**Business, Management & Financial Data Analytics-(MSDS-2) Assignment Two (20 Marks)**

**Goal:**

**To Build Holt-Winter's Time Series Forecasting Models**

**Objective:**

To apply Holt-Winter's time series forecasting methods to predict restaurant visits. This assignment includes data preparation, model selection, parameter tuning, and forecasting.

**Dataset Description:**

You are provided with a dataset "RestaurantVisitors" containing the following columns:

* date: Date of observation
* weekday: Day of the week (0 = Monday, 1 = Tuesday, ..., 6 = Sunday)
* holiday: Indicator if the day is a holiday (0 = No, 1 = Yes)
* holiday\_name: Name of the holiday (if applicable)
* rest1, rest2, rest3, rest4: Number of visitors to four different restaurants
* total: Total number of visitors across all restaurants

**Instructions**

1. **Data Preparation** (5 marks)
2. Convert the date column to a datetime object and set it as the index of the DataFrame. (1 Mark)
3. Check for and handle any missing values in the dataset. (2 Marks)
4. Create additional features if necessary. (1 Mark)
5. Split the data into training and testing sets. (1 Mark)
6. **Model Selection** (5 marks)
7. Determine whether to use an additive or multiplicative Holt-Winters model by analyzing the seasonality and trend of the data. (2 Marks)
8. Provide a rationale for your choice between the additive and multiplicative models. (3 Marks)
9. **Parameter Tuning** (5 marks)
10. Use grid search or another optimization method to tune the smoothing parameters (alpha, beta, gamma) of the Holt-Winters model. (3 Marks)
11. Evaluate the model's performance on the training data using appropriate metrics (e.g., MAPE, RMSE). (2 Marks)
12. **Forecasting** (5 marks)
13. Use the tuned Holt-Winters model to forecast future restaurant visits for a specified period. (2 Marks)
14. Plot the historical data and the forecasted values to visualize the model's performance. (1 Mark)
15. Assess the forecast's accuracy on the testing set using appropriate metrics. (2 Mark)
16. **Submission:**

* Submit your Python code following this: Assignment2\_Surname.
* Ensure your code is well-documented and includes comments explaining each step.
* Deadline: 31.07.2024

**Good luck!**