

Branch Name:	M.Sc. (Artificial Intelligence & Data Science)
Program Code:	ET214
Course Title:	Time Series Analysis and Forecasting
Course Code:	1ET2140203
Pre-requisite Course:	Basic Probability & Statistics, Basic Machine Learning

Course Objectives:

1. To introduce the principles and methodologies of prediction and forecasting.
2. To understand time series components and statistical forecasting models for real-world datasets.
3. To apply performance evaluation criteria for forecasting model accuracy.
4. To explore both descriptive and predictive analytics approaches in time series modeling.
5. To develop practical forecasting solutions using statistical and machine learning techniques.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
03	00	02	04	50	50	25	25	150

Course Contents:

Unit No	Topic	Total Hours	Weightage (%)
1	Basics to Prediction and Forecasting: - Overview of prediction and forecasting, Types of forecasting: Qualitative, Quantitative, Time Series, Probability and Statistics.	10	22%
2	Planning and Forecasting – Forecasting process – Time Series patterns – Statistical fundamentals for forecasting – Descriptive statistics – Measuring errors – Correlation and Covariance – Autocorrelations – Linear Regression analysis – Dependent and independent variables – Method of least square deviations – Durbin-Watson Statistic – Univariate methods.	10	22%
3	Univariate ARIMA methods – ARIMA model identification – Time series examples – Integrated Stochastic process – Backward shift operator – Autoregressive processes – Yule-Walker equations – ARIMA prediction intervals – Multiple Regression models – Serial correlation – Elasticities and Logarithmic relationships – Heteroscedasticity – Intervention functions – Nonstationary series.	10	22 %
4	Smoothing methods – Decomposition methods – Trend-Seasonal and Holt-Winters smoothing – SARIMA processes – SARIMA fitting – Akaike Information Criterion- Schwarz Bayesian Information Criterion and Model Quality. Machine learning & Deep learning for Forecasting, Evaluating Model Quality for Prediction and Forecasting	10	22 %
5	Applications of forecasting in business and industry.	05	12 %

Text Books:

1. Hyndman & Athanasopoulos – *Forecasting: Principles and Practice*, OTexts.
2. Chris Chatfield – *Time Series Analysis and Forecasting*, Chapman & Hall.
3. Jason Brownlee – *Machine Learning for Time Series Forecasting*, MachineLearningMastery.

Reference Books:

1. Box, Jenkins & Reinsel – *Time Series Analysis: Forecasting and Control*, Wiley.
2. Brockwell & Davis – *Introduction to Time Series and Forecasting*, Springer.
3. Montgomery, Jennings & Kulahci – *Time Series Analysis and Forecasting*, Wiley.
4. Hamilton – *Time Series Analysis*, Princeton University Press.

LIST OF PROBABLE EXPERIMENTS / PRACTICALS/ CASE STUDIES

1. Visualization and decomposition of time series data (trend, seasonality, residuals).
2. Implementation of linear regression model for time series forecasting.
3. Autocorrelation (ACF) and partial autocorrelation (PACF) analysis.
4. Implementation of AR, MA, and ARIMA models using real datasets.
5. Exponential smoothing and Holt-Winters forecasting method implementation.
6. SARIMA model fitting and seasonal forecasting analysis.
7. Model performance evaluation using MAE, MSE, RMSE, and MAPE metrics.
8. Forecasting energy demand using historical time series data.
9. Financial time series forecasting using regression and ARIMA models.
10. Weather forecasting case study using time series prediction techniques.
11. Comparative study of statistical vs machine learning forecasting models.
12. Mini Project: End-to-end forecasting pipeline including pre-processing, modeling, validation, and prediction.

Course Learning Outcomes (CLO):

CO	Statement	Bloom's Level
CO1	Understand principles and processes of prediction and forecasting	L2 – Understand
CO2	Apply and analyze univariate ARIMA models for real-world time series problems	L3 – Apply
CO3	Analyze smoothing and decomposition techniques for forecasting	L4 – Analyze
CO4	Evaluate forecasting models using performance evaluation criteria	L5 – Evaluate
CO5	Develop multivariate and machine learning-based forecasting solutions for real-world datasets	L6 – Create

Mapping of CLO with PO and PSO

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1	H	M	–	–	M	–	–	–	–	L	–	M	M	M	H	L
CLO2	M	H	M	H	H	–	–	–	L	M	–	M	H	H	H	M
CLO3	M	H	H	H	H	–	–	–	L	M	–	M	H	H	H	M
CLO4	M	M	H	H	H	–	–	–	M	H	M	M	H	H	M	M
CLO5	M	H	H	H	H	M	L	M	M	H	H	H	H	H	H	H

H:High, M:Medium, L:Low