A STUDY ON IDENTIFYING HIDDEN FACTORS ASSOCIATED WITH CUSTOMER SATISFACTION LEVELS OF AN AIRLINE

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DECLARATION OF THE CANDIDATE

"I declare that this is my own work and this thesis/ dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any University or other institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text"

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DECLARATION OF THE SUPERVISORS

I have supervised and accepted this thesis for the submission of the degree.

…… ……..

Signature of the supervisor Date

…… ……..

Signature of the co-supervisor Date

Dedicated to my mother . . .

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ABSTRACT

Air transportation plays an important role in the modern world as it is the easiest way to travel to any part of the world within a very short period of time. With the increasing number of passengers travelling through airlines, new airline companies have evolved with time. Due to the high competitiveness among the airline companies, retaining the existing customers seems a challenging task. Among such strategies, identifying the reasons behind their customers' priorities for their choice of airline plays an important facet. This study is based on feedback of the passengers for a "Service and Performance Survey" conducted by a certain airline company. Among the few customer satisfaction survey results that have been published, possibly due to the confidentiality, the analyses are mainly based on descriptive analysis. This study was carried out to find out hidden factors or characteristics of the customers that are associated with their satisfaction level using Latent Class Analysis which was not done in the previously literature. The passengers were classified based their satisfaction levels and it was found out that the airline company has achieved their desired satisfaction level of 80% their passengers only to few attributes like crew friendliness, crew efficiency, overall crew satisfaction level, cabin lighting and cabin cleanliness. Inflight entertainment attributes (choice of movies, video quality, choice of music, headset quality and choice of newspaper/magazine) have very low satisfaction levels compared to other onboard services and must be improved a lot. More choices of meals should be provided and special attention should be paid for the choices of meals for the air planes taking more Middle Eastern people.

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CHAPTER 01

INTRODUCTION

CHAPTER 01 - INTRODUCTION

The first chapter provides a detailed introduction about the research including the background of the study, significance of it and the objectives of the study. This chapter concludes by providing an outline of the dissertation.

1.1. Background of the Study

Air transportation plays an important role in the modern world as it is the easiest way to travel to any part of the world within a very short period of time. With the increasing number of passengers travelling through airlines, new airline companies have evolved with time. This has created a highly competitive atmosphere within the airline industry. These companies have started to focus on implementing new strategies to enhance the customer base, by attracting more customers to their airlines while retaining the existing customers. Among such strategies, identifying the reasons behind their customers' priorities for their choice of airline plays an important facet. For this aspect, air passenger satisfaction surveys contribute greatly.

Due to the high competitiveness among the airline companies, retaining the existing customers seems a challenging task. This study is based on feedback of the passengers for a "Service and Performance Survey" conducted by a certain airline company. For the confidentiality, the company name will be used as "***AirJet***" airlines.

1.2. Service and Performance Survey of the AirJet Airlines

The AirJet airlines company conducts periodic customer satisfaction surveys to understand the attitudes of the passengers about their services. The data set used for this research was based on the feedback of the passengers who participated for the Service and Performance survey in 2010. This survey had been conducted to capture the satisfactions level of the passengers about the airline services based on three main factors: general information of the passengers, on-board services and passenger opinions. A questionnaire had been given to the passengers of the airline during the period of 27-04-2010 to 30-09-2010.The data were collected by distributing the questionnaires just before boarding at the airport based on systematic random

sampling method to cover around 10% of the passengers of each chosen flight and to ensure a fair representation of all passengers travelling on the AirJet airlines.

1.3. Significance of the Study

As stated in section 1.1, it is of importance for airline companies to understand the reasons behind their customers' actions for selecting an airline for their travel as the success of the companies rely on the passenger choice of airline. Among the few customer satisfaction survey results that have been published, possibly due to the confidentiality, the analysis are mainly based on descriptive analysis. Therefore it is of importance to perform a detailed analysis to extract the hidden factors that influence the satisfaction of the passengers and hence the significance of this study.

1.4. Objective of the Study

The main objective of this study is to find out the hidden factors or characteristics of the customers that are associated with their satisfaction level.

1.5. Outline of the Thesis

The dissertation focuses on the use of statistical methods in selecting hidden factors for airline passenger satisfaction level of the AirJet airlines. After providing an introduction in the first chapter, the areas discussed in the next chapters are as follows.

- Chapter 2 includes details about the previous studies related to this research and a critical review of their content to bring out the importance of this research.
- Chapter 3 discusses the fundamental statistical theories the research is based on and states the statistical methodologies used in the analytical process.
- Chapter 4starts with an introduction to the data set and the method of data collections. The preliminary analysis by observing descriptive statistics then follows.
- Chapter 5 includes an advanced statistical analysis of the data to identify the most important features of the passengers.
- Chapter 6 concludes the thesis by providing a discussion of the analysis conducted in previous chapters and presents important findings, states the limitations of the study, problems encountered and makes suggestions for future work.

CHAPTER 02

LITERATURE REVIEW

CHAPTER 02 – LITERATURE REVIEW

This chapter discusses about previous studies carried out regarding airline passenger satisfaction surveys and studies that had used categorical clustering techniques. A thorough review about the methods is presented to illuminate the importance of this research.

2.1. Researches about Airline Passenger Satisfaction Surveys

The literature reveals that there are many surveys conducted throughout, thus indicating the importance of assessing the satisfaction of the airline passengers to the airline companies. Many of the results, however, have not been published due to the confidentiality of the companies. The literature also reveals that, most of the analyses are basic descriptive analysis (Archana & Subha, A Study on Service Quality and Passenger Satisfaction on Indian Airlines, 2012).Out of the published researches; Upadhyaya(2012), Nicolini & Salini (2006) and Salim (1998) have incorporated advanced analysis to identify factors affecting passenger satisfaction using statistical techniques.

Nicolini & Salini (2006) had used two techniques for consumer evaluation of the service received in one of the largest worldwide airline companies. One study was based on a probabilistic model, which was the Rasch model, which had been originally adopted in psychometric studies and the second technique was a data driven method which is the decision trees. Finally, to make the process more effective, a joint application using both the Rasch model and decision trees was proposed.They had found out that, the highest customer satisfaction level was for the cabin crew, whilst the lowest quality was attributes of the meals. Their suggestion was at the operating level, and suggested that the company should invest in low-quality items, like meal and refreshments, which are important for subject global satisfaction.

Another study by Upadhyaya (2012) presented a study capturing customer complaints and had suggested quick solutions. He had used Need- Gap analysis to determine deviations between actual and expected quality of services and had suggested corrective actions to be taken by the airline company to minimize the customer

complaints. The relation between complaint and complaint behaviours have been interpreted through with Pearson correlation analysis.

A study to investigate the relationship between airline service quality, passenger satisfaction and passenger loyalty had been carried out by Salim (1998). Responses of 500 passengers using Royal Jordanian airline had been used for this research and based on her investigations, airline service quality, passenger satisfaction and passenger loyalty could be identified as the main aspects of the services provided by an airline. A factor analysis has been performed to identify the main factors of the airline service quality and passenger loyalty. Further, in order to segment the passengers based on their loyalty levels and psychographic characteristics a cluster analysis has been used. A path analysis has been carried out to investigate the relationships among the identified three factors. For conclusions, she has noted that the overall service quality was highly related to both passenger satisfaction and loyalty but, the relationship between passenger satisfaction and loyalty toward the airline was less clear.

Archana & Subha (2012) had examined whether the underlying forces of service quality influences on passengers' satisfaction in aircraft transportation. Their objective was to identify the airline service attributes that have positive influence on service quality and the attributes which have least important impact on service quality in international air travel based on the 270 passengers that have been considered for their study. When selecting the sample, they had paid their attention to select passengers from all the three classes of the airline; economy, business and premium. Many important suggestions had been made by them about the customer satisfaction respect to different airline services.

After a thorough literature review, no research was found to have carried out to identify hidden factors/characteristics of airline passengers to study about their satisfaction levels by classifying passengers having similar attitudes towards the airline services. Therefore it is of importance to perform a detailed analysis to extract the hidden factors that influence the satisfaction of the passengers.

When considering all the above studies, it can be clearly seen that almost all the variables were categorical. Therefore, usual clustering mechanisms cannot be directly applied and a suitable method had to be used.

2.2. Qualitative Data Clustering

The problem of clustering categorical data involves complexity not encountered in the corresponding problem for numerical data. (Gibson, Kleinberg, & Raghavan, 2000) That is why there are many algorithms in the literature for clustering continuous data like K-means, EM algorithm, Hierarchical clustering, CLARAN and OPTICS while there are only few algorithms for clustering categorical data like K modes (modification of K-means), Auto Class (based on EM algorithm), ROCK and CLOPE. Most of these categorical clustering techniques are based on non-parametric measures and hence the performance may not be higher than parametric ones. When considering literature regarding qualitative data clustering, Latent Class analysis is becoming one of the most popular data analysis tool in the social and marketing research. (Kasprzyk, 2010).

2.3. Latent Class Analysis

According to the definition given in the free encyclopedia Wikipedia, a **Latent Class Model (LCM)** relates a set of observed (usually discrete) multivariate variables to a set of latent variables. It is a type of latent variable model. A class is characterized by a pattern of conditional probabilities that indicate the chance that variables take on certain values. It is a statistical method for finding subtypes of related cases from multivariate categorical data. (Latent class model, 2014)

When going through the literature, many applications of the Latent Class models could be found out in the medical field. Kendler, Karkowski, & Walsh (1998) applied latent class analysis to detailed symptomatic and outcome assessments of probands with broadly defined schizophrenia. They required to identify the affective illness ascertained from a population-based psychiatric registry in Roscommon County, Ireland. Rindskopf & Rindskopf (2006)had used Latent Class Analysis for the estimation of the characteristics of indicators even when an accurate diagnosis is unavailable. In addition, this method was ideal for them as the method deals with

several indicators at once, and provides a way to combine the information from all the indicators to make a diagnosis.

