Quantitative Research Methods

Indexes & Scales

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STAND: APRIL 2024

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Introduction

Imagine you're a researcher, a government official, or just work in finance and you want to know how the economy is doing.

- … wouldn't it be nice if there were measurements for complex constructs like "the economy"?
- But not every (social) phenomenon can be measured by a single variable.

→ Indexes and scales are used to measure a composite of constructs (e.g. giving an abstract concept a numerical value).

→ Indexes serve as important indicators and enable us to analyze trends and developments

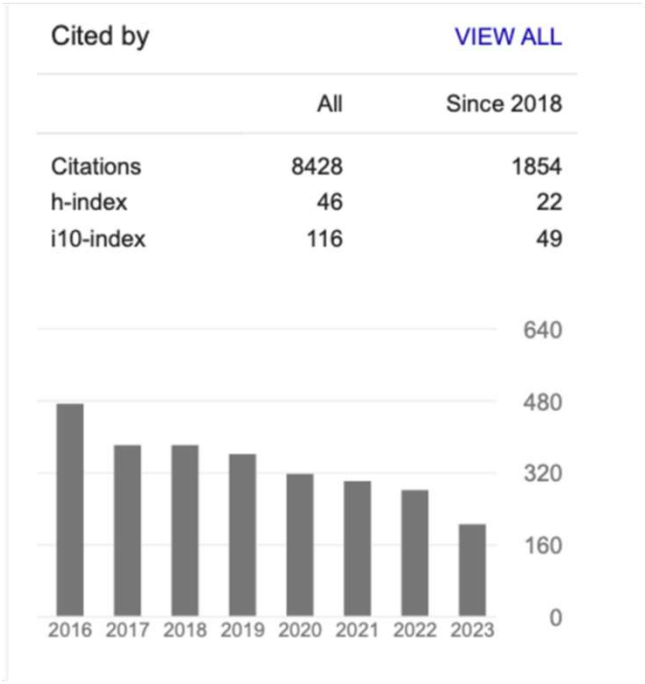
Indexes vs Scales

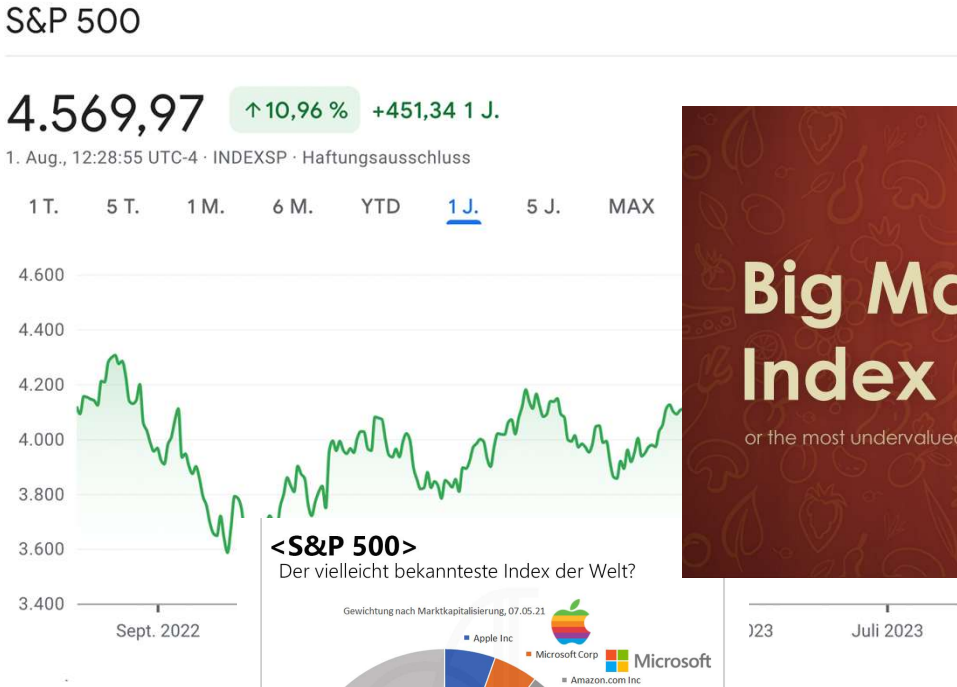
Common Characteristics

Scales and indices are the most common approaches to creating quantitative measures of a construct. The two terms are difficult to distinguish, and there are conflicting views in social research about how to define and distinguish them. Nevertheless, here is an attempt:

	Indexes	Scales
Definition	▪ An index combines two or more variables into a single quantitative score (e.g. a numerical value). ▪ It is used to reflect a more general construct by combing different variables. The combined variables are often very different types of constructs and may even be measured in very different ways and on different scales. ▪ To combine the different variables a set of rules is applied. This can be simply adding up or averaging up to using formula or a set of procedures.	▪ Scaling evolved from the need to measure abstract or subjective constructs that may seem to be unmeasurable, such as attitude and beliefs. ▪ Like an index, a scale is typically designed to yield a single numerical score that represents the construct of interest. ▪ Scales are generally divided into two broad categories: (1) Unidimensional and (2) multidimensional.
Use Case	▪ Consumer price index (CPI) ▪ Socioeconomic status (SES) ▪ Stock indexes	▪ Attitude toward immigration ▪ Employment Self-Esteem

Examples of Indexes





Constructing an Index

Conceptualize the Index

- What is the **concept** you want to measure?
- What components are needed?
  - Intuition
  - Literature and theories
  - Expert knowledge
- E.g. for the SES:
  - Income
  - Occupation
  - Education

Operationalize the components

- Make the components accessible to measurement
- Decide how you want to measure the components
