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Investigation of Customer Priorities for Machine Made Carpet Through Conjoint and Cluster Analysis (Case Study in Yazd, Iran)

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Abstract

The machine made carpet industry is one of the main and most famous industries in Iran and especially in the city of Yazd. However there is little information about customer preferences for different attributes of this product. In this article we tried to estimate the relative importance of the main attributes affecting customer desire for purchasing machine made carpet and the utility values for the different levels of each one by means of conjoint analysis. In addition to this, we created customer segments with similar preference structures using cluster analysis. Six attributes have been considered in this paper: design, color, number of colors, density, primary material and brand. Twenty seven profiles by combining different levels of these attributes using fractional factorial design approach have been created. These profiles were evaluated by 380 customers in the city of Yazd. Results have shown that design of carpet is the most important attribute for the choice of carpet. Color, primary material, brand, density and number of colors are the next priorities for customers respectively. Also cluster analysis identified five clusters of customers with similar preferences.

Key words: Conjoint analysis, Customer's preferences, Segmentation, Machine made carpet, Yazd

Introduction

The customers of each organization, in each occupation are the most important invests of any organization in which the survival of any organization depends on their satisfaction and loyalty (Mansouri et al., 2012). In other words, customers are a key factor in success of any organization and business, thus implementing and practicing the principles of customer's satisfaction is so much essential in the success of organization. The most important key factor in achieving customer's

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satisfaction and loyalty is to provide suited services and products for them. Providing appropriate products is only possible based on recognition of customer's preferences, priorities and attitudes (Alibeik et al., 2005).

The Persian carpet is an essential part of Persian art and culture. Carpet-weaving is undoubtedly one of the most distinguished manifestations of Persian culture and art, and dates back to ancient Persia. Iran is also the world's largest producer and exporter of carpets, producing three quarters of the world's total output (Wikipedia, 2012). In recent decades although Persian handmade carpet still has high popularity in global markets, but in domestic market due to its cheaper price, machine made carpet is replaced with handmade one. Of course this replacement is not due to the lack of interest for handmade carpet, but the price difference between these two carpet types, and on the other hand, flexibility in size, color and design, have caused that Iranian customers were propelled to machine-made carpet (Pakzad, 2010). However, unfortunately much effort has not been done for identifying customer's preferences with regards to machine-made carpet product (Daneshian et al., 2012). The research presented in this paper seeks to provide a general model of customer's preferences and perceptions by using methodologies applied in the marketing.

When customers are willing to make a purchasing decision, including machine made carpet purchasing, they usually consider several factors. Thus a methodology of analysis like conjoint analysis that determines estimation for the importance of various attributes at the same time in the purchasing decision of the customers could be very useful (Moskowitz & Silcher, 2006).Conjoint analysis is an established validated method that has received considerable academic and industry attention for years as a major set of techniques for measuring buyers' tradeoffs among multi attributed products and services. It is a very powerful tool for obtaining information about the effect of different product attributes on purchasing desire of products (Green & Srinivasan, 1978).Conjoint analysis is unique among multivariate methods. In this method the researcher first constructs a set of hypothetical products by combining selected levels of each attribute, these combinations result in the design of the profile which is presented to the respondents. Customers will provide their evaluations based on their interest. Thus, the researcher is asking the respondent to perform a very realistic task – choosing among a set of products – (Hair et al., 1998).Normally those attributes and levels are used in conjoint

analysis which cover the key characteristics considered in purchasing situation (Grunert, 1997).This technique has been used in the number of marketing researches to determine the relative importance of product attributes among potential buyers as well as the customer's preferences (Ares & Deliza, 2010; Ares, Gimenez & Deliza, 2010; Behzadian, Aghdaie & Razavi, 2011; Chen, Hsu & Lin, 2010; Claret et al., 2011; Cox, Evans & Lease, 2011; Evans, 2008; Frank et al., 2001; Furnols et al., 2011; Haddad et al., 2007; Hailu, 2009; Hersleth et al. 2012; Hill, 2008; Krystallis & Ness, 2005; Lihra, Buehlmann & Graf, 2012; Mesias et al., 2009; Min et al., 2011; Nelson et al., 2005; Schnettler et al., 2009; Villalobos et al., 2010; Yun, 2007).

