Variable Selection Using Principal Component Analysis for Retail Shopping Experience in Saudi Arabia

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Abstract: Many a formats of retail are now available leading to an increasing competition amongst stores to attract shoppers. In this respect, an understanding of the shopper's perception towards shopping assumes huge importance. Though worldwide there have been many a studies to study shoppers' perception but none of them are on the population of Saudi Arabia. A Principal Component Analysis of the respondents in the city of Al Kharj identifies four broad factors namely service quality, ease of shopping, convenience factor and lastly product variety and quality.

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1. Introduction

Saudi Arabia is an oil-based economy with the largest proven crude oil reserves in the world. It ranks as the largest producer as well as exporter of petroleum in the world. The non-oil sector also plays an important role in the economy. Saudi Arabia not only has a huge public sector but also a vibrant private sector. Both of them have contributed to the development of an effective and sustainable non-oil economy. Recently there has been a lot of emphasis on diversification of its economy and attracting foreign direct investments. In fact the soundness of the economy can be gauged by the fact that it was one of the least effected countries in the recent financial crisis of 2009.

As per the 48th Annual Report of Saudi Arabian Monetary Agency the GDP per capita has increased from 5083 in 1971 to 78924 riyals in 2011. The wholesale and retail, restaurants and hotels increased from 894 million riyals in 1968 to 107433 million riyals in 2011. It has a 3.8 percentage share of the total GDP in 2011. It grew at a rate of 7.1% in 2011.

While concentrating on retail sector it is found that there are many a types of retail formats now a day like convenience stores, departmental stores, supermarkets, discounters, specialty stores, hypermarkets. Convenience stores are smaller and offer few products; has mainly convenience items and has limited brands. Departmental store is a larger retail format which offers varieties of goods and services and is divided into departments. It is usually a part of retail chain. Typical goods available here are fashion goods, home electronics and furnishing etc. Supermarket is larger in size; self service store which sells basically household food items like grocery, meat etc. Hypermarkets are bigger than supermarkets and sell non food items like consumer durables, textiles and apparels in addition to food items. Specialty stores are general merchandise retailers who specialize in selling a particular type of goods.

There has been a huge surge in intra retail sector competition. A study by Morganosky (1997) argued that with the emergence of new formats of retail, competition has increased between retailers of all types and also lead to increased complexity in consumer cross-shopping patterns. Thomas (et al. 2004) found that the rapid rise of supermarkets have intensified competition. There may be differences in prices and also differences in service quality but the products are basically the same. The success of any retail format depends on its sales or in other words its customer base. In this respect shopper perception for the store assumes huge importance.

A consumer chooses a store when the store attributes match with his perception of the store. And this store preference is governed by store attributes. Sinha and Banerjee (2004) had successfully correlated the perceived features of stores with the true motivations of different consumers in patronizing these stores. Morschett (et al. 2005) argued that shopping motives influence the perception of retail store attributes as well as the attitude towards retail stores. Kamarulzaman and Lih (2010) found that customer's perception of a mall which leads to branding of the mall is based on factors like location, lifestyle, social class, price sensitivity and the situation of the buyers. So now we try to identify other factors which affect shopping behavior of customers.

2. Review of Literature

Many a studies have tried to identify factors which aid in explaining shoppers behavior. An important element in them was price and related factors like promotion, assortment and likewise. Bell and Lattin (1988), and Barnard and Hensher (1992) found prices and promotions to be important in effecting the customer's shopping behavior. Handerman and Tigert (1996) and Solgaard and Hansen (2003) identified price and assortment as the major factors for store preference. Fox (et al. 2004) found that product assortments and promotions are more important to shoppers than prices. Bhatnagar and Ratchford (2004) found that consumer prefer stores which are based on the combination of product price, product assortment and travel cost. Solgaard and Hansen (2003) identified advertisement and promotion campaign as important factors. Tendai and Crispen, (2009) found that factors such as lower prices, coupons and supportive assistants aided impulsive buying. Brennan and Lundsten (2000) found that shoppers prefer stores for their low prices and large varieties and unique items they cannot find elsewhere.

