

Table of Contents

Acknowledgements	1
Table of Contents	3
Definitions.....	8
1 Introduction	9
1.1 Background.....	9
1.2 Problem statement.....	10
1.3 Purpose	11
1.4 Hypothesis Tests	11
1.4.1 Alpha Level	11
1.4.2 Hypothesis 1	11
1.4.3 Hypothesis 2	11
1.4.4 Accompanying Questions	12
1.5 Perspective	12
1.6 Delimitations	12
2 Frame of reference.....	14
2.1 Previous research.....	14
2.2 Strategy Development	15
2.2.1 Motives behind a strategy	15
2.2.2 The Strategies.....	15
2.3 Strategic Alliances	16
2.4 Network structures.....	16
2.4.1 Point-to-Point Model	18
2.4.2 Hub-and-Spoke model	19
2.5 Denied boarding compensation	20
2.6 Load Factor Distribution.....	20
2.6.1 Means	20
2.6.1.1 Standard Mean.....	20
2.6.1.2 Unadjusted Mean	21
2.6.1.3 Distance Weighted	21
2.7 Quantitative Theories.....	21
2.7.1 Probability	21
2.7.2 Distributions	22
2.7.2.1 Normal Distribution.....	22
2.7.2.2 Beta Distribution.....	22
2.7.3 Kurtosis	23
2.7.4 Skewness	24
2.7.5 Law of Large Numbers.....	24
3 Method	25
3.1 Research approach.....	25
3.2 Deduction vs. Induction.....	26
3.3 Quantitative vs. Qualitative	27
3.4 Selection and perspective.....	28
3.5 Collection of Data.....	28
3.6 Analyzing Data.....	29
3.7 Credibility of the Research.....	30

3.7.1	Reliability	30
3.7.2	Validity	30
3.7.3	Generalizability	31
4	Empirical findings	32
4.1	The Big Three	32
4.1.1	Star Alliance	32
4.1.2	Skyteam	33
4.1.3	Oneworld	34
4.1.4	Similarities and Differences	34
4.2	Load Factors	35
4.2.1	Errors	35
4.2.2	Frequency Distribution Patterns	35
4.2.2.1	1994	36
4.2.2.2	1995	36
4.2.2.3	1996	37
4.2.2.4	1997	38
4.2.2.5	1998	39
4.2.2.6	1999	40
4.2.2.7	2000	40
4.2.2.8	2001	41
4.2.2.9	2002	42
4.2.2.10	2003	43
4.2.2.11	2004	43
4.2.2.12	2005	44
4.2.2.13	2006	45
4.2.2.14	2007	45
4.3	Denied Boarding Compensation	46
4.3.1	International policies and regulations	46
4.3.2	Quantitative View	48
5	Analysis	49
5.1	Load Factors	49
5.1.1	Issues to be analyzed	49
5.1.2	Deciles	49
5.1.3	Probability Density Function	51
5.1.3.1	1994	52
5.1.3.2	1995	53
5.1.3.3	1996	53
5.1.3.4	1997	54
5.1.3.5	1998	55
5.1.3.6	1999	56
5.1.3.7	2000	57
5.1.3.8	2001	58
5.1.3.9	2002	59
5.1.3.10	2003	60
5.1.3.11	2004	61
5.1.3.12	2005	62
5.1.3.13	2006	63
5.1.3.14	2007	64
5.2	Distribution Shifts	65
5.3	Star Alliance and the environment	67
5.4	Analysis summary	68
6	Conclusion	70

7 Final Discussion.....	71
7.1 Limitation	71
7.2 Further Research	71
References.....	73
Appendix 1.....	76
Beta Parameter Expectation Plots.....	76
Appendix 2.....	83
Alpha Parameter	83
Beta Parameter	83
Mode Estimation.....	83
X Parameter	83
Beta PDF.....	83
1994	84
1995	84
1996	84
1997	84
1998	85
1999	85
2000	85
2001	86
2002	86
2003	86
2004	86
2005	87
2006	87
2007	87
Appendix 3.....	88
Appendix 4.....	89

List of figures

Figure 1-1 Star Alliance timeline (Star Alliance 2007a)	10
Figure 2-1 Old network structure (Brueckner & Whalen, 2000)	17
Figure 2-2 Current network structure (Brueckner & Whalen, 2000).....	17
Figure 2-3 First-order conditions for non-allied and allied carriers (Brueckner & Whalen, 2000)	18
Figure 2-4 Simple point-to-point model.....	19
Figure 2-5 Simple hub-and-spoke model (Caves et al., 1984)	19
Figure 3-1 Modified Trapezoid (Davidson, 2001)	25
Figure 3-2 Study population	28
Figure 4-1 Overview of the Big Three (Star Alliance, 2007b/c, Oneworld 2007a, Skyteam 2007b).....	32
Figure 4-2 Member airlines as of 2008-05-27 (Star Alliance, 2007b/c, Oneworld 2007a, Skyteam 2007b).....	32
Figure 4-3 Frequency Distribution of Load Factor 1994	36
Figure 4-4 Frequency Distribution of Load Factor 1995	37

Figure 4-5 Frequency Distribution of Load Factor 1996	38
Figure 4-6 Frequency Distribution of Load Factor 1997	39
Figure 4-7 Frequency Distribution of Load Factor 1998	39
Figure 4-8 Frequency Distribution of Load Factor 1999	40
Figure 4-9 Frequency Distribution of Load Factor 2000	41
Figure 4-10 Frequency Distribution of Load Factor 2001	42
Figure 4-11 Frequency Distribution of Load Factor 2002	42
Figure 4-12 Frequency Distribution of Load Factor 2003	43
Figure 4-13 Frequency Distribution of Load Factor 2004	44
Figure 4-14 Frequency Distribution of Load Factor 2005	44
Figure 4-15 Frequency Distribution of Load Factor 2006	45
Figure 4-16 Frequency Distribution of Load Factor 2007	46
Figure 4-17 Denied Boardings 1994-2007.....	48
Figure 5-1 Load Factor Deciles	50
Figure 5-2 PDF curve for load factor distribution in 1994	52
Figure 5-3 PDF curve for load factor distribution in 1995	53
Figure 5-4 PDF curve for load factor distribution in 1996	54
Figure 5-5 PDF curve for load factor distribution in 1997	55
Figure 5-6 PDF curve for load factor distribution in 1998	56
Figure 5-7 PDF curve for load factor distribution in 1999	57
Figure 5-8 PDF curve for load factor distribution in 2000	58
Figure 5-9 PDF curve for load factor distribution in 2001	59
Figure 5-10 PDF curve for load factor distribution in 2002	60
Figure 5-11 PDF curve for load factor distribution in 2003	61
Figure 5-12 PDF curve for load factor distribution in 2004	62
Figure 5-13 PDF curve for load factor distribution in 2005	63
Figure 5-14 PDF curve for load factor distribution in 2006	64
Figure 5-15 PDF curve for load factor distribution in 2007	65
Figure 5-16 Correlations.....	66
Figure 5-17 Correlation.....	67
Figure 5-18 Kurtosis and Skew development.....	69

List of equations

Equation 1 - Mean	21
Equation 2 - Unadjusted mean	21
Equation 3 - Weighted mean	21
Equation 4 - Probability density function of a normal distribution (Hogg & Tanis, 2006)	22
Equation 5 - Probability Density Function (Johnson et al., 1995)	23
Equation 6 - Beta Function (Johnson et al., 1995)	23
Equation 7 - Measuring the Kurtosis (Aczel, 2002)	23
Equation 8 - Kurtosis measurements in a Beta Distribution (NIST, 2008)	23
Equation 9 - Measuring the Skew (Aczel, 2002).....	24
Equation 10 - Skewness measurement in a beta distribution (NIST, 2008).....	24
Equation 11 - Law of Large Numbers (Johnson et al., 1995)	24
Equation 12 - Probability Density Function for a Beta Distribution	51
Equation 13 – The Beta Function	51
Equation 14 - The Alpha constant estimator.....	51

Equation 15 - The Beta constant estimator	51
Equation 16 - Mode (NIST, 2008).....	52

Definitions

Code sharing – The ability for a company to legally register a flight number and allow the sale of tickets for a continuous route though the operating carrier is a separate entity.

Efficiency – For the purposes of this study the efficiency relates to the ability of the carriers to consistently return load factors tightly about the mean which reduces the costs associated with outliers.

Kurtosis – The fourth moment about the mean, measures the peak at the mode.

Load factor – The number of filled seats divided by the number of available seats.

Mode – The value which appears most often in a data set.

Segment – This is each non-stop flight between two points.

Skewness – The third moment about the mean, measures the difference between the mode and the mean.

Strategic alliance – An alliance which is critical to the core business success or a mean to maintain a competitive advantage as well as core competences. A strategic alliance should also be hard to imitate and thereby reduce/block competitive threats.

1 Introduction

The introduction provides a background to the problem and the chosen subject. It also discusses the purpose and provides a hypothesis as well as the research questions necessary to fulfill the purpose. It will conclude a short discussion about perspective and delimitation.

1.1 Background

It has been widely acknowledged that there has been an increased interest for “strategic alliances” in the business world during the last several years. According to Quinn (1999), strategic alliances could be seen as one of the main approaches to improving the total output of a firm. Quinn reasons that, by focusing efforts on a small set of activities at the same time as acquiring input from various different specialized suppliers companies are able to obtain the best of both worlds (cited in Shenkar & Reuer, 2006). Although, the topic “strategic alliances” is comparatively new to the business world there has already been a great deal of research performed within this area. However, many questions associated with this subject still remain to be answered.

Due to the amount of previous research in the area of strategic alliances, it has been determined that there are a variety of positive attributes related to the performance of strategic alliances. This phenomenon is usually referred to as ‘synergies’ and can be defined as the, intentional or unintentional, benefits that accrue to the allied members as a result of jointly taken decisions and procedures (Miles, Snow & Sharfman, 1993).

This research focuses on one of the most competitive industries in the world, namely the airline industry. This industry has shown the importance of collaboration with different competitors in order to remain competitive or simply to avoid elimination. Through an alliance, member airlines can collaborate and thereby attempt to increase destinations served and the frequency of flights and also endorse traveling through different efforts to deliver a higher sense of service and satisfaction to their customers (Czipura & Jolly, 2007).

Pan-am started the first alliance to expand its services into Latin America under Pan-American Grace Airways when it purchased Peruvian Airways in the 1930’s (Delta Museum, 2008). In 1989, Northwest Airlines and KLM also started collaborating but this partnership did not take off until in 1992 when they jointly launched the world’s first open-skies agreement between the Netherlands and the United States (Brueckner & Whalen, 2000).

Due to the ongoing changes in the business world in the late 1990’s, the airline industry was pressured to develop better business solutions to meet higher demands among business travelers. During the same time, factors such as an increased usage of Internet and globalization have also had a huge impact on both business traveling and the overall airline industry environment. It was under these circumstances that Air Canada, Lufthansa, SAS, Thai Airways and United Airlines joined forces to create Star Alliance in 1997. This was a revolutionary change in an industry, which previously was mostly familiar with incremental changes over time. By creating a network of airline companies, Star Alliance aimed to adapt to the changes in global mobility by offering their customers a faster and more convenient way of traveling (Star Alliance, 2007d).

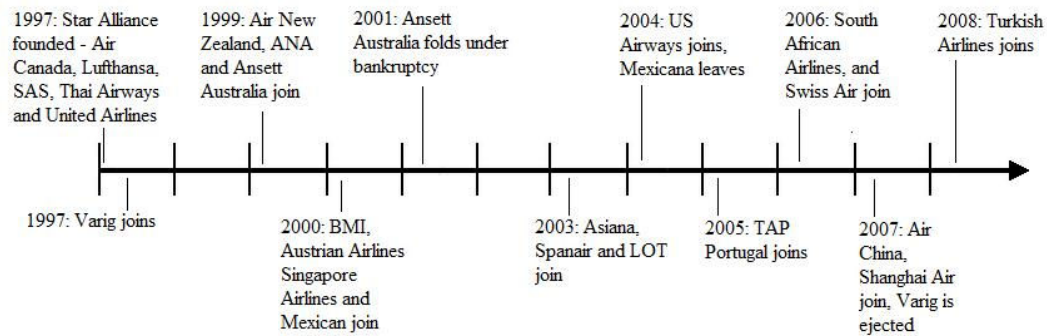


Figure 1-1 Star Alliance timeline (Star Alliance 2007a)

The airline industry is often described as an oligopoly-structured market where a few actors possess a majority of the market share and power. At the time of writing, there were three major airline alliances which controlled the lion's share of the market. Star Alliance had by far the greatest share with 25.1 %¹ of the market, the second largest was Skyteam with 20.8 %¹ of the market share and Oneworld commanded a 17.9 %¹ of the total market. In this study, the authors have, through a case study, chosen to further investigate Star Alliance due to its current standing as the largest strategic airline alliance in the world.

1.2 Problem statement

The airline industry experienced a major crisis in 2001 with the 9/11-catastrophe; this resulted in a decline in travel sales in the entire industry which in turn led to massive layoffs and cutbacks. At the same time as the industry was suffering from these horrible events both oil prices and labor costs had increased and the number of low-fare competitors continued to grow. This further weakened the current situation of several actors in the industry (Czipura & Jolly, 2007). Many airlines encountered financial problems and were in desperate need of change during the years following 9/11. During 2002 and 2003, many major airline carriers in the US were either on the verge of bankruptcy or under bankruptcy protection (Rubin & Joy, 2005). In years that followed the 9/11 terrorist attacks, the amount of airlines joining airline alliances increased because of issues such as: decreasing profits, additional investments in airline security as well as changes in the travel behavior of customers.

"The industry is at a turning point... The airlines that remain will face the challenges of having to make significant changes to both their revenue and cost structures." (Czipura & Jolly, 2007, p. 58).

In an article written by Jenmert & Lundberg (2006), it was stated that supplementary investigations should be performed within the area of strategic airline alliances and allied members. They further suggest that a particular focus should be put on how the largest alliances differ and how allied members are affected by a membership.

In order to get a deeper understanding of the previous assumptions and findings associated with strategic alliances in the airline industry this research specifically investigates the capacity performance of the allied members of Star Alliance. By focusing on load factors as well as associated costs, the aim of this study is to provide evidence that the members

¹ Numbers retrieved from Star Alliance (2007)

of a strategic alliance have increased their capacity performance which may reduce overall costs and allow members to become more efficient.

1.3 Purpose

The *raison d'être* of this study is to quantify and analyze the augmentation of load factors over time, in terms of distribution, as they pertain to capacity performance of allied carriers within Star Alliance.

1.4 Hypothesis Tests

Because the majority of the analysis was of the quantitative sort, it was thus most appropriate to use hypotheses in this section (Aczel, 2002). This idea however should be considered carefully, as is described in the method section of this report the data collected is in the form of a case study and is exhaustive for the population. For this reason the load factors represent 100% of the data fitting the delimited requirements, that is to say flights between 1994 and 2007 by carriers in Star Alliance as of December 31, 2007 for flights to/from/or wholly within the United States, as described in section 3.4 'Selection and Perspective.' This completeness eliminates the possibility of a statistical error for the mean load factor for that given population, barring the forewarning in section 4.2.1. The generalizability of the data is mentioned in later sections.

1.4.1 Alpha Level

In accordance with generally accepted theories in statistics the alpha level was set at $\alpha=.05$ in all of the statistical tests, this includes but is not limited to hypothesis test, confidence intervals, and z-tests.

1.4.2 Hypothesis 1

The first hypothesis that the quantitative data tested was focused on load factors, due to its importance as a measure of efficient use in the airline industry; specifically a null hypothesis and an alternative hypothesis were used as a testing basis for this data. The null hypothesis, here within H_0 , stated that load factors have not changed. Proving the alternative hypothesis, here within H_A , would show that allying companies have increased their load factor. The tests were conducted for the mean change from one year to the next. In looking only at the increase it would not be possible to reject the null hypothesis if there was a decrease in load-factor. This purpose of this hypothesis is to examine the benefits of alliances attributable to their carriers.

Allied companies load-factor has not changed.

$$H_0: LF_{x-1} \geq LF_x$$

Allied companies load-factor has increased.

$$H_A: LF_{x-1} < LF_x$$

1.4.3 Hypothesis 2

After looking into the changes in load factors it was deemed necessary to investigate how the percentage of oversold flights had changed. Though it is healthy for an airline to sell

more seats per flight there are many costs associated with over sold flights. For this reason this test was conducted on the relation between oversold flight statistics vis-à-vis denied boardings, and the shape of the frequency distribution for flight load factors. The null hypothesis, H_0 , then became allied the proportion of denied boardings was unchanged relative to an increase in average load factors. The percentage of denied boardings was defined as D and mean remained μ . The first alternative hypothesis, H_A , stated that the proportion of flights reporting denied boardings had increased relative to load factors. This would be expected if the shape parameters of the distribution remained constant or the ‘clustering’ about the mean were to weaken. The second alternative test, H_B , stated that the proportion of denied boardings decreased relative to an increase in average load factor. This would imply that the shape parameters of the distribution were to change such that the ‘fit’ of returns were more concentrated about the mean.

$$H_0: D_x = \mu_x$$

$$H_A: D_x > \mu_x$$

$$H_B: D_x < \mu_x$$

1.4.4 Accompanying Questions

In addition to the hypothesis, research questions were utilized, to assist in fulfilling the purpose. They were also used to verify and strengthen the findings of the hypothesis tests auditatively. The following research questions are posed and used as guidance throughout the paper:

- How has the distribution of the load factors changed over the years? And what model does it follow?
- What are the implications of a higher load factor as they pertain to efficiency and over selling?

1.5 Perspective

The aim of the research is to provide managers, of both non-allied and allied airlines, with information on how strategic alliances affect their own member organization. Furthermore, this research may aid in the decision-making process and help executives to obtain a deeper understanding of strategic alliances and the effects on capacity performance. This information could therefore work as a determinant to whether or not an airline should join or stay in an alliance.

1.6 Delimitations

In the case study of this research, only one alliance was examined since an investigation of more alliances would increase the complexity and reduce the feasibility, because of factors related to both limitations on time and accessibility. Additionally, a careful analysis was conducted on Star Alliance, which later was briefly compared with Oneworld and Skyteam in order to discover possible similarities and differences. However, a deeper investigation of the latter two alliances was never performed.

Further aspects worth mentioning are the other interesting variables that could have been included in this type of study, such as: revenues, price and time. Conversely, it was later

found that some airlines only offered either insufficient or conflicting data, which therefore led to a direct exclusion of these variables. Despite this, due to the importance and accessibility of load factors, this variable was chosen to be of the main concern of this research. However, this report will not include any data from Shanghai Airlines, Ansett Australia, Mexicana or Varig, since these either have left Star Alliance or do not report to the US data collectors.

Another important fact is that this study will not take antitrust issues into consideration, due to that these issues are highly complex and because there are many different opinions concerning antitrust and strategic alliances within the airline industry.

2 Frame of reference

The theoretical framework presents previous research made in this field. It also aims at presenting relevant theories and models used. It also includes a presentation of the statistical measurements used throughout the paper.

2.1 Previous research

There are several reports written on the chosen topic even though the concept of strategic alliance is fairly new to the market. Many approaches and fields of research have been applied to this concept, such as management, finance, strategy and marketing. There is also a vast quantity of descriptive studies covering the concept.

A study that was conducted by Park and Cho (1997) focused on the performance of strategic alliances in the international airline industry. They chose to investigate if the market share of code-sharing alliances was increased after joining a strategic alliance or not. This involved analyzing time-series data of 56 different airlines between the years 1986 to 1993. In the study there are three different hypotheses which the writers tried to answer, which are the following:

- Strategic alliances in a particular market have had a positive effect on the performance of allied firms.
- Strategic alliances between current competitors (among large market sharers) will have greater impact on the allied firms' performance than the impact of strategic alliances between new entrants (among small market sharers).
- The performance of strategic alliances will be negatively associated with the number of participating firms in the markets.

In using various statistical calculation methods, such as: descriptive statistics, correlation matrix, frequency analysis and multivariate regression, the researchers managed to answer these hypotheses with a minimal level of uncertainty. For the first hypothesis, it was concluded, just as presumed, that strategic alliances had a positive effect on the performance of allied members. They continue to explain that they also found evidence that implied that the performance of strategic alliances between greater market sharers was larger than the performance between smaller market shares. However, they also found that the market share for alliances with new entrants, in a specific market, tended to increase more in comparison to the alliances with already existing airlines. As for the last hypothesis, the researchers discovered that the impact alliances had on performance was correlated with the amount of members in the alliance. They also realized that in markets with fewer competitors and new entrants, the impact of an alliance was likely to be greater than in markets with a larger amount of competitors and entrants. These findings further led to the assumption that strategic alliances would likely be more successful in markets in which they are more dynamic and experiencing higher growth (Park & Cho, 1997).

2.2 Strategy Development

2.2.1 Motives behind a strategy

When looking at the survival of an organization or the success of an organizational strategy there is a direct connection to the firm's ability respond to three different types of pressures, namely: the competing pressures from the business environment, the firm's strategic capability and the cultural and political issues. Furthermore, these pressures work as the fundamental aspects when creating the organizational motives of a firm. It is extremely important that the organizational motives are "correct" since the motives, in turn, are used to help the organization in deciding which strategy they should implement. Motives are generally categorized in three different groups, which separate their intention and focus. The first type is environmental-based motives, which simply stated means that the organization is trying to fit their new strategy to a changing business environment. The second group is capability-based motives these focus on stretching and exploiting the resources and competences of the organization. Finally, the expectations-based motives which focus on meeting the expectations created by issues related to culture and politics (Johnson, Scholes & Whittington, 2005).

2.2.2 The Strategies

There are different schools proposing methods on how to pursue the development of a specific strategy. An organization which is able to decide if they wish to continue on its own, also called *internal development*, or to collaborate with other organizations in form of a *strategic alliance* or through either an *acquisition* or a *merger*. This report focuses on allied airline companies, only two of the three methods are further discussed in the following sections (Johnson et al., 2005).

Internal development is an organization making use of its own capabilities to develop strategies organically. There are several reasons why firms ultimately decide to go with internal development instead of a collaborative approach. Organizations which use complex technology in design or in manufacturing often choose to base their strategies on their own capabilities. Through the process of development, companies can acquire important capabilities and also gain valuable knowledge about the market. These capabilities and newly attained knowledge could also be helpful when the organization is creating market opportunities and competitive advantage as well as developing new products or services for their customers. Another important factor is the actual cost of internal development. Great initial investments are not needed here since the costs are spread over a long period of time in comparison to the more collaborative approach, which often requires huge initial investments. It also offers the ability to grow in network with investment in infrastructure (Johnson et al., 2005).

A *strategic alliance* is a type of collaboration between two or more organizations, which share specific resources and activities in order to achieve a mutual goal. As mentioned earlier, this type of partnership has increased in popularity over the years and has often been said to be a direct consequence of complex business environments. In the same way as there are different motives behind the decision of entering an alliance; there are also different types of alliances available to organizations (Johnson et al., 2005).

2.3 Strategic Alliances

There are several differences between a regular alliance and a strategic alliance. Wakeam (2003) writes in the article *The Five Factors of a Strategic Alliance*, about various differences and what constitutes a strategic alliance. He claims that in order for an alliance to be regarded as strategic, it has to incorporate at least one of these alternatives, the alliances block a competitive threat, are critical to the core business success or crucial to maintain competitive advantage and core competence. It should also create or maintain strategic choices for the firms or mitigate a significant risk. Note that it is not necessary to match all of these criteria, one is sufficient to be able to call an alliance strategic. To continue, it is also very important to understand the partner/s and their view on the criteria, otherwise the alliance is likely to fail. It is further suggested to look in-depth of each of these criteria, since it might bring insight on how to manage and control the strategic values of the alliance.

Stout and Beaucaire (2005) talk about strategic alliances as a wide concept that includes other concepts such as joint ventures, merger, out-sourcing, etc. They define strategic alliance as “*more than one person/company collaborating to achieve a result – ultimately to increase profitability*” (Stout & Beaucaire, 2005, p. 1). They also define a strategic alliance as an exchange and sharing of information, expertise and capital investments. Another concept brought up by the researchers is the difference between vertical and horizontal alliances. The horizontal alliance is an alliance between companies in the same industry while the vertical is between companies in different industries. Star Alliance is a horizontal alliance as all the members are active in the airline business.

