

Uses of Mathematics in Economics

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I think economic history is fascinating and agree we should have more of it.

Turning to the uses of mathematics in economics. I think I should concede that mathematics is abused at times. I have seen papers with unnecessarily advanced maths which do not actually say very much. However despite this, the use of mathematics in economics research does have significant benefits.

A key advantage of mathematical statements is that they are precise. Thus everybody can tell what is being said. Consequently it is relatively easy to tell whether a theory is right or wrong. Maynard Keynes understood the economy and financial markets very well. However he only provided imprecise verbal statements of how the economy worked. As a result we are not able to apply his insight in new situations Economists as diverse as Joan Robinson and Milton Friedman have claimed that Keynes would agree with their policy recommendations.

Most economic problems involve either time or uncertainty. Typically both. For instance economic growth is concerned with how the economy develops over time. It also involves many uncertainties from factors such as climate change and technical progress. Both time and uncertainty are difficult to describe without the use of mathematics.

The main applications of economics are to government policy and to financial markets. In both of these areas we are dealing with complex systems. Quants have taken over finance from a previous generation which relied upon intuition. In a world of big data and high frequency trading where trades take place in thousandth of a second or less, finance can only be conducted using a mathematical framework.

Likewise much of Government policy is sufficiently complex to require mathematical techniques. The UK government used mathematical economics to design

the highly successful spectrum auction. This raised \$22bn enough money to pay for all research ever done in universities. In contrast other countries which used bureaucratic processes to determine the sale method achieved disappointing results. Now many ordinary companies use economic theory. For instance Mars uses mathematical economics e.g. by running on-line auctions to purchase inputs. Top mathematical economists are often hired by private sector firms. Google has hired Hal Varian and Preston McAfee is at Microsoft.

Models of Human Behaviour

It has been argued that economics models human behaviour in an over-simplified manner. Current theories should be replaced by more realistic models based on insights from psychology. Sometimes mathematics is blamed for this deficiency. However I would argue to the contrary that more realistic models often need more complex mathematics.

A current policy question is why many people do not save enough for when they retire. This is explained by a behavioural bias which causes them to overweight the near future at the expense of the more distant future. To describe this it is necessary to replace the standard theory of linear discounting with a mathematically more complex model of hyperbolic discounting.

My own research concerns developing more realist models of uncertainty. In this it has been necessary to replace standard expectations with the more complex Choquet integral.

To sum up mathematics is very useful in economics. We need more mathematics not less to build better economic theories.