Basic Scientific Concepts

55F152 - Academic Writing and Defending

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‘Correlation’ and ‘Causality’

Probably the most fundamental problem of social sciences

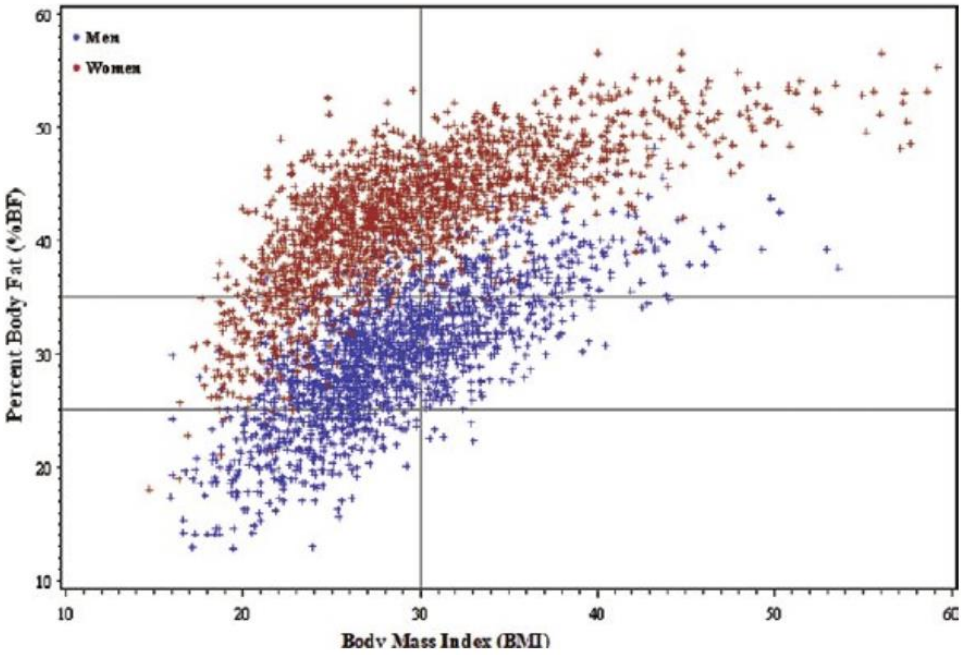
‘Correlation’ and ‘Causality’

Correlation is a statistical regularity, ‘joint movement’ of variables

If A grows, B grows also; if A grows, B falls etc.

“People wearing business suits live longer.”

“GDP growth correlates with an increase in the quality of health care and life expectancy.”

