

Managing Customer Heterogeneity II

Factor Analysis for Perceptual Maps

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Agenda



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- **Discuss perceptual mapping methods for measuring and portraying how consumers perceive brands**
- **We will discuss:**
 - Positioning
 - Perceptual mapping
 - Factor analysis

Positioning



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Consumer perceptions



Safety

Performance

Luxury

Fuel efficient



Positioning

- **Positioning vs. differentiation**
 - **Differentiation** = What you do to an **offering**
 - **Positioning** = What you do to the **minds** of consumers
- **Perception is reality**
 - Know your customer
 - Know your brand's perception
 - Find touchpoints that connect
 - Manage your perceptions

Positioning

Positioning statements

- For [target segment], the [product/service] is [most important claim] because [single most important support]
- For [females of age-group 18-49 yrs who possess dry damaged hair and believe they cannot achieve truly healthy/shiny hair], Pantene is a [hair care system (shampoo/conditioner/styling aids)] that offers [“hair so healthy it shines”] because it [“penetrates from root to tip” through its patented Pro-Vitamin B5 formula].





Positioning

Positioning base





Perceptual mapping

- **Positioning can be influenced by consumers perceptions**
- **Perceptual mapping is a technique used to visually display consumer's views**
- **Consumers are asked questions about their perceptions of the product**
 - Select a set of brands of interest to the target group of customers
 - Identify a set of key attributes on which these brands need to be evaluated by the target group
 - Have customers evaluate the products on the chosen set of attributes
- **Results are employed either improving existing product or developing a new one**

Perceptual mapping

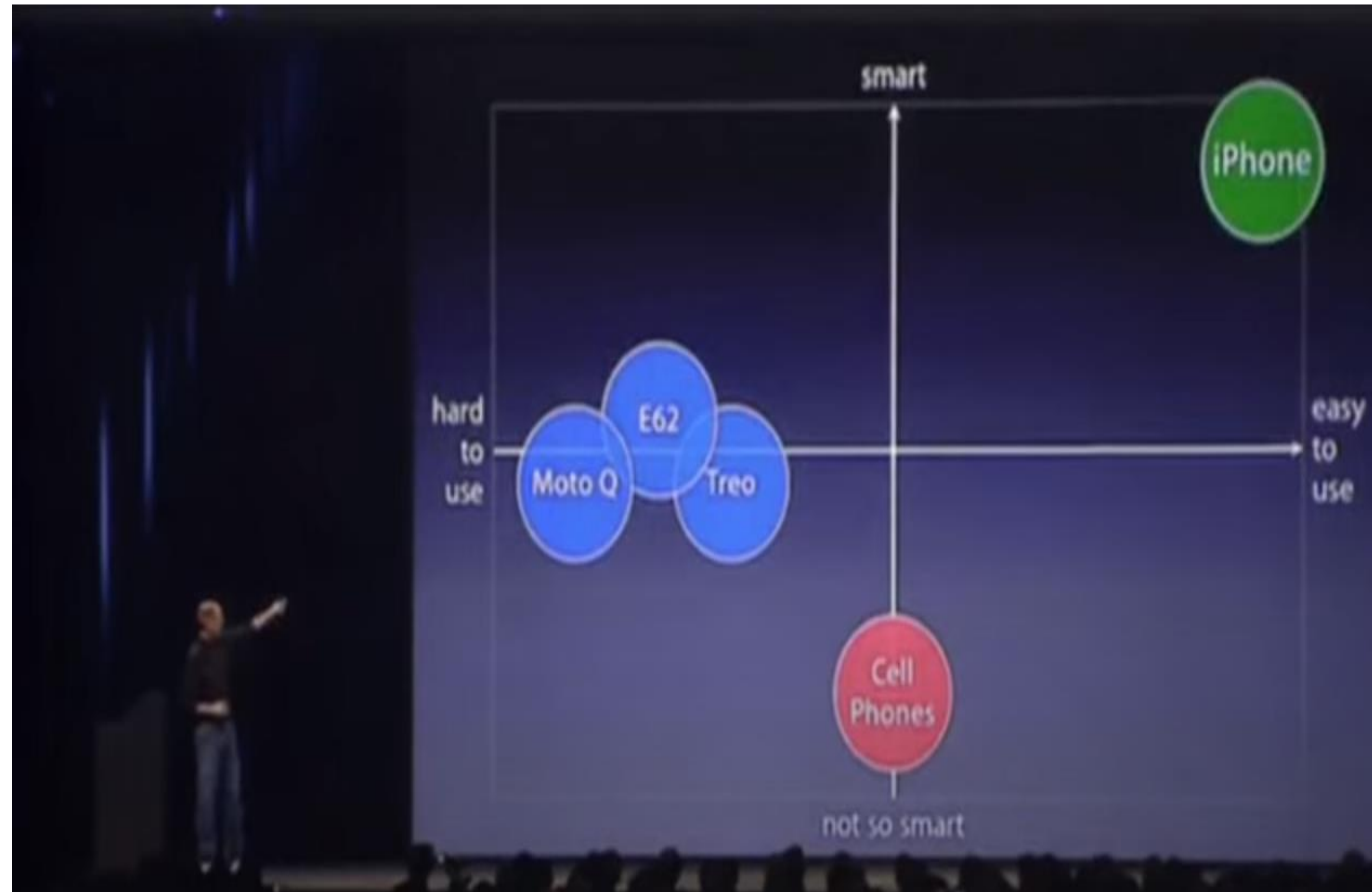
A perceptual map provides a picture of how consumers perceive different competitors



