

Introduction to Statistics

INWT Statistics GmbH

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What Statistics can do

- Make life easier...
- Compress data, aggregate information
- Analyse complex associations
- Discover... display... test...
 - relationships
- Statistical analysis and expert knowledge
- Statistics as tool for science



What Statistics cannot do

- Change life...
- Create...
 - relationships
- Develop a good theory
- “Proof” things
- Substitute expertise
- Replace thinking and questioning



What about Statistics?

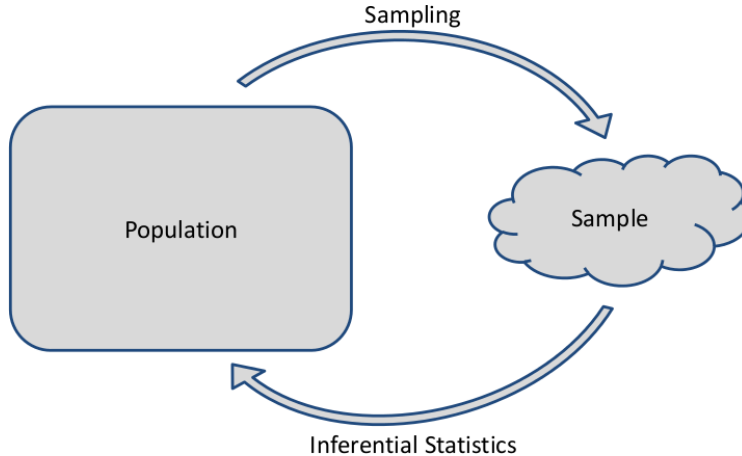


Figure: Inferential Statistics



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At the beginning there was...

- ... a theory.
- ... a question.

That is where hypotheses are derived from.



Does it pay off spending a lot of time for preparing for a statistics test?

- What does “pay off” mean?
- How much time is “a lot of time”?

Does more time spent lead to better grades?

- The more time spent, the better the grade.
- What are grades?
 - Summary of points achieved

The time spent for studying (LZ) is (positively) correlated with the points achieved (Y)!



What is “time spent”?

- Answered by theory:

- Time to prepare tests
- Pre- and post preparation of lectures
- Discussion with fellow students
- Processing during sleep
- ...

- Operationalisation:

- What is “measurable” or “observable”, respectively?
- Time to prepare tests in hours
- Pre- and post preparation in hours



What is “success of studying”?

- Answered by theory:
 - Possibly very abstract
 - Can “success of studying” be measured?
- Operationalisation:
 - Grade
 - Points achieved
 - Self-assessment?



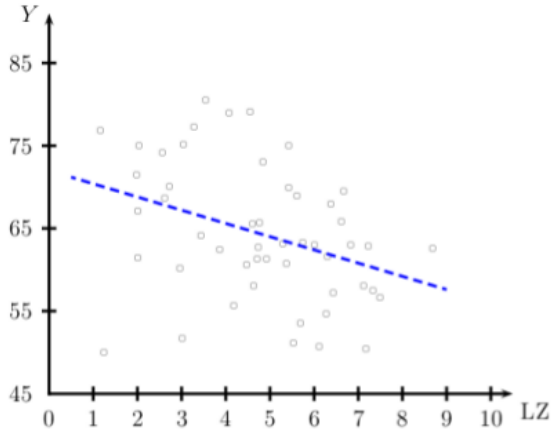


Figure: Points achieved (Y) vs. time spent studying (LZ)



What drives success of studying?

- Time spent (positive)
- Predisposition (positive)
- Prior knowledge (positive)
- Intelligence (positive)
- ...



Relationship between drivers:

- Time spent vs. Intelligence (negative)
- Time spent vs. Predisposition (negative)
- Time spent vs. Prior knowledge (negative)
- ...



Example Success of Studying

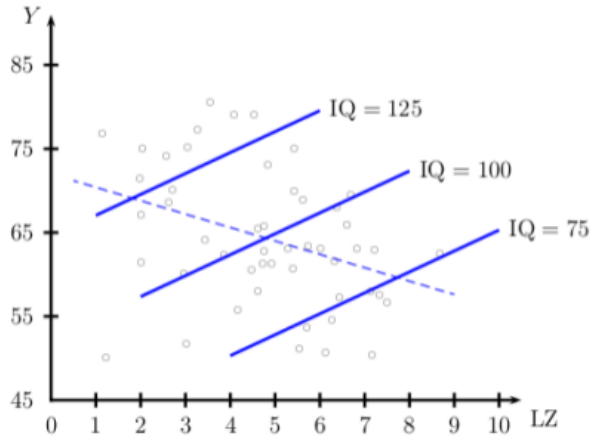


Figure: Points achieved (Y) vs. time spent studying (LZ), controlled for IQ

- Mean of x: 9
- Sample variance of x: 11
- Mean of y: 7.5
- Sample variance of y: 4.125
- Correlation: 0.816



Correlation does not imply Causation

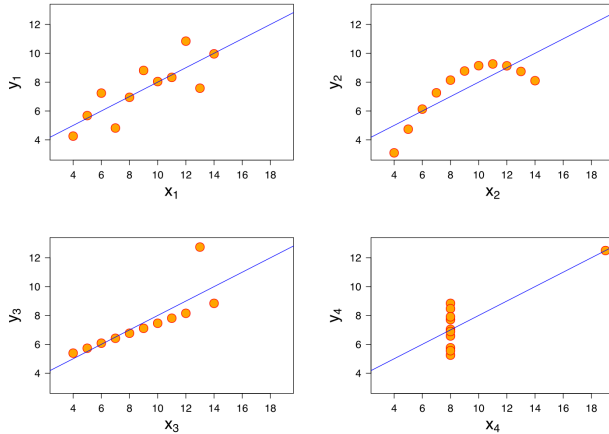


Figure: Anscombe's Quartet By Anscombe.svg: Avenue - Anscombe.svg, CC BY-SA 3.0,
<https://commons.wikimedia.org/w/index.php?curid=9838454>

- Statistics by itself produces funny results:
 - Studying does not pay off!
 - People with big feet gain more money!
 - Storks deliver children!
- Insights from statistical analyses are often misleading...
 - ... if they are not motivated by foregoing theoretical considerations.
 - ... if they are not questioned by theoretical considerations afterwards.



Thanks for Your Attention!

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