Measurement and Scaling: Fundamentals and Comparative Scaling
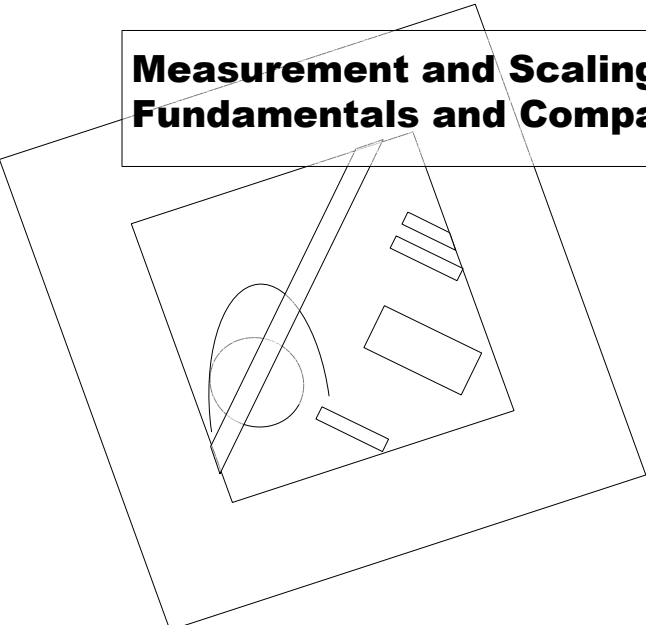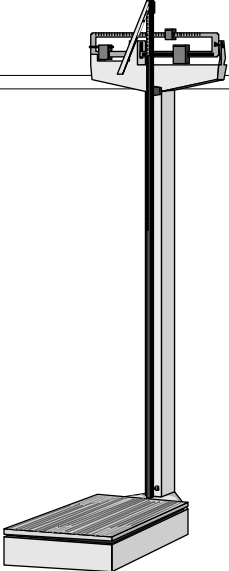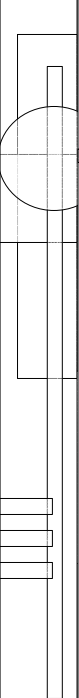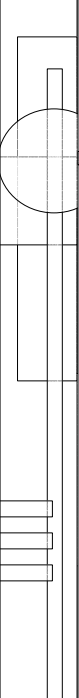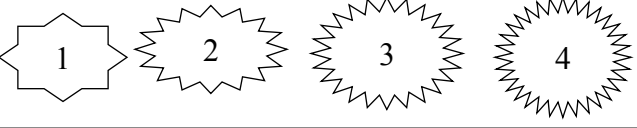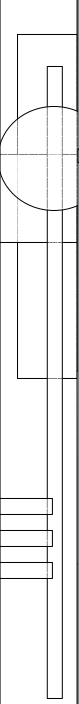
Agenda

1) Overview
2) Measurement and Scaling
3) Primary Scales of Measurement
- i. Nominal Scale
- ii. Ordinal Scale
- iii. Interval Scale
- iv. Ratio Scale
4) A Comparison of Scaling Techniques
Comparative Scaling Techniques
- i. Paired Comparison
- ii. Rank Order Scaling
- iii. Constant Sum Scaling
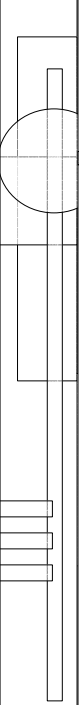- iv. Q-Sort and Other Procedures
6) Verbal Protocols

Measurement and Scaling

Measurement means assigning numbers or other symbols to characteristics of objects according to certain prespecified rules.

- One-to-one correspondence between the numbers and the characteristics being measured.
- The rules for assigning numbers should be standardized and applied uniformly.
- Rules must not change over objects or time.

Measurement and Scaling

Scaling involves creating a continuum upon which measured objects are located.