Perceptual mapping



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Perceptual mapping

- **Procedure:**

- Generate a matrix of rating data consisting of each customer's (C1, C2,...) ratings of each brand (B1, B2, ...) on each of the attributes (A1, A2, A3,...)
- Compute average ratings of each brand on each attribute
- Use factor analysis for dimension reduction
- Interpret the underlying key dimensions of the map using the directions of the individual attributes
- Articulate the implications of how customers' view the competing products and concepts



Factor Analysis

- **Factor analysis is a data reduction technique that can be used to identify a small number of latent “factors” that explain the variation in a large number of observed variables.**
- **It is employed to construct perceptual maps for product positioning, by condensing a large pool of potential customer needs, wants, and preferences into a short set of similar characteristics.**

Factor Analysis : Intuition

- **Example**
 - The manager of an online retailer collected customer rating data (on a 100 scale) from a survey of **1,000** customers on **6 aspects** of the company’s focal product and other competitors’ products (**10 brands** in total)

Customer	Brand	Diversity	Speciality	Price	Delivery	Customer Care	Communication
1	1	x	x	x	x	x	x
1	2	x	x	x	x	x	x
1	3	x	x	x	x	x	x
1	4	x	x	x	x	x	x
1	5	x	x	x	x	x	x
1	6	x	x	x	x	x	x
1	7	x	x	x	x	x	x
1	8	x	x	x	x	x	x
1	9	x	x	x	x	x	x
1	10	x	x	x	x	x	x
2	1	x	x	x	x	x	x
2	2	x	x	x	x	x	x
2	3	x	x	x	x	x	x
2	4	x	x	x	x	x	x
2	5	x	x	x	x	x	x
2	6	x	x	x	x	x	x
2	7	x	x	x	x	x	x
2	8	x	x	x	x	x	x
2	9	x	x	x	x	x	x
2	10	x	x	x	x	x	x
3	1	x	x	x	x	x	x
3	2	x	x	x	x	x	x
...



Factor Analysis: Intuition

How would you summarize such rating data and draw a perceptual map?

The average of all the customers' ratings on the 6 aspects of the 10 brands are calculated.

