APPLIED TIME-SERIES ANALYSIS

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TYPE OF COURSE : Rerun | Core | PG
COURSE DURATION : 12 Weeks (24 Jan' 22 - 15 Apr' 22)
EXAM DATE : 24 Apr 2022

PRE-REQUISITES : Basics of probability and statistics; View MOOC videos on Intro to Statistical Hypothesis Testing

INTENDED AUDIENCE : Students, researchers and practitioners of data analysis from all disciplines of engineering, economics, humanities and medicine

INDUSTRIES APPLICABLE TO : Gramener, Honeywell, ABB, GyanData, GE, Ford, Siemens, and all companies that work on Data Analytics

COURSE OUTLINE :

The course introduces the concepts and methods of time-series analysis. Specifically, the topics include (i) stationarity and ergodicity (ii) auto-, cross- and partial-correlation functions (iii) linear random processes - definitions (iv) auto-regressive, moving average, ARIMA and seasonal ARIMA models (v) spectral (Fourier) analysis and periodicity detection and (vi) parameter estimation concepts and methods. Practical implementations in R are illustrated at each stage of the course.

The subject of time-series analysis is of fundamental interest to data analysts in all fields of engineering, econometrics, climatology, humanities and medicine. Only few universities across the globe include this course on this topic despite its importance. This subject is foundational to all researchers interested in modelling uncertainties, developing models from data and multivariate data analysis.

ABOUT INSTRUCTOR :

Prof. Arun K. Tangirala is a Professor in the Department of Chemical Engineering, IIT Madras. He specializes in process systems engineering with research in data-driven modelling, process control, system identification and sparse optimization. Dr. Tangirala has conducted several courses, workshops on time-series analysis, applied DSP and system identification over the last 12 years. He is the author of a widely appreciated classroom text on "Principles of System Identification: Theory and Practice"

COURSE PLAN :

Week 1: Introduction & Overview; Review of Probability & Statistics-Parts 1 & 2

Week 2: Introduction to Random Processes; Stationarity & Ergodicity

Week 3: Auto- and cross-correlation functions; Partial correlation functions

Week 4: Linear random processes; Auto-regressive, Moving average and ARMA models

Week 5: Models for non-stationary processes; Trends, heteroskedasticity and ARIMA models

Week 6: Fourier analysis of deterministic signals; DFT and periodogram

Week 7: Spectral densities and representations; Wiener-Khinchin theorem; Harmonic processes; SARIMA models

Week 8: Introduction to estimation theory;Goodness of estimators; Fishers information

Week 9: Properties of estimators; bias, variance, efficiency; C-R bound; consistency

Week 10: Least squares, WLS and non-linear LS estimators

Week 11: Maximum likelihood and Bayesian estimators.

Week 12: Estimation of signal properties, time-series models; Case studies