IBM Specialized Models: Time Series and Survival Analysis Final Assignment

By

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Introduction

The objective of this project is to perform an exploratory data analysis on London Bike Sharing Dataset and predict number of bike sharing using Deep Neural Network. This is a multivariate time-series problem.

Data Summary

Source: https://www.kaggle.com/hmavrodiev/london-bike-sharing-dataset

This dataset contains 17,414 rows and 9 columns. Data was recorded between 2015-01-31 to 2017-01-31

Data Description:

Variables

- "timestamp" - timestamp field for grouping the data
- "cnt" - the count of a new bike shares (**Target variable for this project**)
- "t1" - real temperature in C
- "t2" - temperature in C "feels like"
- "hum" - humidity in percentage
- "windspeed" - wind speed in km/h
- "isholiday" - boolean field - 1 holiday / 0 non holiday
- "isweekend" - boolean field - 1 if the day is weekend
- "season" - category field meteorological seasons:
    - 0-spring ;
    - 1-summer;
    - 2-fall;
    - 3-winter.
- "weathercode" - category of the weather
    - 1 = Clear ; mostly clear but have some values with haze/fog/patches of fog/ fog in vicinity
    - 2 = scattered clouds / few clouds
    - 3 = Broken clouds
    - 4 = Cloudy
    - 7 = Rain/ light Rain shower/ Light rain

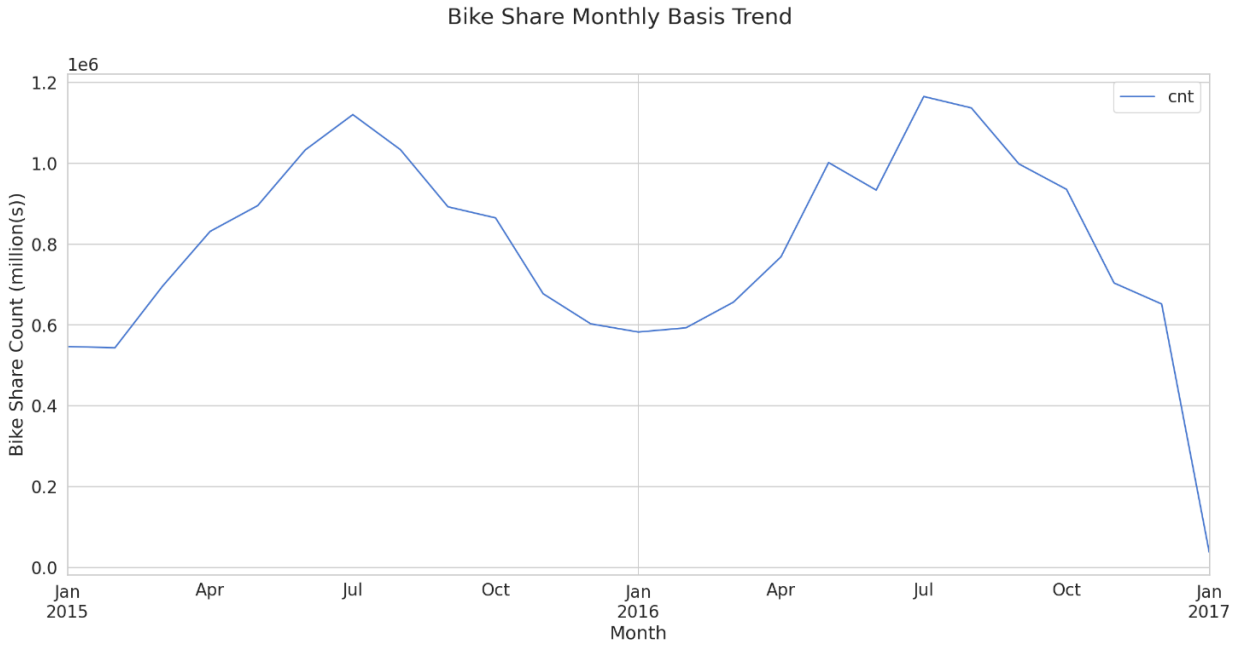
- 10 = rain with thunderstorm
- 26 = snowfall
- 94 = Freezing Fog