Brand	Diversity	Speciality	Price	Delivery	Customer Care	Communication
1	90	85	88	56	60	49
2	23	33	31	90	78	79
3	65	59	49	60	58	55
4	88	92	94	90	93	98
5	22	19	33	45	34	12
6	82	78	79	85	79	90
7	96	95	94	45	67	53
8	43	36	45	89	93	87
9	66	76	45	34	44	40
10	70	80	75	60	65	70

Variance Calculation



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$$\sigma^2 = \frac{\sum_{i=1}^n (xi - \mu)^2}{N}$$

fx =(E2+E3+E4+E5+E6)/COUNT(A2:A6)						
	A	B	C	D	E	
1	No. of Items (N)	Observations(x)	μ	$x - \mu$	$(x - \mu)^2$	
2	1	50	50	0	0	
3	2	55		5	25	
4	3	45		-5	25	
5	4	60		10	100	
6	5	40		-10	100	
7						
8	σ^2	=(E2+E3+E4+E5+E6)/COUNT(A2:A6)				
9						
10						

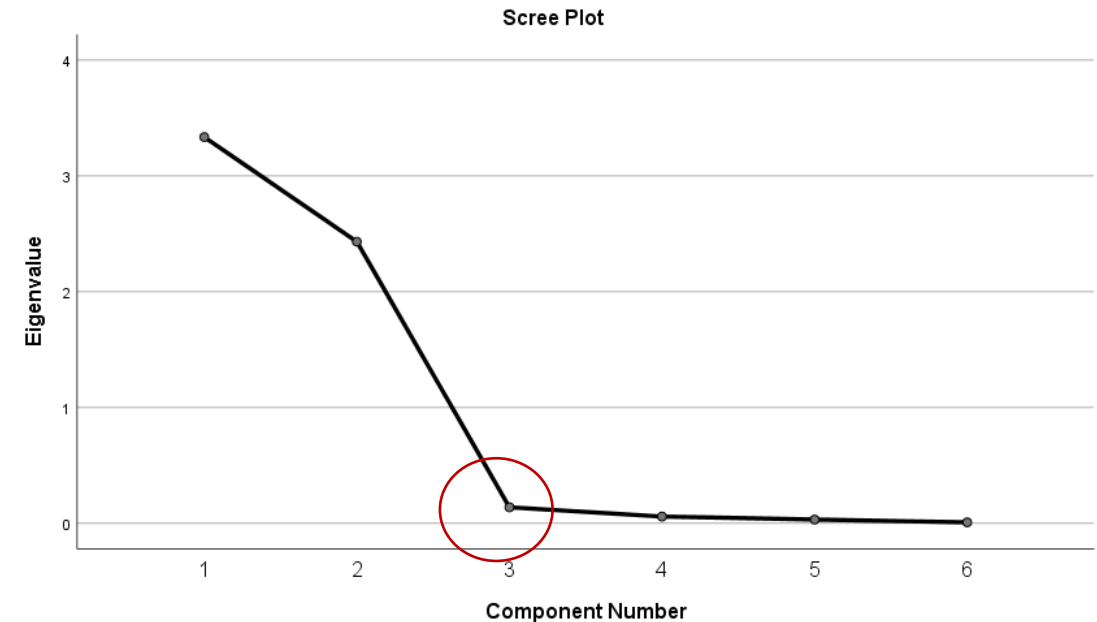
Using Population
Variance Formula

$$\sigma^2 = 250/5$$

Factor Analysis

How many factors/components?

Total Variance Explained			
Component	Eigenvalues	% of Variance	Cumulative %
1	3.335	55.581	55.581
2	2.431	40.521	96.102
3	0.137	2.288	98.390
4	0.057	0.956	99.346
5	0.032	0.531	99.877
6	0.007	0.123	100.000



Criteria:

- Eigenvalue > 1
- Elbow from the scree plot
- Evaluate the percent of variance explained

Factor Analysis: Intuition

- **A factor is a group of variables ...**
 - measuring something in common
 - highly correlated
- **Two “latent” factors seems to be able to capture majority of the variance of the six attributes:**
 - Factor 1 is highly associated with product diversity, specialty, and price; it can be interpreted as the “product” factor.
 - Factor 2 is highly associated with delivery service and customer service; and is labeled the “service” factor.

