EXPERIMENT REPORT

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Project Name	Forecasting Model of the Total Sales Revenue
Date	10/10/2023
Deliverables	Lim_Simon-24661225-forecasting_Prophet.ipynb SimonUTS24661225/ADV_MLA_AT22 (github.com)

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1. EXPERIMENT BACKGROUND

Provide information about the problem/project such as the scope, the overall objective, expectations. Lay down the goal of this experiment and what are the insights, answers you want to gain or level of performance you are expecting to reach.

1.a. Business Objective	The goal of the project is to build a forecasting model using a time-series analysis algorithm to forecast the total sales revenue across all stores and items for the next 7 days. Also, the project aims to deploy trained models with Heroku and thus the model can be used as a service for business uses.
1.b. Hypothesis	1.It is hypothesized that Prophet model will be a suitable time-series model to forecast the total sales revenue for the next 7 days. Prophet model is highly flexible and can handle various time series, including seasonality and special events effects. Also, Prophet model is simple and straightforward model, especially specialized in deploying forecasting models. 2.Also, RMSE score will be likely to be a suitable performance metric in this project, in order to predict the sales revenue for a specific item at a specific date.

1.c. Experiment Objective	The expected outcome of the experiment is that the Prophet model will be trained and used to forecast the total sales revenue across stores and dates for next 7days. Subsequently, once the performance of the model is assured, the model will be deployed by using deployment techniques and tools, including FastAPI, Docker and Heroku. Finally, the trained model will be used as a service, in order to forecast the total sales revenue for next 7 days.

2. EXPERIMENT DETAILS

	Elaborate on the approach taken for this experiment. List the different steps/techniques used and explain the rationale for choosing them.
2.a. Data Preparation	1. There were five separate datasets, including training dataset, testing dataset, selling price per week, calendar and calendar of events. The first stage in data preparation was to merge those datasets. Training and testing datasets were merged first and columns of each day's sales were switched into rows using "**pd.melt()**". 2. Calendar and calendar of events were merged on "**date**" and then this combined calendar dataset was merged with combined training and testing dataset on common column "**d**" (day). 3.Finally, combined training and testing datasets were merged with selling price per week dataset on common columns, "**store_id**" and "**item_id**". 4.There were some null values in **'event_name'** columns. I converted null values to 'No Event'. The column '**event_name**' will be used as an external feature in training Prophet forecasting model.
2.b. Feature Engineering	- The sales revenue (**'revenues'**) column was created by multiplying '**sales**' by **'sell_price'.** This column will be used as a target variable when training models. - **'Event_name'** column was used as an external feature, by filling null values with 'No Event'. - The sales revenue for each item from different store and date was summed based on the **'date'** column.
2.c. Modelling	U.S country holidays were added into Prophet model using Prophet technique ("prophet.add_country_holidays(country_name = 'US')"). Only one Prophet model was used to forecast the total sales revenue for the next 7 days. Prophet model took U.S holidays or events into account. Prophet model was trained on data from 2011-01-29 to 2016-05-29 and predicted the next 7days and the trends of the total sales revenue.

	3. EXPERIMENT RESULTS
Analyse in detail the results achieved from this experiment from a technical and business perspective. Not only report performance metrics results but also any interpretation on model features, incorrect results, risks identified.
3.a. Technical Performance	For performance metrics, four different performance metrics were used, including RMSE, MAE, MSE and R2. Mean Absolute Error (MAE) is mainly used to assess the performance of trained models. Given that the purpose of the experiment is to build a forecasting model that can forecast the total sales revenue for next 7 days, MAE measures the average magnitude of errors in a set of predictions and provides a balanced view of the overall model performance. Therefore, MAE is more suitable as a performance metric for forecasting trends of the predictive total sales revenue.
3.b. Business Impact	MAE score of Prophet model obtained was 19057.38. The trends of total sales revenue tend to increase as dates go by. RMAE and MAE scores were high, indicating that the model is not optimal in terms of performance. However, the scale of predicted values and actual values was very high, the MAE score of 19057.38 was reasonable. The model successfully forecasted the total sales revenue for the next 7 days (e.g., from 2016-05-23 to 2016-05-29). Models will be deployed by using Heroku, which allows access to online.
3.c. Encountered Issues	It was a bit difficult to interpret the performance of Prophet model, with high scale of predicted values and actual values but focused on overall trends of the total sale revenues over times and decided to use them as a final model (solved).

	4. FUTURE EXPERIMENT
Reflect on the experiment and highlight the key information/insights you gained from it that are valuable for the overall project objectives from a technical and business perspective.
4.a. Key Learning	1. Explanatory Data Analysis (EDA) is an essential stage prior to training models, to investigate and obtain particular trends of data. 2. Feature engineering is a crucial process in machine learning, which can potentially increase the performance of models. 3. It is also crucial to find the optimal hyperparameters of the model for better results. 4. If conducting a few different experiments, using functions and methods (i.e., custom packages) can be useful to simplify codes and identify patterns. 5. Consider subsampling if the dataset is extremely large. 6. Selection of algorithm for training model is also important depending on the context of dataset. 7. Deploying trained models, using tools such as Fastapi and Heroku for users to access the models

4.b. Suggestions / Recommendations	1.Feature engineering is an essential stage in machine learning, that can influence models and outcomes of projects. 2. Use functions or classes to simplify code and use in other experiments. 3. Use docker containers to smoothly operate and perform productions 4. Use Heroku that allows an access to everyone online.