

DSOM 5514 - FALL 2009
Forecasting Theories and Applications

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Textbook Website <http://forecast.umkc.edu/forecasting>

Time and Room: Monday night from 7:00 to 9:45 in computer classroom 4, approx. half time in class lecture and discussions and half time doing data analysis on the computer.

Focus: Computer based forecasting methods - theory and applications

Text: DeLurgio, S. A., **Forecasting Principles and Applications**, McGraw Hill-Irwin, Burr Ridge, Il. 1998. Textbook contains a diskette of 245 time series and about 50 *.WK1 templates. This textbook is available from the UMKC Bookstore at a special price to students enrolled in this class. Source of data and templates: <http://forecast.umkc.edu/forecasting/>

Software: All software is available either on your computer or in our computer laboratory and computer classroom. This course teaches you how to use EXCEL for many different forecasting applications. In addition, Forecast Pro for Windows (tm) (FPW), SPSS (Statistical Package for the Social Sciences), and SAS (Statistical Analysis System) software are available. SPSS and SAS programs prewritten by past graduate students (Roseann Pakiz and Marc Gogol) and me are available on the forecasting web-site <http://forecast.umkc.edu/>. If you are computer literate you can learn SPSS and SAS in the context of forecasting through these facilities and appropriate manuals. Finally, SPSS for windows is available in our classroom and computer lab and it is an excellent way to learn forecasting. Also, importantly, to streamline analysis, we will be using ForecastPro software available in our classroom and computer lab. This powerful package will be used during class so you might very easily use it outside of class. The following URL will provide highlights of this award winning software package. <http://www.forecastpro.com/>. As mentioned, I will be sharing prepared spreadsheet examples with the class as the semester progresses and thus you will benefit from my efforts in this regards.

Prerequisites: A basic statistics course.

Some Highlights: Some of the interesting aspects of this class include:

* Understanding forecasting/time series principles that relate to personal and professional financial planning, investments, marketing, general management, international business and human resource management.

* Learning contemporary forecasting methods such as Artificial Neural Networks. These methods are presented as intuitively as possible, thus, making them understandable and usable by manager and analyst like.

- * Using a book and course materials developed here at UMKC during a 27 year development cycle. I have attempted to write one of the best books on forecasting principles and applications.
- * Using the forecasting WEBSITE developed for this course. It will assist you in learning more about forecasting applications throughout the world <http://bloch.umkc.edu/forecast/>
- * Using one of the most sophisticated forecasting expert systems, Forecast Pro (tm) which is available to you in our lab.
- * Learning basic-to-advanced forecasting methods that are presented in an intuitive manner.
- * Using some of the 250 specifically selected time series from marketing, finance, operations, and general management to study actual applications of forecasting. For example, the September 11, 2001 Terrorism, October 1987 and 1997 stock market crashes, 1993 and 2007 Midwest floods, the financial bubble and meltdown of 2007, and other notable events are studied in the context of time series analysis and forecasting. These time series are included with the book and are on the Website.

Description of Course: A study of the principles and applications of alternative forecasting methods. Typical methods included are smoothing and decomposition time series methods, regression methods, econometric models, intervention analysis, and univariate and multivariate autoregressive integrated moving average methods (ARIMA building methods popularized by Box and Jenkins), artificial neural networks, and forecasting expert systems.

This course studies the essentials of effective statistical forecasting methods. In a very general sense, all decisions are based upon forecasts. Many decision makers use unscientific methods of forecasting to arrive at decisions, and often such methods are effective. However, if the decision maker possessed knowledge of more scientific approaches, the effectiveness of his or her decisions should be enhanced. It is for these reasons that managers, engineers, economists, and analysts should study statistical forecasting methods. In addition, few topics are as inherently interesting to as large a number of disciplines as forecasting. This course tries to further refine and stimulate your interest and success in forecasting.

Important forecasting applications are studied in the areas of financial planning and analysis, marketing research, sales forecasting, operations planning and analysis, accounting/financial forecasting, and international management including manpower, market forecasting, sales forecasting, and the analysis of stock prices.

Statistical forecasting methods and applications have taken on significantly greater importance in the last decade. This is due in part to greater competitiveness in business and the wider availability of low-cost, high-tech computer applications. Inexpensive microcomputer based statistical forecasting packages rival or exceed those available on mainframe computers. Supply Chain Management, Project Management, Computer-based management information systems, integrated Enterprise Resource Planning ERP systems, marketing and financial information systems all require forecasts as inputs for long-to-immediate term planning, execution, and control.

While this course covers a full range of forecasting methods, it concentrates on the most widely used methods of forecasting including simple smoothing, Winter's, econometric, and Box-Jenkins (ARIMA Building) methods. These methods are important tools in production, marketing, finance, engineering, and economics. The emphasis of the course will be on the theory and applications of successful forecasting.