Literature reveals that the easiest software to fit a Latent Class Model is the Latent Gold package and it is a very expensive one. However, the freely available R software could be used installing the poLCA package to fit Latent Class models. (Linzer & Lewis)

2.4. Synopsis

The selected sample sizes of the above stated surveys were less than 500 and many had not discussed about the data collection method. But this research seems more reliable than those as the sample size is 826 and the data collection was based on a systematic sampling scheme. Based on the gathered literature it was decided to use Latent Class Analysis to identify hidden factors/characteristics of the passengers using the R software. This technique was not used to analyse data related to this field had hence will contribute towards applications for such studies.

CHAPTER 03

THEORY AND METHODOLOGY

CHAPTER 03 – THEORY & METHODOLOGY

This chapter discusses the theories used in this research and how those theories were applied.

3.1. Preliminary Analysis

Descriptive statistics provide a quantitative description about the features of a collection of data. A detailed descriptive analysis was conducted in order to get an idea about the dataset, to select the most appropriate variables for the advanced analysis and to re-categorize variable if necessary.

The descriptive analysis was conducted using SPSS 21statistical software. Pie charts, bar charts, multiple bar charts and heat shading based tables were used for the analysis.

3.2 Advanced Analysis

The most appropriate variables that should be further analyzed was selected from the preliminary analysis and based on them the advanced analysis was conducted.

3.2.1 Latent Class Analysis

Latent class analysis is a statistical technique that can be used to work with multivariate categorical data. As mentioned by Linzer and Lewis (2011), when the observed data is in the form of categorical responses, latent analysis will help to identify and characterize similar classes. A latent model relates a set of observed multivariate variables to a set of unobserved (latent) variables. The specialty in latent class analysis is that the latent model groups each observation probabilistically into a latent class. The model estimates parameters which are the proportion of observations in each latent class and probabilities of observing each response to each observed/manifest variable, conditional on the latent class. The basic latent model deals with assigning categorical variables into different classes. However as an extension to this model, if the data includes covariates these can be added to the basic model, making it the latent class regression model.

3.2.2 Latent Class Model

Linzer and Lewis (2011) provided a detailed description about the latent class model which was considered to be a finite mixture model first proposed by Lazarsfeld in 1950.Consider a situation where J polytomous categorical variables are observed which are also known as manifest variables, each having K_j possible outcomes for individuals i=1,…,N.

Let Y_{ijk} be the observed values of the J manifest variables.

It is defined as:

$$Y_{ijk} = \begin{cases} 1 & \text{if respondent i gives the } k^{th} \text{ response to the } j^{th} \text{ variable} \\ 0 & \text{otherwise} \end{cases} \quad \text{where } j = 1,\ldots,J \text{ and } k = 1,\ldots,K_j$$

The observed joint distribution of the manifest variables is approximated as the weighted sum of a finite number R.R is considered to be the total number of latent classes specified by the model. R is a predefined value and it can be determined to cater to the requirement of the study, based on the goodness of fit of the model or due to other theoretical reasons.

Let π_{jrk} denote the class-conditional probability that an individual in class r =1,…,R provides the k^{th} response on the j^{th} variable.

Therefore for each class and each manifest variable: $\sum_{k=1}^{K_j} \pi_{jrk} = 1$

Define p_r as the mixing proportions that provide the weights in the weighted sum of the component tables where $\Sigma\, p_r = 1$.

Assuming local independence, the probability that a respondent i in class r produces a particular set of J outcomes on the manifest variables is given by:

$$f(Y_i; \pi_r) = \prod_{j=1}^{J} \prod_{k=1}^{K_j} \left(\pi_{jrk}\right)^{Y_{ijk}}$$

The probability density function across all classes is given by:

$$f(Y_i \mid \pi, p) = \sum_{r=1}^{R} p_r \prod_{j=1}^{J} \prod_{k=1}^{K_j} \left(\pi_{jrk}\right)^{Y_{ijk}}$$

The latent class model estimates the parameters p_r and π_{jrk}.

Using the Bayes' formula the posterior probability of each respondent belonging to each class, conditional on the observed values of the manifest variables can be

calculated as: $\hat{P}(r \mid Y_i) = \frac{\hat{p}_r f(Y_i; \hat{\pi}_r)}{\sum_{q=1}^{R} \hat{p}_q f(Y_i; \hat{\pi}_q)}$ where $\hat{p}_r$ and $\hat{\pi}_{jrk}$ denote the parameter estimates.

It is important to notice that the number of parameters estimated by the model will depend on the values R, J and K_j.

3.2.3 Parameter Estimation in Latent Class Analysis

As stated by Francis (2011), the unknown parameters in the model are the class profiles and class sizes; p_r and π_{jrk}. The estimates are obtained by maximizing the log-likelihood function with respect to the unknown parameters. The log-likelihood function is defined as:

$$\log L = \sum_{i=1}^{N} \ln \sum_{r=1}^{R} p_r \prod_{j=1}^{J} \prod_{k=1}^{K_j} (\pi_{jrk})^{Y_{ijk}}$$

Package poLCA facilitated by R statistical software, which is used to conduct latent class analysis uses the Expectation-Maximization (EM) algorithm to maximize the log-likelihood function. Arbitrary estimates are made for p_r and π_{jrk}. Next in the expectation step, class membership probabilities are calculated by substituting those initial values and in the maximization step, the log-likelihood function is maximized giving the new estimates:

$$\hat{p}_r^{new} = \frac{1}{N} \sum_{i=1}^{N} \hat{P}(r \mid Y_i) \text{ and } \hat{\pi}_{jr}^{new} = \frac{\sum_{i=1}^{N} Y_{ij} \hat{P}(r \mid Y_i)}{\sum_{i=1}^{N} \hat{P}(r \mid Y_i)}$$

The process continues iteratively and converges when the log-likelihood cannot increase beyond a certain value (Linzer & Lewis, 2011).The advantage of using poLCA is that even if some of the observations of the manifest variables are missing, it will still estimate the latent classes. As the EM algorithm at times identify the local maximum instead of the global maximum, when using poLCA in latent class analysis, the model is re-estimated several times to ensure that the global maximum is reached.

3.2.4 Goodness of Fit of the Model

Latent class analysis provides a range of tools to assess the goodness of fit of a model and determine the most appropriate number of classes (Linzer & Lewis, 2011). As mentioned previously the number of classes will depend on the requirement of the

study or theoretical reasons. If the number of classes is not specified poLCA will classify the objects based on the data. Usually the best model is considered to be the most parsimonious model. As the number of classes increase the fit of the model will increase too. However this will increase the number of parameters to be estimated. A parsimonious model will ensure that there is a proper balance between the fit and the simplicity and there will be no over-fitting or under fitting.

The Pearson's Chi-square $\chi^2$and the likelihood ratio chi-square statistics G^2can be used to assess the goodness of fit of the model. These statistics are defined as:

$$\chi^2 = \sum_c \left(q - \hat{Q}\right)^2 / \hat{Q} \text{ and } G^2 = 2\sum_c q \log\left(q / \hat{Q}\right)$$

Where $\hat{Q}$ is defined as: $\hat{Q} = N\sum_{r=1}^{R} \hat{p}_r \prod_{j=1}^{J} \hat{\pi}_{jrk}$

The likelihood ratio chi-square statistic is one of the simplest and most common measures of goodness of fit of a model. Similar to a normal chi-square test the formulated value is compared against the table value at 5% or 10% significance level. The corresponding degree of freedom is calculated as;

df = $2^{\text{Number of factor variables}}$ – Number of parameters estimated – 1

If the value exceeds the critical value the null hypothesis is rejected and it is concluded that the model is not suitable. However this test no longer holds when there are a large number of multi-category variables as the degree of freedom will not be a standard value. When using this test it is assumed that the statistics follow a theoretical chi-square distribution and this assumption does not hold when the observed rating patterns are extremely large. Many observed cells in the cross-classification table containing very few observations might be the cause for this (Linzer & Lewis, 2011).

Linzer and Lewis (2011) suggested using the statistics AIC (Akaike Information Criterion)and BIC (Bayesian Information Criterion) to assess the parsimony of a latent class model. Using these statistics would avoid the shortcomings of using the chi-squared statistics. These statistics use the concepts of -2 log-likelihood of the model, number of parameters estimated, sample size and other factors.

They are defined as:

$AIC = -2\Lambda + 2\Phi$ and $BIC = -2\Lambda + \Phi \ln N$

Λ- maximum log-likelihood of the model Φ- total number of estimated parameters Usually the model which minimizes the BIC and/or AIC is selected as the most parsimonious model. Thus the number of classes corresponding to the best model is considered to be the most appropriate number of classes to model the data.

In a situation where AIC and BIC produce different answers, as stated by Francis(2011), BIC is more reliable when the sample size is large. The package poLCA calculates all the above statistics automatically while constructing the latent classes. Thus the goodness off it can be directly assessed.

3.2.5 Assigning Observations to Classes

As mentioned by Francis (2011), observations are assigned to classes based on the class membership probabilities. A certain observation will have a high probability for one class while a low probability for the others. A common method is to assign an observation to a class only if the probability is large enough. Usually a cut-off probability of 0.9 is used, however deciding this cut-off probability is up to the researcher. Based on the requirements of the research and the suitability the cut-off probability can vary.

3.3 Synopsis

The chapter provided a description of the theories and statistical methodologies used in the research procedure. It briefly discussed the methods used in the preliminary analysis and an extended discussion was done regarding the theoretical background of latent class analysis which was used as an advance analysis technique and the methodology used in the process.

CHAPTER 04

PRELIMINARY ANALYSIS

CHAPTER 04 – PRELIMINARY ANALYSIS

The fourth chapter includes a brief description about the dataset and a detailed descriptive analysis which will lead to the advanced analysis.

