Understanding the Incidents on Legacy Airlines with Machine Learning: Case Study Top 5 US Airlines

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Background

- The air transportation system is part of most nations critical infrastructure
- Rigorous safety standards are effective; however minor accidents/incidents are somewhat frequent in comparison to major accidents even with standards in place
- There are known patterns pilots see anecdotally; but the data must be analyzed
- Incident have a substantial cost to the airlines, raise ticket prices, erode consumer confidence, and generate insurance claims
- Modeling minor accidents to identify causal and contributing data stands to save the industry substantial costs and increase margins

Literature

Main Relevant Research Problems

qualitative/quantitative approaches to detect anomalous aircraft behavior (Hwang et al, 2008)

assess the safety, and quantify the risk associated

causal models, collision risk models, human error models, and third-party risk models (Netjasov and Janic, 2008)

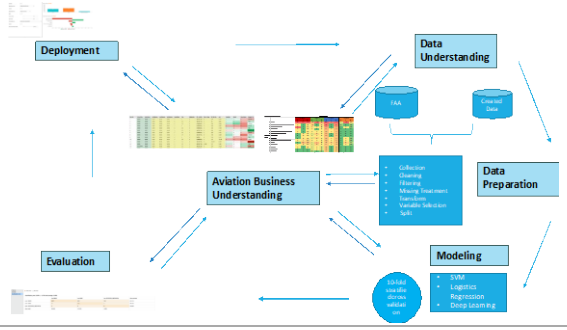
automatically detect flight trajectory anomalies (Di Ciccio et al, 2016)

A hybrid model blending SVM and DNN ensemble prediction for aviation incidents (Zhang et al. 2019)

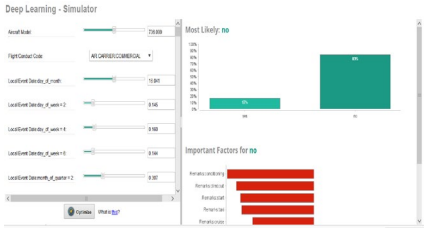
Gap: Predicting Incident Damage Type and Impacting Variables is not addressed

Solution Model

Criterion	Value	Standard Deviation
accuracy	0.994	0.003
classification_error	0.006	0.003
AUC	0.991	0.014
precision	1.0	0.0
recall	0.928	0.041
f_measure	0.962	0.022
sensitivity	0.928	0.041
specificity	1.0	0.0



Results



Results

	Method Accuracy		
	Deep Learning	Logistic Regression	SVM
Accuracy	**99.4**	97.1	100
Class Recall	**92.7**	64.4	100
AUC	**0.99**	0.87	1

Results

Table 1: Text Mining Important Terms

Term Cutoff	Topic	Topic ID
0.051	+flight attendant, +attendant, flight, +injure, turbulence	1
0.053	+engine, fire, evacuation, takeoff, NR2	2
0.056	aircraft, +crew, landing, +report, emergency	3
0.05	+seat, +belt, +seat belt, +sign, +sign	4
0.049	clear, air turbulence, air, turbulence, +encounter	5
0.053	+fall, overhead, bin, +passenger, +open	6
0.055	cart, +door, +service, service cart, galley	7
0.051	people, +injure, turbulence, fire, +encounter	8

Conclusions

- Minor damages category can be significantly predicted
- Weights by correlations define the essential variables in prediction for minor damages.
- The relations between variable is meaningful for SME

References: Anbil R., Tanga R., Johnson E.L.**A global approach to crew-pairing optimization**, IBM Syst. J., 31 (1) (1992), pp. 71-78, Elsayed S.M., Sarker R.A., Essam D.L.**A new genetic algorithm for solving optimization problems,** Eng. Appl. Artif. Intell., 27 (2014), pp. 57-69, Bazargan M.**Airline Operations and Scheduling,** (second ed.), Ashgate Publishing Ltd. (2004-2010)