Exploratory Data Analysis

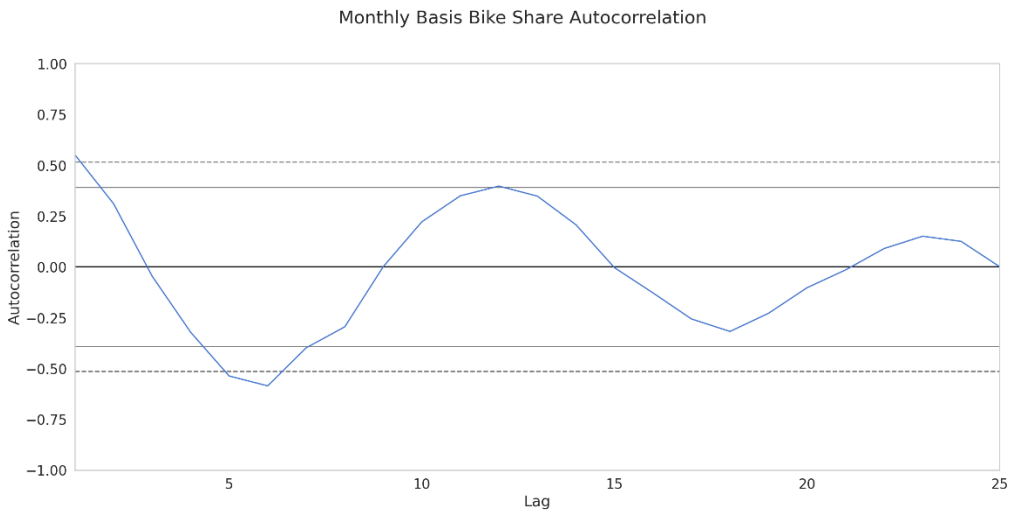
Columns	count	mean	std	min	25%	50%	75%	max
cnt	17414	1143.10	1085.11	0.0	257.0	844.0	1671.75	7860.0
t1	17414	12.49	5.57	-1.5	8.0	12.5	16.00	34.0
t2	17414	11.520	6.61	-6.0	6.0	12.5	16.00	34.0
hum	17414	72.32	14.31	20.5	63.0	74.5	83.00	100.0
wind_speed	17414	15.91	7.89	0.0	10.0	15.0	20.50	56.5
weather_code	17414	2.72	2.34	1.0	1.0	2.0	3.00	26.0
is_holiday	17414	0.02	0.14	0.0	0.0	0.0	0.00	1.0
is_weekend	17414	0.28	0.45	0.0	0.0	0.0	1.00	1.0
season	17414	1.49	1.11	0.0	0.0	1.0	2.00	3.0

- Four new columns were added - 'hour', 'month', 'day_of_week', and 'day_of_month'.

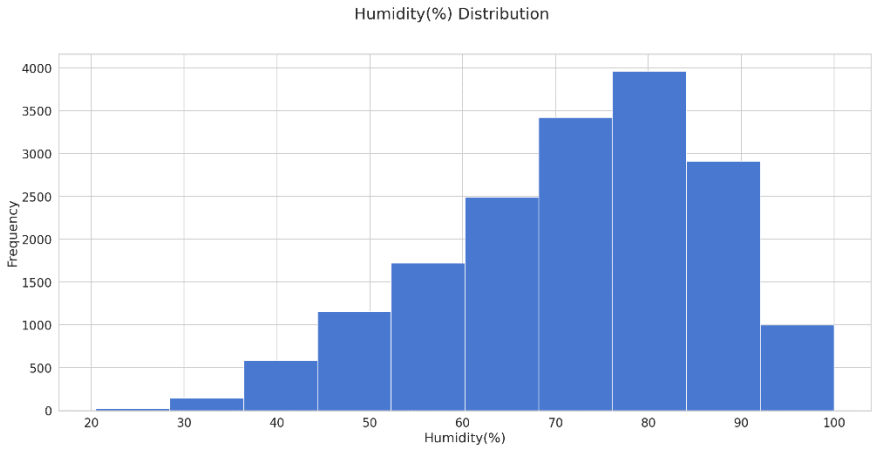
Bike Share Trend ('cnt')



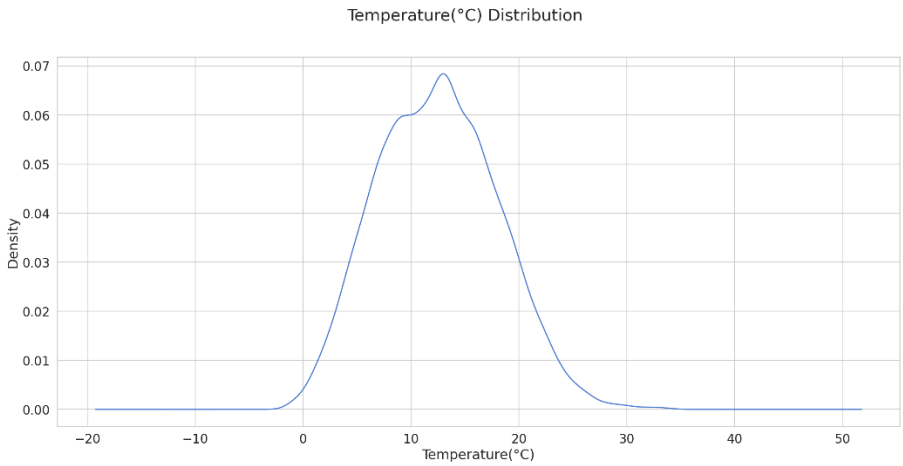
- From the graph above it is clear that it has a strong seasonality component. Summer months are good for bike sharing business