- E.g. Education:
  - Highest degree
  - Years in school / college

Develop rules for calculating

- Decide how to combine the different components
- Simplest way: Add / Average the individual scores (e.g. CPI)
- Complex if different measures are used or formulas are needed
- Develop a model which shows how the components are (theoretically) related

Decide on weighting

- Decide if all components are equally important
- Decide if individual items need more emphasis
- Example: Grades
  - 50% Written Exam
  - 20% Assignments
  - 30% Presentation

Validate the score

- Question if the index measures what it is supposed to measure
- Repeat validation over time to ensure the index is not outdated

Use Case 1: Consumer Price Index (CPI)

Quiz: What are the 8 categories of the CPI?

Use Cases

Each month the Bureau of Labor Statistics reports the CPI. It is considered to be a reflection of generally how much consumers have to pay for things and therefore, a general economic indicator.

How is it measured?

- To construct the single score, government analysts identified eight major areas of spending for the typical consumer: (1) food and beverages, (2) housing, (3) apparel, (4) transportation, (5) medical care, (6) recreation, (7) education and communication, and (8) other goods and services.
- The eight areas are broken up into more than 200 specific categories. For each of these samples are taken from the many items that reflect each category.
- For example, to represent the "apple" category that is in the "food and beverage" area, the Bureau might sample a "particular plastic bag of golden delicious apples, U.S. extra fancy grade, weighing 4.4. pounds"
- Each month prices all over the country for more than 80,000 items are collected. A rather complicated weighting scheme that considers location and the probability that the item will be purchased is used so that these prices can be combined.
- These series of formulas and rules are used to combine all the prices into on index score each month. To be precise, the Bureau computes thousands of different CPI Scores each month to reflect different groups of consumers and different locations. Typically, only one CPI Score is reported in the news.

Use Case 2: Socio Economic Status Index (SES)

Use Cases

The socioeconomic status index combines, unlike the CPI, almost always several different variables. Traditionally, SES is a combination of three constructs: income, education and occupation.

How is it measured?

