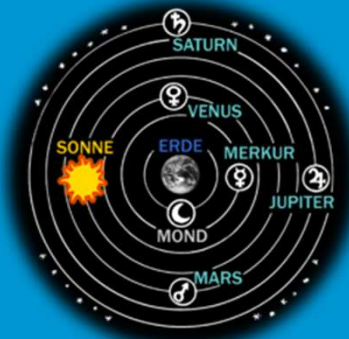




WIRTSCHAFTS
UNIVERSITÄT
WIEN VIENNA
UNIVERSITY OF
ECONOMICS
AND BUSINESS

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Quantitative Research Methods Introduction

https://statmath.wu.ac.at/courses/m1bw/m1bw_en.html

Today's agenda

- *Quantitative* versus qualitative research
- Good versus bad research
- The researcher's mind

- 10 topics to be dealt with in this course
- Assignment of topics
- Technicalities

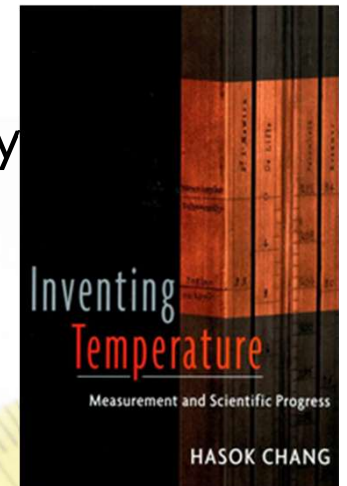
Quantitative Research

- Key element: some sort of measurement and/or counting
 - Counting: total number of more or less identical objects
 - E.g. 10 oranges in a bag; 200 passengers in one airplane
 - Natural “unit”: 1 object
 - Also used in qualitative research
 - Measurement: estimation of some (quantitative) property of an object
 - E.g. 1 litre of orange juice; 14 000 kilograms of total passenger load – a magnitude of volume, mass
 - Unit of measurement
 - Measurement: magnitude = scalar (a real number) times a unit of measurement (which is itself a magnitude of the property)

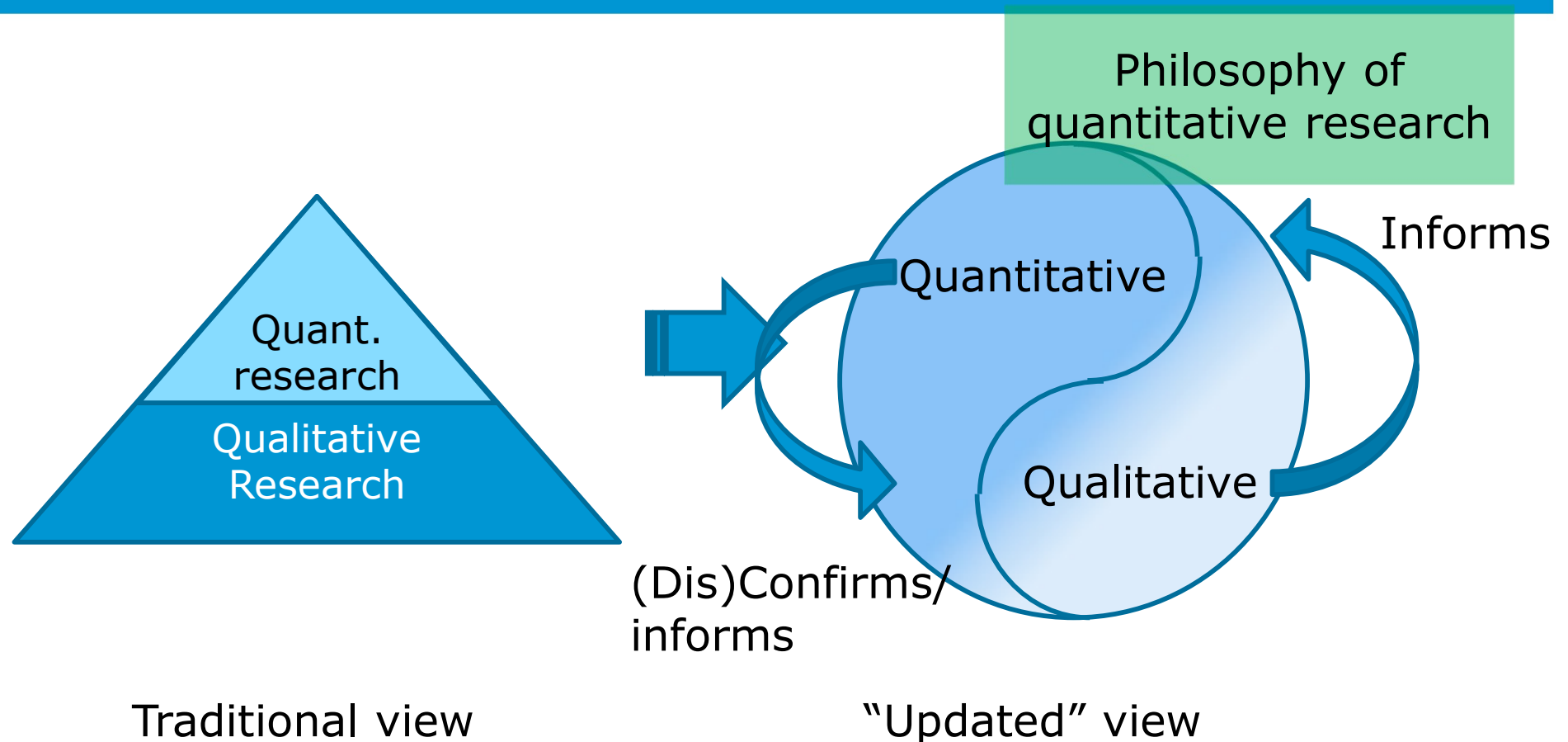
→ MEASUREMENT as a topic

Quantitative Research

- Measurement is by no means trivial
 - Requires deep understanding of *the quality* of the property
 - Relatively easy in case of length or mass
 - (But then *what is mass actually?*)
 - Temperature?
 - Latent constructs in social research such as attitudes, satisfaction, trust, loyalty, etc. represent unique challenges
- Quantitative research needs a solid qualitative foundation
- Qualitative research may be based on very little prior knowledge
(or none at all; grounded theory Glaser & Strauss, 1967)