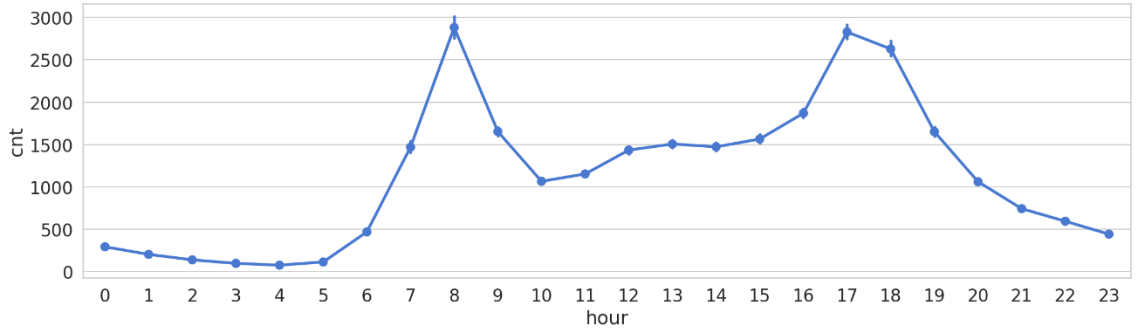
- If month is considered as the lag unit, then, there can be seen cycles of strong negative and positive correlation. Correlation values above the dotted lines are statistically significant

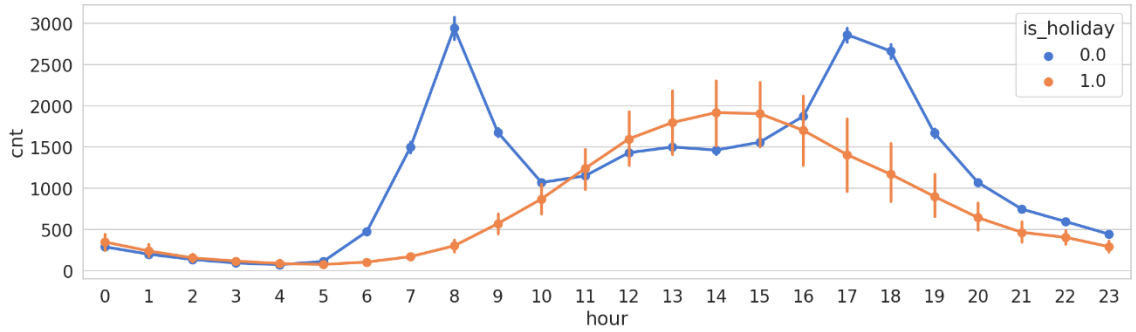


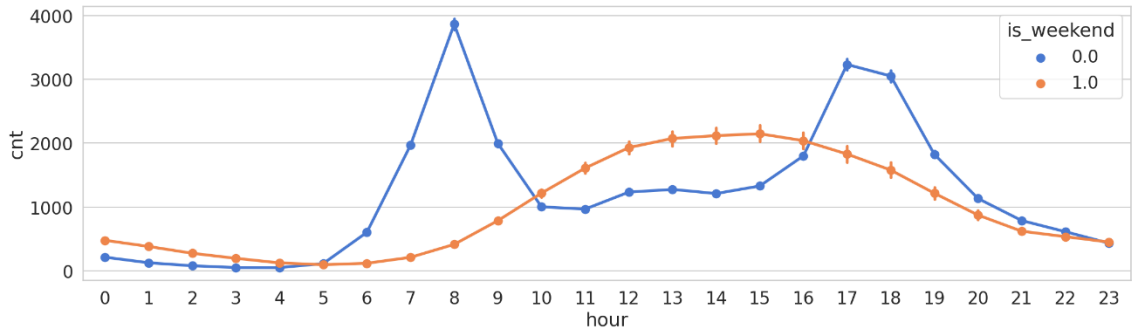
- The humidity mostly falls around 80%, and temperature mostly around 10-18(°C)