Some other studies have identified other factors besides price. Hutcheson and Moutinho (1998) attempted to identify factors which were chiefly important in determining choice of store and were significantly associated with customer's satisfaction. They identified 'quality of produce and staff' and the 'occurrence of low prices and frequency of special promotions' as important factors. Mazursky and Jacoby (1985), and Hildebrandt (1988) identified quality of goods and service, store personnel, store lay out, convenience, cleanliness and store atmosphere as important elements of retail store selection. Brown (1989) found that product assortment influenced the shopping pattern. Cassill (et al. 1993) identified brand availability as an important factor for store preference. Arentze (et al. 1993), Dellaert (et al. 1997), Bell (et al. 1998) and, Solgaard and Hansen (2003) specified the store's distance from the customer's home as a factor leading to choice of stores. Meyers (2005) found price, quality and location to be the top three factors that influence the choice of a store. Ali and Kapoor (2010) found that shoppers look for hygiene/freshness of food products, price, variety, quality, non-seasonal availability, packaging, children's attraction, and basic amenities.

Currently the debate over type of store and the shopping experience has assumed huge importance. Watkin (1986) proposed that small businesses should avoid lowering price and differentiation aspect of large retailers and stress on a focused strategy. Covin and Covin (1990) proposed improved customer service and product customization as correct strategy to compete with big retailers. Brennan (1991) found that specialized services, better quality and customer service were more successful than promotions, lowering prices in attracting customers. Seiders (et al. 2000) found that shoppers were not willing to trade off location convenience or, in some cases, quality and assortment. And even big retailers had to differentiate themselves in some significant way to counter increased competition. Hallsworth and Worthington (2000) found that loyalty card system adopted by large retailers was successful.

3. Research Objective

In the review of past literature done for this study there were no studies with reference to the behavior of shoppers in Saudi Arabia. Attracting customers is the prime objective of the competitive market structure with competition between retailers of all formats. All the retail formats are in somehow or the other in competition with each other. This article aims at studying consumer's preferences with respect to shopping. The rationale of this study is to identify the factors affecting a customer's decision regarding preference of shopping and type of store. In fact an understanding of the rationale for choosing a particular type of store would be beneficial both for the profitability of stores and its customers.

4. Methodology

Based on the factors identified in the review of the literature a comprehensive questionnaire was designed. It had 30 statements on likert scale whereby the respondent has to indicate how much he agrees/disagrees with statements regarding his shopping experience. A 5-point interval likert scale to examine how strongly respondents agree (5) or disagree (1) with statements to measure variables in the hypotheses of this research was used. The questionnaire was filled by respondents in the city Al Kharj. These selected respondents represent a balanced mix of various demographic factors (age, gender, marital status, education levels, and employment status and income groups. In total, 101 questionnaires were validated. To check for reliability of the multiple items we look for the results of Cronbach alpha to ascertain that the given scale would produce consistent results if measurements are repeated. Cronbach alpha has a value of 0 to 1 and a value exceeding 0.6 is generally accepted.

As we have 30 statements pertaining to shoppers' experience we need to reduce the number of variables to be analyzed. For this we do factor analysis. Here we will reduce the 30 statements into few dimensions called factors which then become the

new variables. Here we will be having few concepts to define like factor loadings which are the coefficient for correlation between the variables and the factors. Then, eigen values which help in explaining the importance of the factor with respect to the variables are calculated by adding the squares of factor loadings of all the variables in a factor. Normally factors with eigen values more than 1.0 are considered stable. Next we have communalities which measure the percentage of variance in each variable explained by the factor extracted and is calculated by adding the squared factor loadings of a variable across the factors. As communality ranges from 0 to 1, a high communality value indicates the maximum amount of variance in the variable is explained by the factors extracted from the factor analysis. Further, by adding all the communality values of each variable and dividing it by the number of the variables we get the total variance explained. This is the percentage of total variance of the variables explained by all the factors. The variables are grouped into factors, which are now the new variables. Finally the factors in the correlation matrix are rotated to develop clearer factor patterns on the basis of loadings on the particular factor by varimax rotation process which happens to be the generally accepted method for performing principal component analysis.

5. Analysis

As we have multi-item scale hence check for reliability is required to ascertain that results would be consistent if measurements are done again. One of the common methods for measuring internal consistency is split-half reliability which is best captured by Cronbach alpha. It helps us to identify the variables which relate to the same underlying construct. Cronbach alpha has a value between 0 and 1. Closer is the value to 1 higher is the reliability. The relevant value for all the items is 0.652 which is fairly good.

