Merely asking respondents how much importance they attach to an individual indicator is unlikely to yield effective “willingness to pay” valuations.

These can be inferred by using conjoint analysis from respondents’ rankings of alternative scenarios (Hair et al., 1995).

Frequently applied in marketing research, consumer research and environmental economics.

Conjoint analysis

- Source → the theory of consumer preference
- Belongs to the larger family of preference-based methods where preferences for a product/situation/service are assessed
• Correspondence analysis is based on the utility maximization:

→ consumer utility (or satisfaction/well-being) stems from the characteristics of the goods rather than from the goods themselves → goods are valued for their attributes

→ the overall utility of a product/situation/service is decomposed into separate utilities of its attributes

Conjoint analysis in the field of CI is used to:

1) Explore experts’ preferences over various dimensions/sub-dimensions/variables and to estimate their relative importance on the aggregate measures

2) Identify the hidden rules experts employ to make trade-offs between different dimensions/sub-dimensions/variables and between the values they place on different levels of dimensions/sub-dimensions/variables

Steps in conjoint analysis

Marketing research

1. Determine attributes
2. Assign levels of attributes

Composite indicators

1. Determine the framework (dimensions, sub-dimensions, indicators)
2. Assign levels to each dimension/sub-dimension/indicator

EXAMPLE

To establish the importance of the variables in the Economic Component


Table 1

<table>
<thead>
<tr>
<th>Economic sustainability attributes’ levels</th>
<th>Desirable attribute level</th>
<th>Undesirable attribute level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prospects for long-run profit</td>
<td>Good prospects</td>
<td>Odds are against long-run profits</td>
</tr>
<tr>
<td>Income stability/profits in the short-run in comparison with other opportunities</td>
<td>More stable/more predictable</td>
<td>Less stable/less predictable</td>
</tr>
<tr>
<td>Reliance on purchased inputs (fertilizers, pesticides, fuel)</td>
<td>More reliant</td>
<td>Highly reliant</td>
</tr>
<tr>
<td>Sufficient of cash flows to cover operational expenses on time</td>
<td>More than enough</td>
<td>May require borrowing</td>
</tr>
<tr>
<td>Reliance on governmental subsidies or payments (governmental programs)</td>
<td>Not required</td>
<td>May be required</td>
</tr>
<tr>
<td>Extent of governmental regulations</td>
<td>Easy to comply</td>
<td>DIFFICULT to comply</td>
</tr>
</tbody>
</table>
Steps in conjoint analysis

Marketing research

1. Determine attributes
   1. Determine the framework (dimensions, sub-dimensions, indicators)

2. Assign related attributes levels
   2. Assign levels to each dimension/sub-dimension/indicator

3. Compile the profiles of the levels of attributes
   3. Compile the profiles of the levels of dimensions/sub-dimensions/indicators

Composite indicators

EXAMPLE


We ask experts to give an overall evaluation of product/situation bundles that vary systematically on a number of attributes → evaluation = ranking

Example:
To understand stakeholders preferences for agricultural sustainability in the economic dimension we select

We choose realistic levels of each variable/attribute

<table>
<thead>
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<td>Less stable/less predictable</td>
</tr>
<tr>
<td>Reliance on purchased inputs (fertilizers, pesticides, fuel) and borrowed capital</td>
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<td>Highly reliant</td>
</tr>
<tr>
<td>Sufficient of cash flow to cover operational expenses on time</td>
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</tr>
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</table>

as the most important variables/attributes.
Based on the selected variables/attributes and their levels, we create profiles of possible combinations of levels of attributes for experts to evaluate (rank) in terms of their knowledge, preference, acceptability, soundness, etc.

In our case it is $2^6=64$ possible economic agricultural sustainability profiles → TOO MANY!!!

A reduced selection of profiles should represent the full number of stimuli as close as possible. This is usually done using an orthogonal design.

In an orthogonal design the proportional frequency of occurrence of any variable/attribute level in the full design is maintained in the reduced design.

That is, for any combination of two variables/attributes, the levels of one variable/attribute must occur with equal frequency with the levels of the other variable/attribute.

Using *orthoplan* command in SPSS we establish that is it enough to give experts 8 different economic agricultural sustainability profiles to calculate weights (i.e., part-worths/utilities) of all 64 economic agricultural sustainability.
### Table 1: Economic sustainability attributes' levels

<table>
<thead>
<tr>
<th>Prospects for long-run profit</th>
<th>Income stability/predictability in the short comparison with other opportunities</th>
<th>Reliance on purchased inputs and borrowed capital</th>
<th>Sufficiency of cash flow to cover operational expenses on time</th>
<th>Reliance on governmental subsidies or payments</th>
<th>Extent of governmental regulations</th>
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</thead>
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<td>Good prospects</td>
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<td>Moderately reliant</td>
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<td>Not required</td>
<td>Difficult to comply</td>
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<td>More stable/more predictable</td>
<td>Less stable/more predictable</td>
<td>More stable/more predictable</td>
<td>May required borrowing</td>
<td>Not required</td>
<td>Difficult to comply</td>
</tr>
<tr>
<td>Less stable/less predictable</td>
<td>More stable/more predictable</td>
<td>Less stable/less predictable</td>
<td>May required borrowing</td>
<td>Not required</td>
<td>Difficult to comply</td>
</tr>
<tr>
<td>Highly reliant</td>
<td>High stability/more predictable</td>
<td>Highly reliable</td>
<td>Highly reliant</td>
<td>Highly reliant</td>
<td>Highly reliable</td>
</tr>
<tr>
<td>More than enough</td>
<td>May required borrowing</td>
<td>May required borrowing</td>
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<td>May required borrowing</td>
<td>May required borrowing</td>
</tr>
<tr>
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</tr>
<tr>
<td>Difficult to comply</td>
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<td>Difficult to comply</td>
<td>Difficult to comply</td>
<td>Difficult to comply</td>
<td>Easy to comply</td>
</tr>
</tbody>
</table>

