Time Series and Forecasting In-depth Seminar Workshop - August 7, 14 & 21, 2021

Course Description:

Time Series consist of values of a variable recorded in an order over a period of time. Such data arise in just about every area of science and the humanities, including econometrics and finance, engineering, medicine, genetics, sociology, environmental science. What makes time series data special is the presence of dependence between observations in a series, and the fact that usually only one observation is made at any given point in time. This means that standard statistical methods are not appropriate, and special methods for statistical analysis are needed.

This course provides an introduction to time series analysis using current methodology and software. Topics covered are: descriptive methods, plots, smoothing, differencing; the autocorrelation function, the correlogram and variogram, the periodogram; estimation and elimination of trend and seasonal components; stationary processes, modelling and forecasting with autoregressive moving average (ARMA) models; spectral analysis, the fast Fourier transform, periodogram averages and other smooth estimates of the spectrum; time-invariant linear filters; non-stationary and seasonal time series models; ARIMA processes, identification, estimation and diagnostic checking, forecasting, including extrapolation of polynomial trends, exponential smoothing, and the Box-Jenkins approach.

Objectives:

1. Learn how to perform time series analysis using MS Excel and other freewares.
2. Learn how to interpret time series data.
3. Learn to forecast and read trends.

Course Learning Outcomes

1. Demonstrate advanced understanding of the concepts of time series and their application to health, climate, finance and other areas.
2. Demonstrate familiarity with a range of examples for the different topics covered in the course.
3. Demonstrate an advanced understanding the underlying concepts in the time series and frequency domains.
4. Apply ideas to real time series data and interpret outcomes of analyses.

COURSE OUTLINE

1. Examples, objectives of analysis, notation, stationarity
2. Smoothing, linear filters, moving average smoothers. serial correlation
3. Iterated smoothing, spline smoothing, autocorrelation and trend. Removing seasonality, decomposing a series, differencing
4. The autocoviance and autocorrletions functions

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5. The sample autocorrelation function
6. Statistical properties of the sample autocovariance function. Mean ergodicity. Gaussian white noise
7. Tests for serial correlation. The variogram for unequally spaced data
8. Periodicity and the periodogram
9. The cumulative periodogram
10. Stationary random processes. The general linear process
11. The backward shift operator. The moving average model
12. The autoregressive process. Causality. The Yule-Walker equations
13. ARMA processes
14. Spectral analysis and the spectrum. Wold's Theorem
15. Spectral analysis, aliasing. Convergence of the spectra
16. Spectra for ARMA processes. Processes with continuous spectra
17. ARIMA models. Identification
18. The partial autocorrelation function
19. Identification of ARIMA models. The Akaike Informatio Criterion
20. Likelihood ratio tests. SARIMA models
21. Forecasting for ARMA processes
22. Minimum mean squared error prediction
23. Forecasting with SARIMA models, diagnostics and prediction.

The speaker:

Paolo G. Hilado
Data Scientist, Educator, Consultant

- **Data Scientist**
- **Director for Research and Planning - Colegio San Agustin Bacolod**
- **Certificate in Data Science and Connectivity to Artificial Intelligence - Johns Hopkins University, Baltimore Maryland**
- **Micromasters in Data Science - University of California San Diego**
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