Airline Ancillary Services: An Investigation into Passenger Purchase Behavior

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U.S. airlines have a vested interested in the intentions and purchase behavior of their domestic airline passengers, especially their willingness to pay for assorted ancillary services. For this research, antecedents to purchase intention and actual purchase behavior of airline ancillary services were evaluated using logistic regression and generalized linear model (GLM) and data collected from Amazon Mechanical Turk. The results show differences in airline passenger preferences when purchasing ancillary services. The number of times a passenger flies per year and the trip purpose are significant, while age and gender are not.

INTRODUCTION

Ancillary service fees have become a popular revenue stream as airlines look for ways to grow revenue. Ancillary revenue strategies and à la carte pricing have long been used and the trend does not appear to be slowing (Tuzovic et al. 2014). Baggage fees and cancellation or change fees account for a significant amount of revenue for airlines in the United States. IdeaWorksCompany (2015) estimated that airline ancillary revenue reached $59.2 billion worldwide in 2015, a 163% increase from 2010. In 2015, U.S. airlines collected more than $3.8 billion in baggage fees and amassed more than $3.0 billion in reservation cancelation and change fees (USDOT Bureau of Transportation Statistics 2015).

Ancillary service fees, or à la carte pricing, refers to companies unbundling service offerings and charging for supplementary services that were previously provided free of charge (Garrow et al. 2012, Tuzovic et al. 2014). Holloway (2008) views ancillary service fees as "unbundling the traditional airline product and charging for product attributes that were formerly encompassed within the ticket price or were available only to travelers in premium cabins." Sorenson (2012) and Wittmer et al. (2012) most closely match how we define ancillary service revenue: "Revenues beyond the sale of tickets and [that] are indirectly seen as part of the travel experience." These fees are considered non-ticket revenues and are not required for travel. The fees are only paid when passengers choose the service.

As airlines allocate resources for implementing new ancillary services, there is a risk that customers will not purchase them. Traditionally, airline employees randomly ask passengers if they want to purchase ancillary services or the airlines create marketing and selling strategies based largely on a segmentation approach. Neither approach is sufficient, because neither adequately captures the individual preferences among passengers. Airlines may be missing revenue maximization opportunities and optimal resource allocation by not providing appropriate ancillary services or developing marketing and sales strategies to account for the complexity of customer choice drivers (Teichert et al. 2008). Consequently, it is important for airlines to understand the ancillary services passengers are likely to purchase and which passengers will purchase them.

Even though airlines collect massive amounts of data about their customers and their purchases, it cannot be assumed that they are collecting the most useful data or that employees have access to the data. Organizational policies, processes, and IT infrastructure hinder timely data collection and data access. Just as important, they do not have access to non-customer data or data related to new or untested ancillary service offerings. An opportunity to take the guesswork out of trying new

services could be to use pools of online survey respondents to test ideas and gain customer purchase behavior insights. Airline analysts and decision-makers would benefit from readily available and accessible data drawn from the surveys. These respondents may provide insights into passenger ancillary service purchase intentions and actual purchase behavior, prior to allocating significant organizational resources and also circumvent organizational roadblocks. Therefore, we set out to answer three research questions:

RQ1. Which ancillary services should airlines sell to and who should they sell?

RQ2. Can airlines use *intention* to purchase to predict if customers will purchase ancillary services?

RQ3. Can we make reasonable inferences using pools of online survey respondents?

The remainder of this paper is organized as follows: literature review, research methodology, data analysis and results, and discussion and conclusion.

LITERATURE REVIEW

Ancillary Services

Although many air transportation choice and behavior studies have been conducted, such as, airline choice (Hess et al. 2007), airline itinerary choice (Brey and Walker 2011), and airport choice (Leon 2011), minimal airline ancillary service research has been conducted. Ødegaard and Wilson (2016) state that the sale of ancillary and secondary services is a relatively undeveloped research area and according to Espino et al. (2008), more research should be done in this focus area. Despite the prevalence and growing importance of ancillary service fees, few studies have examined the factors that lead to customers purchasing ancillary services and their willingness to pay fees for such services (Mumbower et al. 2015). Table 1 provides a detailed account of airline ancillary service research as it relates to passenger behavior.

Of the airline ancillary service studies that have been conducted, many of them used stated choice experiments to identify passenger purchase behavior (Balcombe et al. 2009, Chen and Wu 2009, Correia et al. 2012; Espino et al. 2008, Martin et al. 2008, and Wittmer and Rowley 2014). While stated choice studies and experiments provide insight into how customers may behave in actual purchase situations, these studies have some drawbacks. They limit the number of attributes and levels in the experiment because increasing them greatly increases the size of the experimental design. Consequently, they limit the number of insights that can be found surrounding passenger heterogeneity. Further, stated choice experiments essentially ask passengers at the time of booking which airline they would choose given a particular combination of attributes. However, what is not being asked and answered is if a passenger would purchase or intends to purchase a particular ancillary service. Moreover, these studies omit actual purchase behavior of ancillary services. Lastly, many of the previously stated choice studies collected data at the airport, as it is a time-consuming endeavor for research teams.

Other ancillary service studies narrowly focused on examining passenger seating. Lee and Luengo-Prado (2004) compared business and leisure travelers and their willingness to pay for additional legroom on two U.S. legacy airlines. Their results were mixed. Mumbower et al. (2015) investigated system factors that influence airline customers' purchase of premium coach seats at JetBlue Airlines. They found that passengers were more willing to purchase premium seats if no free reserved aisle or window seats were available.