Table 1: Reliability Statistics

Cronbach's Alpha	N of Items
0.652	30

As Cronbach's alpha simply gives the overall reliability coefficient for variables hence if the variables are dealing with items for the same constructs then it would not be able decide between these. For this, we do Principal Components Analysis (PCA). Theoretically as the variables are correlated with each other hence factor analysis using PCA is chosen for the analysis. This will help us to reduce the number of variables under study.

A formal test statistics for testing the appropriateness of the analysis is Kaiser-Meyer-Olkin measure of sampling adequacy. Here it has a value of 0.626 which indicates that correlation between the variables can be explained by other variables. Generally a value of more than 0.5 indicates that factor analysis is appropriate. Another test statistics which tests the null hypothesis that the population correlation matrix is an identity matrix is rejected by Bartlett's test of sphericity as it is significant at 5% level of significance. The concerned p-value is 0.00.

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.626
Bartlett's Test of Sphericity	Approx. Chi-Square	1.14E+03
	Df	435
	Sig.	0

Now the purpose is to obtain the weights through the method of PCA as our purpose is to determine the number of factors which accounts for most of the variance in the data. The initial communalities for all the variables are 1.0. This is because there are unities in the diagonal of the population correlation matrix. But the values under the heading of extracted communalities are different from 1.0 as it shows variance of the retained variables only (Appendix).

Next, the eigen values are decreasing as we move downwards. These eigen values represents the amount of variance associated with each factor hence only those factors are retained whose eigen values are more than 1.0. Here in our analysis in total 10 factors are having eigen values more than 1.0 hence are retained.

Moreover, an important item is the cumulative percent of variance extracted by these 8 extracted factors, which here is 68.38%. This is higher than the recommended 60%. That is, these 8 factors explain around 68% of the variance of all the 30 variables taken together.

Table 3: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.091	20.304	20.304	6.091	20.304	20.304	3.544	11.814	11.814
2	2.86	9.535	29.838	2.86	9.535	29.838	3.523	11.742	23.556
3	2.211	7.369	37.208	2.211	7.369	37.208	2.389	7.964	31.52
4	1.795	5.983	43.191	1.795	5.983	43.191	1.857	6.189	37.708
5	1.519	5.065	48.256	1.519	5.065	48.256	1.815	6.052	43.76
6	1.481	4.937	53.193	1.481	4.937	53.193	1.552	5.173	48.933
7	1.261	4.204	57.397	1.261	4.204	57.397	1.527	5.091	54.024
8	1.18	3.934	61.331	1.18	3.934	61.331	1.471	4.902	58.926
9	1.113	3.71	65.041	1.113	3.71	65.041	1.422	4.739	63.665
10	1.003	3.343	68.384	1.003	3.343	68.384	1.416	4.719	68.384
11	0.96	3.198	71.582						
12	0.937	3.125	74.707						
13	0.864	2.881	77.588						
14	0.785	2.615	80.204						
15	0.686	2.288	82.492						
16	0.62	2.067	84.558						
17	0.592	1.974	86.532						
18	0.543	1.809	88.341						
19	0.475	1.582	89.923						
20	0.445	1.485	91.408						
21	0.392	1.307	92.715						
22	0.356	1.186	93.901						
23	0.347	1.156	95.057						
24	0.323	1.075	96.132						
25	0.27	0.9	97.032						
26	0.236	0.785	97.817						
27	0.224	0.746	98.563						
28	0.164	0.545	99.108						
29	0.16	0.532	99.64						
30	0.108	0.36	100						

Extraction Method: Principal Component Analysis.