Quantitative and Qualitative Research Methods



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

Quantitative Research (versus Qualitative Research)

- Different philosophy of science, different underpinnings
 - Idea of quantitative properties
 - Different concept of reality
 - Quant: Critical realism/post-positivism
 - Different methods of acquiring knowledge
 - Quant: Survey research, experiments
 - Different quality criteria
 - Quant: Objectivity, reliability, validity
- PHILOSOPHY OF SCIENCE/BASIC CONCEPTS as a topic
- SURVEY RESEARCH as a topic
- EXPERIMENTAL DESIGN as a topic
- QUASI-EXPERIMENTAL DESIGN as a topic (if experiments are not feasible)

Quantitative Research (versus Qualitative Research)

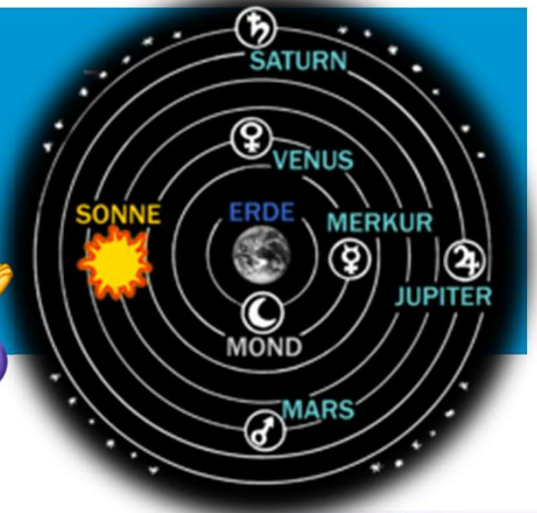
- Different goals
 - Generalisation from sample to some population
 - Explanatory
 - Causal relationships
- Different methods of data analysis

→ SAMPLING as a topic
→ DATA ANALYSIS as a topic

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

- Many concepts/constructs in empirical research are *hypothesized (assumed)* to be quantitative
 - Measurement
 - Analytical processing
- Use of quantitative methods in your own doctoral research project
- Quantitative methods as part of the curriculum
 - Interpreting quantitative research
 - Familiarisation with “quantitative thinking”
 - Research ambidexterity (knowledgeable in qualitative and quantitative research)

Quantitative Science as a Success Story



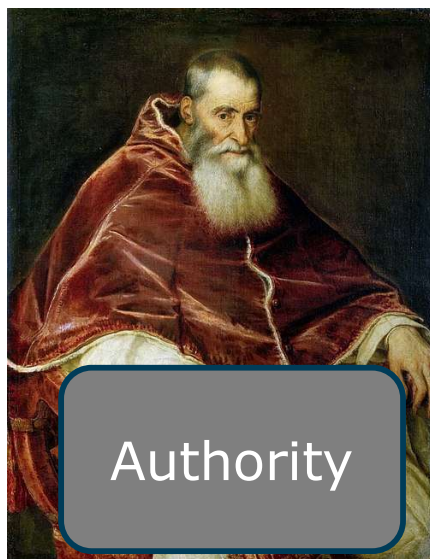
- Roman Catholic doctrine/geocentric model:
 - *Earth at the centre of the universe*
 - Echoed Greek geographer Ptolemy (~100 to ~>160)
 - Even though Aristarchus of Samos (~310 BC to ~230 BC) *proposed that the Earth orbits the Sun (Heliocentric theory)*
 - But no sound empirical evidence was available
 - *(In fact, existing evidence pointed towards geocentric theory*)*
- Heliocentric theory only revived in the 16th 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



DE REVOLUTIONIBUS ORBIUM COELESTIUM

* Constellations were supposed to change as the Earth revolved around the Sun

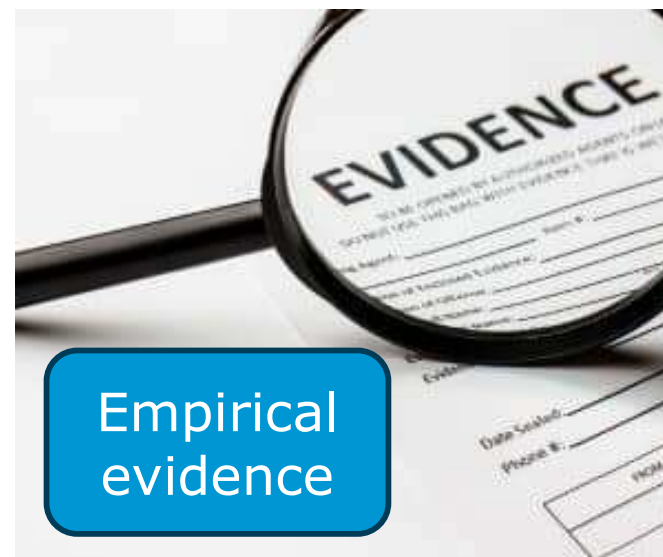
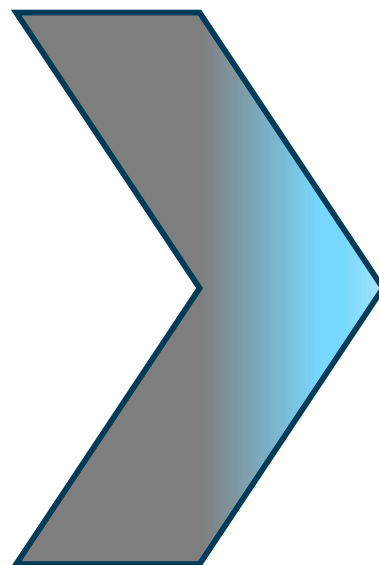
Quantitative Science as a Success Story



Authority

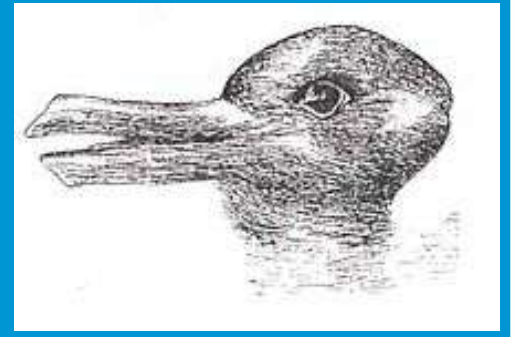


Beauty
(as a sine qua non)



Empirical
evidence

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

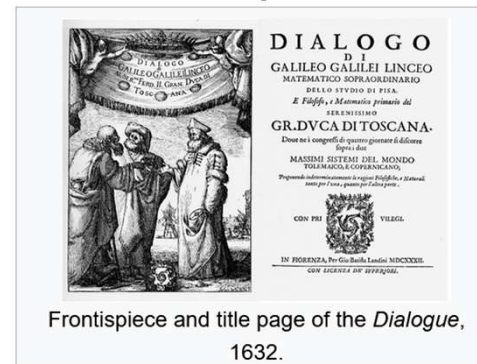


“Measure what can be measured, and make measurable what cannot be measured.”

