KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DEPARTMENT OF MATHEMATICS & STATISTICS

STAT 460 - Time Series
Term 162 Syllabus

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Office Hours: UR (9.15 - 11:30am) and T: (9.15-10.45am) or by appointment

Course Description: Examples of simple time series. Stationary time series and autocorrelation. Autoregressive moving average processes. Modeling and forecasting with ARMA processes. Maximum likelihood and least squares estimator. Nonstationary time series.
Prerequisite: STAT 310

Textbooks: Cryer, J. D. and Chan, K. (2009). Time Series Analysis with Applications in R, 2nd Edition, Springer, New York, USA.

References: Diebold, F. X. (2007). Elements of Forecasting. 4th Edition, Thomson, South-Western, Mason OH, USA.

Software: *R* statistical language and EXCEL.

Assessment

Assessment for this course will be based on homework and/or quizzes, term project, two major exams and a comprehensive final exam, as in the following:

Activity	Weight
Homework and other class activities	10%
Term project **(week 13): Tues May 9**	15%
Exam 1 **(week 6): Tues March 14 Ch:1-3)**	20%
Exam 2 **(week 10): Tues Apr 18 (Ch:4-5, Ch6:6.1-6.2)**	20%
Final Exam (Comprehensive): **Sun June 4 12.30pm**	35%

***The letter grades are assigned as follows:

Letter grade	A+	A	B+	B	C+	C	D+	D	F	DN
Cut-off	88%	82%	75%	70%	65%	60%	55%	50%	<50%	≥ 9 absences

Academic Integrity: All KFUPM policies regarding ethics and academic honesty apply to this course.

Important Notes:

- ✓ Unexcused absences will result in a grade of DN in accordance with University rules.
- ✓ Attendance on time is very important.
- ✓ Homework is due in class every Sunday a chapter is completely covered.
- ✓ A formula sheet and statistical tables will be provided for you in every exam.

The course is in line with the latest (January 8th 2017) **SOA learning objectives** for time series portion of the **SRM professional exam** and the VEE Applied Stats As such, students should be able to:

a) Define and explain the concepts and components of stochastic time series processes, including stationarity and autocorrelation.
b) Describe specific time series models, including random walk, exponential smoothing, autoregressive, and autoregressive conditionally heteroskedastic.

c) Interpret predicted values and confidence and prediction intervals.
d) Explain uses of time series models.

Topics covered in this course

Introduction to Time Series

- Types of data
- Components of Time Series
- Real life examples

Smoothing techniques

- Moving average
- Exponential weighted moving average

Trends

- Modeling and forecasting deterministic trend

Seasonality

- Modeling and forecasting deterministic seasonality

Stationary, non-stationary, and heteroscedastic time series

a) Models for Stationary Time series
   - Random walk
   - MA models
   - AR models
   - ARMA models
   - Invertability
   - Forecasting ARMA models
b) Models for Non-stationary Time series
   - Stationary through differencing
   - ARIMA models
   - Forecasting ARIMA models
c) Models for Heteroscedastic Financial Time series
   - ARCH models
   - GARCH models

Model Specification

- Properties of Auto Correlation Function
- Properties of partial autocorrelation function
- Specification of some actual time series

Parameter Estimation

- Least square estimation
- Maximum Likelihood estimation

Model Diagnostics

- Residual Analysis
- Checking Assumptions
- Model fit evaluation

Forecasting

- Forecast errors and confidence intervals

Tentative weekly topical breakdown

Week	Date (2017)	Section	Topics
1	Feb. 05-09	1.1-1.4 2.1	Introduction: Examples of Time Series, A Model-Building Strategy , Time Series and Stochastic processes
2	Feb. 12-16	2.2-2.4	Means, Variances, and Covariances, Stationarity
3	Feb. 19-23	3.1-3-3	Deterministic Versus Stochastic Trends, Estimation of a constant mean, Regression Methods.
4	Feb. 26-March 2	3.3-3.6	Regression Methods(Continued), Reliability and validity of estimates, Interpreting Regression Output, Residual Analysis
5	March 05-09	3.6-3.7, part of 8.1, 4.1	Residual Analysis (Continued), General Linear Processes
			Exam I: Tues March 14 (chap 1- 3)
6	March 12-16	4.2-4.3	Moving Average processes, Autoregressive Processes
7	March 19- 23	4.4-4.5, 5.1	The Mixed Autoregressive Moving Average (ARMA) Model, Invertibility, Stationarity Through Differencing
8	March 26-30	5.2-5.3, 9.7	ARIMA models, Meaning of Constant Terms in Model, Forecast Weights and Exponentially Weighted Moving Average
			April 2-6, Midterm Break
9	April 9- 13	5.4 , 6.1-6.2	Other Transformations, Properties of the sample Autocorrelation Function, The partial and Extended Autocorrelation Functions
			Exam 2: Tues Apr 18 (chap 4-5, 6.1-6.2)
10	April 16-20	6.3-6.6	Specification of Simulated Time Series, Nonstationarity, Other Specification Methods, Specification of Some Actual Time Series
11	April 23- 27	7.1-7.3	The Method of Moments, Least Squares Estimation, Maximum Likelihood and Unconditional Least Squares
12	April 30-May 4	7.4-7.6, 8.1-8.2	Properties of the Estimates, Illustrations of Parameter Estimation, Bootstrapping ARIMA models, Residual Analysis, Overfitting and Redundancy
13	May 7-11	10.1-10.4, 12.1	Seasonal ARIMA Models, Multiplicative and Nonstationary Seasonal Models, Model Specification Fitting and Checking, Financial Time Series
14	May 14- 18	12.2-12.4, 9.1-9.5	ARCH and GARCH Models, MLE of Heteroscedatic Models, Minimum Mean Square Error Forecasting, Deterministic Trends, ARIMA Forecasting, Prediction limits, Forecasting illustrations
15	May 21- 25	10.5, 9.6, 9.8-9.9	Forecasting Models (updating ARIMA Forecasts, certain ARIMA Models, Seasonal Models, Transformed Series)
			Final Exam (Comprehensive): Sunday, June 4, 2017, 12:30-03:30 pm