		Factor 1			Factor 2		
		Diversity	Speciality	Price	Delivery	Customer Care	Communication
Correlations	Diversity	1.00					
	Speciality	0.97	1.00				
	Price	0.92	0.89	1.00			
	Delivery	-0.14	-0.16	0.04	1.00		
	Customer care	0.21	0.19	0.34	0.88	1.00	
	Communication	0.25	0.27	0.34	0.87	0.95	1.00



Pearson Correlation Coefficient

Formula

$$r = \frac{\sum (x_i - \bar{x}) (y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}}$$

r = correlation coefficient

x_i = values of the x-variable in a sample

\bar{x} = mean of the values of the x-variable

y_i = values of the y-variable in a sample

\bar{y} = mean of the values of the y-variable

Factor analysis



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- Factor loading is the correlation between a variable (an attribute) and a factor.

Factor Loading Matrix

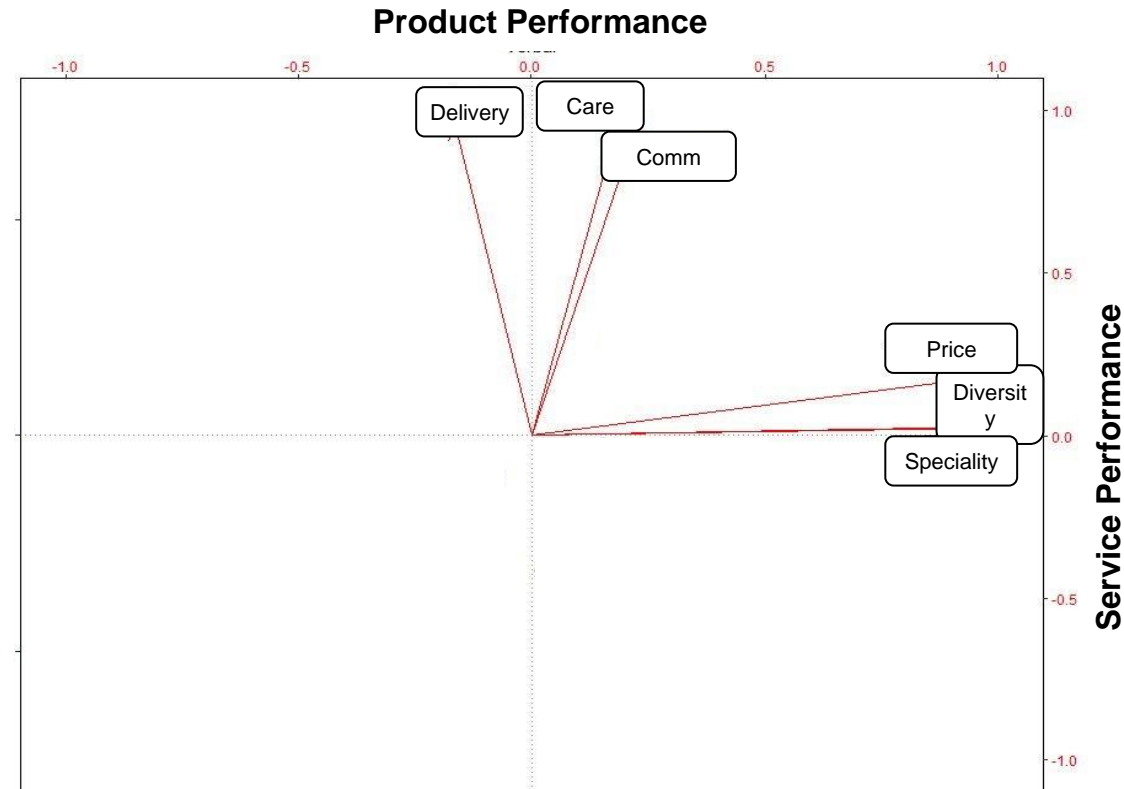
	Product performance	Service performance
Variable	Factor 1	Factor 2
Diversity	0.99	0.03
Speciality	0.98	0.02
Price	0.95	0.18
Delivery	-0.17	0.97
Customer care	0.18	0.97
Communication	0.22	0.96