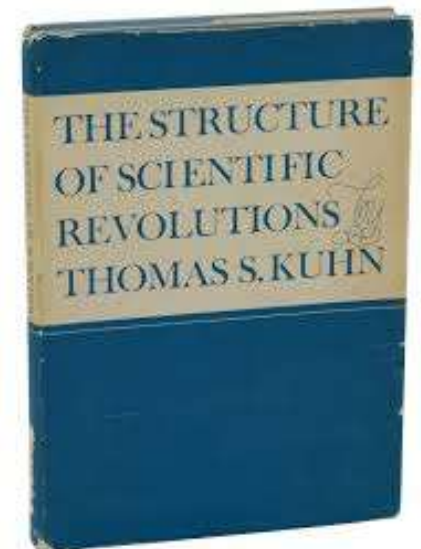
— Galileo Galilei

On top of that, Galileo apparently wasn't a particularly likeable guy.

Dialogue Concerning the Two Chief World Systems



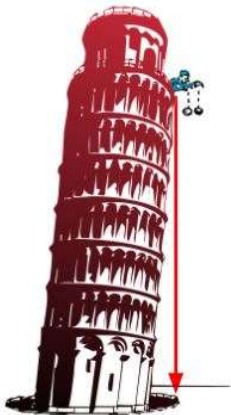
Frontispiece and title page of the *Dialogue*, 1632.



Mathematics and Empirical Evidence

(→post-positivism, critical realism)

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

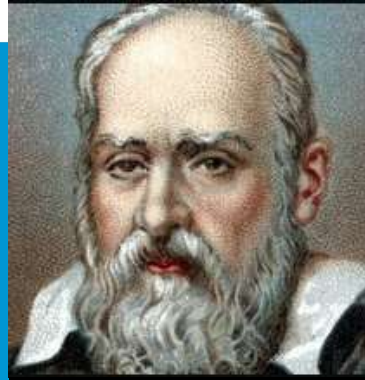


- Ideal theoretical model versus imperfect empirical experiment
- The inclined plane is not a perfect plane, the cannon balls are no perfect balls
- "Both Galileo and his opponents saw the same 'fact.' But they interpreted the same fact differently and made the same happening visible to themselves in 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 must be quantitative to be recognized as science
 - Measurement crucial

Quantitative Research

- Key element: some sort of measurement and/or counting
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 - E.g. 10 oranges in a bag; 200 passengers in one airplane
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 - Unit of measurement
 - Measurement: magnitude = scalar (a real number) times a unit of measurement (which is itself a magnitude of the property)

→ MEASUREMENT as a topic

Quantitative Science: Can Social Sciences Follow the Lead? Can we measure things?

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.

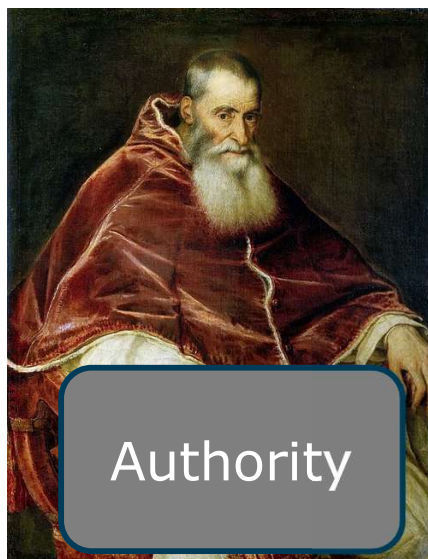
Stevens spent his entire career at Harvard University during which time he was director of the Psycho-Acoustic Laboratory, published his seminal reference book, *The Handbook of Experimental Psychology* and became the world's first Professor of Psychophysics.

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.

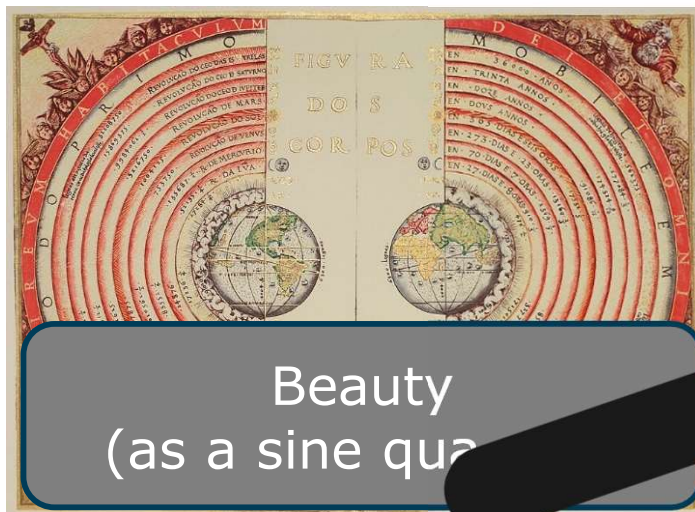
www.all-about-psychology.com

Measurement by assigning numerals to objects

Quantitative Science as a Success Story



Authority



Beauty
(as a sine qua non)

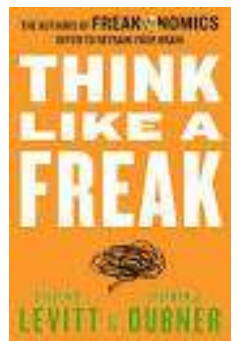


Empirical
evidence

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

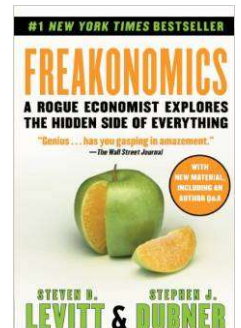
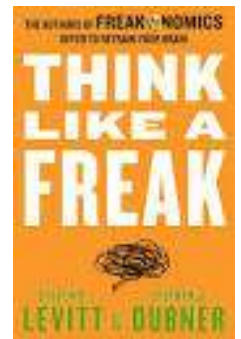


- Large multinational retailer*
 - Spends millions of \$ on advertising in the US
 - TV commercials
 - Print circulars in Sunday newspapers
 - Effectiveness?



