

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF BACHELOR OF SCIENCE IN
ACTUARIAL SCIENCE

ACMT 312: LINEAR MODELS AND FORECASTING

STREAMS: BSc.

TIME: 2 HOURS

DAY/DATE: TUESDAY 09/04/2024

11.30 A.M. – 1.30 P.M.

Question one

- Stability versus responsiveness is a critical question when deciding on the most appropriate forecasting method. Briefly explain how the balance between the two is achieved when using the Weighted Moving Average approach. (4 marks)
- Explain any two AI systems commonly used in forecasting. (4 marks)
- Given the time series data: [12, 14, 16, 18, 20], an initial smoothed value (S_0) of 12, and a smoothing parameter (α) of 0.2, calculate the forecasts for the next three periods. (6 marks)
- Discuss what judgmental forecasting is and highlight the general settings in which the method is most appropriate. (8 marks)
- Calculate the seasonal indices for the quarters based on the following data (8 marks)

Year	I st Quarter	2 ⁿ Quarter	3 ^r Quarter	4 th Quarter
2004	3.7	4.1	3.3	3.5
2005	3.7	3.9	3.6	3.6
2006	4.0	4.1	3.3	3.1
2007	3.3	4.4	4.0	4.0

Question two

- a. Calculate the Weighted Mean Absolute Percentage Error for the following set of forecasted and actual values, considering weights for each observation: -
Forecasted: [120, 150, 200, 180, 160] Actual: [100, 140, 180, 160, 140] Weights: [0.1, 0.2, 0.3, 0.2, 0.2] (5 marks)
- b. Discuss the limitations that may arise from using Sales Force Composite method of forecasting. (6 marks)
- c. Given a set of data points $\{(1,2),(2,3),(3,4),(4,5)\}$ demonstrate how to derive the regression equation using the Least Squares Method. (9 marks)

Question Three

- a) An Office Supply Company sells and delivers office supplies to companies and schools. The manager of the company wants to be certain that enough drivers and vehicles are available to deliver orders promptly and that they have adequate inventory in stock. Therefore, the manager wants to be able to forecast the demand for deliveries during the next month. From the records of previous orders, management has accumulated the following data for the past 10 months:

Month	Jan	Feb	Mar	April	May	June	Jul	Aug	Sept	Oct
Orders	120	90	100	75	110	50	75	130	110	90

- i. Compute the monthly demand forecast for April through November using a 3-month moving average. (8 marks)
- ii. Compute the monthly demand forecast for April through November using a 3-month weighted moving average. Use weights of 0.5, 0.33, and 0.17, with the heavier weights on the more recent months. (8 marks)
- iii. Compute the mean absolute deviation for June through September for the 3-month weighted moving average methods (4 marks)

Question Four

a) A bakery markets cakes through a chain of food stores. It has been experiencing over and under production because of forecasting errors. The following data are its demand for cakes for the past four weeks. Cakes are made for the following day; for example, Sunday's cakes production is for Monday's sales, Monday's production is for Tuesday's sales and so on. The bakery is closed on Sunday. So Friday's production must satisfy demand for both Saturday and Sunday.

	4 weeks ago	3 weeks ago	2 weeks ago	Last week
Monday	2200	2400	2300	2400
Tuesday	2000	2100	2200	2200
Wednesday	2300	2400	2300	2500
Thursday	1800	1900	1800	2000
Friday	1900	1800	2100	2000
Saturday				
Sunday	2800	2700	3000	2900

Make a forecast for this week on the following basis:

- i. Daily, using a simple four week moving average. (6 marks)
- ii. Daily, using a weighted average of 0.40, 0.30, 0.20, and 0.10 for the past four weeks. (9 marks)
- iii. The bakery is also planning its purchases for bread production. If bread demand had been forecast for last week at 22,000 loaves and only 21,000 loaves were actually demanded, what would the bakery's forecast be for this week using exponential smoothing with $\alpha = 0.10$? (2 marks)
- iv. Suppose, with the forecast made in (c) above, this week's demand actually turns out to be 22,500. What would the new forecast be for the next week? (3 marks)

Question Five

- a. Explain the role of alpha, beta, and gamma in the Holt-Winters method. How would you choose appropriate values for these parameters based on the characteristics of the time series data? (6 marks)
- b. Jigsaw company that wants to measure forecast accuracy and has sales data for the last five days as follows:
 - Day 1: Forecasted Sales = 100 units, Actual Sales = 120 units

- Day 2: Forecasted Sales = 120 units, Actual Sales = 110 units
- Day 3: Forecasted Sales = 110 units, Actual Sales = 115 units
- Day 4: Forecasted Sales = 130 units, Actual Sales = 140 units
- Day 5: Forecasted Sales = 140 units, Actual Sales = 130 units

Evaluate

- i. MAPE (5 marks)
 - ii. MAE (4 marks)
 - iii. RMSE (5 marks)
-