Mathematical Modelling with Case Studies
By Belinda Barnes, Glenn Robert Fulford
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It is possible to gain entry to mathematics degrees at prestigious UK institutions with only a single AS-level module of applied mathematics, covering nothing beyond "$v=u+at$". Discrete mathematics modules that have supplanted traditional A-level applied topics require only regurgitation of well-trodden algorithms. Students thus often arrive with the expectation that the degree is just an extended set of increasingly difficult Pavlovian exercises, isolated and abstracted from all reality. They complain that questions applying mathematics to the real world "contain too many words" and "are for physicists or engineers". If mathematicians, of any persuasion, are to play a role in the economic future of the UK (and so be rewarded by our political paymasters), this dangerous view must be reversed. "Mathematical Modelling with Case Studies" by Belinda Barnes and Glenn Robert Fulford is a book that could help to change this attitude, rooting the subject of first year differential equations firmly in a modelling context.

Although there are many competing first year texts, many of their case studies are drawn from novel contexts, presented in a lively style with "red-top" section headings: "Pacific rats colonise New Zealand", "Anchovy wipe-out", "Possums threaten New Zealand cows" (a country that seems to be afflicted with many threats!); "Nile perch catastrophe"; "Lemming mass suicides?"; "Prickly-pear meets its moth", leading up to the classic (and highly nonlinear) "Fish and chips explode".

More traditional models include: detecting art forgeries, finding land mines and cooling computer chips. For Daily Mail readers there is also, "Double glazing: what's it worth?"

Arising from the research background of the authors, population modelling features highly, spanning the traditional (Australian blowflies); the highly topical (SIR models for influenza) and the sociological (rise and fall of ancient civilisation due to feudal interactions between rulers, bandits and farmers).

One example of interest to freshers might be the mathematical models of alcohol consumption ("Dull Dizzy or Dead?"). Behaviour is categorised from "dull and dignified" through "disgusting and dishevelled", which apparently is less drunk than "delirious and disorientated", up to "dead". We learn that, evidently only 41% of Australian men resort to confrontational behaviour after excessive alcohol. To distract them, perhaps, there is also an exercise in modelling how quickly beer warms.

The text reads well, with the necessary mathematics and background carefully presented in sufficient detail for new students. Most of the usual topics of a first year differential equations syllabus are covered, both analytically and numerically using Matlab and Maple. Each chapter ends with a set of exercises expanding the case-studies.

The book could certainly serve as a text or source material to liven up a first year course on modelling with differential equations or associated project-work. It is certainly one to check out.

449 words