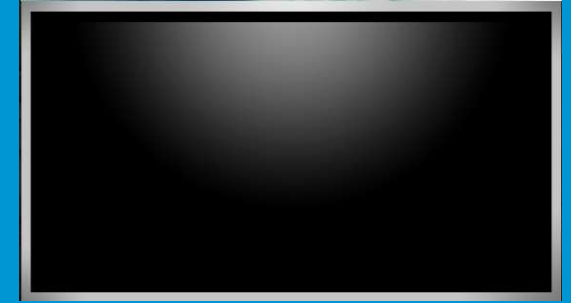
TV four times more effective than print ads

- 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?

Experiments

-
- Experiments

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?

- Tradition
 - We always have been doing it this way
- Lack of expertise (Hanlon's razor: Never attribute to malice that which is adequately explained by stupidity.)
- Cost of obtaining evidence
- We know the answer (arrogance)
 - 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



Overcoming the "I don't know"



- *Observational studies can be 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

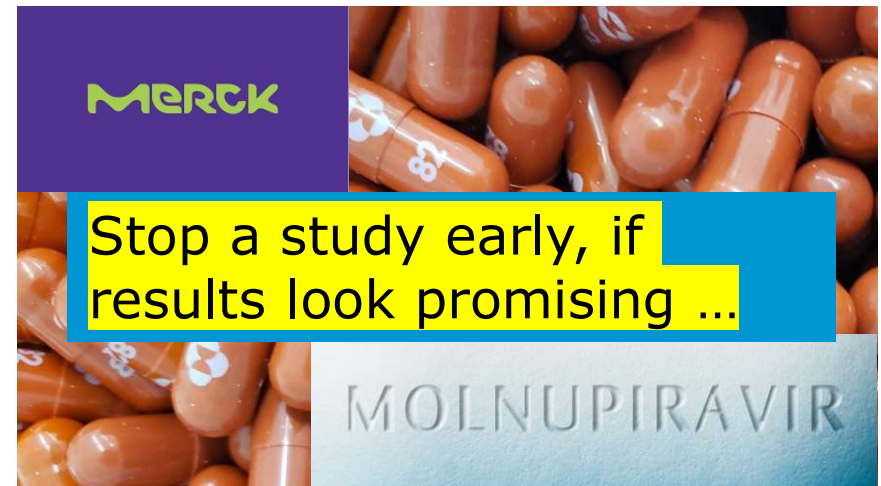
minimal limitations



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

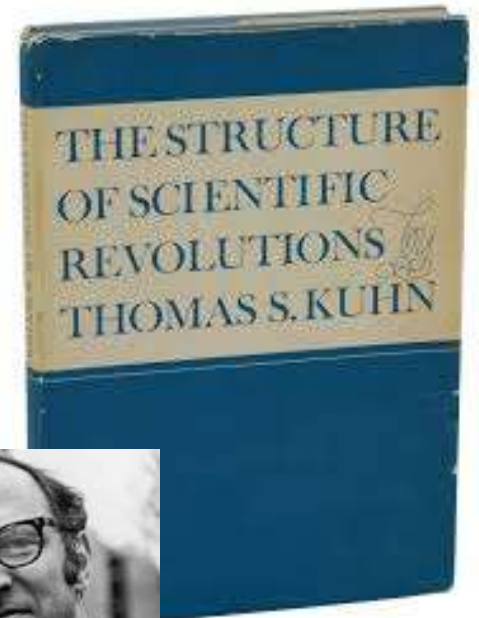
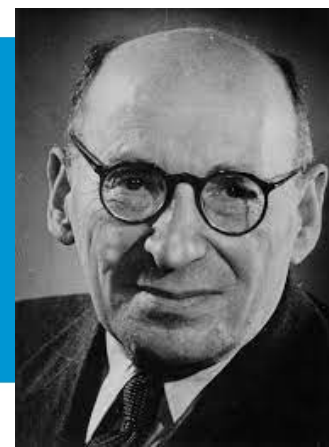


But wait a minute!

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.

Ethics

- 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
 - Publication industry



Perfect vs. imperfect Science

- Evidence-based
- Neutral, objective
- Pre-registered study protocol and analysis plan (which are rigorously followed)
- Making data available for re-analysis
- Emphasis on cross-validation, replication, meta-analyses
- Framing findings as preliminary insight
- ...
- What imperfections in scientific research may exist?



Ethics & Imperfections – A Continuum

How
science
ought to
be (ideal)



Non-disclosure of data

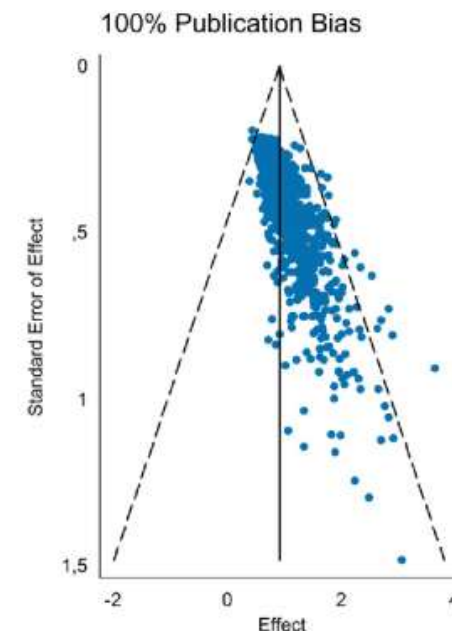
p-hacking (cherry-picking)



How
science
must not
be
(totally
flawed)



Manuscripts ending
up in the drawer



Fraud, lie

Publication bias

Ethics & Imperfections – A Continuum



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

How
science
must not
be
(totally
flawed)

How
science
ought to
be (ideal)



Duplicate publication

Fraud, lie

Different
audience

Boosting
publication
record

Plagiarism

Ethics & Imperfections – A Continuum

How
science
ought to
be (ideal)



Fraud, lie

How
science
must not
be
(totally
flawed)



Fraudulent suppressing or
manipulation of data



7 CEOs tobacco industry

Generating data
(claimed to be real data);
False claims





The entities enabling scientific fraud at scale are large, resilient, and growing rapidly

Reese A. K. Richardson^{a,b}, Spencer S. Hong^c, Jennifer A. Byrne^{d,e,1}, Thomas Stoeger^{f,g,h,1}, and Luís A. Nunes Amaral^{a,b,i,j,k,1}

Affiliations are included on p. 10.