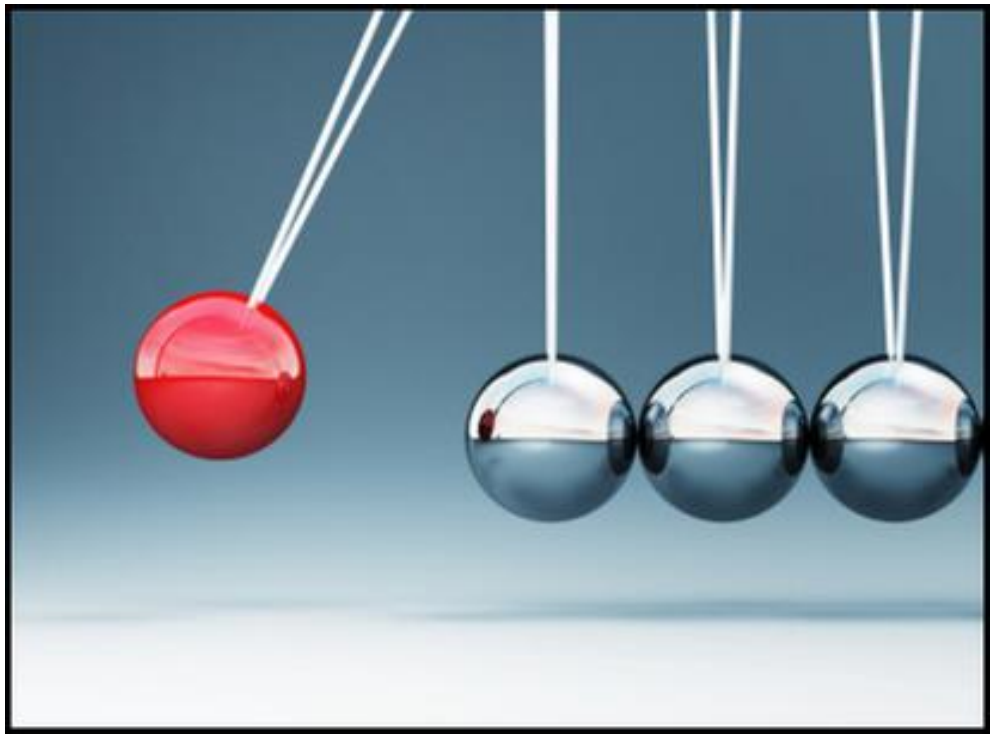


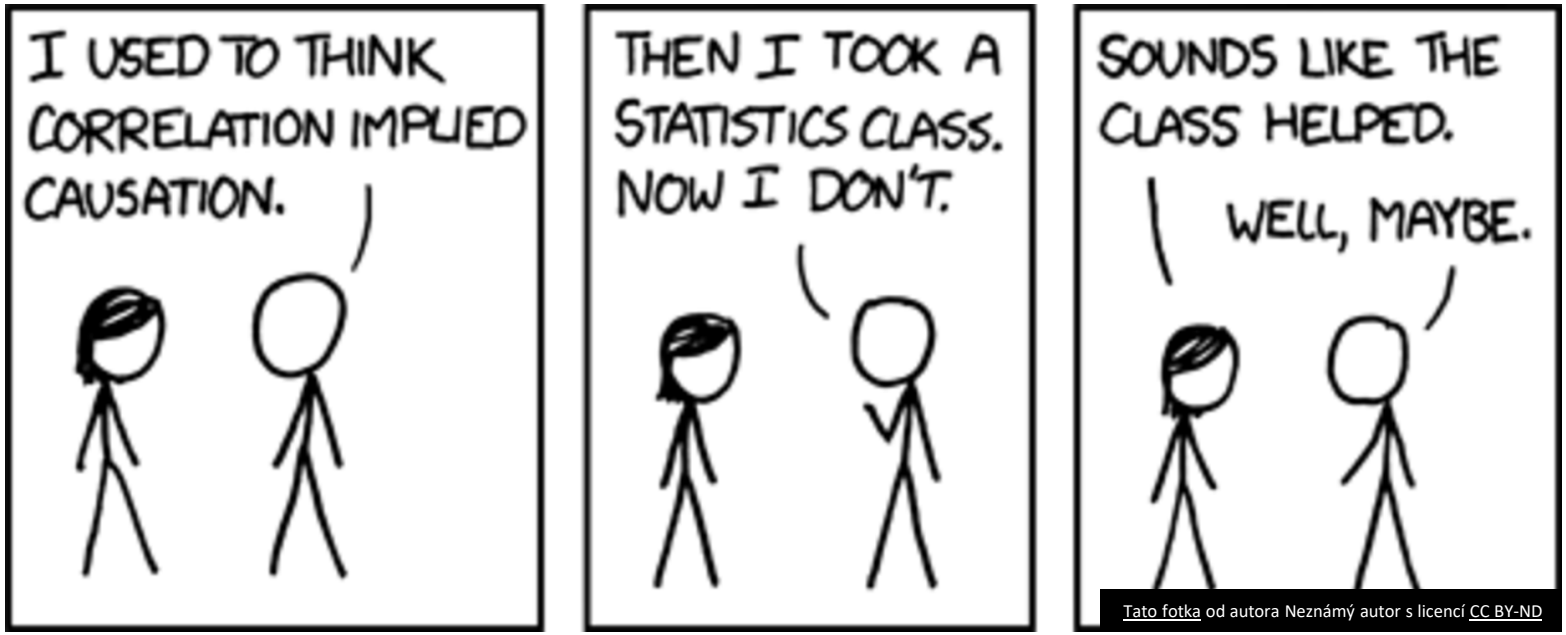
‘Correlation’ and ‘Causality’

Causality includes cause-effect relationship between variables

1. The growth of A causes the growth of B.
2. The growth of A causes the fall of B.

„The growth of GDP causes the growth of life expectancy.”