Table 4: Component Matrix

	Component									
	1	2	3	4	5	6	7	8	9	10
VAR00001	-0.271	0.13	0.422	-0.03	0.031	-0.103	0.123	-0.578	-0.278	0.118
VAR00002	0.283	0.28	0.48	0.363	0.001	0.313	-0.006	-0.125	0.062	-0.02
VAR00003	-0.075	0.184	0.402	0.316	-0.189	0.48	-0.458	0.043	-0.14	-0.083
VAR00004	0.461	0.429	0.378	-0.06	-0.004	0.12	-0.093	0.336	-0.073	-0.046
VAR00005	-0.514	0.298	-0.342	0.321	0.117	0.136	-0.121	-0.14	-0.024	0.118
VAR00006	-0.4	0.248	-0.335	-0.053	0.383	0.129	-0.154	-0.288	0.042	-0.431
VAR00007	0.621	0.334	-0.059	-0.146	0.091	0.075	0.267	0.276	0.046	-0.171
VAR00008	-0.324	0.341	-0.059	-0.257	0.252	0.425	0.355	-0.031	-0.323	-0.09
VAR00009	0.053	-0.395	0.125	0.023	-0.013	0.34	0.528	0.149	0.351	0.208
VAR00010	-0.174	0.106	0.462	0.049	0.503	0.112	-0.196	-0.031	0.282	0.335
VAR00011	-0.612	0.315	-0.025	-0.239	-0.025	-0.035	0.173	-0.033	0.137	0.089
VAR00012	0.085	0.034	-0.012	-0.325	0.732	0.068	-0.122	0.015	0.248	-0.013
VAR00013	-0.59	0.265	0.173	-0.039	-0.071	-0.13	-0.043	-0.014	0.205	0.003
VAR00014	0.409	0.238	0.178	-0.35	-0.057	-0.217	-0.163	-0.02	-0.248	0.302
VAR00015	0.684	0.273	0.027	-0.078	-0.101	-0.19	-0.172	-0.18	0.043	-0.004
VAR00016	0.648	0.375	-0.12	-0.146	0.181	-0.07	-0.057	-0.052	0.079	0.168
VAR00017	0.441	0.145	0.443	0.07	0.195	-0.489	0.096	-0.087	0.087	-0.302
VAR00018	0.414	0.189	0.161	0.534	0.131	-0.176	0.104	0.243	0.111	0.102
VAR00019	-0.453	0.385	0.29	-0.023	-0.267	0.162	0.066	-0.073	0.285	-0.085
VAR00020	0.536	0.301	0.097	-0.225	-0.097	0.366	0.16	-0.102	-0.116	-0.073
VAR00021	-0.394	0.386	-0.061	-0.448	-0.259	0.13	-0.107	0.148	0.164	0.217
VAR00022	0.616	0.178	-0.388	0.177	0.172	0.156	-0.038	0.026	-0.021	0.047
VAR00023	-0.62	0.263	-0.082	-0.149	-0.037	-0.055	-0.276	0.393	-0.073	-0.039
VAR00024	0.381	0.349	-0.278	0.181	0.082	0.051	0.085	0.167	-0.356	0.085
VAR00025	-0.429	0.395	-0.24	0.486	0.066	-0.118	0.087	-0.032	-0.06	0.306
VAR00026	-0.536	0.319	-0.152	0.23	0.1	-0.23	-0.009	0.256	0.054	-0.11
VAR00027	-0.412	0.39	0.281	0.092	-0.07	-0.198	0.286	0.123	-0.024	-0.342
VAR00028	0.346	0.408	-0.402	0.25	-0.227	0.067	0.171	-0.3	0.289	0.011
VAR00029	-0.425	0.216	0.187	-0.061	0.162	-0.216	0.318	0.043	-0.29	0.25
VAR00030	0.348	0.52	-0.21	-0.235	-0.269	-0.183	-0.049	-0.119	0.237	0.051
Extraction Method: Principal Component Analysis.										
a. 10 components extracted.										

Subsequently in the component matrix larger factor loadings indicates a close relationship between the variable and the factor and is used to interpret the factors. As a variable can sometimes be correlated with more than one factor hence the rotation of factors is done. Here rotation has been done using the varimax procedure with Kaiser Nomalization which is a commonly used for rotation in PCA. From the rotated component matrix the variables having large loading on the same factor are interpreted as factors.

