Prophet Algorithm Cheat Sheet

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1 What is Prophet Algorithm?

Prophet is a forecasting tool developed by Facebook, designed to handle time series data with strong seasonal patterns and missing data. It is particularly useful for forecasting when the data has multiple seasonalities (e.g., yearly, weekly) and holidays. The Prophet algorithm works by decomposing the time series into three components:

- Trend: The long-term growth or decline in the data.
- Seasonality: The periodic fluctuations that occur at fixed intervals, such as daily, weekly, or yearly.
- Holidays: Special events that might have an effect on the data.

Prophet is robust to missing data and outliers, and it can be used by non-experts because it requires minimal tuning. It provides a straightforward way of producing both point forecasts and uncertainty intervals.

2 Installation

```
pip install prophet  # For Python
install.packages("prophet")  # For R
```

3 Importing Prophet

```
from prophet import Prophet
```

4 Data Preparation

Prophet expects a DataFrame with two columns:

- **ds** (datetime column)
- **y** (values to forecast)

```
import pandas as pd

df = pd.DataFrame({
    'ds': pd.date_range(start='2024-01-01', periods=100, freq='D'),
    'y': [x + (x * 0.1) for x in range(100)]
})
```

5 Initializing & Training Prophet Model

```
model = Prophet()
model.fit(df)
```

6 Making Future Predictions

```
future = model.make_future_dataframe(periods=30)
forecast = model.predict(future)
```

7 Plotting the Forecast

```
import matplotlib.pyplot as plt

model.plot(forecast); plt.show()
```

8 Understanding Prophet's Mathematical Model

Prophet models time series as:

$$y(t) = g(t) + s(t) + h(t) + \epsilon_t \tag{1}$$

Where:

- $g(t)$ = Trend (linear or logistic growth)
- $s(t)$ = Seasonality (daily, weekly, yearly)
- $h(t)$ = Holiday effects
- ϵ_t = Noise (random variations)

9 Adding Custom Seasonality

```
model.add_seasonality(name='monthly', period=30.5, fourier_order=5)
```

10 Adding Holidays

```
holidays = pd.DataFrame({
    'holiday': 'special_day',
    'ds': pd.to_datetime(['2024-07-04', '2024-12-25']),
    'lower_window': 0,
    'upper_window': 1
})

model = Prophet(holidays=holidays)
```

11 Handling Logistic Growth (Saturation Limits)

```
df['cap'] = 100
df['floor'] = 10

model = Prophet(growth='logistic')
model.fit(df)
```

12 Evaluating Model Performance

```
from sklearn.metrics import mean_absolute_error
mae = mean_absolute_error(df['y'], forecast['yhat'][:len(df)])
print(f'MAE: {mae}')
```

13 Saving & Loading the Model

```
import pickle

# Save model
with open('prophet_model.pkl', 'wb') as f:
    pickle.dump(model, f)

# Load model
with open('prophet_model.pkl', 'rb') as f:
    loaded_model = pickle.load(f)
```

14 Common Use Cases

- Sales Forecasting
- Stock Market Analysis

- Website Traffic Prediction
- Energy Consumption Forecasting
- Weather Forecasting