Edited by Daniel Acuña, University of Colorado Boulder, Boulder, CO; received September 30, 2024; accepted March 18, 2025 by Editorial Board Member Mark Granovetter



How
science
ought to
be (ideal)

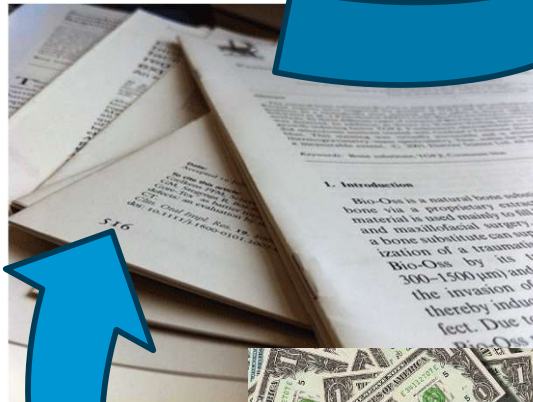


Buying big names

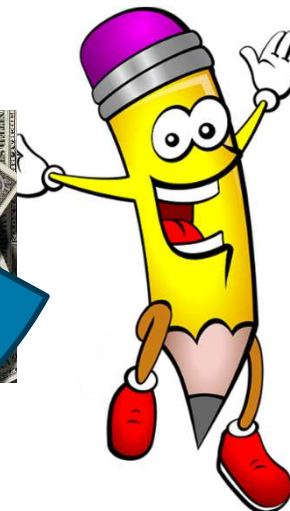


Fraud, lie

How
science
must not
be
(totally
flawed)



Research paper mills
producing fake papers



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>

Some Trends in the Social Sciences

IRB review

- Institutional review board (ethical approval)

Pre-registration of study protocol

- Expected outcomes
- Planned analyses

Documentation of data collection

- Online implementation of survey
- Screenshots

Availability of data

- Be prepared to make data available
- “Data available on request” may not be acceptable anymore
- Consider upload in data repository

<https://datamanagement.hms.harvard.edu/share-publish/data-repositories>

 Repository Comparison Grid comparing several generalist data repositories and data publication resources.											
Requirement	Harvard Dataverse	Dryad	figshare	CopSIDS	ICbB DataPort	Mendeley Data	Open Science Framework	Science Data Bank	Synapse	Yink	Zenodo
Data Size and Format											
Hosting of common file formats (e.g. csv, xls, xlsx, doc, pdf)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hosting of proprietary file formats (e.g. raw image files)	Yes	Yes	Yes	No	Yes	Yes	Yes	Not Preferred	Yes	Yes	Yes
Unlimited size per file	No	No	No	Yes	No	No	No	Yes	Yes	No	No
Unlimited total dataset size	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	No	No
Data Licensing											
CC0 waiver	Recommended	Required	Recommended	Required	CC-BY	Recommended	Yes	Yes	Unknown	Yes	Yes
Data Attribution and Citation Tools											
Assignment of dataset DOIs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
User Access Controls											
Tiered access (e.g. administrator-level, collaborator-level, custom-level)	Yes	No	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes
Journal-integrated, anonymous access (for peer review pre-publication)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Optional embargo to data release following publication	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes
Data Access Tools											
Comprehensive data and metadata search tools	Yes	No	Yes	No	No	Yes	Yes	Yes	No	Yes	No
Data access via direct download	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Data downloading via API	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes
Built-in tools for reading proprietary file formats	No	No	Yes	No	Yes	No	No	No	No	Yes	No
Integrated data analysis tools	Yes	No	No	Yes	Yes	No	No	No	No	Yes	No
Cost											
Data deposition fees	None	Yes	None	None	Membership	None	None	None	None	Membership	None
Data maintenance fees	None	None	None	None	Membership	None	None	None	None	Membership	None

Some Trends in the Social Sciences

IRB review

- Institutional review board (ethical approval)

Pre-registration of study protocol

- Expected outcomes
- Planned analyses

Documentation of data collection

- Online implementation of survey
- Screenshots

Availability of data

- Be prepared to make data available
- "Data available on request" may not be acceptable anymore
- Consider upload in data repository

Adherence to reporting guidelines

- E.g., *Checklist for Reporting Of Survey Studies (CROSS)*
<https://www.equator-network.org/reporting-guidelines/a-consensus-based-checklist-for-reporting-of-survey-studies-cross/>

Contributions

- Who contributed what (roles of authors)



Reporting guidelines for main study types

<u>Randomised trials</u>	<u>CONSORT</u>	<u>Extensions</u>
<u>Observational studies</u>	<u>STROBE</u>	<u>Extensions</u>
<u>Systematic reviews</u>	<u>PRISMA</u>	<u>Extensions</u>
<u>Study protocols</u>	<u>SPIRIT</u>	<u>PRISMA-P</u>
<u>Diagnostic/prognostic studies</u>	<u>STARD</u>	<u>TRIPOD</u>
<u>Case reports</u>	<u>CARE</u>	<u>Extensions</u>
<u>Clinical practice guidelines</u>	<u>AGREE</u>	<u>RIGHT</u>
<u>Qualitative research</u>	<u>SRQR</u>	<u>COREQ</u>
<u>Animal pre-clinical studies</u>	<u>ARRIVE</u>	
<u>Quality improvement studies</u>	<u>SQUIRE</u>	<u>Extensions</u>
<u>Economic evaluations</u>	<u>CHEERS</u>	<u>Extensions</u>

Checklist for Reporting Of Survey Studies (CROSS)



Section/topic	Item	Item description	Reported on page #
Title and abstract			
Title and abstract	1a	State the word “survey” along with a commonly used term in title or abstract to introduce the study’s design.	<page number>
	1b	Provide an informative summary in the abstract, covering background, objectives, methods, findings/results, interpretation/discussion, and conclusions.	Or <NA>
Introduction			
Background	2	Provide a background about the rationale of study, what has been previously done, and why this survey is needed.	...
Purpose/aim	3	Identify specific purposes, aims, goals, or objectives of the study.	