Grading: The course grade will be determined from the following formulas:

Forecasting Project	50%
Homework	10%
Midterm	30%
Final Exam (using your project)	10%
	100%

Final Course Letter Grades

95--100 A
91--94 A-
88--90 B+
80--87 B
77--79 B-
74--76 C+
69--73 C
65--68 C-
55--64 D
Less than 55 F

Homework and Project Letter Grades

100 A+
97 A
92 A-
89 B+
84 B
78 B-
75 C+
72 C
67 C-
62 D
55 F

Forecasting projects are to be undertaken by each student. The scope of these projects will be discussed early in the semester. You should select a time series of interest to you for study in this class. If you do not have a project of interest, our book includes 8 different projects. Your project is to be analyzed and completed solely by you.

COMPREHENSIVE FORECASTING OUTLINE

Our course must be a subset of this outline.

- I. Introduction
 - A. Forecasting Models and Methodology
 - B. Elementary Statistics: A Review
 - C. Introduction to the Regression Model

- II. Univariate Time-Series Methods
 - A. Smoothing and Extrapolation of Time Series
 - B. Exponential Smoothing - Holt-Winters Method
 - C. Linear ARIMA (i.e., Box-Jenkins) Time-Series Models
 - D. Identification of ARIMA Models
 - E. Estimation of ARIMA Models
 - F. Diagnosing ARIMA Models
 - G. Forecasting with ARIMA Models

- III. Multiple Regression and Econometric Methods
 - A. Two-Variable (Bivariate) Regression Model
 - B. The Multiple Regression Model
 - C. Using Multiple Regression Models
 - D. Serial Correlation and Heteroscedasticity
 - E. Instrumental Variables and Two-Stage Least Squares
 - F. Forecasting with a Single Equation Regression Model

- IV. Multivariate ARIMA Time Series Models
 - A. Intervention (Impact) Assessment
 - B. The Cross-Correlation Function
 - C. Prewhitening
 - D. Model Identification
 - E. Model Estimation
 - F. Model Diagnostics
 - G. Model Forecasting

- IV. Other Methods and Contemporary Topics
 - A. Artificial Neural Networks
 - B. Cyclical Forecasting

- V. Qualitative and Technological Forecasting Methods
 - A. Forecasting Emerging Technologies and Products
 - B. Panel Consensus, Sales Force Composite, Delphi Method
 - C. Historical Analogy
 - D. Relevance Trees
 - E. Other Longer Term Methods Including Market Research

- VI. Forecasting Software and Applications are Integrated Throughout
 - A. Financial
 - B. Marketing
 - C. Operations
 - D. Accounting
 - E. General Planning

You are to select a time series of interest for your study in this class from your company, other data sources, or the minicases identified in this book. To lessen the load of doing a minor research project, you must select your data for this class by the beginning of the third week of class.

<u>PERIOD</u>	<u>DATE</u>	<u>TOPIC READING</u>	<u>ASSIGNMENTS</u>
1	AUG 24	<u>Introduction to Course</u> Grading, Forecasting Projects and Software - Sources of time series data – Intro. SPSS. Review of Statistics	Chap. 1
2	AUG 31	<u>Statistical Fundamentals</u> ACFs and Q-statistic ACFs and Q-statistic for Random Series, Random Walks (e.g., stock prices), Trending Series, and Seasonal Series	Chap. 2
3	SEP 14	<u>Simple Linear Regression</u> Assumptions of Regression Analysis, Durbin- Watson Statistic, Modeling Lead-Lag Relationships with Cross Correlation Coefficient. US and German Stock Indexes.	Chap. 3
4	SEP 21	<u>Simple Smoothing Methods</u> Simple and Seasonal Exponential Smoothing Methods. Forecasting and Smoothing Time Series such as Births and Marriages.	Chap. 4
5	SEP 28	<u>Decomposition</u> <u>Classical Additive and Multiplicative</u> Decomposition Methods, Interpreting Seasonal Indexes, identifying cyclical influences. Applying these methods to many different time series.	Chap. 5
6	OCT 5	<u>Trend-Seasonal and Winters' ACF and PACF</u> Identification of models, identifying random walks, trends, seasonality, and trend-seasonal series.	Chap. 6
7	OCT 12	<u>Trend-Seasonal and Winters' ACF and PACF</u> Identification of models, identifying random walks, trends, seasonality, and trend-seasonal series.	Chap. 6 & 7
8	OCT 19	<u>ARIMA Model Building Methods I</u> Using Differences to Achieve Stationarity and Effective Forecasts Holt-Winters Smoothing. Applying these methods to many different time series. Estimating ARIMA Models, US Stock Index, Demand for FAD product, Stock Prices, Demand for Dairy Product, Achieving Variance Stationarity,	Chap. 7
9	OCT 26	<u>ARIMA Building Methods II</u> Estimating More Complex ARIMA Models, the extraordinary versatility of ARIMA methods, modeling Demand for Animal Pharmaceuticals, Common Stock Prices, Utility Electricity Demand, Japanese Stock Index, among others. Common Stock Prices, Utility Electricity Demand, Japanese Stock Index, among others.	Chap. 8