Finally, two studies took a descriptive approach. Garrow et al. (2012) provide a review of product unbundling trends that have occurred in the U.S. airline industry, whereas O'Connell and Warnock-Smith (2013) provided an account of international passenger acceptance of ancillary fees. Though these studies are important and provide interesting accounts of ancillary services, they do not seek to understand passengers' intent to purchase or actual purchase behavior.

Table 1: Summary of Relevant Literature Review

Author(s)	Data Collection	Ancillary Service	Antecedents/Attributes[1]	Region/Airline	Findings
Balcombe et al. (2009)	Focus Groups, Interviews, Survey, Travel Company Website	Seat Pitch, Width, Meal, Entertainment	Age, Income, Gender, Education, Ticket Price	UK, LCC and Charter International Flights	Age, Gender, and Income are significant
Chen and Wu (2009)	Survey, Two Airports	Meal Service, Onboard Entertainment, Change Ticket	Business, Non-Business	LCC, Direct Flight Between Taiwan and China, Hypothetical Airlines	Difference are found between Business and Non-Business travelers
Correia et al. (2012)	Survey, Airport	Luggage, Meal, Sports Equipment Allowed	Leisure Passengers	LCC at Faro International Airport, Portugal	Baggage, sports equipment fee important to leisure passengers
Espino et al. (2008)	Survey, Airport	Latent Variables-Service Quality Changes, Penalty Ticket Changes, Food On Board	Trip Purpose, Fare Class	Gran Canaria and Madrid, Hypothetical Airlines	Differences based on model used
Lee and Luengo-Prado (2004)	Online Government Database	Legroom	Business/Leisure Travelers, Market Share, On Time, Nonstop, Fare, Distance, Frequency, Firm Financial Performance	United States / United Airlines & American Airlines	UA achieved fare premium, AA did not
Martin et al. (2008)	Survey, Airport	Penalty Ticket Changes, Food On Board, Comfort,	Trip Purpose, Traveler Pays Ticket, Age	Las Palmas de Gran Canaria and Madrid, Two Virtual Airlines	Trip purpose is significant
Mumbower et al. (2015)	Automated web robot to query airline website	Premium Coach Seats	Seat Fee, Advance Ticket Purchase, Number Of Passengers Traveling Together, Load Factor	United States / JetBlue	Purchase of premium coach seats with extra legroom and early boarding privileges when no free reserved regular coach window or aisle seat is available, timing of ticket purchase correlates with seat fees paid
O'Connell and Warnock-Smith (2013)	Interviews and Online Survey via FlyerTalk Forum	Priority Boarding, Legroom, Baggage Seat Reservation	None	Not specified, International Travellers	Checked baggage yields greatest acceptance and willingness to pay
Wittmer and Rowley (2014)	Survey, Airport	Seat Selection, Internet, Security Lane, Priority Check-In, Priority Baggage Delivery, Priority Boarding Lane	Economy Class, Long Haul, Short Haul	European Full-Service Network Carrier at Zurich, Switzerland Airport	Economy passengers display a general intention to purchase preferred seat selection, internet access, priority baggage delivery

Note: 1. Antecedents/Attributes in stated preference models otherwise dependent variables in regression models.

Amazon Mechanical Turk

Amazon Mechanical Turk (MTurk) is a quick and inexpensive approach to collecting data. Researchers from diverse domains such as health (Boynton and Richman 2014), retail (Munzel 2016), and tourism (Dedeke 2016) have used this approach for collecting data. However, transportation studies using MTurk have been scarce. Krupa et al. (2014) studied the market penetration of plug-in hybrid electric cars, and Winter et al. (2017) examined consumer perceptions and the use of pilot medication. Even though researchers who have used crowd-sourced respondents usually acknowledge potential issues regarding their use or cite previous studies that have used these sources as a reason to use crowd-sourced data, generally there is no attempt to validate their research conclusions or models. Crowdsourcing is a practice by which information is collected or work completed by a readily available crowd or large pool of people. Participants are usually solicited from an online platform and may or may not be paid for their work.

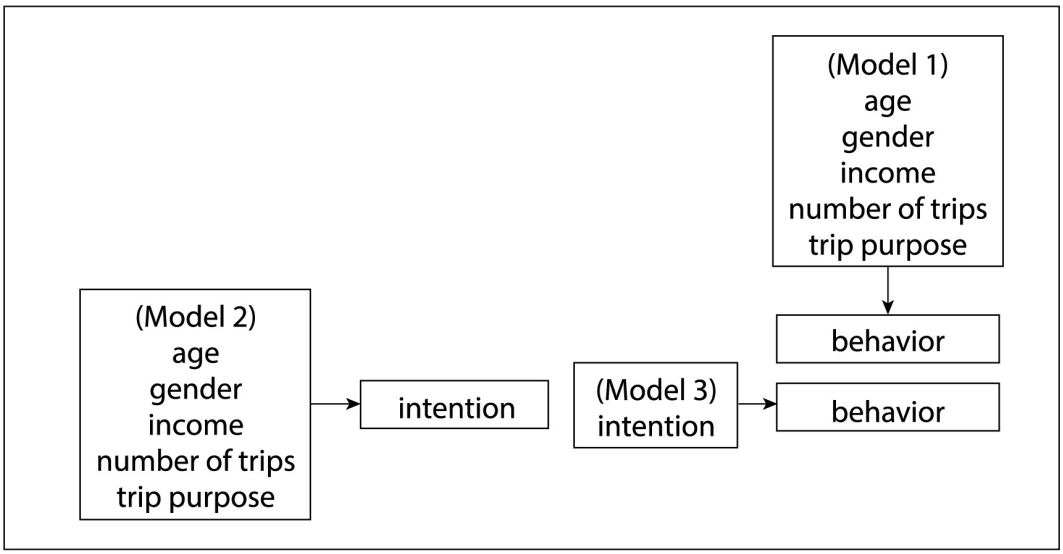
The literature review highlights the areas of airline ancillary service research that could be examined further. Previous research studies generally examined a limited number of ancillary services, narrowed the study (by region or airline), or only compared large customer segments, such as business vs. non-business travelers. In addition, many of the studies had collected data using approaches considered time consuming.

