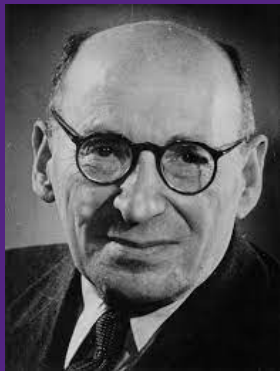


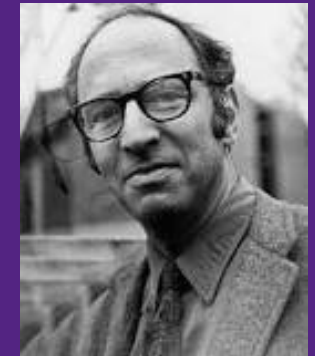
# WU

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ECONOMICS  
AND BUSINESS

**Thomas Salzberger, PD Dr.**  
**thomas.salzberger@wu.ac.at**

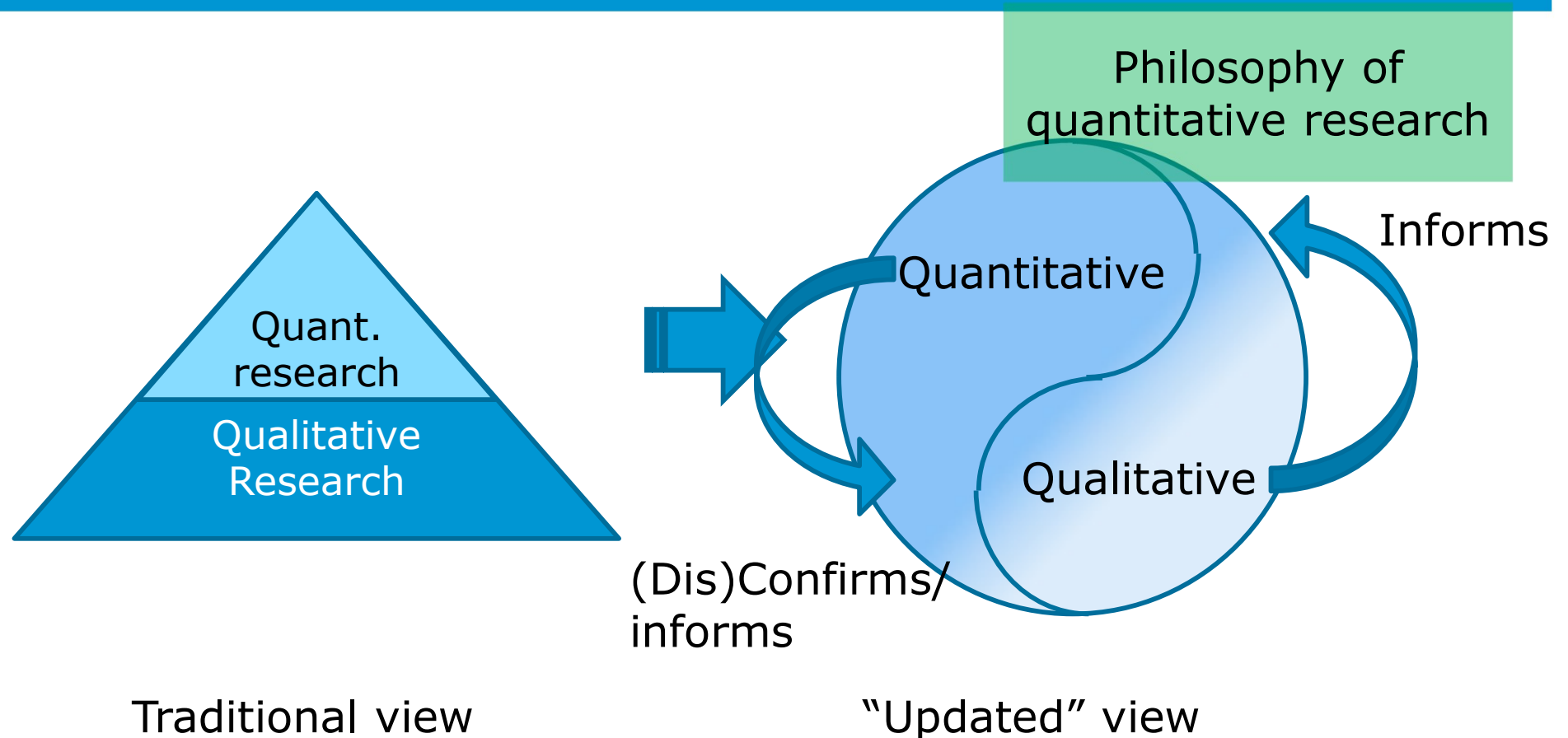


## Quantitative Research Methods Introduction



[http://statmath.wu.ac.at/courses/m1bw/m1bw\\_en.html](http://statmath.wu.ac.at/courses/m1bw/m1bw_en.html)

# Quantitative and Qualitative Research Methods

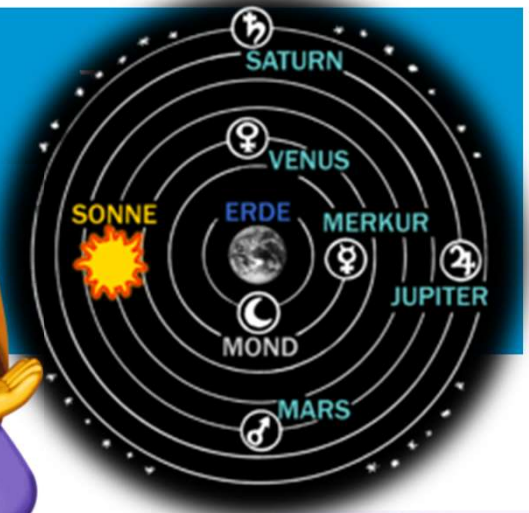


**Alternative -> Building upon one another -> complementary (Mixed methods)**

# Why Quantitative Research Methods as a Course in the Doctoral Program?

- Many concepts/constructs in empirical research are *hypothesized (assumed)* to be quantitative
- Use of quantitative methods in doctoral research project
- Quantitative methods as part of the curriculum
  - Interpreting quantitative research
  - Familiarisation with “quantitative thinking”

