtg"vq"eqpvco kpcvgf "dnggf "ckr"crg"cnuq"f khhkewn'vq"

gxcnwcvg"cpf "s wcpvkf{0'Vj g"u{o r vqo u'tgr qrtgf "d{"etgy "o go dgtu'o c{"dg'tgncvkxgn{"pqp/

ur gekhke"*J ci go cp"gv'cn0"4242c+."etgy "o go dgtu'o c{"pqv'tgeqi pk| g"qt'tgr qtv'u{o r vqo u."

cpf "vj g'ncem'qh'c'egpvtcn| gf "u{uvgo "hqt'eqngevkpi "cpf "cpcn{ kpi "gzr quwtg'f cvc'iko ku'vj g"

cdknkv{ "vq'u{uvgo cvkecn{ "cuuguu'j gcnj "ghhgevu'cpf "eqttgncvg'vj gug'y kij "gzr quwtg"*J cttkuqp"

gv'cn0"422; +0Dgyy ggp"y q'cpf "vj tgg'r kmqu'qw'qh'gxgt{ "vj qwucpf "ctg"o gf kecn{ "

f kus wcnkhkgf "hqt'pgwtqvqzke'ghhgevu'gxgt{ "{ gct."uwhhgtkpi "htqo "pgwtqnqi kecn'u{o r vqo u"

uwej "cu'j gcf cej gu'cpf "o go qt{ "nquu"*f g'Dqgt"gv'cn0"4237+0J qy gxgt.'j gcnj "ectg"

r tcevkvkqpgtu'o c{"pqv'tgeqi pk| g"c'nkpm'dgyy ggp"gzr quwtg'vq'eqpvco kpcvgf "dnggf "ckt'cpf "

j gcnj "ghhgevu."ur gekcn{ "y kij qw'cp'qdlgevkxg"o gcuwtg'qh'gzr quwtg0

Reporting Systems

F qewo gpvcvkqp"qh'WCS "gxgpvu."dngef "ckt'eqpvco kpcvkqp'gxgpw."cpf "qyj gt"

qr gtcvkqpcn'f kuetgr cpekgu'ecp"qeewt'vj tqwi j "ugxgtcn'guvcdnkuj gf "tgr qtvkpi "o gej cpkuo u."cu"

f kur nc{gf "kp"Vcdng"30'Vj g'Hgf gtcn'Cxkcvkqp'Cf o kpkuvtcvkqp"*HCC+"o ckpvckpu'ugxgtcn'"

tgr qtvkpi "u{uvgo u'cpf "f cvcdcugu'hqt'vj g'gpj cpego gpv'qh'uchgv{ "d{ "vtcemkpi "gxgpvu'cpf "

uchgv{ "kuuwgu0'O cpf cvqt{ "tgr qtvkpi "u{uvgo u'tgs wktg'tgr qtvkpi "uqo g'v{r gu'qh'kpekf gpvu"

ceeqtf kpi "vq'tgi wncvkqpu0'Vj gug'u{uvgo u'r tko ctkn{ "cf f tguu'ur gekhke"eqpetgvg"kuuwgu'cpf "

vgpf "vq'eqnngev'o qtg"kphqto cvkqp'tgi ctf kpi "vgej pkecn'hcknwtgu='j qy gxgt.'xqnwpvct{ "

tgr qtvkpi "u{uvgo u'ctg"o qtg"uweeguuhwn'kp"eqnngevkpi "j wo cp'hcevqt/tgncvgf "kphqto cvkqp"

*Tqf tki wgu'cpf "Ewukem'4234+0Gzr gtkgpeg"kp"vj g"WU0'cpf "qyj gt"eqwpvtkgu'j cu"

f go qpuvtcvgf "vj g"pggf "hqt'c"vtwuvgf "vj ktf 'r ctv{ "vq'o cpci g"xqnwpvct{ "tgr qtvkpi "u{uvgo u'cu"

tgr qtvgtu'o c{ "dg"tgnwevcpv'vq'tgr qtv'gttqtu'vq'go r nq{gtu'qt'tgi wncvqtu"*Y gmu."4223+0

Vj g'Cxkcvkqp"Uchgv{ "Cevkqp"Rtqi tco "*CUCR+"ku'c"xqnwpvct{ "tgr qtvkpi "u{uvgo "hqt"

go r nq{ggu'qh'egtvckp'egtvkhkecvgf 'j qnf gtu='ku'i qcn'ku'vq'gpj cpeg"cxkcvkqp"uchgv{ "vj tqwi j "vj g"

r tgxgpvkqp"qh'ceekf gpvu'cpf "kpekf gpvu"*HCC."4239c+0Vj g'HCC "qhhgtu'CUCR"cu'c"vqqn'hqt"

"

go r nq{ggu"qh'r ctvkekr cvkpi "cktrkpgu"cpf "tgr ckt"uvcvkqpu"vq "kfgpvkh{'cpf "tgr qtv'uchgv{"kuuwgu"

vq "eqo r cp{'o cpci go gpv'cpf "vj g'HCC"hqt'f qewo gpvcvkqp'cpf "tguqnwvkqp0'Vj g'HCC"

r tqxkf gu'i wkf cpeg"vq 'ckt "ecttkgtu"hqt "vj g'eqngevkqp."eqo r tgj gpukxg"gxgpv'ecvgi qti| cvkqp."

tkum'cpcn{uku."f cvc"vtgpf kpi .'cpf "uvqtci g'qh'vj g'uchgv{'f cvc'qdvckpgf "vj tqwi j "vj g'CUCR"

tgr qtvkpi "r tqeguu"*HCC."4242c+0"

Table 1

Safety Reporting Programs for U.S. Aviation Operations

P co g"	Hktuv'[gct"qh'" Cxckncdrg" F cvc"	Ci gpe{'" Tgur qpukdrg"	Uqwteg"qh'F cvc"	Xqnwpvct{'" Tgr qtvkpi "	Rwdrken{'" Ceeguukdrg" F cvcdcug"
Ceekf gpv'cpf " Kpekf gpv'F cvc" U{uvgo " *CKF U+"	3; 9: "	HCC"	Ceekf gpv'cpf "kpekf gpv' kpxguvki cvkqpu"*HCC"Hqto " : 242/45+.'P VUD)u'ceekf gpv' f cvcdcug"	P q"	Nko kvgf "vq " kpekf gpvu'kp" CUKCU"
" Cxkcvkqp" Ceekf gpv' F cvcdcug"	" 3; : 4"	" P VUD"	" Ceekf gpv'cpf "kpekf gpv' kpxguvki cvkqpu."r knqv'qr gtcvqt " tgr qtvu"*P VUD"Hqto " 834208+"	" P q"	" [gu"
Cxkcvkqp" Uchgv{'"Cevkqp" Rtqi tco " *CUCR+"	Xctkgu'y kvj " qr gtcvqt"	HCC"	S wcnkhkgf "go r nq{gg'tgr qtvu"	[gu"	P q"
Cxkcvkqp" Uchgv{'" Tgr qtvkpi " U{uvgo " *CUTU+"	3; : : "	P CUC"	Rknqv."go r nq{gg. 'r cuugpi gt " tgr qtvu"*P CUC"CTE"499+"	[gu"	[gu" *f gkf gpvk/ hkgf +"
" Ugtxkeg" F khhkewnv{" Tgr qtvkpi " U{uvgo """""""""""	" 3; 97"	" HCC"	" O gej cpke.'kpur gevqt.'r knqv." qr gtcvqt'tgr qtvu"*HCC" : 292/3.': 292/6+"	" [gu"	" [gu'"
Xqnwpvct{'" F kuenquwtg" Tgr qtvkpi " Rtqi tco " *XFTR+"	Xctkgu'y kvj " qr gtcvqt"	HCC"	Qr gtcvqtu.'qy pgtu.'" o cpwhcevwtgtu'"	[gu"	P q"

"

Vj tqwi j "vj g'CUCR. "kpfkxkfwcn'o c{'uwdo kv'xqnwpvct{'tgr qtvu'qh'uchgv{'kuuwgu'cpf "gxgpvu"

y j kej "o c{'qvj gty kug'tgo ckp'wpkfgpvkhkgf 0Tguqnwvkqp'vj tqwi j "eqttgevkxg'cevkqp'tcj gt"

yj cp'fkuekrnkpg'qeewtu'vj tqwi j "c'r ctvpgtuj kr "y kj "vj g'ckt'ecttkgt'cpf "vj g'HCC. "cpf "c'vj ktf "

r ctv{'cu'pggfgf ."uwej "cu'c'ncdqt'qti cpk| cvkqp'qt'wpkqp"*HCC. "4242c+0"

Vj g'Xqnwpvct{'Fkuenquwtg'Tgr qtvkpi "Rtqi tco "*XFTR+'ku'cpqvj gt'tgr qtvkpi "

u{uvgo "guvcdnkuj gf "cpf "o ckpvckpgf "d{ "vj g'HCC 'hqt'qr gtcvqtu. "qy pgtu. "cpf "o cpwhcevwtgtu"

vq 'xqnwpvctkn{'fkuenqug'cr r ctgpv'xkqncvkqpu'kp'c'eqqr gtcvkxg'cpf "cf xkuqt{'cr r tqcej "vq"

r tqdngo /uqnxkpi "*HCC. "422; +0Kp'i gpgtcn'vj ku'r tqi tco "o c{'dg'wugf "hqt'kfgpvkh{kpi ."

tgr qtvkpi ."cpf "eqttgevkpi "kpuvcpegu'qh'tgi wncvqt{'pqp/eqo r nkcpeg'y j gp'vj g'egtvkhkecvg"

j qnfgt'pqvkhkgu'vj g'HCC'ko o gfkcvgn{'chvgt'vj g'cr r ctgpv'xkqncvkqp'y cu'fkueqxgtgf "wukpi "

vj g'qpnkpg'XFTR'u{uvgo "cpf "dghqtg'vj g'HCC 'ngctpu'qh'vj g'xkqncvkqp'htqo "cpqvj gt'o gcpu0"

Vj g'HCC'vj gp'tgxkgy u. "ceegr vu. "cpf "cr r tqxgu. "qxgtuggu'eqttgevkxg'cevkqp. "cpf "eqpfwevu"

hqnnqy -wr "uwtxgknncpeg'y kj 'kg'y ckvkpi "gphqtego gpv'cevkqp0Vj ku'r tqeguu'r tqvgevu'vj g"

cpqp{o kv{'qh'tgr qtvgtu'kphqto cvkqp'tgi ctfkpi "cp{'uwdugs wgpv'eqttgevkxg'cevkqpu. "cpf "vj g"

r wdnke'tgngcug'qh'fkuenquwtgu"*HCC. "4238c+0Tgr qtvgf "xkqncvkqpu'o c{'dg'cuuqekcvgf "y kj "

hnki j v'qr gtcvkqpu. "o ckpvgpcpeg. 'j wo cp'kpvgtxgpvkqp'o qvkxcvkqpu'uwfd{'qt'cpvk/ftwi "cpf "

cneqj qn'o kuwug'r tgxgpvkqp'r tqi tco u. "cpf "y kj "o cpwhcevwtkpi "qr gtcvkqpu'qh'vj g"

qti cpk| cvkqp"*HCC. "422; +0

Vj g'HCC'cnuq 'o ckpvckpu'vj g'Ceekfgpv'cpf "Kpekfgpv'Fcvc'U{uvgo "*CKFU+'fcvcdcug"

*j vvr u<1ly y y 0cku0hcc0 qx lcr gz lhAr ? 322-34≪≪P Q≪≪0'Kphqto cvkqp'hqt'vj ku'fcvcdcug'ku"

eqnngevgf "htqo "ugxgtcn'uqwtegu. "kpenwfkpi "vj g'P cvkqpcn'Vtcpur qtvcvkqp'Uchgv{ "Dqctf)u"

*P VUD)u+'ceekfgpv'fcvcdcug. "cpf "HCC 'kpxguvki cvqtu'cu'r ctv'qh'vj gkt'ceekfgpv'cpf "kpekfgpv"

kpxguvki cvkqpu"*HCC. "423: +0Vj gug'kpxguvki cvkqpu'qeewt'hqnnqy kpi "HCC'Qtfgt'": 242013F "

Cktetchv'Ceekf gpv'cpf "Kpekf gpv'P qvkhkecvkqp."Kpxguvki cvkqp."cpf "Tgr qtvkpi "*HCC."423: +"
cpf "uug'ucpf ctf k| gf "hqto u"*HCC."4232+0"

Vj g'HCC)u'Ugtxkeg'F khhkewn{ "Tgr qtv'U{uvgo "eqnngevu "qti cpk| gu."cpcn{ gu."cpf "
f kuugo kpcvgu'kphqto cvkqp'qp"qeewttgpeg."r tqdngo u."cpf "f ghgevu'uwdo kwgf "d{"o gej cpkeu."
kpur gevqtu."r knqvu."cpf "qr gtcvqtu0Tgr qtvu'kpenwf g'f gvckngf "kphqto cvkqp'cdqw'r tqdngo u"
gpeqwpvgtgf ."eqo r qpgpv'V{r gu."j qwtu'kp'ugtxkeg."cpf "c'htgg'vgzv'hkgnf 0Tgr qtvu'ctg"
cuugo dngf "ceeqtf kpi "vq'V{r gu'qh'tgr qtvu."uwej "cu'ugtxkeg'f khhkewn{ "tgr qtvu."o cnhwpevkqp"qt"
f ghgev'tgr qtvu."qt"o ckpvgpcpeg'f khhkewn{ "tgr qtvu"*HCC": 292/3."HCC": 292/6+0Vj g"
f cvcdcug'ku'cxckncdng'vq'vj g'r wdnke'vq'ko r tqxg'vj g'uchgv{ "cpf "tgnkcdknkv{ "qh'cgtqpcwwecn'
r ctvu'cpf "r tqf wevu"*j wr <1ly y y (cxkcvkqpf d0eqo 1Cxkcvkqp1UftS wgt{0j vo %UWDO KV+0"

Vj g'P VUD"o ckpvckpu'vj g'Cxkcvkqp'Ceekf gpv'cpf "Kpekf gpv'F cvc'U{uvgo ."y j kej "
eqpvckpu'kphqto cvkqp'eqnngevgf "qp'uvcpf ctf k| gf "hqto u'eqo r ngvgf "d{'qr gtcvqtu."r knqvu."cpf "
P VUD"uvchh'f wtkpi "ekxkn'cxkcvkqp'ceekf gpv'cpf "ugnngevgf "kpekf gpv'kpxguvki cvkqpu'y kj kp'vj g"
Wpkvgf "Uvcvgu."ku'vgttkqtkgu'cpf "r quuguukqpu."cpf "kp'kpvgtpcvkqpcn'y cvgtu0Tgr qtvu'kp'vj g"
f cvcdcug'eqpvckp'kphqto cvkqp'htqo "vj g'hqto u."f gvcknu'cdqw'vj g'ceekf gpv."cpcn{uku'qh'
hcewcn'f cvc."eqpenwukqpu."r tqdcdng'ecwug*u+'qh'vj g'ceekf gpv."cpf "cp{ "tgncvgf "uchgv{ "
tgeqo o gpf cvkqpu."kpenwf kpi "htgg'vgzv'hkgnf u"*j wr <1cr r 0pvud0 qv lcxkcf cvc+0'Hwnn'pcttcvkxg"
f guetkr vkqpu'o c{'pqv'dg'cxckncdng'hqt'gxgpu'qeewttkpi "dghqtg'3; ; 5."ecugu'wpf gt'tgxkukqp."
qt'hqt'gxgpu'y j gtg'vj g'P VUD"f kf "pqv'j cxg'tgur qpukdknkv{ "hqt'vj g'r tko ct{ "kpxguvki cvkqp"
*P VUD."p0f 0+0

Vj g'Cxkcvkqp'Uchgv{ "Tgr qtvkpi "U{uvgo "*CUTU+'ku'cp'HCC/hwpf gf "u{uvgo "
o cpci gf "d{'vj g'P cvkqpcn'Cgtqpcwvkeu'cpf "Ur ceg'Cf o kpkuvtcvkqp"*PCUC+'vq'eqnngev."
tgxkgy ."eqf g."encuukh{ "f gkf gpvkh{ ."cpf "o ckpvckp'tgr qtvu'qh'kuuwgu'vj cv'o c{ "chhgev'uchgv{ "kp"

yj g"WUU0cxkcvkqp"u{uvgo 0Tgrqtvu"ctg"xqnwpvctkn{"uwdokwgf"qp"uvcpf ctf k{gf "hqto u"d{"ckt"

vtchhke"eqpvtqnngtu"*P CUC"CTE"499C+."r knqvu."f kur cvej gtu"cpf "qyj gtu"*P CUC"CTE"

499D+."ecdkp"etgy "*P CUC"CTE"499E+."cpf "tgr ckto gp."o ejcpkeu."cpf "kpur gevqtu"

*P CUC"CTE"499F +0O wnukr ng"tgr qtvu"ctg"kf gpvkhkgf "cpf "knuvgf "d{ "yj g"gxgpv"kp"c"r wdtken{"

ceeguukdng"f cvcdcug"*j wr u<1lcutu0cte(pcuc0 qx lugctej lf cvcdcug(j vo n+."y j kej "kpenwf gu"

kphqto cvkqp"qp"yj g"r quktkqp"qh"yj g"tgr qtvgt."yj g"ckrctchv."encuukhkecvkqp"cpf "ecwug"qh"yj g"

gxgpv."cpf "htgg"vgzv"pcttcvkxg"hkgnf u"f guetkdkpi "cpf "uwo o ctk|kpi "yj g"gxgpv0"

C"tgxkgy "qh"ceekf gpv"kpxguvki cvkqp"tgr qtvu"ecp"dg"wugf "vq"f gvgtm kpg"ceekf gpv"

ecwucvkqp."y j kej "ecp"dg"wugf "vq"f gxgnqr "uchgv{ "i wkf cpeg."tgeqo m gpf cvkqpu."cpf "

tgi wncvkqpu0Uchgv{ "kpxguvki cvkqpu"ctg"dqyj "tgcevkxg"cpf "r tqcevkxg."cu"hggf dcek"ecp"dg"wugf "

vq"f gxgnqr "pgy "npqy ngf i g"cpf "kpuki v"cpf "ecp"dg"kpeqtr qtcvgf "kpvq"hwvwtg"i gpgtcvkqpu"qh"

qr gtcvkqpu"*Uvqqr "("F gmmgt."4234+0C"o qtg"r tggo r vkxg"r tqeguu"ku"yj g"kf gpvkhkecvkqp"qh"

ceekf gpv"r tgewtuqtu."uwej "cu"j c| ctf qwu"eqpf kvkqpu."gxgpvu."qt"dgj cxkqtu"r tkqt"vq"yj g"

qeewttgpeg"qh"cp"ceekf gpv."y j kej "ecp"o kki cvgf "vq"kpvgttwr v"yj g"ugs wgpeg"qh"gxgpvu"

ngcf kpi "vq"cp"ceekf gpv0Kf gpvkhkecvkqp"qh"hwo g"gxgpv"tgncvgf "eqpf kvkqpu."gxgpvu."qt"

dgj cxkqtu"o c{ "cuukuv"etgy u"kp"f gvgevkpi "c"hwo g"gxgpv."vcmg"cevkqp"vq"kko kv"cp{ "r qvgpvkcn"

f gvtko gpvcn"ghhgevu."cpf "tgf weg"cf xgtug"nki v"qwveqo gu0""

Vj g"HCC"f gxgnqr gf "tgs wktgo gpvu"hqwpf "kp"uchgv{ "o cpci go gpv"u{uvgo u"*UO Uu+"vq"

gpj cpeg"uchgv{ "hqt"ckt"ecttkgtu"cpf "qyj gt"qti cpk| cvkqpu"d{ "kpeqtr qtcvkpi "yj tgg"uvci gu"qh"

uchgv{ "cvkqpcng<tgcevkxg."r tqcevkxg."cpf "r tgf kevkxg"yj kpmkpi "*HCC."4238d+0C"uchgv{ "

o cpci go gpv"u{uvgo "ku"c"$u{uvgo cvke"cr r tqcej "vq"o cpci kpi "uchgv{ ."kpenwf kpi "yj g"

pgeguuct{ "qti cpk| cvkqpcn"uvtwevwtgu."ceeqwpvcdknkvkgu."r qnkekgu"cpf "r tqegf wtgu$"*KECQ."

4235."r 0kz+0Vj g"HCC"r wdnkuj gf "yj g"hkpcn"UO U"twng"hqt"ckt"ecttkgtu"qr gtcvkpi "wpf gt"36"

"

E0H0T0È'343'F qo guvke.'Hnci "cpf "Uwr r ngo gpvcn'Qr gtcvkqpu'kp"4237"*Uchgv{'O cpci go gpv'
U{uvgo u."4237+'cpf 'r tqxkfgf 'i wkf cpeg'hqt 'ckt 'ecttkgtu'vq 'f gxgnqr "cpf "ko r ngo gpv'cp"UO U'
*HCC."4237+0'Ceeqtfkpi "vq 'vj ku'i wkf cpeg."vj gtg'ctg'hqwt 'eqo r qpgpvu'qh'cp"UO U<'r qnke{."
uchgv{'tkum'o cpci go gpv."uchgv{'cuuwtcpeg."cpf 'uchgv{'r tqo qvkqp0'Cu'c'r ctv'qh'uchgv{'tkum'
o cpci go gpv."cktnkpg'o cpci go gpv'r gtuqppgn'ctg'gzr gevgf 'vq 'gzgtekug'f wg'f knki gpeg'vq "
kf gpvkh{'vj g'uki pkhkecpv'cpf 'tgcuqpcdn{'hqtguggcdng'j c| ctf u'tgncvgf 'vq 'vj gkt'qr gtcvkqpu'cpf "
vq 'cpcn{| g'cpf 'cuuguu'vj g'tkum'cuuqekcvgf 'y kj 'vj gug'j c| ctf u'*Uvqr j gt'("I qi nkc."4237+0'
Kf gpvkhkecvkqp'cpf 'vtcemkpi "qh'j c| ctf u'ctg'hqwpf cvkqpcn'tgswktgo gpvu'hqt 'uweeguuhwn'uchgv{'
tkum'o cpci go gpv'*HCC."4239d+0'Kp'vgto u'qh'uchgv{'tkum'o cpci go gpv'kp'cxkcvkqp"
qr gtcvkqpu."vj g'kf gcn'tkum'cuuguuo gpv'r tqeguu'ku'dcugf 'qp'o qf gnkpi '*Uvqr j gt'("I qi nkc."
4237+0"

Tgeqo o gpf cvkqpu'vq 'cnmg'r tgecwvkqpct{'o gcuwtgu'gxgp'y j gp'c'vj tgcv'vq 'j wo cp"
j gcnj "qt 'vj g'gpxktqpo gpv'ecppqv'dg'hwm{'uekgpvkhkecm{'guvcdnkuj gf 'ku'vj g'etwz 'qh'vj g'
r tgecwvkqpct{'r tkpekr ng'*Hktkgpf '("Mqj p."4236+0'Hwtvj gt."y j gp'vj g'r qvgpvkcn'f co ci g'htqo "
ceekf gpvu'kp'ncti g'uecng'u{uvgo u'ku'i tgcv'cpf "vj g'ko g'dgvy ggp'ceekf gpvu'ku'ngpi vj {.'f guki p"
cpf "qr gtcvkqp'o wuv'dg'hqwpf gf "qp'eqpukuvgpv'r tgf kevkxg'o qf gnu'dcugf 'qp'ceekf gpv'
r tqeguugu'cpf 'r tqdcdknkv{'qeewttgpeg.'y j kej "cnki pu'y kj "vj g'r wtr qug'qh'r tqdcdknkuke'tkum'
cpcn{uku'*Tcuo wuugp."3; ; 9+0'Rtqdcdknkuke'tkum'cuuguuo gpv'ku'c'u{uvgo cvke'o gyj qf 'vq "
cuuguu'tkumu'cuuqekcvgf "y kj "c'eqo r ngz "vgej pqnqi kecn'wpkv'vq 'ko r tqxg'uchgv{'qt "
r gthqto cpeg'*Uvqr j gt'("I qi nkc."4237+'cpf "o c{'kpenwf g'c'xctkgv{'qh'r tgf kevkxg'o qf gnu0'
Kf gpvkhkecvkqp'cpf 'xgtkhkecvkqp'qh'vj g'qeewttgpeg'qh'hwo g'gxgpvu'ctg'pgeguuct{'vq 'swcpvkh{'
vj gkt'htgswgpe{.'tkumu'r tgugpvgf .'vtwg'equmu.'cpf 'f gxgnqr 'r tgf kevkxg'o qf gnu0'

Statement of the Problem

Gxgpu'kpxqnxkpi "WCS '"j cxg"'vj g"'r qvgpvkcn'hqt"'etgy "'f kuvcevkqp.'"nnki j v'f kxgtukqp."

go gti gpe{"ncpf kpi u."qt"qvj gt"f kuvwr vkxg"ghhgevu"cpf "qweqo gu0'Hwo g"gxgpvu"cpf "gzr quwtg"

vq"'vqzkle"eqo r qwpf u'"j cxg"'vj g"'r qvgpvkcn'hqt"cf xgtug"qweqo gu'kh'hnki j v'qt"ecdkp"etgy "ctg"

ko r cktgf "qt"kpecr cekcvgf ."cpf "o c{"ecwgn{"qt"ej tqpkecn{"chhgev"j g"j gcnj "qh"etgy "cpf "

r cuugpi gtu0'Kf gcm{."'vj g"r tgf kevkqp"qh'qeewttgpegu"qt"elktewo uvpegu"ngcf kpi "vq"WCS "cpf "

hwo g"gxgpvu"eqwnf "cuukuv'kp"cxqkf kpi "etgy "cpf "r cuugpi gt"gzr quwtg='j qy gxgt.'pq"

eqphkto cvqt{"tgeqtf u"qt"r tgf kevkxg"o gcuwtgu"ctg"ewttgpvn{"cxcknccdng0'Tgcn'vko g"

o qpkvqtkpi "cpf "cpcn{uku"hqt"f gvgevkqp"qh'hwo g"gxgpvu"eqwnf "kf gpvkh{"cp"gxgpv'cu"kv'

qeewttgf "cpf "cngtv'etgy "cpf "vj wu"ko kv'gzr quwtg0'J qy gxgt.'vj gtg"ctg"ewttgpvn{"pq"ckt"

swcnkv{"o qpkvqtkpi "u{uvgo u'kp"y kf gur tgcf "wug"qp"ckretchv'vq"f gvgev'WCS "qt"eqpvco kpcvgf "

dngef "ckt0'Hkpcn{."c"tgxkgy "qh'tgr qtvu'htqo "etgy u"cpf "r cuugpi gtu"hqnqy kpi "f qewo gpvgf "

WCS "cpf "hwo g"gxgpvu"eqwnf "r tqxkf g'kphqto cvkqp"vj cv'eqwnf "dg"wugf "vq"r tgxgpv'vj gug"

gxgpvu0'Vj gtg"ctg"ewttgpvn{"pq"kpf wuvt{/y kf g"o cpf cvqt{"tgr qtvkpi "tgswktgo gpvu"hqt"vj g"

qeewttgpeg"qh'vj gug"gxgpvu"qt"r qvgpvkcn'gzr quwtg"vq"j c|ctf qwu"eqo r qwpf u"f wtkpi "vj gug"

gxgpvu0'Nko kvgf "kphqto cvkqp"ku"mpqy p"cdqwv'vj g"kpekf gpeg"cpf "ej ctcevgtkuvkeu"qh'kp/hnki j v'

o gf kecn'go gti gpekgu"*Ej cpftc"(""Eqtr{.'4235+."cpf "vj gtg"ctg"ewttgpvn{"pq"kpf wuvt{/y kf g"

o cpf cvqt{"tgr qtvkpi "tgswktgo gpvu"hqt"kp/hnki j v'o gf kecn'go gti gpekgu0'J qy gxgt.'hnki j v'

f kxgtukqpu"kp"tgur qpug"vq"o gf kecn'go gti gpekgu"ecp"tguwnv'kp"uwduvcpvkcn'hkpcpekcn'cpf "ngi cn'

equwu"*Xcncpk'gv'cn0'4232+"cpf "r qvgpvkcn'kpetgcugf "tkum'qh'ceekf gpvu"cpf "kplwtkgu"vq"

r cuugpi gtu"cpf "etgy u"*I CQ.'4225+0"

F gur kvg"'vj g"r qvgpvkcn'hqt"ugxgtg"cf xgtug"j gcnj "cpf "uchgv{"qweqo gu.""vj g"hcevqtu"

cuuqekcvgf "y kj "WCS "cpf "hwo g"gxgpvu"j cxg"pqv'dggp"gzr nqtgf 0'Cu"vj g'kf gpvkhkecvkqp"qh'

"

j c| ctf u'ku'etkvkecn'vq'uchgv{'o cpci go gpv.'r tqeguu'cpcn{uku'qt'qr gtcvkqpcn'qdugtxcvkqpu'ecp"

qhvgp'dg'wugf "vq'f gvgev'cpf 'o kvki cvg'j c| ctf u0'Y kj "hko kvgf 'f cvc'eqmgevkqp'qp'WCS "cpf "

hwo g'gxgpv'qeewttgpeg.'ceewtcvg'cpcn{uku'qh'vj g'r tqeguu'ku'wprkmgn{0'Qr gtcvkqpcn"

qdugtxcvkqpu'htqo "xqnwpvct{'uchgv{'tgr qtvu'o c{'dg'wughwn'kp'f gvgto kpkpi "ej ctcevgtkuvkeu'vq"

kf gpvkh{'r qvgpvkcn'gzr quwtg'vq'eqpvco kpcvgf "dngef "ckt'dwv'qr vko cm{'tguwnv'kp'c'tgcevkxg"

tgur qpug'vq'vj g'j c| ctf 0'S wcrkvcvkxg'cpf 'swcpvkcvkxg'f cvc'htqo "xqnwpvct{'uchgv{'tgr qtvu"

o c{'r tqxkf g'kphqto cvkqp'qp'ko r qtvcpv'hcevqtu'hqt'kf gpvkh{kpi "WCS "cpf 'hwo g'gxgpvu0'Cu"

r ctv'qh'vj g'uchgv{'tkum'o cpci go gpv'eqo r qpgpv'qh'c'uchgv{'o cpci go gpv'u{uvgo .'ckt"

ecttkgtu'uj qwnf 'o cmg'ghhqtvu'vq'kf gpvkh{'cpf 'hqtgugg'j c| ctf u"*Uvqr, gt"("I qi nkc.'4237+0'

Kf gpvkhkecvkqp'qh'ko r qtvcpv'hcevqtu'cuuqekcvgf 'y kj "WCS "cpf 'hwo g'gxgpvu'ecp'dg'wugf "vq"

f gxgnqr "r tgf kevkqp'o qf gnu=f gxgnqr "o kvki cvkqp'uvtcvgi kgu=r qukvkqp'o qpkvqtkpi "gswkr o gpv"

vq'kf gpvkh{'eqpvco kpcpvu=dgwgt'r tgr ctg'etgy "cpf 'ckrkpg'uwr r qtv'uvchh'hqt'f kxgtukqpu'cpf "

wtpdcemu'cpf 'uwdugswgpv'tguej gf wnkpi "qh'hki j vu'vq'ceeqo o qf cvg'r cuugpi gtu=tgf weg'vj g"

tkumu'cuuqekcvgf 'y kj "go gti gpe{'ncpf kpi u.'f kxgtukqpu.'cpf 'wtpdcemu=cpf 'tgf weg"

cuuqekcvgf "equvu0""

Purpose Statement

Vj g'r wtr qug'qh'vj ku'gzr nqtcvqt{.'o kzgf "o gvj qf 'f guki p'uvwf {'y cu'vq'wug'vgzvwcn'

f cvc'htqo "vj g'pcttcvkxg'hkgnf u'kp'tgr qtvu'uwdo kwgf "vq'vj g'Cxkcvkqp'Uchgv{'Tgr qtvkpi "

U{uvgo "*CUTU+'kp'vj g'vgzv'o kpkpi "r tqeguu'vq'gzr nqtg'vgto u'cpf 'vqr keu'cpf 'kf gpvkh{'pgy "

hcevqtu'cuuqekcvgf 'y kj "WCS "cpf 'hwo g'gxgpvu0Vj gug'hcevqtu'y gtg'vj gp'kpenwf gf 'y kj "

swcpvkcvkxg'xctkcdngu'htqo "vj g'CUTU'f cvcdcug'cpf 'wugf "kp'o cej kpg'ngctpkpi "cni qtkj o u"

vq'f gxgnqr "o qf gnu'vq'f gvgto kpg'vj g'ko r qtvcpeg'qh'hcevqtu'cuuqekcvgf 'y kj "vj g'qeewttgpeg"

qh'WCS "cpf 'hwo g'gxgpvu'cu'tgr qtvgf "d{"hki j v'cpf "ecdkp'etgy u0Vj gug'o qf gnu'y gtg"

f gxgnqr gf .'\tckpgf .'xcnkf cvgf .'cpf '\guvgf '\q'kf gpvkh{'ko r qtvcpv'hcevqtu'cuuqekcvgf 'y kj '\j g"

vcti gv'xctkcdng0Vj g'\cti gv'xctkcdng'eqpukuvu'qh'\j tgg''ngxgnu'qh'tgr qtvgf 'gxgpvu<'gxgpvu'\j cv'

ctg''pqv'tgncvgf '\q'WCS =''gxgpvu'\j cv'ctg'tgncvgf '\q'WCS ''dwv'ctg'pqv'hwo g'gxgpvu=''cpf ''

gxgpvu'\j cv'ctg'tgr qtvgf '\q'dg'hwo g'gxgpvu0'

Significance of the Study

Vj ku'uvwf { "eqpvtkdwvgu'\q'\j g'dqf { 'qh'cxkcvkqp'uchgv{ "npqy ngf i g'd{ 'kf gpvkh{kpi "

hcevqtu'cuuqekcvgf 'y kj "WCS "cpf "hwo g'gxgpvu'wukpi "f cvc'htqo "\j g'CUTU0'Vgz wcn'f cvc"

htqo "\j g'CUTU'tgr qtv'pcttcvkxgu'y cu'o kpf "hqt 'hcevqtu.'cpqo cnkgu.'qt 'r cwgtpu'cpf "

eqo dkpgf 'y kj "s wcpvkvcvkxg'xctkcdngu'htqo "\j g'f cvcdcug'\q'f gxgnqr "o qf gni0P gy "hcevqtu"

cuuqekcvgf 'y kj "\j g'qeewttgpeg'qh'WCS "cpf "hwo g'gxgpvu'y gtg'kf gpvkhkgf "cpf "wugf "kp"\j g"

f gxgnqr o gpv'qh'\j g'o qf gni0'

O qf gni'kf gpvkh{kpi "hcevqtu'cuuqekcvgf 'y kj "hwo g'gxgpvu'\j cv'o c{'eqo r tqo kug"

etgy 'j gcnj "cpf "uchgv{ "ecp'dg'wugf 'd{ '\j g'cxkcvkqp'kpf wuvt{ '\q'ko r tqxg'hnki j v'uchgv{ "cpf "

uchgi wctf '\j g'j gcnj "qh'etgy u'cpf 'r cuugp i gtu0'Rtgxkqwu'uvwf kgu'wukpi '\j g'f cvc'htqo '\j g"

CUTU'j cxg'tguwngf 'kp'\j g'f gxgnqr o gpv'qh'en:uukhkecvkqp'o qf gni'cpf '\j g'kf gpvkhkecvkqp'qh"

tkun'hcevqtu'*Uj k'gv'cn0"423: +'cpf 'tkun'r tgf kevkqp'o qf gni'*\ j cpi "(''O cj cf gxcp."423; +0'

Vj ku'uvwf { 'hwtj gt 'gzr nqtgf '\j g'wug'qh'\gz v'o kpkpi "qh'\j g'pcttcvkxg'hkgnf u'cpf '\j g"

kpeqtr qtcvkqp'qh'kpf kpi u'kpvq'xctkcdngu'\q'f gxgnqr "o qf gni'\q'kf gpvkh{ 'hcevqtu'cuuqekcvgf "

y kj "hwo g'gxgpvu0'Vj gug'o qf gni'o c{'dg'wugfwn'kp'kf gpvkh{kpi .'o kki cvkpi .'qt 'r tgxgpvkpi "

hwo g'gxgpvu0"

Vj g''o cej kpg''ngctpkpi "cni qtkj o u'f gxgnqr gf "cu'r ctv'qh'\j ku'uvwf { 'o c{'dg'wugf "kp"

uko knct 'tgugctej "uvwf kgu'\q'kf gpvkh{ "ko r qtvcpv'hcevqtu'qt 'r tgf kevqtu'wukpi 'c'eqo dkpcvkqp'qh"

vgz wcn'cpf 's wcpvkcvkxg'f cvc0'Vj ku'tgugctej "eqpvtkdwgu'\q'\j g'dqf { 'qh'npqy ngf i g'y kj '\j g"

"

cr r rkecvkqp"qh'o cej kpg"rgctpkpi "cri qtkj o u'vq'kf gpvkh{ 'vj g'ko r qtvcpv'hcevqtu"cuuqekcvgf "

y kj "vj g'qeewttgpeg'qh'hwo g'gxgpvu0'Vj g'vgzv'o kpkpi "r tqeguu'o c{'dg'crr rkecdrg'hqt"

uko krct"f cvc"vq'kf gpvkh{ 'hcevqtu"cuuqekcvgf "y kj "gxgpvu'vj cv'o c{'eqo r tqo kug'hrki j v'uchgv{."

cpf "hkpf kpi u'htqo "o qf gn'gxcnwcvkqp"eqwnf "uwr r qtv'ghhqtuu'kp'f gxgnqr kpi ."vtckpkpi ."

xcnkf cvkpi ."qt"vguvkpi "o qf gnu'hqt'kf gpvkh{kpi "qvj gt"gxgpvu"qt"eqpf kvkqpu"chhgevkpi "hrki j v'

uchgv{0"

Mg{"dgpghkekctkgu"qh'vj ku'tgugctej "kpenwf g'ckrnkpgu."wpkqpu."hrki j v'cpf "ecdkp"etgy u."

cpf "r cuugpi gtu0'Ckrnkpg"uchgv{"o cpci gtu'cpf "f gekukqp/o cngtu'ecp"wug'vj g"o qf gnu'vq"

cuuguu'ko r qtvcpv'hcevqtu"cuuqekcvgf "y kj "hwo g'gxgpvu'cpf "f gxgnqr "r tgxgpvkqp"qt"

o kvki cvkqp"utcvgi kgu0'Ckrnkpgu"cpf "ncdqt"wpkqpu"ecp"wug'vj g"tguwnu'qh'vj ku"uwuf {"vq"

kpetgcug"cy ctgpguu"qh'WCS "cpf "hwo g'gxgpv'qeewttgpeg."dgvgt'r tgr ctg'etgy u'hqt"

o kvki cvkqp"qh'gxgpvu."cpf "j ki j rki j v'vj g'pgeguukv{"qh'f gxgnqr kpi "c"uwtxgknrcpeg"u{uvgo "hqt"

vtcemkpi "vj gug'gxgpvu0'D{'kf gpvkh{kpi "vj g"o qu'kphrwgpvkcr'hcevqtu"cuuqekcvgf "ur gekhkecm{"

y kj "hwo g'gxgpvu."uchgv{"o cpci gtu'ecp'f gxgnqr "vtckpkpi "hqt'hrki j v'cpf "ecdkp"etgy u'y kj "

rkmgn{"uegpctkqu'vq "ko r qxg'cy ctgpguu."tgeqi pkvkqp."cpf "go gti gpe{'r tqegf wtgu'vq "dg"

go r rq{gf "kp'vj g'qeewttgpeg"qh'hwo g'gxgpvu0"

Hkpf kpi u'htqo "vj ku'uwuf {'o c{'dg'wugf "d{'vj g'HCC"cu'lwuvkhkecvkqp"vq"guvcdrkuj "c"

f gf kecvgf "tgr qtvkpi "u{uvgo "hqt"uwtxgknrcpeg'cpf "kpxguvki cvkqp'qh'WCS "cpf "hwo g'gxgpvu0'

Kphqto cvkqp"qp"hcevqtu"cuuqekcvgf "y kj "hwo g'gxgpvu'cpf "cp"kpf kecvkqp"qh'c"r tqdcdng"

vko ghtco g'hqt's wcrkh{kpi "cpf "s wcpvkh{kpi "vqzke'eqo r qwpf u'o c{'r tqxkf g'cxkcvkqp"uchgv{"

r tcevkvkqpgtu'y kj "i wkf cpeg'hqt'f gxgnqr kpi "uco r rkpi "r tqvqeqn0'Wpf gtuvcpf kpi "vj g"o qu'

r ncwukdng"ckrctchv'eqphki wtcvkqp."hrki j v'r j cug."qt"vko g'hqt'r tqf wevkqp"cpf "tgngcug"qh'vqzke"

eqo r qwpfu'o c{'cnuq'i wkfg'uchgv{'rtcevkvkqpgtu'kp'fgxgnqrkpi "kpvgtxgpvkqpu'hqt'rtqvgevkpi "

etgy "cpf 'r cuugpi gtu'htqo "gzrquwtg'vq'vqzke'eqo rqwpfu0'

Research Questions

Vj ku'tgugctej "ku'gzrnqtcvqt{'kp'pcwwtg'cpf "ku'dcugf 'qp'vjtgg'hwpfco gpvcn'tgugctej "

s wguvkqpu<

Research Question 1

J qy "ecp'vgzv'o kpkpi "vgej pkswgu'dg'wugf "vq'gzrnqtg'cpf "kf gpvkh{'ko rqtvcpv"

xctkcdngu'cuuqekcvgf "y kj "vj g'qeewttgpeg'qh'c'tgrqtvgf "hwo g'gxgpv."wukpi "vgzwwcn'fcvc"

hqwpf "kp'xqnwpvct{'tgrqtvu'uwdo kwgf "d{'hnki j v'cpf "ecdkp'etgy "o go dgtuA"

Research Question 2

J qy "ecp'o qf grkpi "vgej pkswgu'dg'wugf "vq'kf gpvkh{'hcevqtu'cuuqekcvgf "y kj "vj g"

qeewttgpeg'qh'c'r gtegkxgf "cpf "tgrqtvgf "hwo g'gxgpv."wukpi "s wcrkcvkxg'cpf "s wcpvkcvkxg"

xctkcdngu'hqwpf "kp'xqnwpvct{'tgrqtvu'uwdo kwgf "d{'hnki j v'cpf "ecdkp'etgy "o go dgtuA"

Research Question 3

Y j cv'ctg'vj g'ko rqtvcpv'hcevqtu'cuuqekcvgf "y kj "vj g'qeewttgpeg'qh'c'hwo g'gxgpv'cu"

kf gpvkhkgf "kp'xqnwpvctkn{'tgrqtvgf "f cvcA"

Vj gug's wguvkqpu'ctg'f ktgevn{'tgncvgf "cu'gzrnqtcvqt{'vgej pkswgu'y gtg'wugf "vq"

gzr qtg'vj g'vgzwwcn'f cvc"kp'vj g'pcttcvkxgu."f cvc'o kpkpi "vgej pkswgu'y gtg'wugf "vq'kf gpvkh{'vj g"

xctkcdngu'cuuqekcvgf "y kj "vj g'qeewttgpeg'qh'WCS "cpf "hwo g'gxgpvu."cpf "vj gp'kf gpvkh{'vj g"

ko rqtvcpv'hcevqtu'cuuqekcvgf "y kj "vj g'qeewttgpeg'qh'WCS "cpf "hwo g'gxgpvu0"

Delimitations

Vj ku'uwf {'hqewugf 'qpn{'qp'tgrqtvu'tgncvgf "vq'WCS "cpf "hwo g'gxgpvu'uwdo kwgf "d{"

ecdkp'cpf 'hnki j v'etgy "o go dgtu0Gxgpvu'vj cv'y gtg'pqv'tgrqtvgf "y gtg'pqv'tgxkgy gf "d{"

"

PCUC"cpcn{uu"cpf"ygtg"pqv"kpenwfgf "kp"yjg"CUTU"fcvcdcug0Cniltgrqtu"uwdokvgf "vq"

CUTU"o c{"pqv"dg"kpenwfgf"kp"yjgkt"fcvcdcug0Tgrqtvu"o c{"dg"uwdokvgf "vq"yjg"u{uvgo "

rtko ctkn{"cu"c"o gcpu"qh"rtqvgevkpi "egtvkhkecvg"jqrfgtu"htqo "gphqtego gpv"cevkqp"cpf "hqt"

tgrqtvkpi "fgxkcvkqpu"qt"cpo cnkgu. "uwej "cu"cp"cnkwfg"fgxkcvkqp. "go gti gpe{"ncpfkpi ."qt"c"

hrki j v"fkxgtukqp0Tgrqtvgf "gxgpvu"y qwf "dg"eqpukfgtgf "cu"cp"qeewttgpeg"qh"WCS "qt"hwo g"

gxgpv"kh"kv"ku"fguetkdgf "cu"uwej "kp"yjg"pcttcvkxg"qt"gpqwij "fgvckn"ku"kpenwfgf "kp"yjg"tgrqtv"

hqt"yjg"cpcn{uv"vq"eqfg"kv"cu"uwej 0Tgrqtvu"uwdokvgf "d{"o ckpvgpcpeg"r gtuqppgn "

o ckpvgpcpeg"kpurgevqtu. "cpf "vgej pkekcpu. "qt"tgrqtvu"hqt"yjg"uqrg"r wtr qug"qh"fguetkdkpi "

o gej cpkecn"cpo cnkgu"cpf "o ckpvgpcpeg"gttqtu"y gtg"pqv"kpenwfgf "kp"yjku"uvwf{."cu"yjg"

hqewu"qh"yjku"uvwf{"y cu"pqv"yjg"ecwug"qh"yjg"gxgpv0Vjg"hqewu"y cu"qp"yjg"gzr nqtcvkqp"cpf "

kfgpvkhkecvkqp"qh"xctkcdngu"o kpf "htqo "yjg"pcttcvkxgu"qt"tgrqtvu"htqo "etgy "o go dgtu"

gzr gtkgpekpi "yjg"gxgpvu"cpf "yjg"fgxgnqr o gpv"qh"o qfgn"wukpi "yjgug"xctkcdngu"hqt"yjg"

r wtr qug"qh"kfgpvkh{kpi "ko r qtcpv"hcevqtu"cuuqekcvgf "y kj "WCS "cpf "hwo g"gxgpvu0Cnhqwij "

qyjgt"tgrqtvkpi "u{uvgo u"uwej "cu"yjqug"hqt"yjg"Ugtxkeg"Fkhhkewnv{"Tgrqtvu"*UFTu+."yjg"

Cxkcvkqp"Uchgv{"Cevkqp"Rtqi tco "*CUCR+."qt"Ceekfgpv"cpf "Kpekfgpv"Fcvc"*CKF+"u{uvgo "

o c{"kpenwfg"kphqto cvkqp"tgi ctfkpi "WCS "cpf "hwo g"gxgpvu."yjg"CUTU"fcvcdcug"ku"ugngevgf "

vq"kpeqtr qtcvg"c"fkxgtukhkgf "r qvgpvkcn"tgrqtvkpi "r qr wncvkqp"gzr gtkgpekpi "yjgug"gxgpvu0"

Hrki j v"cpf "ecdkp"etgy u"o c{"j cxg"xgt{"fkhhgtgpv"mpqy ngfi g."gzr gtkgpegu."cpf "fguetkr vkqpu"

qh"hwo g"gxgpvu"cpf "r tqxkfg"fkur ctcvg"kphqto cvkqp"kp"yjg"tgrqtv"pcttcvkxgu."y j kej "gpj cpegu"

yjg"tkej pguu"qh"yjg"ceeqwpvu"cpf "cff u"xcnwg"vq"yjg"vgzv"o kpkpi "r tqeguu0Vjg"wug"qh"yjg"

CUTU"fcvcdcug"kpeqtr qtcvgf "j wo cp"hcevqtu"kpvq"yjg"uwf{."y j kej "o c{"kpenwfg"uwdlgevkxg"

hggnkpi u. "u{o r vqo u. "gzr gtkgpegu. "cpf "qweqo gu0Cu"yjg"ewttgpv"uwf{"ku"gzr nqtcvqt{."

tgeqo o gpfcvkqpu"ctg"o cfg"hqt"hwwwtg"qdlgevkxg"uwfkgu. "uwej "cu"hqewugf "ckt"s wcnkv{"

"

o qpkvqtkpi "qt "uvcpf ctf k¦ gf "swcpvkcvkxg "o gf kecn"cuuguuo gpv"qh"etgy "o go dgtu"qt"

r cuugpi gtu0'

       Hkpf kpi u'htqo "vj ku'tgugctej "ctg "î gpgtcnk| cdng "vq "vj g"eqo r cpkgu"qr gtcvkpi "

eqo o gtekcn'r cuugpi gt"qt"ecti q'lgv'cktetchv'kp"vj g"WOU0 "cu'vj g"f cvc"y gte"uwr r rkgf "d{ "

go r nq{ggu"qh'WOU0 eqo r cpkgu"qr gtcvkpi "eqo o gtekcn'lgv'cktetchv'wpf gt'36 'E(H)T0È '343 "

F qo guvke. "Hnci . "cpf "Uwr r ngo gpvcn'Qr gtcvkqpu0'Vj ku'uvwf {"wugf 'f cvc'htqo "vj g'CUTU"

f cvcdcug "cpf "y cu'lko kvgf "vq "vj g"tgr qtvu'r tqxkf gf "kp"vj g'f cvcdcug0Cnn'tgr qtvu'uwdo kvgf "vq "

vj g"u{uvgo "y gtg "pqv'kpenwf gf "kp"vj g'f cvcdcug;'vj wu. "tgr qtvu'qh'hwo g"gxgpvu'o c{"dg"o kvgf "

htqo "vj g'f cvcdcug0Cff kvkqpcn{. "vj g'f cvc"y gtg "nko kgf "vq'xqnwpvctkn{'tgr qtvgf "kpekf gpvu"

cpf "ukvwcvkqpu'htqo "vj g"uvcgf "{gctu'qh'kpenwukqp'hqt'hki j v'qr gtcvkqpu0""

Limitations and Assumptions

       Gxkf gpeg'uwi i guu'wpf gttgr qtvkpi "qh'hwo g'gxgpvu'cpf "ku'c"lko kcvkqp'qh'vj g'uwf {0'

Cuuwo r vkqpu'y gtg "vj cv'hki j v'cpf "ecdkp"etgy u'ctg "cdng "vq 'tgeqi pk| g'cpf "tgr qtv'WCS "cpf "

hwo g'gxgpvu'cpf "f guetkdg "cpf "tgr qtv'ceewtcvg'cpf "eqo r ngvg'kphqto cvkqp'cdqwv'vj gug "

gxgpvu0'Vj g'f cvc'y gtg "cuuwo gf "vq 'dg'f gkf gpvkhkgf "cpf "ceewtcvg{"eqf gf "d{ "cpcn{uu'cv'vj g "

P cvkqpcn'Cgtqpcwkeu'cpf "Ur ceg'Cf o kpkuvtcvkqp "*P CUC± . 'y j kej "ku'tgur qpukdng "hqt "

o cpci kpi "vj g'xqnwpvctkn{'uwdo kvgf "tgr qtvu'cpf "vj g'CUTU'f cvcdcug0'Vj g'f cvc'y gtg "

cuuwo gf "vq "dg 'tgr tgugpvcvkxg'qh'cnn'WOU0 eqo o gtekcn'cktetchv'qr gtcvkqpu'ewttgpv{"

qr gtcvkpi "wpf gt 36 'EHT 'Rctv '343 "dw'ctg 'pqv'r ctvkewct'vq 'cp{ 'ur gekhke'cktetchv. 'ckrkpg. 'qt "

ckrr qtv0'Gzr cpf kpi "vj g'uwf {'vq 'eqwpvtkgu'qt 'ckrrkpgu'y kj "ujo knct 'tgr qtvkpi "u{ugo u'o c{"

r tqxkf g'cff kvkqpcn'kpuki j v0Cu'hwwtg 'ckrtetchv'gpi kpg'f guki p'hqewugu'qp'i tgcvgt'ghhlekgpe{"

cpf "nguu'gpxktqpo gpvcn'ko r cev. 'vj g'qr r qtwpk{'hqt'WCS 'cpf "hwo g'gxgpv'qeewttgpeg'o c{"

ej cpi g'f gr gpf kpi "qp'gpi kpg'f guki p. 'nwdtkecvkqp'r tqf wev'wugf . 'qr gtcvkpi "vgo r gtcwtgu."

r ncego gpv"qh"ckt"kpngvu."cpf "qyjgt "hcevqtu0"Vjg"o qfgnu"uj qwnf "dg"tgxkgy gf "cpf "vguvgf "

r gtkqfkecnn{"y kj "vjg"o quv"ewttgpv"fcvc"vq"gpuwtg"vjg{"ctg"tgrtgugpvcvkxg"qh"vjg"cktetchv"

cpf "gpi kpgu"ewttgpvn{"kp"wug0"

Summary

Eqpvco kpcvgf "dnggf "ckt"htqo "cktetchv"gpi kpgu"ecp"gzrqug"etgy "cpf "r cuugpi gtu"vq"

j cto hwn"eqo r qwpfu0"Vjgug"gzrquwtg"gxgpvu"ctg"fkhhkewnv"vq"s wcpvkh{"cpf "r tgfkev."cnj qwij "

j gcnj "ghhgevu"cpf "vj gkt"eqpugs wgpegu"o c{"dg"ugtkqwu."cu"gnwekfcvgf "kp"vjku"ejcrvgt0"Vjku"

s wcnkkcvkxg"cpf "s wcpvkcvkxg"o kzgf "o gvj qfu"uvwf{"y cu"eqpfwevgf "vq"gzr nqtg"cpf "kfgpvkh{"

ko rqtcpv"hcevqtu"cuuqekcvgf "y kj "vj g"kpekfgpeg"qh"WCS "cpf "hwo g"gxgpvu"tgr qtvgf "d{"

ecdkp"etgy u"cpf "hnki j v"etgy u"cpf "eqpvckpgf "kp"tgrqtv"pcttcvkxgu"kp"vj g"CUTU"fcvcdcug0"

Vjgug"hcevqtu"y gtg"wugf "y kj "s wcpvkcvkxg"xctkcdngu"htqo "vj g"fcvcugv"vq"fgxgnqr ."vtckp."

xcnkfcvg."cpf "vguv"o qfgnu"wukpi "c"xctkgv{"qh"o cej kpg"ngctpkpi "cni qtkj o u"wukpi "UCUᴿ "

Gpvgtr tkug"O kpgtⱽᴼ "37030"Vjg"o qfgnu"y gtg"gxcnwcvgf "cpf "eqo r ctgf "hqt"vj g"i tgcvguv"

tgnkcdknkv{"cpf "xcnkfkv{"vq"kfgpvkh{"vj g"dguv"o qfgnⱼhqt"kfgpvkh{kpi "ko rqtcpv"hcevqtu"

cuuqekcvgf "y kj "vj g"qeewttgpeg"qh"WCS "cpf "hwo g"gxgpvu0"

Vj g"hqnqy kpi "ugevkqpu"fguetkdg"vj g"pggf "hqt"kfgpvkh{kpi "ko rqtcpv"hcevqtu"

cuuqekcvgf "y kj "hwo g"gxgpvu0Rtgxkqwu"tgugctej "gzr qukpi "vj g"ej cngpi gu"kp"fgvgto kpkpi "

vj g"pwo dgr"qt"tcvg"qh"hwo g"gxgpv"qeewttgpeg."fkhhkewnkgu"kp"kfgpvkhkecvkqp"qh"vj g"

eqpvco kpcpvu"r tgugpv"fwtkpi "hwo g"gxgpvu."eqo r ngzkkgu"kp"fgvgto kpkpi "vj g"eqpvco kpcpv"

ngxgnu"cpf "vj g"gzr qukvg"r ctco gvgtu."cpf "vj g"ej cngpi gu"kp"kfgpvkh{kpi "cpf "o gcuwtkpi "

dkqrq{ekcnⱼkpfkecvqtu"qh"gzr qukvg"ctg"r tgugpvgf "kp"Ejcr vgr"KK0Tgugctej "wukpi "uko knct "

fcvcugvu"cpf "r tqeguugu"vq"kfgpvkh{j c|ctfu"qt"dwknf "r tgfkevkxg"o qfgnu"ku"cnq"r tgugpvgf "cpf "

gzco kpgf 0"Vj g"r tqeguugu"qh"vgzv"cpf "fcvc"o kpkpi "wugf "kp"vj ku"uvwf{."cu"y gn"cu"

f guetkr vkqpu"qh'vj g"o qf gnu"vq"dg"f gxgnqr gf ."ctg"f kuewuugf "kp"Ej cr vgt"KKK0'Ej cr vgt"KX"

r tqxkf gu"vj g"tguwnu"qh"vj g"uwxf { ."cpf "Ej cr vgt"X'f kuewuugu"vj g"eqpenwukqpu"cpf "

tgeqo o gpf cvkqpu"hqt"kpvgtxgpvkqp"cpf "hwwtg"tgugctej 0"

Definitions of Terms

Dkqo ctngt "   C"f ghkpgf "ej ctcevgtkuvke"o gcuwtgf "cu"cp"kpf kecvqt"qh"pqto cn'

dkqnqi kecn'r tqeguugu."r cvj qi gpke"r tqeguugu."qt "tgur qpugu"vq"cp"

gzr quwtg"qt"kpvgtxgpvkqp."kpenwf kpi "vj gtcr gwke"kpvgtxgpvkqpu"

*HF C."4238+0'

Dkqo qpkvqt "   O gcuwtgo gpv'qh"vj g"co qwpv'qh'ej go kecnu"*uwej "cu"vqzkpu+"kp"vj g"

j wo cp"dqf { "*O gttkco /Y gduvgt."p0f 0+0"

F cvc'O kpkpi "   Vj g"wug"qh"o cej kpg"ngctpkpi "cni qtkj o u"vq"hkf "tgncvkqpuj kr "

r cwgtpu'dgwy ggp"f cvc"gngo gpu"kp"ncti g"f cvcugvu."y j kej "ecp"ngcf "vq"

cevkqpu"vj cv'r tqxkf g"uqo g"hqto "qh'dgpghkv'*Pkudgv'gv'cn0'422; +0"

F gekukqp"Vtgg C"pqpnkpgct ."pqp/r ctco gvtke."nqi kecn'tug/dcugf "f cvc'o kpkpi "

o gwj qf "vj cv'wugu'uwr gtxkugf "f kxkukxg'j kgtctej kecn'o gwj qf u'vq"

ugi o gpv'vj g'r qr wncvkqp'kpvq'pqf gu'd{ "cr r n{kpi "gzr nkekv'twngu'hqt"

encuukhkecvkqp"*Vwhh?t{."4233+0"

Gpugo dng'O qf gn'   C"o qf gn'etgcvgf "d{ "eqo dkpkpi "o wnkr ng"o qf gnkpi "o gwj qf u"

vq"qdvckp'ugr ctcvg"o qf gnu'htqo "vj g"uco g"vtckpkpi "f cvc'ugv'cpf "

kpvgi tcvkpi "vj go "kpvq"c"hkpcn'o qf gn'uqnwkqp"*UCS³."4239d+0"

Gpxktqpo gpvcn'Eqpvtqn'U{uvgo "   Vj g"gs wkr o gpv'wugf "vq"r tguuwtk| g."xgpvkncvg."

ckt"eqpf kkqp."qt"j wo kf kh{ "vj g"ckt"kp"cp"ckretchv."kpenwf kpi "vj g"

"

ckthrqy "eqpvtqn'hqt"ecdkp"uwr r n{."vgo r gtcwvtg"cpf "r tguuwtg"eqpvtqn"

fkuvtkdwvkqp.'tgektewncvkqp."cpf "hknvtcvkqp"qh'ckt"*KECQ."4237+0'

HCT "Rctv'343""   Vj g"ugevkqp"qh'vj g"Eqf g"qh'Hgf gtcn'Tgi wncvkqpu"eqxgtkpi "

uej gf wngf "cktrnkpg"qr gtcvqtu."cu'hqwpf "kp"36'E0H0T0È'343'F qo guvke."

Hrci ."cpf "Uwr r ngo gpvcn'Qr gtcvkqpu0'

Hrki j v'F kxgtukqp"   Hrki j vu'tgswktgf "vq"cpf "cv'qvj gt"vj cp"vj gkt"qtki kpcn'

f guvkpcvkqp'hqt'tgcuqpu'dg{qpf "vj g"eqpvtqn'qh'vj g'r knqv'qt"vj g"

eqo r cp{."g0i 0r gtkqf u'qh'ukipkhkecpv'y gcvj gt"*HCC."4238e+0"

Hwo g"Gxgpv"   Eqpvco kpcvkqp"qh'cktetchv'ecdkp"ckt"y kvj "r qvgpvkcm{"j c| ctf qwu"

eqo r qwpf u'htqo '"j {f tcwrke"hnwkf u.'1gv'gpi kpg"qkm."cpf "eqo dwuvgf "

qt"r {qn{| gf "o cvgtkcnu'hqwpf "kp"dngf "ckt "htqo "cktetchv'gpi kpgu"

*J cttkuqp"('O cemgp| kg"Tquu."4238+0'

I tcf kgpv'Dqquvkpi "   C'r ctvkvkqpkpi "cni qtkvj o "vj cv'ugctej gu'hqt'cp'qr vko cn'

r ctvkvkqp'qh'f cvc'cu'f gvgto kpgf "d{'vj g"xcnwgu'qh'c'ukpi ng'xctkcdng."

y kvj "vj g"qr vko crkv{'etkvgtkqp'f gr gpf gpv'qp'j qy "vj g"vcti gv'xctkcdng"

ku'f kuvtkdwvgf "kpvq"vj g'r ctvkvkqp'ugi o gpvu'*UCU¾."4239+0"

Nqi kuvke"Tgi tguukqp"   C'rkpgct"eqo dkpcvkqp"qh'kpf gr gpf gpv'r tgf kevqtu'eqpxgtvgf "

vq'xcnwgu'dgvy ggp'| gtq'cpf "qpg'wukpi "c'nqi kuvke."qt'nqi "qh'qf f u"

hwpevkqp.'y j kej "ecp"dg"wugf "vq"guvko cvg"vj g'r tqdcdkrkv{'qh'c"

f kej qvqo qwu'qwveqo g"*J guu'('J guu."423; +0"

O cej kpg"Ngctpkpi "   Vj g"hkgnf "qh'uvwf { 'vj cv'r tqxkf gu'eqo r wvgtu'vj g"cdkrkv{'vq"

ngctp'y kvj qwv'dgkpi "gzr rkekvn{'r tqi tco o gf "*Uco wgn'3; 7; +0"

"

O gf kecn'Go gti gpe{"   Cp'kp/hnki j v'go gti gpe{'f wg'vq'cp'kplwt{/tgncvgf 'qt'j gcnj /

tgncvgf "ukwwcvkqp"*Um{dtct{.'423; +0"

Rtgf kevkxg'O qf gn"   Vj g'r tqeguu'qh'wukpi "npqy p'tguwnu'vq'etgcvg.'r tqeguu.'cpf "

xcnkf cvg'c'o qf gn'yj cv'ecp'dg'wugf "vq'hqtgecuv'hwwwtg'qwrqo gu"

*Htcpmgphkgnf .'423; +0'

Tcpf qo "Hqtguv"   Uwr gtxkugf "gpugo dng"ngctpkpi "encuukhkecvkqp'cn qtkj o u"

yj kej "ctg'c'eqo dkpcvkqp'qh'f gekukqp'vtgg'r tgf kevqtu.'y kj "gcej "vtgg"

f gr gpf kpi "qp'yj g'xcnwgu'qh'c'tcpf qo "xgevqt'y j kej "ku'uco r ngf "

kpf gr gpf gpvn{.'y kj "yj g'uco g'f kuvtkdwvkqp'qeewttkpi "hqt'gcej "qh'yj g"

vtggu'kp'yj g'hqtguv'*Dtgko cp.'4223+0"

Vgzv'O kpkpi "   C'xctkcvkqp'qh'f cvc'o kpkpi "kp'y j kej "pgy .'r tgxkqwun{'wpmpqy p"

kphqto cvkqp'ku'f kueqxgtgf "d{'cwqo cvkecn{'gzvtcevkpi "f cvc'htqo "

pcwwtcn'ncpi wci g'vgzv'kpr wugf "qh'htqo "uvtwewtgf "f cvcdcugu'qt'hkgnf u"

*J gctuv.'4225+0"

Wpf guktcdng'Ckt'S wcnkv{"   Vj g'eqpf kvkqp'qh'qyj gt'yj cp'uvcpf ctf .'dtgcyj cdng'ckt"

kp'yj g'ecdkp'qt'hnki j v'f gem'cpf "o c{'kpenwf g'uo qmg.'j c| g.'qf qtu."

vgo r gtcwwtg.'j wo kf kv{.'dcevgtkc.'xktwugu.'o qnf .'qt'qyj gt'r ctvkewncvg"

o cwgt0"

List of Acronyms

CKF U"   Ceekf gpv'cpf "Kpekf gpv'F cvc'U{uvgo "

CHC"   Cuuqekcvkqp'qh'Hnki j v'Cwgpf cpvu"

CRW"   Cwzknkct{'Rqy gt'Wpkv"

CTHH"   Cwtkdwg'Tgncvkqp'Hkng'Hqto cv'

"

CUCR"	Cxkcvkqp"Uchgv{"Cevkqp"Rtqitco "
CUKCU"	Cxkcvkqp"Uchgv{"Kphqtocvkqp"cpf "Cpcn{uku"Ujctkpi ""
CUTU"	Cxkcvkqp"Uchgv{"Tgrqtvkpi "U{uvgo "
HCC"	Hgfgtcn"Cxkcvkqp"Cfokpkuvtcvkqp"
HCT"	Hgfgtcn"Cxkcvkqp"Tgiwncvkqp "
HQKC"	Htggfqo "qh"Kphqtocvkqp"Cev"
HQSC"	Hnkijv"Qrgtcvkqpu"Swcnkv{ "Cuuwtcpeg""
KECQ"	Kpvgtpcvkqpcn"Ekxkn"Cxkcvkqp"Qticpk|cvkqp"
OT"	Okuencuukhkecvkqp"tcvg"
PCUC""	Pcvkqpcn"Cgtqpcwvkeu"cpf "Urceg"Cfokpkuvtcvkqp""
PVUD""	Pcvkqpcn"Vtcpurqtvcvkqp"Uchgv{ "Dqctf "
RCP " "	Rjgp{n'crr jc/pcr jyj{nco kpg'"
RQU" "	Rctv'qh/urggej "
TQE" "	Tgegkxgt"Qrgtcvkpi "Ejctcevgtkuvke "
UCU³ "GO ᵛᵒ ""	UCU³ "Gpvgtrtkug"Okpgtᵛᵒ ""
UFT"" "	Ugtxkeg"Fkhhkewn{ "Tgrqtv""
UGOOC"	Uco rng."Gzr nqtg."Oqfkh{."Oqfgn"cpf "Cuuguu"
UOU" "	Uchgv{ "Ocpcigogpv"U{uvgo "
VER" "	Vtketgu{n'rjqurjcvg"
VZR" "	Vtkz{ngp{n'rjqurjcvgu'"
WCS "	Wpfguktcdng"Ckt "Swcnkv{ "
XFTR"	Xqnwpvct{ "Fkuenquwtg"Tgrqtvkpi "Rtqitco

Vj ku'r ci g'kpvgpvkqpcm{ 'ngh'dncpm0'

"

Chapter II: Review of the Relevant Literature

Kfgpvkhkecvkqp"cpf"rtgxgpvkqp"qh'hwo g"gxgpvu"ctg"qh'etkxkecn'ko rqtvcpeg"kp"

rtqvgevkpi "etgy "cpf"rcuugpi gt"j gcnj ."\j g"uchg"qwveqo g"qh'hnki j vu."cpf"\wrj qnf kpi "\j g"

rtkpekr ngu"qh'c"uchgv{"o cpci go gpv"u{uvgo 0'Ej cr vgt"KK'rtqxkf gu"cp"gzco kpcvkqp"qh'\j g"

rwdnkuj gf "hkpfkpi u"cpf "ej cngpi gu"kp"kf gpvkh{kpi ."ej ctcevgtk\ kpi ."cpf "s wcpvkh{kpi "hwo g"

gxgpvu"cpf "r qvgpvkcn'qr gtcvkqpcn'qwveqo gu."uwej "cu"o gf kecn'go gti gpekgu"cpf "go gti gpe{"

ncpf kpi u."cpf "j ki j nki j vu"\j g"uwdugs wgpv'f khhkewn{"kp'r kpr qkpvkpi "uj qtv"cpf "nqpi /vgto "

j gcnj "ghhgevu0'I cr u"kp"gzkuvkpi "nkvgtcwtg"ctg"r tgugpvgf ."cpf "tgugctej "wukpi "gzr nqtcvqt{"

vgzv'o kpkpi "r tqeguugu"cpf "wukpi "uko knct"f cvcugvu"vq"kf gpvkh{"hcevqtu"cpf "dwknf "r tgf kevkxg"

o qf gnu"ctg"r tgugpvgf "cpf "gzco kpgf ."cnqpi "y kj "c"dtkgh'f guetkr vkqp"qh'\j g"o cej kpg"

ngctpkpi "cni qtkj o u"wugf "kp"\j ku"uwwf {0'

Characterization and Quantification of Fume Events

Background

Cnj qwi j "c"uo cn'f gi tgg"qh'ko r ckto gpv'y cu"gzr gevgf "vq"dg'j c\ ctf qwu"cpf "eqwnf "

chhgev'etgy "o go dgtu)'r gthqto cpeg."\j g"eqpegpvtcvkqp"qh'vqzke"eqo r qwpf u"cpf "\j g"

htgs wgpe{"qh'etgy "o go dgtu)'gzr quwtg"vq"eqpvco kpcvgf "dnggf "ckt"y gtg"cf o kwgf n{"

wpmpqy p"cno quv'ugxgpv"{gctu'ci q"*CuO C."3; 75+0'Gpi kpg"qkn'eqpvco kpcvkqp"qh'dnggf "ckt"

cpf "\j g"r qvgpvkcn'vq"ugtkqwun{"chhgev'c"r knqv)u"cdknkv{"vq"eqpvtqn'cp"cktetchv'y gtg"

f qewo gpvgf "kp'3; 77."y kj "u{o r vqo u"qh'g{g/y cvgtkpi ."kttkvcvkqp"vq"pqug"cpf "\j tqcv."o knf "

pcwugc."cpf "nquu"qh'ugpug"qh'f ktgevkqp"*Tgf f cn'3; 77+0'Cu'vgej pqnqi kgu'vq"kf gpvkh{"cpf "

o gcuwtg"eqpvco kpcpvu"dgeco g"o qtg"uqr j kuvkecvgf ."eqo r qwpf u'kp'r {tqn{| gf "gpi kpg"qkn'

cpf "j { f tcwnke'hnwkf 'y gtg'kf gpvkhkgf "kp'ecdkp"ckt."cpf "ghhgevu'qh'gzr quwtg'y gtg"

f qewo gpvgf 0"

Hgf gtcri'cxkcvkqp''tgi wncvkqpu''hqt''egtvkhkecvkqp''qh'cktetchv''tgs wktg''eqo r rlcpeg'y kj "

xgpvkncvkqp''cpf ''gpxktqpo gpvcrl'eqpvtqri'u{uvgo ''f guki p''y j kej ''r tqxkfg''hqt''etgy ''cpf "

r cuugpi gt''eqo r ctvo gpv''ckt''vq''dg''htgg''htqo ''j cto hwrl'qt''j c| ctf qwu''eqpegpvtcvkqpu''qh'i cugu"

qt''xcr qtu''*36'EHT ''È'470 5+''cpf ''lko kv''vj g''eqpegpvtcvkqp''qh'q| qpg''kp''cktetchv''ecdkp"

gpxktqpo gpvu''*36'EHT ''È'470 54+0'Cnvj qwi j ''cktetchv''u{uvgo ''f guki p''pgeguukvcvgu''vj g"

r tqxkukqp''qh'xgpvkncvkqp''cpf ''r tguuwtk| cvkqp''hqt''c''uchg''ecdkp''gpxktqpo gpv'''u{uvgo "

kpcf gs wcekgu'''j wo cp''gttqr''qt''o gej cpkecri'hcknwtgu''ecp''qeewt'''tguwnlkpi ''kp''eqpvco kpcvkqp"

qh'dnlggf ''ckt''y j kej ''ku''uwr r nlkgf ''vq''vj g''nlki j v'f gem''cpf ''r cuugpi gt''eqo r ctvo gpv0''

Characterization of fume events

Cpf gtuqp''*4236+'''O wtcy umk''*4233+'''Etwo r 'gv'cri0''*4233c+'''J cttkuqp''gv'cri0''*422; +''

cpf ''O kej cgrlu''*4225+'j cxg''f guetkdgf ''eqo o qp''gngo gpvu''tgr qtvgf ''d{ ''etgy '''kpenwf kpi ''cp"

qf qt''qh'f ktv{ ''uqemu'''uo gm{ ''hggv'''o wuv{ '''o qnf '''o knf gy '''xqo kv'''ej go kecri'qt''hqwri'qf qt0''Kp"

cf f kvkqp''vq''cp{ ''tgr qtvgf ''knlpguu'''vj gug''vgto u'y gtg''cnuq''wugf ''d{ ''Uj gj cf k'gv'cri0''*4238+''vq"

kf gpvkh{ ''hwo g''gxgpvu0''

Frequency of Occurrence

J cttkuqp''cpf ''O cemgp| kg''Tquu''*4238+''hqwpf ''guvko cvgu''qh'vj g''htgs wgpe{ ''qh'

qeewttgpeg''qh'hwo g''gxgpvu''xct{ ''d{ ''uqwteg'''y kj ''tgi wncvqt{ ''cwvj qtkvkgu'''cktnlkpgu'''cpf ''vtcf g"

wpkqpu''uj qy kpi ''y kf g''xctkcvkqp0'Vj g''HCC''o ckpvckpu''u{uvgo u''hqt''tgr qtvkpi ''uchgv{ ''kpekf gpvu"

d{ ''cktnlkpgu'''uwej ''cu''vj g''Ugtxkeg''F khhkewnlv{ ''Tgr qtv'*UF T +''u{uvgo ''''cpf ''vj g''Ceekf gpv'cpf "

Kpekf gpv''F cvc''*CKF +''u{uvgo 0'Vj gug''f cvcdcugu''ctg''r wdnlken{ ''ceeguukdng''cpf ''cxcknlcdng''hqt"

cpcn{uku''d{ ''tgugctej gtu0'Tgugctej gtu''kpf kecvg''ci ttgo gpv'kp''qeewttgpeg'''dwv'pqv'kp"

htgs wgpe{ '''cu''O wtcy umk''cpf ''Uwr r ngg''*422: +''hqwpf ''cp''cxgtci g''qh'20 9''hwo g''gxgpvu''r gt"

f c{ ''y j kng''Uj gj cf k'gv'cri0''*4238+''hqwpf ''cp''cxgtci g''qh'40 3''hwo g''gxgpvu''r gt''32.222''hnki j u'''qt"

cr r tqzko cvgn{"; "gxgpvu"r gt"f c{"*HCC."423;+0Cktnkpgu"kp"yj g"WUU0tgr qtvgf "cp"cppwcn" cxgtci g"qh"qxgt"3.222"uo qmg"cpf "hwo g"gxgpvu"\q"yj g"HCC"f wtkpi "422; /4234"*Cpf gtuqp." 4236+."gs wkxcngpv"\q"40 "hwo g"gxgpvu"r gt"f c{0"Vj g"P cvkqpcn'Tgugctej "Eqwpekn'*4224+" tgr qtvgf "dgw ggp"202; "cpf "50 "kpekf gpvu"r gt"3.222"hkki j v'e{engu"qp"yj tgg"Ecpcf kcp" cktnkpgu."qt"cp"cxgtci g"qh"y q"\q"yj tgg"hwo g"gxgpvu"r gt"f c{."ceeqtf kpi "\q"cktnkpg"f cvc0Kp" cff kvkqp"\q"yj g"f kur ctkv{"kp'pwo dgtu"qh"tgr qtvu"cu"uggp"kp"Vcdng"4."gxkf gpeg"cnuq"uwi i guvu" hwo g"gxgpvu"ctg"wpf gttgr qtvgf "*HCC."4228=O kej cgnku."4229=Y kpf gt"("O kej cgnku." 4227+0"

Table 2

Rates of Smoke, Fume, and Odor Events Reported from Studies on Aircraft

F cvgu"	F cvc"Uqwteg""	P wo dgt"qh" Gxgpvu"	F ckn{" *Cppwcn+" Cxgtci g"	Tghgtgpeg"
23 3;: 8/ 2514222"	UFT"	: 68: "	30 7"*773+"	CHC."4225"
23 3;;;/ 331422: "	UFT"	474"	2029"*47+"	CECGT."4234"
4224/4233"	UFT"	5882[a]"	30 2"	Cpf gtuqp."4243"
23 14228/ 2814229"	UFT."CKF."CHC"	692"	20 9"*535+"	O wtcy umk'(" Uwr r ngg."422: "
4229/4234"	UFT"cpf "CUTU"	40 3132.222" hkki j vu[b]"	; 02"*5595+"	Uj gj cf k'gv'cn0" 4238"
422; /4232"	Hkki j v'cwgpf cpv'cpf " r knqv'tgr qtvu"\q"yj g" cktnkpgu'wpkqpu"cpf " UFT""	: 9"	2034"*65+"	O wtcy umk"4233"
422; /4234"	HCC"*HQKC" tgs wguv+"	62: 2"	40 "*3242+"	Cpf gtuqp."4236"

[a]"Vj g"pwo dgt"qh"uo qmg"qt"hwo g"gxgpvu"ecwugf "d{ "dngmf "ckt."qkn"qt"j {f tcwnke"hnwkf "y cu" f gvgto kpgf "\q"dg"5882."[b]"Cxgtci g"htgs wgpe{ "hqt"cnn"ckretchv"o qf gnu0'

"

Quantification of Contaminants

Tguwnu'qh'ghhqtvu'vq'kfgpvkh{'hwogg'gxgpv'eqpvcokpcpvu'cpf ''vjgkt'eqpegpvtcvkqpu'jcxg'pqv'ceeqwpvgf ''hqt''vjg'jgcnj ''ghhgevu'tgrqtvgf ''d{''etgy u0'Vjg'kttgiwnct'qeewttgpeg'qh'hwogg'gxgpvu'rtgenwfgu'rnppkpi ''cpf ''eqnngevkqp'qh'y qtuvecug'ckt'ucorngu'hqt'cpcn{uku'*Fc{.'4237=''Ogiiuqp'gv'cn'4238+0Etworg'gv'cn0*4233c=4233d+'oqpkvqtgf 'ckt's wcnkv{'cpf ''eqnngevgf 'ucorngu'fwtkpi ''322'hnkijvu'kp'hkxg'fkhhgtgpv'V{rgu'qh'cktetchv'cpf 'rtqxkfgf ''vjg'etgy u'y kij 's wguvkqppcktgu'tgictfkpi ''hwogu0'Cnijqwij '5: 'qh'322'hnkijvu'jcf 'hwogu'qt'uognn'tgrqtvgf 'd{'etgy u.'pqpg'qh'vjg'gxgpvu'vtkiigtgf 'vjg'cktnkpg)u'rtqvqeqn'hqt'uchgv{'kpekfgpv'tgrqtvkpi 0

Vjgkt'hkpfkpiu'qh'pq'eqpvcokpcpv'eqpegpvtcvkqpu'gzeggfkpi ''jgcnj 'cpf 'uchgv{'uvcpfctfu'ciittgf 'y kij ''vjg'hkpfkpiu'qh'Uejwejctf 'gv'cn0*423; +0Vjku'uvwf{'kpfkecvgf 'vjg'rtgugpeg'qh'VER'kp'ucorngu'htqo ''c'Dqgkpi '9: 9.'uwiiguvkpi 'dnggf 'ckt'oc{'pqv'dg'vjg'qpn{'uqwteg'qh'VER0'Jqw\cigt'gv'cn0*4235+'hqwpf '59'qh': 2'ckt'ucorngu'eqnngevgf 'fwtkpi ''42'fkhhgtgpv'hnkijvu'qh'pkpg'Dqgkpi '959'cktetchv'eqpvckpgf 'VER'kuqogtu=jqy gxgt.'vjg'ogfkcp'eqpegpvtcvkqpu'y gtg'dgnqy 'gzrquwtg'nko ku0'Gxkfgpeg'uwiiguvu'c'pggf 'hqt'eqpukfgtcvkqp'qh'qvjgt'r quukdng'eqpvcokpcpvu'cpf ''dgwgt/s wcnkv{'vqzkekv{'uvwfkgu'*fg'Dqgt'gv'cn0'4237+0

Health Effects

Tgugctej 'tgictfkpi 'fkci pquku'cpf ''vtgcvo gpv'cpf ''ecwucvkqp'qh'kplwt{'qt'knnpguu'htqo ''gzrquwtg'vq'jc| ctfqwu'eqo r qwpfu'fwtkpi ''hwo gg'gxgpvu'jcu'pqv'dggp'eqpenwukxg0'Kpfkxkfwcn'tgur qpug'cpf ''uwuegr vkdknkv{'vq'gzrquwtg'crrgct'vq'xct{'i tgcvn{'co qpi 'uwdlgevu'*O kej cgnku'gv'cn0'4239+0Uwfkgu'vq'o gcuwtg'gzrquwtg'jcxg'eqpukuvgf 'qh'ghhqtvu'vq'kfgpvkh{'cpf ''ej ctcevgtk| g'dkqo ctmgtu'*Fkpi 'gv'cn0'422: =Uej qrgt'gv'cn0'4232+0Cdqw'Fqpkc'gv'cn0'*4235+'j cxg'ngf 'ghhqtvu'vq'uwduvcpvkcvg'gzrquwtg'wukpi 'o ctmgtu'kp'etgy 'o go dgtu)'dnqqf 0

Vj g{ "hqwpf "gngxcvgf "ngxgnu'qh'cwuqcpvkdqf kgu'kp'hnkj j v'etgy u.'y kj 'nqy "qt'pq'ngxgnu'qh"

cpvkdqf kgu'f gvgevgf "kp'j gcnj{ 'eqpvtqnu0'Gngxcvgf "cwuqcpvkdqf { 'ngxgnu'kp'dnqqf 'uco rngu"

htqo "etgy "o go dgtu'y gtg'eqttqdqtcvgf 'd{ 'tgugctej 'hkpf kpi u'htqo "J ci go cp"gv'cn0'"

*4242d+0Vj gug 'hkpf kpi u'uwi i guv'gxkf gpeg'qh'egpvtcn'pgtxqwu'u{uvgo 'f co ci g'dww'f q'pqv'"

kpf kecvg'ecwucvkqp0Tqki 'gv'cn0'*4243+'hqwpf 'gxkf gpeg'qh'tgurktcvqt{ 'u{o rvqo u'kp'vj tgg"

r cvkgpvu.'y j kng'qpg'r tgugpvgf 'y kj 'egpvtcn'pgtxqwu'u{uvgo 'f co ci g'cu'enkpkecn'

o cpkhguvcvkqpu'hqnqy kpi 'gzr quwtg'f wtkpi 'cktetchv'hwo g'gxgpvu0Rj {ukecn'u{o rvqo u'cpf "

dkqej go kecn'ghhgev'o qpkqtkpi 'kp'gngxgp'ckt'etgy "o go dgtu'y gtg'uwf kgf 'd{ 'J gwgnldgem'gv'"

cn0'*4238+0Vj gkt'hkpf kpi u'qh'dkqej go kecn'ngxgn'kp'vj g'dnqqf "kpf kecvgf "qti cpqr j qurj cvgu"

qt'tgncvgf "eqo r qwpf u'eqpvtkdwvgf "vq"vj g'qdugtxgf "u{o rvqo u.'dww'f ktgev'eqttgncvkqp"

dgw ggp'vj g'u{o rvqo u'cpf 'ej go kecn'eqo r qwpf u'r tgugpv'kp'hwo g'gxgpvu'y cu'pqv'r quukdng0'"

