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THE AIRLINE QUALITY RATING: DEVELOPING AN INDUSTRY STANDARD

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This article presents a brief summary of the Airline Quality Rating (AQR) methodology, AQR results for 1991 and 1992, an overview of the Statistical Process Control (SPC) method, and its application to AQR data. Due to the AQR monthly quantitative data, AQR scores can be used to create an SPC chart that, in turn, provides a means for developing standard levels of quality for individual airlines and for the industry.

The AQR was developed and first announced in early 1991 as an objective method of comparing airline performance. The AQR combines multiple quality factors important to consumers into a single numerical score. Development history and calculation details for the AQR rating system are detailed in The AQR (NIAR Report 91-11) issued in April 1991 by the National Institute for Aviation Research at Wichita State University and published in the Winter 1992 issue of *The Journal of Aviation/Aerospace Education and Research*. A full reporting of the 12-month periods of 1991 and 1992 AQR scores is available in Airline Quality Report 1992 (NIAR Report 92-11) and AQR Report 1993 (NIAR Report 93-11).

THE AIRLINE QUALITY RATING

The AQR combines objective monthly performance data, available to the public, using a quantitative weighted average method. Other ratings such as those developed by Frequent Flyer and Airline Passenger Association are based on subjective opinion surveys. Since they are more time-consuming, they are seldom done and are therefore dated. The AQR uses public monthly objective data; thus, monitoring the quality of airline performance can be done on a timely, objective, and comparable basis for all major airlines.

The AQR (NIAR Report 91-11) is a weighted average of 19 factors (see **Table 1**) that have importance to consumers when judging the quality of airline services. Factors were identified through research and opinion polling. An initial list of more than 80 factors was screened to meet two basic criteria: factors must be readily obtainable from published data sources for each airline, and factors must have relevance to consumer concerns regarding airline quality. The following methods were used to reduce the list of factors: record searches to determine availability of data, survey of experts in the airline industry regarding importance to consumers, and judgment of the researchers. Before the final 19 factors were selected, a final inquiry was made to 65 field experts. Factors selected generally represent performance aspects such as on-time performance, number of accidents, mishandled baggage, denied boardings, and financial performance. These factors are relevant to all consumers' perceptions of quality and perceived value. Pricing in the industry generally is not an issue because of price similarity. Thus, purchase decisions are based on inputs such as frequent flyer programs, schedules, and perceived value/quality.

The basic formula for calculating the AQR is:

Equation 1

$$AQR = \frac{-w_1F1 + w_2F2 + w_3F3 +/- \ldots w_{19}F19}{w_1 + w_2 + w_3 + \ldots w_{19}}$$

To establish a weighted method, experts were surveyed regarding their opinion of what consumers would rate as important (on a scale of 0 to 10) in judging airline quality. Each factor is assigned a plus or minus sign to reflect the nature of impact for that factor from a consumer's point of view. Weights and positive/negative signs are independent of each other. Weights reflect the importance of a factor to the

Table 1
Airline Quality Rating Factors, Weights and Impact

	Factor	Weight	Impact (+/-)
1	Average Age of Fleet	5.85	-
2	Number of Aircraft	4.54	+
3	On-Time	8.63	+
4	Load Factor	6.98	-
5	Pilot Deviations	8.03	-
6	Number of Accidents	8.38	-
7	Frequent Flier Awards	7.35	-
8	Flight Problems*	8.05	-
9	Denied Boardings*	8.03	-
10	Mishandled Baggage*	7.92	-
11	Fares*	7.60	-
12	Customer Service*	7.20	-
13	Refunds*	7.32	-
14	Ticketing/Boarding*	7.08	-
15	Advertising*	6.82	-
16	Credit*	5.94	-
17	Other*	7.34	-
18	Financial Stability	6.52	+
19	Average Seat-Mile Cost	4.49	-

*Data for these factors are drawn from consumer complaints as registered with the Department of Transportation and published monthly in the Air Travel Consumer Report.

consumer in decision-making, while signs reflect the direction of impact that a factor should have on the consumer's rating of airline quality. Weights and impacts are combined with actual performance data for an airline and averaged using the formula in **Equation 1**. The result is a single numerical score that is comparable across airlines and across time periods. Because the weights and directional impacts are constant for all airlines and periods, any differences noted in AQR scores are a direct result of differences in actual performance of the various airlines.