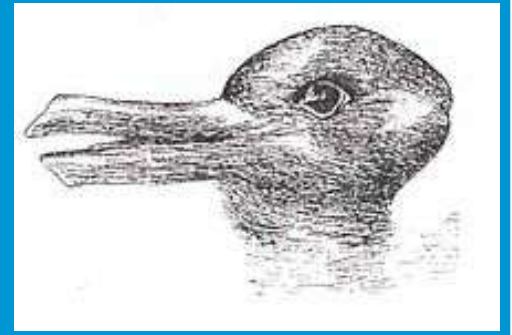
# Quantitative Science as a Success Story



- Roman Catholic doctrine:
  - *Earth at the centre of the universe*
  - Echoed Greek geographer Ptolemy (~100 to ~>160)
  - Even though Aristarchus of Samos (~310 BC to ~230 BC) *proposed that the Earth orbits the Sun (Heliocentric theory)*
  - But no empirical evidence was available
- Heliocentric theory only revived in the 16<sup>th</sup> century by Nicolaus Copernicus (1473-1543)
  - New empirical evidence: Mathematics & Observations confirmed heliocentric theory
  - And yet did Copernicus dare to publish his results only in 1543 - the year of his death



# Quantitative Science as a Success Story (cont.)



- Galileo Galilei (1564-1642; born 21 years after Copernicus' death) collected further evidence for the heliocentric theory
  - Use of mathematics in physics (→ measurement)
  - Experiment as a way to put questions to nature
- Withdrew due to massive resistance from the Roman Catholic Church (*think of different paradigms!*)
- Copernican turn as a gradual process

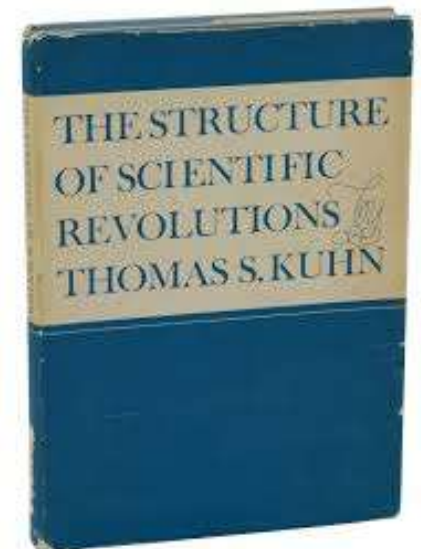


Thomas Kuhn



“Measure what can be measured, and make measurable what cannot be measured.”

– Galileo Galilei

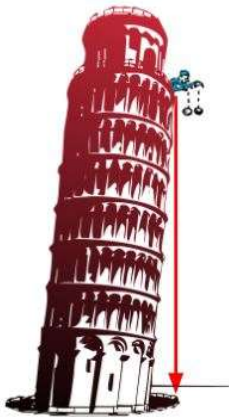




# Mathematics and Empirical Evidence

(→post-positivism, critical realism)

- Galileo Galilei's experiment to test the speed of fall (generally supposed to depend on mass of objects)

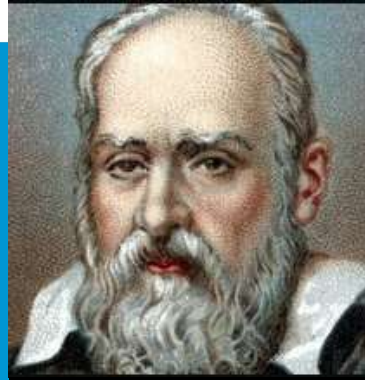


- Ideal theoretical model versus imperfect empirical experiment
- The inclined plane is not a perfect plane, the cannon balls are no perfect balls
- "Both Galileo and his opponents saw the same 'fact.' But they interpreted the same fact differently and made the same happening visible to themselves in different ways. Indeed, what appeared for them as the essential fact and truth was something different."

*Heidegger, M. (1967). What is a thing? (W. B. Barton, Jr. & V. Deutsch, Trans.). South Bend, Indiana: Regnery/Gateway, p.90.*

- <http://www.scielo.org.mx/pdf/trf/n56/0188-6649-trf-56-167.pdf>

# All is Quantitative Is it?



Measure what can be measured,  
and make measurable what  
cannot be measured.

~ Galileo Galilei



*"The world is built upon  
the power of numbers."*

\*

"All is number."

Pythagoras

Explaining the world using  
mathematics.

Mathematics: "that which is learned"  
(from *manthanein* "to learn")  
Mathematics tells us lessons.

# Quantitative Science: Can Social Sciences Follow the Lead?

- Quantitative approach to science proved enormously successful in the natural sciences
- Role model for the social sciences (marketing, management, health, psychology, education, etc.)
  - Quantitative imperative:  
Social sciences have to be quantitative to be of any use, to be accepted as science
  - Measurement crucial





# Quantitative Science: Can Social Sciences Follow the Lead?

## SCIENCE

Vol. 103, No. 2684

Friday, June 7, 1946

### On the Theory of Scales of Measurement

S. S. Stevens

Director, Psycho-Acoustic Laboratory, Harvard University

FOR SEVEN YEARS A COMMITTEE of the British Association for the Advancement of Science debated the problem of measurement. Appointed in 1932 to represent Section A (Mathematical and Physical Sciences) and Section J (Psychology), the committee was instructed to consider and report upon the possibility of "quantitative estimates of sensory events"—meaning simply: Is it possible to measure human sensation? Deliberation led only to disagreement, mainly about what is meant by the term measurement. An interim report in 1938 found one member complaining that his colleagues "came out by that same door as they went in," and in order to have another try at agreement, the committee begged to be continued for another year.