Uej kpf ngt'gv'cn0'*4234+'o gcuwtgf 'j ki j gt'ngxgnu'qh'ugxgtcn'VER'o gvcdqnkvgu'kp'wtkpg"

uco rngu'htqo "etgy "o go dgtu'eqo r ctgf "vq'vj g'i gpgtcnr qr wncvkqp0Tgpgo cp'gv'cn0'*4238+'"

hqwpf "ej cpi gu'kp'dtckp'y j kvg'o cwgt'o ketquvwewwtg'co qpi 'r knqwu'cpf 'cnuq'hqwpf "o qtg"

ugrh/tgr qtvgf 'eqi pkvkxg'eqo r nckpu.'f gr tguukxg'u{o rvqo u.'cpf 'ko r cktgf /tcpi g'vguv'ueqtgu"

kp'r knqwu'eqo r ctgf 'vq'c'eqpvtqn'i tqwr 0Vj ku'uwf { 'y cu'cnuq'kpeqpenwukxg'kp'f gvgto kpkpi "

ecwucvkqp'dgw ggp'vj g'tgugctej gtu)'qdugtxcvkqpu'cpf 'gzr quwtg'vq'VERu0Hkpcm{.'Cdqw/

F qpkc'gv'cn0'*4236+'eqpf wevgf 'r quv/o qtgo 'vguvkpi 'qp'c'r knqv'r tgugpvkpi 'y kj 'pgwtqnqi kecn'

f ghkeku'cpf 'eqphkto gf 'cwuqcpvkdqf { 'dkqo ctmgtu'eqpukuvgpv'y kj 'qti cpqr j qurj cvg/

kpf wegf 'pgwtqvqzkeky0Eqpvtct{ 'vq'vj gug 'hkpf kpi u.'Dci uj cy "*4236+'tgxkgy gf 'r tgxkqwu"

tgugctej 'cpf 'uwo o ctk| gf 'tgr qtvgf 'u{o rvqo u'y gtg'kpeqpukugpv'cpf 'qtf kpct{=gzr quwtg'vq"

qti cpqr j qurj cvgu'y cu'kpuwhhkekgpv'vq'r tqf weg'pgwtqvqzkeky{.'cpf 'vqzke'kplwt{ 'y cu'pqv'

o gf kecm{ 'hgcukdng'y kj 'VER'gzr quwtg'ngxgn'qp'cktetchv0"

"

Medical Emergencies on Aircraft

C"uwf{"qh"hkxg"kpvgtpcvkqpcn"cpf"fqo guvke"cktnkpgu"d{"Rgvgtuqp"gv"cn0"*4235+"hqwpf"
ecnnu"q"c"r j{ukekcp"fktgevgf"o gfkecn"eqo o wpkecvkqpu"egpvgt"hqt"kp/hnki j v"o gfkecn"
go gti gpekgu"qeewttgf"cv"c"tcvg"qh"qpg"o gfkecn"go gti gpe{"r gt"826"hnki j vu0"Vj ku"ku"ikmgn{"cp"
wpfgttgr tgugpvcvkqp"qh"yj g"cewcn"pwo dgt"cpf"yj g"dwtfgp."cu"pqv"cnn"kp/hnki j v"o gfkecn"
go gti gpekgu"tguwnv"kp"eqpuwncvkqpu"y kyj "yj g"o gfkecn"eqo o wpkecvkqpu"egpvgt"*O ctvkp/I km"
gv"cn0"423: =Uwnn("Dcf cy c{."423: +0Ucpf"gv"cn0"*422; +"hqwpf "co qpg "54"eqo o gtekcn"
cktnkpgu."qpn{"hqwt"eqwf "r tqxkfg"tgs wguvgf"tgr qtvu"hqt"kp/hnki j v"o gfkecn"go gti gpekgu0"
Vj gtg"ku"pq"uvcpfctfk| gf"pcvkqpcn"qt"kpvgtpcvkqpcn"tgr qtvkpi "u{uvgo "hqt"tcemkpi "kp/hnki j v"
o gfkecn"go gti gpekgu"co qpg "yj g"cktnkpgu"*Ej cpftc"("Eqtr{."4235=Twumkp."422; =Uwnn("
Dcf cy {."423: +."pqt"fqgu"c"wpkhqto "uvcpfctf "hqt"yj g"ej ctcevgtk| cvkqp"cpf "ecvgi qtk| cvkqp"
qh"enkpkecn"u{o r vqo u"qt"fkci pqugu"gzkuv"*I tch"gv"cn0"4234+0"

Diversion

Cv"yj g"qpugv"qh"c"hnwo g"gxgpv."etgy u"uj qwf "cpvkekr cvg"c"fkxgtukqp."cpf "ej gemkuwu"
uj qwf "ecnn"hqt"f kxgtukqp"wpnguu"yj g"uqwteg"qh"yj g"hwo gu"ku"r qukkxgn{"kfgpvkhkgf ."
gzvkpi wkuj gf ."cpf "yj g"hwo gu"ctg"f kuukr cvkpi "*O eMgp| kg."422; +0Fkxgtukqpu"tgr tgugpv"c"
r qvgpvkcn"kpetgcugf "tkum"qh"ceekf gpvu"cpf "kpjwtkgu"vq"r cuugpi gtu"cpf "etgy u"kp"yj g"gxgpv"qh"
cp"go gti gpe{"gxcewcvkqp."npcf kpi "cv"wphco kkct"ckt qtvu."ej cpi g"kp"ckt "vtchhke"r cwgtpu."
uj qtv"twpy c{u."kko kvgf "hktghki j vkpi "ecr cdktkvgu."nquu"qh"ecti q."qt"kphgtkqt"pcxki cvkqpcn"ckf u"
*I CQ."4225+0Vj g"fgekukqp"vq"fkxgtv"tgs wktgu"ectghwn"eqpukf gtcvkqp"qh"yj gug"hcevqtu."y j kng"
y gki j kpi "yj g"ko o gfkce{"qh"yj g"ukwcvkqp"cpf "yj g"r qvgpvkcn"qwveqo g"qh"yj g"r cuugpi gt"qt"
etgy "o go dgt."cpf "wnko cvgn{"tkgu"y kj "yj g"ecr vckp"qh"yj g"ckttchv"*KCVC."423: +0"

Hkpcpekcn'nquugu'kpewttgf "d{ "ckttkpgu"f wg"vq"f kxgtukqpu."tgwvtpu"vq"vj g"f gr ctwtg"

cktr qtv."cpf "hnki j v'ecpegncvkqpu'hqt"hnki j vu'gzr gtkgpekpi "uo qng"cpf "knnpguu'gxgpvu'ecp'dg"

uwduvcpvkcn0F kxgtukqpu'ecp'tguwnv'kp'ugxgtg'f kutwr vkqpu'vq'ckttkpg'uej gf wngu."r cuugpi gt"

htwuvtcvkqp'cpf "knn'y km"cpf "eqpukf gtcdng"o qpgvct{"cpf "ngi cn'equvu"*J qmg{."422; ="

Lqj puqp."4236=Xcncpk'gv'cn0"4232+0Lqj puqp"*4236+"guvko cvgf "equvu'hqt'f kxgtukqpu"

tcpi kpi "htqo "&37.222'hqt"c'f qo guvke'hnki j v'vq"qxgt"&322.222'hqt"cp'kpvgtpcvkqpcn'hnki j v'

f kxgtukqp0Uj gj cf k'gv'cn0"*4237+'guvko cvgf "cp'cxgtci g'hkpcpekcn'equv'qh'&54.222'vq"&69.222"

r gt"f kxgtukqp'hqt'hwo g'gxgpv.'y kj "c"vqvcn'hkpcpekcn'nquu'tcpi kpi "htqo "&607'o knkqp'vq"&9"

o knkqp'cppwcm{0Vj gug'equvu'eqwnf "dg'o wej "j ki j gt.'cu'hwo g'gxgpvu'ctg'r wtr qtgfn{"

wpf gttgr qtvgf "*HCC."4228='O kej cgnku."4229='Y kpf gt"("O kej cgnku."4227+0"

Rgvgtuqp'gv'cn0*4235+'hqwpf "co qpi "hnki j vu'y kj "o gf kecn'go gti gpekgu.'905'   qh"

vj gug'hnki j vu'tguwnvgf "kp'ckretchv'f kxgtukqpu0Vj ku'ku'cp'kpetgcug'htqo "vj g'hkpf kpi "qh'40 '   qh"

cnn'kp/hnki j v'o gf kecn'go gti gpekgu'tguwnvkpi "kp'c'f kxgtukqp.'cu'hqwpf "kp'422; "d{ "Ucpf "gv'cn0'

Cp"guvko cvgf "66.222'kp/hnki j v'o gf kecn'go gti gpekgu'qeewt'y qtnf y kf g'cppwcm{.'y j kej "y km'

nkmgn{ "kpetgcug'kp'pwo dgt"cu'cf f kvkqpcn'hnki j vu'ctg'cf f gf "cpf "o qtg'r cuugpi gtu'vcxgnd{ "

ckt"*F gncwpg'gv'cn0"4225=Rgvgtuqp'gv'cn0"4235+0"

Previous Research in Fume Events"

Rtgxkqwu'tgugctej "j cu'r tkqtkvk|gf "f qewo gpvcvkqp'qh'vj g'qeewttgpeg'qh'hwo g'gxgpvu."

r tko ctkn{ "d{ "o qpkvqtkpi "ckt"s wcnkv{"cpf "eqnngevkpi "y kr g'uco r ngu='kf gpvkhkecvkqp'qh'vj g"

ur gekhke"eqo r qwpf u'cuuqekcvgf "y kj "hwo g'gxgpvu'cpf "vj gkt"ghhgevu'qp'j wo cp'j gcnj ='cpf "

dkqo qpkvqtkpi "qt'kf gpvkh{kpi 'dkqo ctmgtu'qh'gzr quwtg'vq'eqpvco kpcpvu'hqwpf "kp'hwo gu'cu"

f gvgevgf "kp'dqf {'hnwkf u'qt'vkuuwg0Vcdng"5'j ki j nki j vu'hwo g'gxgpv'tgncvgf "tgugctej "kp'vj gug"

ctgcu0"

"

Table 3

Relevant Fume Event-Related Literature"

Vqrke"qh" Kpvgtguv"	Tgugctej "V{rg"	Ucorng"	Nkokvcvkqpu"	Tghgtgpeg"
Ckt"Swcrkv{""	Oqpkvqtkpi ."ucorng" eqmgevkqp."cpf " swguvkqppcktgu"	322"hrki j vu"kp" hkxg"V{rgu"qh" ckretch""	Qpg"ckrrkpg." nqy "vjtgujqrf " hqt"tgrqtvkpi ""	Etwor "gv'cr0"4233c" cpf "4233d"
Ckt"Swcrkv{"	Ckt"cpf "ykrg" ucorngu"	42"hrki j vu"qh" pkpg"Dqgkpi " 959u""	Qpg"ckrrkpg." nko kvgf " pwo dgt"qh'ckt" cpf "ykrg" ucorngu" "	Jqw| ci gt." gv'cr0"4235"
"	"	"	"	"
Dkqo qpkvqtkpi "	Fguetkr vkxg."ecug" uvwf { "	56"hrki j v'etgy " eqo r ctgf "vq"34" j gcrj { "eqpvtqnu"	Uo cnn'uco r ng" uk| g." u{o r vqo u" ugrh/tgr qtvgf ." wpmpqy p" gzr quwtg" "	Cdqw/ Fqpkc"gv' cr0"4235"
J gcrj "Ghhgevu"	Ecug"Uvwf { "	5"ckrrkpg"etgy " o go dgtu"y kyj " tgur ktcvqt{" u{o r vqo u"	Uo cnn'uco r ng" uk| g."ncem'qh" uvcpf ctf k| gf " vtgcvo gpv' r tqvqeqn'	Tqki "gv'cr0" 4243"
J gcrj " Ghhgevu1" Dkqo ctmgtu"	Ecug"uvwf { "	5"ckrrkpg"etgy " o go dgtu"y kyj " egpvtcn'pgtxqwu" u{uvgo "f co ci g""	Uo cnn'uco r ng" uk| g."wpmpqy p" gzr quwtgu." uvwf { "uj qy u" gxkf gpeg"dwv' pqv'ecwucvkqp" " " " " " " " "	J ci go cp" gv'cr0" 4242d"

"

Vqrke''qh'' Kpvgtguv''	Tgugctej ''V{rg''	Uco rng''	Nko kcvkqpu''	Tghgtgpeg''
J gcnj ''Ghhgevu''	*3+Vgngrj qpg''uwtxg{'' qt''y tkwgp'' s wguvkqppcktg'' *4+Ecug''uwf {''	4''uwf kgu'' eqpukuvkpi ''qh'' *3+''43; '' r lqru'' cpf ''*4+''37'' gxgpvu''	Ncem'qh'' gzkukvkpi '' gzrquwtg'' rtqvqeqn'cpf '' uvcpfctfk| gf '' f cvc'' eqmgevkqp''	O kej cgnku'' gv'cn0''4239''
J gcnj ''Ghhgevu''	Uwtxg{''	; 8''Dqgkpi ''979'' r knqv'' tgurqpfgpvu'' tgrqtvgf ''3896- '' gxgpvu''	Uwdlgevkxg'' tgr qtvu''	O kej cgnku.'' 4225''
J gcnj ''Ghhgevu	Uwtxg{'qh'' gzr qugf '' cktetgy	Cktetgy ''kp''WM.'' Cwuvtcrkc.''cpf ''WU''	Ugrh/ugngevgf '''''''' cktetgy .''''''' uwdlgevkxg''' tgr qtvu.''uo cm'' uco rng''uk| g	J ctr gt.'' 4227
J gcnj '' GhhgevulGzr quwtg''	Ecug''uwf {	UFT.''tgr qtvu''q'' wpkqpu	O gf kecn'''''''' tgeqtfu'' kpceeguukdng.'' qpg''cktnkpg	O wtcy unk'' 4233
Qeewttgpeg	Ctej kxcn'' tgxkgy	UFT.''CKF ''tgr qtvu.'' cktnkpgu''cpf ''wpkqp.'' qpnkpg''ugctej gu	P q''cvkqpcn'' tgr qtvkpi '' u{uvgo .''nko kgf '' ceeguu''\q''HCC '' cpf ''hnki j v'' cwgpfcpv'' tgr qtvu	O wtcy unk'' cpf '' Uwr rngg.'' 422:
Qeewttgpeg''	Ctej kxcn'' tgxkgy ''	UFT''cpf ''CUTU'''	Wpfgttgr qtvkpi '' qh'gxgpvu.'' uo cn'pwo dgtu'' qh'cktetchv'' v{r gu.''f {pco ke'' gpxktqpo gpv	Uj gj cf k'' Lqpgu.''('' J qpi '' 4238''

Vj g''nkvgtcvwtg''r tqxkfgu''gxkfgpeg''qh'vj g''qeewttgpeg''qh'hwo g''gxgpvu''qp''cktetchv.''y kj ''

etgy u''cpf ''r cuugp gtu''gzr gtkgpekpi ''ecwg''cpf ''ej tqpke''j gcnj ''ghhgevu0Xctkqwu''tgugctej ''

"

o gyj qf u'j cxg"dggp"wugf "vq"f qewo gpv'vj gug"gxgpvu."kpenwfkpi "vj g"eqmgevkqp"qh"ckt"cpf "
tgukfwg"uco r ngu"hqt"cpcn{uku"qh'j c| ctf qwu"eqo r qwpfu0Dmqqf ."dqf { "hmwkf ."cpf "vkuuwg"
uco r ngu"htqo "r gtuqpu"y kj "uwur gevgf "gzr qwvtg"vq"j c| ctf qwu"eqo r qwpf u"f wtkpi "hwo g"
gxgpvu"j cxg"dggp"cpcn{| gf "kp"cp"cwgo r v'vq"kf gpvkh{"eqo r qwpf u"qt"vj gkt"o gvcdqnkgu0
Cnij qwg'j "eqo r qwpf u'j cxg"dggp"kf gpvkhkgf ."vj g"eqpegpvtcvkqp"qh"eqpvco kpcpvu"f wtkpi "vj g"
gzr qwvg"r gtkqf ."tqwvg"qh'gzr qwvg."ngpi vj "qh'gzr qwvg."cpf "kpf kxkf wcn'ugpukvkxkvkgu"vq"
j c| ctf qwu"eqo r qwpf u"eqpvtkdwvg"vq"eqo r nkecvgf "eqpf kvkqpu"y j kej "ecppqv'dg"
uvcpf ctf k| gf 0Vj gug"hcevqtu"cnuq"eqpvtkdwvg"vq"vj g"ej cnngpi gu"kp"pqto cn| kpi "cewg"cpf "
ej tqpke"j gcnj "ghhgevu"y kj kp"cp"gzr qugf "r qr wncvkqp0'

Gaps in the Literature

Gz kuvkpi "nkvgtcvwtg"ku"r tko ctkn{ "hqewugf "qp"f qewo gpvkpi "vj g"qeewttgpeg"qh'hwo g"
gxgpvu"cpf "vj g"eqpvco kpcpvu"r tgugpv."kf gpvkh{kpi "eqo r qwpf u"cuuqekcvgf "y kj "hwo g"gxgpvu"
cpf "vj gkt"ghhgevu"qp"j wo cp"j gcnj ."cpf "kf gpvkh{kpi "dkqo ctmgtu"qh'gzr qwvg"vq"
eqpvco kpcpvu0Vj gug"uvwf kgu"ctg"tgcevkxg"tcvj gt"vj cp"r tgf kevkxg="tgugctej gtu"tgn{ "qp"vj g"
qeewttgpeg"qh'hwo g"gxgpvu"vq"kpxguvki cvg"vj g"chvgtghhgevu0Kf gpvkh{kpi "hcevqtu"cuuqekcvgf "
y kj "hwo g"gxgpvu"o c{ "dg"vj g"hktuv'uvgr "kp"r tgf kevkpi "cpf "o kki cvkpi "vj g"qeewttgpeg"qh'
hwo g"gxgpvu0Tgeqi pkvkqp"qh'hwo g"gxgpv'qeewttgpeg"ecp"ckf "kp"xgtkh{kpi "cpf "f qewo gpvkpi "
qeewttgpegu"qh'hwo g"gxgpvu."kf gpvkh{kpi "eqpvco kpcpvu."ecr vwtkpi "swcpvkcvkxg"
o gcuwtgo gpvu."cpf "f gxgmqr kpi "uvtcvgi kgu"vq"r tqvgev'j wo cp"j gcnj "cpf "ko r tqxg"hnki j v'
uchgv{0Tguwnu"qh'vj ku"uvwf { "uwr r qtv'c"r tgf kevkxg"cr r tqcej "vq"tkum"o cpci go gpv'cu"
o cpf cvgf "d{ "vj g"uchgv{ "o cpci go gpv'u{ugo u"tgswktgf "hqt"Rctv'343"ecttkgtu0Eqpvkpwqwu"
ko r qxgo gpv'kp"uchgv{ "d{ "kf gpvkhkecvkqp"qh'hcevqtu"cpf "r tgf kevkqp"qh'j c| ctf u"vj tqwi j "

"

cpcn{uku'qh'go r nq{gg'tgr qtwu'cu'r tqr qugf ''d{''yj g'HCC''*HCC.''4238+'ku'pqv'ewttgpvn{"

cr r nkgf ''vq'hwo g'gxgpvu0''

C ''ncem'qh'tgugctej ''eqpegtpkpi ''yj g'qeewttgpeg'cpf ''yj g'ektcwo uvcpegu'tgncvgf ''vq'yj g"

qeewttgpeg'qh'hwo g'gxgpvu'ku'ewttgpvn{'qdugtxgf .''tguwnkpi ''kp'c''i cr ''kp'yj g''dqf { 'qh''

npqy ngfi g'kpxqnxkpi ''j c| ctfu'cuuqekcvgf ''y kj ''eqpvco kpcvgf ''dngef ''ckt0'Rtgf kevkxg'

o qf gnkpi ''wukpi ''npqy p'tguwnu''vq''etgcvg.''r tqeguu.''cpf ''xcnkf cvg'c'o qf gn'vq''hqtgecuv'hwwwtg''

qweqo gu''*Htcpmgphlgnf .''423; +'ecp'r qvgpkcn{ 'dg'cr r nkgf ''vq'yj g'hqtgecuvkpi ''qh'hwo g''

gxgpvu'wukpi ''f cvc'y kj ''tqdwuv'kf gpkhkecvkqp'cpf ''f qewo gpvcvkqp'qh'hwo g'gxgpv'qeewttgpeg0'

Ewttgpv'nkgtcvwtg'kpf kecvgu'cp'cr r tqr tkcvg'wug'qh'CUTU'f cvc'vq'kf gpvkh{'xctkcdngu'qh'

kpvgtguv'kp'cxkcvkqp'uchgv{0'Wug'qh'yj qug'xctkcdngu'kp'dwknf kpi ''r tgf kevkxg'o qf gnu'wukpi ''f cvc''

y kj ''engct'kf gpkhkecvkqp'cpf ''f qewo gpvcvkqp'qh'hwo g'gxgpvu'o c{''dg'c'xcnwcdng'pgzv'uvgr 0''

Vj g'HCC)u'CKF U'eqpvckpu'c'r ngyj qtc'qh'kphqto cvkqp'cpf ''ku'r wdnken{ 'ceeguukdng=j qy gxgt.''

yj ku'f cvcdcug'eqpvckpu'kphqto cvkqp'ko kvgf ''vq'cxkcvkqp'kpekf gpvu'f ghkpgf ''cu'cp'qeewttgpeg.''

qyj gt'yj cp'cp'ceekf gpv'cuuqekcvgf ''y kj ''yj g'qr gtcvkqp'qh'cktetchv.'y j kej ''chhgevu'qt'eqwnf ''

chhgev'yj g'uchgv{'qh'qr gtcvkqpu''*HCC.''p0f 0c+0'Rtkqt'vq'3; ; 7.'yj g'eqpvgpvu'qh'yj g'pcttcvkxg''

hkgnf u'y gtg'ko kvgf ''vq'337''ej ctcevgtu.''y j kej ''o c{''ko kv'yj g'kphqto cvkqp'r tqxkf gf 0'Tgr qtvu''

chvgt'3; ; 7'eqpvckp'gpvktg'pcttcvkxgu'cu'r tgr ctgf ''d{''yj g'HCC'kpur gevqt''*HCC.''p0f 0c0+'cpf ''

ctg'pqv'r tgr ctgf ''d{''yj g'etgy u0'

Vj g'HCC)u'UFT'u{uvgo ''eqpvckpu'r wdnken{ 'ceeguukdng'tgr qtwu'cpf ''hqewugu'qp'yj g''

ecwug'qh'yj g'qeewttgpeg'vq'ko r tqxg'yj g'uchgv{'cpf ''tgnkcdknkv{ 'qh'cgtqpcwkecn'r ctwu'cpf ''

r tqf wevu0'Kp'cf f kvkqp.''c'i qxgtpo gpv'tgr qtv'hqwpf ''cktnkpg'tgr qtvu'vq'yj g'UFT'u{uvgo ''xctkgf ''

uki pkhkecpvn{ 'f wg'vq'wpengct'tgr qtvkpi ''tgs wktgo gpvu'cpf ''hgctu'tgi ctf kpi ''r wdnke'ceeguu'vq''

tgr qtwu=kpcf gs wcvg'f cvc.''ncem'qh'ko gn{ 'tgr qtvkpi .''cpf ''ko kvgf ''cpcn{uku'tguwngf ''kp'nqy /

swcnkv{"fcvc="cpf"o quv"wugtu"dgnkgxgf "vj g"rtqitco "uj qwrf "pqv"dg"eqpvkpwgf "wprnguu"vj g"

HCC"o cf g"o cqt"ko r tqxgo gpwu"*I CQ."3; ; 3+0Cnj qwj "i wkfcpeg"ku"r tqxkfgf "d{"cp"

cf xkuqt{"ekuewnct"*HCC."3; ; 5+"cpf "tgswktgf "d{"tgi wncvkqp"*36'EHT'È'3430925."36'EHT'È"

347062; ="36'EHT'È'3570637."36'EHT'È'3670443+."vj ku"kphqto cvkqp"ku"kpeqpukuvgpvn{"

tgr qtvgf ."tguwnkpi "kp"r qqt"swcnkv{"fcvc"cpf "cp"kpeqo rngvg"fcvcdcug"*I CQ."3; ; 3="Ugtxkeg"

Fkhhkewn{"Tgr qtvu."4222+0'

Vj g"wug"qh'CUTU'fcvc"hqt"vj g"kfgpvkhkecvkqp"qh'xctkcdngu"qh'kpvgtguvu"kp"WCS "cpf "

hwo g"gxgpvu'cmqy u'hqt'fktgev'wug"qh'tgr qtvgtu)'ncttcvkxgu'cpf "kphqto cvkqp"htqo "vj gkt"

gzr gtkgpegu'cpf "ecp"dg"wugf "vq"gzr nqtg"ko r qtcpv'hcevqtu"kphrwgpekpi "vj gug"qeewttgpegu0'

Vj ku"uvwf {"eqpvtkdwvgu"vq"tgf wekpi "vj ku'npqy ngfi g'i cr "cpf "ko r qxkpi "vj g"j gcnj "cpf "

uchgv{"qh'etgy u'cpf "r cuugpi gtu0'"

Theoretical Foundation

Vj ku'uvwf {'wugf "vgzv'o kpkpi "o gyj qf u'vq"gzr nqtg"cpf "kf gpvkh{"ko r qtcpv'hcevqtu"

cuuqekcvgf "y kj "hwo g"gxgpvu'cpf "wugf "f cvc"o kpkpi "o gyj qf u'vq'f gxgmqr ."vtckp."xcnkf cvg."

cpf "vguv'o qf gnu'vq"kf gpvkh{"ko r qtcpv'hcevqtu"kp"vj g"qeewttgpeg"qh'hwo g"gxgpvu0'Vgzv'

o kpkpi eqo dkpgu'f cvc"o kpkpi "cpf "vgzv'cpcn{ukeu'kp"vj g"wug"qh'wputwewwtgf "qt"vgzwcn'fcvc"

y kj "uvtwewwtgf "fcvc"hqt"gzr nqtcvkqp."f kueqxgt{."cpf "encuukhkecvkqp."qt"r tgf kevkxg'o qf gnkpi "

*Fgcp."4236+0Fcvc"o kpkpi "ku"vj g"wug"qh'\$o cej kpg"ngctpkpi "cni qtkvj o u'vq 'hkpf 'hckpv'

r cwgtpu'qh'tgncvkqpuj kr "dgwy ggp"fcvc"ngo gpvu"kp"ncti g."pqku{"cpf "o guu{'f cvc'ugwu.'y j kej "

ecp"ngcf "vq"cevkqpu"vq"kpetgcug"dgpghkv'kp"uqo g"hqto "*f kci pquku."rtqhkv.'f gvgevkqp."gve0\$"

*P kudgv'gv'cn0"422; .'r 039+0Dqvj 'f cvc"cpf "vgzv'o kpkpi "cni qtkvj o u'j cxg'dggp"wugf "kp"r tkqt"

tgugctej "vq'kf gpvkh{."encuukh{."cpf "r tgf kev'vj g"qeewttgpeg"qh'gxgpvu"kp"y j kej "cxkcvkqp"

uchgv{"o c{"dg"eqo rqo kugf 0'"

"

Text Mining"

      J gctuv'*4225+'f guetkdgf "vgz v'o kpkpi "cu'vj g'f kuecqxgt{'qh'pgy ."r tgxkqwun{'wpmpqy p"

kphqto cvkqp"d{'cwwqo cvkecm{'gz vtcevkpi "f cvc"htqo "pcwtcn'rcpi wci g'vgz v'kpuvgf "qh'htqo "

uvtwewtgf "f cvcdcugu'qt'hkgnf u'cpf "ku'c'xctkcvkqp'qh'f cvc'o kpkpi 0'C "hqto "qh'vgz v'o kpkpi "ku"

vqr ke"o qf gnkpi ."y j kej "ku'c"o gyj qf "hqt"hkpf kpi "i tqwr u'qh'y qtf u'qt'vqr keu'htqo "vgz wcn'

o cvgtkcn'vj cv'dguv'f guetkdg'vj g"kphqto cvkqp0'Ugxgtcn'tgngxcpv'uvwf kgu'f go qpuvtcvkpi "vj g"

xgtucvkrkv{'cpf "cr r tqr tkcvgpguu'qh'vgz v'o kpkpi "hqt'vj ku'uvwf {'ctg'uj qy p'kp"Vcdng'60"

Table 4

Relevant Aviation Text Mining Literature

Vqr ke"qh"Kpvgtguv"	F cvc"Wugf "	Cni qtkvj o "Wugf "	Hkpf kpi u"	Tghgtgpeg"
Kf gpvkhkecvkqp" qh'hcevqtu" eqpvkdwwkpi "vq" cpqo cnkgu	CUTU"	KDO "URUU" O qf gngt'35<'Vgz v' Cpcn{vkeu"	O quv'eqo o qp" ecvgi qt{" eqpvckpgf " eqpegr vu'tgncvgf " vq "wpuchg" eqpf kvkqpu."vj gp" d{'twng/dcugf ." vj gp"unkm/dcugf ." hqmqy gf "d{" mpqy ngf i g/ dcugf "gttqtu" "	Cpf t| gle| cm" gv'cn0"4237"
Ncvgpv'vqr keu" cpf "vtgpf u"	CUTU"	Uvtwewtcn'vqr ke" o qf gnkpi "	Vy q"cr r tqcej " r cvj u'cv'qpg" cktr qtv" htgs wgpvn{" kf gpvkhkgf "kp" kpekf gpv'tgr qtvu" " " " " "	Mlvj p.'423: "

Vqr ke"qh" Kpvgtguv	F cvc"Wugf	Cri qtkj o "Wugf	Hkpf kpi u	Tghgtgpeg
Tkunlhcevqtu"kp" uchgv{" o cpci go gpv u{uvgo u"	CUTU"	Vqr ke"o kpkpi "cpf " j tgg" encuuhkecvkqp" cri qtkj o u"*pc¹xg" Dc{gu."J qghhf kpi " vtgg."cpf " Q| cDci CF Y RP "+	Q| cDci CF Y RP " ku"dguv" r gthqto kpi " encuuhkecvkqp" cri qtkj o "	Uj k'gv'cn0" 423: "

"

Cpf t| gle| cm'gv'cn0"*4236+"kpxguvki cvgf "tgncvkqpuj kr u"dgvy ggp"ur gekhke"hcevqtu"cpf "

ugrh/tgr qtvgf "kttigi wnctkvkgu"wvkrk| kpi "eqttgur qpf gpeg"cpcn{uku"cpf "f cvc"o kpkpi "wukpi "

gzkuvkpi "cz qpqo kgu"cpf "vgz v"pcttcvkxgu"kp"vj g"CUTU"f cvcdcug0Hkpf kpi u"tgxgcngf "c"

dtqcf n{"f ghkpgf "j wo cp"hcevqtu"ecvgi qt{"cpf "y gcvj gt"eqpf kvkqpu"y gtg"vj g"o ckp"hcevqtu"

cuuqekcvgf "y kj "vj g"ugrh/tgr qtvgf "cpqo cnkgu0Mvj p"*423: +"cr r rkgf "uvtwewtcn'qr ke"

o qf grkpi ."c"hqto "qh'vgz v'o kpkpi ."vq"vj g"CUTU'f cvcdcug"vq"cnrg"cf xcpvci g"qh'vj g"xcnwcdrg"

kphqto cvkqp"r tqxkf gf "kp"vj g"htgg"vgz v"kp"vj g"tgr qtu"cpf "vj g"wughwn'o gvcf cvc"kpenwf gf "kp"

vj g"f cvcdcug0Hkpf kpi u"kf gpvkhkgf "mpqy p"kuuwgu"dw'cnuq"tgxgcngf "r tgxkqwun{"wptgr qtvgf "

kuuwgu"cpf "cuuqekcvkqpu"dgvy ggp"vqr keu0Uj k'gv'cn0"*4239+"wugf "vqr ke"o kpkpi "o gvj qf u"vq"

gz vtcev'uvtwewtgf "kphqto cvkqp"htqo "vgz vwcn'f cvc"eqpvckpgf "kp"CUTU'tgr qtv'pcttcvkxgu0"

Vj ku"uvtwewtgf "kphqto cvkqp"y cu"wugf "cu"kpr w'kp"vj tgg"f cvc/uvtgco kpi "cri qtkj o u"vq"cuuguu"

vj g"r qvgpvkcn'hqt"encuuhkecvkqp"qh"vj g"kpekf gpvu"cpf "vq"dwknf "cpf "vguv"kpekf gpv'ecwug"

encuuhkecvkqp"o qf gru0Vj g"dguv'r gthqto kpi "o qf gn'y cu"vj g"Q| cDci CF Y RP "cri qtkj o "

y j kej "ku"cp"cf cr vcvkqp"qh"vj g"dci i kpi "cri qtkj o "y kj "cp"cf f gf "f tkhv"f gvgevqt"*cf cr vkxg"

y kpf qy kpi "qt"CF Y RP +"dcugf "qp"tgr ncekpi "vj g"y qtuv'qh"vj g"encuuhkgtu"y kj "c"pgy "dcug"

encuuhkgt"*F kc| "gv'cn0"4237+0"

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"

"

Data Mining

Kfgpvkhkecvkqp"qh'r tgewtuqtu'cpf "eqo o qp"eqpf kkqpu."gxgpvu."qt"dgj cxkqtu" cuuqekcvgf "y kj "uchgv{"kpekf gpvu'ku'c'xcnwcdng'hwpevkqp'qh'f cvc'o kpkpi 0Enwuvgt"cpcn{uku'ku" c'f cvc'o kpkpi "vgej pks wg"wugf "vq'kf gpvkh{"cpf "i tqwr "uko knct'f cvc'r qkpvu'qt'r cwgtpu'kp"c" f cvcugv'cpf "ecp'dg'wughwn'kp'cpcn{ kpi "ncti g"co qwpu'qh'f cvc0Enwuvgt/dcugf "cpqo cn{" f gvgevkqp'y cu'wugf "vq'f gvgev'cdpqto cn'hki j u'htqo "hki j v'qr gtcvkqpu's wcnkv{"cuuwtcpeg" *HQS C+'r tqi tco u'f cvc"kp"uwf kgu'd{ "Nk'gv'cn0*4237+0Vj gkt'hkpf kpi u'f go qpuvtcv'vj g" enwuvgt"cpcn{uku'o gyj qf "y cu'cdng'vq'f gvgto kpg'cdpqto cn'hki j u'y kj qw'j cxkpi "r tgxkqwu" mpqy ngf i g'qh'cpqo cnkgu'cpf "ku'wughwn'kp'kf gpvkh{kpi "cdpqto cn'hki j u'htqo "tqwvkpg'hki j w0' Cf f kkqpcn'tgugctej "wukpi "HQS C'r tqi tco "f cvc'y cu'eqpf wevgf "d{ "Cuncpgt"gv'cn0*4238+" wukpi "cp"ci i tgo gtcvkxg'j kgtctej kecn'enwuvgtkpi "vgej pks wg'vq'kf gpvkh{"cdpqto cn'hki j v" ej ctcevgtkuvkeu'f wtkpi "vj g'ncpf kpi "cr r tqcej 'r j cug'qh'hki j v0Vj ku'uwf { 'f go qpuvcvgu'vj g" cdknkv{"qh'vj g'enwuvgtkpi "cr r tqcej "vq'encuukh{"ncpf kpi "cr r tqcej gu'wukpi "ugngevgf "hki j v'f cvc" cu'kpr ww."vj gtgd{ "ucxkpi "cpcn{uvu)'ko g'cpf "ghhqtv0"

Wukpi "uecncdng'f cvc'o kpkpi "cni qtkj o u'vq'cpcn{ g'HQS C'f cvc."O cwj gy u'gv'cn0' *4235+'hqwpf "cpqo cnkgu'kp'cktur ggf ."o qf g'eqphwukqp."cpf "wpuvcdng'cr r tqcej gu'y gtg'vj tgg" qr gtcvkqpcn{ "uki pkhkecpv'gxgpvu'ngcf kpi "vq'cxkcvkqp'uchgv{"kpekf gpvu0Hkpf kpi u'htqo "vj gug" uwf kgu'f go qpuvcv'vj g'cdknkv{"vq'f gvgto kpg'cdpqto cn'hki j u'y kj qw'j cxkpi "r tgxkqwu" mpqy ngf i g'qh'cpqo cnkgu0"

Hkuq'gv'cn0*423: +'wugf "c'eqo dkpcvkqp'qh'o cej kpg'ngctpkpi "vgej pks wgu."y j kej "f q" pqv'tgs wktg'r tgf ghkpgf "etkvgtkc'qt'f qo ckp'mpqy ngf i g."vq'ej ctcevgtk| g'cpf "kf gpvkh{" cuuqekcvgf "tkumr tgewtuqtu'wukpi "vj g'Hkpcn'cr r tqcej ."twpy c{ 'tcf ct."cpf "y gcvj gt'f cvc'vq" r tgf kev'cdpqto cn'cttkxcn'twpy c{ "qeewr cpe{ "ko gu0Hkpcn'cr r tqcej ."twpy c{ 'tcf ct'f cvc."cpf "

y gcvj gt"f cvc"y gtg"wugf "\q"f gvgto kpg"\j g"\gp "hgcwtgu"o quv"kphnwgpvkcn"qp"cttkxcn"twpy c{"

qeewr cpe{"\ko g0Tgi tguukqp"vtgg"cpcn{uku"kpfkecvgf "cdpqro cn"cpf "pqto cn"cttkxcn"twpy c{"

qeewr cpe{"\ko gu"ecp"dg"ceewtcvgn{"r tgf kevgf "y kj "cf xcpegf "lpqy ngf i g"qh"\j g"\qr "ugxgp"

hgcwtgu0Qr gp"uqwteg"swcuk/uvcmn'hnki j v"\guv"f cvc"htqm "\j g"I gto cp"Cgtqur ceg"Egpvgt"y gtg"

wugf "d{"Mwo ct"("I j quj "*423; +"\q"f gxgnqr "o qf gnu"\q"r tgf kev"wpuvgcf {"cgtqf {pco keu"kp"

\j g"F NT/CVVCU"cktetcn0Emcuukhkecvkqp"cpf "tgi tguukqp"\tgg"cpf "tcpf qm "hqtguv"o qf gnu"

y gtg"f gxgnqr gf "cpf "eqm r ctgf.'y kj "tcpf qm "hqtguv'r tqf wekpi "unki j vn{"dgwgt"tguwnu."

cnj qwi j "dqvj "o qf gnu"y gtg"hqwpf "\q"dg"xkcdng"cnvgtpcvkxgu"\q"o czko wm "nkmgnkj qqf "

guvko cvkqpu0'

      Vy q"f cvc"o kpkpi "o gvj qf u"y gtg"wugf "d{"Vtwqpi "gv'cn0*423: +'\q"r tgf kev'\j g"

r tqdcdknkv{"qh'hnki j v'f gnc{u'dgwy ggp'y q"dwu{"cktr qtvu0Qr gtcvkqpu"cpf "r gthqto cpeg"f cvc"

y gtg"wugf "\q"dwknf "f gekukqp"\tgg"cpf "Dc{gukcp"kphgtgpeg"o qf gnu0Cnj qwi j "dqvj "o qf gnu"

uj qy gf "uko knct'ktkvkgu"cpf "f khhgtgpegu"kp'hnki j v'f gnc{'r tgf kevkqp"tguwnu."\j g"Dc{gukcp"o qf gn'

r tqxkf gf "o qtg"kphqto cvkqp"qp"ecwucn'tgncvkqpuj kr u'dgwy ggp"ko r cev'hcevqtu"cpf "\j g"\cti gv"

xctkcdng"y j kng"\j g"f gekukqp"\tgg"y cu"unki j vn{"o qtg"ceewtcvg"kp"r tgf kevkpi "f gnc{u0Dqvj "

o gvj qf u"y gtg"uj qy p"\q"dg"uwr gtkqt"\q"qvj gt"\tcf kvkqpcn'r tgf kevkqp"o gvj qf u0Ugxgtcn'

r tgf kevkxg"o qf gnu"y gtg"f gxgnqr gf "d{"Gwcpk"*423; +"\q"r tgf kev"qp/ko g"hnki j v'cttkxcn'wukpi "

hnki j v'f cvc"cpf "y gcvj gt"r tguuwtg"f cvc"htqm "\j tgg"y gcvj gt"qdugtxcvkqp"uvcvkqpu"kp'Lcr cp0'

I tcf kgpv'dqquvkpi .'tcpf qm "hqtguv.'f gekukqp"\tgg.'Cf cDqquv.'cpf "uwr r qtv'xgevqt"o cej kpg"

o qf gnu"y gtg"wugf "y kj "cpf "y kj qw'y gcvj gt"f cvc0Tguwnu'kpf kecvgf "\j g"tcpf qm "hqtguv'y cu"

\j g"uwr gtkqt"o qf gn'y kj ''99' ''ceewtce{=kv'cnuq"qwr gthqto gf "\j g'i tcf kgpv'dqquvkpi "o qf gnu"

kp"r tgf kevkqp"cpf "tgecm0'Vtwqpi "cpf 'Ej qk"*4242+'hqwpf "\j g'i tcf kgpv'dqquvkpi "cni qtkj o "

r tqf wegf "\j g"dguv"o qf gn'hqt"r tgf kevkpi "cktur ceg"xkqncvkqp"kpekf gpu"co qpi "uo cn'"

"

wpo cppgf "cktetchv'u{uvgo u0'Cri qtkj o u'r tgxkqwun{"wugf "kp"cxkcvkqp"uchgv{ "tgugctej "ctg"

uwo o ctk| gf "kp"Vcdng"7"cpf "kpenwf g"f gekukqp"vtggu."ctvkhkekcn'pgwtcn'pgw qtmu."tcpf qo "

hqtguvu."Dc{gukcp"kphgtgpeg."cpf "o wnkr ng/mgtpgn'cpqo cn{"f gvgevkqp"*Curcpgt"gv'cn0"4238="

Gvcpk"423;=Htkuq."gv'cn0"423:=Mwo ct"("I j quj ."423;=Nk'gv'cn0"4237=O cvj gy u'gv'cn0"

4235="Vtwqpi "gv'cn0"423:+0

Table 5

Relevant Aviation Safety Data Mining Literature

Vqr ke"qh"Kpvgtguv"	F cvc"Wugf "	Cri qtkj o "Wugf "	Hkpf kpi u"	Tghgtgpeg"
Cdpqto cn' hnki j u"	HQS C"	P qxgn'enwuvgt" cpcn{uku."o wnkr ng" mgtpgn"	Enwuvgt/dcugf " cpqo cn{"f gvgevkqp" r gthqto gf "dgwgt" y kj "eqpvkpwqwu" r ctco gvgtu." o wnkr ng'mgtpgn' cpqo cn{"f gvgevkqp" y cu'o qtg" ugpukkxg"y kj " f kuetgvg" r ctco gvgtu"	Nk'gv'cn0"4237"
Cdpqto cn'hnki j v' ej ctcevgtkuvkeu" f wtkpi "ncpf kpi u"	HQS C"	Ci i qo gtcvkxg" j kgtctej kecn'enwuvgt" cpcn{uku"	Cdpqto cn'hnki j v' ej ctcevgtkuvkeu" kf gpvkhkgf "f wtkpi " y g'ncpf kpi 'r j cug" qh'hnki j v"	Curcpgt"gv'cn0" 4238"
Hnki j v' cpqo cnkgu"	HQS C"	O wnk/mgtpgn" Kpf gz/Qtec."" ngctpkpi .'pqxgn" o wnkxctkcvg"ko g/ ugtkgu"ugctej ""	Ckturggf .'o qf g" eqphwukqp."cpf " wpuvcdng" cr r tqcej gu'y gtg" uki pkhkecpv' r tgf kevqtu"	O cvj gy u'gv' cn0"4235"
Cdpqto cn' twpy c{" qeewr cpe{" ko gu"	Hkpcn'cr r tqcej " tcf ct"f cvc." twpy c{'f cvc." cpf "y gcvj gt" f cvc"	Ncuuq."o wnk/nc{gt" r gtegr vkqp.'pgwtcn' pgw qtm"cpf " tgi tguukqp'vtgg"	Tgi tguukqp'vtgg" dguv'o qf gn"	Htkuq"gv'cn0" 423: "

Vqr ke"qh" Kpvgtguv"	F cvc"Wugf "	Cni qtkj o "Wugf "	Hkpf kpi u"	Tghgtgpeg"
Qp/vko g" r gthqto cpeg"	HCC"Cxkcvkqp" U{uvgo " Rgthqto cpeg" O gvtkeu." Qr gtcvkqpcn' P gvy qtm"cpf " Dwtgcw"qh" Vtcpur qtvcvkqp" Uvcvkuvkeu'"	F gekukqp"vtgg." Dc{gukcp"kphgtgpeg"	F gekukqp"vtgg" unki j vn{"o qtg" ceewtcvg."Dc{gukcp" o qf gn'r tqxkf gu" o qtg"wughwn" tgncvkqpuj kr " kphqto cvkqp" co qpi "ko r cev" hcevqtu"cpf "cti gv" xctkcdng"	Vtwqpi "gv'cn0" 423: "
"	"	"	"	"
Qp/vko g'hnki j v" cttkxcn'	Hnki j v'cpf " y gcvj gt"f cvc"	Tcpf qo "Hqtguv"	99' "ceewtce{"kp" qp/vko g'cttkxcn'	Gvcpk"423; "
Wpo cppgf " cktetchv'u{uvgo " xkqncvkqpu" *WCU+"	HCC"WCU" uki j vkpi u" tgr qtvu"	I tcf kgpv'dqquvkpi ." encuukhkecvkqp" tgi tguukqp." f gekukqp"vtgg." pgwtcn' pgwy qtm"tcpf qo " hqtguv."Dc{gukcp" pgwy qtmu."cpf " O go qt{"Dcugf " Tgcuqpkpi "	I tcf kgpv'dqquvkpi " y cu'vj g"o quv" ceewtcvg" r tgf kevkxg"o qf gn' hqnnqy gf "d{" tcpf qo "hqtguv'cpf " f gekukqp"vtgg" o qf gnu'	Vtwqpi "(" Ej qk"4242"

"

Vj g"r tqeguu'wugf "hqt"f cvc"o kpkpi "kp"vj ku"uvwf {"y cu"f gxgnqr gf "d{"UCU[superscript] "cpf "

hqewugu'qp"c'nqi kecn'cpf "o gvj qf kecn'uvtwewvtg'vq"vj g"o qf gn'f gxgnqr o gpv'r j cug'vq"cr r n{"

gzr nqtcvqt{"uvcvkuvkecn'cpf "xkuwcnk| cvkqp"o gvj qf u."ugngev'cpf "vtcpuhqto "vj g"o quv'ko r qtcpv'"

xctkcdngu."o qf gn'vj g"xctkcdngu'vq"r tgf kev'tguwnvu."cpf "eqphkto "vj g"ceewtce{"qh'vj g"o qf gn'

*F gcp0"4236+0'Vj ku'r tqeguu'kpenwf gf "uco r nkpi ."gzr nqtkpi ."o qf kh{kpi ."o qf gnkpi ."cpf "

cuuguukpi "*UGO O C+'uvgr u."uqo g"qh'y j kej "o c{"dg'tgr gcvgf "ugxgtcn'vko gu'dghqtg'vj g"

eqo r ngvkqp"qh'vj g"cpcn{uku'*UCUÌ ."4235+0'Vj g"UGO O C'r tqeguu'ecp'dg"wugf "tgi ctf nguu"

qh'f cvc"uk| g"qt"eqo r ngzkv{"*F gcp0"4236+0""

"

Combined Text and Data Mining

Vj g"wughwrpguu"qh"eqo dkpkpi "vgzv"cpf "f cvc"o kpkpi "vqqnu "j cu"dggp"f go qpuvtcvgf "

wukpi "tgr qtvu"htqo "cp"ckrnkpg)u"cxkcvkqp"uchgv{ "cevkqp"r tqi tco ."y j gtg"y q "vgzv"hkgnf u"

y tkwgp"d{ "vj g"r knqv"uwdo kwkpi "vj g"tgr qtv"cpf "gki j v"uvtwewtgf "hkgnf u"y gtg"cpcn{ gf "

*P c| gtk "4225+0P c| gtk"gv"cn0"*4223+"hqwpf "vj g"cr r nkecvkqp"qh"vgzv"cpf "f cvc"o kpkpi "vqqnu"vq"

CUTU"f cvc"{kgnf gf "c"nquu"kp"f gvckn"f wg"vq"vj g"f g/kf gpvkhkecvkqp"qh"kphqto cvkqp0J qy gxgt."

vj g"tgugctej gtu"kpf kecvgf "f cvc"kp"vj g"CUTU"eqwnf "dgpghkv"htqo "f cvc"o kpkpi ."cpf "pgkij gt"

hkgnf "uj qwnf "dg"ki pqtgf 0Kp"ci tggo gpv"y kj "Mwj p.'P c| gtk"gv"cn0"*4223+"qdugtxgf "vj g"ncem"

qh"f cvckn"kp"tguwnu"qh"f cvc"o kpkpi "wukpi "CUTU"f cvc"tgs wktgu"ectghwn"tgxkgy "d{ "uwdlgev"

o cwgt"gzr gtvu"vq"kpvgtr tgv"cpf "f gvgto kpg"cp"kpvwkvkxg"o gcpkpi "vq"hkpf kpi u"cpf "f qgu"pqv"

f ko kpkuj "vj g"tqng"qh"vj g"f cvc"cpcn{ uv0"

Ej tkuvqr j gt"gv"cn0"*4238+"cr r nkgf "f kihgtgpv"f cvc"o kpkpi "o gvj qf u"vq"cktetchv"

ceekf gpv"tgr qtvu0F kihgtgpv"hgcvwtg"ugngevkqp"vgej pks wgu"cpf "encuukhkecvkqp"cni qtkj o u"y gtg"

wugf "vq"f gxgnqr "c"encuukhkecvkqp"o qf gn"hqt"gzco kpkpi "cpf "tgf wekpi "cxkcvkqp"tkum"wukpi "

f gekukqp"tgg"kpf wevkqp"o gvj qf u0F cvc"o kpkpi "o gvj qf u"y gtg"cnuq"wugf "d{ "Mqvgguuy ctcp"gv"

cn0"*4239+"vq"kf gpvkh{ "cpf "gzco kpg"ghhgevkxg"cwtkdwvgu"vq"tgf weg"vj g"pwo dgt"qh"cxkcvkqp"

ceekf gpvu0Vj g"cwj qtu"eqo dkpgf "vj g"m/pgctguv"pgki j dqt"encuukhkgt"cpf "eqttgncvkqp/dcugf "

hgcvwtg"ugngevkqp"cni qtkj o u"y kj "cp"quekncvkpi "ugctej "vgej pks wg"vq"encuukh{ "cxkcvkqp"

ceekf gpv"tkum"hcevqtu"kp"c"ekxkn"ckrtetchv"ceekf gpv"f cvcdcug0C "uwo o ct{ "qh"vj gug"uvwf kgu"ku"

hqwpf "kp"Vcdng"80"

"

"

"

Table 6

Relevant Aviation Data and Text Mining Literature

Vqr ke"qh" Kpvgtguv"	F cvc"Wugf "	Cni qtkj o "Wugf "	Hkpf kpi u"	Tghgtgpeg"
Rtqqh"qh" Eqpegr v" F go qpuvtcvkqp"	CUCR"	Hkpf Uko knct." Hkpf Cuuqekcvkqpu"cpf "" Hkpf F kuvtkdwvkqpu"vqqn" kp"Cxkcvkqp"Uchgv{"F cvc" O kpkpi "Y qtmdgpej "vqqn" " "	F cvc"o kpkpi "vqqn" ctg"j gnrhwn'dw/'f q" pqv"grko kpcvg"vj g" pggf "hqt"j wo cp" cpcn{uu"	Pc| gtk"4225"
Cuukuv'y kj " cpcn{uku'qh'f cvc""	CUTU"	Cxkcvkqp"Uchgv{"F cvc" O kpkpi "Y qtmdgpej "vqqn"	F g/kf gpvkhkecvkqp" qh'CUTU'f cvc" tguwnu'kp'nquu'qh" f gvckn'f qo ckp" ecp"dgpghkv'htqo " f cvc"o kpkpi ." rkpnkpi "tgr qtvu"q" qvj gt'f cvc"uqwtegu" ecp'j gnr 'hkpf " ecwucn" tgncvkqpuj kr u" "	Pc| gtk'gv'cn0" 4223"
Kpekf gpv' r tgf kevkqp'tkum'	" CUTU"	J {dtkf "o qf gn'qh'uwr r qtv' xgevqt"o cej kpg"cpf " f ggr "pgwtcn'pgvy qtmu." f gekukqp"vtgg"	58"wpkswg"gxgpv" qwveqo gu" eqnrcr ugf "kpvq"7" tkum'i tqwr u." j {dtkf "o qf gn" qwr gthqto u" kpf kxkf wcn'o qf gnu" "	" | j cpi "(" O cj cf gxcp." 423; "
" Kf gpvkh{"cpf " gzco kpg" ceekf gpv' ghhgevkxg" cwtkdwvgu""	" HCC" ceekf gpv" kpekf gpv' f cvcdcug" "	" Ko r tqxgf "ceknkcvgf " eqttgncvkqp'hgcvwtg" ugngevkqp"cni qtkj o ." Pc¹xg"Dc{gu."uwr r qtv' xgevqt"o cej kpg." ctvkhkekcn'pgwtcn'pgvy qtm" m/pgctguv'pgki j dqt." o wnikencuu"encuukhkgt."cpf " f gekukqp"vtgg"" "	" Dguv'tguwnu"ctg" hqwpf "y kj "m/PP " encuukhkgt"	" Mqvgguy ctcp" gv'cn0"4239"

Machine Learning Algorithms

O cej kpg''gctpkpi ''cri qtkxj o u''wug''y gm/f ghkpgf ''f cvcugu''vq''etgcvg''cuuqekcvkqpu.'' f kueqxgt''r cwgtpu.''hkpf ''tgncvkqpuj kr u.''i gpgtcvg''pgy ''uco r ngu.''cpf ''o qtg''*Dqpceeqtuq.'' 423: +0Cu''r tgxkqwun{''kmuvtcvgf .''o cej kpg''ngctpkpi ''j cu''dggp''wugf ''gzvgpukxgn{''kp''cxkcvkqp'' cr r nkecvkqpu''vq''r tgf kev''ugxgtcn''eqpf kvkqpu.''kpenwf kpi ''tkumi'hcevqtu.''ceekf gpvu.''wpuchg'' eqpf kvkqpu.'''cpf ''cktetchv''cttkxcn'vko gu0F gekukqp''vtgg.''i tcf kgpv''dqquvkpi .''nqi kuvke'' tgi tguukqp.''cpf ''tcpf qo ''hqtguv''cri qtkxj o u''y km''dg''wugf ''vq''dwkf ''vj g''o qf gnu''wugf ''kp''vj ku'' uwf {0''

Decision Tree.''F gekukqp''vtggu''ctg''c''pqpr ctco gvtke.''pqp/r ctco gvtke .''nqi kecn''twrg/dcugf '' f cvc''o kpkpi ''o gyj qf ''yj cv''wugu''uwr gtxkugf ''f kxkukxg''j kgtctej kecn''o gyj qf u''vq''ugi o gpv''yj g'' r qr wncvkqp''kpvq''pqf gu''d{ ''cr r n{kpi ''gzr nkekv''twrgu''hqt ''encuukhkecvkqp''*Vwhf?r t{.''4233+0'Vj g'' tqqv''ku''yj g''hktuv''pqf g''qh''yj g''vtgg='yj g''vgto kpcn''pqf gu''ctg''ngcxgu0Vj g''gzr tguukqp''qh''c''twrg'' f gvgto kpgu''yj g''r cyj ''dgwy ggp''yj g''tqqv''cpf ''gcej ''ngch.''y kj ''yj g''r qr wncvkqp''kp''gcej ''pqf g''uwd/ r qr wncvkqp''eqpvckpkpi ''yj g''ncti guv''r quukdng''r tqr qtvkqp''qh''kpf kxkf wcnu''kp''c''ukpi ng''encuu0' Twrgu''ctg''tgkvgtcvkxgn{ ''cr r nkgf ''vq''gcej ''pgy ''pqf g''y kj ''gcej ''r ctgpv''pqf g''ugr ctcvgf ''kpvq''y q'' qt''o qtg''ej knf ''pqf gu''vq''kpetgcug''yj g''f kuetko kpcvkqp''wpvkn'tgcej kpi ''yj g''vgto kpcvkqp''etkvgtkc'' qt''wpvkn''yj g''kpf kxkf wcnu''ecppqv''dg''hwtyj gt''ugr ctcvgf 0''''

Vj g''cf xcpvci gu''qh''f gekukqp''vtggu''kpenwf g''yj g''cdknkv{ ''vq''j cpf ng''j gvgtqi gpgqwu''f cvc.'' o kuukpi ''xcnwgu.''cpf ''pqpr ctco gct''tgncvkqpuj kr u='yj kgt''tgncvkxg''r qy gt''cpf ''gcug''qh''wug='yj kgt'' tqdwuvpguu''y kj ''c''xctkgv{ ''qh''f cvc='cpf ''yj g''gcug''qh''kpvgtr tgvcvkqp''*f gXkmg''(''P gxkmg.''4235+0' F kucf xcpvci gu''qh''f gekukqp''vtggu''kpenwf g''tgf wegf ''r gthqto cpeg''y kj ''c''uo cm'\tckpkpi ''ugv.'' tki kf ''f gekukqp''etkvgtkc.''cpf ''qwwkgt''cwtkdwug''xcnwgu''*Mcv| ''gv'cn0''4236+0'Ghhqtvu''y gtg''o cf g'' vq''o kkki cvg''yj gug''ghhgevu''kp''yj ku''uwf {.''cp''cf gs wcvg''uco r ng''uk| g''hqt''yj g''vtckpkpi ''ugv'lko kgf ''

"

qxgtri{"uko r rkuvke"emuukhkecvkqp"vtggu."cpf "yj g"f gekukqp"cv"gcej "pqfg"y cu"tgxkgy gf "vq"
gpuwtg"yj g"emuukhkecvkqp"y cu"eqttgev0Cnvgtpcvkxg"r cyj u"y gtg"eqpukfgtgf "y j gtg"
cr r tqr tkcvg."cpf "xct{kpi "o cti kpu"y gtg"wugf "vq"emuukh{"yj g"f cvcugv"cu"pggf gf 0"

Gradient Boosting. I tcf kgpv'dqquvkpi "ku'c'r ctvkvkqpkpi "cni qtkj o "yj cv'uggmu'cp"
qr vko cnr ctvkvkqp"qh'yj g"f cvc"cu'f gvgto kpgf "d{"yj g"xcnwgu"qh'c"ukpi ng"xctkcdng."y kj "yj g"
qr vko cnit{"etkgtkqp"f gr gpf gpv"qp"yj g"f kuvtkdwvkqp"qh'yj g"vcti gv"xctkcdng"kpvq"yj g"r ctvkvkqp"
ugi o gpvu"*UCU .4239+0Cu"yj g"vcti gv"xcnwgu"y kj kp"yj g"ugi o gpvu"ctg"o qtg"eqo r ctcdng."
yj g"i tgcvgt"yj g"r tqo kpgpeg"qh'yj g"r ctvkvkqp0Ceeqtf kpi "vq"UCU "*4239+."o quv'r ctvkvkqpkpi "
cni qtkjo u'cf f kvkqpcm{'f kxkf g"gcej "ugi o gpv'kp"c'tgewtukxg"r ctvkvkqpkpi "r tqeguu"y kj "
r ctvkvkqpu"eqo dkpgf "vq"r tqf weg"c"r tgf kevkxg"o qf gn0Vj g"o qf gn'ecp"dg"gxcnwcvgf "d{"
i qqf pguu/qh/hkv'uvcvkuvkeu'ur eekhke"hqt"yj g"vcti gv"xctkcdng."y kj "yj g"uvcvkuvkeu'kpf kecvkpi "c"
f khhgtgpv'o gcuwtg"htqo "yj g"y qtj "qh'cp"kpf kxkfwcnr ctvkvkqp"*UCU .4239+0"

Vj g"i tcf kgpv'dqquvkpi "cni qtkj o "etgcvgu"c"ugtkgu"qh'f gekukqp"vtggu"y j gtg"gcej "vtgg"
kp"yj g"ugswgpeg"qh'vtggu"ku'hkv'vq"yj g"tgukf wcn'qh'yj g"r tgf kevkqp"dcugf "qp"yj g"gctkgt"vtggu"kp"
yj g"ugtkgu="yj wu"gcej "vko g"yj g"f cvc"ku"wugf "vq"i tqy "c"vtgg."yj g"ceewtcec{ "ku'eqo r wgf "hqt"
gcej "vtgg"cpf "r tgf kevkxg"o qf gm"ctg"f gxgnqr gf "*UCU .p0f 0+0Kp"yj ku"cni qtkj o ."yj ku"
dqquvkpi "cr r tqcej "tguco r ngu"yj g"f cvc"o wnkr ng"ko gu'vq"r tqf weg"tguwnu'yj cv"{kgnf "c"
y gki j vgf "cxgtci g"qh'yj g"tg/uco r ngf "f cvc"ugv*UCU .423; f +0Cu"gcej "uweeguukxg"uco r ng"ku"
y gki j vgf "eqttgur qpf kpi "vq"yj g"emuukhkecvkqp"ceewtcec{ "qh'yj g"r tgxkqwu'o qf gnu."kv'ku"
tghgttgf "vq"cu"uvqej cuke"i tcf kgpv'dqquvkpi "*UCU .4239d +0Vj ku'o cej kpg/ngctpkpi "
cni qtkj o "ecp"dg"wugf "vq"eqpuvtwev'tgi tguukqp."emuukhkecvkqp."cpf "tcpmkpi "o qf gnu'd{"
ugswgpvkcn{ "hkwkpi "c"uko r ng"r ctco gvtk| gf "hwpevkqp"*dcug"ngctpgt+"vq"ewttgpv"r ugwf q/
tgukf wcn"d{ "ngcuv/uswctgu"cv'gcej "kvgtcvkqp"*Htkgf o cp."4224="Nk."p0f 0+0P q"cuuwo r vkqpu"

"

cdqwv'\j g''f kuvtkdwvkqp''qh'\j g''f cvc''ctg''tgs wktgf ''hqt''i tcf kgpv''dqquvkpi ''cni qtkjo u.''cpf ''\j g{''

ctg''ngu u''r tqpg''vq''qxgthkv'\j g''f cvc''\j cp''c''ukpi ng''f gekukqp''vtgg''*UCU³ .''423; e+0''

Logistic Regression. ''Nqi kuvke''tgi tguukqp''ku''c''f cvc''o kpkpi ''o gyj qf ''qhvgp''r tghgttgf ''

hqt''tkum''r tgf kevkqp.''f wg''vq''ku''i gpgtcrkv{.''kpvgtr tgvcdkrkv{.''cpf ''tqdwuvpguu''*Vwhh²t{.''4233+0'

Tgrkcdkrkv{''o c{''dg''o qpkvqtgf ''wukpi ''uvcvkuvkecr'kpf kecvqtu.''cpf ''\j g''o qf gn'jcu''pq'tgs wktgf ''

cuuwo r vkqpu''hqt''pqto crkv{.''qr''kpgctkv{''*Vwhh²t{.''4233+0'Kp''qi kuvke''

tgi tguukqp.''c''kpgct''eqo dkpcvkqp''qh''kpf gr gpf gpv'r tgf kevqtu''ecp''dg''eqpxgtvgf ''vq''c''xcnwg''

dgvy ggp'| gtq''cpf ''qpg''wukpi ''c''qi kuvke.''qt''qi ''qh''qf f u''hwpevkqp.''y j kej ''ecp''dg''wugf ''vq''

guvko cvg'\j g''r tqdcdkrkv{''qh''c''f kej qvqo qwu''qwveqo g''*J guu''(''J guu.''423; +0'Vj ku''r tqdcdkrkv{''

ecp''dg''gzr tguugf ''cu''qf f u.''y kej ''\j g''eqpvtkdwvkqp''qh''gcej ''r tgf kevqt''vq''\j g''qwveqo g''

gzr tguugf ''cu''cp''qf f u'tcvkq''*J guug''(''J guu.''423; +0'Nqi kuvke''tgi tguukqp''o qf gru''ctg''cnuq''hkv''

y j tqwi j ''o wnkr ng''kvgtcvkqpu.''\j g''tguwnu''qh''y j kej ''eqpxgti g''qp''cp''r r tqzko cvg''uqnwkqp''

y j kej ''ku''f gvgto kpgf ''d{''guvko cvkpi ''\j g''eqghhkekgpv'hqt''gcej ''r tgf kevqt''cpf ''vguvkpi ''kh''

ej cpi gu''f getgcug''\j g''uwo ''qh''\j g''us wctgf ''f gxkcvkqpu0'Vj g''o czko wo ''rkmgrkjqqf ''guvko cvg''ku''

tgcej gf ''y j gp''uo crl'ej cpi gu''hckr'vq''ko r tqxg''\j g''uwo .''cv'y j kej ''r qkpv'\j g''r tqdngo ''ku''

eqpukf gtgf ''uqnxgf 0''

Random Forests. ''Tcpf qo ''hqtguv'cni qtkjo u''ctg''uwr gtxkugf ''gpugo dng''ngctpkpi ''

encuukhkecvkqp''cni qtkjo u'\j cv'ctg''c''eqo dkpcvkqp''qh''f gekukqp''vtgg''r tgf kevqtu.''y kj ''gcej ''vtgg''

f gr gpf kpi ''qp''\j g''xcnwgu''qh''c''tcpf qo ''xgevqt''\j cv'ku''uco r ngf ''kpf gr gpf gpv{.''y kj ''\j g''uco g''

f kuvtkdwvkqp''qeewttkpi ''hqt''gcej ''qh''\j g''vtggu''kp''\j g''hqtguv'*Dtgko cp.''4223+0'Vj g''tguwnkpi ''

f qwdng''tcpf qo k|cvkqp''qeewtu''y kj ''\j g''tcpf qo k|cvkqp''qh''xctkcdng''ugrgevkqp''cpf ''

tcpf qo k|cvkqp''qh''\j g''ngctpkpi ''uco r ng''*Vwhh²t{.''4233+0'Vj g''pqf gu''qh''\j g''kpf kxkf wcr'

f gekukqp''vtggu''y kj kp''\j g''tcpf qo ''hqtguv'eqpukuv'qh''ur rku''dcugf ''qp''c''tcpf qo ''n{''ej qugp''ugv'

"

qh'xctkcdngu'cpf 'ugtxg'vq'gpuwtg'\j g'uco g'xctkcdngu'f q'pqv'crr gct'cv'gxgt{'pqf g.'f getgcugu"

\j g'eqttgncvkqp'dgw ggp'\j g'uweeguukxg'vtggu."cpf 'f getgcugu'\j g'xctkcpeg'qh'\j g'ci i tgi cvgf "

o qf gn'*Vwhh?t{.'4233+0'Vj ku'dqquvrcr "ci i tgi cvkpi .'qt'dci i kpi .'j gnr u'vq'tgf weg'qxgthkwkpi "

cpf "ko r tqxg'\j g'r tgf kevkqp'ceewtce{'qh'\j g'o qf gn'*Vwhh?t{.'4233+0"

　　　　Tcpf qo "hqtguv'cni qtkj o u'j cxg'r tqf wegf "\j g'o quv'ceewtcvg'encuukhhecvkqp'tguwnu"

kp"uekgpvkhke"cpf "o gf kecn'hkgnf u'*F ko kvtkcf ku'("Ncr ctcu."423: +"cpf 'j cxg'dgeqo g"

gzvtgo gn{'r qr wnct'dgecwug'qh'\j gkt'cdknkv{'vq'j cpf ng'pqp/nkpgctn{'eqttgncvgf "f cvc."

uko r nkekv{.'uvcdknkv{'kp'\j g'r tgugpeg'qh'qwvnkgtu."cp'qr r qtwpkv{'hqt'ghhkekgpv'r ctcngn'

r tqeguukpi .'cpf 'tgukuvcpeg'vq'pqkug'kp'\j g'f cvc'*Ectwcpc'("P kewugw/O k| kn"4228=Uctkec"

gv'cn0"4239=Vwhh?t{.'4233+0Tcpf qo "hqtguv'o c{'j cxg'cf xcpvci gu'qxgt'qvj gt"

o gvj qf qnqi kgu'kp'\j gkt'kpetgcugf "ko o wpkv{'vq'f cvc'v{r g'cpf "ecr cdknkv{'qh'j cpf nkpi "

f kuetgvg'f cvc'cpf "vq'cr r n{'f kuetgvk| cvkqp'cni qtkj o u'vq'f cvc'dghqtg'\j g'ngctpkpi "uvgr "

*O qtcf k'gv'cn0"4237+0Tcpf qo "hqtguvu'ctg'cnuq'vqngtcpv'qh'qxgtngctpkpi "f wg'vq'\j g"

cxgtci kpi "qh'\j g'qwvr wu'qh'\j g'kpf kxkf wcn'vtggu'*O qtcf k'gv'cn0"4237+0Tcpf qo "hqtguvu"

j cpf ng'o kzwtgu'qh'eqpvkpwqwu'cpf "ecvgi qtkecn'f cvc=o kuukpi "xcnwgu=y kf g'f cvc.'y j gtg'\j g"

pwo dgt'qh'r tgf kevqtu'hct'qwpwo dgtu'\j g'pwo dgt'qh'f cvc'tgeqtfu=cu'y gnn'cu'gcug'qh'wug"

*Ucnhqtf "U{uvgo u."4236+0'

　　　　Cpqvj gt'dgpghkv'qh'\j g'tcpf qo "hqtguv'cni qtkj o "ku'\j g'cdknkv{'vq'tcpm'\j g"

r tqo kpgpeg'qh'kpr w'xctkcdngu'd{'tcpf qo n{ "dw'kpf kxkf wcm{ 'r gto wkpi "\j g'xcnwgu'qh'gcej "

xctkcdng."cpf 'cr r tqzko cvkpi "\j g'f tqr 'kp'ceewtce{'*Dtgko cp.'4223+0Vj ku'hwpevkqp'y cu"

go r nq{gf "vq'f gvgto kpg'\j g'ko r qtvcpeg'qh'\j g'xctkcdngu'cuuqekcvgf "y kj "\j g'qeewttgpeg'qh"

gxgpvu'\j cv'ctg'pqv'tgncvgf 'vq'WCS .'gxgpvu'\j cv'ctg'tgncvgf 'vq'WCS 'dw'ctg'pqv'hwo g"

gxgpwu."cpf "gxgpw'\j cv'ctg'r gtegkxgf "d{ "\j g'tgr qtvgtu'\q "dg'hvo g"gxgpwu0Hgcwtg'ugngevkqp"

cpf "gzvtcevkqp"y gtg'cr r rkgf "r tkqt"\q "\j g'encuukhlecvkqp"\q "ko r tqxg"qxgtcm'ceewtce{0"

Vj g'ceewtce{'qh'c'tcpf qo "hqtguv'f gr gpf u'qp"\j g'uvtgpi \j "qh'\j g'encuukhlgtu'qh'gcej "

vtgg."cpf "uqo g'o gcuwtg'qh'\j g'kpf gr gpf gpeg'dgwy ggp'\j go "*Dtgko cp."4223+0Tcpf qo "

hqtguv'o qf gm'r gthqto "dguv'y j gp'vtggu'ctg'i tqy p'\q "c'ncti g'uk| g."\j wu'ctg'y gm/uwkvgf "hqt"

\j g'cpcn{uku'qh'eqo r ngz'f cvcugvu'y kj "o cp{ "eqnwo pu'dwv'qpn{ "c'o qf gtcvg'pwo dgt'qh'tqy u"

*Ucrhqtf "U{uvgo u."4236+0F kucf xcpvci gu'qh'tcpf qo "hqtguvu'o c{ "kpenwf g'c'tkum'qh"

qxgthkwkpi ="\j g'co qwpv'qh'tguqwtegu'tgs wktgf "kp'vgto u'qh'uqhwy ctg'cpf "eqo r wvcvkqp="

f khhlewn{ "kp'kpvgt r tgvkpi "\j g'encuukhlecvkqpu."tgs wktkpi "umkm'cpf "vko g="cpf "\j g'ncem'qh"

vtcpur ctgpe{ "kp"wukpi "\j ku'*black box*'o gvj qf "*Uj o wgrk'Dtweg."("Rcvgn'4238+0"

Summary

Y kj "o cp{ "wpmpqy pu'uwttqwpf kpi "\j g'qeewttgpeg."htgs wgpe{."ghhgevu."cpf "

qwveqo g'qh'hwo g'gxgpwu."f gxgnqr kpi "r tgxgpvkqp'uvtcvgi kgu'hqt'\j gug'gxgpw'ku'ej cngpi kpi 0"

Ghhqtwu'\q "kf gpvkh{ "cpf "ej ctcevgtk| g'gxgpwu'cpf "\j g'r qvgpvkcn'j ctoj "ghhgevu'ctg'ewttgpvn{ "

tgcevkxg'cpf "qeewt'chvgt'cp'gxgpv'ku'uwur gevgf "cpf "ctg'o cf g'o qtg'f khhlewn/'y kj "c'ncem'qh"

eqpukuvgpv'f cvc'qt'c'pcvkqpcn'tgr qtvkpi "cpf "vtcemkpi "u{uvgo 0Kf gpvkhlecvkqp'qh'eqpf kvkqpu."

gxgpwu."cpf "dgj cxkqtu'cuuqekcvgf "y kj "\j g'qeewttgpeg'qh'hwo g'gxgpwu'eqwrf "r tqxkf g"

r cuu}gpi gtu'cpf "etgy "y kj "gpj cpegf "uchgv{ "cpf "ckf "cktrkpgu'kp'ko kvkpi "j c| ctf qwu"

eqpf kvkqpu'cpf "equvn{ "f grc{u'cpf "f kxgtukqpu0"

Vj ku'rkvgtcwtg'tgxkgy "j cu'r tqxkf gf "c'hqwpf cvkqp'hqt'\j ku'tgugctej 0Rwdrkuj gf "

uwf kgu'wukpi "vgzv'cpf "f cvc'o kpkpi "o gij qf u'\q "kf gpvkh{ "ko r qtvcpv'hcevqtu'cuuqekcvgf "y kj "

uchgv{ "kpekf gpwu."f gxgnqr "o qf gm'hqt'kf gpvkh{kpi "hrki j v'cpqo crkgu."ko r tqxkpi "uchgv{."

kf gpvkh{kpi "ncvgpv'vqr keu'cpf "vtgpf u."cpf "\q "kf gpvkh{ "hcevqtu'eqpvtkdwvkpi "\q "ceekf gpwu'y gtg"

tgxkgy gf0'Vj g'pgz v'ej cr vgt'f guetkdgu'yj g'o gyj qf qmqi {'hqt'yj g'kf gpvkhkecvkqp''qh'ko r qtvcpv'

hcevqtu'cuuqekcvgf'y kyj ''WCS ''cpf ''hwo g'gxgpvu'kp'yj g'CUTU'f cvcugv'cpf ''yj g'f gxgnqr o gpv'

cpf ''gxcnwcvkqp''qh'r tgf kevkxg'o qf gnu'vq 'cuuguu'yj gug'hcevqtu0'

"   "

"

Chapter III: Methodology

Vj ku'o kz gf ''o gyj qf ''uwf { ''uwgf ''s wcrkxckxg''vgzwcrl'f cvc''cpf ''s wcpvkxckxg''f cvc''htqo ''
xqnwpvctkn{''uwdo kwgf ''tgr qtvu''q ''gzco kpg''j qy ''vgzv''o kpkpi ''gej pkswgu''ecp''dg''uwgf ''q''
gzr nqtg''cpf ''kf gpvkh{''vj g''o quv''ko r qtvcpv''xctkcdngu''cuuqekcvgf ''y kj ''WCS ''cpf ''hwo g''gzxgpvu.''
cpf ''j qy ''f cvc''o kpkpi ''cpf ''o qf gnkpi ''vgej pkswgu''ecp''dg''uwgf ''q''kf gpvkh{''ko r qtvcpv''hcevqtu''
cuuqekcvgf ''y kj ''WCS ''cpf ''hwo g''gzxgpv''qeewttgpeg0''

Vj g''rkvgtcwtg''tgxkgy ''kf gpvkhkgf ''i cr u''kp''uckgpvkhke''f cvc''cuuqekcvgf ''y kj ''vj g''
qeewttgpeg''qh''hwo g''gxgpvu.''kpenwfkpi ''vj gkr''htgswgpe{''qh''qeewttgpeg.''vj g''kf gpvkhkecvkqp''qh''
j c| ctf qwu''eqo r qwpf u''cuuqekcvgf ''y kj ''hwo g''gxgpvu.''cpf ''ecwugu''qh''r j {ukecn''pgwtqnqi kecn''
r j {ukqnqi kecn''cpf ''pgwtqdkqnqi kecn'u{o p r qo u''cuuqekcvgf ''y kj ''gzr quwtg''q''vqzke''hwo gu00C ''
ncem'qh''gzkuvkpi ''r tgf kevkxg.''r tqcevkxg.''cpf ''tgcevkxg''f cvc''cpf ''f cvc''eqnngevkqp''o gyj qf u''iko ku''
vj g''cdknkv{''q''f qewo gpv''vj g''qeewttgpeg''qh''hwo g''gxgpvu''cpf ''uwr r qtv''vj g''kf gpvkhkecvkqp''qh''
kpf kxkf wcn'eqo r qwpf u''cpf ''vj gkr''tgncvkqpuj kr ''q''j gcnvj ''ghhgevu''htqo ''gzr quwtg''q''vqzke''
hwo gu00Vj g''eqpvkpwgf ''qeewttgpeg''qh''hwo g''gxgpvu''gzr qugu''etgy u''cpf ''r cuugpi gtu''q''
j c| ctf u''htqo ''gzr quwtg''q''vqzke''hwo gu.''hnki j v''f kxgtukqpu.''cpf ''go gti gpe{''ncpf kpi u.''cpf ''vj g''
cktnkpgu''q''r qvgpvkcn'cf f gf ''hkpcpekcn'cpf ''ngi cn'equw00''

Vj ku'o ej cr vgr''f guetkdgu''vj g''tgr qtvu''eqo r tkukpi ''vj g''f cvcdcug.''f cvc''o kpkpi ''uqhyy ctg.''
cpcn{vkecn'o gyj qf u.''cpf ''cni qtkjo u''wugf ''kp''vj ku'uwf {0'Vj g''r wtr qug''qh''vj ku'gzr nqtcvqr{.''
f cvc/f tkxgp''uwf {''y cu''q''gzr nqtg''vgzwcrl'cpf ''s wcpvkcvkxg''f cvc''q''kf gpvkh{''hcevqtu''
cuuqekcvgf ''y kj ''qeewttgpegu''qh''WCS ''cpf ''hwo g''gxgpvu''cpf ''f gxgnqr ''cpf ''vguv''f cvc''o kpkpi ''
cni qtkjo u''q''kf gpvkh{''hcevqtu''cuuqekcvgf ''y kj ''vj g''qeewttgpeg''qh''vj gug''gxgpvu0'Vj g''tgxkgy ''
qh''gzkuvkpi ''rkvgtcwtg''hqwpf ''gzco r ngu''qh''vgzv''o kpkpi ''uugf ''q''kf gpvkh{''xcnwcdng''kphqto cvkqp''
htqo ''CUTU'tgr qtv''pcttcvkxgu.''cpf ''f cvc''o kpkpi ''o gyj qf u''j cxg''dggp''uugf ''q''kf gpvkh{''uchgv{''

"

rtgewtuqtu"kp"HQS C"fcvc0Uvtwewtgf "kphqtocvkqp"htqo "vgzv"cpf "fcvc"o kpkpi "ghhqtvu"jcu"

dggp"wugf "kp"xctkqwu"cni qtkjo u"vq"etgcvg"rtgfkevkxg"o qfgnu=jku"uwf{ "cnuq"eqpvtkdwgu"vq"

yjg"eqnrgevkxg"dqf{ "qh"mpqy ngfi g"cpf "uchgv{ "ko rtqxgo gpvu"cfxcpegf "d{"vjg"fgxgnqro gpv"

qh"o qfgnu"vq"kfgpvkh{ "ko rqtcpv"hcevqtu"cuuqekcvgf "y kij "jc| ctfqwu"gxgpvu0"""

Research Method Selection

C"eqo dkpcvkqp"qh"vgzv"o kpkpi "cpf "o cej kpg"ngctpkpi "vgej pkswgu"y cu"wugf "vq"

kfgpvkh{ "xctkcdngu"kp"ugrh/tgrqtgf "pcttcvkxgu"cpf "kfgpvkh{ "yj g"o qu"ko rqtcpv"hcevqtu"

cuuqekcvgf "y kij "yj g"qeewttgpeg"qh"hvo g"gxgpvu0C"pgy "rcwgtp"y cu"fgvgevgf "hqt"yj g"

ko rqtcpv"hcevqtu"kfgpvkhkgf "kp"xqnwpvctkn{ "tgrqtgf "fcvc"hwpevkqpkpi "cu"kprw"xctkcdngu"

eqpvtkdwwkpi "vq"yj g"rtqdcdknkv{ "qh"yj g"cti gv"xctkcdngu0Vj g"cti gv"xctkcdng"eqpukuvgf "qh"

yj tgg"ngxgnu"qh"tgrqtvgf "gxgpvu<"

3"? "Gxgpvu"yj cv"ctg"pqv"tgncvgf "vq"WCS =""

4"? "Gxgpvu"yj cv"ctg"tgncvgf "vq"WCS "dw"ctg"pqv"hvo g"gxgpvu="cpf ""

5"? "Gxgpvu"yj cv"ctg"tgrqtvgf "vq"dg"hvo g"gxgpvu0'

Vq"cfftguu"yj g"tgugctej "swguvkqpu."fcvc"o kpkpi "wukpi "fgekukqp"vtgg."i tcfkgpv"

dqquwkpi ."nqi kuvke"tgi tguukqp."cpf "tcpfqo "hqtguv"cni qtkjo u"y gtg"wugf "vq"dwknf "o qfgnu"

dcugf "qp"yj g"kprw"xctkcdngu"kfgpvkhkgf "yj tqwi j "yj g"vgzv"o kpkpi "rtqeguu0"

Population and Sampling Frame

Vj g"cti gv"rqr wncvkqp"hqt"yj ku"uwf{"y cu"yj g"ugv"qh"cxkcvkqp"gxgpvu"qeewttkpi "kp"36"

EHT "Rctv"343"qrgtcvkqpu"kp"yj g"Wpkvgf "Uvcvgu"y jkej "ctg"fqewo gpvgf "kp"tgrqtu"uwdo kwgf "

vq"yj g"CUTU0Tgrqtu"ctg"uwdo kwgf "d{ "kpfkxkfwcnu"cpf "tgxkgy gf "d{ "CUTU"rgtuqppgn0'

Tgrqtu"fguetkdkpi "yj g"uco g"gxgpv"ctg"i tqwr gf "cpf "rtgugpvgf "cu"qpg"gxgpv"qt"ecug0'

"

Vj g"uco r nkpi "htco g"eqpukuvgf "qh"tgr qtvu"uwdo kwgf "vq "vj g"CUTU"f wtkpi "4237/

423; "f guetkdkpi "uchgv{ "kpekf gpvu"co qpi "WUU0ckrtnkpgu"tgi wncvgf "wpf gt "Hgf gtcn'Cxkcvkqp"

Tgi wncvkqpu'36"E(H0T "È"Rctv'343"F qo guvke."Hrci ."cpf "Uwr r ngo gpvcn'Qr gtcvkqpu0'Vj gug"

qr gtcvkqpu'y gtg"ugngevgf "f wg"vq "vj g"tgi wncvqr { "ucpf ctf k| cvkqp"qh"ckrctchv."etgy u. "tckpkpi ."

cpf "tgr qtvkpi "tgs wktgo gpvu0'Vj g"uco r nkpi "htco g"kpenwf gf "gxgpvu'tgr qtvgf "d{ "cm'hnki j v'

etgy "cpf "ecdkp"etgy "qr vkqpu'hqt'tgr qtvgt'hwpevkqpu."kpenwf kpi "r knqv."ecr vckp."ej gm'r knqv."

hktuv'qhhkegt."ugeqpf "qhhkegt."hnki j v'gpi kpggt."kpuvtwevqt."r knqv'hn{kpi ."r knqv'pqv'hn{kpi ."tgrkgh"

r knqv."ukpi ng"r knqv."tckpggg."qvj gt."cpf "wpmpqy p"hqt"hnki j v'etgy 0'Hqt"hnki j v'cwgpf cpu."

hwpevkqpu'kpenwf gf "hnki j v'cwgpf cpv'qp"f wv{ ."kp"ej cti g."qhh'f wv{ ."qvj gt."cpf "wpmpqy p0""""

Sample Size"

Vj g"uco r nkpi "htco g"eqpukuvgf "qh"kpekf gpvu"f guetkdgf "d{ "tgr qtvu"uwdo kwgf "vq "vj g"