Most of the airlines have indicated that they track data similar to that of the AQR. The uniqueness of the AQR is in the data that goes beyond the Department of Transportation data and includes other factors. Also, there has been no indication that the airlines have developed a weighted average approach like the AQR. Southwest Airlines and American were the only airlines to indicate that they track data besides that from DOT. Southwest suggested that there is substantial similarity between their results and those of the AQR. However, airlines have not been willing to release their findings. Comments from the industry include:

"The value of studies like this is good over a long period of time." — Mike Mitchell, America West

"It appears the researchers have come up with a way of using a certain standard and we find this intriguing and refreshing." — John Hotard, American

"Anything that provides consumers with more information is worthwhile, as long as it's based on reliable data." — Bill Jackson, Air Transportation Association

The AQR methodology allows comparison of major domestic airlines on a regular basis (as often as monthly) using a standard set of quality factors. Unlike other consumer opinion approaches that rely on consumer surveys and subjective opinion, the AQR uses a mathematical formula that takes multiple weighted objective factors into account in arriving at a single numerical rating for an airline. The rating scale is useful because it provides consumers and industry watchers a means of looking at comparative quality for each airline on a timely basis using objective, performance-based data.

AQR RESULTS FOR 1991 AND 1992

For comparison purposes, monthly AQR results for each major airline for 1991 and 1992 are displayed in **Table 2** and **Figure 1**. Also shown is a composite industry average chart that combines the nine airlines tracked for 1991 and 1992. After examining the data available for 1991 and 1992, we find that:

1. American Airlines, consistently the highest rated

Table 2
Airline Quality Rating Scores, 1991-1992

	AA	AW	Cont	Delta	NW	SW	TWA	United	USAIR	Industry Average
Jan '91	0.287	-0.339	-0.341	0.149	-0.087	0.244	-0.470	0.123	0.075	-0.040
Feb '91	0.332	-0.361	-0.332	0.210	-0.062	0.254	-0.434	0.123	0.015	-0.028
Mar '91	0.333	-0.362	-0.353	0.202	-0.138	0.241	-0.426	0.133	0.084	-0.032
Apr '91	0.316	-0.251	-0.288	0.195	-0.076	0.245	-0.420	0.083	0.145	-0.006
May '91	0.331	-0.401	-0.244	0.179	-0.213	0.250	-0.481	0.192	0.148	-0.027
Jun '91	0.313	-0.379	-0.248	0.183	-0.177	0.254	-0.456	0.175	0.149	-0.021
Jul '91	0.338	-0.286	-0.235	0.198	-0.156	0.203	-0.454	0.185	0.150	-0.006
Aug '91	0.332	-0.282	-0.239	0.192	-0.168	0.183	-0.436	0.201	0.141	-0.008
Sep '91	0.346	-0.265	-0.227	0.201	-0.149	0.202	-0.446	0.219	0.138	0.002
Oct '91	0.316	-0.321	-0.221	0.222	-0.153	0.196	-0.409	0.175	0.113	-0.009
Nov '91	0.310	-0.319	-0.232	0.200	-0.174	0.190	-0.373	0.211	0.128	-0.007
Dec '91	0.318	-0.338	-0.235	0.185	-0.161	0.179	-0.408	0.194	0.098	-0.019
1991 Avg.	0.323	-0.325	-0.266	0.193	-0.143	0.220	-0.435	0.168	0.115	
Jan '92	0.339	-0.296	-0.249	0.119	-0.166	0.291	-0.470	0.235	0.097	-0.011
Feb '92	0.327	-0.280	-0.230	0.142	-0.143	0.287	-0.436	0.250	0.107	0.003
Mar '92	0.302	-0.292	-0.277	0.130	-0.164	0.274	-0.450	0.222	-0.048	-0.034
Apr '92	0.317	-0.262	-0.264	0.117	-0.147	0.266	-0.455	0.203	-0.013	-0.026
May '92	0.312	-0.267	-0.230	0.140	-0.133	0.263	-0.475	0.203	-0.027	-0.024
Jun '92	0.287	-0.285	-0.285	0.113	-0.166	0.261	-0.489	0.215	-0.033	-0.042
Jul '92	0.283	-0.250	-0.293	0.118	-0.220	0.265	-0.316	0.214	-0.058	-0.029
Aug '92	0.289	-0.248	-0.311	0.101	-0.168	0.270	-0.332	0.193	-0.073	-0.031
Sep '92	0.224	-0.230	-0.276	0.135	-0.208	0.258	-0.288	0.224	-0.056	-0.024
Oct '92	0.296	-0.237	-0.285	0.145	-0.215	0.266	-0.279	0.224	-0.058	-0.016
Nov '92	0.236	-0.263	-0.246	0.113	-0.304	0.159	-0.384	0.198	-0.051	-0.060
Dec '92	0.269	-0.285	-0.347	0.098	-0.279	0.149	-0.400	0.183	-0.073	-0.076
1992 Avg.	0.290	-0.267	-0.274	0.123	-0.193	0.251	-0.398	0.214	-0.024	