High factor loading
Low cross-factor loading

Note: this is the matrix after rotation

Factor analysis: Intuition

- A summary map of the variables on the two factors (using factor loading)



Factor analysis



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- Factor score is a weighted sum of the variables. The weights are regression-like coefficients which are output by the computer program.

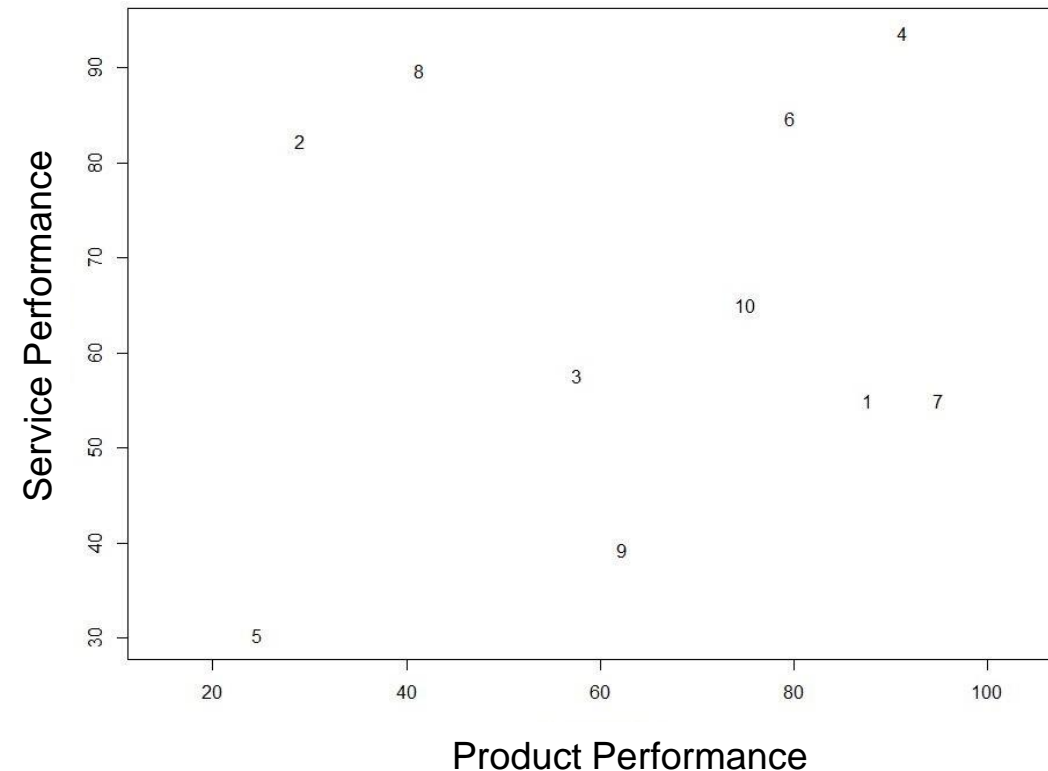
Brand	Diversity	Speciality	Price	Delivery	Care	Comm.	Product Score	Service Score
							Factor 1	Factor 2
1	90	85	88	56	60	49	87.67	55.00
2	23	33	31	90	78	79	29.00	82.33
3	65	59	49	60	58	55	57.67	57.67
4	88	92	94	90	93	98	91.33	93.67
5	22	19	33	45	34	12	24.67	30.33
6	82	78	79	85	79	90	79.67	84.67
7	96	95	94	45	67	53	95.00	55.00
8	43	36	45	89	93	87	41.33	89.67
9	66	76	45	34	44	40	62.33	39.33
10	70	80	75	60	65	70	75.00	65.00