CUTU"f wtkpi "4237/423; "d{ "hnki j v'etgy "cpf "ecdkp"etgy "o go gdtu'cpf "cxcknrcdng"kp"vj g"

r wdrken{ "ceeguukdng"f cvcdcug0'Chvgt"f qy pnqcf kpi "vj g'CUTU'Gzegn "hkng. "f cvc'y cu"

wr nqcf gf "kpvq "UCÙ "Gpvgtr rkug'O kpgt^{VO} "*UCÙ "GO ^{VO} +0'Hqt"f cvc'o kpkpi ."vj g"ecugu"y gtg"

r ctvkvkqpgf "kpvq "tckpkpi ."xcrkf cvkqp."cpf "vguv'uwduco r ngu0'Rwdrkuj gf "etkvgtkc"hqt"

f gvgto kpkpi "vj g"vgto kpcvkqp"qh"cevkxg"ngctpkpi "kp"tckpkpi "f cvc"hqt"encuukhkecvkqp"f q"pqv'

f ktgevn{ "r tgf kev'c"uco r ng"uk| g"cnj qwi j "r tgxkqwu'tgugctej "tgs wktgf "dgy ggp": 2"vq "782"

cppqvcvgf "uco r ngu"vq "qdvckp"o gcp"cxgtci g"cpf "tqqv'o gcp"us wctgf "gttqt"dgmy "2023"

*Hki wgtqc"gv'cn0"4234+0'Vj g"uco r ng"uk| g"hqt"vj ku"uvwf { "kpenwf gf "35.: 95"gxgpvu"y kj "3: .; 88"

pcttcvkxgu"tgr qtvgf 0'Hqwt"tgr qtvu"y gtg"o kueqf gf "cpf "y gtg"tglgevgf "chvgt"eqpuwncvkqp"y kj "

cp"CUTU"cpcn{ uv'hqt"c"vqvcn'qh"35.: 8; "gxgpvu"cpf "3: .; 84"pcttcvkxg"hkgrfu0'F cvc"wugf "hqt"

o qf gr"tckpkpi "cpf "xcrkf cvkqp"gcej "eqpukuvgf "qh"hqtv{ "r gtegpv'qh"vj g"ecugu."qt"

cr r tqzko cvgn{ "7.76: "uco r ngu"gcej 0'Vj g"tgo ckpkpi "y gpv{ "r gtegpv'qh"vj g"ecugu"qt"

cr r tqzko cvgn{"4.996"uco r ngu"y gtg"wugf "hqt"vguvkpi "vj g"o qf gnu0"O kpkpi "c'tgr tgugpvcvkxg"

uco r ng'tgf wegu'r tqeguukpi "ko g.'cpf "r cwgtpu'cr r gctkpi "kp"vj g'eqo r ngvg'f cvcugv'y kn'dg"

kf gpvkhkgf "kp"c'tgr tgugpvcvkxg"uco r ng"*Fgcn.'4236+0"

Data Collection Process

Vj ku'tgugctej "uwf{ "wugf "ugeqpfct{ "f cvc'eqnmgevgf "d{ "PCUC"cpf "o cf g"cxcknadrg"

kp"vj g'CUTU0Vj g'HCC"wkknk{gu'PCUC"cu'c'vj kf r'r ctv{ "vq"o cipvckp"vj g'CUTU'hqnmqy kpi "c"

o go qtcpf wo "qh'ci tggo gpv"*HCC."4233d+0PCUC"cpcn{uu'tgegkxg"cpf "r tqeguu'cxkcvkqp"

uchgv{ "tgr qtvu'y j kej "ctg"xqnwpvctkn{ "uwdo kwgf "htqo "r knqvu."hnki j v'cwgpf cpvu."eqpvtqngtu."

o ckpvckpgtu."cpf "qvj gtu0Vj gug'tgr qtvu'o c{ "dg"uwdo kwgf "ngevtqpkecm{ "qt"qp"y tkwgp"

hqto u'tj tqwi j "vj g'r quvcn'u{uvgo "qp"PCUC'hqto "CTE"499D'hqt'hnki j v'etgy u."f kur cvej gtu."

cpf "qvj gtu"*ugg'Cr r gpf kz "C+0Ecdkp"etgy u"wug'tgr qtv'hqto "CTE"499E"*Cr r gpf kz "D+"

y j kng'tgr ckto gp."o gej cpkeu."cpf "kpur gevqtu"wug'tgr qtv'hqto "499F ."cpf "ckt "vtchhke"

eqpvtqngtu"wug'tgr qtv'hqto "499C0"

Cp"kpegpvkxg"hqt'tgr qtvkpi "ku'r tqxkfgf "vj tqwi j "vj g'cxcknadkht{ "qh'y ckxgtu'qh"

f kuekr nkpct{ "cevkqp."ekxkn'r gpcnvkgu."qt "uwur gpukqp"qh'HCC/kuuwgf "egtvkhkecvgu0Vj g'HCC"

y kn'pqv'wug'kphqto cvkqp"kp"tgr qtvu'uwdo kwgf "vq"PCUC"wpf gt "vj g'CUTU"kp"cp{ "

gphqtego gpv'cevkqp."r tqxkfgf "vj g'r qvgpvkcn'xkqncvkqpu"y gtg"kpcf xgtvgpv'cpf "pqv'f gnkdgtcvg="

vj g'cevkqpu'f kf "pqv'f kuenqug'c'ncem'qh'swcnkhkecvkqp"qt 'eqo r gvgpe{="vj g'tgr qtvgt'j cu'pqv'

dggp"uwdlgev'vq"cp"HCC"gphqtego gpv'cevkqp"kp"vj g'hkxg"{gctu'r tkqt="vj g'cevkqpu'y gtg"pqv'

ceekf gpvu"qt'etko kpcn'cevkxkv{="cpf "vj g'tgr qtvgr'ecp'r tqxg'y kj kp"32"f c{u'chvgt'vj g"

xkqncvkqp."qt'f cvg'y j gp"vj g'r gtuqp'dgeco g"cy ctg'qh'vj g'xkqncvkqp."vj g{ "uwdo kwgf "c'tgr qtv'

vq"PCUC"*HCC."4243+0Gcej "tgr qtv'hqto "eqpvckpu'c'tgr qtvgt'kf gpvkhkecvkqp"uvtkr "

kf gpvkh{kpi "vj g'r gtuqp'uwdo kwkpi "vj g'tgr qtv'cpf "r tqxkf gu'PCUC"cpcn{uu'y kj "eqpvcev'

"

kphqto cvkqp"kh'\yj gtg"ku"c"pggf "\q"eqrngev'cff kvkqpcnl'kphqto cvkqp0'P CUC"uvchh'\ko g"uvco r u"

\yj g"uvtkr u'cpf "tgwutpu'\yj go "\q"\yj g"tgr qtvgr "cu'r tqqh'c"tgr qtv'y cu'hkngf 0'

Qpeg"tgegkxgf ."tgr qtvu'ctg"tgxkgy gf "d{"c"vgco "qh'cpcn{uu."j c| ctf u'ctg"hrci i gf "hqt"

ko o gf kcvg"cwgpvkqp."cpf "tgr qtvu'ctg"eqf gf ."encuukhkgf ."f gkf gpvkhkgf ."cpf "o cf g"cxckrcdng"kp"

c"r wdrkely"ceeguukdng"f cvcdcug<'j wr u<1lcutu0cte0pcuc0 qx lugctej lf cvcdcug0] vo r0'Qpg"gxgpv"

o c{"tguwnv'kp"o wnkr ng"tgr qtvu'cu'r kq vu. "hrki j v'cwgpf cpvu. "o ckpvckpgtu. "cpf "ckt "vtchhke "

eqpvtqmgtu"o c{"gcej "dg"kpxqnxgf "cpf "kpf kxkf wcm{"tgr qtv'c"ukpi ng"gxgpv0'Cpcn{uu'tgxkgy "

tgr qtvu'cpf "kf gpvkh{"eqo o qp"gxgpwu'cpf "i tqwr "vj qug"tgr qtvu'kp"c"ukpi ng"gxgpv'vj cv'

eqpuvkwwgu"c"ecug"y kj kp"vj g"CUTU"f cvcdcug0'Encuukhkecvkqpu'cpf "ecwugu"qh'gxgpvu"ctg"

f gvgto kpgf "d{"cpcn{uu'chvgt'tgxkgy kpi "tgr qtvu'cpf "ctg"cnuq"cxckrcdng"kp"vj g"f cvcdcug"

*CUTU."p0f 0l0b0l0'Vj ku"f cvcdcug"ku"ugctej cdng"d{"ugngevkpi "hkrvgtu. "uwej "cu"vj g"36'EHT"r ctv'

wpf gt"y j kej "vj g"hrki j v'y cu"eqpf wevgf ."vj g"v{r g"qh'cktetchv."qt"vj g"tgr qtvgr'r qukkqp"*CUTU."

p0f 0e+0'

Design and Procedures"

Vj ku"ugswgpvkcnl'o kzgf "o gvj qf "tgugctej "qeewttgf "kp"vy q"uvgr u0'Kp"vj g"hktuv'uvgr ."vgzv'

o kpkpi "vgej pks wgu'y gtg"wugf "vq"f kueqxgt"ko r qtvcpv'xctkcdngu"htqo "vj g"wpuvtwewtgf "

vgzwcrl'f cvc"eqpvckpgf "kp"vj g"CUTU'tgr qtv'pcttcvkxgu0'Kp"vj g"ugeqpf "uvgr ."vj g"f cvc"o kpkpi "

r tqeguu"eqo dkpgf "vj gug"ko r qtvcpv'xctkcdngu'cpf "cr r tqr tkcvg"o gcpkpi hwn's wcpvkvcvkxg"

xctkcdngu"kp"vj g"f cvcdcug"vq"f gxgnqr "cpf "vguv'o qf gn'hqt"vj g"kf gpvkhkecvkqp"qh'hcevqtu"

cuuqekcvgf "y kj "vj g"vj tgg"ngxgnu'qh'vj g"vcti gv'xctkcdng<'gxgpvu'vj cv'ctg"pqv'tgncvgf "vq"WCS ="

gxgpvu"vj cv'ctg"tgncvgf "vq"WCS "dwv'ctg"pqv'hwo g"gxgpvu=''cpf "gxgpvu"vj cv'ctg"tgr qtvgf "vq"dg"

hwo g"gxgpvu0'Kp"vj ku"o kzgf "o gvj qf "f guki p."ecvgi qtk| gf "cu'f gxgnqr o gpv'f guki p. "vj g"

ugswgpvkcnl'wug"qh's wcrkvcvkxg"cpf "s wcpvkvcvkxg"o gvj qf u'cnqy u'tguwnu'htqo "vj g"hktuv'o gvj qf "

vq "kphqto "vj g"f gxgnqr o gpv"qt"cpcn{uku"qh"vj g"ugeqpf "o gvj qf "cpf "cuuguugu"vj g"uco g"

r j gpqo gpc"*I tggpg"gv"cn0"3; ; ; +0C"o kzgf "o gvj qf "f guki p"ku"cr r tqr tkcvg"dgecwug"vj g"

CUTU"f cvcdcug"eqpvckpu"dqvj "vgz wcn"f cvc"hqwpf "kp"tgr qtvgt"pcttcvkxgu"cpf "gxgpv"u{pqr ugu"

cpf "s wcpvkvcvkxg"hnki j v"f cvc"y j kej "ecp"dg"eqo dkpgf "kp"o qf gnu"f gxgnqr gf "vq"cf f tguu"vj g"

tgugctej "s wguvkqpu0Etguy gn'cpf "Enctm'*4229+'kf gpvkhkgf "ugxgtcn'uvtgpi vj u"qh"vj g"

gzr nqtcvqt{"o kzgf "o gvj qf "f guki p."kpenwf kpi "uvtcki j vhqty ctf "f guetkr vkqp."ko r ngo gpvcvkqp."

cpf "tgr qtvkpi =ceegr vcpeg"qh"vj g"s wcnkvcvkxg"cur gev"d{"vj g"kpenwukqp"qh"vj g"s wcpvkvcvkxg"

cr r tqcej =cpf "cr r nkecvkqp"vq"o wnkr j cug"tgugctej "uvwf kgu0Vj ku"uvwf {"wugf "ugs wgpvkcn'

gzr nqtcvqt{"o kzgf "o gvj qf u."kp"y j kej "vj g"s wcnkvcvkxg"cpf "s wcpvkvcvkxg"eqo r qpgpw"y gtg"

eqpf wevgf "kp"uvci gu."y kj "vj g"tguwnw"qh"vj g"s wcnkvcvkxg"vgz v"o kpkpi "kphqto kpi "vj g"

s wcpvkvcvkxg"f cvc"o kpkpi "uvci g"qh"vj g"uvwf {0Qpy wgi dw| kg"cpf "Nggej "*4226+"kf gpvkhkgf "

ugxgtcn'cf f kvkqpcn'uvtgpi vj u"qh"ugs wgpvkcn'o kzgf "o gvj qf u"tgugctej 0Vj g{"r qukv"wukpi "c"

ugs wgpvkcn'o kzgf "o gvj qf "cpcn{uku"kp"c"r tgf qo kpcpvn{"s wcnkvcvkxg"qt"s wcpvkvcvkxg"uvwf {"ecp"

cf f tguu"vj g"i qcnu"qh"eqo r ngo gpvctkv{."f gxgnqr o gpv."cpf "gzr cpukqp0Qpg"f kucf xcpvci g"qh"

vj ku"v{r g"qh"tgugctej "ku"vj g"r qvgpvkcn'hqt"vj g"qtf gt"qh"vj g"s wcnkvcvkxg"cpf "s wcpvkvcvkxg"

tgugctej "vq"chhgev"vj g"kpvgtr tgvcvkqp"qh"f cvc"*Qpy wgi dw| kg"gv"cn0"4233+0Cpqvj gt"eqpegtp"

ku"vj g"cpcn{uku"qh"f cvc"hqt"qpg"eqo r qpgpv"qh"c"o kzgf "o gvj qf "uvwf {"ecp"r qvgpvkcm{"chhgev"

vj g"cpcn{uku"cpf "tgr qtvkpi "qh"f cvc"kp"cpqvj gt"r ctv"qh"vj g"uvwf {"*Xqi v"gv"cn0"4234+0Vj g"

uvtwevwtg"qh"vj ku"tgugctej "tgs wktgf "vj g"s wcnkvcvkxg"f cvc"vq"dg"cpcn{| gf "hktuv."y kj "vj g"tguwnu"

wugf "vq"kphqto "vj g"s wcpvkvcvkxg"cpcn{uku."vj wu"vj g"gzr gevcvkqp"ku"hqt"vj g"kpkvkcn'f cvc"

cpcn{uku"vq"kphnwgpeg"vj g"rcwgt"cpcn{uku0S wcnkvcvkxg"cpf "s wcpvkvcvkxg"tgugctej "f guki pu"

uj qwnf "dg"eqo dkpgf "y j gp"qpg"o gvj qf "y km'dg"wugf "vq"kphqto "cpqvj gt"*Xqi v"gv"cn0"4234+."

vj wu."vj ku"f guki p"y cu"cr r tqr tkcvg"vq"cf f tguu"vj g"tgugctej "s wguvkqpu0""

"

Text Mining. Vgzv'o kpkpi "kpxqnxgu'vj g'ghhlekgpv'cpcn{uku'cpf "gzr nqtcvkqp"qh"

wpuvtwewtgf "qt"vgzwwcn'kphqto cvkqp'hqt "vj g'gzvtcevkqp"qh'o gcpkpi hwl'kphqto cvkqp"cpf "

mpqy ngf i g'htqo "ncti g'co qwpu'qh'vgzv"*J wuugkp'gv'cn0"4237+0'Htgg'vgzv'kphqto cvkqp'hqwpf "

kp"vj g'pcttcvkxgu'uwdo kvgf "d{'tgr qtvgtu'cpf "u{pqrugu'f gxgnqr gf "d{'CUTU'cpcn{uu'o c{"

eqpvckp'xcnwcdng'kpuki j v'kpvq 'hcevqtu'cuuqekcvgf "y kj "WCS "cpf "hwo g'gxgpw0Tguwnu'qh"

vgzv'o kpkpi "ecp'dg'eqo dkpgf "y kj "f cvc'o kpkpi "o qf gnu'vq 'i tgcvn{'o r tqxg'vj g'r tgf kevkxg"

r qy gt'qh'o qf gnu'*Ej cmtcdqtv{'gv'cn0"4235+0"

Vj g'tguwnu'qh'o kpkpi "f cvc'htqo "vj g'htgg'vgzv'hkgnf u'qh'vj g'tgr qtu'uwdo kvgf "vq "

CUTU'gpj cpegf "vj g'o qf gnu'f gxgnqr gf "vq 'kf gpvkh{ "hcevqtu'cuuqekcvgf "y kj "hwo g'gxgpw'kp"

yj ku'tgugctej 0'Vj g'hktuv'htgg'vgzv'hkgnf "qh'vj g'CUTU'tgr qtu'kpenwfgu'c'f guetkr vkqp'qh'vj g"

gxgpv'qt 'ukwwcvkqp0'Vj g'tgr qtvgt 'ku'cumgf "vq 'f kuewuu'vj g'ej ckp'qh'gxgpw. 'kpenwfkpi 'j qy "vj g"

r tqdngo "ctqug. 'eqpvtkdwwkpi "hcevqtu. 'j qy "kv'y cu'f kueqxgtgf . 'cpf "eqttgevkxg'cevkqpu. 'cpf "

j wo cp'r gthqto cpeg'eqpukf gtcvkqpu'kpenwfkpi "r gtegr vkqpu. 'lwf i o gpw. 'f ekukqpu. 'hcevqtu"

chhgevkpi "vj g's wcnkv{'qh'j wo cp'r gthqto cpeg. 'cpf "cevkqpu'qt 'kpcevkqpu'*CUTU. '422; +0'Vj g"

ugeqpf "htgg'vgzv'hkgnf "ku'c'u{pqr uku'qh'vj g'gxgpv'cu'r tqxkf gf "d{ "vj g'cpcn{uv0'Cpcn{uu'j cxg"

gzr gtkgpeg'kp'c'hwwl'ur gevtwo "qh'cxkcvkqp'cevkxkv{'kpenwfkpi "ckt 'vtchhke'eqpvtqn=o knkct{. "

eqtr qtcvg. 'eqo o gtekcn'cpf "i gpgtcn'cxkcvkqp="cpf "o ckpvgpcpeg. 'cpf "ctg'mpqy ngf i gcdng"kp"

j wo cp'hcevqtu'cpf "r u{ej qmqi { 'tgugctej ="etgy 'tguqwteg'o cpci go gpv="hcvki wg="cpf "wugt "

kpvgthceg'f guki p"*CUTU. 'p0f 0d0+"cpf "ctg'vj wu'cdng'vq 'r tqxkf g'ceewtcvg'cpf "uweekpev"

f guetkr vkqpu'qh'gxgpw0"

Vj g'vgzv'o kpkpi "r tqeguu'qh'vj ku'uwwf { 'kpenwfgf "f cvc'eqnngevkqp. 'vgzv'r ctukpi "cpf "

vtcpuhqto cvkqp. 'vgzv'hknvgtkpi . 'cpf "vgzv'o kpkpi . 'cu'uj qy p"kp'Hki wtg'4 "*Ej cmtcdqtv{'gv'cn0"

4235+0'Vj g'eqnngevkqp'qh'f cvc'vqqm'r nceg'd{ "cr r n{kpi "vj g'cr r tqr tkcvg'hknvgtu'vq 'vj g'CUTU"

f cvcdcug"vq"ugngev"f cvc"tgrqtvgf "htqo "36"EHT"Rctv"343"qrgtcvkqpu"kp"vj g"WU0f wtkpi "

4237/423;0"Vj gug"f cvc"y gtg"f qy pnqcf gf "kpvq"c"Oketquqhv"Gzegn̂"ur tgcf ujggv"cpf "

o cpwcm{"tgxkgy gf "hqt"eqo r ngvgpguu"cpf "ceewtce{0"Cp"cxkcvkqp"tgugctej "f cvc"cpcn{uv"cv"

PCUC"y cu"eqpuwngf "vq"eqphko "xctkcdngu"cpf "eqf kpi "y j gp"swguvkqpu"ctqug0"C"xctkcdng"

y cu"etgcvgf "vq"eqpvckp"cm"qh"vj g"tgrqtv"pctttcvkxgu"kp"qpg"xctkcdng"hqt"vj g"vgzv"o kpkpi "

r tqegf wtgu0Vj gug"f cvc"y gtg"j gp"ko r qtvgf "kpvq"UCŜ "GÔ"wukpi "vj g"Vgzv̂"Ko r qtt"pqf g0"

Vj ku"pqf g"gzvtcevgf "vgzv̂"htqo "vj g"hkngu"cpf "r ncegf "eqr kgu"qh"vj ku"vgzv"kp"c"r nckp"vgzv"hkng"

cpf "c"UCŜ "f cvcugv̂"vj cv"y cu"ko r qtvgf "kpvq"vj g"Vgzv̂Rctukpi "pqf g0Vj g"uvgr u"kp"vj g"

r tqeguu"hnqy "f kci tco "wukpi "UCŜ "Vgzv̂Okpgt"ctg"knmwuvtcvgf "kp"Hki wtg"50"

"

Figure 2

The Text Mining Process Using SAŜ Text Miner
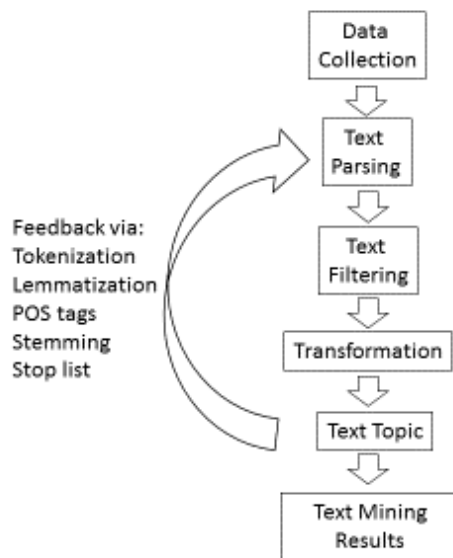
Figure 3

The Process Flow Diagram Used in the Text Mining Process"
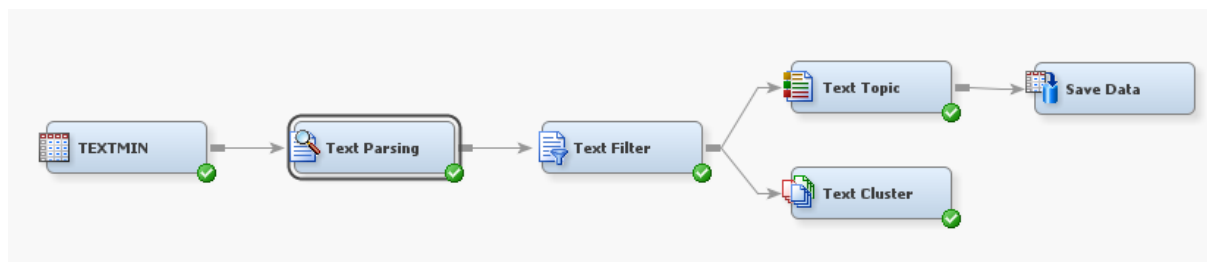
Note. "Htqo "UCUꟷ "Vgzv"O kpgt0"

"

Text parsing. Vj g'hktuv'uvgr "kp"eqpxgtvkpi "wpuvtwewwtgf "vgzv'vq "c"uvtwewwtgf "hqto cv" hqt"cpcn{uku'y cu'vgzv'r ctukpi "*Ej cmtcdqtv{ "gv'cn0"4235+"cpf "hqewugf "qp"vj g'r tgr ctcvkqp"qh" vj g"f cvc0"Vj g"vgzv'r ctukpi "uvgr "wugf "vj g"Vgzv'Rctukpi "pqf g"cpf "kpenwf gf "vqmgpk| cvkqp," ngo o cvk| cvkqp."cpf "r ctv'qh"ur ggej "*RQU+"vci i kpi 0"Vqmgpk| cvkqp"ku"vj g"r tqeguu"qh"dtgcmkpi " vj g"ugtkgu"qh"ugpvgpegu"eqpvckpgf "kp"vj g"pcttcvkxgu"kpvq "wpku"qt"y qtfu"*Ej cmtcdqtv{ "gv'cn0" 4235+0Cpcn{uku"qh"vj g"uvtwewwtg"cpf "hqto "qh"y qtf u"kp"m quv"Fkf q/Gwtqr gcp"npi wci gu"cnuq " kpenwf gu"ngo o kpi "kp"cf f kvkqp"vq "ngo o cvk| cvkqp."cpf "RQU"vci i kpi "qh"y qtf u. "cu"vj g"eqtg" r ctv'qh'c"y qtf "o wuv'dg"kf gpvkhkgf "vq "cuuku"kp"f gvgto kpkpi "uko knctkvkgu"qh"y qtf u"*Fkpi "gv'cn" 423; +0UCUꟷ "Vgzv'O kpgt"wugu"c"f kevkqpct{/dcugf "cni qtkvjo "vq "uvgo "y qtf u"cpf "cmqy u"vj g" cwvqo cvke"cuuki po gpv'qh'u{pqp{o u"vq "vgto u"cu'tgr tgugpvgf "d{ "vj g"hqto "qh'vj g'tqqv'y qtf " *Ej cmtcdqtv{ "gv'cn0"4235+0Ngo o cvk| cvkqp"ku'wugf "y kj "uvgo o kpi "vq "kf gpvkh{ "tqqv'ngzkecn" eqo r qpgpvu"kp"y qtf u'vq "tgf weg"vj g"eqo r ngzkv{ "qh'c"f qewo gpv'y kj qwv'c"mquu"qh" kphqto cvkqp"*Ej cmtcdqtv{ "gv'cn0"4235+0RQU"vci i kpi "ku"vj g"r tqegf wtg"kp"y j kej "gcej "vqmgp" qt"y qtf "kp"c"ugpvgpeg"ku"ncdgngf "y kj "vj g"cr r ncecdng"r ctv'qh'ur ggej ."uwej "cu'pqwp."xgtd." cf lgevkxg."cf xgtd."gve0"Vj g"vgzv'r ctukpi "uvgr "cnuq "kpenwf gf "gz vtcevkqp."engcpkpi ."cpf "

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" Vj g"vgzv"r ctukpi "r tqeguu"go r nq{gf "vj g"wug"qh"c"uvqp "rkuv."y j ej "ku"c"f cvcugv"qh"

vgto u'qeewttkpi "uq"htgs wgpvn{"vj g{"f q"pqv"cf f "xcnwg"kp"vj g"kf gpvkhkecvkqp"qh"vqr keu"cpf "ecp"

yj wu"dg"gzenwf gf "htqo "vj g"r ctukpi "tguwmu"*Dcpmu"gv'cn0"423: +0C"f ghcwnv"vqr "rkuv"uwr r rkgf "

d{"UCUᵀ "GO ᵛᵒ "eqpvckpkpi "eqo o qp"y qtf u'kp"vj g'Gpi rkuj "ncpi wai g"cpf "kpenwfkpi "r ctVqh/

ur ggej "*RQU+'vci u'y cu"wugf "cu'cp'kpkvkcn'uvqr "rkuv0Rgthqto cpeg"qh'vj g'uvqr "rkuv'y cu"

qr vko k| gf "d{"o qfkf{kpi "vj ku'dcug"rkuv'd{"o cpwcn{"cff kpi "cpf "tgo qxkpi "y qtf u'cpf "d{"

tgo qxkpi "RQU"vci u0Gfkkpi "qeewttgf "qxgt"o wnkr rg"kvgtcvkqpu"vq"kpenwf g"cff kkqpcn'vgto u"

yj cv'eqpvckpgf "kuwg"tgngxcpv'kphqto cvkqp"qt"y gtg"gzvtcpgqwu"vq"vj g"vgzv'o kpkpi "i qcn'cu"vj g"

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Cu'eqphko to gf "d{"\ kr h"*P gy o cp."4227+."vj g"htgs wgpe{"kp"y j kej "y qtf u'cr r gct"kp"

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tguwmu'r ci g"qh'UCUᵀ "GO ᵛᵒ "cpcn{ugu0Vj wu'htgs wgpvn{"qeewttkpi "y qtf u"j cv'fkf "pqv'

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r qy gt"tgs wktgo gpvu"*Dcpmu"gv'cn0"423: +0Vj g'kvgtcvkxg"r tqeguu"qh'f gxgnqr kpi "vj g"uvqr "rkuv'

kpenwf gf "tgo qxkpi "ur ctug"vgto u'y j ej "y gtg"kphtgs wgpvn{"wugf "cpf "f kf "pqv'eqpvtkdwvg"vq"

yj g"kf gpvkhkecvkqp"qh'vqr keu'cpf "kpenwf gf "y qtf u'uwej "cu'1wo r "ugcv.'1wo r ugcvgt."cpf "1wo r "

ugcvgtu0"

"

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wpko r qtvcpv'vgto u."cmoy kpi "qpn{ "vj g'o quv'tgngxcpv'vgto u'eqpvckpkpi "xcnwcdng"

kphqto cvkqp"vq 'dg'kpenwf gf "kp'vj g'cpcn{uku'*UCU .'423; +0'Vj g'Vgzv'Hknvgt"pqf g'wugf "c"

y gkij vgf "vgto /d{/f qewo gpv'o cvtkz "vq "cpcn{ g'cpf "grko kpcvg"vgto u'vj cv'f kf "pqv'eqpvtkdwg"

xcnwg"kp'vj g'f gxgnqr o gpv'cpf "kf gpvkhecvkqp"qh'vqr keu0'Vj g'vgto u'cr r gctkpi "nguu'htgs wgpvn{ "

y gtg'cuuki pgf "j ki j gt"y gki j vu'dgecwug'vj g{ 'dgwgt"f khhgtgpvkcvg"vj g'pcttcvkxgu'kp'vj g"

f cvcugv."y j kng"vgto u'cr r gctkpi "o qtg'htgs wgpvn{ 'ctg'cuuki pgf 'j ki j gt"y gki j vu'dgecwug"vj g{ "

dgwgt"f guetkdg"vj g'pcttcvkxgu'*Ej ctcdqtv{."4235+0"

Vj g'vgto /d{/f qewo gpv'o cvtkz "wugu'vj gug'y q'y gki j vu."vj g'htgs wgpe{ 'y gki j v."qt"

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ecmgf "vj g'i nqdcn'y gki j v0'Vj g'htgs wgpe{ 'y gki j v'tcpuhqto u'vj g'htgs wgpe{ 'qh'vj g"

qeewttgpeg'qh'vj g'y qtf "kp'vj g'pcttcvkxg'wukpi "c'y gki j vkpi "hwpevkqp."y j gtgcu'vj g'vgto "

y gki j v'ku'cuuki pgf "dcugf "qp'vj g'qxgtcm'htgs wgpe{ 'cpf "vj g'pcttcvkxg'htgs wgpe{ "

*Ej ctcdqtv{ 'gv'cn0'4235+0'Wugf "qi gvj gt."vj g'y gki j vkpi "o gj qf u'kp'vj g'o cvtkz 'kf gpvkh{ "

ko r qtvcpv'vgto u'vj cv'ecp'f khhgtgpvkcvg"vj g'pcttcvkxgu'htqo "gcej "qvj gt0"

Text Cluster. Vgzv'o kpkpi "o c{ 'cmq "kpenwf g'enwuvgtkpi ."encuukhecvkqp."cpf "

cuuqekcvkqp'cpcn{uku'vq "kf gpvkh{ 'vgto u'qt "qr keu'cuuqekcvgf "y kj "vj g'qeewttgpeg'qh'hwo g"

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f khhgtgpv'f cvc'r qkpvu'kpvq "uwdi tqwr u'qh'uko knct'f cvc."y j ej "ctg'ecmgf "enwuvgtu."y j kng"

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ugxgtcn'V{ r gu'qh'enwuvgtkpi ."f gr gpf kpi "qp'vj g'cttcpi go gpv'cpf "xkgy u'qh'vj g'enwuvgtu=cm'

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encuukhkgf "ceeqtfkpi "vq"yj g"twngu'qt "wukpi "c"o cej kpg"ngctpkpi /dcugf "crr tqcej "yj gtg"yj g"

encuukhkecvkqp"ecvgi qtkgu"ctg'f ghkpgf "d{ "yj g"uco r ng"f cvc"cpf "gcej "f cvc'r qkpv'ku"encuukhkgf "

d{ "kv"*Lq."423: +0'Cuuqekcvkqp"kpxqnxgu"gzvtcevkpi "cuuqekcvkqpu"qh'f cvc'r qkpvu"kp"yj g"hqto "qh"

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yj kej "ctg"i kxgp"cu"yj g"kh/yj gp"tgur qpugu"ctg"i gpgtcvgf "cu"yj g"qwr w"*Lq."423: +0'Cu"uj qy p"

kp"Hki wtg"4."yj g"vgzv"r ctukpi ."hknvgtkpi ."vtcpuhqto cvkqp."vqr ke"kf gpvkhkecvkqp."cpf "vgzv"

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qr vko cn"vgzv"enwuvgt"tguwnv0"

Text Topic. Wug"qh'yj g"Vgzv"Vqr ke"pqf g"y cu"o qtg"crr tqr tkcvg"yj cp"vgzv"enwuvgtkpi "

hqt"gzr nqtkpi "CUTU'pctrcvkxgu'hqt"ugxgtcn'tgcuqpu0'Vj g'pctrcvkxgu'hqt"gcej "gxgpv"y gtg"

eqo dkpgf "kpvq"qpg"xctkcdng"hqt"vgzv"o kpkpi "cpf "gzvtcevkqp"qh'xctkcdngu"hqt"yj g"o qf gnkpi "

r tqeguu0'Vj ku'kpetgcugf "yj g"qr r qtwpkkgu"hqt"c"xctkgv{ "qh'vgto u"cpf "vqr keu"kp"yj g"xctkcdng"

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kpetgcugf "crr tqcej "ur ggf "f wg"vq"gzr gf kvgf "r tqegf wtgu"vq"ncpf "cp"cktetchv'y kj "c"ecdkp"

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yj go gu"gzkuv'kp"yj g"tgr qrv0'Hqt"c"i qcn'qh'qpn{ "vqr ke"gzr nqtcvkqp."vgzv"enwuvgtkpi "o c{ "

r tqxkf g"o qtg"uugfwn'tguwnu'kh'yj g"pctrcvkxgu'htqo "gcej "tgr qrv'ctg"cpcn{| gf "kpf kxkf wcm{ "vq"

r tqxkf g"cf f kkqpcn'qr r qtwpkkgu"vq"kf gpvkh{ "vgto u"cpf "vqr keu0"

Data Mining. "Fcvc"o kpkpi "ku"\$yj g"r tqeguu"qh"hkpf kpi "cpqo cnkgu."r cwgtpu"cpf "

eqttgncvkqpu"y kj kp"ncti g"fcvc"ugvu"vq"r tgfkev"qwveqo gu0"*UCU]"."423; c."Fcvc"O kpkpi "

ugevkqp."r ctc03+0'Rtgfkevkxg"o qfgnkpi "gpvcknu"yj g"crrnkecvkqp"qh"c"uvcvkuvkecnlo qfgnlqt"c"

fcvc"o kpkpi "cni qtkj o "vq"fcvc"vq"r tgfkev"wpmpqy p"hwwxtg"qdugtxcvkqpu"*Uj o wgnk "4232+0'

Fcvc"o kpkpi "vgej pkswgu"y gtg"wugf "kp"yj ku"uvwf{ "vq"cpcn{ g"tgr qtvu"qh"gxgpvu"kp"yj g"CUTU"

fcvcdcug"vq"f gxgnqr "o qf gnu"hqt"yj g"kf gpvkhecvqp"qh"hcevqtu"cuuqekcvgf "y kj "hwo g"gxgpvu0'

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Vj ku"uvwf { "hqmqy gf "yj g"UGO O C "r tqeguu"wukpi "cr r tqr tkcvg"uqhwy ctg"hqt"gcej "

cpcn{uku0'Vj g"UGO O C "r tqeguu"kpenwf gf "uco r nkpi ."gzr mtkpi ."o qf kh{kpi ."o qf gnkpi ."cpf "

cuuguukpi "uvgr u."uqo g"qh"y j kej "o c{"dg"tgr gcvgf "ugxgtcn'ko gu"dghqtg"yj g"eqo r ngvkqp"qh"

yj g"cpcn{uku0'Vj ku"r tqeguu"ku"f kur nc{gf "kp"Hki wtg"60'

Figure 4

The SEMMA Process

Sample   Sampling

Explore   Data visualization   Classification, Clustering

Modify   Variable selection, creation   Data transformation

Model   Decision Tree   Logistic Regression   Random Forest   Gradient Boosting

Assess   Model assessment

"
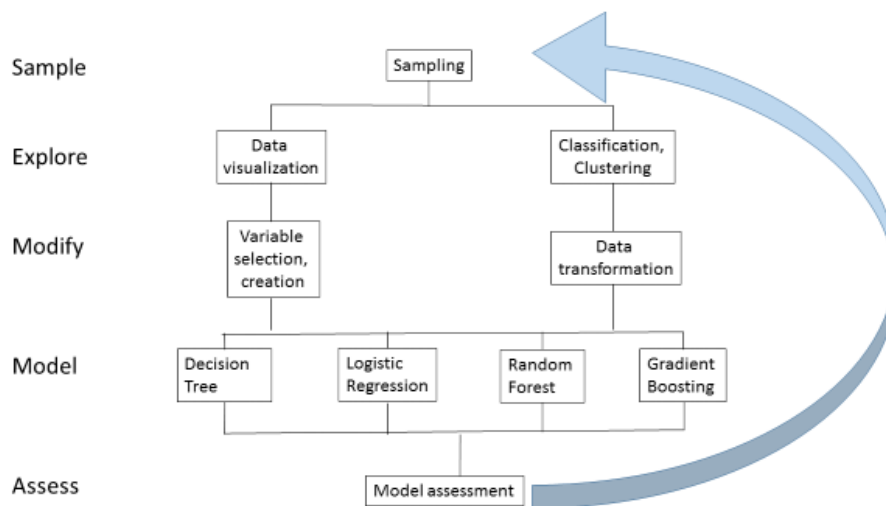
Note."Cfcrvgf"htqo"*$*Introduction to SEMMA,*"htqo"UCU³"Kpuvkwg."Kpe0*4242."Octej"3:0

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"

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Kp"vj g"O qfgn"uvgr."uwr gtxkugf "ngctpkpi "cni qtkj o u"y gtg"wugf "kpenwfkpi "fgekukqp"
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gxgpvu"y j kej "ctg"tgrqtvgf "vq"dg"hwo g"gxgpvu0Vj g"Gzegń "hkng"y cu"wrnqcfgf "kpvq"UCŮ "
GO VO "cpf "hqnnqy gf "vj g"rtqeguugu'fgxgnqr gf "d{"UCŮ "hqt'fcvc"o kpkpi "cpf "eqpuvtwevkpi "
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"

Dghqtg"fgxgnqrkpi "vjg"oqfgnu."vjg"ctigv"xctkcdngu"ygtg"rtqhkngf "wukpi "vjg"UCU^3 "

Cuuguu"hwpevkqp"vq"tgfweg"fkogpukqpcnkv{"d{"tgoqxkpi "tgfwpfcpv'xctkcdngu"cpf "xctkcdngu"yjkej "ctg"pqv'tgngxcpv'vq"vjg"ctigv'xctkcdngu0'Kp"vjg'Cuuguu'uvgr ."vjg"qwequ gu"qh'vjg"oqfgnu"ygtg"eqorctgf "cpf "gxcnwcvgf "hqt"tgnkcdknkv{"cpf "xcnkfkv{0Cuuguuo gpv'qh'vjg"tguwnu"htqo "vjg"vtckpkpi ."xcnkfcvkqp."cpf "vguv'oqfgnu"y cu'rtkoctkn{"eqpukfgtgf "cp"cuuguuo gpv'kp'tgnkcdknkv{."cpf "oqfgn'xcnkfkv{"y cu'gxcnwcvgf "wukpi "okuencuukhkecvkqp"tcvg"vq"fgvgtokpg"oqfgn'ceewtce{="tgegkxgt"qrgtcvkpi "ejctv'ewtxgu'cpf "rkhv'ejctu"y gtg"wugf "vq"fgvgtokpg"oqfgn'rtgfkevkxg'r qy gt0"

Wukpi "vjg"CUUU'fcvcdcug."vjg"fgxgnqro gpv'qh'vjg"oqfgnu"wugf "fcvc'htqo "gxgpu"yjcv'jcxg'tguwngf "kp"vjg"tgrqtvkpi "qh'vjg"kpekfgpeg"qh'WCS "cpf "hwo g"gxgpu0Oqfgnu"ygtg"fgxgnqrgf "dcugf "qp"hcevqtu"cuuqekcvgf "y kj "vjg"vjtgg"ngxgnu"qh'vjg"ctig v'xctkcdng<"gxgpu"yjcv'ctg"pqv'tgncvgf "vq"WCS ."gxgpu"yjcv'ctg"tgncvgf "vq"WCS "dwv'ctg"pqv'hwo g"gxgpu."cpf "gxgpu"yjcv'ctg"tgrqtvgf "vq"dg"hwo g"gxgpu0Xctkcdngu"gzvtcevgf "htqo "vjg"vgzv'okpkpi "r tqeguu"y gtg"wknk|gf "cu"kpr wv'xctkcdngu"cpf "y gtg"kpenwfgf "y kj "vjg"c'r tkqtk'swcpvkvcvkxg"xctkcdngu"htqo "vjg"CUUU'fcvcugv."yjkej "y gtg"r tko ctkn{"ecvgi qtkecn0'C "nkuv'qh'vjgug"gzr gevgf "xctkcdngu"ku"hqwpf "kp"Vcdng"90"

"

Table 7

A Priori ASRS Variables and Their Attributes for Model Development

Xctkcdng""	Xctkcdng"V{rg"	Xctkcdng"" Uecng"	Fguetkrvkqp"
Nqecn"Vko g"	Kprw"	Qtfkpcn"	Nqecn"vko g"kp"6"8"j qwt" dnqemu."kp"46/j qwt"enqem<" 2223/2822" 2823/3422" 3423/3: 22" 3: 23/4622"
Cnkkwfg" "	Kprw"	Kpvgtxcn"	Ukpin ng"xcnwg."kp"o gcp"ugc" ngxgn"hggv"
Cktetchv'O cmg1" O qfgn'	Kprw"	Pqo kpcn"	O cmg"cpf "o qfgn'qh'yj g" cktetchv'kpxqnxgf "*g0 0"D959/ : 22.'C543+"
O kuukqp"	Kprw"	Pqo kpcn"	Rwtr qug"qh'yj g'hnki j v'*g0 0" ecti q.'r cuugpi gt+"
Hnki j v'Rj cug"	Kprw"	Pqo kpcn"	Rj cug"qh'cktetchv'hnki j v'y j gp" yj g"gxgpv'y cu'f gvgevgf "*g0 0' vczk'r ctngf ."vcmgqhh."erko d." etwkug+"
Cktur ceg"	Kprw""	Pqo kpcn'	Cktur ceg"yj g"cktetchv' qeewr kgf "y j gp"yj g"gxgpv' qeewttgf "*g0 0"Encuu'C.'D.'E." F.'G.'I +"
Cktetchv' Eqo r qpgpv'	Kprw"	Pqo kpcn'	Eqo r qpgpv'f gvgto kpgf "vq"dg" tgur qpukdng"hqt"yj g"gxgpv'cu" eqf gf "d{"cpcn{uv'*g0 0' gpi kpg.'cwzknkct{'r qy gt'wpkv.' ckt"eqpf kkqpkpi +"
Eqo r qpgpv' Rtqdngo "	Kprw"	Pqo kpcn'	Tgcuqp"hqt"yj g'r tqdngo "y kyj " yj g"eqo r qpgpv'*g0 0f guki p." hcknwtg."o cnhwpevkqp+" " " " " "

Xctkcdng"	Xctkcdng"V{r g"	Xctkcdng" Uecng"	F guetkr vkqp"
Cpqo cn{"	Kpr w"	P qo kpcn"	Cpqo cn{"ecvgi qt{"ku"cp" gxgpv'V{r g"cu"eqf gf "d{" cpcn{uv"*g0 0"cktetch/' gs wkr o gpv'r tqdngo ."hki j v' f gemlecdkp lcktetch/'gxgpv+"
Y gtg"Rcuugpi gtu" Kpxqnxgf "kp"Gxgpv"	Kpr w" "	P qo kpcn"	Rcuugpi gt"kpxqnxgo gpv'kp"\j g" gxgpv<{ gu"*3+"qt"P q"*2+"
F gvgevqt"	Kpr w"	P qo kpcn"	Gpvkt{"tgur qpukdng"hqt" f gvgevkqp"qh'\j g"gxgpv'cu" eqf gf "d{ "cpcn{uv"*g0 0" r gtuqp"hki j v'etgy ."r gtuqp" q\j gt."cwwqo cvkqp"cktetch/+"
Eqpvtkdwvkpi " HcevqtulUkwwcvkqpu"	Kpr w"	P qo kpcn"	Hcevqtu"\j cv'eqpvtkdwvgf "vq" \j g"gxgpv'cu"eqf gf "d{ 'CUTU" cpcn{uv"*g0 0"cktetch/.j wo cp" hcevqtu."gpxktqpo gpv+"
Rtko ct{"Rtqdngo "	Kpr w"	P qo kpcn"	Rtko ct{"r tqdngo "y j kej " eqpvtkdwvgf "vq"\j g"gxgpv'cu" eqf gf "d{ 'CUTU'cpcn{uv"*g0 0" cktetch/.j wo cp'hcevqtu." eqo r cp{"r qnke{+"

Sources of the Data"

Vj ku"uwf { "wugf "eqpvgpv'cpcn{uku"qh'ugeqpf ct {"ctej kxcn'f cvc"hqwpf "kp"\j g"CUTU"

f cvcdcug"*j wr u<llcutu0ctefpcuc0 qx lugctej lf cvcdcug0) wo n+0'Vj g"CUTU'f cvcdcug"eqpvckpu"

qxgt "308"o knkqp"xqnwpvctkn{ "uwdo kwgf "eqphkf gpvkcn'tgr qtwu"htqo "r knqwu."hki j v'cwgpf cpwu."

o ckpvckpgtu."ckt "vtchhke"eqpvtqngtu."cpf "q\j gtu"*CUTU."423; +0'Vj gug"tgr qtwu"eqpvckp"

s wcnkvcvkxg"cpf "s wcpvkvcvkxg"f cvc"uwdo kwgf "d{ "tgr qtvgtu"cpf "eqf gf "d{ "cpcn{uwu"\q"r tgxgpv'

cxkcvkqp"ceekf gpwu"d{ "kf gpvkh{kpi "f ghkekgpekgu"cpf "f kuetgr cpekgu."uwr r qtvkpi "r qnkekgu"cpf "

r ncppkpi "\q"ko r tqxg"\j g"pcvkqpcn'cxkcvkqp"u{uwo ."cpf "uvtgpi \j gpkpi "\j g"hqwpf cvkqp"qh'

cxkcvkqp'j wo cp'hcevqtu'tgugctej "*CUTU."p0f 0c+0'Chvgt'tgr qtwu"ctg"tgegkxgf ."\j g{ "ctg"tgcf "

d{ "\j g"cpcn{uwu."cevgf "wr qp"kh'pgeguuct{."encuukhkgf "cpf "eqf gf ."cpf "f gkf gpvkhkgf "cpf "

"

kpeqtrqtcvgf "kpvq "yj g"fcvcdcug"yjkej "ku"rwdnkely "ceeguukdng0'Vj g"fcvcdcug"ku"ugctej cdng."

hqt "yj ku"uwuf{ "yj g"ugctej "vgto u"wugf "y gtg"yj g"fcvg"qh"yj g"kpekf gpv"*Lcpwct{ "3."4237"vq "

Fgego dgt "53."423; +."Hgfgtcn'cxkcvkqp'tgiwncvkqpu"*Rctv"343+."cpf "tgrqtvgt "hwpevkqp"*hnki j v"

cwgpfcpv"cpf "hnki j v"etgy ."cmn'r qukkqpu+0Tgrqtvu"ctg"cxckncdng"kp"Gzegn¹."eqm m c/"

ugrctcvgf "xcnwgu"hkngu."qt "Y qtf "hkngu"cpf "y gtg"fqy pqcfgf "kp"Gzegn¹0Chvgt "fcvc"engcpkpi "

y cu"eqpfwevgf."yj g"hkngu"y gtg"eqpxgtvgf "kpvq "UCU¹ "hkngu"wukpi "UCU¹ "Uwfkq0"

Vj g"fcvcdcug"eqpvckpu"; 8 "rqvgpvkcn'xctkcdngu."kpenwfkpi "s wcpvkvcvkxg"hlki j v"

fcvc."c"htgg/vgzv"pcttcvkxg"rtqxkfgf "d{ "yj g"tgrqtvgt."cpf "c"vgzvwcn'u{pqruku."cu"uwm m ctk{ gf "

d{ "cp"cpcn{uv0UCU¹ "Vgzv"Okpgt "uqhvy ctg"y cu"wugf "vq "kfgpvkh{ "uki pkhkecpv'xctkcdngu"

cuuqekcvgf "y kj "hwm g"gxgpvu"htqm "yj g"pcttcvkxg"vgzv"hkngu."yj kej "y gtg"eqm dkpgf "y kj "

r gtvkpgpv"s wcpvkvcvkxg"hlki j v'xctkcdngu"vq "fgxgnqr "cpf "vguv'yj g"m qfgmu"wukpi "UCU¹ "GO VO 0'

Vj gug"xctkcdngu"kpenwfgf "dwv'y gtg"pqv'ko kvgf "vq "tgrqtvgr rqukvkqp."m cmg"cpf "m qfgn'qh"

cktetchv."rj cug"qh"hlki j v."gxgpv'v{r g."cpf "rtko ct{ "rtqdngm 0C "nku v'qh"c "rtkqtk'rtqr qugf "

xctkcdngu"cpf "yj gkt "cwtkdwvgu"ku"hqwpf "kp "Vcdng "90"

Ethical Consideration

Vj g"fcvc"uqwteg "wugf "kp "yj ku "tgugctej "kpenwfgf "ctej kxcn'fcvc"rtqxkfgf "qp "c"

rwdnkely "ceeguukdng "y gdukg0Cpcn{uku "cv'P CUC'j cxg "fgkfgpvkhlgf "yj g"fcvc"dghqtg "

kpenwukqp "kp "yj g"fcvcugv'*CUTU."p0f0f 0+0P q "j cm "qt "j wo cp "uwdlgevu "qeewttgf "cu "c "tguwn'qh"

yj ku "tgugctej 0Kp "ceeqtfcpeg "y kj "yj g"Go dt{/Tkffng "Cgtqpcwkecn'Wpkxgtukv{ "Kpukwkqpcn'

Tgxkgy "Dqctf "fghlpkkqp "*4243+."yj ku "tgugctej "ku "encuukhlgf "cu "gzgo r v'htqm "tgxkgy "cu "kv'ku "

ugeqpfct{ "tgugctej "cpf "yj g"r ctkekr cpuø'tgeqtfgf "kphqtm cvkqp 'ecppqv'dg "cuegtckpgf "

fktgevn{ "qt "yj tqwi j "kfgpvkhlgtu "nkpmgf "vq "yj g"r ctkekr cpu0Vj ku "uwf{ "fkf "pqv'kpxqnxg "fcvc"

eqmgevkqp'htqm "j wo cp "uwdlgev'vguvkpi "qt "gzr gtko gpvcvkqp."yj g"fgkfgpvkhlgf "fcvc"ku"

"

r wdrken{"cxckncdng."cpf "yj g"tgugctej gt"j cu"o cf g"pq"cwgo r v"vq"eqpvcev"qt"kf gpvkh{"yj g"

r ctvkekr cpvu. "yj wu"cr r tqxcn"htqo "cp"kpuvkwwkqpcn"tgxkgy "dqctf "y cu"pqv"tgs wktgf 0"

Data Analysis Approach

F guetkr vkxg"uvcvkuvkeu"y gtg"wugf "vq "tgxkgy "cpf "uwo o ctk| g"yj g"f cvc0"Vj g"r tqeguu"

uwi i guvgf "d{ "Ej cmtcdqtv{ "gv"cn0*4235+"y cu"wugf "hqt "yj g"f cvc"o kpkpi "uvgr "qh"yj ku"uvwf { "

cpf "kpenwf gf <"f cvc"eqmgevkqp."vgz v"r ctukpi "cpf "vtcpuhqto cvkqp."vgz v"hkmgtkpi ."cpf "vgz v"

o kpkpi 0"Vj g"UGO O C"r tqeguu"y cu"hqmqy gf "hqt "yj g"f cvc"o kpkpi "uvgr u"cpf "eqpukuvgf "qh"yj g"

hqmqy kpi "uvgr u<"uco r ng."gz r nqtg."o qf kh{."o qf gn"cpf "cuuguu0Dcuke"cpcn{uku"qh"yj g"

xctkcdngu"hqt "qwvrkgtu."o kuukpi "xcnwgu."cpf "f kuvtkdwvkqp"vqqm"r nceg"wukpi "yj g"UCUÌ "Gz r nqtg"

hwpevkqp"cpf "ku"tgr qtvgf 0"Nko kvgf "vtcpuhqto cvkqp"qh"xctkcdngu"qeewttgf "cu"pggf gf "kp"yj g"

O qf kh{ "uvgr 0"O qf gnu"y gtg"f gxgnqr gf "cpf "vguvgf "dcugf "qp"hcevqtu"cuuqekcvgf "y kyj "yj g"

yj tgg"ngxgnu"qh"yj g"cti gv"xctkcdng<"gxgpvu"yj cv"ctg"pqv"tgncvgf "vq"WCS ."gxgpvu"yj cv"ctg"

tgncvgf "vq"WCS "dwv"ctg"pqv"hwo g"gxgpvu."cpf "gxgpvu"yj cv"ctg"tgr qtvgf "vq"dg"hwo g"gxgpvu0"

O cej kpg"ngctpkpi "cni qtkyj o u"y gtg"wugf "vq"f gxgnqr "yj g"o qf gnu"cpf "kpenwf gf "f gekukqp"vtgg."

i tcf kgpv"dqquvkpi ."nqi kuvke"tgi tguukqp."cpf "tcpf qo "hqtguv"cni qtkyj o u."cpf "ctg"f guetkdgf "kp"

yj g"hqmqy kpi "r ctci tcr j u0"

Decision Tree

Vj g"F gekukqp"Vtgg"pqf g"kp"UCUÌ "GO [VO] "y cu"wugf "vq "f gxgnqr "o qf gnu0F gekukqp"

vtgg"pqf gu"o c{ "tgr tgugpv"ugr ctcvg"encuugu"qh"kpf kxkf wcnu"hqt "ecvgi qtkecn"xctkcdngu. "tcpi gu"

hqt "eqpvkpwqwu"xctkcdngu. "qt "c"ukpi ng"ugr ctcvkqp"eqpf kkqp"hqt "dkpct{ "xctkcdngu0Gcej "qh"yj g"

ngcxgu"ku"eqo r qugf "qh"c"ukpi ng"encuu"qh"kpf kxkf wcn0Cp"kpf kxkf wcn"kp"c"ngch"y km"j cxg"c"

tgcuqpcdn{ "j ki j "r tqdcdknkv{ "qh"eqphqto kpi "vq"cm"yj g"twngu"cr r nkgf "vq"yj g"pqf gu"ngcf kpi "vq"

yj ku"ngch0Vj g"o qf gn"ku"yj gp"hqto gf "d{ "yj g"ugv"qh"twngu"cr r nkgf "vq"cm"yj g"pqf gu"cpf "gpf kpi "

kp''ngcxgu0'F gekukqp''tggu'kp''UCÙ ''GO VO ''ctg''cwwo cvecm{''tckpgf''cpf ''r twpgf ''wukpi ''yj g''

mqi y qtyj ''cni qtkyj o ''*Vtwqpi .''4238+='j qy gxgt.''cwwo cvec''uvgr u''ecp''dg''qxgttkf f gp.''cpf ''

ur nkvkpi ''cpf ''r twpkpi ''twngu'm c{''dg''f ghkpgf ''*UCÙ .''p0f 0+0'

Vj g''wug''qh'f gekukqp''tggu''ku''cp''cr r tqr tkcvg''cr r tqcej ''hqt''yj ku''uvwf {.''cu''yj g{''r tqxkf g''

c''tgr tgugpvcvkqp''qh'yj g''r tgugpeg''qh'tgncvkqpuj kr ''cwtgpu''dgw ggp''yj g''vcti gv''xctkcdngu''cpf ''

kpf gr gpf gpv'xctkcdngu0'Vj g''ugr ctcvkqp''etkvgtkc''y gtg''f gr gpf gpv''qp''yj g''v{r g''cpf ''r ctco gvgt''

ugwkpi ''qh'yj g''vtgg''cpf ''y gtg''dcugf ''qp''qpg''qh'yj g'y kf gn{''wugf ''qr vkqpu.''uwej ''cu''ej k/us wctg.''

I kpk''Vy qkpi .''qtf gtgf ''Vy qkpi .''qt''gpvtqr {''*VwHH?t{.''4233+0'Vj g''uvqr ''etkvgtkqp''y cu''cnuq''

f gr gpf gpv''qp''yj g''v{r g''cpf ''r ctco gvgt''ugwkpi u''qh'yj g''vtgg0'Ugwkpi u''y gtg''f gvgto kpgf ''dcugf ''

qp''yj g''eqf kpi ''qh'kpf gr gpf gpv'xctkcdngu0'Rtqr gtv{''ugwkpi u''kp''ur nkvkpi ''twngu.''pqf g'i tqwr .''

ur nkv'ugctej .''cpf ''uwdvtgg''y gtg''cf lwuvgf ''vq''kpenwf g''qr vko cn'o qf gu.''cpf ''yj g''vtggu''y gtg''

r twpgf ''cwwo cvecm{''kpkvkcm{''cpf ''cf lwuvgf ''cu''pggf gf ''hqt''qr vko cn'qwwr ww0''

Gradient Boosting

O wnkr ng''o qf gnu'y gtg''f gxgnqr gf ''wukpi ''yj g''i tcf kgpv'dqquvkpi ''cni qtkyj o ''cpf ''yj g''

I tcf kgpv'Dqquvkpi ''pqf g''kp''UCÙ ''GO VO ''vq''etgcvg''yj g''o quv'ceewtcvg''o qf gn0'Ceeqtf kpi ''vq''

Htkgf o cp''*4224+.''dqyj ''yj g''ceewtce{''qh'yj g''cr r tqzko cvkqp''cpf ''i tcf kgpv'dqquvkpi ''

eqo r wcvkqp''ur ggf ''ecp''dg''uwduvcpvkcm{''ko r tqxgf ''d{''kpeqtr qtcvkpi ''tcpf qo k| cvkqp''kpvq''yj g''

r tqegf wtg''d{''f tcy kpi ''c''uwduco r ng''*y kj qw'tgr ncego gpv+'qh'yj g''vtckpkpi ''f cvc'tcpf qo n{''cv'

gcej ''kvgtcvkqp0'Vj ku''tcpf qo n{''ej qugp''uwduco r ng''y cu''wugf ''kpuvgcf ''qh'yj g''gpvktg''uco r ng''vq''

hkv'yj g''dcug''ngctpgt''cpf ''dwknf ''yj g''o qf gn'vq''kpetgcug''yj g''tqdwuvpguu''qh'yj g''dcug''ngctpgt0'

Qr r qtwpkvkgu'hqt'qxgthkvkpi ''y gtg''o kpko k| gf ''d{''cf lwuvkpi ''yj g''uj tkpmci g''r ctco gvgt.''yj g''

f gr yj ''qh'yj g''vtggu.''cpf ''yj g''pwo dgt''qh'tggu''vq''r tqxkf g''qr vko cn'tgunwu'y kj qw'qxgthkvkpi 0''

"

Logistic Regression

Cu'\j g'\cti gv'xctkcdng'\j cu'\j tgg''gzxgm''qt''f kuetgvg''qwveqo gu.''o wnkpqo kcn'hqi kuvke''

tgi tguukqp''ku'cp''cr r tqr tkcvg''o gyj qf''hqt''kf gpvkh{kpi ''hcevqtu''cuuqekcvgf ''y kj ''gxgpvu'\j cv''ctg''

pqv'tgncvgf ''vq''WCS ='gxgpvu'\j cv''ctg''tgncvgf ''vq''WCS ''dwv''ctg'pqv''hwo g''gxgpvu='cpf ''gxgpvu''

\j cv''ctg''tgr qtvgf ''cu'hwo g''gxgpvu0'\j g'i qqf pguu''qh''hkv''qh'\j ku'o qf gn'\y cu''dcugf ''qp''j qy ''

y gm'\j g'o qf gn'hkv'\j g'\tckpkpi ''f cvc0'\j g''qxgtcm'gzr ncpcvqt{''r qy gt''qh'\j g'o qf gn'\y cu''

gxcnwcvgf ''kpkvkcm{.''\j gp''kpf kxkf wcn'r tgf kevqtu''y gtg''cuuguugf 0'Rtqr gtv{''ugwkpi u''kp''UCU⁴ ''

GO ᵛᴼ ''y gtg''f gvgto kpgf ''dcugf ''qp''\j g''eqf kpi ''qh''kpf gr gpgpv'xctkcdngu.''\j g'r tqr gtvkgu''

kpenwf gf ''kp''o qf gn'ugngevkqp.''qr vko k| cvkqp''qr vkqpu.''cpf ''eqpxgti gpeg''etkvgtkc''y gtg''ugngevgf ''

vq''gpuwtg'\j g''kpenwukqp''qh''cp''qr vko wo ''pwo dgt''qh''o qf gni0'

F kucf xcpvci gu''qh''nqi kuvke'\tgi tguukqp''kpenwf g'\j g'\tgs wktgo gpv'hqt''gzr ncpcvqt{''

xctkcdngu''vq''dg''nkpgctn{''kpf gr gpf gpv='kv''ku''c''pwo gtke''cr r tqzko cvkqp''cpf ''f qgu''pqv''cny c{u''

eqpxgti g''vqy ctf ''cp''qr vko cn'qwveqo g='kv''f qgu''pqv''j cpf ng''o kuukpi ''xcnwgu''qh''eqpvkpwqwu''

xctkcdngu='cpf ''kv''ku''ugpukvkxg''vq''gzvtgo g''xcnwgu''qh''eqpvkpwqwu'xctkcdngu''*Vwhh?t{.''4233+0'

Tgugctej ''uwi i guvu''f cvc'\j qwf ''eqpvckp''cv'\ngcuv''vgp''gxgpvu'hqt''gcej ''xctkcdng'gpvgtgf ''kpvq''c''

nqi kuvke'\tgi tguukqp''o qf gn'*Rgf w| | k'gv'cn0''3; ; 8+0'Vj gug''f kucf xcpvci gu''y gtg''cf f tguugf ''kp''

\j g''uvwf {''cu''hqmqy u<''\j g''o qf gn'\kf gpvkhkgf ''ecvgi qtkecn'qwveqo gu.''gzr ncpcvqt{''xctkcdngu''

y gtg'\kf gpvkhkgf ''f wtkpi ''\j g'\gzv'o kpkpi ''uvgr ''cpf ''y gtg''nkpgctn{''kpf gr gpf gpv.''wug''qh''

eqpvkpwqwu''xctkcdngu''y cu''nko kvgf .''c''ncti g''pwo dgt''qh''ecugu''y gtg''wugf ''vq''vtckp''cpf ''xcnkf cvg''

\j g''o qf gn'cpf ''kpenwf gf ''cv''ngcuv''vgp''ecugu''hqt''gcej ''xctkcdng0''

Random Forest

Tcpf qo ''hqtguv'o qf gni''y gtg''f gxgnqr gf ''wukpi ''\j g'Tcpf qo ''Hqtguv''pqf g''kp''UCU⁴ ''

GO ᵛᴼ 0Tcpf qo ''hqtguvu''ctg''cp''ghhgevkxg''r tgf kevkxg''vqqn'cpf ''\j g''wug''qh''cr r tqr tkcvg''

tcpf qo pguu"cnqy u"hqt"ceewtcvg"encuukhkecvkqp"cpf "tgi tguukqpu"*Dtgko cp."4223+0"

Fkucf xcpvci gu"qh'tcpf qo "hqtguvu."uwej "cu"vj g'tkum'qh'qxgthkvvkpi "cpf "eqo r kecvgf "tguwnu"

y gtg"o kpko k| gf "d{"qr vko k| kpi "vj g"wpkpi "r ctco gvgt"y j kej "eqpvtqrgf "vj g"pwo dgt"qh"

tcpf qo n{"ej qugp"hgcwtgu"wugf "vq "i tqy "gcej "vtgg0"Vj ku"nko kvgf "qxgthkvvkpi "qh'vj g"o qfgn"

cpf "tguwnu"y gtg"qdugtxgf "hqt"c"j ki j "ngxgn'qh'ceewtce{"kp"vj g"vtckpkpi "fcvc"cpf "c"nqy "ngxgn"

qh"ceewtce{"kp"vj g"vguv'f cvc0Vj g"tgnkcdknkv{"qh"vj g"tguwnu"qh"o qfgnu"wukpi "tcpf qo "hqtguv"

cni qtkj o u"y cu"cuuguugf "ci ckpuv"vj qug"qh'qvj gt"o qfgnu."cpf "o qfgn'tguwnu"y gtg"xcnkf cvgf "

y kj "gxgpu"cewcn{"qeewttkpi "kp"vj g"cktrkpg"kpf wuvt{0"

Reliability Assessment Method

Tgnkcdknkv{"kp"f cvc"o kpkpi "o gj qf u"ku"uko knct"vq"vj cv'hqwpf "kp"s wcpvkcvkxg"f cvc"

cpcn{uku."y j gtg"tgnkcdknkv{"ku"eqttqdqtcvgf "kh'tguwnu"ctg"eqpukuvgpv'j tqwi j qw'tgr gvkkxg"

kpxguvki cvkqpu"wpf gt"f khhgtgpv'ektewo uvcpegu"d{"f khhgtgpv'kpxguvki cvqtu"*I kddu0"4229+0'Vq "

gxcnwcvg"vj g"tgnkcdknkv{"qh'vj g"o qfgn'cpf "vj g"qwr wu."ttckpkpi "tguwnu"cpf "xcnkf cvkqp"tguwnu"

y gtg"eqo r ctgf "co qpi "cm'o qfgnu0Kp"cf f kkqp."cp"cf gs wcvg"pwo dgt"qh'ttckpkpi "cpf "

xcnkf cvkqp"ecugu"y gtg"wugf "vq"gpcdrg"vj g"o qfgnu"vq"r tqf wce"eqpukuvgpv'tguwnu"qxgt"

tgr gcvgf "kgtcvkqpu0Vj g"o qfgn'y cu"vguvgf "wukpi "ugr ctcvg"f cvc="tguv'tguwnu"y gtg"eqo r ctgf "

y kj "xcnkf cvkqp"tguwnu"hqt"c"o gcuwtg"qh'tgnkcdknkv{."y j kej "ku"vj g"gzvgpv'vq"y j kej "vj g"o qfgn"

qt"cp{"o gcuwtkpi "r tqegf wtg"{kgrf u"vj g"uco g"tguwnu"y j gp"vj g"r tqeguu"ku"tgr gcvgf "

*O {tvgkv'gv'cn0"4227+0'Y j kng"vj g"r qvgpvkcn'hqt"kro kgf "tgnkcdknkv{"f wg"vq"vj g"wug"qh"

kpcr r tqr tkcvg"o qfgnu"*Ectnuqp"gv'cn0"4239+"y cu"c"eqpegtp."o qfgn'o qf khkecvkqp"f wtkpi "vj g"

kgtcvkxg"r j cugu"qh'vj g"o qfgnkpi "r tqeguu"qt"vj g"wug"qh'cp"gpugo dng"o qfgn'eqwrf "dg"

go r nq{gf "cu"pggf gf "vq"ko r tqxg"tgnkcdknkv{0Eqo r ctkuqp"qh'xcnkf cvkqp"cpf "vguv'f cvc"hqt"

gcej "qh'\j g"o qf gnu"{kgnf gf "uko knct 'tguwnu."cpf "\j g"hqwt 'Vqr /r gthqto kpi "o qf gnu'r tqf wegf "
uko knct 'tguwnu.'\j wu'o qf gn'tgnkcdknkv{'y cu'f gvgto kpgf "\q'dg'j ki j 0"

C 'r tko ct{ 'kphnwgpeg'qh'tgnkcdknkv{ 'ku'\j g's wcnkv{ 'qh'\j g's wcpvkcvkxg'f cvc 'hqwpf 'kp"
\j g'tgr qtu'uwdo kwgf "\q'CUTU0'Tgr qtvgtu'ctg'r tguwo gf "\q'tgr qtv'gxgpvu'\twj hwnn{ "cpf "
eqo r ngvgn{ "\q'\j g'dguv'qh'\j gkt 'nmqy ngf i g0'Tgr qtvu'ctg'eqphkf gpvkcn="cpcn{uu'f gkf gpvkh{ "
tgr qtvu'r tkqt 'tq'kpenwukqp'kp'\j g'r wdnke'f cvcdcug'**CUTU."p0f 0g+0'Vj gtg'ku'cp'kpegpvkxg'\q'
tgr qtv.'cu'\j g'HCC 'y ckxgu'hkpgu'cpf 'r gpcnkgu'hqt 'wpkpvgpvkqpcn'xkqncvkqpu'qh'cxkcvkqp"
tgi wncvkqpu'y j gp'\j g{ 'ctg'tgr qtvgf "\q'CUTU'**CUTU."p0f 0g+0"

Vj tqwi j "c'"jqkpv'ghhqtv'd{ 'kpf wuvt{."i qxgtpo gpv."cpf "kpf kxkf wcnu'\q'ko r tqxg"
cxkcvkqp'uchgv{.'CUTU'cpcn{uu'gzr gtkgpegf "kp'cxkcvkqp'eqnngev."cpcn{|g.'eqf g.'cpf "
tgur qpf "\q'cxkcvkqp'uchgv{ 'tgr qtvu'**CUTU."p0f 0c0+0'Vj gug'cpcn{uu'kpenwf g'j ki j n{ "
gzr gtkgpegf "r knqwu.'ckt 'vtchhke 'eqpvtqngtu."o gej cpkeu."cpf "c'o cpci go gpv'\gco "\j cv'r quuguu"
cxkcvkqp'j wo cp'hcevqtu'cpf "r u{ej qnqi {"tgugctej "gzr gtkgpeg'y kj "qxgt '422 'ewo wncvkxg"
{gctu'qh'cxkcvkqp'gzr gtvkug'**CUTU."p0f 0d+0'Vj wu."kv'ku'y kj kp'\j g'tgr qtvgt)u'dguv'kpvgtguv'cpf "
\j g'kpvgtguv'qh'uchgv{ "\q'tgr qtv'kpekf gpvu'cpf "ukwcvkqpu'y j kej "o c{ 'dg'cpcn{|gf .'eqf gf .'cpf "
wugf "\q'r tgxgpv'hwwtg'kpekf gpvu'cpf "ceekf gpvu'htqo "qeewttkpi 0"

Validity Assessment Method

Xcnkf cvkqp'qh'\j g'o qf gnu'f gxgnqr gf "qqm'r nceg'wukpi "\j g'O qf gn'Eqo r ctkuqp"
hwpevkqp'kp'UCU® 'GM^{VO} 'hqt '\j g'f gekukqp'\tgg.'i tcf kgpv'dqquvkpi .'nqi kuvke 'tgi tguukqp.'cpf "
tcpf qo "hqtguv'cni qtkjo u'\q'gpuwtg'\j g'o qf gnu'tgcej gf "'uwuhkhcdng'eqpenwukqpu'cpf "y gtg"
i gpgtcn{ cdng'cpf "tgnkcdng0'Eqo r ctkuqp'qh'\j g'tguwnu'htqo "\j g'ttckpkpi .'xcnkf cvkqp.'cpf "
vguv'o qf gnu'y cu'r tko ctkn{ "eqpukf gtgf "cu'cp'cuuguuo gpv'kp'tgnkcdknkv{ "dww'cnuq 'cp"
cuuguuo gpv'qh'xcnkf kv{0'O qf gn'xcnkf kv{ 'y cu'r tkpekr cm{ "gxcnwcvgf "wukpi "o kuencuukhkecvkqp"

"

tcvg"*O T+"hqt"o qf gn"ceewtce{"cpf "tgegkxgt"qr gtcvkpi "ej ctv"*TQE+"ewtxgu"cpf "rkhv"ej ctu"

hqt"o qf gn"r tgf kevkxg"r qy gt0"

O kuencuukhhecvkqp"tcvg"ku"y kf gn{"wugf "f wg"vq"vj g"gcug"kp"kpvgtr tgvcvkqp"cpf "

ko r ngo gpvcvkqp."vj g"cdknkv{"qh"r tqdcdknkv{/dcugf "etkvgtkc"vq"r tqxkf g"c"o qtg"eqpvkpwqwu"

o gcuwtg."cpf "vj g"kpf kecvkqp"qh"vj g"f gi tgg"qh"wpegtvckpv{"y kj "y j kej "r tgf kevkqpu"j cxg"dggp"

o cf g"*O cngf"gv"cn0"4222+0"Ceeqtf kpi "vq"Vtwqpi "gv"cn0"*423: +."vj g"O T"ecp"dg"wugf "vq"

cuuguu"vj g"xcnkf cvkqp"ceewtce{"qh"vj g"r tgf kevkqp0Cu"vj g"cwj qtu"uvcvg"$vj g"o kuencuukhhecvkqp"

tcvg"?"3"ó"xcnkf cvkqp"ceewtce{"$"*r 0'59+."qy gt"O T"kpf kecvgu"j ki j gt"xcnkf cvkqp"ceewtce{0'

Vj g"o qf gn"y kj "vj g"nqy guv"O T"kpf kecvgf "vj g"o qf gn"y kj "vj g"o quv"ceewtce{"kp"kf gpvkh{kpi "

hcevqtu"cuuqekcvgf "y kj "hwo g"gxgpvu0Vj g"qxgtcnn"r tgf kevkqp"ceewtce{"ecp"dg"ecnewncvgf "cu"

vj g"vqvcn"ceewtcvg"r tgf kevkqp"f kxkf gf "d{"vj g"vqvcn"pwo dgt."qt"qpg"o kpwu"vj g"

o kuencuukhhecvkqp"tcvg"*Vtwqpi "("Ej qk"4242+0Ceewtce{"ku"f ghkpgf "cu"vj g"r tqr qtvkqp"qh"

vj g"uvwf {"r qr wncvkqp"y j kej "ku"f gvgto kpgf "eqttgev{"*O gv| ."3; 9: +"cpf "ku"uj qy p"kp"vj g"

hqto wnc"dgnqy 0Vj g"vtwg"r qukkxgu."vtwg"pgi cvkxgu."hcnug"r qukkxgu."cpf "hcnug"pgi cvkxgu"

y gtg"cf luwgf "vq"ceeqo o qf cvg"vj g"vj tgg"ngxgnu"qh"vj g"cti gv"xctkcdng0"

""""""""""""VR"- "VP "'''''''aaaaVR"- "VP aaaaa"
CEE"? ""R"- "P """"? """VR"- "VP "- "HR"- "HP "

y j gtg<"

R"? "r qukkxg"

P "? "pgi cvkxg"

HR"? "hcnug"r qukkxg"

HP "? "hcnug"pgi cvkxg"

VR"? "vtwg"r qukkxg"

VP "? "vtwg"pgi cvkxg"

"

TQE"ewtxgu"y gtg"wugf "vq"cuuguu"urgekhkekv{"cpf "ugpukvkxkv{."y kj "ugpukvkxkv{"

tghngevkpi "yj g"rtqdcdknkv{ "qh'eqttgevn{"f gvgevkpi "c"hwo g"gxgpv'cpf "urgekhkekv{"tghngevkpi "yj g"

rtqdcdknkv{ "qh'eqttgevn{"kf gpvkh{kpi "c"pqp/hwo g"gxgpv"*Vwhh?t{."4233+0'Ugpukvkxkv{."qt"yj g"

rtqdcdknkv{ "qh'c"hwo g"gxgpv'dgkpi "eqttgevn{"kf gpvkhkgf "cu'c'vtwg'rtgf kevkxg'r qukvkxg."ku"

gzrtguugf "cu<

"""""""""a VRa"""""aa VRaaa"
VR"? ""R"""? ""VR"- "HP "? "3/HP "
"

y j gtg<

VR"? "vtwg"r qukvkxg"

HP "? "hcnug"pgi cvkxg"

Vj ku'ku"kp"eqpvtcuv'vq"urgekhkekv{."y j kej "ku"yj g"rtqdcdknkv{ "qh'pq"hwo g"gxgpv."y j kej "

ku'c'pgi cvkxg"r tgf kevkxg'xcnwg"qt"c"vtwg'pgi cvkxg."cu"uggp"kp"yj g"hqmqy kpi "hqto wnc<

"""""""""a VP a"""""aa VP aaa"
VP "? "P """? ""VP "- "HR"""? ""3/HR"
"

y j gtg<

P "? "pgi cvkxg"

HR"? "hcnug"r qukvkxg"

VP "? "vtwg"pgi cvkxg"

HR"? "hcnug"r qukvkxg"

C"hcnug"r qukvkxg"qeewtu"y j gp"c"hwo g"gxgpv'ku"kpeqttgevn{"kf gpvkhkgf "cu'qeewttkpi "

dww'f kf "pqv'cevwcm{"qeewt."cpf "c"hcnug"pgi cvkxg"qeewtu"y j gp"c"hwo g"gxgpv'ku"pqv'

kf gpvkhkgf ."dww'cevwcm{"f qgu"qeewt0C"TQE"ewtxg"eqpukuvu"qh'c"i tcrj "qh'ugpukvkxkv{"r nqvgf "

ci ckpuv'3"ó"ugpukvkxkv{."y j kej "ku"yj g"vtwg"r qukvkxg"tcvg"r nqvgf "ci ckpuv'yj g"hcnug"r qukvkxg"

"

tcvg."y kj "c'r gthgev'r tgf kevkxg"o qf gn'j cxlkpi "c'ugpukvkxkv{"cpf "ur gekhkekv{"dq'yj "gs wcn'\q'3"

*Dgy kem'gv'cn0"4226+0'Vj g'ncti gt "yj g"ctgc"wpf gt "yj g'TQE"ewtxg"qh'yj g"o qf gn"yj g"dgwgt"

yj g"o qf gn'u'r gthqto cpeg0"

Nkhv'ej ctw'i tcr j kecn{ "f gr kev'yj g"ghhgevkxgpguu"qh'c'r tgf kevkxg"o qf gn'cu"c"

rkmgrnkj qqf "qh'yj g'tguwnu'qdvckpgf "y kj "cpf "y kj qw'yj g"wug'qh'yj g'r tgf kevkxg"o qf gn'

*Lchhgt{"("Nkw."422; +0Dcugnkpg"ewtxgu"ctg"ecnewncvgf "hqt"gxgpvu'ej qugp"cv'tcpfqo ."cpf "

rkhv'ewtxgu"ctg'i gpgtcvgf "hqt"gxgpvu'ej qugp'htqo "c"o qf gn'ucqtg"tcpmgf "rkuv'hqt"eqo r ctkuqp"

qh'j qy "yj g"o qf gn'r gthqto u'dgwgt"yj cp"gxgpvu'ej qugp"cv'tcpfqo 0'Vj g"ctgc"wpf gt "yj g"ewtxg"

ku'ncti gt "hqt"yj g"o qf gn'y kj "j ki j gt "r tgf kevkxg"ceewtce{ "*Lchhgt{"("Nkw."422; +0Ceeqtf kpi "

\q"I kddu"*4229."r 0; 2+.'tguwnu'ctg "$xcnkf "kh'yj g"gzr ncpcvkqpu'ctg'tgcm{ "rtwg"qt "ceewtcvg"cpf "

eqttgevn{ "ecr wtg"y j cv'ku'cewcm{ "j cr r gpkpi 0$'Eqphwukqp"o cvtkegu"y gtg"f gxgmqr gf "\q"

dgwgt"wpf gtucpf "yj g"r tgf kevkqp"ceewtce{ "qh'yj g'qr /r gthqto kpi "o qf gnu"cpf "f go qpuvcvg"

r tgf kevgf "xgtuwu"ce\wcn'hwo g"gxgpvu0Tguwnu'qh'yj g"o qf gnu"y gtg'tgxkgy gf "kp"yj g"eqpvgz\'

qh'r tgxkqwun{ "r wdrkuj gf "tguwnu'tgr qtkpi "pwo dgtu"qh'hki j u'tguwnnkpi "kp"go gti gpe{ "

rcpf kpi u."f kxgtukqpu."cpf "ckt "wtpdcemu'f wg"\q"o gf kecn'go gti gpekgu"cpf "guvko cvkqpu'qh'

pwo dgtu"qh'qeewttgpegu"qh'hwo g'gxgpvu0"

Summary

F cvc'htqo "xqnwpvctkn{ "tgr qtvgf "kpekf gpvu'kp'yj g'CUTU y gtg"gzr nqtgf "cpf "cpcn{| gf "

\q"kf gpvkh{ "ko r qtcpv'hcevqtu'kp'yj g"qeewttgpeg"qh'WCS "cpf "hwo g"gxgpvu'kp'yj ku'uwf {0C"

r tqeguu"qh'f cvc"eqmgevkqp."gz\'r ctukpi "cpf "tcpuhqto cvkqp."gz\'hkngtkpi ."cpf "gz\'o kpkpi "

*Ej cmcdqtv{ "gv'cn0"4235+'y cu"wugf "\q"kf gpvkh{ "kphqto cvkqp'htqo "htgg"gz\'hkgnf u'kp"

pcttcvkxgu'cpf "u{pqr ugu'qh'CUTU'tgr qtv0Vj gug"xctkcdngu'y gtg"eqo dkpgf "y kj "xctkcdngu"

qdvckpgf "htqo "f cvc"o kpkpi "gej pkswgu'\q"gpj cpeg'yj g"r tgekukqp"qh'yj g"o qf gnu0Vj g"

UGO O C'r tqeguu'y cu'wugf "vq'f gxgnqr ."cuuguu."cpf "eqo r ctg'o qf gnu'wukpi "f gekukqp'vtgg." i tcf kgpv'dqquvkpi ."nqi kuvke'tgi tguukqp."cpf "tcpfqo "hqtguv'cni qtkvjo u0"

Vj g'o qf gnu'y gtg'tckpgf "cpf "xcnkfcvgf "qp'y q'gswcn/uk| gf "itqwru'qh'fcvc'htqo " gxgpwu'tgr qtvgf "kp'y g'CUTU'f cvcdcug'cpf "vguvgf "qp'f cvc'htqo "y g'uco g'f cvcdcug0Chvgt " o qf gnu'y gtg'gxcnwcvgf ."c'tgxkgy "qh'y g'f cvc'o kpkpi "o gyj qf u'wugf "y cu'wpf gtvcmgp'vq" f gvgto kpg'y g'o quv'ko r qtcpv'hcevqtu'cuuqekcvgf "y kj "y g'qeewttgpeg'qh'hwo g'gxgpwu'cpf " y g'o qf gnu)'r tgf kevkqp'ceewtce{'qh'y g'qeewttgpeg'qh'hwo g'gxgpwu'cu'tgr qtvgf "d{'hnki j v' cpf "ecdkp'etgy "o go dgtu0"

"   "

Chapter IV: Results

Vj ku'uwf{'y cu'eqpfwevgf'kp''ceeqtfcpeg'y kj ''vj g''o gvj qf u'fguetkdgf ''kp''vj g''

r tgxkqwu''ej cr vgt0'Vj ku'ej cr vgt'fguetkdgu''vj g''vgz v'o kpkpi ''r tqeguu''cpf ''tguwnu''wukpi ''

r wdnken{'cxckncdng'f cvc''htqo ''P CUC øu''CUTU'f cvcdcug0'Vj g''vgz v'o kpkpi ''r tqeguu''hqnnqy gf ''

vj g''vgz v'r ctukpi .''vgz v'hknvgtkpi .''cpf ''vgz v'qr ke''uvgr u''cu''knnwuvtcvgf ''kp''Hki wtg''5''vq''kf gpvkh{''

ko r qtvcpv'xctkcdngu''hqt''kpenwukqp''kp''vj g''o qf gnkpi ''r tqeguu0'Vj g''f cvc''o kpkpi ''r tqeguu''y cu''

eqpf wevgf ''cu''uj qy p''kp''Hki wtg''6.''cpf ''vj g''tguwnu''ctg''r tqxkf gf 0'Vj g''o qf gnu''kpenwf gf ''

f gekukqp''vtgg.''i tcf kgpv'dqquvkpi .''nqi kuvke''tgi tguukqp.''cpf ''tcpf qo ''hqtguv'cni qtkj o u''cpf ''

y gtg''f gxgnqr gf .''vtckpgf .''xcnkf cvgf .''cpf ''vguvgf 0'Tguwnu''y gtg''gxcnwcvgf ''vq''f gvgto kpg''vj g''

dguv'o qf gn'hqt''kf gpvkh{kpi ''hcevqtu''cuuqekcvgf ''y kj ''vj g''qeewttgpeg''qh'hwo g''gxgpvu0'Ncuvn{.''

