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Construction and Analysis of Airport Customer Demand Mathematical Model of "Beidouheel" Baggage Locator

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Abstract

Problems such as lost luggage, mistaken baggage and long waiting time for baggage claim also cropped up from time to time. It brought great inconvenience for people to travel. Travelers are looking forward to a smart product that is easy to carry and easy to operate, which can monitor and locate luggage in real time. This paper makes an in-depth study of the current situation through field research, SPSS and Python software were used for questionnaire survey and data analysis

Keywords

Mathematical Model; Baggage Locator.

1. Introduction

In recent years, China's sharing economy has developed rapidly. It has played an important role in improving the efficiency of resource utilization and the quality of economic development. It has also provided new support for the transformation of economic quality, efficiency and driving force. The emergence of the sharing economy has brought new support points and highlights to China's economic transformation.

According to the prediction and analysis of the State Information Center, the transaction volume of the sharing economy will account for more than 10% of GDP by 2020, and it is expected to reach 20% by 2025. In the era of "Internet plus", the leasing method of baggage locator also makes it easier to enter the society and be accepted by the public. At the same time, the sharing economy is having a disruptive impact on the traditional business model of buying. Consumers no longer need to buy goods to meet the needs of "use", but only need to pay a small cost to rent. This economic model has been put into practice in a number of areas in China and achieved results.

According to IATA's Global Baggage report: one in every 200 checked bags at airports around the world goes wrong, with problems such as stolen, misplaced and long waiting times for baggage claims, "Follow Li all the way" is a platform dedicated to providing users with online baggage tracking services. The “Beidouheel” baggage locator is Offline leasing service. It is a professional baggage escort product.

2. Data Analysis of Market and Customer Demand

In order to have a general and extensive understanding of airport passengers' attitude to baggage checking, the necessity of putting baggage locator into trial use is explored, the multi-functional demand of passengers on baggage locator is found, and the data of market and customer demand is analyzed.

Passengers were selected as the survey subjects from Jinan Yaoqiang Airport, Xiamen Gaoqi International Airport, Fuzhou Changle International Airport and Wuxi Sunan Shuofang Airport. Passengers of different genders, ages and destinations were selected as samples to conduct a

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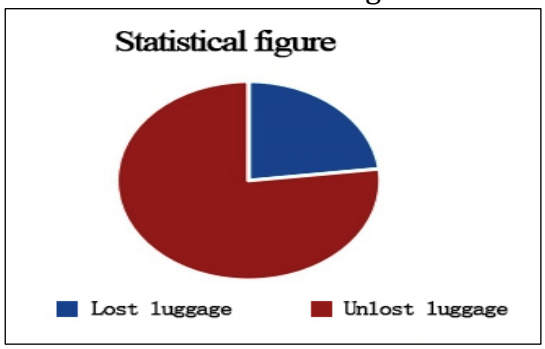
questionnaire survey. A total of the 4,000 questionnaires that were sent out, 3,500 valid questionnaires were collected.

Table 1. Questionnaire recovery table

The name of the airport	Num of questionnaire	Num of valid questionnaires	The recovery rate
Jinan Yaoqiang Airport	1000	869	86.90%
Xiamen Gaoqi Airport	1000	901	90.10%
Fuzhou Changle Airport	1000	887	88.70%
Wuxi Sunan Shuofang Airport	1000	843	84.30%
Totle	4000	3500	87.50%

The effective questionnaire recovery rate was 87.5%. Through SPSS data analysis, the following important conclusions can be obtained:

Table 2. Statistical figure



23.1 percent had lost their luggage of these, 15.3 percent were lost due to mistaken handling and theft, while 7.8 percent were lost due to airport errors. It did not find the number of luggage as high as 29%. Forty-three percent of people worry about their luggage when they travel, 25 percent said the loss of luggage would affect their future travel and mood. 31% of travelers found it annoying that they had to wait too long for their luggage after getting off the plane, which affected their travel experience.