“*An overview of strategic alliances*” (Elmuti & Kathawal, 2001) is another article that defines the concept of strategic alliances. They define the concept as “an agreement between firms to do business together in ways that go beyond normal company-to-company dealings, but fall short of a merger or a full partnership”. There are drawbacks and risks with strategic alliances, as almost 70% of all alliances fail, and the decision to join an alliance must be carefully considered. One must take care to understand their firm hopes to gain from an alliance and what position is needed in order to fulfill those needs.

2.4 Network structures

In the article “*The Price Effects of International Airline Alliances*”, by Brueckner and Whalen (2000), the evolution of an alliance is described. Figure 2-1 represents a model of the earliest airline alliances and this would be an identical view for a passenger traveling from “B” to “E” on non-allied carriers, with the difference being however that the latter would require a traveler to buy two tickets.

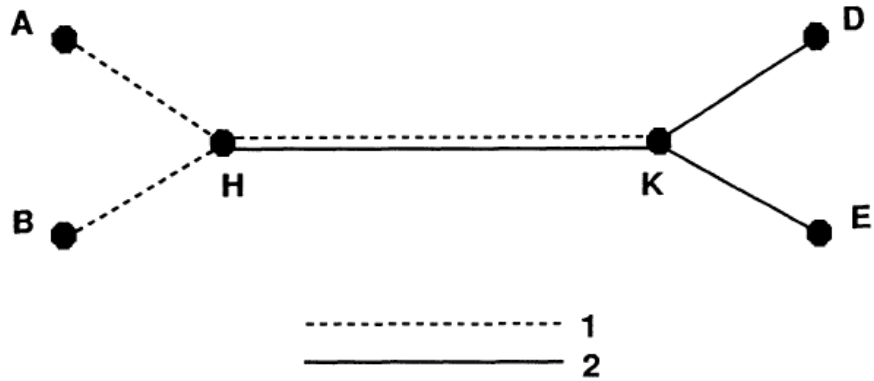


FIGURE 1.—Network structure from earlier model

Figure 2-1 Old network structure (Brueckner & Whalen, 2000)

Brueckner and Whalen then developed a model of the current organization of international airline alliances; this simplified model of the world contains less overlap and complication because of the use of “H” as the main hub. This alleviates the need for the two companies in alliance to deal with the added cost of maintaining more hubs and running the additional route between “H” and “K”.

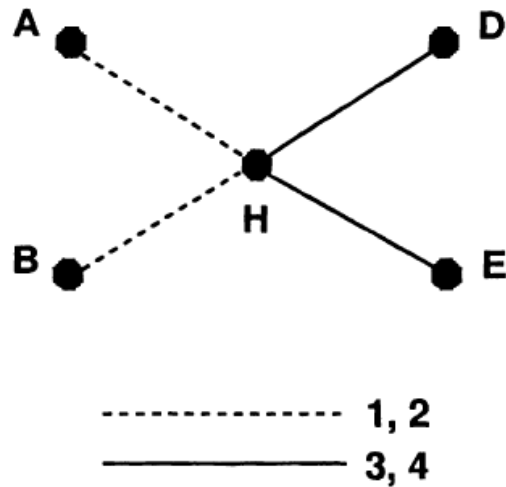


FIGURE 2.—Current network structure

Figure 2-2 Current network structure (Brueckner & Whalen, 2000)

In the same article, “*The Price effects of International Airline Alliances*”, the equations of profits, which are found below, are also illustrated. These equations are products of Figure 2-1 and 2-2 and evaluate the effect of price on the profits of the companies. Simply defined, the Figure below (2-3) is the mathematical model of a simple route 2-2. $2c'$ is to represent the marginal cost of serving a client on the two spokes and will be a constant. P_{xx} represents the interline fare of the allying carriers, 1 and 3, and q_{xx} would represent the traffic density

of the route. By setting the equation to zero one would then solve for the break-even price and density of the route. When the equations are compiled the first-order derivative of q_{xx} in respect to p_{xx} will denote an inverse relation of q_{xx} and p_{xx} . From the figure one can conclude that an allied carriers should effectively be able to charge a lower interline while maintaining profits because the density is multiplied by 2, connoting a division of traffic, as opposed to the latter which does not face competition on the route in the models, or operates in some respects as a monopoly. This is useful when used in conjunction with the efficiency of capacity, which comes into play in both sides of the model in the focal point q_{xx} , by demonstrating the role that higher loads play in the financial aspects of airlines.

$$2q_{xx}^{13} \left(\frac{\partial q_{xx}^{13}}{\partial p_{xx}^{13}} \right)^{-1} + p_{xx}^{13} - 2c' = 0 \quad (\text{nonalliance})$$

and

$$q_{xx}^{13} \left(\frac{\partial q_{xx}^{13}}{\partial p_{xx}^{13}} \right)^{-1} + p_{xx}^{13} - 2c' = 0 \quad (\text{alliance}).$$

Figure 2-3 First-order conditions for non-allied and allied carriers (Brueckner & Whalen, 2000)

2.4.1 Point-to-Point Model

Brueckner and Whalen went on to further describe the two prevailing models of organization in the airline industry. The first model, point-to-point, connects all origins to all destinations. Traditional full-service airlines have shunned this model so as to capitalize on the density benefits of the hub-and-spoke model. The reason for this should be simple to see, each carrier serving the world represented in example 2-4 would be required to fly over six routes as opposed to the hub-and-spoke model, Figure 2-5, which requires half that many.

Because of the additional routes the company must fly more planes with fewer passengers. This organization does have advantages over the hub-and-spoke model in that is more direct which can allow a passenger to fly, without stops, from one point on the globe to another (Brueckner & Whalen, 2000). This model has, since 1985, come back into vogue with the most famous modern-day implementations of these models appearing in the low-cost airline industry including Ryanair in Europe (Ryanair, 2008) and Southwest Airlines in the US (Southwest Airlines, 2008), neither of which has a true hub.

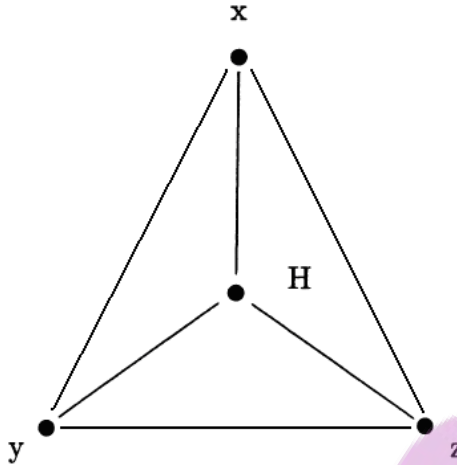


Figure 2-4 Simple point-to-point model

2.4.2 Hub-and-Spoke model

With the hub-and-spoke network, there is a larger hub that sends out routes to smaller airports so that a traveler can reach more remote airports via larger hub airports.

The model was developed in 1984 by Caves, Christensen and Tretheway in their article “*Economies of Density versus Economies of Scale: Why Trunk and Local Service Airline Costs Differ*”. This model differs from the point-to-point system by centralizing its operations at a hub. This mandates that most or all routes to and from spokes shall be connected at a central hub.

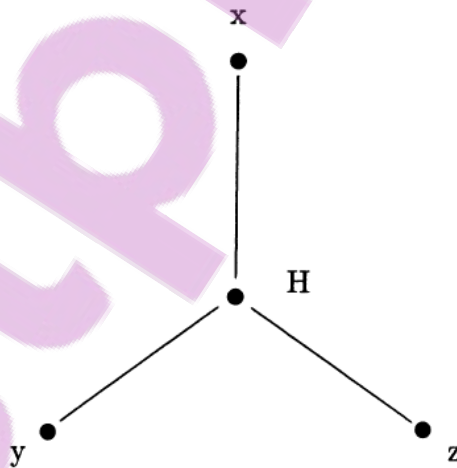


FIGURE 1.—A simple hub-and-spoke network

Figure 2-5 Simple hub-and-spoke model (Caves et al., 1984)

According to Markusen (1996), the major benefit of this model is that it takes fewer connections to build a network of routes. When the number of routes is lower, the use of

transportation generally becomes more efficient, for example, the aircraft are more likely to fly at full capacity and are able to fly the same routes multiple times during the same day. It is easy and quick to connect new spokes to the network. Customers benefit from having fewer routes and more frequent flights, thus giving them a simpler booking service with more options to choose from.

However, there are drawbacks as well to this model. If the network is large, it may be inflexible to changes and a change at the hub or on one of the routes might affect the entire network. Demand highs might be hard to handle as well, especially if they are occasional. The same way as the scheduling is easier for the customers, it is becoming more complicated for the planners, the network operators. To keep the hub running efficiently, there is a need for careful analysis of the traffic and precise timing (Markusen, 1996).

Everything is dependent on the capacity of the hub, for example limits on cargo, as the hub works as a bottleneck for the entire network. If there is a delay at the hub, there might be a delay throughout the entire network. Delays and disturbance at the spokes does not affect the network at the same extent. The cargo must be routed through the hub, which might take more time compared to the point-to-point connection. This may be upsetting for cargo which is dependent on short time transportation. An example of that kind of cargo would be the passengers (Markusen, 1996).

2.5 Denied boarding compensation

In accordance to EU (EC No. 261/2004) and US (14 CFR §250) law, airline carriers are allowed to deliberately overbook flights to increase the number of passengers on each plane thereby reducing the risk for airlines of flying with empty seats. Involuntary denied boarding is a term used by airlines for a passenger who is denied passage on a plane, for which they have purchased and reserved a place, against their wishes. In contrast, there are also voluntarily denied boardings, which occurs when a flight is overbook and a passenger agrees to exchange their reserved seat for some type of payment, such as vouchers for travels in the future.

2.6 Load Factor Distribution

One of the most important variables in the analysis was the load factor. The load factor is also known as passenger density, the amount of passengers on board the flights. A special emphasis was put on examining how the load factor is affected by the changes in the other variables not related to the independent variables under study. In order to maximize efficiency it was crucial to maximize the load factor while maintaining a low number of over sales compensation settlements.

2.6.1 Means

The following mean calculations have been created for the purpose of this study and will be used extensively throughout this paper.

2.6.1.1 Standard Mean

When not otherwise mentioned this referred to the load factor of each individual flight and then averaged. Therefore this mean does not have any adjustments for the size of the aircraft or distance that it flew.

$$Mean = \sum \left(\frac{Pass}{Seats} \right) \div N$$

Equation 1 - Mean

2.6.1.2 Unadjusted Mean

This mean referred to the mean of the year and was calculated by summing all revenue passenger kilometers and dividing that sum by the sum of the available seat kilometers.

$$Mean(Unadjusted) = \left(\frac{\sum Pass}{\sum Seats} \right)$$

Equation 2 - Unadjusted mean

2.6.1.3 Distance Weighted

Load factors were also weighted to produce a mean that takes into account the benefits of a global airline alliance. This was done by producing a distance weighted load factor for each flight segment in the data and then created a sum total. In doing so flights that flew long distances and flights that flew with 0% load factors were weighted more heavily than full flights and short-distance flights. The extra weighted attributed to the long-distance flights allowed the flights, which before alliance would have forced passengers to separately purchase multiple independent tickets, to have more impact on the benefits of allying and would have highlighted the costs of flying an under loaded plane.

$$Mean(Weighted) = \sum \left(\frac{Dist \times Pass}{Dist \times Seats} \right) \div N$$

Equation 3 - Weighted mean

2.7 Quantitative Theories

Due to the quantitative nature of the empirical findings in this report it necessary that the reader shall have at minimum a grasp in the underlying statistical assumptions and theories utilized in this study. For this reason this section will give an overview of the issues to be covered in the empirical findings and analysis section and is ultimately used to reach conclusions.

In analyze the synergy benefits that an allied carrier receives from joining an alliance, the study measured the efficiency of the use of an allied members' aircraft. This data was conducted across an aggregate of the carriers in the alliance at the end of 2007, see 'Selection and Perspective'. Before examining the empirical data in section 4.2 it is expected that the reader will have a casual understanding of the topics discussed in this section.

2.7.1 Probability

"Probability is a measure of uncertainty. The probability of event A is a numerical measure of the likelihood of the event's occurring" (Aczel, 2002)

Because each flight has a load factor, which is a measure of the percentage of paying passengers filling its seats, it has a bounded limit of possible returns between 0% and 100%. Mathematically, this can be written as $0 \leq P(A) \leq 1$. Therefore the realm of possibilities for each load factors is reduced to numbers between 0% and 100%, and thus a load factor of 1.1 or 110% is as impossible as a load factor of -.1 or -10% (Aczel, 2002).

A load factor of one flight is independent of the load factor of another flight segment. This assumption can be made because of the possibility to buy flight tickets in any routing combination on any day of the year. This allows for the possibility of a flight segment between point A and point B to have a load factor of 75% and during the aircraft's next journey, which could be a return from point B to point A or a journey from point B to point C, to have any load factor between 0% and 100% (Hogg & Tanis, 2006).

2.7.2 Distributions

The load factor data, which is aggregated to produce a probability density function for each year in section 4.2 is a visual depiction of how full the aircraft operated by member carriers of Star Alliance. These graphs naturally follow the limit set forth in the previous assumption with the minimum load factor of 0 and maximum of 1.

2.7.2.1 Normal Distribution

The distribution graphs display some of the properties of a normal or Gaussian distribution. The normal distribution produces the familiar bell-shaped curve, which is present in many statistical models the probability density function of a normal distribution is mathematically written as:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left[-\frac{(x - \mu)^2}{2\sigma^2}\right] \text{ and assumes } -\infty < x < \infty$$

Equation 4 - Probability density function of a normal distribution (Hogg & Tanis, 2006)

In the normal distribution probability density function, x is the variable for the observation x , and σ is the constant for the standard deviation in the population.

This presents a challenge to the load factor data which assumes $0 \leq x \leq 1$. Under the normal distribution it could be hypothesized that the curve would translate to the right as the load factor rose, because of the limit of 100% load factor on an aircraft on a given flight segment, this assumption would follow that the 100% anomaly would increase in percentage. This translation could imply that the demand for air travel increases and is bounded by the limits of the air travel provider.

2.7.2.2 Beta Distribution

This type of distribution is found in a myriad of applications including, strategic planning in risk analysis, finance, marketing, and engineering. This distribution is useful because of its versatility and tolerance for skewness both negatively and positively (Moitra, 1990). Johnson, Kotz and Balakrishnan (1995) state that beta distributions are among the most frequently employed model of theoretical distributions because of this versatility and their ability to represent binomial distributions in skewness and kurtosis using continuous data. As with the Gaussian function it is possible to create a probability distribution function using the Beta distribution, this function is defined as:

$$f(x) = \frac{x^{\alpha-1}(1-x)^{\beta-1}}{B(\alpha, \beta)}$$

Equation 5 - Probability Density Function (Johnson et al., 1995)

where α and β are constants for which $\alpha > 0$ and $\beta > 0$, x is the variables for the observed point x , and

B , the beta function in the denominator, defined as:

$$B(x, y) = \int_0^1 t^{x-1} (1-t)^{y-1} dt$$

Equation 6 - Beta Function (Johnson et al., 1995)

where x and y are the variables for the function and t is the upper bound of the integral, for the purposes of this study $t=1$.

By imitating a beta distribution, the frequency distribution, the increasing mean over time the distribution will assume a more efficient use of aircraft networks. This is because the anticipated need for available seat miles (kilometers) is more similar to the demand. In joining an alliance the realized available seat miles for an air travel passenger increases because of the greater availability of travel options without the increase in flights provided (Johnson et al. 2005).

These boundaries or class limits as they are known of 0 and 1 force the analysis to be done using alternative methods of analysis. The boundaries in this data also provides two interesting anomalies, they have been dubbed the 0%, 100% anomaly and are described further in the empirical results and analysis sections of this study.

2.7.3 Kurtosis

To measure how clustered returns around the mean are it is necessary to study the kurtosis of the distribution. The kurtosis which is the forth movement about the mean and is written as:

$$\gamma_2 = \sum_{i=1}^N \left[\frac{x_i - \mu}{\sigma} \right]^4 \div N$$

Equation 7 - Measuring the Kurtosis (Aczel, 2002)

where N is the number of observations, μ is the constant for the expected mean, x_i is the observed value at point 'i' and σ is the standard deviation of the population.

In beta distributions this function is adapted to:

$$\gamma_2 = 6 \frac{\alpha^3 - \alpha^2(2\beta - 1) + \beta^2(\beta + 1) - 2\alpha\beta(\beta + 2)}{\alpha\beta(\alpha + \beta + 2)(\alpha + \beta + 3)}$$

Equation 8 - Kurtosis measurements in a Beta Distribution (NIST, 2008)

where α and β are the constants in the beta distribution function.

2.7.4 Skewness

The measure of the third movement about the mean is the skewness. This measurement explains to what degree and to which direction the mode differs from the mean. For the purposes of this report it is essential in measuring how ‘accurate’ a traditional measure of the mean is in relation to the frequency distribution of the system. The function for measuring skewness is written as:

$$\gamma_1 = \sum_{i=1}^N \left[\frac{x_i - \mu}{\sigma} \right]^3 \div N$$

Equation 9 - Measuring the Skew (Aczel, 2002)

where N is the number of observations, μ is the constant for the expected mean, x_i is the observed value at point ‘i’ and σ is the standard deviation of the population during a continued rightward shift.

Because μ is subtracted from x a positive skew will denote a leftward skew with a long tail to the right of the mean and a negative skew says the contrary or a large mounding to the right of the mean and a long tail to the left of the mean.

In a beta distribution the function adapted for the measures of α and β becomes:

$$\gamma_1 = \frac{2(\beta - \alpha)\sqrt{\alpha + \beta + 1}}{(\alpha + \beta + 2)\sqrt{\alpha\beta}}$$

Equation 10 - Skewness measurement in a beta distribution (NIST, 2008)

where α and β are the constants in the beta distribution function.

Skewed probability density functions allow for the possibility of a fairly stable return in the ever-present 0%, 100% anomalies that occur in airline system load factors.

2.7.5 Law of Large Numbers

Coupled with the sampling techniques the study used the law of large numbers to insure an efficient perspective on the load factors. Developed by S.D. Poisson in 1837 known in French as “La loi de grands nombres,” The law of large numbers explains a convergence between a sample average, $\bar{X}_N$, and the expected value, μ (MacTutor, 2002). The law states that when the probability of an event is less than or equal 1 then, in a beta distribution:

$$\lim_{N \rightarrow \infty} \bar{X} = \frac{1}{N} \sum_{i=1}^N x_i \rightarrow \mu$$

Equation 11 - Law of Large Numbers (Johnson et al., 1995)

However due to the case study nature of the data when compared with the delimited population the mean is equal to μ given that all data that satisfied the requirements was included, see section 2.6.

3 Method

The method section presents the process in which the research was conducted. It covers aspects as research approach and collection of data. It also contains discussions about credibility, quantitative or qualitative and induction versus deduction.

3.1 Research approach

The following model explains the research approach utilized in the study and how these sections are correlated with each other.

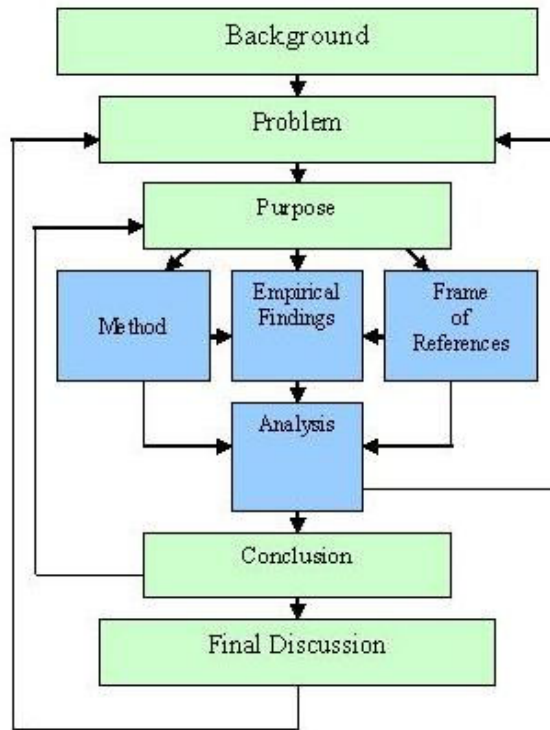


Figure 3-1 Modified Trapezoid (Davidson, 2001)

In the introduction of this report, the background of the study is presented. This part involves facts and discussions about strategic alliances as well as history, trends and forecasts for the airline industry. The background is very broad and should work as a prologue to the next section, namely the problem statement.

The problem statement is, as explained before, an extension to the background, in which further discussions are presented on the current situation of the airline industry, why it has been decided to study strategic alliances within this industry and specifically why Star Alliance was chosen.

The purpose is related to the problem statement, where it is clearly and concisely explains what specific aspects of the problem have been chosen as a focal point in the study.

In the following section, the three following parts are explained. The first part is the frame of reference, which involves all theory and previous articles that were used throughout the research. These references are used as a guiding tool as well as to strengthen the findings throughout the research. The second part is the method and is used as a tool for fulfilling the purpose. Here it is further explained how the authors intend to proceed with the work, in other words, how the empirical work of the study were carried out. One of the main issues mentioned in this part is the research approach and how the analysis of the data will be carried out. The last part is the empirical findings, where the statistical results as well as other findings are presented. All these three parts are based on the purpose and both the method as well as the frame of references is, as illustrated in the figure, used to develop the empirical findings. Furthermore, all the three parts are together connected to the analysis in which they all played a vital part when analyzing the data and the overall findings.

In the analysis, the findings were integrated with the conceptual models and theories found in the frame of reference, in order to reveal interesting observations and patterns. The analysis is connected to the problem statement and works as the groundwork of the conclusion.

The final two parts are the conclusion and the final discussion of the study. In the conclusion a summary of the output from the analysis as well as the interpretations of the overall research are presented. The conclusion is directly connected to the purpose and will therefore state the answers to both the hypotheses and the research questions. This part also works as a reversed funnel approach towards the final discussion. In the final discussion, a further focus is put on the implications of the results. This section will also have two subsections where both further research and limitations will be discussed. As illustrated in the figure above, the final discussion is broader than the conclusion and connects to the problem statement of this report.

3.2 Deduction vs. Induction

As part of the initial stage of the research project, the researchers have taken a decision which concerns the actual design of the research. When deciding on the correct research approach, there are two options to choose between, namely an inductive or deductive approach. The main difference between these two concerns the disposition of the research as well as how to manage and use different theories and hypothesis (Saunders, Lewis & Thornhill, 2003).

The *deductive* approach offers the researcher a structured process in which a specific theory or general rule gets tested by using data from specifically chosen areas or occasions. In other words, the researchers extract appealing theories from an area of interest that will constitute the foundations of research and help the researchers to realize what relevant data to make use of as well as how to collect it. When the data has been collected, the next step will be to connect it to the theory and to see if the actual data is supporting the chosen theory. Since deduction is a scientific approach and mostly associated with quantitative research, the researchers are only able to show whether or not that their hypothesis is true for the specifically collected and analyzed data. If they are successful in deducing the hypotheses from the theories, the conclusions and findings might possibly strengthen their theory (Maylor & Blackmon, 2005).

Robson (1993) has summarized five chronological stages of how a deductive research is to proceed:

- Deduce a hypothesis from the chosen theory.
- State the hypothesis in operational terms, which accurately indicates how the variables are to be measured. Furthermore, aim at finding a relationship between two specific variables.
- Make an empirical inquiry and test the operational hypothesis.
- Investigate the probable outcome of the inquiry to realize if any modifications are needed.
- Make modifications to the theory so that it better matches the findings.