Factor1 = $\frac{1}{3}$ Div + $\frac{1}{3}$ Spec + $\frac{1}{3}$ Price
+ 0 Deli + 0 Care + 0 Comm

Factor2 = 0 Div + 0 Spec + 0 Price +
 $\frac{1}{3}$ Deli + $\frac{1}{3}$ Care + $\frac{1}{3}$ Comm

Factor analysis: Intuition

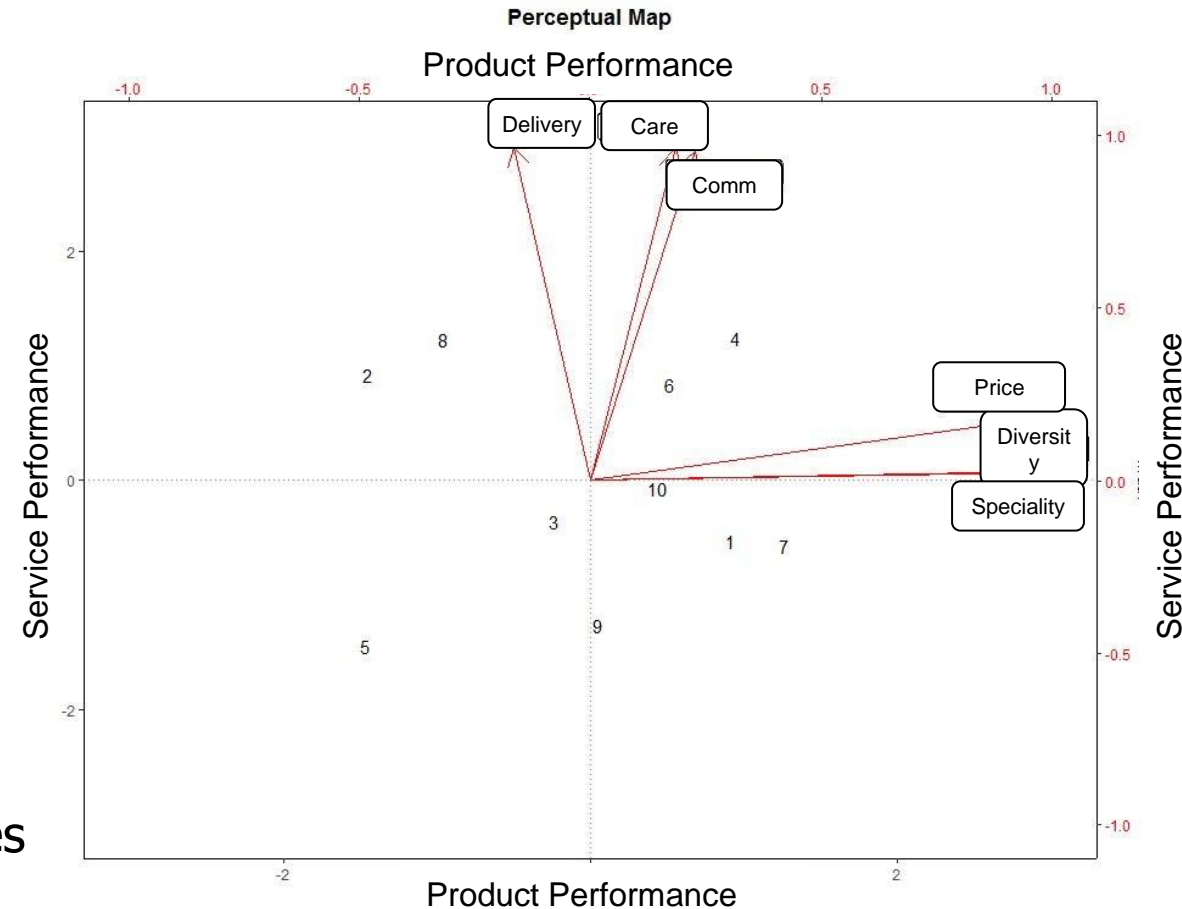
- A summary map of the ratings on the two factors (using factor score)