For its final report (1940) the committee chose a common bone for its contentions, directing its arguments at a concrete example of a sensory scale. This was the Sone scale of loudness (S. S. Stevens and H. Davis. *Hearing*. New York: Wiley, 1938), which purports to measure the subjective magnitude of an auditory sensation against a scale having the formal properties of other basic scales, such as those used to measure length and weight. Again the 19 members of the committee came out by the routes they entered, and their views ranged widely between two extremes. One member submitted "that any law purporting to express a quantitative relation between sensation intensity and stimulus intensity is not merely false but is in fact meaningless unless and until a meaning can be given to the concept of addition as applied to sensation" (Final Report, p. 245).

It is plain from this and from other statements by the committee that the real issue is the meaning of measurement. This, to be sure, is a semantic issue, but one susceptible of orderly discussion. Perhaps agreement can better be achieved if we recognize that measurement exists in a variety of forms and that scales of measurement fall into certain definite classes. These classes are determined both by the empirical operations invoked in the process of "measuring" and

by the formal (mathematical) properties of the scales. Furthermore—and this is of great concern to several of the sciences—the statistical manipulations that can legitimately be applied to empirical data depend upon the type of scale against which the data are ordered.

#### A CLASSIFICATION OF SCALES OF MEASUREMENT

Paraphrasing N. R. Campbell (Final Report, p. 340), we may say that measurement, in the broadest sense, is defined as the assignment of numerals to objects or events according to rules. The fact that numerals can be assigned under different rules leads to different kinds of scales and different kinds of measurement. The problem then becomes that of making explicit (a) the various rules for the assignment of numerals, (b) the mathematical properties (or group structure) of the resulting scales, and (c) the statistical operations applicable to measurements made with each type of scale.

Scales are possible in the first place only because there is a certain isomorphism between what we can do with the aspects of objects and the properties of the numeral series. In dealing with the aspects of objects we invoke empirical operations for determining equality (classifying), for rank-ordering, and for determining when differences and when ratios between the aspects of objects are equal. The conventional series of numerals yields to analogous operations: We can identify the members of a numeral series and classify them. We know their order as given by convention. We can determine equal differences, as  $8 - 6 = 4 - 2$ , and equal ratios, as  $8/4 = 6/3$ . The isomorphism between these properties of the numeral series and certain empirical operations which we perform with objects permits the use of the series as a model to represent aspects of the empirical world.

The type of scale achieved depends upon the character of the basic empirical operations performed. These operations are limited ordinarily by the nature of the thing being scaled and by our choice of procedures, but, once selected, the operations determine



NOVEMBER 4 1906



Stanley Smith Stevens was born. Widely considered one of the most eminent psychologists of the 20th century, S. S. Stevens is renowned for his profoundly influential work within the field of psychoacoustics; most notably his "power law" experiments designed to measure the perceived intensity of a stimulus e.g. loudness of sound.

Stevens spent his entire career at Harvard University during which time he was director of the Psycho-Acoustic Laboratory, published his seminal reference book, *The Handbook of Experimental Psychology* and became the world's first Professor of Psychophysics.

Stanley Smith Stevens was awarded the Warren Medal of the Society of Experimental Psychologists in 1945, was elected to the National Academy of Sciences in 1946 and received the Distinguished Scientific Contribution Award of the American Psychological Association in 1960.

[www.all-about-psychology.com](http://www.all-about-psychology.com)



**And Now For Something  
Completely Different**

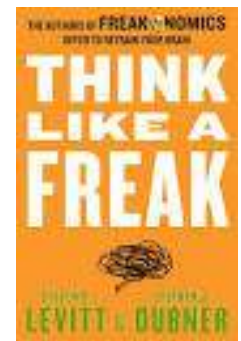


John Cleese on Creativity In Management (1991)  
<https://www.youtube.com/watch?v=Pb5oIIP062g>

# A Short Story

*A little girl named Mary goes to the beach with her mother and brother. They drive there in a red car. At the beach they swim, eat some ice cream, play in the sand, and have sandwiches for lunch.*

\* Steven D. Levitt and Stephen J. Dubner: *Think like a freak*, 2014.



# A Short Quiz

*(1) What colour was the car?*

*red*

*(2) Did they have fish and chips for lunch?*

*no, sandwiches*

*(3) Did they listen to music in the car?*

*maybe, we don't know*

*(4) Did they drink lemonade with lunch?*

*maybe, we don't know*

# A Bluff

- This little quiz was administered to British **schoolchildren between the ages of 5 and 9** by academic researchers. Nearly all of the children **answered the first two questions correctly** (red and no, respectively) as it was merely a matter of retaining those details of the story.
- However, an **overwhelming majority of the children** who participated **did not get the last two questions right**.
- Seventy-six percent (76%) of the children quizzed answered the last two questions **in the same way many business leaders and politicians** approach issues and problems: they **bluffed through them**.
- The last two questions are unanswerable. One may have an *opinion* on these issues, but one cannot *know*.



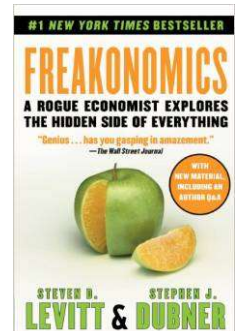
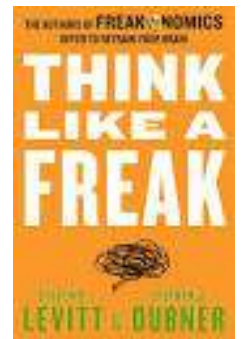
# Cause and Effect we know



- Large multinational retailer\*
  - Spends millions of \$ on advertising in the US
    - TV commercials
    - Print circulars in Sunday newspapers
  - Effectiveness?

