Instructor: Dr. Mohammad H. Omar
E-mail: omarmh@kfupm.edu.sa, (Not by WebCT/Blackboard email)
Office: Bldg. 5-508.
Phone: 2471
Office Hours: UR (9.15 - 11:30am) and T: (9.15-10.45am) or by appointment


Prerequisite: STAT 310


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:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Homework and other class activities</td>
<td>10%</td>
</tr>
<tr>
<td>Term project (week 13): Tues May 9</td>
<td>15%</td>
</tr>
<tr>
<td>Exam 1 (week 6): Tues March 14 Ch:1-3</td>
<td>20%</td>
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<tr>
<td>Exam 2 (week 10): Tues Apr 18 (Ch:4-5, Ch6:6.1-6.2)</td>
<td>20%</td>
</tr>
<tr>
<td>Final Exam (Comprehensive): Sun June 4 12.30pm</td>
<td>35%</td>
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*The letter grades are assigned as follows:

<table>
<thead>
<tr>
<th>Letter grade</th>
<th>A+</th>
<th>A</th>
<th>B+</th>
<th>B</th>
<th>C+</th>
<th>C</th>
<th>D+</th>
<th>D</th>
<th>F</th>
<th>DN</th>
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<tbody>
<tr>
<td>Cut-off</td>
<td>88%</td>
<td>82%</td>
<td>75%</td>
<td>70%</td>
<td>65%</td>
<td>60%</td>
<td>55%</td>
<td>50%</td>
<td>&lt;50%</td>
<td>&gt;9 absences</td>
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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

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