Consider an attitude scale from 1 to 100. Each respondent is assigned a number from 1 to 100, with 1 = Extremely Unfavorable, and 100 = Extremely Favorable. Measurement is the actual assignment of a number from 1 to 100 to each respondent. Scaling is the process of placing the respondents on a continuum with respect to their attitude toward department stores.
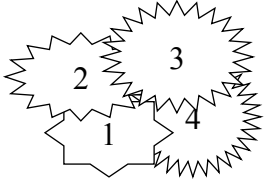
1　　2　　3　　4

- Numbers are usually assigned for two reasons:
  - First, numbers permit statistical analysis of the resulting data
  - Second, numbers facilitate the communication of measurement rules and results

Scale Characteristics Determine the Level of Measurement

- Description

- Order

- Distance

- Origin

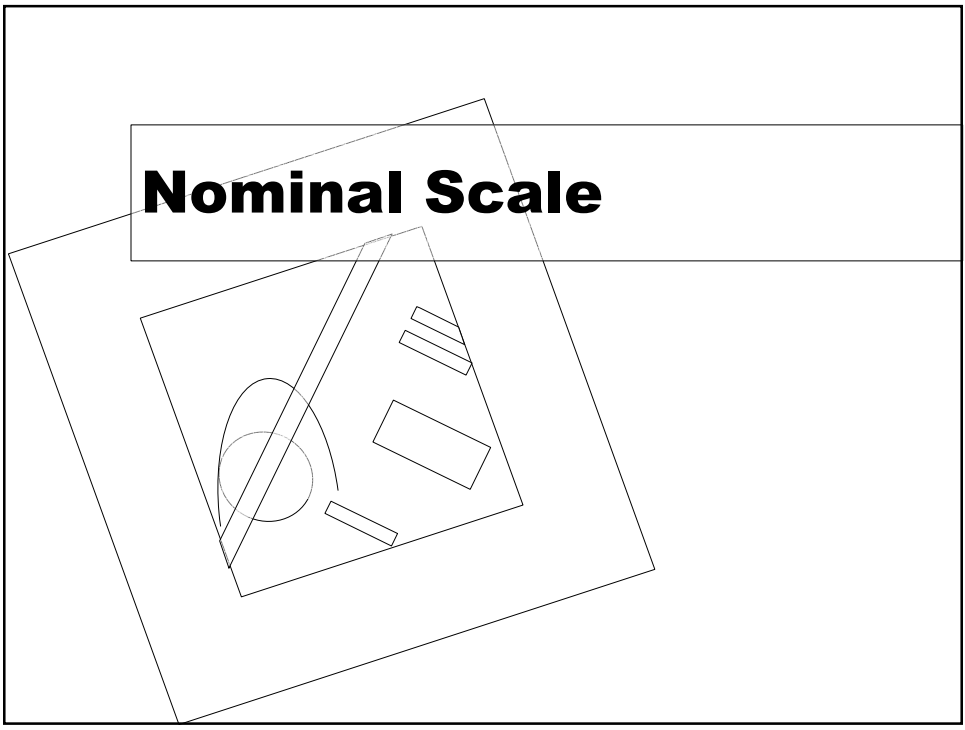2　3　1　4

Primary Scales of Measurement

Scale				
Nominal	Numbers Assigned to Runners	7	8	3	**Finish**
Ordinal	Rank Order of Winners	**Third place**	**Second place**	**First place**	**Finish**
Interval	Performance Rating on a 0 to 10 Scale	8.2	9.1	9.6	
Ratio	Time to Finish, in Seconds	15.2	14.1	13.4	

Table 12.2 Illustration of primary scales of measurement

	Nominal scale	Ordinal scale	Interval scale		Ratio scale
No.	Bank	Preference rankings	Preference ratings		
			1–7	11–17	
1	ABN AMRO	1	10	7	17	60%
11	Banco Bilbao Vizcaya			4	14	0%
23	Bank Brussels Lambert			5	15	0%
27	Bank of Ireland			7	17	0%
37	Budapest Bank			5	15	0%
44	Citibank	3	50	5	15	30%
48	Credit Lyonnais			6	16	0%
54	Den Danske Bank			6	16	0%
56	Deutsche Bank	2	25	7	17	10%
80	Okobank Finland			2	12	0%