4.1. AirJet Service and Performance Survey Dataset

The dataset used for this research was prepared based on the feedback of the AirJet airlines passengers who participated for the Service and Performance survey in 2010. This survey had been conducted to capture the satisfaction level of the passengers about their services based on three main factors: general information, on-board services and passenger opinions. A questionnaire had been given to the Economy class passengers of the airline travelling during the period of 27-04-2010 to 30-09-2010.The data were collected by distributing the questionnaires just before boarding at the airport on a systematic basis to cover around 10% of the passengers. Flights were selected based on different routes considering weekly flights ensuring fair representation of all passengers travelling on AirJet airlines.

After data pre-processing and missing value imputation, a complete dataset including 825 records for 42 categorical variables was obtained.(Appendix I)

4.2. Descriptive Analysis

Gender of the Passengers

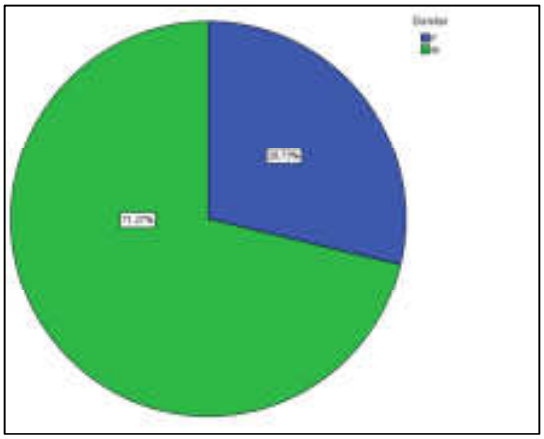

Figure 4.1: Passengers with respect to their gender

Figure 4.1 clearly displays that 71% of the passengers were males and 29% of them were females.

Nationalities of the Passengers

There were 36 different types of nationalities in the sample of respondents and the variable was recoded into four types of nationalities as Asian, European, Western and Middle Eastern.

Table 4.1: Categorization of the nationalities

Category	Nationality			
Sri Lankan	Sri Lanka	Bangladesh	Korea	Philippines
	Bangladesh	Chinese	Singapore	Pakistan
	Chinese	Indians	Thailand	Maldives
	Indians	Malaysians	Japanese	
Europeans	Dutch	Russians	Turkey	British
	French	Belgian	Italy	Hungarian
	German	Spanish	Irish	Sweden
Western	Americans	Brazil	Canada	Mexico
	Australians			
Middle East	Arab	Oman	Israel	Bahrain

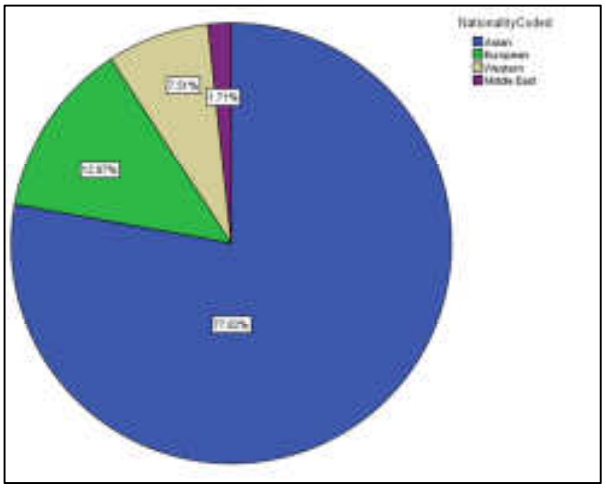

Figure 4.2: Different types of nationalities using the airline

Figure 4.2 displays different types of nationalities that were travelling in the airline. It can be clearly seen that a clear majority of travellers (nearly 78%) were Asians. The smallest proportion of the passengers was from the Middle Eastern countries. Nearly one out of eight passengers was from a European country.

Variation of age categories

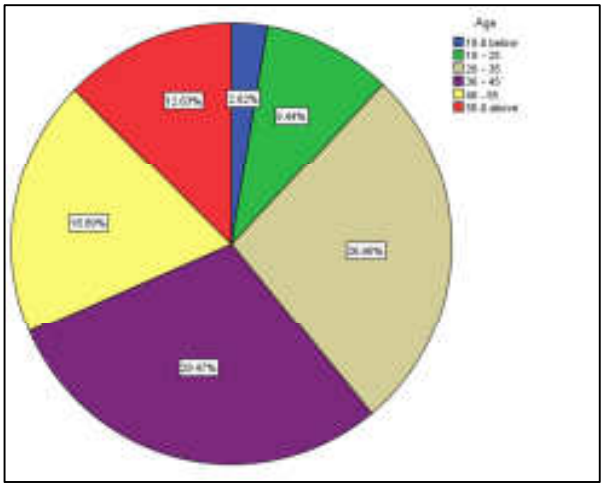

Figure 4.3: Age variations of the passengers

According to Figure 4.3 which displays the age variations of the passengers, more than half of the passengers (56%) were young adults aged between 26 and 45 and one out of eight passengers was a person who is below 25 years. Nearly 12% of them were elderly persons who are above 56 years.

Purpose of travel

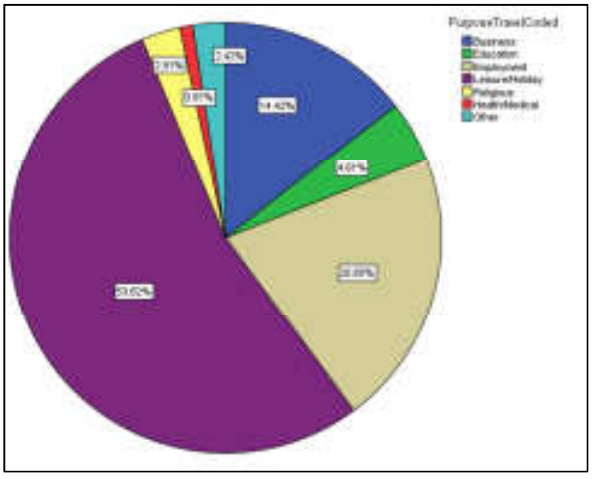

Figure 4.4: Purpose of travel

Figure 4.4 displays the purposes of the passengers that were involved in this survey. More than half (54%) of the passengers had traveled for leisure/holiday purposes, while one out of five had travelled for employment. The percentage of passengers travelled for business purposes was around 14%. Considerably small fractions of the passengers had travelled for religious (3%), health (1%) and other purposes (2%).

Travel with

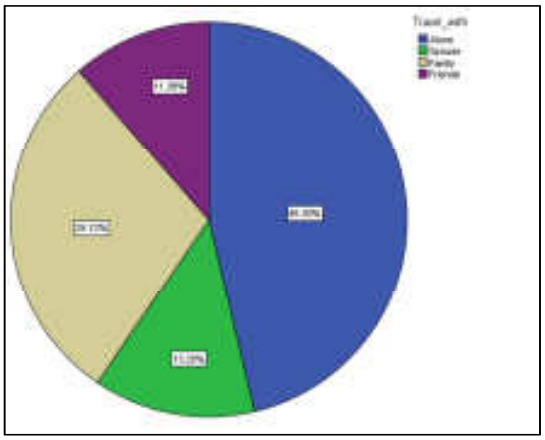

Figure 4.5: Passengers that had travelled with

Figure 4.5 displays with whom the passengers were travelling in the airline. Nearly half of the passengers (47%) were travelling alone and nearly one third of them had travelled with their families. The rest travelled with their friends or spouse.

Frequency of Traveling using AitJet Airlines

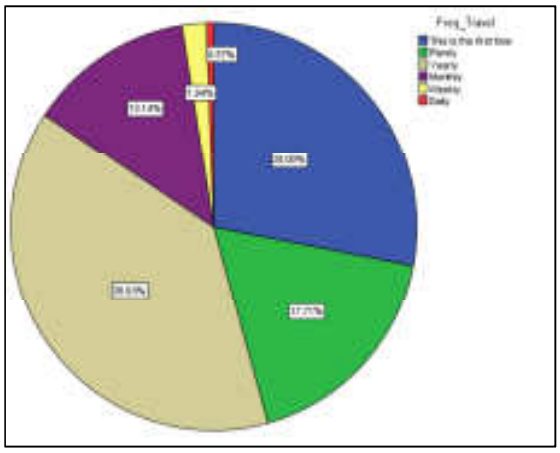

Figure 4.6: How often the passengers had used AirJet airlines

Figure 4.6 represents the travelling frequency of the passengers through the AirJet airlines. 28% of the passengers had chosen AirJet airline for the first time and nearly 70% which is the rest of the customer had travelled before using this airline. 40% of them were annually travelling using this airline while 1% of them were daily travellers.

Number of Airlines the Passengers that had Used Before

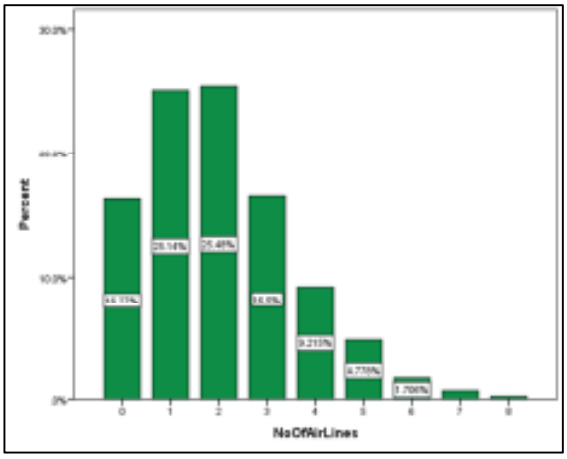

Figure 4.7: Number of other airlines the passengers had used before

Number of other airlines that the passengers had used before is shown in Figure 4.7. One out of six of them had never used any other airline other than AirJet airlines. Nearly 60% of them had used more than one airline indicating that majority of them had more air travelling experience using different airlines. Quarter of them had used only one other airline before, and their satisfaction level may highly influence the airline that they had travelled before.