Since there appears to be a need to add to the airline ancillary services stream of research, this paper sets out to make several research contributions. First, we provide a comprehensive analysis of which ancillary service customers are willing to purchase by exploring airline passenger heterogeneity and purchase intentions. Second, we add to the limited ancillary service research about the United States market. Since our research is not restricted to leisure or business travelers, low cost or legacy airlines, or to a particular route or airline we provide generalized results. Last, we introduce the transportation domain to a readily available pool of useful online respondents revealing a quick and simple data collection method.

RESEARCH METHODOLOGY

This research includes three separate analyses as shown in Figure 1.

Figure 1: Overview of Research



Model 1 uses logistic regression with categorical independent variables and a binary dependent variable to identify how the covariates affect actual purchase behavior. This helps us answer RQ1, which ancillary services should airlines sell and to whom should they sell? Model 2 uses a general linear model (GLM) with categorical independent variables and a continuous dependent variable to identify significant covariates as they relate to intention to purchase. This also helps us to answer RQ1. Model 3 uses logistic regression with metric independent variables and a binary dependent variable to identify if intention to purchase can predict actual purchase behavior. This helps us to answer RQ2, can airlines use *intention* to purchase to predict if customers will in fact purchase ancillary services. We use model 3 to answer RQ3, can we make reasonable inferences using readily available online pools of respondents from the likes of Amazon's Mechanical Turk?

Model 3 was guided in part by Theory of Planned Behavior (TPB). Fishbein and Ajzen (1975) suggest behavior can be predicted based on the intention to perform the behavior. TPB views behavioral intention as the immediate source of behavior. The stronger the intention, the more likely the behavior will be performed. Therefore, TPB, in part, was chosen for a two reasons: 1) TPB has had a pronounced impact on explaining decision-making and choice behaviors (Crano and Prislin 2008), and 2) TPB has been used to explain behavior in the transportation domain (Bamberg et al. 2003, Chaney et al. 2013, Chen et al. 2016, and Schniederjans and Starkey 2014).

Following the analyses, the Brier score was used to validate the predictive power of the logistic regression probability equations and the research findings. The Brier score is a measure of the deviation from a perfect model fit (Bukszar 2003).

Data Collection Instrument

To collect data, an online survey was developed using items from previous research articles. The survey was pretested on several subjects who would be typical survey respondents and only non-substantive changes were deemed necessary.

The categorical independent variables used for model 1 and 2 are discussed next and are shown in Table 2. Usage frequency, number of trips, and previous experience have been widely used in previous studies (Balcombe et al. 2009, Harris and Uncles 2007, Jou et al. 2013, Olson and Kendrick 2008, and Venkatesh and Agarwal 2006). Thus, respondents were asked, on average, how many times they fly on domestic flights (DF) per year. Categories included 0, 1-2, 3-5, and more than 5 times. The reference category is more than 5 times. Respondents were also asked, on average, how many times they fly on international flights (IF) per year. Categories included 0, 1-2, and more than 2 times. The reference category is more than 2 times.

Trip purpose, age, gender, and total annual household income were included in previous studies and were included in this study as well (Balcombe et al. 2009; Harris and Uncles 2007; Jou et al. 2013). Survey respondents were asked to select one: On most occasions, I am a *(business or leisure)* traveler (TP_B and TP_L). Leisure traveler is the reference category. Generations of people are generally explained by the differences in their characteristics. Initially, we selected four generational categories in our survey. However, data collected for two of the categories did not return an adequate number of responses for analysis. Therefore, age was divided into two categories: born in 1981 and earlier (AGE_B), and born in 1982 and later (AGE_A) (Pew Research Center 2011). The split in years was done to group Generation Y/Millennials into one group and to group earlier generations into another. Since there is great interest in understanding Millennial behavior, this split was deemed most appropriate. The reference category is 1981 and earlier. The reference category for gender (GEN) is male. Total annual household income (INC) contains five categories, whereas more than $120,000 is the reference category.

The dependent variables (Table 3) for this study were identified from Garrow (2012), O'Connell and Warnock-Smith (2013), Sorenson (2012), and Wittmer and Rowley (2014). For model 1, respondents were asked to answer 13 behavior items related to actual purchases of various ancillary

services on domestic flights. Behavior is a categorical dependent variable. An example of one of the 13 behavior items in the survey is, "On a past domestic flight, I have paid extra airline fees for an aisle seat. Yes, No, Not an Option." Each of the 13 behavior items is listed in Table A.1.