Illustration of Primary Scales of Measurement

No. Snack	**Ordinal Scale** Preference Rankings	**Interval Scale** Preference Ratings 1-7 11-17		**Ratio Scale** € spent last 3 months
1. KitKat	7	79	5	15	0
2. Crunch	2	25	7	17	200
3. Lion	8	82	4	14	0
4. Bounty	3	30	6	16	100
5. Nesquik	1	10	7	17	250
6. Galak	5	53	5	15	35
7. Snikers	9	95	4	14	0
8. Nuts	6	61	5	15	100
9. Toffee Crisp	4	45	6	16	0
10. Smarties	10	115	2	12	10

(**Nominal Scale** applies to the No. Snack column)

Nominal Scale

Examples

- Gender
  - Male ☐
  - Female ☐

- Marital Status
  - Married ☐
  - Single ☐
  - Divorced ☐

- With whom are you traveling on this flight?
  - No one ☐
  - Spouse ☐
  - Spouse and children ☐
  - Children only ☐
  - Business associates/ friends ☐
  - An organized tour group ☐
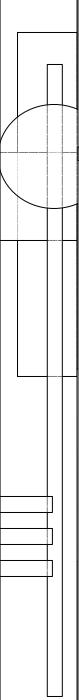
Nominal Scale

- The numbers serve only as labels or tags for identifying and classifying objects.
- When used for identification, there is a strict one-to-one correspondence between the numbers and the objects.
- The numbers do not reflect the amount of the characteristic possessed by the objects.
- The only permissible operation on the numbers in a nominal scale is counting.
- Only a limited number of statistics, all of which are based on frequency counts, are permissible, e.g., percentages, and mode.

Ordinal Scale
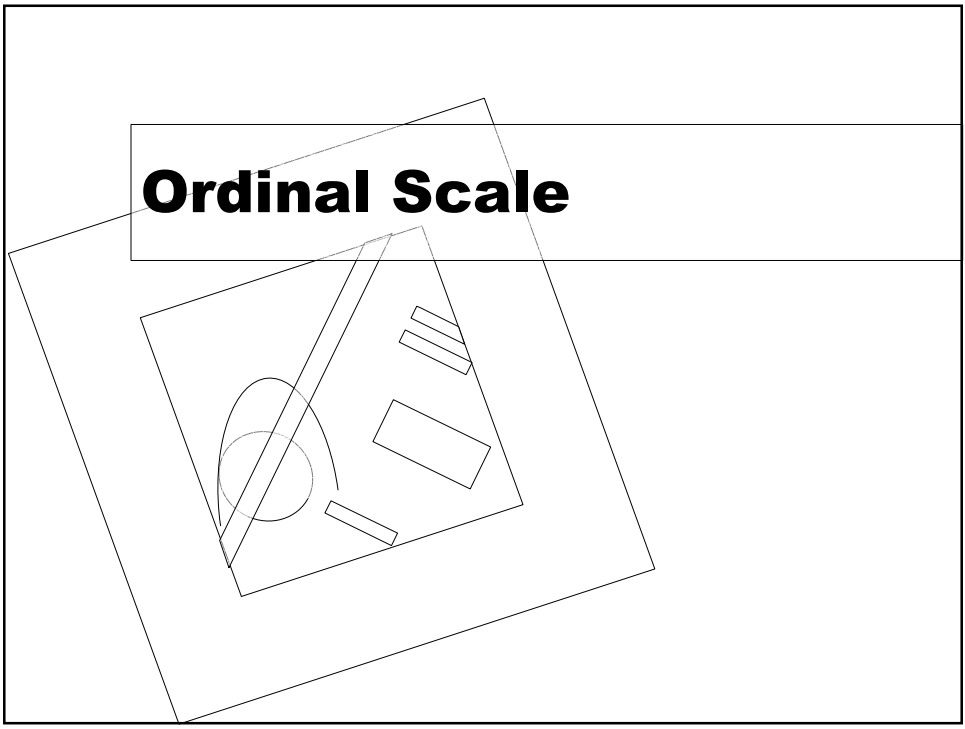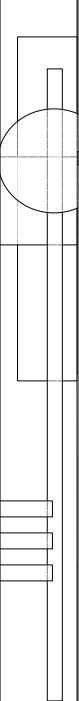
Examples