Reuse / recommend

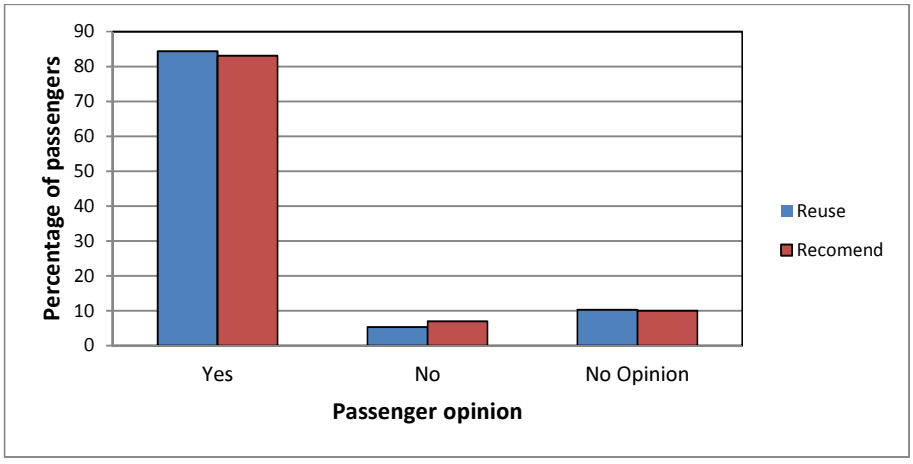

Figure 4.8: Choice of reusing and recommending the AirJet airline

Figure 4.8 displays whether the passengers were willing to reuse and recommend the AirJet airline. Nearly 85% of them were willing to reuse the airline as well as to recommend to the others. 5% of them were not willing to use the airline and 7% of

them were not willing to recommend this airline to the others. It seems that there are nearly 2% of them willing to reuse the airline without recommending it to the others. Nearly 10% of the passengers had no opinion about reusing/recommending the airline. The 15% who do not want to re-use or recommend will be analysed in the consequent sections.

Satisfaction Level of the Passengers about the Services and Performance of the Airline

The main objective is to find out the hidden factors or characteristics of the customers that are associated with their satisfaction level. Thus the preliminary analysis will give an insight into the services/facilities that were not in the expected level of the AirJet passengers.

Table 4.2 gives a summary about the satisfaction level of the passengers to six main aspects of their air travel; airport services, cabin crew services, inflight entertainment, seats, cabin condition &facilities and meals &beverages served. Heat shading based tables has been used to represent the magnitudes of the percentage of customers in different satisfaction levels. Dark green represents very high percentages and red represents very low percentages. Two major airport services provided at the check in process and the boarding process had also been taken into consideration, to check whether there had been any association with this to the dissatisfaction of the airline services.

As there were 5 satisfaction levels to be chosen in the questionnaire, they were re-categorized into 3 satisfaction levels as 1 = Satisfied (1:Excellent and 2:Good), 2 = Average (3:Average) and 3= Not satisfied (4:Poor, 5:Very Poor) to make the analysis more meaningful.

Since the standard of the airline company is to maintain above 80% of passengers who are satisfied about their services and performances, the attributes where the percentage of satisfaction is lower than 80% must be taken into detailed analysis.

Table 4.2: Customer satisfaction level for services

		Percentage of passengers		
	Attribute	Satisfied	Average	Not Satisfied
Airport services	CheckIn_Overall	**81.09**	11.39	7.52
	Boarding_Overall	**84.73**	11.27	4.00
Cabin Crew Services	Crew_Announcement_Clarity	76.36	15.27	8.36
	Crew_Respond_Requests	76.97	13.94	9.09
	Crew_Meal_Service	72.00	16.73	11.27
	Crew_Friendliness	**84.85**	9.70	5.45
	Crew_Effi	**84.73**	9.45	5.82
	Crew_Overall	**84.12**	10.18	5.70
Inflight Entertainment	Inflight_Movies	42.79	21.70	35.52
	Inflight_VideoQuality	39.15	21.94	38.91
	InFlight_Music_Choice	39.15	20.85	40.00
	InFlight_Headset_Quality	43.15	17.94	38.91
	Inflight_Games_Choice	34.30	17.58	48.12
	InFlight_Newspare_Variety	30.91	20.48	48.61
Seats	Seats_Comfort	64.36	21.70	13.94
	Seats_LegSpace	55.88	30.30	13.82
	Seats_Quality_Pillow	64.36	21.70	13.94
	Seats_Adjustments	63.52	24.73	11.76
Cabin Condition & Facilities	Cabin_Envir	78.55	16.97	4.48
	Cabin Temperature	77.21	17.24	5.55
	Cabin Lighting	**84.97**	11.27	3.76
	Cabin Cleanliness	**81.58**	13.58	4.85
	Cabin Space	70.18	24.48	5.33
	Cabin Toilet Cleanliness	60.00	20.73	19.27
	Cabin Overall	78.91	16.36	4.73
Meals and Beverages Served	Meals choice	58.67	24.97	16.36
	Meals quality	61.70	24.00	14.30
	Meals presentation	68.6	20.7	10.7
	Meals temperature	68.12	18.79	13.09
	Meals timing	73.82	16.48	9.70
	Meals snack choice	43.88	26.18	29.94
	Meals overall	62.79	24.00	13.21
	Beverages_Overall	64.80	20.00	15.20

According to table 4.2, the airline company has achieved their desired satisfaction level of their passengers for crew friendliness, crew efficiency, overall crew

satisfaction level, cabin lighting and cabin cleanliness. Inflight entertainment attributes have very low satisfaction levels compared to other onboard services. Even though “Meals and Beverages Served” can be considered as one of the most important aspects, the satisfying percentage was low and far away from their desired target of 80%. Unlike the attributes regarding the seats which cannot be further improved, meals can be identified as the most important aspect that should be address to make the satisfaction of the passengers to higher levels. Meals snack choice has the lowest satisfaction level compared to other attributes in the meals and beverages served section.

Based on the above findings, associations between some of the selected attributes and general information about the passengers were identified.

Since the choice of meals and choice of snacks they had, have the lowest percentage of satisfaction in the ‘meals served category’ those two aspects have been further analyzed. All the sub-attributes of the inflight entertainment category had a low satisfaction percentage and hence those will be considered in the advanced analysis section.

Association between nationality and choice of meal

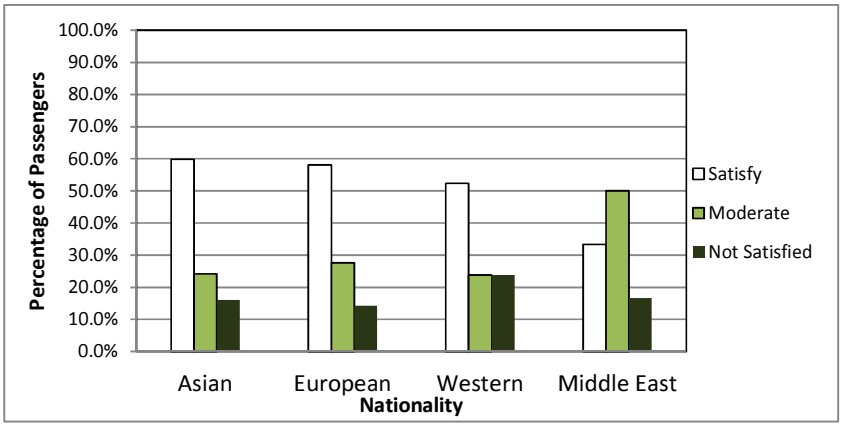

Figure 4.9:Satisfaction of choice of meal with respect to nationality

Figure 4.9 displays how the satisfaction levels for the choice of meals differ for different types of nationalities. Most of the Asians, Europeans and Westerns were satisfied about the choice of meals they had while most of the Middle Eastern passengers were moderately satisfied about this attribute. Westerns have the highest percentage of dissatisfaction compared with other nationalities.

Association between age and choice of meals

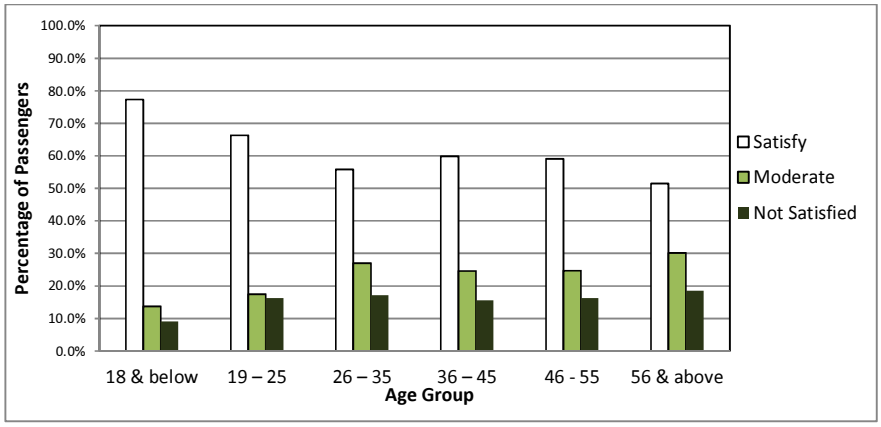

Figure 4.10: Satisfaction of choice of meals with respect to age group

Satisfaction levels for choice of meals with respect to the age categories have been displayed in Figure 4.10.The lowest percentage of satisfaction within an age group has been recorded for the oldest passenger category which is 56 and above. Only half of them were satisfied for the choice of meals they had. Nearly 80% of the youngest category was satisfied about the variety of food they had for meals. However, the satisfaction patterns of 26-35, 36-45 and 46-55 seems almost the same. The satisfaction pattern of 19-25 age category is also similar to that. Therefore, in case when there is a necessity to categorize the age groups in the advanced analysis, the results from obtained from Figure 4.9 can be considered.