Factor analysis



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Factor analysis

- **Summary of the steps**

- We begin with a large number of measured variables of customer survey measures.
- Factor analysis synthesizes a large number of measured variables into smaller sets (e.g., 3–4) of latent “factors” that capture the essence of the meaning in the larger number of variables.
- To choose the total number of factors to retain, we observe how many factors have an Eigenvalue greater than 1.
- The strength of the association between a measured variable and its factor is called “factor loading.” We categorize the measured variable with a factor with the highest loading (e.g., if a measured variable has factor loadings of 0.01 and 0.8 with Factors 1 and 2, we would associate the measured variable with Factor 2).
- Finally, we interpret each latent factor by surmising the conceptual commonality underlying the measured variables’ loading on the factor.



Other issues: standardisation

- Standardized data

Brand	Diversity	Speciality	Price	Delivery	Care	Comm.	Factor 1	Factor 2
1	0.95	0.73	0.98	-0.44	-0.37	-0.54	0.89	-0.45
2	-1.54	-1.20	-1.28	1.15	0.56	0.59	-1.34	0.77
3	0.02	-0.23	-0.57	-0.25	-0.47	-0.31	-0.26	-0.35
4	0.87	0.99	1.22	1.15	1.34	1.31	1.03	1.27
5	-1.58	-1.71	-1.20	-0.95	-1.71	-1.194	-1.50	-1.53
6	0.65	0.47	0.62	0.92	0.62	1.01	0.58	0.85
7	1.17	1.10	1.22	-0.95	-0.01	-0.39	1.16	-0.45
8	-0.80	-1.09	0.73	1.10	1.34	0.89	-0.87	1.11
9	0.06	0.40	-0.73	-1.47	-1.19	-0.88	-0.09	-1.18
10	0.20	0.54	0.46	-0.25	-0.11	0.25	0.40	-0.04



Takeaway

- **Factor Analysis is useful for data reduction (reducing the number of variables)**
- **Decide on the number of factors to be retained**
 - Use eigenvalue criterion and own judgment
 - Evaluate the percent of variance explained
- **Use the rotated factor loadings to interpret the factor structure**
 - Loadings should be greater than 0.5
- **Save factor scores for subsequent analyses**

You should be able to ...



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-
- **Understand that perception influences positioning and thus perceptual maps are useful for positioning.**
 - **Explain the purpose of Factor Analysis and how it works**
 - **Draw conclusions regarding the positioning of brands based on perceptual mappings**



- **The manager of Intelligentsia Coffee collected consumers' ratings of 10 coffee brands ("a" to "j") on 9 attributes from N= 100 respondents. They are interested in any insights about how consumers see these brands.**

- Data file: Data_Factor_Analysis.csv
- Handout: Workshop3_Factor_Analysis.pdf

Perceptual attributes	Survey question 1 = completely disagree, 10 = completely agree
Perform	<i>Brand</i> has strong performance
Leader	<i>Brand</i> is a leader in the field
Latest	<i>Brand</i> has the latest products
Fun	<i>Brand</i> is fun
Serious	<i>Brand</i> is serious
Bargain	<i>Brand</i> products are a bargain
Value	<i>Brand</i> products are a good value
Trendy	<i>Brand</i> is trendy
Rebuy	I would buy from <i>Brand</i> again