- Airline food service to me is
  - Extremely important ☐
  - Very important ☐
  - Somewhat important ☐
  - Not very important ☐
  - Nor all important ☐

- What age group are you in?
  - 18-24 ☐
  - 25-29 ☐
  - 30-34 ☐
  - 35-44 ☐
  - 45 and over ☐

- How often do you consume soft drinks in a typical week?
  - Less than once a week ☐
  - 1 to 3 times per week ☐
  - 4 to 6 times per week ☐
  - 7 or more times per week ☐

Examples

- Please rank the following snacks in terms of your preference
    - Bounty _____
    - Tofee Crisp _____
    - Nuts _____
    - Lion _____
    - Crunch _____

Ordinal Scale

- A ranking scale in which numbers are assigned to objects to indicate the relative extent to which the objects possess some characteristic.
- Can determine whether an object has more or less of a characteristic than some other object, but not how much more or less.
- Any series of numbers can be assigned that preserves the ordered relationships between the objects.
- In addition to the counting operation allowable for nominal scale data, ordinal scales permit the use of statistics based on centiles, e.g., percentile, quartile, median.

Interval Scale
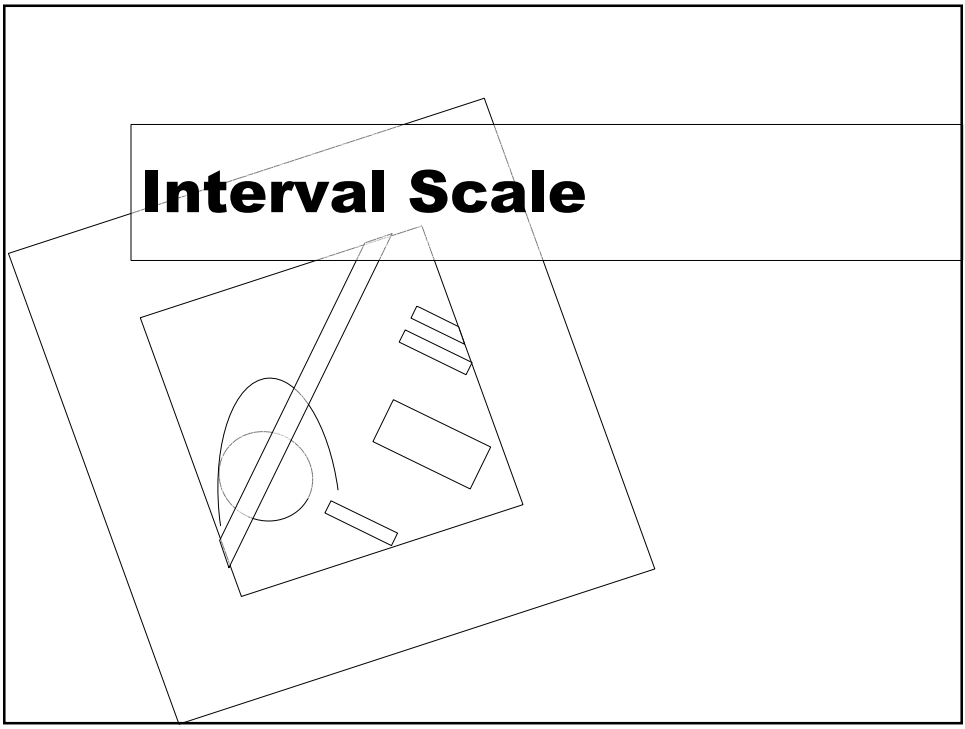
Scales: Fahrenheit & Celsius