The purpose behind the *inductive* approach is that the researchers make use of data in order to develop and generate theory. This data will be compiled, examined and analyzed by the researchers to discover patterns that can, through generalization, be used as a conceptual framework or theory. In the sense of our research, a conceptual framework or theory could then be a pattern between e.g. load factor and shifts in efficiency. An inductive approach is usually used in an area of interest where a lack of theory exists. Since the theory works as a guiding-tool for both the development of hypothesis as well as the data collection, the researchers have to start by collecting huge amounts of data to further be able to develop theory and create hypotheses for the research. This approach is also commonly used in areas where the researchers believe that already existing conceptual framework or theory will create biases in their own research (Maylor & Blackmon, 2005).

3.3 Quantitative vs. Qualitative

In order to obtain empirical data, it is vital that a research strategy was agreed upon at an early stage. When choosing an appropriate strategy to the study, the researchers are faced with two different alternatives, namely: a quantitative or a qualitative approach. There is a third alternative as well, which is a mixture of both the quantitative and the qualitative kind, but this approach will not be further discussed since it is not a commonly used research strategy.

According to Collis & Hussey (2003), quantitative research is normally associated with the deductive research approach and theory- testing whereas qualitative research is associated with induction and the formation of theory. A quantitative approach is also described as being objective in nature and focuses on measuring variables or phenomena while a qualitative approach is more subjective and involves understanding social and human activities or behavior. Since this study is of the deductive sort and concerns analyzing numerical data, the most appropriate research strategy is a quantitative approach.

In quantitative methodology, there are various strategies to collect and analyze empirical data. These different strategies have both advantages and disadvantages, as they are associated with specific characteristics. Since this study focuses on investigating both how and why, the researchers have been able to narrow down the number of strategies and are faced with three alternatives, namely: Experiment, History and Case study (Yin, 2003). After reviewing these options, the researchers came to the conclusion that the purpose of the research is most likely to be linked to the case study approach. The following quote, by Schramm (1971), briefly explains the characteristics of a case study (cited in Yin, 2003):

“The essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or a set of decisions: why they were taken, how they were implemented, and with what result.”

3.4 Selection and perspective

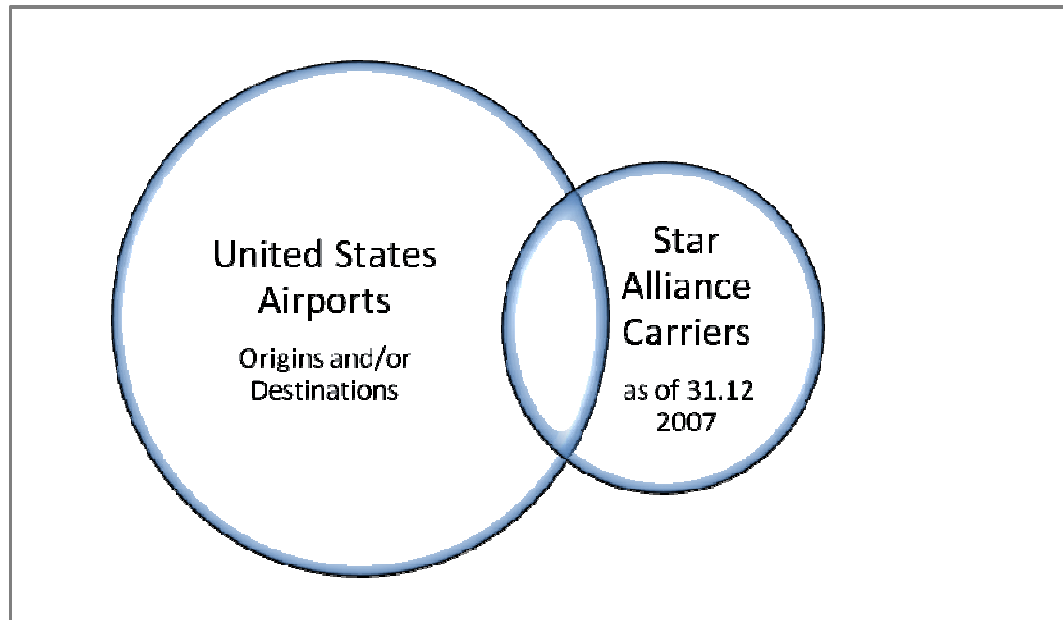


Figure 3-2 Study population

Figure 3-2, above, is a schematic of the population chosen for the study. The square represents the whole population of flights in the world between 1994 and 2007. The two circles are sub-populations one of which represents the US market and the other Star Alliance carriers. The common area represents Star Alliance’s flights in US market. The sizes of the figures are not representative of the actual sizes of the industry, but are rather used to give an overview of the samples selected.

As can be seen, the samples selected are the Star Alliance carriers’ operations, origin and/or destinations in the US market, meaning the traffic that takes off and/or lands in the US. This was chosen because it was deemed to be representative for the population. Additionally Star Alliance, as mentioned previously, is the largest airline alliance in the world and the United States is one of their largest markets. Another reason for this selection was the availability of information and data offered in the US market compared to the European or Asian markets.

According to Park & Cho (1997), in their investigation of the performance of strategic alliances within the airline industry, the size of the observation period is of great importance when analyzing and evaluating the long-term effect of strategic alliances. In order to get a deeper understanding and attain better results, researchers should extend the observation period as long as possible. As a result, the observation period of this paper will start several years before the actual creation of Star Alliance and end in 2007, the most recent completed calendar year at the time of writing.

3.5 Collection of Data

In research, data can appear in two different forms, either as primary or as secondary data. Primary data is the collection of new data that is specifically related to the purpose of the study while secondary data is already collected data, which allow the researcher to re-analyze the data and connect the findings to their own research questions. Primary data is usually more precise than secondary data since it is collected for a specific purpose. However, both the cost and the amount of time for collecting primary data is rather high and therefore secondary data can work as a cheaper useful source (Maylor & Blackmon, 2005). Because of the nature of this research, the researchers have decided to gather secondary data instead of primary data.

Secondary data can come in the form of either raw or compiled data. Majority of the organizations today, collect and store huge amount of data to support different operations. There are also different departments of the government, consumer research organizations as well as other institutions that stand for a large amount of the secondary data that currently is available to researchers and the public. Since secondary data is a large topic, researchers have therefore tried to classify data under three categories, namely: survey-based data, documentary data and multiple sources data (Saunders et al., 2003). Since the data in this research is partially retrieved from a survey made by the Bureau of Transportation Statistics (US Department of Transportation) as well as from records/reports by Star Alliance and its allied members, the data must be classified as multiple-source secondary data.

The data collected for this study comes primarily from the Bureau of Transportation Statistics (BTS), this includes segment market data from 1994 until 2007 of the form 41 series Air Carrier Traffic Statistics. Due to the restrictions of data from the BTS, which is based in the United States, carriers in Star Alliance that did not fly to the United States were not used in this aspect of the research. This method gives information for every airport in the United States to which a Star Alliance carrier has flown to or from between 1994 and 2007 as well as any airport outside of the United States with service to the United States on a route operated by a Star Alliance carrier.

3.6 Analyzing Data

As mentioned previous sections, the secondary data used throughout this research, was limited to the load factors of the members of Star Alliance as well as the flights departing from and arriving in the United States. After removing all unassociated data from the research, the researchers continued to calculate three different means in order to be able to continue analyzing the load factors. To analyze how the load factors have changed over the years frequency distribution charts were produced. These charts measured the number of instances that each specific load factor appeared in the data for each year. This showed a more detailed and useful way to measure exactly how load factors have been affected by alliances as opposed to using only a median and mean result. It was also evident that the charts needed to be processed further due to the anomalies that appeared at 0% and 100% load in these distribution charts. As excluding anomalies would cause misleading results, these values were calculated so that they still could be included in the empirical findings and the analysis.

When the calculations were complete, the focus was shifted to analyzing the load factor distribution as an equation, which could be represented by a probability distribution function. Additional research was then put on the implications of the charts as well as the

changes in load factor over time.

After the supplementary research was conducted, the next step was to calculate the shape parameters for the beta distribution in order to determine and calculate a probability density function. The attention then switched to analyzing the trends of the anomalies in the load factor distribution charts and comparing the anomalies with the shift in the beta distribution shape.

As the final part of the analysis, the denied boarding statistics were introduced and incorporated into the findings. These statistics and the previously calculated means were then compared with the related hypothesis tests and research questions.

3.7 Credibility of the Research

When discussing the credibility of the research, many questions and issues arise. This part of the research is very important given that it involves how others will perceive the evidence and the conclusions of the research, which in other words translates to the truthfulness and the correctness of the research.

3.7.1 Reliability

According to Easterby-Smith, Thorpe & Lowe (2002), the matter of reliability can be measured by making use of the three following questions:

- Can other researchers obtain similar observations?
- Could the research attain the same result on another occasion?
- Does the raw data make sense in terms of transparency?

Because this is a quantitative research study that only includes secondary data, it is likely to assume that the reliability in general is quite high. The reliability of qualitative research is usually lower than quantitative research because qualitative studies usually require human interactions and/or interviews, which often are associated with different kinds of biases. It is also important to mention that all the raw data has been retrieved from reliable sources, such as the US Department of Transportation and official documents from Star Alliance available to the public, which even further increase the reliability of this research.

As the replication of research is of great importance in quantitative studies, it is fair to assume that it would be rather easy for any researcher to go back and process the secondary data and thereby obtain the same results. Furthermore, there is a strong belief that similar observations could be obtained by analyzing other strategic alliances in the airline industry and possibly strategic alliances in other industries.

In terms of transparency, the data presented in this report has been processed, analyzed and presented in both a clear and structured way. By summarizing the raw data and the processed data, in various figures and tables, the reader will be able to understand and make a clear connection of how the data has been processed and used.

3.7.2 Validity

In comparison to the reliability of the research, validity concerns correctness of the research study. This means that the researchers must provide evidence that the findings accurately reflect the reality of the phenomena. Factors that seriously could affect the validity of the research could be: a poor sampling method, questionable research procedures or unreliable/incorrect numbers and measurements (Collis & Hussey, 2003).

According to Robson (2002), there are six different categories that deal with the various validity-issues. The categories are the following: *history*, *testing*, *instrumentation*, *mortality*, *maturational* and *ambiguity about casual direction*. Many of these categories are more related to ethnographic research, the section which is most interesting and correlated to this research is history.

History relates to that the researchers must take significant changes in the environment into account when conducting their research. For example, the 9/11 terrorist attacks had a huge impact on the entire airline industry and therefore would cause a research study of the airline industry during this specific period to produce misleading results. Consequently, a study based on misleading results could never represent the reality of the phenomena. The authors of this study are well aware of major past events, but since this type of unpredicted catastrophe affects the whole industry, no changes either can or have been made. In addition, because the time-span of the research is relatively significant, ranging from 1994 to 2007, an event like this will most likely not have profound effect on the conclusion of this research.

As this research study has a statistical approach and primarily deals with numerical secondary data, the probability of attaining low validity is not considerable issue. However, due to human error, there is a small risk that incorrect numbers may have occurred in the research. Although this might be seen as a threat, several precautions have been made in order to reduce this risk. By re-checking entered values and making use of multiple sources of data, the authors of the research are confident that the risk of this happening is minimal.

3.7.3 Generalizability

Generalizability usually works as an external validity of the research where the researchers are asked how their findings are applicable to other areas in the outside world. Because the researchers must make generalizations based on their findings, this becomes one of the toughest questions to answer (Maylor & Blackmon, 2005).

Though it was intended to be oriented towards analyzing performance of allied carriers in Star Alliance, this research can be reasonably assumed find applicable correlations in other large alliances in the airline industry, see section 4.1.4 'Similarities and Differences.' It is also likely that the findings will have similarities with findings and conclusions of related works on other strategic alliances in industries which display similar organizational structures.

Due to the fact that the data used is specific for the case, and is thus hard to generalize to the whole population. A probability sample is generally of better suited for generalizations qualitatively however there are similarities between this study and other research. It can be claimed that there is a certain level of generalizability to the quantitative study performed here in a qualitative sense. If a study would be performed on the topic with a probability sample, it would likely generate similar results (Bryman & Bell, 2003).

4 Empirical findings

This section presents the actual data collected and obtained through the research. The data is not analyzed in this section but rather processed and presented.

4.1 The Big Three

In this section, important data and information about Star Alliance is presented and compared with the other major horizontal alliances in the airline industry, namely: Oneworld and Skyteam.

	Star Alliance	Oneworld	Skyteam
Founded (Year)	1997	1999	2000
Allied members	20	10	11
Destinations	965	688	841
Serving countries	162	142	162
Daily departures	≈18000	9297	16409
Lounges	740	487	>400
Employees	396 195	263 350	333 482
Fleet	3087	2339	2513
Total Revenue	122.79 billion USD	90.713 billion USD	102.99 billion USD

Figure 4-1 Overview of the Big Three (Star Alliance, 2007b/c, Oneworld 2007a, Skyteam 2007b)

	Star Alliance	Oneworld	Skyteam
Members	Air Canada, Lufthansa, Thai Airways, Air China, SAS, Turkish Airlines, Air New Zealand, Shanghai Airlines, United Airlines, ANA, Singapore Airlines, US Airways, Asiana Airlines, South Africa Airways, Austrian Airlines, Spanair, BMI, Swiss Air, Polish Airlines, POT Portugal.	American Airlines, British Airways, Cathay Pacific, Finnair, Iberia, Japan Airlines, LAN, Hungarian Airlines, Quantas, Royal Jordanian.	Aeroflot, Aeromexico, Air France, KLM, Alitalia, China Southern, Continental Airlines, Czech Airlines, Delta Airlines, Korean Air, Northwest Airlines.

Figure 4-2 Member airlines as of 2008-05-27 (Star Alliance, 2007b/c, Oneworld 2007a, Skyteam 2007b)

4.1.1 Star Alliance

By creating a network of airline companies, Star Alliance was the first alliance to be able to adapt to the change in global mobility and offer their customers a faster and a more convenient way of traveling. Star Alliance has since the actual start, invested a large amount of resources in order to establish themselves as an alliance that is based on partnership, trust and shared values (Star Alliance, 2007b).

Through the use of the "Move under one Roof" strategy, member airline companies try to improve their services at the same time as they put effort into creating synergies between the members and cut overall costs. A recent action that has helped Star Alliance with cutting their costs heavily is the efforts put on connecting passengers. By helping passengers

to reach their flight in time, Star Alliance has managed to increase the satisfaction among travelers. Since every passenger and every piece of luggage that misses a plane represents a great cost for the airline companies, Star Alliance has focused on saving about 10 million Euros per year by reducing the number of delayed passengers and pieces of luggage. The alliance has also realized the importance of technology, meaning that they continuously try to develop new and common technologies in order to improve internal communications as well as creating efficiencies for the airlines and the customers (Star Alliance, 2007a).

Under the same strategy, Star Alliance is also successful in matching the expectations of their customers and thereby generating great benefits for travelers. One of these benefits relates to the coordination of flight schedules between the allied members, which means that travelers will reduce the amount of time spent in waiting between flights. Another important benefit is frequent flyer programs, which enables the customer to earn points on the miles traveled that later work as a direct reduction in ticket costs for them. It is also important not to forget about the increased number of airport lounges affiliated with Star Alliance as well as the benefits, mentioned above, that relates to the efforts that the alliance has put in helping connecting travelers to get to their gate in time (Star Alliance, 2007a).

4.1.2 Skyteam

With the creation of the Skyteam Alliance, the aim was to create a global collaborative network that would result in great benefits for its members. By using the slogan “Caring more about you”, Skyteam wants to deliver a message to the public that they have a large international network of destinations and that they focus a lot of efforts on both quality and customer service (Skyteam, 2007a).

Skyteam has also put up three main strategic priorities that they believe match both their and the customers’ expectations. The first priority is to continue to expand their network and increase the amount of destinations being served. They focus much energy in finding new strategic regions and areas that they could explore and potentially make use of in their worldwide network. Currently, they see themselves as strong in the United States and in Europe but want to strengthen their position in South-East Asia and also focus on specific countries such as: Brazil and India (Skyteam, 2007a).

The next priority concerns the mileage the customers obtain by flying with Skyteam. According to them, it is very important to continuously offer the customers alternative ways of using the mileage within the network. One of the issues that Skyteam currently is concentrating on is finding a solution for a customer that creates a common currency that on which mileage can be transferred or exchanged from different airline companies within the network. This would make it possible for a customer to use the miles from one allied member to upgrade a flight when traveling with another allied member (Skyteam, 2007a).

The last of the priorities is the facilities at the airports, in which they are operating. Skyteam wants to better represent themselves as an alliance at all the airports in their network to further satisfy their customers. They are therefore exploring as to whether they could set up joint lounges or to offer network customers the ability to use other lounges within the alliance. Skyteam also realizes that they need to collaborate better at the check-in counters in order to make traveling more efficient. In addition to this, Skyteam is also investigating if they, at some airports, can decrease the distance between gates and possibly create a Skyteam “wing” where all of their passengers would be gathered together. This would increase the efficiency, and make transit more convenient as well as easier for travelers (Skyteam, 2007a).

4.1.3 Oneworld

Oneworld is currently the third largest alliance operating in the world. It is also the alliance with the strongest profitability record and is also the winner of more international awards than both its competitors combined. Furthermore, Oneworld focuses great efforts on innovation in order to improve service and overall satisfaction among their customers. Oneworld is the only alliance that has interlined e-ticketing between all their allied airline carriers (Oneworld, 2007b).

As the other airline alliances, Oneworld explains that they offer services that are far better than any individual airline carrier or airline alliance. They offer their customers an extensive network of destinations and lounges, smoother travel, better value for the money spent as well as superior service and support. In their frequent flyer program, Oneworld also offer mileage and points that could be transferred to any of the airline carriers within the network (Oneworld, 2007b).

The Oneworld-vision is to *“generate more value for customers, shareholders and employees than any airline can achieve by itself”*. In order to achieve and fulfill this vision, Oneworld has put up a specific set of guidelines to guarantee that the alliance stay focused on their objective. The following paragraph further explains how Oneworld plans to stay competitive and achieve success (Oneworld, 2007b).

- By making traveling smoother and easier as well as creating better value for customers.
- Go beyond and offer customers travel solutions that other individual airline networks cannot match.
- To establish a mutual commitment that will reassure that high quality-standards, service and safety are attained.
- Make customers feel comfortable while traveling, by creating a home-like environment.
- Deliver savings and benefits greater than non-allied airline carriers.

4.1.4 Similarities and Differences

When examining the three alliances there are evident similarities and differences. All three of the alliances claim to put the customer in focus and want to operate in the best way possible for their customers. The alliances aim to cater to the customers and make their traveling more convenient. They all work with code-sharing agreements and further claim to invest resources to develop new technology that could be of use throughout the whole alliance. All three also have a vision to move all of their shared operations into a common terminal or so that the members have a proximity to each other. In addition, the alliances also have a focus on the member benefits, specifically the so-called frequent flyer benefits. Frequent flyers usually get access to both alliance- and member lounges at airports and are also able to earn points or mileage that can be used either to reduce or eliminate the price of a ticket at chosen point-in-time.

At a first glance, it is obvious that some factors differ between the alliances. The amount of members that Star Alliance possesses, is twice the size of the other alliances. Furthermore, in

terms of fleet, daily departures, employees and lounges, Star Alliance is much larger than its competitors.

When investigating the allied members of the alliances, there is also a visible pattern in the focus of each of the alliances. Skyteam and Oneworld are spread around the globe with one or two airlines in each geographical area, while, for example, Star Alliance has two American companies, six companies in the Asia-Pacific region and no partner in South America.

4.2 Load Factors

Load factors were obtained for all flights originating or arriving at a US airport. The data was obtained from the Bureau of Transportation Statistics at the US Department of Transportation as a part of the Form 41 Traffic survey. This survey is a part of the mandatory reporting procedures for all U.S certified air carriers which travel to or from at least one airport in the United States. After retrieval this data was recorded for all years of interest for the research, namely 1994 until 2007, yielding the total number of seats available, the total number of passengers and the total number of miles on each flight segment. This data was used to calculate the load factor on each flight during the 14 years under examination; this was done as a percentage of passengers on each flight divided by the number of seats available on each flight.

4.2.1 Errors

After initial calculations were conducted it was discovered that several, but not all, of the years returned one or more flights as having more than 100% load factor. It was then decided to control for this error. The reason for this error could stem from several reasons, the first is the possibility of “over selling” of flights, this allows the carrier to sell more tickets for a flight than there are seats available, this would then be reported to the Bureau of Transportation Statistics. Another possibility is that there were errors in the reporting. To standardize the data and reconcile these errors with reality it was decided to change all flights reporting load factors higher than 100% to become 100%. This decision was based on the assumption that a majority of the overloaded flights were a result of over booking, in which case planes would be loaded to capacity and all remaining passengers would be re-routed and tabulated on the alternative flight. This also minimized the possibility of calculating passengers twice whom purchased a trip on an oversold flight.

4.2.2 Frequency Distribution Patterns

The results for the load factor were plotted using SPSS to produce a graphical presentation of the recorded load factors. These are shown in Figures 4.3-4.16 below, this data is categorized by year and represents all of the carriers included in the study for flights which are partially or wholly under the direction of the Federal Aviation Administration. The most noticeable formation in the graphical results is the mounded structure which reaches a height around the median and statistical mean for each year. Secondly there are notable anomalous peaks at 0% and 100%. Due to the presence of these two peaks it becomes impossible to carry out a simple statistical analysis under the assumption of a normal distribution. The reason for these results is likely a result of many possibilities. The most plausible reason is the limited capacity of each aircraft on each flight segment. In a theoretical world the load factors could stretch from negative infinity to positive infinity, this would allow for a normal or close to, distribution albeit with skew and kurtosis. However the real-

world limitation of 100% capacity makes the possibility of a flight handling more than the available amount of seats, or less than zero, null. This would then push all returns of a load factor about 100% or 0% into the domain of possibility which is continuous between 0% and 100%. These anomalies are discussed further in the analysis section of this study.

4.2.2.1 1994

This year was the first under examination in this study, as mentioned before it contains data for all of the current, as of December 31, 2007, Star Alliance carriers except for Shanghai Airlines and is centered on data that is either wholly within the United States or has an origin and/or destination in the United States. From the figure 4.1 it is clearly evident that the distribution has a mound similar to what would be expected in a normal distribution but it is not continuous due to the realistic bounds of 0 and 1 where there are pronounced spikes in the number of observations. During this year 0.2% or 142 flights in this study reported 0% load factors and 483 or 0.8% revealed 100% load factors. Aside from this it should also be noted that the mound is not perfectly symmetrical, this is visible in the fatter right tail. The median was at 60.9% load factor and the mean weighed in at 62.3%. The measurements for kurtosis and skewness for the frequency distribution in 1994 were -.424 and -.322 respectively.

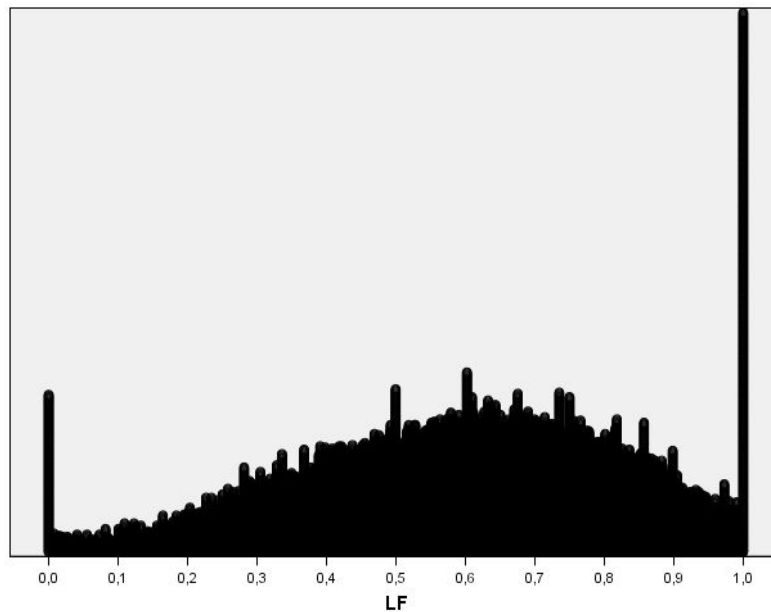


Figure 4-3 Frequency Distribution of Load Factor 1994

4.2.2.2 1995

The next year in the study, 1995, showed a similar shape as the previous year, but with a slightly more profound peak around the 75% load factor and a thinner lower tail. The mean for 1995 was a 59.2% load factor and the median was higher at 63.1% load factor, this became 65.2% when adjusted for distance. As with the previous year the mode remained 100% load factor with 449 or 0.8% of the reporting flights and 0% load factor totaled 0.1% with 78 reports. The frequency distribution saw a rise in kurtosis to -.306 and a lower return in skewness, indicating a rightward movement, with -.38.

