

# How to tip the scale



## GUESSTIMATION: SOLVING THE WORLD'S PROBLEMS ON THE BACK OF A COCKTAIL NAPKIN BY LAWRENCE WEINSTEIN AND JOHN A. ADAM

Princeton Univ. Press: 2008. 320 pp. \$19.95 pbk

Physicists have their own equivalent of corporate water-cooler gossip. In their laboratories, you can witness a weird flavour of coffee-time banter, often involving a large dose of geek pride. Almost invariably, someone will throw up a challenge to estimate some quantity  $X$  from first principles, or at least only with the knowledge available in the round. Although no one can remember an exact formula for  $X$ , or the precise values of the relevant underlying data, a wild approximation is obtained through a daring and haphazard approach, and the computation quickly performed on the clean side of a paper napkin. There's a whoop of joy if the result lies within a factor of ten of whatever Google spews out afterwards, and long faces if it isn't.

There is an art to this type of order-of-magnitude estimation, but it is not usually taught to students in any systematic way. In fact, most physics textbooks concentrate on exactly solvable problems and then, well, solve them exactly. *Guesstimation* steps into this breach and presents an entertaining collection of some 60 estimation problems, complete with an introductory bluffers' guide on how to master them. The book is pitched at high-school physics level, and the most advanced concepts covered are work and energy. The questions are fairly wide-reaching in scope, but environmental, transportation and energy issues are a recurring theme. In this vein, we calculate the sea level rise if the polar ice caps melt, the relative refuelling rates of conventional and electric cars, and the fraction of the US that needs to be covered with solar panels to satisfy the country's electricity needs. We also determine a few other quantities with more entertainment value than immediately apparent relevance, such as the end-to-end distance of all pickled gherkins sold in the US every year.

For experienced physicists, *Guesstimation* definitely misses a trick or two because it seems dumbed down for the benefit of a wider, more general audience. The book grew out of a physics course taught by Lawrence Weinstein at senior undergraduate level at Old Dominion University — and in comparison with the online course contents, the readers of the book

have definitely been cheated out of the most interesting and 'physics-y' bits. In this way, sadly, *Guesstimation* does not even aim to be that much-needed textbook on order-of-magnitude physics and its close relative, dimensional analysis. Perhaps the authors can twist the arm of their publisher and start working on *Guesstimation Reloaded*, pitched at a higher level for the more discerning audience.

Still, the target readership — a motley crew of students, popular-maths enthusiasts and job-interview candidates, according to the blurb and preface — will be entertained by the assorted problems presented in the book. After slightly too many questions of the 'how many golf balls/lottery tickets/angels fit on the equator/truck/pinhead' variety, we reach the interesting parts of the book where, between the lines, *Guesstimation* tells a compelling story about the energy challenges that society is facing. But beware: the bite-sized nature and the quirky ordering of the content (some questions are ordered thematically, some more bizarrely by physical unit of the result) make the book more suitable for browsing, rather than cover-to-cover reading.

One weakness is that the solutions often rely on somewhat esoteric hints. For example, a question on the fuel consumption of a nuclear power plant crucially states that "Each fission [of  $^{235}\text{U}$ ] produces about 200 MeV of energy" — a number that few people will have at their fingertips. In the coffee break/back-of-a-napkin scenario, we would certainly prefer to get the answer from more basic principles, perhaps by invoking some underlying facts about nuclear binding energies. Of course, this in turn requires some knowledge of nuclear physics, which brings us back to the issue of scope and target readership of the book. Pitched at a basic level, *Guesstimation* manages to entertain, but once our interest is piqued, the trained physicist is left craving more depth and substance.

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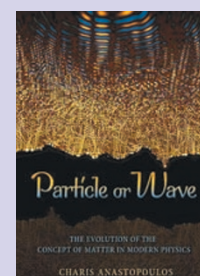
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Prometheus Books:  
2008. 270 pp. \$27.95

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### Particle or Wave: The Evolution of the Concept of Matter in Modern Physics by Charis Anastopoulos

Princeton Univ. Press:  
2008. 432 pp. £19.95

From philosophical discussions in antiquity to modern-day quantum field theories and beyond, this book retraces the origins and ongoing discussions regarding the Universe's elementary building blocks.