Indirect Cost Forecasting

Md Ismail Hossain

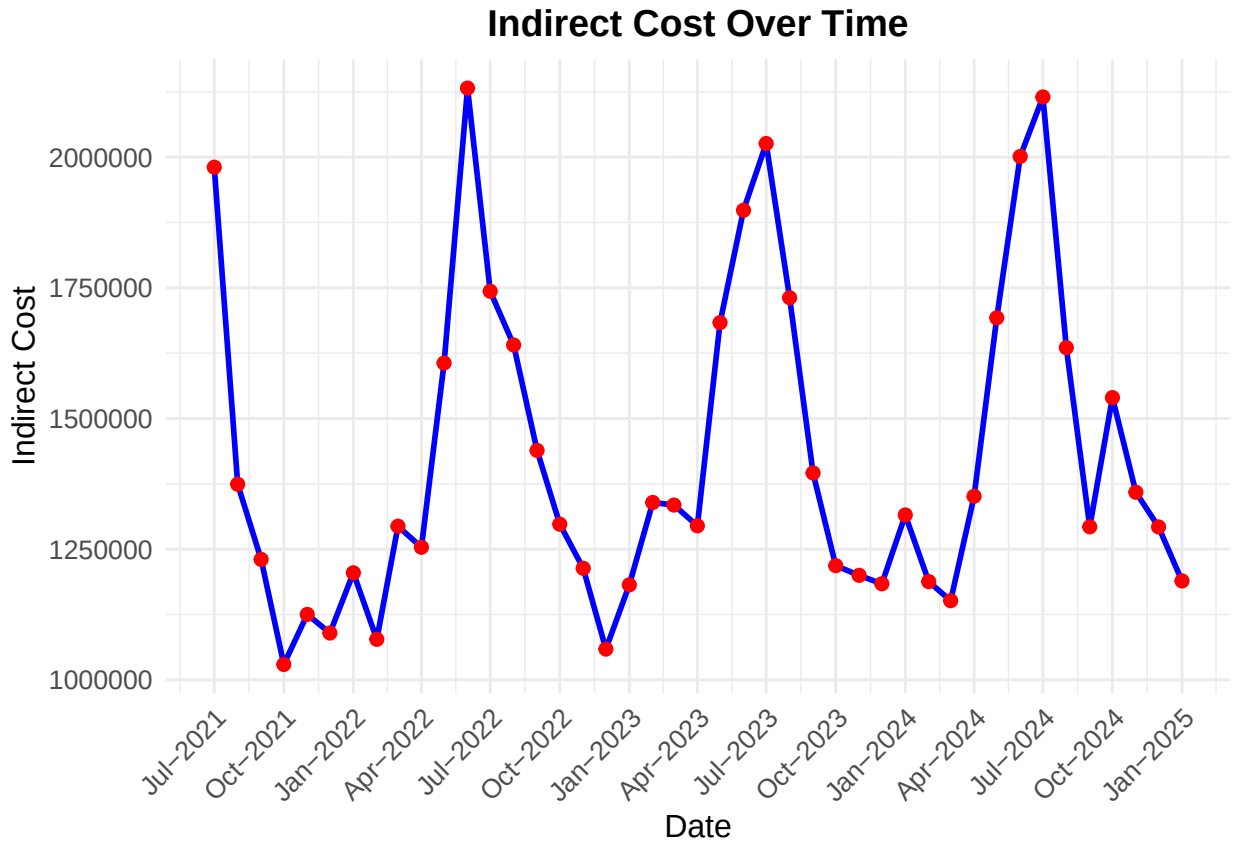
2025-01-30

Introduction

This report presents the analysis and forecasting of indirect costs using three different models: **SARIMA, ETS, and Prophet**. The objective is to identify the most suitable forecasting method and predict future costs with high accuracy.

Understanding the Data

The dataset consists of **monthly indirect cost data from July 2021 to January 2025**. A preliminary analysis revealed **seasonality and trend variations**, necessitating an advanced forecasting approach.