Usually customer's attitudes, beliefs or purchase intention are not homogeneous. Consequently attributes of the products do not have the same importance for different customers(verbeke & viaene, 1999).In that case it is needed to detect segments of customers with similar preferences, purchasing behaviors and other characteristics using backward approaches and therefore, the clustering approach is very appropriate for this purpose (Sahmer, Vigneau& Qannari, 2006).The purpose of segmentation is to link customer's characteristics with their preferences for product attributes (Hailu et al., 2009).Segmentation is important to choose the most appropriate marketing strategies that better fit the interests of each segment (Naes, Kubberod & Sivertsen, 2001) especially if segments can be characterized in terms of demographic characteristics (Andrews & Currin, 2003).

The main objectives of the present study were to: 1) explore the importance weights of each attribute for stated purchasing customer's preferences for machine made carpets and to investigate the attribute levels for which customers have positive or negative inference, 2) identify different segments of customers based on their preferences and purchasing behaviors, and 3) investigate any significant difference between clusters with regards to demographic and behavioral variables.

The reminder of the paper is organized as follows. The second section explains research methodology and is followed in the third section by the presentation and discussion of the empirical results; finally, in forth section concluding remarks are given.

Methodology

Selection of attributes (factors), levels and profiles: conjoint analysis design

The first step in the conjoint experiments concerns the identification of appropriate attributes and, subsequently, the design of feasible attribute levels (Hair et al., 1998). For this purpose we first investigated a list of attributes by reviewing of books, sites and etc, and then these attributes were presented to a panel of carpet experts, who choose the final attributes among them. They also determined the appropriate levels for each attribute. The selected attributes were design, color, number of colors used, density, primary material and brand. Regarding the design, four different levels were chosen: Lachak toranj, Afshan, Kheshti, Derakhti. These are the main and most famous designs in Iranian machine made carpets. Concerning the attribute of color, the colors of crimson, midnight blue, cream and walnut that are the most common ones in producing machine made carpets in Yazd city, were the four levels considered. With respect to brand attribute, brands of 'Bastan', 'Setare kavir', 'Kabir' and 'Sanaat' were selected. Also three levels of Low, Medium and High were considered for density attribute. Concerning the attribute of primary material, Wool, Acrylic, Polyester and BCF were the four levels selected and finally 5, 8 and 10 colors were three levels selected for the number of colors attribute. Table (1) shows these different attributes and levels selected.

Once the attributes and their levels were selected, the profiles (combinations of different levels of the attributes) that would be presented to the customers in survey were created. Since fullfactorial design was not appropriate in the present study due to the large number of possible different combinations ($4\times4\times3\times4\times4\times3=2304$),consequently, and in order to reduce the number of product profiles to be evaluated by participants, a fractional factorial design was used to effectively test the effect of attributes on buyer's preferences, missing the least of information (Halbrendt,Wirth, & Vaughn, 1991; Harrison, Ozayan& Meyers, 1998).A fractional factorial design is the most common method used for defining a subset of profiles for evaluation (Hair et al., 1998). It designs a sample of possible profiles, which the number of profiles depending on the type of composition rule assumed to be used by respondent. The composition rule describes how the researcher postulates that the respondent combines the utilities of each attribute to obtain overall worth or utility of product profiles. The most common and basic composition rule is an additive

model. It assumes the respondent simply adds the values for each attribute (i.e. the utilities of the levels) to get the total value for a profile. It means that in this composition rule, only main effects of the selected attributes are considered and interactions between them are assumed negligible (Hair et al., 1998). In this study we used this model of composition rule.