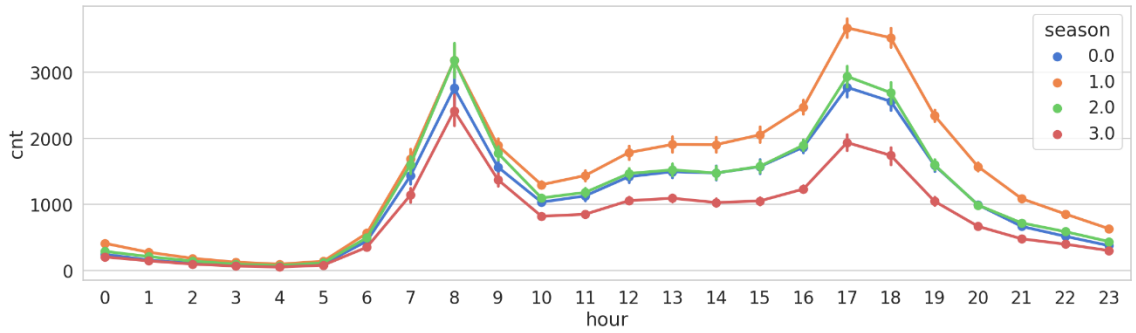


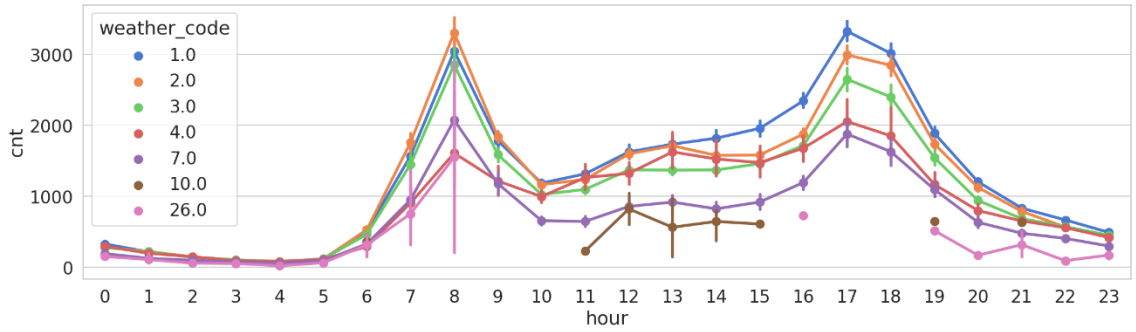
Bike Sharing Trend Over Time (Hourly Basis)











Bike Sharing (hourly basis) based on -

1. Day Type –

- The number of Bike shares differs a lot on an hourly basis based on the day type - workday or weekend or holiday.
- During the workday, people mostly use bike share bikes in two times - during the morning and late afternoon (work in between)
- On the other hand, on weekends (or holidays) early to late afternoon hours seem to be the busiest