vj gug''tguwnu''cpf ''vj g''gxcnwcvkqp''qh'vj gkt''tguwnu''ctg''r tgugpvgf 0''

Demographics Results

Vj g''uco r ng''uk| g''hqt''vj ku''uwf {''kpenwf gf ''35.: 95''gxgpvu''y kj ''3: .; 88''pcttcvkxgu''

tgr qtvgf 0'Hqwt''tgr qtvu''y gtg''o kueqf gf ''cpf ''y gtg''tglgevgf ''chvgt''eqpuwnvcvkqp''y kj ''cp''CUTU''

cpcn{uv'hqt''c''vqvcn'qh'35.: 8; ''gxgpvu''cpf ''3: .; 84''pcttcvkxg''hkgnf u0'Cnj qwi j ''vj g''ugctej ''hknvgt''

hqt''vj g''f cvcdcug''y cu''eqphki wtgf ''vq''eqnngev'tgr qtvu''htqo ''hnki j v'cpf ''ecdkp''etgy ''o go dgtu.''

pcttcvkxgu''htqo ''cf f kkqpcn'r gtuqppgn'y gtg''kpenwf gf ''kp''vj g''gxgpv'tgr qtv'y j gp''c''ugeqpf ''

r gtuqp''tgr qtvgf ''vj g''uco g''gxgpv'cu''c''hnki j v'qt''ecdkp''etgy ''o go dgt0'Vj gug''cf f kkqpcn'

tgr qtvu''ctg''pqvgf ''y kj ''ugr ctcvg''ecug''pwo dgtu''cpf ''ctg''kpenwf gf ''kp''c''ugr ctcvg''xctkcdng''hkgnf ''

kp''vj g''CUTU'f cvcdcug0'Vj g''pcttcvkxg''r tgugpvkpi ''cf f kkqpcn'kphqto cvkqp''o c{''r tqxkf g''

cf f kkqpcn'kpuki j v'vq''tgr qtvgf ''gxgpvu''cpf ''ctg''kpenwf gf ''kp''vj ku''cpcn{uku''vq''cf f ''vq''vj g''

i gpgtcn'z cdknv{''qh'vj g''tgugctej ''hkpf kpi u0'Vj g''tgr qtvg''tqngu''ctg''hqwpf ''kp''Vcdng'': 0''

"

Chvgt"tgr qtv"uwdo kuukqp."P CUC"cpcn{uu"tgxkgy "yj g"pcttcvkxgu."cpf "kh'pq"pgy "kphqto cvkqp"ku"r tqxkfgf "kp"yj g"ugeqpf "tgr qtv."yj g"pcttcvkxg"eqpvckpu"yj g"ncpi wci g"õTgr qtv" pcttcvkxg"eqpvckpgf "pq"cf f kvkqpcn'kphqto cvkqpö"qt"uko knct"ncpi wci g0"Vj gug"pcttcvkxgu" ncemkpi "cf f kvkqpcn'kphqto cvkqp"qt"f gvckn'y gtg"pqv'kpenwf gf "kp"yj g"vgz v'o kpkpi "r tqeguu'uq"cu" pqv"vq"umgy "yj g"xcnwg"qh'vgto u"wugf "kp"f guetkdkpi "yj g"tgf wpf cpe{0"Vj gtg"y gtg"4.24; "qh' yj gug"pcttcvkxgu"y j kej "eqpvckpgf "pq"cf f kvkqpcn'kphqto cvkqp"cpf "y gtg"tgo qxgf "htqo "yj g" cpcn{uku."hqt"c"vqvcn'qh'38.; 55"pcttcvkxgu"cpcn{ gf "kp"yj g"vgz v'o kpkpi "uvci g"qh'yj ku"uvwf {0"

"

Table 8

Role of Persons Submitting ASRS Reports "

"	""""P wo dgt"qh""	"
Tqng"	Tgr qtvu"Uwdo kwgf "	Rgtegpv"
Hnki j v'Etgy """	"	; ; 0%' "
""""Ecr vckp"	3297: "	"
""""Hktuv'Qhhkegt"	9727"	"
""""Ugeqpf "Qhhkegt"	5"	"
""""Rknqv'õ"Rqukvkqp"Wpur gekhkgf .'Qyj gt"	6; 7"	"
Ecdkp'Etgy "	"	20%' "
""""Hnki j v'Cwgpf cpv"	67"	"
P qp/Etgy """	"	20%' "
""""Fkur cvej gt"	84"	"
""""Vgej pkekcp"	; "	"
""""Tco r "Rgtuqppgn"	8"	"
Qyj gt"cpf "Wpmpqy p"	83"	20%' "
O kuukpi "	3: "	20%' "
Vqvcn"	3: ; 84"	323' "

Note. Tqngu"f gvgto kpgf "htqo "tgr qtvu"uwdo kwgf "vq"CUTU"d{ "hnki j v'cpf "ecdkp"etgy "kp"HCT"

Rctv"343"qr gtcvkqpu"htqo "Lcpwct{"3."4237."vq"F gego dgt"53."423; 0Hnki j v'etgy "tqngu"y gtg"

ugnh/tgr qtvgf "cpf "qhvgp"kpenwf gf "cf f kvkqpcn'f gvckngf "kphqto cvkqp"uwej "cu'r knqvln{kpi .'r knqv'

"

pqv'hn{kpi .'ej gem'r kpqv.'tgrkgh'r kpqv.'kpuvtwevqt.'gve0'F wg'vq'tqwpf kpi .'vj g'vqvcn'f qgu'pqv'

gswcn'322'r gtegpv0'

"

Hki j v'etgy u'uwdo kwgf 'vj g'xcuv'o clqtkv{'qh'tgr qtvu0'O cp{'qh'vj g'gxgpvu'tgr qtvgf '

vq'vj g'CUTU'kpxqnxg'ecuu'vj cv'eqwnf 'r qvgpvkcn{'tguwn'kp'f kuekr nkpct{'qt'gphqtego gpv'

cevkqp.'uwej 'cu'cnkwf 'f gxlcvkqpu.'nquu'qh'ukwcvkqp'cy ctgpguu.'tghwukpi 'cktetchv.'qt'

o kuwpf gtuvcpf kpi 'engctcpegu0'Vj g'cxckncdkrkv{'qh'y ckxgtu'qh'f kuekr nkpct{'qt'gphqtego gpv'

cevkqp'r tqxkf gu'tgr qtvkpi 'kpegpvkxgu'hqt'egtvkhkecvgf 'kpf kxkfwcnu'*CUTU.'p0f 0 0Vj g'HCC'

y knn'pqv'wug'kphqto cvkqp'kp'tgr qtvu'uwdo kwgf 'vq'P CUC'wpf gt'vj g'CUTU'kp'cp{'

gphqtego gpv'cevkqp.'r tqxkf gf 'vj g'r qvgpvkcn'xkqncvkqpu'y gtg'kpf xgtvgpv'cpf 'pqv'f grkdgtcvg="

cevkqpu'f kf 'pqv'f kuenqug'c'ncem'qh's wcnkhkecvkqp'qt'eqo r gvgpe{='vj g'tgr qtvgt'j cu'pqv'dggp'

uwdlgev'vq'cp'HCC'gphqtego gpv'cevkqp'kp'vj g'hkxg'{gctu'r tkqt='cpf 'vj g'tgr qtvgt'ecp'r tqxg'

y kij kp'32'f c{u'chvgt'vj g'xkqncvkqp.'qt'f cvg'y j gp'vj g'r gtuqp'dgeco g'cy ctg'qh'vj g'xkqncvkqp.'

vj g{'uwdo kwgf 'c'tgr qtv'vq'P CUC'*HCC.'4243+0'Vj wu.'hki j v'etgy u'egtvkhkecvgu'ecp'

r qvgpvkcn{'dg'r tqvgevgf 'htqo 'uwur gpukqp'qt'tgxqecvkqp'kh'vj g'etgy 'o go dgtu'uwdo kv'

tgr qtvu'vq'CUTU0'

Vj g'35.: 8; 'gxgpvu'y gtg'tgr qtvgf 'd{'hki j v'cpf 'ecdkp'etgy 'hqt'WU0'ecttkgtu'

qr gtcvkpi 'wpf gt'36'EHT 'Rctv'3430'O qtg'vj cp'vj tgg/s wctvgtu'qh'tgr qtvgf 'gxgpvu'qqm'r nceg'

kp'WU0'cktur ceg.'cu'uj qy p'kp'Hki wtg'70'

Vj gug'tgr qtvgf 'gxgpvu'kpenwf gf 'cktetchv'eqpf wevkpi 'qr gtcvkqpcn'o kuukqpu'cu'hqwpf '

kp'Vcdng'; 0'Vj g'pwo dgtu'qh'gxgpvu'tgr qtvgf 'cr r gct'vq'dg'eqpukuvgpv'y kj 'pcvkqpcn'

r tqr qtvkqpu'qh'r cuugpi gt'cpf 'ecti q'hki j vu0'Rcuugpi gt'hki j vu'kp'vj g'WU0'i tgcvn{'

"

qwpwo dgt"ecti q'hrki j vu."y kj "ckt"vtchhke"eqpvtqmgtu"kp"yj g"WU0'j cpf rkpi "cp"guvko cvgf "

4: .759"eqo o gtekcn'cktrkpg'hrki j vu'cpf "4.36: "ecti q'hrki j vu'f ckn{ "*P QCC.'p(f 0)0'

Figure 5

Event Location as Provided in ASRS Reports
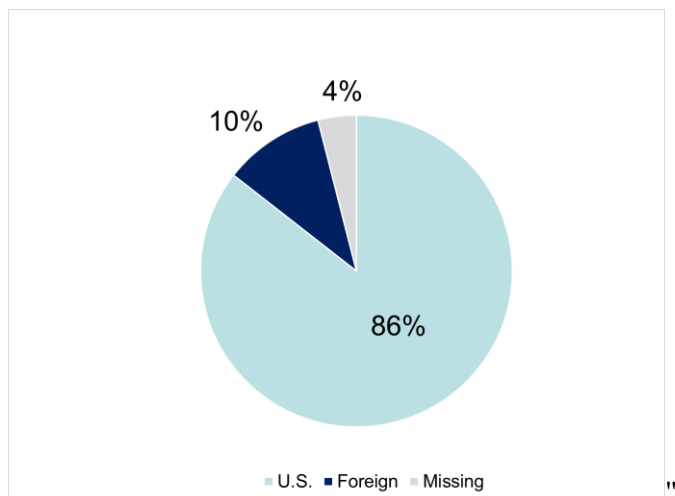
Note. WU0'cktur ceg"kpenvf gu"cktur ceg"qxgt "WU0'uvcvgu"cpf "\gttkvqtkgu0P ? 35.: 8; 0'

Table 9

Operational Mission of Aircraft Involved in Events as Provided in ASRS Reports

Qr gtcvkqpcn'O kuukqp"	"P wo dgt"qh'Gxgpvu"	Rgtegpvci g"qh'Vqvcn"
Rcuugpi gt"	33573"	: 30 ' "
Ecti q'qt'Htgki j v"	334: "	: 08' "
Hgtt{"	99"	208' "
Vguv'Hrki j v"	32"	>208' "
Vtckpkpi "	9"	>208' "
Qyj gt/Kpkvkcn'Qr gtcvkpi " Gzr gtkgpeg"	3"	>202' "
O kuukpi "Kphqto cvkqp"	34; 7"	; 05' "
Vqvcn'	35: 8; "	; ; 0 ' "

"

Note."Hnki j vu'eqpf wevgf "y j krg'hnki j v'qt'ecdkp'etgy "ctg'wpf gti qkpi "kpkvkcri'qr gtcvkpi "

gzr gtkgpeg'ecp'dg'tgxgpwg'hnki j vu="j vu'qyj gt'hnki j vu'encuukhkgf "cu'r cuugpi gt"qt'ecti q"qt"

htgki j v'o kuukqpu'o c{'cnuq'kpenwf g'etgy "o go dgtu'wpf gti qkpi "kpkvkcri'qr gtcvkpi "gzr gtkgpeg0'

F wg''q'tqwpf kpi .''j g''qvcri'f qgu'pqv'gs wcri'322'r getgpv0'

"

      Cktetchv'wugf "kp'Rctv'343"qr gtcvkqpu'ctg'f kxgtug'y kj "xct{kpi 'r wtr qugu."uk| gu."

gpi kpg'v{r gu."gpxktqpo gpvcri'eqpvtqri'u{uvgo u."cpf "qr r qtwpkvkgu'hqt'WCS "gxgpvu'vq'qeewt0'

Vj g"o cpwhcevwtgu'qh'cktetchv'tgr qtvgf "hqt'vj g'gxgpvu'kpenwf gf "kp'vj ku'uvwf { "ctg'kmwuvtcvgf "

kp'Hki wtg'80C"f gvckngf "ikuv'qh'tgr qtvgf "cktetchv'o cmgu'cpf "o qf gnu'ctg'r tqxkf gf "kp'Vcdng"

E3"qh'Crr gpf kz'E0Tgr qtvu'kp'vj g'CUTU'eqpvckp'f kurctcvg'kphqto cvkqp'tgi ctf kpi "vj g"

cktetchv."cu'tgr qtvgtu'o c{'pqv'cny c{u'kpenwf g'vj g'cktetchv'o cmg'cpf "o qf gn'kh'vj g{'ctg'pqv'

cuuqekcvgf "y kj "vj g'tgcuqp'hqt'vj g'tgr qtv0Cktetchv'f gvcknu'o c{'pqv'dg'eqpukf gtgf "etkvkecri'vq"

wpf gtucpf kpi "cpf "f gxgnqr kpi "ko r tqxgo gpvu'vq'uchgv{."cpf "cpcn{uu'f gkf gpvkh{'vj g"

cktetchv'y j gp'pgeguuct{ "hqt'o ckpvckpkpi "eqphkf gpvkcrik{ "dwv'r tqxkf g'xct{kpi "ngxgnu'qh'

f gvcknu'hqt'cktetchv'uk| g'qt'ecvgi qt{0'Vj wu."cp{ "cdknkv{ "vq'f ktgevn{ "eqo r ctg'cktetchv'kpxqnxgf "

kp'tgr qtvgf "gxgpvu'ku'gz vtgo gn{ 'ko kvgf 0'P q"eqpenwukqpu'ecp'dg'o cf g"cdqwv'cktetchv'

o cpwhcevwtgu."o cmgu."cpf "o qf gnu."qt'gxgpvu."cpf "pq"kpvgtr tgvcvkqp'qh'tkum'qt'uchgv{ "ecp"

dg"o cf g'htqo "vj g'v{r gu'cpf "pwo dgtu'qh'cktetch0'Vj g'xctkgf "pwo dgtu'cpf "v{r gu'qh'cktetchv'

tgr qtvgf "ctg'cr r ctgpv'cpf "tgr tgugpv'vj g'i gpgtcri| cdknkv{ "qh'vj g'tgr qtvu'vq'vj g'cxkcvkqp"

kpf wuvt{0'

Figure 6

Manufacturers of Aircraft as Provided in ASRS Reports
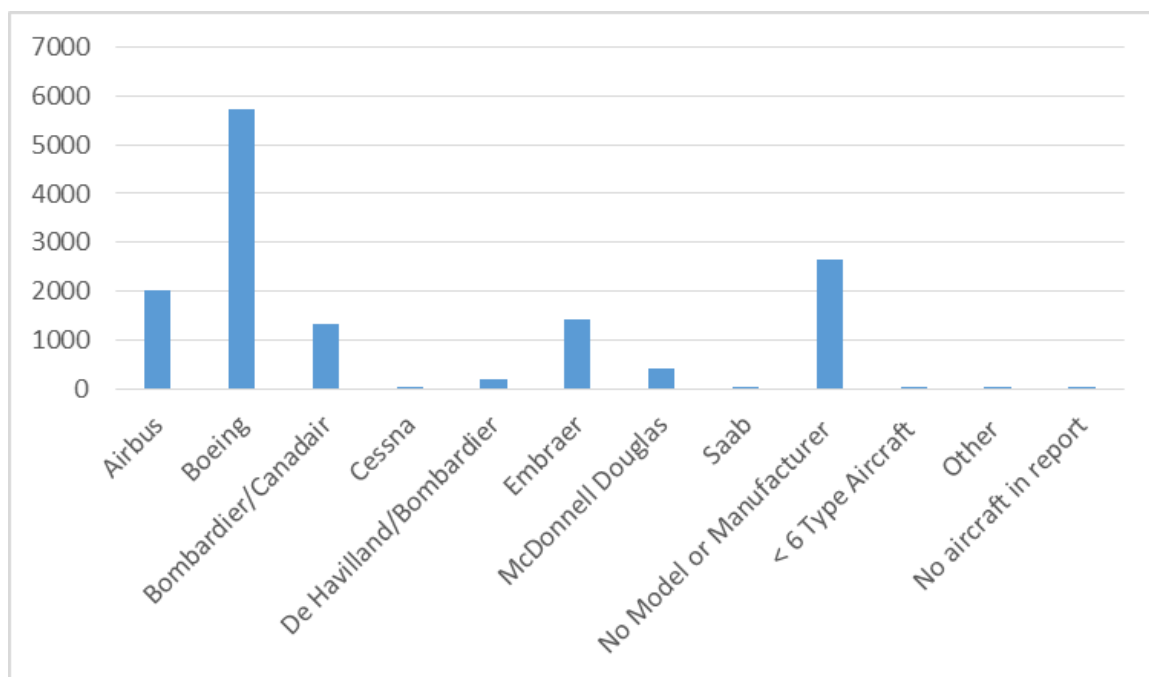
Note. Cktetchv'o cpwhcewwtgtu''cpf ''pwo dgt''qh'cktetchv'kpxqnxgf ''kp''CUTU''tgr qtvu''uwdo kwgf "
d{''ckt''cpf ''ecdkp''etgy ''kp''HCT ''r ctv''343''qr gtcvkqpu''htqo "Lcpwct{''3.''4237.''vq''F gego dgt''53."
423; 0P ? 35.: 8; 0'

"

"   Cktetchv'qr gtcvkqpu''cmg''r nceg''ctqwpf ''vj g''enqem''r tqxkf kpi "qr r qtwpkkgu''hqt "
tgr qtvcdng''gxgpu0'Vj g''ko gs''qh'gxgpv'qeewttgpeg''cu''r tqxkf gf ''d{''hrki j v''cpf ''ecdkp''etgy "
tgr qtvgtu''ctg''hqwpf ''kp''Hki wtg''90'Vj g''chvgtpqqp''y cu''vj g''o quv'htgsw gpvn{''tgr qtvgf ''tko g''hqt "
gxgpv'qeewttgpeg.''hqmq y gf ''enqugn{''d{''o qtpkpi u''*8<23''co "vq''34<22''r o +''cpf ''vj gp''gxgpkpi "
cpf ''pki j v'j qwtu0'Cnj qwi j ''tgr qtvgtu''ctg''cumgf ''vq''kpenwf g''vj g''f cvg''cpf ''vj g''nqecn''tko g''vj g"
gxgpv'qeewttgf .''kphqro cvkqp''o c{''dg''o kuukpi "htqo "vj g''tgr qtvu''dgecwug''vj g''tko g''o c{''pqv''dg"
r gtegkxgf ''d{''vj g''tgr qtvgt''q''dg''tgngxcpv'vq''vj g''tgr qtv'qr kle.''uwej ''cu''eqo r cp{''r qnkekgu.''

"

y gcyj gt"kuuwgu."cp"gswkr o gpv"o crhwpevkqp."qt"f gxkcvkqp"htqo "cp"cuuki pgf "cnkwwf g"qt"

j gcf kpi 0"

"

Figure 7"

Time of Event Occurrence as Provided in ASRS Reports"
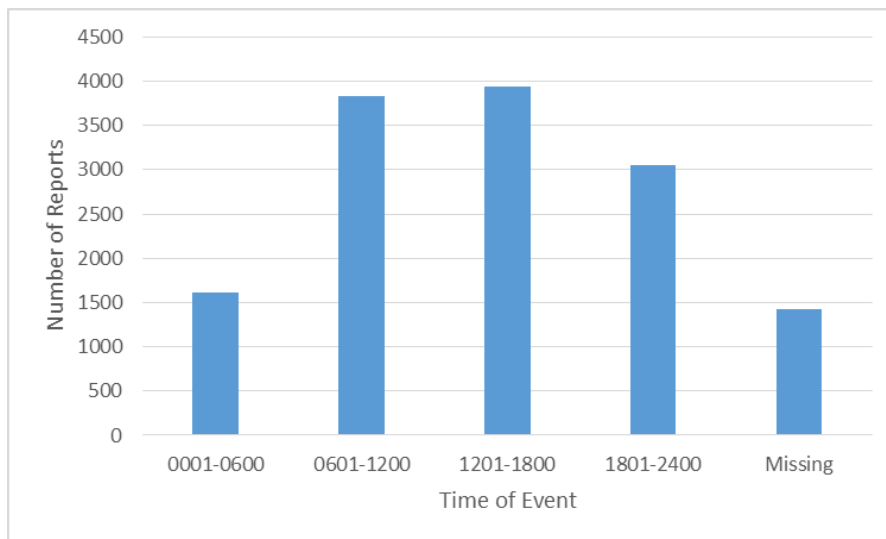
Note."Vko g"qh"qeewttgpeg"ku"r tqxkf gf "kp"nqecn"vko g0"

"

Tgr qtvgtu"ctg"cnuq"s wgtkgf "qp"yj g"r j cug"qh"hnki j v"yky kj "c"nkuv"qh"qr vkqpu"htqo "c"f tqr /

f qy p"o gpw"qp"gngevtqpke"hqto u"qt"d{ "vkemkpi "dqzgu"qp"yj g"r cr gt "hqto u"uwdo kwgf "yj tqwi j "

yj g"WLO0"o ckn0"Qr vkqpu"kpenwf g<r ctmgf ."vczk"vcmgqhh."kpkvkcn'enko d."enko d."etwkug."f guegpv."

kpkvkcn'cr r tqcej ."hkpcn'cr r tqcej ."o kuugf li q"ctqwpf ."ncpf kpi ."qt"qyj gt0O qtg"yj cp"qpg"hnki j v"

r j cug"o c{ "dg"ugngevgf "hqt"gxgpvu"qeewttkpi "yj tqwi j qw"ugxgtcn'r j cugu0Vj g"hktuv'vgto "

nkuvgf "kp"yj g"f cvcdcug"ku"yj g"r j cug"kp"y j kej "yj g"tgr qtvgf "gxgpv'hktuv'dgeco g"cr r ctgpv="yj gug"

tgr qtvgf "hnki j v'r j cugu"ctg"hqwpf "kp"Vcdng"320Tgr qtvgf "gxgpvu"dgeqo g"hktuv'cr r ctgpv'o qu v"

htgs wgpvn{ "f wtkpi "yj g"cr r tqcej "r j cug0Vj ku"r j cug"eqpukuvu"qh"kpetgcugf "kpvgtcevkqpu"y kj "

ckt "vtchhke"eqpvtqmgtu."vtcpukkqp"vq"nqy gt"cnkwwf gu."pcxki cvkqp"vq"y c{ r qkpvu"cpf "hkz gu."

"

f getgcukpi "ckturggf ."cpf "qrgtcvkqpu"kp"ckturceg"y kj "kpetgcugf "pwo dgtu"qh"cktetchv."y j kej "

rtqxkfg"qrrqtwpkkgu"hqt"qrgtcvkqpcn'gttqtu"cpf "tgeqo o gpfcvkqpu"hqt"ko rtqxgo gpu"vq"

cxkcvkqp"uchgv{0"

"

Table 10

Phase of Flight of Event Occurrence as Provided in ASRS Reports

Rj cug"qh"Hnki j v"	"""""""P wo dgt"qh"Gxgpvu"	"""""""Rgtegpvci g"qh"Vqvcn'
Rctmgf "	37; : "	330[' "
Vczk"	3896"	340[' "
Vcmgqhh"	339: "	: 0[' "
Enko d"	4397"	370[' "
Etwkug"	426; "	360 ' "
F guegpv'	3558"	; 0[' "
Crrtqcej "	5358"	440[' "
Ncpf kpi "	728"	50[' "
Qvj gt"	325"	20[' "
O kuukpi "	336"	20 ' "
Vqvcn'	35: 8; "	; ; 0[' "

P qvg0"Vj g"rj cug"kpenwf gf "ku"vj g"hktuv"rj cug"nkuvgf "kp"vj g"tgrqtv0Enko d"rj cug"kpenwf gu"

kpkkcn'enko d."crrtqcej "rj cug"kpenwf gu"kpkkcn'cpf "hkpcn'crrtqcej 0'Qvj gt"kpenwf gu"rtghnki j v'

rncppkpi ."dqctf kpi ."r wuj "dcem"tglgevgf "vcmgqhh."o kuugf "crrtqcej ."i q"ctqwpf ."gve0'F wg"vq"

tqwpf kpi ."vj g"vqvcn'f qgu"pqv'gs wcn'322'r gtegpv0'

"

Cpcn{uku"eqf g"vj g"tgrqtvu"d{ "v[r g"qh"gxgpv."y j kej "ctg"ugctej cdng"hkgnf u"kp"vj g"

CUTU'f cvcdcug0V[r gu"qh"gxgpvu"kpenwf g"cktetchv'gs wkr o gpv'r tqdngo ."CVE "kuuwg."

f gxkcvkqp"ö "cnkvwf g."f gxkcvkqp"ö "ur ggf ."hnki j v'f gemlecdkp'cktetchv'gxgpv.'i tqwpf "gzewtukqp."

i tqwpf "kpewtukqp."cpf "pq"ur gekhke"cpqo cn{"kpewttgf 0'Gcej "tgr qtv'kpenwf gu"qpg"qt"o qtg"

gxgpvu"cu"crrtqrtkcvg"hqt"vj g"f guetkr vkqp"r tqxkf gf "d{ "vj g"tgr qtvgt0'Vj g"gxgpv'hnki j v'

f gemlecdkp'cktetchv'gxgpv'ku"hwtvj gt"ecvgi qtk| gf "kpvq"knpguu kpjwt{ .'qvj gt"kplpmpqy p."

"

r cuugpi gt"gngevtqpke"fgxkeg."r cuugpi gt"o kueqpfwev."cpf "uo qmglhktglhwo gulqfqt0Qh"\j g"

35.:8; "gxgpvu"kpenwfgf "kp"\j ku'uvwf{.'35.349"**; 6087' +"gxgpvu"y gtg"pqv'tgncvgf "\q"WCS "

**cti gv'xctkcdng'ngxgn'3+"cpf "964"*7057' +"y gtg"eqfgf "d{"P CUC"cpcn{uvu"cu"dgkpi "

uo qmglhktglhwo gulqfqt"gxgpvu0'Vj gug"uo qmglhktglhwo gulqfqt"gxgpvu"y gtg"o cpwcn{"

tgxkgy gf "y kj "675'"*5049' +"gxgpvu"hqwpf "\q"dg"tgncvgf "\q"WCS "dw"ctg"pqv"hwo g"gxgpvu"

cti gv'xctkcdng'ngxgn'4+."cpf "4: ; "*40: ' +"ctg"r qvgpvkcn{"hwo g"gxgpvu"cti gv'xctkcdng'

ngxgn'5+0'

Descriptive Statistics

Vj g"CUTU"f cvcugv'kpenwfgf "; 8"xctkcdngu0'Vj g"xctkcdngu"uwr r qtv'\j g"y kf g"tcpi g"qh"

kphqto cvkqp"eqnngevgf "\q"f guetkdg"\j g"f kur ctcvg"gxgpvu"tgr qtvgf "dw'cnuq"kpenwfg'ncti g"

co qwpvu"qh'o kuukpi "f cvc"y j gp"\j g"xctkcdng"ku"pqv'cuuqekcvgf "qt'tgngxcpv'\q"\j g"gxgpv'

tgr qtvgf 0'Hqt"gzco r ng."c'hki j v'cwgpfcpv'o c{"tgr qtv'c'hki j v'f kxgtukqp'fwg"\q"c'hqwn'qf qt"

cpf "uo qmg"kp"\j g"ecdkp'cpf "o c{"pqv'tgr qtv'\j g"ckretchv/cnkwf g."\{r g"qh'ckur ceg."

y gcvj gt"eqpf kkqpu."o ckpvgpcpeg"uvcwu"qh'\j g"ckretchv."qt'qvj gt"hcevqtu"kttgngxcpv'\q"\j g"

gxgpv0'C"eqo r ngvg"nkuv'qh'xctkcdngu"cpf "\j gkt"uvcwu"ku"hqwpf "kp'Vcdng'E6'kp'Cr r gpfkz'E0'

Vj gug"xctkcdngu"eqpvckp'kphqto cvkqp"uwr r nkgf "d{"\j g"tgr qtvgtu"cpf "d{"\j g"P CUC"cpcn{uvu"

cu"\j g{"tgxkgy "tgr qtvu0'Hqt"\j g"r wtr qug"qh"\gzv'o kpkpi ."qpg"gzv'xctkcdng"y cu"etgcvgf "\q"

kpenwfg'cnn'qh'\j g"pcttcvkxgu'r tqxkfgf "d{"tgr qtvgtu."y j kej "ctg'qvj gty kug"eqpvckpgf "kp'\y q"

xctkcdngu"y j gp"\y q'r gqr ng"ctg"tgr qtvkpi "\j g"uco g"gxgpv0'Vj g"\gzv'o kpkpi 'r tqeguu"\qqm'

r nceg"wukpi "\j ku'xctkcdng"eqpvckpkpi "cnn'qh'\j g"tgr qtv'pcttcvkxgu0'Cnn'qh'\j g"xctkcdngu"

kpenwfgf "kp'\j g"f cvc"o kpkpi "cpcn{uku"y gtg"gzr nqtgf "wukpi "\j g"Uvcv'Gzr nqtg"pqfg0'C"

j kuvqi tco "hgcwtkpi "xctkcdng"y qtvj "ku"hqwpf "kp'Hki wtg": 0'Vj ku'hki wtg'j ki j nki j vu"\j g"

ko r qtvcpeg"qh'\j g"xctkcdngu."cpf "kp'r ctvkewnct."\j g"ko r qtvcpeg"qh'\j g"xctkcdngu"kfgpvkhkgf "

yj tqwi j "yj g"vgzv'o kpkpi "r tqeguu0'Cf f kkqpcn'kphqto cvkqp"tgi ctf kpi "yj g"ko r qtvcpeg"qh'yj g"

xctkcdngu'ku'hqwpf "kp"Vcdng'35"qp'r ci gu'323/3240""""

Figure 8"

Results of Stat Explore Node Showing Variable Worth
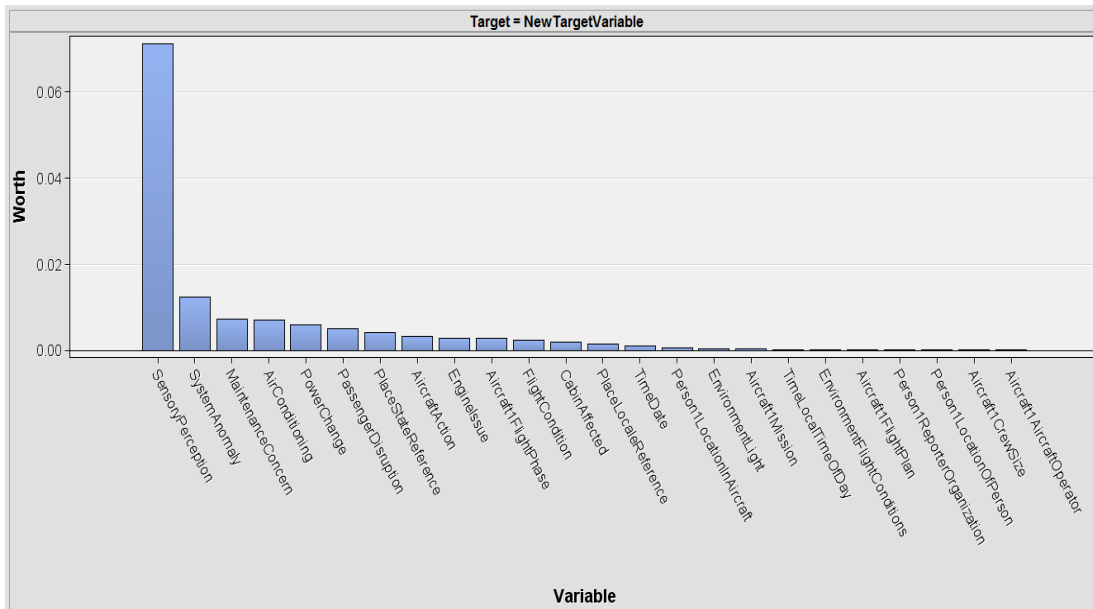
Text Mining Process and Results"

Vj g"vgzv'o kpkpi "r tqeguu'y cu'eqpf wevgf "vq"gzr nqtg"vgto u'cpf "vqr keu'kp"yj g"CUTU"
tgr qtv'pcttcvkxgu0'Vgto u'y gtg'i tqwr gf "kpvq"eqo o qp"yj go gu"qt "vqr keu'cpf "cf f gf "vq"yj g"
xctkcdngu'r tqxkf gf "kp"yj g'CUTU'f cvcugv'vq"f gxgnqr "o qf gnu'hqt"yj g'kf gpvkh{kpi "hcevqtu"
cuuqekcvgf "y kyj "yj g'qeewttgpeg'qh'WCS "gxgpvu"cpf "hwo g'gxgpvu0'

Text Parsing

Vgzv'r ctukpi "y cu'yj g'kpkvkcn'uvgr "kp'eqpxgtvkpi "wpuvtwevwtgf "vgzv'kp'yj g'tgr qtv'
pcttcvkxgu'uvtwevwtgf "hqto cv'hqt"cpcn{uku'cpf "kpr wv'kpvq"yj g'o qf gnu0'Vj g'f cvcugv'eqpvckpkpi "
cnn'tgr qtv'pcttcvkxgu'y cu'ucxgf "kp'yj g'UCṢ "nkdtct{"cpf "ko r qtvgf "cu'c'f cvc'uqwteg0'Hqt"yj g"

"

r wtr qug"qh'vgzv'o kpkpi ."vj g'xctkcdng'eqpukuvkpi "qh'cm'vj g'tgrqtv'pcttcvkxgu'y cu'ugngevgf "hqt"

vgzv'o kpkpi "cpcn{uku."cpf "cpcn{uku'qh'cm'qyj gt'xctkcdngu'y cu'tglgevgf 0'Vj g"Vgzv'Rctukpi "

pqf g"kp"UCÙ "Vgzv'O kpgt'y cu'eqppgevgf "vq'vj g'F cvc"Uqwteg'pqf g'cpf "y cu'wugf "vq"

cpcn{| g"vj g'ugtkgu'qh'ugpvgpegu"kp"vj g'tgrqtv'pcttcvkxgu0'Kpf kxkf wcn'y qtf u'y gtg'kf gpvkhkgf "

f wtkpi "vj g'vqmgp{| cvkqp"uvgr ."y j kej "ugr ctcvgf "vj g'ugpvgpegu'eqpvckpgf "kp"vj g'tgrqtv'

pcttcvkxgu'kpvq'kpf kxkf wcn'y qtf u0'Ngo o cvk| cvkqp"cpf "uvgo o kpi "y gtg'wugf "vq'tgf weg'vgto u"

vq"vj gkt'tqqv'hqto u0'Kp"UCÙ "Vgzv'O kpgt."vj g'uvgo o gt"ku'wtpgf "qp"qt'qhh'kp"vj g'Uvgo "

Vgto u'qr vkqp"kp"vj g'U{pqp{o u'ugvvkpi "y kj "{gu'cu'vj g'f ghcwnv'xcnwg'cpf "ku'wugf "kp"vj gug"

cpcn{ugu0'Tguwnu'qh'vj gug'r tqegf wtgu'y gtg'tgrqtvgf "kp"vj g"Vgzv'Rctukpi "pqf g'cpf "y gtg"

tgxkgy gf ."cnqpi "y kj "RQU'vci i kpi "tguwnu'f wtkpi "cr r tqzko cvgn{'vgp"kvgtcvkqpu'qh'vj gug"

r tqeguugu'vq'kf gpvkh{'y qtf u'vj cv'y gtg'f khhgtgpv'r ctu'qh'ur ggej ."u{pqp{o u."qt'u{pvcevkecm{"

tgncvgf 0'Tguwnu'htqo "vj g'vgzv'r ctukpi "r tqeguu'kpenwf gf "kpf kxkf wcn'vgto u."r ctv'qh'ur ggej ."

cwtkdwvg."htgs wgpe{."cpf "vj g'pwo dgt'qh'f qewo gpvu'eqpvckpkpi "gcej "r ctvkewnct'vgto 0'Vj g"

pwo dgt'qh'tgrqtvu'd{'htgs wgpe{."vj g'vgto øu'tqng'd{'htgs wgpe{."vj g'cwtkdwvg'd{'htgs wgpe{."

cpf "vj g'pwo dgt'qh'f qewo gpvu'r gt'vgto "ctg'r tqxkf gf "kp"i tcr j kecn'f kur nc{u0'Hki wtg; "

f kur nc{u'vj g'htgs wgpe{'qh'vgto u'd{'vj gkt'tqng0'O quv'vgto u'mgr v'vj tqwi j "vj g'vgzv'r ctukpi "

uvgr "y gtg'pqwpu'*57' +'hqmqy gf "d{'xgtdu'*54' +0'Vj gug'tguwnu'uwi i guv'pqwpu'uwej "cu"

r gtuqppgn"gs wkr o gpv."qt'qvj gt'kvgo u."cpf "xgtdu'uwej "cu'cktetchv'o qxgo gpv'qt'etgy "

cevkqpu'ctg'o quv'htgs wgpvn{'hqwpf "kp"vj g'tgrqtv'pcttcvkxgu0"

Figure 9

Term Role by Frequency Chart from Text Parsing Results
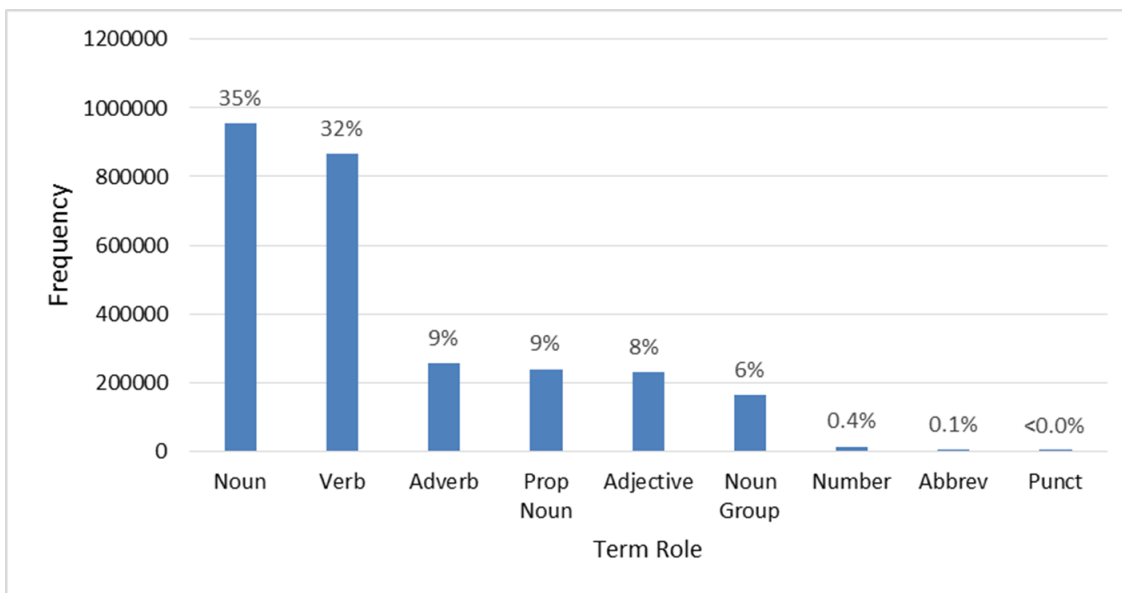
```
1200000

         35%
1000000
              32%
 800000

 600000

 400000
                     9%    9%   8%
 200000                              6%
                                          0.4%  0.1%  <0.0%
      0
        Noun  Verb Adverb Prop Adjective Noun  Number Abbrev Punct
                          Noun         Group
                              Term Role
```

Frequency (y-axis)

"*Note.* "F wg"\q "tqwpf kpi ."\j g"\qvcri'f qgu"pqv'gs wcri322"r gtegpv0"

"

Vj g"pwo dgt"qh'tgr qtvu"d{ "htgs wgpe{ "ku"cpq\j gt"o gcuwtg"qh'\gto "htgs wgpe{ "hqwpf "

kp"\j g"\gz v"r ctukpi "tguwnu"cpf "ku"knwuvtcvgf "kp"Hki wtg"320"Vj g"pwo dgt"qh'gxgp\tgr qtvu"kp"

y j kej "c"\gto "cr r gctu"ku"r qnqwgf "ci ckpu\'\j g"htgs wgpe{ "qh'qeewttgpeg"qh'\j g"\gto "kp"\j g"

gp\ktg"f cvcugv0F cvc"r qkpvu"tgr tgugp\'r ctugf "\gto u="\j qug"hqwpf "kp"\j g"wr r gt/tki j v's wcf tcpv"

qh'\j g"uecwgt"r nqv'ctg"hqwpf "o qtg"htgs wgp\n{ "cpf "kp"o qtg"tgr qtv'pcttcvkxgu"\j cp"f cvc"

r qkpvu"kp"\j g"nqy gt/nghv's wcf tcpv0Hqt"gzco r ng."\j g"\gto "±dgø'ku"hqwpf "kp"35.342"gxgp\'

tgr qtvu"cpf "ku"wugf "337.3; 2"\ko gu."y j kng"\j g"\gto "±ki j gt'ckttetchø'ku"hqwpf "kp"hqwt"gxgp\'

tgr qtvu"cpf "ku"wugf "c"\qvcn'qh'hqwt"\ko gu0"Vj gug"xcnwgu"ecp"dg"wugf "\q"gpj cpeg"

wpf gtuvcpf kpi "qh'\j g"ko r qtvcpeg"qh'\j g"\gto u"cpf "kphqto "cpf "i wkf g"f gekukqpu"kp"mggr kpi "

qt"f tqr r kpi "\j go 0"Vgto u"\j cv'f q"pqv'eqpvtkdwvg"\q"\j g"kf gpvkhkecvkqp"qh'qr kpu"qh'kpvgtguv'

ecp"cf f "pqkug"\q"\j g"\cum'qh'kf gpvkh{ kpi "tgngxcpv'qr kqpu0'Dcugf "qp"\j g"htgs wgpe{ "qh'wug"cpf "

"

pwo dgt''qh''f qewo gpwu''eqpvckpkpi ''yj g''vgto ''÷dgø''kv''ku''tcpmgf ''o quv''ko r qtvcpv0'J qy gxgt.''yj g''

eqpvtkdwwkqp''qh''yj ku''vgto ''vq''yj g''kf gpvkhkecvkqp''qh''vqr keu''ku''o kpko cn''cff u''c''uwduvcpvkcn''

co qwpv''qh''pqkug.''cpf ''y cu''f tqr r gf ''htqo ''yj g''vgzv''o kpkpi ''r tqeguu0

Figure 10

Number of Report Narratives (Docs) by Term Frequency from Text Parsing Results

"
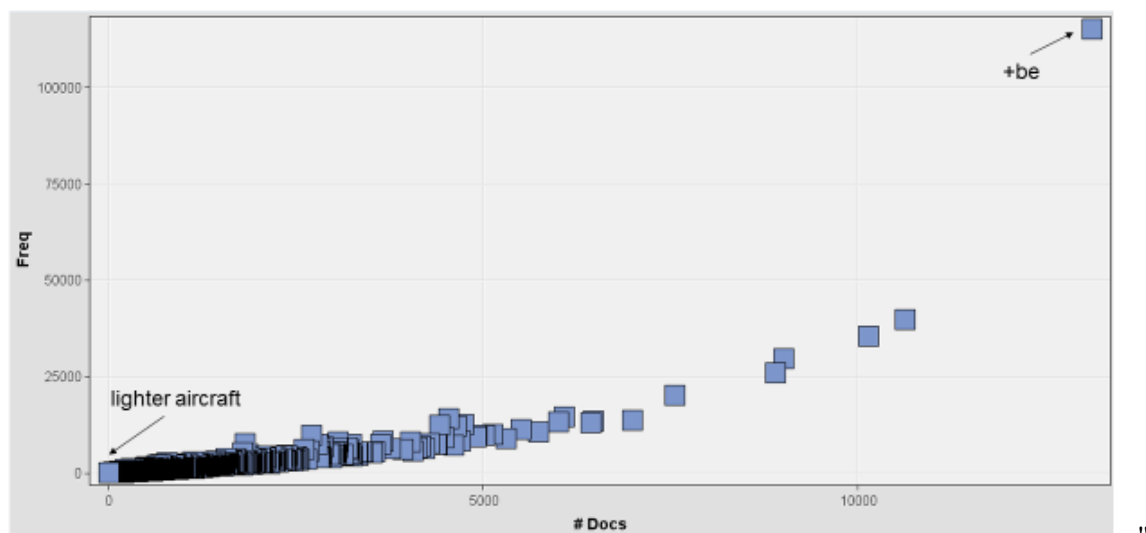
Tguwnvu''htqo ''yj g''Vgzv''Rctukpi ''uvgr ''y gtg''tgxkgy gf ''vq''kf gpvkh{ ''vgto u''yj cv''f kf ''pqv''

eqpvtkdwwg''xcnwg''vq''yj g''vgzv''o kpkpi ''r tqeguu''cpf ''eqwnf ''yj wu''dg''gzenwfgf ''htqo ''yj g''cpcn{uku0'

Vj g''tgxkgy gf ''r tqeguu''y cu''kvgtcvkxg''cpf ''uwdlgevkxg''y kj ''tguwnvu''qh''Vgzv''Hknvgt''cpf ''Vgzv''Vqr ke''

pqf gu''eqpukf gtgf ''dghqtg''gzenwf kpi ''y qtf u0'Vq ''tgf weg''yj g''pqkug''htqo ''y qtf u''yj cv''f kf ''pqv''

ko r ctv''o gcpkpi ''qt''xcnwg''vq''yj g''cpcn{uku.''yj gug''vgto u''y gtg''cff gf ''vq''yj g''vgto u''eqpvckpgf ''kp''

UCU³ ''Vgzv''O kpgtøu''f ghcwnv''uvqr ''nkuv0'Vj g''ugs wgpeg''qh''Vgzv''Rctukpi .''Vgzv''Hknvgt.''cpf ''Vgzv''

Vqr ke''y cu''yj gp''tgr gcvgf ''cr r tqzko cvgn{ ''yj ktv{/hkxg''ko gu''y kj ''c''tgxkgy ''qh''tguwnvu''hqnnqy gf ''

d{ ''gf kvkpi ''qh''yj g''uvqr ''nkuv.''cu''cr r tqr tkcvg0'Ur gekhkecn{ .''vgto ''tcpm'kp''Vgzv''Rctukpi ''tguwnvu.''

"

vgto ''y gki j v'kp''Vgzv'Hknvgt''tguwnvu.''cpf ''yj g'hkv'qh''yj g'vgto u'kp'yj g'vqr ke''i tqwru'r tqxkf gf ''kp''

Vgzv'Vqr ke''tguwnvu'y gtg''eqpukf gtgf ''yj gp''f gvgto kpkpi ''vgto u'hqt''cf f kvkqp''vq''yj g'uvqr ''nkuv0''

Ugxgtcn''qr ke''yj go gu'y gtg''kf gpvkhkgf ''hqt''vgto uø'cf f kvkqp''vq''yj g'nkuv.''kpenwf kpi <

- cktetchv'eqo r qpgpvu''*y kpi vkr ."gngxcvqt."hncr ''j cpf ng."pqug''i ct."gve0+="

- v{r gu'qh'cktetchv'*C542''ugtkgu."Eguupc.''989u.''wwtdqlgv'cktetchv."gve0+="

- y gcyj gt'r j gpqo gpc''*i wuv{'y kpf u."y kpf uj gct."ugxgtg''wwtdwngpeg."gve0+="

- vgto u'tgncvgf ''vq''ectf kpcn'cpf ''qtf kpcn'f ktgevkqpu''*gcuvdqwpf."pqtyj gtn{."

  uqwwj ''ukf g."gve0+="

- i gqi tcr j ke''nqecvkqpu''*Co gtkec."J qwuvqp.''O UR."gve0+="

- vgto u'tgncvgf ''vq''kpuvtwo gpv'pcxkicvkqp''*KNU'6T''cr r tqcej ."HCH'cnkwwf g."

  O P P KG."TP CX''i wkf cpeg."I RU'hcknwtg."gve0+="

- cxkcvkqp''r gtuqppgn'*o ctuj cngt."vqy gt''i w{."CVE''ci gpe{."gve0+="

- cktetchv'hnki j v'ukwwcvkqpu''*HN622.''; 2mu.''8222hv."cktur ggf ''cuuki po gpv."gve0+="

- i tqwpf ''r tqzko kv{'y ctpkpi ''u{uvgo ''*I RY U+'f gxkeg'vgto u'*I RY U''

  cppwpekcvkqp."GI RY U'y ctpkpi .''vgttckp'vgttckp."gve0+="

- vtchhke''cngtvu'cpf ''eqnnkukqp''cxqkf cpeg''*VECU'cngtv.''TC''y ctpkpi .''VECU''

  eqo o cpf ."gve0+''cpf ''''

- ur gekhke''twpy c{u'cpf ''vczky c{u''*twpy c{''35T.''35N.''ty {''37T.''vczky c{'{.''

  gve0+0'

Cktetchv'eqo r qpgpvu.''r lq}uø'gngevtqpke''f gxkegu.''cpf ''gswkr o gpv'y gtg'gzenwf gf ''

htqo ''yj g'uvqr ''nkuv'kh'yj gtg'y cu'c''r qvgpvkcn'vq''go kv'uo qng.''hwo gu.''qf qtu.''qt''ecwug''c''hktg0'

Rgtuqppgn'y j q''o ki j v'tgur qpf ''vq''WCS ''qt''hwo g''gxgpvu'uwej ''cu''o ckpvgpcpeg''uvchh.''

go gti gpe{''o gf kecn'vgej pkekcpu.''qt''qhhkegtu'y gtg'cnuq''gzenwf gf ''htqo ''yj g'nkuv0'Cf f kvkqp'cpf ''

"

f gngvkqp"qh"\gto u"\q"\j g"uvqr "kluv"y gtg"eqpenwf gf "dcugf "qp"\j g"tguwnu"qh"\j g"Vgz\"Hknvgtkpi "

pqf g"cpf "\j g"f kuvkpevkqp"qh"\gto u."\gto "y gki j w."htgswgpe{."cpf "\j g"pwo dgt"qh"f qewo gpwu"

kpenwfkpi "\j g"\gto u."cpf "\j g"Vgz\"Vqrke"pqf g"tguwnu"qh"qrkeu"r tqxkf gf ."cpf "\j g"\gto u"

ngrv0"Vgto u"qh"s wguvkqpcdng"xcnwg"kp"eqpvtkdwvkpi "\q"\j g"\qrke"y gtg"pqv"kpenwf gf "kp"\j g"

uvqr "kluv"dwv"y gtg"kpenwf gf "kp"hwwwtg"cpcn{ugu0"Cnn"\gto u"y gtg"tgxkgy gf "d{ "c"uwdlgev"

o cwgt"gzr gtv"y kj "gzvgpukxg"gzr gtkgpeg"kp"cktnkpg"qr gtcvkqpu"cpf "hco kkctk{"y kj "hwo g"

gxgpw0"Eqpugs wgpvcn"\gto u"y gtg"tgxkgy gf "d{ "cp"guvcdnkuj gf "uwdlgev"o cwgt"gzr gtv"y kj "

gzr gtkgpeg"kp"cktnkpg"qr gtcvkqpu"cpf "tgugctej "gzr gtkgpeg"y kj "r ggt/tgxkgy gf "r wdnkecvkqpu"

tgi ctfkpi "hwo g"gxgpw0"C "kluv"qh"gzco r ng"\gto u"gzenwf gf "htqo "\j ku"cpcn{uku"\j tqwi j "\j g"

wug"qh"c"uvqr "kluv"ku"hqwpf "kp"Cr r gpf kz"F 0"C "kluvkpi "qh"\j g"hkpcn"qr "322"\gto u."cu"

f gvgto kpgf "d{ "\j g"Vgz\"Rctukpi "pqf g"cnj qtkj o u"ku"hqwpf "kp"Cr r gpf kz"E."Vcdng"E40"

Text Filter

Vj g"Vgz\"Hknvgt"pqf g"y cu"wugf "\q"hknvgt"\j g"tgr qtv"pcttcvkxgu"cpf "tghkpg"\j g"kluv"qh"

\gto u"d{ "cuuki pkpi "\gto "y gki j v"cpf "htgs wgpe{"y gki j v0"Kp"\j ku"uvgr ."y qtfu"htgs wgpvn{ "

qeewttkpi "kp"\j g"pcttcvkxgu"y gtg"cuuki pgf "c"j ki j gt"y gki j v"cpf "y gtg"eqpukfgtgf "ko r qtvcpv"

dgecwug"\j g{ "dgwgtf guetkdgf "\j g"gxgpv."y j gtgcu"y qtfu"qeewttkpi "nguu"htgs wgpvn{"y gtg"

cuuki pgf "c"j ki j gt"y gki j v"dgecwug"\j g{ "dgwgtf kuetko kpcvgf "\j g"gxgpu"*Ej cntcdqtv{"gv"cn0"

4235+0"Qr vkqpu"hqt"\gto "y gki j vkpi "kp"\j g"Vgz\"Hknvgt"pqf g"cnqy "xctkcvkqp"kp"\j g"

ko r qtvcpeg"qh"y qtfu"\q"dg"f gvgto kpgf "dcugf "qp"\j gkt"htgs wgpe{"qh"cr r gctcpeg"kp"\j g"

kpf kxkf wcn"pcttcvkxgu"cpf "j qy "\j g"y qtfu"ctg"f kur gtugf "\j tqwi j qw"\j g"pcttcvkxgu"kp"\j g"

f cvcugv"*UCU."4239c+0"

Vj g"htgs wgpe{"tcvg."qt"c"tcvg"y kj kp"\j g"pcttcvkxg."ku"f gxgnqr gf "wukpi "c"y gki j vkpi "

hwpevkqp"\q"vtcpuhqto "\j g"htgs wgpe{"qh"\j g"qeewttgpeg"qh"\j g"y qtf "ceeqtf kpi "\q"qpg"qh"

"

hqwt"qr vkqpu'cxckncdng"kp"UCU "Vgz v'O kpgt0'Vj g"qr vkqpu"hqt"htgs wgpe{"y gki j vkpi "r tqr gtv{"

ugwkpi u'kpenwf g"f ghcwn/"*nqi .'y kyj "vj g"gzegr vkqp"qh'o wnkr ng"Vgz v'Hknwgt"pqf gu"eqpvckpgf "kp"

vj g"r tqeguu"hnqy +'nqi .'dkpct{."qt"pqpg0'Kp"vj ku"uwf {."vj g"qr vkqp"qh'pqpg"y cu"ej qugp."cpf "

vj g"tcy "htgs wgpe{"xcnwg"ku"wugf "y kj "pq"vtcpuhqto cvkqp"qeewttkpi 0"

Vgto "y gki j vkpi u'y gtg"wugf "vq"f kuvkpi wkuj "ko r qtvcpv'y qtf u'htqo "qvj gt"y qtf u0'Vj g"

hqwt"qr vkqpu"hqt"o gvj qf u'qh'vgto "y gki j vkpi "vgej pkswgu'cxckncdng"kp"vj g"UCU "Vgz v'O kpgt"

Vgz v'Hknwgt"pqf g"kpenwf g"f ghcwn/"*gpvtqr {+."gpvtqr {."kpxgtug"f qewo gpv'htgs wgpe{."o wwcn"

kphqto cvkqp."cpf "pqpg0'Cnl"qr vkqpu"y gtg"cuuguugf ."y kj "tguwnu"htqo "vj g"gpvtqr {"qr vkqp"

r tqxkpi "vq"dg"vj g"o qu'tqdwu'cu'kv'i kxgu'i tgcvgt"y gki j v'vq"vgto u'vj cv'qeewt"kphtgs wgpvn{"kp"

vj g"pcttcvkxgu"d{"r ncekpi "vj g"pwo dgt"qh'pcttcvkxgu"eqpvckpkpi "vj g"vgto "kp"vj g"pwo gtcvqt"qh'

vj g"hqto wnc"wugf "vq"ecnewncvg"vj g"y gki j v'qh'vj g"vgto "*UCU ."4242d+0'Vj ku"cnqy u'vgto u"

kphtgs wgpvn{"qeewttkpi "kp"c"hgy "pcttcvkxgu'vq"tgegkxg"j ki j gt"y gki j vu."o gcpkpi "vj g{"

r qvgpvkcnl{"r tqxkf g"o qtg"kphqto cvkqp"vj cp"vgto u'y kj "nqy gt"y gki j vu0'Tguwnu'htqo "vj g"

Vgz v'Hknwgtkpi "pqf g"ctg"f kur nc{gf "kp"i tcr j kecn'cpf "vcdwnct'hqto cvu0'Vj g"pwo dgt"qh'

f qewo gpvu"kp"y j kej "c"vgto "qeewtu'xgtuwu'vj g"y gki j v'qh'vj g"vgto "ku'f kur nc{gf "kp"vj g"

P wo dgt"qh'F qewo gpvu"d{"Y gki j v'ecwugt"r nqv."cu"uj qy p"kp'Hki wtg"330'Y qtf u'tgr tgugpvgf "

d{"f cvc'r qkpvu"qp"vj g"wr r gt/ngh/'ukf g"qh'vj g"ewtxg"j cxg"c"j ki j gt"y gki j v'dw'ctg"hqwpf "kp"

hgy gt"pcttcvkxgu."y j gtgcu"y qtf u'qp"vj g"tki j v'ukf g"qh'vj g"ewtxg"ctg"hqwpf "kp"o qtg"

pcttcvkxgu'dw'ctg"cuuki pgf "c"nqy gt"y gki j v0'Kp"vj ku'knnwutcvkqp."vj g"vgto "÷cwqo cvkqp"

u{uvgo ø'ku"hqwpf "hkxg"vko gu"kp'hqwt"pcttcvkxgu'cpf "j cu"c"y gki j v'qh'20 8."y j kng"vj g"vgto "

÷dgø'ku"hqwpf "337.3; 2"vko gu"kp"35.342"pcttcvkxgu'cpf "j cu"c"y gki j v'qh'20 2220'Vj g"us wctgu"

cv'vj g"dqwqo "qh'vj g"hki wtg"tgr tgugpv'vgto u'vj cv'ctg"eqpvckpgf "kp"vj g"vqr "nku'qt"qvj gty kug"

j cxg"pq"y gki j v'qt"xcnwg"cpf "j cxg"dggp"f tqr r gf "htqo "vj g"cpcn{ugu0'Kphqto cvkqp'tgi ctf kpi "

"

yj g"\gto u"cpcn{| gf "ku"hqwpf "kp"yj g"Vgto u"vcdrg"qh"yj g"Vgz v"Hkngt"pqf g"tguwnu"y kpf qy 0"

Vcdrg"33"eqpvckpu"yj g"qr "47"\gto u"tcpmgf "d{ "y gki j v0"C"nku v'qh"yj g"qr "322"tcpmgf "\gto u"

cpf "yj gkt"xcnwgu"ku"hqwpf "kp"Cr r gpf kz "E."Vcdrg"E50"

"

Figure 11

Text Filter Node Scatter Plot Results Showing Number of Narratives (Docs) by Weight"""
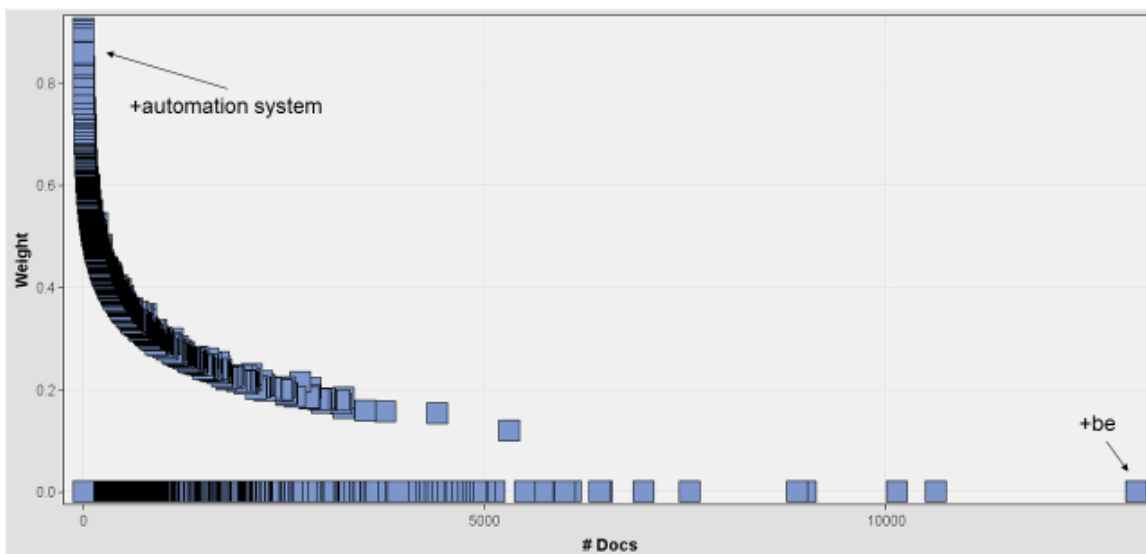
Table 11

Text Filter Node Results: Top 25 Terms by Weight
"

Vgto "	"Tqng"	"Ucwu"	Y gki j v"	"Htgs wgpe{"	"Tcpm"	"P wo dgt "qh" Fqewo gpvu"	Rctgpv"
y qtmuj ggv"	"Pqwp"	"Mggr "	20 2: "	54"	37; 28"	7"	- "
y qwpf "	"Pqwp"	"Mggr "	20 24"	35"	3: 367"	6"	- "
j r uqx"	"Rtqr "	"Mggr "	20 23"	32"	3: 367"	6"	"
pqp/uqr "	"Rtqr "	"Mggr "	20 23"	32"	3: 367"	6"	"
j wo r "	"Pqwp"	"Mggr "	20 ; 7"	; "	3: 367"	6"	"
qr "	"Rtqr "	"Mggr "	20 ; 7"	; "	3: 367"	6"	"
ur kmci g"	"Pqwp"	"Mggr "	20 ; 7"	; "	3: 367"	6"	"
lqd"	"Rtqr " "Pqwp"	"Mggr "	20 ; 4"	33"	3: 367"	6"	"
f ckn{"ej gem"	I tqwr "	"Mggr "	20 ; 4"	33"	3: 367"	6"	- "

"

Vgto "	"Tqng"	"Uvcwu"	Y gki j v'	Htgs wgpe{ "	"Tcpm'	"P wo dgt "qh" F qewo gpvu"	Rctgpv'
cy ctgpguu"	"P qwp"						
vcrg"	I tqwr "	"Mggr"	20 ; 4"	33"	3: 367"	6"	"
f 4"	"Rtqr "	"Mggr "	20 : : "	52"	37; 28"	7"	"
9c"	"Rtqr "	"Mggr "	20 : 9"	: "	3: 367"	6"	"
o kzwtg"	"P qwp"	"Mggr "	20 : 9"	: "	3: 367"	6"	- "
cr tqp"	"Rtqr "	"Mggr "	20 : 9"	34"	3: 367"	6"	"
37e"	"P qwp"	"Mggr "	20 : 9"	: "	3: 367"	6"	"
tgtgngcug"	"P qwp"	"Mggr "	20 : 8"	32"	3: 367"	6"	"
vcmg/qhh"	"P qwp"						
f cvc"	I tqwr "	"Mggr "	20 : 8"	32"	3: 367"	6"	"
tgf kur cvej "	"P qwp"	"Mggr "	20 : 8"	32"	3: 367"	6"	"
	"P qwp"						
j k'uvci g"	I tqwr "	"Mggr "	20 : 5"	34"	3: 367"	6"	"
cgtq"	"Rtqr "	"Mggr "	20 : 4"	34"	3: 367"	6"	"
nqwpi g"	"P qwp"	"Mggr "	20 : 4"	33"	3: 367"	6"	- "
ekfu"	"Rtqr "	"Mggr "	20 : 3"	37"	3: 367"	6"	"
uj qy vko g"	"P qwp"	"Mggr "	20 : "	; "	3: 367"	6"	"
	"P qwp"						
j qnf "ctgc"	I tqwr "	"Mggr "	20 : "	; "	3: 367"	6"	"

*Note*0- "kpf kecvgu 'c'r ctgpv'pqf g0Rtqr "ku'r tqr gt 'c'pqwp0Cddtgxkcvkqpu'kpenwf g'J RUQX "hqt "

j ki j "r tgusuvtg'uj wuqhh'xcnxg. "P QP /UQR 'hqt 'pqp/uvcpf ctf "qr gtcvkpi "r tqegf wtgu. "QR 'hqt "

qr gtcvkqp. "E KF U'hqt "eqo r wvgt 'kpvgthceg'f gxkegu0'

"

"   Vj g "vgto u'kp 'vj ku'vcdng 'ctg 'cnn'mgr v. 'o gcpkpi "vj g{ 'j cxg 'dggp 'kpenwf gf "kp 'vj g "

cpcn{ugu'kp 'hwwwtg 'pqf gu'f wg 'vq 'vj gkt 'r qvgpvkcn'vq 'r tqxkf g 'xcnwg 'kp 'kf gpvkh{kpi "hcevqtu"

cuuqekcvgf "y kvj "vj g 'qeewttgpeg 'qh'WCS "cpf "hwo g 'gxgpvu0'Vj g 'o clqtkv{ 'qh'vgto u'ctg 'pqwpu"

qt 'pqwp'i tqwru. "kpf kecvkpi "c 'r tgxcngpeg 'qh'r gtuqppgn'kvgo u. 'qt 'gs wkr o gpv'pqwpu'cpf "

nko kvgf "xgtdu'qt 'cf xgtdu. "uwi i guvkpi "hgy gt 'vgto u'f guetkdkpi "cevkqpu'qt 'o qxgo gpv0Tg/

kpur gev. 'tgtgngcug. "cpf "tgf kur cvej "uwi i guv'tgr gvkvkqp'qh'gxgpvu. "r quukdn{ 'f wg 'vq 'cpqo cnkgu"

hqwpf "y kvj "vj g 'hktuv'kvgtcvkqp0'Vgto u'tgr tgugpvkpi "nqecvkqpu. "uwej "cu 'cr tqp. 'nqwpi g. "cpf "

j qnf "ctgc'ctg 'xcuvn{ 'f khhgtgpv'ukvgu0'Vj g 'pwo gtke 'vgto u. '9c'cpf '37e'o c{ 'f guki pcvg "

r cuugpi gt 'ugcvu'kp 'vj g 'ecdkp0F 4'o c{ 'dg 'c 'i gqo gvtke 'xgevqtkpi "vgto . 'kpf kecvkpi "vj g "

"

fkuvcpeg"qh'c"ugeqpf "cktetchv'vq"c"etquukpi "rqkpv"*Um{dtct{."4243+"qt"o c{"tghgt"vq"c"eqfg"

wugf "vq"kpfkecvg"vj g"KECQ"eqfg"hqt"c"v{rg"qh'r gthqto cpee/dcugf "pcxki cvkqp"gswkro gpv"qp"

cp"cktetchv0Cy ctgpguu"'crg"ku"c"vgto "wugf "vq"f guetkdg"vj g"fkurnc{"hgcvwtgu"eqo o qpn{"

hqwpf "vq"kpfkecvg"cnkwf g"cpf "cktur ggf "y j kej "cr r gct"cu"c"xgtvkecn'cr g"vj cv'uetqmu'wr "qt"

fqy p"y kj "ej cpi g0J k'uvci g"o c{"kpfkecvg"c"ugevkqp"qh'vj g"gpi kpg"eqo r tguuqt."y j kng'j ki j "

r tguuwtg"uj wuqhh'xcnxg"o c{"tghgt"vq"c"eqo r qpgpv'qh'vj g"gpxktqpo gpvcn'eqpvtqn'u{uvgo 0"

Vj g"y kf g"xctkcvkqp"kp"vgto u'y kej qw'gxkf gpv'vj go gu"kp"vj ku'nkuv'o c{"dg"kpfkecvkxg"

qh'vj g"o wnkvwf g"qh'tgcuqpu'tgr qtvu"ctg"uwdo kwgf "vq"vj g"CUTU'f cvcdcug."y j kng'vj g"

fkuuko knctkv{"kp"vgto u'kpenwf gf "kp'vj ku'nkuv'f gpqvgu'c'ncem'qh'ucpf ctfk\gf "qt"eqo o qp"

kpfkecvqtu'hqt'hwo g"gxgpvu'cpf "vj g'f khhkewn{'kp'kf gpvkh{kpi 'hcevqtu'cuuqekcvgf "y kij "vj gkt "

qeewttgpeg0Vj g"kio kgf "pwo dgt"qh'xgtdu'kpenwf gf "kp'vj ku'nkuv'uwi i guvu'vj g"r tgugpeg"qh'"

engctn{'kf gpvkhkcdng'cevkqpu'qt'cevkxkvkgu'cuuqekcvgf "y kj "vj g"qeewttgpeg"qh'hwo g"gxgpvu'ku'"

wpnkmgn{0Vj g"tgncvkxgn{'nqy "pwo dgt"qh'xcnwgu'hqt'htgs wgpe{'cpf "pwo dgt"qh'f qewo gpvu'"

cnuq'ko r nkgu'c'ko kgf "pwo dgt"qh'vgto "wuci gu."cpf "vj wu'cf f kvkqpcn'f khhkewn{'kp'kf gpvkh{kpi "

hcevqtu'cuuqekcvgf "y kj "vj g"qeewttgpeg"qh'hwo g"gxgpvu0"

Text Cluster

Vj g"Vgzv'Enwuvgt"pqf g"hqmqy u'vj g"Vgzv'Rctukpi "cpf "vj g"Vgzv'Hknvgt"pqf gu'cpf "y cu"

wugf "vq"gzr nqtg"uko knctkvgu'cpf "f kuuko knctkvgu'y kij kp"vj g"f cvc0Vj ku'pqf g"wugu"

wpuwr gtxkugf "encuukhkecvkqp"vq"enwuvgt"vj g"kpf kxkf wcn'pcttcvkxgu'kpvq'i tqwr u'qh'pcttcvkxgu"

cpf "tgr qtvu'vj g"f guetkr vkxg'vgto u'hqt'vj qug"enwuvgtu'wukpi "c"ej qkeg"qh'vy q"cni qtkj o u"

*UCU."4239d+0UCUὶ "Vgzv'O kpgt"wugu'vj g"f ko gpukqpcnk{'tgf wevkqp'vgej pks wg"ncvgpv"

ugo cpvke"kpf gzkpi "*NUK."y j kej "go r nq{u'ukpi wnct"xcnwg"f geqo r qukvkqp"*UXF +'vq"ej cpi g"

vj g"qtki kpcn'y gki j vgf ."vgto /f qewo gpv'htgs wgpe{'o cvtkz"kpvq'c"f gpug"dw'nqy "f ko gpukqpcn'

tgr tgugpvcvkqp"d{"ugr ctcvkpi "qtki kpcn'vgto u"kpvq "nkpgctn{"kpf gr gpf gpv'grgo gpvu"

*Ej ctcdqtv{"gv'cn0"4235+0'Vj gug"grgo gpvu"ctg"eqpuvtwevu"ugr ctcvg"htqo "vj g"pqku{"

eqttgncvkqpu"kp"vj g"qtki kpcn'f cvc"cpf "cnqy "cr r tqzko cvkqp"qh'vj g"hwpf co gpvcn'uvtwevwtg"qh'

vj g"f cvc0D{"ki pqtkpi "vj g"o clqtkv{"qh'vj g"grgo gpvu"y j kej "j cxg"uo cnl'xcnwgu."vj g"

f ko gpukqpcnkv{"qh'vj g"f cvc"ecp"dg"tgf wegf 0NUK'eqo dkpgu"uwthceg"f cvc."qt"vj g"r cwgtp"qh'

qeewttgpeg"qh'vgto u"vj tqwi j qw'cnl'qh'vj g"pcttcvkxgu."kpvq "c"f ggr gt"eqpuvtwev'qh'ncvgpv'

ugo cpvke"f ko gpukqpu"vj cv'ecr wwtgu"vj g"o wwcnl'cuuqekcvkqpu"qh'vgto u"cpf "pcttcvkxgu"

*Ej ctcdqtv{"gv'cn0"4235+0"

Dqvj "cni qtkj o "qr vkqpu"wug"vj g"o cj go cvkecnl'o cvtkz"f geqo r qukvkqp"vgej pkswg"

UXF "vq "dtgcnl'f qy p"qtki kpcn'f cvc"kpvq "nkpgctn{"kpf gr gpf gpv'grgo gpvu0UXF "tgf wegu'j ki j "

f ko gpukqpcnl'f cvc"vq "c"nguugt'f ko gpukqp"y j kej "o qtg"engctn{"f guetkdgu"vj g"wpf gtn{kpi "

uvtwevwtg"qh'vj g"f cvc=d{"tgf wekpi "pqkug"cpf "tgf wpf cpe{."pgy "f ko gpukqpu"ecp"dgwgt"

f gr kev'vj g"eqtg"qh'gzkuvkpi "tgncvkqpuj kr u"kp"vj g"f cvc"*Vcf guug"("Ectr gpvgt."423: +0"

Kp"vj g"Vgzv'Enwuvgt"pqf g."vj g"tgf wevkqp"qh'vj g"f ko gpukqpcnkv{"qh'vj g"y gki j vgf "

vgto /d{/f qewo gpv'o cvtkz"ecp"dg"eqpvtqngf "d{"cf lwuvkpi "vj g"UXF "tguqnwvkqp"vq "nqy ."

o gf kwo ."cpf "j ki j 0Nqy "tguqnwvkqp"tguwnu"kp"cp"kpetgcugf "nquu"qh'kphqto cvkqp."y j krg"c"

j ki j "tguqnwvkqp"ugwkpi "tguwnu"kp"c"uo cngt'tgf wevkqp"kp"f ko gpukqpcnkv{"*Ej ctcdqtv{."

Rci qnw."("I ctnc."4235+0'Vj g"f ghcwnv'ugwkpi "hqt"UXF "tguqnwvkqp"ku"nqy ."cpf "vj g"f ghcwnv'

qr vkqp"hqt"cni qtkj o u"ku"vj g"gzr gevcvkqp/o czko k| cvkqp"*G/O +'cni qtkj o ."cnj qwi j "vj g"

j kgtctej kecnl'cni qtkj o "ecp"dg"ugngevgf 0Chvgt"c"tgxkgy "qh'tguwnu'wukpi "f khhgtgpv'ugwkpi u"

hqt"UXF "tguqnwvkqp"cpf "cni qtkj o u."vj ku"uwwf{"wugf "vj g"nqy "UXF "tguqnwvkqp"qr vkqp"cpf "

vj g"G/O "cni qtkj o ."y j kej "y cu"cp"kvgtcvkxg"r tqeguu0Chvgt"kpkkcnl'r ctco gvgt"uguo cvgu"y gtg"

qdvckpgf ."vj g"Vgzv'Enwuvgt"pqf g"cwwqo cvkecnn{"cr r nkgf "vj g"uvcpf ctf "qt"uecngf "xgtukqp"qh'

yj g"cri qtkij o "\q"hkpf "r tko ct{"enwuvgtu"cpf "wrf cvg"r ctco gvgt"guvko cvgu"*UCU."4239d+0'

Vgto kpcvkqp"qh"vj g"cri qtkij o "qeewttgf "yj gp"wy q"uweeguukxg"hgi /rkmgrkj qqf "xcnwgu"

f kihgtgf "d{"c"ugv"co qwpv"qt"yj gp"c"o czko wo "qh"hkxg"kvgtcvkqpu"y cu"cej kgxgf "*UCU."