- Income is typically measured in dollars while education is measured in either years or degrees achieved. Occupation is classified into categories or levels by status.
- These very different elements need to be combined to get the SES score. In one of the classic studies in this area (Duncan, 1981), the degree to which education and income predicted occupation was used as the basis for the index score. This is commonly referred to as the *Duncan socioeconomic index* (SEI).
- This index is based on an SEI score. It is calculated for each of hundreds of occupations. The score is a weighted combination of:
  - **"occupational education"** (the percentage of people in that occupation who had 1 year or more of college education) and
  - **"occupation income"** (the percentage of people in the occupation who earned more than a specific annual income).
- The SEI score reflects the status of the occupation as related to both education and income and can be looked up.
- The measurement of socioeconomic status has been controversial and different researchers attempt to accomplish it in a variety of ways (Hauser & Warren, 1996; Stevens & Cho, 1985)

Use Case: Consumer Price Index (CPI)

Use Cases		
Consumer price index (CPI)	Socioeconomic status (SES)	Stock indexes
How is it measured?		
▪ Each month the Bureau of Labor Statistics reports the CPI. It is considered to be a reflection of generally how much consumers have to pay for things. ▪ To construct the single score, government analysts identified eight major categories of spending for the typical consumer: food and beverages, housing, apparel, transportation, medical care, recreation, education, communication, and other goods and services. ▪ The eight areas are broken up into more than 200 specific categories .	An index combines two or more variables into a single quantitative score (e.g. a numerical value) to reflect a more general construct by combing different variables.	An index combines two or more variables into a single quantitative score (e.g. a numerical value) to reflect a more general construct by combing different variables.

Scaling

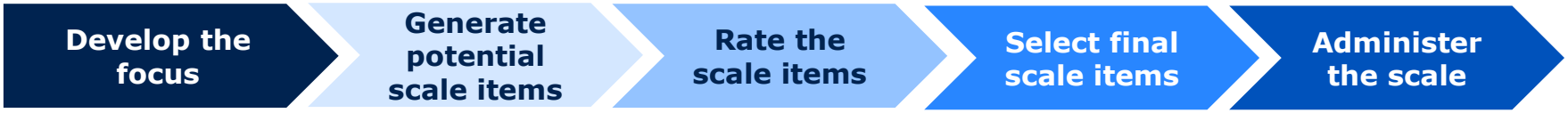
- *scale* (involves a process, refers to a set of items)
  ≠ *response scale* (single item, used to collect responses)
- **Goal:** measuring *qualitative, abstract* judgements about a constuct in *quantitative* units
- **Dimensionality:** *Unidimensional Scales* (construct can be measured in a single number)
  vs *Multidimensional Scales* (multiple dimensions are needed to measure a concept)
- **Purpose:**
  - Test a hypothesis
  - Exploratory research
  - Respresent a construct using a single score

Constructing a Scale

	Develop the focus	Generate potential scale items	Rate the scale items	Select final scale items	Administer the scale
Definition	▪ Describe the concept you want to measure ▪ Potentially formulated as an open-ended statement	▪ Aim for a large set of candidate statements (80-100) ▪ statements should be worded similarly, same structure and grammar constructs	▪ Rate how favourable a statement is towards the construct of interest.	▪ Compute scale score values ▪ Select statements at equal intervals across the range of medians	▪ Assign scales scores to each statement ▪ Decide how to get the final scale score from a person's answers
By who?	▪ You	▪ Experts ▪ People affected ▪ You	▪ Experts		

Thurstone Scaling

- Method of equal-appearing intervals



	agree - disagree statements	Have judges sort each statement on a 1-11 scale in how favorable it is toward the concept	Compute median and interquartile range of each item based on expert ratings Select one statement per score (1-11) with low interquartile range	Average scores of items a person agrees with for the final score

Thurstone Scaling – let‘s apply it!

