U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: VI**

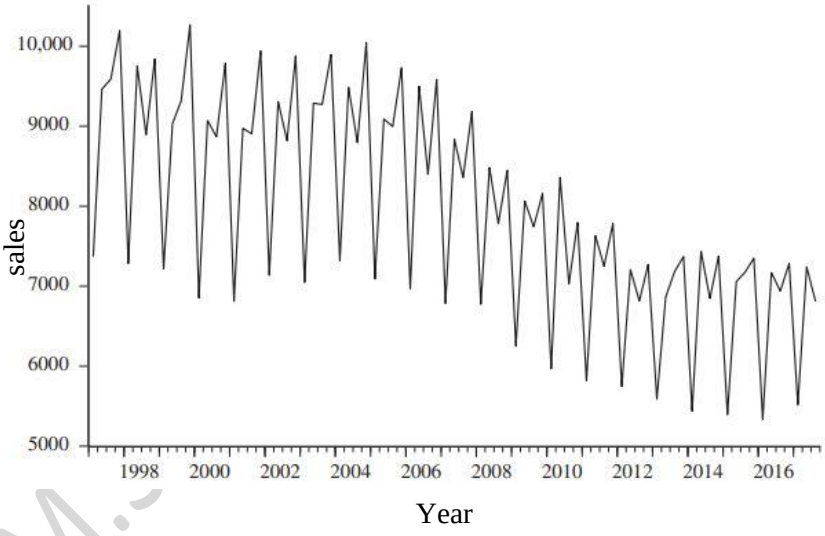
Branch: Artificial Intelligence and Machine Learning **Duration: 3 hrs.**

Course Code: 24AM6PCTFM **Max Marks: 100**

Course: Time Series and Financial Mathematics

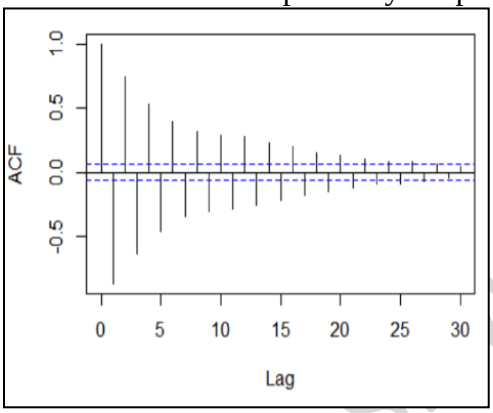
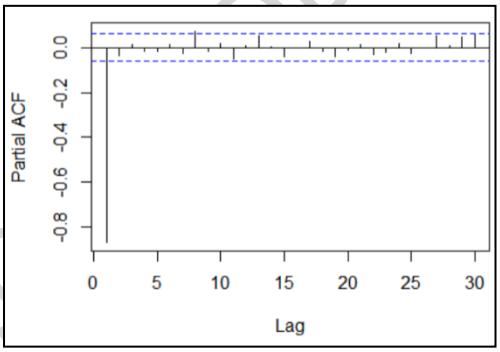
Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Examine the following time series graph of quarterly sales of a cosmetic product during 1997 to 2016. Identify and describe the key characteristics such as trend, seasonality, cyclical patterns, and any irregular components.  	*CO2*	*PO3*	**5**
	b)	The table below represents the quarterly figures of bank deposits for five years. Calculate the seasonal indices using the link relative method.	*CO1*	*PO3*	**10**
	c)	Given the household net income for the years 2016 to 2023: i. Fit a trend line to the data using graphical method.	*CO2*	*PO3*	**5**

Year\Qtr	I	II	III	IV
2019	45	54	72	60
2020	48	56	63	56
2021	49	63	70	65
2022	52	65	75	72
2023	60	70	83	86

