# NATIONAL UNIVERSITY OF ENGINEERING
# COLLEGE OF ECONOMICS AND STATISTICAL ENGINEERING
# STATISTICAL ENGINEERING PROGRAM

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# ES914 – TIME SERIES

## I. GENERAL INFORMATION

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| **CODE** | **:** | ES914 Time Series |
| **SEMESTER** | **:** | 9 |
| **CREDITS** | **:** | 3 |
| **HOURS PER WEEK** | **:** | 7 (Theory–Practice–Laboratory) |
| **PREREQUISITES** | **:** | ES815 Stochastic Processes |
| **CONDITION** | **:** | Compulsory |
| **DEPARTMENT** | **:** | Statistics |
| **INSTRUCTOR** | **:** | Alipio Ordoñez |
| **INSTRUCTOR E-MAIL** | **:** | alorme@uni.edu.pe |

## II. COURSE DESCRIPTION

The course has a theoretical and practical approach and considered as the first part the main automatic models for forecasts: polynomial adjustment, smoothing moving averages and exponential smoothing. On the second part, the famous Box and Jenkins methodology is applied and ARMA, ARIMA and SARIMA processes and their extensions to the ARCH Models. Obtaining forecasts for each of these models are emphasized at all times,

## III. COURSE OUTCOMES

1. Recognizes and manipulate the structure of a time series to know the stationary statistics properties.
2. Determine, explains and evaluates the forecasts obtained by smoothing moving averages.
3. Determine, explains and evaluates the forecasts obtained by exponential smoothing.
4. Identify the structure of a time series model in the form of general exponential smoothing.
5. Determines, explains and evaluates the forecasts obtained by ARMA processes.
6. Determine, explains and evaluates the forecasts obtained by ARIMA processes.
7. Determine, explains and evaluates the forecasts obtained by SARIMA processes.
8. Apply and solves by the most appropriate time series model the forecasts of an interested variable.

## IV. LEARNING UNITS

### 1. INTRODUCTION TO THE TIME SERIES / 7 hours

Time series / Notation, representation and classification / Probabilistic fundamentals: stationarity and ergodicity / Types of variation.

### 2. TREND SETTINGS AND STATION IN UNOBSERVABLE COMPONENTS / 14 hours

Trend settings: polynomial, smoothing and differentiation / Station settings: deterministic and stochastic.

### 3. SMOOTHING METHODS / 28 hours

Smoothing of moving averages centered and not centered: single and double / Singles, doubles and linear exponential smoothing / Stationary exponential smoothing / General exponential smoothing / Discounted least squares.

**4. BOX AND JENKINS METHODS / 49 hours**

Introduction / Explicit form of time series model / AR models / MA models / Mixed ARMA models / ARIMA models: ARI, IMA, and mixed ARIMA processes / SARIMA models: SARI process, SIMA and mixed SARIMA / ARMA model extensions: ARCH and GARCH types.

## V. LABORATORY AND PRACTICAL EXPERIENCES

Lab 1: Notions about the types of variation in a time series.
Lab 2: Setting trends for real series.
Lab 3: Stationed adjustments for actual series.
Lab 4: Forecasts using moving averages.
Lab 5: Predictions using exponential smoothing.
Lab 6: Bi-parametric smoothing for real series.
Lab 7: Holt and Winters stationed exponential smoothing.
Lab 8: Analysis of autocorrelation functions (stationary).
Lab 9: Adjustments of AR (p) models
Lab 10: Setting series by MA (q) models.
Lab 11: Adjusting series by ARMA (p, q) models.
Lab 12: Adjustment series by mixed ARIMA (p, q) models.
Lab 13: Adjustment series by SARIMA (p, d, q) models.
Lab 14: Adjustment series with ARCH and GARCH structures.

## VI. METHODOLOGY

The course takes place in theory, practice and computer lab sessions. In the theory sessions, the instructor introduces the concepts, theorems and applications. In the practical sessions, various problems are solved and their solutions are discussed. In the lab sessions, a statistical software for time series is used to solve problems involving forecasting with a lot of computer processing. At the end of the course students present a group work (no more than 05 members) to demonstrate their skills acquired in the course development. In all sessions the active participation of student is encouraged.

## VII. EVALUATION FORMULA

The Average Grade PF is calculated as follow:

**PF = ( EP + EF + 2*PP ) / 4**

**EP**: Mid-Term Exam
**EF**: Final Exam
**PP**: Average of practices

## VIII. BIBLIOGRAPHY


1. **BOX, G.E.P.; JENKINS, G.M. AND REINSEL, GREGORY**
   Time Series Analysis Forecasting and Control. Prentice Hall International. New Jersey, 1994.
2. **HAMILTON, D.J.**
   Time Series Analysis. Princeton University Press. New Jersey, 1994.