Association between gender and choice of meals

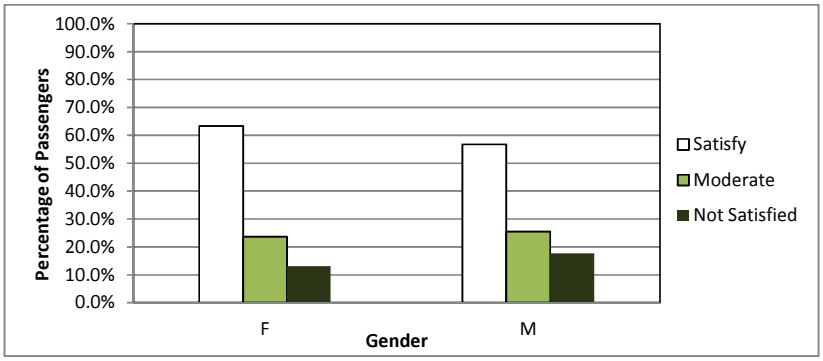

Figure 4.11:Satisfaction of choice of meals with respect to gender

Figure 4.11 displays how the gender has been associated with the choice of meals the passenger had. According to the graph, it can be seen that there was not much difference between males and females for the choice of meals they had.

Association between choice of meals and purpose of travel

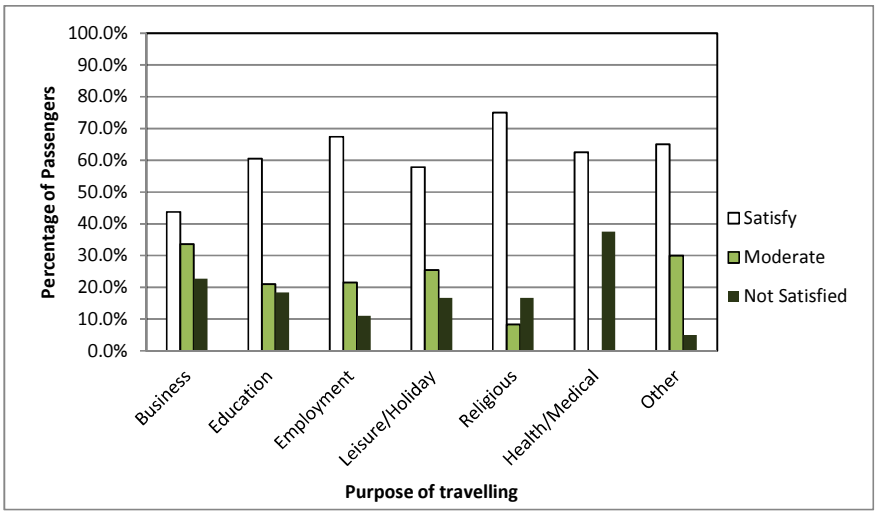

Figure 4.12: Satisfaction of choice of meals with respect to purpose of travel

In order to identify whether the purpose of travel has any association with the choice of meals served, Figure 4.12 has been plotted. Passengers travelling for business purposes has the lowest percentage (44%) of satisfaction while the highest for the passengers travelling for religious purposes. It can be clearly noted that the highest percentage of dissatisfaction (38%) has been recorded for the passengers travelling for Health/Medical purposes. Even though there were only a very small percentage of passengers travelling for Health/Medical purposes (1%), it would be better if the airline company can pay attention to their needs.

Association between choice of meals and whom they travel with

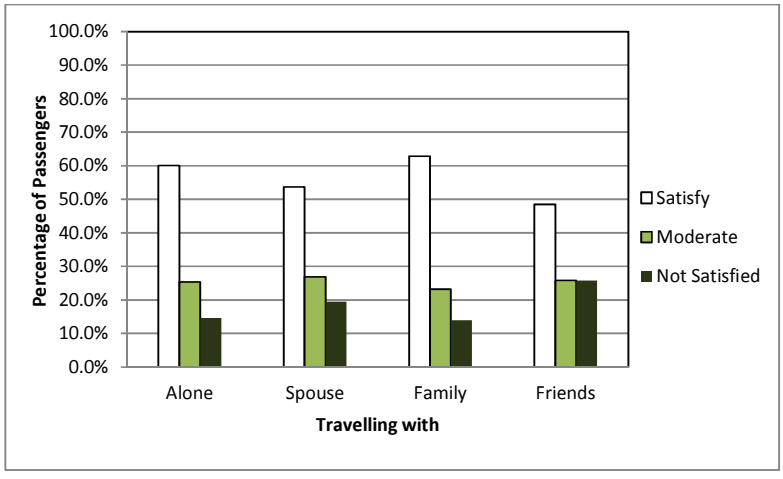

Figure 4.13: Satisfaction of choice of meals with whom they were travelling with

Figure 4.13 displays the association between the choice meals and with whom the passengers were travelling with. Even though there seems less discrepancies of the satisfaction level of the four categories, the passengers that were travelling with their friends have the highest percentage of dissatisfaction towards the choice of meals that they had.

Association between choice of snacks served & nationality of the passenger

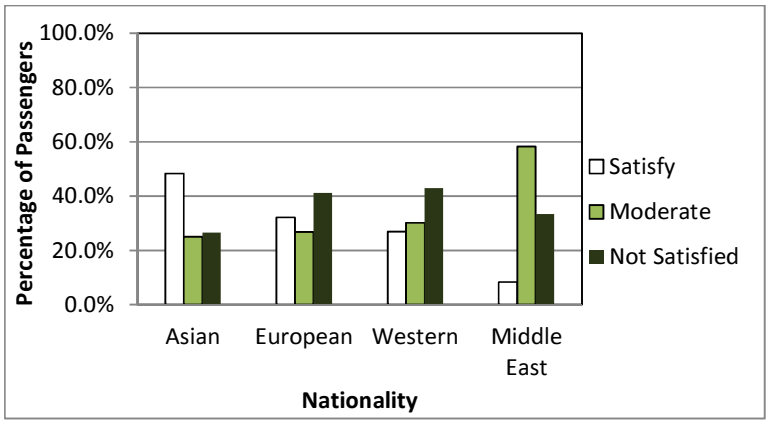

Figure 4.14: Satisfaction of choice of snacks with respect to nationality

Figure 4.14 displays how the satisfaction levels of the different nationalities vary for the choice of snacked served. Majority of Europeans and Westerns were not satisfied about the choice of snacks they had while nearly half of the Asians are satisfied about the choice they had. Nearly 60% of the Middle Eastern passengers are averagely satisfied about the option they had for the snacks.

Identifying association between choice of snacks & Age Group

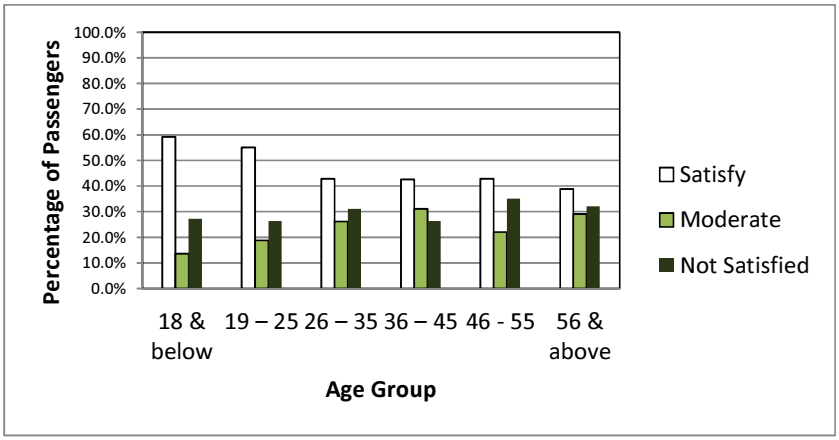

Figure 4.15:Satisfaction of choice of snacks with respect to age group

Figure 4.15 has been plotted to identify whether age has any association with the choice of snacks served. The satisfaction pattern of the first two age categories were similar and also the last four categories. Apart from the 36-45 age category, the second highest percentage was recorded for the dissatisfied passengers about the choice of meals they had.

4.3. Synopsis

This chapter provided a detailed descriptive analysis in order to identify variables that should be used for the advanced analysis and to identify similar type of categories that can be re-categorized in order to make the classification process of the advanced analysis more effective. The expected standard of the airline company was to maintain the percentage of satisfied passengers above 80% for the services provided by them. However, only very few attributes were in their expected standards and they were crew friendliness (85%), crew efficiency (85%), overall crew satisfaction level (84%), cabin lighting (85%) and cabin cleanliness (82%). All the inflight entertainment attributes had a very low percentage of satisfaction level. The attributes for the “Meals and Beverages Served” section also did not have high percentages of satisfaction and choice of meals they had and choice of snacks they had gave the lowest satisfaction percentages. There were noticeable associations between the choice of meals with nationalities and purpose of travel. There were no significant effect on the gender for the satisfaction levels of the choice of meals served and choice of snacks served and the six age categories can be combined to form three categories as 25 and below, 26-55 and above 56 as the satisfaction patterns seems similar.

CHAPTER 05

ADVANCED ANALYSIS

CHAPTER 05 – ADVANCED ANALYSIS

This chapter provides a detailed analysis based on the Latent Class Analysis. The results from the preliminary analysis were used to identify most suitable variables that should be considered and to re-categorize variable when necessary. In the preliminary analysis, the effect of considering more than two variables together was not possible but in the advanced analysis section, the associations between several variables could be measured.

5.1: Latent Class Model 1 – Satisfaction of the Passengers for the 'Meals and Beverages Served' attributes

The first latent class model was fitted to classify passenger attributes regarding 'meals and beverages served'. As there were no continuous variables, a latent class model without covariates was fitted. A sequence of models was then fitted with different numbers of classes to identify the most suitable number of classes and Table 5.1 displays the goodness of fit measures for the models.

