DSE363 Time Series Analysis and Forecasting

Semester: VI	**Course Title:** Time Series Analysis and Forecasting	Credit: 4
Course Code: DSE363		(3 T + 1 P)

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVEABILITIES	COURSEOUTCOMES
CO1	REMEMBERING	Define the fundamental concepts of time series, its components, and basic statistical properties.
CO2	UNDERSTANDING	Explain the concepts of stationarity, autocorrelation, and various time series models (AR, MA, ARIMA, Exponential Smoothing, etc.).
CO3	APPLYING	Apply time series techniques for decomposition, model fitting, and forecasting using R/Python.
CO4	ANALYSING	Analyze temporal data to identify trends, seasonality, and residual patterns; evaluate model assumptions and diagnostics.
CO5	EVALUATING	Compare and assess different forecasting models (ARIMA, Exponential Smoothing, GARCH, VAR, etc.) using accuracy measures (AIC, BIC, RMSE, MAPE).
CO 6	CREATING	Design and implement forecasting solutions for real-world datasets (finance, business, environment) and present actionable insights.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	2	2	2
CO 2	3	3	2	2	2
CO 3	2	3	3	3	2
CO 4	3	3	3	3	3
CO 5	3	3	3	3	2
CO 6	3	3	3	3	3

Unit No.	Detailed Syllabus	Teaching Hours
I	**Fundamentals of Time Series** • Introduction to time series and applications • Components: trend, seasonality, cyclicity, and irregularity • Time series decomposition (additive and multiplicative models) • Stationarity and non-stationarity • Autocorrelation and partial autocorrelation functions (ACF, PACF)	15
II	**Time Series Models** • White noise, Random walk, AR, MA, ARMA models • ARIMA models: identification, estimation, diagnostics • Seasonal ARIMA (SARIMA) • Exponential smoothing methods: Single, Double, Holt's, Holt-Winters • Model selection criteria: AIC, BIC	15
III	**Advanced Forecasting Methods & Applications** • State space models and Kalman filter	15

	• ARCH and GARCH models for volatility forecasting • Vector Auto Regression (VAR) and multivariate time series • Introduction to machine learning for time series: Regression-based forecasting, LSTM/Deep Learning overview • Applications in finance, economics, marketing, and environmental science	
IV	**Practical Applications Python (statsmodels, pandas, scikit-learn), R (forecast, tseries)** • Importing and visualizing time series data • Time series decomposition into trend, seasonality, and residuals Mini Projects: • Testing for stationarity (ADF, KPSS tests) • Fitting ARIMA and SARIMA models • Exponential smoothing and Holt-Winters forecasting • Forecast accuracy measures: MAPE, RMSE, MAE • Volatility modeling with GARCH • Case studies using real-world datasets (stock prices, weather data, sales data)	**15**

Suggested Reference Books:

1. Box, G. E. P., Jenkins, G. M., Reinsel, G. C., & Ljung, G. M. (2015). Time Series Analysis: Forecasting and Control. Wiley.
2. Brockwell, P. J., & Davis, R. A. (2016). Introduction to Time Series and Forecasting. Springer.
3. **Hyndman, R. J., & Athanasopoulos, G.** (2021). *Forecasting: Principles and Practice* (3rd ed.) – Online Open Textbook. Free resource with R (forecast package); widely used in teaching forecasting. Available at: https://otexts.com/fpp3/
4. **Shumway, R. H., & Stoffer, D. S.** (2017). *Time Series Analysis and Its Applications with R Examples*. Springer.
5. Chatfield, C. (2016). The Analysis of Time Series: An Introduction. CRC Press.

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