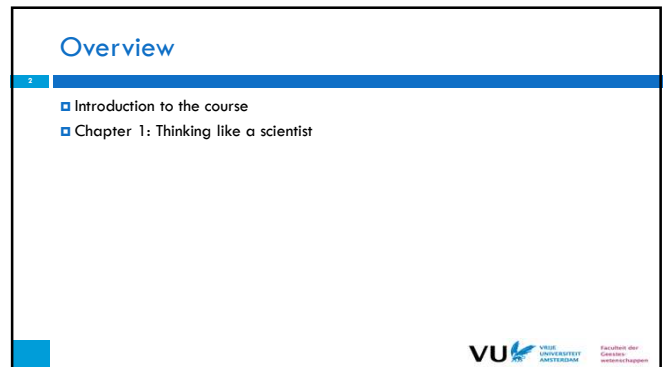
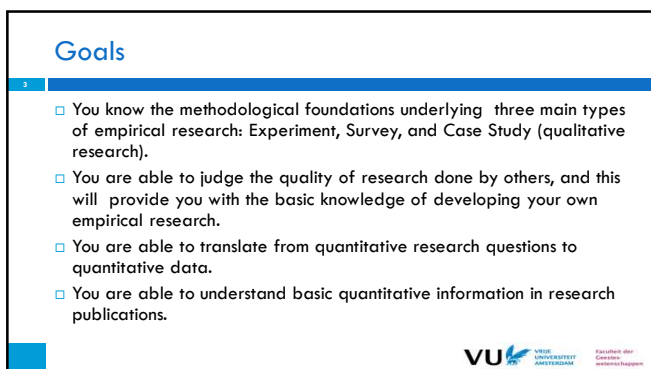


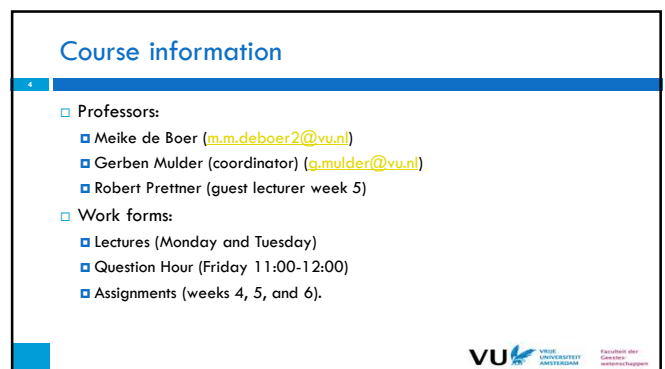
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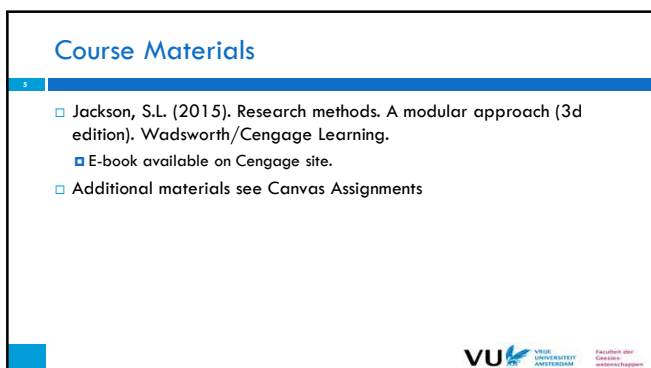
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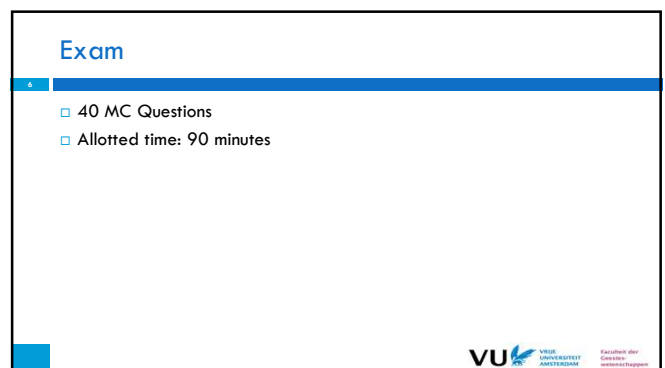
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CHAPTER 1: THINKING LIKE A SCIENTIST

7

Chapter 1: Thinking like a scientist

- Module 1:
 - How does science compare to other ways of acquiring knowledge?
 - Criteria for science.
 - Thinking like a scientist.
 - Goals of science.