$$C = (F - 32) * \frac{5}{9}$$
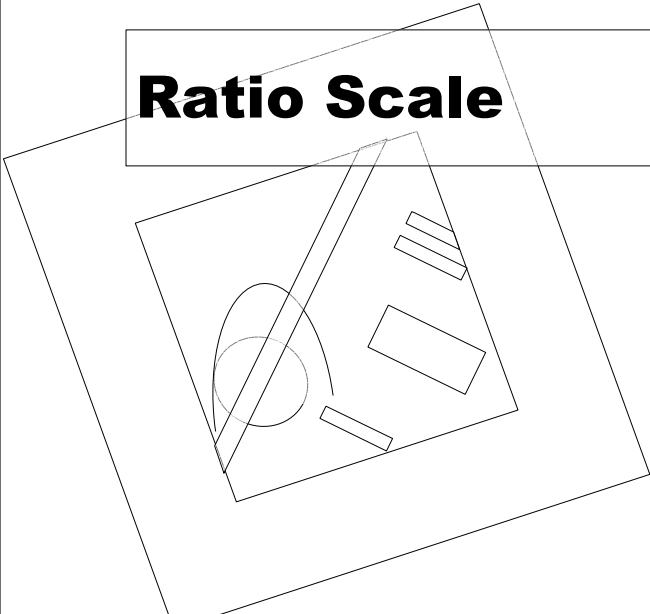
ºC	ºF
0	32
10	50
20	68
30	86
40	104

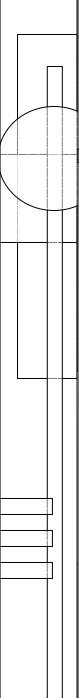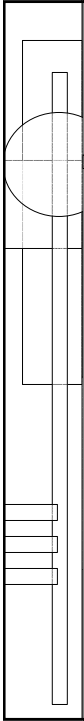Diference between adjacent classes = 10

Diference between adjacent classes = 18

$$\frac{40}{10} = 4 \neq \frac{104}{50} = 2,08$$
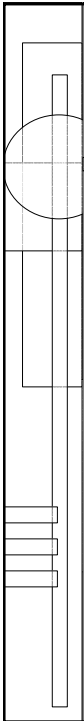
Interval Scale

- Numerically equal distances on the scale represent equal values in the characteristic being measured.
- It permits comparison of the differences between objects.
- The location of the zero point is not fixed. Both the zero point and the units of measurement are arbitrary.
- Any positive linear transformation of the form $y = a + bx$ will preserve the properties of the scale.
- It is meaningful to take ratios of scale values.
- Statistical techniques that may be used include all of those that can be applied to nominal and ordinal data, and in addition the arithmetic mean, standard deviation, and other statistics commonly used in marketing research.

Ratio Scale

Examples

- Education (Nº of schooling years) _____

- Monthly net household income _____

- Age __

- Nº of family members _____

Ratio Scale

- Possesses all the properties of the nominal, ordinal, and interval scales.
- It has an absolute zero point.
- It is meaningful to compute ratios of scale values.
- Only proportionate transformations of the form y = bx, where b is a positive constant, are allowed.
- All statistical techniques can be applied to ratio data.

