

Choice Model Analysis Using JMP®

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ABSTRACT

Choice experiments help discover which product or service attributes a potential customer prefers. Choice models are an excellent tool to analyze the results of choice experiments. Choice models help a researcher to estimate the probability of individuals making a particular choice from presented alternatives. A choice experiment studies customer preference for a set of product attributes. Consumers are presented sets of product attributes, called profiles. Each respondent is shown a small set of profiles, called a choice set, and asked to select the preference that he or she most prefers. Each respondent is usually presented with several choice sets.

The choice model presented in this study aims to analyze the business travelers' choice of travel options given the options available. A randomized set of options are presented to the user from a predefined choice set. The attributes for each travel choice includes Mode, Time, Cost, Privacy, Flexibility and Productivity. Data was collected from 400 participants using an online survey tool. The participants were required to select one of the six travel options presented to them in each scenario. Four such scenarios were presented to each participant. The data collected included the choices that users selected among the given options and did not contain any missing values.

A Choice model was developed using SAS JMP® Pro to analyze the choices made by survey participants. The aim of the analysis is to answer the specific research question: Does Privacy, Productivity and Flexibility have an influence on the travel choices made by participants? The results from the analysis includes Effect Summary and Likelihood Ratio tests that can be used to determine the validity of the model. Additionally, the Utility Profiler, Probability profiler and Effect marginal provide Utility and Probability scores for each level of attributes. This allows the researcher to make conclusions about the likelihood the user will make a choice given the set of attributes.

INTRODUCTION

The idea of this paper is to analyze business travelers' choice of travel option given the available options. A survey was sent out to 400 business travelers who were presented with a predefined set of travel options. The attributes in each choice set were carefully chosen based on research. The modes of travel options were Ground Based Autonomous vehicle (GBAV), Commercial Air and Automobile. The other attributes in the survey are Time, Cost, Privacy, Productivity and Flexibility. Each choice set contains six travel options and the participant selects his or her most preferred option for that trip. Four such scenarios were presented to each participant and their travel choice is recorded.

A Choice model, developed using SAS JMP Pro was used to analyze the survey data. The data was cleaned to ensure there were no missing values or outliers.

SURVEY DESIGN

The survey is designed to display a randomized set of trip options to the participant. The randomization is achieved by Javascript programming within the Qualtrics survey design

application. The attributes for each of each travel option include Mode, Time, Cost, Privacy, Productivity and Flexibility.

Mode - categorical variable with options GBAV, Commercial Air and Automobile.

Time – the number of hours it takes to make a certain trip.

Cost – the cost in USD needed to cover the trip.

Privacy – the amount of privacy the traveler can expect during the trip. Ranges from 0% - 100%, where 0% is no privacy and 100% is complete privacy.

Productivity - indicates how productive the traveler can expect to be during the trip. Ranges from 1 - 5, where 1 is not productive and 5 is highly productive.

Flexibility - indicates how flexible the trip can be in terms of time and date changes. Ranges from 1 - 5, where 1 is not flexible and 5 is highly flexible.

As shown in the figure below, each participant four scenarios, each containing six trip options.

Scenario 1 out of 4

	Mode	Travel Time	Travel Cost	Productive Time (%)	Flexibility (1-5)	Privacy (1-5)
Trip 1	GBAV	6	\$600	80%	4	4
Trip 2	GBAV	7	\$500	100%	5	4.5
Trip 3	AUTOMOBILE	7.5	\$500	10%	5	4.5
Trip 4	AUTOMOBILE	8	\$500	20%	5	4
Trip 5	COMMERCIAL AIR	4	\$700	30%	1	2
Trip 6	COMMERCIAL AIR	5	\$600	10%	1	1.5

Select the box for the trip you would select:

Trip 1

Trip 2

Trip 3

Trip 4

Tip 5

Trip 6

Figure 1. Sample Survey Page

The javascript code that is used to randomize the options from a given set of options is shown below:

```
var TIME_GBAV = ["5", "6", "7", "8", "9"];
var TIME_AIR = ["4", "5", "6", "7", "8"];
var TIME_CAR = ["6", "6.5", "7", "7.5", "8"];
var COST_GBAV = ["$400", "$500", "$600", "$700", "$800"];
var COST_AIR = ["$400", "$500", "$600", "$700", "$800"];
var COST_CAR = ["$450", "$500", "$550", "$600", "$650"];
var PROD_GBAV = ["100%", "90%", "80%"];
```

```

var PROD_AIR = ["30%", "20%", "10%"];
var PROD_CAR = ["20%", "15%", "10%"];
var FLEX_GBAV = ["5", "4.5", "4"];
var FLEX_AIR = ["2", "1.5", "1"];
var FLEX_CAR = ["5", "4.5"];
var PRIV_GBAV = ["5", "4.5", "4"];
var PRIV_AIR = ["2", "1.5", "1"];
var PRIV_CAR = ["5", "4.5", "4"];

var TIME_a1 = TIME_GBAV[Math.floor(Math.random()*TIME_GBAV.length)];
var COST_a1 = COST_GBAV[Math.floor(Math.random()*COST_GBAV.length)];
var PROD_a1 = PROD_GBAV[Math.floor(Math.random()*PROD_GBAV.length)];
var FLEX_a1 = FLEX_GBAV[Math.floor(Math.random()*FLEX_GBAV.length)];
var PRIV_a1 = PRIV_GBAV[Math.floor(Math.random()*PRIV_GBAV.length)];

```

CHOICE MODEL USING SAS JMP

Once the data is collected and prepared, a choice model analysis was performed using SAS JMP PRO 13.2. To open the choice model dialog, open the dataset and click on Analyze → Consumer Research → Choice. The choice model in JMP allows you to select data from a single dataset or from multiple datasets.

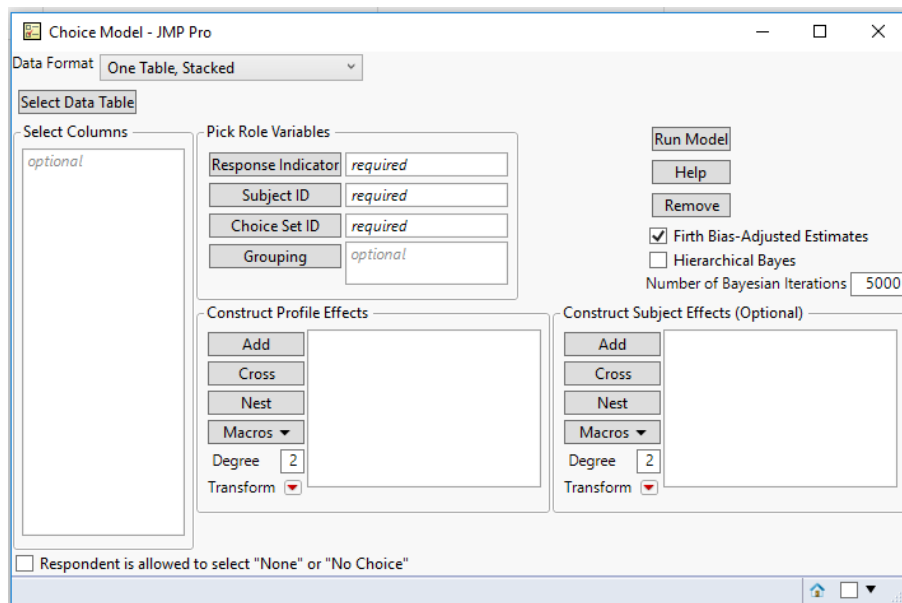


Figure 2. Choice Model in SAS JMP PRO

The variables in the dataset can be dragged and dropped into the appropriate boxes to build the choice mode. The response Indicator is the outcome variable, the subject ID is the unique ID of each participant and choice set ID is scenario ID being shown to the survey participant.