Methods

Study design	4	Specify the study design in the methods section with a commonly used term (e.g., cross-sectional or longitudinal).
	5a	Describe the questionnaire (e.g., number of sections, number of questions, number and names of instruments used).
	5b	Describe all questionnaire instruments that were used in the survey to measure <u>particular concepts</u> . Report target population, reported validity and reliability information, scoring/classification procedure, and reference links (if any).
Data collection methods	5c	Provide information on pretesting of the questionnaire, if performed (in the article or in an online supplement). Report the method of pretesting, number of times questionnaire was pre-tested, number and demographics of participants used for pretesting, and the level of similarity of demographics between pre-testing participants and sample population.
	5d	<u>Questionnaire</u> if possible, should be fully provided (in the article, or as appendices or as an online supplement).
	6a	Describe the study population (i.e., background, locations, eligibility criteria for participant inclusion in survey, exclusion criteria).

- Sample characteristics
- 6a Describe the study population (i.e., background, locations, eligibility criteria for participant inclusion in survey, exclusion criteria).
 - 6b Describe the sampling techniques used (e.g., single stage or multistage sampling, simple random sampling, stratified sampling, cluster sampling, convenience sampling). Specify the locations of sample participants whenever clustered sampling was applied.
 - 6c Provide information on sample size, along with details of sample size calculation.
 - 6d Describe how representative the sample is of the study population (or target population if possible), particularly for population-based surveys.

Survey administration	7a	Provide information on modes of questionnaire administration, including the type and number of contacts, the location where the survey was conducted (e.g., outpatient room or by use of online tools, such as SurveyMonkey).
	7b	Provide information of survey's time frame, such as periods of recruitment, exposure, and follow-up days.
	7c	Provide information on the entry process: →For non-web-based surveys, provide approaches to minimize human error in data entry. →For web-based surveys, provide approaches to prevent "multiple participation" of participants.
Study preparation	8	Describe any preparation process before conducting the survey (e.g., interviewers' training process, advertising the survey).
Ethical considerations	9a	Provide information on ethical approval for the survey if obtained, including informed consent, institutional review board [IRB] approval, Helsinki declaration, and good clinical practice [GCP] declaration (as appropriate).
	9b	Provide information about survey anonymity and confidentiality and describe what mechanisms were used to protect unauthorized access.

Statistical
analysis

- 10a Describe statistical methods and analytical approach. Report the statistical software that was used for data analysis.
- 10b Report any modification of variables used in the analysis, along with reference (if available).
- 10c Report details about how missing data was handled. Include rate of missing items, missing data mechanism (i.e., missing completely at random [MCAR], missing at random [MAR] or missing not at random [MNAR]) and methods used to deal with missing data (e.g., multiple imputation).
- 10d State how non-response error was addressed.
- 10e For longitudinal surveys, state how loss to follow-up was addressed.
- 10f Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for non-representativeness of the sample.
- 10g Describe any sensitivity analysis conducted.

Results

Respondent characteristics	11a	Report numbers of individuals at each stage of the study. Consider using a flow diagram, if possible.
	11b	Provide reasons for non-participation at each stage, if possible.
	11c	Report response rate, present the definition of response rate or the formula used to calculate response rate.
	11d	Provide information to define how unique visitors are determined. Report number of unique visitors along with relevant proportions (e.g., view proportion, participation proportion, completion proportion).
Descriptive results	12	Provide characteristics of study participants, as well as information on potential confounders and assessed outcomes.
	13a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates along with 95% confidence intervals and p-values.
Main findings	13b	For multivariable analysis, provide information on the model building process, model fit statistics, and model assumptions (as appropriate).
	13c	Provide details about any sensitivity analysis performed. If there are considerable amount of missing data, report sensitivity analyses comparing the results of complete cases with that of the imputed dataset (if possible).

Discussion

Limitations	14	Discuss the limitations of the study, considering sources of potential biases and imprecisions, such as non-representativeness of sample, study design, important uncontrolled confounders.
Interpretations	15	Give a cautious overall interpretation of results, based on potential biases and imprecisions and suggest areas for future research.
Generalizability	16	Discuss the external validity of the results.

Other sections

Role of funding source	17	State whether any funding organization has had any roles in the survey's design, implementation, and analysis.
Conflict of interest	18	Declare any potential conflict of interest.
Acknowledgements	19	Provide names of organizations/persons that are acknowledged along with their contribution to the research.



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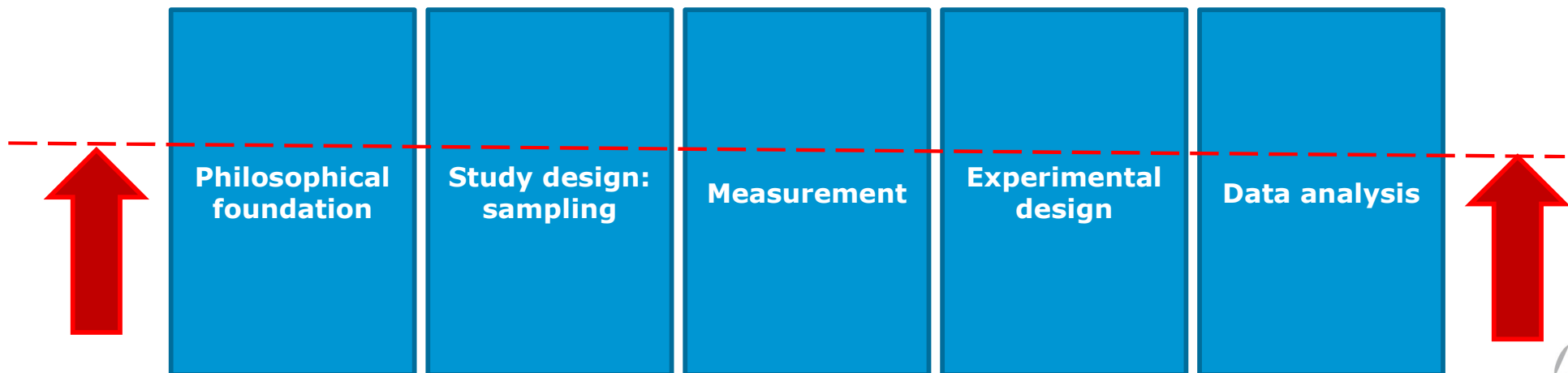
Thomas Salzberger, PD Dr.
thomas.salzberger@wu.ac.at