airline, had lower AQR scores in 1992 than in 1991. American was recovering from a slump in late 1991 and early 1992, but AQR scores began to decline by mid-1992 and become erratic in late 1992.

2. Southwest Airlines held the number-two ranking for 1991 and 1992. Unlike American, Southwest maintained a consistently higher AQR score in 1992 than in 1991 until late in the year. By November and December of 1992 scores fell noticeably and dropped below 1991 score levels. Overall, 1992 was a more stable year for Southwest's AQR scores than 1991.

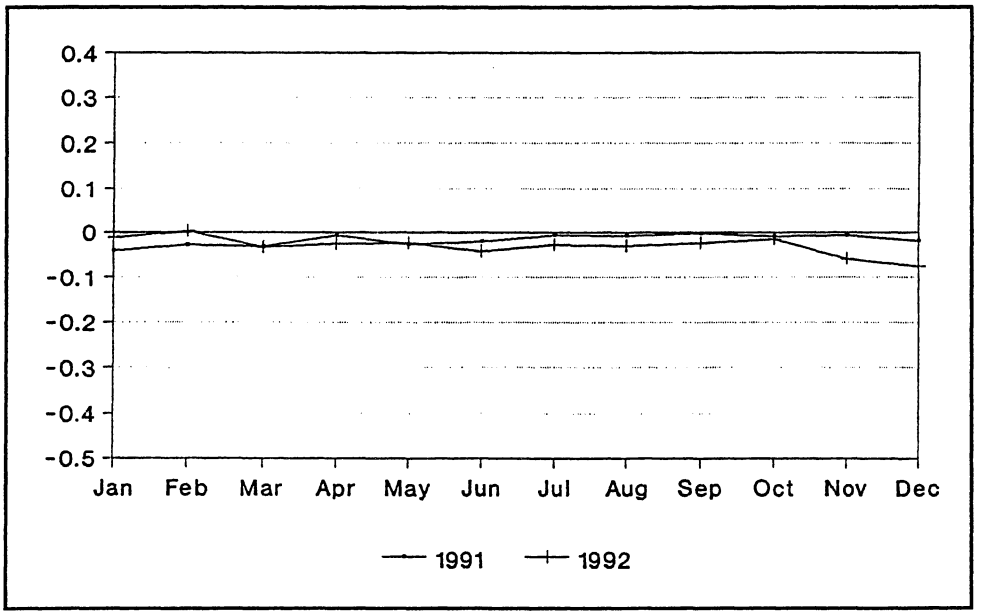
3. Two airlines switched positions in the 1993 AQR reporting period. United moved up from the number-four position in 1991 to the number-three position in 1992, while Delta moved from number three in 1991 to number four in 1992. This change came early in 1992 and was attributed more to United's improvements than to Delta's change in scores. After recovering in mid-1991 to a stable level, United maintained this level throughout 1992. Although a slight downturn in late 1992 is noted, it did not affect the final position for United.

4. Delta Airlines maintained a consistent AQR score in 1991. Their 1992 AQR score was also consistent but slightly lower than in 1991.

5. USAir kept their position in the middle of the nine airline group. Fifth-rated USAir experienced inconsistent AQR scores in the beginning of 1991. By April the airline established a consistent rating score, which was maintained into early 1992. In March of 1992, a drop was noted, and this lower level was maintained for the rest of the year.

6. Northwest Airlines also held their position

Figure 1
Airline Quality Rating
Industry Average of Major U.S. Airlines, 1991-1992



throughout 1991 and 1992. The airline started 1991 with erratic AQR scores that kept moving downward until stabilizing in mid-year. This level was maintained into mid 1992 when another general downward trend is seen that runs through the end of the year.

