

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

STAT 460 - Time Series
Term 192 Syllabus

Instructor: Dr. Mohammad H. Omar

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Office Hours: UTR: (12.30-1.45pm) 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, 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. 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 (week 13): Tues Apr 14	15%
Exam 1 (week 6): Tues Feb 18 Ch:1-3	20%
Exam 2 (week 10): Wed Mar 18 (Ch:4-5, Ch6:6.1-6.2)	20%
Final Exam (Comprehensive): Sun May 10 1.00pm	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 (May 2020) **SRM professional exam**. <https://www.soa.org/globalassets/assets/files/edu/2020/2020-05-exam-srm-syllabi.pdf>. 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

- (1) Types of data (2) Components of Time Series (3) Real life examples

Smoothing techniques

- (1) Moving average (2) 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
 - (1) Random walk (2) MA models, AR models, ARMA models (3) Invertibility (4) Forecasting ARMA models
- b) Models for Non-stationary Time series
 - (1) Stationary through differencing (2) ARIMA models (3) Forecasting ARIMA models
- c) Models for Heteroscedastic Financial Time series
 - (1) ARCH models (2) GARCH models

Model Specification

- (1) Properties of Auto Correlation Function (2) Properties of partial autocorrelation function (3) Specification of some actual time series

Parameter Estimation

- (1) Least square estimation (2) Maximum Likelihood estimation

Model Diagnostics

- (1) Residual Analysis (2) Checking Assumptions (3) Model fit evaluation

Forecasting

Forecast errors and confidence intervals

Tentative weekly topical breakdown

Week	Date (2020)	Section	Topics
1	Jan 19 – 23	1.1-1.4 2.1	Introduction: Examples of Time Series, A Model-Building Strategy , Time Series and Stochastic processes
2	Jan 26 – 30	2.2-2.4	Means, Variances, and Covariances, Stationarity
3	Feb 2 – 6	3.1-3-3	Deterministic Versus Stochastic Trends, Estimation of a constant mean, Regression Methods.
4	Feb 9 – 13	3.3-3.6	Regression Methods(Continued), Reliability and validity of estimates, Interpreting Regression Output, Residual Analysis
5	Feb 16 – 20	part of 8.1, 3.6-3.7, 4.1	Residual Analysis (Continued), General Linear Processes
Exam I: Tues Feb 18 (chap 1- 3)			
6	Feb 23 – 27	4.2-4.3	Moving Average processes, Autoregressive Processes
7	Mar 1 – 5	4.4-4.5, 5.1	The Mixed Autoregressive Moving Average (ARMA) Model, Invertibility, Stationarity Through Differencing
8	Mar 8 – 12	5.2-5.3, 9.7	ARIMA models, Meaning of Constant Terms in Model, Forecast Weights and Exponentially Weighted Moving Average
9	Mar 15 – 19	5.4 , 6.1-6.2	Other Transformations, Properties of the sample Autocorrelation Function, The partial and Extended Autocorrelation Functions
Exam 2: Wed Mar 18 (chap 4-5, 6.1-6.2)			
10	Mar 22 – 26	6.3-6.6	Specification of Simulated Time Series, Nonstationarity, Other Specification Methods, Specification of Some Actual Time Series
11	Mar 29 – Apr2	7.1-7.3	The Method of Moments, Least Squares Estimation, Maximum Likelihood and Unconditional Least Squares
12	Apr 5 – 9	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	Apr 12 – 16	10.1-10.4, 12.1	Seasonal ARIMA Models, Multiplicative and Nonstationary Seasonal Models, Model Specification Fitting and Checking, Financial Time Series
Project due: Tues Apr 14			
14	Apr 19 – 23	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 26 – 30	10.5, 9.6, 9.8-9.9	Forecasting Models (updating ARIMA Forecasts, certain ARIMA Models, Seasonal Models, Transformed Series)
Final Exam (Comprehensive): Sunday, May 10, 2020, 1:00-4:00 pm			