Problems of transforming scales of life satisfaction

Sergiu Bălțătescu
University of Oradea
bsergiu@uoradea.ro

Euromodule workshop
Berlin, WZB, 18-19 October 2002
Life satisfaction

- Defined as an overall, cognitive evaluation of one's life.
- A construct generally measured by single direct questions
- Single scales: two formulation of the questions:
  - referring to the 'satisfaction with the life one leads'
  - referring to 'satisfaction with life-as-a-whole'
- Scales with 3, 4, 5 points
  - with answer categories verbally labeled
- Scales with 10, 11 and 101 points
  - represented on a pseudo-graphic scales,
  - only the extreme values are represented verbally.
  (Veenhoven, 1993)
Why we need knowledge about the transformation of life satisfaction scales?

- **PRACTICAL REASONS:** To homogenize life satisfaction data, in order to compare levels of subjective well-being:
  - between nations
  - through time

**Examples:**
- compare national life satisfaction means of Euromodule and non-Euromodule countries
- make compatible the time-trend of life satisfaction obtained with another survey program (Diagnosis of quality of life 1990-1999) with Euromodule Romania (2003? -
Why we need knowledge about the transformation of life satisfaction scales?

- **THEORETICAL REASONS:**
  - Assess the convergent validity of new measures
    - Example: results from new international programs (like Euromodule) can be compared with the results of other national surveys which are using different life satisfaction scales.
  - Analyze through conversion some characteristics of life satisfaction scale used.
    - Example: which level of measurement can be assessed to life satisfaction scale we use - ordinal or interval?
The initial scale

- Used in ‘Diagnosis of quality of life’ survey program (ICCV, 1990-1999) (for the analysis was used the 1999 data set)
- Sample: national, random, around 1200 cases

A 5-point simple life satisfaction scale:
“Considering the whole situation, how satisfied are you about your daily life?
 a. Very unsatisfied
 b. Unsatisfied
 c. Neither unsatisfied, nor satisfied
 d. Satisfied
 e. Very satisfied”

See also: www.iccv.ro
Distribution of the initial variable (Diagnosis of Quality of life 1999)

- Mean: 2.71 (under the mean value of the scale)
- Slightly positively skewed
- See next the graphic representation of the distribution
The target scale

- 11-point *pseudo-interval scale*
- Only the extremes are represented verbally
- Has graphic elements
- Used in the Euromodule questionnaire

Goals for transforming life satisfaction scales

○ A. Convert an ordinal scale into another
  ● Ex: a 5-step life satisfaction scale into an 11-step life satisfaction scale

○ B. Assigning interval values to an ordinal scale
  ● Ex: assign scores for each answers on a 5-step life satisfaction scale, and assess the true (empirical) distance between the categories

○ C. Combining the two approaches
Methods for converting an ordinal scale into another

1. Linear (conventional) transformation
   - the simplest way to convert scales, using an unique formula
   - used implicitly for homogenizing means of life satisfaction scales in World Database of Happiness (Veenhoven, 1993)

2. Transformation by expert ratings
   - the analyst, a panel of expert researchers or typical respondents are assigning to each category of the original scale a value (or category) on the target variable
     - Ex: very unsatisfied - 3, somehow satisfied - 6, very satisfied - 9
Linear (conventional) transformation

Formula used for converting into a 11 point scale

\[
\frac{A_i - A_0}{A_n - A_0} \times 10
\]

where

- \( B_i \) = Transformed value (to 11-point scale)
- \( A_i \) = Value on original scale
- \( A_0 \) = Lowest possible score on original scale
- \( A_n \) = Highest possible score on original scale

(Veenhoven, 1993)

Examples:

For a 5-point Likert scale (assumed with equal intervals, with values from 1 to 5), the transformed values are: 0, 2.5, 5, 7.5, 10

Properties:

- a. The formula is designed in such a way that the end-points of the original scale coincide after transformation with the endpoints of the target (0-10) scale.
- b. While stretching the scale, the linear transformation preserves the initial distances between the values. That is why it can be used also for transforming scales whose categories are at non-equal distances. See later how useful can be this feature.
Ratings of typical respondents

Typical respondents: Sample of students from the University of Oradea (N=116)
- Specialization: Sociology, Social work
- Sex: Males 14 %, Females: 86 %
- Age mean: 22