- We try to create a scale, measuring:

Develop the focus one‘s attitude towards physical activity

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Rate the scale items rate each statement on how favorable it is towards physical activity

Select final scale items choose one statement for each item 1-11 (with highest agreement)

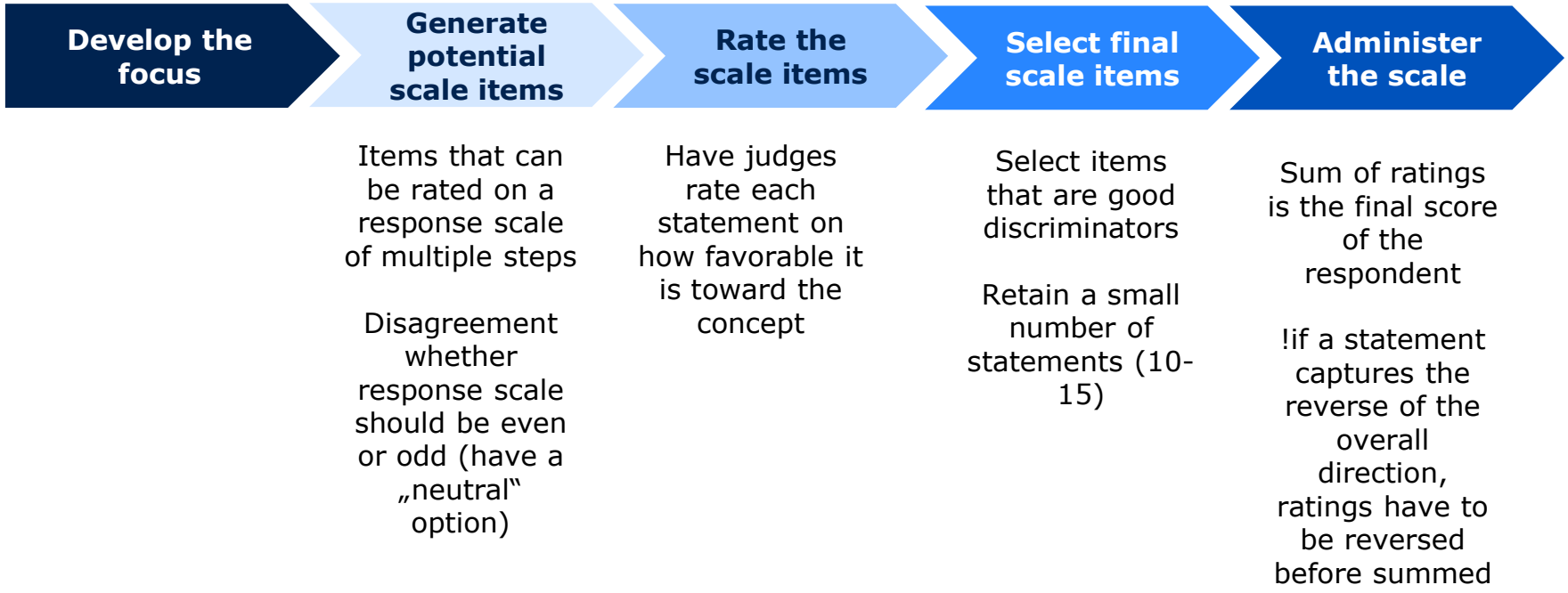
Thurstone Scaling – let‘s apply it!