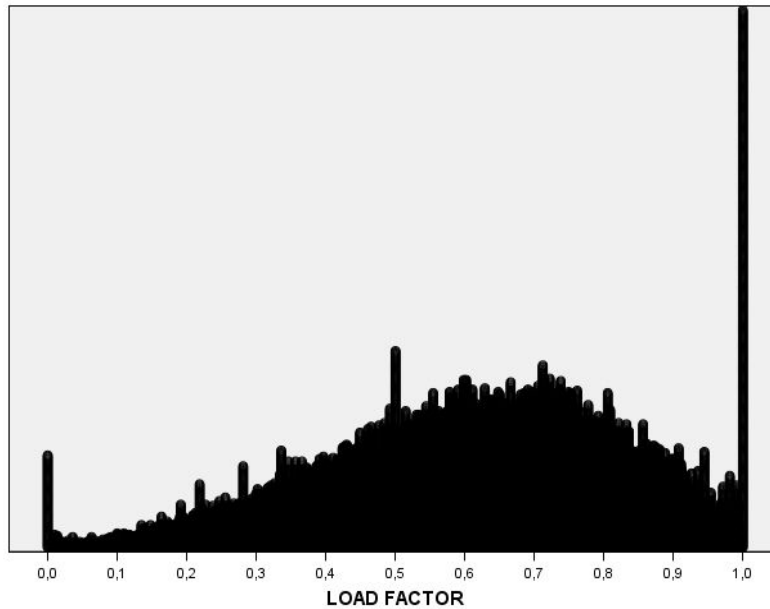


Figure 4-4 Frequency Distribution of Load Factor 1995

4.2.2.3 1996

The trend in the skew towards the right continued in 1996 with a more dramatic fall off around 80% load factor. The unadjusted mean in 1996 was 66.3%, while the distance augmented mean was 67.1% and the median was 66.7%. Empty planes, that is to say flights reporting a 0% load factor comprised 109 of the reporting 52528 flights studied in 1996 which translates to roughly 0.2%. 100% load factors were reported on 447 or 0.9% of the included flights in 1996. The kurtosis in 1996 rose to .024 and the skewness continued to fall to -.555.

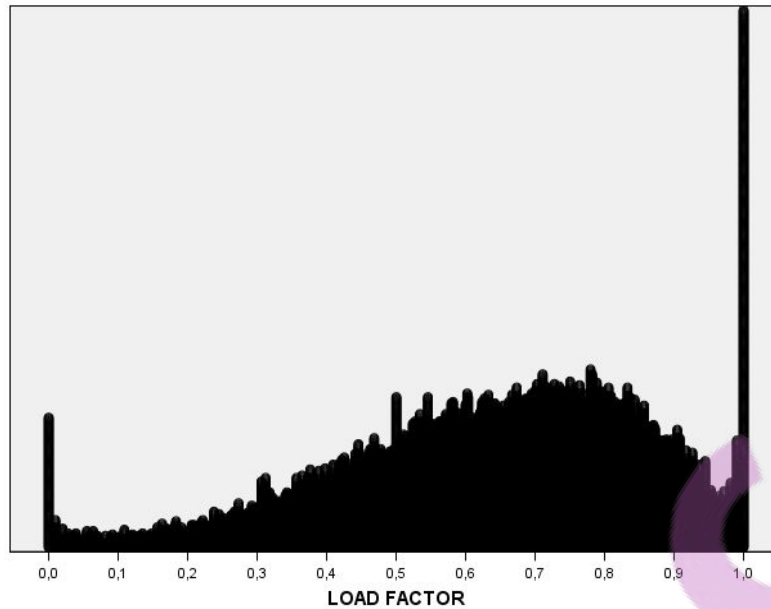


Figure 4-5 Frequency Distribution of Load Factor 1996

4.2.2.4 1997

The year 1997 was the first year of existence for Star Alliance, from this point on the data presented was used as a comparison to the pre-alliance period. The 0%, 100% anomaly in load factors accounted for 0.1% empty flights and 1% fully loaded flights from the total population. The shape in 1997 showed a less high peak about the mean and median. The mean for 1997 was slightly higher than 1996 with an average load factor of 67.3%. In 1997 the median load factor was slightly higher than the mean with 68.5%. In 1997 the mean increased slightly to 68% when factoring distance. The kurtosis dropped slightly during 1997 to .022 and the skewness fell to -.578 which continued the trend for a falling skew.

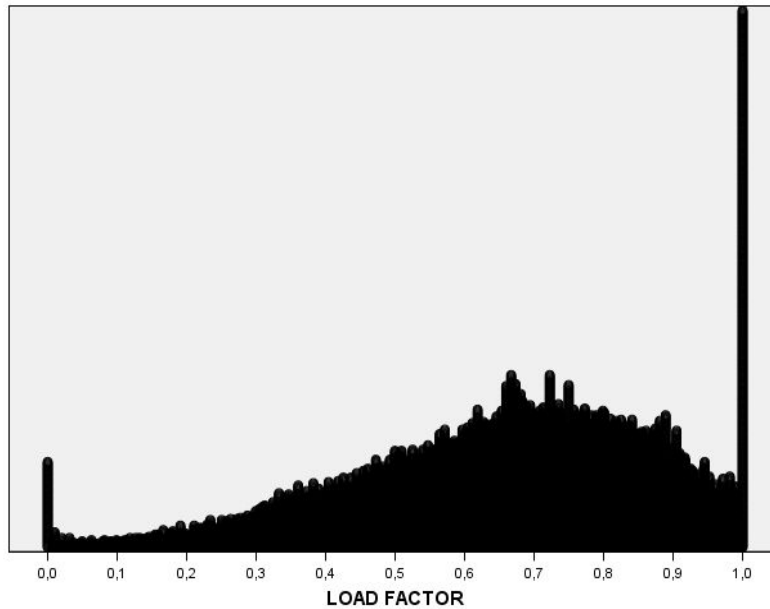


Figure 4-6 Frequency Distribution of Load Factor 1997

4.2.2.5 1998

The second year of Star Alliance reported an average load factor of 69.3% and a median of 69.6%. The 0%, 100% anomaly returned 78 and 390 flights respectively. This accounted for 0.2% of the population reporting 0% load factors and 0.8% reporting 100% load factors. This continues to follow in line with the trend. The distance augmented mean becomes 72.2%. The kurtosis dropped again to .02 and the skew fell to -.654 during 1998.

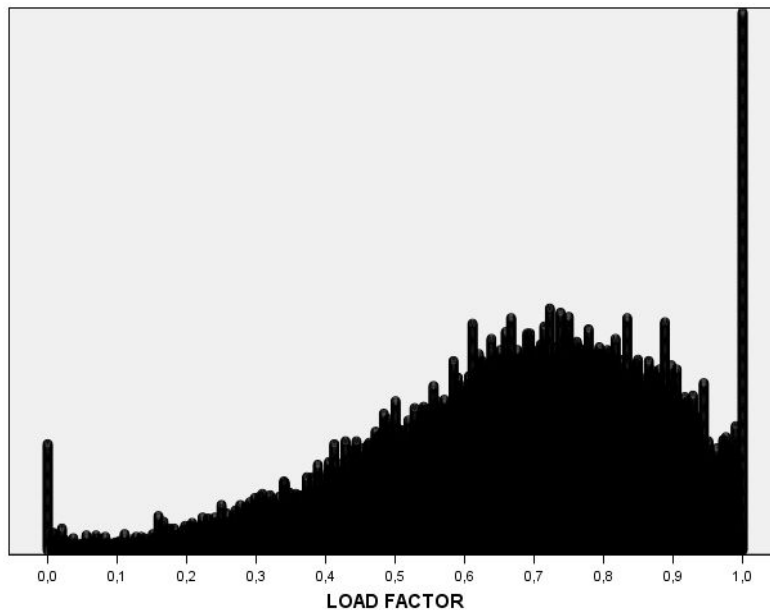


Figure 4-7 Frequency Distribution of Load Factor 1998

4.2.2.6 1999

The third year of operations under Star Alliance there were 95 flights which had 0% load factors, and 370 which reported 100% load factors. These, respectively, accounted for 0.2% and 0.7% of the flights for that year in the population, about par for the course. The median was 67.3% load and the mean load factor was 67.5%. This number increases to 71.5% when factoring in the flight distance. In 1999 the kurtosis moved downwards to .012 and the skewness rose for the first time during the study, to -.544.

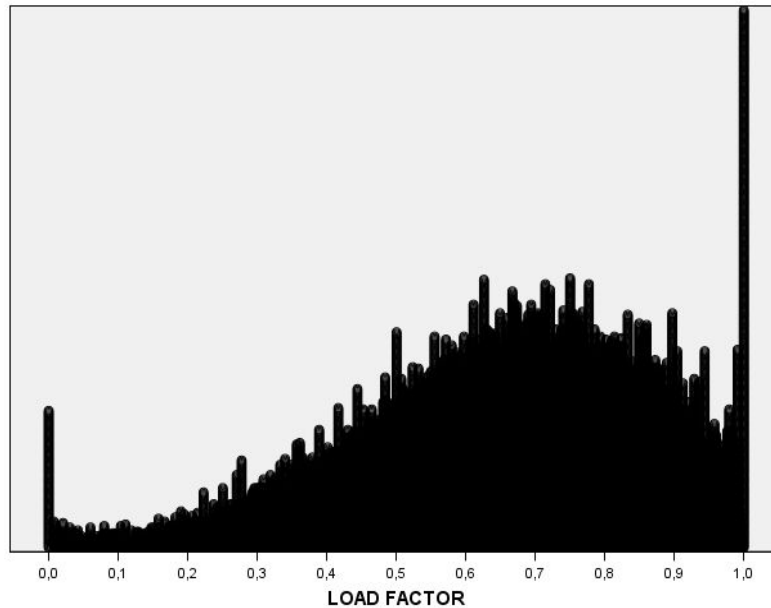


Figure 4-8 Frequency Distribution of Load Factor 1999

4.2.2.7 2000

The first year of the millennium had an average load factor of 67.7% and a median just slightly higher with 67.9%. During that year 149 or 0.3% of the flights in the population flew without any passengers and 398 or 0.8% of the population were full. When the mean is adjusted for distance it increases to 72.8%. 2000 saw a lower kurtosis with .087 and the skewness dropped to follow the general trend returning -.623.

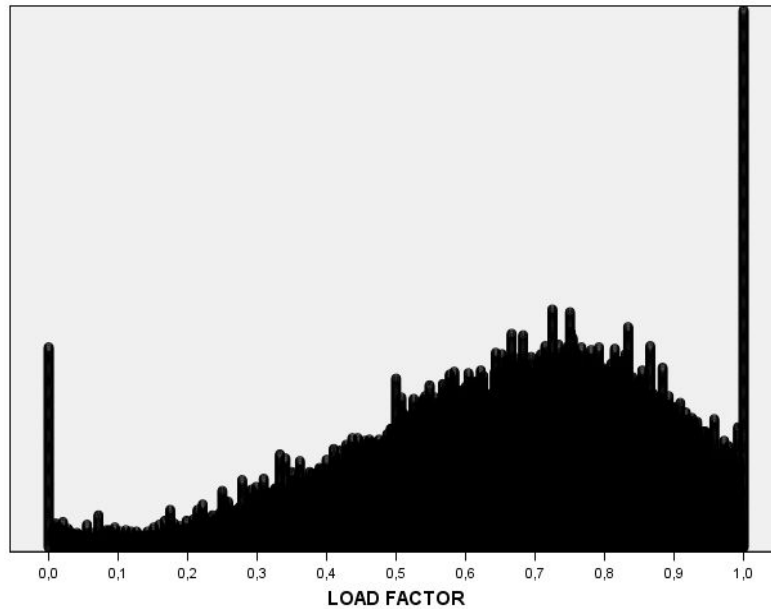


Figure 4-9 Frequency Distribution of Load Factor 2000

4.2.2.8 2001

Because of the focus on the United States, the data from 2001 was heavily impacted. The mound shape that appeared in all other data sets had a more flat top in 2001, this could be partially due to the terrorist attacks on September 11, 2001, though two of the flights hijacked on that day were owned by two of the allied carriers in this study the issues posed are outside of the realm of this study. 137 flights reported flying empty which was 0.3% of the population for that year and 351 flights had 100% load factors which accounted for 0.7% of the flights studied that year. The mean passenger load factor for 2001 was 66.2% when adjusted for distance this rose to 70.5% and the median fell close to the unadjusted mean at 66.4% capacity. The kurtosis fell below zero for the first time since 1994 in 2001, with a return of -0.135 and the skewness rose to -0.515 .

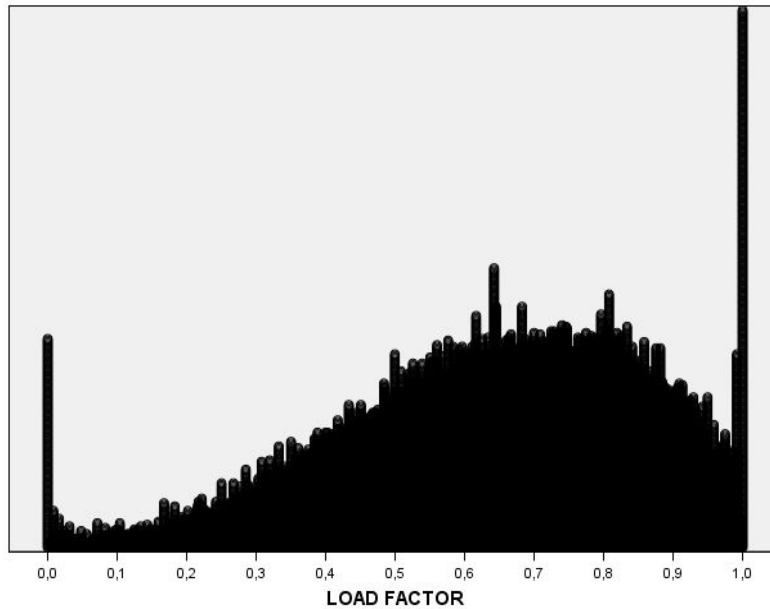


Figure 4-10 Frequency Distribution of Load Factor 2001

4.2.2.9 2002

The year 2002 reported a median population load factor of 69.5% and unadjusted mean of 67.9% after augmentation this moved to 74%. The 0%, 100% anomaly continued with 45 reports of empty planes comprising 0.1% of the total and 299 or 0.8% flew at capacity. The graph in 2002 shows a steep ascent towards the peak which is situated about the mean. In 2002 the skewness began descending again returning -.569 and the kurtosis rose above zero to .024.

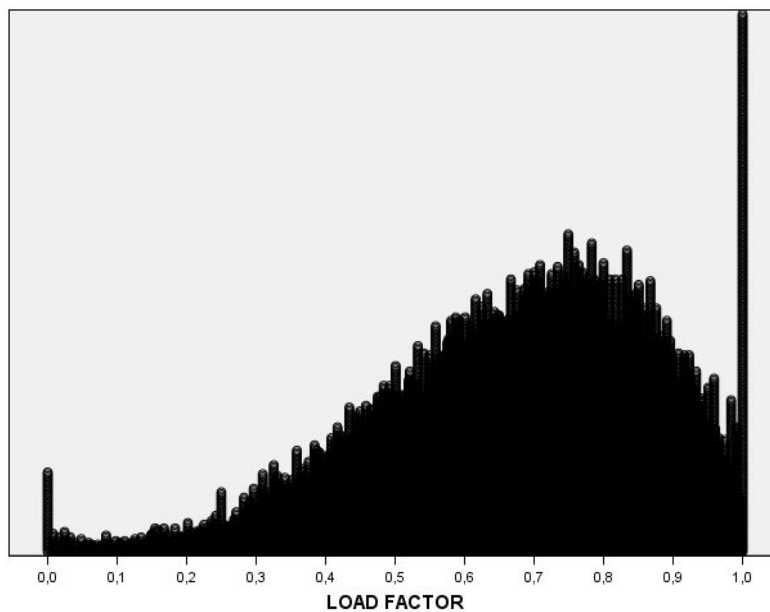


Figure 4-11 Frequency Distribution of Load Factor 2002

4.2.2.10 2003

During the year 2003 0.4% or 151 flights flew empty and 274 or 0.7% flights were flown at capacity. This produced a higher than normal spike at the 0% anomaly. The unadjusted mean load factor rose to 71.2% and the distance adjusted mean came in at 75.6%, the median for 2003 was 72.6%. During 2003 the general trends prevailed in kurtosis and skewness with returns of .884 and -.855 respectively.

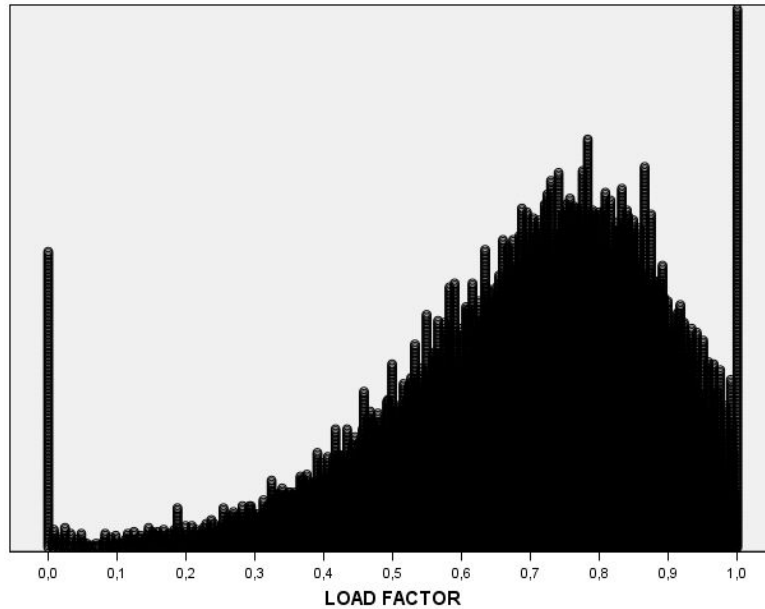


Figure 4-12 Frequency Distribution of Load Factor 2003

4.2.2.11 2004

In the year 2004 the 0%, 100% anomaly returned 0.3% of the flights with 0% load factor which was 96 and 318 or 0.8% of the flights had 100% load factors. The mean without adjustment for distance was 73.6% and once adjusted it became 78.5%. The median was 74.26%, which was about in line with the unadjusted mean. The kurtosis rose to .996 and the skew fell to -.944.

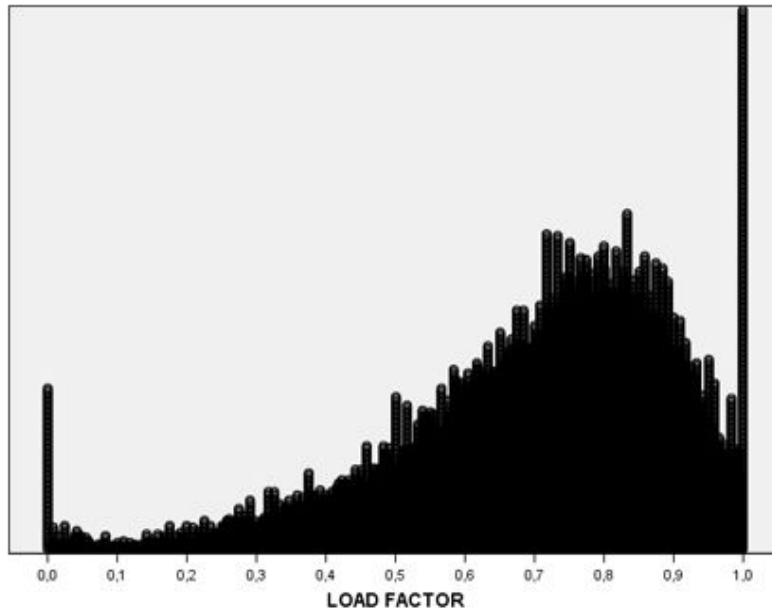


Figure 4-13 Frequency Distribution of Load Factor 2004

4.2.2.12 2005

Of the 37901 flights under investigation in the population during 2005 0.3% or 109 flew without any passengers and another 291 or 0.8% flew with 100% load factors. During that year the population unadjusted load factor was 74.9% and distance adjusted the load factor for the population was 80.1% the median was factored to be between the two means at 76%. 2005 saw the first kurtosis above one and skew below negative one with a measurement of 1.267 and -.1061 respectively.

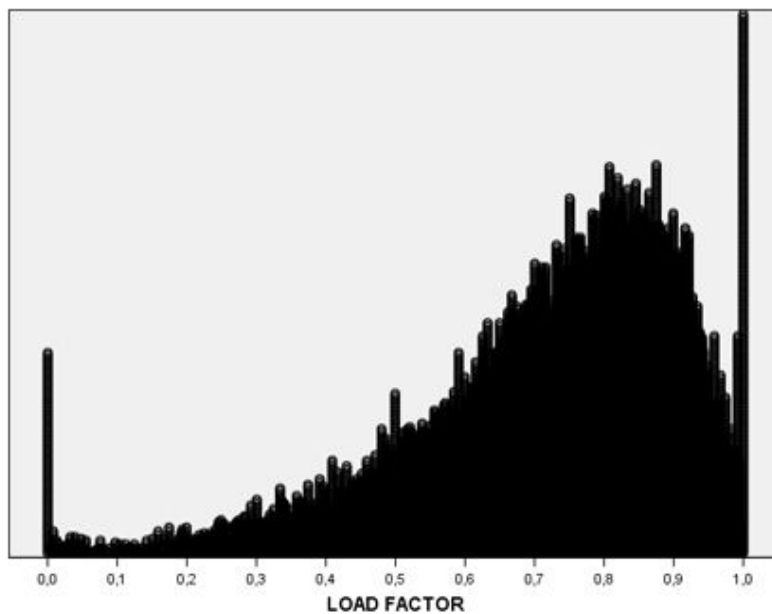


Figure 4-14 Frequency Distribution of Load Factor 2005

4.2.2.13 2006

The 0%, 100% anomaly in the data for 2006 produced 108 empty planes or 0.3% of the population and for the first time the 100% load factor was not the most populated though it reported 303 flights constituting again 0.8% of the population. This visible cluster produced a peak about the median which was 79%. The mean for that year was 78% without distance adjustments and 81% when adjusted for distance. The measurements for moment returned -1.311 for the skew and 2.467 for the kurtosis.

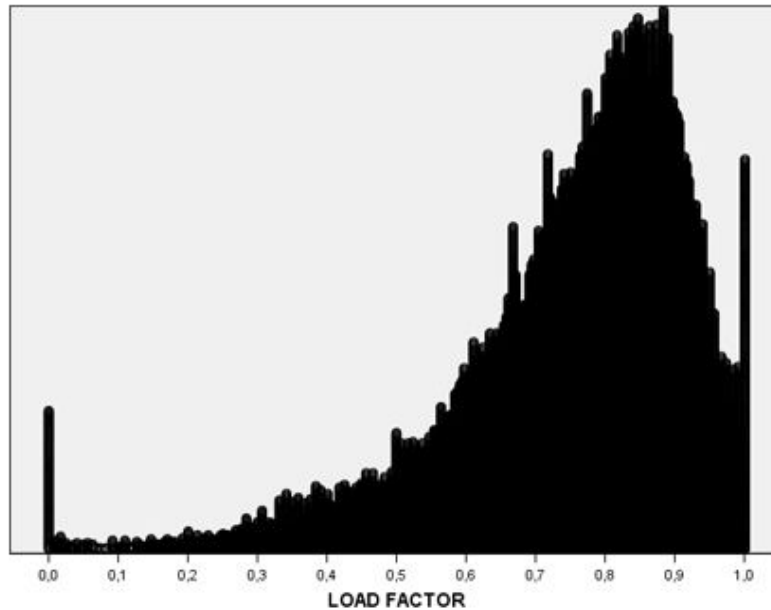


Figure 4-15 Frequency Distribution of Load Factor 2006

4.2.2.14 2007

The final year in the study had a similar formation to 2006 with the peak of the mound producing more results than the 100% load factor peak. The anomaly at 0% accounted for 134 flights which was 0.4% of the total for that year and the 100% load factor had 247 or 0.8% of the population. This continued to be inline with other years albeit the 0% peak was on the high side of the average. The means and median for 2007 were the highest of the period in the study on all measures. The median was 81.4% and the unadjusted mean for the population was slightly lower at 79.8%. When adjusted for distance the mean moved up to 82.6%. The final year in the study showed a dramatic increase in the kurtosis as with the previous year of 4.046 and the skew dropped to -1.629.

