

**KING FAHD UNIVERSITY OF PETROLEUM & MINERALS**  
**DEPARTMENT OF MATHEMATICS & STATISTICS**  
**STAT 460 - Time Series**  
**Term 182 Syllabus**

**Instructor:** Dr. Mohammad H. Omar

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**Office Hours:** UTR (11.00 - 11:50am) and UT: (12.20-12.45pm) 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, 2<sup>nd</sup> 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. Students are required to download R onto their laptop computers for assignments and practice. Instructions for downloading this free software is available on Blackboard.

**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, Quizzes, and other class activities	10%
Term project ( <b>week 13</b> ): <b>Tues Apr 2</b>	15%
Exam 1 ( <b>week 6</b> ): <b>Mon Feb 4 Ch:1-3</b>	20%
Exam 2 ( <b>week 10</b> ): <b>Wed Mar 6 (Ch:4-5, Ch6:6.1-6.2)</b>	20%
Final Exam (Comprehensive): <b>Sat Apr 27 8.00am</b>	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 class quiz is often given at the end of the following week a chapter is completely covered.
- ✓ A formula sheet (check Blackboard) and statistical tables will be provided for you in every exam.

The course is in line with the latest **SOA learning objectives** for “Time Series Models” portion of the (Spring 2019) **SRM professional exam**. As such, students should be able to:

- a) Define and explain the concepts and components of stochastic time series processes, including random walks, stationarity and autocorrelation.

- b) Describe specific time series models, including, exponential smoothing, autoregressive, and autoregressive conditionally heteroskedastic models.
- c) Calculate and Interpret predicted values and confidence and prediction intervals.

## 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
- Invertibility
- 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 (2019)	Section	Topics
1	Jan 6 – 10	1.1-1.4 2.1	Introduction: Examples of Time Series, A Model-Building Strategy , Time Series and Stochastic processes
2	Jan 13 – 17	2.2-2.4	Means, Variances, and Covariances, Stationarity
3	Jan 20 – 24	3.1-3-3	Deterministic Versus Stochastic Trends, Estimation of a constant mean, Regression Methods.
4	Jan 27 – 31	3.3-3.6	Regression Methods(Continued), Reliability and validity of estimates, Interpreting Regression Output, Residual Analysis
5	Feb 3 – 7	3.6-3.7, part of 8.1, 4.1	Residual Analysis (Continued), General Linear Processes
<b>Exam I: Mon Feb 4 (chap 1- 3)</b>			
6	Feb 10 – 14	4.2-4.3	Moving Average processes, Autoregressive Processes
7	Feb 17 – 21	4.4-4.5, 5.1	The Mixed Autoregressive Moving Average (ARMA) Model, Invertibility, Stationarity Through Differencing
8	Feb 24 – 28	5.2-5.3, 9.7	ARIMA models, Meaning of Constant Terms in Model, Forecast Weights and Exponentially Weighted Moving Average
9	Mar 3 – 7	5.4 , 6.1- 6.2	Other Transformations, Properties of the sample Autocorrelation Function, The partial and Extended Autocorrelation Functions
<b>Exam 2: Wed Mar 6 (chap 4-5, 6.1-6.2)</b>			
10	Mar 10 – 14	6.3-6.6	Specification of Simulated Time Series, Nonstationarity, Other Specification Methods, Specification of Some Actual Time Series
11	Mar 17 – 21	7.1-7.3	The Method of Moments, Least Squares Estimation, Maximum Likelihood and Unconditional Least Squares
12	Mar 24 – 28	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	Mar31–Apr4	10.1-10.4, 12.1	Seasonal ARIMA Models, Multiplicative and Nonstationary Seasonal Models, Model Specification Fitting and Checking, Financial Time Series
14	Apr 7 – 11	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	Apr 14 – 18	10.5, 9.6, 9.8-9.9	Forecasting Models (updating ARIMA Forecasts, certain ARIMA Models, Seasonal Models, Transformed Series)
<b>Final Exam (Comprehensive): Saturday, Apr 27, 2019, 8:00-11:00 am</b>			