Respondents were also asked to answer 13 intention items related to their intention to purchase various ancillary services on domestic flights. Intention is a metric dependent variable for model 2. Intention is used again as an independent metric variable for model 3. An example of one of the 13 intention items in the survey is, respondents were asked, using a five-point Likert scale anchored by 1 = Definitely Would Not and 5 = Definitely Would, "When I travel by air, I would pay extra fees for an aisle seat." Each of the 13 intention items is listed in Table A.1.

Data Collection Process

Sample data were collected from MTurk in October 2015 over a four-day period. It took an average of five minutes and five seconds to complete the survey. MTurk has been shown to be a viable data collection source used to obtain high-quality data economically and quickly, and where data obtained are at least as reliable as those obtained through traditional methods (Buhrmester et al. 2011, Germine et al. 2012, and Holden et al. 2013). To entice completion of the survey, $20 was offered to respondents who completed the survey. To ensure completion and lessen the likelihood of duplicates, respondents were notified that the survey must be completed in full to receive payment and that surveys from the same IP address would not be counted. Gentle warnings have been shown to increase attentiveness without creating ill will among survey respondents (Huang et al. 2015).

DATA ANALYSIS AND RESULTS

The survey targeted airline passengers who have flown on U.S. domestic flights. The original sample size consisted of 525 responses. Eight responses had identical IP addresses and were removed from the analysis. Eliminating these responses reduced the possibility of duplicate responses or responses that were intentionally altered to collect the cash reward. Incomplete surveys were also removed from the analysis. Further, if the respondent did not fly at least one domestic flight in a year, their responses were removed from the analysis. In addition, if respondents answered that they did not have an option to purchase ancillary services on their flights, their responses were removed from the behavior model analysis. The net sample size resulted in 357 useable responses available for behavior data analysis (models 1 and 3) and 493 useable responses available for intention data analysis (model 2).

Tables 2 and 3 summarize the responses from MTurk and the variable coding. Table 3 shows that airline passengers show a higher intention score to purchase onboard WiFi, extra legroom, and onboard meals, though these score are not particularly high and the other ancillary services intention scores are even lower. This would suggest that ancillary services are not widely popular among passengers. This is corroborated by airline passengers' actual purchase behavior of ancillary services.

Table 2: Summary of Independent Categorical Variables

Categorical Variable	Variable Code	Model 1 and 3 Behavior Frequency (%)	Model 2 Intention Frequency (%)
Age			
1981 and before [a]	AGE_B	115 (32.21)	171 (34.69%)
1982-1998	AGE_A	242 (67.79)	322 (65.31%)
Gender			
Female	GEN_F	179 (50.14)	245 (49.70%)
Male [a]	GEN_M	178 (49.86)	248 (50.30%)
Income			
Less than $25,000	INC_0	66 (18.49)	89 (18.05%)
$25,000 - $45,000	INC_1	88 (24.65)	133 (26.98%)
$45,001 - $75,000	INC_2	117 (32.77)	153 (31.03%)
$75,001 - $120,000	INC_3	59 (16.53)	86 (17.44%)
More than $120,000 [a]	INC_4	27 (7.56)	32 (6.49%)
Domestic Flights Flown			
1-2	DF_1	208 (58.26)	292 (59.23%)
3-5	DF_3	105 (29.41)	147 (29.82%)
More than 5 [a]	DF_5	44 (12.32)	54 (10.95%)
International Flights Flown			
0	IF_0	82 (22.97)	117 (23.73%)
1-2	IF_1	204 (57.14)	285 (57.81%)
More than 2 [a]	IF_2	71 (19.89)	91 (18.46)
Trip Purpose			
Business	TP_B	91 (25.49)	130 (26.37%)
Leisure [a]	TP_L	266 (74.51)	363 (73.63%)
n =		357	493

Note: a = reference category.

Table 3: Summary of Intention and Behavior Dependent Variables

Ancillary Service	Behavior Model 1 and 3			Intention Model 2
	Yes Frequency (%)	No Frequency (%)	Not an Option Frequency (%)	Mean (Std. Dev.)
Aisle Seat	75 (15.40)	282 (57.91)	130 (26.69)	2.60 (1.41)
Extra Legroom	100 (20.53)	274 (56.26)	113 (23.20)	2.96 (1.42)
Window Seat	111 (22.79)	262 (53.80)	114 (23.41)	2.89 (1.44)
Seat Front of Airplane	70 (14.37)	300 (61.60)	117 (24.02)	2.59 (1.37)
Priority Boarding	114 (23.41)	279 (57.29)	94 (19.30)	2.63 (1.39)
Priority Deplaning	57 (11.70)	288 (59.14)	142 (29.16)	2.60 (1.39)
Reserved Seat	165 (33.88)	239 (49.08)	83 (17.04)	3.16 (1.43)
Reserved Overhead Space	63 (12.94)	272 (55.85)	152 (31.21)	2.72 (1.41)
Onboard Meals	161 (33.06)	242 (49.69)	84 (17.25)	3.01 (1.38)
Onboard Movies	118 (24.23)	276 (56.67)	93 (19.10)	2.70 (1.39)
Onboard TV	86 (17.66)	297 (60.99)	104 (21.36)	2.70 (1.39)
Onboard WiFi	133 (27.31)	264 (54.21)	90 (18.48)	3.18 (1.44)
Mobile Tablets Provided by Airline	56 (11.50)	216 (44.35)	215 (44.15)	2.57 (1.47)

Note: Intention – Behavior (model 3) uses intention data as the independent metric variable.