They were asked to rate the categories of the 5-step life satisfaction scale:

a. On a graphic scale (10 cm. long). The distance of the signs to the left extremity was measured in cm.

b. On a pseudo-interval scale (with graphic elements), as used in the Euromodule questionnaire

See right the original questionnaire, in Romanian language
Ratings of the typical respondents

- Means of the ratings have been calculated and plotted (line from every point to centroid point and regression line included)
- 8 outliers (7% of ratings excluded from the analysis)
- The resulted correlation between the mean of ratings on the two scales is high (r = 0.72)
- Mean ratings on pseudo-interval scale was higher \( m(X_p) = 5.19 \)
  \( m(X_g) = 4.94 \)
- The assigned values for the categories were calculated as the mean of ratings of each category
- The resulted ratings:
  \( X_p = (0.8; 2.440; 4.628; 6.973; 9.098) \) - on the pseudo-interval scale
  \( X_s = (1.16; 2.94; 5.03; 7.15; 9.00) \) - on the graphic scale

\[
\text{mean}_s = 2.01 + 0.64 \times \text{mean}_l \\
\text{R-Square} = 0.52
\]
Assigning interval values to an ordinal scale

1. Estimation from the observed frequencies and distributional assumption
2. Optimal scoring
Estimation from the observed frequencies and distributional assumption

- Used when researchers assumes that the latent variable has a particular distribution (ex: rectangular, normal) We can consider that observed categories correspond to separate segments under the *density function* of the latent variables.

  *For normal curve*, we use a table of areas under the normal curve to estimate the upper & lower boundaries of each segment under the density function.

  After that, we calculate (or use a table of) the ordinates of the normal curve for the upper and lower boundaries.

  We subtract the values as and divides the results by a proportion of this category.

  See: Hensler & Stipak (1979)
Computing of the estimation from the observed frequencies and distributional assumption

Z values corresponding areas under the normal curve

(-1.61; -0.77; 1.16; 2.49)

Ordinates on the normal curve of Z values

\[ f(Z) = (0.1092; 0.2966; 0.2036; 0.018) \]

Values of estimates calculated by subtracting ordinate of the lower boundary from the ordinate of the upper boundary and dividing by the proportion of each category

\[ x_j = (-1.01111; -0.56276; 0.3; 0.793162; 1.384615) \]

Scores linearly transformed to 0-10 scale

(0; 1.87145; 5.472708; 7.531217; 10)
The optimal scoring method (OSM)

- The algorithm is rather new (Young et al., 1981).
- Precursors: Cattell (1962), Allen (1976), Hensler & Stipak (1979)
- OSM begins with the premise that the problem of obtaining latent interval scores for ordinal variables is inherently insoluble.
- Thus, we should use scoring systems which maximally simplify the empirical relationship within a set of variable. "Specifically, optimal scores are those which maximize the average inter-item correlation within a set of variables." (Allen, 1976)
- The problem looks similar to that of maximizing the internal consistency of a set of variables. (calculating the Crombach - $\alpha$ coefficient)
Regression with optimal scaling

- Is a version of the optimal scoring method
- Implemented in SPSS (CATREG algorithm)
  See Nichols (1995)
- Represents a variant of linear regression in which the scores for the variables are not given before, but calculated after, in such a way that assures the best fit of the model (maximizing r square)
- Practically, it stretches the measurement scales of the variables, assigning scores for their categories, to obtain a maximal fitness of the linear regression model, the only constraint being that of the monotonicity of variables.
- Allows the theoretical model to prevail: if the researcher assumes that one of the variables is interval-level, this variable will be entered in the model as such, and its values will not be changed
- Used recently for analyzing life satisfaction data (Shen & Lai, 1998)
Regression with optimal scaling as a method for transforming life satisfaction scales

- Source data: Diagnosis of quality of life survey program (ICCV, 1990-1999) (for the analysis was used the 1999 data set)
- Sample: national, random, 1198 cases
- Dependent variable: life satisfaction
- Independent variables: 19 domain satisfaction indicators (ex: satisfaction with family, with the political situation, neighborhood, etc.)
- Theoretical model: bottom-up

