Undergraduate Material

- J. G. Andrews and R. R. McLone. *Mathematical Modelling*. Butterworths, 1976.

  This book is a collection of modeling projects using rather advance mathematical tools. It has a very good chapter on how to set up mathematical models from the description of the problem. Some of the problems of the book can be used for an advance undergraduate class at an institution with good students. The models considered cover a wide range of applications.

- E. A. Bender. *An Introduction to Mathematical Modeling*. Wiley, 1978.

  This book is quite useful since the author clearly outlines the modeling process and gives many examples. It requires knowledge in physics, ODEs, and probability. The drawback of this book is that it was written before personal computers were widely available and before symbolic manipulators were easily accessible.

- R. L. Borrelli, C. Coleman, and W. E. Boyce. *Differential Equations Laboratory Workbook: A Collection of Experiments, Explorations and Modeling Projects for the Computer*. John Wiley & Sons, 1992.

  This book is a collection of modeling projects which can be used either in an introductory modeling course or in a differential equation class where students work on team projects. See Koçak's review [4] for further information on the book.

- M. Braun, C. S. Coleman, and D. A. Drew, Eds. *Differential Equation Models*. Springer–Verlag, 1978.

  This book is a collection of modeling projects using differential equation as the main mathematical tool. It has a very good chapter on how to set up the differential equation model from the description of the problem. It can be used for an advance undergraduate class at an institution with good students. The models considered are population, traffic, mechanical, flow, and heat transfer models.

- D. Burghes, P. Galbraith, N. Price, and A. Sherlock. *Mathematical Modelling*. Prentice–Hall, 1996.

  This book is a collection of case studies based on problems in some British companies. It has a good introduction and it only requires calculus. It can be used in elementary undergraduate classes.

- R. R. Clements. *Mathematical Modelling: A Case Study Approach*. Cambridge Press University, 1989.

  This book outlines the modeling process and examines several examples. It requires knowledge in physics, ODEs, PDEs, probability, and statistics. See Cumberbatch's review [1] for further information on the book.

- M. Cross and A. O. Moscardini. *Learning the Art of Mathematical Modelling.* Ellis Horwood, 1985.

  This book emphasizes the educational aspect of mathematical modeling and considers various modeling projects. The student may not benefit from the book as much as the faculty who lectures.

- P. Doucet and P. B. Sloep. *Mathematical Modeling in the Life Sciences.* Ellis Horwood, 1992.

  This book would give good lecture ideas and projects if you were to teach a modeling class for a non science audience. It requires knowledge in differential equations, probability, and statistics and it is self-contained since the first half of the book is a summary of methods needed to solve the problems presented in the second half. Two chapters are discussing the modeling philosophy. This book is for advanced undergraduate students.

- C. L. Dym and E. S. Ivey. *Principles of Mathematical Modeling.* Academic Press, 1980.

  This book can give good ideas for lectures. It requires knowledge in physics, calculus, and ODEs.

- L. Edelstein–Keshet. *Mathematical Models in Biology.* Random House, 1987.

  This book considers three different types of models: discrete, continuous, and spatially distributed. It can give good ideas for lectures if you want to spend all or the majority of the time on models in biology. The book is self-contained in the sense that only calculus is a mathematical prerequisite and all the more advanced material needed to solve the models is presented in the book. You can use part of this book for an undergraduate course in modeling if you limit yourself to discrete and rather simple continuous models. To investigate the spatially distributed models, the students in the class would have to learn some rather advanced mathematical tools.

- E. Edwards and M. Hamson. *Guide to Mathematical Modelling.* CRC, 1990.

  This book is a core book since it has sections on what modeling is about, how to write a report, and how to organize a presentation. It requires knowledge in physics, calculus, ODEs, linear algebra, probability, and statistics.

- A. Friedman and R. Gulliver. Mathematical modeling for instructors. Technical Report 1254, Institute for Mathematics and its Applications, 1994.

  This report gathers a collection of problems on which teams of student instructors worked on for 8 days while attending the IMA Mathematical Modeling workshop held in August 1994. The problems can be used either for lectures or as projects. The audience needs to have some knowledge in physics, calculus, ODEs, and PDEs.

- A. Friedman and R. Gulliver, Organizers. Mathematical Modeling for Instructors, July 29-August 16, 1996. Institute for Mathematics and its Applications Technical Report 1422, 1996.

  This report gathers a collection of problems on which teams of student instructors and graduate students worked on for 10 days while attending the IMA Mathematical Modeling workshop. The audience needs to have some knowledge in physics, ODEs, PDEs, and some computational experience. To be able to use the problems presented here in a undergraduate modeling class, the students will need quite a strong mathematical background, which is beyond the average undergraduate knowledge.

- A. Friedman and W. Littman. *Industrial Mathematics: A Course in Solving Real–World Problems*. SIAM, 1994.

  This book presents a set of projects. It requires knowledge in physics, calculus, ODEs, PDEs, linear algebra, and numerical analysis. See Cumberbatch's review [3] for further information on the book.

- D. Hart and T. Croft. *Modelling with Projectiles*. Chichester, 1988.

  This book is focused on the motion of projectiles. It can give good lectures or projects. It requires knowledge in physics, ODEs, and numerical analysis.

- F. C. Hoppensteadt and C. S. Peskin. *Mathematics in Medicine and the Life Sciences*. Springer–Verlag, 1992.

  This book is more problem oriented and cannot be used as a textbook for an introductory modeling course since it is geared towards the study of particular problems. It requires knowledge in ODEs, linear algebra, probability, and statistics. It can give several examples for lectures or projects. See Milton's review [5] for further information on the book.

- IMA Summer Program for Graduate Students. Mathematical modeling. Technical Report 1021, Institute for Mathematics and its Applications, 1992.