The demand side of the product： 8 percent are looking forward to a smart product that can solve the problem of lost luggage in checked luggage;47percent of passengers are willing to try the product for free for the first time; 43 percent of people want their luggage locator to be small and lightweight; 41 percent were concerned about the power of their locator.

3. The Establishment of Mathematical Model

Building mathematical models based on econometric models. Mathematical models are used to predict the number of customers an airport is targeting. Get the target customer conversion general formula as a conclusion.

According to the questionnaire template, import the new regional airport data into the general formula of target customer conversion. It can calculate the target customer estimate of the new target airport.

$$Y=M+N$$

According to the survey data:

$$Y = 1.381*M + N$$

$$M = 1.381*m*(47\%+53\%*1/2)$$

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$N=1/2*m*\{0.977a+b+0.525p[q+0.51(1-q)]\}$
$Y=1.381*m*(47\%+53\%*1/2)+1/2*m*\{0.977a+b+0.525p[q+0.51(1-q)]\}$
Control variables: x (Daily airport passenger flow)
Response variable: y (Target number of customers who intend to use the product daily)
$y \xrightarrow{Covariant\ relationship} x$

$y_i=f(x_i)+\mu$(μ:Random disturbance term)

Table 3. The equation is as follows:

Total airport population	m
Number of target customers	Y
Established number of customers	M
Number of potential customers	N
People who worry about the safety of their luggage	a
The number of people who think the loss of their luggage will have an impact on their subsequent trips and mood	b
The number of people who lost their luggage due to an accident during check-in	p
The number of people whose luggage has been lost due to misplaced or theft	q
The number of people who lost luggage due to airport errors	p-q
The number of people who think the travel experience is affected by the long waiting time for luggage after deplaning	c

① The variables of people's thought and behavior are difficult to control completely, There is inherent randomness, This randomly affects people's economic behavior.
② Observational errors of variables: The statistical data processing error of the questionnaire
③The statistical data processing error of the questionnaire
④ Volatility factors in other data not available
The mathematical model is introduced as a random perturbation term to ensure the rigor of the model.
Let's say it's a linear function. δ is a linear parameter of y. It's linear with y by substituting for x.
β_0: The intercept of the population regression line
β_1: The slope of the population regression line
Population regression function:
$y_i=\beta_0+\beta_1 x_i^*+e_i$
Come to a conclusion by calculation, Sample regression model:

$$y_i=\hat{\beta}_0+\hat{\beta}_i x_i^*+e_i$$

Sample estimate:$\hat{\beta}_0$:β1
$\hat{\beta}_1$: The average change in y per change in x
$\hat{y}_i$: the fitting value of the right
In order to make the obtained values of $\hat{\beta}_0\hat{\beta}_1$, have rigor and reference value, In this paper, airports in four cities are taken as samples. Plug in the following formula, Four operations.
$y_i=\hat{\beta}_0+\hat{\beta}_i x_i+e_i$
System components:

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$y_i=\hat{\beta}_0+\hat{\beta}_i x_i$ e_i: residual
You get four different sample regression lines SRF1, SRF2, SRF3, SRF4.
Conclusion:

$$(\hat{\beta}_0)1, (\hat{\beta}_1)1 , (\hat{\beta}_0)2, (\hat{\beta}_1)2 , (\hat{\beta}_0)3 , (\hat{\beta}_1)3, (\hat{\beta}_0)\ 4, (\hat{\beta}_1)4$$

$$\hat{\beta}_0{}^{*}=\frac{(\hat{\beta}_0)1+ (\hat{\beta}_0)2+ (\hat{\beta}_0 0)3 +(\hat{\beta}_0 0)\ 4}{4}$$

$$\hat{\beta}_1{}^{*}=\frac{(\hat{\beta}_1)1+ (\hat{\beta}_1)2+ (\hat{\beta}_1)3 +(\hat{\beta}_1)\ 4}{4}$$

