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

Autonomous Institute Affiliated to VTU

June / July 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)	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.	CO2	PO3	**8**

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

OR

2	a)	Consider a time series dataset representing the monthly sales (in units) of a product for the past 5 months as follows:	CO1	PO2	**5**

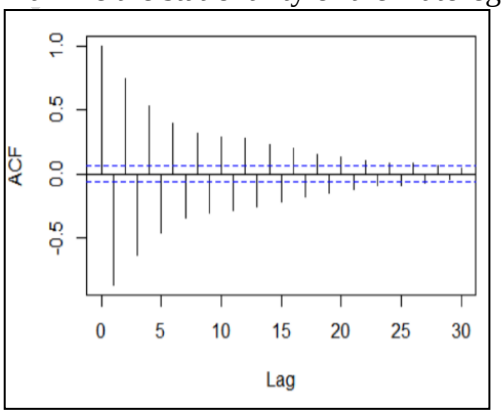
Months	Sales (in units)
Jan	110
Feb	120
Mar	105
Apr	125
Jun	130

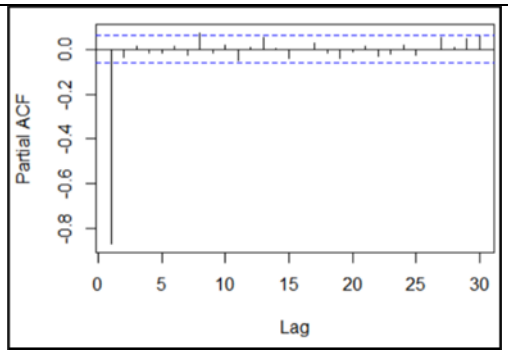
Fit a linear trend line to this data using the least squares method to predict future sales.

	b)	The annual sales (in thousands of units) for a company over the past six years are as follows:	CO1	PO2	**5**

Year	Sales
2015	220
2016	230
2017	250
2018	260
2019	280
2020	310

Apply semi-averages method to determine the trend line equation for the given data.

		c)	Calculate the seasonal indices by Ratio-Trend method from the following data that represents the annual turnover (in Crores). **Year/Industry** | **Textiles** | **Soft toys** | **Metals** | **Agriculture** 2000 | 51 | 48 | 65 | 55 2005 | 55 | 42 | 67 | 58 2010 | 57 | 50 | 63 | 65 2015 | 63 | 54 | 60 | 63	*CO1*	*PO2*	**10**
			UNIT - II			
	3	a)	The sales of an iPad in a Reliance showroom for the last 10 months are given below (α is 0.1). i. Calculate the Simple exponential smoothing (SES) values. ii. Compute the error metrics: MAE, MSE, RMSE, and MAPE. Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 sales | 2 | 4 | 5 | 7 | 6 | 10 | 13	*CO2*	*PO3*	**8**
		b)	How to evaluate the accuracy of a Double exponential smoothing (DES) model in time series forecasting?	*CO1*	*PO1*	**4**
		c)	The sales of books in a bookstall for the last 10 months are given below. i. Calculate a 3-year Exponential Moving Average forecast ii. Calculate Forecasting errors Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 Sales | 5.2 | 4.9 | 5.5 | 4.9 | 5.2 | 5.7 | 5.4 | 5.8 | 5.9 | 6 | 5.2 | 4.8	*CO2*	*PO3*	**8**
			OR			
	4.	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 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 & ii.identify the time series model depicted by the plots. Examine the stationarity of the Autoregressive model:  Fig. 3.b.a. Plot of ACF	CO3	PO4	**6**

			 Fig. 3.b.b. Plot of PACF			
	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.	CO1	PO2	**4**
		UNIT - III			
5	a)	Illustrate how to transfer non stationary time series to stationary time series with an example?	*CO1*	*PO2*	**4**
	b)	Consider the Autocorrelation model: $Z_t=0.2\ Z_{t-2}+0.1\ Z_{t-1}+0.3Z_{t-3}+a_t$. Check whether the given equation satisfies the stationary model or not?	*CO2*	*PO2*	**8**
	c)	Derive the properties of an ARMA model.	*CO2*	*PO3*	**8**
		OR			
6	a)	Given the following Autocorrelation function (ACF) estimates for a time series: $\rho(0)=1$ $\rho(1)=0.8$ $\rho(2)=0.5$ Use the Yule-Walker equations to estimate the parameters of an AR (2) model: $Xt=\phi 1Xt-1+\phi 2Xt-2+Zt$ where Zt is white noise with mean 0 and variance σ2.	CO3	PO3	**5**
	b)	Consider the following AR (1) process: $Xt=0.7Xt-1+Zt$ where Xt is the value of the process at time *t* and Zt is a white noise process with mean 0 and standard deviation 1. Determine if the given AR (1) process is stationary. i. Define lag and its relevance in white noise processes. ii. Explain how the autocorrelation function (ACF) of white noise behaves at different lags. iii. Write the implications of lag in identifying the presence of trends in random walk processes.	CO2	PO3	**5**

		c)	i. Define lag and its relevance in white noise processes. ii. Explain how the autocorrelation function (ACF) of white noise behaves at different lags. iii. Write the implications of lag in identifying the presence of trends in random walk processes.	CO2	PO4	**10**
			UNIT - IV			
	7	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. ii. 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 following strike prices are: $95, $100, and $105. Which strike price will be chosen to maximize potential profits, justify.	*CO2*	*PO4*	**6**
			OR			
	8	a)	Describe the major features of future contract.	*CO1*	*PO2*	**6**
		b)	Elucidate how hedging differs from speculation.	*CO1*	*PO2*	**6**
		c)	Describe the benefits and limitations associated with the application of Value at Risk (VaR) as a risk assessment tool in finance.	*CO2*	*PO2*	**8**
			UNIT - V			
	9	a)	Describe the common features of financial time series.	*CO2*	*PO1*	**6**
		b)	Explain how the GARCH (1) model differs from an ARCH (1) model.	*CO2*	*PO2*	**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*	*PO1*	**8**
			OR			
	10	a)	Illustrate the key properties of Maximum Likelihood Estimation.	*CO1*	*PO2*	**5**
		b)	Apply a GARCH model to estimate and forecast the volatility of different cryptocurrencies. Justify how these forecasts can help in managing trading risk.	*CO2*	*PO4*	**7**
		c)	Consider a financial analyst working for an investment firm to analyze the volatility of a particular stock. Describe how to identify and apply ARCH models and forecast the stock's volatility.	*CO3*	*PO5*	**8**

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