Table 5.1: Goodness of fit measures for the model 1

	Number of classes			
Goodness of fit measures	2 Classes	3 Classes	4 Classes	5 Classes
AIC	9151.414	8364.248	8239.812	8191.983
BIC	9307.022	8600.017	**8555.742**	8588.076
G^2	2264.044	1442.877	1284.441	1202.613
χ^2	24899.06	10632.25	8180.846	5820.664

Identifying the most appropriate number of class is to locate the best fitting or most parsimonious model. The two most widely used parsimony measures are the Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) (Forster, 2000). Generally, the goal is to select the model that minimize χ^2 (Chi-square goodness of fit) or G^2(Likelihood ratio/deviance statistic) statistics, but they cannot be used to model identification when many cells of the observed cross-classification table contain very few observations as the distributional assumptions for these statistics are

not met. Then the BIC statistic usually is more appropriate for basic latent class models. (Linzer & Lewis)

Even though $G^2$and χ^2 statics had minimum values for the 5 class model, the 4 class model was selected as the best model having minimum BIC value as the distributional assumptions for$G^2$and χ^2 do not satisfy since there were cells of the observed cross-classification table.

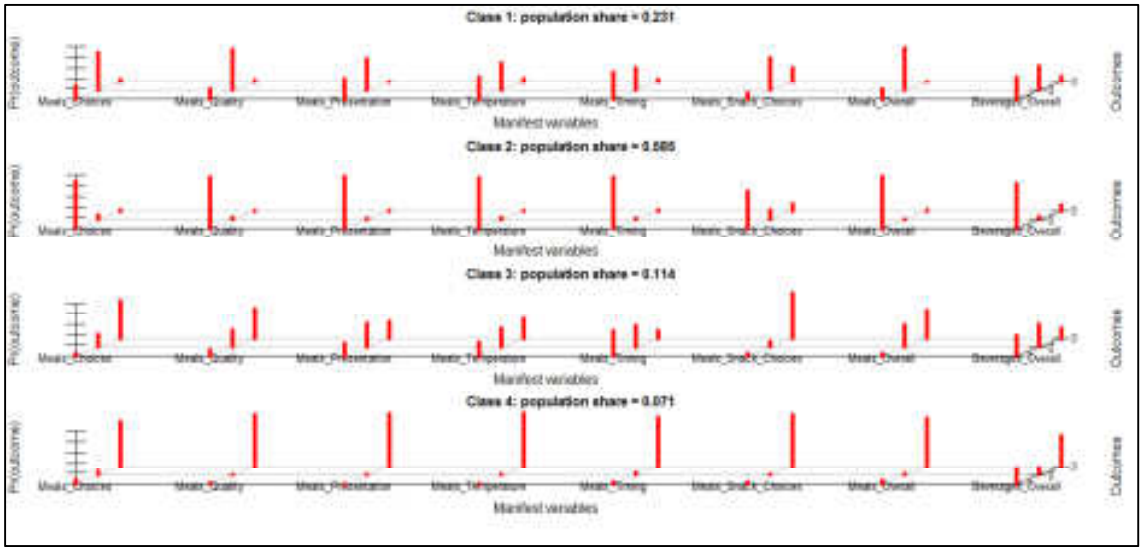

Figure 5.1: Graphical representation of parameter estimates for the four class model

Figure 5.1 displays the parameter estimates of the first latent class model having satisfaction levels of all the 'meals and beverage served' attributes for four class model. Each group of red bars represents the conditional probabilities, by latent class, of being by each of the eight attributes. Taller bars correspond to conditional probabilities closer to 1. It can be clearly seen how the satisfaction levels differ for each attribute among the four classes.

Table 5.2 displays the summary of the conditional probabilities obtained for each satisfaction level of the attributes.

Table 5.2: Conditional probabilities of the attributes among the four classes

Attribute	**Satisfied**	**Average**	**Not satisfied**
Class1: Population share =0.23			
Meals_Choices	0.2425	0.7076	0.0499
Meals_Quality	0.1859	0.7808	0.0333
Meals_Presentation	0.4005	0.5995	0
Meals_Temperature	0.4208	0.5189	0.0603
Meals_Timing	0.5244	0.4273	0.0484
Meals_Snack_Choices	0.106	0.6238	0.2703
Meals_Overall	0.193	0.807	0
Beverages_Overall	0.4282	0.4641	0.1078
Class 2: Population share =0.56			
Meals_Choices	0.8889	0.0929	0.0182
Meals_Quality	0.9579	0.0377	0.0044
Meals_Presentation	0.9693	0.0284	0.0022
Meals_Temperature	0.9489	0.0463	0.0048
Meals_Timing	0.9606	0.0311	0.0084
Meals_Snack_Choices	0.6962	0.1832	0.1206
Meals_Overall	0.9795	0.0101	0.0104
Beverages_Overall	0.8312	0.0588	0.11
Class 3: Population share =0.12			
Meals_Choices	0.0464	0.2403	0.7133
Meals_Quality	0.1155	0.3236	0.5609
Meals_Presentation	0.2372	0.4548	0.308
Meals_Temperature	0.2582	0.3599	0.3819
Meals_Timing	0.4685	0.3991	0.1324
Meals_Snack_Choices	0.0435	0.0947	0.8618
Meals_Overall	0.0525	0.4083	0.5392
Beverages_Overall	0.3803	0.4306	0.189
Class 4: Population share =0.07			
Meals_Choices	0.0827	0.0663	0.851
Meals_Quality	0.0142	0.0122	0.9736
Meals_Presentation	0	0.0058	0.9942
Meals_Temperature	0	0	1
Meals_Timing	0.0317	0.0362	0.9322
Meals_Snack_Choices	0.034	0	0.966
Meals_Overall	0.0681	0.0182	0.9137
Beverages_Overall	0.2896	0.1328	0.5776

According to Table 5.2, majority of the passengers had been assigned to class 2 (Population share 56%) and a few (0.07%=58) has been categorized to class 4. The four classes can be explained as below;

- Class 1: Passengers that were ***averagely satisfied*** about the ***quality of the meals***, ***choice of the meals*** and ***overall of the meals***.
- Class 2: Passengers that were ***satisfied*** about ***all the 'meals and beverages served' attributes except the choice of snacks***.
- Class 3: Passengers that were ***dissatisfied*** about the ***choice of meals*** and the ***choice of snacks***.
- Class 4: Passengers that were ***not satisfied*** about ***all the meal's attributes***.

According to the above classification, following hidden factors/characteristics could be suggested from each of the class results.

- Class 1: The ***average satisfaction*** level for the ***'overall meals'*** attribute may be directly related to the ***choice of meals*** and ***quality of meals***.
- Class 2: It seems that the passengers' ***dissatisfaction towards the choice of snacks was more reasonable*** as the passengers that were satisfied about ***all*** the other meals had a lower conditional probability of being satisfied about the varieties of snacks they had.
- Class 3: The 12% of the customers who were ***not satisfied about the choice of meals*** may have influenced by ***not having a proper choice of snacks***.
- Class 4: ***Dissatisfaction of all the meals attributes*** may not have direct impact on ***satisfaction level of beverages***.

5.1.1. Association between class membership and general information of the passengers

Table 5.3 displays percentage of passengers of each nationality had been assigned into one of the four classes.

Table 5.3: Association between the assigned class and nationality of the passenger

		MealsPredClass			
		1	2	3	4
		Row N %	Row N %	Row N %	Row N %
Nationality	Asian	13.2	51.1	19.6	16.1
	European	12.5	47.3	25.0	15.2
	Western	19.0	44.4	19.0	17.5
	Middle East	8.3	0.0	50.0	41.7

It can be clearly seen how the pattern of customer classification to the four classes. Asians, Europeans and Westerns seems to have similar classification patterns, while half of the Middle Eastern passengers were assigned into the fourth class where majority of its passengers were not satisfied about all the meal's attributes. Nearly half of the Asian had been assigned into the second class where its passengers were satisfied about all the 'meals and beverages served' attributes except the choice of snacks.

Table 5.4: Association between the assigned class and nationality of the passenger

		MealsPredClass			
		1	2	3	4
		Row N %	Row N %	Row N %	Row N %
Gender	F	10.1	52.3	18.1	19.4
	M	14.8	48.1	21.8	15.3

According to table 5.4 it can be clearly seen that the assigning pattern of males and females to the four classes were similar as suggested from the preliminary analysis.

5.2: Latent Class Model 2 – Satisfaction of the Passengers for the Inflight Entertainment Attributes

A sequence of models was fitted with different numbers of classes to identify the most suitable number of classes which represents the satisfaction levels for all the inflight entertainment attributes (choice of movies, video quality, choice of music, headset quality and variety of newspapers). Table 5.7 displays the goodness of fit measures for the fitted models.

Table 5.5: Goodness of fit measures for the model 2

	2 Classes	3 Classes	4 Classes
AIC	6709.221	6061.459	6039.91
BIC	6808.244	6212.351	6242.671

Table 5.8 displays the summary of the class-conditional probabilities obtained for each satisfaction level of the attributes. Figure 5.2 displays how the conditional probabilities of the attribute values of the manifest variables have been distributed among the three classes.

