Problems of transforming scales of life satisfaction

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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:

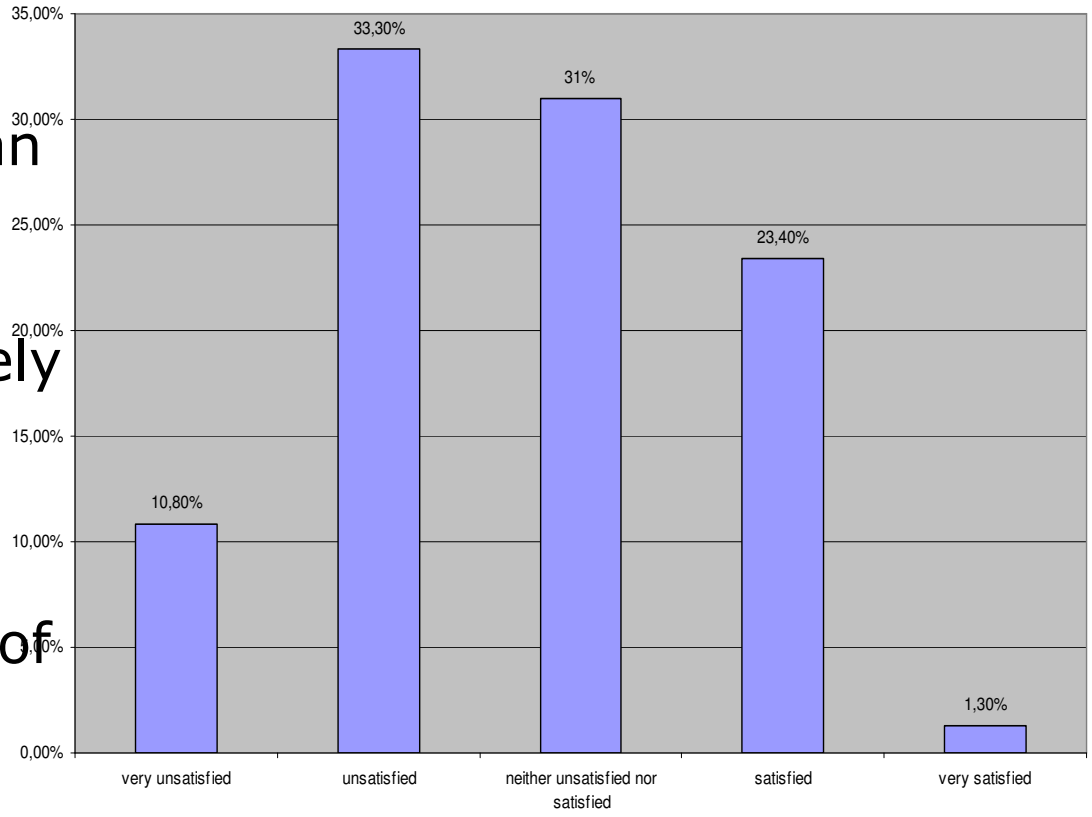
"Considering the whole situation, how satisfied are you about your daily life?

a. Very unsatisfied
b.Unsatisfied
c.Neither unsatisfied, nor satisfied
d.Satisfied
e.Very satisfied"

See: Mărginean (1991), Zamfir (1992)
See also: www.iccv.ro

Distribution of the initial variable (Diagnosis of Quality of life 1999)

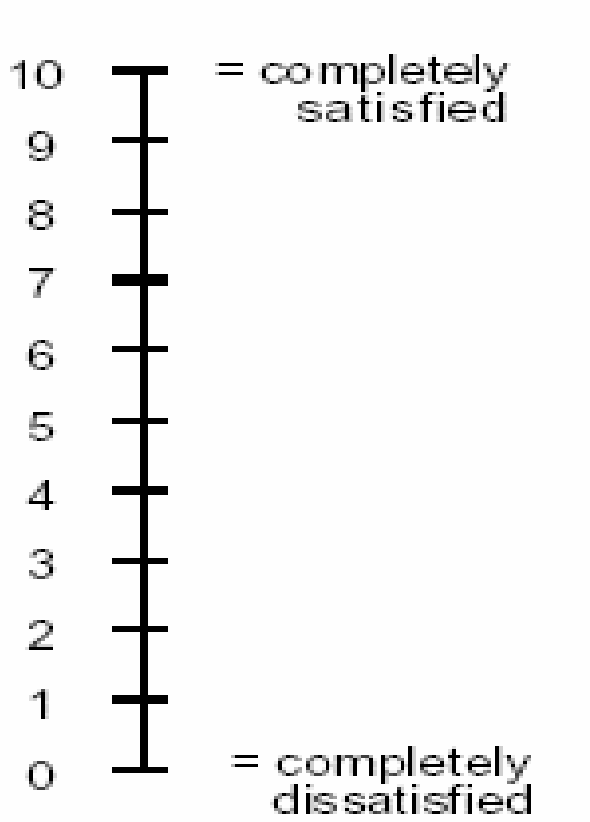
- Mean: 2,71 (under the mean value of the scale)
- Slightly positively skewed
- See next the graphic representation of the distribution



The target scale

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

See: Delhey, J., P. Bohnke, et al. (2002).