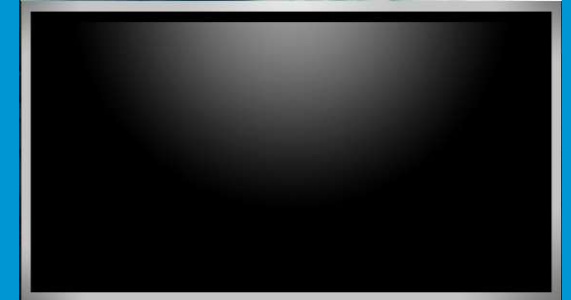
*TV four times more effective than print ads*

- Evidence ?
- Association between TV ads and product sales: mighty sales spike whenever the TV commercial ran
- When are TV ads aired?
  - Very expensive
  - Only Black Friday, Christmas, Father's day



\* Steven D. Levitt and Stephen J. Dubner: *Think like a freak*, 2014.

# Cause and Effect



- But on these dates, the retailer might have sold the same without any TV commercials at all
- Reversed causality?
  - TV ads are aired because of the sales spikes
- Print ads
  - Inexpensive; newspaper inserts every single Sunday for the past 20 years in 250 markets across the US
  - In other words: no variation of the presumed cause ...
- What could we do?



# Cause and Effect

- Pittsburgh
  - Young employee once forgot to book the Sunday ads for the entire summer
  - Company has never looked at the effect
  - In fact, there was none
  - The only available empirical evidence suggests the ads are not (terribly) effective
- And yet the company keeps on running the newspaper ads and does not deem an experiment necessary

# Why Shy Away from Experiments/Evidence?

Never ascribe to malice that which can adequately be explained by incompetence.

- Tradition
  - We always have been doing it this way
- Lack of expertise (Hanlon's razor)
- Cost of obtaining evidence
- We know the answer
  - Status as expert, decider
  - Reluctance to say "I don't know"
- And: Confirm preconceptions rather than trying to disprove them
  - Confirmation bias
    - What we see AND how we see things



There are in fact two things, **science and opinion**; the former begets knowledge, the latter ignorance.

Hippocrates





# Overcoming the "I don't know"



- *Observational studies can be very misleading*
- **Experiments** are the most informative way to learn something about cause-effect relationships
  - Treatment and control group
  - Randomized trial reduces complexity
- Multi-centre-studies (more than one place)
- Limitations
  - Some variables cannot be manipulated
    - Practical, ethical limitations
  - Look for "natural experiment" (-> Pittsburgh)

# *A continuum*

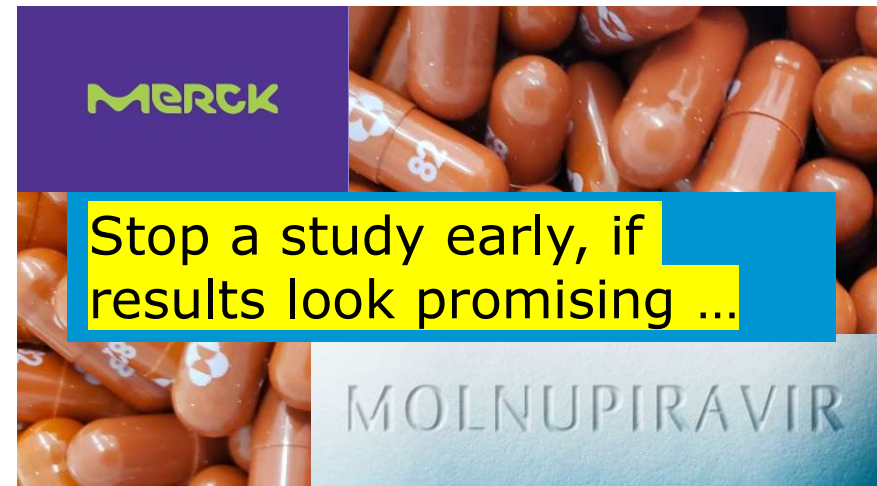
**minimal limitations**



**some limitations**

**fatal limitations**

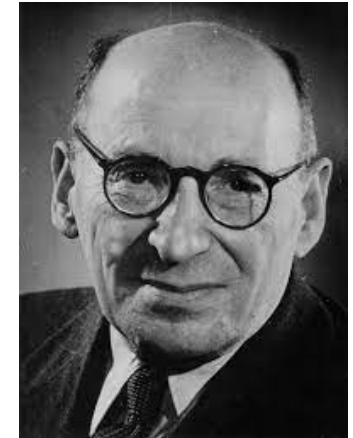
- The way we treat study subjects (consumers, patients, ...)
  - Ethical conduct of studies
  - Doing no harm to study participants/animate beings
  - Who benefits from the study?
  - Problem of denying the treatment (→ cross-over design)
  - Pre-registration of study
  - IRB-Review (institutional review board ethically approves study)
  - Anonymity, privacy, data protection
  - Informed consent



*But wait a minute!*

Simmons, J. P., Nelson, L. D., & Simonsohn, U. (2011). False-positive psychology: Undisclosed flexibility in data collection and analysis allows presenting anything as significant. *Psychological science*, 22(11), 1359-1366.

- The way we conduct science
  - Science is a collective enterprise
    - Thomas Kuhn's scientific paradigms
    - Ludwik Fleck's thinking styles, collective thinking ("Denkstile"; "Denkkollektiv")
  - Incentive scheme is highly individualised
    - Number of publications, citations, etc.
  - Vested interest in research results
    - Corporations, politics, ...
  - Demands from the public
    - Answers: quick, univocal, definitive



# Imperfect Science

- What imperfections in scientific research may exist?



