Quantitative Literacy *versus* **Mathematics**

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Some thinkers about general education propose to substitute "quantitative literacy" for Mathematics. This substitution constrains our students's experience of the world in ways that are inconsistent with the goals of a liberal arts education.

"Quantitative Literacy" means the ability to manipulate and understand quantities, and typically this is satisfied by the study of statistics. This is unfortunate, because statistics bypasses both the power of abstraction that mathematics offers and the need to reason logically. Statistics is mathematical, but it is not mathematics. Statistics determines how people gather data and how they should analyze that data in the presence of uncertainty.

But mathematics has no data. Mathematics, one of the fundamental human urges, determines precise relationships between abstract ideas using rigorous logical argument, and discusses these ideas in precise language. Mathematics is not the study of quantities; mathematics is the study of relationships and abstractions.

Liberal arts education must take as an axiom that there is more to human knowledge than data. Abstract concepts ranging from "Democracy" to "Prime Number" are independent of data, and the use of hypothesis testing or other data-driven techniques is inappropriate. In determining whether a number us prime, no survey is necessary, and there is no uncertainty (uncertainty being a prerequisite for the legitimate use of statistical methods).

The relationship between prime numbers and other whole numbers is intricate and delicate; some call it beautiful. Euclid established *rigorously*, by a clever proof, that there are infinite number of prime numbers. Others later generalized the idea of primality to more abstract number systems, systems that are difficult or impossible to visualize, systems that are not vulnerable to subjective or political whim. Deeper questions about prime numbers remain unanswered, despite decades of effort.

Some object that this view of mathematics is too abstract, although abstraction is surely one of the goals of a liberal arts education. No matter: the objection is incorrect. The results of humankind's wrestling with these abstract comcepts are not just theory: they're part of the inner workings of your cell phone.

General education needs to address both perspectives. Mathematics is an intensely human endeavor, characterized by abstraction and rigor, while at the same time it is a practical endeavor.

Ironically, the power of the statistical reasoning that is the foundation for our management of data comes from the purely mathematical abstractions that led to the development of statistical tools like hypothesis testing. Our students are well served by exposure to both.