Table 5: Rotated Component Matrix

	Component									
	1	2	3	4	5	6	7	8	9	10
VAR00001	-0.101	0.168	0.046	0.092	0.08	0.036	0.109	0.016	0.082	0.803
VAR00002	0.189	-0.064	0.011	0.681	0.262	0.018	0.038	0.072	-0.184	0.156
VAR00003	-0.148	0.076	0.015	0.854	-0.125	-0.006	-0.025	-0.05	0.171	-0.012
VAR00004	0.299	0.02	-0.194	0.448	0.296	0.381	0.221	0.11	0.105	-0.235
VAR00005	-0.044	0.174	0.648	0.069	-0.27	-0.311	0.068	0.038	0.137	0.056
VAR00006	-0.004	0.162	0.166	-0.083	-0.088	-0.699	0.237	0.235	0.353	0.038
VAR00007	0.508	-0.161	-0.209	0.018	0.318	0.13	0.361	0.033	-0.101	-0.356
VAR00008	-0.065	0.213	0.092	0.01	-0.153	-0.151	0.803	0.09	-0.016	0.127
VAR00009	-0.153	-0.037	-0.137	-0.041	-0.052	0.033	0.037	0.045	-0.835	-0.093
VAR00010	-0.142	0.166	0.147	0.284	0.053	0.114	-0.109	0.729	-0.123	0.174
VAR00011	-0.059	0.651	0.22	-0.196	-0.132	-0.074	0.177	0.072	-0.014	0.132
VAR00012	0.057	-0.071	-0.132	-0.162	0.038	-0.149	0.148	0.787	0.054	-0.107
VAR00013	-0.152	0.64	0.21	0.01	0.022	-0.078	-0.083	0.071	0.079	0.118
VAR00014	0.351	-0.076	-0.205	-0.012	0.004	0.567	0.045	0.099	0.278	0.163
VAR00015	0.642	-0.239	-0.227	0.099	0.195	0.177	-0.149	0.004	0.194	0.043
VAR00016	0.681	-0.254	-0.058	-0.009	0.106	0.21	0.073	0.262	0.084	-0.074
VAR00017	0.206	-0.098	-0.233	0.018	0.793	0.079	-0.126	0.128	0.11	0.155
VAR00018	0.199	-0.263	0.308	0.24	0.513	0.217	-0.134	0.049	-0.176	-0.189
VAR00019	0.022	0.704	0.064	0.284	0.005	-0.145	0.024	-0.059	-0.111	0.124
VAR00020	0.494	-0.14	-0.343	0.275	0	0.093	0.398	-0.054	-0.093	0.036
VAR00021	0.144	0.673	0.02	-0.035	-0.406	0.162	0.112	0.054	0.084	-0.104
VAR00022	0.513	-0.529	0.116	0.073	-0.01	-0.032	0.115	0.065	-0.001	-0.268
VAR00023	-0.296	0.546	0.243	-0.029	-0.178	0.052	0.1	0.035	0.39	-0.286
VAR00024	0.337	-0.352	0.281	0.07	0.069	0.188	0.355	-0.12	0.14	-0.183
VAR00025	0.014	0.17	0.844	0.004	-0.019	-0.031	0.031	-0.054	0.023	0.101
VAR00026	-0.185	0.4	0.521	-0.099	0.166	-0.145	0.037	-0.006	0.204	-0.204
VAR00027	-0.151	0.542	0.161	0.053	0.467	-0.095	0.233	-0.18	0.074	0.057
VAR00028	0.739	-0.069	0.245	0.043	0	-0.262	-0.059	-0.226	-0.183	-0.013
VAR00029	-0.241	0.292	0.328	-0.192	0.133	0.283	0.324	0.06	0.017	0.307
VAR00030	0.76	0.204	-0.053	-0.09	0.009	0.091	-0.074	-0.077	0.14	-0.059
Extraction Method: Principal Component Analysis.										
Rotation Method: Varimax with Kaiser Normalization.										
a. Rotation converged in 12 iterations.										

Factor 1 is associated with Item 7 (Staff aim to satisfy), Item 15 (Display of prices), Item 16 (Fair labeling and billing), Item 20 (Short billing time), Item 22 (Quick solving of problems), Item 24 (After sales service), Item 28 (Discounts) and Item 30 (Low prices). Factor 2 is associated with Item 11 (location), Item 13 (Pleasant atmosphere), Item 19 (Shopping carts), Item 21 (Employee cooperation) and Item 23 (Returns and money back). Factor 3 is associated with Item 5 (Adequate parking), Item 25 (Home delivery and Item 26 (Safety and security). Factor 4 is associated with Item 2 (All products at one step), Item 3 (Wide selection of products and Item 4 (Quality of products). Factor 5 is associated with Item 17 (General ambience), Item 18 (Special request) and item 27 (Card payment). Factor 6 is associated with Item 14 (Convenient store hours). Factor 7 is associated with Item 8 (Brand image). Factor 8 is associated with Item 10 (Alluring advertisements) and Item 12 (No. of billing counters. Factor 9 is associated with Item 6 (Facility of exchange). Factor 10 is associated with item 1(Value for money) and Item 29 (Free gifts).