# Ethics – A Continuum

Ethics: treating of subjects



ChatGPT

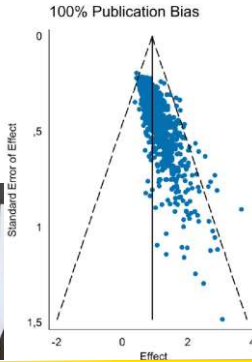


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How science must not be (totally flawed)

How science ought to be (ideal)



evidence-based, neutral, objective, Pre-registration of study protocol and analysis plan, replications, meta-analyses, preliminary insight

Non-disclosure of data

Manuscripts ending up in the drawer

Publication bias

p-hacking (cherry-picking)

Fraudulent suppressing of data

Duplicate publication



CEOs tobacco industry



Diederik Stapel, former Prof. of Social Psychology

# Ethics – A Continuum

How science ought to be (ideal)

Multiple simultaneous publications of the same or highly redundant paper/study/data

How science must not be (totally flawed)



evidence-based  
 neutral, objective,  
 in advance publishing of  
 study protocol and  
 analysis plan,  
 replications, meta-analyses,  
 preliminary insight

Different audience

Duplicate publication

Boosting publication record

# Stapel's retracted papers

## More bad news ...



- Fernández, L. M., & Vadillo, M. A. (2020). Retracted papers die hard: Diederik Stapel and the enduring influence of flawed science. PsyArXiv. <https://doi.org/10.31234/osf.io/cszpy>
- Fraudulent research: Diederik Stapel still often cited Ron Vaessen, 8 December 2022  
<https://universonline.nl/nieuws/2022/12/08/fraudulent-research-diederik-stapel-still-often-cited/>



THE INDEPENDENT  
NEWS SOURCE OF  
TILBURG UNIVERSITY

# ... and more fabricated data?

## Fabricated data in research about honesty. You can't make this stuff up. Or, can you?

JULY 28, 2023 · 4:15 AM ET

By Nick Fountain, Jeff Guo, Keith Romer, Emma Peaslee

- The Hartford, an insurance company that collaborated with Ariely on one implicated study, told NPR this week in a statement that it could confirm that the data it had provided for that study had been altered after they gave it to Ariely, but prior to the research's publication: "It is clear the data was manipulated inappropriately and supplemented by synthesized or fabricated data." (*emphasis added*)
- Ariely denies that he was responsible for the falsified data. "Getting the data file was the extent of my involvement with the data," he told NPR.  
<https://www.npr.org/2023/07/27/1190568472/dan-ariely-francesca-gino-harvard-dishonesty-fabricated-data>

## *The Harvard Professor and the Bloggers*

When Francesca Gino, a rising academic star, was accused of falsifying data — about how to stop dishonesty — it didn't just torch her career. It inflamed a crisis in behavioral science.

- <https://www.nytimes.com/2023/09/30/business/the-harvard-professor-and-the-bloggers.html>



By Noam Scheiber

Published Sept. 30, 2023 Updated Oct. 2, 2023





## ... and more fabricated data?

The school told Dr. Gino it had received allegations that she manipulated data in four papers on topics in behavioral science, which straddles fields like psychology, marketing and economics.

Dr. Gino published the four papers under scrutiny from 2012 to 2020, and fellow academics had cited one of them more than 500 times. The paper found that asking people to attest to their truthfulness at the top of a tax or insurance form, rather than at the bottom, made their responses more accurate because it supposedly activated their ethical instincts before they provided information.





# ... and more fabricated data?



The school told Dr. Gino it had received allegations that she manipulated data in four papers on topics in behavioral science, which straddles fields like psychology, marketing and economics.

Dr. Gino published the four papers under scrutiny from 2012 to 2020, and fellow academics had cited one of them more than 500 times. The paper found that a truthfulness at the top of a tax bottom, made their responses activated their ethical instincts

Though she did not know it at the time, Harvard had been alerted to the evidence of fraud a few months earlier by three other behavioral scientists who publish a blog called Data Colada, which focuses on the validity of social science research. The bloggers said it appeared that Dr. Gino had tampered with data to make her studies appear more impressive than they were. In some cases, they said, someone had moved numbers around in a spreadsheet so that they better aligned with her hypothesis. In another paper, data points appeared to have been altered to exaggerate the finding.

# ... and more fabricated data?

Perhaps most significant, the accusations against Dr. Gino

Fraud, though, is something else entirely. Dozens of Dr. Gino's co-authors are now scrambling to re-examine papers they wrote with her. Dan Ariely, one of the best-known figures in behavioral science and a frequent co-author of Dr. Gino's, also stands accused of fabrication in at least one paper.

Though the evidence against Dr. Gino, 45, appears compelling, it remains circumstantial, and she denies having committed fraud, as does Dr. Ariely. Even the bloggers, who published a four-part series laying out their case in June and a follow-up this month, have acknowledged that there is no smoking gun proving it was Dr. Gino herself who falsified data.

That has left colleagues, friends, former students and, well, armchair behavioral scientists to sift through her life in search of evidence that might explain what happened. Was it all a misunderstanding? A case of sloppy research assistants or rogue survey respondents?







Ergebnisse um jeden Preis

## Wenn Forscher betrügen

Jedes Jahr fließen Milliarden-Summen in die Forschung. Doch immer wieder gibt es Wissenschaftler, die Forschungsergebnisse fälschen oder schlicht erfinden. Problematisch ist auch, dass es hierzulande kein geeignetes System gibt, um Fälschungen zu unterbinden.

