STAT 416 - Statistical Analysis of Time Series   **Spring 2009**

1. <u>**Catalog Description**</u>

   Stat 416   Statistical Analysis of Time Series   (4 units)

   Time series components, descriptive smoothing methods, regression models for time series data, forecasting via exponential smoothing, evaluation of forecasts, autocorrelation, ARIMA models and Box-Jenkins methods, combining forecasts. Prerequisites: STAT 324, STAT 524 or consent of instructor (effective Winter 2010)

2. <u>**Required Background and/or Experience**</u>

   Stat 324 or Stat 524.

3. <u>**Expected Outcomes**</u>

   The student should:

   1. Recognize time series data, be able to represent such data graphically, and draw some tentative conclusions about the behavior of the series from such a representation.
   2. Understand the components of a series and how they can be combined.
   3. Understand the rationale for smoothing a time series and be able to apply several different types of smoothing techniques.
   4. Be able to fit a variety of regression models to time series data, make formal inferences based on such fits, and understand the limitations of such models when applied to time series data.
   5. Understand a variety of forecasting methods based on exponential smoothing and be able to implement these methods in appropriate situations.
   6. Be familiar with the basic properties of AR models, MA models, ARMA models, and ARIMA models, including correlation and partial correlation structure.
   7. Know how to identify appropriate ARIMA models from the sample correlations and partial autocorrelations, perform diagnostic checks for model adequacy to select a tentative model, and forecast with the selected model.
   8. Understand basic properties of seasonal ARIMA models and how to perform the tasks described in (7) above when such models are appropriate.
   9. Have some familiarity with other forecasting techniques and the relationships of various techniques to one another, including the combination of forecasts obtained from employing several different techniques.

4. <u>**Text and References**</u>

   Texts: *Forecasting Principles and Applications* by Stephen A. DeLurgio, McGraw-Hill/Irwin,1997.
   Elements of Forecasting by Francis Diebold, South-Western, 2006

5. Minimum Student Materials

None.

6. Minimum University Facilities

Chalkboards for classroom use, overhead projectors, computer facilities for student use in preparing assignments.

7. Expanded Description of Content and Method

CONTENT	Lecture hours

A.

1.   General Introduction to Time Series and Forecasting   3
    a.   Nature of forecasting
    b.   Graphical representation of time series data
    c.   Components of a time series

2.   Descriptive methods for time series data   4
    a.   Smoothing a time series using moving averages
    b.   Calculation of seasonal indices and deseasonalizing
    c.   Smoothing via exponential smoothing
    d.   Introduction to computer packages for time series analysis

3.   Forecasts based on fitting regression models   5
    a.   Fitting trend models
    b.   Multiple regression models
    c.   Modelling seasonality with trigonometric predictors
    d.   Modelling seasonality with dummy variables
    e.   Autocorrelation and its detection from sample autocorrelation coefficients
    f.   The Durbin-Watson test for autocorrelation
    g.   Regression models with autocorrelated errors

4.   Forecasts based on exponential smoothing   4
    a.   Simple exponential smoothing
    b.   Choice of smoothing constant in simple exponential smoothing
    c.   Holt's linear trend algorithm for non-seasonal data
    d.   The Holt-Winters algorithm for series with seasonality

5.   ARIMA models and Box-Jenkins forecasting methods   12
    a.   The concept of stationarity
    b.   Pure autoregressive models and their properties
    c.   Pure moving average models and their properties
    d.   ARMA models and properties
    e.   Differencing to achieve stationarity and ARIMA models

    f.   Model identification from the ACF and PACF
    g. Model Selection/AIC
    h. Diagnostics for model adequacy
    i.   Forecasting with ARIMA models
    j.   Seasonal ARIMA models
    k. Case studies
    l.   Intervention analysis
    m. Transfer function models

6.   Miscellanous topics in forecasting   5
    a.   Econometric forecasting
    b.   Relationships between forecasting methods
    c.   Other quantitative forecasting methods
    d.   Combining forecasts
    e.   Frequency domain analysis

7.   Selected topics   3

Total   36

METHOD
   Material will be presented in a lecture format.

8. <u>Method of Evaluating Outcome</u>

   By individual student recitation, evaluation of assignments, examinations, and reports.