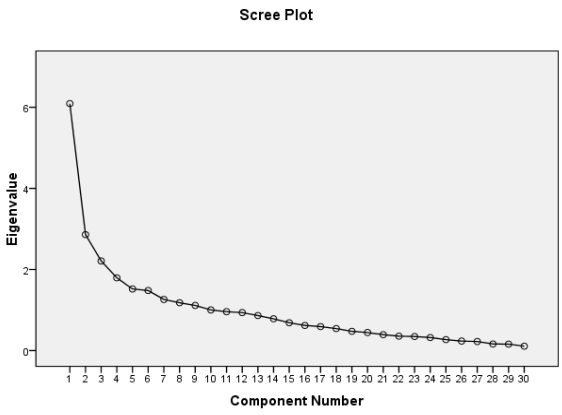

Figure (1): Scree Plot

The above structure has been based on general rules of taking a factor which has a loading of more than 0.3 and has the least correlation with other factors. And the numbers of factors has been based on the criteria of eigen value more than 1. But the scree plot doesn't fully approve the extraction of 10 factors as the distinct break after the 10th item is missing. We also notice there are certain factors which have only one or two significant loadings. In this respect, Hair (et al. 1998) had proposed to take factor a minimal factor loading of 0.3 or more importantly a loading of 0.4 and a loading of 0.5 as practically significant. According to Stevens (2003) for a sample size of 100 the factor loading should be 0.512. Also, Johnson (1996) advised not to include a factor which has only one loading which is significant and Hatcher (1994) advocates to choose a factor with a minimum of three variables.

Hence only four factors are considered. Factor 1 = 0.64 (Staff aim to satisfy) + 0.68 (Display of prices) + 0.49 (Fair labeling and billing) + 0.51 (Short billing time) + 0.34 (Quick solving of problems) + 0.74 (After sales service) + 0.76 (Discounts). Factor 2 = 0.65 (Location) + 0.64 (Pleasant atmosphere) +0.70 (Shopping carts) + 0.67 (Employee cooperation) + 0.55 (Returns and money back). Factor 3 = 0.65 (Adequate parking) + 0.84 (Home delivery) + 0.52 (Safety and security). Factor 4 = 0.68 (All products at one step) + 0.85 (Wide selection of products) + 0.45 (Quality of products). Factor 1 can be dubbed as service quality; Factor 2 as ease of shopping; Factor 3 as convenience factor; and Factor 4 as product variety and quality.

6. Conclusion

The above results points out important managerial implications towards management of retail stores. First, is the emphasis on should be on service factors like staff behavior, proper price display, quick billing and problem solving, discounts and after sales service. Second, the emphasis should be on ease of shopping attributes like good location of the store, pleasant environment within the store, availability of shopping carts, employee cooperation, returns and money back policies. Third, the emphasis should be on convenience factors like adequate parking, home delivery, safety and security. And fourth, the emphasis should be on availability, variety and quality of products.

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Appendix: Communalities

	Initial	Extraction
Value for money is not important	1	0.721
All products at one stop is desired	1	0.638
Wide selection of products is not needed	1	0.805
Quality of products should be good	1	0.687
Adequate parking is not that necessary	1	0.654
Facility of exchange is not important	1	0.794
Staff should aim to satisfy customers	1	0.714
Brand image does not attract me to shop	1	0.774
Friendly service is good	1	0.758
Alluring advertisements do not attract me	1	0.754
Location of stores does not matter	1	0.591
There should be adequate no of billing counters	1	0.731
Pleasant atmosphere is not very important	1	0.515
Store hours should be convenient	1	0.609
Display of prices is important	1	0.66
Labeling and billing should be fair	1	0.674
General ambience is comforting	1	0.81
Special requests should be listened to	1	0.659
Shopping carts & baskets are not always needed	1	0.634
Billing time should be short	1	0.637
Cooperative employees do not help much	1	0.701
Problems should be quickly resolved	1	0.652
Returns and money back facilities is not important	1	0.726
After sales service is needed	1	0.555
Home delivery service is not important	1	0.757
Safety and security is not a serious factor	1	0.608
Card payment is not necessary	1	0.667
Discounts motivates purchasing	1	0.77
Free gifts does not induce purchasing	1	0.588
Low prices stimulates purchasing	1	0.673
Extraction Method: Principal Component Analysis.		