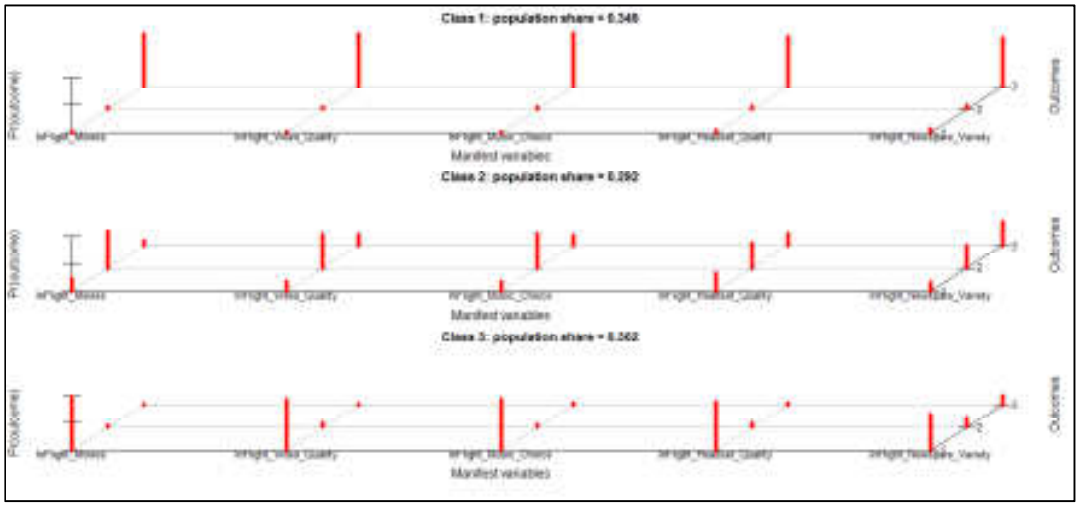

Figure 5.2: Graphical representation of parameter estimates for the four class model

Table 5.6: Class-conditional probabilities of the Model 02

	Satisfied	Average	Not Satisfied
Class 1- Population share =0.346			
Inflight_Movies	0.2286	0.6805	0.0908
Inflight_VideoQuality	0.1715	0.6217	0.2068
InFlight_Music_Choice	0.1783	0.6317	0.19
InFlight_Headset_Quality	0.3213	0.4614	0.2172
InFlight_Newspare_Variety	0.1568	0.4169	0.4262
Class 2 - Population share =0.292			
Inflight_Movies	0.0295	0.0257	0.9448
Inflight_VideoQuality	0.0164	0.0382	0.9454
InFlight_Music_Choice	0.014	0.0279	0.9581
InFlight_Headset_Quality	0.0447	0.0508	0.9045
InFlight_Newspare_Variety	0.0658	0.0587	0.8755
Class 3 - Population share =0.362			
Inflight_Movies	0.97	0.0262	0.0039
Inflight_VideoQuality	0.9281	0.0684	0.0036
InFlight_Music_Choice	0.9249	0.04	0.0351
InFlight_Headset_Quality	0.8907	0.075	0.0343
InFlight_Newspare_Variety	0.6648	0.1737	0.1615

According to Table 5.6, approximately similar proportions of passengers had been assigned to the three classes. The classes can be explained as below;

- Class 1: There are no extremely high class conditional probabilities for the first class but it can be guessed that majority were ***averagely satisfied*** passengers about the ***choice of movies, music and the quality of the videos***.
- Class 2: Nearly 30% of the passengers were ***not satisfied*** about ***all the 'inflight entertainment'*** attributes
- Class 3: 36% of the passengers ***satisfied about*** all the ***inflight entertainment*** attributes ***except variety of newspapers/magazines*** they had.

According to the above classification, following hidden factors/characteristics could be suggested from the class results.

- Inflight entertainment should be improved a lot.
- Class 3: Even though passengers were satisfied about technological entertaining methods like movies and music they also pay attention to read newspapers/magazines as the class-conditional probability for satisfying about the variety of newspapers/magazines is lower in this class.

5.2.1 Association between class membership and general information of the passengers

According to tables 5.7 - 5.10, no prominent classification patterns could be identified with respect to age, gender, purpose of travel and nationality when classifying passengers with respect to inflight entertainment attributes.

Table 5.7: Association between the assigned class and age

		Class		
		1	2	3
		Row N %	Row N %	Row N %
Age	25 & below	26.5	27.5	46.1
	26-55	35.5	28.1	36.5
	Above 56	35.9	33.0	31.1

Table 5.8: Association between the assigned class and gender

		Class		
		1	2	3
		Row N %	Row N %	Row N %
Gender	F	35.4	27.4	37.1
	M	34.0	29.1	36.9

Table 5.9: Association between the assigned class and purpose of travel

		Class		
		1	2	3
		Row N %	Row N %	Row N %
Purpose of travel	Leisure/Holiday	35.6	31.1	33.3
	Not for Leisure/Holidays	33.1	25.7	41.2

Table 5.10: Association between the assigned class and the nationality

		class		
		1	2	3
		Row N %	Row N %	Row N %
Nationality	Asian	33.2	26.6	40.1
	European	35.7	38.4	25.9
	Western	46.0	30.2	23.8
	Middle East	25.0	33.3	41.7

5.3: Latent Class Model 3 – Satisfaction of the Passengers about the Cabin Crew attributes

Based on the goodness of fit measures in Table 5.11, the 4 class model with the lowest BIC was selected as the best model.

Table 5.11: Goodness of fit measures for the model 3

	2 Classes	3 Classes	4 Classes	5 Classes
AIC	5066.59	4854.424	4781.204	4724.425
BIC	5184.474	5033.609	5021.689	5026.209

Table 5.12: Class-conditional probabilities of the Model 03

	Satisfied	Average	Not Satisfied
Class 1 – Population share = 0.044			
Crew_Announcement_Clarity	0.141	0.1164	0.7425
Crew_Respond_Requests	0.0296	0.0307	0.9398
Crew_Meal_Service	0.0281	0.1396	0.8323
Crew_Friendliness	0.0927	0.0939	0.8134
Crew_Effi	0.2613	0.0322	0.7065
Crew_Overall	0.2891	0	0.7109
Class 2 - Population share =0.129			
Crew_Announcement_Clarity	0.4134	0.4306	0.1561
Crew_Respond_Requests	0.2575	0.605	0.1375
Crew_Meal_Service	0.1666	0.6215	0.2118
Crew_Friendliness	0.2856	0.6414	0.0731
Crew_Effi	0.2576	0.6936	0.0488
Crew_Overall	0.2336	0.7185	0.0479
Class 3 - Population share =0.025			
Crew_Announcement_Clarity	1	0	0
Crew_Respond_Requests	0.9081	0.0919	0
Crew_Meal_Service	0.8536	0	0.1464
Crew_Friendliness	0.851	0.149	0
Crew_Effi	0.1828	0	0.8172
Crew_Overall	0.2347	0	0.7653
Class 4 - Population share =0.801			
Crew_Announcement_Clarity	0.8474	0.1146	0.038
Crew_Respond_Requests	0.8892	0.0717	0.0391
Crew_Meal_Service	0.8436	0.1006	0.0557
Crew_Friendliness	0.9813	0.0076	0.0111
Crew_Effi	0.9958	0.0042	0
Crew_Overall	0.989	0.011	0

Based on the class conditional probabilities of Table 5.12, following remarks could be obtained.

- Class 1: 4% of the passengers ***not satisfied*** for all the attributes of the ***cabin crew***.
- Class 2: Passengers that were ***averagely satisfied*** about ***overall services and performances of the cabin crew***.

- Class 3: Passengers who were satisfied about the crew announcement clarity, their responsiveness to passenger requests, serving of meals and friendliness of the crew while dissatisfied about the crew efficiency and overall performances.
- Class 4: 80% of the passengers ***satisfied*** about all the attributes of the ***cabin crew***.

According to the above classification, following hidden factors/characteristics could be suggested from the class results.

- Class 3: Even though passengers were satisfied about crew announcement clarity, their responsiveness to passenger requests, serving of meals and friendliness of the crew, the overall satisfaction level may had been heavily influenced by the crew efficiency.
- When considering all the cabin crew attributes together there is a high probability of satisfaction about the services and performances of the cabin crew.

As in section 5.2.1 no clear patterns could be identified for the association of the general information with the classification process.

5.4: Latent Class Model 4 – Satisfaction of the Passengers about the Cabin Attributes

Based on the goodness of fit measures in Table 5.13, a 3 class model with the lowest BIC was selected as the best model.

Table 5.13: Goodness of fit measures for the model 4

	2 Classes	3 Classes	4 Classes
AIC	4904.812	4701.837	4673.337
BIC	5003.835	4852.729	4876.098

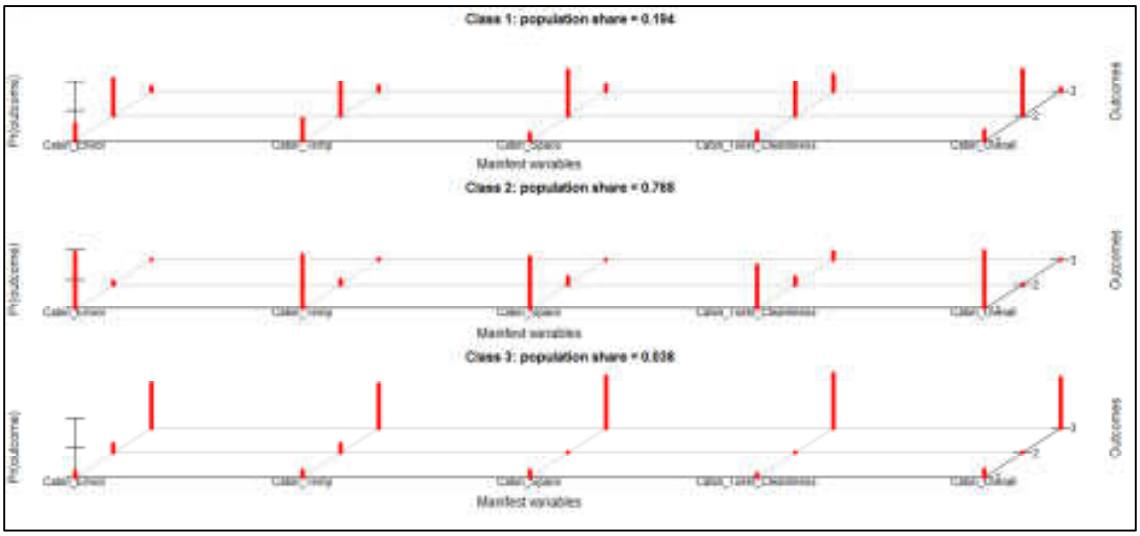

Figure 5.3: Graphical representation of parameter estimates for the three classes

According to Figure 5.6, one can clearly see how the satisfied responses had been classified to the second class, dissatisfied responses to the third class and the average satisfied responses to the first class.