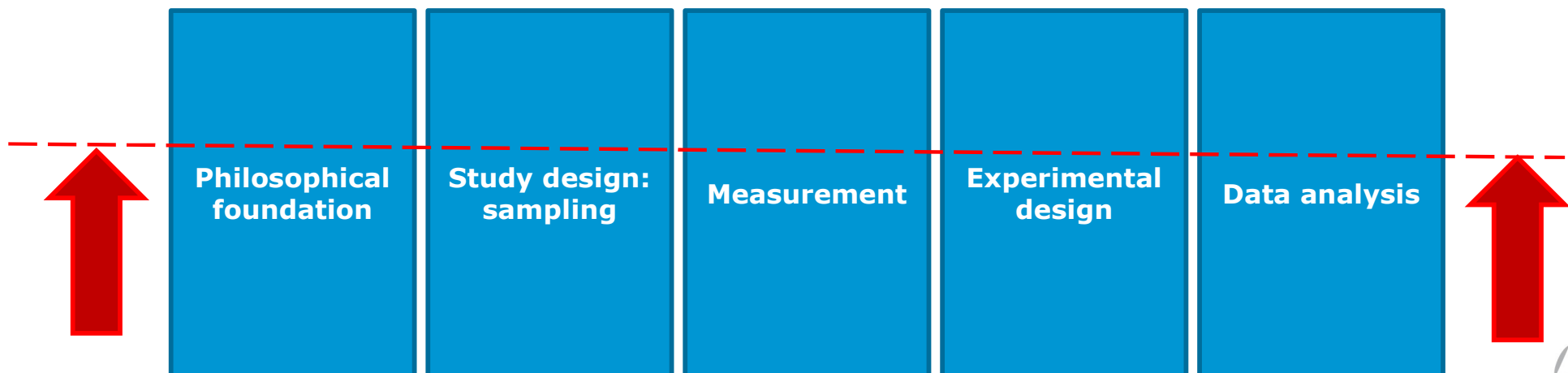
Von Catalina Schröder | 14.02.2018

Interview with Diederik Stapel (in German):

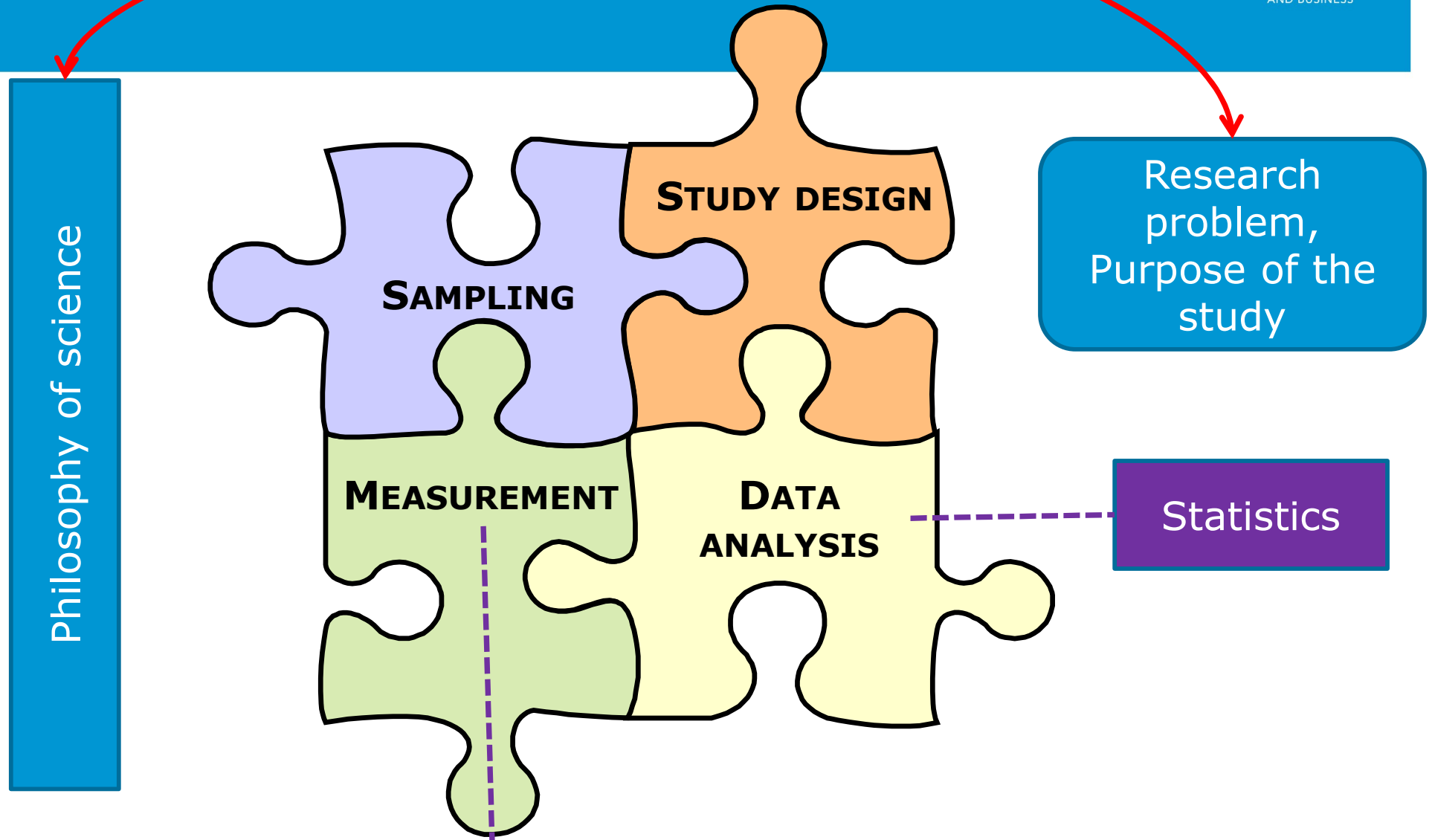
<https://www.deutschlandfunk.de/ergebnisse-um-jeden-preis-wenn-forscher-betruegen-100.html>

# Learning Outcomes

- Familiarize with the *milestones of quantitative empirical research*, *comprehend quantitative studies* and their results, *critically evaluate* and challenge their scientific underpinning, *design own quantitative empirical projects*.



