The Full Employment Theorem in Probability Kinematics

How much philosophy in the philosophy of science? I will show that for probability kinematics (the theory of how probability assignments are rationally updated), the majority view of philosophers can be undermined in favour of the majority view of statistical physicists. At issue is what I am calling the *Full Employment Theorem* (FET). It states that in order to reassess a probability distribution in the light of new evidence one needs a trained epistemologist to apply situation-appropriate tools from a wide range of methods in a pluralistically arranged toolbox.

FET may not be false, but I claim that the main arguments for FET fail. The converse of FET states that there are formal methods that we can successfully apply to all cases in which a probability assessment needs to be adjusted in view of new evidence, without the need for case-by-case interpretation by an epistemological expert. Advocates of FET brandish counterexamples, the pre-eminent one being van Fraassen's *Judy Benjamin* problem. It is alleged that this problem, under the application of the preferred formal method (MaxEnt, see below), produces counterintuitive results. Therefore, so goes the reasoning, the universality claim fails and FET stands.

If your observation comes in the form of an event, a plausible way to update your probabilities is by conditioning. If your observation comes in the form of a redistribution of probabilities over a partition of the event space, it is plausible to use Jeffrey conditioning. Observation can be even more general and come in the form of affine constraints (as in the *Judy Benjamin* problem). If Jeffrey conditioning cannot be applied to an affine constraint, we can use the Principle of Maximum Entropy (MaxEnt), based on the intuition that the observation should lead to an adjustment that in terms of information minimally affects the probabilities. Some, especially statistical physicists, say that MaxEnt delivers the unique solution to this problem that fulfills a set of basic rationality requirements. Advocates of FET believe that MaxEnt is only one of many different strategies to update probabilities rationally. They claim that the *Judy Benjamin* problem decisively undermines the generality of MaxEnt.

I will show various ways in which their arguments go awry. The results provided by MaxEnt for the Judy Benjamin problem are supported, not contradicted, by an intuitive approach that prima facie should support the advocates of FET. The independence assumptions which render the MaxEnt results counterintuitive are improperly applied by advocates of FET; in particular, it is a mistake to treat *Judy Benjamin* as a case for Jeffrey conditioning. The method of coarsening at random does not apply to the *Judy Benjamin* problem once the analogy to the *Three Prisoners* problem is fully appreciated.

In conclusion, philosophers have not made a persuasive case for full employment. Scientists who use the Principle of Maximum Entropy (whose applications span a variety of disciplines) can do so without worry about this instance of "philosophy in the philosophy of science."