The quality of the design is reflected by being orthogonal and balance. A design is orthogonal if all effects can be estimated independently of all of the other effects (excluding the intercept) and a design is balanced when each level occurs equally often within each factor, which means the intercept is orthogonal to each effect (Kuhfeld, 1997).In the present study we created balance and near orthogonal design (D-efficiency of our design was 96.3492) with 24 profiles using the OPTEX Procedure of the SAS (SAS, 2008). We have also used three profiles, in addition to those used as validation or holdout profiles to determine internal validity of our model. Parameters from the estimated conjoint model (using 24 profiles) were used to predict preferences for the holdout set of profiles and then they were compared with actual responses by calculating correlation. For easier and more accurate evaluation of the profiles by respondents, these 27 carpets were designed according to their levels on three attributes of design, color and number of colors. Along with picture of each carpet, descriptions of this (i.e. about color, number of colors, design, primary material, density and brand of them) were presented. Also in addition to these, price of each carpet (for 1 m^2 and 12 m^2) was stated too.

Table 1: Attributes and levels selected for the conjoint analysis

Attributes	Attribute levels
Design	Afshan; Lachaktoranj; Kheshti; Derakhti
Color	Midnight blue; Crimson; Cream; Walnut
Number of colors used	5 colors; 8 colors; 10 colors
Primary material	Wool; Acrylic; Polyester; BCF
Density[1]	Low; Medium; High
Brand	SetareKavir; Bastan; Kabir; Sanaat

[1]Density: 'Low' includes "Between 1300 until 1600" for carpets with Polyester material and "Lower than 1000" for carpets with other defined materials in this study; 'Medium' includes "Between 1600 until 1900" for carpets with Polyester material and "Between 1000 until 1300" for carpets with other defined materials in this study and 'High' includes "Upper than 1900" for carpets with Polyester material and "Upper than 1300" for carpets with other defined materials in this study.

Participants and data collection

In this study, that was conducted in the city of Yazd (one of the central cities of Iran), a sample of 380 customers aged between 18 and 75years old were gathered between September and November 2012. Participants were selected randomly among those who had come to carpet shops for buying. For the evaluation of the purchasing preferences, each customer received 27profiles, which were generated, in a random order. Participants were asked to carefully view picture of carpets and read their descriptions, and rate each of them from 1 to 9, according to their purchasing preferences, where 1 means that the respondent definitely would not buy the product and 9 means that the respondent definitely would buy the product. Another method is ranking order method where some disadvantages of using this method include the inability of respondents to communicate indifferences between profiles and that how much one alternative is preferred over another (Sayadi, Gonzalez & Calatrava, 2005), together with the increasing difficulty for the customers to handle the ranking procedure specially when the number of product profiles is large, like this study, we concluded to the use of rating method in present study. Also note that the utility model developed with rating method provides a more accurate view of the preferences (Sayadi, Gonzalez& Calatrava, 2005).Customers were also asked to provide demographic and behavioral information. Demographic information included customer's age, gender, amount of monthly family income and level of education.

Statistical analysis

Customer's ratings were analyzed by the TRANSREG procedure of SAS (SAS, 2008). Rather than aggregating all participants and obtaining average preference estimates or part worth utilities, this program also generated part worth for each participant. Note that part worths are relative measures and their summation is zero for each attribute. Part worth estimates are expressed in a similar scale. This allows that importance scores for individual respondents can be computed by calculating the ratio of the utility range for the particular attribute to the sum of the utility ranges of all attributes. In the next step, cluster analysis of the part worth estimates for each attribute level that were calculated in the past step (conjoint analysis) was applied to identify distinct clusters or sample segments.

Results and discussion

Conjoint analysis

The model was estimated using ordinary least squares regression analysis, the most common methodology (Wittink & Cattin, 1989). The estimated model establishes the relative importance of the attributes, as well as the part worth for each level of the attributes. One of the main results of the model is the estimation of a utility function (formed by the combination of the part worths for the different levels) for each of the respondents. The accuracy of the estimation was tested by calculating the Pearson Correlation Coefficient between the original ratings given by the respondents and those determined by the model. The high value of this coefficient (0.874 for holdout profiles and 0.985 for all of profiles) indicates that the model provides good prediction of the customer's preferences. Table 2 shows the aggregate results for the whole sample.