# Quantitative Studies





# Text Book by Trochim & Donnelly: **WU** The Research Methods Knowledge Base

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## Research Methods Knowledge Base

by Prof William M.K. Trochim

Search

Navigating the Knowledge Base

Foundations

Sampling


Measurement

Research Design

Analysis

Write-Up

Appendices

 Sign in to Conjoint.ly

 Free online survey tool

 Conjoint.ly research methods

Research Methods Knowledge Base / Home



## What is the Research Methods Knowledge Base?

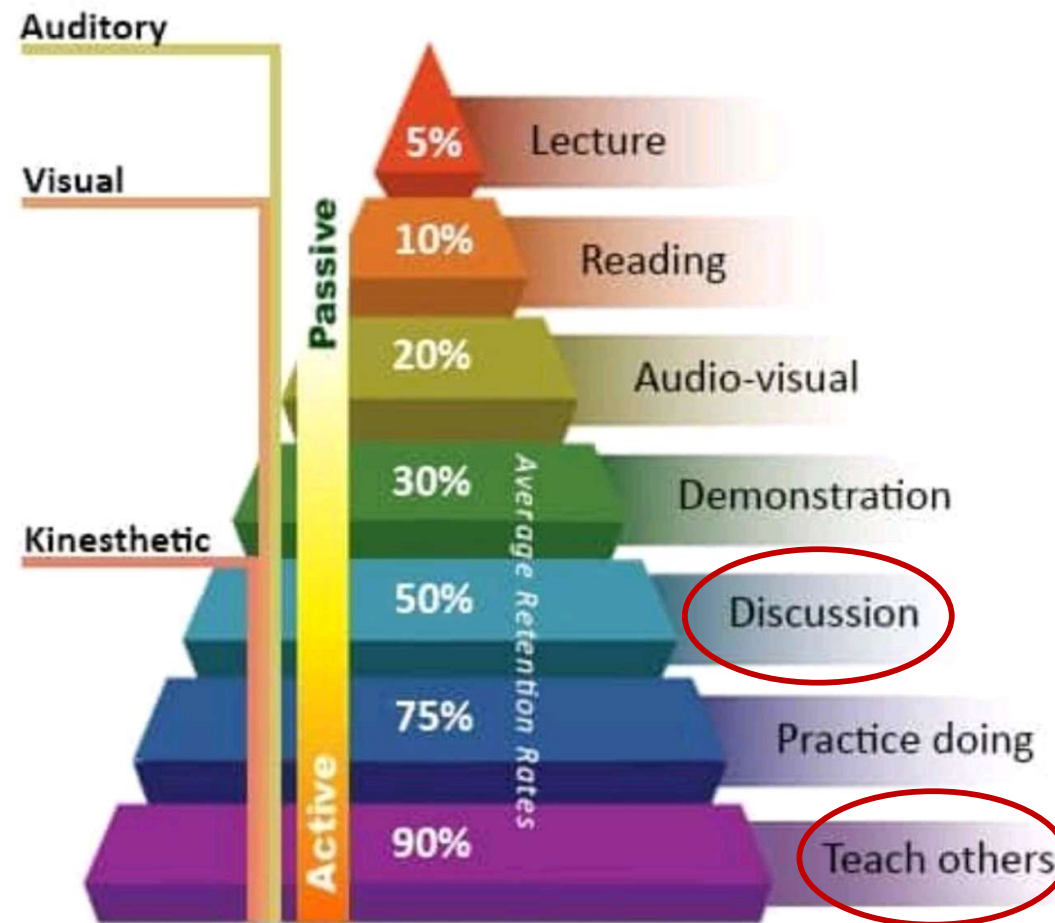
The Research Methods Knowledge Base is a comprehensive web-based textbook that addresses all of the topics in a typical introductory undergraduate or graduate course in social research methods. It covers the entire research process including: formulating research questions; sampling (probability and nonprobability); measurement (surveys, scaling, qualitative, unobtrusive); research design (experimental and quasi-experimental); data analysis; and, writing the research paper. It also addresses the major theoretical and philosophical underpinnings of research including: the idea of validity in research; reliability of measures; and ethics.

# Text Book by Trochim & Donnelly: **WU** The Research Methods Knowledge Base

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- William M.K.Trochim / James P.Donnelly (“Trochim”):  
The Research methods Knowledge Base (3rd edition) Atomic Dog.  
Available for free at URL: <http://www.socialresearchmethods.net/kb/>
- Topics for the units (online version):  
<http://www.socialresearchmethods.net/kb/contents.php>  
*This version may be used to download figures (copy and paste into your own presentation) or clarify some formulae that lack subscripts or superscripts in the pdf version (see below).*
- You may download a pdf version of the chapters from (link is also on the HTML page of the course):  
<http://statmath.wu.ac.at/~salzberger/quantmeth/pdfdownloaddirectory/>  
*Please download pdf files from there. All files may only be used for educational purposes during this course.*

# Engaged critical model of teaching *as opposed to* Transmission model



Adapted from the NTL Institute of Applied Behavioral Science Learning Pyramid

# Topics 1 & 2 to be presented in Unit 1 (Book chapters 1 & 2)

## [1] Theoretical Foundations

- *Language of research, concept of validity*
- Ethical issues and principles in research

## [2] Sampling

- Generalizability of findings, external validity
- Probability and nonprobability sampling
- *In general, statistical analyses will not make up for flawed sampling.*