Primary Scales of Measurement
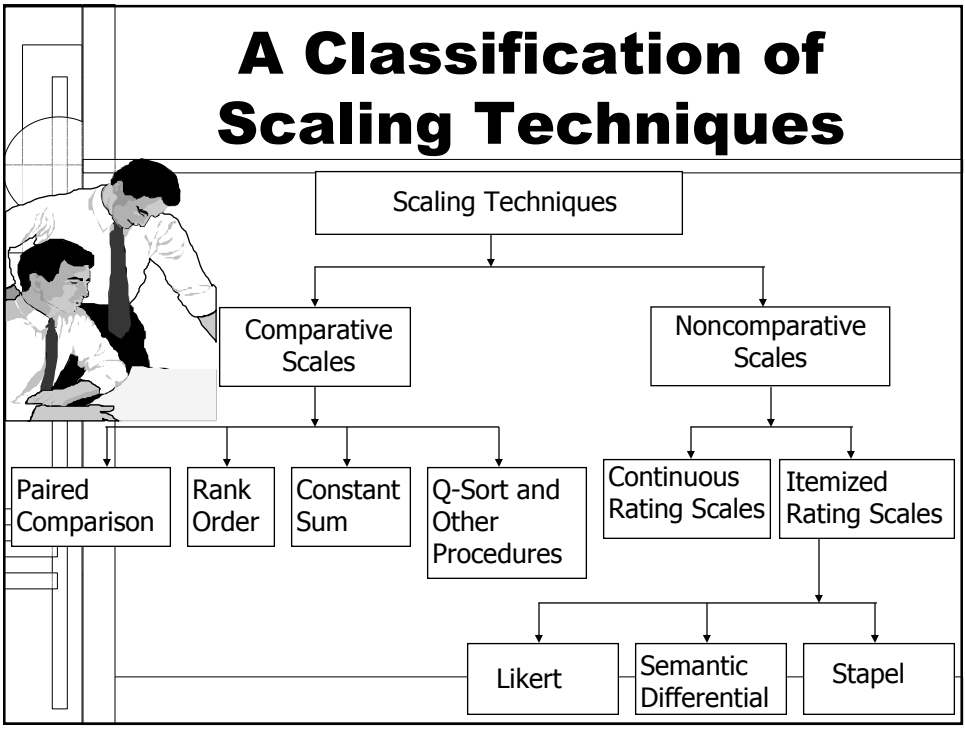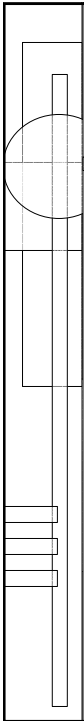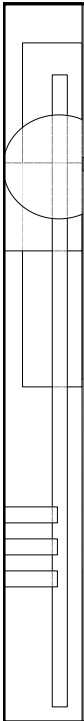
Scale	Basic Characteristics	Common Examples	Marketing Examples	Permissible Statistics	
				Descriptive	Inferential
Nominal	Numbers identify & classify objects	Social Security nos., numbering of football players	Brand nos., store types	Percentages, mode	Chi-square, binomial test
Ordinal	Nos. indicate the relative positions of objects but not the magnitude of differences between them	Quality rankings, rankings of teams in a tournament	Preference rankings, market position, social class	Percentile, median	Rank-order correlation, Friedman ANOVA
Interval	Differences between objects	Temperature (Fahrenheit)	Attitudes, opinions, index	Range, mean, standard	Product-moment
Ratio	Zero point is fixed, ratios of scale values can be compared	Length, weight	Age, sales, income, costs	Geometric mean, harmonic mean	Coefficient of variation

A Classification of Scaling Techniques

Scaling Techniques
- Comparative Scales
  - Paired Comparison
  - Rank Order
  - Constant Sum
  - Q-Sort and Other Procedures
- Noncomparative Scales
  - Continuous Rating Scales
  - Itemized Rating Scales
    - Likert
    - Semantic Differential
    - Stapel
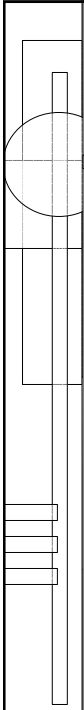
A Comparison of Scaling Techniques

- **Comparative scales** involve the direct comparison of stimulus objects. Comparative scale data must be interpreted in relative terms and have only ordinal or rank order properties.

- In **noncomparative scales**, each object is scaled independently of the others in the stimulus set. The resulting data are generally assumed to be interval or ratio scaled.