10	NOV 2	<u>Midterm Exam</u>	
11	NOV 9	<u>Econometric and Regression Applications I</u> Multicollinearity and Serial Correlation Adjustment Procedures Such as Cochrane-Orcutt, many other time series concepts in regression analysis such as heteroscedasticity, elasticities, dichotomous variables, Goldfeld-Quandt test, and Partial F-test. US versus UK Stock Index relationship, and Computer Lab Work	Chap. 10
12	NOV 16	<u>MARIMA – Intervention</u> Modeling Different Types of Interventions - 911 Terrorism, Midwest Flood, October 1987 and 1997 Stock Market Crashes, Many other Interventions.	Chap. 12
13	NOV 23	<u>MARIMA - Transfer Functions</u> Modeling Complex and Dynamic Relationships Using Transfer Functions. Daily IBM stock prices NY versus London, Lumber Sales, Automobile Market Share.	Chap. 13
14	DEC 30	<u>Neural Networks</u> Understanding how Artificial Neural Networks model extremely complex mathematical and logical relationships, forecasting Automobile Prices based on automobile characteristics.	Chap. 16
15	DEC 7	<u>FINAL EXAM PRESENTATIONS - I</u>	
16	DEC 14	<u>FINAL EXAM PRESENTATIONS – II</u>	8:00 to 10 PM

Academic Calendar for UMKC: <http://www.umkc.edu/registrar/acal.asp#fs2009>

Final Exam Schedule: http://www.umkc.edu/registrar/exam.asp#Fall_2009

Homework Procedures

Homework will be collected regularly and when due. There MAY be a one-half letter grade point penalty for late homework an additional one-half letter grade reduction per week for any homework which is turned in late. Homework is 10% of your grade. Homework relates to tests, the objectives of this class, your grade, and your research project; therefore, your timely and methodical completion of home-work assignments is essential to success in this course.

Optional sessions may be held to introduce and refine computer applications. Times and dates will be established later. These sessions are not mandatory, but are very effective utilization of your time.

RESEARCH PROJECT SCHEDULE

The following is a time schedule of tasks for your Research project unless, these are assigned as homework before each of these dates. Most of these tasks are to be completed using EXCEL or your own statistical package. If you want my comments and advice concerning your time series, you should complete each subtask on time and submit this electronically using email to delurgios@gmail.com. Your subject heading should always be **HOMEWORK**. Do not procrastinate.

<u>PERIOD/DATE</u>	<u>TOPIC</u>	<u>COMPLETED ASSIGNMENT</u>
4	SEP 15	SELECTION OF DATA SERIES IS COMPLETE WITH AN INITIAL PLOT OF SERIES SUBMITTED TO ME
5	SEP 22	IDENTIFYING OUTLIERS AND DOMINANT PATTERNS RECORD STATISTICS BEFORE AND AFTER ADJUSTMENTS
6	SEP 29	FIT AT LEAST 3 UNIVARIATE MODELS TO DATA, IF THE SERIES IS LONG, WITH HOLD DATA AND CALCULATE OUT-OF-SAMPLE STATISTICS, COMPARE AND CONTRAST, COMMENT ABOUT THE MODELS.
8	OCT 13	VERIFY STATIONARITY AND USE NEEDED DIFFERENCES TAKE NEEDED DIFFERENCES AND VERIFY STATIONARITY USING PLOTS AND ITS HISTOGRAM CHECK FOR OUTLIERS
11	OCT 20	START WORK ON ARIMA MODEL IDENTIFICATION
14	NOV 16	COMPLETE ESTIMATES OF ARIMA MODELS VERIFY DIAGNOSTICS AND MODELING IS COMPLETE
15	DEC 8	COMPLETE RESEARCH PROJECT - INCLUSIVE OF COMMENTS REGARDING PRACTICAL VALUE OF FORECASTS

DATA SETS AVAILABLE ON THE NET ETC: There is extensive data available from Economagic, the Federal Reserve, EDGAR and FRED. Department of Commerce, US Bureau of Labor Statistics, Predicasts, Dow Jones & Company, NEXIS, LEXIS, and many other publications, particularly trade publications for specific industries. Common sources of data used in the past have included the following:

EDGAR	Survey of Current Business
Annual Report of the President	Statistical Abstract of the United States
Federal Reserve Bulletin	Wall Street Journal
Barron's	Compuserve
Predicast Data	Numerous trade publications

Many of the time series of these publications are seasonally adjusted, these series are to be avoided.