# Topics 3 to 5 (Book chapters 3 to 5)

## [3] Measurement

**to be presented in Unit 2**

- Quantitative research typically involves measurement.
- Challenge of measuring unobservable (so-called *latent*) variables
- Levels of measurement in the social sciences (according to S.S. Stevens' notion of measurement)
- Quality criteria of measurement (reliability and validity)

## [5] Scaling and Index Construction

**to be presented in Unit 3**

- Selected methods of scaling and index construction
  - Thurstone scaling
  - Likert scaling (additional literature by Likert)
  - Guttman scaling



# Topics 3 to 5 cont. (Book chapters 3 to 5)

## [4] **Survey Research**

**to be presented in Unit 3**

- Very widely used method of data collection in the social sciences
- Principles of good survey research
- Types of surveys, how to select a survey method, how to construct a survey, what kind of questions are appropriate, how should they be phrased, how should a response scale look like, what are the pros and cons of survey research

# Topic 6

## (Book chapters 7)

### [6] **Design**

**to be presented in Unit 4**

- Internal validity
- Fundamentals of establishing cause and effect
- Threats in single or multiple group designs

# Topics 7 & 8 **to be presented in Unit 4** (Book chapters 9 & 10)

## [7] **Experimental Design**

- Investigate causal claims
- Two-group experimental designs
- Probabilistic equivalence and random selection and assignment
- Factorial designs, randomized block designs, covariance designs and hybrid experimental designs

## [8] **Quasi-experimental Design**

- Quasi-experimental designs as an alternative
- Nonequivalent groups design, regression-discontinuity design and other quasi-experimental designs

# Topics 9 & 10 to be presented in Unit 5 (Book chapters 12 & 14-308)

## [9 & 10] **Analysis**

- Data preparation, data description
- Elementary statistics (e.g., correlation coefficients)
- Fundamental inferential statistics (e.g., t-test)
- Concept of dummy variables.
- Conclusion validity, threats to conclusion validity and ways to improve it
  
- *Note: Topic 10 (chapter 14): up to p.308 only*

# How We Deal with these Topics

- Preparation and presentation of the topics by the course participants
  - Text book as the basis
  - Add at least one additional literature source (can also be something from the internet)
  - Challenge Trochim whenever you disagree
- Presenter(s)
  - Aim is to provide an introduction into the topic, stimulate a discussion
  - Expose issues that are unclear to you
  - Try to involve the audience; e.g. by presenting a task, a game, etc., something entertaining, stimulating
- Audience
  - A successful unit needs good presenter(s) and active audience
  - Be prepared and participate in the discussion



# How to Approach the Topics/Presentations

- Setting the stage
  - What are we dealing with? What is <quant research/sampling/measurement/etc.>)
  - Why is the topic important?
  - What do we want to achieve?
  - How can we achieve it?
  - Problems, caveats, limitations in practice, etc.
  - ...
  - Include your own thoughts and considerations!

# Guidelines

- Technicalities
  - Number of slides typically in the order of 30-40 slides (depends heavily on topic, presentation style, etc.)
  - Send presentation (preferably Powerpoint, pdf) to [Thomas.Salzberger@wu.ac.at](mailto:Thomas.Salzberger@wu.ac.at) no later than the day before the presentation
  - If possible, bring a handout (=printout of slides) for participants (different arrangement if needed)

- Attendance and active participation is required and expected
- Presentation
  - Up to 20 credits per presentation (presenters do not need to take the quiz for that chapter, 8 points will be credited automatically)
- Tests (quizzes):
  - 10 quizzes (one per topic), mostly multiple choice format at the beginning of the next class (prior to online sessions, dedicated time period)
  - 8 credits per quiz, thus  $10 \times 8 = 80$  credits
  - Missed quizzes can be done in the final unit or by alternative arrangement
  - Up to 2 quizzes can be cancelled and re-done in the final unit (upgrade)
    - Alternative arrangement for the last two quizzes on analysis I and II
- Grading schemes:
  - Different schemes depending on the number of presentations as max points vary; doing more presentations is rewarded

# Assigning the Topics

## *Presentation topics*

**Unit 1**  
**19 MARCH**

- [1] **Theoretical Foundations**
- [2] **Sampling**

**Unit 2**  
**26 MARCH**

- [3] **Measurement**
- [3E] *Applied Measurement*

**Unit 3**  
**2 APRIL**

- [5] **Scaling and Index Construction**
- [4] **Survey Research**

**Unit 4**  
**9 APRIL**

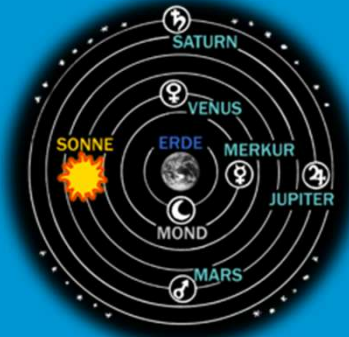
- [6] **Design**
- [7] **Experimental Design**
- [8] **Quasi-experimental Design**

**Unit 5**  
**23 APRIL**

- [9] **Analysis I**
- [10] **Analysis II**

**EXAM Unit**  
**7 MAY**

*Final exams, wrap-up*



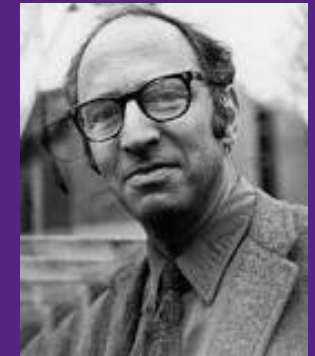
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UNIVERSITY OF  
ECONOMICS  
AND BUSINESS

**Thomas Salzberger, PD Dr.**  
**thomas.salzberger@wu.ac.at**



## Quantitative Research Methods Introduction



[http://statmath.wu.ac.at/courses/m1bw/m1bw\\_en.html](http://statmath.wu.ac.at/courses/m1bw/m1bw_en.html)