### Profile 1 vs Profile 2

<table>
<thead>
<tr>
<th>Odd's are against long-run profits</th>
<th>Good prospects</th>
<th>Good prospects</th>
<th>Good prospects</th>
<th>Good prospects</th>
<th>Good prospects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less stable/less predictable</td>
<td>More stable/more predictable</td>
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<td>More stable/more predictable</td>
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</tr>
</tbody>
</table>

### Model of CA

\[ \hat{U}_{ijp} = \beta'x_{ijp} + \varepsilon_{ijp} \]

- \( \hat{U}_{ijp} \) – utility of an expert \( i \) associated with \( j/p \) profile
- \( \beta \) – utilities/part-worth utilities to be estimated (for each level of each variable/attribute)
- \( x_{ijp} \) – set of \( p \) dummy (or other) variables corresponding to attributes of profile \( j/p \) presented to expert \( i \)
- \( \varepsilon_{ijp} \) – stochastic portion of the utility function

**Estimation – OLS (the most common)**
Model of CA

\[ \hat{U}_{ijp} = \beta^* x_{ijp} + \varepsilon_{ijp} \]

Rating of a given profile

\[ \beta^* \] — utilities/part-worth utilities to be estimated (for each level of each attribute)

\[ x_{ijp} \] — vector of attributes of profile \( p \) presented to expert \( i \)

\[ \varepsilon_{ijp} \] — stochastic portion of the utility function

### Stakeholder Profiles

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Profile 1</th>
<th>Profile 2</th>
<th>Profile 3</th>
<th>Profile 4</th>
<th>Profile 5</th>
<th>Profile 6</th>
<th>Profile 7</th>
<th>Profile 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stakeholder 1</td>
<td>5</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>8</td>
<td>2</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Stakeholder 2</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>7</td>
<td>3</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>…</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stakeholder n</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>4</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>

Variable/Attribute

- **Prospects for long-run profit**
- **Income stability/predictability in the short comparison with other opportunities**
- **Reliance on purchased inputs and borrowed capital**
- **Sufficiency of cash flow to cover operational expenses on time**
- **Reliance on governmental subsidies or payments**
- **Extent of governmental regulations**

### Table 5

<table>
<thead>
<tr>
<th>Variable/Attribute</th>
<th>Entire Sample</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prospects for long-run profit</td>
<td>1.85** (0.25)</td>
<td>35</td>
</tr>
<tr>
<td>Income stability/predictability</td>
<td>0.08 (0.26)</td>
<td>35</td>
</tr>
<tr>
<td>Reliance on purchased inputs</td>
<td>0.49** (0.23)</td>
<td>35</td>
</tr>
<tr>
<td>Sufficiency of cash flow</td>
<td>0.16 (0.20)</td>
<td>35</td>
</tr>
<tr>
<td>Reliance on governmental subsidies</td>
<td>0.25 (0.22)</td>
<td>35</td>
</tr>
<tr>
<td>Extent of governmental regulations</td>
<td>0.66** (0.22)</td>
<td>35</td>
</tr>
</tbody>
</table>

** RELATIVE IMPORTANCE **

- non-significant estimate of part-worth \( \rightarrow \) weight = 0
- significant estimate of part-worth

\[ w_j = \frac{\hat{\beta}_j}{\sum_{j=1}^{n} \hat{\beta}_j} \]

- Significant estimates of part-worth: 1.85 0.49 0.66
**RELATIVE IMPORTANCE**

- non-significant estimate of part-worth \( \Rightarrow \) weight = 0
- significant estimate of part-worth

\[
\begin{align*}
\bar{\beta}_j & = \frac{\beta_j}{\sum_{j=1}^{l} \beta_j} \\
\end{align*}
\]

**Sum of significant estimates of part-worth**

\[
1.85 + 0.49 + 0.66 = 3
\]

**Weight of each significant attribute**

- prospect for long-run profit: \( 1.85/3 = 0.617 \)
- reliance on purchased inputs: \( 0.49/3 = 0.163 \)
- extent of governmental regulations: \( 0.66/3 = 0.220 \)

**Numerator Weight**

\[
\begin{align*}
1.85 - (-1.85) & = 3.7 \\
0.49 - (0.49) & = 0.98 \\
0.25 - (-0.25) & = 0.5 \\
0.66 - (-0.66) & = 1.32 \\
\end{align*}
\]

\[
\frac{3.7}{6.98} = 0.530 \\
\frac{0.98}{6.98} = 0.140 \\
\frac{0.5}{6.98} = 0.072 \\
\frac{1.32}{6.98} = 0.189
\]

**Sum**

\[
6.98 \quad \text{Sum} \quad 1.000
\]

**References**