A positive sign in the value of a level's part worth indicates that, for this survey, the presence of that level of the attribute adds that amount of utility to the product (for two levels with positive signs, that of greater value is the one that provides greater utility). A negative sign, on the other hand, implies that the presence of that level of the attribute in the product lessens its utility.

Customers considered design of the carpet as the most important characteristic (29.485% of importance), the 'Lachak toranj' one being the most preferred design (utility value of 0.467). The least preferred design was the 'Derakhti' one (utility value of -0.533). The second important factor was the color (17.732% of importance), and the most and least preferred levels were colors of cream and midnight blue respectively (utility values of 0.343 and -0.297). Primary material was the third important factor (16.991% of importance), and the most preferred level was the wool one (utility value of 0.147). Brand, density and number of colors were in the next ranks respectively. Also brand of 'Sanaat', high density and 10 colors were the most preferred levels of these factors respectively.

The maximum utility, obtained from the combination of the levels with the greatest part worths for each attribute, would give the ideal product. Therefore the ideal product is as follows: carpet with design of 'Lachak toranj', color of cream, 10 colors, material of wool, high density and brand of 'Sanaat'.

Table 2: Aggregate results of Conjoint Analysis for the overall sample: relative importance of attributes and part worth per level and attribute

Attribute	Level	Part worth	Relative importance (%)
Design	Afshan	0.410	29.485
	Lachaktoranj	0.467	
	Kheshti	-0.344	
	Derakhti	-0.533	
Color	Midnight blue	-0.297	17.732
	Crimson	-0.130	
	Cream	0.343	
	Walnut	0.084	
Number of colors used	5 Colors	-0.128	10.475
	8 Colors	-0.024	
	10 Colors	0.151	
Primary material	Wool	0.147	16.991
	Acrylic	0.067	
	Polyester	-0.038	
	BCF	-0.176	
Density	Low	-0.084	10.818
	Medium	-.104	
	High	0.189	
Brand	Setare kavir	-0.018	14.499
	Bastan	-0.110	
	Kabir	0.062	
	Sanaat	0.067	

Segmentation

Having determined the preferences from the utilities estimated in the Conjoint Analysis, a Cluster Analysis was then applied to classify the customers into homogeneous preference groups. Before starting clustering, outliers should be identified (Hair et al., 1998). In order to remove outliers, we first calculated Mean (μ) and Std. Deviation (σ) for each variable of clustering and then values of each variable that were more than $\mu+3\sigma$ or less than $\mu-3\sigma$have been considered as outliers and omitted. By omitting outliers, 332 respondents were remained. The calculations of clustering these respondents were performed by using the Cluster unit of the SPSS 16 software and the Ward and k-means clustering procedures. The inputs that are used in cluster analysis were the coefficients of each respondent's utility function. We first used Ward procedure for

determining number of clusters. Results showed that 2, 3 and 5 clusters were appropriate. Then k-means procedure was used for k=2, 3 and 5.These cluster solutions obtained from each k were evaluated through Davies Bouldin **(**DB) Index. This Index proposed by Davis and Bouldin (1979), which is $DB = \frac{1}{k}\sum_{i=1}^{k} \max(\frac{\alpha_i+\alpha_j}{d(c_i,c_j)})$, where α_i and α_j are the average within cluster distance of cluster i and cluster j and the denominator 'd' is the distance between centroids c_i and c_j. Minimum value of DB indicates optimal number of clusters. The values of this index for 2,3 and 5- cluster solutions are equal to 4.274, 4.756 and 3.735 respectively. Since the 5-cluster solution has the lowest value of DB Index, this solution was chosen. Table 3 lists detailed socio-demographic characteristics of the clusters and of the overall sample. It also shows the level of significance obtained in a Chi-Square test carried out for five clusters. As shown in this table, there were significant differences among these five clusters according to age and income characteristics. According to this table, majority of young customers ($\leq$ 30 years) are in cluster 1 (58.6%). Middle-aged customers (31-49 years) are also mostly in cluster 1 (46.2%) and then in cluster 4 (22.8%). While majority of older customers ($\geq$50 years) are in cluster 4.On the other hand, most of the population of the cluster 3 are customers with low income level, while cluster 4 is mainly made up by customers with high income level.