Selecting Best Forecasting Model

We compared three forecasting models:

- **SARIMA (Seasonal ARIMA)**
- **ETS (Exponential Smoothing)**
- **Prophet (Additive Time Series Model by Facebook)**

Each model was trained on **80% of the dataset** and evaluated using **Root Mean Squared Error (RMSE)**. The results were:

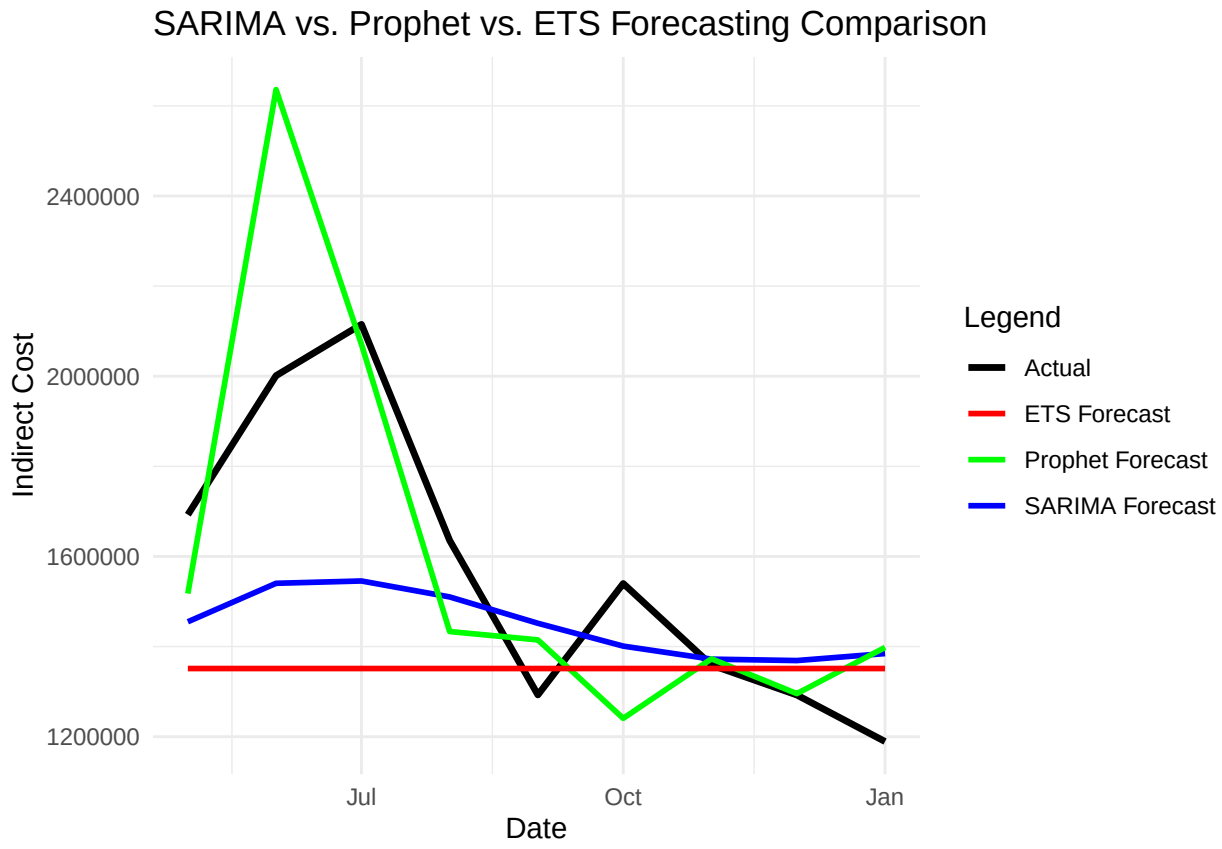
$$\text{RMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}$$

Model	RMSE (Lower is Better)
SARIMA	27,8408.8
Prophet	**26,3486.9**
ETS	37,5984.8

Table 1: Model Performance Comparison Based on RMSE

The **ETS model performed the worst**, while **Prophet had the lowest RMSE, making it the best model** for forecasting indirect costs.

Conclusion: Prophet was selected as the best model due to its superior performance in capturing seasonality and trends.




```
## [1] "RMSE Comparison:"
```