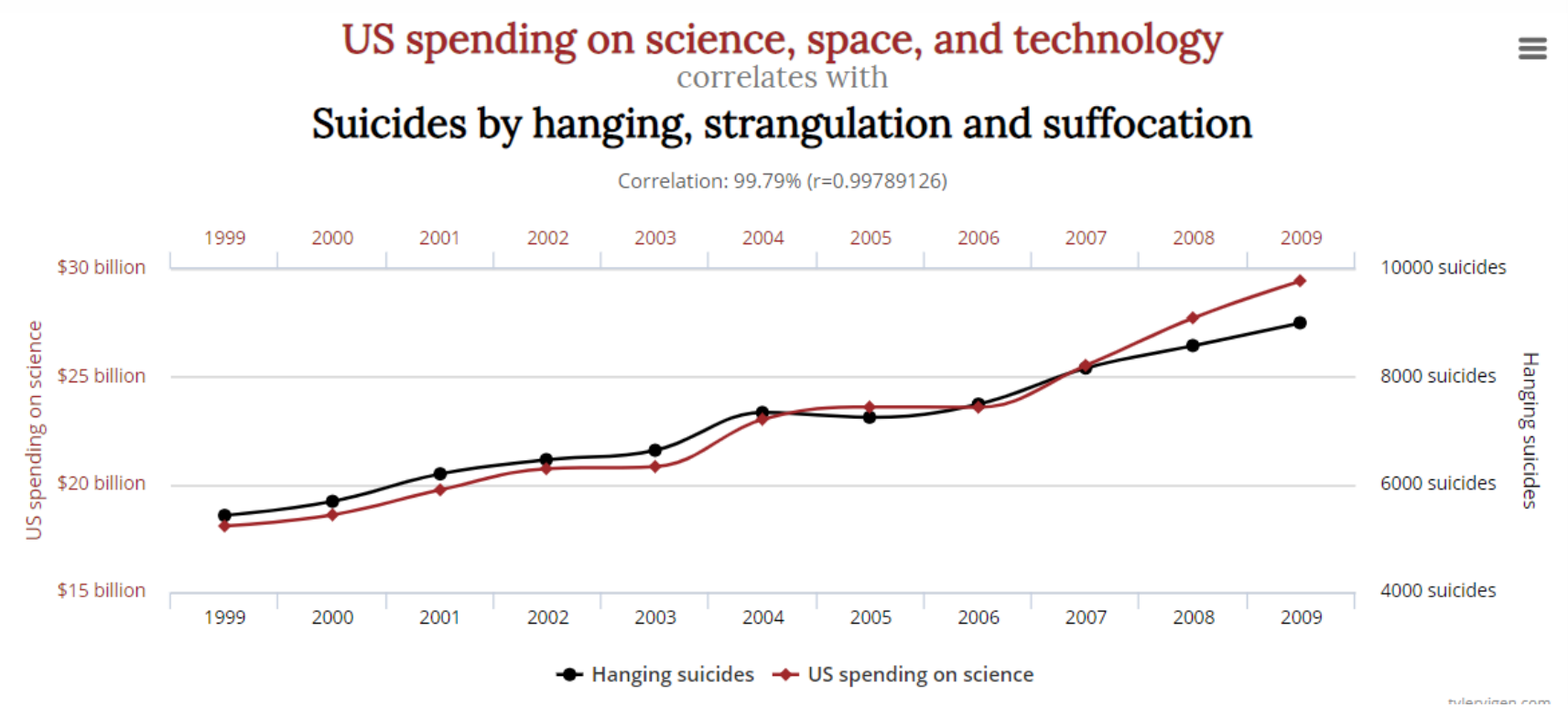




‘Correlation’ and ‘Causality’

