

NUMB3RS Activity: The Perfect House Episode: "Killer Chat"

Topic: Marketing (Conjoint Analysis)

Grade Level: 10 - 12

Objective: The students will explore marketing analysis to determine preferences.

Time: 15 minutes

Introduction

The FBI found three bodies in three different unoccupied houses, all for sale. Because the victims are completely unrelated, Charlie decides that profiling the houses might reveal a discernable pattern. "By profiling the house, we can profile the killer. Using a Multi-Attribute Compositional Model, I can analyze houses by looking at the individual parts that make up the whole. I can analyze our killer's past choices to assign probabilities to his future ones, and I can composite his 'dream house,' which I can compare to databases of other houses for sale, generating a list of likely locations where he'll strike again."

Multi-Attribute Compositional Models (which are the basis for conjoint analysis) are used extensively in marketing research when businesses are unsure what the public really wants in a product. By providing the public with choices and analyzing their preferences, researchers can determine what characteristics the public values over others. This value is called a characteristic's utility score.

Discuss with Students

In order to use conjoint analysis, Charlie compares the houses the killer chose against all the other houses that were for sale—a data set much too large to analyze without a computer program. This activity will instead simplify the situation by stating which houses the killer chose over others within nine choices. At the end of this series of choices, a **part-worth utility score** can be assigned to each sub-characteristic to determine its level of importance. This score is between 0 and 1 and determined by finding the average number of times it was chosen when offered as a choice. That score is also used in determining the ranking of the categories. Through this process, the killer's "ideal" house will be determined.

Student Page Answers:

1. 0.40
- 2.

		Choice	Total	Score
Bedrooms	2 Bedrooms	4	6	0.67
	3 Bedrooms	2	7	0.29
	4 Bedrooms	3	5	0.60
Style	Ranch	6	6	1.00
	Duplex	2	5	0.40
	Colonial	1	7	0.14
Bathrooms	1 Bath	4	6	0.71
	1.5 Bath	3	7	0.43
	2 Bath	2	5	0.40

3. A two bedroom, one bath ranch-style house. 4. bedroom = 0.38, style = 0.86, bathroom = 0.27
5. Style, Bedroom, Bathroom

Name: _____

Date: _____

NUMB3RS Activity: The Perfect House

The FBI found three bodies in three different unoccupied houses, all for sale. Because the victims are completely unrelated, Charlie decides that profiling the houses might reveal a discernable pattern. "By profiling the house, we can profile the killer. Using a Multi-Attribute Compositional Model, I can analyze houses by looking at the individual parts that make up the whole. I can analyze our killer's past choices to assign probabilities to his future ones, and I can composite his 'dream house,' which I can compare to databases of other houses for sale, generating a list of likely locations where he'll strike again."

While Charlie looked at numerous characteristics of the houses in his analysis, we will focus on just three characteristics: the number of bedrooms (two, three or four), the house style (ranch, duplex, or colonial), and the number of bathrooms (one, one-and-a-half, or two).

Multi-Attribute Compositional Models, which are the basis of conjoint analysis, work by giving someone a choice between two situations. For example, the killer could be posed with the following choice:

House A	House B
2 bedrooms	3 bedrooms
Duplex	Ranch
1 bathroom	2 bathrooms

If the killer chose House B, that does not necessarily mean those three sub-characteristics are exactly what the killer was looking for; it only means that when compared to the other choice, it was more desirable. A series of choices need to be analyzed before the individual preferences can be deduced.

At the end of a series of choices like the one above, a **part-worth utility score** can be assigned to each characteristic to determine its level of importance. This score is between 0 and 1 and determined by finding the average number of times it was chosen when offered as a choice. The closer a score is to 1, the more the choice is valued. That score is also used in determining the ranking of the categories.

Suppose the killer made the following nine choices (identified by a body being found at the location).

House A – Body found 2 Bedrooms Ranch 1.5 Bathrooms	House B 4 Bedrooms Colonial 2 Bathrooms
House C 2 Bedrooms Duplex 2 Bathrooms	House D – Body found 3 Bedrooms Ranch 1 Bathroom
House E 3 Bedrooms Duplex 1.5 Bathrooms	House F – Body found 2 Bedrooms Colonial 1 Bathroom
House G 3 Bedrooms Colonial 2 Bathrooms	House H – Body found 4 Bedrooms Duplex 1 Bathroom
House J – Body found 2 Bedrooms Ranch 1.5 Bathrooms	House K 4 Bedrooms Colonial 1 Bathroom
House L 3 Bedrooms Colonial 1.5 Bathrooms	House M – Body found 4 Bedrooms Duplex 1 Bathroom
House N 3 Bedrooms Colonial 1.5 Bathrooms	House P – Body found 4 Bedrooms Ranch 2 Bathrooms
House Q – Body found 3 Bedrooms Ranch 1.5 Bathrooms	House R 2 Bedrooms Colonial 1 Bathroom
House S – Body found 2 Bedrooms Ranch 2 Bathrooms	House T 3 Bedrooms Duplex 1.5 Bathrooms

The part-worth utility score for the colonial is $1 \div 7 \approx 0.14$, because it was chosen one out of the seven times it was available. In general, a characteristic's part-worth utility score is the number of times it was chosen divided by the number of times it was available.

1. Find the part-worth utility score for the duplex.

2. Find the part-worth utility scores for the remaining sub-characteristics and complete the chart to the right.

		Choice	Total	Score
Bedrooms	2 Bedrooms			
	3 Bedrooms			
	4 Bedrooms			
Style	Ranch			
	Duplex			
	Colonial	1	7	0.14
Bathrooms	1 Bathroom			
	1.5 Bathrooms			
	2 Bathrooms			

3. Based upon these scores, what are the sub-characteristics the killer is looking for?

Extending the analysis, it would be beneficial to know which characteristics the killer values most and least. Remember, not all characteristics are valued equally. The killer might prefer the style of the house more than the number of the bedrooms of the house. (as seen by one of the choices the killer made).

To uncover this information, we will look at how the scores vary within each characteristic. If the scores in one characteristic are all very close, then that characteristic must not be very important. On the other hand, if one of the scores is much greater than the others, then that category must matter a great deal. The range for each category of the data is found by (maximum score) – (minimum score).

4. Find the ranges for all three characteristics.

5. What are the characteristics in order of importance?

The goal of this activity is to give your students a short and simple snapshot into a very extensive math topic. TI and NCTM encourage you and your students to learn more about this topic using the extensions provided below and through your own independent research

Extension

Activity: Ordering Pizza

Introduction

How many times have you asked your friends what kind of pizza they would like and been told "I don't know," but when you make a suggestion, they tell you "No?" Using conjoint analysis, it would be possible to determine what type of pizza your friends would like. Go to <http://www.dobney.com/Conjoint/CnjtDemo.htm> and start asking your friends the questions.

Do the results surprise you and your friends? Notice that the Web site uses a Likert scale (a survey that allows the respondent to specify their level of agreement to the question), allowing your friends to choose between one and nine. This is the true way conjoint analysis is done; not all choices are cut and dry.

Additional Resources

An interactive training module on conjoint analysis can be found at the Web site below:
http://www.sawtoothsoftware.com/education/conjoint/cgi-bin/ciwwweb.pl?hid_bypass=con1,user

Related Topic

To learn more about market research, go to the Web site below:
<http://www.knowthis.com/research/methods.htm>

For a list of colleges that offer degrees in marketing research, go to:
<http://www.quirks.com/resources/universities.asp>