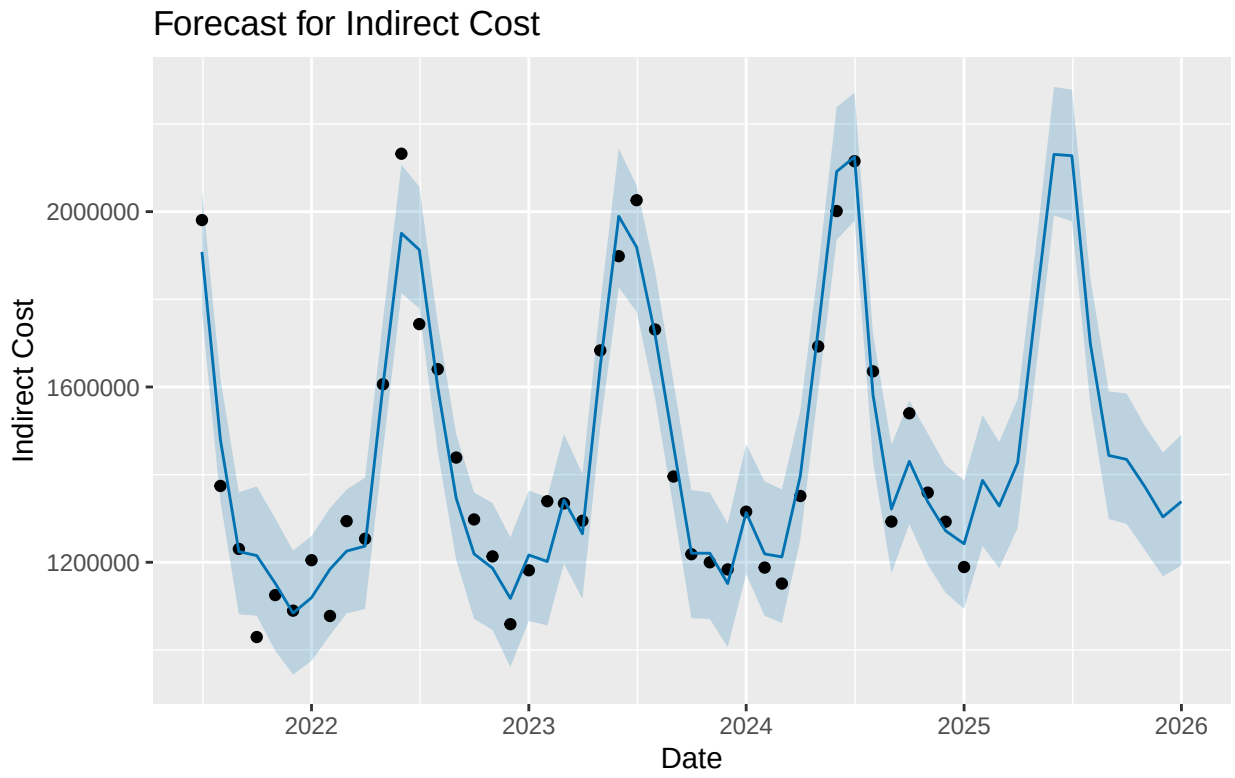
```
## [1] "Best Model Based on RMSE: Prophet"
```

Using Prophet Model to Forcast

Since Prophet performed best, we trained it on the **entire dataset** and generated forecasts for the next **12 months**.

Next 12 Month Forecast

Visualization: The Prophet model effectively captures seasonal patterns and upward trends.




```
##          Date Forecast Lower CI (95%) Upper CI (95%)
## 44 2025-02-01  1386876        1236968        1536147
## 45 2025-03-01  1328533        1186730        1474279
## 46 2025-04-01  1427274        1277952        1572788
## 47 2025-05-01  1776480        1631622        1912026
## 48 2025-06-01  2130652        1990999        2284609
## 49 2025-07-01  2127666        1978413        2278206
## 50 2025-08-01  1699322        1560334        1848586
## 51 2025-09-01  1443746        1298602        1589664
## 52 2025-10-01  1434737        1287433        1585322
## 53 2025-11-01  1371575        1227280        1510348
## 54 2025-12-01  1303459        1167844        1450613
## 55 2026-01-01  1338498        1192730        1491358
```

Interpretation of Forecast

- A **steady increase in indirect costs** is projected.
- Costs are expected to exceed **$2,100,000 by June 2025**.
- The **confidence interval indicates possible fluctuations**. The 95% confidence interval (CI) for the forecasted values tells us the range in which we expect the actual indirect costs to fall, 95% of the time.

Think of it as a margin of error around our prediction.

Conclusion and Recommendations

Conclusion

- The **Prophet model outperformed SARIMA and ETS**, achieving the lowest RMSE.
- The forecast suggests **a steady rise in costs**, emphasizing the need for financial planning.
- Confidence intervals indicate **potential variations**, requiring periodic monitoring.

Recommendations

1. **Monitor monthly actual costs** and compare with forecasts for adjustments.
2. **Retrain the model periodically** to incorporate new data.