Prefix, Number and Name of Course: ACM 621 Empirical Model Building

Credit Hours: 1
In Class Instructional Hours: 1 **Labs: 0** **Field Work:** 0

Catalog Description:
Prerequisites: (MAT 162 and MAT 202) or equivalents
Exploratory data analysis; polynomial interpolation; curve fitting; least squares; cubic splines; minimax polynomial; Taylor and Chebyshev series; applications to fitting experimental data.

Reasons for Addition or Revision:
Where students will create a one-semester-hour core module for the graduate Professional Applied and Computational Mathematics program where students will determine the best fitting model for a given set of data points.

Student Learning Outcomes:	**Course Content References:**	**Assessment:**
Students will: 1. construct and apply different models for fitting data.	I, II, III	1. Group work in class, individual homework assignments, exams and computer projects.
2. analyze, compare and contrast, and approximate various models	III, IV	2. Group work in class, individual homework assignments, exams, and computer projects.
3. write and utilize computer programs to solve for the best fitting curves.	I, II, III, III	3. Group work in class, individual homework assignments, and computer projects.

Course Content:

I. Interpolating data
- A. Lagrange polynomials
- B. Newton polynomials: divided differences
- C. General curve fitting using determinants

II. Smoothing data
- A. Divided differences and model selection

B. Transforming data
C. Polynomial least squares fitting
D. Cubic spline models

III. Minimizing absolute deviations
A. Single term models: golden section and dichotomous search methods
B. Best fitting polynomial of given degree using a linear program
C. Minimax trigonometric polynomial
D. Choosing a best model

IV. Approximating models
A. Taylor series
B. Weierstrass approximation theorem
C. Minimax polynomials: Chebyshev equioscillation condition
D. Chebyshev series
E. Error analysis

Resources:

Scholarships in the Field:

Alberth, O. *Precise Numerical Analysis.* Dubuque, Iowa: Wm. C. Brown, 1988.

Asaithambi, N. S. *Numerical Analysis, Theory and Practice*. New York: Saunders, 1995.

Atkinson, K. E. *An Introduction to Numerical Analysis*, 2nd ed. New York: Wiley, 1989.

Bornstein, M. H. and Bornstein, H. G. "The Pace of Life." *Nature* 259 (1976), 557-559.

Bradie, B. *A Friendly Introduction to Numerical Analysis*. New Jersey: Pearson Prentice Hall, 2006.

Burden, R. L. and Faires, J. D. *Numerical Analysis*, 7th ed. Pacific Grove, CA: Brooks/Cole, 2001.

Chapra, S. C. and Canale, R. P. *Numerical Methods for Engineers*, 5th ed. New York: McGraw-Hill, 2006.

Fausett, L. V. *Applied Numerical Analysis using MATLAB*, 2nd ed. New Jersey: Pearson Prentice Hall, 2008.

Gerald, C. F. and Wheatley, P. O. *Applied Numerical Analysis*, 5th ed. New York: Addison-Wesley, 1994.

Giordano, F. R., Fox, W. P., Horton, S. B. and Weir, M. D. *A First course in Mathematical Modeling*, 4th ed. Belmont, CA: Brooks/Cole, 2009.

Hamming, R. W. *Numerical Methods for Scientists and Engineers*. New York: McGraw-Hill, 1973.

Kincaid, D. and Cheney, W. *Numerical Analysis: Mathematics of Scientific Computing*, 3rd ed. Belmont, CA: Brooks/Cole, 2002.

Lindfield, G. and Penny, J. *Numerical Methods using MATLAB*, 2nd ed. New Jersey: Prentice Hall, 2000.

Linz, P. and Wang, R. L. C. *Exploring Numerical Methods*. Boston: Jones and Bartlett, 2003.

Mathews, J. H. and Fink, K. D. *Numerical Methods using MATLAB*, 4th ed. New Jersey: Pearson Prentice Hall, 2008.

Maron, M. J. *Numerical Analysis, A Practical Approach*. New York: Macmillan, 1982.

Morris, J. L. *Computational Methods in Elementary Numerical Analysis*. New York: Wiley, 1983.

Moursund, D. G. and Duris, C. S. *Elementary Theory and Application of Numerical Analysis*. New York: McGraw-Hill, 1967.

Neter, J. and Wassermann, W. *Applied Linear Statistical Models*, 4th ed. Boston: McGraw-Hill, 1996.

Plybon, B. F. *An Introduction to Applied Numerical Analysis*. Boston: PWS-Kent, 1992.

Recktenwald, G. *Numerical Methods with MATLAB*. New Jersey: Prentice Hall, 2000.

Rao, S. S. *Applied Numerical Methods for Engineers and Scientists*. New Jersey: Prentice Hall, 2002.

Shoup, T. E. *Applied Numerical Methods for the Microcomputer*. New Jersey: Prentice Hall, 1984.

Smith, W. A. *Elementary Numerical Analysis*. New Jersey: Prentice-Hall, 1986.

Stiefel, E. L. *An Introduction to Numerical Mathematics*. New York: Academic Press, 1963.

Vellman, P. F. and Hoaglin, D. C. *Applications, Basics, and Computing of Exploratory Data Analysis*. Boston: Duxbury Press, 1984.

Yakowitz, S. and Szidarovszky, F. *An Introduction to Numerical Computations*. New York: Macmillan, 1989.

Periodicals:

Applied Numerical Analysis and computational Mathematics
IMA Journal of Numerical Analysis
International Journal of Mathematical Modeling
International Journal of Numerical Analysis and Modeling
Mathematical Modeling
Mathematical Modeling and Analysis
Mathematical and Computer Modeling
Natural Resource Modeling
SIAM Journal on Numerical Analysis

Electronic and/or Audiovisual Resources:

Interdisciplinary Lively Applications Projects. Consortium for Mathematics and Its Applications, Inc., COMAP (800-772-6627, www.comap.com).

Undergraduate Applications in Mathematics Modules, COMAP.