Parameter estimation method by ordinary least square OLS Implementation:
$\min \psi = e_i^2\ \sum(y_i-\beta_0-\hat{\beta}_i x_i)^2$

$$\frac{\partial\psi}{\partial\beta 0}=-2\ \sum(y_i-\beta_0-\hat{\beta}_i x_i)^2=0$$

$$\frac{\partial\psi}{\partial\hat{\beta}_1}=-2\ \sum(y_i-\beta_0-\hat{\beta}_i x_i)x_i=0$$

$\hat{\beta}_0$ $\widehat{\text{and}}$ β_1 are satisfied with the formula:

$$\left\{\frac{\sum(y_i-\beta_0-\hat{\beta}_i x_i)=0}{\sum(y_i-\beta_0-\hat{\beta}_i x_i)x_i=0}\right\}$$

$$\sum e_i=0, \sum e_i x_i=0$$

$$\left\{\frac{\sum y_i=n\hat{\beta}_0+\hat{\beta}_1\sum x_i}{\sum x_i y_i=\hat{\beta}_1\ \sum x_i+\hat{\beta}_1\ \sum x_i^2}\right\}\xrightarrow{get}\hat{\beta}_1$$

$$=\frac{n\sum x_i y_i-\sum x_i-\sum y_i}{n\ \sum x_2^2-(\sum x_i)^2}$$

$$=\frac{\sum(x_i-\bar{x})(y_i-\bar{y})}{\sum(x_i-\bar{x})^2}=\frac{\hat{\text{cov}}(x_i y)}{S_x{}^2}$$

Inspection:

$$y_i=\hat{\beta}_0+\hat{\beta}_1 x_i+e_i=\hat{y}_i+e_i$$

$$y_i-\bar{y}=(\hat{y}_i-\bar{y})+e_i=(\hat{y}_i-\bar{y})+(y_i-\hat{y}_i)$$

$$\sum(y_i-\bar{y})^2=\sum(\hat{y}_i-\bar{y})^2+\sum(y_i-\hat{y}_i)^2+2\sum(\hat{y}_i-\bar{y})(y_i-\hat{y}_i)$$

$$\sum e_i=0\text{和}\sum e_i x_i=0$$

$$TSS=\sum(y_i-\bar{y})^2=\sum y_i{}^2-n\bar{y}^2$$

$$ESS=\sum(\hat{y}_i-\bar{y})^2=\hat{\beta}_0\sum y_i+\hat{\beta}_1\sum x_i y_i-n\bar{y}^2$$

$$RSS=\sum e_i{}^2=\sum(y_i-\hat{y})^2=\sum y_i{}^2-\hat{\beta}_i\sum y_i-\hat{\beta}_i\sum x_i y_i$$

$$R^2=\frac{ESS}{TSS}=1-\frac{RSS}{TSS}$$

$$(0\le R^2\le 1)$$

Let's calculate from the previous:

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$$\sum e_i^2 = 766500$$
$$\sum (y_i - \bar{y})^2 = \sum y_i^2 - n\bar{y}^2 = 5870212$$
$$R^2 = 1 - \frac{\sum e_i^2}{\sum (y_i - \bar{y})^2} = 1 - \frac{766500}{5870212} \approx 0.98$$

98% of the total variation can confirm the correctness of the tested conclusion. The problem can be explained by the estimated sample regression model. It is proved that the obtained reliability $\hat{\beta}_0^* \hat{\beta}_1^*$ is good.

The model works: $y_i = \beta_0 + \beta_1 x_i + \mu_i$

Combined with cost, technology, demand and other factors, based on questionnaires, field interviews and other research methods to obtain information and data.

Travelers are looking for a product that is portable and easy to use, that can monitor and locate luggage in real time, "Beidouheel" baggage locator can effectively reduce the risk of luggage leakage, misappropriation and theft, Passengers to the airport to clear the responsibility, fair share the cost of implementation.

"Beidouheel" Baggage locator can help airport passengers properly arrange their personal time, reduce anxiety and improve travel happiness. It has good market prospects.

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