Distinguishing between correlation and causality is probably *the most fundamental problem* of social sciences

Correlation does not imply Causation



http://tylervigen.com/spurious-correlations

‘Hypothesis’

A claim that can be confirmed or refuted using various scientific methods

Hypothesis is confirmed or refuted by its testing

- **Hypothesis 1:** Sleep deprivation reduces the ability to remember new information
- Test of H1: Experiment – experimental and control group

- **Hypothesis 2:** Value orientation of the Czech population is rather left-leaning
- Test of H2: Survey

Verification

Verification = search for phenomena that confirms the validity of a hypothesis

- Observation of the world.
- Experiments.

Logical positivism – verificationism = every scientific theory has to be empirically verifiable.

Empirical verifiability = definitorial feature of scientific theories.

Falsification

Falsification = search for phenomena that disproves the validity of a hypothesis.

Falsificationism

- Karl Popper (1902-1994)
- Only such a theory that can be falsified (rebutted) is a scientific one.
- Verification is in many cases impossible. The necessary feature of scientific theories is falsifiability.

‘Model’

Simplification of reality

- The reality is far too complex for our limited brain power
- It is necessary to select only those components of the reality that are important (problem of assessment of importance)

‘Model’

Model is a simplified picture of reality, which only highlights those features that we consider essential

- A perfect model of reality is only the reality itself.
- A model always rests on certain assumptions - the measure of its success is mainly its predictive ability.

Analysis

Analysis as decomposition

- Decompose the phenomena under study into some elementary parts
- Study relationships between these “atoms”
  - How does the inflation work?
  - Why did party A win the election and not party B instead?

Synthesis

Synthesis as a “re-composition”

- Starting with the simplest and most easily solved partial problems, build knowledge of more complex ones.
- Assemble component parts into higher levels of complexity.

Induction

Induction means drawing a general conclusion from individual observations

- “Democratic states do not wage wars against each other.“

Empirical induction is always imperfect

- “Natural“ and scientific induction
- Basic tool of empirical science

Deduction

Deduction means application of a general rule to individual cases

- Individual phenomena interpreted in the context of the general laws
- “The growth in demand leads increase in price.“
- It also means drawing logical conclusions from some assumptions

Definition

Demarcation of a concept

'Definiendum' and '*definiens'*

- *Definiendum = genus proximum + differentia specifica*

Human being is:

- A political animal
- A rational animal
- A two-legged creature without feathers

What is economics?
What is university?

Research

- Based on a particular system of knowledge of reality – the aim is to modify or improve this knowledge, to broaden the scope of its application
- Deliberate and systematic process
- Analysis / synthesis, induction / deduction,
  theory / practice

1. Empirical research
   a) Observation
   b) Experiment
2. Theoretical research

Empirical Research

'Empirical' means 'based on experience'

Testing of hypotheses

- Always in a framework of some pre-existing wider theory

Use of statistical techniques

Data collection

- Primary and secondary data

Experimental Research

"Everyday experiments" vs. scientific experiments

Part of empirical research (together with observation)

Replicability = it must be possible to replicate the experiment

- Record of empirical research must provide sufficient information to enable other researchers to replicate the research.

Experimental Research

Problems with the use of an experiment in social (and even some natural) sciences

- The inability to replicate the phenomenon in laboratory conditions.
- Ethical implications of the experiments (experimentation on humans).

Theoretical Research

"Armchair/library research"

An analysis, comparison of existing theories

- "Mises' and Weber's theory of human action"

Summary of pros and cons of the given theories, evaluation.

The purpose of the evaluation is modification of existing theory, or creation of new theories.

A difficult option for research of beginners.

