# Course Specification
## (Bachelor)

| | |
|---|---|
| Course Title: | **Time Series Analysis** |
| Course Code: | **STA 1427** |
| Program: | **Bachelor of Science in Actuarial and Financial Mathematics** |
| Department: | **Mathematics and Statistics** |
| College: | **Science** |
| Institution: | **Imam Mohammad Ibn Saud Islamic University** |
| Version: | **2024 – V1** |
| Last Revision Date: | **None** |

## Table of Contents

## A. General information about the course:

### 1. Course Identification

| 1. Credit hours: | | | | | |
|---|---|---|---|---|---|
| 3 (2 Lectures, 0 Lab, 2 Tutorial) | | | | | |
| **2. Course type** | | | | | |
| A. | ☐University | ☐College | ☒ Program | ☐Track | ☐Others |
| B. | ☒ Required | | ☐Elective | | |
| **3. Level/year at which this course is offered: Level 7 / Year 4** | | | | | |
| **4. Course general Description:** | | | | | |
| In statistics, time series is a fundamental technique to study model-building strategies. The course introduces the general concept of time series and their stochastic processes, regression methods, residual analysis, models for stationary time series, autoregressive processes, models for nonstationary time series, ARIMA models, specifications of simulated time series, parameter estimations, moment, last square and maximum likelihood estimations. | | | | | |
| **5. Pre-requirements for this course** (if any): | | | | | |
| STA 1335 | | | | | |
| **6. Co-requisites for this course** (if any): | | | | | |
| None | | | | | |
| **7. Course Main Objective(s):** | | | | | |
| At the end of this course, the student will be able to compute and interpret a correlogram and a sample spectrum, derive the properties of ARMA and state-space models, and choose an appropriate ARIMA model for a given set of data and fit the model using an appropriate package. | | | | | |

### 2. Teaching mode (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1. | Traditional classroom | 60 | 100% |
| 2. | E-learning | 0 | 0% |
| 3. | Hybrid<br>• Traditional classroom<br>• E-learning | 0 | 0% |
| 4. | Distance learning | 0 | 0% |

### 3. Contact Hours (based on the academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1. | Lectures | 30 |
| 2. | Laboratory/Studio | 0 |
| 3. | Field | 0 |
| 4. | Tutorial | 30 |
| 5. | Others (specify) | 0 |
| Total | | 60 |

## B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| **1.0** | **Knowledge and understanding** | | | |
| 1.1 | Define the concept of time series and its decomposition in the trend part and stochastic part. | K1, K2 | Lectures, problem solving, Classroom discussions. | Direct: Regular Exams, Lab Assignments, Practical exams. |
| 1.2 | Outline stationary and nonstationary time series and the ARIMA model. | K2, K3 | Lectures, problem solving, Classroom discussions. | Direct: Regular Exams, Lab Assignments, Practical exams. |
| **2.0** | **Skills** | | | |
| 2.1 | Interpret MA, AR, ARMA, ARIMA, and RW models. | S1, S2 | Use of statistical software, Lecturing, Interactive learning. | Direct: Lab-Exam, Assignments, Practical exams. |
| 2.2 | Construct nonlinear stochastic models. | S1, S2 | Lecturing, Interactive learning. | Direct: Assignments, Practical exams. |
| 2.3 | Evaluate stationary in time series. | S2, S3 | Lecturing, Interactive learning. | Direct: Assignments, Practical exams. |
| 2.4 | Justify the fitted trend and seasonal trend to the data. | S3 | Use of statistical software, Lecturing, Interactive learning. | Direct: Lab-Exam, Assignments, Practical exams. |
| 2.5 | Produce basic calculations and summaries of time series data. | S3 | Use of statistical software, Lecturing, Interactive learning. | Direct: Lab-Exam, Assignments, Practical exams. |
| **3.0** | **Values, autonomy, and responsibility** | | | |
| 3.1 | Generate the formulated conclusions. | V2 | Interactive learning, Group interaction, Problem solving. | Direct: Lab-Exam, Practical exams, Assignments. |
| 3.2 | Debate in groups. | V2 | Group interaction, Problem solving. | Direct: Assignments and Mini projects. |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1. | **Fundamental Concepts:** Examples of Time Series, A Model-Building Strategy, Time Series Plots in History, Time Series and Stochastic Processes, Means, Variances, and Covariances, Stationary. | **12** |
| 2. | **Trends:** Deterministic Versus Stochastic Trends, Estimation of a Constant Mean, Regression Methods, Reliability and Efficiency of Regression Estimates, Interpreting Regression Output, Residual Analysis. | **12** |
| 3. | **Models for Stationary Time Series:** General Linear Processes, Moving Average Processes, Autoregressive Processes, The Mixed Autoregressive Moving Average Model, Invertibility | **6** |
| 4. | **Models for Nonstationary Time Series:** Stationarity Through Differencing, ARIMA Models, Constant Terms in ARIMA Models, Other Transformations. | **12** |
| 5. | **Model Specification:** Properties of the Sample Autocorrelation Function, The Partial and Extended Autocorrelation Functions, Specification of Some Simulated Time Series, Nonstationarity, Other Specification Methods, Specification of Some Actual Time Series. | **6** |
| 6. | **Parameter Estimation:** The Method of Moments, Least Squares Estimation, Maximum Likelihood and Unconditional Least Squares, Properties of the Estimates, Illustrations of Parameter Estimation, Bootstrapping ARIMA Models. | **12** |
| **Total** | | **60** |

