

Calculus and the Rolling Stones

Bob Eisenberg, reply by Jim Holt
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In response to:

In the Mountains of Mathematics from the December 3, 2015 issue



Christopher Simon Sykes/Hulton Archive/Getty Images

Mick Jagger and keyboardist Billy Preston on board the Rolling Stones' private jet during their Tour of the Americas, 1975

To the Editors:

Jim Holt in his otherwise admirable review of Michael Harris's *Mathematics Without Apologies: Portrait of a Problematic Vocation* [NYR, December 3, 2015] says "physicians don't really need calculus" and then discusses "the presumed value" of mathematics.

These comments reflect a profound ignorance of the role of mathematics in creating the world we live in. That world is built on the engineering of devices where mathematics works so precisely that trial-and-error experimentation is not needed, and in many cases no experimentation at all is needed. The design of buildings is done with equations, not models; so is the design of airplanes, even our plumbing. Our electronic devices (that have nearly one trillion components switching, say, 100 million times a second with negligible error) would be inconceivable without mathematics.

And the greatest advance of clinical science in the last decade has been imaging technology, which is an engineering implementation of a mathematical idea, the Radon transform, etc.

Indeed, most engineering devices (and that word has a precise meaning) are conceived of as equations, and then physical implementations are built that realize that equation. (For example, an amplifier implements the simplest equation one can imagine, multiplication by a constant, whether the amplifier is made of tubes/valves, bipolar transistors, FETS, or digital modules.)

The necessity of mathematics is indeed obvious to everyone in computer science, to anyone who has programmed at all, and of course to all engineers and almost all scientists.

Perhaps it would be helpful if the public, or at least the educated public, realized that our standard of living is directly the result of that tiny part of the world that mathematics describes accurately (with simple equations and unchanging parameters).

Is it a coincidence that electricity is described by most accurate laws, verifiable to something like eighteen significant figures from inside atoms to between stars, and electricity is the main player in the digital technology that has remade our world, by increasing in capability nearly one billion times since 1955?

Bob Eisenberg
Bard Professor and Chairman Emeritus
Department of Molecular Biophysics and Physiology
Rush University Medical Center
Chicago, Illinois

Jim Holt *replies*:

And the Rolling Stones need calculus too, since without aeronautical engineering

they could not fly to their concerts. But do they need to know calculus themselves? Do doctors?

When, as a college freshman, I aspired to go to medical school, I was told that the reason admissions committees insisted that pre-meds prove their mettle by taking calculus—and physics and organic chemistry—was to weed out applicants who were short on commitment and might drop out of medical school once admitted. (A first-year medical school dropout leaves an expensive hole in that class for the next three years.) So I grudgingly signed up for calculus—and, to my surprise, became so interested in mathematics that three years later I was teaching calculus to undergraduates myself. Today, as I see from checking the pre-med requirements at Yale, calculus is no longer universally required of those who wish to attend medical school (although organic chemistry—“orgo,” as we loathingly called it—still is).

As for Professor Eisenberg’s point about the technological usefulness of mathematics, he is of course absolutely right, as his well-chosen examples attest. But it is also true that a great deal of work in higher mathematics today (like that behind the long-sought resolution of Fermat’s last theorem) leaves our “standard of living” completely untouched—which is why the purported value of that work makes for an interesting philosophical discussion.

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