The intention survey items show good reliability with a Cronbach's alpha reliability coefficient of 0.94 (Nunnally 1978). Since independent and dependent variables were collected from the same survey instrument, a number of steps were taken to minimize the occurrence of common method variance. The survey was developed and administered in accordance with the recommendations from Podsakoff et al. (2003). Careful attention was given to the order and position of the survey items to create temporal distance. In addition, the independent and dependent items were displayed in different formats, using five-point Likert scales and dichotomous rating scales. Harman's single-factor procedure was also conducted, and it was found that a single factor accounts for less than the majority of the variance at 37.32% (Podsakoff et al. 2003). Using separation, scale differences, and statistical methods provides added confidence in our research findings.

Model 1 Behavior Results

The dependent variable behavior represents the choice between, Yes, I bought the ancillary service, and No, I have not bought the ancillary service. This is modeled using logistic regression, which is an acceptable method of analysis when modeling discrete choice behavior and is commonly employed when studying choice behavior. It facilitates the understanding of individual purchases, provides predictions, and includes characteristics of consumers and their behaviors (Harris and Uncles 2007). We use the same approach as Leon and Uddin (2016) did in a previous study that modeled behavior antecedents directly using logistic regression.

We find the probability of selecting, Yes, I bought the ancillary service, using the general formulation (1), where K is the number of independent variables in the equation.

$$(1)\quad P(B) = \frac{e^{\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k}}{1 + e^{\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k}}$$

Thirteen (13) binary logistic regressions, one for each ancillary service, were conducted with the results shown in Table A.2 of the appendix. The column labeled Reciprocal of Odds Ratio exists to show the reciprocal of the odds ratio when it is less than one. This helps to show which variables are most prominent and provides a more intuitive meaning of the results with less room for misinterpretation.

The number of times a traveler flies on domestic and international flights in a year is found to be a significant factor. The odds of fliers who fly more than five domestic flights a year choosing to purchase onboard movies over not purchasing onboard movies is 4.95 times than that of fliers who fly one or two domestic flights a year. Similarly, the odds of fliers who fly more than five domestic flights in a year choosing to purchase seats in front of the airplane over not purchasing seats in front of the airplane is 4.484 times than that of fliers who fly one or two domestic flights a year. The odds of fliers who fly more than two international flights in a year choosing to purchase reserved overhead space on domestic flights over not purchasing reserved overhead space on domestic flights is 4.444 times than that of fliers who fly zero (0) international flights in a year.

Trip purpose and income are significant factors as well; however, age and gender are not. The odds of business travelers choosing to purchase an aisle seat over not purchasing an aisle seat is 1.858 times than that of leisure travelers. Similar results are seen for extra legroom, window seats, and reserved seats. Surprisingly, the odds of travelers with income less than $25,000 choosing to purchase onboard movies over not purchasing onboard movies is 2.516 times than that of those travelers with income levels of more than $120,000.

Model 2 Intention Results

SAS Proc GLM (General Linear Model) was used to identify significant independent variables as they relate to the metric dependent variable intention to purchase. Since each of the independent variables is categorical, GLM is an appropriate analysis method. GLM has become a popular means of estimating ANOVA and MANOVA models because of its flexibility and simplicity in model design (Hair et al. 2006).

GLM analysis was conducted 13 times, one for each ancillary service. The results of the analysis, including Least Square Means (LSMeans - SAS keyword) and significant differences between air traveler characteristics when the dependent variables are intention to purchase ancillary services, are displayed in Table 4.

The number of times a traveler flies on domestic and international flights in a year is significant. When fliers were asked about their intention to purchase ancillary services on domestic flights, fliers who flew more domestic flights were generally more inclined to purchase various seating options, boarding and deplaning priority, overhead space, and onboard WiFi than those fliers who flew fewer domestic flights per year. The results show there are significant differences in purchase intention by domestic fliers for eight of the 13 ancillary services.

Air travelers who have flown internationally are more apt to purchase ancillary services on domestic flights than fliers who only flew domestically. Also, fliers who flew more than two international flights per year were more inclined to purchase domestic ancillary services than those who flew fewer international flights per year. The results show there are significant differences in purchase intention by international fliers for 12 of the 13 ancillary services.

Trip purpose is also a significant factor. When travelers were asked about their intention to purchase ancillary services, business travelers were more apt to pay for an aisle seat, extra legroom, and meals than leisure travelers. While there is no difference in the purchasing intention for priority boarding or deplaning, business travelers are more inclined to purchase seats near the front of the airplane and overhead space than leisure travelers. The results show there are significant differences in purchase intention by trip purpose for five of the 13 ancillary services.