Relative Advantages of Comparative Scales
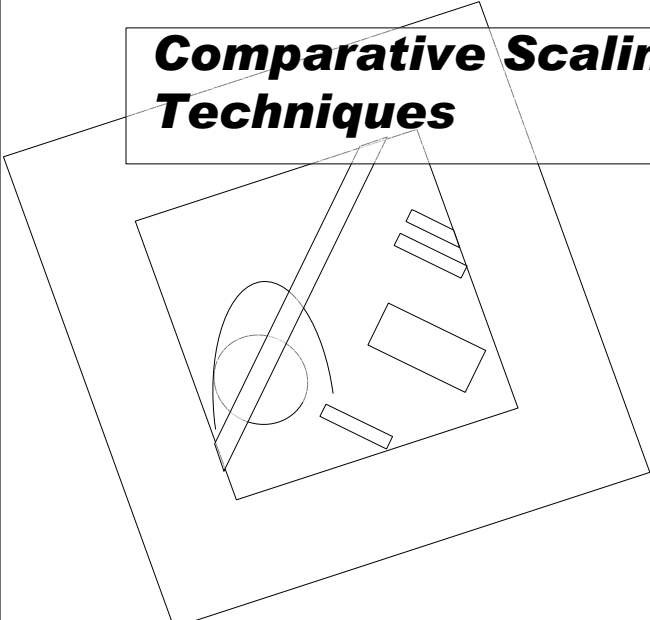
- Small differences between stimulus objects can be detected.
- Same known reference points for all respondents.
- Easily understood and can be applied.
- Involve fewer theoretical assumptions.
- Tend to reduce halo or carryover effects from one judgment to another.
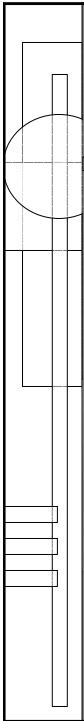
Relative Disadvantages of Comparative Scales

- Ordinal nature of the data
- Inability to generalize beyond the stimulus objects scaled.
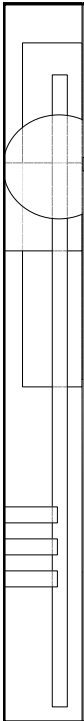
Comparative Scaling Techniques

Paired Comparison Scaling

- A respondent is presented with two objects and asked to select one according to some criterion.
- The data obtained are ordinal in nature.
- Paired comparison scaling is the most widely used comparative scaling technique.
- With n brands, $[n(n - 1) /2]$ paired comparisons are required
- Under the assumption of transitivity, it is possible to convert paired comparison data to a rank order.

Paired Comparison Scaling

- Paired comparison data can be analyzed in several ways
  - The researcher can calculate the percentage of respondents who prefer one stimulus to another
  - Under the assumption of transitivity, it is possible to convert paired comparison data to range order
  - It's also possible to derive an interval scale from paired comparison data using the Thurstone´s procedure

Obtaining Shampoo Preferences Using Paired Comparisons

Instructions: We are going to present you with ten pairs of shampoo brands. For each pair, please indicate which one of the two brands of shampoo you would prefer for personal use.

Recording Form:

	Jhirmack	Finesse	Vidal Sassoon	Head & Shoulders	Pert
Jhirmack		0	0	1	0
Finesse	1[a]		0	1	0
Vidal Sassoon	1	1		1	1
Head & Shoulders	0	0	0		0
Pert	1	1	0	1	
Number of Times Preferred[b]	3	2	0	4	1

[a]A 1 in a particular box means that the brand in that column was preferred over the brand in the corresponding row. A 0 means that the row brand was preferred over the column brand. [b]The number of times a brand was preferred is obtained by summing the 1s in each column.

Paired Comparison Selling

The most common method of taste testing is paired comparison. The consumer is asked to sample two different products and select the one with the most appealing taste. The test is done in private and a minimum of 1,000 responses is considered an adequate sample. A blind taste test for a soft drink, where imagery, self-perception and brand reputation are very important factors in the consumer's purchasing decision, may not be a good indicator of performance in the marketplace. The introduction of New Coke illustrates this point. New Coke was heavily favored in blind paired comparison taste tests, but its introduction was less than successful, because image plays a major role in the purchase of Coke.

A paired comparison taste test

Paired Comparison Scaling

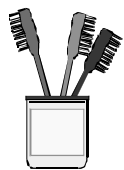|	A	B	C	D	E
A	-	0.9	0.64	0.14	0.27
B	0.1	-	0.32	0.02	0.21
C	0.36	0.68	-	0.15	0.36
D	0.86	0.98	0.85	-	0.52
E	0.73	0.79	0.64	0.48	-

Rank Order Scaling

- Respondents are presented with several objects simultaneously and asked to order or rank them according to some criterion.
- It is possible that the respondent may dislike the brand ranked 1 in an absolute sense.
- Furthermore, rank order scaling also results in ordinal data.
- Only (n - 1) scaling decisions need be made in rank order scaling.