As displayed by Figure 5.6, the values of the conditional probabilities have been displayed in the Table 5.14.

Table 5.14: Class conditional probabilities of Model 04

	Satisfied	Average	Not Satisfied
Class 1 – Population share= 0.19			
Cabin_Envior	0.2828	0.6468	0.0705
Cabin_Temp	0.3574	0.5568	0.0858
Cabin_Space	0.1186	0.7837	0.0977
Cabin_Toilet_Cleanliness	0.1535	0.5552	0.2913
Cabin_Overall	0.1628	0.7969	0.0403
Class 2 – Population share=0.768			
Cabin_Envior	0.9466	0.0505	0.0028
Cabin_Temp	0.913	0.0762	0.0107
Cabin_Space	0.8789	0.1211	0
Cabin_Toilet_Cleanliness	0.74	0.1298	0.1302
Cabin_Overall	0.9803	0.012	0.0077
Class 3 – Population share=0.038			
Cabin_Envior	0.0961	0.1459	0.7579

Cabin_Temp	0.1082	0.1486	0.7432
Cabin_Space	0.1017	0	0.8983
Cabin_Toilet_Cleanliness	0.0512	0	0.9488
Cabin_Overall	0.1243	0	0.8757

Following suggestions can be made by the classification of the passengers based on their choice of attributes of the cabin.

- Three classes were for the three satisfaction levels. First class has passengers averagely satisfied about all the attributes, second class has passengers satisfied about all the attributes while third one having passengers not satisfied about all the attributes.

5.4.1 Association between class membership and general information of the passengers

According to Table 5.10 all the nationalities seems to be having a similar classification pattern for the three clusters based on the cabin attributes while the percentage of Middle Eastern passengers classified to the second cluster is lower than the other nationalities.

Table 5.15: Association between the assigned class and the nationality

		Class		
		1	2	3
		Row N %	Row N %	Row N %
Nationality	Asian	17.1	79.3	3.6
	European	25.9	70.5	3.6
	Western	25.4	68.3	6.3
	Middle East	33.3	58.3	8.3

5.5. Synopsis

This chapter confirmed the results obtained from the preliminary analysis. Out of the attributes the passengers were not satisfied; choice of movies, video quality, choice of music, headset quality, choice of newspaper/magazine, choice of snacks and choice of meals seems prominent. When considering passengers of different nationalities, Middle Eastern passengers seem to be dissatisfied with most of the meals related attributes. No clear discrepancies could be identified based on the gender of the passengers. For some groups of passengers, the overall satisfaction/dissatisfaction level for a set of related attributes were strongly influenced by dissatisfaction of even one or two sub attributes as the choice of snacks they had.

CHAPTER 06

DISCUSSION AND CONCLUSION

CHAPTER 06 – DISCUSSION & CONCLUSION

This chapter provides a discussion of the analysis conducted in previous chapters and presents important findings, states the limitations of the study, problems encountered and makes suggestions for future work.

6.1 General Discussion

Based on the feedback from the Service and Performance Survey of the AirJet airline in 2010, following findings could be extracted

- Majority of the passengers travelling were male Asians and more than half of the passengers were travelling for leisure/holiday purposes. Majority of the passengers were young adults aged between 26-45 years.
- More than 80% of the passengers were willing to reuse/recommend the AirJet airline.
- The airline company has achieved their desired satisfaction level of 80% satisfaction level of their passengers for crew friendliness, crew efficiency, overall crew satisfaction level, cabin lighting and cabin cleanliness.
- Inflight entertainment attributes (choice of movies, video quality, choice of music, headset quality, choice of newspaper/magazine) have very low satisfaction levels compared to other onboard services.
- Even though "Meals and Beverages Served" can be considered as one of the most important aspects, the satisfying percentage was low and far away from their desired target of 80%. Choice of snacks has the lowest satisfaction level compared to other attributes
- It would be better if there was a choice of meals and choice of snacks which suits the Middle Eastern passengers.
- Compared with passengers travelling for other purposes, passengers travelling for business purposes have the lowest percentage of satisfaction about the choice of meals they had.
- Even though there were a very small percentage of passengers travelling for Health/Medical purposes, it would be better if the airline company can pay attention to their needs about the choice of meals they have.

- For some passengers, average satisfaction level for the ‘overall meals’ attribute may be directly related only to the choice of meals and quality of meals.
- It seems that the passengers’ dissatisfaction towards the choice of snacks was reasonable as the passengers that were satisfied about all the other meals were not satisfied about the choice of snacks they had.
- There can be passengers who were not satisfied about the choice of meals may be because not having a proper choice of snacks.
- Asians, Europeans and Westerns seems to have similar classification patterns based on the meals attributes, while half of the Middle Eastern passengers were not satisfied about all the meal’s attributes.
- Nearly half of the Asians were satisfied about all the ‘meals and beverages served’ attributes except the choice of snacks.
- Inflight entertainment should be improved a lot by including different varieties of movies and music. Technical aspects like video quality and headset quality also must be improved.
- Even though some passengers were satisfied about technological entertaining methods like movies and music they also have interest on newspapers/magazines.
- Even though some passengers were satisfied about crew announcement clarity, their responsiveness to passenger requests, serving of meals and friendliness of the crew, the overall satisfaction level had been heavily influenced by the crew efficiency.

6.2: Conclusions

- The number of attributes that the airline company has achieved their desired satisfaction level of 80% satisfaction level of their passengers was very few. (crew friendliness, crew efficiency, overall crew satisfaction level, cabin lighting and cabin cleanliness)
- Inflight entertainment attributes (choice of movies, video quality, choice of music, headset quality and choice of newspaper/magazine) have very low satisfaction levels compared to other onboard services and must be improved a lot.

- More choices of meals should be provided and special attention should be paid for the choices of meals for the air planes taking more Middle Eastern people. Snack choices are very poor.
- Crew efficiency also considered one of the major attributes that influence the overall service and performance of the cabin crew.

6.3: Limitation and Suggestions of the Study

- Even though duration of the journey and route of the journey plays an important role in an air travel, those aspects have not been considered for this study and a more effective analysis could be done when those details were known.
- The percentage of Asian was much higher than other nationalities and hence that attribute could not be included for the latent class model as it influences the classification a lot.

6.4: Further Work

- If continuous variables that affect the satisfaction of the airline can be obtained, a Latent Class Model with covariates can be fitted.

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APPENDIX I

Table 7.1: Variables in the dataset and their values

Variable	Values	Variable	Values
Gender	1-Female, 2- Male	Seats_Comfort	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
NationalityCoded	1-Asian, 2-European, 3-Western, 4-Middle East	Seats_LegSpace	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
Age	1-18&below, 2-19to25, 3- 26to35, 4- 36to45, 5-46to55, 6- 56 & above	Seats_Quality_Pillow	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
PurposeTravel	1- Business, 2-Education, 3- Employment, 4-Leisure/Holliday, 5- Religious, 6-Helth/Mediical, 7-Other	Seats_Adjustments	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
Travel_with	1-Alone, 2-Spouse, 3-Family, 4-Friends, 5-Other	Cabin_Envior	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
Freq_Travel	1-This is the first time, 2-Rarely, 3-Yearly, 4-Monthly, 5-Weekly, 6-Daily	Cabin_Temp	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
NoOfAirLines	Number of airline they had travelled before	Cabin_Lighting	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor

CheckIn_Overall	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor	Cabin_Cleanliness	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
Boarding_Overall	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor	Cabin_Space	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
Crew_Announcement_Clarity	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor	Cabin_Toilet_Cleanliness	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
Crew_Respond_Requests	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor	Cabin_Overall	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
Crew_Meal_Service	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor	Meals_Choices	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
Crew_Friendliness	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor	Meals_Quality	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
Crew_Effi	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor	Meals_Presentation	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
Crew_Overall	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor	Meals_Temperature	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
InFlight_Movies	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor	Meals_Timing	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
InFlight_Video_Quality	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor	Meals_Snack_Choices	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
InFlight_Music_Choice	1-Excellent, 2-Good, 3-Average, 4-Poor,	Meals_Overall	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-

	5-Very Poor		Very Poor
InFlight_Headset_Quality	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor	Beverages_Overall	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor
InFlight_Games_Choice	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor	Reuse	1-Yes, 2 –No, 3-No Opinion
InFlight_Newspare_Variety	1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor	Recommend	1-Yes, 2 –No, 3-No Opinion

APPENDIX II

Using "poLCA" Package for Latent Class Analysis in R

"poLCA" is a package which can be used to conduct latent class analysis and this package in the software application R. In order to use poLCA in R, the package was first installed and downloaded from the library.

After importing the dataset to the R software, a latent class model was fitted to the data and replicated for 5 times in order to avoid the solution to be the local minima.

R code to fit a model without covariates

```
Model1<-cbind(A,B,C,D)~1
```

Where A,B,C and D are the manifest variables. ~1 represents that this model does not have any covariates.

```
Result1<-poLCA(Model1,data,nclass=2,graph=TRUE,maxier=5000)
```

List of outputs that can be generated from function poLCA

	Term Description
y	Data frame of manifest variables
x	Data frame of covariates
N	Number of cases in the model
Nobs	Number of fully observed cases
probs	Matrices containing class-conditional probabilities
probs.se	Standard errors of class-conditional probabilities
P	Size of each latent class
P.se	Standard errors of P
posterior	Matrix of posterior class membership probabilities of each class
predclass	Vector of class membership
predcell	Table of observed vs. predicted cell counts
llik	Maximum value of estimated model log-likelihood
numiter	Number of iterations taken to converge
coeff	Matrix of estimated multinomial logit coefficients

coeff.se	Standard errors of the coefficients
coeff.V	Covariance matrix of the coefficients
aic	Akaike Information Criterion
bic	Bayesian Information Criterion
Gsq	Likelihood ratio/deviance statistic
Chisq	Pearson chi-square goodness of fit statistic
resid.df	Number of residual degrees of freedom
probs.start	Starting probabilities for EM algorithm