4239d+0F guetkr vkxg"vgto u."htgswgpe{."cpf "r gtegpvci g"hqt"gcej "qh"vj g"vj tgg"enwuvgtu"

kf gpvkhkgf "d{"vj g"Vgzv"Enwuvgt"pqf g"ctg"kmwuvtcvgf "kp"Vcdng"340"

Table 12

Text Cluster Node Results: Descriptive Terms, Frequencies, and Percentages"'

Enwuvgt"	"F guetkr vkxg"Vgto u"	Htgswgpe{"	Rgtegpv'
3"	- kuuwg"'- rcvg"'- uj qrt√"- pwo dgt"'- eqo r cp{"' f ktgev"'- uvcvg"'- npqy "'- uj qy "'- dtkgh"- j cr r gp"' - pqvg"'- tgr qrt√"- eqpvcev"- i qqf "	5343"	45' "
4"	- erko d"'- hqqv√"- f guegpf "'- eqpvkpwg"'- ngxgn"' - j ki j "'ko o gf kcvgn{"- nqy "'- dgi kp"'- gxgpv"' - dtkgh"- eqpf kvkqp"'- ugeqpf "'- r cuu"'- tcvg"	5398"	45' "
5"	o ckpvgpcpeg"'- tgvwtp"'- r cuugpi gt"'- gpi kpg"' - o kpwvg"'- r tqegf wtg"'- twp"'- ukwucvkqp"' - cf xkug"'√tj "'- nki j √"- eqo r ngvg"'- kphqto "' - r tqdngo "'- ej gem'	9794"	77' "

Note."- "kpf kecvgu"vj g"vgto "ku"c"r ctgpv"vqr ke"cpf "kpenwf gu"uvo o gf "xgtukqpu"qh"vj g"vgto 0"

"

Vj gug"vj tgg"enwuvgtu"gcej "eqpvckp"fkhngtgp"f guetkr vkxg"vgto u"hqt"i tqwr u"qh"pcttcvkxgu"

tgr qrtgf "kp"vj g"qwr wv"htqo "vj g"Vgzv"Enwuvgt"pqf g0Vj g"hktuv"enwuvgt"kpenwf gu"vgto u"eqoqugn{"

kf gpvkhkgf "y kj "c"eqo r cp{/tgr qrtgf "kuuwg."y j kng"vj g"vgto u"kp"vj g"ugeqpf "enwuvgt"kpf kecvg"

cp"cuuqekcvkqp"y kj "hki j √"r j cugu."uwej "cu"erko dkpi "qt"f guegpf kpi 0Vj g"vj ktf "enwuvgtøu"

vgto u"ctg"tgncvgf "vq"gpi kpg"o ckpvgpcpeg"qt"r tqdngo u"cpf "vj g"kpxqrxgo gpv"qh"ej gemkuvu"qt"

r tqegf wtcn'cevkqpu0"

"

Cpqyj gt"qwr w'htqo "yj g"Vgzv'Enwuygt"pqf g"kpenwf gu"c"uecwgt"r nqv'uj qy kpi "yj g"

f kuvcpeg"dgwy ggp"enwuygtu"wukpi "c"Ectvgukcp"eqqtf kpcvg"u{uvgo "cpf "ku"f kur nc{gf "kp"Hki wtg"

340'Vj g"f kuvcpeg"dgwy ggp"yj g"enwuygtu"ku"o czko k| gf ."kpf kecvkpi "f kuuko knctk{"dgwy ggp"gcej "

qh'yj g"enwuygt"vqr keu0'Y j krg"yj g"f kuuko knctk{"dgwy ggp"enwuygtu"ku"gxkf gpv."yj g"uko knctk{"

dgwy ggp"vgto u"kpenwf gf "kp"yj g"enwuygtu"o c{"dg"ko kgf ."cu"yj g"Vgzv'Enwuygt"pqf g"cnqy u"

pcttcvkxgu"vq"dgnqpi "vq"qpn{"qpg"enwuygt0'Vj ku"o wwcm{"gzenwukxg"cuuki po gpv'cxqkf u"cp{"

qxgtncr "dw'r qvgpvkcn{"rko ku"yj g"hwm'f kueqxgt{"qh"o wnkr ng"vgto u"kpenwf gf "kp"pcttcvkxgu0'

Vj g"Vgzv'Vqr ke'pqf g"y cu"wugf "vq"gzr nqtg"vqr keu"yj cv'eqwf "dg"tgr tgugpvgf "kp"o wnkr ng"

pcttcvkxgu0"""

Text Topic"

Vj g"Vgzv'Vqr ke'pqf g"y cu"wugf "vq"f kueqxgt'ko r qtvcpv'vqr keu"kp"yj g"pcttcvkxg"vgzv0'

Vj ku"y cu"ceeqo r nkuj gf "d{"cwqo cvkecm{"cuuqekcvkpi "y qtf u"cpf "pcttcvkxgu"ceeqtf kpi "vq"

dqyj "wugt/f ghkpgf "cpf "f kueqxgtgf "vqr keu"qt'i tqwr u"qh'vgto u"f guetkdkpi "cpf "ej ctcevtk| kpi "

"

c''o ckp''yj go g''qt''kf gc''*UCUÌ."4239c+0'Kp''yj g''Vgz v''Enwugt''pqf g."gcej ''pcttcvkxg''ku''cuuki pgf ''

vq''c''wpks wg''i tqwr.''yj kej ''f kkhgtu''htqo ''yj g''Vgz v''Vqr ke''pqf g."yj gtg''c''ueqtg''ku''cuuki pgf ''vq''

gcej ''pcttcvkxg''cpf ''c''vgto ''vq''gcej ''qr ke0'Vgto u''cpf ''pcttcvkxgu''ecp''dgnqpi ''vq''o qtg''yj cp''

qpg''qr ke''qt ''vq''pqpg''cv''cnn''kp''Vgz v''Vqr ke0'Vj g''Vgz v''Vqr ke''pqf g''cnuq''wugu''UXF ''vq''ecr wtg''

kphqto cvkqp''htqo ''c''vgto /d{/f qewo gpv''o cvtkz''*Ej cmtcdqtv{''gv'cm0''4235+0''

C''ueqtg''y cu''cuuki pgf ''d{''yj g''Vgz v''Vqr ke''pqf g''hqt''gcej ''qr ke."yj kj ''c''qr ke''f ghkpgf ''

cu''c''eqmgevkqp''qh''vgto u''ej ctcevgtk| kpi ''cpf ''f guetkdkpi ''c''yj go g''*UCUÌ."4239c+0'Vj tguj qnf u''

ctg''wugf ''vq''f gvgto kpg''kh''cuuqekcvkqpu''ctg''tqdwuv''gpqwi j ''vq''eqpukf gt''yj g''pcttcvkxg''qt''vgto ''

yj cv''dgnqpi u''vq''c''qr ke=''yj wu."pcttcvkxgu''cpf ''vgto u''ctg''pqv''hko kgf ''vq''qpg''qr ke0'O wnkrrng''

kvgtcvkqpu''qh''vgz v'r ctukpi ."vgz v'hkngtkpi .''cpf ''vgz v'qr ke''y gtg''eqpf wevgf ''y kj ''cf f kkqpu''vq''

yj g''uvqr ''hkuv''vq''kf gpvkf{''yj g''qr ''ko r qtvcpv''qr keu0'Vj gug''qr keu''y gtg''o cpwcm{''tgxkgy gf ''hqt''

yj go gu.''cpf ''yj g''kvgtcvkxg''r tqeguu''y cu''eqpenwf gf ''y j gp''yj g''cf f kkqp''qh''gzenwf gf ''vgto u''

hckngf ''vq''{kgnf ''cf f kkqpcn''f kuvkpevkxg''qr keu0'Xctkcdng''ncdgnu''y gtg''yj gp''cuuki pgf ''vq''yj g''

qr keu0'Vcdng''35''eqpvckpu''yj gug''vgp''ko r qtvcpv''qr keu''cu''kf gpvkkhgf ''d{''yj g''Vgz v''Vqr ke''pqf g0''

Table 13

Text Topic Node Results for Topics, Assigned Variable Labels, and Topic Characteristics

Vqr ke''' KF ''	Xctkcdng'' Ncdgn'	Vqr ke''	P wo dgt''' qh'Vgto u''	P wo dgt''' qh'' F qewo gpvu''
3''	Ugpuqt{'' Rgtegr vkqp''	uo qng.''- uo gn''- qf qt.''' - uo gn''- hwo g''	729''	3324''
4''	Cktetchv'' Cevkqp''	- hqqv.''- erko d.''- f guegpf .''' - erko d.'''- ngxgn''	928''	4346''
5''	O ckpvgpcpeg'' Eqpegtpu''	- o kn''o ckpvgpcpeg.''o ckpvgpcpeg.''' - o gej cpke.''- y tkg''	::6''	3899''
6''	Gpi kpg''Kuuwg''	- gpi kpg.''- qkn''- uj wv.''- rghv'gpi kpg.''' ''- tki j v'gpi kpg''	72;''	38;2''

"

Vqrke"" KF "	Xctkcdng" Ncdgn'	Vqrke"	Pwo dgt"" qh'Vgto u"	Pwo dgt"" qh' Fqewo gpvu"
7"	U{uvgo " Cpqo cn{"	stj .'j {ftcwrle.'- u{uvgo .'gkeca.''- rlkij v'''	995"	3;65"
8"	Ecdkp" Chhgevgf"	- f kxgtv.'- r cuugpi gt.'- cwgpf cpv." o gf kecn.'- rlkij v'cwgpf cpv'	3322"	3;67"
9"	Ckt" Eqpf kkqpkpi "	- ecdkp.'- drggf .'- o cum"- r cem'" r tguuwtk|cvkqp'	836"	3384"
: "	Rcuugpi gt" F kutwr vkqp"	- r cuugpi gt.'- pqug.'- uvctv.'uj qtv.'''- f gr ncpg'	3257"	425; "
; "	Hrlkij v' Eqpf kkqp"	ho e.'- f guegpf .'- dtkgh.'- ngi .'- uy kej "	3249"	43: ; "
32"	Rqy gt "Ej cpi g"	yj twuv.'- r qy gt.'- eqpf kkqp.'- gxgpv." - hggn'	3298"	4259"

Note. - "kpf kecvgu'vj g'vgto "ku'c'r ctgpv'vqr ke'cpf "kpenwfgu'uvgo m gf "xgtukqpu'qh'vj g'vgto 0'

Cddtgxkcvkqpu'kpenwfg'O GN"*o kpko wo "gswkro gpv'lkuv+.'S TJ "*swkem'tghgtgpeg'j cpf dqqm+.'GKECU'

*gpi kpg/kpf kecvkpi "cpf "etgy /cngtvkpi "u{uvgo +.'cpf "HO E"*hrlkij v'o cpci go gpv'eqo r wgt+0'

"

Vj g'hktuv'vqr ke''*sensory perception*''kpenwfgu'vj g'gngo gpvu'eqo o qpn{'kf gpvkhkgf "d{ "

yj g'qrhcevqt{'cpf "xkuwcn'ugpugu'eqo o qpn{'wugf "kp "vj g'kf gpvkhkecvkqp'qh'WCS "gxgpvu.'qt"

yj g'r tgugpeg'qh'uo qmg.'hktg.'hwo gu.'qt'qf qtu0'Vj g'ugeqpf "vqr ke''*aircraft action*''eqpukuvu'qh'

o qxgo gpv'qh'vj g'ckretchv'uwej "cu'enko dkpi "qt'f guegpf kpi .'qt'ngxgn'hrlkij v.'y j kej "o c{ "

kphnwgpeg'hwo g'gxgpv0'*Maintenance concerns*''kpenwfgu'o ckpvgpcpeg.'o gej cpkeu.'cpf "

o kpko wo "gswkro gpv'lkuvu'y j kej "eqpvckp'r tqxkukqpu'hqt'hrlkij v'y kj "kpqr gtcvkxg'gswkro gpv'

dcugf "qp'vj g'eqpf kkqpu'qh'vj g'hrlkij v'cpf "cnqy "hqt'gswkro gpv'tgr cktu'vq'dg'f ghgttgf "wpvkl'c"

hwwtg'r qkpv'kp'vko g'*HCC.'4243d+0'Vj g'hqwtvj "vqr ke''*engine issue*''kpenwfgu'vj g'vgto u"

gpi kpg.'qkl'cpf "uj ww.'uwi i guvkpi "qr gtcvkqpcl'f khhkewnkgu'qt'gpi kpg'hcknwtg0'*System*

anomaly vqr ke''vgto u'kpf kecvg'u{uvgo "kttgi wlctkkgu.'uwej "cu'kp'vj g'j {ftcwrle'u{uvgo "qt'qpg'

kp'y j kej "hrlkij v'etgy "y qwnf "dg'pqvkhkgf "d{ "cp'cngtvkpi "rlkij v'qt'vj g'gpi kpg/kpf kecvkpi "cpf "

"

etgy /cngtvkpi "u{uvgo ."y j kej "r tqxkfgu'hnki j v'etgy u'y kj "kpuvtwo gpvcvkqp"cpf "cppwpekcvkqp"

hqt"gpi kpgu'cpf "qyj gt'kpvgi tcn'u{uvgo u0'Vj gug"cpqo cnkgu'o c{"dg'ugtkqwu'gpqwi j "vq"

y cttcpv'yj g'wug'qh'yj g's wkem'tghgtgpeg'j cpf dqqm'y j kej "ku'c's wkem/ceeguu'o cpwcn'

eqpvckpkpi "r tqegf wtgu'cr r nkecdng'f wtkpi "cdpqto cn'qr 'go gti gpe{"eqpfkkqpu0'Vj g'qr ke"

cabin affected "kpenwf gu'vgto u'y j cv'kpf kecvg'y j g'qeewr cpwu'qh'y j g'ecdkp.'yj g"r cuugpi gtu."cpf "

hnki j v'cwgpf cpvu'ctg'kpxqnxgf ."cpf "cnuq"kpenwf gu'yj g'vgto u'f kxgtv'cpf "o gf kecn0'Vj g'vgto u"

kpenwf gf "kp"yj g"ugxgpyj "qr ke"*air conditioning* "tghgt'vq"yj g"u{uvgo "cpf "ku"eqo r qpgpwu"

y j kej "r tqxkf g'dtgcyj cdng'ckt."uwej "cu'dngf ."r cem"cpf "r tguuwtk| cvkqp0'Vj g'*passenger*

disruption "qr ke"kpeqtr qtcvgu'vgto u'kpf kecvkpi "cp"kpvgttwr vkqp"qt"kpvgthgtgpeg"kp"r cuugpi gt"

ugtxkeg."uwej "cu'pqug."uvctv."cpf "f gr ncpg0'Vj g'qr ke"*flight condition* "kpenwf gu'yj g'vgto u"

f guegpf ."dtkgh."ngi ."cpf "hnki j v'o cpci go gpv'eqo r wgt."y j kej "ku'c'eqo r wgt"wugf "vq"

ecnewncvg'pcxki cvkqp."hnki j v'r ncppkpi ."qr vko k| gf "tqwvkpi ."cpf "r gthqto cpeg"eqo r wcvkqpu"

*J gtdgtqp."4234+.'uwi i guvkpi "cnvgtgf "hnki j v'r ncpu"qt"ej cpi gu'kp'tqwvkpi 0'Vj g'hkpcn'qr ke"

power change "kpenwf gu'vgto u'ko r n{kpi "cnvgtcvkqpu'kp'r qy gt'ugwkpi u'qt"cktetchv'

r tqr wnukqp0"

     Vj gug'vgp"qr keu'y gtg'kpeqtr qtcvgf "cu'xctkcdngu'kp'yj g'pgzv'uvgr u'kp'yj g"

f gxgnqr o gpv'qh'yj g'o qf gn0'Vj g'xcnwgu'cuuqekcvgf "y kj "gcej "ecug'hqt"gcej "qh'yj g'pgy "

xctkcdngu'y gtg'f qy pnqcf gf "htqo "UCÙ "GOÎ "cpf "cff gf "vq"yj g'CUTU'xctkcdngu'kp"cp"

Gzegnî "ur tgcf uj ggv'cpf "y gtg'wr nqcf gf "kpvq"UCÙ "Uwf kq'hqt"eqpxgtukqp"kpvq"c"UCÙ "

f cvcugv'hqt"wug'kp'yj g"o qf gnkpi "r tqeguu0

Data Mining Process and Results

     Vj g"UGO O C "r tqeguu'y cu'wugf "hqt"r gthqto kpi "yj g"f cvc"o kpkpi "cevkxkvkgu0'Vj g"

uco r ng."gzr nqtg."o qf kh{."o qf gn"cpf "cuuguu'uvgr u'f kf "pqv'qeewt"kp"c'uvtkev'eqpvkpwqwu"

r tqi tguukqp"cpf "y gtg"qhvgp"uwdlgev"vq"cp"kvgtcvkxg"crr tqcej 0'Vj g"UGO O C"r tqeguu"y cu"

kpkvkcvgf "cv"y j g"dgi kppkpi "qh'y j g"hktuv'uvci gu"qh'y j g"vgz v'o kpkpi "r tqeguu0""

Sample"

F cvc"y gtg"ugngevgf "d{"hknvgtkpi "hqt"y j g"f guktgf "uco r ng"qh'tgr qtvu"uwdo kwgf "

dgvy ggp"Lcpwct{"3."4237."cpf "F gego dgt"53."423; ."d{"hnki j v'cpf "ecdkp"etgy u"hqt"36"EHÍ "

Rctv'343"qr gtcvkqpu"htqo "y j g"CUÍU"f cvcdcug"cpf "f qy pnqcf gf "cu"cp"Gzegní "hkng0F cvc"

y gtg"cnuq"r ctvkvkqpgf "kpvq"vtckpkpi "*%62' +."xcnkf cvkqp"*%62' +."cpf "vguv"*%42' +"f cvc"ugwu"chvgt"

y j g"vgz v'o kpkpi "uvgr u"y gtg"eqo r ngvg0'

Explore

F cvc"y gtg"gzr nqtgf "hqt"qwwnkgtu."o kuukpi "xcnwgu."cpf "o kueqf gf "xctkcdng"xcnwgu"kp"

y j g"Gzr nqtg"pqf g."cu"y gnn'cu"o cpwcn{"tgxkgy gf 0'Hqwt"tgr qtvu"y gtg"f gngvgf ."cpf "ugxgtcn'

xctkcdng"xcnwgu"y gtg"eqttgevgf "chvgt"eqpuwncvkqp"y kj "cp'CUÍU'cpcn{uv'eqphkto gf "

o kueqf kpi "qh'y j g"ecugu"cpf "xcnwgu0""

Modify""

Cu'tgr qtvu"ctg"uwdo kwgf "vq"CUÍU."cpcn{uvu'tgxkgy "y j g'tgr qtvu"cpf "eqo dkpg"y j go "

kpvq"qpg"ecug"y j gp"vy q"tgr qtvgtu"uwdo kv'tgr qtvu"hqt"y j g"uco g"gxgpv0'Vj wu'gcej "CUÍU"

tgr qtv'eqpvckpu"c"o kpko wo "qh'qpg"pcttcvkxg"cpf "o c{"eqpvckp"vy q"pcttcvkxgu0'Y j gp"y j g"

ugeqpf "pcttcvkxg"eqpvckpu"pq"pgy "kphqto cvkqp."cpcn{uv'r tqxkf g"vgz v'uvcvkpi "uq"kp"y j g"

ugeqpf "pcttcvkxg"hkgnf 0'Hqt"vgz v'o kpkpi ."y j g'f cvcugv'y cu"o qf khkgf "vq"etgcvg"c"pgy "xctkcdng"

y j cv'eqpvckpgf "dqyj "pcttcvkxgu."y j gp"vy q"pcttcvkxgu"y gtg"r tqxkf gf 0'P cttcvkxgu'htqo "y j g"

ugeqpf "tgr qtvgt"y j kej "f kf "pqv'kpenwf g"pgy "kphqto cvkqp"y gtg"pqv'kpenwf gf "kp"y ku'pgy "

xctkcdng"y j kej "y cu'wugf "qpn{"hqt"y j g"vgz v'o kpkpi "r tqeguu0""

"

Ugxgtcn'xctkcdngu'kp'\j g'CUU'f cvcugv'eqpvckpgf "uq'o cp{'o kuukpi "xcnwgu'cu'vq'dg"

qh'rkwng'wug'kp'kf gpvkh{kpi "hcevqtu'cuuqekcvgf "y kj "\j g'vctig'xctkcdng'ngxgnu'cpf "y gtg"

gzenwf gf "htqo "\j g'o qf gnkpi "rtqeguu0Hqt'gzco r ng."ugxgtcn'xctkcdng'hkgnf u'hqt'f cvc"

kpxqnxkpi "c'ugeqpf "cktetchv'kp'c'tgr qtvgf "gxgpv'y gtg'hqwpf "vq'j cxg"o qtg'\j cp'pkpgv{"

r gtegpv'qh'\j g'egnu'go r v{.'cu'\j g'j cf "qpn{'dggp'qpg'cktetchv'kpxqnxgf "kp'\j g'gxgpw"

tgr qtvgf 0Xctkcdngu'y kj "o qtg'\j cp'hkhw{'r gtegpv'qh'\j g'xcnwgu'o kuukpi "y gtg'gzenwf gf "

htqo "\j g'o qf gn'f gxgnqr o gpv'rtqeguu0C'ukuv'qh'\j g'; 8'xctkcdngu'eqpvckpgf "kp'\j g'CUU"

f cvcugv.'\j gkt'ej ctcevgtkuvkeu.'cpf "\j g'pgy "xctkcdngu'etgcvgf "htqo "\j g'\gzv'o kpkpi "r tqeguu"

ku'hqwpf "kp'Cr r gpf kz'E.'Vcdng'E60'Vj g'hkpcn'f cvcugv'eqpukukpi "qh'\j g'xctkcdngu'htqo "\j g"

qtki kpcn'CTUT 'f cvcugv.'\j g'\gp'pgy "xctkcdngu'f gtkxgf "htqo "\j g'\gzv'o kpkpi "r tqeguu.'cpf "

\j g'vctig'xctkcdng'y gtg'wr nqcf gf "vq'UCU³ "Uvwf kq'kp'cp'Gzegn'hqto cv.'cpf "c'UCU³ "f cvcugv'

y cu'i gpgtcvgf "hqt'\j g'f gxgnqr o gpv'qh'\j g'o qf gn0Vj g'4; 'xctkcdngu'tgvckpgf "htqo "\j g"

CTUT'f cvcugv.'\j g'\gp'pgy "xctkcdngu'f gtkxgf "htqo "\j g'\gzv'o kpkpi "r tqeguu.'cpf "\j g'vctig'

xctkcdngu'y gtg'wugf "kp'\j g'f gxgnqr o gpv'qh'\j g'o qf gn="cn" qvj gt'xctkcdngu'y gtg'tglgevgf 0'

Model

Ukz 'o qf gnu'y gtg'dwknv'kp'UCU'GO "wukpi "hqwt'o cej kpg'ngctpkpi "cni qtkj o u."

kpenwf kpi "f gekukqp"vtgg."i tcf kgpv'dqquvkpi .'nqi kuvke'tgi tguukqp.'cpf "tcpf qo "hqtguv0Vj g"

UCU³ "r tqeguu'hnqy "f kci tco "ku'uj qy p'kp'Hki wtg'35'cpf "kpenwf gu'\j g'O qf gn'Eqo r ctg"

pqf g.'y j kej "y cu'wugf "vq'eqo r ctg'o qf gn'r gthqto cpeg'cpf "tcpm'\j g'o qf gnu0Vj g"

xcnkf cvkqp'f cvc øu'o kuencuukhecvkqp'tcvg'y cu'eqpukf gtgf "\j g'r tko ct{'cuuguuo gpv'o gcuwtg'qh"

o qf gn'ceewtce{.'cu'ku'cr r tqr tkcvg'hqt'c'ecvgi qtkecn'vctig v'xctkcdng0Vj g'o kuencuukhecvkqp"

tcvg'uki pkhkgu'\j g'r tgf kevkqp'gttqt.'y j kej "ku'\j g'uwo "qh'hcnug'r qukvkxgu'cpf "hcnug'pgi cvkxgu"

cu'f kxkf gf "d{'\j g'vqvcn'pwo dgt'qh'gxgpvu'*Vtwqpi "("Ej qk'4242+0Vj gtg'ctg'\j tgg'ngxgnu'qh"

"

gxgpvu"uwgf "kp"vj ku"uwf {<"tgr qtvgf "gxgpvu'pqv'tgncvgf "vq"WCS ."gxgpvu'tgncvgf "vq"WCS "dw"

ctg"pqv'hwo g"gxgpvu."cpf "gxgpvu'tgr qtvgf "cu'hwo g"gxgpvu0TQE"cpf "Nkhv'ej ctu"y gtg"

tgxkgy gf "vq"gzco kpg"vj g"r tgf kevkxg"r qy gt"qh"vj g"o qf gnu."cpf "vj g"tgncvkxg"xctkcdng"y qtj "

y cu'tgxkgy gf "vq"f gvgto kpg"vj g"ko r qtvcpeg"qh"gcej "xctkcdng'cuuqekcvgf "y kj "WCS "cpf "

hwo g"gxgpvu0'

"

Figure 13

Diagram from SAS Model Development Process

"
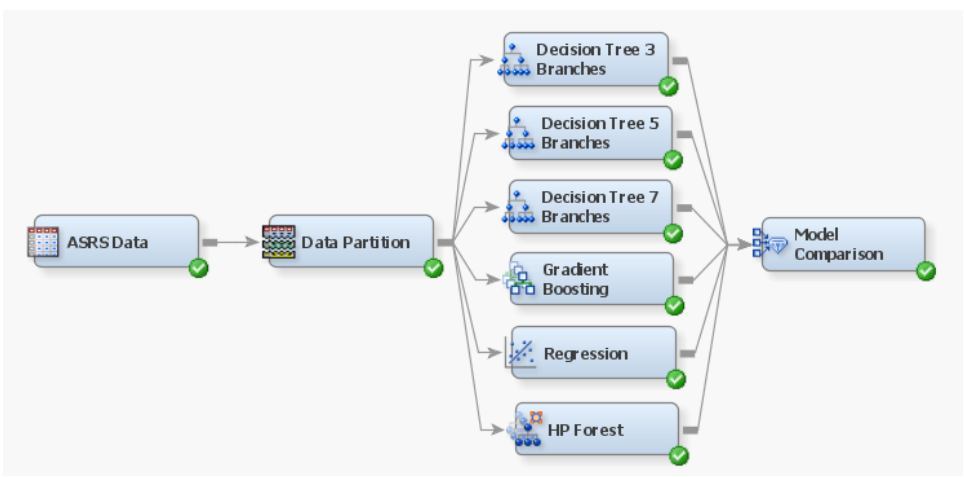
Assess

O qf gnu"y gtg"eqo r ctgf "cpf "gxcnwcvgf "wukpi "vj g"Eqo r ctg'O qf gn'pqf g"wpf gt"vj g"

Tgnkcdknkv{"cpf "Xcnkf kv{"Vguvkpi "Tguwnu'j gcf kpi 0Tguwnu'htqo "vj g"xcnkf cvkqp"f cvc"ctg"

wugf "vq"cuuguu'cpf "eqo r ctg"vj g"o qf gnu."y j kng"vj g"tguwnu'htqo "vj g"vguv'f cvc"ctg"wugf "vq"

cuuguu"vj g"i gpgtcnk| cdknkv{"qh"vj g"ugngevgf "o qf gn'y j gp"pgy "f cvc"ku"cpcn| gf 0'

O kuencuukhkecvkqp'tcvgu."cxgtci g"us wctgf "gttqt."cpf "TQE"kpf gz "tguwnu'hqt"vj g"ukz "o qf gnu"

eqpuvtwevgf "kp"vj ku"uwf {"ctg"hqwpf "kp"Vcdng"360Tguwnu'htqo "vj g"O qf gn'Eqo r ctkuqp"pqf g"

kpf kecvg"vj g"nqi kuvke'tgi tguukqp."i tcf kgpv'dqquvkpi ."tcpf qo "hqtguv."cpf "9/dtcpej "f gekukqp"

"

vtgg"o qf gnu'j cxg'uko knct"o kuemcuukhkecvkqp'tcvgu'cpf "cxgtci g'us wctgf "gttqt'xcnwgu'co qpi "

xcnkf cvkqp"cpf "vguv'f cvc."cpf "uko knct'TQE "kpf kegu'y kj 'pq'tguwnu'kpf kecvkpi "c"engct"

ej co r kqp"o qf gn0'

"

Table 14

Fit Statistics for Models for the Target Variable UAQ – Fume Event

O qf gn'	Vtckp" OT"	Vtckp" CUG"	Xcnkf " OT"	Xcnkf " CUG"	Vguv' OT"	Vguv' CUG"	Xcnkf " TQE"	Tcpm'
I tcf kgpv' Dqquv'	20232:3;"	2023839:"	2025;34"	20248544"	20256444"	20247448;"	20,97"	3141516"
Tcpf qo " Hqtguv'	2024::7"	2023798"	20259359"	2023:88"	202567:4"	2023:3:6"	20::"	3141516"
Nqi kuvke" Tgi tguukqp"	202533;6"	202376;5"	20257:97"	20239755"	20257525"	2023:256"	20::"	3141516"
9/dtcpej " Fgekukqp" Vtgg"	202497:9"	20236789"	202596;:"	2023;447"	2056;64"	2023:3:6"	20:8"	3141516"
7/dtcpej " Fgekukqp" Vtgg"	2024;5;3"	20237557"	2025:43;"	2023;269"	20257525"	2023:256"	20:5"	7"
5/dtcpej " Fgekukqp" Vtgg"	20247;87"	20236897"	2025:43;"	20422::"	20257885"	2023:893"	20,7:"	8"

Note. CUG'ku'Cxgtci g'Us wctgf "Gttqt.'O T "ku'O kuencuukhkecvkqp'Tcvg.'cpf "Xcnkf "kpf kecvu'"

tguwnu'htqo "vj g'cpcn{uku'qh'vj g'xcnkf cvkqp'f cvc0"

"

Reliability and Validity

Vj g'tgnkcdknkv{'qh'vj g'o qf gnu'y cu'cuuguugf "wukpi 'tguwnu'htqo "vj g'vtckpkpi ."

xcnkf cvkqp.'cpf "vguv'f cvc.'y j kng'o qf gn'xcnkfkv{'y cu'cuuguugf "wukpi "o kuencuukhkecvkqp'tcvgu"

vq'f gvgto kpg'o qf gn'ceewtce{.'cpf "TQE "kpf kegu'cpf "Nkhv'ewtxgu'vq'f gvgto kpg'o qf gn'

r tgf kevkxg'r qy gt0'Tgnkcdknkv{'ku'f go qpuvtcvgf "vj tqwi j "eqo r ctcdng'tguwnu'dgvy ggp"vj g"

vtckpkpi .'xcnkf cvkqp.'cpf "vguv'f cvc.'cu'uj qy p'kp'vj g'hqnqy kpi "vcdngu'cpf "kp'dgvy ggp"vj g"

"

o qf gnu'y j tqwi j "uko knctky{ "kp"Nkh{'ewtxg'tguwnu0'Cu'qdugtxgf "kp"Vcdng"36. 'tguwnu'dgvy ggp"

y j g"o qf gnu/o o kuc"ossuchhecvkqp"tcvgu'cpf "cxgtci g'us wctgf "gttqtu'hqt "tckpkpi ."xcnkfcvkqp. "

cpf "vguv'f cvc"y gtg'tgncvkxgn{ "eqpukuvgpv."y kj "pq"o qf gn'r tqf wekpi "xcuvn{ 'f kuuko knct 'tguwnu"

htqo "yj g"qyj gt "o qf gnu0"

Vj g'tgegkxgt "qr gtcvkpi "ej ctcevgtkuvke "*TQE+"kpf gz "ku"cp"kpf kecvqt "qh'y j g"xcnkfkv{ "

cpf "r tgf kevkxg "cdknkv{ 'qh'c"o qf gn0'Cu'r tgxkqwun{ "uvcvgf ."yj g"TQE "ewtxg"eqpukuvu"qh'c"i tcr j "

qh'ugpukvkxkv{ 'r nqwgf "ci ckpuv'ur gekhkekv{ ."y kj "c"r gthgev'r tgf kevkxg "o qf gn'j cxkpi "c"

ugpukvkxkv{ "cpf "ur gekhkekv{ "dqyj "gs wcn'vq"3"*Dgy kem'gv'cn0."4226+0'Vj g'j ki j gt "yj g"ugpukvkxkv{ "

cpf "yj g"ur gekhkekv{ ."yj g"ncti gt "yj g"ctgc"wpf gt "yj g"TQE "ewtxg"qh'y j g"o qf gn"qt "yj g"j ki j gt "

yj g"TQE "kpf gz."yj g"dgvvgt "yj g"o qf gnu'r gthqto cpeg0'Xcnwgu'htqo "Vcdng"36'kfgpvkh{ "yj g"

j ki j guv'TQE "kpf kegu'hqt "xcnkfcvkqp'f cvc"ctg"hqwpf "kp"yj g"tcpf qo "hqtguv'cpf "yj g"nqi kuvke "

tgi tguukqp"o qf gnu."hqnmqy gf "d{ "yj g"9/dtcpej "f gekukqp'vtgg"o qf gn'cpf "yj g"i tcf kgpv'

dqquvkpi "o qf gn0"

Vj g'r tgf kevkxg 'r qy gt "qh'y j g"o qf gnu'y cu'cnuq "gzco kpgf "d{ "eqo r ctkpi "yj g"Nkh{'

ewtxgu0'Vj g'Nkh{'ewtxgu'hqt "yj g"xcnkfcvkqp'f cvc'htqo "yj g"ukz"o qf gnu'ctg'r tgugpvgf "kp"Hki wtg"

360'Vj g"ewtxgu'tgr tgugpv'yj g"cdknkv{ "qh'y j g"o qf gn'vq"r tgf kev'yj g'vcti gv'xctkcdng'hqt "cnn'yj g"

gxgpvu"*Vtwqpi "("Ej qk"4242+. 'y kj "yj g"o qf gnu'y kj "dgvvgt'r tgf kevkxg'r qy gt'j cxkpi "c"

ncti gt "ctgc"wpf gr "yj g"ewtxg0'Vj gug"ewtxgu"ctg'xgt{ "uko knct. "kpf kecvkpi "uko knct'r tgf kevkxg"

r qy gt "co qpi "cnn'o qf gnu'cpf "tgrkcdknkv{ "co qpi "yj g"o qf gnu0'Vj g'uko knctkvkgu'qh'yj g"

o qf gnu/o o kuc}hhecvkqp'tcvgu. "cxgrci g'us wctgf "gttqr'xcnwgu. "Nkh{'ewtxgu. "cpf "eqpugpguu"

qh'TQE "kpf gz"xcnwgu'y cttcpv'hwtyj gr"gzco kpcvkqp'qh'y j g'qr "o qf gnu0'

"

Figure 14

Lift Chart from the Model Compare Node
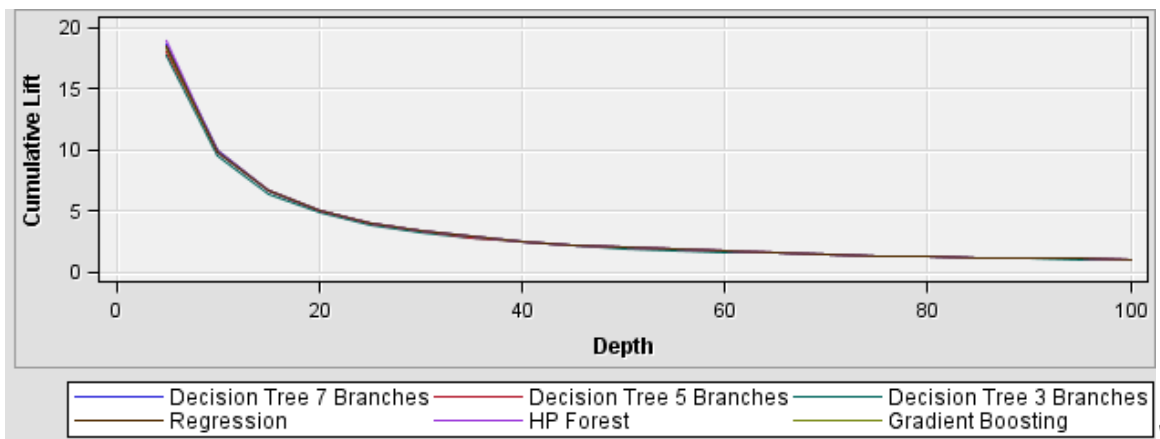
Gradient Boosting Model Results. Tguwnu'htqo "yj g'i tcf kgpv'dqquvkpi "o qf grl'
kpf kecvg'yj g'nqy guv'o kuencuukhecvkqp'tcvgu'hqt"yj g'vtckp'cpf "vguv'fcvc."kpf kecvkpi "yj g'o quv'
ceewtcvg"o qf grl'dcugf "qp"yj gug"etkvgtkc0'Vj g'xcnwg"hqt"yj ku'o qf gnu'o kuencuukhecvkqp"tcvg"
dcugf "qp"xcnkf cvkqp"f cvc"ku'yj g'nqy guv'co qpi "yj g'o qf gnu0'Vj g'TQE "kpf gz "ku'yj g'hkhyj /
ncti guv."ko r n{kpi "yj g'vqr "o qf gnu'ctg"uko knct"kp"yj gkr"r tgf kevkxg"cdknkv{"dw'xct{"urki j vn{"kp"
yj gkr"ceewtce{"cpf "r tgf kevkxg'r qy gt0'Vq "hwtyj gr"cuuguu"yj ku'o qf gn'c"eqphwukqp"o cvtkz "ku"
r tgugpvgf "kp"Vcdrg"370C "eqphwukqp"o cvtkz "cnqy u'xkuwcnk{ cvkqp"qh'yj g'r gthqto cpeg"qh'c"
o qf grl'qxgr"yj g'vguvkpi "f cvc"*GO E"Gf wecvkqp"Ugtxkegu."4237+0C"j ki j /r gthqto kpi "o qf grl'
y km'gzj kdkv/ncti g'pwo dgru'hqt"VR"cpf "VP "cpf "uo cm'pwo dgru'hqt"HR"cpf "HP 0'Vj ku'o qf grl'
r gthqto u'y gm'cu'yj g'j ki j guv'pwo dgru'ctg'hqwpf "kp"yj g'VR"cpf "VP "xcnwgu0'

Vj g'ugpukvkxkv{ "cpf "ur gekhkekv{ 'y gtg'ecnewncvgf "hqt"gcej "ngxgn'qh'yj g'vcti gv'xctkcdng"
cpf "ctg'hqwpf "kp"Vcdrg"380Ceeqtf kpi "vq "Vtwqpi "cpf "Ej qk'*4242+'ugpukvkxkv{ "o gcuwtgu"
yj g'vtwg'r qukvkxg'ecugu."qt"yj g'o qf gnu'cdknkv{ "vq"eqrrgevn{ "r tgf kev'c"WCS "qr "hwo g"gxgpv."
y j kng'ur gekhkekv{ "o gcuwtgu'yj g'vtwg'pgi cvkxg'htcevkqp"qr"yj g'o qf gnu'cdknkv{ "vq"eqrrgevn{ "

r tgf kev'gxgpvu'pqv'tgncvgf "q'WCS "qt'hwo g'gxgpvu0'Ugpukkxkv{'hqt "yj g'hktuv'ngxgn'*pqp/

WCS "qt'hwo g'gxgpv+'y cu'j ki j "cv'20 : 7.'o gcplkpi "yj g'o qf gn'eqwnf "ceewtcvgn{ 'r tgf kev'cp"

gxgpv'pqv'dgkpi "tgncvgf "q'WCS "gxgpvu'qt'hwo g'gxgpvu'; : 07'r gtegpv'qh'yj g'vko g0'Vj g"

ugpukkxkv{ 'xcnwg'hqt'ngxgnu'y q'cpf "yj tgg'kpf kecvgf "yj g'o qf gn'eqwnf "r tgf kev'WCS "gxgpvu"

6; 04'r gtegpv'qh'yj g'vko g'cpf "hwo g'gxgpvu'8: 0 "r gtegpv'qh'yj g'vko g0Ur gekhkekv{ 'xcnwgu"

kpf kecvg'yj g'o qf gn'ecp"eqttgevn{ 'r tgf kev': : 02'r gtegpv'qh'yj g'gxgpvu'yj cv'ctg'pqv'tgncvgf "q"

WCS "cpf "ctg'pqv'hwo g'gxgpvu'*ngxgn'qpg+.'cpf "; 90 "r gtegpv'qh'yj g'gxgpvu'yj cv'ctg'pqv'

WCS "gxgpvu."cpf "; : 0 "r gtegpv'qh'yj g'gxgpvu'yj cv'ctg'pqv'hwo g'gxgpvu0'Vj g'qxgtcnn'

r tgf kevkqp'ceewtce{ 'hqt'yj g'i tcf kgpv'dqquvkpi "o qf gn'ku'; 80'r gtegpv.'y kj "i qqf "r tgf kevkqp"

ceewtce{ 'cpf "i qqf "r tgf kevkxg'r qy gt'hqt'ngxgn'qpg'gxgpvu'dwv'ko kgf "r tgf kevkxg'r qy gt'hqt"

WCS "cpf "hwo g'gxgpvu0'

Table 15

Gradient Boosting Model Confusion Matrix

"	Rtgf kevgf "*3+"	Rtgf kevgf "*4+"	Rtgf kevgf "*5+"
Cewcn'*3+"	7376"]VR*3+_"	97"]HR*4+3+_"	7"]HP*3+_"
Cewcn'*4+"	47"]HR*3+4+_"	; 8"]VR*4+_"	76"]HP*4+_"
Cewcn'*5+"	3"]HR*3+5+_"	64"]HR*4+5+_"	; 7"]VP_"

Note."Y j gtg'*3+'ku'cp'gxgpv'pqv'tgncvgf "q'WCS =*4+'ku'cp'gxgpv'tgncvgf "q'WCS "dwv'ku'pqv'

c'hwo g'gxgpv='cpf "*5+'ku'cp'gxgpv'r gtegkxgf "d{ "yj g'tgr qtvgt'vq'dg'c'hwo g'gxgpv0'VR'ku'vtwg"

r qukkxg."VP "ku'vtwg'pgi cvkxg.'HR'ku'hcnug'r qukkxg.'cpf 'HP 'ku'hcnug'pgi cvkxg0'

"

Table 16

Gradient Boosting Model Sensitivity and Specificity

Gxgpv" V{r g"	P qp/WCS "qt"Hwo g" Gxgpv'*3+"	WCS "*4+"	Hwo g"Gxgpv'*5+"
Ugpukkxkv{"	20 : 7"	206; 4"	208: : "
Ur gekhkekv{"	20 : 2"	20 9: "	20 : ; "

"

Vj g"Nkhv'ewtxgu"hqt"vj g"i tcf kgpv'dqqquvkpi "o qf gnsu'tckpkpi "cpf "xcnkf cvkqp'f cvc"ctg" hqwpf "kp"Hki wtg"370'Vj g"tckpkpi "cpf "xcnkf cvkqp'ewtxgu"ctg"xgt{"uko knct.'ci ckp'kpf kecvkpi " i qqf "o qf gn'tgnkcdknkv{0'Vj g'xcnwg"qh'; 07; "ku"gs wcn'q"vj cv'qh'vj g'tcpf qo "hqtguv'cpf "vj g" f gekukqp"vtgg"o qf gnuø'Nkhv'ewtxg"xcnwgu0'

Figure 15

Gradient Boosting Model Lift Curve
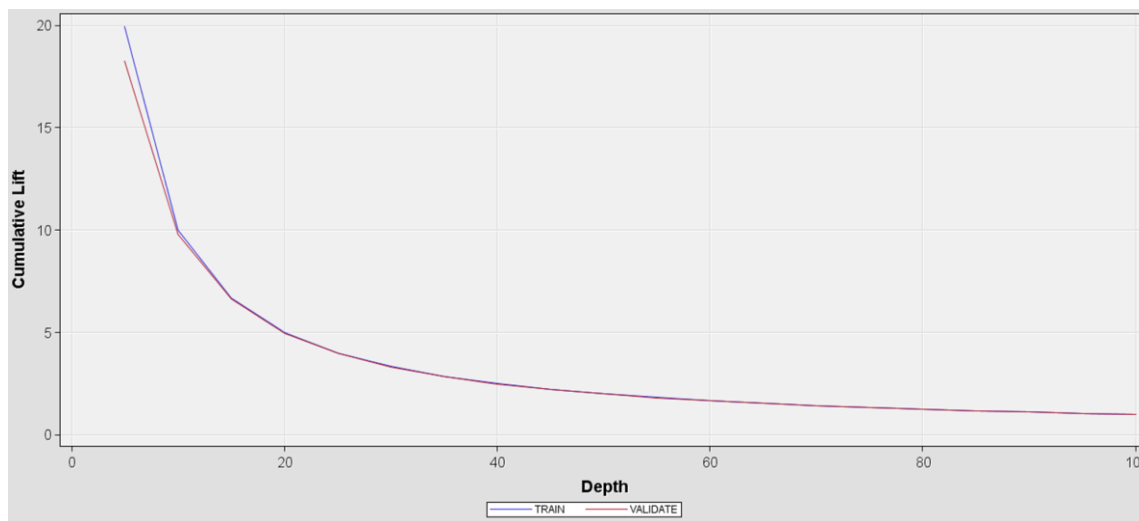
Random Forest Model Results. Vj g'tcpf qo "hqtguv'o qf gn'r tqf wegf "vj g"ugeqpf/ nqy guv'o kuenuukhkecvkqp'tcvg"cpf "vj g"ugeqpf/nqy guv'cxgtci g'us wctgf "gttqt"xcnwgu"cpf 'j cf "

"

cp'kf gpvkecn'TQE"kpf gz"xcnwg"cu'\j g"nqi kuvke"tgi tguukqp"o qf gn"y j kej "y cu'cnuq"\j g'j ki j guv"

TQE"kpf gz0'Vj g"eqphwukqp"o cvtkz"cu'uj qy p"kp"Vcdng"39"kpf kecvgu'xcnwgu'uko knct"\q"\j qug"

r tqxkf gf "d{ "\j g"i tcf kgpv"dqquvkpi "o qf gn0'Ugpukvkxkv{ "cpf "ur gekhkekv{ "xcnwgu'y gtg"

ecnewncvgf "hqt "gcej "ngxgn'qh'\j g"\cti gv"xctkcdng"cpf "ctg"hqwpf "kp"Vcdng"3: 0'Ugpukvkxkv{ "

xcnwgu'hqt "WCS "gxgpvu'cpf "hwo g"gxgpvu'ctg"uki j n{ "ko r tqxgf "qxgt "\j qug"qh'\j g"i tcf kgpv"

dqquvkpi "o qf gn"cpf "\j g"ur gekhkekv{ "xcnwgu'hqt "\j g"eqttgev"r tgf kevkqp"qh'gxgpvu'\j cv'ctg'pqv"

WCS "cpf "pqv'hwo g"gxgpvu'ctg"cnuq "uki j n{ "ko r tqxgf 0'Qxgtcn'r tgf kevkqp"ceewtce{ "qh'\j ku'

o qf gn'ku'; 805'r gtegpv. "o cti kpcn{ "dgwgt "\j cp"\j cv'qh'\j g"i tcf kgpv'dqquvkpi "o qf gn0'

Table 17

Random Forest Model Confusion Matrix

"	Rtgf kevgf "*3+"	Rtgf kevgf "*4+"	Rtgf kevgf "*5+"
Cewcn'*3+"	737; "]VR*3+_"	: 4"]HR*4+3+_"	9"]HP *3+_"
Cewcn'*4+"	43"]HR*3+4+_"	; 4"]VR*4+_"	79"]HP *4+_"
Cewcn'*5+"	2"]HR*3+5+_"	5; "]HR*4+5+_"	; 2"]VP _"

Note. "Y j gtg '*3+'ku'cp"gxgpv'pqv'tgncvgf "\q "WCS ="*4+'ku'cp"gxgpv'tgncvgf "\q "WCS "dw'ku'pqv'

c'hwo g"gxgpv=cpf '*5+'ku'cp"gxgpv'r tgekevgf "d{ "\j g'tgr qtvgt "\q 'dg'c'hwo g"gxgpv0'VR'ku'ttwg"

r qukvkxg. "VP "ku'ttwg'pgi cvkxg. "HR'ku'hcnug'r qukvkxg. "cpf "HP "ku'hcnug'pgi cvkxg0'

"

Table 18

Random Forest Model Sensitivity and Specificity

Gxgpv" V{r g"	P qp/WCS "qt'Hwo g" Gxgpv'*3+"	WCS "*4+"	Hwo g'Gxgpv'*5+"
Ugpukvkxkv{ "	20 : 5"	20762"	208; ; "
Ur gekhkekv{ "	20 ; 9"	20 ; 9: "	20 : : "

"

Vj g"Nkhv'ewtxg"ku"uko knct"\q"\j g"j ki j /tcpmkpi "o qf gnu"y kyj "\j g"\tckpkpi "cpf "

xcrkf cvkqp"ewtxgu"cr r gctkpi "xgt{"uko knct."cu"uj qy p"kp"Hki wtg"380"Vj ku"Nkhv'ewtxg"xcnwg"qh"

; 07; 9"ku"gs wcn'\q"\j cv'qh"\j g"tcpf qo "hqtguv'cpf "\j g"f gekukqp"vtgg"o qf gnu0"Nkhv'ewtxg"xcnwgu."

kpf kecvkpi "\j g"\j tgg"o qf gu"ctg"uko knct"kp"r tgf kevkxg"r qy gt."dcugf "qp"\j ku"hcevqt0'

Figure 16

Random Forest Model Lift Curve
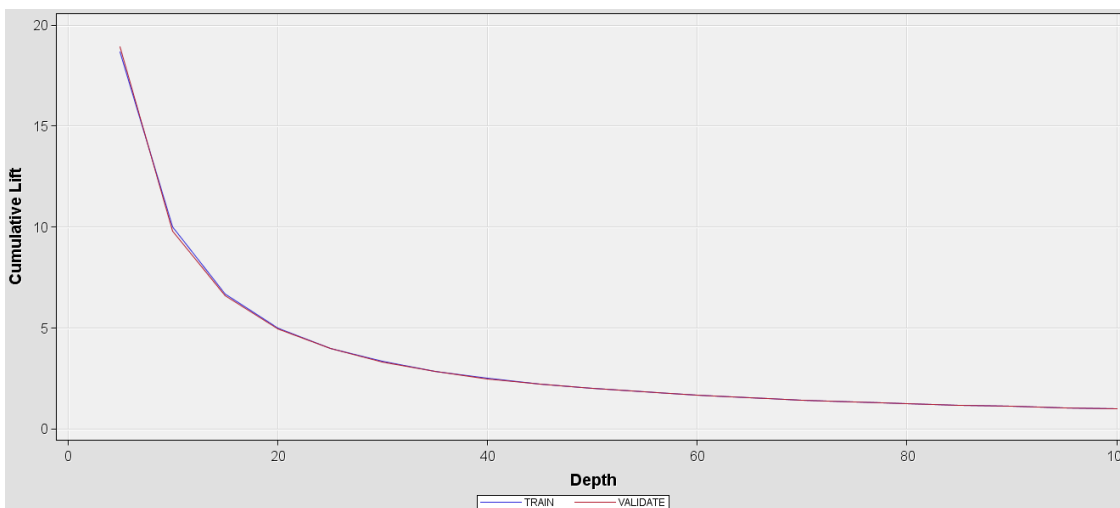
Logistic Regression Model Results. Vj g"nqi kuvke"tgi tguukqp"o qf gn'r tqf wegf "\j g"

nqy guv'xcnwgu"hqt"O T "cpf "CUG."dcugf "qp"xcrkf cvkqp"f cvc0'Vj ku"o qf gn'uj ctgf "\j g"j ki j guv'

xcnwg"hqt"\j g"TQE"kpf gz"y kyj "\j g"tcpf qo "hqtguv'o qf gn0'C"eqphwukqp"o cvtkz "hqt"\j ku"

o qf gn'ku"hqwpf "kp"Vcdng"3; ."cpf "\j g"ugpukvkxkv{"cpf "ur gekhkekv{"xcnwgu"ctg"r tgugpvgf "kp"

Vcdng"420'Xcnwgu"hqwpf "kp"\j g"eqphwukqp"o cvtkz "ctg"uko knct"\q"\j qug"qh"\j g"i cf kgpv'

dqquvkpi "cpf "\j g"tcpf qo "hqtguv'o qf gn0'Vj g"ugpukvkxkv{"xcnwg"hqt"\j g"eqttgev'r tgf kevkqp"qh"

WCS "gxgpvu"ku"j ki j gt"\j cp'hqt"\j g"i cf kgpv'dqquvkpi "qt"\j g"tcpf qo "hqtguv'o qf gn'cv'79&0"

r gtegpv."cnj qwi j "\j g"ur gekhkekv{"qt"\j g"cdkntkv{"\q"eqttgev{"r tgf kev'\j g"gxgpvu"pqv'tgncvgf "\q"

"

WCS "qt"hwo g"gxgpvu": 70, "r gtegpv"qh"vj g"ko g"ku"vj g"nqy guv"qh"vj g"vj tgg"o qf gnu"cuuguugf 0'

Vj g"qxgtcnl"r tgf kevkqp"ceewtce{ "qh"vj ku"o qf gnl"ku"vj g"j ki j guv"qh"cnl"o qf gnu"cv'; 806 "r gtegpv0'

Table 19

Logistic Regression Model Confusion Matrix

"	Rtgf kevgf "*3+"	Rtgf kevgf "*4+"	Rtgf kevgf "*5+"
Cewcn"*3+"	7369"]VR*3+_"	94"]HR*4+3+_""	9"]HP*3+_"
Cewcn"*4+"	52"]HR*3+4+_"	322"]VR*4+_"	68"]HP*4+_"
Cewcn"*5+"	5"]HR*3+5+_"	63"]HR*4+5+_"	323"]VP_"

Note. "Y j gtg"*3+"ku"cp"gxgpv"pqv"tgncvgf "vq"WCS =*4+"ku"cp"gxgpv"tgncvgf "vq"WCS "dwv"ku"pqv"

c"hwo g"gxgpv="cpf "*5+"ku"cp"gxgpv"r tegkxgf "d{ "vj g"tgr qtvgt"vq"dg"c"hwo g"gxgpv0'VR"ku"vtwg"

r qukkxg. "VP "ku"vtwg"pgi cvkxg. 'HR"ku"hcnug"r qukkxg. "cpf "HP "ku"hcnug"pgi cvkxg0'

Table 20

Logistic Regression Model Sensitivity and Specificity

Gxgpv" V{r g"	P qp/gxgpv"*3+"	WCS "*4+"	Hwo g"gxgpv"*5+"
Ugpukkxkv{ "	20: 7"	20792"	208; 9"
Ur gekhkekv{ "	20 7; "	20, 9; "	20, ; 2"

"

Vj g"Nkhv'ewtxg"hqt"vj g"vtckpkpi "f cvc"ku"xgt{ "uko kct"vq"vj g"ewtxg"hqt"vj g"xcnkf cvkqp"

f cvc"y j kej "ko r nkgu"o qf gnl'tgnkcdknkv{ ."cu"uggp"kp"Hki wtg"390'Vj g"Nkhv'xcnwg"qh'; 0948 "ku"vj g"

j ki j guv"qh"vj g"r tgf kevkxg"o qf gnu"f gxgnqr gf "kp"vj ku"uvwf { ."uwi i guvkpi "dcugf "qp"vj ku"

etkvgtkqp."vj g"nqi kuvke"tgi tguukqp"o qf gnl'j cu"vj g"j ki j guv"r tgf kevkxg"r qy gt"co qpi "vj g"

o qf gnu0"

"

Figure 17

Logistic Regression Model Lift Curve
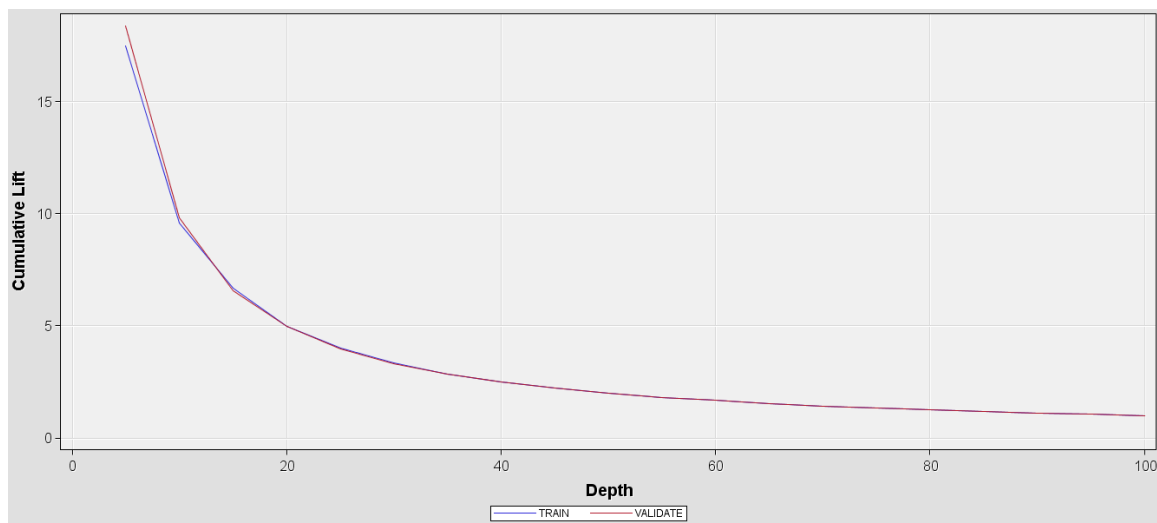
7-branch Decision Tree Model Results. Vj ku"o qf gn"r tqf wegf "vj g"vj ktf /nqy guv"

o kuncuukhhecvkqp'tcvg"chvgt"vj g"nqi kuvke"tgi tguukqp"cpf "vj g"tcpf qo "hqtguv"o qf gnu"wukpi "vj g"

xcnkf cvkqp"cpf "vguv'f cvc"cpf "j cf "vj g"ugeqpf /j ki j guv'TQE"kpf gz"cv'20, : 8"chvgt"vj g"tcpf qo "

hqtguv"cpf "nqi kuvke"tgi tguukqp"o qf gnu."y j kej "y gtg"dqvj "20, : : 0'Vj g"eqphwukqp"o cvtkz"cpf "

ugpukvkxkv{"cpf "urgekhkekv{"xcnwgu"ctg"hqwpf "kp"Vcdngu"43"cpf "44."tgurgevkxgn{0'Tguwnu"

htqo "vj g"eqphwukqp"o cvtkz"ctg"tgncvkxgn{"eqpukuvgpv'y kj "vj g"o qf gnu'r tgxkqwun{"cuuguugf 0'

Vj g"ugpukvkxkv{"xcnwgu"hqt"vj g"eqttgev'r tgf kevkqp"qh"WCS "ctg"vj g"ugeqpf /nqy guv."chvgt"vj g"

i tcf kgpv'dqquvkpi "o qf gn"cpf "hqt"hwo g"gxgpvu."vj ku"o qf gn'uj qy u"vj g"nqy guv'ugpukvkxkv{."qt "

vj g"ngcuv'cdknkv{"vq"eqttgevn{"r tgf kev'hwo g"gxgpvu0'Vj g"ur gekhkekv{."qt"vj g"cdknkv{"vq"eqttgevn{"

r tgf kev'gxgpvu'pqv'tgncvgf "vq"WCS "qt"hwo g"gxgpvu."j cf "vj g"j ki j guv'xcnwg"qh"vj g"o qf gnu"

cuuguugf 0'Vj g"qxgtcnn'r tgf kevkqp"ceewtce{"hqt"vj g"9/dtcpej "f gekukqp"vtgg"o qf gn'ku"; 805"

r gtegpv0'

Table 21

7-branch Decision Tree Model Confusion Matrix

"	Rtgf kevgf "*3+"	Rtgf kevgf "*4+"	Rtgf kevgf "*5+"
Cewcerl*3+"	7384"]VR₍₃₎"	: 6"]HR₍₄₊₃₊₎"	7"]HP ₍₃₊₎"
Cewcerl*4+"	38"]HR₍₃₊₄₊₎"	: ; "]VR₍₄₊₎"	83"]HP ₍₄₊₎"
Cewcerl*5+"	4"]HR₍₃₊₅₊₎"	62"]HR₍₄₊₅₊₎"	: : "]VP _"

Note. "Y j gtg"*3+"ku"cp"gxgpv"pqv"tgncvgf "vq"WCS ="*4+"ku"cp"gxgpv"tgncvgf "vq"WCS "dww"ku"pqv"

c"hwo g"gxgpv="cpf "*5+"ku"cp"gxgpv"r tegkxgf "d{ "vj g"tgr qtvgt"vq"dg"c"hwo g"gxgpv0"VR"ku"vtwg"

r qukkxkg. "VP "ku"vtwg"pgi cvkxg. "HR"ku"hcnug"r qukkxkg. "cpf "HP "ku"hcnug"pgi cvkxg0'

"

Table 22

7-branch Decision Tree Model Sensitivity and Specificity

Gxgpv" V{r g"	P qp/WCS "qt"Hwo g" Gxgpv"*3+"	WCS "*4+"	Hwo g"Gxgpv"*5+"
Ugpukkxkv{"	20: 5"	20758"	20899"
Ur gekhkekv{"	20 2: "	20 99"	20: : "

"

Uko knct"vq"vj g"qvj gt"o qfgnu. "vj g"Nkhv'ewtxg"hqt"vj g"vtckpkpi "fcvc"ku"xgt{ "uko knct"vq"

vj g"ewtxg"hqt"vj g"xcnkfcvkqp"fcvc"y kej "ko r nkgu"o qfgn"tgnkcdknkv{. "cu"uggp"kp"Hki wtg"3: 0'

Vj g"Nkhv'xcnwg"qh'; 07; 9"hqt"vj g"9/dtcpej "fgekukqp"vtgg "ku"gs wcn"vq"vj g"Nkhv'xcnwgu"qh'j g"

tcpfqo "hqtguv'cpf "i tcf kgpv'dqquvkpi "o qfgn0"

"

Figure 18"

7-branch Decision Tree Model Lift Curve

??"

"
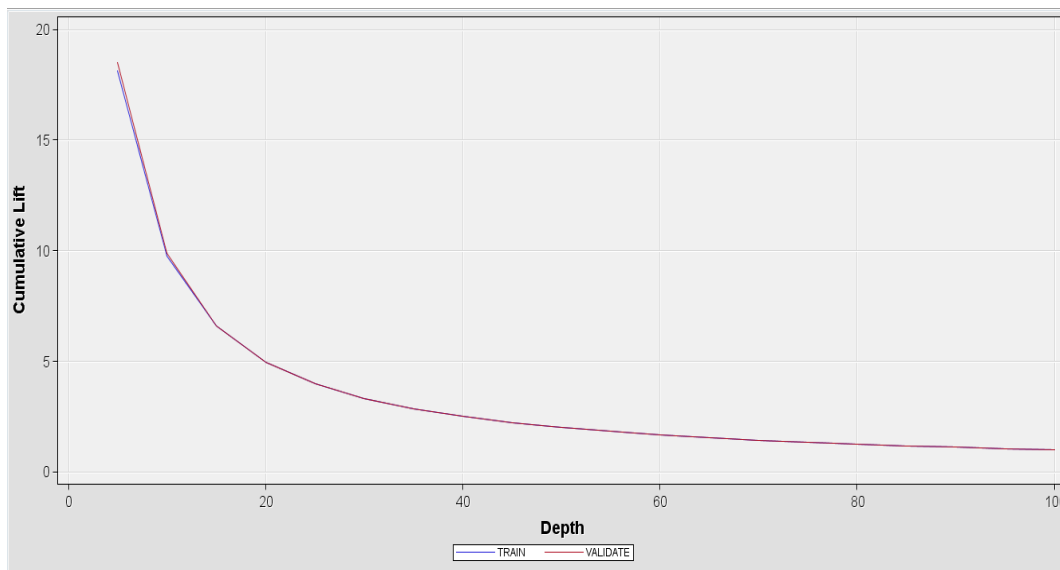
Vj g"xcnwgu"hqt"cuuguuo gpv"qh"vj g"xcnkf kv{"cpf "tgnkcdknkv{"dgw ggp"o qf gnu"ctg"
uko knct"cpf "kpf kecvg"uki j vn{"dgwgt"r gthqto kpi "o qf gnu"ctg"dcugf "qp"f khhgtgpv"etkvgtkc"y kj "
pq"qpg"o qf gn'go gri kpi "cu'c"engct"ej co r kqp"o qf gn0'C "uwo o ct{"qh'r gekukqp"cpf "
ceewtce{"tguwnu"hqt"vj g"r gf kevkqp"qh'hww g"gxgpvu"*ngxgn'vj tgg"qh'vj g"ctgi gv"xctkcdng+"hqt"
vj g"vqr "hqwt"o qf gnu"dcugf "qp"xcnkf cvkqp"f cvc"ku"uj qy p"kp"Vcdng"450"

Dcugf "qp"vj g"xcnwgu"uj qy p."vj g"nqi kuvke"tgi tguukqp"o qf gn'f kur nc{u"uki j vn{"dgwgt"
ceewtce{"vj cp"vj g"qvj gt"o qf gnu=j qy gxgt."vj g"hqwt"o qf gnu"ctg"eqo r ctcdng"cpf "gcej "eqwnf "
dg"tgeqo o gpf gf "y kj "tgcuqpcdng"gzr gevcvkqpu"qh'ceewtce{0'Ugpukkxkv{."vj g"twg"r qukkxg"
tcvg."qt"vj g"o qf gnu'cdknkv{"vq"eqttgevn{"r gf kev'hww g"gxgpvu"ku'j ki j guv'hqt"vj g"tcpf qo "
hqtguv'o qf gn'cpf "cnqy u"vj g"o qf gn'vq"r gf kev'hww g"gxgpvu"8; 0 "r gtegpv'qh'vj g"ko g0'Vj g"
hcnug"r qukkxg"tcvg."y j kej "tghngevu"V{r g"Kgttqtu."tcpi gu"htqo "302"vq"304"r gtegpv."y j ng"vj g"
hcnug"pgi cvkxg"tcvg."y j kej "tghngevu"V{r g"KK'gttqtu'tcpi gu."htqo "4; 05"vq"5405"r gtegpv0'

"

Rtgf kevkxg"r tgekukqp"xcnwgu."qt"j qy " enqug"y\j g"o qf gnu"r tgf kevgf "gxgpvu"ctg"vq "\j g"cewcn"

gxgpvu"ctg"dgwgt"\j cp"72"r gtegpv"hqt"cnm"o qf gnu"y kj "\j g"nqi kuvke"tgi tguukqp"o qf gn"

gzj kdkvkpi "\j g"o quv"r tgekukqp0"Cnm"\j g"o qf gnu"f kurnc{gf "j ki j "pgi cvkxg"r tgf kevkqp"tcvgu."

kpf kecvkpi "cp"cdkmkv{ "vq "eqttgevn{ "r tgf kev"\twg"pgi cvkxg"gxgpvu0"Vj g"hwtj gt "\j g"pwo dgt"qh"

qdugtxcvkqpu"qh"\j g"gxgpv"htqo "\j g"pwo dgt"qh"r tgf kevgf "gxgpv."\j g"nguu"wughwn"\j g"

o qf gnu"ctg"cv"r tgf kevkpi "cewcn"gxgpvu0"Ceeqtf kpi "vq "J cp"cpf "Mco dgt"%4228+."ugpukkxkv{ "

qt"tgecnm"y j kej "ku"\j g"cdkmkv{ "qh"c"o qf gn"vq "hkpf "cnm"qh"\j g"tgngxcpv"gxgpvu"y kj kp"\j g"

f cvcugv."ku"\j g"o gvtke"vq "dg"wugf "vq "ugngev"\j g"dguv"o qf gn"y j gp"\j gtg"ku"c"j ki j "equv"

cuuqekcvgf "y kj "hcnug"pgi cvkxgu"%Uj wpi ."423: +0"Kp"\j g"ecug"qh"hwo g"gxgpvu."y j keh "j cxg"\j g"

r qvgpvkcn"hqt"ecwug"qt"ej tqpkc"ghhgevu"qp"etgy "o go dgtu\u0"cpf "r cuugpi gtu\u0"j gcnj "cpf "

uchgv{ ."hcnug{ "kf gpvkh{kpi "cp"gxgpv"cu"pgi cvkxg"eqwnf "j cxg"f ktg"eqpug wgpegu0"Wukpi "\j ku"

etkvgtkqp."\j g"tcpf qo "hqtguv"o qf gn"hqmqy gf "d{ "\j g"nqi kuvke"tgi tguukqp"o qf gn"j cxg"\j g"

j ki j guv"tgecnm"xcnwgu"cpf "uj qwnf "dg"wugf 0"Vj g"cuuguuo gpv"uwo o ct{ "hqt"\j g"nqi kuvke"

tgi tguukqp"o qf gn"ku"hqwpf "kp"Crrgpf kz "G0"Vj g"UCŜ"eqf gu"hqt"\j g"i tcf kgpv"dqquvkpi ."

tcpf qo "hqtguv."cpf "9/dtcpej "f gekukqp"vtgg"o qf gnu"ctg"hqwpf "kp"Crrgpf kegu"H."I ."cpf "J 0"

Table 23

Precision and Accuracy Values for Fume Event Prediction for Validation Data for Top

Four Models

"	O qf gn"			
O gcuwtg"	""I tcf kgpv" ""Dqquvkpi "	Tcpf qo " Hqtguv"	Nqi kuvke" Tgi tguukqp"	9/dtcpej " Fgekukqp"Vtgg "
Rtgf kevkqp" Ceewtce{"	"" "20; 83"	20 85"	20 86"	20 85"
Ugpukkxkv{"	"" "208: : "	208; : "	208; 9"	20899"
Ur gekhkekv{"	"" "20 : ; "	20 : : "	20 ; 2"	20 : : "
Rqukkkxg" Rtgf kevkqp" Xcnwg"	"" "20839"	207: 6"	20878"	20793"
P gi cvkxg" Rtgf kevkqp" Xcnwg"	"" "20 ; 4"	20 ; 5"	20 ; 4"	20 ; 4"

"

"

Importance of the Variables

Xctkcdng"ko r qtvcpeg"hqt"vj g"ugeqpf"cpf "vj ktf "ngxgnu"qh"vj g"vcti gv'xctkcdng"cu"

fgvgtokpgf "d{"vj g"hqwt"vqr/tcpmkpi "o qf gnu'ku"eqpukuvgpv'cetquu"vj g"o qf gnu0Tguwnu'htqo "

vj g"i tcf kgpv'dqquvkpi "o qf gn'tcpmgf "vj g"xctkcdng"ugpuqt{"r gtegr vkqp"cu"vj g"o quv'ko r qtcpv'

xctkcdng."hqnqy gf "d{ "u{uvgo "cpo cn{."ecdkp"chhgevgf ."cktetchv'cevkqp."r cuugpi gt"

fkutwr vkqp."ckt "eqpfkvkqpkpi ."o ckpvgpcpeg"eqpegtp."r qy gt"ej cpi g."gpi kpg"kuuwg."cpf "hnki j v'

eqpfkvkqp0C "vqvcn'qh"vy gpv{/qpg"xctkcdngu'y gtg"tcpmgf "cu'xctkcdngu'qh'ko r qtcpeg=vj gug"

tguwnu'ctg"hqwpf "kp"Vcdng"460Vy gpv{/vy q'xctkcdngu'y gtg"tcpmgf "kp"tguwnu'htqo "vj g"

tcpf qo "hqtguv'o qf gn'y kj "ugpuqt{'r gtegr vkqp"tcpmgf "cu'j cxkpi "vj g'j ki j guv'ko r qtcpeg."

"

hqmqy gf "d{ "u{uvgo "cpqo cn{. "cktetchv'cevkqp. "r cuugpi gt "f kutwr vkqp. "ecdkp "chhgevgf . "ckt "

eqpf kvkqpkpi . "r qy gt "ej cpi g. "gpi kpg "kuuwg. "o ckpvgpcpeg "eqpegtp. "cpf "hnki j v'eqpf kvkqp0"

Vj gug "tguwnu "ctg "hqwpf "kp "Vcdng "470"

    "

Table 24

Gradient Boosting Model Variables of Importance Results

Xctkcdng "P co g"	Ur rkvvkpi "Twngu"	Ko r qtvcpeg"	Xcrkf cvkqp" Ko r qtvcpeg"	Tcvkq "qh" Xcrkf cvkqp "vq" Vtckpkpi " Ko r qtvcpeg"
Ugpuqt{ "Rgtegr vkqp"	; ; 2"	3"	3"	3"
U{uvgo "Cpqo cn{"	7: 5"	20529; 657: 8"	2036369278: "	2067; 62639"
Ecdkp "Chhgevgf "	784"	20528662; 36"	2034; 5; 67; "	2064446; 94"
Cktetchv'Cevkqp"	692"	204; : 53; 923"	2033585; 52: "	205; 2384453"
Rcuugpi gt 'F kutwr vkqp"	6: ; "	204; 5: 8; 876"	202; ; 9; 524"	2055; ; 95; 76"
Ckt "Eqpf kvkqpkpi "	723"	204942; ; 595"	2034242799 4"	206639937: : "
O ckpvgpcpeg "Eqpegtp"	7: 2"	2047: 955753"	202; 422354: "	205777: 553; "
Rqy gt "Ej cpi g"	749"	20468359258"	202; 65: : 377"	205: 569: 28: "
Gpi kpg "Kuuwg"	63: "	2045; 986395"	202; 77685: : "	205: ; 723744"
Hnki j v'Eqpf kvkqp"	62; "	20447; 34828"	202; 68; : 797"	2063; 3: 4563"
Vko g "F cvg"	529"	203: : 696675"	202: 4697674"	2065 97: 6; 7; "
Vko g "Nqecn'Vko g "Qh'F c{ "	; 2"	2033369929; "	2029328533; "	2035968: 66"
Cktetch3 "Hnki j v'Rj cug"	76"	20289; 89; 2; "	2023; ; 259: "	204; 358; 785"
Rncej "Nqecn'Tghgtgpeg"	78"	2028593: 665"	20242: ; ; 633"	2059 49; ; 848"
Gpxktqpo gpv'Hnki j v' Eqpf kvkqpu"	77"	2027654: 5: : "	2039263276"	2053588 97: 4"
Cktetch3 "O kuukqp"	34"	20276438348"	2024435445"	20262: 4444: "
Gpxktqpo gpv'Nki j v'	48"	2024843248: "	2023: 988: 74"	20; 3823369; "
Cktetch3 "Hnki j v'Rncp"	5"	2024439; 5497"	2"	2"
Rncej "Ucvg "Tghgtgpeg"	35"	2024372: 2: 5"	20223: 568: "	202: 7523: 95"
Cktetch3 "Etgy "Uk| g"	7"	2023; 95; 228"	2"	2"
Rgtuqp3 "Nqecvkqp "Kp "Cktetchv"	3"	20225878576"	2"	2"
Rgtuqp3 "Nqecvkqp "Qh'Rgtuqp"	2"	2"	2"	""
Rgtuqp3 "T gr qtvgt " Qti cpk| cvkqp"	2"	2"	2"	""
Cktetch3 "Cktetchv'Qr gtcvqt"	2"	2"	2"	""

"

Table 25

Random Forest Model Variables of Importance Results"

Xctkcdng"Pco g"	P wo dgt" qh" Ur rkwkpi " Twrgu	Vtckp<" I kpk" Tgf we/ vkqp	Vtckp<" O cti kp Tgf we/ vkqp	QQD<" I kpk" Tgf we/ vkqp	QQD<" O cti kp Tgf we/" vkqp	Xcnkf <" I kpk" Tgf we/ vkqp	Xcnkf <" O cti kp Tgf we/ vkqp
Ugpuqt{"Rgtegrvkqp"	369"	2027578: "	20;396"	202724; "	20:9;: "	2026:44"	20:887"
U{uvgo "Cpqocn{"	6: "	202252: "	2026:9"	2022358"	2022556"	2022367"	2022565"
Cktetchv"Cevkqp Rcuugpigt"	63"	2022:9; "	20238"	2022245"	2022;4"	2022233"	2022;3"
Fkutwrvkqp"	56"	2023394"	20239; "	/2022228"	2022295"	/2022233"	2022285"
Ecdkp"Chhgevgf "	55"	202232;9"	2022426"	/2022229"	2022325"	/2022245"	2022293"
Ckt"Eqpfkkpi "	53"	2023:38"	2024;; "	2022333"	2022458"	2022;9"	2024"
Rqy gt"Ej cpi g"	52"	2022375; "	2024;4"	2022; "	2022427"	20233: "	2022489"
Gpi kpg"Kuuwg O ckpvgpcpeg"	45"	20225:6"	2022293"	/2022239"	2022239"	/2022244"	2022243"
Eqpegtp"	43"	2022354: "	2022487"	2022:8"	2022426"	20227;: "	2023;7"
Hrki jv"Eqpfkkqp"	37"	20225;8"	20228: "	/2022234"	20225: "	/2022228"	2022249"
Vko g"F cvg Cktetchv3"Etgy "	34"	2022487"	20225; "	/20223"	/2022224"	/2022229"	2022236"
Uk| g Cktetchv3"Hrki jv	32"	2022237"	/2022223"	/2022223"	2022227"	/2022223"	2022227"
Rj cug"	: "	2022263"	2022229"	2022223"	2022233"	2"	202223"
Cktetchv3"O kuukqp Rgtuqp3"Nqecvkqp"	: "	2022275"	2022229"	/2022224"	2"	/2022223"	2022225"
Qh"Rgtuqp Rrceg"Nqecrg"	: "	2022222; "	2022224"	/2022224"	2022224"	/2022223"	2022226"
Tghgtgpeg"	9"	2022267"	2022228"	/2022224"	2022229"	/2022227"	2022223"
Gpxktqpo gpv"Nki jv" Rrceg"Uvcvg"	7"	2022226: "	20222;; "	2022224"	2022234"	/2022223"	2022228"
Tghgtgpeg" Vko g"Nqecrl"Vko g"	7"	2022229"	2022223"	/2022224"	/2022226"	/2022223"	/2022224"
Qh"F c{" Rgtuqp3"Nqecvkqp"	7"	2022223: "	2022225"	/2022227"	2"	2"	2022225"
Kp"Cktetchv" Gpxktqpo gpv"Hrki jv"	6"	2022226"	2022227"	/2022223"	2022226"	2022225"	2022227"
Eqpf kkqpu" Cktetchv3"Hrki jv"	5"	2022226"	/2022225"	2"	/2022225"	2"	/2022225"
Rrcp" Cktetchv3"Cktetchv"	4"	2022224"	2"	2"	2"	2"	/2022223"
Qr gtcvqt" Rgtuqp3"Tgr qtvgt"	2"	2"	2"	2"	2"	2"	2"
Qti cpk| cvkqp"	2"	2"	2"	2"	2"	2"	2"

""

"

Ghhgevu"r nqu"f kur rc{kpi "c"dct"ej ctv'qh'cduqnwvg"xcnwgu"qh'vj g"eqghhkekgpvu'kp"vj g"

nqi kuvke"tgi tguukqp"o qf grl"y gtg"r tqf wegf 0'Vj g"dctu"ctg"eqnqt/eqf gf "y kij "dnwg"kpf kecvkpi "

"

c''r qukkkxg''ghhgev''cpf ''tgf ''kpf kecvkpi ''c''pgi cvkxg''ghhgev''qp''yj g''vctig gv''xctkcdng0''Vj g''

eqghhkekgpvu''hqt''yj g''ugeqpf ''ngxgn''qh''yj g''vctig gv''xctkcdng.''yj kej ''ku''cp''gxgpv''tgncvgf ''vq''WCS ''

dwv''ku''pqv''c''hwo g''gxgpv.''ctg''uj qy p''kp''Hki wtg''3; 0'Kp''yj gug''tguwnu.''vqr keu''3''*ugpuqt{''

r gtegr vkqp+''cpf ''6''*gpi kpg''kuuwg+''r qukkxgn{''chhgev''WCS ''gxgpvu.''yj kng''vqr keu''8''*ecdkp''

chhgevgf +.''32''*r qy gt''ej cpi g+.''cpf ''; ''*r cuugpi gt''f kutwr vkqp+''pgi cvkxgn{''chhgev''WCS ''gxgpvu0'

Hqt''yj g''kf gpvkhkecvkqp''qh''hcevqtu''cuuqekcvgf ''y kj ''hwo g''gxgpvu''qt''ngxgn''yj tgg''qh''yj g''vctig gv''

xctkcdng.''Hki wtg''42''uj qy u''vqr keu''3''*ugpuqt{''r gtegr vkqp+.''6''*gpi kpg''kuuwg+.''cpf ''32''*r qy gt''

ej cpi g+''j cxg''r qukkxg''ghhgevu.''yj kng''vqr keu'': ''*r cuugpi gt''f kutwr vkqp+''cpf ''8''*ecdkp''chhgevgf +''

pgi cvkxgn{''kphnwgpeg''yj g''gxgpvu0'Vj gug''tguwnu''ctg''f kur nc{gf ''y kj ''o qtg''f gvckngf ''cff kvkqpcn''

kphqto cvkqp''cdqwv''dqyj ''vctig gv''xctkcdng''ngxgnu''kp''Vcdng''480'

Figure 19

Logistic Regression Effects Plot for Target Variable Level 2: UAQ Event
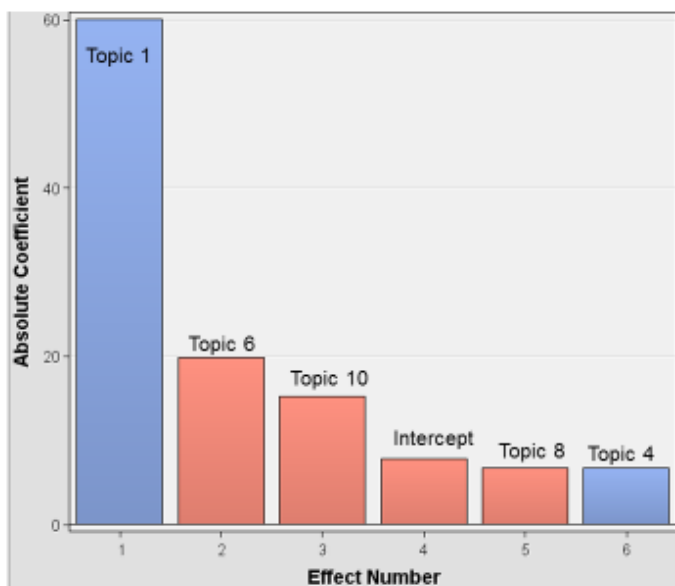
Figure 20

Logistic Regression Effects Plot for Target Variable Level 3: Fume Event

"
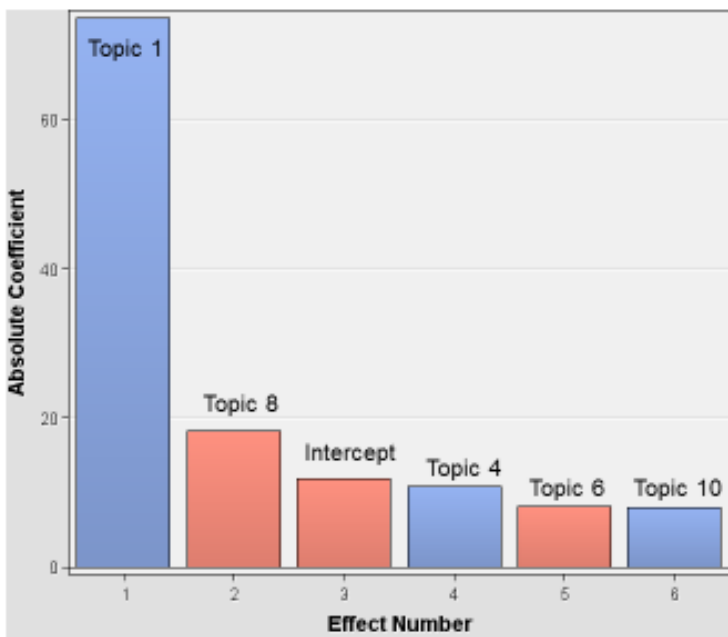
Table 26

Logistic Regression Model Analysis of Maximum Likelihood Results for Variables of

Importance

Rctco gygt"	Vcti gy" Xctlcdng"	F H"	Guvko cvg"	Uvcpf ctf " Gttqt"	Y crf " Ej k/ Us wctg"	Rt @Ej k/ Us wctg"	Uvcpf ctf k| gf " Guvko ctg"	Gzr " *Guv+"
Kpvgtegr v"	5"	3"	/330 677"	304; 9: "	: 5053"	>02223"	/"	20222"
Kpvgtegr v"	4"	3"	90 779"	20 6; 5"	: 7078"	>02223"	/"	20222"
Ecdkp" Chhgeygf "	5"	3"	/: 0322: "	90756: "	3038"	204: 45"	/204269"	20222"
Ecdkp" Chhgeygf "	4"	3"	/3; 0 ; 64"	7066: 7"	35055"	202225"	/207248"	20222"
Gpi kpg"Kuuwg""	5"	3"	3209932"	50 ; 58"	9087"	202279"	20578: "	; ; ; 0222"
Gpi kpg"Kuuwg"	4"	3"	808: 8; "	4094; ; "	8022"	202365"	204437"	: 230 33"
Rcuugpi gt" F kutwr vkqp"	5"	3"	/3: 05294"	805876"	: 049"	202262"	/206659"	20222"
Rcuugpi gt" F kutwr vkqp"	4"	3"	/8099; 8"	60 558"	30 ; "	2038; 6"	/203865"	20223"

"

Rctco gvgt"	Vcti gv" Xctkcdng"	FH"	Guvko cvg"	Uvcpfctf" Gttqt"	Y cnf" Ej k/ Us wctg"	Rt@Ej k/ Us wctg"	Uvcpfctf k| gf" Guvko ctg"	Gzr " *Guv+"
Rqy gt" Ej cpi g"	4"	3"	/3704865"	80 : ; 5"	60 3"	202489"	/205; ; 8"	20 222"
Ugpuqt{" Rgtegr vkqp"	5"	3"	9509997"	: 045: ; "	: 20 ; "	>02223"	405 25"	; ; ; 0 222"
Ugpuqt{" Rgtegr vkqp"	4"	3"	8203978"	907692"	8507: "	>02223"	30 637"	; ; ; 0 222"

"

"

"   Qf f u'tcvkqu'y gtg'tgxkgy gf "hqt"vj g"vcti gv'xctkcdngu'kp"vj g"nqi kuvke'tgi tguukqp"o qf gn'
vq"gxcnwcvg"vj g"uvtgpi vj "qh"vj g"cuuqekcvkqp"dgwy ggp"vj g"hcevqtu"cpf "vj g"qeewttgpeg"qh'hwo g"
gxgpvu0'Vj g"hcevqtu"ugpuqt{"r gtegr vkqp."r qy gt"ej cpi g."cpf "o ckpvgpcpeg"eqpegtp"
kpfkecvgf "qf f u'tcvkqu'qh'; ; ; 022."hqmqy gf "d{"gpi kpg kpg"kuuwg"y kj "9: 0 6."ckt"eqpfkvkqpkpi "
y kj "20234."cpf "u{uvgo "cpqo cn{."ecdkp"chhgevgf ."hnki j v'eqpfkvkqp."cpf "r cuugpi gt"
f kutwr vkqp'y kj "qf f u'tcvkqu'nguu'vj cp"202230"

        Vj g"xctkcdngu'qh'ko r qtvcpeg"vcdng"hqt"vj g"9/dtcpej "f gekukqp"vtgg"o qf gn'y cu"
tgxkgy gf "cpf "ku'hqwpf "kp"Vcdng"490'Vj g"xctkcdngu'kp"tcpm'qh'ko r qtvcpeg"hqt"vj ku'o qf gn'ctg"
ugpuqt{"r gtegr vkqp."ecdkp"chhgevgf ."cktetchv'cevkqp."u{uvgo "cpqo cn{."r qy gt"ej cpi g."cpf "
cktetchv3'o kuukqp0'Vj g"ncuv'xctkcdng"ku'htqo "vj g"CUTU'f cvcugv≠'vj g"qvj gtu'y gtg"kf gpvkhkgf "
htqo "vj g"tguwnvu'qh'vj g"vgzv'o kpkpi "r tqeguu0'Vj g"xctkcdng"cktetchv'cevkqp"y cu'kf gpvkhkgf "kp"
vj g"xcnkf cvkqp"f cvc'dww'y cu'pqv'hqwpf "vq"dg"c"xctkcdng"qh'ko r qtvcpeg"y j gp"xcnkf cvkqp"f cvc"
y gtg"eqo r ctgf "vq"vtckpkpi "f cvc0'

        "

347"

Table 27

7-branch Decision Tree Model Variables of Importance Results"

Xctkcdng'Pco g"	P wo dgt"qh" Ur nkwkpi " Twngu"	Xcnkfcvkqp	Xcnkfcvkqp Ko rqtvcpeg	Tcvkq"qh" Xcnkfcvkqp"vq" Vtckpkpi " Ko rqtvcpeg
Ugpuqt{"Rgtegrvkqp"	3"	302222"	302222"	302222"
Ecdkp"Chhgevgf "	3"	203899"	202575"	20432: "
Cktetch/Cevkqp"	3"	20874: "	202222"	202222"
U{uvgo "Cpqocn{"	4"	203743"	202987"	207252"
Rqy gt"Ejcpi g"	3"	203664"	20277; "	205:96"
Cktetch3"Okuukqp"	3"	202;43"	2026;2"	207536"

Kp"cnn"hqwt"o qfgnu."yj g"xctkcdng"ugpuqt{"rgtegrvkqp"y cu"tcpmgf "cu"yj g"o quv"ko rqtvcpv"xctkcdng"cuuqekcvgf "y kj "yj g"qeewttgpeg"qh"hwo g"gxgpvu0"Y j kng"yj ku"o c{"uggo "qdxkqwu."kv"o c{"ugtxg"cu"cp"kpfkecvqt"qh"yj g"f khhkewnv{"kp"kf gpvkh{kpi "cp{"cevkqpu."cevkxkvkgu."o kuj cr u."cngtvu."uki pu."qt"y ctpkpi u"yj cv"eqwnf "dg"wugf "vq"xgtkh{"yj g"qeewttgpeg"qh"c"hwo g"gxgpv0"Kv"cnuq"r ncegu"yj g"qpwu"vq"kf gpvkh{"yj g"qeewttgpeg"qh"c"hwo g"gxgpv"qp"j wo cp"ugpugu"y j kej "o c{"dg"uwdlgevkxg."xctkcdng."cpf "hcnnkdng0"Vj g"xctkcdngu"u{uvgo "cpqo cn{."ecdkp"chhgevgf ."cktetch/cevkqp."r cuugpi gt"f kuvwtr vkqp."r qy gt"ej cpi g."cpf "gpi kpg"kuuwg"ctg"kpenwfgf "kp"yj g"vqr /tcpmgf "xctkcdngu"qh"ko rqtvcpeg"hqt"yj g"hqwt"dguv"r gthqto kpi "o qf gnu0"

Summary

F cvc"htqo "tgr qtvu"uwdo kvgf "d{"hnki j v"cpf "ecdkp"etgy "o go dgtu"y gtg"f qy pnqcf gf "htqo "yj g"r wdnke n{"cxckncdng"CUTU"f cvcdcug0"Vgzv"o kpkpi "vgej pks wgu"cnqy gf "gzr nqtcvkqp"qh"yj g"f cvc"hqt"vgto u"cpf "yj go gu"eqpvckpgf "kp"yj g"pcttcvkxg"hkgnf u"qh"yj gug"tgr qtvu0Vgto u"y gtg"i tqwr gf "kpvq"vqr kes."cpf "pgy "xctkcdngu"y gtg"etgcvgf "hqt"kpenwukqp"kp"yj g"o qf gnu"

"

cnqpi "y kj "xctkcdngu"htqo "vj g"CUTU"f cvcugv0Ukz"o qf gnu"y gtg"f gxgnqr gf "cpf "gxcnwcvgf "

wukpi "f gekukqp"vtgg."tcpf qo "hqtguv."i tcf kgpv"dqquvkpi .'cpf "nqi kuvke"tgi tguukqp"cni qtkjo u0"

Tguwnu"htqo "vj g"vqr "hqwt"o qf gnu"y gtg"tgxkgy gf "vq"kf gpvkh{ "vj g"r tggo kpgpv'o qf gnlhqt "

ceewtce{ "cpf "r tgf kevkxg"r qy gt."y kj "pq"qpg"o qf gnlr tgugpvkpi "cu"c"ej co r kqp"o qf gn0'