7. America West switched positions with Continental. Seventh-placed America West improved upon their consistent 1991 scores, which led to higher scores in 1992.

8. Continental Airlines' scores, while consistent in 1991, became more volatile and generally lower in 1992. Continental finished 1992 with a noticeable downturn in December.

9. The lowest-rated airline for 1991 and 1992 was Trans World Airlines. Some improvements were seen in late 1991 and early 1992. The scores took a noticeable positive jump in 1992 (July through October). However, in late 1992 (November and December), AQR scores returned to their previous lower levels.

10. For the industry, the average AQR score indicates that performance was best during the early months of 1992. From mid-1992, the monthly industry average AQR score was consistently lower for 1992 than for the same month in 1991. This dip reflects the general increasing stress on the industry from economic, international, regulatory, competitive, and consumer elements.

STATISTICAL PROCESS CONTROL (SPC)

There are many advantages to using a quantitative approach to the measurement of quality. One of the most important is that it provides a means to more accurately document the performance of an organization and to compare organizations within the industry. Many organizations are currently trying to better control quality within their organization and the industry. A simple and useful tool to help accomplish management of quality is charting the level of quality using an SPC chart. The idea behind SPC is to apply basic statistical concepts such as control limits and standard deviation to performance data and to model variability in quality in a more graphic manner (Wilcox, 1987). **Figure 2** is an example of an SPC chart using AQR scores. The center line of the chart is the average of the AQR results for an airline for the base year 1991. The top line is the upper control limit (UCL). The lower line is the lower control limit (LCL) (Rohan, 1989). These limits represent a targeted range of variability based on one year (12 months) of experience and are projected outward across the next year.

There are two types of variability to be understood when using an SPC chart. The first, common cause variability, occurs when points are randomly distributed about the center line within the upper and lower control limits. Common cause variability involves more complicated factors that cannot be easily altered in the short-term. In the airline industry these factors could be areas such as financial stability, age of the fleet, and

number of accidents. These areas usually require active long-term involvement by top management (Fellers, 1992). Common cause variability represents the level of quality that the organization or industry is capable of producing. It is entirely possible that an organization may be within control limits (within the UCL and LCL) and still be performing at an inadequate level of quality to successfully compete.

The second type of variability is termed local faults. A local fault is depicted by one of the following (Fellers, 1992):

1. The last point plotted is outside UCL or LCL.
2. There is a long run of consecutive points above or below the center line (five to seven in a row are cause for concern).
3. There are two out of three consecutive points in the outer zones of the chart.
4. There is an obvious trend or shift.

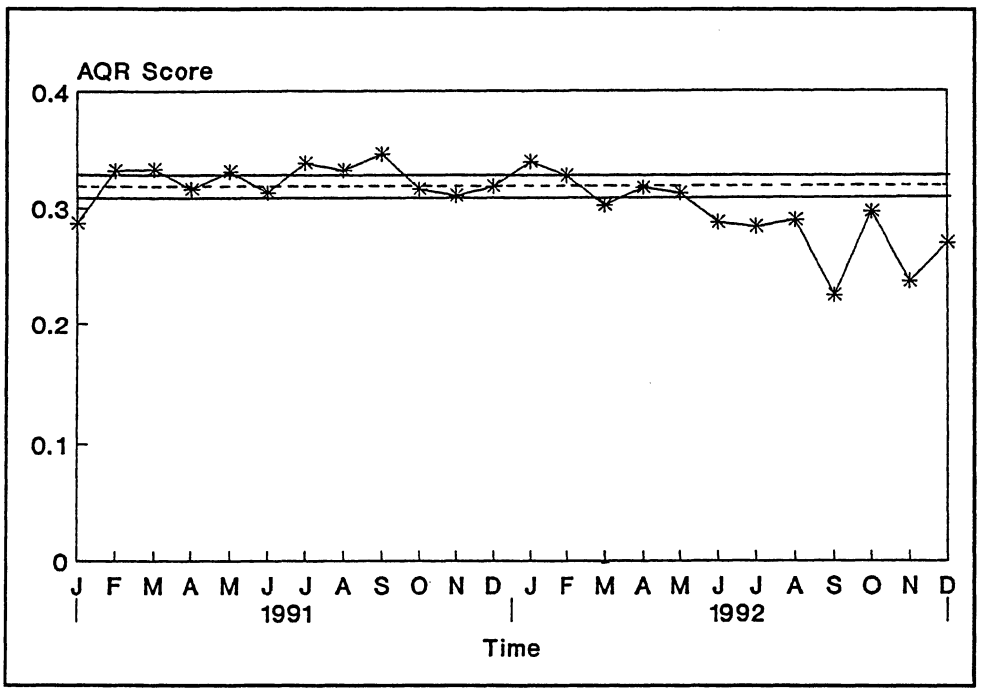
Local faults are factors that are easily identifiable and can generally be controlled by front-line employees. In the airline industry these factors would be such things as mishandled baggage or customer complaints about ticketing/boarding or customer service. A local fault is indicative of a situation that is temporarily out-of-control. Local faults are typically short-term and are often identified and corrected by the employees actually responsible for performance (Fellers, 1992).