		ii. Use the semi-average method to estimate the trend and represent it graphically. **Year** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** **Income** | 102 | 105 | 114 | 110 | 108 | 116 | 112			
		OR			
2	a)	Describe the methods for determining trends in a time series.	CO1	PO1	6
	b)	Differentiate between seasonal variations and cyclical fluctuations.	CO1	PO1	6
	c)	Compute seasonal variation for the given sales data using the Ratio-to-trend method. **Year** | **1st Quarter** | **2nd Quarter** | **3rd Quarter** | **4th Quarter** 1979 | 30 | 40 | 36 | 34 1980 | 34 | 52 | 50 | 44 1981 | 40 | 58 | 54 | 48 1982 | 52 | 76 | 68 | 62	CO2	PO3	8
		UNIT - II			
3	a)	Consider the time series data: **Month** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** **Demand** | 105 | 106 | 110 | 110 | 114 | 121 | 130 | 128 | 137 i. Use Simple Exponential Smoothing (SES) with $\alpha = 0.1$ and smooth the series. Assume the initial forecasted value to be 105 ii. Forecast the demand for the 10^{th} month. iii. Determine the forecast errors and obtain the adjusted forecast.	*CO2*	*PO3*	**10**
	b)	In time series forecasting, the smoothing constant ensures that the more recent datapoints have a stronger impact on the forecast compared to older data. Justify	*CO1*	*PO2*	**5**
	c)	An E-commerce platform has experienced consistent growth in monthly revenue over the past few years. Considering a linear trend in the revenue: i. Identify which forecasting technique would be most suitable to accurately predict future revenue. ii. Justify your reasoning by explaining how the chosen technique addresses the upward trend in the data	*CO1*	*PO3*	**5**
		OR			
4	a)	Differentiate between call and put options	*CO1*	*PO1*	**6**
	b)	Consider managing a portfolio that needs to balance growth with capital preservation. i. Describe how to classify risky and non-risky assets with suitable examples. Illustrate how to allocate a $100,000 investment between risky and non-risky asset categories to balance growth and safety.	*CO2*	*PO3*	**8**
	c)	Consider a Stock ABC, currently trading at $100, which will rise significantly over the next six months. Call options with the	*CO2*	*PO4*	**6**

			following strike prices are: $95, $100, and $105. Which strike price will be chosen to maximize potential profits, justify.			
			UNIT - III			
	5	a)	i. Describe the AutoRegressive Moving Average(ARMA) model and its key parameters. ii. Derive the variance of ARMA (1,1). iii. Examine the Concept of the AutoRegressive Integrated Moving Average (ARIMA) Model in Achieving Stationarity in Time Series Data.	*CO3*	*PO3*	**10**
		b)	i. Interpret the Autocorrelation Function (ACF) (Fig.3.b.a.) and Partial Autocorrelation Function (PACF) (Fig. 3.b.b.) plots & identify the time series model depicted by the plots.  Fig. 3.b.a. Plot of ACF  Fig. 3.b.b. Plot of PACF ii. Examine the stationarity of the Autoregressive model: $Z_t = 0.9\, Z_{t-1} + 0.1\, Z_{t-2} + a_t$	*CO3*	*PO4*	**6**
		c)	A time series model is described as SARIMA(1,0,1)(1,0,0)$_{12}$. Identify the characteristics of the model by interpreting the notations and formulate the equation.	*3*	*4*	**4**
			OR			
	6	a)	Describe the common features of financial time series.	*CO1*	*PO1*	**6**
		b)	Elucidate how the GARCH (1) model differs from an ARCH (1) model.	*CO1*	*PO1*	**6**
		c)	The stock market has been experiencing increased volatility and needs to assess the risk of a particular portfolio using time series models. Explain how to use an ARCH (1) model to estimate and forecast volatility.	*CO2*	*PO2*	**8**

			UNIT - IV			
	7	a)	Analyze the need of portfolio analysis and explain the steps involved in it.	*CO2*	*PO2*	**5**
		b)	Consider a stock named "BioMed" currently trading at $70 per share. Discuss under what circumstances an investor might find call options or put options to be more suitable for managing risk or capitalizing on potential gains.	*CO2*	*PO4*	**7**
		c)	i. Analyse the need of stock markets for the economic development of a country. ii. Discuss the following: A. Volatality B. Risky and Non-Risky Assets.	*CO2*	*PO2*	**8**
			OR			
	8	a)	Distinguish between Forwards and Futures.	*CO2*	*PO2*	**5**
		b)	Analyse the significance of measuring Value at Risk (VaR). Discuss the various methods used to compute Value at Risk.	*CO2*	*PO4*	**5**
		c)	i. Discuss the significance of market indicators and provide examples of commonly used indicators in analyzing stock market trends. ii. Discuss the concept of hedging in investment and risk management.	*CO2*	*PO2*	**10**
			UNIT - V			
	9	a)	Describe the concept of Heteroscedasticity in modelling time series.	*CO2*	*PO3*	**10**
		b)	Explain the concepts of Autoregressive Conditional Heteroscedasticity (ARCH) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models in time series analysis	*CO2*	*PO3*	**10**
			OR			
	10	a)	Obtain the Maximum Likelihood Estimator(MLE) of GARCH(1,1) model.	*CO2*	*PO3*	**10**
		b)	Explain the ARCH(1) model. How it differ from traditional time series models in addressing volatility?	*CO2*	*PO3*	**5**
		c)	Outline the GARCH(1,1) model. What are the key parameters in this model, and how do they capture volatility dynamics?	*CO2*	*PO4*	**5**

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