Tguwnu"htqo "vj g"vqr "hqwt"o qf gnu"y gtg"tgxkgy gf "vq"kf gpvkh{ "ko r qtvcpv'hcevqtu"cuuqekcvgf "

y kj "vj g"qeewttgpeg"qh'hwo g"gxgpvu"wukpi "xqnwpvctkn{ "tgr qtvgf "f cvc0"

"
"   "

"

Chapter V: Discussion, Conclusions, and Recommendations"

Vj ku'ej cr vgt''gzco kpgu''vj g'tguwnu''r tgugpvgf ''kp''vj g'r tgxkqwu'ej cr vgt''cpf ''cf f tguugu''
vj g''vj tgg'tgugctej ''s wguvkqpu''r tgugpvgf ''kp''Ej cr vgt''K0'F kuewuukqp''qh''vj g''hkpf kpi u'htqo ''vj g''
vgzv''cpf ''f cvc''o kpkpi ''r tqeguugu''cpf ''vj g''ugxgp''ko r qtvcpv'xctkcdngu''kf gpvkhkgf ''d{ ''vj g''o qf gn'
cni qtkvj o u''ctg''hqwpf ''kp''Ej cr vgt''X0'Vj g''vj gqtgvkecn'cpf ''r tcevkecn'eqpvtkdwvkqpu''qh''vj ku''
tgugctej ''cpf ''j qy ''hkpf kpi u'ecp'dg''wugf ''d{ ''kpf wuvt{ .'tgi wncvqtu.''cpf ''gf wecvqtu'ctg''cnuq''
r tgugpvgf ''cnqpi ''y kj ''tgeqo o gpf cvkqpu''hqt''hwvwtg'tgugctej 0"""

Discussion

Cu'vj g'cxkcvkqp'kpf wuvt{ ''tgdqwpf u''hqnnqy kpi ''vj g'UCTU/EqX/4''r cpf go ke''cpf ''
eqpvkpwgu''vq ''i tqy ''kp''vj g'pwo dgtu''qh''hnki j vu''cpf ''j qwtu''hnqy p.''r cuugpi gtu.''ecdkp'etgy u.''
cpf ''hnki j v'etgy u'y knn'dg''cv'kpetgcugf ''tkum'qh''r qvgpvkcn'gzr quwtg''vq 'j c| ctf qwu'eqo r qwpf u''
f wtkpi ''hwo g'gxgpvu0'Ewttgpv'ghhqtvu''vq ''o kki cvg''uchgv{ 'j c| ctf u'ecp'kpenwf g'tgcevkxg''
tgur qpugu''chvgt''tgxkgy kpi ''kpf kpi u'htqo ''uchgv{ ''kpxguvki cvkqpu''cpf ''r tqcevkxg'tgur qpugu''kh''
vj ku'kphqto cvkqp'ku'kpeqtr qtcvgf ''kpvq ''vj g'ko r qxgo gpv'qh''qr gtcvkqpu.''r tqegf wtgu.''qt''
r qnkekgu0'Vj g'kf gpvkhkecvkqp'qh''eqpf kvkqpu.''gxgpvu.''cpf ''dgj cxkqtu''cuuqekcvgf ''y kj ''ceekf gpvu''
ecp''cnuq ''dg''wugf ''vq ''kpvgttwr v''c''ugs wgpeg''qh''gxgpvu''cpf ''r tgxgpv'cp'kpekf gpv'qt''ceekf gpv''
htqo ''qeewttkpi 0'Kf gpvkhkecvkqp'qh''vj gug''hcevqtu''ecp''r tqf weg''kphqto cvkqp'wugf ''vq 'r ncp.''
kpvgtxgpg.''cpf ''f gxgnqr ''i wkf cpeg''vq ''o ki kv'cf xgtug''qwveqo gu''cpf ''o kki cvg''gxgpvu0'Cu''cp''
kpvgi tcn'r ctv'qh''vj g'uchgv{ ''tkum'o cpci go gpv'eqo r qpgpv'qh''HCC/o cpf cvgf ''uchgv{ ''
o cpci go gpv'u{ uvgo u.''ghhqtvu''vq 'kf gpvkh{ 'cpf ''hqtgugg'j c| ctf u'uj qwnf ''dg''cf cr vgf ''vq 'cf f tguu''
cpf ''o kki cvg''vj g'tkumu'cuuqekcvgf ''y kj ''vj g''qeewttgpeg''qh''hwo g'gxgpvu0'Vj g'kf gpvkhkecvkqp'qh''
ko r qtvcpv'hcevqtu''cuuqekcvgf ''y kj ''hwo g'gxgpvu''ecp''cuukuv'kp''vj gug''ghhqtvu.''cu'y gnn'cu''

"

r tqxkf g''tgugctej gtu''y kj "cf f kvkqpcn''kphqto cvkqp''hqt''r kpr qkpvkpi "yj g''r qvgpvkcn''hqt"

qeewttgpeg''cpf "o czko k| kpi "qr r qtwpkvkgu''vq''kf gpvkh{ "cpf "s wcpvkh{ "j c| ctf qwu''eqo r qwpf u0"

"   Gf wecvkqpcn''ghhqtvu''cpf "kpkvkcvkxgu''vq "gf wecvg''ecdkp''cpf "hrki j v'etgy u''q''tgeqi pk| g"

cpf "dgwgt''r tgr ctg''hqt''yj g''kpkvkcvkqp''qh'r tqegf wtgu''vq "o kki cvg''yj g''j c| ctf u''cpf "tgf weg"tkum'

ecp "dg"gpj cpegf "d{ "kphqto cvkqp''htqo "yj ku'tgugctej "cu''y gm0"Vj g''hkpf kpi u''htqo "yj ku"

tgugctej "ecp''dg"wugf "vq"cuukuv'tgi wncvqtu''cpf "ncdqt''tgr tgugpvcvkxgu''kp''yj g''f gxgnqr o gpv'qh'c"

f cvcdcug''vq"f qewo gpv'hwo g''gxgpvu.''yj g''o kki cvkpi "cevkqpu''vcmgp''d{ "etgy "o go dgtu.''cpf "

f qewo gpvcvkqp''qh'cp{ 'j gcnj "ghhgevu''cpf "u{o r vqo u''gzr gtkgpegf "d{ "hrki j v'etgy u.''ecdkp"

etgy u."qt''r cuugpi gtu0"

Vj g''gzv'o kpkpi "r tqeguu''y cu''eqpf wevgf "wukpi "tgr qtv'pcttcvkxgu''uwdo kwgf "vq"yj g"

CUTU'd{ "ecdkp''cpf "hrki j v'etgy "o go dgtu''vq'f gvgto kpg''ko r qtcpv'vqr keu''cuuqekcvgf "y kj "

yj g''qeewttgpeg''qh'hwo g''gxgpvu0Vgp''vqr ke''ctgcu''y gtg''kf gpvkhkgf "cpf "eqpukf gtgf "cu'pgy "

xctkcdngu''htqo "yj g'CUTU'f cvcdcug''hqt'cpcn{uku0Vj gug''vgp''vqr keu''y gtg''eqo dkpgf "y kj "

xctkcdngu''htqo "yj g'CUTU'f cvcugv'cpf "y gtg''wugf "kp'f gxgnqr kpi ."vtckpkpi ."xcnkf cvkpi ."cpf "

vguvkpi "o cej kpg''ngctpkpi "cni qtkj o u''kp''ukz 'f khhgtgpv'o qf gnu''vq"cuuguu'yj g''ko r qtvcpeg''qh"

yj g''hcevqtu''cuuqekcvgf "y kj "yj g''qeewttgpeg''qh'hwo g''gxgpvu0Ko r qtvcpv'hcevqtu''eqpvtkdwvkpi "

vq"yj g''qeewttgpeg''qh'hwo g''gxgpvu'y gtg''kf gpvkhkgf "yj tqwi j "yj g''gzv'o kpkpi "r tqeguu''cpf "

xgtkhkgf "kp''yj g''o qf gn'tguwnu0Vj g''ko r qtvcpv'xctkcdngu''kpenwf g''ugpuqt{ 'r gtegr vkqp."u{uvgo "

cpqo cn{ ."ecdkp''chhgevgf ."cktetchv'cevkqp."r cuugpi gt''f kutwr vkqp."r qy gt''ej cpi g."cpf "gpi kpg"

kuuwg0Vj gug''hkpf kpi u''cff "xcnwg''vq"yj g''gzkuvkpi "dqf { 'qh'nkvgtcwtg''cu''yj g{ 'tgxgcn'cf f kvkqpcn'

f gvcknu''qp''hwo g''gxgpv'qeewttgpeg''cpf "gpj cpeg''uchgv{ 'tgugctej "d{ "j ki j ni j vkpi "yj g"

ko r qtvcpeg''qh'yj gug''hcevqtu''cuuqekcvgf "y kj 'hwo g''gxgpvu0

Vj g'r wtr qug"cpf "f guki p"qh"vj ku"tgugctej "y gtg"dcugf "qp"cpuy gtkpi "vj tgg"

hwpf co gpvcn"tgugctej "s wguvkqpu<"

Research Question 1: "J qy "ecp"vgz√'o kpkpi "vgej pks wgu"dg"wugf "vq"gzr nqtg"cpf "

kf gpvkh{"ko r qtvcpv"xctkcdngu"cuuqekcvgf "y kij "vj g"qeewttgpeg"qh'c"tgr qtvgf "hwo g"gxgpv."

wukpi "vgz wvcn'f cvc"hqwpf "kp"xqnwpvct{"tgr qtvu"uwdo kwgf "d{ "hnki j v'cpf "ecdkp"etgy "

o go dgtuA"Vgz√'o kpkpi "vgej pks wgu"y gtg"uweeguuhwn{ "wugf "kp"cp"gzr nqtcvqt{"cpf "f cvc/

f tkxgp"r tqeguu"wukpi "vqr keu"hqwpf "kp"vj g"pcttcvkxg"vgz√'hkgnf "kp"xqnwpvct{"tgr qtvu"eqpvckpgf "

kp"vj g"CUTU"f cvcdcug0"CUÙ "Vgz√'O kpgt"y cu"go r nq{gf "vq"eqpf wev"vj g"vgz√'o kpkpi "

r tqeguu"cpf "kpenwf gf "vgz√'r ctukpi ."vgz√'hknvgtkpi ."gzr nqtcvkqp"qh'vgz√'enuvgtkpi ."cpf "

gzr nqtcvkqp"cpf "kf gpvkhkecvkqp"qh'vgz√'vqr keu0"CUÙ "Gpvgtr tkug"O kpgt^{VO} "y cu"vj gp"wugf "vq"

f gxgnqr ."vtckp."xcnkf cvg."cpf "vguv'o qf gnu"eqo dkpkpi "vj gug"vqr keu"cu's wcpvkvcvkxg"xctkcdngu"

cpf "s wcpvkvcvkxg"xctkcdngu"htqo "vj g"CUTU"f cvcugv0"

Vgz√'r ctukpi "y cu"wugf "vq"eqpxgtv'vj g"wpuvtwewtgf "vgz√'qh'vj g"tgr qtv'pcttcvkxgu"kpvq"

c"uvtwewtgf "hqto cv'hqt"cpcn{uku0"Kpf kxkf wcn'y qtf u"y gtg"kf gpvkhkgf "htqo "ugpvgpeg"f wtkpi "

vj g"vqmgpk|cvkqp"uvgr ."cpf "ngo o cvk|cvkqp"cpf "uvgo o kpi "y gtg"wugf "vq"tgf weg"vgto u"vq"vj gkt"

tqqv'hqto u0'Qwveqo gu"htqo "vj g"vgz√'r ctukpi "r tqeguu"kpenwf gf "kpf kxkf wcn'vgto u.'r ct√'qh/

ur ggej ."cvtkdwvg."htgs wgpe{.'cpf "vj g"pwo dgt"qh'f qewo gpvu"eqpvckpkpi "vj cv'r ctvkewnct"

vgto .'y j kej "y gtg"tgxkgy gf "kp"vj g"f gxgnqr o gpv'qh'c"uvqr "nkuv0'Vj g"uvqr "nkuv'eqpvckpgf "

vgto u"vj cv'f kf "pqv'cf f "xcnwg"kp"vj g"kf gpvkhkecvkqp"qh'vqr keu"cpf "y gtg"gzenwf gf "htqo "vj g"

vgz√'r ctukpi "r tqeguu0'O cp{ "o wnkr ng"kvgtcvkqpu"qh'vj g"vgz√'r ctukpi .'vguv'hknvgtkpi ."cpf "vgz√'

vqr ke"tgxkgy "r tqeguu"qeewttgf "vq"kf gpvkh{"cpf "gzenwf g"vgto u"vj cv'y gtg"pqv'kphqto cvkxg"vq"

vj g"f cvc0"

Vj g'hlknvgtkpi "uvgr "y cu'wugf "\q"f gxgnqr "c"y gki j vgf "\gto /d{/f qewo gpv'o cvtkz "\q"
tgf weg'\j g'\qvcn'pwo dgt "qh'r ctugf "\gto u'\q"dg"cpcn{ gf 0'Ko r qtvcpv'\qr keu'y gtg'kf gpvkhkgf "
cpf "gzr nqtgf "chvgt'i tqwr kpi y g'\gz v'kpvq "enwuvgtu"cpf "\qr keu0'Vgp'\qr keu'y gtg'kf gpvkhkgf "
cpf "cf f gf "\q"\j g'CUTU'f cvcugv'cu'swcpvkvcvkxg'xctkcdngu"\q"dg"wugf "kp'f gvgtokpkpi "\j g"
hcevqtu"cuuqekcvgf "y kj "\j g'\j tgg'ngxgnu'qh'\j g'cti gv'xctkcdng."y j kej "y gtg"*3+'gxgpvu'pqv'
tgncvgf "\q"WCS ."*4+'gxgpvu'tgncvgf "\q"WCS "dwv'pqv'hwo g'gxgpv."cpf "*5+'r qvgpvkcn'hwo g"
gxgpvu0"

Tguwnu'htqo "\j g'\gz v'o kpkpi 'r tqeguu'hqwpf "xctkcdngu'tgr tgugpvkpi "ugpuqt{ "
r gtegr vkqp."ecdkp'chhgevgf ."cpf "r qy gt'ej cpi g'y gtg'rkuvgf "cu'ko r qtvcpv'hcevqtu'kp'\j g"
qeewttgpeg'qh'hwo g'gxgpvu'kp'cnn'hqwt'qr/r gthqto kpi 'o qf gnu0'Vj g'xctkcdngu'tgr tgugpvkpi "
\j g'hcevqtu'cktetchv'cevkqp."r cuugpi gt'f kutwr vkqp."u{uvgo "cpqo cn{."cpf "gpi kpg'kuuwg'y gtg"
cuuqekcvgf "y kj "hwo g'gxgpvu'kp'\j tgg'qh'\j g'hqwt'qr/r gthqto kpi 'o qf gnu0"

Research Question 2: "J qy "ecp'o qf gnkpi "vgej pkswgu'dg"wugf "\q"kf gpvkh{ "hcevqtu"
cuuqekcvgf "y kj "\j g'qeewttgpeg'qh'c'r tgekxgf "cpf "tgr qtvgf "hwo g'gxgpv."wukpi "s wcrkvcvkxg"
cpf "s wcpvkvcvkxg'xctkcdngu'hqwpf "kp'xqnwpvct{ "tgr qtvu'uwdo kvgf "d{ "hnki j v'cpf "ecdkp'etgy "
o go dgtuA'O qf gnkpi "o gy qf u'y gtg'wugf "\q"f gxgnqr "o qf gnu'\q"kf gpvkh{ "hcevqtu'cuuqekcvgf "
y kj "\j g'qeewttgpeg'qh'hwo g'gxgpvu'\j tqwi j "c'uvgr y kug'r tqeguu'd{ "hktuv'eqpf wevkpi "\gz v'
o kpkpi "\q"gzr nqtg'cpf "kf gpvkh{ "ko r qtvcpv'\qr keu—eqo dkpkpi "\j g'pgy n{ "kf gpvkhkgf "\gz v'\qr ke"
xctkcdngu'y kj "gzkuvkpi "xctkcdngu'eqpvckpgf "kp'\j g'CUTU'f cvcugv—cpf "wukpi "\j ku'f cvc'\q"
f gxgnqr ."vtckp."xcnkf cvg."cpf "\guv'o qf gnu'wukpi "o cej kpg'ngctpkpi "cni qtkj o u. Tguwnu'qh'
\j gug'o qf gnu'y gtg'wugf "\q"kf gpvkh{ "ko r qtvcpv'hcevqtu'cuuqekcvgf "y kj "hwo g'gxgpvu0'Vj g"
cni qtkj o u'wugf "y gtg'f gekukqp'vtggu'y kj "\j tgg."hkxg."cpf "ugxgp'dtcpej gu.'i tcf kgpv'
dqquvkpi ."nqi kuvke'tgi tguukqp."cpf "tcpf qo "hqtguv0"

"

Research Question 3: "Y j cv'ctg"vj g"ko r qtvcpv'hcevqtu"cuuqekcvgf "y kj "vj g" qeewttgpeg"qh'c"hwo g"gxgpv'cu'kf gpvkhkgf "kp"xqnwpvctkn{ "tgr qtvgf "f cvcAUgxgp"hcevqtu" crr gctgf "eqpukuvgpvn{ "kp"tguwnu'hqt"vj g"o quv'ko r qtvcpv'hcevqtu"cuuqekcvgf "y kj "vj g" qeewttgpeg"qh'hwo g"gxgpvu'co qpi "vj g"vqr "o qf gnu0'Vj gug"hcevqtu"kpenwf gf "ugpuqt{ " r gtegr vkqp."ecdkp"chhgevgf ."cpf "r qy gt"ej cpi g."y j kej "y gtg"kuvgf "cu"hcevqtu"kp"cnl'hqwt"vqr / r gthqto kpi "o qf gnu0'Vj tgg"qh'vj g"vqr /r gthqto kpi "o qf gnu"kpenwf gf "vj g"hqmqy kpi "hqwt" hcevqtu<cktetchv'cevkqp."r cuugpi gt"f kutwr vkqp."u{uvgo "cpqo cn{."cpf "gpi kpg"kuuwg0'Vj g" hcevqtu"ckt"eqpf kkqp."o ckpvgpcpeg"eqpegtp."cpf "hki j v'eqpf kkqp"y gtg"gcej "hqwpf "kp"vy q" o qf gnu0Tguwnu'hqt"vy q"o qf gnu'r tqf wegf "tcpmkpi u'hqt"cf f kkqpcn'hcevqtu."cu'hqwpf "kp" Vcdngu'46"cpf "47"hqt"vj g"i tcf kgpv'dqquvkpi "cpf "tcpf qo "hqtguv'o qf gnu0'Vj g"ugxgp"o quv' htgs wgpvn{ "kuvgf "hcevqtu"hqwpf "kp"vj g"vqr "hqwt"o qf gnu"ctg"f guetkdgf "hwtvj gt0"

Rtgxkqwu'tgugctej "uwr r qtvu'vj g"ko r qtvcpeg"qh'hqwt"qh'vj g"vzv'o kpkpi "dcugf /" hcevqtu."kpenwfkpi "ugpuqt{ "r gtegr vkqp."r qy gt"ej cpi g."cktetchv'cevkqp."cpf "gpi kpg"kuuwg0' P gy n{ "kf gpvkhkgf "hcevqtu"vj cv'j cxg"pqv'dggp"go r j cuk| gf "kp"r tgxkqwu"kkgtcwtg"kpenwf g" ecdkp"chhgevgf ."r cuugpi gt"f kutwr vkqp."cpf "u{uvgo "cpqo cn{0'C"hqewu"qp'vj gug"hcevqtu" vj tqwi j "tgugctej ."vtckpkpi ."cpf "gf wecvkqp"o c{ "{kgnf "cf xcpego gpu'kp"cy ctgpguu." tgeqi pkvkqp."cpf "r tgf kevkqp"qh'hwo g"gxgpvu"cpf "gpj cpegf "uchgv{0Qpn{ "qpg"xctkcdng"htqo " vj g'CUTU'f cvcdcug"y cu'kpenwf gf "kp"vj g"vqr "vgp"ko r qtvcpv'hcevqtu'co qpi "cnl'vj g"o qf gnu;'kv' y cu'ukz'y j "co qpi "vj g"ko r qtvcpv'hcevqtu"kp"vj g"9/dtcpej "f gekukqp"vtgg"o qf gn0Cktetchv'3" O kuukqp"y cu'vj g"xctkcdng"cf f tguukpi "vj g'r wtr qug"qh'vj g"hki j v'qh'vj g"cktetchv'kpxqnxgf "kp" vj g"tgr qtvgf "gxgpv'uwej "cu'r cuugpi gt."ecti q'lhgtt{ ."cpf "vtckpkpi 0"

Sensory Perception0'Vj ku'vqr ke'y cu'tcpmgf "cu'vj g"o quv'ko r qtvcpv'hcevqt" cuuqekcvgf "y kj "vj g'qeewttgpeg"qh'hwo g"gxgpvu'kp'vj g'hqwt"dguv'r gthqto kpi "o qf gnu0'Kf'

"

kpenwfgu'yj g'vgto u'uo qmg."uo gm'qf qt."uo gm'cpf 'hwo g.'y j kej "ctg"gngo gpwu'eqo o qpn{"

kf gpvkhkgf "d{"yj g'qrhcevqt{"cpf "xkuwcn'ugpugu0Cnj qwi j "yj gug'vgto u'o c{"uggo "qdxkqwu."

yj g'r tgugpeg'qh'uo qmg"qt"qf qtu"ku"eqo o qpn{"yj g'hktuv'kpfkecvkqp'qh'c"WCS "qt"c"hwo g"

gxgpv0'Vj g'r tgugpeg'qh'qf qtu'qt"uo qmg"kp'hwo g'gxgpvu'ku'uvtqpin{"uwr r qtvgf "d{"yj g"

rkvgtcwtg"*Cpf gtuqp."4236=Etwo r "gv'cn0"4233c=J cttkuqp"gv'cn0"422; =O kej cgnku."4225="

O wtcy umk"4236=Tqki "gv'cn0"4243=Tqugpdgti gt"gv'cn0"4238=Uj gj cf k'gv'cn0"4238+0'

Tgugcretj "d{"Uej wej ctf v'gv'cn0"*423; +'kpfkecvgu'tgr qtvgf "uo gm'gxgpvu'ecppqv'dg'xgtkhkgf "

y kj "tgi wctn{"wugf "cpcn{vkecn'o gyj qf u."cpf "o gcpkpi hwn'f gvgevkqp'qh'qkn'qt"ku'r {tqn{| gf "

d{/r tqf wevu"ecppqv'dg'eqpf wevgf "d{"qf qt"cnqpg0Cu'cp'ko r qtcpv'hcevqt"cuuqekcvgf "y kj "

hwo g'gxgpvu."yj gtg'ku'pq'r tgguwo r vkqp'yj cv'ugpuqt{"r gtegr vkqp'cnqpg'y qwnf "kpfkecvg"qt"

r tgfkev'c"hwo g'gxgpv0'Cu'cp'ko r qtcpv'hcevqt"cuuqekcvgf "y kj "hwo g'gxgpvu."ugpuqt{"

r tgegr vkqp'y qwnf "pqv'dg'wugf "vq'kf gpvkh{'qt"s wcpvkh{'c'hwo g'gxgpv."dwv'ku'tcpmkpi "cu'yj g"

o quv'ko r qtcpv'xctkcdng'dgnikgu'f kutgi ctf kpi "yj g'eqttgncvkqp'y kj 'hwo g'gxgpv0"""

Y j kng'yj g'vgto u'eqpvckpgf 'kp'yj g'ugpuqt{"r gtegr vkqp'vqrke'o c{"cnuq"dg"cuuqekcvgf "

y kj "cewug'go gti gpekgu."uwej "cu'hktg'qp'dqctf "cp'cktetchv.'tgeqi pkvkqp'qh'c"uo gm'qt"qf qt"

o c{"xct{"d{"yj g'tgr qtvgt"cpf "o c{"dg"c'j ki j n{"uwdlgevkxg"qdugtxcvkqp.'yj g'tcpmkpi "cu'o quv'

ko r qtcpv'hcevqt"dgctu'cenkpqy ngfi o gpv'qh'yj g'ko r qtcpeg'qh'yj g'vqrke'kp'tgr qtvgf "WCS "

cpf "hwo g'gxgpvu0'Vj g'ko r qtcpeg'qh'yj ku'vqrke'kp'ku'kf gpvkhkecvkqp'cu'yj g'o quv'ko r qtcpv'

hcevqt'kp'gcej "qh'yj g'hqwt"vqr /r gthqto kpi "o qf gnu'o c{"cnuq"ugtxg"cu'cp'kpfkecvqt"qh'yj g"

f khhkewn{ 'kp'kf gpvkh{kpi "qyj gt"hcevqtu'r tgugpv'kp'cf xcpeg'qh'yj g'qeewttgpeg'qh'c"hwo g"

gxgpv0"

Cabin Affected0'Vj g'vqrke'ecdkp'chhgevgf "y cu'kpenwf gf "kp'yj g'tguwnvu'qh'gcej "qh'

yj g'vqr "hqwt"o qf gnu'cu'cp'ko r qtcpv'hcevqt"cpf "kpenwf gu'vgto u'f kxgtv.'r cuugpi gt."cwgpf cpv."

"

o gf kecn "cpf "h‹ki j v"cwgpf cpv0'Vj gug"vgto u"kpf kecvg"vj g"qeewr cpu"qh"vj g"ecdkp."vj g"

r cuugp i gtu. "cpf "h‹ki j v"cwgpf cpu"ctg "kpxqnxgf "kp"vj g"gxgpv0'Vj gkt "r qvgpvkcn'vq "dg"kpxqnxgf "

kp "vj g"tgeqi pkvkqp."tgr qtvkpi ."cpf "qweqo g"qh'hwo g"gxgpvu"uwi i guvu"c"i tgcvgt"go r j cuku"qp"

vj g"gf wecvkqp"cpf "vtckpkpi "qh"ecdkp"etgy u"kp"tgeqi pkvkqp"cpf "cy ctgpguu"qh'hwo g"gxgpvu"

o c{ "dg"dgpghkekcn'vq "r tgf kevkqp"cpf "o kvki cvkqp0'Hkpf kpi u"htqo "vj ku"uvwf {"kpf kecvg"ngu u"vj cp"

qpg'r gtegpv'qh"vj g"tgr qtvu"kpenwf gf "kp"vj g"CUT U"f cvcdcug"ctg "htqo "ecdkp"etgy "o go dgtu0'

Hk‹ki j v"cwgpf cpu. "y j kng'r qvgpvkcn{ "dgkpi "co qpi "vj g"hktuv"vq "tgeqi pk| g"hwo g"gxgpvu"cpf "

gzr gtkgpeg"vj gkt "ghhgevu. "f q "pqv'j cxg "tgr qtvu"tgr tgugpvgf "kp"vj g"CUT U'f cvcdcug"vq "vj g"

uco g"gzvgpv"cu'h‹ki j v"etgy u0'Vj ku"vqr ke"cnuq "kpenwf gu"vj g"vgto u"f kxgtv"cpf "o gf kecn'y j kej "

o c{ "kpf kecvg"tgur qpugu"vq "hwo g"gxgpvu"cpf "kpxqnxg"vj g"ecdkp"etgy "cpf "r cuugp i gtu"cu"

tgekr kgpvu"qh"o gf kecn'pggf u"qt "vtcvo gpv."cpf "r qvgpvkcn{ "chhgevgf "d{ "vj g"kpeqpxgpkgpeg"qh"

cktetchv"f kxgtukqpu0'"

Power Change. Cnuq "kpenwf gf "kp"vj g"nkuv"qh"ko r qtvcpv'hcevqtu"hqt "cn'hqwt"qh"vj g"

vqr "o qf gnu'y cu"vj g"vqr ke r qy gt "ej cpi g0'Vj ku"vqr ke"kpenwf gf "vgto u"ko r n{kpi "cnvgtcvkqpu"kp"

r qy gt "ugwkpi u"qt "cktetchv'r qr wnukqp."uwej "cu'vj twuv."r qy gt."eqpf kvkqp."gxgpv."cpf "hggn0'

Vj g"kpenwukqp"qh"vj ku"vqr ke"co qp i "ko r qtvcpv'hcevqtu"cuuqekcvgf "y kj "hwo g"gxgpvu"ku"

uwr r qtvgf "d{ "ko r nkecvkqpu"qh"ugcn'ngcmci g"f wtkpi "ej cpi gu"kp"gpi kpg"r qy gt "*Cpf gtuqp."

4243=''f g'Dqgt"gv'cn0"4237='O kej cgnku."423: +0'"

Aircraft Action.'T cdf kgpv'dqqukpi ."tcpf qo "hqtguv."cpf "vj g"9/dtcpej "f gekukqp"vtgg"

o qf gnu'kpenwf gf "vj g"vqr ke cktetchv'cevkqp"cu"cp"ko r qtvcpv'xctkcdng"cuuqekcvgf "y kj "vj g"

qeewttgpeg"qh'hwo g"gxgpvu0'Vj ku"vqr ke'eqpukuvu"qh'vgto u'f guetkdkpi "vj g"o qxgo gpv'qh"vj g"

cktetchv'uwej "cu'enko d. "f guegpf ."ngxgn'cpf "hqqv0'Hqqv'ku"c'r ctgpv'vgto "cpf "kpenwf gu"

ngo o cvk| gf "xgtukqpu"qh'vj g"vgto ."uwej "cu"hggv. "y j kej "ku"cuuqekcvgf "y kj "cnkvwf g"

"

cuuki po gpvu"qt"ecrqwu0"Cktetchv"cevkqp"o c{"dg"cuuqekcvgf "y kj "\j g"\qr ke"r qy gt"ej cpi g"kp"

uqo g"ektecwo uvcpegu."cu"\j g"o qxgo gpv"qh"\j g"cktetchv"o c{"kpxqnxg"ej cpi gu"kp"r qy gt"

ugwkpi u."uwej "cu"c"tgswktgo gpv"hqt"kpetgcugf "cktetchv"r gthqto cpeg"vq"enko d"vq"c"j ki j gt"

cnkwwf g"qt"c"f getgcug"kp"r qy gt"hqt"f guegpv0"Vj ku"hcevqt"ku"uwr r qtvgf "d{"r tgxkqwu"tgugctej "

cu"c"ej cpi g"htqo "cktetchv"ugcf {"uvcvg"o c{"dg"tgncvgf "vq"ej cpi gu"kp"r qy gt"ugwkpi u"*"f g"

Dqgt"gv"cn0"4237=O kej cgnku."423: +0"

Passenger Disruption. Vj g"\qr ke"r cuugpi gt"f kutwr vkqp"y cu"kpenwf gf "kp"\j g"nkuv"qh"

ko r qtvcpv"xctkcdngu"hqt"\j g"i tcf kgpv"dqquvkpi ."tcpf qo "hqtguv"cpf "nqi kuvke"tgi tuukqp"

o qf gnu0"Vj g"vgto u"r cuugpi gt."pqug."uvctv."uj qtv."cpf "f gr ncpg"ctg"eqpvckpgf "kp"\j ku"\qr ke"

cpf "r qvgpvkcn{"tgr tgugpv"f kutwr vkqp"cpf "kpeqpxgpkgpeg"vq"r cuugpi gt"ugtxkeg0"Hwo g"gxgpvu"

o c{"qeewt"cv"\j g"dgi kppkpi "qh"c"hnki j v"y j kng"cv"\j g"i cvg"f wtkpi "dqctf kpi ."f wtkpi "f g/kekpi "

r tqegf wtgu."qt"f wtkpi "vczk"y j gp"\j g"cktetchvxu"CRW"ku"dgkpi "wugf "vq"r qy gt"\j g"cktetchv"

*O wtcy umk"("Uwr r ngg."422: =Qxgthgnv"gv"cn0"4234=Uj gj cf k"gv"cn0"4238+0"C"f kutwr vkqp"kp"

r cuugpi gt"ugtxkeg"o c{"qeewt"cv"cp{"\ko g"kh"\j g"r cuugpi gtu"ctg"tgswktgf "vq"f gr ncpg."\j g"

hnki j v"ku"f kxgtvgf ."qt"kh"cp"ckt"wtpdcem ku"eqpf wevgf 0"Vj ku"\qr ke"o c{"cnuq"kpxqnxg"

r cuugpi gt"r gtegr vkqp"qh"qf qtu"qt"hwo gu"y kj "\j g"vgto "pqug"ko r n{kpi "cp"qdlgevkqpcdng"

ugpuqt{"qt"r j {ukecn"cy ctgpguu0"

System Anomaly. Vj g"u{uvgo "cpqo cn{"\qr ke"kpenwf gf "\j g"vgto u"s wkem"tghgtgpeg"

j cpf dqqm"j {f cwnke."u{uvgo ."gpi kpg-kpf kecvkpi "cpf "etgy /cngtvkpi "u{uvgo "*GKECU+."cpf "

nki j v"r qvgpvkcn{"kpf kecvkpi "u{uvgo "kttgi wctkvkgu0Vj gug"cpo cnkgu"o c{"kpxqnxg"j {f cwnke"

hnwkf ."\j g"j {f cwnke"u{uvgo ."qt"qy gt"u{uvgo u."cpf "o c{"kpenwf g"etgy "pqvkhkecvkqp"d{"c"

y ctpkpi "nki j v"qt"\j g"GKECU0Vj g"GKECU"r tqxkf gu"nki j v"etgy u"y kj "kpuvwo gpvcvkqp"cpf "

cppwpekcvkqp"hqt"gpi kpgu"cpf "qy gt"kpvgi tcn"u{uvgo u"cpf "cnuq"r tqxkf gu"kphqto cvkqp"hqt"\j g"

"

o cpci go gpv'qh'cdpqto cn'qt"go gti gpe{"eqpf k\kqpu0'Vj gug"cpqo cnkgu"o c{"y cttcpv'\j g'\wug"

qh'c"s wkem'tghgtgpeg"j cpf dqqm'y j kej "ku'c"s wkem/ceeguu"o cpwcn'eqpvckpkpi "r tqegf wtgu"

cr r nkecdng"f wtkpi "cdpqto cn'qt"go gti gpe{"eqpf k\kqpu'y j gp"cp"ckretchv'ku'pqv'gs wkr r gf "

y kj "cp"GKECU"qt"qyj gt"gngevtqpke"egpvtcn{ gf "ckretchv'o qpkqtkpi "u{uvgo 0'Vj ku'pgy n{"

kf gpvkhkgf "\qr ke'kpeqtr qtcvgu'r tgxkqwun{'kf gpvkhkgf "eqo r qpgpvu'cuuqekcvgf "y kj "hwo g"

gxgpvu'dwv'ku'c'dtqcf gt''cpf ''o qtg''o wnkhcegvgf ''hcevqt''y kj ''\j g'kpenwukqp''qh'\j gug'\qr keu0'

Engine Issue. "Vj g'\qr ke'gpi kpg'kuuwg'y cu'nkuvgf ''cu'\j tgg''qh'\j g'\qr ''o qf gnu/''

ko r qtvcpv'hcevqtu'cuuqekcvgf "y kj "\j g'qeewttgpeg''qh'hwo g''gxgpvu0'Vj g'\qr ke'kpenwf gu'\j g"

vgto u'gpi kpg.''nghv'gpi kpg.''tki j v'gpi kpg.''qkn''cpf ''uj w.''uwi i guvkpi ''gpi kpg''qr gtcvkqpcn''

f khhkewnkgu'qt''hcknwtg0'Vj g'kpenwukqp''qh'qkn'kp''\j g'\qr ke'uwi i guvu'\j g''cuuqekcvkqp''qh'qkn'y kj "

hwo g''gxgpvu''cpf ''ku''uwr r qtvgf ''d{''o wej ''qh'\j g'r wdnkuj gf ''tgugctej ''qp''\j ku'\qr ke.''kpenwf kpi "

d{''Cpf gtuqp''*4243+.'f g''Tgg''gv'cn0'*4239+.'Uj gj cf k''Lqpgu.''cpf ''J qupk''*4238+.'Uej kpf ngt''

*4235+.'O wtcy umk'cpf ''Uwr r ngg''*422: +.'cpf ''Y kpf gt''cpf ''Dcnqwgv'*4224+0''

Conclusions

Vj ku'gzr nqtcvqt{.''o kzgf ''o gyj qf ''f guki p''uvwf {''wugf ''wpuvwevwtgf ''\gzwwcn'f cvc'htqo "

yj g'pcttcvkxg'hkgnf u'kp''tgr qtvu'uwdo kvgf ''\q''\j g'CUTU'kp''c''\gzv''o kpkpi ''r tqeguu'\q''gzr nqtg"

vgto u'cpf ''\qr keu'cpf ''kf gpvkh{'pgy ''hcevqtu'cuuqekcvgf ''y kj ''WCS ''cpf ''hwo g''gxgpvu0'Vj gug"

hcevqtu'y gtg''yj gp''kpenwf gf ''y kj ''s wcpvkvcvkxg''xctkcdngu'htqo ''yj g'CUTU'f cvcdcug''cpf ''wugf "

kp''o cej kpg''ngctpkpi ''cni qtkyj o u'\q''f gxgnqr ''o qf gnu'\q''kf gpvkh{'yj g'ko r qtvcpv'hcevqtu"

cuuqekcvgf ''y kj ''yj g'qeewttgpeg''qh'WCS ''cpf ''hwo g''gxgpvu'cu'tgr qtvgf ''d{''hnki j v'etgy u''cpf "

ecdkp''etgy u0'Vj gug''o qf gnu'y gtg''uweeguuhwn{''f gxgnqr gf .''\tckpgf .''xcnkf cvgf .''cpf ''\guvgf 0'

Vj g'hkpf kpi u'qh'yj ku'uvwf {''eqpvtkdwvg''dqyj ''yj gqtgvkecn{''cpf ''r tcevkecn{''\q''yj g''dqf {''qh'

mpqy ngf i g''eqpegtpkpi ''hwo g''gxgpvu'cpf ''cxkcvkqp''uchgv{0'

"

Theoretical Contributions
"

Vj ku'tgugctej "r tqxkfgu"y j gqtgvkecn'eqpvtkdwvkqpu"kp"cf xcpekpi "y j g"uwwf{"qh'hwo g" gxgpvu"cpf "y j g"wug"qh'vgz v"cpf "f cvc"o kpkpi "o gy qf u"vq"kf gpvkh{"hcevqtu"cuuqekcvgf "y kj " y j gug"gxgpvu0'Kv'cf f tguugu'i cr u"kp"y j g"gz kuvkpi "nkvgtcwtg"d{"gz r nqtkpi "vgz vwcn'f cvc"vq" kf gpvkh{"vqr keu"cpf "vgto u"cpf "r qr wncvkpi "o qf gnu"y kj "xctkcdngu'f gtkxgf "htqo "y j gug"vqr keu0'

Ko r qtvcpv'hcevqtu'cuuqekcvgf "y kj "y j g"qeewttgpeg"qh'hwo g"gxgpvu'y gtg"gz r nqtgf "cpf " kf gpvkhkgf "y tqwi j "y j g"vgz v'o kpkpi "r tqeguu"cpf "y j g"f cvc"o kpkpi "r tqeguu"cpf "xcnkf cvgf " wukpi "cni qtkyj o u0'Ko r qtvcpv'vqr keu"y cv'y gtg"uwduvcpvkcvgf "kpenwf g"ugpuqt{"r gtegr vkqp." u{uvgo "cpqo cn{."ecdkp"chhgevgf ."cktetchv'cevkqp."r cuugp i gt'f kutwr vkqp."r qy gt'ej cpi g."cpf " gpi kpg"kuuwg0'Vj g"ko r qtvcpeg"qh'y j g"hcevqtu'ugpuqt{"r gtegr vkqp."r qy gt'ej cpi g."cktetchv' cevkqp."cpf "gpi kpg"kuuwg"y kj "hwo g"gxgpvu"y cu'uwr r qtvgf "cpf "eqphkto gf "d{"r tgxkqwu" tgugctej 0'Vj g"wug"qh'vgz v'o kpkpi "vq"kf gpvkh{"y j gug"hcevqtu'htqo "pcttcvkxgu'qh'xqnwpvctkn{" uwdo kwgf "tgr qtvu"d{"hnki j v'cpf "ecdkp'etgy u'tgkphqtegu'y j g"xcnwg"qh'y j gug"hcevqtu'kp"y j g" cy ctgpguu."tgeqi pkvkqp."cpf "o kki cvkqp"qh'hwo g"gxgpvu0'Vj g"hcevqtu'u{uvgo "cpqo cn{." ecdkp'chhgevgf ."cpf "r cuugp i gt'f kutwr vkqp"y gtg"kf gpvkhkgf "cu'pgy "hcevqtu'cpf "uj qwf "dg" eqpukf gtgf "y j gp'tgr qtvkpi "cpf "kpxguwki cvkpi "y j g"qeewttgpeg"qh'hwo g"gxgpvu."cpf "kp"y j g" gf wecvkqp"cpf "vtckpkpi "qh'etgy "o go dgtu0'Kpetgcugf "cy ctgpguu'qh'u{uvgo "cpqo cnkgu"y cv' eqwf "chhgev'y j g"qeewttgpeg"qh'hwo g"gxgpvu'uj qwf "dg'eqpukf gtgf "d{"hnki j v'etgy u'y j gp" y j gug"gxgpvu'ctkug0'Eqqtf kpcvgf "ghhqtvu'dgy ggp'hnki j v'cpf "ecdkp'etgy "vq"eqo o wpkecvg" co qpi uv'yj go ugnxgu'cpf "y kj "r cuugp i gtu'eqwf "gpcdng'ectnkgt'f gvgevkqp'cpf "o kki cvkqp'qh" hwo g"gxgpvu'vq"nguugp"y j g"ko r cev'qp'pgi cvkxg'j gcnyj "cpf "uchgv{"qwveqo gu'cpf "tgf weg'y j g" nkmgnkj qqf "qh'kpvgttwr vkqp'kp'hnki j v'uej gf wngu0''

O qf gnu'hqt''yj g''qeewttgpeg''qh'WCS ''cpf ''hwo g''gxgpvu''y gtg''f gxgnqr gf .''tckpgf .''
xcnkfcvgf .''cpf ''vguvgf ''vq''r tqxkfg''kphqto cvkqp''qp ''hcevqtu'cuuqekcvgf ''y kj ''hwo g''gxgpvu''cpf ''
dcugnkpg''kphqto cvkqp''vq''cuuku''kp ''yj g''kfgpvkhkecvkqp''qh''yj ku'tctg''gxgpv''y kj ''yj g''r qvgpvkcn'hqt''
ugtkqwu''eqpugs wgpegu0''Yj g''qr /r gthqto kpi ''o qf gnu''wukpi ''i tcf kgpv'dqquvkpi .''tcpf qo ''
hqtguv.''nqi kuvke'tgi tguukqp .''cpf ''9/dtcpej ''f gekukqp''vtgg''cni qtkj o u'ecp ''dg''wugf ''vq''r tqxkfg''
ceewtcvg''kphqto cvkqp''tgi ctf kpi ''yj g''ko r qtvcpeg''qh'hcevqtu''cuuqekcvgf ''y kj ''yj g''qeewttgpeg''
qh'hwo g''gxgpvu0'Hkpf kpi u''htqo ''yj ku''uvwf {'ecp ''dg''wugf ''cu'c''dcugnkpg''qh''wpf gtuvcpf kpi ''
r tqr gtvkgu'cuuqekcvgf ''y kj ''hwo g''gxgpvu''Kp''cf f kvkqp .''yj gug'o qf gnu''ecp ''dg''dwknv'wr qp ''cpf ''
hwtyj gt''tghkpgf ''kp ''hwtwtg''uvwf kgu''vq''kf gpvkh{''cf f kvkqpcn'vgto u.''vqr kcu.''cpf ''f gvcknu''cuuqekcvgf ''
y kj ''hwo g''gxgpv'qeewttgpeg''cu'tgr qtvu'ctg''cf f gf ''vq''yj g''CUTU''f cvcdcug''cpf ''cf f kvkqpcn'
uwf kgu''ctg''eqpf wevgf 0'Yj ku''kphqto cvkqp''ecp ''dg''wugf ''d{ ''tgi wncvqtu.''cktrkpgu.''qt''
o cpwhcevwtgtu''vq ''dgwgt''wpf gtuvcpf ''yj g''ej cngpi gu''kp ''yj g''r tgf kevkqp.''o kiki cvkqp .''cpf ''
r tgxgpvkqp''qh'hwo g''gxgpvu0''

Vj ku''tgugctej ''r tqxkfgu''c''uweeguuhwl'fgo qpuvtcvkqp''qh'wukpi ''yj g''vgzv'o kpkpi ''
r tqeguu''vq ''gzr nqtg''wpuvtwevwtgf ''f cvc.''yj g''kf gpvkhkecvkqp''qh'ko r qtvcpv'hcevqtu.''cpf ''yj g''wug''
qh'yj qug''hcevqtu''cu'xctkcdngu''kp ''c''f cvc''o kpkpi ''r tqeguu''vq ''kf gpvkh{''cni qtkj o u''vq ''kf gpvkh{''
qyj gt''gxgpvu.''eqpf kvkqpu.''qt''dgj cxkqtu''chhgevkpi ''uchgv{0'Yj ku''r tqeguu''o c{ ''dg''tgr nkecvgf ''vq ''
gzr nqtg''vgzwcl'f cvc.''kf gpvkh{''ko r qtvcpv'hcevqtu.''cpf ''f gxgnqr ''o qf gnu''vq ''kf gpvkh{''qyj gt''
hcevqtu''y j kej ''o c{''eqo r qo kug''uchgv{''kp ''cxkcvkqp''qr gtcvkqpu0''

Practical Contributions
"
Vj ku''tgugctej ''r tqxkfgu''yj g''HCC''cpf ''yj g''cxkcvkqp''kpf wvt{''y kj ''ko r qtvcpv'hcevqtu''
cuuqekcvgf ''y kj ''yj g''qeewttgpeg''qh'hwo g''gxgpvu''qdvckpgf ''htqo ''yj g''gzr nqtcvkqp''qh'CUTU''
tgr qtv'pcttcvkxgu''y tqwi j ''vgzv'o kpkpi 0'Cnj qwi j ''yj g''cxkcvkqp''kpf wvt{''ku''pqv'gzr gevgf ''vq ''

"

uwtrcuu'vjg'rtg/rcpfgo ke'pwodgtu'qh'cktrlkpg'vtcxgngtu'wpvknl'4245"'*KCVC."4243+."KCVC"

uwiigguu'rtgugpv'vtgpfu'kp'rcuugpigt'pwodgtu'hqt'iqnbcnl'cktvtcpurqtcvkqp'eqwnf'fqwdng'vq"

: 04"dknnkqp'kp'4259"'*KCVC."423: d+0'Vjg'kpetgcug'kp'hnkijv'qrgtcvkqpu'oc{'kpetgcug'vjg"

rqvgpvkcnl'hqt'vjg'qeewttgpeg'qh'hwog'gxgpvu'ykj 'cf f kvkqpcnl etgy "ogo dgtu'cpf "rcuugpigtu"

cv'tkum'qh'gzrquwtg'vq'jc|ctfqwu'eqorqwpfu'qt'wpegtvckp'hnkij v'qwveqogu'kh'hnkij v'etgyu"

ctg'ko rcktgf "qt'kpecrcekvcvgf0Hkpfkpiu'htqo "vjku'tgugctej "cpf "vjg'kfgpvkhlecvkqp'qh"

ko rqtvcpv'hcevqtu'cuuqekcvgf "ykj "hwog'gxgpvu'ecp'dg'wugf 'd{'vjg'HCC"cpf "kpfwuvt{'vq"

dgwgt'wpfgtuvcpf "hwog'gxgpvu."cuuguu'uchgv{'tkum'o cpci go gpv'rtqitcoou'cpf 'rqnkekgu."cpf "

fgxgnqr "crrtqrtkcvg'kpvgtxgpvkqp'uvtcvgikgu'vq'o kkicvg'vjg'qeewttgpeg'qh'hwog'gxgpvu0"

Hkpfkpiu'htqo "vjku'uvwf{'o c{'dg'wugf 'd{'vjg'HCC"cu'c'tcvkqpcng'vq'uwrrqtv'vjg"

guvcdnkujo gpv'qh'c'fgfkecvgf 'tgrqtvkpi 'u{uvgo 'hqt'uwtxgkmcpeg'cpf 'kpxguvki cvkqp'qh'WCS "

cpf 'hwog'gxgpvu0Kphqto cvkqp'qp'hcevqtu'cuuqekcvgf "ykj 'hwog'gxgpvu'eqmgevgf 'htqo "

hnkij v'cpf 'ecdkp'etgyu."o ckpvgpcpeg'vgej pkekcpu."kpurgevqtu."f kur cvej gtu."cpf 'qvj gtu'ecp"

dg'eqmgevgf ."fkfgpvkhlgf ."ci i tgi cvgf ."cpf 'uj ctgf "co qpi uv'ckrlkpgu'vq'cf xcpeg'vjg"

eqmgevkxg'mpqy ngfi g."cy ctgpguu."cpf 'rtgxgpvkqp'qh'hwog'gxgpvu'hqt'qrvko k| cvkqp'qh"

cxkcvkqp'uchgv{0"

Cktrlkpgu'cpf 'ncdqt'wpkqpu'ecp'wug'vjg'tguwnvu'qh'vjku'uvwf{'vq'kpetgcug'cy ctgpguu'qh"

hwog'gxgpv'qeewttgpeg."dgwgt'rtgrctg'etgy u'hqt'o kkicvkqp'qh'gxgpvu."cpf 'j ki j nki j v'vjg"

pgeguukv{'qh'fgxgnqrkpi 'c'uwtxgkmcpeg'u{uvgo 'hqt'vtcemkpi 'vj gug'gxgpvu0Wukpi 'vj g'o quv"

ko rqtvcpv'hcevqtu'cuuqekcvgf "ykj 'hwog'gxgpvu."uchgv{'o cpci gtu'ecp'f gxgnqr 'vtckpkpi 'hqt"

hnkij v'cpf 'ecdkp'etgy u'y kj 'nkmgn{'uegpctkqu'vq'ko rqxg'cy ctgpguu'tgeqi pkvkqp."cpf "

crrtqrtkcvg'tgurqpug'vq'hwog'gxgpvu0Gf wecvkqp'qh'hnkij v'cpf 'ecdkp'etgy u'vq'tckug"

cy ctgpguu'qh'hcevqtu'cuuqekcvgf "ykj 'hwog'gxgpvu'ecp'cuukuv'vj go "kp'o kkicvkqp'qh'gxgpvu"

cpf "j ki j rki j v'vj g'pgeguukv{"qh'r tqxkfkpi "f gvckngf "tgr qtvu'y j gp'tgr qtvkpi "vj gug"gxgpvu"vq"

vj g'CUTU."UFT"u{uvgo ."cpf "cp{"kpvgtpcn'eqo r cp{"uchgv{"tgr qtvkpi "u{uvgo u'tgs wktgf "d{"

vj g'eqo r cp{øu'uchgv{"o cpci go gpv'u{uvgo 0D{"kf gpvkh{kpi "vj g"o quv'ko r qtvcpv'hcevqtu"

cuuqekcvgf "ur gekhkecm{"y kj "hwo g"gxgpvu."uchgv{"o cpci gtu'ecp'y qtm'y kj "vtckpkpi "

f gr ctvo gpvu'vq'f gxgnqr "vtckpkpi "hqt'hki j v'cpf "ecdkp'etgy u'y kj "tgcnkuvke"uegpctkqu'vq"

ko r qxg'cy ctgpguu."tgeqi pkvkqp."cpf "j cpfrkpi "qh'go gti gpe{'r tqegfwtgu'hqt'vj g"

qeewttgpeg"qh'hwo g"gxgpvu0Rtqhguukqpcn'rknqvkpi "r tqi tco u'cpf "hki j v'uej qqnu'ecp"

kpeqtr qtcvg"hwo g"gxgpv'cy ctgpguu'cu'cp"gf wecvkqpcn'eqo r qpgpv'qh'nguuqpu'kp'hki j v'

r j {ukqnqi {.'r knqv'j gcnj .'tkum'cuuguuo gpv."cpf "uchgv{"o cpci go gpv'u{uvgo u0Tgeqi pkvkqp"qh'

ko r qtvcpv'hcevqtu'cuuqekcvgf "y kj "vj g"qeewttgpeg"qh'hwo g"gxgpvu"co qpi "pgy "r knqvu'ecp"

ngcf "vq'j gcnj "cpf "uchgv{"ko r qxgo gpvu'hqt'kpf kxkfwcnu'cpf "vj g'kpf wuvt{'qxgtcm0"""

　　　　Hkpf kpi u'htqo "vj ku'tgugctej "o c{"dg"wugfwn'vq"cktrkpg"uchgv{"r gtuqppgn0Uchgv{"

o cpci go gpv'uvchh'y qtmkpi "y kj "ckt'ecttkgtu'eqwnf "wug'kpvgtpcn'uchgv{"tgr qtvu'vq"etgcvg"

uko knct'f cvcugu'vq'vj qug'cxckncdng'vj tqwi j "vj g'CUTU'cpf "wug"qpg"qh'vj g"qr /r gthqto kpi "

cni qtkjo u'vq'eqphkto "qt'kf gpvkh{"cf f kvkqpcn'hcevqtu'cuuqekcvgf "y kj "hwo g"gxgpvu'kp'vj gkt"

qr gtcvkqpu0Cf f kpi "f gvckngf "kphqto cvkqp'vq'vj g'f cvcugv'uwej "cu'cktetchv'tgi kuvtcvkqp"

pwo dgtu'qt'ugtkcnpwo dgtu."gpi kpg"r qy gt'ugwkpi u."vko g"cpf "v{r g"qh'gpi kpg"o ckpvgpcpeg"

r gthqto gf ."qt'hkpf kpi u'htqo "o ckpvgpcpeg'kpur gevkqpu"eqwnf "r qvgpvkcm{"kf gpvkh{"cf f kvkqpcn'

hcevqtu'ur gekhke"vq'vj g'cktrkpgu¤'qr gtcvkqpu0'

　　　　Y kj "vj g'ctg"qeewttgpeg"qh'hwo g"gxgpvu."o qpkvqtkpi "qh'ckt's wcnkv{"f wtkpi "hnki j vu"

j cu'dggp "ko kvgf "kp'vj g'uweeguuhwn'o gcuwtgo gpv'qh'f gvgevcdng'ngxgnu'qh'j c| ctfqwu"

eqo r qwpfu'*Etwo r "gv'cn0'4233c'cpf "4233d="Fc{."4237="J qw| ci gt'gv'cn0'4235="P KQUJ ."

3; ; 5+0Tgugctej gtu'cpf "kpxguvki cvqtu'eqwnf "wug'hkpf kpi u'htqo "vj ku'uwf {'vq'j gnr "vcti gv'

"

vko gu"vq"eqmgev"uco rngu"hqt"o qpkqtkpi "ckt"swcnkv{"qt"vcti gv"hnki j vu"hqt"eqmgevkpi "y kr g"

uco rngu"htqo "uwthcegu0'Kf gpvkhkecvkqp"cpf "swcpvkhkecvkqp"qh"cp{"j c| ctf qwu"eqo rqwpf u"

o c{"dg"wughwn"kp"vj g"f gxgnqro gpv"qh"o k\ki cvkqp"uvtcvgi kgu"uwej "cu"hkngt"u{uvgo u"qt"vj g"

o gf kecn"\tgcvo gpv"qh"gzrqugf "r gtuqpu0'

Limitations of the Findings

"

Vj g"uwf { "wugf "ctej kxcn"f cvc"hqt"vj g"gzrnqtcvkqp"qh"\tgto u"cpf "vqr keu"cpf "vj g"

f gxgnqro gpv."vtckpkpi ."xcnkf cvkqp."cpf "vguvkpi "qh"vj g"o qf gnu"cpf "ku"vj wu"dqwpf "d{ "

rko kvcvkqpu"qh"vj g"f cvc0'Vj g"uvcpf ctf k| gf "hqto u"hqt"tgr qtvkpi "ctg"f guki pgf "vq"eqmgev"

kphqto cvkqp"cr r nkecdng"vq"uchgv{ "eqpegtpu."gxgpvu."kpekf gpvu."cpf "ceekf gpvu0'Cu"uwej ."vj g{ "

eqpvckp"o cp{ "hkgnf u"pqv"tgngxcpv'vq"kpxguvki cvkpi "qt"kf gpvkh{kpi "hcevqtu"cuuqekcvgf "y kj "

hwo g"gxgpvu0'Vj g"tguwnv"ku"c"uwduvcpvkcn'pwo dgt"qh"go r v{ "xctkcdng"hkgnf u"cpf "o kuukpi "f cvc."

cpf "xctkcdngu"y j kej "f q"pqv"eqpvtkdwvg"kphqto cvkqp"vq"vj g"ctc"qh"kpvgtguv0'Kp"cf f kvkqp."vj g"

r tko ct{ "kpegpvkxg"hqt"uwdo kvkpi "tgr qtvu"o c{ "kpenwf g"vj g"r tgxgpvkqp"qh"gphqtego gpv"

cevkqp="j wu."c"r qvgpvkcn'xkqncvkqp"qh"tgi wncvkqpu."r qnkekgu."r tqegf wtgu."qt"kpuvtwevkqpu"htqo "

CVE "ctg"vj g"vqr ke"qh"o cp{ "tgr qtvu"cpf "vj g"o qvkxcvkqp"hqt"tgr qtvkpi 0'Ugxgtcn'xctkcdngu"

y j kej "y gtg"kttgngxcpv'vq"vj qug"tgr qtvu"dwv'r qvgpvkcm{ "tgngxcpv'hqt"gzr nqtkpi "hcevqtu"

cuuqekcvgf "y kj "WCS "cpf "hwo g"gxgpvu"y gtg"pqv'cxckncdng"hqt"wug"kp"vtckpkpi ."xcnkf cvkpi ."

qt"vguvkpi "vj g"o qf gnu'f wg"vq"vj g"co qwpv"qh"o kuukpi "f cvc."uwej "cu"vj qug"hqt"cnkwf g"cpf "

cktetchv'eqo r qpgpv'kpxqnxgf 0"

WCS "qt"hwo g"gxgpvu"pqv'tgr qtvgf "vq"CUTU"y gtg"pqv'kpenwf gf "kp"vj g"f cvcdcug0'

Etgy u"wpcdng"vq"tgeqi pk| g."f guetkdg"qt"kf gpvkh{ "vj g"qeewttgpeg"qh"c"WCS "qt"hwo g"gxgpv"

o c{ "pqv'uwdo kv'tgr qtvu0'Kpekf gpvu"kpxqnxkpi "qdxkqwu"cpqo crkgu."uwej "cu"uvtqpi "qt"

f kuvkpevkxg"qf qtu"qt"uo qng."o c{ "dg"o qtg"rknkgn{ "vq"grkekv'tgr qtvu"cpf "o c{ "j cxg"kphnwgpegf "

yj g'tcpmkpi "qh'yj g'o quv'ko r qtvcpv'xctkcdng'kf gpvkhkgf ."ugpuqt{'r gtegr vkqp0Cnn'tgr qtvu"

uwdo kwgf "vq'yj g'CUT U'tgi ctf kpi "WCS "cpf "hwo g'gxgpvu'o c{'pqv'dg'kpenwf gf "kp'yj g"

f cvcdcug."cpf "yj gtghqtg'y gtg'pqv'cdng'vq"eqpvtkdwvg'vq'yj g'gzr nqtcvkqp'qh'vgto u'cpf "qr keu"

cuuqekcvgf "y kj "WCS "cpf "hwo g'gxgpvu0Vj g'o qf gm'kp'yj ku'uvwf {'y gtg'qpn{'cdng'vq"

kf gpvkh{ "WCS "cpf "hwo g'gxgpvu'yj cv'y gtg'tgeqi pk|gf "cpf "tgr qtvgf 0"

    Vj g'wpuvtwevwtgf "pcttcvkxg'hkgnf u'r tqxkf g'cp'qr r qtwpkv{'vq'f guetkdg'gxgpvu'kp"

i tgcv'qt'ikwne'f gvckn'cpf "yj g'f kur ctkv{ "kp'tgr qtvgf "f gvckm'y cu'pqvgf 0Uqo g'tgr qtvgtu"

gzj kdkvgf "kp-f gr yj "lpqy ngf i g'qh'hwo g'gxgpvu'kp'yj gkt'tgr qtvu.'y j kng'qyj gtu'r tqxkf gf "

o kpko cn'f guetkr vkxg'kphqto cvkqp'cdqwv'yj g'gxgpv0P cttcvkxg'hkgnf u'eqpvckpgf "cu'hgy "cu'y q"

y qtf u'—hwo g'gxgpvø'qt'eqwnf "eqpvckp'gzvgpukxg'f guetkr vkqpu'qh'ektewo uvcpeg'ngcf kpi "wr "

vq'cp'gxgpv.'f kuewuukqp'co qpi 'hnki j v'cpf "ecdkp'etgy .'cevkqp'vcmgp.'u{o r vqo u"

gzr gtkgpegf .'cpf "tgr qtvgt'tgeqo o gpf cvkqpu'hqt'yj g'cktnkpgøu'o cpci go gpv0"

    Ncuvn{.'f gvckmu'o kuukpi "htqo "yj g'CUT U'f cvcugv'pggf "vq'dg'uwr r ngo gpvgf "d{"

cktnkpgu.'o cpwhcevwtgtu.'qt'o cpci gtu'qh'c'hwo g'gxgpv'uwtxgknncpeg'u{uvgo "vq'kpetgcug'yj g"

xcnwg'qh'yj g'o qf gnkpi 0Hqt'gzco r ng.'c'i tgcv'pwo dgt'qh'cktetchv'y gtg'nkuvgf "y kj "i gpgtke"

f guetkr vkqpu'uwej "cu'y kf gdqf {'vtcpur qtv.'o gf kwo "ncti g'vtcpur qtv.'nki j v'vtcpur qtv.'qt'uo cnl"

vtcpur qtv.'nqy "y kpi .'4"wtdqlgv'gpi kpgu0Y j kng'yj g'o cng'cpf "o qf gn'qh'yj g'cktetchv'o c{'pqv"

dg"guugpvkcn'kphqto cvkqp'hqt'uqo g'tgr qtvgf "gxgpvu.'yj g'ncem'qh'f gvckn'ko ku'yj g'vzv'o kpkpi "

r tqeguu'kp'yj g'kf gpvkhkecvkqp'qh'ko r qtvcpv'hcevqtu'kp'yj g'qeewttgpeg'qh'hwo g'gxgpvu0Vj g"

cdknkv{'qh'yj g'o qf gnu'vq'f gvgto kpg'gxgpvu'cpf "pqp/gxgpvu'ku'eqpuvtckpgf "d{'c'ncem'qh'

f gvckn'ur gekcm{ "y kj "ko kvgf "tgr qtvu'hqt'WCS "cpf "hwo g'gxgpvu0Vj g'f gxgnqr o gpv'qh'c"

uwtxgknncpeg'u{uvgo "ur gekhkecm{'hqt'tgr qtvkpi "cpf "vtcemkpi "hwo g'gxgpvu'eqwnf "r tqxkf g'c"

"

uvcpf ctf k| gf "o gej cpkuo "hqt "tgr qtvkpi "gxgpvu "cpf "kpenwf g"c "vcknqtgf "hqto cv'hqt "eqmgevkpi "

kphqto cvkqp "wughwn'kp "gz r qtvkpi "tgngxcpv'f cvc "cpf "dwknf kpi "cr r qrtkcvg "o qf gnu0"

Recommendations

Tgeqo o gpf cvkqpu'hqewu"qp "hwtvj gtkpi "vj g"hkpf kpi u"htqo "vj ku'tgugctej "vq "qdvckp"

f cvc"qh'dgwgt"s wcnkv{"cpf "kpetgcugf "s wcpvkv{"cpf "vj g"eqpvkpwgf "wug"qh'vj g"vzv"o kpkpi "

r tqeguu"vq "kphqto "vj g"f cvc"o kpkpi "r tqeguu"cpf "f gxgnqr o gpv'qh"o qf gnu0Gzr cpukqp"qh'vj ku"

tgugctej "ecp "gpj cpeg"vj g"dqf {"qh"uekgpvkhke"mpqy ngf g"cpf "ko r tqxg"cxkcvkqp"uchgv{0"

Recommendations to Industry

Hkpf kpi u'htqo "vj ku'tgugctej "cf f tguu"cpf "j ki j nki j v'c"pggf "hqt"cf f kvkqpcn'

kphqto cvkqp'tgi ctf kpi "WCQ "cpf "hwo g"gxgpvu'dqvj "kp"s wcpvkv{"cpf "s wcnkv{"qh'f cvc0Vj g"

tgeqo o gpf cvkqpu'vq "kpf wuvt{"cf f tguu"cevkqpu'd{ "tgi wncvqtu."cktnkpgu."ncdqt"qti cpk| cvkqpu."

cpf "uchgv{ "r tqhguukqpcnu"vj cv'eqwnf "dg "vcmgp"vq "ko r tqxg"vj g"mpqy ngf g"dcug"cpf "ko kv"

i cr u'kp "hwo g"gxgpv'tgugctej "cpf "ko r tqxg"cxkcvkqp"uchgv{ "hqt"etgy u"cpf "r cuugpi gtu0"

Recommendation 1. Guvcdnkuj "c"f cvcdcug"hqt"tgr qtvkpi "cm'WCQ "cpf "hwo g"gxgpvu"

cu"r ctv'qh'c"pcvkqpcn'uwtxgkmcpeg"u{uvgo "vq "vtcem'vj gug"gxgpvu"cpf "vj gkt"qwveqo gu0Vj gtg"

ctg"ewttgpvn{"pq"kpf wuvt{/y kf g"o cpf cvqt{"tgr qtvkpi "tgs wktgo gpvu"hqt"vj g"qeewttgpeg"qh"

hwo g"gxgpvu"qt"r qvgpvkcn'gzr quwtg"vq "j c| ctf qwu"eqo r qwpf u"f wtkpi "vj gug"gxgpvu0Rwdnke"

Ncy "334/; 7"*4234+'o cpf cvgf "vj g"HCC "vq "f gxgnqr "c"u{uvgo cvke"tgr qtvkpi "uvcpf ctf "hqt"

eqpvco kpcvgf "dnggf "ckt"gxgpvu."j qy gxgt."vj ku'f ktgevkxg'j cu"pqv'eqo g"vq "htwkvkqp0"

Vj g"CUTU"eqpvckpu"c"r ngvj qtc"qh'kphqto cvkqp"tgncvgf "vq "uchgv{"cpf "vj g"gzr grtkug"qh'

vj g"cpcn{uvu."cpf "vj gkt"eqpukuvgpey "kp"eqf kpi "r tqxkf gu"c"tkej "qr r qrtwpkv{"hqt"gzr nqtcvqt{"

tgugctej 0J qy gxgt."egrvckp"cur gevu"r tgenwf g"gzvgpukxg"wug"qh'vj g"f cvc"hqt"ugxgtcn'

cr r nkecvkqpu0Vj g"f gkf gpvkhkecvkqp"qh'xctkcdngu"kp"CUTU"ko ku"vj g"cdknkv{ "vq "cf f "f gvckn'vq "

"

yj g"o qf gnu."uwej "cu"o cmg"qt"o qf gn'qh'cktetchv'cpf "yj g'pcwwtg'qh'xqnwpvct{'tgrqtvkpi "

cmqy u'hqt"xcuv'fkur ctkv{'kp'fgvcknu'eqpvckpgf "kp"yj g'pcttcvkxg'hkgnfu0'Vguw'hqt"o gfkecn'

gxcnwcvkqp'cpf "fkci pquku'hqmqy kpi "gzrquwtg'fwtkpi "hwo g'gxgpvu"ctg"pqv'uvcpfctfk| gf."

cpf "tgcvo gpv'cpf "hqmqy /wr "ctg"i gpgtcn{'pqv'kpenwfgf "kp'tgrqtvu0'C "uwtxgknncpeg"u{uvgo "

kpenwfkpi "yj gug'hkgnfu'eqwnf "eqpvtkdwvg"vq"yj g'dqf {'qh'mpqy ngfi g"cpf "ckf "kp"ectg"hqt"etgy "

o go dgtu"cpf "r cuugpi gtu"y j q"o c{"j cxg"dggp"cewugn{"qt"ej tqpkecn{"gzr qugf "vq"j c| ctf qwu"

eqo r qwpfu0'

Cktnkpgu"o c{"r ctgcf {"tcem'hwo g'gxgpv'qeewttgpe{'y kj kp"yj gkt"qti cpk| cvkqpu"cu"

r ctv'qh'cp'UO U'qt'CUCR0'C "f cvcdcug'f gxgmqr gf "cpf "o cpci gf "d {"c'pqp/i qxgtpo gpvcn'

yj ktf "r ctv{'hqt"yj g'uqng"r wtr qug'qh'tcemkpi "hwo g'gxgpvu'qp"c'pcvkqpcn'ngxgn'wukpi "i wkfcpeg"

r tqxkfgf "d {"KECQ"*4237+'eqwnf "hqewu"qp'eqmgevkpi "etkkecn'kphqto cvkqp'hqt"r tgxgpvkpi "

yj gug'gxgpvu'cpf "r tqxkfg'f gvcknu'pqv'cxcknmdng"kp"yj g'CUTU'f cvcdcug0'Vj g"ko r qtcpv'

hcevqtu'kf gpvkhkgf "kp"yj ku'uvwf {"eqwnf "dg"wugf "vq"gpj cpeg"yj g's wguvkqppcktg"eqpvgpv'vq"

gpuwtg"cf gs wcvg"f cvc"ku"qdvckpgf "hqt"uweeguuhwn'wug"qh"yj g'f cvcdcug"kp"hwwtg"WCS "cpf "

hwo g"gxgpv'tgugctej 0""

Recommendation 2. Kpetgcugf "cwgpvkqp"uj qwf "dg"i kxgp"vq"yj g"kphtgs wgpv'dwv'

r qvgpvkcn{'ugtkqwu'eqpugs wgpeg"qh'hwo g'gxgpvu."kpenwfkpi "vtckpkpi "cpf "gf wecvkqp"vq"

kpetgcug"etgy "o go dgtuØ'cy ctgpguu'cpf "tgeqi pkkqp'qh'WCS "cpf "hwo g'gxgpvu0'Hqmqy kpi "

i wkf gnkpgu"hqt"gf wecvkqp."vtckpkpi ."cpf "tgr qtvkpi "hqt"hwo g'gxgpvu'cu'guvcdnkuj gf "d {"KECQ"

*4237+'ecp"o kpko k| g"cy ctgpguu'cpf "tgur qpug"ko g."gpuwtg"cr r qr tkcvg"cevkqpu'ctg"vcmgp"

cpf "r tqxkfg"f qewo gpvcvkqp"hqt"yj g"qeewttgpeg"qh'hwo g'gxgpvu0'Mpqy ngf i g"qh"yj g"

ugtkqwupguu'qh'cewwg'cpf "ej tqpke'gzr quwtg'vq"j c| ctf qwu'eqo r qwpfu'cpf "tgeqi pkkqp'qh'

yj g"r tgewtuqtu'qh'hwo g'gxgpwu'o c{"hcekkkcvg"cr r qr tkcvg"tgur qpug'd {"etgy u'cpf "yj g"

"

f gxgmqr o gpv'qh'r twf gpv'r qnkekgu"cpf "r tqegf wtgu"d{"cktnkpg"o cpci go gpv0'Gpj cpegf "

cy ctgpguu"qh'WCS "cpf "hwo g'gxgpwu"o c{"kpetgcug"vj g"o cti kp'qh'uchgy{'kh'hwo g'gxgpwu'ctg"

tgeqi pk| gf "cpf "o kki cvgf "qt "go gti gpe{"cevkqp'ku'vcmgp'su wkenn{='etgy u'ctg'vtckpgf "kp"

cy ctgpguu'qh'ko r qtvcpv'hcevqtu'cuuqekcvgf "y kj "vj g'qeewttgpeg'qh'hwo g'gxgpwu'cpf "

cr r tqr tkcvg'tgcevkqpu'vq'kpfkecvkqpu'qh'hwo g'gxgpwu='cpf "ecdkp'cpf "hnki j v'etgy u'ctg"

eqqtfkpcvgf "kp'vj kt'tgur qpug0'Hnki j v'cpf "ecdkp'etgy "o go dgtu'ctg'cnuq'ngggu'hkngn{"vq'tgr qtv'

hwo g'gxgpwu'kh'vj g{"fqpø'tgeqi pk| g'vj go ."fq'pqv'r gtegkxg'vj go "cu'cdpqto cn'gxgpwu."qt'fq"

pqv'cuuqekcvg'vj go "y kj "r qvgpvkcn'gzr quwtg'vq'j c| ctf qwu'eqo r qwpfu0'Gzr cpfkpi "vj g"

gf wecvkqp"gngo gpv'vq'uvwfgpw'kp'r tqhguukqpcn'r knqvkpi "r tqi tco u'cpf "hnki j v'uej qqnu'eqwnf "

hquvgt "tgeqi pkkqp'qh'cuuqekcvgf "hcevqtu."hquvgt 'gctn{"tgeqi pkkqp'cpf "o kki cvkqp'qh'hwo g"

gxgpwu."cpf "cnqy "hqt"vj g'cwi o gpvcvkqp'qh'tgr qtvkpi "u{uvgo u'y j gp'cpf "kh'vj g'pgy "r knqvu"

gzr gtkgpeg'hwo g'gxgpwu'kp'vj kt'lqdu0'Vj ku'tgeqo o gpf cvkqp'ku'uwr r qtvgf "d{"vj g'HCC"

Tgcwj qtk| cvkqp'Cev'qh'423: ."y j gtgd{"vj g'HCC "ku'eqpf wevkpi "c'rkvgtcwtg'tgxkgy "cpf "

eqpuwnkpi "y kj "uvcmgj qnf gtu"vq"fgxgnqr "gf wecvkqpcn'o cvtkcnu"vq"gf wecvg"etgy u'kp"vj g"

tgur qpug"vq"uo qng"qt"hwo g"kpekf gpwu"qp"dqctf "cktetchv"*HCC."4242d+0'

Recommendations for Future Research

Recommendation 3. Vj g'hqtgo quv'eqpvtkdwvkqp'qh'vj ku'tgugctej "y cu'vj g"

kf gpvkhkecvkqp'qh'ko r qtvcpv'qr keu'vj tqwi j "vj g'wug'qh'vgzv'o kpkpi "kp'vgzv'hkgnf u'qh'

pcttcvkxgu'eqpvckpgf "kp'xqnwpvct{'tgr qtvu0'Hwwwtg'tgugctej "uj qwf "dwknf "wr qp'vj gug"

hkpf kpi u'cpf "eqpvkpwg'vq'tghkpg'vj g'r tqeguu'wukpi "pgy "f cvc."fkhhgtgpv'f cvcugu."cpf "

fkhhgtgpv'cni qtkjo u'vq'o qtg'hwn{'f ghkpg."wpf gtuvcpf ."cpf "r tgf kev'vj g'qeewttgpeg'qh'hwo g"

gxgpwu0'Vj g'CUTU'f cvcdcug'uj qwf "dg'gzr nqtgf "r tkqtkdecn{'vq'kpenwf g'cff kkqpcn'{gctu'qh'

tgr qtwu."cu'kphqto cvkqp'tgi ctfkpi "hwo g'gxgpv'cy ctgpguu'cpf "tgeqi pkkqp'dgeqo g'o qtg"

"

y kf gur tgcf ."vj g"rkmgrkj qqf "gzkuvu"hqt'tgr qtvu"qh'hwo g"gxgpvu"vq"kpetgcug0'Y kj "vj g"

qeewttgpeg"cpf "tgr qtvkpi "qh'cf f kvkqpcn'gxgpvu."pcttcvkxgu"o c{"eqpvcdp"i tgcvgt'f gvcdn'

tgi ctf kpi "vj g'gxgpvu."cpf "o qtg"pwcpegf "hgcvwtgu'qh'hwo g"gxgpvu"o c{"dgeqo g"cr r ctgpv0'

Vj g"kpetgcugf "pwo dgtu"qh'tgr qtvu'qh'WCS "cpf "hwo g"gxgpvu"cu'c"i tgcvgt'r gtegpvci g"qh'vj g"

vqvcn'tgr qtvu"o c{"gpj cpeg"ecr cdkrkvkgu"vq"dgvwgt"vtckp"vj g"o qf gn0'Vj g"kpenwukqp"qh'

cf f kvkqpcn'WCS "cpf "hwo g"gxgpvu"cpf "f gvckn'tgi ctf kpi "vj gkt"ektewo uvcpegu"o c{"ko r tqxg"

vj g"o qf gnø'ugpukvkxkv{"cpf "cnqy "vj g'f gxgnqr o gpv'qh'o qf gnu'y kj "cp"cdkrkv{"vq"eqttgevn{"

r tgf kev'c"WCS "qt'hwo g"gxgpv0"

Hwtvj gt"gzr nqtcvkqp"qh'ko r qtvcpv'hcevqtu"cuuqekcvgf "y kj "WCS "o c{"dg"gpj cpegf "

d{"hwtvj gt"f kuvkpi wkuj kpi "vj g"uqwteg"cpf "eqpfwevkpi "hqewugf "vgzv'o kpkpi "cpf "f gxgnqr kpi "

o qf gnu"dcugf "qp"vj g'f khhgtgpv'uqwtegu0'O qf gnuø'ugpukvkxkv{"xcnwgu"o c{"dg"ko r tqxgf "d{"

eqpukf gtkpi "ecwugu"qh'WCS "uwej "cu'uo qmg.'hktg."cpf "qf qtu'ugr ctcvgn{0'Kp"cf f kvkqp."

f kuvkpi wkuj kpi "xctkqwu'uqwtegu"qh'WCS "uwej "cu'r cuugpi gt/ecwugf ."cktetchv/tgncvgf .'i cmg{/

dcugf ."eqo r qpgpv'hcknwtg."hkj kwo "dcwgt{"hktg."gve0'eqwnf "cmqy "hqt"c"o qtg'f gvckngf "

cpcn{uku'qh'kpf kxkfwcn'xctkcdngu0'Cr r tqr tkcvg'eqf kpi "qh'ur gekhke"uqwtegu"qh'WCS "o c{"

cuukuv'kp"eqttgevn{"kf gpvkh{kpi "vj g"vtwg'r qukvkxgu"cpf "vj g'hcnug'pgi cvkxgu"cpf "eqwnf "ko r qxg"

vj g"ngxgn'qh'f gvckn'eqpvckpgf "kp"vj g"vgzv'o kpkpi "qr keu"cpf "gpj cpeg'vj g'cdkrkv{"qh'vj g"

o qf gnu"vq"kf gpvkh{"ko r qtvcpv'qr keu0""""

Eqpfwevkpi "c"uko krct'r tqeguu'qh'vgzv'o kpkpi "vq"gzr nqtg"ko r qtvcpv'qr keu."f cvc"

o kpkpi ."cpf "r tgf kevkxg"o qf gnkpi "eqwnf "dg"cr r nkgf "vq"pgy "f cvcugvu'vq"r tqxkf g"pgy "

r gtur gevkxgu"qp"vj g"eqpf kvkqpu."gxgpvu."cpf "dgj cxkqtu"cuuqekcvgf "y kj "vj g"qeewttgpeg"qh'

hwo g"gxgpvu0'Hqt"gzco r ng."vj g"Ugtxkeg'F khhkewnv{"Tgr qtv'f cvcdcug"eqpvckpu'tgr qtvu"

uwdo kwgf "d{"ckrnkpgu."qr gtcvqtu."o ckpvgpcpeg"vgej pkekcpu."qt"egtvkhkecvgf "tgr ckt"uvcvkqp"

"

r gtuqppgn'chvgt"vj g"f kueqxgt{"qh"c"ugtkqwu"hcknwtg."o crhwpevkqp."qt"f ghgev"qh"eqo r qpgpvu."