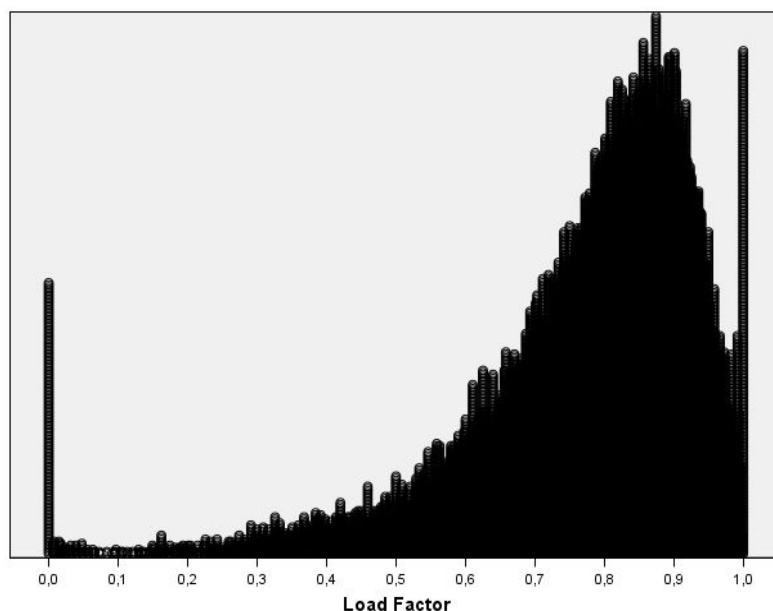


Figure 4-16 Frequency Distribution of Load Factor 2007

4.3 Denied Boarding Compensation

4.3.1 International policies and regulations

Because of globalization, the progression of liberalization and the growth of the airline industry governing policies and regulations of airline carriers are of great importance. The reason why these types of policies and regulations are developed is to create common rules that will both protect passengers against airline misconduct and increase the levels of compensation to the passengers. However, regulations tend to differ between various regions and countries, this section has only described the set of policies and laws related to the United States, the European Union and the members of Star Alliance.

U.S. Department of Transportation (DOT) – 14 CFR §250

In accordance to the regulations of the US Civil Aeronautics Board, a passenger that is voluntarily or involuntarily denied boarding, when holding a reserved seat, is entitled to financial compensation. This regulation applies to all airline carriers, both domestic and foreign, that depart from an airport from the United States. In case of an overbooking, the airline carrier must start by asking for volunteers who would be willing to give up their seat in exchange for compensation, which is a mutual agreement between the carrier and the passenger. However, if the number of volunteers is too small, the airline will, according to priority procedures and the magnitude of excessive amount of passengers, deny an additional amount of passenger enplanement.

If substitute transportation can be arranged within one hour, an involuntary denied passenger shall either be paid the maximum amount of \$200 or be re-paid for the value of the ticket, if the ticket is worth less than the maximum amount. Conversely, if the airline is not able to arrange substitute transportation, the passenger can receive twice the amount of the maximum compensation.

However, the Department of Transportation announced recently that they have decided to modify the existing regulation and double the maximum amount, paid out to involuntary denied passengers. If substitute transportation enables passengers to reach their domestic destination within two hours or four hours internationally, these passengers will be able to collect compensations equal to their one-way ticket cost with a maximum of \$400. Although, if this time-limit exceeds either two or four hours, depending on the situation, the airline carrier will be forced to compensate the passenger with \$800. Another modification of the regulation is that it now also applies to aircrafts that can carry between 30 and 60 passengers, which previously have been excluded from this regulation.

Regulation (EC) No 261/2004 of the European Parliament

The following section will explain the scope of this regulation:

- This law applies to passengers that are departing from an airport situated in an EU member state.
- It also concerns passengers departing from an airport situated outside EU and arrive in an airport in a member state, except for when is operated by non-EU carrier or when compensations are received through the departing country.

In a situation when a flight is overbooked, the airline begins by asking the passengers for volunteers whom are ready to surrender their reserved seat in exchange for various benefits, mutually agreed between the carrier and the passenger. If the number of volunteers is insufficient the airline carrier is forced to deny boarding for an additional amount of passengers. These passengers are therefore denied boarding against their wishes, hence the name: involuntary denied boarding.

A passenger that is unwillingly denied boarding for a flight, shall receive payment according to the following section:

- The passenger shall receive €250 for all flights, when traveling less or equal to 1500 kilometers.
- The passenger shall receive €400 for all intra-Community flights, when traveling more than 1500 kilometers. The same amount is also paid for all other flights, when traveling 1500 to 3500 kilometers.
- The passenger shall receive €600 for all other flights.

Other laws and regulations

Due to the fact that airlines, included in this study, departed domestically within the US or from other countries than those being part of the European Union, the EU and the US regulations might not apply. Research reveals that regulations, on an international level, differ and might even occasionally overlap each other. Because of the contradiction and confusion in domestic and international laws in the airline industry, the next paragraph will attempt to further explain the majority of the remaining carriers' position on this subject.

Association of Asia Pacific Airlines (AAPA), which speaks on behalf of several of the concerning airline carriers in the Asia Pacific-region, states that the regulatory development in both the European Union and the United States has a profound impact on all international airline carriers, including the members of AAPA. This statement even further reiterates that regulations originating from the EU and the US dominate the airline industry and af-

fect all operating airline carriers (AAPA, 2006).

Furthermore, International Air Transportation Association (IATA) also recognizes the regulations issued by the US Department of Transportation and European Parliament. Because IATA represents 94% of the international air traffic, they have on several occasions corresponded to these regulations and questioned the magnitude of the accountability that is put on airline industry, concerning these matters. It is therefore likely to assume that IATA, which represents a majority of the airline industry, regards these regulations as the dominating guidelines of how airlines should handle denied boarding compensations (IATA, 2007).

4.3.2 Quantitative View

The Bureau of Transportation Statistics publishes yearly figures on denied boarding, both for the involuntary and voluntary sort for a variety of reasons. Though this report will not delve into the intricacies of the motivation behind collections of these statistics, the data was analyzed for the purposes of the study. The complete table for the figures can be found in Appendix 4. The general trend for denied boardings in the United States can be seen in Figure 4-15 below, the data was gathered from the BTS and comprises of denied boarding statistics from all major American domestic airlines on domestic flights..

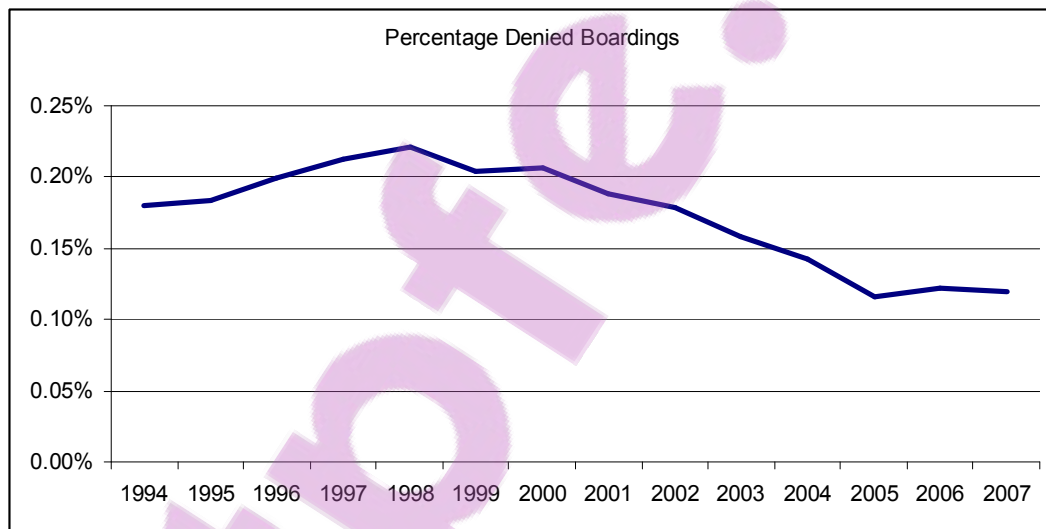


Figure 4-17 Denied Boardings 1994-2007

This figure shows that through the middle of the 1990's the ratio of passengers denied access to their flights increased and then began a steady drop beginning in 1998. Though the data does not match the same selection criteria as the rest of the report there were many correlations with the findings in those sections. This helped to validate the findings of the studies and was useful in testing the theories related to beta distribution movements and the 100% anomaly. These issues are discussed in further detail in the analysis section of the study.

5 Analysis

In this section an analysis is presented by bringing theories and empirical data together. This will give the reader an understanding of how load factors have changed during the years for the allied companies.

5.1 Load Factors

5.1.1 Issues to be analyzed

Due to the presence of the 0%, 100% load factor anomalies, statistical estimations of distributions are discussed in the analysis which also includes a discussion on the motion of the means versus the mode. It was determined that a simple mean would not fairly represent the distribution of passengers because of the change in shape of the distribution. This can be clearly seen by the steepening of the slope towards the peak of the mound. Furthermore, the analysis discussion investigates the above graphs using a deciles distribution chart.

5.1.2 Deciles

As mentioned previously the skewness and excess kurtosis present in the frequency distribution chart made analysis under the normal distribution assumption impossible. Initially the data was simplified to establish an estimation of the distribution; this was done using deciles 1 through 9 of the load factor returns. The figure 5-1, graphically presents this. As can be viewed reading from left to right the load factors exhibit a generally increasing median load factor, represented by the 5th deciles. This shows that the demand of air travel provided by the carriers under investigation increased faster than the supply. The notable factor in this graph is that the lower deciles, which show the lowest load factors, have a more exaggerated movement upwards and downwards than the upper deciles, which represent the higher load factors. This causes bunching around the mean as was visible in the empirical findings section under the frequency distribution charts for 1994 to 2007. Because of the bunching or kurtosis and skewness the nearly-normal-distributions seen in the mid 1990s cannot have merely translated to the right, this can also be assumed because of the fairly stable returns in the 0%, 100% anomalies.

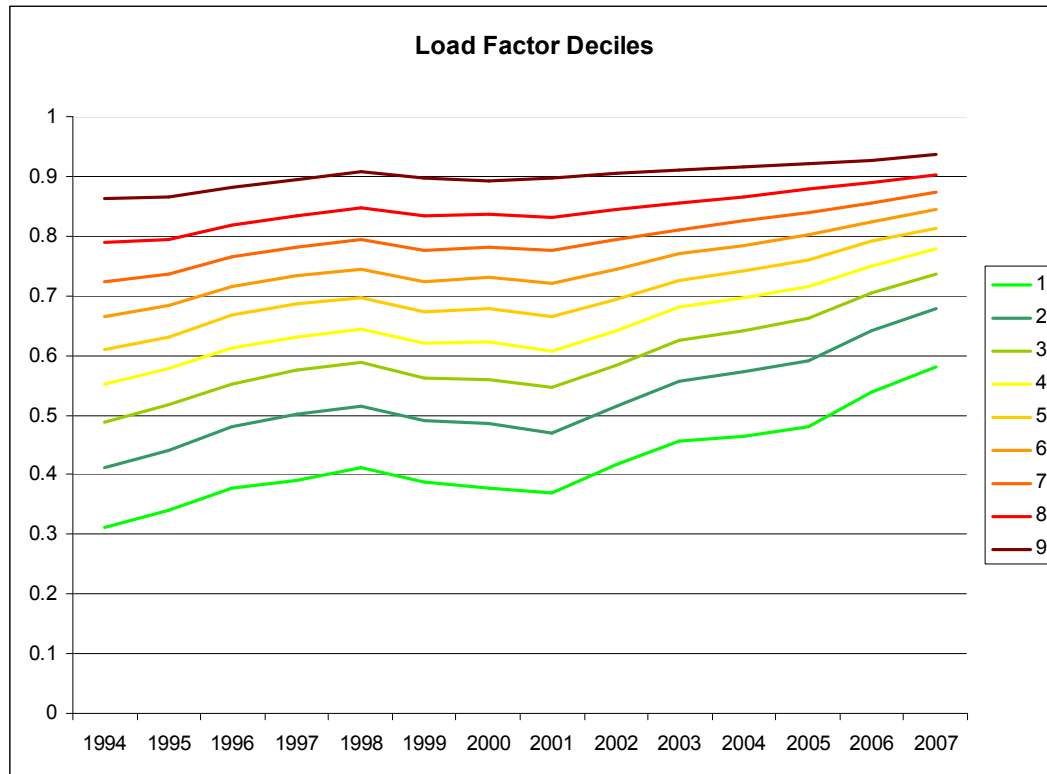


Figure 5-1 Load Factor Deciles

Theoretically, were the airlines to simply increase load factors because of an increase in customer demand relative to carrier supply, the load factors would maintain a similar shape and translate rightwards. In this case the relative frequency of a 100% load factor would increase as more planes flew at capacity. This would provide a positive and negative effect for the profits of the airlines. The airline would have a full plane but that would come at a cost, due to regulations set forth by the DOT, IATA, as well as regulatory bodies dealing with aviation in many other countries as well as self-imposed company policies, airlines are required to provide compensation to passengers whom are denied the right to board the aircraft. The higher average load factors which maintain neutral or negative kurtosis can provide extra costs to carriers providing air travel services because of the higher probability of overselling flights which are overbooked.

In contrast to the hypothetical translation of load factor from left to right on the frequency distribution graphs or an upwards translation on the load factor deciles figure above the negative skewing and increasing kurtosis should be looked at as a positive outcome of allying. The high level kurtosis reduces the chance for an outlier above 100%, which would create a demand greater than the capacity of the flight because a distribution with a higher kurtosis will have a greater level of concentration about the mean. A negative skew in the frequency distribution is also a positive attribute as it deems the mean, which is often used a performance measurement by airlines in their annual reports and press reports, is lower than the expected value on the probability density function. Both of these factors are seen in the higher latitudes of load factor which suggests more efficient prediction during times

of higher demand and utilization of the equipment. For most investors and managers a high negative skew could provide an added bonus to a higher average load factor.

5.1.3 Probability Density Function

The frequency distribution data presented in the empirical findings section lead the production of probability density functions. These functions are useful in describing the curve along the data and ultimately lead to prediction models of the data. Because of the high levels of skew and kurtosis seen in the statistical measurements section 4.2.3, it was decided to test the distribution of the data against pre-established continuous probability distributions. From these test it was revealed that a beta distribution was the most appropriate, the results from the tests as measured by SPSS are to be found in Appendix 1. As mentioned in the theoretical framework the probability density function for a beta distribution is:

$$f(x) = \frac{x^{\alpha-1} (1-x)^{\beta-1}}{B(\alpha, \beta)}$$

Equation 12 - Probability Density Function for a Beta Distribution

where α and β are constants for which $\alpha > 0$ and $\beta > 0$, x is the variables for the observed point x , and

B is the beta function, defined as:

$$B(x, y) = \int_0^1 t^{x-1} (1-t)^{y-1} dt$$

Equation 13 – The Beta Function

In order to predict α and β constants for the purposes of describing the frequency formulas using the variance and mean produced using SPSS and presented in the statistical measurement section of the empirical findings sections the following models from the US National Institute of Standards and Technology were adapted for use:

$$\alpha = \bar{X} \left(\frac{\bar{X}(1 - \bar{X})}{\sigma} - 1 \right)$$

Equation 14 - The Alpha constant estimator

$$\beta = (1 - \bar{X}) \left(\frac{\bar{X}(1 - \bar{X})}{\sigma} - 1 \right)$$

Equation 15 - The Beta constant estimator

The parameters for each year were then used as the α and β constants in the beta distribution probability density function to produce the figures in sections 5.1.3.1 through 5.1.3.14.

The mode for this distribution is calculated using:

$$\text{mode} = \frac{\alpha - 1}{\alpha + \beta - 2}$$

Equation 16 - Mode (NIST, 2008)

5.1.3.1 1994

The first year of the study had a probability density function which yielded $\alpha=2.738236$ $\beta=1.862411$. As expected given the beta-distribution probability density function, this produced a fairly symmetrical curve; see Figure 5-1.

Before looking at further probability density curves it should be noted that y-axis in the figures is not constant, this can graphically under- or overstate the degree of kurtosis to an injudicious reader.

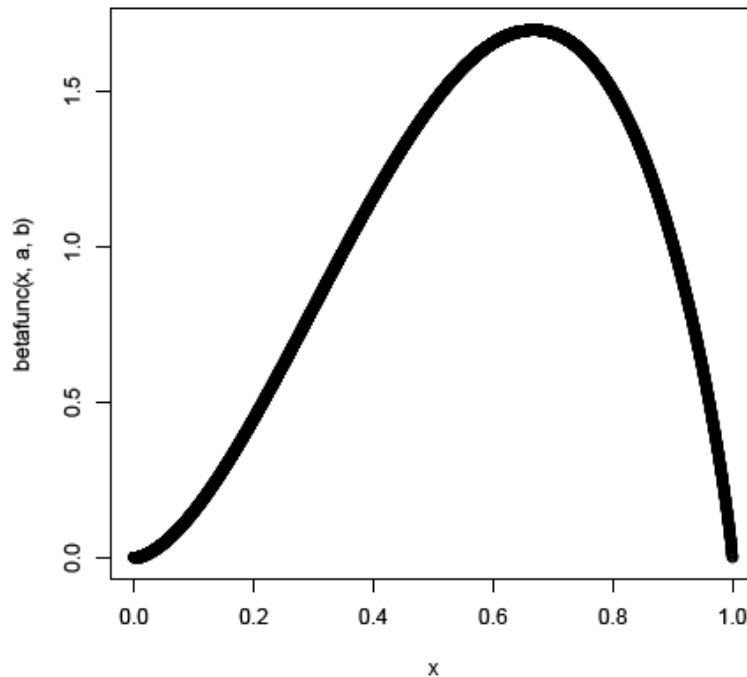


Figure 5-2 PDF curve for load factor distribution in 1994

To interpret Figure 5-1, as well as Figures 5-2 through 5-14, the x-axis should be read as the load factor. The y-axis should be viewed as the probability, in percentage terms, of returning a load factor along the curve. This curve then roughly estimates the leading edge of the histograms in section 4.2.2.1 through section 4.2.2.14, save the anomalies return at 0% and 100%.

The 1994 probability density function, Figure 5-1 above, yields a peak at the mode of 66.8% load factor, see Appendix 1, which theoretically represents roughly 1.75% of the returns from the year. It can then be expected that roughly 1020 flights of the 58202 population sample had a roughly 65% load factor, which is consistent with data found at the BTS and therefore is consistent with the frequency distributions seen in the empirical findings section, 4.2.2.1.

5.1.3.2 1995

In analyzing the frequency distribution for 1995 the Figure 5-2 was created using the parameters of 3.031677 and 1.902757 for alpha and beta, respectively. From these numbers it can be immediately seen that not only was α higher than β proportionally but also in absolute terms which yields both a lower skewness and higher kurtosis. As can be seen in the statistical measurements these were -.380 and -.306 respectively as mentioned previously in the empirical findings.

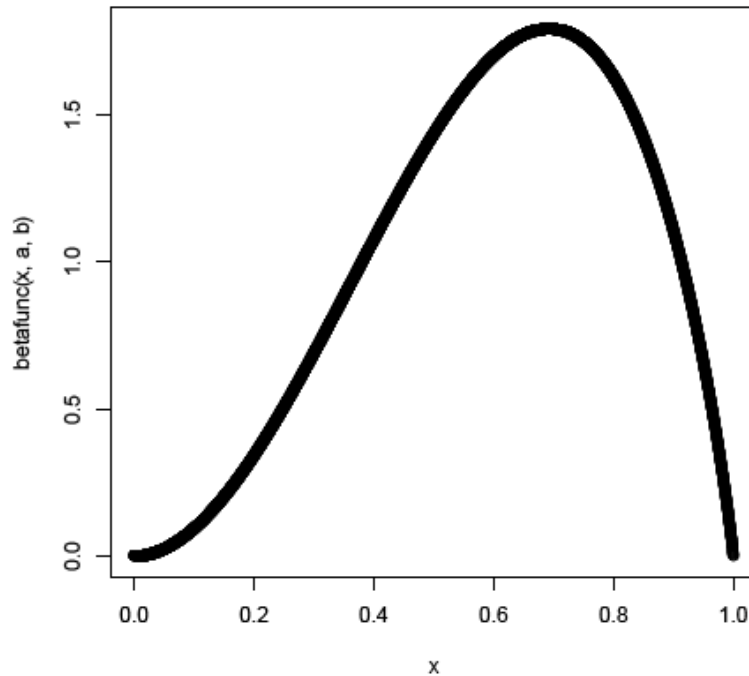


Figure 5-3 PDF curve for load factor distribution in 1995

The mode for the probability density function plotted for 1995, was at 69.2% load factor. This registered above the mean of 59.2% load factor and median of 63.1% load factor and 65.2% when adjusted for distance. Figure 5-2 returned a calculated peak of roughly 1.75% of all data in the study.

5.1.3.3 1996

The probability density function plotted for 1996 used the parameters of $\alpha=3.210144$ and $\beta=1.776526$. This produced a mode of 74% load as compared with the calculated unadjusted mean of 66.3%. This continued trend of a larger mode than mean is consistent with the negative skew present in these beta distributions and highlights the untold advantage that the management cannot present to their shareholders through a simple unadjusted mean of load factors on their flights. The figure below also indicates a mode which captured roughly 2% of the values distributed for that year.

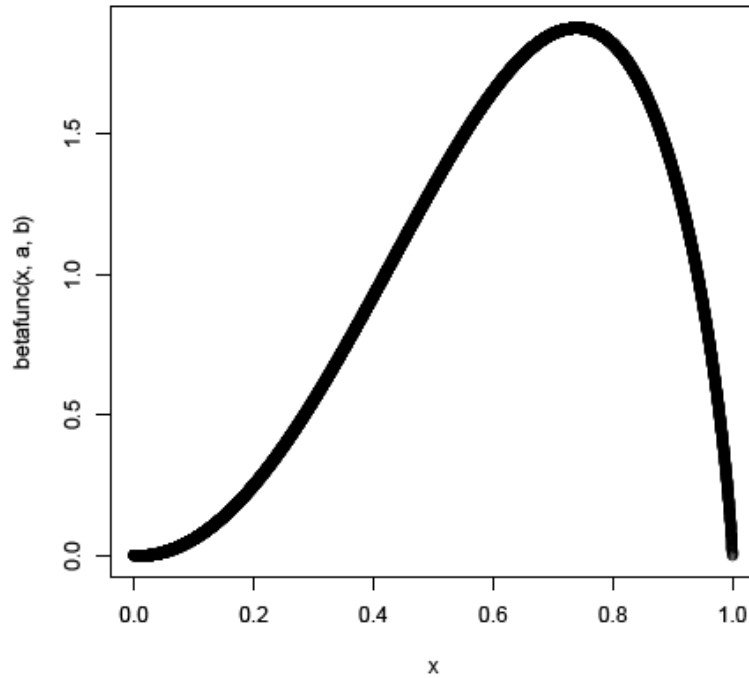


Figure 5-4 PDF curve for load factor distribution in 1996

5.1.3.4 1997

The estimation parameters for alpha in 1997 was 3.327107, and for beta was 1.719505 which yielded a mode at 76.4% load compared with the mean of 67.4% for the same year. This follows in line with the trends for the kurtosis and the skewness presented in the empirical findings in that the kurtosis continued to rise and the skewness fell and this is emulated by the ratio of alpha to beta and the absolute value in both parameters. Figure 5-4 demonstrated that the mode of 76.4% load represented approximately 2% of the flight segments in the study for that year.