Quantitative & Qualitative Research

	Quantitative research (statistical analysis of data)	Qualitative research (e.g. participant observation)
Relationship of a researcher to the subject of investigation	distant	close
Attitude of a researcher towards the social phenomena	outside of situation	inside of situation
Connection between research and theory	verification, falsification	theory is often being created
Validity of results	generalization	contextual understanding
Data	hard, reliable	rich, deep
Focus	macro	micro

‘Methodology’ and ‘Method’

The method as a way to progress towards the an objective (in our case towards new knowledge)

Methodology = science of method

- Analysis and description of methods
- The legitimacy and limits of application of different methods
- Philosophical foundation of the scientific method

Quantitative and qualitative methods

Theory

Theory is an internally consistent set of propositions regarding some research area.

A broad synthesis of many findings into a coherent whole

- Theory of evolution, string theory, …

Theory is not “mere opinion”.

Validated and tested hypothesis becomes a theory.

‘Positive’ and ‘Normative’

In social sciences

Positive

Positive statement => describes factual state

- What is, what exists, what is real
- „GDP of Czech Republic is 215 billion USD.“
- “GDP growth in developing countries correlates with the increase in meat consumption.”
- May or may not be true (still is positive statement).

Normative

Normative statement => evaluation

- What should be, what is right, good, fair –> ethics
- “GDP of Czech Republic should be higher.”
- “VAT tax should be lower.”

‘Explanation’

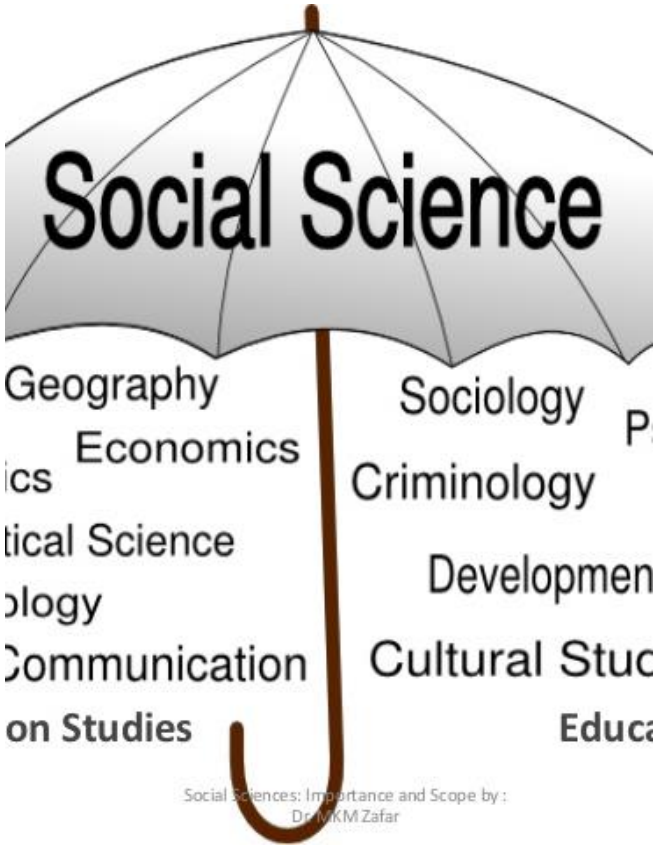
Explanation is interpretation of a phenomenon in some broader context.

Often answers question „Why“.

“GDP growth in the developing countries correlates with a growth in meat consumption.”

- E1: “People prefer meat, because it tastes better.”
- E2: “People prefer meat due to the higher content of nutrients.”
- E3: “Meat consumption in the developing countries is associated with the notion of a higher social status.”

Natural sciences vs Social sciences



Natural Sciences

A scientist examines the nature, ‘objective reality’, ‘hardware’.

An unbiased observer outside the observed system.

Experimental evidence, measurement, mathematization.

Social Sciences

A scientist examines the ‘human world’, ‘software’

- Human action, understanding of reality
- Social reality is *constituted* by people’s beliefs and actions

The independence of the observer cannot be achieved in full

- Observer as a part of the system
- Understanding method (Max Weber)

Limitations on use of experiment, problem of the complexity of systems, problem of functional relationships and concepts

Economics vs. historiography

- To what extent is economic knowledge historical?

Thank you for your attention

Národohospodářská fakulta VŠE v Praze