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

$$Bi = \frac{Ai - A0}{An - A0} \times 10$$

where

Bi = Transformed value (to 11-point scale)

Ai = Value on original scale

A0 = Lowest possible score on original scale

An = 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

Proprieties:

a. 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:

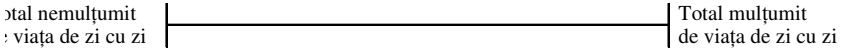
a. On a *graphic scale* (10 cm. long). The distance of the signs to the left extremity was measured in cm.

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

See right the original questionnaire, in Romanian language

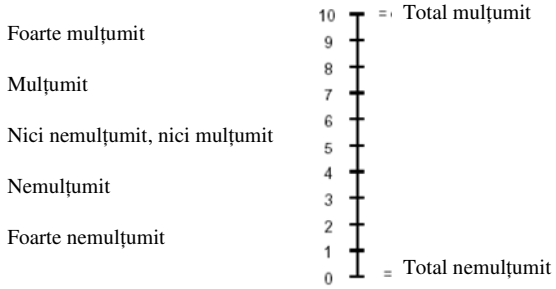
1. În ce loc, pe scala de mai jos, s-ar afla cineva care dă unul din cele 5 răspunsuri la următoarea întrebare? Puneți câte un x pe scală, acolo unde credeți că ar corespunde cele 5 răspunsuri.

LUÂND ÎN CONSIDERARE ÎNTREAGA SITUATIE, CÂT DE MULȚUMIT SUNTETI DE VIATA DVS. DE ZI CU ZI ?
Foarte nemulțumit
Nemulțumit
Nici nemulțumit, nici mulțumit
Mulțumit
Foarte mulțumit



2. La ce număr, pe scara de mai jos, s-ar afla cineva care dă unul din cele 5 răspunsuri la următoarea întrebare? Încercuiți numărul din dreptul scalei care i s-ar potrivi cel mai bine:

LUÂND ÎN CONSIDERARE ÎNTREAGA SITUATIE, CÂT DE MULȚUMIT SUNTETI DE VIATA DVS. DE ZI CU ZI ?

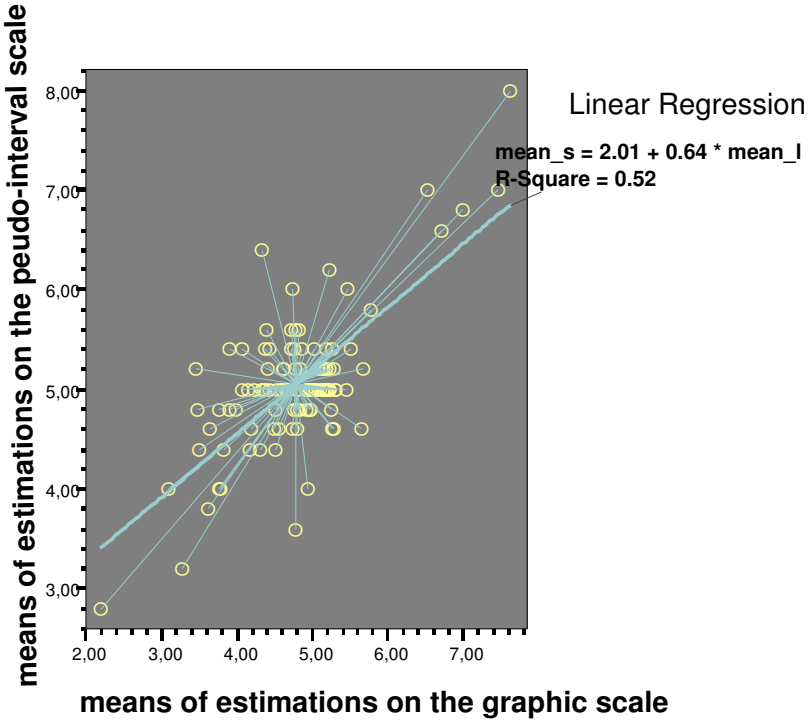


Ratings of the typical respondents

- 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(Xp)=5.19 m(Xg)=4.94
- The assigned values for the categories were calculated as the mean of ratings of each category
- The resulted ratings:

Xp=(0.8; 2.440; 4.628; 6.973; 9.098) - on the pseudo-interval scale

Xs=(1.16; 2.94; 5.03; 7.15; 9.00) - on the graphic scale



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

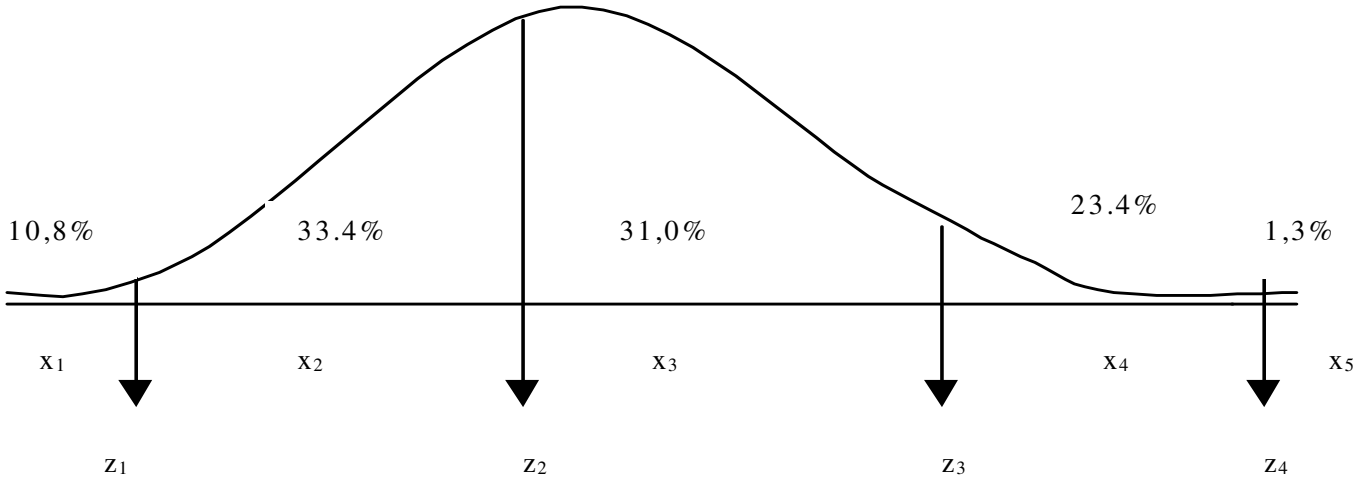
For normal curve, we use a table of areas under the normal curve to estimate the upper & lower boundaries of each segment under the density function.

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

We substract the valueas and divides the results by a propostion 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

xj=(-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 - α 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

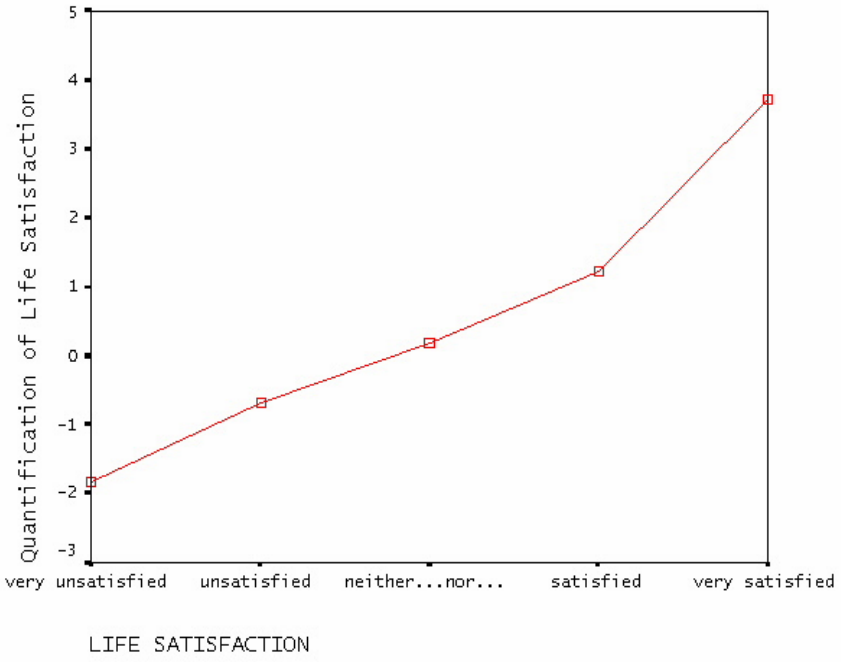
- Source data: Diagnosis of quality of life survey program (ICCV, 1990-1999) (for the analysis was used the 1999 data set)
- Sample: national, random, 1198 cases
- Dependent variable: life satisfaction
- Independent variables: 19 domain satisfaction indicators (ex: satisfaction with family, with the 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 amplitud on the target scale (see figure) As a result, the computed mean on 0-11 scale is lower than the mea calculated by other method (see next slide)
- Possible interpretation: it is ver 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

	very unsatisfied	unsatisfied	neither unsatisfied nor satisfied	satisfied	very satisfied	Mean
Linear calculation (equal-interval 0-10 scale)	0	2,5	5	7,5	10	4,27
Equal-interval 1-9 scale	1	3	5	7	9	4,41
Expert rating-graphic scale	0,8	2,4	4,6	7,0	9,1	4,08
Expert rating - pseudo-interval scale	1,2	2,9	5,0	7,1	9	4,45
Values calculatted assuming normal distribution	0	1,9	5,5	7,5	10	4,21
Quantification by regression with optimal scaling	0	2,1	3,6	5,5	10	3,23

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 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 asses 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 assumes 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

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