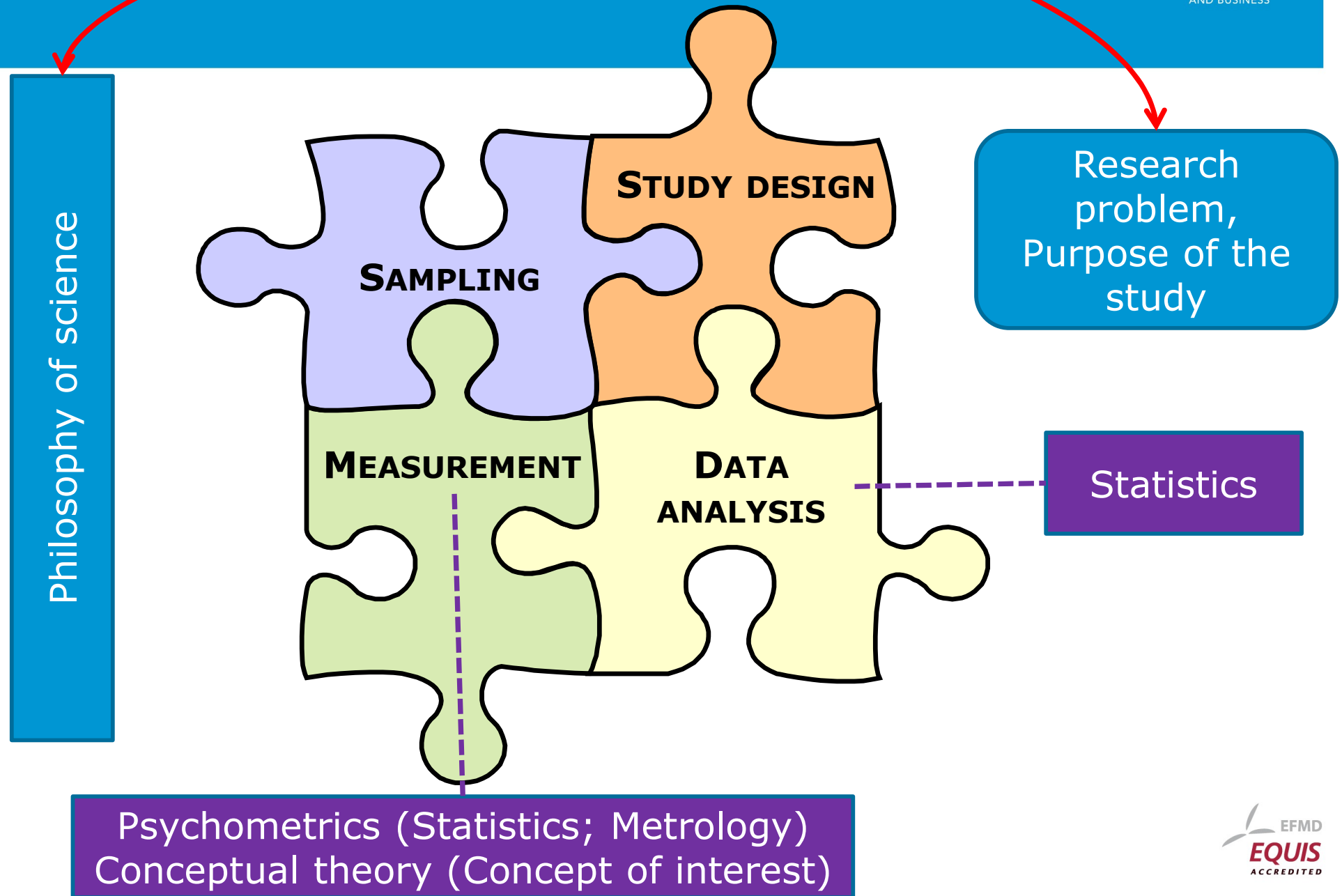
Quantitative Research Methods

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

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?

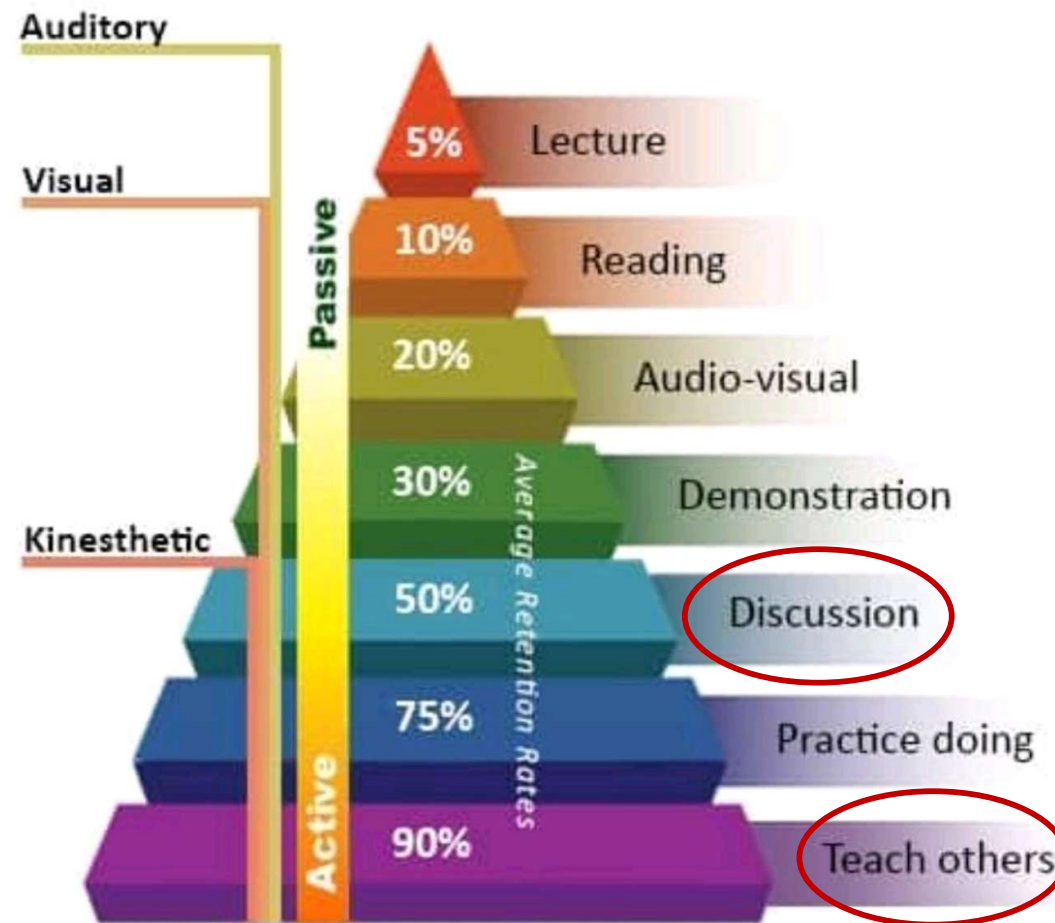
The Research Methods Knowledge Base is a comprehensive web-based textbook that addresses all of the topics in a typical introductory undergraduate or graduate course in social research methods. It covers the entire research process including: formulating research questions; sampling (probability and 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.*