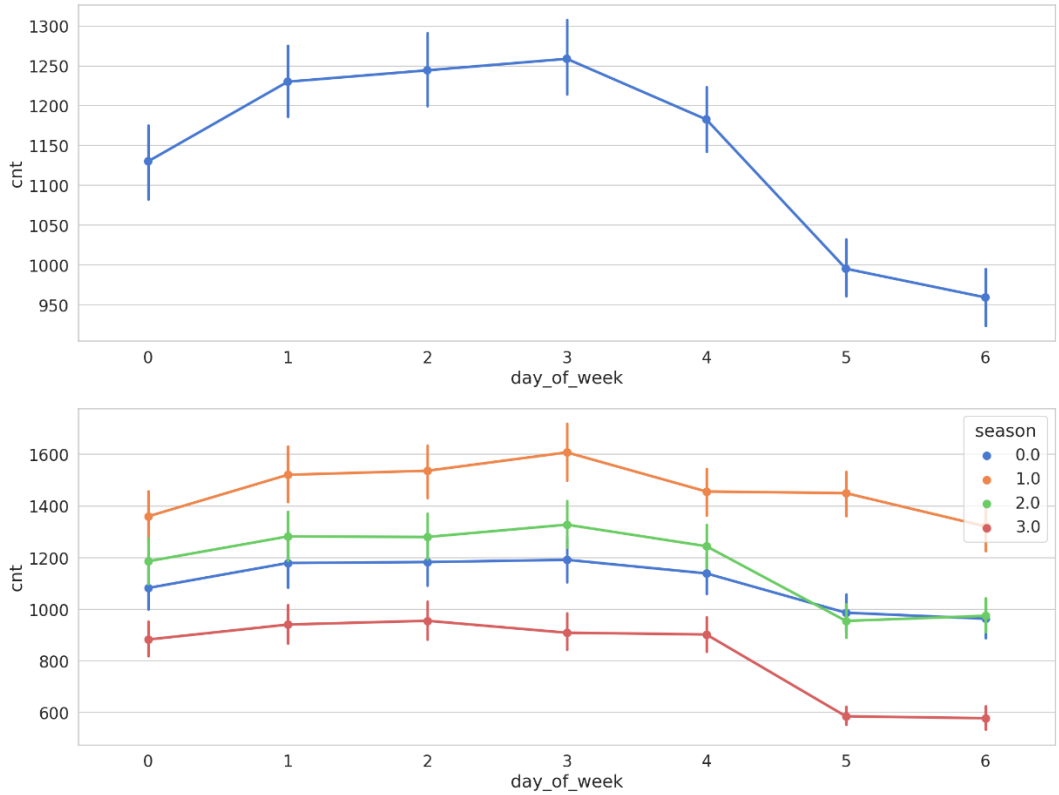
2. Season Type –

- In terms of the ride-share summer season is the busiest, then fall, spring and winter

3. Weather condition –

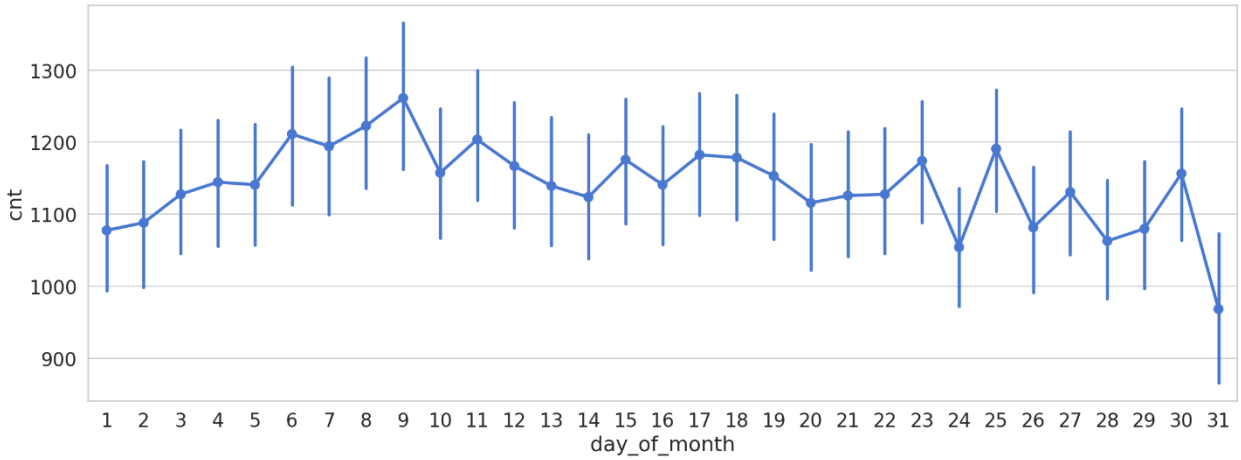
- Bike share is higher when the sky is clear or has few clouds, its lowest when there is rain with a thunderstorm or snowfall
- People don't prefer bike share when there is rain

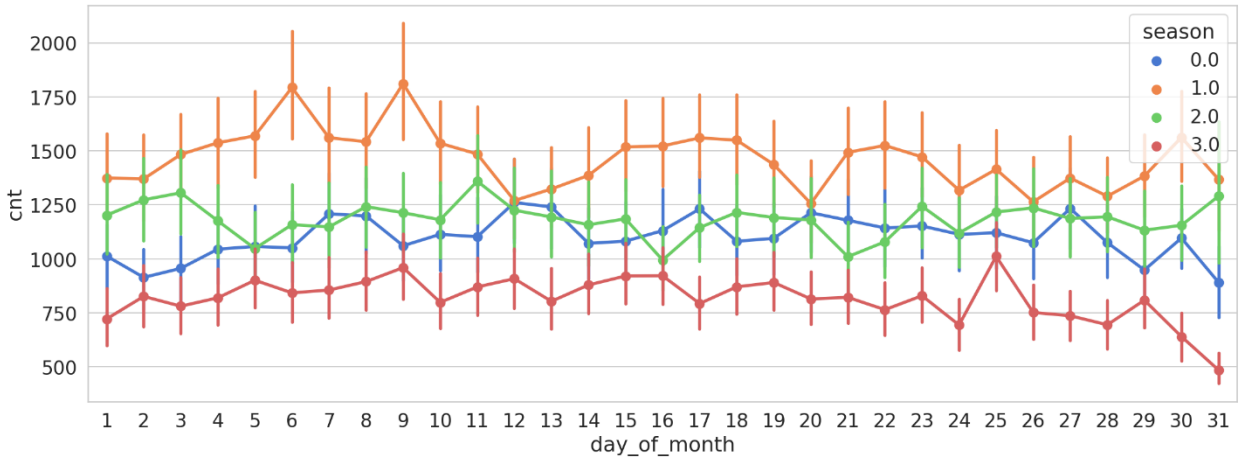
Bike Share Trend Over Time (Weekly Basis)