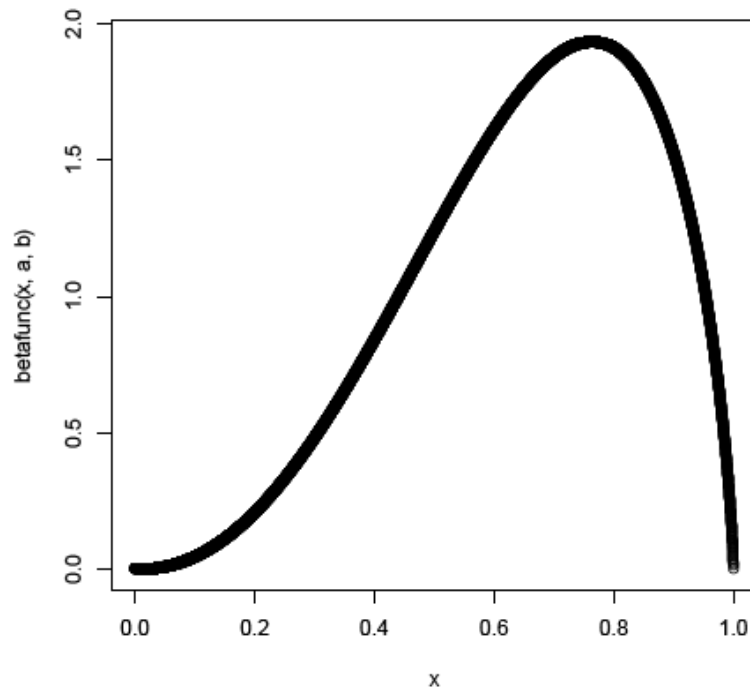


Figure 5-5 PDF curve for load factor distribution in 1997

5.1.3.5 1998

Figure 5-5 shows that again roughly 2% of the flights had a load factor of 79.1%, which was the mode; this can be compared with the mean that year of 69.3% without adjustments for distance. The parameters for the 1998 model were $\alpha=3.320463$ and $\beta=1.611865$.

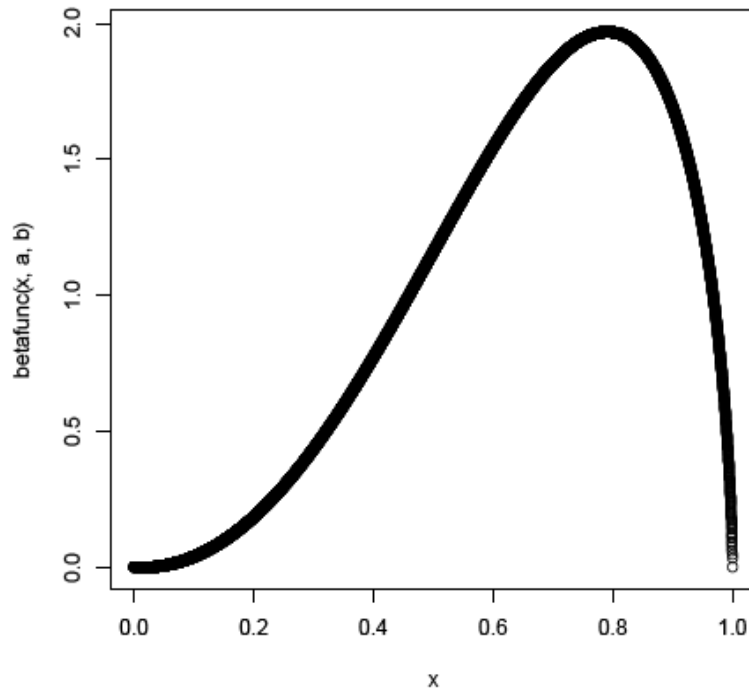


Figure 5-6 PDF curve for load factor distribution in 1998

5.1.3.6 1999

The probability density function used the constants of 3.174861 for alpha and 1.596335 for beta which produced Figure 5-6. The mode was then calculated to be at 78.5% which is the first time that there was an observed drop in the mode and which correlates with the first time that the sample observed a drop in the unadjusted mean, to 67.3%, during the study. The mode again fell to represent roughly 1.75% of the flights under investigation during the last year of the last millennium.

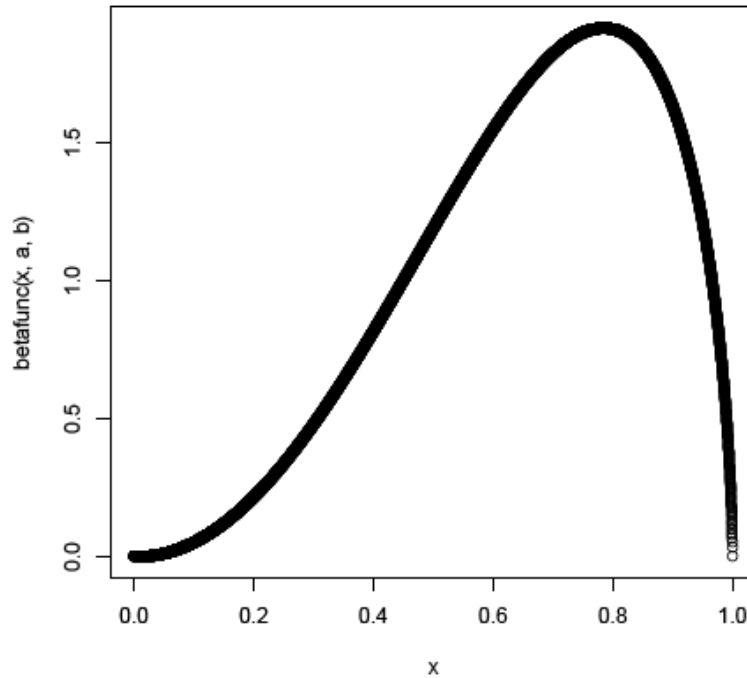


Figure 5-7 PDF curve for load factor distribution in 1999

5.1.3.7 2000

The unadjusted mean for the aggregate of carriers under investigation rose slightly to 67.7% in 2000. When α and β were calculated for this sample it produced constants of 2.949405 and 1.561285, from these constants the mode was calculated to end at 77.6, which again fell from the previous year. This spread in direction between the mean and the mode can be explained by the drop in α from the previous year whilst β remained fairly stable. This resulted in a lower kurtosis than the previous year, -.544 in 2000 comparison with .012 in 1999, though the data returned a higher skew which would normally cause the mode to increase relative to the mean. In Figure 5-7 it can also be seen that roughly 1.75% of the data is explained at the maximum point, which is the mode.

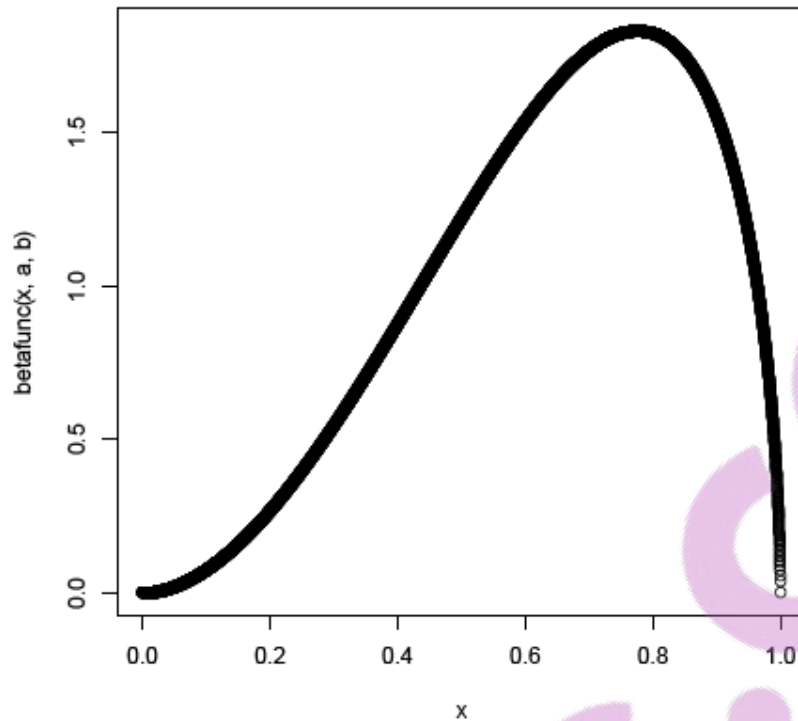


Figure 5-8 PDF curve for load factor distribution in 2000

5.1.3.8 2001

In 2001 the alpha was calculated to be 2.927107. The beta constant was estimated at 1.612085 and in tandem with the alpha constant the parameters were used to create Figure 5-8. The mean for 2001 dropped to 66.2% and the mode dropped to 75.9% which was not unexpected given the US-centric approach of the data. Though the empirical data showed a notable flatness in the peak of the distribution in the frequency distribution graphs the beta expectation plot in Appendix 1 still shows the model following expectations

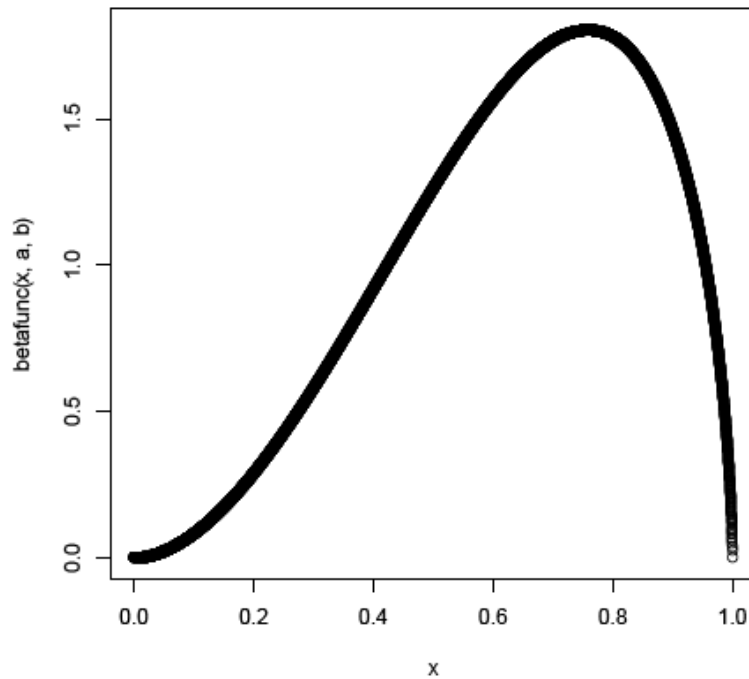


Figure 5-9 PDF curve for load factor distribution in 2001

Figure 5-9 also showed that the mode predicting roughly 1.75% of the flights in the population for 2001.

5.1.3.9 2002

The years following the year 2001 showed an interesting pattern. These years were difficult for many airlines, but the measurements of kurtosis and skew began to grow at a faster pace than in the former part of the study. The alpha calculated in 2002 was 3.534949 and the beta was 1.710109, this produced a mode of 78.1%. The mode compared with the unadjusted mean of 67.9%. The mode also returned 2% of the flights contained in the dataset for 2002, as can be seen in Figure 5-9.

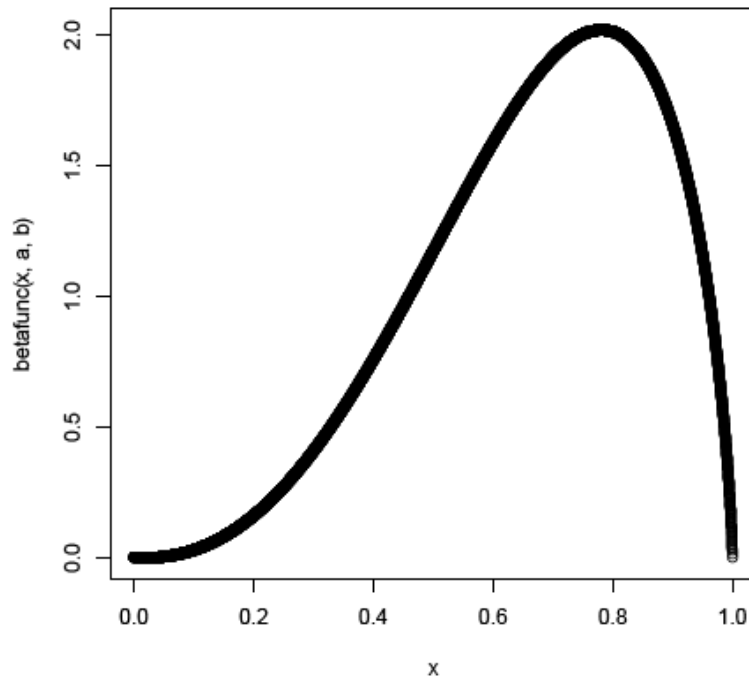


Figure 5-10 PDF curve for load factor distribution in 2002

The model for 2002 and the metrics of its parameters closely represented the model and probability density curve as seen in 1997, though they are not identical.

5.1.3.10 2003

The trend of increasing kurtosis and skew sped in 2003 which returned $\alpha=3.79563$ and $\beta=1.630994$. This model was used to estimate a mode at 81.6% which represented over 2% of the flights during that year, see Figure 5.10. The mode of over 80% was a boon to the mean of 71.2% which was already higher than any seen before in the study.

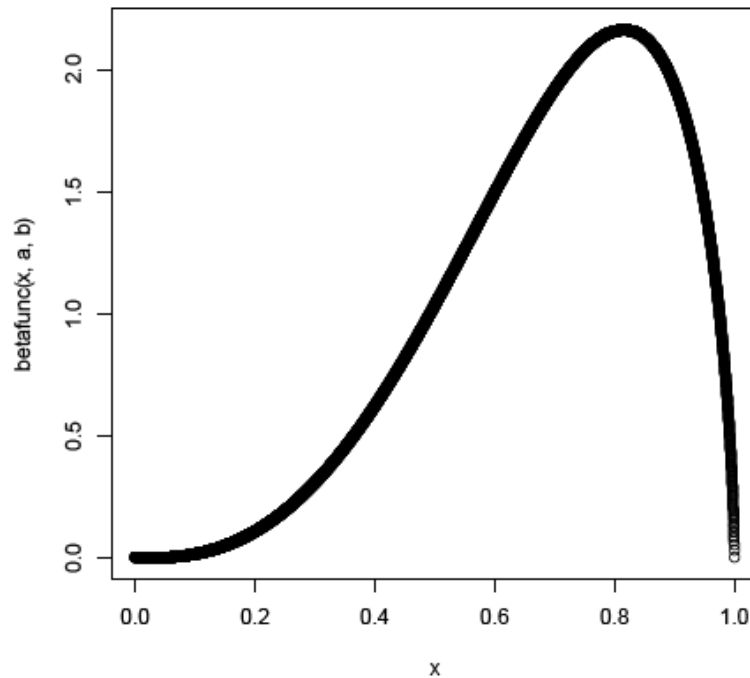


Figure 5-11 PDF curve for load factor distribution in 2003

5.1.3.11 2004

The leap in the previous year understated the advancements made in 2004 when the model had the estimated parameters of $\alpha=3.760583$ and $\beta=1.522856$. This yielded a mode equal to 84.1% load compared to the mean of 73.6% load. As can be seen in Figure 5-12 the mode represented well over 2% of the flights in the frequency distribution.

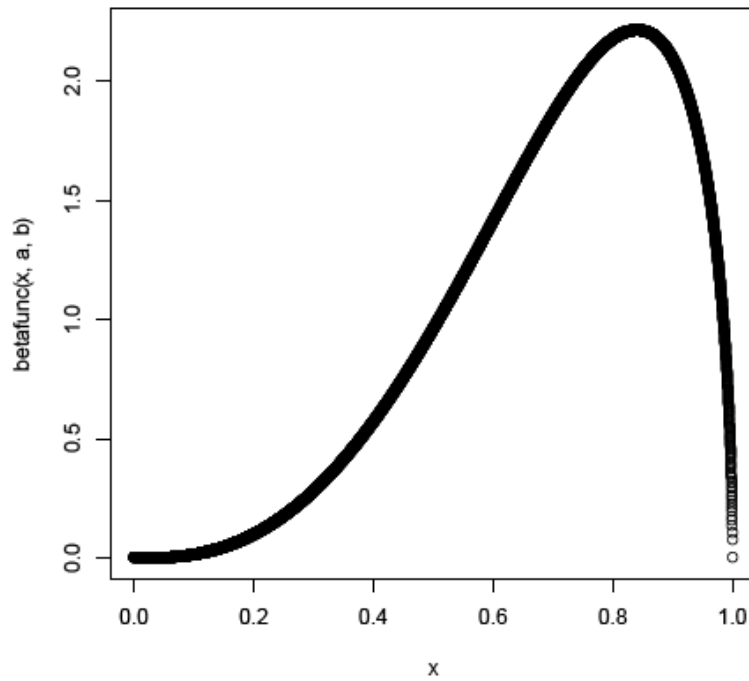


Figure 5-12 PDF curve for load factor distribution in 2004

5.1.3.12 2005

The α in 2005 remained fairly stable at 3.764886 but the β constant decreased to 1.42466 which caused the decrease in skew to be greater than the increase in kurtosis for that year. The mode increased to 86.7% while the unadjusted mean rose to 74.9% load. The mode represented roughly 2.25% of the data and as visible in the figure showed a quick drop in frequency after the mode.

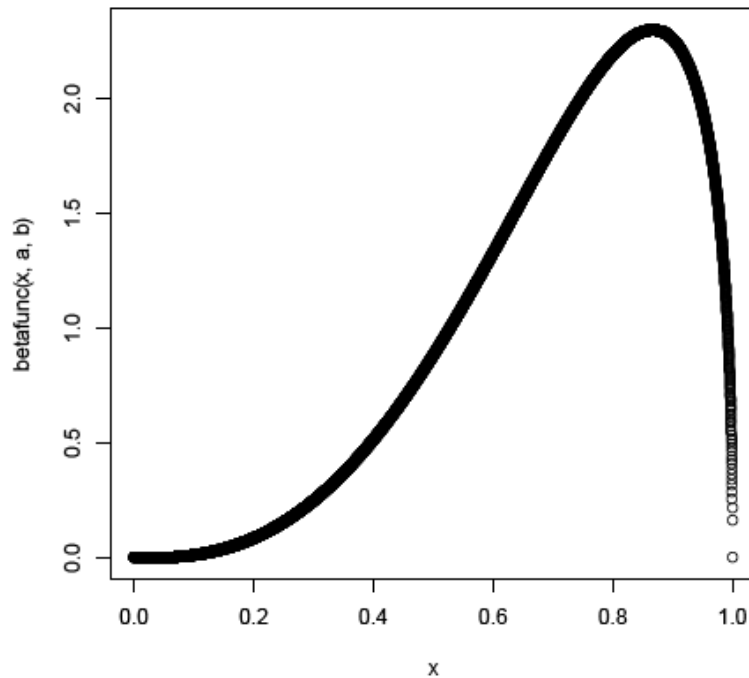


Figure 5-13 PDF curve for load factor distribution in 2005

5.1.3.13 2006

In 2006 the alpha constant rose quickly again and was calculated to be 4.458387 while the beta rose only slightly to 1.443002. This resulted in a high variation in both the kurtosis and the skewness measures for 2006. The mode at 88.6% represented over 2.5% of the flights for that year while the unadjusted mean was ‘only’ 78%. This year, as was mentioned in the beginning of this section, also was the first time that there was a notable deviation from the expectation on along the beta expectation plot, Appendix 1. Though there was a deviation it was not deemed to be substantial. If the deviation became too great then there would be a risk that the underlying shape of the distribution would have fundamentally changed. The meager deviations were mostly results of the high kurtosis and skew which lead the 0% anomaly to be highly influential in the calculation of the expectations of the beta distribution.

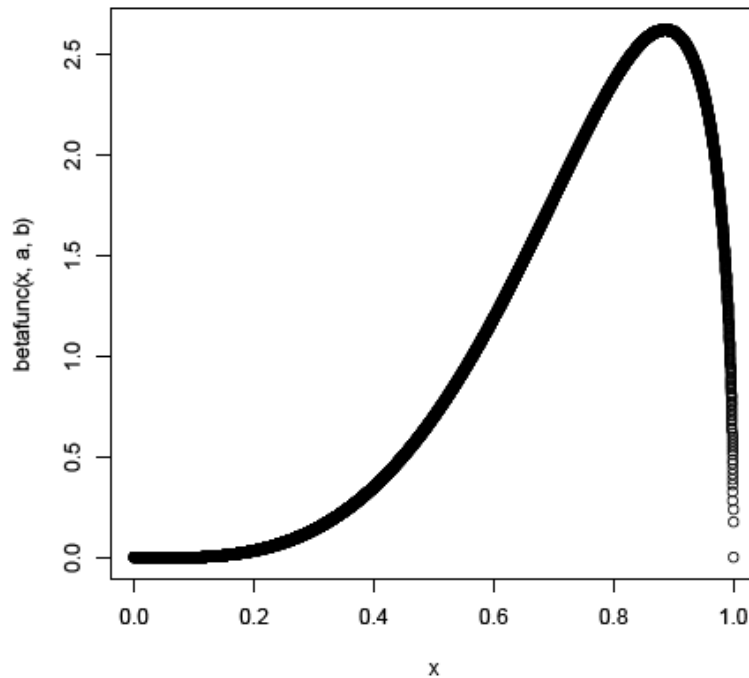


Figure 5-14 PDF curve for load factor distribution in 2006

5.1.3.14 2007

During the final year of the study the distribution continued rapidly rising in terms of kurtosis though the parameters estimating the probability density function did not change as rapidly. The alpha increased slightly to 4.642669 and the beta fell to 1.31996. This then lead to a mode of 91.9% load where as the calculated mean was only at 79.8%, the mode represented nearly 3% of the flights on the frequency distribution for 2007.

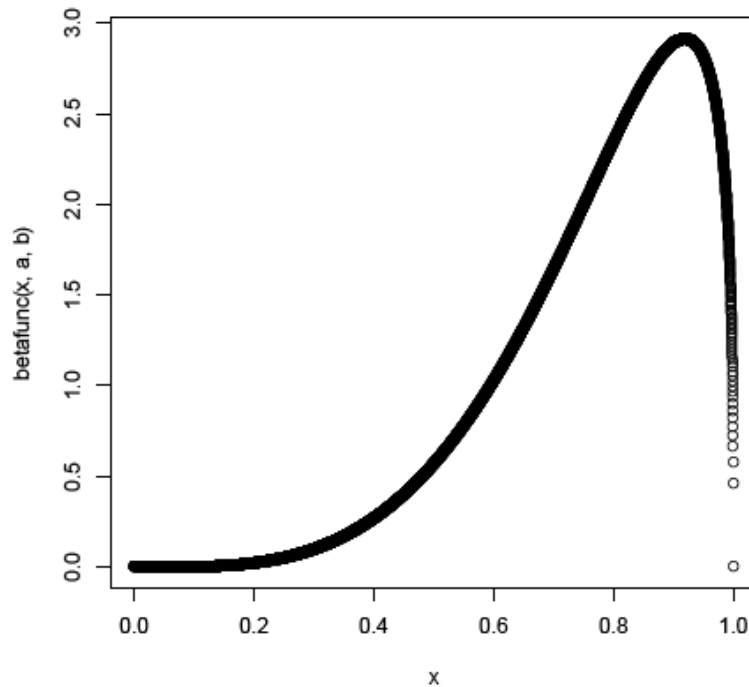


Figure 5-15 PDF curve for load factor distribution in 2007

5.2 Distribution Shifts

Due to the assumptions made in the initial analysis pertaining to the beta distribution shift versus the normal distribution shift, it was necessary to investigate further the impact of the 100% anomaly as it pertained to the shifts and denied boarding statistics. As stated in the theoretical framework, Section 2.6.1.2, there were discussions about the assumption of a distribution shift in a normal and beta distribution. The ability for the beta distribution to skew itself and take on kurtosis allows the limiting load at 100% to not pose a complication, if the normal distribution were to be used in analysis of these curves it would not allow for this solid stop point and thus would require further statistics on potential demand and further investigation on over selling of flights.

