Assumptions and Axioms in the Construction of Theories

Aman Chawla

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Abstract

In this note the authors compare the properties of assumptions vis-a-vis axioms in their role of specifying, delimiting and defining theories.

There is a difference between a set of axioms and a set of assumptions. We provide basic examples of both first. There are three axioms famously at the foundation of quantum mechanics (see for example the text on quantum information by Nielsen and Chuang [1]). Assumptions are present in countless theories. For example, the ephaptic coupling work of Reutskiy et. al. [2] contains more than five assumptions under which the subsequent theory is derived. Likewise the work of V. S. Markin [3, 4, 5] contains assumptions which simplify the ion channel current formulation.

Generally, axioms are held in the position of truth whereas assumptions are props which aid in the subsequent analysis or solution and need not necessarily hold in reality. With regard to assumptions, the most general theory tries to eliminate them, but axioms are usually sacrosanct once established. Nevertheless, if axioms can be eliminated, that would make for a stronger and more transparent and reason-based theory. Ontologically the theory would be the same, but epistemologically it would contribute more. In contrast, when assumptions are eliminated, ontological corroboration is added to the theory. Thus we see that assumptions and axioms are subtly different in not only what they are defined to mean, but also in what they imply about the strength of a theory.

One can try and remove assumptions one-by-one to construct the most general theory. However, the removal of axioms is generally harder and may require deeper insight. Nevertheless, assumptions and approximations or relaxations, as well as fundamental axioms need not be viewed as authoritative statements in a critical approach. Furthermore, it is only such an approach that can lead to a framework devoid of both assumptions and axioms and hence to the most desirable description of reality.

References

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