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**Choice of weights
for subjective variables**

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1. Introduction
2. Obtaining weights: underlying principles
3. Obtaining weights: approaches
4. Conclusions




1. Introduction



One of the more vexed and discussed issues in the field of social research

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comparison between findings observed at
both macro (e.g. countries) and micro (cases or groups) level




Example

comparison between different levels of subjective well-being

Explanatory models
Differences in well-being can be explained by


- objective characteristics, different
 - living conditions (objective micro level)
 - national structures (objective macro level)
- different cultural traits and value orientations at micro level.



Example

comparison between different levels of subjective well-being

Question
how comparisons between individuals (or groups) can be carried on by taking into account inter-individual (or inter-group) differences yielded by different contextual conditions (cultural traits and value orientations)?




Possible answers

definition of “subjective weights”

Example
Satisfaction with life defined as a combination of satisfaction with family, work, income, ...
Combination has to take into account the importance that each individual assigns to each domain/ambit.
Comparison of satisfaction scores
↓
by taking into account the importance that individuals can assign to each ambit

income
career
family
neighbors
friends
physical aspect
financial independence
ideals
health
partner
...


Life as a whole



Past results

Studies that have specifically compared weighted and unweighted scores in the field of quality of life has produced almost uniformly negative results.
(Andrews & Withey, 1976; Campbell et al., 1976; Cummins et al., 1994)

However,
many researchers urge the scientific community to explore this topic by more research that specifically compares weighted and unweighted scores in particular in assessing quality of life measures
(Russell et al., 2006)




Determining differential subjective weights

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solid conceptual framework helping in clarifying how

- to obtain importance weights at individual-subjective level through subjective judgments
- to assign weights to the corresponding subjective scores



2. Underlying principles in obtaining weights

Preliminary statements

$$AS_i = \sum_{j=1}^K x_{ij} w_{ij}$$

x_{ij} sub-score j to be aggregated for individual i
 K number of sub-scores
 w_{ij} weight j to be attribute to x_{ij} for individual i
 AS_i aggregate score (synthetic score) for individual i

Preliminary statements

In order to reproduce as accurately as possible the contribution of each sub-score to the construction of AS
a criterion has to be adopted to define a weighting system

↓

improvement and refinement of the adopted model of measurement.

Preliminary statements

Identification of a weighting system needs to **take into account** :

- ⇒ **rationale and theoretical framework** on which the measurement of the complex characteristics is founded and that will consequently regard the synthetic score
- ⇒ **meaning and contribution of each sub-score** to the synthesis
- ⇒ **quality of data and statistical adequacy of indicators**

Preliminary statements

Identification of a weighting system needs to **decide**:

- ⇒ **proportional size of weights**
 1. **equal** or **differential** weighting
- ⇒ **adopted aggregation technique**
 2. **compensatory** or **non-compensatory**
- ⇒ **level** at which weights are determined/applied
 3. **individual** or **group** weights


Preliminary statements

N.B.

A whole set of weights
 able to express in
a perfect way
 the contribution of each indicator
does not exist

Preliminary statements


2.1 Equal vs. differential weighting



Equal vs. differential weighting

The **first decision** that needs to be made and that will strongly influence the final results is between

Equal Weighting (EW) ↔ Different Weighting (DW)




Equal vs. differential weighting

Equal weighting

Doubtful procedure mainly **when**

- **different components have to be aggregated by different numbers of indicators** (→ synthetic score = unbalanced structure);
- **indicators exist measuring the same component** (*double weighted or double counting*).




Equal vs. differential weighting

Differential weighting

Doubtful procedure mainly **when not supported by**


- **theoretical reflections** on the meaning and impact of each indicator on the synthesis,
- **methodological concerns** aimed at identifying proper and consistent techniques.




Equal vs. differential weighting

In order to make the decision about **subjective weights** we should explore

- psychometric properties of importance ratings (internal consistency and test-retest reliability),
- theoretical issue (importance and satisfaction are distinct constructs?)
- criteria used in assessing weighted scores.



2.2 Weights and aggregating techniques: compensatory and non-compensatory feature




Weights and aggregating techniques: compensatory and non-compensatory feature

In order to avoid incoherencies between

theoretical meaning of weights	↔	actual application of weights
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↓

a consistent aggregating technique is needed by considering **compensability** among the elementary indicators



Weights and aggregating techniques:
compensatory and non-compensatory
feature

Compensatory aggregating approach


- **additive approach** (simple addition)
- **geometrical approach** (multiplicative technique)

↓

low values compensated by high values

↓

synthetic score does not allow us to return to the original individual profiles



Weights and aggregating techniques:
compensatory and non-compensatory
feature


CAUTION

↓

problems of interpretation



2.3 Subjective weights obtained at individual or group level




Subjective weights obtained at individual or group level

The weights can be defined at


↓

- ↪ **individual level:** individual data will be used in order to construct weights that will differ from each subject to another,
- ↪ **group level:** individual data will be used in order to construct different weights for different groups of individuals.