Our library has extensive collections of Federal Documents that include relevant data for your projects. Unless you get permission from me before doing so, you are required to choose a time series that is not seasonally adjusted. That is, your time series should be hourly, daily, weekly, monthly, or quarterly data that potentially contains seasonality. In addition, your data should not be trivial data such as monthly stock prices or market indexes, unless you speak with me before choosing such series. There are many valid and interesting projects that can be undertaken using stock prices, however, a univariate analysis of a single stock price is a trivial task.

The following list of web-sites are great sources of potential data for your time series projects. Spend some time studying this list before deciding on a topic and time series. Many students have found the *economagic* site very useful. I will purchase access to *economagic*.

1) Bill Goff's Resources For Economist on the Web is sponsored by the [American Economic Association](#). It lists 1,311 resources in 96 sections and sub-sections available on the Internet of interest to academic and practicing economists, and those interested in economics. All resources are also described at <http://www.aeaweb.org/RFE/>.

2) *Economagic*: Economic Time Series Page: This is one of the best economic data site with over 100,000 series. Users have the ability to make their own custom charts, XY plots, regressions, and get data in excel files, or in copy and paste format etc. <http://www.economagic.com/> This site is free when used from a computer connected to through the UMKC network.

3) *STAT-USA* is a service of the U.S. Department of Commerce, is the site for the U.S. business, economic and trade community, providing authoritative information from the Federal Government. This is possibly the largest online source of times series data from almost all governmental agencies of the United States Federal Government. <http://www.stat-usa.gov/>

4) The Bureau of Labor Statistics (BLS) is the principal fact-finding agency for the Federal Government in the broad field of labor economics and statistics. The BLS is an independent national statistical agency that collects, processes, analyzes, and disseminates essential statistical data to the American public, the U.S. Congress, other Federal agencies, State and local governments, business, and labor. The BLS also serves as a statistical resource to the Department of Labor.

BLS data must satisfy a number of criteria, including relevance to current social and economic issues, timeliness in reflecting today's rapidly changing economic conditions, accuracy and consistently high statistical quality, and impartiality in both subject matter and presentation. <http://stats.bls.gov/data/>

5) *BEA Home GDP* and related data from the national accounts programs of the U.S. Department of Commerce's Bureau of Economic Analysis ... <http://www.bea.gov/>

6) **The Data Archive at the University of Essex** houses the largest collection of accessible computer-readable data in the social sciences and humanities in the United Kingdom. It is a national resource... <http://www.data-archive.ac.uk/>

7) A website for **economy.com**, www.economy.com has the mission of being the premiere destination on the Internet for anyone seeking high-quality information, data, or products on the world economy. At the following location which is sponsored by economy.com you will find information and data ... <http://www.dismal.com/>

8) Through the **FRED** database, the Federal Reserve Bank of St. Louis provides consumers, students, economists and financial institutions around the world with economic and financial information in an easy-to-use format. FRED provides historical U.S. economic and financial data, including daily U.S. interest rates, monetary and business indicators, exchange rates, balance of payments and regional economic data for Arkansas, Illinois, Indiana, Kentucky, Mississippi, Missouri and Tennessee. <http://www.stls.frb.org/fred/>

9) A very good source of econ & financial data links on the web is World Bank <http://econ.worldbank.org> National Bureau of Economic Research <http://www.nber.org/>

DATA LINKS. Federal Reserve has **data** on all kinds of US interest rates and the exchange ... has a lot of US and international **data**, as well as **links** to other sites ® ...www.econ.yale.edu

10) **Data & Research**... annual compilation of **data** about development. Global Economic ... to development research and **data**, with **links** to language translations and related websites. ... <http://econ.worldbank.org>

11) Some forecasting links of interest to students in this course: <http://cpcug.org/user/sigstat/framstat.htm> or <http://cpcug.org/user/sigstat/index.htm>

12) Econometric Links for the Econometrics Journal for the Royal Economic Society. <http://www.eur.nl/few/ei/links> which may be of interest for forecasters and researchers.

13) Stock market data used in the book, **Irrational Exuberance**, 2000, are available here: <http://www.econ.yale.edu/~shiller/data.htm>. In addition, there are several other data series that may be of interest to those modeling stock market movements.

[CLICK FOR SOME OF THE MINICASES USED THROUGHOUT THIS BOOK](#)