

**Prefix, Number and Name of Course:** ACM 662 Time Series Analysis and Forecasting

**Credit Hours:** 1

**In Class Instructional Hours:** 1

**Labs:** 0

**Field Work:** 0

**Catalogue Description:**

*Prerequisite:* MAT 202 or equivalent

Time and frequency domain techniques including topics such as autocorrelation, spectral analysis, autoregressive moving average and integrated moving average models, Box-Jenkins methodology, fitting, forecasting and seasonal adjustments.

**Reasons for addition:**

To create a one-semester-hour module for the graduate Professional Applied and Computational Mathematics program and where students will formulate and solve real life problems using time series analysis, a statistical tool for the analysis of data which are collections of observations made sequentially in time, where observations are dependent and where the nature of this dependence is of interest in itself.

<b>Student Learning Outcomes:</b> Students will:	<b>Content Reference</b>	<b>Assessments</b>
1. plot time-series data and observe trends, seasonal fluctuations, other cyclical changes and irregular fluctuations.	I, II, VIII	Individual homework assignments, group work, examinations and computer projects.
2. fit a variety of suitable probability models to observed time series in the time domain using the autocorrelation function, to describe the evolution of a process through time.	III, IV, VIII	Individual homework assignments, group work, examinations and computer projects.
3. choose an appropriate forecasting procedure for future values of an observed time series for a given set of conditions.	V, VIII	Individual homework assignments, group work, examinations and computer projects.
4. analyze spectral analysis of time series in the frequency domain using the spectral density function to describe variation in time series accounted for by cyclical components at different frequencies.	VI, VII, VIII	Individual homework assignments, group work, examinations and computer projects.
5. examine and experiment on how statistical software can be used in the field.	VIII	Individual homework assignments, group work, examinations and computer projects.

## **Course Content:**

### **I. Introduction**

- A. The nature of time-series data
- B. Terminology
- C. Objectives of time-series analysis

### **II. Descriptive techniques**

- A. Types of variation
- B. Stationary time series
- C. Time plot
- D. Transformations
- E. Analyzing series which contain a trend
- F. Analyzing series that contain seasonal variation
- G. Autocorrelation and the correlogram

### **III. Time-Series models**

### **IV. Fitting time-series models in the time domain**

- A. Estimating the autocovariance and autocorrelation functions
- B. Fitting an autoregressive process - estimating the parameters and determining the order of an autoregressive process
- C. Fitting a moving average process - estimating the parameters and determining the order of a moving average process
- D. Mixed model
- E. Integrated model
- F. Box-Jenkins model
- G. Residual analysis

### **V. Forecasting**

- A. Univariate procedures
- B. Multivariate procedures
- C. Comparative review of forecasting procedures

### **VI. Stationary processes in the frequency domain**

- A. The spectral distribution function
- B. The spectral density function
- C. The spectrum of a continuous process

### **VII. Spectral analysis**

- A. Fourier analysis
- B. A simple sinusoidal model
- C. Periodogram analysis
- D. Estimation procedures and comparisons
- E. Analyzing a continuous time series

## VIII. Use of statistical software

### Scholarships in the Field:

Box, G. E. P., Jenkins, G. M., Reinsel, G. C., *Time Series Analysis: Forecasting and Control*, 4<sup>th</sup>. ed., NJ: Prentice Hall, 2008.

Brockwell, P. J., Davis, R. A., *Time Series: Theory and Methods*, 2<sup>nd</sup> ed., NY: Springer-Verlag, 1991.

Brockwell, P. J. and Davis, R. A., *Introduction to Time Series and Forecasting*, 2<sup>nd</sup> ed. NY: Springer, 2003.

Chatfield, C., *The Analysis of Time Series: an introduction*, 6<sup>th</sup> edition, FL: Chapman & Hall/CRC, 2004.

Cryer, J. D., *Time Series Analysis*, Boston: Duxbury Press, 1986.

Diggle, P. J., *Time Series: A Biostatistical Introduction*, NY: Oxford University Press, 1990.

Kendall, M. G. and Ord, J. K., *Time Series*, 3<sup>rd</sup> ed., Kent: Edward Arnold, 1990.

Montgomery, D. C., Jennings, C. L. and Kulahci, M., *Introduction to Time Series Analysis and Forecasting*, NJ: Wiley, 2008.

Ostrom, C. W., *Time Series Analysis: Regression Techniques*, 2<sup>nd</sup> ed., CA: Sage, 1990.

Pena, D., Tiao, G. C. and Tsay, R. S., *A Course in Time Series Analysis*, NY: Wiley, 2001.

Quarrie, M. C., Allan, D. R. and Tsai, C. L., *Regression and Time Series Model Selection*, NJ: World Scientific, 1998.

Reinsel, G. C., *Elements of Multivariate Time Series*, 2<sup>nd</sup> ed., NY: Springer, 1997.

Shumway, R. H. and Stoffer, D. S., *Time Series Analysis and Its Applications*, 2<sup>nd</sup> ed., NY: Springer 2006.

Yaffee, R. A. and McGee, M., *Introduction to Time Series Analysis and Forecasting with Applications of SAS and SPSS*, NY: Wiley, 2000.

Zellner, A., *Statistics, Econometrics, and Forecasting*, NY: Cambridge University Press, 2004.

Periodicals:

*Annals of Applied Statistics*  
*Annals of Mathematical Statistics*  
*Annals of Statistics*  
*Biometrics*  
*Biometrika*  
*Communications in Statistics*  
*Econometrica*  
*International Statistical Review*  
*Journal of the American Statistical Association*  
*Journal of Applied Statistics*  
*Journal of Applied Statistical Science*  
*Journal of Statistical Computation and Simulation*  
*Journal of the Royal Statistical Society*  
*Scandinavian Journal of Statistics*  
*Statistics in Medicine*  
*Statistical Methods in Medical Research*  
*Technometrics*  
*The American Statistician*

Electronic and/or Audiovisual Resources:

Electronic Journal of Statistics

Link to electronic journals web site (<http://www.e-journals.org/>)