USING SPC TO SET STANDARDS FOR THE AIRLINE INDUSTRY

Referring back to Figure 2, the SPC method can be used with the AQR scores to set quality standards for individual airlines and for the airline industry. To produce an SPC chart two things are necessary: accurate numerical data and chronologically recorded data. Since the AQR is quantitative and not based on subjective data, it yields accurate numerical data. AQR scores are tabulated monthly, allowing the SPC to be developed for individual airlines and for the industry.

To develop the SPC chart in Figure 2, both the 1991 and 1992 AQR results are needed. Data from the 1991 AQR results are averaged to set the standard for the airline. This average is used to determine the chart centerline and to calculate the UCL and LCL. Data from 1992 are also charted to depict performance for the second year. SPC studies are typically based on several years of data (approximately 20 quarterly measurement periods). With monthly data from the AQR, the SPC chart can be calculated over 24 measurement periods to provide a better representation of variability.

Figure 2
Statistical Process Control Chart
American Airlines 1991-1992



The data in Figure 2 is based on AQR scores for American Airlines. The average AQR score for American Airlines in 1991 was 0.323. The upper control limit is 0.333 and the lower control limit is 0.314 (based on a standard deviation of .015 and

11 degrees of freedom). These limits represent the targeted level of quality that the airline is capable of producing based on past performance. American Airlines remained within or close to this range until early to mid-1992. There were a few months when the airline did not maintain quality within the targeted range. However, these were isolated, and the airline generally returned to the targeted area in the next reporting period.

Even by American Airlines' high standards, quality seemed to slip in the latter part of 1992. In mid-1992 the scores dropped considerably and for the remainder of the year the airline was no longer operating at the standard of quality set in 1991. This drop may be attributed to the general downward trend in the industry and to an increase in customer dissatisfaction primarily due to the unsuccessful summer sale. Customer complaints in the areas of denied boardings and lost bags increased while financial stability decreased.

This SPC chart gives us a glimpse of one airline's performance over a specific time. SPC gives us another tool with which to examine quantitative data in a relevant and understandable way. The AQR, by the nature of its construction, is an important contributor to this tool. As more data become available, the AQR will continue to aid in the better understanding of airline industry quality and help us formulate a more realistic standard of performance for the industry.

CONCLUSION

The ability to determine quality performance in a service industry is a valuable asset. With today's financially troubled aviation industry, airlines need to provide a high level of quality to attract and retain customers. The AQR provides the airline industry with an objective means to quantify the level of quality being produced. The original purpose of developing the AQR was to use the rating as a point of comparison by consumers and industry watchers. However, combining the SPC method and the AQR data allows us to take a step closer to better understanding quality in the industry. If we apply the SPC tool, AQR data can be used by airline managers and other industry analysts as a tool to monitor quality, identify problems, and provide timely feedback on the effectiveness of tactics to improve quality.

The AQR provides many opportunities for further research. For example, scholars can use the data to compare airline quality to other factors such as the airline's stock price or financial performance. In addition, a research data base is being developed for further analysis of the AQR data. The data base will contain data used in the AQR and will provide the researchers with the flexibility to pursue additional options for research. The design of the program allows for the comparison of different combinations of factors. Certain factors or combinations may be more crucial to the ratings of some airlines than to others. This data base will provide many new research opportunities using the AQR data.□

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