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Recommendation 4. Vj g'ty q/uvgr "r tqeguu'qh'vgzv'o kpkpi "cpf "f cvc'o kpkpi "kp"c"

o kzgf "o gyj qf "f guki p'uj qwnf "dg"cr r nkgf "vq"tgugctej "kp"qyj gt"ctgcu'qh'cxkcvkqp"uchgv{ "vq"

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References"

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Etwo r ."F 0"J cttkuqp ."R0"("Ycnqp ."E0*4233c+0'*Aircraft cabin air sampling study; Part 1 of the final report.*"Kpuvkwwg"qh'Gpxktqpo gpv'cpf "J gcnj 0' jwr‹1lf ur ceg0hkd0etcphkgnf0ce0wmlj cpf ng3: 4817527"
"

Etwo r ."F 0"J cttkuqp ."R0"("Ycnqp ."E0*4233d+0'*Aircraft cabin air sampling study; Part 2 of the final report.*"Kpuvkwwg"qh'Gpxktqpo gpv'cpf "J gcnj 0' jwr‹1lf ur ceg0hkd0etcphkgnf0ce0wmlj cpf ng3: 4817528"
"

Ewo o kpu ."T0'Q0"("Uej wdcej ."L0'C0*3; ; +0'Htgswgpe{"cpf "v{r gu"qh'o gf kecn'go gti gpekgu" co qpi "eqo o gtekcn'ckt "vtcxgngtu0'*Journal of the American Medical Association, 261*;.+.'34; 7/34; ; 0'*
"

F cu ."U0"Ej cmcdqtv{."T0"("O ckta ."C0*4239+0'C"tcpfqo "hqtguv'cni qtkjo "hqt'pqy ecuvkpi " qh'kpvgpug"r tgekr kcvkqp"gxgpvu0'*Advances in Space Research,'82*8+.'3493/34: 40' jwr u‹1lf qk0qti 132038238110cur 04239025 0248"
"

F c{."T 0'C0*4237+0'*Aircraft cabin bleed air contaminants: a review.*"Ekxkn'Cgtqur ceg" O gf kecn'Kpuvkwwg. "Hgf gtcn'Cxkcvkqp'Cf o kpkuvtcvkqp0'jwr ‹1ly y y 0hcc0 qx1lf cvca" tgugctej tgugctej o gf aj wo cphceulcqo vgej tgr qtuw4232uo gf kc14237420 r f h"
"

F gcp ."L0*4236+0'*Big data, data mining, and machine learning: Value creation for business leaders and practitioners.*"Lqj p'Y kng{"("Uqpu0"
"

F g'Dqgt ."L0'Cpvgnq ."C0'xcp'f gt'Xggp ."K0'Dtcpfuo c ."U0"("Nco o gtvug ."P 0*4237+0' Vtketgu{p'r j qur j cvg"cpf "vj g'cgtqvqzke"u{pftqo g'qh'hkkj v'etgy "o go dgtu"ó"ewttgpv' i cr u'kp "mpqy ngf i g0'*Chemosphere, 119*4237+.'U7: /U830' f qk320382381 10ej go qur j tg04236027 0237"
"

F gncwpg'G0'H0"Nwecu'T0'J 0"("Kmki "R0*4225+0'Kp/hkkj v'o gf kecn'gxgpvu'cpf "cktetchv' f kxgtukqpu‹'Qpg'ckthkpg)u'gzr gtkgpeg0'*Aviation, Space, and Environmental Medicine, 74*3+.'8468: 0"
"

f gXknng ."D0"("P gxknng ."R0*4235+0'*Decision trees for analytics using SAS® Enterprise Miner0'UCU® "Rwdnkuj kpi 0j wr ‹1uwr r qtv0ucu0eqo leqpvgpv11f co IUCUuwr r qtv' lgp lqqmulf gekukqp/tggu/hqt/cpcn{kku/wukpi /ucu/gpvgtr tkug/o kpgt 18553; a" gzegtr v0r f h"
"

f g'Tgg ."J 0"Ci vgtdgti ."J 0"J qw{ci gt ."O 0"J cxgro cpu ."L0"("Dqu ."L0*4239+0'Gzr quwtg'qh' ckthkpg'uvchh'vq'VERJU'htqo "gpi kpg'qkn0'*ASHRAE Transactions.'345*3+0'Dwukpguu" Kpuki j u‹'Guugpvkcnu0j wr ‹1lkdk0 cngg0eqo 0i|r tqz 0kdr tqz {0f d0gtcw0gf w1' guugpvkcnulctvkeng II CNG®9EC6; 2; : 5: 72Aw?go dt{"
"

F ko kvtkcf ku ."U0'K0"("Nkr ctcu ."F 0*423: +0'J qy "tcpf qo "ku"vj g'tcpf qo "hqtguvA'Tcpf qo " hqtguv'cni qtkjo "qp"vj g'ugtxkeg'qh'uvtwewwtcn'ko ci kpi "dkqo ctmgtu"hqt'Cn| j gko gtu" f kugcug‹'Htqo "Cn| j gko gtu'f kugcug'pgwtqko ci kpi "kpkvkcvkxg"*CFP K+0'f cvcdcug0' *Neural Regeneration Research, 13*8+.'; 846; 920'f qk320632513895/75960455655"
"

"

F kpi ."E0"C{g."J 0"V0"\ 0"Rc."Y 0"R0"P y gv."M0"V0"Uqg."M0"O 0 0"Wki{co c."O 0"("Uwo kc."G0"
*423; +0"Vqy ctf u"Dwto gug"*O {cpo ct+"o qtr j qroi kecri"cpcn{uku<"U{mcdng/dcugf "
vqmgpk{cvkqp"cpf "r ctv"qh/ur ggej "vci i kpi 0"*ACM Transactions on Asian Low-
Resource Language Information Processing.*"3; *3+*"Ctvkeng"70"
f qk0"qti 132036715547: : 7"

F kpi ."U0"L0"Ectt."L0"Ectnuqp."L0"G0"Vqpi ."N0"Z vg."Y 0"Nk"[0"Uej qr hgt."N0"O 0 0"Nk"D0"
P cej qp."H0"Cuqlq."Q0"Vj qo r uqp."E0"O 0 0"J kptkej u."U0"J 0"O cuuqp."R0"("
Nqemkf i g."Q0"*422: +0"Hkxg"v{tquikpgu"cpf "v{q"ugtkpgu"kp"j wo cp"cndwo kp"ctg"
ncdgngf "d{"vj g"qti cpqr j qur j qtwu"ci gpv"HR/dkqvkp0"*Chemical Research in
Toxicology, 21*; +."39: 9639; 60"j wr u<"f qk0"qti 132032431vz: 22366| "

F qo kpi qu"R0"("J wvgp."I 0"*4222+0"O kpkpi "j ki j /ur ggf "f cvc"uvtgco u0"*Proceedings of the
6th ACM SIGKDD International Conference on Knowledge Discovery and Data
Mining0"CEO ."936: 20"j wr u<"f r n"ceo 0"qti 1f qk132036715692; 20"569329"

Gi rk "U0"Vj kgu."D0"("Dgpfkz."L0"*423: +0"C"j {dtkf "cr r tqcej "hqt"hqi "tgvtkgxcn"dcugf "qp"c"
eqo dkpcvkqp"qh"ucvgmkvg"cpf "i tqwpf "vtwj "f cvc0"Remote Sensing, 10*6+."84: 0"
j wr <1f z0f qk0qti 0g| r tqz{0kdr tqz{0f 0gtcw0gf w132055; 21tu3226284: "

Go dt{/Tkf f ng"Cgtqpcwkecn"Wpkxgtukv{0"*4243+0"IRB Frequently Asked Questions0"
j wr u<1gtcw0gf w1tgugctej 1ktd1hcs "

GO E"Gf wecvkqp"Ugtxkegu0"*4237+0"Data science & big data analytics: Discovering,
analyzing, visualizing and presenting data.*"Lqj p"Y kng{"("Uqpu."Kpe0"

Gvcpk "P 0"*423; +0"F gxgnqr o gpv"qh"c"r tgf kevkxg"o qf gn"hqt"qp/vio e"cttkxcn"hnki j v"qh"cktnkpgt"
d{"f kueqxgtkpi "eqttgncvkqp"dgvy ggp"hnki j v"cpf "y gcvj gt"f cvc0"Journal of Big Data,
6*3+."3/390"j wr u<1f z0f qk0qti 0g| r tqz{0kdr tqz{0f 0gtcw0gf w132033: 8 1u62759/23; /
2473/{"

Hcy egw ."V0"*4228+0"Cp"kpvtqf wevkqp"vq"TQE"cpcn{uku. Pattern Recognition Letters.*": 83/
: 960"f qk1320238110r cvtge04227032032"

Hgf gtcn"Cxkcvkqp"Cf o kpkuvtcvkqp"]HCC_0"*p0f 0c0+0"AIDS System Information.*"
j wr u<1ly y y 0cukcu0hcc0i qx lcr gz 1hAr ?322<37≪P Q<R37aTGI KQP aXCT<4"

Hgf gtcn"Cxkcvkqp"Cf o kpkuvtcvkqp"]HCC_0"*3; ; 6+0"FAA Service Difficulty Report.*"HCC"
Hqto ": 292/30"j wr u<1ly y y 0hcc0i qx 1f qewo gpvNkdtct{1o gf kc1Hqto 1"
HCCaHqto a: 292/30r f h"

Hgf gtcn"Cxkcvkqp"Cf o kpkuvtcvkqp"]HCC_0"*3; ; 4+0"FAA malfunction or defect report.*"HCC"
Hqto ": 292/60"j wr u<1ly y y 0hcc0i qx 1f qewo gpvNkdtct{1o gf kc1Hqto 1HCCa: 232/
6a9/3; 0r f h"

"

Hgf gtcn'Cxkcvkqp'Cf o kpkuvtcvkqp"]HCC_0*3; ; 5+0'*Service difficulty program (general aviation).*'Cf xkuqt{'Ektewnct'CE'42/32; C0'
j wr u‹1ly y y 0hcc0 qx lf qewo gpvNkdtct{ lo gf kc1Cf xkuqt{aEktewnct lce42/32; c0rf h"

"

Hgf gtcn'Cxkcvkqp'Cf o kpkuvtcvkqp"]HCC_0*4228+0'*Flight standards bulletin for airworthiness 06-05A guidance for smoke/fumes in the cockpit/cabin*0'Hgf gtcn'
Cxkcvkqp'Cf o kpkuvtcvkqp.'Cktetchv'Ockpvgpcpeg'F kxkukqp."Y cuj kpi vqp.'F E0'
j wr ‹1ly y y 0j tec0qti ly r /eqpvgpv wr nqcf u14236128 1HUCY 28/27c0rf h"

"

Hgf gtcn'Cxkcvkqp'Cf o kpkuvtcvkqp"]HCC_0*422; +0'*Voluntary disclosure reporting program*0Cf xkuqt{'Ektewnct'22/7: D0'Hgf gtcn'Cxkcvkqp'Cf o kpkuvtcvkqp."
Y cuj kpi vqp.'F E0j wr u‹1ly y y 0hcc0 qx lf qewo gpvNkdtct{ lo gf kc1Cf xkuqt{"
aEktewnct1CEa22/7: D0rf h"

"

Hgf gtcn'Cxkcvkqp'Cf o kpkuvtcvkqp"]HCC_0*4232+0'*FAA accident/incident report*0'HCC'Hqto "
: 242/450'j wr u‹1ly y y 0hcc0 qx lf qewo gpvNkdtct{ lo gf kc1Hqto 1HCC' 42: 242/
45' 4234/29/2; 0rf h"

"

Hgf gtcn'Cxkcvkqp'Cf o kpkuvtcvkqp"]HCC_0*4233c+0'*Information for operators 11002: smoke/fumes in the cabin/cockpit of transport category aircraft*0'Hgf gtcn'Cxkcvkqp"
Cf o kpkuvtcvkqp.'Cktetchv'O ckpvgpcpeg'F kxkukqp0'j wr u‹1ly y y 0hcc0 qx lqvj gtaxkukv1"
cxkcvkqpakpf wuvt{ lcktnkpgaqr gtcvqtulcktnkpgauchgv{ lkphq lcmakphquo gf kc14233 1kpHQ
332240rf h"

"

Hgf gtcn'Cxkcvkqp'Cf o kpkuvtcvkqp"*4233d+0'*Flight standards aviation safety reporting program.*'Cf xkuqt{'Ektewnct'22/68G0'Hgf gtcn'Cxkcvkqp'Cf o kpkuvtcvkqp0'
j wr u‹1ly y y 0hcc0 qx lf qewo gpvNkdtct{ lo gf kc1Cf xkuqt{aEktewnct1CE' 4222/
68G0rf h"

"

Hgf gtcn'Cxkcvkqp'Cf o kpkuvtcvkqp"*4237+0'*Safety management systems for aviation service providers*0Cf xkuqt{'Ektewnct'342/; 4D0'Hgf gtcn'Cxkcvkqp'Cf o kpkuvtcvkqp0'
j wr u‹1ly y y 0hcc0 qx lf qewo gpvNkdtct{ lo gf kc1Cf xkuqt{aEktewnct1CEa342/
; 4D0rf h"

"

Hgf gtcn'Cxkcvkqp'Cf o kpkuvtcvkqp"]HCC_0*4238c+0'*Fact sheet – Aviation voluntary reporting programs.* j wr u‹1ly y y 0hcc0 qx lpgy ulhcevauj ggvulpgy uauvqt{ leho A"
pgy ulf ?42436"

"

Hgf gtcn'Cxkcvkqp'Cf o kpkuvtcvkqp"]HCC_0*4238d+0'*Safety management system basis.*"
j wr u‹1ly y y 0hcc0 qx lcdqwv1kpkvkcvkxguluo ulgzr nckpgf ldcuku1"

"

Hgf gtcn'Cxkcvkqp'Cf o kpkuvtcvkqp"]HCC_0*4238e+0'*Pilot/controller glossary*0Ckt 'Vtchhke"
Qti cpk| cvkqp'Rqnke{'LQ '7332087Y 'EJ I '30j wr u‹1ly y y 0hcc0 qx lf qewo gpvkdtct{1"
o gf kclqtf gt lce v0rf h"

"

"

Hgf gtcnlCxkcvkqp'Cf o kpkuvcvkqp"]HCC_0*4239c+0'*Aviation safety action program.*"
    j wr u‹1ly y y 0hcc0' qx lcdqwwlkpkvkcvkxgulcucr 1"
"

Hgf gtcnlCxkcvkqp'Cf o kpkuvcvkqp"]HCC_0*4239d+0'*Safety risk management policy.*"Qtf gt"
    : 26206d0'j wr u‹1ly y y 0hcc0' qx lf qewo gpvNkdtct{ lo gf kc1Qtf gt1HCCaQtf gt"
    a: 26206D0'rf h'
"

Hgf gtcnlCxkcvkqp'Cf o kpkuvcvkqp"]HCC_0*423: +0'*Aircraft accident and incident
    notification, investigation, and reporting.*'Qtf gt": 242083F 0'
    j wr u‹1ly y y 0hcc0' qx lf qewo gpvkdtct{ lo gf kc1qtf gt1hccaqtf gta: 242083f 0'rf h""'
"

Hgf gtcnlCxkcvkqp'Cf o kpkuvcvkqp"]HCC_0*423; +0'*Air traffic by the numbers*0'
    j wr u‹1ly y y 0hcc0' qx lcktavtcHhkeld{ avj gapwo dgtu1"
"

Hgf gtcnlCxkcvkqp'Cf o kpkuvcvkqp"]HCC_0*4242c+0'*Aviation safety action program.*
    Cf xkuqt{ 'Ektewnct"342/88E0'Hgf gtcnlCxkcvkqp'Cf o kpkuvcvkqp0'
    j wr u‹1ly y y 0hcc0' qx l'f qewo gpvNkdtct{ lo gf kc1Cf xkuqt{ aEktewnct1CEa342/
    88Ea*Gf kv+0'rf h'
"

Hgf gtcnlCxkcvkqp'Cf o kpkuvcvkqp"]HCC_0*4242d+0'*Fact sheet – cabin air quality*0'Hgf gtcn'
    Cxkcvkqp'Cf o kpkuvcvkqp0'
    j wr u‹1ly y y 0hcc0' qx lpgy ulhccvauj ggwlpgy uauvqt{ 0eho Apgy uK ? 47723"
"

Hgf gtcnlCxkcvkqp'Cf o kpkuvcvkqp"]HCC_0*4243c+0'*Aviation safety reporting program*0'
    Cf xkuqt{ 'Ektewnct"22/68H0'Hgf gtcnlCxkcvkqp'Cf o kpkuvcvkqp0'
    j wr u‹1cutu0cte0pcuc0' qx lf qeu1CEa22/68H0'rf h'
        "

Hgf gtcnlCxkcvkqp'Cf o kpkuvcvkqp"]HCC_0*4243d+0'*Minimum equipment list.*'EHK'
    Pqvgdqqn0'j wr u‹1ly y y 0ehkpqvgdqqn0pgvlpqvgdqqm1rwdnkecvkqpu/cpf /
    tghgtgpgulo kpko wo /gswkrm gpvlkuv'
"

Hki wgtqc."T0'N0"\ gpi /Vtgkwrgt."S 0"Mcpfwnc."U0"("Pi q."N0'J 0*4234+0'Rtgf kevkpi "uco r ng"
    uk| g"tgswktgf "hqt"encuukhecvkqp'r gthqto cpeg0'*BMC Medical Informatics and
    Decision Making 12*: +0'f qk‹320083: 813694/8; 69/34/: "
"

Hqqf "cpf "F twi 'Cf o kpkuvcvkqp"]HF C_0*4238+0'*FDA-NIH Biomarker Working Group.
    BEST (Biomarkers, EndpointS, and other Tools) Resource*']Kpvgtpgv_0'Hqqf "cpf "
    F twi 'Cf o kpkuvcvkqp"*WU+‹'I nquuct{ 04238'Lcp"4: 0'
    j wr u‹1ly y y 0pedk0pno 0pkj 0' qx ldqqmulPDM55: 66: 0'
"

Hcpmgphkgnf ."L0*423; +0'*What is predictive modeling*A'
    j wr u‹1ly y y 0kpxguvqr gf kc0eqo lvgto ulr lrtgf kevkxg/o qf gnkpi 0cur "
"

Hrkgf o cp.'L0'J 0*4224+0'Uvqej cuvke'i tcf kgpv'dqquvkpi 0'*Computational Statistics & Data
    Analysis, 38*6+.'589/59: 0'f qk‹320083811U2389/; 695*23+22287/4"

"

Htkgpf ."O 0C0"("Mqj p."L0R0*4236+0*Fundamentals of Occupational Safety and Health*
*8ᵗʰ "gf kkqp+0Dgtpcp"Rtguu0'
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Htkuq."J 0H0"Tkej ctf ."E0"Xkuugr ."J 0I 0"Xkpegpv."V0"("Dtwpq."F0*423: +0Rtgf kevkpi "
cdpqto cn"twpy c{"qeewr cpe{"vko gu"cpf "qdugtxkpi "tgncvgf "r tgewtuqtu0*Journal of
Aerospace Information Systems, 15*3+."32/430f qk320473613011123276: "
"

I kddu."I 0T0*4227+0*Analytic quality and ethics."Kp"S wcnkcvkxg"Tgugctej "nkv<"Cpcn{| kpi ""
s wcnkcvkxg"f cvc"*r r 0; 2/326+0UCI G"Rwdnkecvkqpu."Nvf 0'
f qk3206357l; 9: 3: 6; 42: 796"
"

I qxgtpo gpv"Ceeqwpvkpi "Qhhkeg"]I CQ_0*3; ; 3+0*Aviation safety: Changes needed in
FAA's service difficulty reporting program0'
j wr u<lly y y 0i cq0i qx lcuugwu4421435: 820f f h"
"

I tch."L0"Uwdgp."W0"("Rwo r ."U0*4234+0Kp/hnkj v"o gf kecn'go gti gpekgu. Deutsches
Ärzteblatt International 109*59+."7; 3/8240f qk320545: lct| vgdn04234027; 3"
"

I tggpg."L0E0"Ectcegnk"X0L0"("I tcj co ."Y 0H0*3; ; ; +0Vqy ctf "c"eqpegr wcn'htco gy qtm'
hqt"o kzgf /o gyj qf "gxcnwcvkqp"f guki pu0*Educational Evaluation and Policy
Analysis 11*5+."477/4960f qk3205324123845959233225477"
"

I wk"I 0"Nkw."H0"Uwp."L0"[cpi ."L0"\ j qw."\ 0"("\ j cq."F 0*4242+0Hnki j v'dgnc{"r tgf kevkqp"
dcugf "qp"cxkcvkqp"dki "f cvc"cpf "o cej kpe"ngctpkpi 0IEEE Transactions on Vehicular
Technology."69*3+."362/3720f qk320332; IVXV0423; 04; 762; 6"
"

J ci go cp."I 0"Rcn"V0O 0"P kj qm ."L0"O cengp| kg"Tquu."U0L0"("xcp"f gp"Dgti ."O 0*4242c+0'
Cgtqvqzke"u{pf tqo g."f kuewukqp"qh'r quukdng"f kci pquvke"etkvgtkc0Clinical
Toxicology."58<7."636/6380f qk320332: 21377858720423; 0386; 63; "
"

J ci go cp."I 0Rcn"V0O 0"P kj qp."L0"O cengp| kg"Tquu."U0L0"("xcp"f gp"Dgti ."O 0*4242d+0'
Vj tgg"r cvkgpvu"y kj "r tqdcdng"cgtqvqzke"u{pf tqo g0Clinical Toxicology, 58<4."
f qk320332: 21377858720423; 038382; 4"
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J ctr gt."C0*4227+0C"uwtxg{"qh'j gcnj "ghhgevu"kp"cktetgy "gzr qugf "vq"cktdqtpg"
eqpvco kpcpvu0Journal of Occupational Health and Safety, Australia and New
Zealand, 21*7+."655/65; 0'
"

J cttkuqp."T0"O wtcy umk"L0"O cP ggn{."G0"I wgttkgtq."L0"("O kuqp."F 0*422; +0Exposure to
aircraft bleed air contaminants among airline workers: A guide for health care
providers0Tgr qtv'vq"vj g"HCC0"
"

J cttkuqp."X0"("O cengp| kg"Tquu."U0L0*4237+0Cp"go gti kpi "eqpegtp<Vqzke"hwo gu"kp"
cktr ncpg"ecdkpu0Cortex."f qk320323811eqtvgz042370330236"
"

"

J cw|ci gt.'O 0'O 0'I 0,'J cxgto cpu.'L0'I 0'D0C0'('Dqu.'L0'I 0'J 0*4235+0'*Investigation of presence and concentration of tricresyl phosphates in cockpits of KLM Boeing 737 aircraft during normal operational conditions.*'VP Q'Tgr qtv'4235'T33; 980' j wr u<lly y y 0ggtuvgmco gt0pnlqxgtki l42362: 42 lvpqatcr r qtvaqxgta"
qpf gt|qgmapcct lf qewo gpv'
"

J gctuv.'O 0*4225+0'*What is text mining?*'j wr u<lly y y 0cluw0ce0r l¢dcq lO QV/ Klj kmcy c lHwtvj gt T gcf kpi P q30 rf h'"
"

J gtpf qp.'C0C0*4234+0'*Flight management computer (FMC) navigation database capacity.* Vj g'O KVT G'Eqtr qtcvkqp0u'Egpvgt'hqt'Cf xcpegf 'Cxkcvkqp'U{uvgo ""
"   F gxgnqr o gpv0'j wr u<lly y y 0b kvg0qti luuksugulf ghcwnvhkngulr f h l34a35460rf h"
"

J gttgo c.'H0'Ewttcp.'T 0'J ctvlgu.'U0'Gmelo k'O 0'Dcpetqhv.'U0'('Uej wn| .'O 0*423; +0'"
C"o cej kpg'ngctpkpi 'o qf gn'\q'r tgf kev'twpy c{'gzkv'cv'Xkgppc'ckr r qtv0' *Transportation Research Part E: Logistics and Transportation Review, 131.*'54; / 5640'f qk<320B238 1l0tg0423; 03020224"
"

J guu.'C0'U0'('J guu.'L0'T 0*423; +0'Nqi kuvke'tgi tguukqp0'*Transfusion, 59*9+.'43; 9/43; : 0*"
f qk<320B333 lvth0B7628"
"

J gwgnlgem'C0'T 0'T 0'Dqtpgm cpp.'E0'Ncpi g.'O 0'Uggemu.'C0'('O Ã mgt.'O 0'O 0*4238+0' Cegv{nej qlkpguvgtcug'cpf 'pgwtqr cvj {'vcti gv'guvgtcug'cevkxkvkgu'kp'33 'ecugu'qh" u{o r vqo cvke'hlki j v'etgy "o go dgtu'chvgr 'hwo g'gxgpvu0'*Journal of Toxicology and Environmental Health, Part A, 79*44/45.*'3272/32780' f qk<3203: 2 l3374: 95; 604238 0343; 783"
"

J qmg{.'L0'C0*422; +0'T gf welpi "uo qmg'cpf 'dwtpkpi "qf qr'gxgpu0'*Boeing Aero Magazine,*" S wctvgt'30'j wr u<lly y y 0lqgkpi 0eqo leqo o gtekcllcgtqo ci c| kpglctvklenguls vta23a2; l" rf hulCGT Q aS 32; actvleng240rf h"
"

J qpi .'L/Y 0'('Rctm'U/D0*423; +0'Vj g'kf gpvkhkecvkqp'qh o ctngvkpi 'r gthqto cpeg'wulpi "gzv' o kplpi "qh'cktnlpg'tgxkgy "f cvc0*Mobile Information Systems, 20190*' f qk<3203771423; 139; 264; 0'
"

J qw|ci gt.'O 0'O 0'I 0'J cxgto cpu.'L0'I 0'O 0'C0'('Dqu.'L0'I 0'J 0*4235+0'*Research info and concentration of tricresylphosphates in cockpits of KLM Boeing 737 aircraft during normal operational conditions.*'VP Q'4235'*T33; 98+.'3/780'
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J wngp'I 0'Ur gpegt'N0'('F qo kpi qu'R0*4223+0'O kplpi "ko g/ej cpi pi i 'f cvc'uvtgco u0' *Proceedings of the 7th ACM SIGKDD international conference on knowledge discovery and data mining.*'CEO .'r r ; 963280'f qk<3203671724734072474; "
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J wuugkp.'J 0'J chg| .'C0'('O cvj mqwt.'J 0*4237+0'Ugngevkqp'etkvgtkc'hqt'vgzv'o kplpi " cr r tqcej gu0*Computers in Human Behavior, 51,*'Rctv'D.'94; /9550' f qk<3203238 1l0ej d0 4236 03020284"

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Kpvgtpcvkqpcn"Ekxkn"Cxkcvkqp"Qti cpk|cvkqp"]KECQ_0"*4235+0"*Safety Management Manual
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    Technologies, 87, 327/3440f qk⊲32⊲238110te04239⊲04023: """
"

Nk'E0*pOf 0+0A gentle introduction to gradient boosting."
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    of Aerospace Information Systems, 12*;+.'7: 9/7; ; 0f qk⊲32⊲473613⊲023254; "
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    r wtr qugu0Journal of Nutritional & Environmental Medicine, 17*4+.'333/3480'
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O ctuknmcej .'L0.'Tkej vgtcd.'T 0L0.'Mko .'L0J 0.'Uvgxgpu.'T 0E0.'O ceEquu.'O 0L0.'Vqo c¦ gn'F 0."
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    of Aerospace Information Systems, 10*32+.'689/6970f qk⊲32⊲473613⊲02322: 2"
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Aero Magazine.*"S wctvgt"230'j wr u<1ly y y 0dqgkpi @eqo leqo o gtekcnl"
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8*6+.*"4: 5/4; : 0'f qk320 83238 lu2223/4; ; : *9: + 2236/4"

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O kej cgrku. "U0*4225+0C"uwtxg{ "qh'j gcnj "u{o r qo u'kp'DCNRC"Dqgkpi "979"r kmqvu. Journal
of Occupational Health Safety, Australia and New Zealand, 19*5+.*"475/4830'
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The Journal of Navigation, 69*4+.*"499/4; 60'f qk0j wr <1lf z0f qk0Qqti 0@| r tqz{0'
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O {twxgkv.''K0''Uvgputwf.''G0''(''Uj gr r gtf.''O 0'*4227+0'Tgnkcdknkv{''cpf ''xcnkfkv{''kp''eqo r ctcvkxg'' uwfkgu''qh''uqhvy ctg''r tgfkevkqp''o qf gnu0'*IEEE Transactions on Software Engineering, 31*7+.''5:2/5;30'
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P cvkqpcn''Vtcpur qtvcvkqp''Uchgv{''Dqctf ''_]P VUD_0*4235+0'*Pilot operator aircraft accident/incident report form 6120.1.*"
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P gy o cp.''F0'I 0*4229+0'*Pilot incapacitation: Analysis of medical conditions affecting pilots involved in accidents and incidents 1 January 1975 to 31 March 2006.*" Cxkcvkqp''Tgugctej ''cpf ''Cpcn{uku''Tgr qtv''ó'D42281239 20'Cwuvtcnkcp''Vtcpur qtv'' Uchgv{''Dwtgcw0'j wr u<1ly y y 0pwud0 qx0Ccwlo gf kc14; ; 871d422823920rf h"'

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mining applications*"*3'"gf +0'Cecf go le"Rtguu1Gnugxkgt0'

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contamination events - 2012 progress report*0'P cvkqpcn'Ckt "Vtcpur qtvcvkqp"Egpvgt"
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6578*; 8+22458/5"

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go gti gpekgu'qp"eqo o gtekcn'ckrnkpg'hnki j vu0'*New England Journal of Medicine,
368*<4297/: 50'f qk<320B278 lP GLO qc3434274"

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Rwdnke"Ncy '334/; 70'Ugevkqp'5420348"Ucv092/930*4234.'Hgdtwct{'36+0'Uwf{"qh'ckt" swcrkv{"kp'cktetchv'ecdkpu0'Ugevkqp"; 390'348"Ucv03670'*Research and development of equipment to clean and monitor the engine and APU bleed air supplied on pressurized aircraft*0j wr⊲lly y y 0 r q0 qx 1hf u{ulr mi lRNCY / 334r wdn, 7 lr f hlRNCY /334r wdn, 70r f h"

Tco uf gp.'L0*4236+0'Ku'vj gtg'uwej "c'vj kpi "cu'cgtqvqzke"u{pftqo gA'*Journal of Biological Physics and Chemistry, 14*6+'*335/3380'f qk⊳3206246l45tc36t0ldr e03602.6"

Tcpf qo "Hqtguvu0*4238+0'*Introducing Random Forests® one of the most powerful and successful machine learning techniques.*'y y y 0tcpf qo hqtguv0eqo "

Tcuo wuugp.'L0*3; ; 9+0'Tkum'o cpci go gpv'kp"c'd {pco ke"uqekgv{<'C''o qf gmkpi "r tqdngo 0' *Safety Science, 27*415+'3; 5/4350"

Tgcf .'L0'Dkhgv.'C0'J qm gu.'I 0'("Rhcj tkpi gt.'D0*4234+0'Uecncdng"cpf "ghhkekgpv'o wnk/ ncdgn'enuukhkecvkqp"hqt "gxqnxkpi "f cvc'uvtgco u0*Machine Learning, 88*3/4+.'*465/ 4940'f qk⊳3203229 lu32; ; 6/234/749; /8"

Tgff cm"J 0'C0*3; 77+0'Gnko kpcvkqp'qh'gpi kpg"dngef "ckt"eqpvco kpcvkqp0'*Proceedings of the SAE Golden Anniversary Aeronautic Meeting, Hotel Statler, Los Angeles, CA, USA, 11–15 October 1955*0'UCG"Vgej plecn'Rcr gt"7723: 70'UCG'Cgtqur ceg0' j wr u⊲lf qkQqti l32064931l7723: 7"

Tgpgo cp.'N0'Uej ci gp.'UD0'O wnf gt.'O 0'*et al.*'Eqi pkkkxg"lo r ckto gpv'cpf "cuuqekcvgf "nquu" kp"dtckp"y j kvg"o ketquvtwewtg"kp"cktetgy "o go dgtu'gzr qugf "vq"gpi kpg"qkn' hwo gu0'*Brain Imaging and Behavior*'32.'6596666"*4238+0' f qkQqti l3203229 lu338: 4/237/; 5; 7/5"

Tqftki wgu.'E0'E0'("Ewukem'U0M0*4234+0'*Commercial aviation safety*0'O eI tcy /J km' Eqo r cpkgu."kpe0"

Tqki .'L0'F qo kpi q.'E0'Dwtf qp.'L0'("O kej cgnku."U0*4243+0'Ktkvcnv'kpf wegf "cuj o c"ecwugf " d {"cgtqvqzke"u{pftqo g0'*Lung*0'f qkQqti l3203229 lu2262: /243/22653/|"

Tqugpdgti gt.'Y 0'Dgemo cpp.'D0'Y tdkx m{.'T0*4238+0'Cktdqtpg"cnf gj { gu'kp"ecdkn/ckt"qh" eqo o gtekcn'ckterchv:'O gcuwtgo gpt'd {'J RNE"y kj "WX"cduqtdcpeg'f gvgevkqp"qh" 4.6/f kpkvtqr j gp{nj {f tc| qpgu0'*Journal of Chromatography B.*'1019.'339/3490' f qkQqti l3203238 ll0ej tqo d0423702. 02680'

Twunkp.'M0'L0*422; +0'Kp/hnki j v'o gf kecn'go gti gpekgu<'Vko g'hqt"c"tgi kuvt{A'*Critical Care, 13*32+'34430'f qk⊳3203l3: 8 lee9937"

Uchgv{'O cpci go gpt'U{uvgo u'hqt "F qo guvke.'Hnci "cpf "Uwr r ngo gpvcn'Qr gtcvkqpu'Egtvkhkecvg" J qnf gtu.": 2'Hgf 0'Tgi '7"*Lcpwct{": .'4237+0"

"

Ucrhqtf "U{uvgo u0*4236+0'*Random Forests® for beginners.*"
 j wr u‹1ly y y 0uetkdf 0eqo If qewo gpvl574473847 ΓCP F QO /HQT GUVU/HQT/
 DGI KP P GTU/rfh'"
"

Uco wgn 'C0N0*3; 7; +0'Uqo g 'uvwfkgu 'kp'o cej kpg'ngctpkpi "wukpi "vj g 'i co g 'qh'ej gemgtu0*IBM
 Journal of Research and Development, 44.*42864480f qk3203691tf 06630 2428"
"

Ucpf. 'O 0 'Dgej ctc. 'H0I 0 'Ucpf. 'F 0 '("O cpp. 'D0*422; +0'Uwtikecrl 'cpf "o gfkecrl'
 go gti gpekgu 'qp "dqctf "Gwtqr gcp 'ckretcftv‹ 'C 'tgvtqur gevkxg 'uwf { 'qh'323; "ecugu0'
 Critical Care, 13*3+. 'T 50j wr u‹1f qk Qqti 132033: 8 lee98; 2"
"

Uctkec. 'C0 'Egtcuc. 'C0 '("S wcwtqpg. 'C0*4239+0'Tcpf qo "hqtguv'cli qtkvj o "hqt "vj g "
 encuukfkecvkqp 'qh'pgwtqko ci kpi "f cvc'kp 'Cri j ko gt'ju'f kugcug‹ 'C 'u{uvgo cvke 'tgxkgy 0'
 Frontiers in Aging Neuroscience, 6*; +.'54; 0f qk3203 55: ; 1hpci l04239 0 2254; """"
"

UCU˭ "Kpukvwwg"Kpe0']UCUˉ _0*p0f 0+0'Getting started with SAS® Enterprise Miner (T) 14.1.*"
 j wr ‹1uwr r qtv0ucu0eqo If qewo gpvcvkqp lef nlgp lgo g i ul189; : 31"
 J VO Nlf ghcwnvlxkgy gt0j vo %p3erf 2ti r pgs y sp38o hezr 6udlud0j vo "
"

UCU˭ "Kpukvwwg"Kpe0']UCUˉ _0*4229+0'Introduction to SEMMA.*"
 j wr u‹1lf qewo gpvcvkqp0ucu0eqo 1Af qeugvK? go tgh(f qeugvVcti gv? p283d| wto gl6l5p
 3lpl: ddllo 3c40j vo (f qeugvXgtukqp? 3703(mqecng? gp"
"

UCU˭ "Kpukvwwg"Kpe0']UCUˉ _0*4235+0'Data mining and SEMMA. Data Mining Using
 SAS® Enterprise Miner™: A Case Study Approach'*5tf "Gf 0+0"
 " j wr u‹1uwr r qtv0ucu0eqo If qewo gpvcvkqp lef nlgp lgo g eul885; 41ΓF Hlf ghcwnvlgo eu0rfh"
"

UCU˭ "Kpukvwwg"Kpe0']UCUˉ _0*4239c+0'Introduction to SAS® Text Miner and Text Mining
 SAS® Text Miner 14.3: Reference Help0j wr u‹1lf qewo gpvcvkqp0ucu0eqo "
 1Af qeugvK? vo tgh(f qeugvV? r 29rf mcg3r s 4lo p3r 7: s ks g| 226u0j vo (f qeugvXgtukqp
 ? 3605(mqecng? gp""
"

UCU˭ "Kpukvwwg"Kpe0']UCUˉ _0*4239d+0'Ensemble node. SAS® Enterprise Miner™ 14.3:
 Reference Help. j wr u‹1lf qewo gpvcvkqp0ucu0eqo 1Af qeugvK? go tgh(f qeugv'
 Vcti gv? p3wr kzxch{ m{qp3phdqnf pz5j r w0j vo (f qeugvXgtukqp? 3605(mqecng? gp""
"

UCU˭ "Kpukvwwg"Kpe0']UCUˉ _0*4239e+0'What's new in SAS® Enterprise Miner 14.3.*"
 j wr u‹1lf qewo gpvcvkqp0ucu0eqo 1Af qeugvK? go tgh(f qeugvVcti gv? go f qey j cwpgy 3
 650j vo (f qeugvXgtukqp? 3605(mqecng? gp"
"

UCU˭ "Kpukvwwg"Kpe0']UCUˉ _0*4239f +0'SAS Text Miner 14.3: Reference Help0"
 j wr u‹1lf qewo gpvcvkqp0ucu0eqo 1cr klf qeugvulvo tgh13605 leqpvgpvlvo tgh0f hAmqecng? gp"
"

UCU˭ "Kpukvwwg"Kpe0']UCUˉ _0*423; c+0'Data mining what it is and why it matters.*"
 j wr u‹1ly y y 0ucu0eqo 1gpa wulkpuki j wulcpcrl{ vkeulf cvc/o kpkpi 0j vo n'
"

UCÙ "Kpuvkwwg"Kpe0"]UCÙ_0*4242c."Octej "3: +0'*Introduction to SEMMA0*UCÙ "
Enterprise Miner 15.1: Reference help.* jwru<llfqewogpvcvkqp0cu0eqo 1AfqeugvK?"
go tgh(fqeugvVctigv?p283d|wtogl6l5p3lpl:ddllo 3c40Jvo (fqeugvXgtukqp?3703
(mecrg?gp"

"

UCÙ "Kpuvkwwg"Kpe0"]UCÙ_0*4242d."Octej "3: +0'*SAS® Enterprise Miner 15.1: Reference
help. What's new in SAS Enterprise Miner 15.1.* jwru<llfqewogpvcvkqp0cu0eqo 1A'
fqeugvK? go tgh(fqeugvVctigv? go tghyjcwpgcy 3650Jvo (fqeugvXgtukqp?3703(mq
ecrg?gp"

"

Uejkpfrgt."D0M0"Ygkuu."V0"Uej Ãv|g."C0"Mqurkv|."U0"Dtqdkpi ."J0E0"DÃpigt."L0"("
DtÃpkpi ."V0*4235+0'Qeewrcvkqpcl'gzrquwtg'qh'ckt"etgy u'vq"vtkgtgu{n'rjqurjcvg"
kuqo gtu'cpf "qticpqrjqurjcvg"hno g'tgvctfcpu'chgtgrwo g'gxgpvu0*Archives of
Toxicology. Archiv Für Toxikologie, 87*6+."867/:0'fqk3203.2291lu22426/234/2;9:/
2"

"

Uejqrhgt."NOO0"Hwtmqpi ."E0'G0"("Nqemtkfige."Q0*4232+0'Fgxgnqro gpv'qh'fkcipquvku'kp"
yjg'ugctej "hqt'cp'gzrncpcvkqp'qh'cetqvqxzke'u{pftqm go0*Analytical Biochemistry,
404*3+."86/960jwru<llfqk0qti 1320.3238110cd0423202602540'

"

Uejwejctfv."U0"Mqejc."Y0"("Tqugpdgtigt."Y0*423;+0'Ecdkp"ckt's wcrkv{"ö"S wcpkitcvkxg"
eqo rctkuqp'qh'xqncvkng'ckr'eqpvcokpcpvu'cv'fkhhgtgpv'hnki v'rjcugu'fwtkpi "399"
eqo o gtekcl'hnki vu0*Building and Environment, 148*37+."6; ::/7290'
fqk3203238110dwknfgpx0423:03024: "

"

Ugtxkeg'Fkhhkewnv{'Tgrqtvu=87'HT "783; 3"*Ugrvgo dgt'37."4222+*vq'dg'eqfkhkgf "cv'36"
E0HT"rt u0343.347.357."("367+0jwru<llyyy0hgfgtcrgikuvgt0 qxlfqewogpvl4222"
12;137122/45898lugtxkeg/fkhhkewnv{/tgrqtvu"

"

Ujgjcfk"O0"Lqpgu."D0"("Jqppi"O0*4238+0'Ejctcevgrk|cvkqp'qh'yjg'htgswgpe{'cpf'pcwtg"
qh'dlggf "ckt'eqpvco kpcvkqp'gxgpvu'kp'eqo o getckl'ckretchv0*Indoor Air, 26."69:/6::0'
fqk32033331kpc034433"

"

Ujgjcfk"O0"Lqpgu."D0"("Jqppi"O0*4237+0'Dlggf "ckr'eqpvco kpcvkqp'hkpcpekcl'tgncvgf "
equw'qp'dqctf "eqo o getckl'hnki vu0*SAE International Journal of Aerospace 8*4+"
fqk320.493 14237/23/; 2290'

"

Ujk"F0"I wcp."L0"\ wtcfc."L0"("O cpknncu."C0*4239+0*C "fcvc/o kpkpi "crrtqcej "vq"
kfgpvkhkecvkqp"qh'tkum'hcevqtu'kp'uchgv{o cpcigo gpv'u{uvgo u0*Journal of
Management Information Systems, 34*6+."3276/32: 30'
fqk32032: 21.2964344404239035; 6278"

"

Ujk"F0"\ wtcfc."L0"Mctyqy umk"Y0I wcp."L0"("Ecrkv."G0*423; +0Dcvej "cpf "fcvc"
utgco kpi "encuukhkecvkqp'o qfgnu'hqr'fgvgevkpi "cfxgtug'gxgpvu'cpf "wpfgrutcpfkpi "
yjg'kphnwgpekpi "hcevqtu0*Engineering Applications of Artificial Intelligence, 85,*94/
: 60'fqk0qti 1320.3238110gpicrrck0423; 027022 28"

"

UJ M']Uvcvgpu'j cxgtkmqo o kuukqp'Dqctf "qh'Ceekf gpv'Kpxguwki cvkqp_0*3; ; ; +0'*Report RL 2001:41e: Incident onboard aircraft SE-DRE during flight between Stockholm and Malmo, M County, Sweden, on 12 November 19990*'Uy gf kuj "Uvcvgpu" j cxgtkmqo o kuukqp'*Uy gf kuj "Dqctf "qh'Ceekf gpv'Kpxguwki cvkqp+0' j wtu<1y y y 0huu0cgt qlceekf gpv'tgr qtvulf xf hkngulUGI3; ; /33/34/UG0r f h"

Uj o wgrk'T 0*4232+0Vq "gzr nckp"qt'r tgf kevA'*Statistical Science, 25*5+.'4: ; /5320" f qk32034361320UVU552"

Uj o wgrk'T 0'Dtweg.'R0E0'("Rcvgn'P 0T0*4238+0*Data mining for business analytics'*5^{tf} " gf +0Lqj p'Y kng{'("Uqpu."Kpe0'

Uj wpi .'M0R0*423: .'O ctej "37+0Ceewtce{.'r tgekukqp.'tgecn'qt'H3A*Towards Data Science.*" j wtu<1hqwy ctf uf cvcuekgpeg0eqo lceewtce{/r tgekukqp/tgecn/qt/h3/553hd59e7ed; "

Ukppgw.'O 0*4229+09: 9'P q/dnggf "u{uvgo u<Ucxkpi "hwgn'cpf "gpj cpekpi "qr gtcvkqpcn' ghhkekgpekgu0*Boeing Aero Magazine, 4,*'8/330j wtu<1y y y 0dqgkpi 0eqo 1" eqo o gtekcnlcgtqo ci c| kpglctvkengusvta6a29lCGTQaS 629actvkeng40rf h"

Um{dtct{0*423; +0*Medical emergencies – guidance for flight crew.*" j wtu<1y y y 0m{dtct{0cgtqlkpf gz0r j r lO gf kecmGo gti gpekgu/ aI wkf cpegahqtaHnki j vaEtgy "

Um{dtct{0*4243+0*Vectoring geometry.*" j wtu<1y y y 0m{dtct{0cgtqlkpf gz0r j r lXgevqtkpi aI gqo gvt{"

Uqrj gt.'C0L0'("I qi rkc.'L0L0*4237+0*Safety management systems in aviation0*Cuj i cvg0'

Uqqr .'L0'("F gmmgt.'U0*4234+0Ctg "uchgv{ "kpxguvki cvkqpu'r tq/cevkvgA'*Safety Science, 50*8+.'3644/36520j wtu<1f qk0qti 132034238110uuekl04233025026"

Uwn 'E0'("Dcf cy {.'U0O 0*423: +0C"u{uvgo cvke'tgxkgy "qh'r gf kcvtke'cpf "cf wnv'kp/hnki j v' o gf kecn'go gti gpekgu0*International Journal of Pediatrics.*423: *3+.3/: 0' f qk32033771423: 187; 86; 2"

Uwp.'L0'Gmgtdtqgm'L0'("J qguvtc.'L0O 0*423: +0Cktetchv'kpkvkcn'o cuu'guvko cvkqp'wukpi " Dc{gukcp'kphgtgpeg'o gvj qf 0*Transportation Research Part C: Emerging Technologies, 90.*'7; /950f qk32038238110ute0423: 04204244"

Vcf guug.'F 0I 0'("Ectr gpvgt.'O 0*423: +0C"o gvj qf "hqt'ugngevkpi "vj g'tgngxcpv'f ko gpukqpu" hqt'j ki j /f ko gpukqpcn'enuukhecvkqp'kp'ukpi wct'xgevqt'ur cegu0*Advances in Data Analysis and Classification.*3/440f qk32032291lu33856/23: /2533/: "

Vqwo k"J 0"Dtcj o k"\ 0"("O qj j co gf ."O 0'O 0*423; +0TVUNRU<Tgcri'ko g"ugtxgt"nqcf "
   r tgfkevkqp"u{uvgo "hqt"vj g"gxgt/ej cpi kpi "enqwf "eqo r wvkpi "gpxktqpo gpv. *Journal of
   King Saud University - Computer and Information Sciences.*
   fqk320323811 0muwek0423; 040226"
"
Vtwqpi ."F 0"("Ej qk"Y 0*4242+0'Wukpi "o cej kpg"ngctpkpi "cni qtkyj o u"vq"r tgfkev'yj g"tkum'qh"
   uo cm'wno cppgf "cktetchv'u{uvgo "xkqncvkqpu"kp"yj g"pcvkqpcn'cktur ceg"u{uvgo 0'
   *Journal of Air Transport Management, 86*4242+0'
   j wr u<1lf qk0qti 1320323811 0cktvtco cp04242 0823: 44"
"
Vtwqpi ."F 0"Htkgpf ."O 0C0"("Ej pn."J 0*423: +0Cr r nkecvkqpu"qh'dwukpguu"cpcn{vkeu"kp"
   r tgfkevkpi "hnki j v'qp/vko g"r gthqto cpeg"kp"c"eqo r ngz"cpf "f {pco ke"u{uvgo 0'
   *Transportation Journal, 57*3+."46/740'f qk3207547 1tcpur qtvcvkqpl0790 30 0 0246"
       "
Vw "L0'X0*3; ; 8+0Cf xcpvci gu"cpf "f kucf xcpvci gu"qh"wukpi "ctvkhkekcn'pgwtcn'pgwy qtmu"xgtuwu"
   nqi kuvke'tgi tguukqp'hqt'r tgfkevkpi "o gf kecn'qwueqo gu0'*Journal of Clinical
   Epidemiology, 49*33+."3447/34530'f qk320323811 U2: ; 7/6578*; 8+22224/; "
       "
VwH²t{."U0*4233+0'*Data mining and statistics for decision making.'*Lqj p"Y kng{"("Uqpu."'*
   Nvf 0'
       "
W0'U0'I gpgtcn'Ceeqwpvkpi "QHhkeg"*4225+0'*Aviation safety: Advancements being pursued to
   improve airliner cabin occupant safety and health.'*Tgr qtv'vq"vj g"Tcpmkpi "
   F go qetcvke"O go dgt."Eqo o kwggg"qp"Vtcpur qtvcvkqp"cpf "*Khtcuvtwewtg."J qwug"qh'
   Tgr tgugpvcvkxgu0'j wr u<1ly y y 0 cq0 qx 1cuugwu1472 14622; 80 r f h"
       "
Xcncpk"T 0"Eqtpceej kc."O 0"("Mwdg."F 0*4232+0'Hnki j v'f kxgtukqpu'f wg"vq"qpdqctf "o gf kecn'"
   go gti gpekgu"qp"cp"kpvgtpcvkqpcn'eqo o gtekcn'cktnkpg0'*Aviation Space and
   Environmental Medicine, 81*33+."3259/32620'f qk3205579 ICUGO 049: ; 04232"
"
Xcnf²u."T 0'O 0C0'Eqo gpf cf qt."X0'H0'I 0'"Ecucn."L0C0'R0'Ucp| ."C0'T 0'Ucp| ."N0'R0'P kgvq."
   H0L0'U0'("Ctkc."G0'U0*423; +0Dc{gukcp'kphgtgpeg"kp"uchgv{"eqo r nkcpeg"cuuguuo gpv'
   wpfgt "eqpfkkqpu"qh'wpegtvckpv{"hqt'CP U'r tqxkf gtu0'*Safety Science, 116.'3: 5/3; 70'
   fqk320323811 0uuek0423; 025 0234"
"
Xcnf²u."T 0'O 0C0'Eqo gpf cf qt."X0'H0'I 0'"Ecucn."L0C0'R0'Ucp| ."N0'R0'("Ucp| ."C0'T 0'
   *423; +0Rtgfkevkqp'qh'cktetchv'uchgv{'kpekf gpvu"wukpi "Dc{gukcp'kphgtgpeg"cpf "
   j kgtctej kecn'utwewtgu0'*Safety Science.'*104.'438/4520'
   fqk320323811 0uuek0423; 0 23 022: "
"
xcp"P gwgp."E0*4222+0Cpcn{uku'qh'w q"lgv'gpi kpg"nwdtkecvkpi "qknu'cpf "c"h {ftcwnke'hnwkf <"
   yj gkt'r tqn{ike'dtgcnf qy p'r tqf wewu'cpf "yj gkt'ko r nkecvkqp'qp'cktetchv'ckr 's wcnkv{0'Kp'
   P ci f c."P 0'N0*gf 0+0'*Air Quality and Comfort In Airliner Cabins, r r 0 83/970"
"
Xgpvknckqp0'36 'EHT 'È'470 530*3; ; 8+0'
"
"

Y gmu."C0'V0'*4223+0'*Commercial aviation safety0'O eI tcy "J km'Eqo r cpkgu."Kpe0'
"

Y kmkco u."L0'M0'*4236+0'Wukpi "tcpf qo "hqtguvu'vq'f kci pqug'cxkcvkqp''wtdwgpeg0*Machine
        Learning, 95*3+."73/920'f qkejwr <1f z0f qk0Qti l320B229 lu32; ; 6/235/7568/9"
"

Y kpf gt."E0"("Dcmqwgv."L0'*4224+0'Vj g''vqzkekv{ 'qh'eqo o gtekcl'lgv'qku0*Environmental
        Research, 89*4+'368/3860'f qk0Qti l320B228 lgptu04224065680'
"

Y kpf gt"E0"Hqpvg{p"R0"("Dcmqwgv'L0'*4224+0'Cgtqvqzke u{pftqo g<'c'f guetkrvkxg"
        gr kf gm kqmqi kecl'uwtxg{ 'qh'cktergy "gzr qugf "vq "kpecdkp'cktdqtpe"eqpvco kpcpw0'
        *Journal of Occupational Health and Safety, Australia and New Zealand."18*6+"
        543/55: 0'
                    "

Y kwgp."K0'J 0'Htcpm'G0'J cm "O 0'C0"("Rcn 'E0L0*4238+0'F cvc"o kpkpi "r tcevkecl'o cej kpg"
        ngctpkpi "vqqmu'cpf "vgej pks wgu"*5tf 'gf +0'O qti cp"Mcwho cp"Rwdnkuj gtu0'
"

Z kpi ."Y 0'Y cpi ."Z 0'I wq."D0"Uj cq."[0"("Y cpi ."[0*423: +0'Uwf {'qh'vj g''eqttqukqp"
        ej ctcevgtkwkeu'qh'vj g''o gvcl'o cvgtkcn'qh'cp 'cgtq/gpi kpg'wpf gt'c''o ctkpg"
        cvo qur j gtg0*Materials and Corrosion, 69."3: 83/3: 8; 0'
        f qk320B224 lo ceq0423: 32375"
"

[cpi ."J 0"Hqpi ."U0"Uwp."I 0"("Y qpi ."T0*4234+0'C"xgt{'hcuv'f gekukqp'tgg'cli qtkjo "hqt"
        tgcn/vko g''f cvc"o kpkpi "qh'ko r gthgev'f cvc'uvtgco u'kp'c''f kuvtkdwgf "y ktgnguu'ugpuqt"
        pgwy qtm0*International Journal of Distributed Sensor Networks.
        f qk320B377 142341: 85767"
"

\ j cpi ."Z 0"("O cj cf gxcp."U0*423; +0'Gpugo dng''o cej kpg''ngctpkpi "o qf gm'hqt"cxkcvkqp"
        kpekf gpv'tkum'r tgf kevkqp0*Decision Support Systems, 116*423; +."6: /850'
        f qk320B238 ll0f uu0423: 0B2022; "
                    "

\ j w."F 0'Y 0"("P k'[0*4234+0'Vj g''cr r nkecvkqp'qh'f cvc"o kpkpi "kp'vj g''ekxkn'cxkcvkqp"ceekf gpv'''
        cpcn{uku0*Applied Mechanics and Materials, 241-244."52220'
        f qk320624: lyy y 0uekgpvkhke0pgv1CO O 0463/46605222
                                    "
"

Appendix A"

PCUC "Hqto "499D'I gpgtcn'*Rknqv'CUTU'Tgrqtv'Hqto ""

*J ctf "Eqr{1O ckn'Xgtukqp+

NASA ARC 277B (May 2009) GENERAL OMB No. 2700-0172 Exp 7/31/2022

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

AVIATION SAFETY REPORTING SYSTEM

NASA has established an Aviation Safety Reporting System (ASRS) to identify issues in the aviation system which need to be addressed. The program of which this system is a part is described in detail in FAA Advisory Circular 00-46F. Your assistance in informing us about such issues is essential to the success of the program. Please fill out this form as completely as possible, enclose in a sealed envelope, affix proper postage, and and send it directly to us.

The information you provide on the identity strip will be used only if NASA determines that it is necessary to contact you for further information. THIS IDENTITY STRIP WILL BE RETURNED DIRECTLY TO YOU. The return of the identity strip assures your anonymity.

Section 91.25 of the Federal Aviation Regulations (14 CFR 91.25) prohibits reports filed with NASA from being used for FAA enforcement purposes. This report will not be made available to the FAA for civil penalty or certificate actions for violations of the Federal Air Regulations. Your identity strip, stamped by NASA, is proof that you have submitted a report to the Aviation Safety Reporting System. We can only return the strip to you if you have provided a mailing address. Equally important, we can often obtain additional useful information if our safety analysts can talk with you directly by telephone. For this reason, we have requested telephone numbers where we may reach you.

Thank you for your contribution to aviation safety.

NOTE: AIRCRAFT ACCIDENTS SHOULD NOT BE REPORTED ON THIS FORM. SUCH EVENTS SHOULD BE FILED WITH THE NATIONAL TRANSPORTATION SAFETY BOARD AS REQUIRED BY NTSB Regulation 830.5 (49CFR830.5).

Paperwork Reduction Act Statement - This information collection meets the requirements of 44 U.S.C. § 3507, as amended by section 2 of the Paperwork Reduction Act of 1995. You do not need to answer these questions unless we display a valid Office of Management and Budget control number. The OMB control number for this information collection is 2700-0172 and it expires on 7/31/2022. We estimate that it will take about 30 minutes to read the instructions, gather the facts, and answer the questions. You may send comments on our time estimate above to: P.O. Box 189 Moffett Field, CA 94035-0189.

If you want to mail this form, please fold pages, enclose in a sealed, stamped envelope, and mail to:

NASA AVIATION SAFETY REPORTING SYSTEM
POST OFFICE BOX 189
MOFFETT FIELD, CA 94035-0189

Keeping in mind the topics shown below, discuss those which you feel are relevant and anything else you think is important. Include what you believe really caused the problem, and what can be done to prevent a recurrence, or correct the situation. (USE ADDITIONAL PAPER IF NEEDED)

CHAIN OF EVENTS		**Page 2 of 3**	HUMAN PERFORMANCE CONSIDERATIONS	
- How the problem arose	- How it was discovered		- Perceptions, judgments, decisions	- Actions or inactions
- Contributing factors	- Corrective actions		- Factors affecting the quality of human performance	

NASA ARC 277B (May 2009)

DESCRIBE EVENT/SITUATION (continued)

CHAIN OF EVENTS
- How the problem arose
- How it was discovered
- Contributing factors
- Corrective actions

HUMAN PERFORMANCE CONSIDERATIONS
- Perceptions, judgments, decisions
- Actions or inactions
- Factors affecting the quality of human performance

NASA ARC 277B (May 2009)

"

Appendix B"

P CUC "Hqto "499E "Ecdkp "*Hki j v'Cwgpfcpv+'CUTU'T gr qtv'Hqto ""

"*J ctf "Eqr { 'O ckn'Xgtukqp+"

C

DO NOT REPORT AIRCRAFT ACCIDENTS AND CRIMINAL ACTIVITIES ON THIS FORM.
ACCIDENTS AND CRIMINAL ACTIVITIES ARE NOT INCLUDED IN THE ASRS PROGRAM AND SHOULD NOT BE SUBMITTED TO NASA.
ALL IDENTITIES CONTAINED IN THIS REPORT WILL BE REMOVED TO ASSURE COMPLETE REPORTER ANONYMITY.

(SPACE BELOW RESERVED FOR ASRS DATE/TIME STAMP)

IDENTIFICATION STRIP: *Please fill in all blanks to ensure return of ID strip to you.*
NO RECORD WILL BE KEPT OF YOUR IDENTITY. This section will be returned to you.

TELEPHONE NUMBERS where we may reach you for further details of this occurrence:

HOME Area _____ No. _____ Hours _____

WORK Area _____ No. _____ Hours _____

TYPE OF EVENT/SITUATION

NAME _____

ADDRESS/PO BOX _____

DATE OF OCCURRENCE _____ (MM/DD/YYYY)

CITY _____ STATE _____ ZIP _____

LOCAL TIME (24 hr. clock) _____ (HH:MM)

PLEASE FILL IN APPROPRIATE SPACES AND CHECK ALL ITEMS WHICH APPLY TO THIS EVENT OR SITUATION.

REPORTER	EXPERIENCE	
☐ Flight Attendant (FA)	Total years as Flight Attendant	_____
☐ FA in charge	Total years as FA with your current airline	_____
☐ Off-Duty FA	Number of aircraft types currently qualified to work on	_____
☐ Other_____	Percent of duty time in past year on aircraft type involved	_____

FLIGHT INFORMATION

Type of Aircraft	(Make/Model) _____
	number of seats _____ number of pax on board _____ number in cabin crew _____
	number of exits: floor level _____ window _____ tailcone _____
Flight Segment	flight origin _____ destination _____ departure time _____ (HH:MM)
	time since takeoff _____ hrs/mins nearest city/state (if known) _____
Cabin Activity (check all that apply)	☐ boarding ☐ beverage service ☐ cart service
	☐ deplaning ☐ meal service ☐ tray service ☐ other _____
	☐ safety related duties, specify _____

OPERATOR	FLIGHT PHASE		WEATHER		LIGHTING	
☐ air carrier	☐ parked	☐ descent	☐ clear	☐ cloudy	**CABIN**	**OUTSIDE**
☐ air taxi	☐ taxi	☐ approach	☐ rain	☐ fog	☐ high	☐ daylight
☐ corporate	☐ takeoff	☐ landing	☐ turbulence	☐ snow	☐ medium	☐ night
☐ fractional	☐ climb	☐ gate arrival	☐ thunderstorms	☐ ice	☐ low	
☐ other _____	☐ cruise	☐ other _____	☐ unknown		☐ off	

EVENT CHARACTERISTICS

Reporter's location in aircraft at time of event _____

Reporter's activity at time of event _____

Was a passenger directly involved in the event?	○ Yes ○ No Reset	Was fire/smoke involved in the event? ○ Yes ○ No Reset	
Did this event result in an injury? to passenger? to crew?	○ Yes ○ No / ○ Yes ○ No / ○ Yes ○ No Reset	Was there an evacuation during or as a result of this event? ○ Yes ○ No Reset	

NASA ARC 277C (May 2009)   **CABIN CREW**   OMB No. 2700-0172 Exp 7/31/2022 "

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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AVIATION SAFETY REPORTING SYSTEM

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CHAIN OF EVENTS	Page 2 of 3	HUMAN PERFORMANCE CONSIDERATIONS
- How the problem arose - How it was discovered		- Perceptions, judgments, decisions - Actions or inactions
- Contributing factors - Corrective actions		- Factors affecting the quality of human performance

NASA ARC 277C (May 2009)

DESCRIBE EVENT/SITUATION (continued)

CHAIN OF EVENTS		HUMAN PERFORMANCE CONSIDERATIONS	
- How the problem arose	- How it was discovered	- Perceptions, judgments, decisions	- Actions or inactions
- Contributing factors	- Corrective actions	- Factors affecting the quality of human performance	

NASA ARC 277C (May 2009)

"

Appendix C

Vcdngu"

E3"   V{rg"qh"Cktetchv"cu"Rtqxkfgf"kp"CUTU"Tgrqtvu"

E4"   Vgzv"Rctukpi "Pqfg"Tguwnu"ó"Vqr "322"Vgtou."Tqngu."Cvtkdwvgu."Htgswgpekgu."""

"   Uvcwu."cpf "Tcpmu"

E5"   Vgzv"Hknvgt"Pqfg"Tguwnu"ó"Vqr "322"Vgtou."Ygkijvu."cpf "Htgswgpekgu"""

E6"   Nkuv"qh"Xctkcdngu"htqo "CUTU"cpf "Vgzv"Okpkpi

"

"   "

Table C1

Type of Aircraft as Provided in ASRS Reports

V{rg'Cktetchv"	Pwo dgt"
Cktdwu"	"
""C522"	376"
""C53; "	7:6"
""C542"	8;9"
""C543"	633"
""C552"	92"
""C53: 153; 15421543"Wpf khgtgpvkcvgf "	"
""qt'Qyjgt'Oqfgn'	;8"
Cgtgki'fc'Vtcurqtvq'Tgi kqpcrg"*CVT+"64.'94"	"
	36"
Dqgkpi "	"
""959"	5774"
""969"	436"
""979"	842"
""989"	876"
""999"	722"
""9:9"	387"
""Wpf khgtgpvkcvgf "qt'Qyjgt'Oqfgn'	53"
Dqm dctf kgt lEcpcf ckt""	"
""Tgi kqpcrl'Lgv'422.'922.'; 22'"	34;9"
""EN87."Wpf khgtgpvkcvgf "qt'Qyjgt "	34"
Eguupc"ó"o wnkrng"o qfgnu."r kuvqp."wtdqr tqr "cpf "lgv"""	"
gpi kpg"cktetchv"	43"
Fg"J cxkmcpf lDqo dctf kgt"	"
""Fcuj ":"	372"
""S 622"	5:"
Go dtcgt"	"
""Tgi kqpcrl'Lgv'/'357 1362 1367 1392 1397 13; 213; 7"	3624"
""Wpf khgtgpvkcvgf "qt'Qyjgt'Oqfgn'	45"
O eFqppgm'Fqwincu"	"
""FE/; 132"	32"
""OF/33"	462"
""OF/:21:41:51: "Ugtkgu"	37;9"
""Wpf khgtgpvkcvgf "qt'Qyjgt'Oqfgn'	33"
Uccd""	"
""562"	42"
Pq'Oqfgn'qt'Ocpwhcewtgt'Urgekhkgf "	"
""Eqo o gtekcrl'Hkzgf "Ykpi "	994"
""Nki j v'Vtcpurqtv'	49"
""Uo cm'Vtcpurqtv'	:"
""O gfkwo "Vtcpurqtv'	527"
""O gfkwo "Ncti g"Vtcpurqtv'	56:"
""Ncti g"Vtcpurqtv'	953"
""J gcx{'Vtcpurqtv'	64"
""Ykfgdqf { "	45:"

"

""Y kf gdqf { "Vtcpur qtv'	42; "
Cketchv'v{ r g"nkuvgf "kp"≥'7'tgr qtvu"	49"
Qvj gt."Wpmpqy p"qt"Wprkuvgf "	9"
Cketchv'kphqto cvkqp"o kuukpi "	: "
P q"cketchv'kp'tgr qtv'	4"
Vqvcn'	35: 8; "

Note. Cketchv'v{ r g"cpf "pwo dgt"qh'cketchv'kpxqnxgf "kp'CUTU'tgr qtvu'uwdo kvgf "d{ "ckt"cpf "ecdkp'etgy "kp"

HCT'r ctv'343"qr gtcvkqpu'htqo 'Lcpwct{ "3."4237."vq'F gego dgt "53."423; 0'

"   "

"

Table C2

Text Parsing Node Results – Top 100 Terms, Roles, Attributes, Frequencies, Status, and

Ranks"

Vgto "	"Tqng"	"Cwtkdwvg"	" Htgswgpe{'	P wo dgt"qh Pcttcvkxgu'	Mggr "	Rctgpv Uvcwu""	"Rctgpv'KF "	"Tcpm'
"- "dg"	"Xgtd"	"Crrjc"	3373;2"	35342"	P "	- "	366832"	3"
pqv"	'Cfx"	"Crrjc"	5;:27"	32856"	P "	"	364;85"	4"
"- "jcxg"	"Xgtd"	"Crrjc"	575:;"	32363"	P "	- "	364869"	5"
cktetchv"	"Pqwp"	"Crrjc"	4;96;"	;234"	P "	"	36497:"	6"
"- "fq"	"Xgtd"	"Crrjc"	48322"	:;25"	P "	- "	367495"	7"
"- "hnki jv"	"Pqwp"	"Crrjc"	42476"	9783"	P "	- "	366:54"	8"
pq"	'Cfx"	"Crrjc"	35837"	8;;4"	P "	"	36788;"	9"
yjgp"	'Cfx"	"Crrjc"	355;3"	868;"	P "	"	3637;:"	:"
"- "vko g"	"Pqwp"	"Crrjc"	35325"	8658"	P "	- "	3657:8"	;"
cvg"	"Rtqr "	"Crrjc"	36853"	82;4"	P "	"	367;32"	32"
"- "i gv"	"Xgtd"	"Crrjc"	35464"	8223"	P "	- "	363:33"	33"
"- "o cng"	"Xgtd"	"Crrjc"	32882"	7957"	P "	- "	36588;"	34"
"- "i q"	"Xgtd"	"Crrjc"	3346;"	7726"	P "	- "	364392"	35"
"- "eqpvkpwg"	"Xgtd"	"Crrjc"	;22;"	752:"	["	- "	33427;"	36"
"- "ecm"	"Xgtd"	"Crrjc"	;;;:6"	734:"	P "	- "	364;;7"	37"
"- "cum"	"Xgtd"	"Crrjc"	;;:6:"	7235"	P "	- "	36832:"	38"
"- "vgm"	"Xgtd"	"Crrjc"	;;35"	6;39"	P "	- "	363294"	39"
"- "engct"	"Xgtd"	"Crrjc"	;539"	6;25"	P "	- "	36798:"	3:"
"- "twpy c{"	"Pqwp"	"Crrjc"	348:;"	695;"	P "	- "	364287"	3;"
"- "ncpf "	"Xgtd"	"Crrjc"	:524"	68;5"	P "	- "	366:6;"	42"
"- "ecr vckp"	"Pqwp"	"Crrjc"	34446"	6865"	P "	- "	366954"	43"
cnuq"	'Cfx"	"Crrjc"	;542"	6827"	P "	"	3633:;"	44"
"- "crr rtqcej "	"Pqwp"	"Crrjc"	36259"	6765"	P "	- "	366:;6"	45"
"- "uc{"	"Xgtd"	"Crrjc"	;3;3"	6692"	P "	- "	367547"	46"
"- "hqqv"	"Pqwp"	"Crrjc"	34672"	6858"	["	- "	;7872"	47"
"- "i kxg"	"Xgtd"	"Crrjc"	;9759"	65;3"	P "	- "	366::7"	48"
"- "ugg"	"Xgtd"	"Crrjc"	;9;6"	6796"	P "	- "	364;85"	49"
"- "ncpf kpi "	"Pqwp"	"Crrjc"	;:7:"	64:8"	P "	- "	364;::"	4:"
hktuv"	'Cfl"	"Crrjc"	:7;4"	6668"	P "	"	363;;;"	4;"
"- "hn{"	"Xgtd"	"Crrjc"	;4:6"	638;"	P "	- "	365439"	52"
"- "vcng"	"Xgtd"	"Crrjc"	:987"	6569"	P "	- "	36684:"	53"
qp"	'Cfx"	"Crrjc"	9:;;"	6486"	P "	"	362;;7"	54"
"- "i cvg"	"Pqwp"	"Crrjc"	:5;:"	624:"	P "	- "	365454"	55"
"- "tgegkxg"	"Xgtd"	"Crrjc"	:698"	7;49"	P "	- "	365386"	56"

"

"- "uvctv"	"Xgtd"	" Crrjc"	85:9"	5992"	["	- "	3;692"	57"
"- "cnkwfg"	"Pqwp"	" Crrjc"	:46;"	5886"	P "	- "	365744"	58"
"- "etgy "	"Pqwp"	"Crrjc"	9642"	5855"	P "	- "	364;55"	59"
xgt{"	"Cfx"	"Crrjc"	776:"	5776"	P "	"	3644;;"	5:"
"- "pqvleg"	"Xgtd"	"Crrjc"	749;"	5738"	["	- "	;7442"	5;"
"- "crrtqzkocvgn{"	"Cfx"	"Crrjc"	768;"	5626"	P "	- "	3657;2"	62"
"- "wtp"	"Xgtd"	"Crrjc"	7779"	559;"	P "	- "	363855"	63"
lwuv"	"Cfx"	"Crrjc"	6858"	554;"	P "	"	3644:3"	64"
"- "rknqv"	"Pqwp"	"Crrjc"	757:"	554;"	P "	- "	365676"	64"
"- "rqkpv"	"Pqwp"	"Crrjc"	7678"	553;"	P "	- "	36478:"	66"
kooofkcvgn{"	"Cfx"	"Crrjc"	6683"	5473"	["	"	45:27"	67"
ockpvgpcpeg"	"Pqwp"	"Crrjc"	9752"	546;"	["	"	8337:"	68"
"- "nqqm"	"Xgtd"	"Crrjc"	7226"	5465"	P "	- "	366964"	69"
"- "eqog"	"Xgtd"	"Crrjc"	6997"	5447"	P "	- "	3679;8"	6:"
"- "okpwg"	"Pqwp"	"Crrjc"	7529"	5437"	["	- "	323;28"	6;"
"- "rtqegfwtg"	"Pqwp"	"Crrjc"	82:2"	53;8"	["	- "	53794"	72"
"- "fguegpv"	"Pqwp"	"Crrjc"	87:8"	53;2"	P "	- "	3654:6"	73"
qyjgt"	"Cfl"	"Crrjc"	683:"	5353"	P "	"	367828"	74"
"- "wug"	"Xgtd"	"Crrjc"	6;24"	534:"	P "	- "	364977"	75"
hq"	"Rtqr "	"Crrjc"	:2;7"	5289"	P "	"	367343"	76"
"- "cttkxcn"	"Pqwp"	"Crrjc"	8697"	5277"	P "	- "	364;:6"	77"
"- "cktrqtv"	"Pqwp"	"Crrjc"	7662"	525;"	P "	- "	367329"	78"
"- "kuuwg"	"Pqwp"	"Crrjc"	6;63"	5254"	["	- "	32965"	79"
"- "gxgpv"	"Pqwp"	"Crrjc"	6:96"	5248"	["	- "	6398:"	7:"
cickp"	"Cfx"	"Crrjc"	6842"	523;"	P "	"	363595"	7;"
"- "cfxkug"	"Xgtd"	"Crrjc"	73;6"	5228"	["	- "	56999"	82"
"- "vjkpm"	"Xgtd"	"Crrjc"	68:4"	5223"	P "	- "	36448:"	83"
"- "dcem"	"Pqwp"	"Crrjc"	62:3"	4;98"	["	- "	74;89"	84"
"- "ukwcvkqp"	"Pqwp"	"Crrjc"	6:34"	4;8:"	["	- "	3:528"	85"
"- "dgikp"	"Xgtd"	"Crrjc"	6987"	4;5;"	["	- "	744;6"	86"
"- "ejgemkuv"	"Pqwp"	"Crrjc"	89;;"	4:88"	P "	- "	365954"	87"
yjcv"	"Cfx"	"Crrjc"	62;6"	4:6;"	P "	"	368372"	88"
"- "rcuugpigt"	"Pqwp"	"Crrjc"	8857"	4:57"	["	- "	;;97"	89"
"- "eqpvtqn"	"Pqwp"	"Crrjc"	6:39"	4:53"	P "	- "	366;9;"	8:"
"- "vczk"	"Xgtd"	"Crrjc"	69:4"	4:49"	P "	- "	36384;"	8;"
uvkm"	"Cfx"	"Crrjc"	622;"	4:48"	P "	"	36823:"	92"
"- "fguegpf"	"Xgtd"	"Crrjc"	769:"	4:45"	["	- "	;582:"	93"
"- "npqy "	"Xgtd"	"Crrjc"	6379"	4:43"	["	- "	335:52"	94"
"- "qhhkegt"	"Pqwp"	"Crrjc"	5:;8"	4:36"	["	- "	44;::"	95"
"- "vcmgqhh"	"Pqwp"	"Crrjc"	9599"	49::"	P "	- "	365969"	96"
"- "gpikpg"	"Pqwp"	"Crrjc"	;;95"	4934"	["	- "	49334"	97"

"

"- "ergctcpeg"	"Pqwp"	"Crrjc"	7926"	4898"	P "	- "	363:2:"	98"
dcem"	"Cfx"	"Crrjc"	57:6"	4864"	["	"	9883:"	99"
||| "	"Rtqr"	"Crrjc"	83:6"	4829"	P "	"	3666;;"	9:"
"- "ejgem"	"Xgtd"	"Crrjc"	5874"	4767"	["	- "	34757"	9;"
"- "hqmqy"	"Xgtd"	"Crrjc"	5585"	475:"	["	- "	;8333"	:2"
"- "tgwtp"	"Xgtd"	"Crrjc"	5986"	4758"	["	- "	;643"	:3"
qhhkegt"	"Rtqr"	"Crrjc"	6446"	472;"	["	"	9:45;"	:4"
"- "eqorrngvg"	"Xgtd"	"Crrjc"	5:62"	46;5"	["	- "	477;:"	:5"
"- "rtqdngo"	"Pqwp"	"Crrjc"	5;79"	46;4"	["	- "	59:27"	:6"
qpg"	"Pwo "	"Crrjc"	54::"	46;3"	P "	"	365692"	:7"
"- "kphqto"	"Xgtd"	"Crrjc"	626;"	4693"	["	- "	324763"	:8"
qw"	"Cfx"	"Crrjc"	5475"	4693"	P "	"	366;82"	:8"
"- "erkod"	"Xgtd"	"Crrjc"	6365"	4692"	["	- "	432:5"	::"
"- "pggf"	"Xgtd"	"Crrjc"	5795"	4689"	P "	- "	367863"	:;"
"- "tgswguv"	"Xgtd"	"Crrjc"	588;"	4677"	P "	- "	363636"	;2"
cm"	"Cfl"	"Crrjc"	544:"	4676"	P "	"	366928"	;3"
yq"	"Pwo "	"Crrjc"	5678"	464;"	P "	"	366468"	;4"
"- "vt{"	"Xgtd"	"Crrjc"	583:"	4645"	P "	- "	365;22"	;5"
oqtg"	"Cfl"	"Crrjc"	53;2"	45::"	P "	"	363;56"	;6"
"- "fgrctwtg"	"Pqwp"	"Crrjc"	6952"	45:6"	P "	- "	3666:3"	;7"
"- "dgnkgxg"	"Xgtd"	"Crrjc"	553;"	4593"	P "	- "	367557"	;8"
"- "iqqf"	"Cfl"	"Crrjc"	5362"	4576"	["	- "	:;5;"	;9"
"- "eqpvcev"	"Xgtd"	"Crrjc"	5596"	4559"	["	- "	;2897"	;:"
hktuv"	"Rtqr"	"Crrjc"	5;2;"	4559"	P "	"	365764"	;:"
"- "urggf"	"Pqwp"	"Crrjc"	6554"	4547"	P "	- "	3662:6"	322"

""" "

Table C3

Text Filter Node Results – Top 100 Terms, Weights, and Frequencies

Vgto "	"Tqng"	"Cwtkdwvg"	"Uvcwu"	"Y gki j v"	" Htgs wgpe{"	%' F qewo gpvu"	Tcpm'
"- "dg"	"Xgtd"	"Crr j c"	"F tqr "	2"	3373; 2"	35342"	3"
pqv'	"Cf x"	"Crr j c"	"F tqr "	2"	5; : 27"	32856"	4"
"- "j cxg"	"Xgtd"	"Crr j c"	"F tqr "	2"	575: ; "	32363"	5"
cktetchv'	"P qwp"	"Crr j c"	"F tqr "	2"	4; 96; "	; 234"	6"
"- "f q"	"Xgtd"	"Crr j c"	"F tqr "	2"	48322"	: ; 25"	7"
"- "hnki j v'	"P qwp"	"Crr j c"	"F tqr "	2"	42476"	9783"	8"
pq"	"Cf x"	"Crr j c"	"F tqr "	2"	35837"	8; ; 4"	9"
yj gp"	"Cf x"	"Crr j c"	"F tqr "	2"	355; 3"	868; "	: "
"- "ko g"	"P qwp"	"Crr j c"	"F tqr "	2"	35325"	8658"	; "
cve"	"Rtqr "	"Crr j c"	"F tqr "	2"	36853"	82: 4"	32"
"- "i gv'	"Xgtd"	"Crr j c"	"F tqr "	2"	35464"	8223"	33"
"- "o cng"	"Xgtd"	"Crr j c"	"F tqr "	2"	32882"	7957"	34"
"- "i q"	"Xgtd"	"Crr j c"	"F tqr "	2"	3346; "	7726"	35"
"- "eqpvkpwg"	"Xgtd"	"Crr j c"	"Mggr "	203; "	; 22; "	752: "	36"
"- "ecn"	"Xgtd"	"Crr j c"	"F tqr "	2"	; ; : 6"	734: "	37"
"- "cun"	"Xgtd"	"Crr j c"	"F tqr "	2"	; : 6: "	7235"	38"
"- "vgn"	"Xgtd"	"Crr j c"	"F tqr "	2"	; ; 35"	6; 39"	39"
"- " engct"	"Xgtd"	"Crr j c"	"F tqr "	2"	; 539"	6; 25"	3: "
"- "twpy c{"	"P qwp"	"Crr j c"	"F tqr "	2"	348: 9"	695; "	3; "
"- "ncpf "	"Xgtd"	"Crr j c"	"F tqr "	2"	: 524"	68; 5"	42"
"- "ecr vckp"	"P qwp"	"Crr j c"	"F tqr "	2"	34446"	6865"	43"
cnuq"	"Cf x"	"Crr j c"	"F tqr "	2"	; 542"	6827"	44"
"- "cr r tqcej "	"P qwp"	"Crr j c"	"F tqr "	2"	36259"	6765"	45"
"- "uc{"	"Xgtd"	"Crr j c"	"F tqr "	2"	; 3; 3"	6692"	46"
"- "hqqv'	"P qwp"	"Crr j c"	"Mggr "	20376"	34672"	6638"	47"
"- "i kxg"	"Xgtd"	"Crr j c"	"F tqr "	2"	; 759"	65; 3"	48"
"- "ugg"	"Xgtd"	"Crr j c"	"F tqr "	2"	; 694"	6596"	49"
"- "ncpf kpi "	"P qwp"	"Crr j c"	"F tqr "	2"	; 858"	64: 8"	4: "
hktuv'	"Cf l"	"Crr j c"	"F tqr "	2"	: 592"	6446"	4; "
"- "hn{"	"Xgtd"	"Crr j c"	"F tqr "	2"	; 284"	638; "	52"
"- "vcng"	"Xgtd"	"Crr j c"	"F tqr "	2"	: 765"	6347"	53"
qp"	"Cf x"	"Crr j c"	"F tqr "	2"	78; ; "	6286"	54"
"- "i cvg"	"P qwp"	"Crr j c"	"F tqr "	2"	: 3: 8"	624: "	55"
"- "tgegkxg"	"Xgtd"	"Crr j c"	"F tqr "	2"	8476"	5; 49"	56"
"- "uvctv'	"Xgtd"	"Crr j c"	"Mggr "	203: "	85: 9"	5992"	57"
"- "cnkwwf g"	"P qwp"	"Crr j c"	"F tqr "	2"	: 46; "	5886"	58"
"- "etgy "	"P qwp"	"Crr j c"	"F tqr "	2"	; 642"	5855"	59"

"

xgt{"	'Cf x"	'Crr j c"	'F tqr"	2"	776: "	5776"	5: "
"- "pqvkeg"	'Xgtd"	'Crr j c"	'Mggr "	20B7; "	749; "	5738"	5; "
"- "crr tqzko cvgn{"	'Cf x"	'Crr j c"	'F tqr"	2"	768; "	5626"	62"
"- "wvtp"	'Xgtd"	'Crr j c"	'F tqr"	2"	7779"	559; "	63"
lwuv'	'Cf x"	'Crr j c"	'F tqr"	2"	6858"	554; "	64"
"- "r knqv"	'P qwp"	'Crr j c"	'F tqr"	2"	757: "	554; "	64"
"- "r qkpv"	'P qwp"	'Crr j c"	'F tqr"	2"	7678"	553; "	66"
ko o gf kcvgn"	'Cf x"	'Crr j c"	'Mggr "	20B85"	6683"	5473"	67"
o ckpvgpcpeg"	'P qwp"	'Crr j c"	'Mggr "	20B: 7"	9752"	546; "	68"
"- "nqqm'	'Xgtd"	'Crr j c"	'F tqr"	2"	7226"	5465"	69"
"- "eqo g"	'Xgtd"	'Crr j c"	'F tqr"	2"	6997"	5447"	6: "
"- "o kpwg"	'P qwp"	'Crr j c"	'Mggr "	20B94"	7529"	5437"	6; "
"- "r tqegf wtg"	'P qwp"	'Crr j c"	'Mggr "	20B: "	82: 2"	53; 8"	72"
"- "f guegpv"	'P qwp"	'Crr j c"	'F tqr"	2"	87: 8"	53; 2"	73"
qyj gt"	'Cf 1"	'Crr j c"	'F tqr"	2"	683: "	5353"	74"
"- "wug"	'Xgtd"	'Crr j c"	'F tqr"	2"	6; 24"	534: "	75"
hq"	'Rtqr "	'Crr j c"	'F tqr"	2"	: 2; 7"	5289"	76"
"- "cttkxcn"	'P qwp"	'Crr j c"	'F tqr"	2"	8697"	5277"	77"
"- "cktr qtv"	'P qwp"	'Crr j c"	'F tqr"	2"	7662"	525; "	78"
"- "kuuwg"	'P qwp"	'Crr j c"	'Mggr "	20B: "	6; 63"	5254"	79"
"- "gxgpv"	'P qwp"	'Crr j c"	'Mggr "	20B9; "	6: 96"	5248"	7: "
ci ckp"	'Cf x"	'Crr j c"	'F tqr"	2"	6842"	523; "	7; "
"- "cf xkug"	'Xgtd"	'Crr j c"	'Mggr "	20B: 4"	73; 6"	5228"	82"
"- "vj kpm'	'Xgtd"	'Crr j c"	'F tqr"	2"	68: 4"	5223"	83"
"- "dcem'	'P qwp"	'Crr j c"	'Mggr "	20B96"	62: 3"	4; 98"	84"
"- "ukwcvkqp"	'P qwp"	'Crr j c"	'Mggr "	20B: 3"	6: 34"	4; 8: "	85"
"- "dgi kp"	'Xgtd"	'Crr j c"	'Mggr "	20B: 3"	6987"	4; 5; "	86"
"- "ej gemkuv"	'P qwp"	'Crr j c"	'F tqr"	2"	89; ; "	4: 88"	87"
yj cv'	'Cf x"	'Crr j c"	'F tqr"	2"	62; 6"	4: 6; "	88"
"- "r cuugpi gt"	'P qwp"	'Crr j c"	'Mggr "	20B424"	8857"	4: 57"	89"
"- "eqpvtqn"	'P qwp"	'Crr j c"	'F tqr"	2"	6: 39"	4: 53"	8: "
"- "cczk"	'Xgtd"	'Crr j c"	'F tqr"	2"	69: 4"	4: 49"	8; "
uvkm'	'Cf x"	'Crr j c"	'F tqr"	2"	622; "	4: 48"	92"
"- "f guegpf "	'Xgtd"	'Crr j c"	'Mggr "	20B; "	769: "	4: 45"	93"
"- "mpqy "	'Xgtd"	'Crr j c"	'Mggr "	20B: 4"	6379"	4: 43"	94"
"- "qhhkegt"	'P qwp"	'Crr j c"	'Mggr "	20B: 7"	5: ; 8"	4: 36"	95"
"- "vcmgqhh"	'P qwp"	'Crr j c"	'F tqr"	2"	9599"	49: : "	96"
"- "gpi kpg"	'P qwp"	'Crr j c"	'Mggr "	20B437"	; : 95"	4934"	97"
"- "engctcpeg"	'P qwp"	'Crr j c"	'F tqr"	2"	7926"	4898"	98"
dcem'	'Cf x"	'Crr j c"	'Mggr "	20B: 8"	57: 6"	4864"	99"
||| "	'Rtqr "	'Crr j c"	'F tqr"	2"	83: 6"	4829"	9: "
"- "ej gem'	'Xgtd"	'Crr j c"	'Mggr "	20B; 5"	5874"	4767"	9; "
"- "hqmqy "	'Xgtd"	'Crr j c"	'Mggr "	20B: ; "	5585"	475: "	: 2"

"- 'tgwvtp"	"Xgtd"	"Crrj c"	"Mggr "	2Œ; 5"	5986"	4758"	: 3"
qhhkegt"	"Rtqr "	"Crrj c"	"Mggr "	20427"	6446"	472; "	: 4"
"- "eqo r ngvg"	"Xgtd"	"Crrj c"	"Mggr "	2Œ; : "	5: 62"	46; 5"	: 5"
"- 'r tqdrngo "	"P qwp"	"Crrj c"	"Mggr "	2Œ; : "	5; 79"	46; 4"	: 6"
qpg"	"P wo "	"Crrj c"	"F tqr "	2"	54: : "	46; 3"	: 7"
"- "kphqto "	"Xgtd"	"Crrj c"	"Mggr "	20423"	626; "	4693"	: 8"
qw"	"Cf x"	"Crrj c"	"F tqr "	2"	5475"	4693"	: 8"
"- "enko d"	"Xgtd"	"Crrj c"	"Mggr "	20423"	6365"	4692"	: : "
"- "pggf "	"Xgtd"	"Crrj c"	"F tqr "	2"	5795"	4689"	: ; "
"- 'tgs wguv"	"Xgtd"	"Crrj c"	"F tqr "	2"	588; "	4677"	; 2"
cm"	"Cf l"	"Crrj c"	"F tqr "	2"	544: "	4676"	; 3"
vy q"	"P wo "	"Crrj c"	"F tqr "	2"	5678"	464; "	; 4"
"- "vt{"	"Xgtd"	"Crrj c"	"F tqr "	2"	583: "	4645"	; 5"
o qtg"	"Cf l"	"Crrj c"	"F tqr "	2"	53; 2"	45: : "	; 6"
"- "f gr ctwvtg"	"P qwp"	"Crrj c"	"F tqr "	2"	6952"	45: 6"	; 7"
"- "dgnkgxg"	"Xgtd"	"Crrj c"	"F tqr "	2"	553; "	4593"	; 8"
"- 'i qqf "	"Cf l"	"Crrj c"	"Mggr "	2Œ; : "	5362"	4576"	; 9"
"- "eqpvcev"	"Xgtd"	"Crrj c"	"Mggr "	20424"	5596"	4559"	; : "
hktuv"	"Rtqr "	"Crrj c"	"F tqr "	2"	5; 2; "	4559"	; : "
"- "ur ggf "	"P qwp"	"Crrj c"	"F tqr "	2"	6554"	4547"	322"