Due to the analysis provided on the mean shift over the year it was necessary to return to the hypothesis test 1 to clarify the likelihood of an increase in mean load factor. For the delimited population this can be ascertained immediately from the empirical findings without the aid of a prediction test because the calculated mean was not sampled and comprised all of the data which remained in the set. The analysis for the unadjusted mean then becomes:

1994-1995: $62.3\% \geq 59.2\%$, do not reject H_0

1995-1996: $59.2\% < 66.3\%$, reject H_0

1996-1997: $66.3\% < 67.3\%$, reject H_0

1997-1998: $67.3\% < 69.3\%$, reject H_0

1998-1999: $69.3\% \geq 67.5\%$, reject H_0

1999-2000: $67.5\% \geq 67.7\%$, reject H_0

2000-2001: $67.7\% \geq 66.2\%$, do not reject H_0

2001-2002: $66.2 < 67.9\%$, do not reject H_0

2002-2003: $67.9\% < 71.2\%$, reject H_0

2003-2004: $71.2\% < 73.6\%$, reject H_0

2004-2005: $73.6\% < 74.9\%$, reject H_0

2005-2006: $74.9\% < 78\%$, reject H_0

2006-2007: $78\% < 79.8$, reject H_0

This shows that in a majority of the years the mean did actually increase. This would suggest that 10 of the 13 years witnessed an increase in the mean.

The capacity measures, load factor, followed a normal distribution making a rightward shift the over selling of flights would increase, *ceteris paribus*. Figure 5-1 showed the tendency of over selling under denied boarding and allowed for initial skepticisms of this possibility. Correlation analysis was run against the data from BTS and the calculated kurtosis and skewness measures presented in section 4, the results can be seen below in Figures 5-16 and 5-17.

Correlations

		Denied_Boarding	Kurtosis
Denied_Boarding	Pearson Correlation	1	-.783(**)
	Sig. (2-tailed)		.001
	N	14	14
Kurtosis	Pearson Correlation	-.783(**)	1
	Sig. (2-tailed)	.001	
	N	14	14

Figure 5-16 Correlations

** Correlation is significant at the 0.01 level (2-tailed).

Figure 5-16 shows the correlation returns as analyzed by SPSS. The correlation was significant at $-.783$ with a two-tailed sigma of $.001$ which was less than 5% , this implied that as kurtosis increased the percentage of denied boardings decreased. Figure 5-17, below, showed the correlation analysis between denied boarding and the skew of the frequency distribution. There was a $.804$ correlation with the same two-tailed sigma level as kurtosis and denied boardings. This meant that as the skew went further below zero and graphically moved rightwards the percentage of denied boardings decreased as well.

Correlations

		Denied_Boarding	Skew
Denied_Boarding	Pearson Correlation	1	,804(**)
	Sig. (2-tailed)		,001
	N	14	14
Skew	Pearson Correlation	,804(**)	1
	Sig. (2-tailed)	,001	
	N	14	14

Figure 5-17 Correlation

** Correlation is significant at the 0.01 level (2-tailed).

These two factors proved some link between the capacities of aircraft in the study and the amount of excess demand, and when coupled with the beta distribution excess tests in Appendix 1 severely reduced the possibility of a simple translation of distributions and thus makes it possible at the $\alpha=.05$ level to reject the null hypothesis. It then comes that the negative correlation in between kurtosis and denied boardings that as time passed and the mean load factor increased that the amount of denied books decreased, H_B must then be the correct assumption. This is furthered in the decrease in skew which moved the mode rightwards, increasing with the mean while the proportion of denied boardings decreased, still aligning with H_B .

5.3 Star Alliance and the environment

When analyzing the numbers and strategies of Star Alliance and its competitors, it becomes obvious that there is much in common. However, as this research only includes a case study of Star Alliance additional connections to the condition of other horizontal alliances are discussed in this section only topically.

Because Star Alliance and its main competitors are closely related in terms of strategy and goals, it is fair to assume that these alliances have been created for similar reasons. As stated in the article written by Johnson et al. (2005), there are three different organizational motives behind the creation of a strategic alliance. After further investigating which of the motives are most likely to be associated with each of the alliances, it became clear that this could not be entirely concluded as organizations and alliances have different types of focus over time. The environmental-based motive is strongly connected to Star Alliance, as they were the first to react to the change in globalization and customer demand. However, because both Skyteam and Oneworld quickly reacted to the creation of Star Alliance, it cannot be stated that these did not create their alliances because of changes in the environment. A more fair assumption is that environmental motives play a huge role for any organization that attempts to join or establish an alliance. The next alternative is the capability-based motive, which is probably mostly connected to Star Alliance as they found new ways to better utilize their own capabilities by joining forces with other competitors and thereby generate synergies. Seeing that synergies are closely related to the sharing of resources and capabilities between partners, there is a high probability that these synergies resulted in the overall increase in efficiency and load factors of Star Alliance, as shown in this study and in the article by Park & Cho. This motive is also connected to the other compet-

ing alliances albeit probably at a later stage considering that they first needed to adapt to the changing environment and create an alliance that could compete with Star Alliance before investing large amounts of resources in order to develop these synergies. Because of recent changes in industry regulations, security and customer traveling behavior, it is reasonable to assume that all three alliances, at this point in time, are driven by expectation-based and/or environmental-based motives. In order to stay competitive or 'simply alive' the large alliances are trying to adapt to the environment and find new ways to reach customers, reduce costs and become more efficient. According to this research, there is evidence that Star Alliance has experienced a higher efficiency in terms of capacity in the aftermath of 9/11. Furthermore, as Star Alliance has continued to recruit members to the alliance, this has made them grow in size which thereby has enabled them to make use of the new members' capabilities.

According to the article "*The Five Factors of a Strategic Alliance*", in order for an alliance to be called a strategic alliance it has to incorporate at least one out of three alternatives. When investigating the alliances in the airline industry, there is evidence implying that all three alliances can regard themselves as being strategic. It would not be fair to say that these strategic alliances 'block a competitive threat' seeing that they offer their customers similar services and destinations. Although, the each of the three alliances are stronger in specific regions, the main factor that separate them from each other is the size of the alliance. However, even if past research differs to a certain degree in their conclusions, it is obvious that these alliances are both 'critical to the core business success' of its members as well as the 'crucial to maintain competitive advantage and core competence' in the industry. This statement is further strengthened by this study as it was observable that the members of Star Alliance, after only a few years, experienced a heavy increase in capacity efficiency.

5.4 Analysis summary

In section 5.3, Star Alliance was investigated in terms of strategy and actions and thereafter compared with main competitors. This discussion brought to light the similarities in the theoretical framework and the findings of this report.

The previous subsections of the analysis presented the year-by-year propositions for beta distribution density functions describing the frequency distributions of flight capacities in Star Alliance as well as a discussion on the possibility of simpler movements in the distribution. This section and the empirical finds on which the analytical reasoning was based presented the skewness and kurtosis, which measured efficiency and movement about the means; these are summarized in Figure 5-18 below.

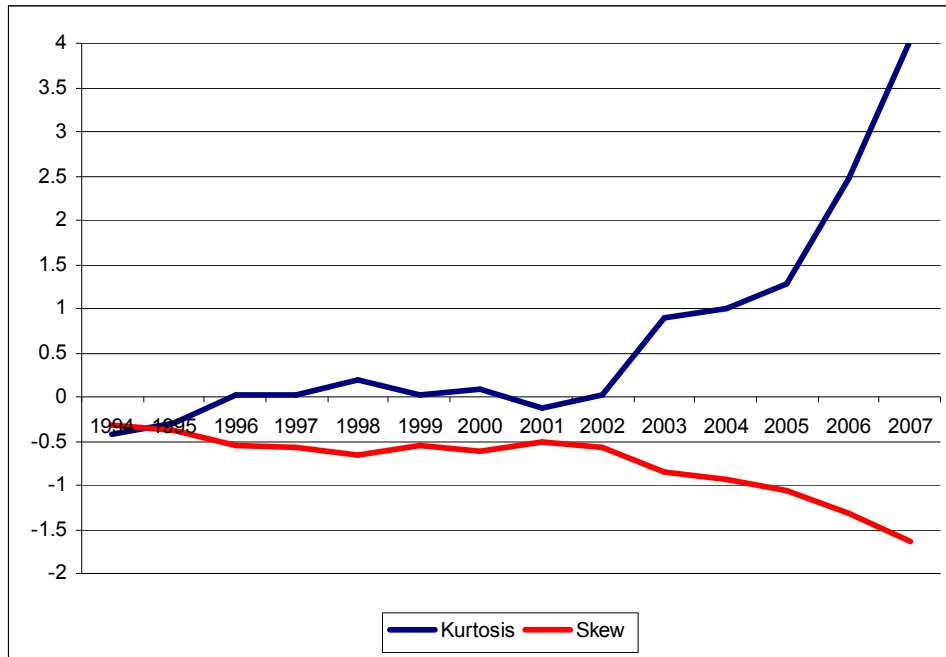


Figure 5-18 Kurtosis and Skew development

The figure shows a general pattern of increasing kurtosis, or 'peakedness', about the mean while the skew moved in an opposite direction. This increasing skew left the mode increasingly above the mean. Overall these measurements have been positive for the airlines in the alliance. It showed a better method of prediction as to the frequency of flights and the size of aircraft used for the flight. It also highlights the benefits of a more efficient utilization of aircraft vis-à-vis alliance partner carriers. This is made possible by using of a more extensive network of routes and aircraft for an individual carrier in alliance through the use of excess capacity in the operations of their partners. The benefits in terms of economies of density were maintained through the continued use of hub-and-spoke organizations which when allied begin to function in a fashion more similar to that of the point-to-point model (Brueckner and Spiller, 1994). This transformation is possible because of the multitude hub-and-spoke organizations, which are included in large airline alliances allowing consumers and operators to pick and choose from a myriad of routing options rather than from only a small number of hubs (Brueckner and Whalen, 2000).

6 Conclusion

This section presents the conclusions that were drawn by the researchers.

Through this study it has come to light that many factors affect the performance of individual carriers in a strategic alliance. The continually maturing nature of the industry has lead to further regulation of the providers whilst the consumers demanded lower prices and increases in customer benefits. Demands have forced airlines to find ways to reduce costs by allying themselves with former competitors. Cooperation has produced something greater than the sum of all parts; perhaps one of the most important of these is the advances made in use of existing resources and more specifically for load factors. The purpose of this study was to investigate the augmentation of the increases in those efficiencies over time for the allied carriers in Star Alliance.

The important questions answered in this study followed that ten of the 13 years saw an increase in average, unadjusted, load factor which forced the rejection of the null hypothesis in the analysis section.

$$H_A: LF_{x-1} < LF_x$$

While the mean moved upwards it became clear that the bounds set on the aircraft could present a hindrance for the providers due to regulations in denied boarding. Thus it was necessary to test the upper limit; the data concluded that denied boarding actually reduced as the mean increased thus allowing the rejection of the null hypothesis and the first alternative hypothesis.

$$H_B: D_x < \mu_x$$

Aside from a generally increasing mean that saw a decrease in outliers above the load limit the distribution of the load factors saw an increase in kurtosis. The distribution also presented a decrease in skew which also lead to the acceptance of a beta distribution to describe the distribution of the load factor for the data under investigation.

Higher load factors were shown to have a strong correlation with the increase in efficiency and decrease in overselling. This was due to the shape which caused a continually peaked curve skewed to the right of the mean.

Because of the exhaustive sense of the data for the chosen population and the reliability of their source, these conclusions may prove to be useful for their intended audiences in decision making processes and historical performance analysis.

As mentioned previously in the 'Perspective' section, this research may provide executives and decision-makers, within the airline industry, with a deeper understanding of the efficiency and capacity performance related to strategic alliances. This information might assist this audience in determining whether or not an airline should stay or join a strategic alliance. Furthermore, this research might also be interesting for regulators and policy-makers as to understand how airlines and the industry are affected by strategic alliances.

7 Final Discussion

This section presents the limitations of this study. It also presents suggestions for further research and other issues to be analyzed.

7.1 Limitation

Though every measure has been made to insure the statistical validity of the findings in this report the empirical data was based on case of Star Alliance. It included the most complete and most reliable data available for the purposes of Star Alliance, however it should not be assumed that this data would be directly translatable to other airlines, other alliances or Star Alliance's operations in other countries which have no connections with the United States. Because the data selection was exhaustive only for Star Alliance's operations having at least one foot in the US and not a probability sample that would be required to obtain some level of statistical certainty which would allow it more generalizability to other samples in a large population than that delimited in this research. This having been said it is quite likely that further research will find similar trends and relationships to those revealed through this research.

This study also does not make the case of causation, though possible causations have been mentioned. Its aim was to primarily investigate the correlation between frequency distribution trends, over sales and airline alliances. Because comparisons to other major players in the industry were not made it cannot begin to delve into the complexities of analyzing whether the airline was benefitted more or less from the alliance. This case has been well documented in previous research and it is the belief of the authors of this report that it is up to the managers of each individual airline to carry out the due diligence required to make the final decision.

Finally, as mentioned throughout it was the aim of this report to investigate, quantify, and analyze the efficiency in load factors aboard the major carriers of Star Alliance. The researchers stand by their work and its validity and ability to be duplicated.

7.2 Further Research

As this study investigated capacity efficiency of Star Alliance, several suggestions for further research were discovered throughout the progression of the paper. To attain the necessary results in this research, a quantitative statistical research approach was used to analyze the allied members of Star Alliance.

Further investigation of the capacity efficiency in other strategic airline alliances would yield interesting comparisons. By performing this kind of additional research, empirical findings will likely confirm that there is a high correlation between increased capacity efficiency and strategic alliances in the airline industry. Another interesting approach would be to introduce a probability sample that also could prove that the findings of this research are applicable to the rest of the industry. In addition, if more research would be performed on non-allied airlines it might even further strengthen these previous statements.

Throughout the development of this study other interesting factors were also discovered, such as price of tickets, profits and customer satisfaction. It would be of great interest to obtain a deeper understanding of the customer benefits associated with strategic alliances. This kind of research would most likely require a qualitative approach which in turn would

result in understanding many of the intangible factors that are related to customer benefits. In other words, this research would more precisely reveal how and to what extent the customers have been affected by strategic alliances. If these factors were to be incorporated with the findings of this paper as well as with the suggestions previously stated, this would give a deep and thorough understanding of the effects of a strategic alliance in the airline industry.

References

- Aczel, A.D. (2002). *Complete Business Statistics* (5th ed.). Boston: McGraw-Hill.
- Association of Asia Pacific Airlines (AAPA). (2008). *Policies and Regulations*. Retrieved April 1 from http://aapairlines.org/Policies_and_Regulations.aspx
- Brueckner, J.K. & Whalen, T.W. (2000). The Price Effects of International Airline Alliances. *Journal of Law and Economics*, Vol. 43 (No. 2), 503-545.
- Brueckner, J.K. & Spiller, P.T. (1994). Economies of Traffic Density in the Deregulated Airline Industry. *Journal of Law and Economics*, Vol. 37 (No. 2), 379-415.
- Bryman, A. & Bell, E. (2003). *Business Research Method*. New York: Oxford University Press.
- Bureau of Transport Statistics. (2008). *Database T-100 International Segment (All Carriers)*. Retrieved April 1, 2008, from http://www.transtats.bts.gov/DL_SelectFields.asp?Table_ID=261&DB_Short_Name=Air%20Carriers
- Caves, D.W., Christensen, L.R. & Tretheway, M.W. (1984). Economies of Density versus Economies of Scale: Why Trunk and Local Service Airline Costs Differ. *The RAND Journal of Economics*, Vol. 15 (No. 4), 471-489.
- Collis, J. & Hussey, R. (2003). *Business Research: A practical guide for undergraduate and postgraduate students* (2th ed.). London: Palgrave Macmillan.
- Delta Museum. History of Delta. (2003). Retrieved May 12, 2008, from http://deltamuseum.org/M_Education_DeltaHistory_Facts_History.htm
- Easterby-Smith, M., Thorpe, R. & Lowe, A. (2002). *Management Research: An Introduction* (2th ed.). London: Sage Publications.
- Elmuti, D. & Kathawal, Y. (2001). *An overview of strategic alliances*, Management Decision, 39/3, 205-217.
- European Union - Regulation (EC) No. 261/2004
- Davidsson, P. (2001). *Anvisningar för kandidat- och magisteruppsats i företagsekonomi*. Jönköping: Internationella Handelshögskolan.
- Hogg, R. V., Tanis E. A. (2006). *Probability and statistical inference*. Upper Saddle River: Pearson Prentice Hall.
- International Air Transportation Association (IATA). (2008). *Government and Industry Affairs*. Retrieved April 1, 2008, from http://iata.org/whatwedo/policies_regulations/government_industry/index.htm
- Johnson, G., Scholes, K. & Whittington, R. (2005). *Exploring Corporate Strategy*. London: Prentice Hall.
- Johnson, N. L., Kotz, S., & Balakrishnan, N. (1995). *Continuous Univariate Distributions*. Vol. 2, (2nd ed.). New York: Wiley Series in Probability and Mathematical Statistics.
- MacTutor. Siméon Denis Poisson. (2002). Retrieved May 13, 2008, from <http://www->

history.mcs.st-andrews.ac.uk/Biographies/Poisson.html

Markusen, A. (1996). Sticky places in slippery space: a typology of Industrial Districts, *Economic Geography*, Vol. 72 (No. 3), 293-313.

Maylor, H. & Blackmon, K. (2005). *Researching Business and Management*. New York: Palgrave Macmillan.

Miles, G., Snow, C.C. & Sharfman, M.P. (1993). Industry Variety and Performance. *Strategic Management Journal*, Vol. 14 (No. 3), 163-177.

Moitra, S.D. (1990). Skewness and the Beta Distribution. *The Journal of the Operational Research Society*, Vol. 41 (No. 10), 953-961.

NIST/SEMATECH. 2008. *e-Handbook of Statistical Methods*, Retrieved May 18, 2008, from <http://www.itl.nist.gov/div898/handbook/>

Oneworld. (2007a). *Oneworld at a Glance*. Retrieved April 1, 2008, from <http://www.oneworld.com/ow/news-and-information/fact-sheets>

Oneworld. (2007b). *Introduction to oneworld - the alliance that revolves around you*. Retrieved April 1, 2008, from <http://www.oneworld.com/ow/news-and-information/fact-sheets>

Park, N.K. & Cho, D. (1997). The effect of strategic alliance on performance: A study of international airline industry. *Journal of Air Transport Management*, Vol. 3 (No. 3), 155-164.

Robson, C. (1993). *Real World Research: A Resource for Social Scientists and practitioner-researchers*. Oxford: Blackwell.

Robson, C. (2002). *Real World Research* (2th ed.). Oxford: Blackwell.

Ryanair. (2008). *About Us*. Retrieved April 1, 2008, from <http://www.ryanair.com/site/EN/about.php?page=About&sec=story>

Saunders, M., Lewis, P. & Thornhill, A. (2003). *Research Methods for Business Students*. Harlow: Prentice Hall.

Shenkar, O. & Reuer, J. (2006). *Handbook of Strategic Alliances*. Thousand Oaks: Sage Publications.

SkyTeam. (2007a). *SkyTeam Associate Program Fact Sheet*. Retrieved April 1, 2008, from <http://www.skyteam.com/EN/aboutSkyteam/skyteamInformation.jsp>

SkyTeam. (2007b). *SkyTeam Fact Sheet*. Retrieved April 1, 2008, from <http://www.skyteam.com/EN/aboutSkyteam/skyteamInformation.jsp>

Southwest Airlines. (2007). *Southwest Airlines Fact Sheet*. Retrieved April 1, 2008, from http://www.southwest.com/about_swa/press/factsheet.html

Star Alliance. (2007a). *10 years Star Alliance from "The airline network for Earth" to "The way the Earth Connects"*. Retrieved March 2, 2008, from http://www.staralliance.com/en/press/facts_figures/index.html

Star Alliance. (2007b). *About Star Alliance*. Retrieved March 2, 2008, from http://www.staralliance.com/en/meta/star_alliance/index.html

Star Alliance. (2007c). *Star Alliance Facts and Figures*. Retrieved March 2, 2008, from http://www.staralliance.com/media_library.do?mediaType=presentations&language=en

Star Alliance. (2007d). *Star Alliance – The Way the Earth Connects*. Retrieved March 2, 2008, from http://www.staralliance.com/en/press/facts_figures/index.html

Stout, D., Beaucaire, J., (2005). *Strategic Alliances and Partnership: A way to gain access to new markets and opportunities*. Nelligan O'Brien Payne LLP.

U.S. Department of Transportation (DOT) – 14 CFR §250

U.S. Department of Transportation. (2008). *U.S. Transportation Secretary Peters Announces New Measures to Improve Air Travel Experience*. Retrieved May 1, 2008, from <http://www.dot.gov/affairs/dot5308.htm>

Wakeam, J. (2003). *Five Factors of a Strategic Alliance*. Ivey Business Journal May/June 2003. Ivey Management Service.

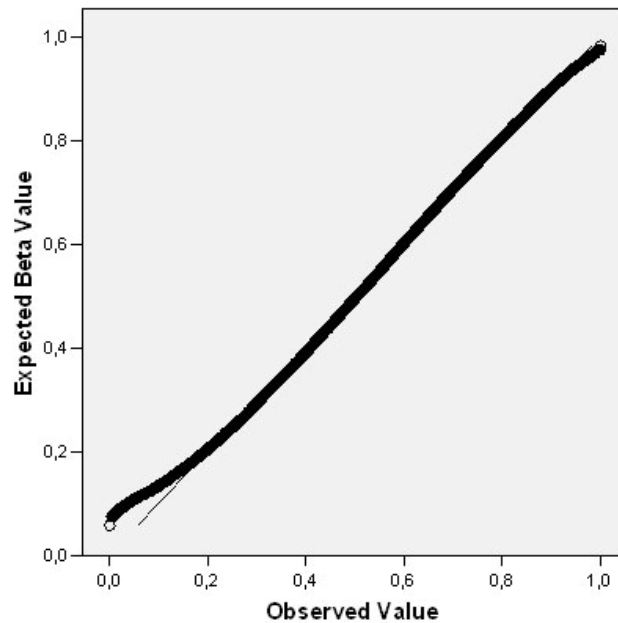
Yin, R.K. (2003). *Case study research: design and methods* (3th ed.). Thousand Oaks: Sage Publications.

Appendix 1

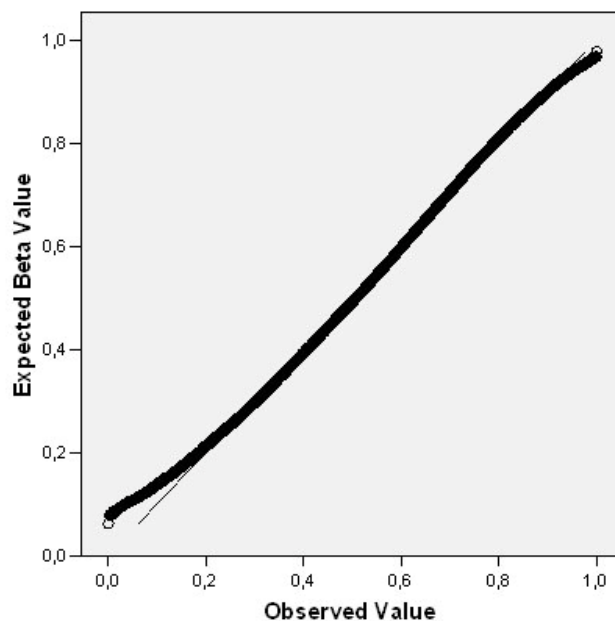
Beta Parameter Expectation Plots

This appendix shows the estimated distribution patterns and their deviation from expected beta, for a perfect match it is expected that the points should follow the 45° line. The major deviations, especially in 2006 and 2007, are found at the 0%, 100% anomalies.