Table 4: GLM Ancillary Service Model 2 Results

Ancillary Service	Comparisons of Least Square Means														
	DF1	**DF3**	**DF5**	**DF1 vs DF3**	**DF1 vs DF5**	**DF3 vs DF5**	**IF0**	**IF1**	**IF2**	**IF0 vs IF1**	**IF0 vs IF2**	**IF1 vs IF2**	**TP_B**	**TP_L**	**TP_B vs TP_L**
Aisle Seat	2.67	3.01	3.21	**	**	ns	2.85	2.70	3.36	ns	**	***	3.21	2.72	***
Extra Legroom	2.95	3.20	3.84	*	***	***	3.49	3.10	3.41	**	ns	*	3.49	3.17	**
Window Seat	2.89	3.12	3.55	ns	***	*	3.26	2.83	3.46	***	ns	***			
Seat Front of Airplane	2.64	3.04	2.98	***	ns	ns	2.78	2.64	3.23	ns	**	***	3.09	2.68	***
Priority Boarding	2.55	2.91	3.37	***	***	**	2.84	2.65	3.34	ns	**	***			
Priority Deplaning	2.57	2.98	3.18	***	***	ns	2.81	2.52	3.40	*	***	***			
Reserved Seat							3.29	2.90	3.79	**	**	***			
Reserved Overhead Space	2.89	2.86	3.36	ns	**	**	2.96	2.74	3.42	ns	**	***	3.23	2.84	***
Onboard Meals							3.06	2.98	3.55	ns	**	***	3.40	2.99	***
Onboard Movies							2.63	2.58	3.25	ns	***	***			
Onboard TV							2.63	2.51	3.36	ns	***	***			
Onboard WiFi	3.06	3.18	3.81	ns	***	***									
Mobile Tablets Provided by Airline							2.48	2.34	3.42	ns	***	***			

Note: Numerical values are Least Square Means; *$p < 0.10$; **$p < 0.05\%$; ***$p < 0.001$; ns and empty cells = not significant.

The level of income, age, and gender were not found to be significant factors, thus there is no difference in the purchase intention between fliers from different income brackets, age, or gender groups.

Model 3 Intention - Behavior Results

Intention is the single independent metric variable and behavior is the binary dependent variable. This is modeled 13 times, one for each ancillary service, using logistic regression (Ajzen 1991, Ajzen and Driver 1992)

These models seek to understand whether or not the choice behavior of purchasing ancillary services for domestic flights can be predicted by a respondent's stated intention to purchase the ancillary services. Thirteen binomial logistic regressions were conducted with behavior representing the choice of, *Yes*, I bought the ancillary service, or *No*, I have not bought the ancillary service.

From the previous equation (1), we reduce K to equal one (1) independent variable *X*, where *X* is the intention score. Given the intention score, we are determining the probability of selecting, *Yes,* that a passenger will purchase the ancillary service using the general formulation in equation (2).

(2) $$P(B) = \frac{e^{\beta_0 + \beta_1 X_1}}{1 + e^{\beta_0 + \beta_1 X_1}}$$

The results of the 13 binary logistic regressions are shown in Table 5 and indicate that intention may indeed predict behavior.

For each of the 13 domestic ancillary services, intention is significant. As intention scores increase, fliers tend to purchase the respective ancillary service. For example, a one-unit increase in a flier's intention to purchase an aisle seat will increase the odds of choosing to purchase an aisle seat over not purchasing an aisle seat by approximately 189% (odds ratio = 2.889).

Model Validation

We tested the prediction accuracy of intention – behavior ≈ probability models (model 3) by comparing the predicted outcome with the actual outcome using the Brier score.

The Brier score in equation (3) is the mean squared error of the probability forecast and is a measure of forecast accuracy. It was first introduced by Brier (1950) and is frequently used to examine forecast accuracy (Brozyna et al. 2016, Bukszar 2003).

(3) $$\text{Brier Score} = \frac{1}{N}\sum_{t=1}^{N}(P(B)_t - B_t)^2$$

Where *P(B)* is the probability that was forecast, *B* is the actual behavioral outcome of the event at instance *t*, and N is the number of forecasting instances. The score is reported between and including 0 and 1, where a lower score is better. Zero implies a perfect prediction.

Using the general probability equation (2), a determination of the probability of *Yes*, that a passenger will purchase the ancillary service, is made. $P(B)$ is $\in(0,1)$, where *B* is behavior and is either 0 or 1, B_0 and B_1 are coefficient estimates derived from the MTurk sample data, and *X* is the intention score. The Brier score results, displayed in Table 5, are low, implying that the prediction models developed using MTurk sample data are reliable.

Table 5: Intention-Behavior Model 3 and Validation Results

Dependent Variable	Intercept	Coefficient	Std. Error	Wald Chi-square	Significance	Odds Ratio	Brier Score
Aisle Seat	-4.7454	1.061	0.1354	61.4419	<.0001	2.889	0.12
Extra Legroom	-4.3893	1.002	0.1234	65.9249	<.0001	2.724	0.15
Window Seat	-4.0995	0.961	0.1178	66.5727	<.0001	2.614	0.16
Seat Front of Airplane	-5.1722	1.1273	0.1495	56.8766	<.0001	3.087	0.12
Priority Boarding	-3.5791	0.8905	0.102	76.175	<.0001	2.436	0.16
Priority Deplaning	-4.5835	0.9239	0.1374	45.2071	<.0001	2.519	0.12
Reserved Seat	-2.8977	0.7394	0.0925	63.9047	<.0001	2.095	0.20
Reserved Overhead Space	-4.026	0.7859	0.1258	39.0494	<.0001	2.194	0.13
Onboard Meals	-2.6554	0.6977	0.0901	60.0037	<.0001	2.009	0.20
Onboard Movies	-3.4567	0.8728	0.101	74.6927	<.0001	2.394	0.16
Onboard TV	-4.2935	0.9512	0.1221	60.7433	<.0001	2.589	0.14
Onboard WiFi	-3.9324	0.9328	0.1084	74.0013	<.0001	2.542	0.17
Mobile Tablets Provided by Airline	-3.9493	0.8017	0.1318	36.9805	<.0001	2.229	0.14

DISCUSSION AND CONCLUSION

This study comprehensively examined a number of airline ancillary services and factors that may influence the purchase of ancillary services. In the examination of ancillary services, we answered 1) which ancillary services should airlines sell and to whom should they sell, 2) can airlines use *intention* to purchase to predict if customers will purchase ancillary services, and 3) can we make reasonable inferences using readily available pools of online respondents.

