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Marks : 30

CO 4 & CO5 CASE STUDY

CO4 - Case Study 1: Production Planning

1) Binary Integer Programming Model:

Objective: Minimize total production time.

Decision Variables:

XA: 0 or 1 (Product A on Machine M1)
XB: 0 or 1 (Product B on Machine M2)

Constraints:
Machine M1: $2 * XA + 1 * XB \leq 8$
Machine M2: $1 * XA + 2 * XB \leq 8$
Meet demands: $XA \geq 100$, $XB \geq 80$

2) Optimal Production Plan:
Use tools like Python's PuLP or Excel Solver to determine values for XA and XB.

3)Binary Integer Programming Model:

- **Objective:** Minimize total cost (fixed + transportation).
- **Decision Variables:**
  - YW: 0 or 1 (whether warehouse W is open)
  - ZWC: 0 or 1 (whether customer C is served by warehouse W)
- **Constraints:**
  - Warehouse capacity limits.
  - Customer demand must be fulfilled.
  - If a warehouse serves a customer, it must be open.

4) Impact of Demand Changes:
Use sensitivity analysis—higher demand may require more warehouses, lower demand fewer.

CO5 - Case Study 1: Sales Forecasting

1) **Linear Regression Model:**
   Sales = b0 + b1 * Advertising Spend + b2 * Seasonality Index
- **Significant Predictors:** Use p-values to identify important variables.
- **Performance Metrics:**
  - MAE (Mean Absolute Error)
  - RMSE (Root Mean Square Error)
  - R-squared (explains model fit)

6-Month Forecast: Use the regression equation with new inputs.

2) Multiple Linear Regression Model:

Energy Consumption = b0 + b1 * Temperature + b2 * Occupancy Rate

- **Relationships:** Use correlation analysis to understand variable impact.
- **Multicollinearity Check:** Use VIF (Variance Inflation Factor). Remove or transform variables if needed.
- **30-Day Forecast:** Predict based on future temperature and occupancy data.

General Questions on Linear Regression

- **Assumptions:**
  - Linearity: Relation between variables is linear.
  - Independence: Errors are independent.
  - Normality: Residuals follow a normal distribution.
  - Homoscedasticity: Residuals have constant variance.
- **Outliers/Missing Values:**
  - Outliers: Remove or transform.
  - Missing Values: Use mean, median, or interpolation.
- **Performance Metrics:** MAE, RMSE, R-squared.
- **Model Refinement:** Use feature engineering, regularization (Lasso/Ridge), and cross-validation to improve accuracy.

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