  This report gathers a collection of problems on which teams of graduate students worked on for 5 days while attending the IMA Mathematical Modeling workshop held in August 1992. The problems can be used either for lectures or as projects. The audience needs to have knowledge in physics, calculus, ODEs, and PDEs.

- J. N. Kapur. *Mathematical Modelling*. Wiley, 1988.

  This book considers mathematical modeling with a different perspective than most of the other books listed here: it introduces it through one or more specific techniques rather than through obtaining an insight on real-world problems with mathematical tools. It can be used for an undergraduate class if the students have had ordinary differential equations and a numerical analysis class.

- M. S. Klamkin. *Mathematical Modelling: Classroom Notes in Applied Mathematics*. SIAM, 1987.

This book gathers problems from various application areas and it cannot, per se, be used as the sole textbook for a modeling course. It gives several examples for lectures or projects. It requires knoledge in physics, calculus, and ODEs.

- M. S. Klamkin. *Problems in Applied Mathematics: Selections from SIAM Review.* SIAM, 1990.

  This book gathers problems in the area of applied mathematics; it includes a few problems that can be used in a modeling course but it is not limited to that only. It gives several examples for lectures or projects. It requires knowledge in physics and applied mathematics beyond ODEs and linear algebra. The problems previously appeared in SIAM review.

- M. M. Meerschaert. *Mathematical Modeling.* Academic Press, 1993.

  This book is an introductory modeling book and can give material for lectures and projects. It requires knowledge in physics, calculus, ODEs, linear algebra, probability, statistics, and optimization.

- M. Mesterton-Gibbons. *A Concrete Approach to Mathematical Modelling.* Addison Wesley, 1989.

  This book is a good book to have in your own library since it has many examples. It requires knowledge in physics, calculus, ODEs, linear algebra, probability, and statistics. See Cumberbatch's review [2] for further information on the book.

- W. J. Meyer. *Concepts of Mathematical Modeling.* McGraw–Hill, 1984.

  This book can give good ideas for lectures. It requires knowledge in physics, calculus, and ODEs.

- D. N. P. Murthy, N. W. Page, and E. Y. Rodin. *Mathematical Modelling. A Tool for Problem Solving in Engineering, Physical, Biological and Social Sciences.* Pergamon Press, 1990.

  This book covers quite a few application areas. It requires knowledge in physics, ODEs, probability, and statistics. See Sherman's review [6] for further information on the book.

Additional unevaluated references for undergraduate classes

- R. L. Borrelli and C. Coleman. *Differential Equations: A Modeling Perspective.* Wiley, 1996.

- D. N. Burghes and M. S. Borrie. *Modelling with Differential Equations.* Halsted Press, 1981.

- D. N. Burghes, I. Huntley, and J. McDonald. *Applying Mathematics: A Course in Mathematical Modelling.* Halsted Press, 1982.

- D. N. Burghes and A. D. Wood. *Mathematical Models in the Social, Management, and Life Sciences.* Halsted Press, 1980.

- K. R. Coombs, B. R. Hunt, R. L. Lipsman, J. Osborn, and G. J. Stuck. *Differential Equations with Mathematica*. Wiley, 1997.

- K. R. Coombs, B. R. Hunt, R. L. Lipsman, J. Osborn, and G. J. Stuck. *Differential Equations with Maple*. Wiley, 1997.

- F. R. Giordano and M. D. Weir. *A First Course in Mathematical Modeling*. Brooks/Cole, 1985.

- A. C. Fowler. *Mathematical Models in the Applied Science*. Cambridge University Press, 1997.

- G. Fulford, P. Forrester, and A. Jones. *Modelling with Differential and Difference Equations*. Cambridge University Press, 1997.

- F. R. Giordano and M. D. Weir. *A First Course in Mathematical Modeling*. Brooks/Cole, 1985.

- F. R. Giordano and M. D. Weir. *Differential Equations: A Modeling Approach*. Addison–Wesley, 1991.

- S. G. Krantz. *Techniques of Problem Solving*. AMS, 1997.

- A. M. Starfield, K. A. Smith, and A. L. Bleloch. *How to model it: Problem Solving for the Computer Age*. McGraw–Hill, 1990.

- T. P. Svobodny. *Mathematical Modeling for Industry and Engineering*. Prentice-Hall, 1998.

- F. Y. M. Wan. *Mathematical Models and their Analysis*. Harper & Row, 1989.

Book Reviews

[1] E. Cumberbatch. Book review of *Mathematical Modelling: A Case Study Approach* by R. R. Clements. *SIAM Rev.*, 33:136, 1991.

[2] E. Cumberbatch. Book review of *A Concrete Approach to Mathematical Modelling* by M. Mesterton–Gibbons. *SIAM Rev.*, 34:140–141, 1992.

[3] E. Cumberbatch. Book review of *Industrial Mathematics: A Course in Solving Real–World Problems* by A. Friedman and W. Littman. *SIAM Rev.*, 38:341–342, 1996.

[4] H. Koçak. Book review of *Differential Equations Laboratory Workbook: A Collection of Experiments, Explorations and Modeling Projects for the Computer* by R. L. Borrelli, C. Coleman, and W. E. Boyce. *SIAM Rev.*, 36:129–130, 1994.

[5] J. Milton. Book review of *Mathematics in Medecine and the Life Sciences* by F. C. Hoppensteadt and C. S. Peskin. *SIAM Rev.*, 36:134–135, 1994.

[6] A. Sherman. Book review of *Mathematical Modelling. A Tool for Problem Solving in Engineering, Physical, Biological and Social Sciences* by D. N. P. Murthy, N. W. Page, and E. Y. Rodin. *SIAM Rev.*, 33:681–682, 1991.