The relative importance of factors and part worths of their levels with the size of each cluster are presented in Table 4.Customers from cluster 1 (n=154) is the largest group, including 46.38% of the respondents. This cluster, among design levels gave the highest utility to the 'Afshan', while clusters 3,4 and 5 assigned the negative utility to this level. In cluster 3, 'Afshan' is the least preferred level. In cluster 2, 'Lachak toranj' is the most preferred level (utility value of 2.3902).Customers in cluster 3 assigns the highest utility to the 'Kheshti' and cluster 5 to the 'Derakhti'. In cluster 4 similar to cluster 2, the highest preferred level is 'Lachak toranj', but in this clusters 'Kheshti' is the second one. While in cluster 2, 'Afshan' is the second preferred level. In all of clusters rather than cluster 4 which in that one, color of crimson is the most preferred color, color of cream has the highest utility. Color of crimson in clusters 3 and 5 is the least preferred color, while in clusters 1 and 4 color of midnight blue has the lowest utility. In cluster 2, the least preferred color is walnut. Clusters 1, 2, 4 and 5 assigned the highest utility to carpet with 10 colors, second to 8 colors

and third to 5 colors. In cluster 3, carpet with number of 8 colors is the least preferred one. In clusters 2,3 and 5,onlyone level (i.e. 10 colors) has positive utility and other two levels have negative utility. Clusters 4 and 5 prefer high density than the others, medium and low densities are next preferences, while clusters 1, 2 and 3 prefer high density than low density. With regards to clusters 1 and 4, only high density has positive utility. Clusters 1 and 5 assigned the highest utility to acrylic material and cluster 4 to wool material. In cluster 3, BCF material has high positive utility. Also in cluster 2, BCF material has highest utility but after that and with small difference in utility value, wool material is placed. Clusters 1 and 5 among levels of brand factor gave highest utility to 'Bastan', cluster 2 to 'Sanaat', cluster 3 to 'Kabir' and finally cluster 4 to 'Setare kavir'.

Table 3: Descriptions of clusters and general sample by socio-demographic characteristics together with level of significance obtained by Chi-Square test

Demographic characteristics		Clusters					Total	Significance[a]
		1	2	3	4	5		
Gender	Man	71	28	13	40	11	163	n.s
		43.6%	17.2%	8%	24.5%	6.7%	100%	
	Woman	83	18	18	31	19	169	
		49.1%	10.7%	10.7%	18.3%	11.2%	100%	
Age	≤ 30 years	65	19	7	10	10	111	**
		58.6%	17.1%	6.3%	9%	9%	100%	
	31-49 years	79	20	17	39	16	171	
		46.2%	11.7%	9.9%	22.8%	9.4%	100%	
	≥ 50 years	10	7	7	22	4	50	
		20%	14%	14%	44%	8%	100%	
Level of studies	High school and Lower	54	14	14	31	10	123	n.s
		43.9%	11.4%	11.4%	25.2%	8.1%	100%	
	Associate's and Bachelor's degrees	73	23	14	36	14	160	
		45.6%	14.4%	8.8%	22.5%	8.8%	100%	
	Master's and Doctoral degrees	27	9	3	4	6	49	
		55.1%	18.4%	6.1%	8.2%	12.2%	100%	
Monthly family income level	≤ 6.000.000Rials[1]	23	9	21	3	4	60	**
		38.3%	15%	35%	5%	6.7%	100%	
	Upper than 6.000.000 until 10.200.000 Rials	90	31	8	19	20	168	
		53.6%	18.5%	4.8%	11.3%	11.9%	100%	
	Upper than 10.200.000 until 10.800.000 Rials	31	4	1	31	2	69	
		44.9%	5.8%	1.4%	44.9%	2.9%	100%	
	≥ 10.800.000 Rials	10	2	1	18	4	35	
		28.6%	5.7%	2.9%	51.4%	11.4%	100%	