"

Table C4

List of Variables from ASRS and Text Mining

Ecvgi qt{	Xctkcdng	Tqng	P wo dgt O kuukpi	Rgtegpv O kuukpi Xcnwgu	Ucwwu
KF	CEP	KF	2	2'	Mggr
Vko g	Fcvg	Kpvgtxcn	2	2'	Mggr
Vko g	Nqecn'Vko g'Qh'Fc{	Pqo kpcn	3644	32'	Mggr
Rnceg	Nqecng'Tghgtgpeg	Vgzv	774	6'	Mggr
Rnceg	Ucvg'Tghgtgpeg	Vgzv	773	6'	Mggr
Rnceg	Tgncvkxg'Rqukkqp(Cpi ng0Tcfkcn	Kpvgtxcn	358;9	;;'	Ftqr
Rnceg	Tgncvkxg'Rqukkqp(Fkuvcpeg0 Pcwlecn'O kngu	Kpvgtxcn	35639	;9'	Ftqr
Rnceg	Cnkwwf g0CI N0Ukpi ng'Xcnwg	Kpvgtxcn	:5;4	83'	Ftqr
Rnceg	Cnkwwf g0O UN0Ukpi ng'Xcnwg	Kpvgtxcn	:222	7:'	Ftqr
Gpxktqpo gpv	Hnki j v'Eqpfkkqpu	Pqo kpcn	68;2	56'	Mggr
Gpxktqpo gpv	Y gcvj gt'Grgo gpwu'1'Xkukdknkv{	Pqo kpcn	338:;	:6'	Ftqr
Gpxktqpo gpv	Y qtm'Gpxktqpo gpv'Hcevqt	Pqo kpcn	35988	;;'	Ftqr
Gpxktqpo gpv	Nki j v	Pqo kpcn	7658	5;'	Mggr
Gpxktqpo gpv	Egknkpi	Kpvgtxcn	35394	;7'	Ftqr
Gpxktqpo gpv	TXT0Ukpi ng'Xcnwg	Kpvgtxcn	35:57	322'	Ftqr
Cktetchv'3	CVE'1'Cfxkuqt{	Pqo kpcn	5352	45'	Mggr
Cktetchv'3	Cktetchv'Qr gtcvqr	Pqo kpcn	87	2'	Mggr
Cktetchv'3	O cmg'O qf gn'Pco g	Vgzv	:	2'	Mggr ,
Cktetchv'3	Cktetchv'\ qpg	Vgzv	35:8;	322'	Ftqr
Cktetchv'3	Etgy 'Uk|g	Kpvgtxcn	554	4'	Mggr
Cktetchv'3	Qr gtcvkpi 'Wpf gt'HCT'Rctv	Pqo kpcn	2	2'	Ftqr ,
Cktetchv'3	Hnki j v'Rncp	Pqo kpcn	9:4	8'	Mggr
Cktetchv'3	O kuukqp	Pqo kpcn	34;7	;'	Mggr
Cktetchv'3	Pcx'Kp'Wug	Pqo kpcn	;4::	89'	Ftqr
Cktetchv'3	Hnki j v'Rj cug	Pqo kpcn	336	3'	Mggr
Cktetchv'3	Tqwg'Kp'Wug	Pqo kpcn	33236	9;'	Ftqr
Cktetchv'3	Cktur ceg	Pqo kpcn	8285	66'	Mggr
Cktetchv'3	O ckpvgpcpeg'Ucvwu0 O ckpvgpcpeg'Fghgttgf	Fkej qvqo qwu	3582;	;:'	Ftqr
Cktetchv'3	O ckpvgpcpeg'Ucvwu0 Tgeqtfu'Eqorngvg	Fkej qvqo qwu	358:7	;;'	Ftqr
Cktetchv'3	O ckpvgpcpeg'Ucvwu0 Tgngcugf 'Hqt'Ugtxkeg	Fkej qvqo qwu	35859	;:'	Ftqr
Cktetchv'3	O ckpvgpcpeg'Ucvwu0Tgswktgf '1'' Eqttgev'Fqe'Qp'Dqctf	Fkej qvqo qwu	358;7	;;'	Ftqr
Cktetchv'3	O ckpvgpcpeg'Ucvwu0 O ckpvgpcpeg'V{rg	Fkej qvqo qwu	35867	;:'	Ftqr

"

Cktetchv'3"	O ckpvgpcpeg'Uvcwu0' O ckpvgpcpeg'Kgo u'Kpxqnxgf "	P qo kpcn'	358:2"	;;' "	Ftqr "
Cktetchv'3"	Ecdkp'Nki j vkpi "	P qo kpcn'	35:89"	322' "	Ftqr "
Cktetchv'3"	P wo dgt'Qh'Ugcwu0P wo dgt"	Kpvgtxcn'	35:8;"	322' "	Ftqr "
Cktetchv'3"	Rcuugpi gtu'Qp'Dqctf 0P wo dgt"	Kpvgtxcn'	35:84"	322' "	Ftqr "
Cktetchv'3"	Etgy "Uk| g'Hhki j v'Cwgpf cpv0' P wo dgt'Qh'Etgy "	Kpvgtxcn'	35:84"	322' "	Ftqr "
Eqo r qpgpv"	Cktetchv'Eqo r qpgpv"	Vgzv"	:65:"	83' "	Ftqr "
Eqo r qpgpv"	O cpwhcewwtgt"	Vgzv"	3596;"	;;' "	Ftqr "
Eqo r qpgpv"	Cktetchv'Tghgtgpeg"	P qo kpcn'	:687"	83' "	Ftqr "
Eqo r qpgpv"	Rtqdngo "	P qo kpcn'	:947"	85' "	Ftqr "
Cktetchv'4"	CVE "I'Cf xkuqt{"	P qo kpcn'	34:3:"	;4' "	Ftqr "
Cktetchv'4"	Cktetchv'Qr gtcvqt"	P qo kpcn'	34;73"	;5' "	Ftqr "
Cktetchv'4"	O cmg'O qf gn'P co g "	Vgzv"	345:5"	::' "	Ftqr "
Cktetchv'4"	Cktetchv\ qpg"	Vgzv"	35:8;"	322' "	Ftqr "
Cktetchv'4"	Etgy "Uk| g"	Kpvgtxcn'	34:;3"	;6' "	Ftqr "
Cktetchv'4"	Qr gtcvkpi "Wpf gt'HCT"Rctv"	P qo kpcn'	34;86"	;5' "	Ftqr "
Cktetchv'4"	Hhki j v'Rncp"	P qo kpcn'	3524;"	;6' "	Ftqr "
Cktetchv'4"	O kuukqp"	P qo kpcn'	3548:"	;8' "	Ftqr "
Cktetchv'4"	P cx'Kp'Wug"	P qo kpcn'	358:;"	;;' "	Ftqr "
Cktetchv'4"	Hhki j v'Rj cug"	P qo kpcn'	34853"	;3' "	Ftqr "
Cktetchv'4"	Tqwg'Kp'Wug"	P qo kpcn'	35975"	;;' "	Ftqr "
Cktetchv'4"	Cktur ceg"	P qo kpcn'	34:4;"	;5' "	Ftqr "
Cktetchv'4"	O ckpvgpcpeg'Uvcwu0' O ckpvgpcpeg'F ghgttgf "	F kej qvqo qwu"	35:8;"	322' "	Ftqr "
Cktetchv'4"	O ckpvgpcpeg'Uvcwu0' Tgeqtf u'Eqo r ngvg"	F kej qvqo qwu"	35:8;"	322' "	Ftqr "
Cktetchv'4"	O ckpvgpcpeg'Uvcwu0' Tgngcugf "Hqt"Ugtxkeg"	F kej qvqo qwu"	35:8;"	322' "	Ftqr "
Cktetchv'4"	O ckpvgpcpeg'Uvcwu0Tgs wktgf "I"" Eqttgev'F qe'Qp'Dqctf "	F kej qvqo qwu"	35:8;"	322' "	Ftqr "
Cktetchv'4"	O ckpvgpcpeg'Uvcwu0' O ckpvgpcpeg'V{r g"	F kej qvqo qwu"	35:8;"	322' "	Ftqr "
Cktetchv'4"	O ckpvgpcpeg'Uvcwu0' O ckpvgpcpeg'Kgo u'Kpxqnxgf "	P qo kpcn'	35:8;"	322' "	Ftqr "
Cktetchv'4"	Ecdkp'Nki j vkpi "	P qo kpcn'	35:8;"	322' "	Ftqr "
Cktetchv'4"	P wo dgt'Qh'Ugcwu0P wo dgt"	Kpvgtxcn'	35:8;"	322' "	Ftqr "
Cktetchv'4"	Rcuugpi gtu'Qp'Dqctf 0P wo dgt"	Kpvgtxcn'	35:8;"	322' "	Ftqr "
Cktetchv'4"	Etgy "Uk| g'Hhki j v'Cwgpf cpv0' P wo dgt'Qh'Etgy "	Kpvgtxcn'	35:8;"	322' "	Ftqr "
Rgtuqp'3"	Nqecvkqp'Qh'Rgtuqp"	P qo kpcn'	352"	3' "	Mggr "
Rgtuqp'3"	Nqecvkqp'Kp'Cktetchv"	P qo kpcn'	375"	3' "	Mggr "
Rgtuqp'3"	Tgr qtvgt'Qti cpk| cvkqp"	P qo kpcn'	96"	3' "	Mggr "
Rgtuqp'3"	Hwpevkqp"	P qo kpcn'	2"	2' "	Mggr "
Rgtuqp'3"	S wcnkhkecvkqp"	P qo kpcn'	974"	7' "	Mggr "
Rgtuqp'3"	Gzr gtkgpeg"	Kpvgtxcn'	9583"	75' "	Ftqr "
Rgtuqp'3"	Ecdkp'Cevkxkv{"	P qo kpcn'	34:24"	;4' "	Ftqr "

"

Rgtuqp"3"	J wo cp"Hcevqtu"	P qo kpcn'	5573"	46' "	Mggr "
Rgtuqp"3"	Eqo o wpkecvkqp"Dtgcmfqy p"	P qo kpcn'	; 997"	92' "	F tqr "
Rgtuqp"3"	CUUU'Tgr qtv'P wo dgt0' Ceeguukqp"P wo dgt"	KF "	2"	2' "	F tqr "
Rgtuqp"4"	Nqecvkqp"Qh'Rgtuqp"	P qo kpcn'	: 36; "	7;' "	F tqr "
Rgtuqp"4"	Nqecvkqp"Kp'Cktetchv'	P qo kpcn'	: 428"	7;' "	F tqr "
Rgtuqp"4"	Tgr qtvgt"Qti cpk| cvkqp"	P qo kpcn'	: 385"	7;' "	F tqr "
Rgtuqp"4"	Hwpevkqp"	P qo kpcn'	: 32: "	7;' "	F tqr "
Rgtuqp"4"	S wcnkhkecvkqp"	P qo kpcn'	: 847"	84' "	F tqr "
Rgtuqp"4"	Gzr gtkgpeg"	Kpvgtxcn'	32; 4: "	9;' "	F tqr "
Rgtuqp"4"	Ecdkp'Cevkxkv{"	P qo kpcn'	34: 48"	; 4' "	F tqr "
Rgtuqp"4"	J wo cp"Hcevqtu"	P qo kpcn'	; 895"	92' "	F tqr "
Rgtuqp"4"	Eqo o wpkecvkqp"Dtgcmfqy p"	P qo kpcn'	33: : 4"	: 8' "	F tqr "
Rgtuqp"4"	CUUU'Tgr qtv'P wo dgt0' Ceeguukqp"P wo dgt"	KF "	: 9: ; "	85' "	F tqr "
Gxgpvu"	Cpqo cn{"	P qo kpcn'	; "	2' "	Mggr "
Gxgpvu"	O kuu'F kuvcpeg"	Kpvgtxcn'	34957"	; 4' "	F tqr "
Gxgpvu"	Y gtg"Rcuugpi gtu"Kpxqnxgf "Kp" Gxgpv'	F kej qvqo qwu"	33: 62"	: 7' "	F tqr "
Gxgpvu"	F gvgevqt"	P qo kpcn'	: : "	3' "	Mggr "
Gxgpvu"	Y j gp"F gvgevgf "	P qo kpcn'	442"	4' "	Mggr "
Gxgpvu"	Tguwnv'	Vgzv'	669"	5' "	Mggr "
Cuuguuo gpvu"	Eqpvtkdwvkpi "Hcevqtu"I'Ukvwcvkqpu"	P qo kpcn'	56"	2' "	Mggr "
Cuuguuo gpvu"	Rtko ct{"Rtqdngo "	P qo kpcn'	56"	2' "	Mggr "
Tgr qtv'3"	P cttcvkxg"	Vgzv'	2"	2' "	Mggr "
Tgr qtv'3"	Ecmdcem'	Vgzv'	3482; "	; 3' "	F tqr "
Tgr qtv'4"	P cttcvkxg"	Vgzv'	: 2; 4"	7;' "	F tqr "
Tgr qtv'4"	Ecmdcem'	Vgzv'	34: 23"	; 4' "	F tqr "
Tgr qtv'3"	U{pqruku"	Vgzv'	2"	2' "	Mggr "
Vgzv'O kpkpi "	Ugpuqt{"Rgtegrvkqp"	Kpvgtxcn'	2"	2' "	Mggr "
Vgzv'O kpkpi "	Cktetchv'Cevkqp"	Kpvgtxcn'	2"	2' "	Mggr "
Vgzv'O kpkpi "	O ckpvgpcpeg"Eqpegtp"	Kpvgtxcn'	2"	2' "	Mggr "
Vgzv'O kpkpi "	Gpi kpg"Kuuwg"	Kpvgtxcn'	2"	2' "	Mggr "
Vgzv'O kpkpi "	U{uvgo "Cpqo cn{"	Kpvgtxcn'	2"	2' "	Mggr "
Vgzv'O kpkpi "	Ecdkp'Chhgevgf "	Kpvgtxcn'	2"	2' "	Mggr "
Vgzv'O kpkpi "	Ckt"Eqpfkkqpkpi "	Kpvgtxcn'	2"	2' "	Mggr "
Vgzv'O kpkpi "	Rcuugpi gt"F kutwrvkqp"	Kpvgtxcn'	2"	2' "	Mggr "
Vgzv'O kpkpi "	Hnki j v'Eqpfkkqp"	Kpvgtxcn'	2"	2' "	Mggr "
Vgzv'O kpkpi "	Rqy gt"Ej cpi g"	Kpvgtxcn'	2"	2' "	Mggr "

"

"

Appendix D"

Uco r ng"Vgto u"Kpenwf gf "kp"Vgz v'Rctukpi "Uvqr "Nkuv"

)f "	eqo r cp{'f kurcvej gt"	o qf gtcvg"vwtdwngpeg"	uvgr /f qy p"cnkwf g"
)m"	er f ne"	pgy "cuuki pgf "cnkwf g"	uvkem'uj cmgt"
)o "	er f ne"engctcpeg"	pqug"y j ggrn'ktg"	u{pqr vke"f kur nc{"
)tg"	er f ne"o guuci g"	pqvco "u{uvgo "	vckn'uvtkng"
)u"	f gcf j gcf kpi "	qegcpke"	vckny kpf "
)xg"	f gr ctvkpi "cktetchv'	qxgt/ur ggf "	vczky c{"egpvgtnkpg"
23t"	f gr ctwtg"	r cr k'i wkf cpeg"	vecu'cngtv'
3.222/3.722"	f kurcvej gt"	r knqv'f gxkcvkqp"	vecu'tc'i wkf cpeg"
32.222hv"	f qqdk4"cttkxcrn"	r kej "cvkwf g"	vgttckp'cxqkf cpeg'r tqegf wtg"
36eht"	geco "	r ngcug"	vj gtghqtg"
3: l58"	geco "o guuci g"	r wdnkuj gf "ugi o gpv'	vqi c"
472mu"	gi r y u'y ctpkpi "	r wuj dcem'	vqy gt'kuuwg"
5uo "	hch"	tc'f guegpv'	vtchhke'r cwgtp"cnkwf g"
c/542"	hn572"	tc'i wkf cpeg"	vtko "o crhwpevkqp"
cectu'f kurcvej "	ho u"	tcf kq'eqo o wpkecvkqp"	wphco knkct'gpxktqpo gpv'
cectu'o guuci g"	ho u'cpqo cn{"	tg/ecnewncvg"	x3"eww"
cevkxg"twpy c{"	ho u'gttqt"	tgf "hnki j v'	xgevqt"
cevkxg"czky c{"	hqf "	tgi wnct'ckur qtv'	xgnqekv{"
cewcrn'hrki j v'	hqzvtqv'	tglgevgf "vcmgqhh'ej gemnkuv'	xgtvkecrn"
cewcrn'j gcf kpi "	hwgn'	tgr qtvgf "y gcvj gt"	xht"cktetchv'
cf xgtug"y gcvj gt"	hwgn'cf xkuqt{"	tgxgtug"j v twuv'	xht"f c{"
chvgt"unctv'ej gemkuv'	i nkf gunqr g"	twpy c{'j gcf kpi "	xkuwcrn'4: t"
ckt qtv'	i r u'f cvc"	twpy c{'kpewtukqp"	xqt"tcf kcrn"
ckturggf "	j ki j "cvkwf g"	twpy c{'39t"	y cng"wtdwngpeg"
cf u/d"	j qrf kpi "r cwgtp"	ucv'eqo "eqo o wpkecvkqp"	y gcvj gt"
cnkwf g"	kg"	ueko kct"	y guv'hnqy "
co dgt"	knu'38t"	ugtkqwun{"	y j kuvng{"eqo r cuu"
cr r tqcej "	lhm'ckturceg"	ugxgtg"vwtdwngpeg"	y kpf "
cttkxcrn'r tqegf wtg"	lwuv'uj qtv'	uj cnqy "wtp"	y kpf "f ktgevkqp"
cttkxcrn'r tqhkng"	nkqi tco "	ukf "f gr ctwtg"	y kpf uqem'
cve"eqo o wpkecvkqp"	ncvgtcrn'qhhugv'	um{'f kxgt"	y j kvg"pggf ng"
cwtcrn'y ctpkpi "	ngcf kpi "gf i g"	uqhwy ctg'kuuwg"	zc22"nqecrn"
cwtcrn'cngtv'	nghv'ckngtqp"	uqo gj qy "	zy kpi "
dquvqp"	my u'cf xkuqt{"	ur gekcrn'ckur qtv'	{)crn"
dwnm'ecti q'f qqt""	mqecrn{gt"eqwtug"	ur gekhke"cttkxcrn'	{gcj "
dwu{'ukwcvkqp"	mqemgf "r qukvkqp"	ur ggf "		ggmnß"cttkxcrn"
ecwkqp'o guuci g"	o czko wo "ckturggf "	ur ggf "dwi "	||| "ckur qtv'
ef w'o guuci g"	o f c"cnkwf g"	uvcdknk| gf "cr r tqcej "	||| n'y gcvj gt"
ej gemkuv'	o grn'r tqegf wtg"	uvcpf ctf "ecnqwu"	||||| 'y c{r qkpv'
engctcpeg"f grkxgt{"	o kpko wo u"	uvcvwu'o guuci g"	||||| 3"kpvgtugevkqp"

Appendix E

Nqi kuvke'Tgi tguukqp'Pqfg'Qwvrwv'htqo "UCUǃ "GOÎ "

Hkv'Uvcvkuveu"

Vcti gv?Pgy Vcti gvXctkcdng"Vcti gv'Ncdgn?Pgy Vcti gvXctkcdng"

"""Hkv"

Uvcvkuveu	Uvcvkuveu'Ncdgn	Vtckp	Xcrkfcvkqp	Vguv
"aCKEa	Cmckng)u"Kphqto cvkqp'Etkvgtkqp	"5: : 306:	0	0
"aCUGa	Cxgtci g'Us wctgf 'Gttqt	2025	2026	2026"
"aCXGTTa	Cxgtci g'Gttqt'Hwpevkqp	2036	2038	2039"
"aFHGa	F gi tggu'qh'Htggfqo "hqt'Gttqt	3253022	0	0
"aFHO a	O qfgn'F gi tggu'qh'Htggfqo	996022	0	0
"aFHVa	Vqvcn'F gi tggu'qh'Htggfqo	332; 4022	0	0
"aFKXa	Fkxkuqt'hqt'CUG	3885: 022	38863022	: 54: 022"
"aGTTa	Gttqt'Hwpevkqp	455506:	493: 084	359: 089"
"aHRGa	Hkpcn'Rtgfkevkqp'Gttqt	2026	0	0
"aO CZa	O czko wo 'Cduqnwvg'Gttqt	3022	3022	3022"
"aO UGa	O gcp'Us wctg'Gttqt	2025	2026	2026"
"aP QDUa	Uwo "qh'Htgs wgpekgu	'7768022	'7769022	4998022"
"aP Y a	P wo dgt'qh'Guvko cvg'Y gki j vu	996022	0	0
"aTCUGa	TqqvCxgtci g'Uwo "qh'Us wctgu	208:	208;	208; "
"aTHRGa	Tqqv'Hkpcn'Rtgfkevkqp'Gttqt	208;	0	0
"aTO UGa	Tqqv'O gcp'Us wctgf 'Gttqt	208:	208;	208; "
"aUDEa	Uej y ct|)u'Dc{gukcp'Etkvgtkqp	'; 764072	0	0
"aUUGa	Uwo "qh'Us wctgf 'Gttqtu	742083	7; : 0 2	522087"
"aUWO Y a	Uwo "qh'Ecug'Y gki j vu'Vko gu'Htgs	3885: 022	38863022	: 54: 022"
"aO KUEa	O kuenuukhhecvkqp'Tcvg	2027	2028	2028"

Encuukhhecvkqp'Vcdng"

"Fcvc'Tqng?VTCKP "Vcti gv'Xctkcdng?Pgy Vcti gvXctkcdng"Vcti gv'

Ncdgn?Pgy Vcti gvXctkcdng"

"

Vcti gv	Qwveqo g	'Htgs wgpe{	Vqvcn'		
Vcti gv	Qwveqo g	Rgtegpvci g	Rgtegpvci g	Eqwpv	Rgtegpvci g"

"

'"'

"3	"3	'; 70.3693	; ; 0, 643	"7398	; 5.054: 7"
"4	"3	40, 52;	940.5227	"376	40.998: "
"5	"3	40.2443	930.64: 8	"332	30, : 56"
"3	"4	70.2222	20.279;	"5	20.2763"
"4	"4	: 80.8889	460.353	"74	20, 598"
"5	"4	: 0.5555	50.468:	"7	20.2; 24"
"4	"5	370.4396	50.4: 86	"9	20.3484"
"5	"5	: 60.9: 48	470.5469	"5;	20.9254"

'"'

'"Fcvc"Tqng?XCNKFCVG"Vcti gv"Xctkcdng?P gy Vcti gvXctkcdng"Vcti gv"

Ncdgn?P gy Vcti gvXctkcdng"

'"'

Vcti gv	Qweqo g	Rgtegpvci g	Rgtegpvci g	Eqwpv	Rgtegpvci g
"3	"3	'; 60, 7; 8	; ; 09.6; 2	"7389	'; 50.36; 7
"4	"3	"40, ; 47	'980.747:	"385	"40, 5: 7
"5	"3	"40.36: 2	'970, 962	"339	"40.32; 4
"3	"4	"3: 0.8: 3:	"20.8; 53	"32	"20.8: 25
"4	"4	"780.5858	360.7762	"53	"20.77: ;
"5	"4	"470.6767	'; 02; 2;	"36	"20.4746
"3	"5	"80.8889	20.279;	"5	"20.2763
"4	"5	"640.4444	: 0, 424	"3;	"20.5647
"5	"5	"730.3333	360, 573	"45	"20.6368

'"'

'"'

'"Gxgpv"Encuukhkecvkqp"Vcdng"

'"Fcvc"Tqng?VTCKP "Vcti gv?P gy Vcti gvXctkcdng"Vcti gv"Ncdgn?P gy Vcti gvXctkcdng"

	Hcnug	Vtwg	Hcnug	Vtwg
	P gi cvkxg	P gi cvkxg	Rqukvkxg	Rqukvkxg
aa337	75: 7	9	5; aaa

"

Fcvc"Tqng?XCNKFCVG"Vcti gv?P gy Vcti gvXctkcdng"Vcti gv"Ncdgn?P gy Vcti gvXctkcdng"

"

3; 2"

""""Hcnıg""""""""Vtwg"""""""""Hcnıg""""""Vtwg"
P gı cvkxg"""""P gı cvkxg"""""Rqukkxg"""""Rqukkxg"
""'

""""353""""""""""""7593"""""""""""""44"""""""""""45aaa"

"

""'

Cuuguuo gpv'Ueqtg'Tcpmkpi u"

Fcvc'Tqng? VTCP "Vcti gv'Xctkcdng? P gy Vcti gvXctkcdng"Vcti gv"

Ncdgn? P gy Vcti gvXctkcdng"

'""'

Rquvgtkqt"   "   "   Ewo wncvkxg""""""""""' "   """"Ewo wncvkxg"""""""P wo dgt'qh" "
Fgrxj """""""""""I ckp"""""Nkhv"""""""""Nkhv""""""""""Tgurqpug"""   "Tgurqpug""""Qdugtxcvkqpu""""O gcn""
Rtqdcdknkv{ aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa"
""'
""""7""""" """""""7950 93""""8095: 93""8095: 93"""""3: 0933; """""""""""3: 0933; """""""""""""49: """""""""20i89; 7; "
"32"""" """"""4; 507; : """"""304535"""50 57; : """"""503: 9"""""""""""320 4; 5"""""""""499"""""""""202442: "
"37""" """"""3; ; 0 6; """"304535"""40 ; ; 6; """""503: 9"""""""""""": 054: ; """"""""""""499"""""""""202442: "
"42"""" """"""3740 78""304535"""40r4; 78"""""503: 9"""""""""""902462""""""""""""""49: """"""""""202442: "
"47"""" """"""3460 8: """304535"""40r46: 8: """""503: 9"""""""""""804663""""""""""""499"""""""""202442: "
"52"""" """""3280353"""304535"""402I8353"""""503: 9"""""""""""70i945: """""""""""499"""""""""202442: "
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"62"""" """"""": 40r888""304535"""30 4888"""""503: 9"""""""""""702944""""""""""""499"""""""""202442: "
"67"""" """""""960 7: """304535"""30r96: 7: """""503: 9"""""" """""60 776"""""""""""499"""""""""202442: "
"72""""""""""""""8: 0r833""304535"""308: 833"""""503: 9"""""""""""60r8: 3; """"""""""499"""""""""202442: "
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"82"""""""""""""7; 0r444""304535"""30r7; 444"""""503: 9"""""""""""606434""""""""""""499"""""""""202442: "
"87""""""""""""""750 64""20r; 424"""30r75: 64"""""40r698; """""""""""60r493: """"""""""499"""""""""2023: 9; "
"92"""""""""""""640 4: """202222"""30r64: 4: """"202222"""""""""""50i882""""""""""""49: """"""""""2022239"
"97"""""""""""""550r539""202222"""30r55539"""""202222"""""""""""50i923; """""""""""499"""""""""2022222"
": 2"""""""""""460 ; 6""202222"""30r46; ; 6"""""202222"""""""""""50i692: """""""""""499"""""""""2022222"
": 7""""""""""""390r847""202222"""30r39847"""""202222""""""' """""504884""""""""""""49: """""""""2022222"
"; 2"""""""""""330r2; : """202222"""30r832; : """"202222""""""' """""50r2: 6; """"""""""499"""""""""2022222"
"; 7"""""""""""70r479""202222"""30r27479"""""202222"""""" """""40r 44: """"""""""499"""""""""2022222"
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Fcvc'Tqng? XCNKFCVG"Vcti gv'Xctkcdng? P gy Vcti gvXctkcdng"Vcti gv"

Ncdgn? P gy Vcti gvXctkcdng"

""'

"

'''

Rquvgtkqt''''''''''''''''''''''''Ewo wncvkxg''''''''''   '''''''''''Ewo wncvkxg''''''''Pwo dgt"qh"
Fgryj ''''''''''I ckp'''''Nkhv''''''''''Nkhv''''''''''Tgurqpug''''   'Tgurqpug''''''Qdugtxcvkqpu'''''''O gcp'"
Rtqdcdknkv{ aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa"
'"
''''7''''' ''''5; 4]954''''6Q 4954'''''6Q 4954'''''35]89; 8'''''''35]89; 8''''''''''49: ''''''''2]393; 8"
''32''''' ''''4260]687'''3]87739''''5]26687'''''5]4293''''''''''':]674: ''''''''499''''''''2]2442: "
''37''''' '''''363]629''3]87739''''4]63629''''5]4293'''''''''8]9243''''''''49: ''''''''2]2442: "
''42''''' ''''32; Q ; 3''3]87739''''4Q; ; ; 3''''5]4293''''''''70 4; ; ''''''''''499''''''''2]2442: "
''47'''''''''''; 3]845''3]87739''''3Q 3345'''''5]4293''''''''70]5283''''''''499''''''''2]2442: "
''52'''''''''9:]722''3]87739''''3Q9: 722''''5]4293''''''''6Q 778''''''''49: ''''''''2]2442: "
''57''''' ''''''8:]738''3]87739''''3Q8; 738''''5]4293''''''''69]284'''''''''499''''''''2]2442: "
''62''''' '''''840]997''3]87739''''3Q84997''''5]4293''''''''6Q73; 3'''''''499''''''''2]2442: "
''67''''''''''''790]736''3]87739''''3Q79736''''5]4293''''''''6]5952''''''''49: ''''''''2]2442: "
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''77''''' '''''''6; Q : : ''3]87739''''3]6; : : : ''''5]4293''''''''6Q3835''''''''499''''''''2]2442: "
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''92''''' '''''''640 75''3Q42363''''3]64: 75'''''5]5576''''''''5Q 882''''''''499''''''''2]22; 47"
''97''''' ''''55]52; ''2Q22222''''3Q5552; '''''2Q2222''''''''59]232'''''''''49: ''''''''2]22223"
'': 2''''' '''''''46Q : ; ''2Q22222''''3Q46; : ; '''''2Q2222''''''''5Q6922''''''''499''''''''2]22222"
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''; 7''''' '''''''''70]478''2Q22222''''3Q27478'''''2Q2222''''''''4Q 444''''''''499''''''''2]22222"
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'"'"'

'"'

Cuuguuo gpv'Ueqtg'Fkuvtkdwvkqp"

'Fcvc'Tqng?'VTCP "Vctigv'Xctkcdng?Pgy Vctigv]Xctkcdng"Vctigv'

Ncdgn?Pgy Vctigv]Xctkcdng"

"

"

'"Rquvgtkqt''''''''''Pwo dgt'''''''''''''''''''''''''''''O gcp"
Rtqdcdknkv{'''''''''''''qh''''''''''''''''Pwo dgt"qh"'''Rquvgtkqt"
'''Tcpi g''''''''''''''Gxgpvu''''''''Pqpgxgpvu''''''Rtqdcdknkv{'''Rgtegpvci g"
'"'

'2Q 7/3]22''''''''''''''42''''''''''''''''''''''''''2'''''''''''''' 2Q ; 254''''''''2]5828"
'2Q 2/2Q 7'''''''''''''''7'''''''''''''   '''''''2'''''''''''   2Q 4; 28''''''''2]2; 24"

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"20 7/20 2"	6	2	20 9565	20 943"
"20 2/20 7"	6	2	20 33; ;	20 943"
"2097/20 2"	5	2	2099576	202763"
"2092/2097"	2	4	2093534	202583"
"2087/2092"	2	3	2088323	2023: 2"
"2082/2087"	4	2	208425:	202583"
"2077/2082"	3	2	207; 73;	2023: 2"
"2072/2077"	2	6	2075366	202943"
"2067/2072"	3	3	206; 543	202583"
"2062/2067"	2	3	2064259	2023: 2"
"2057/2062"	2	3	205: 795	2023: 2"
"2052/2057"	3	2	2055; 44	2023: 2"
"2042/2047"	4	8	204488;	203664"
"2037/2042"	3	7	203: 272	2032: 4"
"2032/2037"	2	4	2035883	202583"
"2027/2032"	3	7	2028834	2032: 4"
"2022/2027"	32;	7586	2023634	; ; 08: 59aaa"

'"'

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Fcvc"Tqng?XCNKFCVG"Vcti gv"Xctkcdng?P gy Vcti gvXctkcdng"Vcti gv"

Ncdgn?P gy Vcti gvXctkcdng"

"Rquvgtkqt"	P wo dgt			O gcp"
Rtqdcdkrkv{	qh	P wo dgt"qh		"Rquvgtkqt"
""Tcpi g"	"Gxgpvu"	"P qpgxgpvu"	"Rtqdcdkrkv{"	"Rgtegpvci g"

20 7/3022	33	5	20 : 972	204746"
20 2/20 7	5	5	20 44: 4	2032: 4"
20 7/20 2	3	2	20 77: ;	2023: 2"
20 2/20 7	2	6	20 4455	202943"
2097/20 2	2	4	209: 653	202583"
2092/2097	3	6	2094: 52	202; 23"
2087/2092	6	3	208: 364	202; 23"
2077/2082	4	3	2078245	202763"
2072/2077	3	5	2074635	202943"
2067/2072	2	4	206: 56;	202583"
2062/2067	2	3	2066954	2023: 2"
2057/2062	2	3	205924;	2023: 2"
2052/2057	3	4	2054676	202763"

"

2047/2052"""""""""""""3""""""""""""""""6"""""""""' 204936; """"""""202; 23"
2042/2047"""""""""""""2""""""""""""""""7"""""""""' 204487; """"""""202; 23"
2037/2042"""""""""""""3""""""""""""""""5"""""""""' 2088: 24"""""""202943"
2032/2037"""""""""""""4""""""""""""""""8"""""""""' 203382; """"""""203664"
2027/2032"""""""""""""4""""""""""""""""8"""""""""' 2029627""""""""203664"
2022/2027"""""""""""346"""""""""""7564"""""""""' 2023695"""""""""; : 075; : aaaa"

Appendix F
"

I tcfkgpv'Dqquv'P qf g''UCU̦ ''Eqfg''htqo ''Vtckpkpi 'Fcvc'Nqi ""

, "Vtckpkpi 'Nqi "
Fcvg<""""""""""""""Lwn{'38.'4243"
Vko g<""""""""""""29‹5;‹72"
, // , "
37447"'rtqe'htgs 'fcvc? GO Y U8(DqquvaXctkcdngUgv'pqr tkpv="
37448"'\cdrg''TQNG, NGXGNlqw? Y QTM(DqquvO GVC="
37449"'twp="
3744: "rtqe'rtkpv'fcvc? Y QTM(DqquvO GVC'ncdgn'pqqdu="
3744; "xct 'TQNG'NGXGN'EQWP V="
37452"'ncdgn'TQNG''? '$' u{uhwpe*ucuo ui *ucuj grr (fo kpg."o gvcatqrgaxncdgn'P QS WQVG+)$"
NGXGN''? '$' u{uhwpe*ucuo ui *ucuj grr (fo kpg."o gvcarqvgxnxncdgn'P QS WQVG+)$'EQWP V''? "
$' u{uhwpe*ucuo ui *ucuj grr (fo kpg."tr vaeqwpvaxncdgn'P QS WQVG+)$="
37453"'kvng; ")')="
37454"'kvng32'$' u{uhwpe*ucuo ui *ucuj grr (fo kpg."tr vaxctUwo o ct{avkvng'".'P QS WQVG+)$="
37455"'twp="
37456"'kvng32="
37457"" rgv'GO P QTNGP ''? " FO P QTNGP ="
GO Y U8(RctvaVTCKP 'GO Y U8(RctvaVTCKP "
GO Y U8(RctvaVTCKP 'GO Y U8(RctvaVTCKP 'GO Y U8'RctvaVTCKP "
GO Y U8(RctvaVTCKP 'GO Y U8(RctvaVTCKP "
GO Y U8(RctvaVTCKP 'GO Y U8(RctvaVTCKP 'GO Y U8'RctvaVTCKP "
Gzgewkpi '"UCUJ GNR(GO EQTG(GO KP HQKVGTCVQT(ECN'aKP KV"'@@'
Gzgewkpi '"UCUJ GNR(GO EQTG(GO KP HQKVGTCVQT(ECN'ugvO gvaFcvc"'@@'
Gzgewkpi '"UCUJ GNR(GO EQTG(GO KP HQKVGTCVQT(ECN'pgzv"'@@'
Gzgewkpi '"UCUJ GNR(GO EQTG(GO KP HQKVGTCVQT(ECN'pgzv"'@@'
Gzgewkpi '"UCUJ GNR(GO EQTG(GO KP HQKVGTCVQT(ECN'ugvO gvaFcvc"'@@'
Gzgewkpi '"UCUJ GNR(GO EQTG(GO KP HQKVGTCVQT(ECN'pgzv"'@@'
Gzgewkpi '"UCUJ GNR(GO EQTG(GO KP HQKVGTCVQT(ECN'pgzv"'@@'
Gzgewkpi '"UCUJ GNR(GO EQTG(GO KP HQKVGTCVQT(ECN'avgto "'@@'
37486"'fcvc'Y QTM(DqquvaGXGP V*MGGR? XCTKCDNG'NCDGN'NGXGN'GXGP V'P WO NGXGNU"
QTFGT+="
37487"'rgpi vj 'QTFGT '"&42="
37488"'ncdgn'XCTKCDNG''? '$' u{uhwpe*ucuo ui *ucuj grr (fo kpg."tr vaxctgva xncdgn'"P QS WQVG+)$"
GXGP V''? '$' u{uhwpe*ucuo ui *ucuj grr (fo kpg."cuu vagxgpvaxncdgn'P QS WQVG+)$'P WO NGXGNU''? "
$' u{uhwpe*ucuo ui *ucuj grr (fo kpg."tr vapwo ecvaxncdgn'P QS WQVG+)$'NGXGN''? "
37489"""""$' u{uhwpe*ucuo ui *ucuj grr (fo kpg."o gvcarqvgxncdgn'P QS WQVG+)$'QTFGT''? "
$' u{uhwpe*ucuo ui *ucuj grr (fo kpg."o gvcaqtfgtaxncdgn'P QS WQVG+)$'NCDGN''? "
$' u{uhwpe*ucuo ui *ucuj grr (fo kpg."o gvcancdgnaxncdgn'P QS WQVG+)$="
3748: "ugv'GO Y U8(KF U5aP GY VCTI GVXCTKCDNaF O *y j gtg? *aV[RGa? $VCTI GV$++="
3748; "P wo Ngxgnu? 5="
37492"'ugngev'wr ecug*QTFGT ++="
37493"'y j gp*(F GUE)+'QTFGT ''? "'F guegpf kpi)="
37494"'y j gp*(CUE)+'QTFGT ''? ")Cuegpf kpi)="
37495"'y j gp*(HO VF GUE)+'QTFGT ''? "'Hqto cwgf 'F guegpf kpi)="
37496"'y j gp*(HO VCUE)+'QTFGT ''? ")Hqto cwgf 'Cuegpf kpi)="
37497"'qvj gty kug'QTFGT ''? ")F guegpf kpi)="
37498"'gpf ="
37499"'qwr w="
3749: "twp="
3749; "'kvng; ")')="

"

374: 2"'rtqe'rtkpv'fcvc?Y QTMlDqquva GXGP V'pqqdu'ncdgn="

374: 3""xct'XCTKCDNG'GXGP V'NGXGN'P WO NGXGNU'QTFGT'NCDGN="

374: 4""kvng; ")')="

374: 5""kvng32'"$" u{uhwpe*ucuo ui *ucuj gnr 0f o kpg.'trva o qf gnGxgpva kvng'"".'P QS WQVG+)$="

374: 6"twp="

374: 7""kvng32="

$P q"f gekukqpu'fghkpgf "hqt "vcti gv"$P gy Vcti gvXctkcdng$0$"

374: 8"'rtqe'rtkpv'fcvc"? 'GO Y U8(Kfu5aP gy Vcti gvXctkcdmFO "pqqdu'ncdgn="

374: 9"'xct'av{rga'xctkcdng'ncdgn="

374: : "'yjgtg"av{rga" kp*'O CVTKZ)'"FGEKUKQP)'"VTCKPRTKQT)'"FCVCRTKQT)'"FGERTKQT)="

374: ; "'ncdgn'aV[RGa"? '"$" u{uhwpe*ucuo ui *ucuj gnr 0f o kpg.'trva v{rga xncdgn""""P QS WQVG+)$" XCTKCDNG"? '"$" u{uhwpe*ucuo ui *ucuj gnr 0f o kpg.'trva xctkcdnga xncdgn'P QS WQVG+)$'NCDGN"? " $" u{uhwpe*ucuo ui *ucuj gnr 0f o kpg.'o gvcancdgm xncdgn'P QS WQVG+$="

374; 2"kvng; ")')="

374; 3""kvng32'"$" u{uhwpe*ucuo ui *ucuj gnr 0f o kpg.'trva r tgfF geXctuakvng'"".'P QS WQVG+)$="

374; 4"twp="

374; 5""kvng32="

374; 6"" ngv'GO GZ EGRVKQP UVTKP I ?="

RGTHQTO CP EG"FGVCKNU"

37: 22"'/// , ="

37: 23"'"Dqquv<I gpgtcvkqp"qh'o cetqu'cpf 'o cetq'xctkcdngu="

37: 24"'"Vq"ugg'yj g"eqf g"i gpgtcvgf .'ugv'yj g'GO aF GDWI "o cetq'xctkcdng'vq "UQWTEG'qt 'aCNNa="

37: 25"'/// , ="

37: 26"" ngv'GO GZ EGRVKQP UVTKP I ?="

37: 27"'/// , ="

37: 28"'"VTCKP <'Dqquv="

37: 29"'/// , ="

37: 2: "" ngv'GO aCEVKQP "? 'VTCKP ="

37: 2; "" ngv'u{uee"? '2="

37: 32"" o cetq'o ckp="

37: 33"

37: 34"""hkngpco g"vgo r "ecvcnqi ")ucuj gnr 0go o qf nlqqduva cetqu0uqwteg)="

37: 35"""" kpenwf g"vgo r ="

37: 36"""hkngpco g"vgo r ="

37: 37"

37: 38"""" ugvRtqr gtvkgu="

37: 39"

37: 3: """ kh" wrecug*(GO aCEVKQP +"? 'ETGCVG" yj gp" f q="

37: 3; """"hkngpco g"vgo r "ecvcnqi ")ucuj gnr 0go o qf nlqqduvaetgcvg0uqwteg)="

37: 42""""" kpenwf g"vgo r ="

37: 43"""""hkngpco g"vgo r ="

37: 44"

37: 45"""" etgcvg="

37: 46""" gpf ="

37: 47"

37: 48""" gnug="

37: 49"""" kh" wrecug*(GO aCEVKQP +"? 'VTCKP " yj gp" f q="

37: 4: "

37: 4; """"""hkngpco g"vgo r "ecvcnqi ")ucuj gnr 0go o qf nlqqduva vckp0uqwteg)="

37: 52""""""" kpenwf g"vgo r ="

37: 53"""""""hkngpco g"vgo r ="

37: 54"""""""" vtckp="

37: 55""""" gpf ="

37: 56"

37: 57""" gnug="

"

```
37: 58"""" kh" wr ecug*( GO aCEVKQP +"?"UEQTG" yj gp" f q="
37: 59""""""hkngpco g"vgo r "ecvcrqi "ucuj gnr (go o qf nldqquvaueqtg0uqwteg)="
37: 5; """"" kpenwf g"vgo r ="
37: 5; """"hkngpco g"vgo r ="
37: 62"
37: 63"""" ueqtg="
37: 64"
37: 65"""" gpf ="
37: 66"
37: 67"""" gnug"
37: 68"""" kh" wr ecug*( GO aCEVKQP +"?"TGRQTV" yj gp" f q="
37: 69"
37: 6: """""""hkngpco g"vgo r "ecvcrqi "ucuj gnr (go o qf nldqquvatgr qrtv0uqwteg)="
37: 6; """""""""" kpenwf g"vgo r ="
37: 72"""""""""hkngpco g"vgo r ="
37: 73"
37: 74""""""""""" tgr qtv="
37: 75""""" gpf ="
37: 76"
37: 77""""" f qgpf o <"
37: 78""" o gpf "o ckp="
37: 79"
37: 7: """ o ckp="
```

P QVG<"   KP ENWF G"*ngxgn'3+'hkng"VGO R "ku'hkng"
UCUJ GNR0GO O QF NDQQUVaO CETQUUQWTEG0'

```
37: 82"- '  o cetq"UgvRrqr gtvkgu="
37: 84"- """"1, 'dqquv'qr vkqpu', 1"
37: 85"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aKVGTCVKQP U.""xcnwg? 72.'i qdcn?[ +="
37: 86"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aVTCKP RTQRQTVKQP .""xcnwg? 82."
i qdcn?[ +="
37: 87"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aECVGI QTKECNDKP U.""xcnwg? 52."
i qdcn?[ +="
37: 88"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aKP VGTXCNDKP U.""xcnwg? 322.'i qdcn?[ +="
37: 89"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aJ WDGT.""xcnwg? P Q.'i qdcn?[ +="
37: 8: "- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aUGGF .""xcnwg? 34567.'i qdcn?[ +="
37: 8; "- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aUJ TKP MCI G.""xcnwg? 20: .'i qdcn?[ +="
37: 92"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aNGCHHTCECVKQP .""xcnwg? 20223."
i qdcn?[ +="
37: 93"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aURNKVUKK G.""xcnwg? 0'i qdcn?[ +="
37: 94"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aP QF GUKK G.""xcnwg? 42222.'i qdcn?[ +="
37: 95"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aUWDUGT KGU.""xcnwg? DGUV.'i qdcn?[ +="
37: 96"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aKVGTCVKQP P WO .""xcnwg? 3.'i qdcn?[ +="
37: 98"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aRTGEKUKQP .""""xcnwg? 2.'i qdcn?[ +="
37: 99"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aO KUUKP I .""""""xcnwg? WUGP UGCTEJ ."
i qdcn?[ +="
37: 9: "- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aO KP ECVUK G.""xcnwg? 7.'i qdcn?[ +="
37: 9; "- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aO CZDTCP EJ .""xcnwg? 4.'i qdcn?[ +="
37: : 2"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aO CZF GRVJ ."""xcnwg? 4.'i qdcn?[ +="
37: : 3"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aTGWUGXCT.""xcnwg? 3.'i qdcn?[ +="
37: : 4"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aGZJ CWUVKXG.""xcnwg? 7222.'i qdcn?[ +="
37: : 5"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aRGTHQTO CP EG.""""xcnwg? F KUM."
i qdcn?[ +="
37: : 7"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aCUUGUUO GCUWTG.""xcnwg? RTQHKV."
i qdcn?[ +="
37: : 8"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aO GCUWTG.""xcnwg? RTQHKV.'i qdcn?[ +="
37: : 9"- """"" go aej gem o cetq*pco g?GO aRTQRGTV[ aP UWTTU.""xcnwg? 2.'i qdcn?[ +="
```

"

37: : : "- """"   go aej gemo cetq*pco g? GO aRTQRGTV[aXCTUGNGEVKQP .'xcnwg? [.''i nqdcn?[+='
37: : 2"- """"   go aej gemo cetq*pco g? GO aRTQRGTV[aQDUKO RQTVCPEG .'xcnwg? P ."
i nqdcn?[+='
37: : 3"- """"   go aej gemo cetq*pco g? GO aRTQRGTV[aP WO UKP I NGKO R .'xcnwg? 7.''i nqdcn?[+='
37: : 4"- """"   go aej gemo cetq*pco g? GO aRTQRGTV[aP WO RCKTKO R .'xcnwg? 2.''i nqdcn?[+='
37: : 6"- ' o gpf "UgvRtqr gtvkgu='
P QVG<' KP ENWF G"*ngxgn'3+'gpf kpi 0'
P QVG<'Hkngtgf 'VGO R'j cu 'dggp''f gcuuki pgf 0'
P QVG<' KP ENWF G"*ngxgn'3+'hkng "VGO R'ku'hkng"
UCUJ GNR'GO O QF NDQQUVaVTCKP 0UQWTEG0'
37: : : "- ' o cetq 'vtckp='
37; 22"- ""'hkngpco g'vgo r 'ecvcnqi '")ucuj gnr (go o qf nldqquvatckpo cetqu0uqwteg)='
37; 23"- "" kpenwf g'vgo r ='
37; 24"- ""'hkngpco g'vgo r ='
37; 26"- "" kh'(GO aKO RQTVaF CVC"gs " yj gp" f q='
37; 27"- """"" ngv'GO GZ EGRVKQP UVTKP I ?"'gzegr vkqp0ugtxgt0KO RQTV0P QVTCN .3='
37; 28"- """"" r ww'(go aeqf gdct='
37; 29"- """"" ngv'gttqto ui "?" u{uhvpe*ucuo ui *ucuj gnr 0o kpg.'gttqtanqf gVtckpTcy F cvtapqvg."
P QS WQVG++='
37; 2: "- """"" r ww'(gttqto ui ='
37; 2; "- """"" r ww'(go aeqf gdct='
37; 32"- """"" i qvq 'f qgpf o ='
37; 33"- "" gpf ='
37; 34"- "" gnug"
37; 35"- """"" ngv'GO GZ EGRVKQP UVTKP I ?='
37; 37"- "" kh"(GO aP WO aVCTI GV'ng'3" yj gp" f q='
37; 38"- """"" ngv'GO GZ EGRVKQP UVTKP I ?"'gzegr vkqp0ugtxgt0WUG3VCTI GV='
37; 39"- """"" r ww'(go aeqf gdct='
37; 3: "- """"" ngv'gttqto ui "?" u{uhvpe*ucuo ui *ucuj gnr 0o kpg."o cvf cvc0uug23vcti gvagtt."
P QS WQVG++='
37; 3; "- """"" r ww'(gttqto ui ='
37; 42"- """"" r ww'(go aeqf gdct='
37; 43"- """"" i qvq 'f qgpf o ='
37; 44"- "" gpf ='
37; 46"- "" ngv'vcti gvangxgn'? " GO aVCTI GVaNGXGN='
37; 47"- "" ngv'vcti gvaxct "? " GO aVCTI GV='
37; 49"- "" kh'*$(vcti gvaNgxgn$'ng'$KP VGTXCN$'+" yj gp" f q='
37; 4: "- """"" go adqquvao cngFO F D*kpf cvc?(GO aKO RQTVaF CVC.'vcti gv?(vcti gvaXct."
37; 4; "- """"""""""""""""""""pNgxgn? apVcti gvNgxgn='
37; 52"- "" gpf ='
37; 54"- ""'l, 'ej gem'cewcrl'pwo "qh'vcti gv'ngxgnu'", 1"
37; 55"- "" kh'*(vcti gvaNgxgn'gs 'DKP CT[+" yj gp" f q='
37; 56"- """"" kh'(apVcti gvNgxgn"@4" yj gp" f q='
37; 57"- """"" ngv'GO GZ EGRVKQP UVTKP I ?"
gzegr vkqp0ugtxgt0O GVCF CVC0Y TQP I VCTI GVNGXGN.(vcti gvaXct='
37; 58"- """"" r ww'(go aeqf gdct='
37; 59"- """"" ngv'gttqto ui "?" u{uhvpe*ucuo ui *ucuj gnr 0o kpg."o gvf cvc0y tqpi vcti gvngxgn"
P QS WQVG++='
37; 5: "- """"" r ww'(gttqto ui ='
37; 5; "- """"" r ww'(go aeqf gdct='
37; 62"- """"" i qvq 'f qgpf o ='
37; 63"- """" gpf ='
37; 64"- "" gpf ='
37; 66"- "" kh'*(GO aP WO aKP VGTXCNaKP RWV'>'3+'cpf '*(GO aP WO aDKP CT[aKP RWV'>'3+'
cpf '*(GO aP WO aQTF KP CNaKP RWV'>'3+'
37; 67"- """"""cpf '*(GO aP WO aP QO KP CNaKP RWV'>'3+" yj gp" f q='

"

37; 68"- """"""" ngv'GO GZ EGRVKQP UVTKP I "? "gzegr vkqp0ugtxgt0WUGCVNGCUV3KP RWWTGLGEV="
37; 69"- """"""" rww'(go aeqf gdct="
37; 6: "- """"""" ngv'gttqto ui "? " u{uhwpe*ucuo ui *ucuj grr 0fo kpg."gttqtanqKprwapqvg."
PQSWQVG++="
37; 6; "- """"""" rww'(gttqto ui ="
37; 72"- """"""" rww'(go aeqf gdct="
37; 73"- """"""" i qvq'f qgpfo ="
37; 74"- """ gpf ="
37; 76"- """1, "Kpkvkcnk{g'rtqrgrv{'o cetq'vctkcdngu", 1"
37; 77"- """ UgvRtqr gtvkgu="
37; 79"- """1, 'f cvc'ugu', 1"
37; 7: "- """ GO aI GVP CO G*mg{?O QF GN."v{r g?F CVC+="
37; 7; "- """ GO aI GVP CO G*mg{?KO RQTVCP EG."v{r g?F CVC+="
37; 82"- """ GO aI GVP CO G*mg{?UWDHKV."v{r g?F CVC+="
37; 83"- """ GO aI GVP CO G*mg{?GO QWVHKV."v{r g?F CVC+="
37; 85"- """1, "hkngu"
37; 86"- """ GO aI GVP CO G*mg{?DKP N KP I EQF G."v{r g?HKNG."gzvgpukqp?ucu=, 1"
37; 88"- """1, "tgvtkgxg'vcti gv'kphqro cvkqp", 1"
37; 89"- """ ngv'fukf?' u{uhwpe*qrgp'(GO aF GEaF GEO GVC*y j gtg?'aV[RGa?)VCTI GV)+++="
37; 8; "- """ ngv'xpagxgpv'?' u{uhwpe*xctpwo *(fukf."GXGP V++="
37; 92"- """ ngv'xpavcti gvav{r g"? " u{uhwpe*xctpwo *(fukf."V[RG++="
37; 93"- """ ngv'xpavcti gvahqro cv'?" u{uhwpe*xctpwo *(fukf."HQTO CV++="
37; 94"- """ ngv'xpavcti gvangxgn"?" u{uhwpe*xctpwo *(fukf."NGXGN++="
37; 95"- """ f q" y j kng* " u{uhwpe*hgvej *(fukf ++="
37; 96"- """"""" ngv'vgo r "? " ptdswqvg* u{uhwpe*i gvxcte*(fukf."(xpagxgpv++="
37; 97"- """"""" ngv'Vcti gvaGxgpv'?" ptdswqvg* u{uhwpe*trcpy tf*(vgo r." uvt* $+.$$++="
37; 98"- """"""" ngv'Vcti gvaV{r g"?"" u{uhwpe*i gvxcte*(fukf."(xpavcti gvav{r g++="
37; 99"- """"""" ngv'Vcti gvaHqro cv'?" u{uhwpe*i gvxcte*(fukf."(xpavcti gvahqro cv++="
37; 9: "- """"""" ngv'Vcti gvaNgxgn'?" u{uhwpe*i gvxcte*(fukf."(xpavcti gvangxgn++="
37; 9; "- """ gpf ="
37; : 2"- """ ngv'fukf "? " u{uhwpe*enquge*(fukf ++="
37; : 4"- """1, "kh'vcti gv'ngxgn'ku'QTF KP CN."vj tqy 'twp'vko g'gzegr vkqp'//'r tqce'dqquv'f qgu'pqv'uwr r qtv'
qtf kpcn'vcti gv", 1"
37; : 5"- """ kh'(Vcti gvaNgxgn'gs "QTF KP CN" vj gp" f q="
37; : 6"- """"""" ngv'GO GZ EGRVKQP UVTKP I "? "
gzegr vkqp0ugtxgt0O GVCF CVC0KP XCNKF QTF KP CNVCTI GV="
37; : 7"- """"""" rww'(go aeqf gdct="
37; : 8"- """"""" ngv'gttqto ui "? " u{uhwpe*ucuo ui *ucuj grr 0fo kpg."gttqtaikpxcnkf qtf kpcnvci gvanqvg."
PQSWQVG++="
37; : 9"- """"""" rww'(gttqto ui ="
37; : : "- """"""" rww'(go aeqf gdct="
37; : ; "- """"""" i qvq'f qgpfo ="
37; ; 2"- """ gpf ="
37; ; 4"- """1, "kh'uwdUgtkgu?KVGTCVKQP U'cpf 'kvgtcvkqpN wo 'pqv'ur gekhkgf ."gzegr vkqp'uj qwnf 'dg"
vj tqy p", 1"
37; ; 5"- """ kh'**(GO aRTQRGTV[aUWDUGTKGU'gs "KVGTCVKQP U+'cpf "
*(GO aRTQRGTV[aKVGTCVKQP N WO 'gs '0++" vj gn" f q="
37; ; 6"- """"""" ngv'GO GZ EGRVKQP UVTKP I "? "
gzegr vkqp0ugtxgt0GO VQQN DQQUV0P QKVGTCVKQP N WO ="
37; ; 7"- """"""" rww'(go aeqf gdct="
37; ; 8"- """"""" ngv'gttqto ui "? " u{uhwpe*ucuo ui *ucuj grr 0fo kpg."gttqtanqkvgtcvkqppwo anqvg."
PQSWQVG++="
37; ; 9"- """"""" rww'(gttqto ui ="
37; ; : "- """"""" rww'(go aeqf gdct="
37; ; ; "- """"""" i qvq'f qgpfo ="
38222"- """ gpf ="

3; ; "

38224"- """ twpDqqunRtqegfwtg="
38227"- """ fqgpfo <"
38228"- ' o gpf "vtckp="
P QVG<" KP ENWFG "*ngxgn'3+'gpfkpi 0'
P QVG<"Hkngtgh "VGO R"j cu'dggp'f gcuuki pgf 0'
P QVG<" KP ENWFG "*ngxgn'3+'hkng"VGO R"ku'hkng"
UCUJ GNR0GO O QF NDQQUVaVTCP O CETQUUQWTEG0'

38229"- ' O cetq"go adqqunao cmgF O F D*kpf cvc? . "\cti gv? . "pNgxgn? "+="
3822:"- """ i mqdcrl'(pNgxgn="
38232"- """ ngV'cti gvNgxgn?="
38233"- "f cvc"apwnm="
38234"- """"ngpi yj "qtfgtUvtkpi "&86="
38235"- """"ugv'(go af cvaxctkcdngugv'gpf ? gqh="
38236"- """"yj gtg'P CO G? $(cti gV$="
38237"- """"ugngev*qtfgt+="
38238"- """""""""yj gp*)+"""""qtfgt"?)F GUE)="
38239"- """"""""yj gp*HO VCUE)+"qtfgt?)CUEHO V)="
3823:"- """"""""yj gp*HO VF GUE)+'qtfgt?)F GUHO V)="
3823;"- """"""""qvj gty kug="
38242"- """"gpf ="
38243"- """"kh'gqh'yj gp'f q="
38244"- """""""ecml'u{o rw*$vcti gvQtfgt$. "vtko *qtfgt++="
38245"- """""""ecml'u{o rw*$vcti gvNgxgn$. "vtko *Ngxgn++="
38246"- """"gpf ="
38247"- "twp="
38249"- "" kh'$(cti gvNgxgn$'pg'$KP VGTXCN$" yj gp" f q="
3824:"- "rtqe'fo f d"dcvej "f cvc?(kpf cvc'fo fEcv?aDqqunFO F D"
3824;"- """encuuqw?avo r af o fdqw="
38252"- """encuu'(cti gv*(cti gvQtfgt+="
38253"- """\cti gV'(cti gv="
38254"- "twp="
38255"- "f cvc"avo r af o fdqw="
38256"- """ugv'avo r af o fdqw="
38257"- """"kh'uvtkr *V[RG+? "")P)'cpf "uvtkr *NGXGN+? ")0)'yj gp'f gngvg="
38258"- """"kh'uvtkr *V[RG+? "")E)'cpf "uvtkr *NGXGN+? ")))'yj gp'f gngvg="
38259"- "twp="
3825:"- "f cvc"apwnm="
3825;"- """ ngV'fukf "? " u{uhwpe*qr gp*y qtm0avo r af o fdqw++="
38262"- """ ngV'aqdu"? " u{uhwpe*cwtp*(fukf .'P QDU++="
38263"- """ ngV'fukf "? " u{uhwpe*encug*(fukf ++="
38264"- """"ecml'u{o rw*$(pNgxgn$.'rw*(aqdu."Dguv340++="
38265"- "twp="
38267"- "rtqe'f cvcugu'nkd? w qtm'pqnkuv="
38268"- """"f gngvg"avo r af o fdqw="
38269"- "twp="
3826:"- "s wkv="
3826;"- "" gpf ="
38273"- ' O gpf "go adqqunao cmgF O F D="
38275"- ' o cetq'twpDqqunRtqegfwtg="
38277"- "rtqe'us n="
38278"- """tgugv'pqr tkpv="
38279"- """"ugngev'eqwpv*, +'kpvq "pqdu'htqo "(GO aKO RQTVaF CVC="
3827:"- "s wkv="
38282"- "" ngV'ctdqtmwi g? '$y qtm0aDqqunFO F D$="
38283"- "rtqe'ctdqt'rtqe? vtggdqqun'f cvc?(GO aKO RQTVaF CVC"
38285"- """" kh'(GO aRTQRGTV[aKVGTCVKQP U'pg" yj gp" f q="

"

38286"- """"kvgtcvkqpu"? '(GO aRTQRGTV[aKVGTCVKQP U"
38287"- """ gpf ="
38289"- """ kh'(GO aRTQRGTV[aVTCKP RTQRQTVKQP "pg" yj gp" f q="
3828:"- """""" ngv'vtqr "? " u{ugxcrh*(GO aRTQRGTV[aVTCKP RTQRQTVKQP "l'322+="
3828;"- """"""vtckp rtqr qrvkqp"? '(vr tqr "
38292"- """ gpf ="
38294"- """ kh'(GO aRTQRGTV[aUGGF "pg" yj gp" f q="
38295"- """"""uggf "? '(GO aRTQRGTV[aUGGF "
38296"- """ gpf ="
38298"- """ kh'(GO aRTQRGTV[aUJ TKP MCI G"pg" yj gp" f q="
38299"- """"""uj tkpmci g"? '(GO aRTQRGTV[aUJ TKP MCI G"
3829:"- """ gpf ="
382:2"- """ kh'(GO aRTQRGTV[aNGCHHTCEVKQP "pg" yj gp" f q="
382:3"- """"""ngchhtcevkqp"? '(GO aRTQRGTV[aNGCHHTCEVKQP "
382:4"- """ gpf ="
382:6"- """ ngv'urrkuk{ g"? '(GO aRTQRGTV[aURNKVUK{ G="
382:7"- """ kh'(urrkuk{ g'i g'(pqdu" yj gp" f q="
382:8"- """""" ngv'urrkuk{ g? '0="
382:9"- """ gpf ="
382::"- """ kh'(urrkuk{ g'pg'0" yj gp" f q="
382:;"- """"""urrkuk{ g"? '(urrkuk{ g"
382;2"- """ gpf ="
382;4"- """ kh'(GO aRTQRGTV[aO KP ECVUK{ G'pg" yj gp" f q="
382;5"- """"""o kpecvuk{ g"? '(GO aRTQRGTV[aO KP ECVUK{ G"
382;6"- """ gpf ="
382;8"- """ kh'(GO aRTQRGTV[aO CZDTCP EJ "pg" yj gp" f q="
382;9"- """"""o czdtcpej "? '(GO aRTQRGTV[aO CZDTCP EJ "
382;:"- """ gpf ="
38322"- """ kh'(GO aRTQRGTV[aO CZF GRVJ "pg" yj gp" f q="
38323"- """"""o czf gr yj "? '(GO aRTQRGTV[aO CZF GRVJ "
38324"- """ gpf ="
38326"- """ ngv'puwttu"? '="
38327"- """ kh'(GO aRTQRGTV[aP UWTTU'pg" yj gp" f q="
38328"- """""" ngv'pwo Kpr wu"? '" u{ugxcrh*(GO aP WO aDKP CT[aKP RWV"- "
(GO aP WO aQTF KP CNaKP RWV"- '(GO aP WO aKP VGTXCNaKP RWV"- "
(GO aP WO aP QO KP CNaKP RWV+="
38329"- """""" ngv'puwttu"? " u{ugxcrh* u{uhwpe*o kp*(GO aRTQRGTV[aP UWTTU."*(pwo Kpr wu"
/3"+++="
3832:"- """""o czuwttu"? '(puwttu"
3832;"- """ gpf ="
38333"- """ kh'(GO aRTQRGTV[aO KUUKP I "pg" yj gp" f q="
38334"- """""O kuukpi "? '(GO aRTQRGTV[aO KUUKP I "
38335"- """ gpf ="
38337"- """ kh'(GO aRTQRGTV[aTGWUGXCT"pg" yj gp" f q="
38338"- """"""tgwugxct"? '(GO aRTQRGTV[aTGWUGXCT "
38339"- """ gpf ="
3833:"- 1, "
3833;"- """ kh'(GO aRTQRGTV[aRTGEKUKQP "pg" yj gp" f q="
38342"- """"""kpvgtxcnf geko cn? '(GO aRTQRGTV[aRTGEKUKQP "
38343"- """ gpf ="
38344"- , 1"
38345"- """ kh'(GO aRTQRGTV[aGZJ CWUVKXG'pg" yj gp" f q="
38346"- """"""Gzj cwukxg"? '(GO aRTQRGTV[aGZJ CWUVKXG"
38347"- """ gpf ="
38349"- """ kh'(Vcti gvaGxgpv'pg" yj gp" f q="
3834:"- """"""Gxgpv? $(Vcti gvaGxgpv$"

"

```
3834; "- """  gpf ="
38353"- """  kh'( GO aRTQRGTV[ aECVGI QTKECNDKPU'pg"  yjgp"  fq="
38354"- """"Ecvgiqtkecn.Dkpu"?"( GO aRTQRGTV[ aECVGI QTKECNDKPU"
38355"- """  gpf ="
38357"- """  kh'( GO aRTQRGTV[ aKPVGTXCNDKPU'pg"  yjgp"  fq="
38358"- """"Kpvgtxcn.Dkpu"?"( GO aRTQRGTV[ aKPVGTXCNDKPU"
38359"- """  gpf ="
3835; "- """  kh'( VCTI GVaNGXGN"gs "KPVGTXCN"  yjgp"  fq="
38362"- """"  kh'( GO aRTQRGTV[ aJWDGT"pg"  yjgp"  fq="
38363"- """"""J wdgt?( GO aRTQRGTV[ aJWDGT"
38364"- """"  gpf ="
38365"- """  gpf ="
38366"- """="
38368"- """  kh" GO aKPVGTXCNaKPRWV" GO aKPVGTXCNaTGLGEVGF "pg"  yjgp"  fq="
38369"- """"kprww"  GO aKPVGTXCNaKPRWV"  GO aKPVGTXCNaTGLGEVGF l'ngxgn'?"kpvgtxcn="
3836: "- """  gpf ="
38372"- """  kh" GO aDKPCT[ aKPRWV"  GO aP QO KPCNaKPRWV"
'  GO aDKPCT[ aTGLGEVGF "  GO aP QO KPCNaTGLGEVGF "pg""  yjgp"  fq="
38373"- """"kprww"  GO aDKPCT[ aKPRWV"  GO aDKPCT[ aTGLGEVGF "
'  GO aP QO KPCNaKPRWV"  GO aP QO KPCNaTGLGEVGF "l'ngxgn'?"pqo kpcn="
38374"- """  gpf ="
38376"- """  kh" GO aQTFKPCNaKPRWV"  GO aQTFKPCNaTGLGEVGF "pg"  yjgp"  fq="
38377"- """"kprww"  GO aQTFKPCNaKPRWV"  GO aQTFKPCNaTGLGEVGF l'ngxgn'?"qtfkpcn="
38378"- """  gpf ="
3837: "- """  kh" GO aHTGS "pg"  yjgp"  fq="
3837; "- """"htgs"  GO aHTGS ="
38382"- """  gpf ="
38384"- """"vctigv"  GO aVCTI GV"l'ngxgn'?"( VCTI GVaNGXGN="
38386"- """( GO aFGEaUVCVGO GPV="
38388"- """  kh'( GO aRTQRGTV[ aRGTHQTO CPEG'pg"  yjgp"  fq="
38389"- """"rgthqto cpeg"'y qtnfcvcnqecvkqp"?"( GO aRTQRGTV[ aRGTHQTO CPEG"
3838: "- """  gpf ="
3838; "- """  kh'( GO aRTQRGTV[ aP QFGUK[G'pg"  yjgp"  fq="
38392"- """"pqfguk|g"?"( GO aRTQRGTV[ aP QFGUK[G"
38393"- """  gpf ="
38394"- """="
38395"- """ucxg"o qfgn?( GO aWUGTaO QFGN="
38396"- "twp="
38397"- "s wkv="
38398"- ""  go aej gemgttqt*+="
3839: "- '  o gpf "twpDqquuRtqegfwtg="
PQVG<"  KPENWFG"*ngxgn'3+"gpfkpi 0'
PQVG<"Hkngtgh"VGO R'jcu"dggp"fgcuuk pgf 0'
PQVG<"Xctkcdng"qtfgtUvtkpi "ku"wpkpkkcrk|gf 0'
PQVG<"Vjgtg"y gtg"3"qdugtxcvkqpu"tgcf "htqo "yjg"fcvc"ugv"GO Y U8(DQQUVaXCTKCDNGUGV0'
"""""Y J GTG"PCO G? )P gy Vcti gvXctkcdng)="
PQVG<"FCVC"uvcvgo gpv"wugf "*Vqvcn'r tqeguu"vko g+<"
"""""o go qt{"""""""""""525870, 8m'
"""""QU'O go qt{"""""""""62: 2: 0,22m'
"""""Vko guvco r """"""""29l3814243'29<5; <74'CO "
"""""Ugr "Eqwpv""""""""""""""3"Uy kej "Eqwpv"2"
"""""Rci g'Hcwnu""""""""""""""2"
"""""Rci g'Tgercko u"""""""""""83"
"""""Rci g'Uy cr u""""""""""""""2"
"""""Xqnwpct{'Eqpvgzv'Uy kej gu"""""3"
"""""Kpxqnwpvct{'Eqpvgzv'Uy kej gu"""""2"
```

"

"""""Dnqem"Kpr w"Qr gtcvkqpu"""""""""""2"
"""""Dnqem"Qwr w"Qr gtcvkqpu""""""""""2"
'"'
P QVG‹"Tgeqtfu"r tqeguugf "? '7768""O go qr {"wugf "? '733M0'
P QVG‹"Vj gtg"y gtg '7768"qdugtxcvkqpu"tgcf "htqo "vj g"fcvc"ugv"GO Y U8RCT Va VTCP 0'
P QVG‹"Vj g"fcvc"ugv"Y QTM0a VO RaF O F DQWV"j cu"5"qdugtxcvkqpu"cpf "; "xctkcdngu0'
P QVG‹"RTQEGF WTG"F O F D"wugf "*Vqvcn'r tqeguu"vko g+‹"
"""""tgcn'vko g""""""""""2027"ugeqpfu"
"""""wugt"er w"vko g"""""2023"ugeqpfu"
"""""u{uvgo "er w"vko g"""""2027"ugeqpfu"
"""""o go qr {"""""""""525870, 8m'
"""""QU'O go qr {""""""""64298022m'
"""""Vko guvco r """"""292 13 814243"29-5; ⊲74'CO "
"""""Ugr "Eqwpv""""""""""""""""""3 "Uy kej "Eqwpv"2"
"""""Rci g"Hcwnu""""""""""""""""""2 "
"""""Rci g"Tgercko u""""""""""""""""658"
"""""Rci g"Uy cr u""""""""""""""""""2 "
"""""Xqnwpvct{"Eqpvgzv"Uy kej gu""""""""6 "
"""""Kpxqnwpvct{"Eqpvgzv"Uy kej gu"""""2"
"""""Dnqem"Kpr w"Qr gtcvkqpu"""""""""""2"
"""""Dnqem"Qwr w"Qr gtcvkqpu""""""""""542"
'"'
P QVG‹"Vj gtg"y gtg "5"qdugtxcvkqpu"tgcf "htqo "vj g"fcvc"ugv"Y QTM0a VO RaF O F DQWV0'
P QVG‹"Vj g"fcvc"ugv"Y QTM0a VO RaF O F DQWV"j cu"5"qdugtxcvkqpu"cpf "; "xctkcdngu0'
P QVG‹"F CVC"uvcvgo gpv"wugf "*Vqvcn'r tqeguu"vko g+‹"
"""""tgcn'vko g""""""""""2022"ugeqpfu"
"""""wugt"er w"vko g"""""2022"ugeqpfu"
"""""u{uvgo "er w"vko g"""""2023"ugeqpfu"
"""""o go qr {""""""""""""525870, 8m'
"""""QU'O go qr {""""""""64298022m'
"""""Vko guvco r """"""292 13 814243"29-5; ⊲74'CO "
"""""Ugr "Eqwpv""""""""""""""""""3 "Uy kej "Eqwpv"2"
"""""Rci g"Hcwnu""""""""""""""""""2 "
"""""Rci g"Tgercko u"""""""""""""""349"
"""""Rci g"Uy cr u""""""""""""""""""2 "
"""""Xqnwpvct{"Eqpvgzv"Uy kej gu""""""""2 "
"""""Kpxqnwpvct{"Eqpvgzv"Uy kej gu"""""2"
"""""Dnqem"Kpr w"Qr gtcvkqpu"""""""""""2"
"""""Dnqem"Qwr w"Qr gtcvkqpu"""""""""""486"
'"'
P QVG‹"F CVC"uvcvgo gpv"wugf "*Vqvcn'r tqeguu"vko g+‹"
"""""tgcn'vko g""""""""""2022"ugeqpfu"
"""""wugt"er w"vko g"""""2022"ugeqpfu"
"""""u{uvgo "er w"vko g"""""2022"ugeqpfu"
"""""o go qr {""""""""""""525870, 8m'
"""""QU'O go qr {""""""""64298022m'
"""""Vko guvco r """"""292 13 814243"29-5; ⊲74'CO "
"""""Ugr "Eqwpv""""""""""""""""""3 "Uy kej "Eqwpv"2"
"""""Rci g"Hcwnu""""""""""""""""""2 "
"""""Rci g"Tgercko u""""""""""""""""7: "
"""""Rci g"Uy cr u""""""""""""""""""2 "
"""""Xqnwpvct{"Eqpvgzv"Uy kej gu""""""""2"
"""""Kpxqnwpvct{"Eqpvgzv"Uy kej gu"""""2"
"""""Dnqem"Kpr w"Qr gtcvkqpu"""""""""""2"
"""""Dnqem"Qwr w"Qr gtcvkqpu"""""""""""2"
'"'

"

P Q VG‹"F grgvkpi "Y QTM0‹VO RaF O F DQWV"*‰o go v{ r g? F CVC+0'
'''
P Q VG‹"RTQEGF WTG"F CVCUGVU"wugf "*Vqvcri'rtqeguu"wko g+‹
"""""tgcri'wko g""""""""""2022"ugeqpfu"
"""""wugt "er w'wko g""""""2022"ugeqpfu"
"""""u{uvgo "er w'wko g"""""2022"ugeqpfu"
"""""o go qt{"""""""""""""525870,8m'
"""""QU'O go qt{"""""""""64298022m'
"""""Vko guvco r """"""""""2913814243'29‹5; ⊲74'CO "
"""""Uvgr "Eqwpv""""""""""""""3 "Uy kej "Eqwpv"2"
"""""Rci g'Hcwnu"""""""""""""""""2"
"""""Rci g'Tgercko u""""""""""""""7; "
"""""Rci g'Uy cr u"""""""""""""""2"
"""""Xqnwpvct{'Eqpvgzv'Uy kej gu"""""""2"
"""""Kpxqnwpvct{'Eqpvgzv'Uy kej gu"""""2"
"""""Dnqem'Kpr w'Qr gtcvkqpu"""""""""""2"
"""""Dnqem'Qwvr w'Qr gtcvkqpu""""""""": "
'''
P Q VG‹"RTQEGF WTG"US N'wugf "*Vqvcri'rtqeguu"wko g+‹
"""""tgcri'wko g""""""""""2022"ugeqpfu"
"""""wugt "er w'wko g""""""2022"ugeqpfu"
"""""u{uvgo "er w'wko g"""""2022"ugeqpfu"
"""""o go qt{"""""""""""""558; 5065m'
"""""QU'O go qt{"""""""""67; 54022m'
"""""Vko guvco r """"""""""2913814243'29‹5; ⊲74'CO "
"""""Uvgr "Eqwpv""""""""""""""3 "Uy kej "Eqwpv"2"
"""""Rci g'Hcwnu"""""""""""""""""2"
"""""Rci g'Tgercko u""""""""""""""6: 5"
"""""Rci g'Uy cr u"""""""""""""""2"
"""""Xqnwpvct{'Eqpvgzv'Uy kej gu"""""""6"
"""""Kpxqnwpvct{'Eqpvgzv'Uy kej gu"""""2"
"""""Dnqem'Kpr w'Qr gtcvkqpu"""""""""""2"
"""""Dnqem'Qwvr w'Qr gtcvkqpu""""""""""2"
'''
'''
P Q VG‹"5544: 56"nknqd{vgu"qh'r j {ukecn'o go qt{0'
P Q VG‹"Y km'wug'7768"qw'qh'7768"vtckpkpi "ecugu0'
P Q VG‹"Wukpi "o go qt{"r qqr'y kj "476257; 8: "d{vgu0'
P Q VG‹"Rcuugf "vtckpkpi "f cvc"; 2"wko gu0'
P Q VG‹"Ewttgpv'VTGGDQQUV"o qf gn'eqpvckpu'32"vgto u'y kj "c"vqvcri'qh'52"vtggu0'
P Q VG‹"Vtckpkpi "wugf "8424782"d{vgu'qh'y qtm'o go qt{0'
P Q VG‹"Vj g'f cvc"ugv'GO Y U80DQQUVaO QF GN'j cu'6888; "qdugtxcvkqpu'cpf "6"xctkcdngu0'
'''
P Q VG‹"Vj gtg'y gtg'7768"qdugtxcvkqpu'tgcf "htqo "vj g'f cvc"ugv'GO Y U80RCTVaVTCKP 0'
P Q VG‹"RTQEGF WTG"CTDQT"wugf "*Vqvcri'rtqeguu"wko g+‹
"""""tgcri'wko g""""""""": 56"ugeqpfu"
"""""wugt "er w'wko g""""""6084"ugeqpfu"
"""""u{uvgo "er w'wko g"""""5092"ugeqpfu"
"""""o go qt{"""""""""""""4: 6246022m'
"""""QU'O go qt{"""""""""4; 8294022m'
"""""Vko guvco r """"""""""2913814243'29‹62⊲22'CO "
"""""Uvgr "Eqwpv""""""""""""""3 "Uy kej "Eqwpv"2"
"""""Rci g'Hcwnu"""""""""""""""""2"
"""""Rci g'Tgercko u"""""""""""""""5554"
"""""Rci g'Uy cr u"""""""""""""""2"
"""""Xqnwpvct{'Eqpvgzv'Uy kej gu"""""""7: "

"

""""""Kpxqnwpct{''Eqpvgzv'Uykej gu""""""36"
""""""Dnqem'Kpr w'Qr gtcvkqpu"""""""""54"
""""""Dnqem'Qwr w'Qr gtcvkqpu"""""""""5: 6: "
""

383: 3"" ngv'U[UEE"? "2="
P QVG<"RTQEGF WT G"F KURNC["wugf "*Vqvcn'r tqeguu'\ko g+<"
""""""tgcn'\ko g""""""""""2022'ugeqpf u"
""""""wugt''er w'\ko g"""""2022'ugeqpf u"
""""""u{uvgo ''er w'\ko g"""""2022'ugeqpf u"
""""""o go qt{''""""""""""4: 6246022m'
""""""QU'O go qt{'""""""""""4; 8294022m'
""""""Vko guvco r ''""""""""29 13814243'29<62<22'CO "
""""""Uvgr ''Eqwpv""""""""""""""""""""3 "Uykej 'Eqwpv'3"
""""""Rci g'Hcwnu""""""""""""""""""""2 "
""""""Rci g'Tgercko u""""""""""""""""""69"
""""""Rci g'Uy cr u""""""""""""""""""""2 "
""""""Xqnwpct{''Eqpvgzv'Uykej gu""""""3"
""""""Kpxqnwpct{''Eqpvgzv'Uykej gu""""""2"
""""""Dnqem'Kpr w'Qr gtcvkqpu"""""""""2"
""""""Dnqem'Qwr w'Qr gtcvkqpu"""""""""2"
""'
""'
383: 4""', /// , ="
383: 5""', 'Gpf ''VT CKP <'Dqqqwv="
383: 6""', /// , ="

"

Appendix G

"
Tcpfqo "Hqtguv'Pqfg"UCUⁱ "Eqfg"

' o cetq"go aj rhuvaueqtg="

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, ///, ="

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ar a? "2'="

f tqr "ar a'="

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WaP gy Vcti gvXctkcdng? 4="

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Appendix H

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""""""""""""""""/2o2447'>?'EcdkpChgevgf "CP F "

"""""EcdkpChgevgf ">""""""""""""/2o2225'VJ GP 'F Q="

"""""aP QF Ga""?"""""""""""""""62="

"""""aNGCHa""?"""""""""""""""36="

"""""RaP gy Vcti gvXctkcdrg3""?"""""""""""""""2="

"""""RaP gy Vcti gvXctkcdrg4""?"""""2o 45298; 45298; 4="

"

""""RaP gy Vcti gvXctkcdrg5""? """"20298; 45298; 4529="

"""""S aP gy Vcti gvXctkcdrg3""? """"""""""""""""""2="

"""""S aP gy Vcti gvXctkcdrg4""? """"20 45298; 45298; 4="

"""""S aP gy Vcti gvXctkcdrg5""? """"20298; 45298; 4529="

"""""XaP gy Vcti gvXctkcdrg3""? """"""""""""""""""2="

"""""XaP gy Vcti gvXctkcdrg4""? """"208888888888888="

"""""XaP gy Vcti gvXctkcdrg5""? """"205555555555555="

"""""KaP gy Vcti gvXctkcdrg""? ")4)'="

"""""WaP gy Vcti gvXctkcdrg""? """"""""""""""""""4="

"""""GP F ="

""GNUG'F Q="

"""""aP QF Ga""? """"""""""""""""63="

"""""aNGCHa""? """"""""""""""""37="

"""""RaP gy Vcti gvXctkcdrg3""? """"""""""""""""2="

"""""RaP gy Vcti gvXctkcdrg4""? """"""""""""""20447="

"""""RaP gy Vcti gvXctkcdrg5""? """"""""""""""20997="

"""""S aP gy Vcti gvXctkcdrg3""? """"""""""""""""2="

"""""S aP gy Vcti gvXctkcdrg4""? """"""""""""""20447="

"""""S aP gy Vcti gvXctkcdrg5""? """"""""""""""20997="

"""""XaP gy Vcti gvXctkcdrg3""? """"""""""""""""2="

"""""XaP gy Vcti gvXctkcdrg4""? """"204; : 298; 45298; 4="

"""""XaP gy Vcti gvXctkcdrg5""? """"20923; 45298; 4529="

"""""KaP gy Vcti gvXctkcdrg""? ")5)'="

"""""WaP gy Vcti gvXctkcdrg""? """"""""""""""""5="

"""""GP F ="

"""GP F ="

"GP F ="

GNUG'F Q="

"

```
_NODE_  =              2;

_LEAF_  =              1;

P_NewTargetVariable1  =              1;

P_NewTargetVariable2  =              0;

P_NewTargetVariable3  =              0;

Q_NewTargetVariable1  =              1;

Q_NewTargetVariable2  =              0;

Q_NewTargetVariable3  =              0;

V_NewTargetVariable1  =    0.99932975871313;

V_NewTargetVariable2  =    0.00067024128686;

V_NewTargetVariable3  =              0;

I_NewTargetVariable  = '1' ;

U_NewTargetVariable  =              1;

END;

 ************************************************************;

******        END OF DECISION TREE SCORING CODE        ******;

 ************************************************************;


drop _LEAF_;
```