- Number of Bike share drops on weekends (Saturday and Sunday)

Bike Share Trend Over Time (Month)





- There is a similar pattern between summer and winter

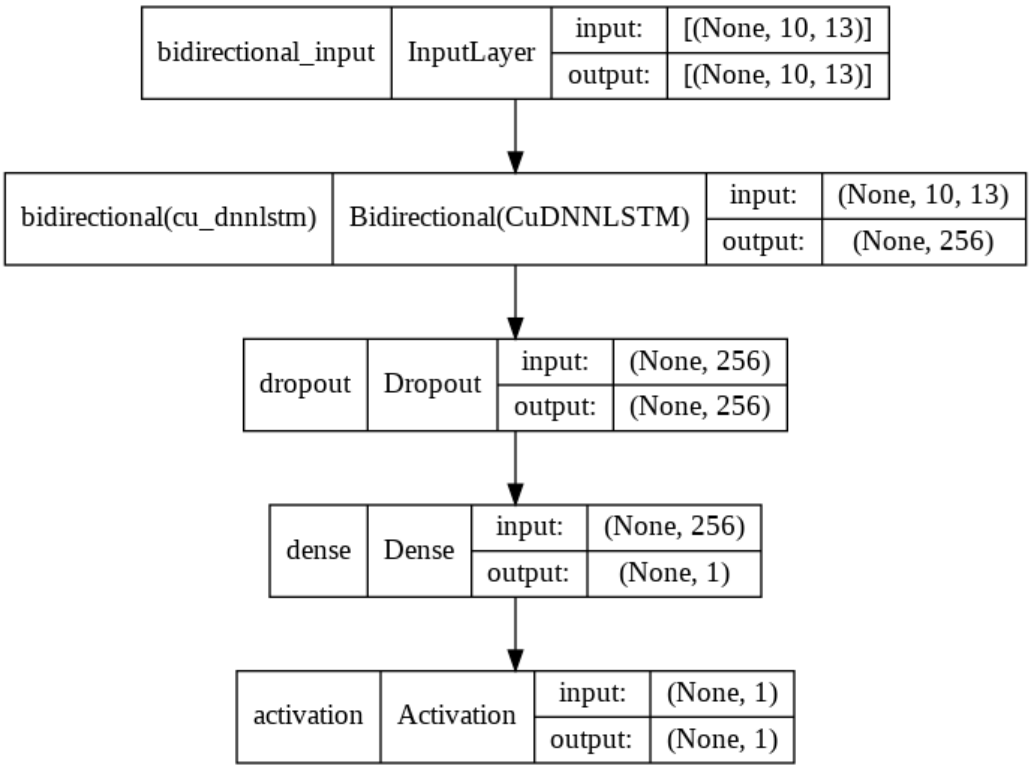
Data Preparation

- Data is divided into train and test set with 90:10 ratio
- Scaled numerical data using robust scaler from sci-kit-learn package which can handle outliers
- Prepare the data for forecasting (Sequence mapping) with 10 timesteps