- We try to create a scale, measuring:

Develop the focus	one‘s attitude towards physical activity
Generate potential scale items	list of statements around the topic
Rate the scale items	rate each statement on how favorable it is towards physical activity
Select final scale items	choose one statement for each item 1-11 (with highest agreement)
Administer the scale	get a respondent‘s score by averaging the score of each agreed statement

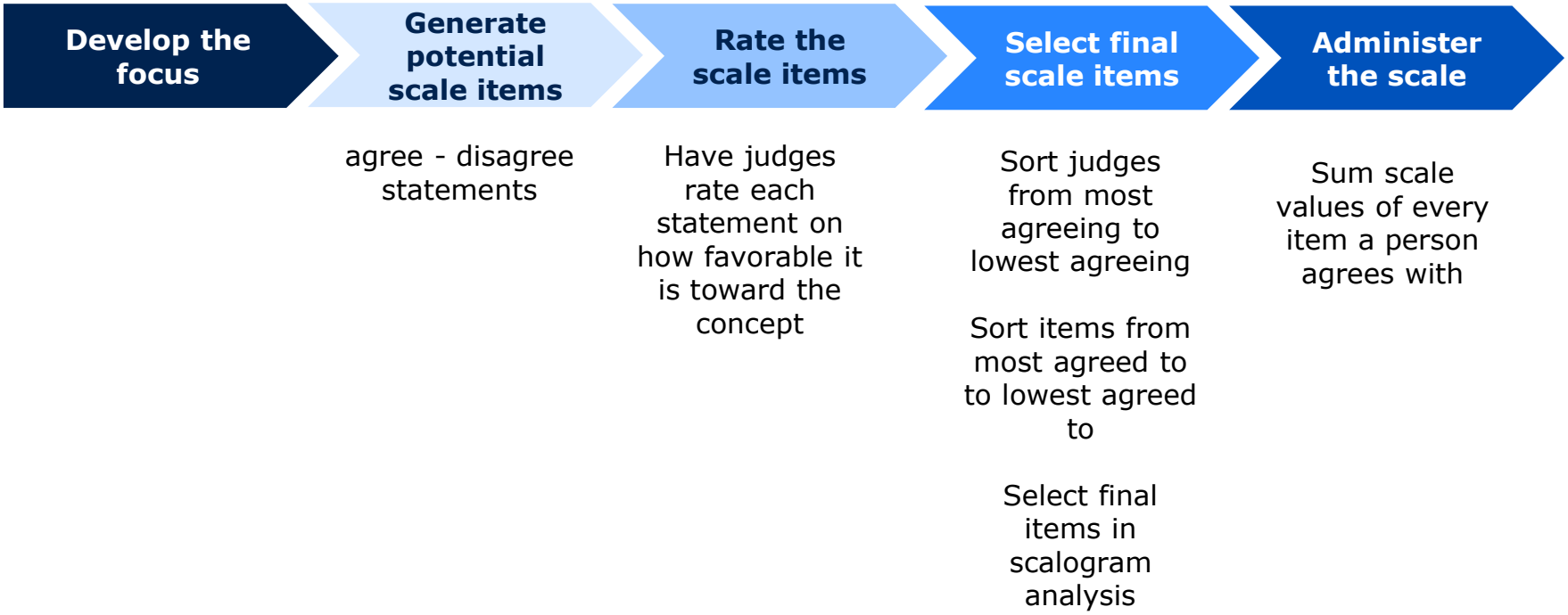
Likert Scaling

- Summative scaling



Guttman Scaling

- Cumulative scaling or scalogram analysis
- Create a scale with a cumulative order of statements



Conclusion

Both indexes and scales give a numerical score designed to reflect a construct of interest

Indexes	Scales
Condense information	
Yield a numerical score or value reflecting a construct of interest	

▪ Indexes combine a set of different variables, each of which might be also measured differently (e.g. income, occupation and education in SES)
  ▪ Often used for objectively observable measure like prices
  ▪ Commonly used indexes (CPI, SES, h-index)
  ▪ Several steps to follow to construct an index
	▪ Scales involve rating a set of similar items on the same response scale (1-to-5,Agree/Disagree, Yes/No)
	  ▪ Often used to measure more subjective and judgmental constructs (e.g., beliefs)
	  ▪ Unidimensional (e.g., Thurstone, Likert, Guttman) and Multidimensional Scaling
	  ▪ Constructed by following a thorough process - Not just a list of items with scores