## D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| 1. | **HomeWorks, Quizzes, Mini projects.** | **During the term** | **10%** |
| 2. | **First Midterm.** | **Week 5-6** | **25%** |
| 3. | **Second Midterm.** | **Week 10-11** | **25%** |
| 4. | **Final Exam.** | **Week 16** | **40%** |

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

## E. Learning Resources and Facilities

### 1. References and Learning Resources

| | |
|---|---|
| **Essential References** | ▪ ***Time Series Analysis with application in R***, Jonathan D. Cryer and Kung-Sik Chan. (2nd Edition) Springer 2008. ISBN: 978-0-387-75958-6 |

| | |
|---|---|
| | ▪ ***An Introduction to Time Series Analysis and Forecasting: With Applications of SAS® and SPSS, 1st Edition***, Robert Yaffee, Monnie McGee, Academic Press, 1996. ISBN: 9780127678702. |
| **Supportive References** | **1-** ***Introduction to Time Series and Forecasting***, Peter J. Brockwell, Richard A Davis, Springer, 2002.<br>**2-** ***Time Series Analysis***, James Douglas Hamilton, Princeton University Press, 1994.<br>**3-** ***The Analysis of Time Series: An Introduction***, Chris Chatfield, Publisher: Chapman and Hall/CRC, 2003. |
| **Electronic Materials** | **None** |
| **Other Learning Materials** | **None** |

## 2. Required Facilities and equipment

| Items | Resources |
|---|---|
| **Facilities**<br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | ▪ **Each classroom should be equipped with a whiteboard and a projector.**<br>▪ **Laboratories should be equipped with computers and an internet connection** |
| **Technology equipment**<br>(projector, smart board, software) | **The rooms should be equipped with a data show and Smart Board. All computers should be equipped with the following software:**<br>▪ **Microsoft Excel**<br>▪ **IBM SPSS**<br>▪ **R-Project**<br>▪ **MATLAB** |
| **Other equipment**<br>(depending on the nature of the specialty) | **None.** |

## F. Assessment of Course Quality

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Effectiveness of teaching | **Students** | **During the semester and at the end of the course each student will complete two evaluation forms.** |
| Effectiveness of students' assessment | **Instructor** | **At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that** |

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| | | need to be made if necessary. |
| Quality of learning resources | Students | During the semester and at the end of the course each student will complete two evaluation forms. |
| The extent to which CLOs have been achieved | Instructor | At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary. |
| Other | None | |

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

## G. Specification Approval

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|---|---|
| COUNCIL /COMMITTEE | MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL |
| REFERENCE NO. | 8/1446 |
| DATE | 05/04/1446 (08/10/2024) |