Rationality and Objectivity in Science or **Tom Kuhn** Meets **Tom Bayes**

Kuhn on Scientific Rationality (552)

- Kuhn's challenge to the logical empiricist philosophy of science concerns the nature of theory choice in science.
- There are two fundamental theories, **they cannot be resolved by proof**
  - To see how they are resolved, you must "techniques or persuasion" or "argument and counter-argument in a situation in which there can be no proof"
  - It cannot be rendered logically explicit and precise.
- Individual scientists may, at a given moment, differ regarding a particular choice of theories.
  - The interactions among individual members of the community of scientists produce a consensus for the group.
- One of Kuhn's major claims seems to be that observation and experiment, in conjunction with hypothetico-deductive reasoning, do not adequately account for the choice of scientific theories.
  - This has led some **philosophers to believe that theory choice is not rational**. Kuhn, in contrast, has tried to locate the additional factors that are involved. These additional factors constitute a crucial aspect of scientific rationality.

Bayes's Theorem (553)

- The first step in coming to grips with the problem of evaluating and choosing scientific hypotheses or theories is the recognition of the inadequacy of the traditional hypothetico-deductive (HD) schema as a characterization of the logic of science.
  1. According to this schema, we confirm a scientific hypothesis by deducing from it, in conjunction with suitable initial conditions and auxiliary hypotheses, an observational prediction out to be true.
- The HD method has a number of well-known shortcomings
  1. It does not take account of alternative hypotheses that might be invoked to explain the same prediction
  2. It makes no reference to the initial plausibility of the hypothesis being evaluated
  3. It cannot accommodate cases, such as the testing of statistical hypotheses, in which the observed outcome is not deducible from the hypothesis.

$$P(T|E.B) = \frac{P(T|B)P(E|B.T)}{P(T|B)P(E|B.T) + P(\sim T|B)P(E|B.\sim T)}$$

Let "**T**" stand for the theory of hypothesis being tested
Let "**B**" for our background information
Let "**E**" for some new evidence we have just acquired
Posterior probability: The expression on the left-hand side of the equation represents the probability of our hypothesis on the basis of the background information and the new evidence.
Prior probabilities: The right-hand side of the equation contains four probability expressions. Two of these; P (T|B) and P (~T|B), they represent the probability on the basis of background information alone, without taking account of the new evidence E, that our hypothesis is true or false respectively.

SEE PAGE 554 FOR EXAMPLE.

There are other forms of that equation on page 555

Kuhn and Bayes

- Kuhn is willing to admit that "each scientist chooses between competing theories and deploying some Bayesian algorithm which permits him to compute a value for P(T|E), i.e., for the probability of the theory T on the evidence E available both to him and the other members of his professional group at a particular period of time "
- If we propose to use Bayes equation as an algorithm, the obvious question is how to get values for the expressions on the right-hand side. Several answers are possible in principle, depending on what interpretation of the probability concept is espoused.
- Inductive logic and confirmation theory in Bayes's thrm can be derived a priori from the (557) structure of the descriptive language and the definition of degree of confirmation.
    - But that can be problematic: Two major alternatives remain:
        1. The probabilities on the right hand side are objective and empirical
        2. Personal probabilities: Subjective in character