Answering these questions has several managerial and research applications. The findings could assist airline management in developing current and prospective ancillary services. Additionally, the findings could assist in developing associated sales, marketing, and training strategies, leading to increases in revenue per passenger. Using a segmentation approach to selling and marketing can lead to missed sales opportunities and wasted resources. However, taking a pointed approach to direct sales and marketing efforts toward customers who are most likely to purchase ancillary services, airlines can increase revenue and reduce wasted resources.

Such a pointed approach requires keen understanding of passenger attributes that lead to ancillary purchases, and which ancillary services customers are willing to purchase. Previous studies have found age, gender, income, and trip purpose as significant factors (Balcombe et al. 2009, Chen and Wu 2009, Martin et al. 2008) when purchasing ancillary services. This study found that the number of domestic and international flights a passenger flies in a year, the trip purpose, and income (to a lesser degree) as significant factors. Moreover, the significance of these factors change based on the ancillary service in question. Our results show that neither age nor gender are significant factors in predicting intent to purchase or the actual purchase of ancillary services. While Generation Y/Millennial behaviors are different than other generations in many ways, we found that their ancillary service purchasing behavior is no different from older generations.

Generally, passengers are not fond of purchasing ancillary services in the first place. If passengers are grouped together and asked which ancillary services they have purchased or are likely to purchase, onboard WiFi, reserved seats, onboard meals, extra legroom, and window seats, rank higher than others. However, without taking the analysis further, we lose some of the heterogeneity among passengers, and airlines might be leaving money on the table. For example, instead of viewing premium seats as one category or limiting this category to pitch and width as previous studies have done (Balcombe et al. 2009, Lee and Luengo-Prado 2004, Martin et al. 2008, Mumbower et al. 2015), it may be more beneficial to expand this category as well as other categories. For example, passengers who have flown more than three domestic flights in a year are more likely to purchase window seats than those who have flown fewer flights; however, these same passengers are more likely to purchase extra legroom rather than window seats. Moreover, while paying extra for aisle seats does not appear high on the list of ancillary purchases, passengers who have flown three or more domestic flights or two or more international flights are more likely to purchase reserved aisle seats than other passengers. Given these types of insights, airlines that might otherwise forgo selling an ancillary service may reconsider their decision. Training front line employees, such as reservation agents, gate agents, and flight attendants, in sales techniques where they can offer the most relevant ancillary services, at the appropriate time, and to the most appropriate customers can pay dividends. Gate agents might upsell extra legroom to a business traveler or to someone who has flown on five or more domestic flights. Meanwhile, flight attendants can upsell onboard amenities such as mobile tablets to passengers who have flown two or more international flights. From the insights provided in this study, there is opportunity for airlines to improve sales of ancillary services for both those that are currently selling well and those that are not.

Evidence suggests that the intent to purchase predicts actual purchase behavior. If the factors that influence a traveler's intent to purchase can be identified, then we can reasonably predict which passengers are most likely to purchase ancillary services and which ones they are most likely to purchase. Airlines managers will not need to rely solely on their customers' actual purchase behavior

to make all of their ancillary service decisions. The need to collect actual purchase data, which can be more difficult and time consuming to collect and may not capture the pertinent details necessary for future decision making, is lessened.

Airlines can survey customers and non-customers alike to obtain intent to purchase scores related to current and new ancillary service offerings in an effort to predict actual purchase behavior. Intent to purchase data are quick, easy, and inexpensive to collect via services similar to MTurk. Using MTurk or similar services can help airline decision makers obtain data that are otherwise not readily available or accessible.

While it is true that current customers are a valuable source of information, data collected from them are not always complete or timely. Incomplete and untimely data are a concern for all companies, and before airlines adjust IT systems for more appropriate data collection capabilities, data needs can be pretested first by using services similar to MTurk.

An unintended contribution of our research is that our findings can assist researchers with the identification and selection of suitable ancillary services and attributes for their airline's stated preference experiments, reducing the time and resources needed in their research. As Balcombe et al. (2009) noted, they identified relevant attributes for their stated choice experiment through focus groups and industry interviews, a time consuming endeavor. They further stated that finding the most appropriate attributes and levels for a stated choice experiment is important because of the possibility of an unwieldy survey design.

Limitations and Future Research

This study followed the same approach as Donald et al. (2014), Mishra (2014), and Stran et al. (2016), where intention and behavior were measured at the same time. Even so, we took precautions to prevent common method variance and validated our results with the Brier score. Yet, a longitudinal study could reaffirm our results. Also, future studies could include additional factors that influence ancillary purchases. Understanding traveler purchase behavior while traveling in groups or families, whether or not the customer is a frequent flier, and the flight duration, including long-haul international flights, could lead to additional purchasing behavior insights. Two other areas of future research could include studying the effect of too many ancillary service choices, where non-choice could become a factor, and studying the effect of competition on ancillary service offerings when applying profit-maximizing strategies.