*Today's unit is referred to as *Introduction unit*
Main Units are *Unit 1* to *Unit 5* (participant presentations)
Closing unit (no participant presentations) concludes course

Topics 3 & 5

(Book chapters 3 & 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

Topic 4

(Book chapter 4)

to be presented in Unit 3

[4] **Survey Research**

- 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 chapter 7)

to be presented in Unit 4

[6] **Design**

- 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] **Analysis I**

- Data preparation, data description
- Descriptive statistics (e.g., central tendency, dispersion)
- Correlation coefficients
- Graphics

[10] **Analysis II**

- Fundamental inferential statistics
- t-test, analysis of variance, linear regression analysis
- 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 the Topics

- Preparation and presentation of the topics by the course participants
 - Text book as the basis
 - Add at least one additional literature/input source of your choice
 - 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.
 - Address the keywords (see next slide)
 - ...
 - Include your own thoughts and considerations!

Guidelines

- Key words (links on course web page)
 - Part 1 (topics 1-5) and part 2 (topics 6-10)
 - For preparation and presentation of topics
 - And preparation for quizzes
- Technicalities
 - Number of slides typically in the order of ~30-40 slides (depends heavily on topic, presentation style, etc.)
 - Send presentation (preferably Powerpoint) to Thomas.Salzberger@wu.ac.at no later than the day before the presentation
 - PDFs will be made available (links on course page)
 - Replaces hand-outs, okay?

- 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/response 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, if applicable

Assigning the Topics

Presentation topics

Unit 1
21 OCT

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

Unit 2
4 NOV

- [3] **Measurement**

Unit 3
11 NOV

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

Unit 4
18 NOV

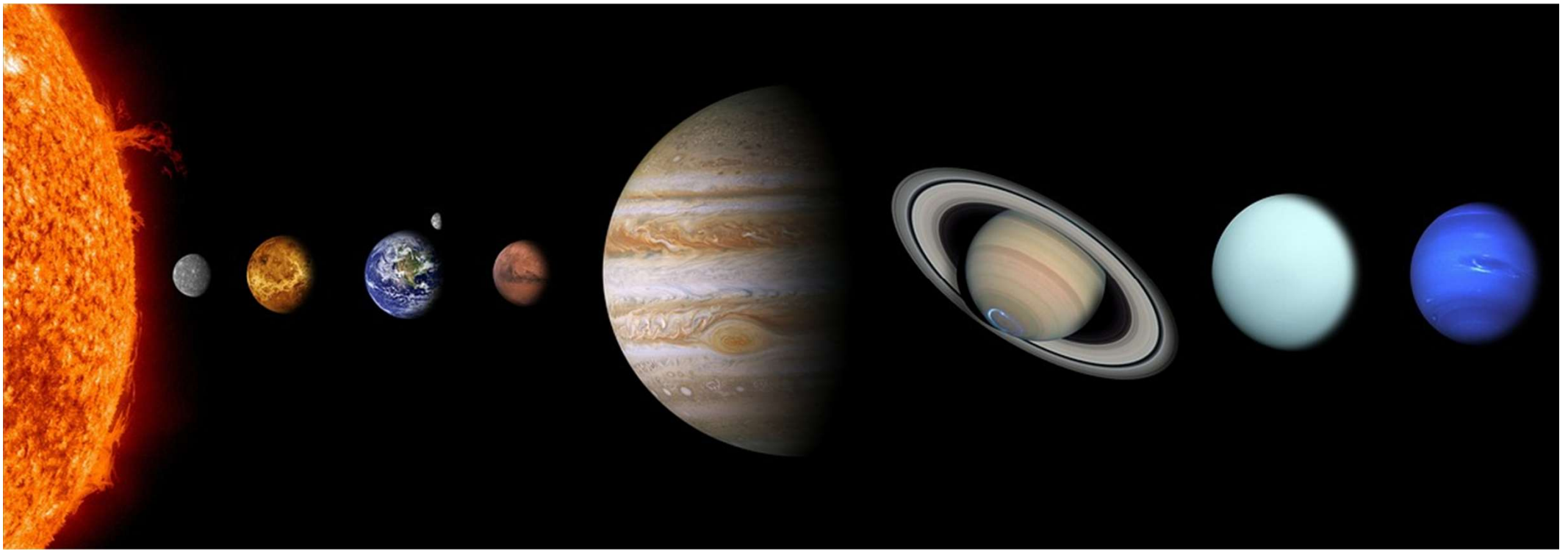
- [6] **Design**
- [7] **Experimental Design**
- [8] **Quasi-experimental Design**

Unit 5
25 NOV

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

EXAM Unit
2 DEC

Final exams, wrap-up



Quantitative Research Methods

Unit 1 21 October 2026

15-19

D2.0.030

https://statmath.wu.ac.at/courses/m1bw/m1bw_en.html