8

Chapter 1: Thinking like a scientist

- Module 2:
 - Introduction to research methods:
 - Descriptive method.
 - Predictive (relational) method.
 - Explanatory method.

9

Sources of knowledge

- How do we know what we know?
 - > Superstition and intuition
 - > Authority
 - > Tenacity
 - > Rationalism
 - > Empiricism
 - > Science

10

Rationalism

- Knowledge via rationalism: knowledge gained through logical reasoning.
- Example: syllogism (more about this in the next lecture)
 - All humans are mortal;
 - I am human;
 - Therefore, I am mortal.
- Problem: valid reasoning can be unsound.
 - All attractive people are good;
 - Nellie is attractive;
 - Therefore, Nellie is good.

11

Empiricism

- Knowledge via empiricism: Knowledge gained through objective observations of phenomena in the real world.
- The empiricist gains knowledge by seeing, hearing, tasting, smelling, and touching. (i.e. by experiencing reality).
- Or by using instruments that enhance the senses.
- Like rationalism, one of the pillars of science, but also not sufficient:
- "Science is built up of facts, as a house is built of stones; but an accumulation of facts is no more a science than a heap of stones is a house."
— Henri Poincare

12

Science

13

- Knowledge via science: Knowledge gained through a combination of empirical methods and logical reasoning.
- Crudely put, what we say and believe must make logical sense (rationalism) and it must correspond to what we observe (empiricism).
- Both are essential to science and related to the three important aspects of doing scientific research:
 - Theory;
 - Collecting data;
 - Data-analysis.

13

Ordinary Human Inquiry

14

- Humans (scientists included) need to answer what and why questions.
- Our survival depends on knowing which events cause other (potentially harmful) events.
- A learning experience is one of those things that says, 'You know that thing you just did? Don't do that.' (Douglas Adams)
- Our species is extremely good in detecting causal patterns in the world around us.
- But frequently our minds deceive us.
- Let's look at some characteristics of our minds.

14

Please note

15

Kida (2006, p. 23):

"Don't feel bad if you find yourself making the kinds of errors in thinking that are discussed [...]. I've made them, my friends have made them, and everyone I've ever known has made them. That's how ingrained they are in our cognitive makeup. Since we're typically not even aware they exist, the first step in making better decisions is to identify the pitfalls in our thinking."

15

Please note

16

Mander (1892-1985):

"Thinking is skilled work. It is not true that we are naturally endowed with the ability to think clearly and logically - without learning how, or without practicing. People with untrained minds should no more expect to think clearly and logically than people who have never learned and never practiced can expect to find themselves good carpenters, golfers, bridge players, or pianists."

16

Ordinary Human Inquiry

17

- Kida (2006). Don't believe everything you think. The 6 basic mistakes we make in thinking:
 1. We prefer stories to statistics
 2. We seek to confirm, not to question our ideas.
 3. We rarely appreciate the role of chance and coincidence in shaping events
 4. We sometimes misperceive the world around us.
 5. We tend to oversimplify our thinking
 6. We have faulty memories.
- Gilovich, T. (1993). How we know what isn't so. The fallibility of human reason in everyday life.

17

Scientific Thinking

18

1. Statistics: anecdotes are not data (nor evidence)
2. Science also tries to falsify.
3. Science explicitly investigates the role of chance and coincidence in a study (with inferential statistics).
4. Studies are replicated, in the hope that this will prevent perceptual error.
5. Ultimately, it is **empirical evidence** that counts.

18

Note

- Science is a *METHOD* not a *SUBJECT*.
- So, if we call "something" a science does not depend on what is being studied but **how** that is done.
- The what (problem definition) and why (research goal) of a study are described in the introduction sections of publications.
- The crucial how is described in the method section of the publication.
- Knowing how a study is done enables us to judge the validity of the conclusions.
- Without considering the method, we cannot say anything about the quality of a study (although we could still judge the reasoning in the introduction section, of course).