Lecture 2: Scientific Thinking

What is Science?

Science is:

- A way of thinking (knowing) or finding things out
- A search for truth or understanding of the natural world
- Iterative rather than linear
- Progressive and always leads to something further (never-ending).
- The application of that understanding to all kinds of problems

Science is NOT:

- A list of facts
- Just a body of knowledge (although that is part of it)
- Fancy equipment
- Technology
- E = mc^2
- A religion
- A belief system

Science (noun): Something you can KNOW.

Science (verb): Something you DO.

Central Components of Scientific Thinking (ERS)

3 central components of scientific thinking:

- Empiricism
- Rationalism
- Skepticism
- + peer review (a pillar of scientific process)

Correspondence theory of truth

Coherence Theory: The truth of a belief can only consist in its coherence with other beliefs. A belief is true to the degree that it coheres with other beliefs

Correspondence Theories of Truth: That truth is a relational property involving a characteristic relation (to be specified) to some portion of reality (to be specified).

Coherence Theories of Truth: The truth of a belief can only consist in its coherence with other beliefs. A belief is true to the degree that it coheres with other beliefs.

Pragmatic Truth: Truth does not exist in some abstract realm of thought. It is a function of an active process of engagement with the world and verification.

Subjective Truth: Something is true for the person(s) making the judgement, even though it may not be true for others.

Relativism (Relative Truth): Points of view have no absolute truth or validity within themselves, but rather only relative, subjective value according to differences in perception and consideration.

Deductive and Inductive Truths:

- Deductive: Conclusions drawn from premises
- Inductive: Generalise beyond the immediate information

Empiricism

- Data!
- Verification
- Objectivity
- Replication
- Therefore, if it doesn't agree with the experiment, it is wrong.

Important attributes of empiricism

3 aspects to data collections and experimentation:

Verification

- Is it true?
- How do you know? (Controlled experiments)
- Honesty

Objective

- How much of you is tied up in the experiment?
- No preconceived ideas, no bias

Replication

- Is it always true?
- Replication is important because scientific argument is won by weight of evidence

Rationalism

- Deductive reasoning
- Broken logic
- Inductive reasoning
- How inductive and deductive reasoning work together in the scientific process

Deductive Reasoning

- Aristotle: Any logical argument can be reduced to 2 premises and a conclusion.
- "GIVEN THAT" (if/because/since)
  a) And
  b) ..

Then

  c) Conclusion
- Deductive reasoning: You deduce the answer

Valid v Sound Arguments

Valid

- Covers all the steps
- BUT can lead to false conclusions if the premise is incorrect

Sound

- Covers all the steps (like Valid)
- Premises are correct

- A true argument is VALID and SOUND

Inductive Reasoning

An argument can be FALSE because of bad logic

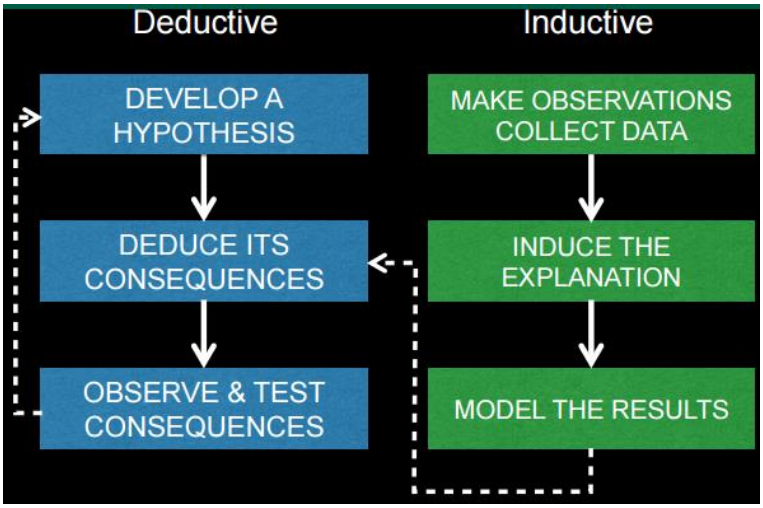
- False premise (valid but not sound)
- Wrong order (Sound but not valid)
- Both (Invalid and unsound)

Rationalism and its place in science

- Deductive reasoning: Traditional view of scientific process
- Inductive reasoning: Actually what is done by a lot of scientists

Inductive Reasoning

- Careful observation -> Specific data
- Compile data
- Derive theory



- Logic is not enough for it to be called Science

Scepticism

- “Never stop questioning”
- “Take nobody’s word for it”