Forecasting Passenger Journeys Using the Prophet Algorithm

Introduction

The Prophet algorithm, developed by Facebook, is designed for time series forecasting, particularly for data with seasonal trends, holiday effects, and missing values. Prophet is known for its robustness and adaptability, making it ideal for forecasting demand and growth metrics. This report provides an overview of Prophet and its key model parameters to fine-tune forecasting accuracy.

Prophet Algorithm Overview

Prophet is an additive model where non-linear trends are combined with daily, weekly, and yearly seasonality, plus holiday effects when applicable. It is designed to handle seasonality, trend changepoints, and missing data efficiently, yielding accurate forecasts without extensive parameter tuning. Prophet uses the following equation for the time series:

$$y(t) = g(t) + s(t) + h(t) + e_t$$

where:

- g(t) represents the trend component,
- s(t) represents seasonal effects,
- h(t) denotes holiday effects,
- e_t is the error term.

Key Model Parameters

1. Growth: This parameter defines the type of trend in the data. It can be either 'linear' or 'logistic'.
   - 'linear' is suitable for data with no saturation point.
   - 'logistic' is used when there is a cap on the values.

2. Changepoints: The locations in the time series where the trend changes. Prophet automatically

detects these points, but they can also be manually specified if necessary.

3. Seasonality: Prophet allows modeling of seasonal effects that repeat at regular intervals. The seasonalities can be specified for daily, weekly, and yearly cycles.

4. Holidays: You can include holiday effects in the model by providing a list of holidays that might impact the data. Prophet can adjust the forecasts to account for these effects.

5. Interval Width: This parameter specifies the uncertainty interval width for the forecast, typically set at 80% or 95%.

6. Seasonality Mode: This can be set to 'additive' or 'multiplicative', affecting how the seasonal effects are applied to the trend.