Modeling

Vanilla Bi-LSTM

Architecture

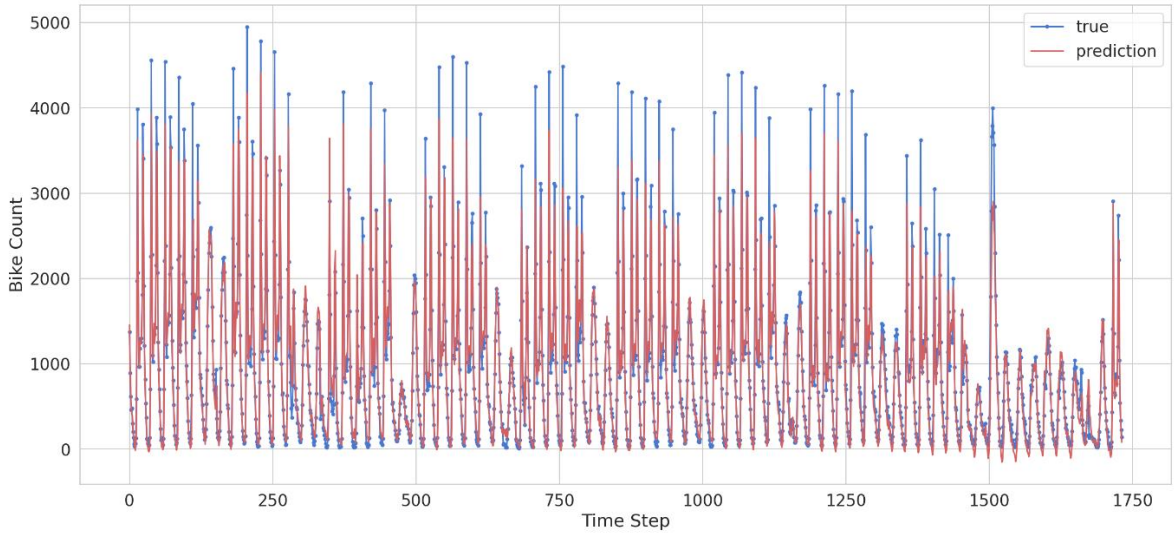


Result:

Evaluation loss **0.0274**

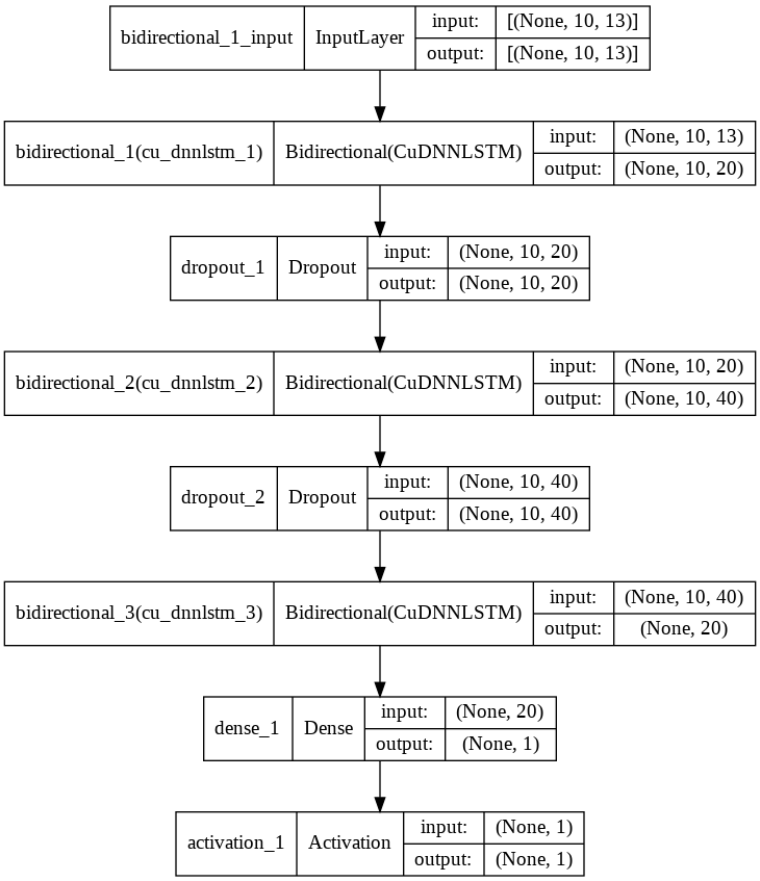
RMSE score: **240.362**

r2 score: **0.9329**



Stacked Bi-LSTM 1

Architecture

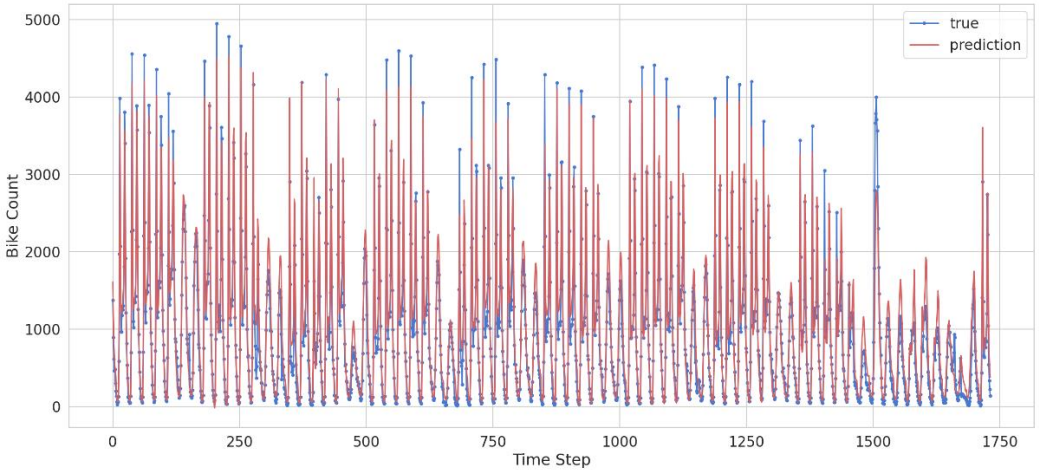


Result:

Evaluation loss **0.0336**

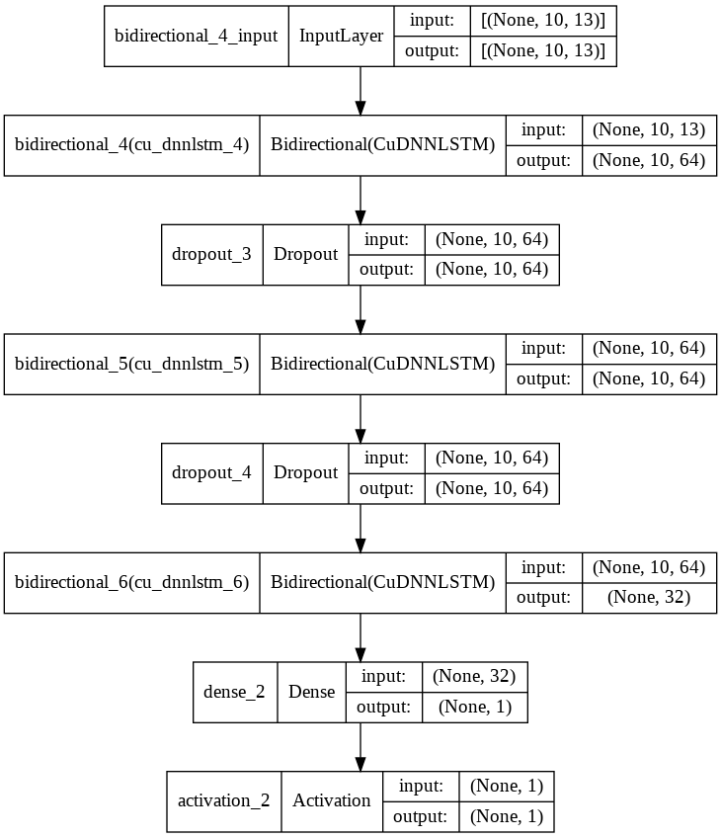
RMSE score: **266.189**

r2 score: **0.9177**



Stacked Bi-LSTM 2

Architecture

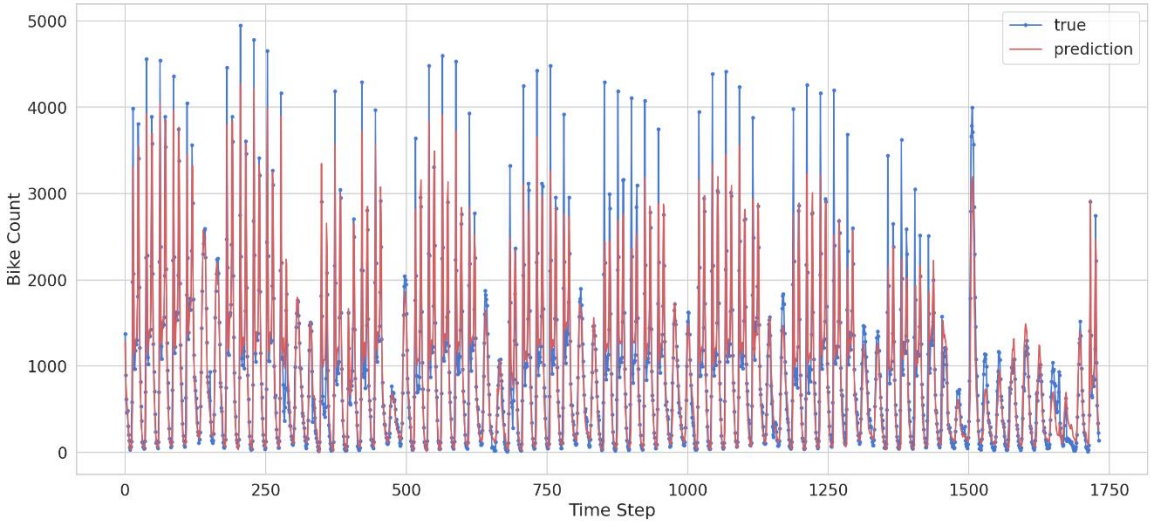


Result:

Evaluation loss **0.05637**

RMSE score: **344.758**

r2 score: **0.862**



Conclusion

- From the above analysis, it's certain that vanilla bi-LSTM model performs better than stacked bi-LSTM models. The loss on the test set is ~0.027
- To improve the model performance different approaches such as - cross-validation, hyperparameter tuning (different number of epochs, number of neurons and layers, optimizer and learning rate etc.,) should be performed.

Full Project Can be found here –GitHub-Demand-Prediction