Results: The goodness of fit (r square) increases from 0.34 to 0.38
- New scores were assigned to life satisfaction indicator categories: (-1.827; -0.665; 0.186; 1.221; 3.729)
- Scores linearly transformed to 0-10 scale
  (0; 2.091; 3.623; 5.485; 10)
Quantification of life satisfaction (By CATREG algorithm)

The algorithm dramatically increases the distance between scores assigned to “satisfied” and “very unsatisfied” categories - to about a half of the amplitude on the target scale (see figure) As a result, the computed mean on 0-11 scale is lower than the mean calculated by other methods (see next slide)

Possible interpretation: it is very hard (or unusual) to be very satisfied in Romania

Indeed, the percent of those who declared themselves being very satisfied is about 1,3 %
## Transformation results

<table>
<thead>
<tr>
<th>Method</th>
<th>very unsatisfied</th>
<th>unsatisfied</th>
<th>neither unsatisfied nor satisfied</th>
<th>satisfied</th>
<th>very satisfied</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear calculation (equal-interval 0-10 scale)</td>
<td>0</td>
<td>2,5</td>
<td>5</td>
<td>7,5</td>
<td>10</td>
<td>4,27</td>
</tr>
<tr>
<td>Equal-interval 1-9 scale</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>9</td>
<td>4,41</td>
</tr>
<tr>
<td>Expert rating-graphic scale</td>
<td>0,8</td>
<td>2,4</td>
<td>4,6</td>
<td>7,0</td>
<td>9,1</td>
<td>4,08</td>
</tr>
<tr>
<td>Expert rating - pseudo-interval scale</td>
<td>1,2</td>
<td>2,9</td>
<td>5,0</td>
<td>7,1</td>
<td>9</td>
<td>4,45</td>
</tr>
<tr>
<td>Values calculated assuming normal distribution</td>
<td>0</td>
<td>1,9</td>
<td>5,5</td>
<td>7,5</td>
<td>10</td>
<td>4,21</td>
</tr>
<tr>
<td>Quantification by regression with optimal scaling</td>
<td>0</td>
<td>2,1</td>
<td>3,6</td>
<td>5,5</td>
<td>10</td>
<td>3,23</td>
</tr>
</tbody>
</table>
Evaluation of the methods: linear transformation

- Preserves the ratio of initial distances between categories
- Can be used to transform values assigned to rank-order categories
- May cause problems because it is thus designed that the end-point of the original scale coincide after transformation to the end-points of the target (0-10) scale, when in fact:
  - The panel of typical respondents assigned the end-points to 1 and 9
  - In the surveys using 0-10 scales, the extreme categories are in very few cases chosen
- It might be recommended to transform values to 1-9 scale, and use scores as if they are on a 0-10 scale
Evaluation of the methods: rating by experts

- Is more complicated to use: we need a separate research to assess the value
- The ratings tend to be close to the equal-interval assigning on a 0-9 scale (1,3,5,7,9)
- It is recommended to be used for recent data (we cannot be sure the meaning of categories of life satisfaction is not changing in time)
Evaluation of the methods:
estimation from the observed frequencies and distributional assumption

- We cannot always assume a normal distribution
  of the life satisfaction variable
- This works in the case of Romania 1990-1999,
  where the distribution is close to normal
- In western European countries, life satisfaction
  scores are markedly positively skewed (Cummins,
  1998)
Evaluation of the methods: regression with optimal scaling

- The value is very dissimilar with the other calculations (in our sample)
- The calculated optimal scores may differ from a sample to another, as the structure of subjective well being differs
- There is no guarantee that the final scoring reflects the true measurement level of the dependent variable, or the functional relationship between variables
- The method is rather new and deserves further tests
Limitations

- The analysis is not exhaustive. Several methods like linear testing both scales in the same sample (recommended by Veenhoven) maximin (Abelson & Tukey), psycholinguistic estimation, estimation from criterion variables (Hensler & Spiwak) and other variants of optimal scaling were omitted.
- The number of predictors in regression with optimal scaling was rather small.
- A closer attention must be given to missing data analysis.
- The issue of transformation of the scales with or not with central points was omitted.
- There was no attention given to the semantic difference of terms between languages.
Reference list


Reference list


Reference list

Reference list