

## The Role of Mathematics in Applications

(Fall 2001)

The role of mathematics in applications has inspired much philosophical reflection, both as a possible guide to our ontological commitment to abstracta and as a puzzle in its own right. Let's take up these topics in turn.

### I. What does the Application of Mathematics tell us about the Ontology of Mathematics?

The discussion of consequences of applied mathematics for mathematical ontology has centered for some time on the indispensability arguments (see Maddy, *Naturalism*, §II.2, for review and references). Realists used the arguments to buttress their case; nominalists tried to undermine it by showing that math is dispensable, after all. But eventually the cogency of the argument itself, from indispensability to reality, was called into question (e.g. by Maddy, *Naturalism*, §II.6, and Sober, 'Mathematics and indispensability', *Philosophical Review* 102 (1993), pp. 35-57). The debate continues:

Michael Resnik, 'Scientific vs. mathematical realism: the indispensability argument', *Philosophia Mathematica* 3 (1995), pp. 166-174.

Susan Vineberg, 'Indispensability arguments and scientific reasoning', *Taiwanese Journal for Philosophy and History of Science* 10 (1998), pp. 117-140.

Mark Colyvan, *The Indispensability of Mathematics*, (Oxford: Oxford University Press, 2000), chapter 5, 'Maddy's objections'.

Mark Colyvan, chapter 6, 'The Empirical nature of mathematical truth'.

Mary Leng, 'What's wrong with indispensability? (or, the case for recreational mathematics)'.

Jody Azzouni, 'Thick epistemic access: distinguishing the mathematical from the empirical', *Journal of Philosophy* 94 (1997), pp. 472-484.

'Applied mathematics, existential commitment, and the Quine-Putnam indispensability thesis', *Philosophia Mathematica* 5 (1997), pp. 193-209.

'On "on what there is"', *Pacific Philosophical Quarterly* 79 (1998), pp. 1-18.

Additional readings:

Anthony Perrisini, 'Troubles with indispensability', *Philosophia Mathematica*, 1997.

Geoffrey Hellman, 'Some ins and outs of indispensability: a modal-structuralist approach', 1999.

Sober, 'Quine', *Proceedings of the Aristotelian Society*, supplementary volume 74, 2000, pp. 237-280, especially pp. 260-280. (See reply to Hellman in footnote 26.)

## II. What is the Puzzle of Applied Mathematics?

Many observers have felt that the continued, effective applicability of pure mathematics -- even of parts of mathematics developed with no physical motives in mind -- is a great and abiding mystery. Let's try to understand the problem.

Eugene Wigner, 'The unreasonable effectiveness of mathematics in the natural sciences', in *Symmetries and Reflections: Scientific Essays of Eugene P. Wigner*, (Indiana University Press, 1967), pp. 222-237.

R. W. Hamming, 'The unreasonable effectiveness of mathematics', *American Mathematical Monthly* 87 (1980), pp. 81-90.

Robert Oldershaw, 'Mathematics and natural philosophy', in R. E. Michens, ed., *Mathematics and Science*, (Singapore: World Scientific Press, 1990), pp. 136-153.

Nancy Cartwright, p. 19 and 'The reality of causes' (pp. 74-86), in *How the Laws of Physics Lie*, (Oxford University Press, 1983).

Mark Wilson, 'On the unreasonable uncooperativeness of mathematics in the natural sciences', *Monist* 83 (2000), *Applying Mathematics*, pp. 296-314.

'On the mathematics of spilt milk', in E. Grosholz and H. Breger, eds., *The Growth of Mathematical Knowledge*, (Kluwer, 2000), pp. 143-151.

Davies, 'Why is the universe knowable?', in R. E. Michens, ed., *Mathematics and Science*, (Singapore: World Scientific Press, 1990), pp. 14-33.

Steiner, 'The Application of mathematics to natural science', *Journal of Philosophy* 86 (1989), pp. 449-480.

Azzouni, 'Applying mathematics: an attempt to design a philosophical problem', *Monist* 83 (2000), pp. 209-223.

Liston, 'Review of Steiner', *Philosophia Mathematica* 8 (2000), pp. 190-207.