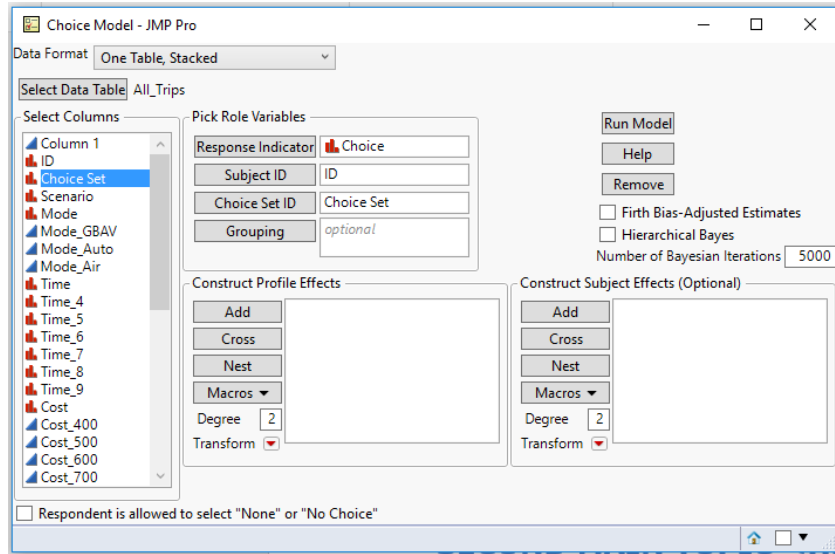


Figure 3. Choice Model in SAS JMP PRO

MODEL OUTPUT

The Choice model provides several output from the analysis and the most relevant ones are discussed below.

1. **Effect Summary** shows the significance level ($p < 0.05$) of each of the attributes. The attributes listed on the top of the table are more significant than the ones at the bottom of the table. It is observed that Cost, Time and Productivity are significant attributes.

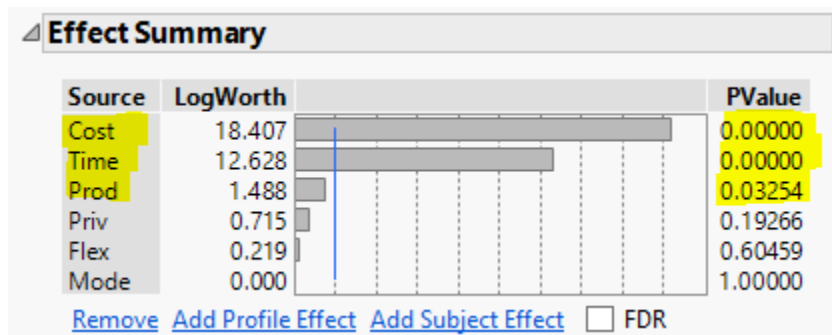


Figure 4. Effect Summary

2. **Chi-square Likelihood Ratio Test** is another test of significance for the attributes. The Chi-square test supports the effect summary results and shows that the attributes Cost, Time and Productivity are significant.

Likelihood Ratio Tests			
Source	L-R ChiSquare	DF	Prob>ChiSq
Mode	0.000	2	1.0000
Time	73.938	7	<.0001*
Cost	102.130	7	<.0001*
Prod	13.752	6	0.0325*
Flex	3.625	5	0.6046
Priv	7.398	5	0.1927

Figure 5. Likelihood Ratio Tests

- Utility Profiler** tells you the value of this utility for different settings of the levels. It can show how the systematic utility changes when the attribute levels change, but there is no internal scale; e.g., a utility of 6 is not necessarily twice as good as a utility of 3.

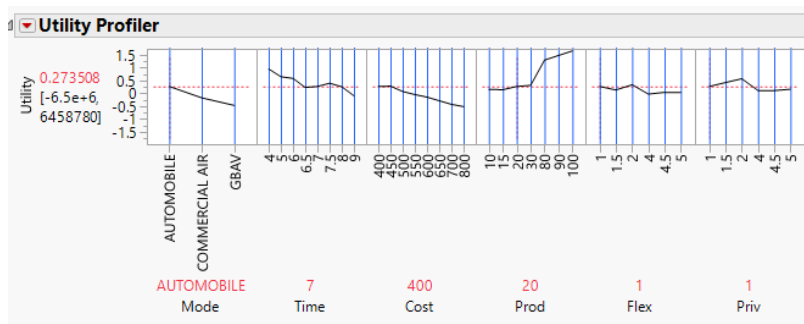


Figure 6. Utility Profiler

- Probability Profiler** shows the shows the probability of choosing between two alternatives. Enables the user to compare choice probabilities among a number of potential products.