1. [a] Differences significant at: **p<0.001; n.s: non-significant

[1]'Rial' is the currency of Iran

Table 4: Results of Conjoint Analysis by cluster: relative importance of attributes and part worths per level and attribute

Attributes and Levels		Clusters				
		1(154 ind.)	2(46 ind.)	3(31 ind.)	4(71 ind.)	5(30 ind.)
Design	Lachaktoranj	.1473	2.3902	.4491	.4657	-.5534
	Afshan	1.2902	.8704	-1.2401	-.1532	-.7040
	Kheshti	-.3205	-1.8305	.7240	.1743	-.8933
	Derakhti	-1.1170	-1.4301	.0671	-.4869	2.1507
Relative importance (%)		30.386	42.680	25.913	22.528	32.280
Color	Crimson	-.3245	.2556	-.4879	.3742	-.4145
	Cream	.5670	.3428	.5491	-.1496	.4878
	Midnight blue	-.4804	-.2085	.0151	-.3633	.0927
	Walnut	.2380	-.3898	-.0763	.1387	-.1660
Relative importance (%)		19.018	16.208	16.898	17.192	18.219
Number of colors used	5 Colors	-.1009	-.2036	-.0077	-.1158	-.3661
	8 Colors	.0381	-.1259	-.0128	.0197	-.0778
	10 Colors	.0628	.3295	.0205	.0961	.4439
Relative importance (%)		9.934	9.656	9.634	11.289	11.925
Density	Low	-.0736	.1001	.1101	-.2356	-.1376
	Medium	-.1103	-.2084	-.2442	-.1002	.0487
	High	.1839	.1084	.1342	.3358	.0889
Relative importance (%)		10.753	8.101	13.150	11.775	9.609
Primary material	Wool	.0340	.1320	-.5207	.8125	-.0217
	Acrylic	.2171	-.0304	-.0951	-.1315	.1926
	Polyester	-.0254	-.2563	.0097	-.0078	.0511
	BCF	-.2257	.1547	.6062	-.6732	-.2220
Relative importance (%)		15.936	12.326	18.556	20.478	13.292
Brand	Bastan	.1219	-.3491	-.0724	-.4422	.3108
	Setarekavir	-.2252	-.0697	-.2380	.3495	-.2766
	Kabir	.0994	.1780	.1603	-.1040	-.1327
	Sanaat	.0039	.2408	.1501	.1967	.0985
Relative importance (%)		13.972	11.030	15.894	16.738	14.676

Conclusion

While the use of machine made carpet has grown dramatically in recent years, research that explores how customers shape their attitudes has been lacking. The research presented in this paper seeks to provide a richer view of customer's preferences and perceptions by applying methodologies from the marketing domain. First, conjoint analysis, which has been widely used in the marketing literature, was used to determine the most important attributes in shaping the preferences of the customers for purchasing machine made carpet. Second, cluster analysis was performed on the part worth values derived from the conjoint analysis to extract salient and homogeneous customer segments with similar preferences. Segmentation according to preferences can be a useful tool to develop different marketing strategies for each segment of the market. Results of conjoint analysis showed that the attribute which most affect on choice of the purchasing carpet is design (29.485% of importance) and the 'Lachak toranj' one is the most preferred design. Also cluster analysis identified 5 distinct segments of customers. Chi-Square test demonstrated that there were significant differences between these clusters according to age and income characteristics.

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