Preference for Toothpaste Brands Using Rank Order Scaling

Instructions: Rank the various brands of toothpaste in order of preference. Begin by picking out the one brand that you like most and assign it a number 1. Then find the second most preferred brand and assign it a number 2. Continue this procedure until you have ranked all the brands of toothpaste in order of preference. The least preferred brand should be assigned a rank of 10.

No two brands should receive the same rank number.

The criterion of preference is entirely up to you. There is no right or wrong answer. Just try to be consistent.

Figure 12.4 Preference for car brands using rank order scaling

Instructions
Rank the various brands of car in order of preference. Begin by picking out the one brand that you like most and assign it a number 1. Then find the second most preferred brand and assign it a number 2. Continue this procedure until you have ranked all the brands of car in order of preference. The least preferred brand should be assigned a rank of 10.

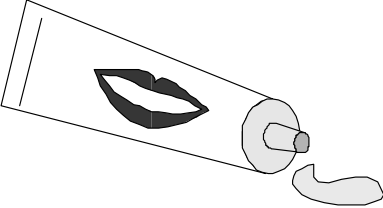*No two brands should receive the same rank number*

The criterion of preference is entirely up to you. There is no right or wrong answer. Just try to be consistent.

	Brand	*Rank order*
1	Porsche	
2	Jaguar	
3	BMW	
4	Bristol	
5	Aston Martin	
6	Mercedes	
7	McLaren	
8	Ferrari	
9	Lamborghini	
10	Bentley	

Preference for Toothpaste Brands
Using Rank Order Scaling

Form

| Brand	Rank Order
1. Crest	_____
2. Colgate	_____
3. Aim	_____
4. Gleem	_____
5. Macleans	_____
6. Ultra Brite	_____
7. Close Up	_____
8. Pepsodent	_____
9. Plus White	_____
10. Stripe	_____

Constant Sum Scaling

- Respondents allocate a constant sum of units, such as 100 points to attributes of a product to reflect their importance.
- If an attribute is unimportant, the respondent assigns it zero points.
- If an attribute is twice as important as some other attribute, it receives twice as many points.
- The sum of all the points is 100. Hence, the name of the scale.

Importance of Bathing Soap Attributes Using a Constant Sum Scale

Instructions

On the next slide, there are eight attributes of bathing soaps. Please allocate 100 points among the attributes so that your allocation reflects the relative importance you attach to each attribute. The more points an attribute receives, the more important the attribute is. If an attribute is not at all important, assign it zero points. If an attribute is twice as important as some other attribute, it should receive twice as many points.
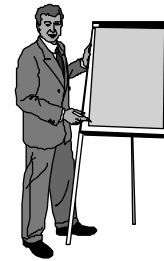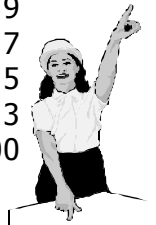
Importance of Bathing Soap Attributes Using a Constant Sum Scale

Form

Average Responses of Three Segments

Attribute	Segment I	Segment II	Segment III
1. Mildness	8	2	4
2. Lather	2	4	17
3. Shrinkage	3	9	7
4. Price	53	17	9
5. Fragrance	9	0	19
6. Packaging	7	5	9
7. Moisturizing	5	3	20
8. Cleaning Power	13	60	15
Sum	100	100	100

Market Research
LCE 508

Q-sort and other Procedures

- Q-sort scaling was developed to discriminate a relatively large number of objects quickly

- A comparative scaling technique that uses rank order procedure to sort objects based on similarity with respect to some criterion

- For example, respondents are given 100 attitude statements on individual cards and asked to place the, into 11 piles, ranging from ´most highly agreed with' to 'least highly agreed with'