How to measure? Which scales exist?

\[ S_x^c \quad \text{Scale name:} \quad \text{mathematical operations} \]

\[ N_x^c \quad \text{Nominal scale:} \quad =, \neq \]

\[ O_x \quad \text{Ordinal scale:} \quad =, \neq, >, < \]

\[ I_x \quad \text{Interval scale:} \quad =, \neq, >, <, -, + \]

\[ R_x \quad \text{Rational scale:} \quad =, \neq, >, <, -, +, \times, \div \]

\[ S_x^c \quad S = \text{scale name [N, O, I, R]; x = number of this scale >1; c = number of categories for N-scale} \]

See further at

http://en.wikipedia.org/wiki/Scale_(measurement)
An easy example: measure of central tendency

- A way of summarising the data using a single value that is in some way representative of the entire data set
  - It is not always possible to follow the same procedure in producing a central representative value: this changes with the shape of the distribution

- **Mode** [recommended for N-scale]
  - Most frequent value
  - Does not take into account exact scores
  - Unaffected by extreme scores
  - Not useful when there are several values that occur equally often in a set
Measures of central tendency (cont’d)

– **Median** [recommended for O-scale]
  - The values that falls exactly in the midpoint of a ranked distribution
  - Does not take into account exact scores
  - Unaffected by extreme scores
  - In a small set it can be unrepresentative

– **Mean** (Arithmetic average) [recommended for I-scale]
  - Sample mean: \( M = \frac{\Sigma X}{n} \)  
    Population mean: \( \mu = \frac{\Sigma X}{N} \)
  - Takes into account all values
  - Easily distorted by extreme values
Differences in means for $N_1^2$-scale and $I_1$-scale

- In order to know whether a difference between two means is important, we need to know how much the scores vary around the means.
Differences in means for $N_1^2$-scale and $I_1$-scale (cont’d)

- Holding the difference between the means constant
- With high variability the two groups nearly overlap
- With low variability the two groups show very little overlap
Scale combinations leads to inference methods

<table>
<thead>
<tr>
<th>Scales</th>
<th>Appropriate Inference Method</th>
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<tbody>
<tr>
<td>$N^2 \times N^2$</td>
<td>Fisher’s exact test; Odds Ratio</td>
</tr>
<tr>
<td>$N^c \times N^d$</td>
<td>$\text{CHI}^2$ (with $c&gt;2$ and/or $d&gt;2$)</td>
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<tr>
<td>$N^2 \times O$</td>
<td>Mann-Whitney-U-test</td>
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<td>$N^2 \times I$</td>
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<td>$N_x^c \times I$</td>
<td>[$M$]Anova (with $x&gt;1$ and/or $c&gt;2$)</td>
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<td>$O \times O$</td>
<td>Spearman’s rank correlation</td>
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<tr>
<td>$I \times I$</td>
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<td>$N_x$</td>
<td>Cluster analysis (with $x&gt;2$)</td>
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<td>$O_x$</td>
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<tr>
<td>$I_x$</td>
<td>Factor analysis (with $x&gt;2$)</td>
</tr>
</tbody>
</table>
Choosing a significance level

• In general
  – Pilot program and intervention evaluations use liberal significance levels (.2 - .1) to avoid discarding effective interventions.
  – Generally accepted is a significance level of .05
  – Pure research uses conservative significance levels (.01-.001) to avoid wide dissemination of erroneous results.
References

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