We need to identify **methods supporting the two weighting perspectives.**




2.4 Conditions for obtaining weights



Conditions for obtaining weights

General basic conditions


- ↪ weights are non negative numbers
- ↪ weights add up to unity
- ↪ weighted score is obtained by relating x to w in some way
- ↪ weights may require to be rescaled in order to have an identical range (0; 1)




Conditions for obtaining weights

Conditions required for obtaining subjective weights

- ⇒ identifying a criterion of importance or preference,
- ⇒ defining a model allowing
 - subjective evaluations and judgments to be collected at individual level (explicitly or implicitly)
 - subjective importance/preference continuum to be constructed




3. Approaches for obtaining weights




Approaches for obtaining weights

The approaches that will be discussed are:

- (i) **statistical methods**, traditionally identified as "objective" approaches
- (ii) **traditional "subjective" approaches**
 - a. **multi-attribute approaches**
 - b. **scaling approaches**
 - handling subjective evaluations and judgments, explicitly or implicitly expressed
 - obtaining subjective weights at group level and at individual level,



3.1 Statistical approaches



Statistical approaches

Statistical methods
They preferred when the choice of weights should rely preferably on "objective" principle:

1. **Correlation Analysis (CA)**
2. **Principal Component Analysis (PCA)**
3. **Data Envelopment Analysis (DEA)**



3.2 Multi-attributes approaches

Multi-attributes approaches

Multi-Attribute Models
allow
subjective importance weights to be identified at subjective level
through an indirect approach
by

- managing a certain number of **combined comparisons**
- applying methods aimed at **making decision among different available alternatives**.

Weights obtained through these methods are considered more stable than those produced by direct evaluations.

Multi-attributes approaches

Among these models we can distinguish:

- Multi-Attribute Decision Making:**
↓
Analytic Hierarchy Process (AHP) (pairwise comparison of attributes).
- Multi-Attribute Compositional Models:**
↓
Conjoint Analysis (CA).

3.3 Scaling approaches

Scaling approaches

Scaling models classification

As known, **scaling models** enable to deal with subjective evaluations and judgments.

Features that can describe and characterize each scaling model are:

- Dimensionality
- Nature of data
- Scaling technique
- Criterion for testing the model
- Standard of measurement
- Contribution to the measurement of each multiple measures

Scaling approaches

	Scaling model	Dimensionality	Nature of data	Scaling technique	Criterion for testing the model	Standard of measurement: final (synthetic) score assigned to
Additive	Uni-dimensional	Uni	Single-stimulus	Not-comparative	Internal consistency	Cases
	Multidimensional	Multi	Single-stimulus	Not-comparative	Dimensionality of the items	Cases
	<i>Thurstone model (differential scale)</i>	Uni	Stimulus-comparison	Comparative (pair-comparison or rank-order)	Matrices between items	Items
	Orthothetic	Uni	Stimulus-comparison	Comparative (rank-order or comparative rating)		Items
Comparative	Guttman	Uni	Single-stimulus	Not-comparative	Scalogram analysis: reproducibility, scalability and ability to predict	Cases and items
	Multidimensional Scalogram Analysis (MSA)	Bi				Regionality and contiguity
	Partial Order Scalogram Analysis (POSA)	Bi		Correct representation	Cases and items	
	Probabilistic	Multi (one or more parameters)	Single-stimulus	Not-comparative	<ul style="list-style-type: none"> • parameters estimation (maximum likelihood) • goodness of fit (chi-square and median analysis) 	Cases and items (without condensation)
Non-spatial Mapping	Multidimensional scaling	Multi	Similarity	Comparative (pair-comparison)	Goodness of fit of distances to proximities (stress, alteration)	Items
	Unfolding	Uni to Multi	Preferential choice	Comparative	Goodness of fit of distances to ordinal preferences	Cases and items
Conjoint model		Multi	Preferential choice	Comparative (rank-order)	Goodness of fit of the model (not applicable to the analysis)	Items at individual level

Scaling approaches

Scaling models allowing subjective weights to be obtained

In our perspective, these models can be distinguished with reference to the possibility to define subjective weights at individual level or at group level (last column of the previous table), in particular:

- **group weighting:** *Thurstone model (differential scale), unfolding model*
- **individual weighting:** *conjoint model (see above)*