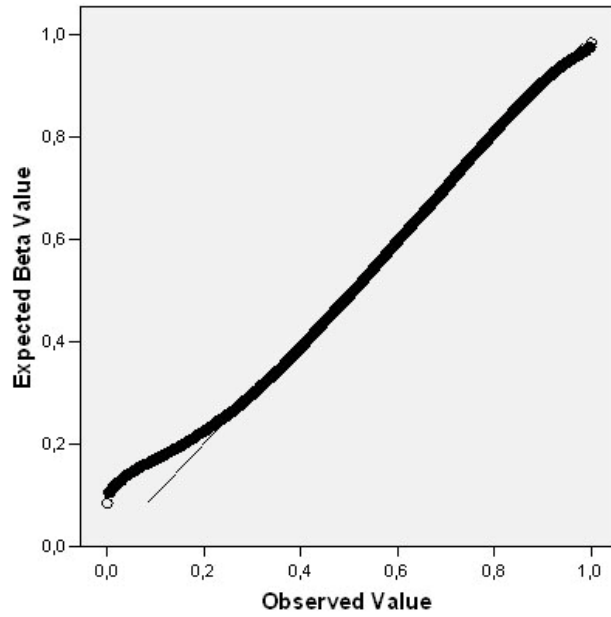
Beta Q-Q Plot of Y94



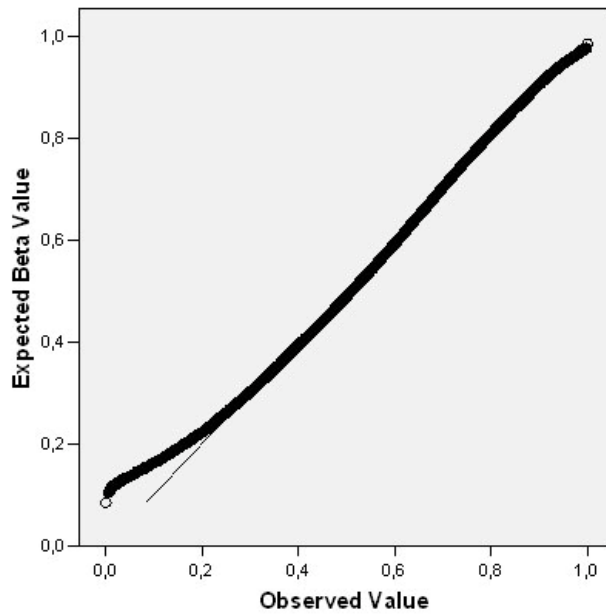
Beta Q-Q Plot of Y95



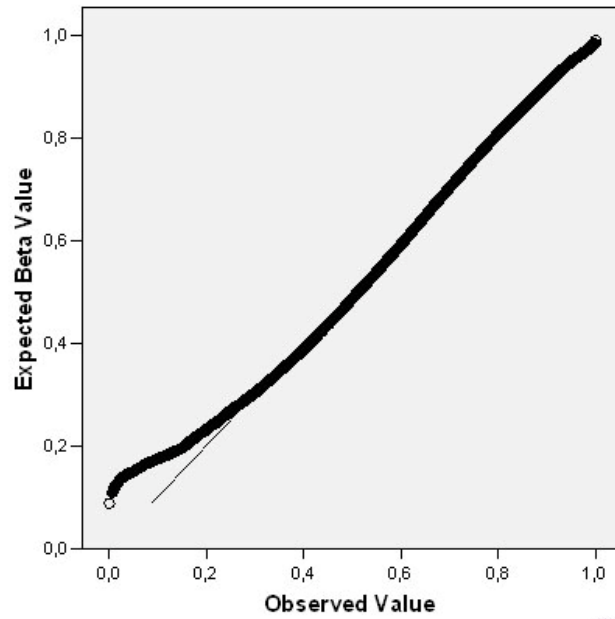
Beta Q-Q Plot of Y96



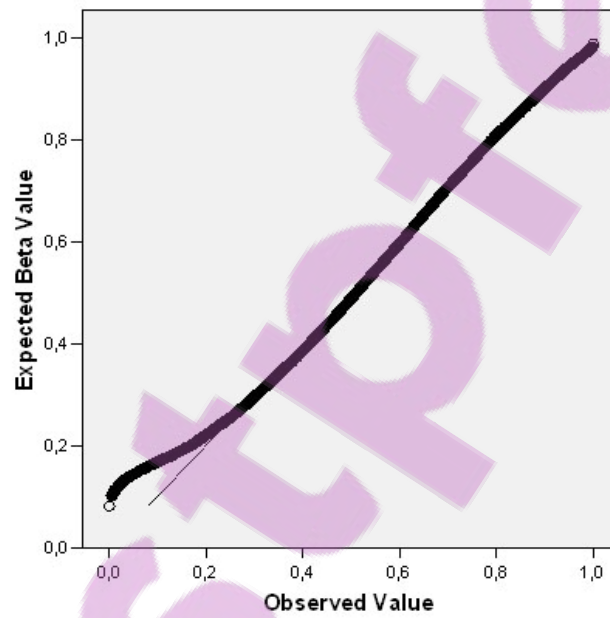
Beta Q-Q Plot of Y97



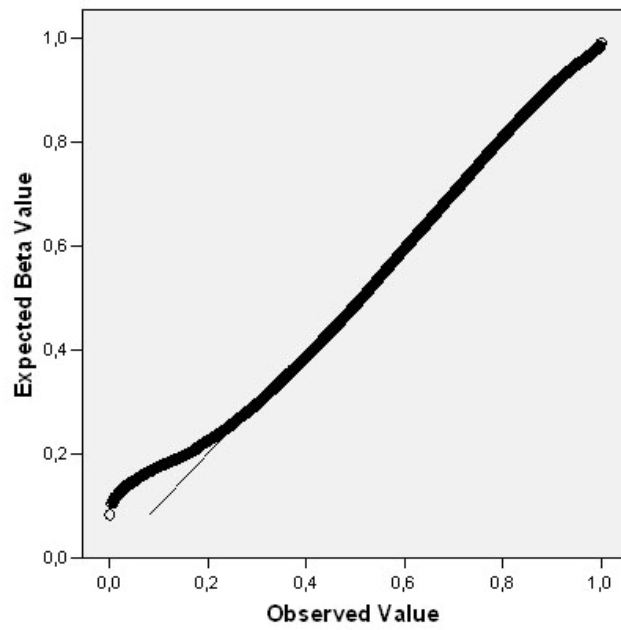
Beta Q-Q Plot of Y98



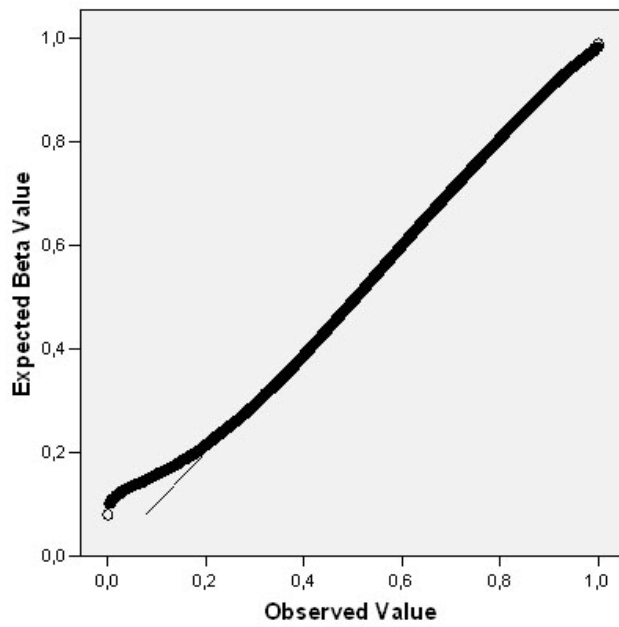
Beta Q-Q Plot of Y99



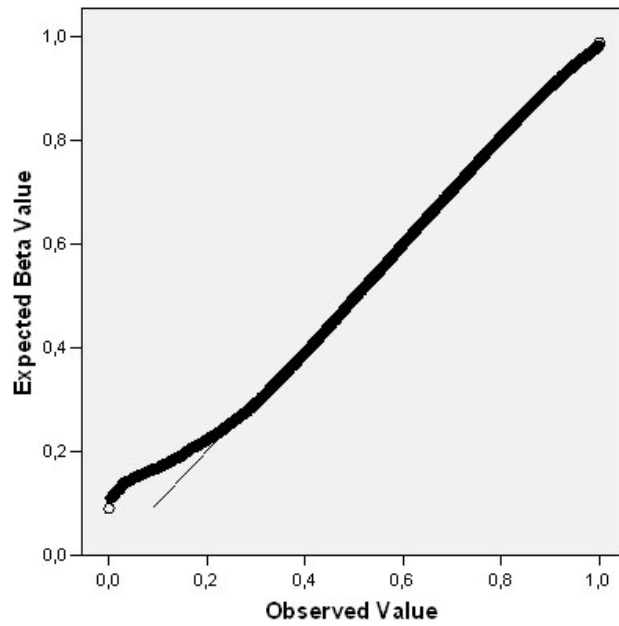
Beta Q-Q Plot of Y00



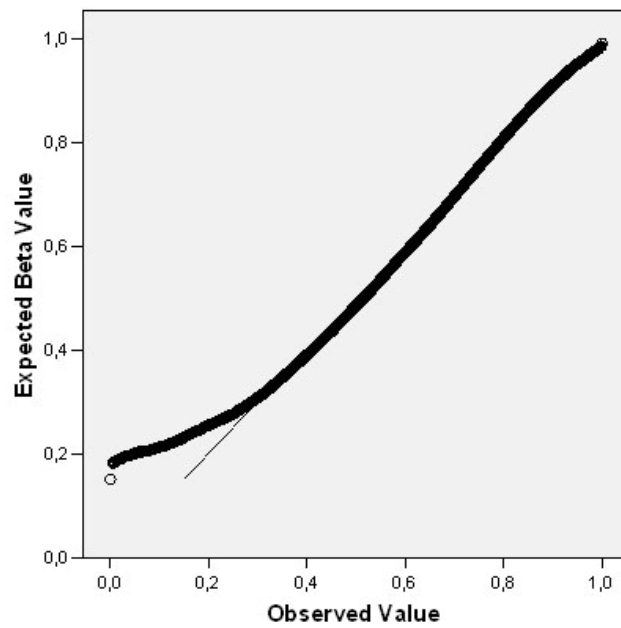
Beta Q-Q Plot of Y01



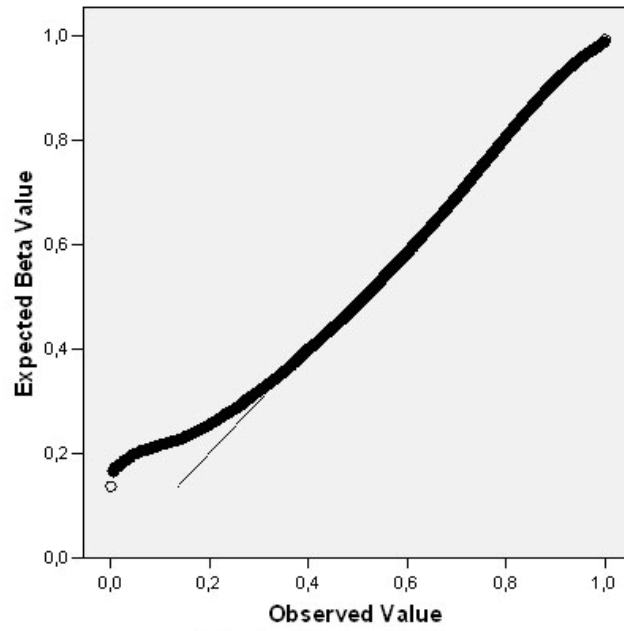
Beta Q-Q Plot of Y02



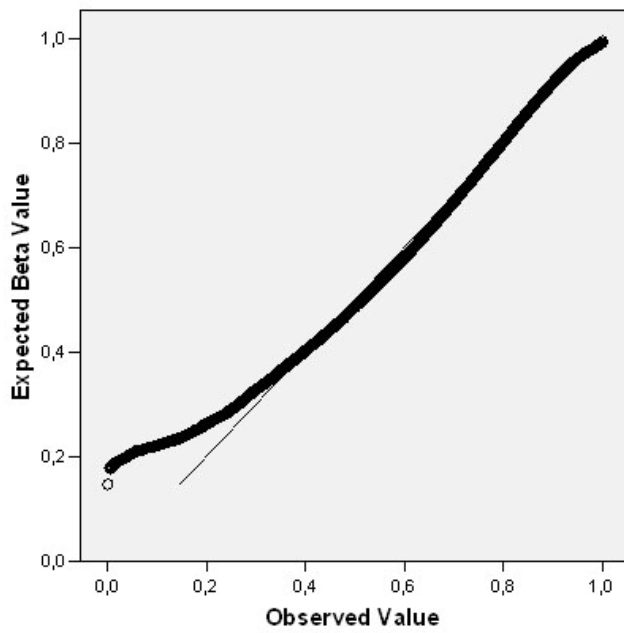
Beta Q-Q Plot of Y03



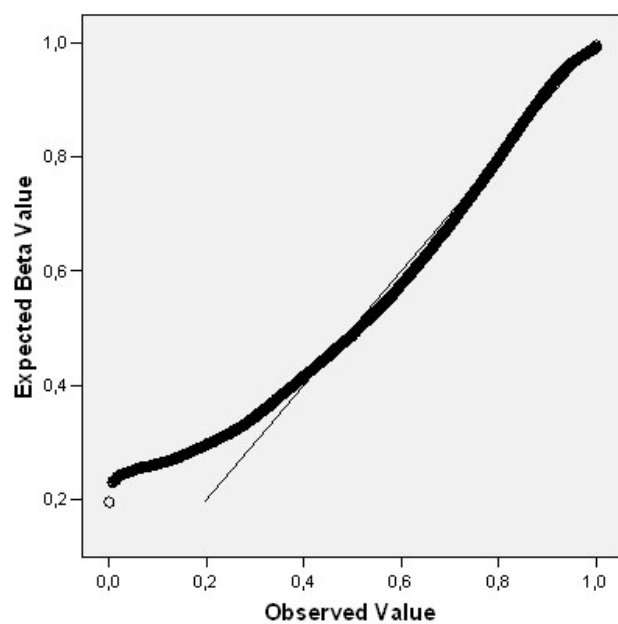
Beta Q-Q Plot of Y04



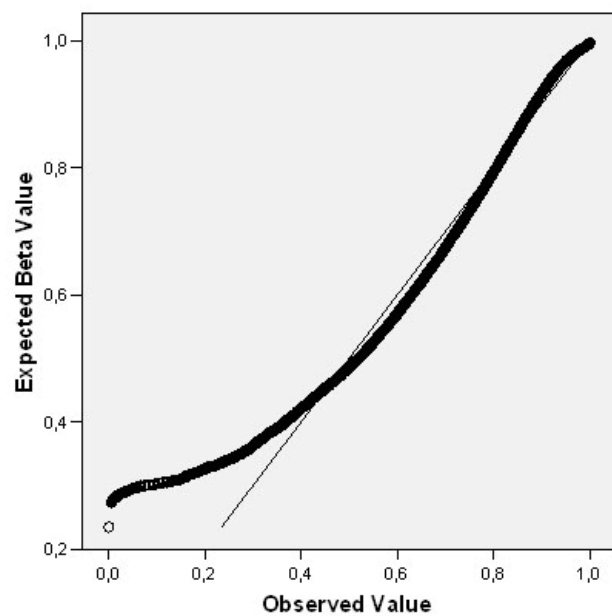
Beta Q-Q Plot of Y05



Beta Q-Q Plot of Y06



Beta Q-Q Plot of Y07



Appendix 2

This appendix contains all programming code used for the calculations of the analytical portion of this report and were deemed necessary for reproduction of the findings as well as for the validity of all calculations. The programs were design for use in an R environment under release 2.6.2, though they may be transferable to other releases are optimized only for that version.

Alpha Parameter

```
>calalpha<-function(x,v){  
>a<-(x*(((x*(1-x))/v)-1))  
>a  
>}
```

Beta Parameter

```
>calbeta<-function(x,v){  
>b<-((1-x)*(((x*(1-x))/v)-1))  
>b  
>}
```

Mode Estimation

```
> betamode<-function(a,b){  
+ m<-((a-1)/(a+b-2))  
+ m  
+ }
```

X Parameter

```
>x<-seq(0,1,by=.0001)
```

Beta PDF

```
>betafunc<-function(x,a,b){  
>c<-((x^(a-1))*((1-x)^(b-1)))/(beta(a,b))  
>c  
>}
```

1994

```
> a<-calalpha(.595185,.04302)
> b<-calbeta(.595185,.04302)
> plot(x,betafunc(x,a,b))
> a
[1] 2.738236
> b
[1] 1.862411
```

1995

```
> a<-calalpha(.614392,.039922)
> b<-calbeta(.614392,.039922)
> plot(x,betafunc(x,a,b))
> a
[1] 3.031677
> b
[1] 1.902757
```

1996

```
> a<-calalpha(.643745,.038308)
> b<-calbeta(.643745,.038308)
> plot(x,betafunc(x,a,b))
> a
[1] 3.210144
> b
[1] 1.776526
```

1997

```
> a<-calalpha(.659275,.03715)
> b<-calbeta(.659275,.03715)
> plot(x,betafunc(x,a,b))
> a
```

```
[1] 3.327102
```

```
> b
```

```
[1] 1.719505
```

1998

```
> a<-calalpha(.673204,.037085)
```

```
> b<-calbeta(.673204,.037085)
```

```
> plot(x,betafunc(x,a,b))
```

```
> a
```

```
[1] 3.320463
```

```
> b
```

```
[1] 1.611865
```

1999

```
> a<-calalpha(.6654225,.038577)
```

```
> b<-calbeta(.6654225,.038577)
```

```
> plot(x,betafunc(x,a,b))
```

```
> a
```

```
[1] 3.174861
```

```
> b
```

```
[1] 1.596335
```

2000

```
> a<-calalpha(.65387,.04107)
```

```
> b<-calbeta(.65387,.04107)
```

```
> plot(x,betafunc(x,a,b))
```

```
> a
```

```
[1] 2.949405
```

```
> b
```

```
[1] 1.561285
```

2001

```
> a<-calalpha(.644852,.041345)
> b<-calbeta(.644852,.041345)
> plot(x,betafunc(x,a,b))
> a
[1] 2.927107
> b
[1] 1.612085
```

2002

```
> a<-calalpha(.673958,.035186)
> b<-calbeta(.673958,.035186)
> plot(x,betafunc(x,a,b))
> a
[1] 3.534949
> b
[1] 1.710109
```

2003

```
> a<-calalpha(.699446,.032711)
> b<-calbeta(.699446,.032711)
> plot(x,betafunc(x,a,b))
> a
[1] 3.79563
> b
[1] 1.630994
```

2004

```
> a<-calalpha(.711768,.03265)
> b<-calbeta(.711768,.03265)
> plot(x,betafunc(x,a,b))
> a
```

```
[1] 3.760583
```

```
> b
```

```
[1] 1.522856
```

2005

```
> a<-calalpha(.725475,.032177)
```

```
> b<-calbeta(.725475,.032177)
```

```
> plot(x,betafunc(x,a,b))
```

```
> a
```

```
[1] 3.764886
```

```
> b
```

```
[1] 1.42466
```

2006

```
> a<-calalpha(.755481,.026767)
```

```
> b<-calbeta(.755481,.026767)
```

```
> plot(x,betafunc(x,a,b))
```

```
> a
```

```
[1] 4.458387
```

```
> b
```

```
[1] 1.443002
```

2007

```
> a<-calalpha(.778627,.024756)
```

```
> b<-calbeta(.778627,.024756)
```

```
> plot(x,betafunc(x,a,b))
```

```
> a
```

```
[1] 4.642669
```

```
> b
```

```
[1] 1.319966
```

Appendix 3

Case Summaries

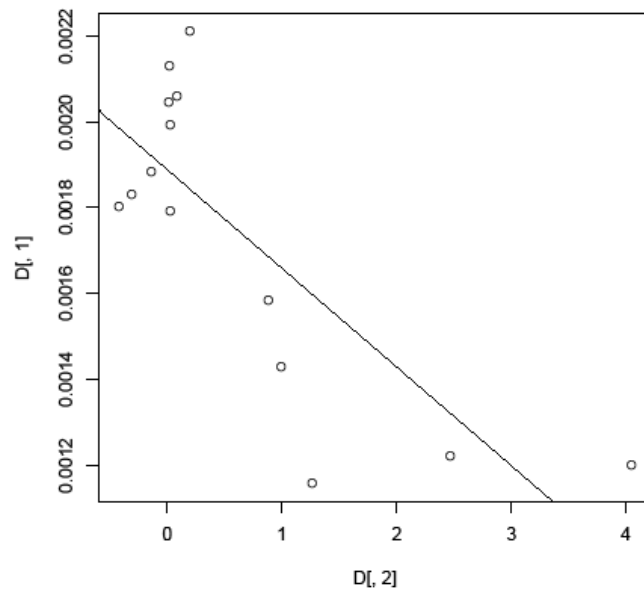
	Y94	Y95	Y96	Y97	Y98	Y99	Y00
Kurtosis	-.424	-.306	.024	.022	.200	.012	.087
Skewness	-.322	-.380	-.555	-.578	-.654	-.544	-.623
Median	.608028	.631119	.666139	.681230	.695903	.672651	.678454
Std. Deviation	.2074116	.1998043	.1957246	.1927446	.1925749	.1964093	.2026648
Variance	.043	.040	.038	.037	.037	.039	.041
Mean	.595185	.614392	.643745	.659275	.673204	.654225	.653870

	Y01	Y02	Y03	Y04	Y05	Y06	Y07
Kurtosis	-.135	.027	.884	.996	1.267	2.467	4.046
Skewness	-.515	-.569	-.855	-.944	-1.061	-1.311	-1.629
Median	.664428	.695218	.726073	.742706	.760243	.790495	.813721
Std. Deviation	.2033345	.1875785	.1808617	.1806927	.1793796	.1636818	.1573418
Variance	.041	.035	.033	.033	.032	.027	.025
Mean	.644852	.673958	.699446	.711768	.725475	.755481	.778627

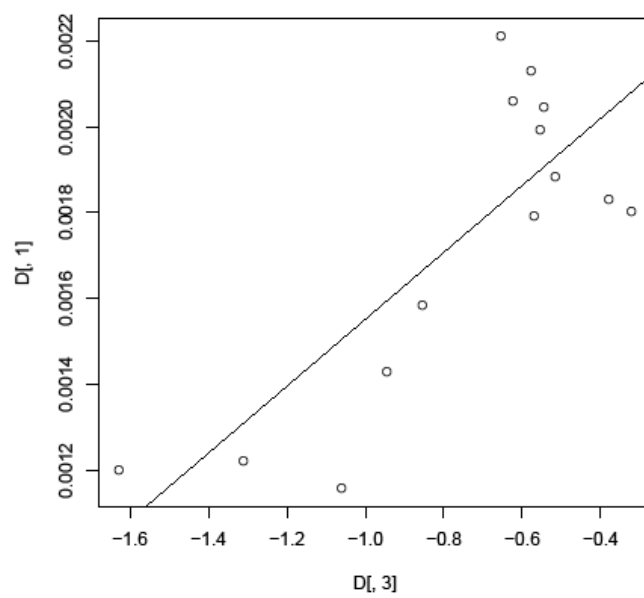
Table 0-1 Statistical measurements

Appendix 4

Plot of the relation between denied boarding statistics and the measure of the kurtosis of the flight load factor distribution.



Plot of relationship between skew measurement of the load factor distribution and denied boarding statistics.



Plot of the relationship between skew of the flight load factors and kurtosis of the distribution of flight load factors.