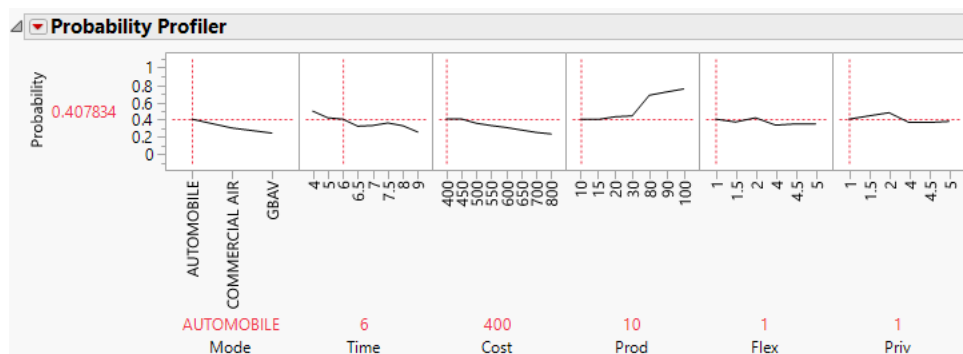


Figure 6. Probability Profiler

- Effect Marginals** shows the marginal probabilities and marginal utilities for each main effect in the model. The marginal probability is the probability that an individual selects attribute A over B with all other attributes at their mean or default levels.

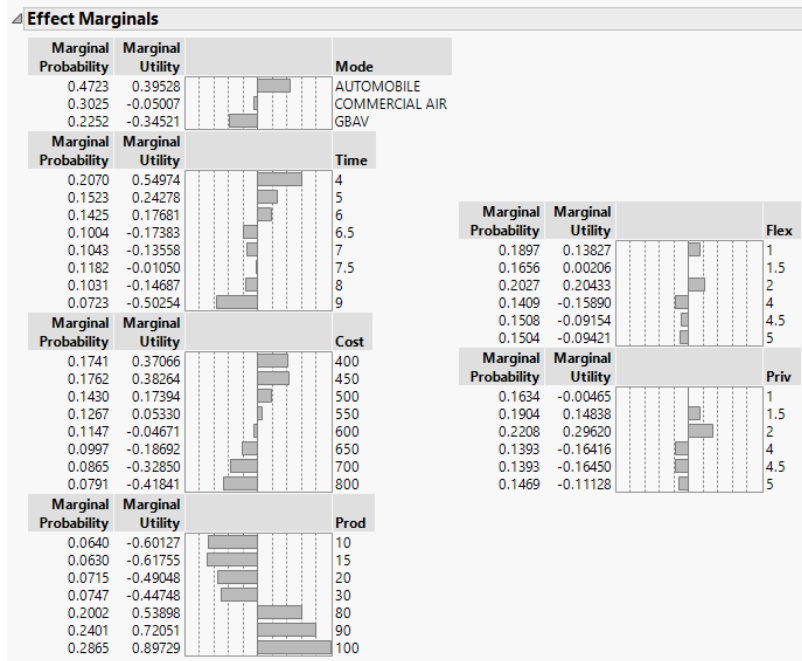


Figure 7. Effect Marginals

CONCLUSION

Based on the analysis of the survey data, it can be concluded that Cost, Time and Productivity are significant factors for a traveler to make a decision. Additionally, Privacy and Flexibility were not so significant factors. Holding all other attributes constant, the marginal probability of a participant choosing a trip with 80% or higher productivity over a trip with lower productivity is 0.72.

CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the authors at:

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