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APPENDIX

Table A.1: Ancillary Service Survey Items

Intention	Ancillary Service	Behavior	Ancillary Service
When I travel by air, I would pay extra fees for …	Aisle Seat	On a past domestic flight, I have paid extra fees for…	Aisle Seat
	Extra Legroom		Extra Legroom
	Window Seat		Window Seat
	Seat Front of Airplane		Seat Front of Airplane
	Priority Boarding		Priority Boarding
	Priority Deplaning		Priority Deplaning
	Reserved Seat		Reserved Seat
	Reserved Overhead Space		Reserved Overhead Space
	Onboard Meals		Onboard Meals
	Onboard Movies		Onboard Movies
	Onboard TV		Onboard TV
	Onboard WiFi		Onboard WiFi
	Mobile Tablets Provided by Airline		Mobile Tablets Provided by Airline

Table A.2: Ancillary Service Behavior Model 1 Results

Dependent Variable	Independent Variable	Estimate	Std. Error	Wald Chi-square	Significance	Odds Ratio	Reciprocal of Odds Ratio
Aisle Seat	Intercept	-0.7429	0.3611	4.2333	0.0396		
	DF_1	-1.0348	0.3845	7.2420	0.0071	0.355	2.817
	DF_3	-0.6966	0.3943	3.1200	0.0773	0.498	2.008
	TP_B	0.6193	0.2977	4.3291	0.0375	1.858	
Extra Legroom	Intercept	-0.2552	0.3451	0.5468	0.4596		
	DF_1	-1.2109	0.3626	11.1512	0.0008	0.298	3.356
	DF_3	-0.9208	0.3751	6.0259	0.0141	0.398	2.513
	TP_B	0.6278	0.2695	5.4259	0.0198	1.874	
Window Seat	Intercept	-0.2340	0.3442	0.4621	0.4967		
	DF_1	-0.9992	0.3590	7.7460	0.0054	0.368	2.717
	DF_3	-0.7197	0.3744	3.6946	0.0546	0.487	2.053
	TP_B	0.5309	0.2629	4.0794	0.0434	1.701	
Seat Front of Airplane	Intercept	-0.4418	0.3021	2.1389	0.1436		
	DF_1	-1.4988	0.3655	16.8105	<.0001	0.223	4.484
	DF_3	-0.7701	0.3784	4.1423	0.0418	0.463	2.160
Priority Boarding	Intercept	0.1603	0.2838	0.3193	0.5720		
	DF_1	-1.4876	0.3269	20.7074	<.0001	0.226	4.425
	DF_3	-0.8143	0.3457	5.5489	0.0185	0.443	2.257
Priority Deplaning	Intercept	-0.6931	0.3273	4.4840	0.0342		
	DF_1	-1.4143	0.3976	12.6504	0.0004	0.243	4.115
	DF_3	-0.6318	0.4092	2.3842	0.1226	0.532	1.880
Reserved Seat	Intercept	-0.5360	0.1200	19.9343	<.0001		
	TP_B	0.6115	0.2285	7.1627	0.0074	1.843	

Reserved Overhead Space	Intercept	-0.6506	0.2518	6.6754	0.0098		
	IF_0	-1.4895	0.4507	10.9227	0.0009	0.225	4.444
	IF_1	-0.9780	0.3194	9.3784	0.0022	0.376	2.660
Onboard Meals	Intercept	0.1541	0.2782	0.3070	0.5795		
	DF_1	-0.8081	0.3112	6.7407	0.0094	0.446	2.242
	DF_3	-0.3663	0.3321	1.2169	0.2700	0.693	1.443
Onboard Movies	Intercept	-0.1248	0.4791	0.0678	0.7945		
	INC_0	0.9226	0.5205	3.1419	0.0763	2.516	
	INC_1	0.7529	0.4970	2.2950	0.1298	2.123	
	INC_2	-0.0051	0.4880	0.0001	0.9917	0.995	1.005
	INC_3	0.3882	0.5124	0.5739	0.4487	1.474	
	DF_1	-1.6003	0.3466	21.3164	<.0001	0.202	4.950
	DF_3	-0.9802	0.3538	7.6743	0.0056	0.375	2.667
Onboard TV	Intercept	0.0697	0.3186	0.0479	0.8268		
	DF_1	-0.9987	0.3954	6.3793	0.0115	0.368	2.717
	DF_3	-0.6413	0.3827	2.8088	0.0937	0.527	1.898
	IF_0	-0.5039	0.4170	1.4603	0.2269	0.604	1.656
	IF_1	-0.8641	0.3225	7.1777	0.0074	0.421	2.375
Onboard WiFi	Intercept	0.1224	0.2862	0.1828	0.6690		
	DF1	-1.1627	0.3238	12.891	0.0003	0.313	3.195
	DF3	-0.5553	0.3410	2.6513	0.1035	0.574	1.742
Mobile Tablets Provided by Airline	Intercept	0.0419	0.3488	0.0144	0.9044		
	DF_1	-1.1865	0.477	6.1884	0.0129	0.305	3.279
	DF_3	-0.8824	0.4547	3.7659	0.0523	0.414	2.415
	IF_0	-1.7746	0.6915	6.5860	0.0103	0.170	5.882
	IF_1	-0.5170	0.3816	1.8363	0.1754	0.596	1.678

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