# Predicting Rainfall in Australia

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**PROJECT GROUP #3**
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# Contents

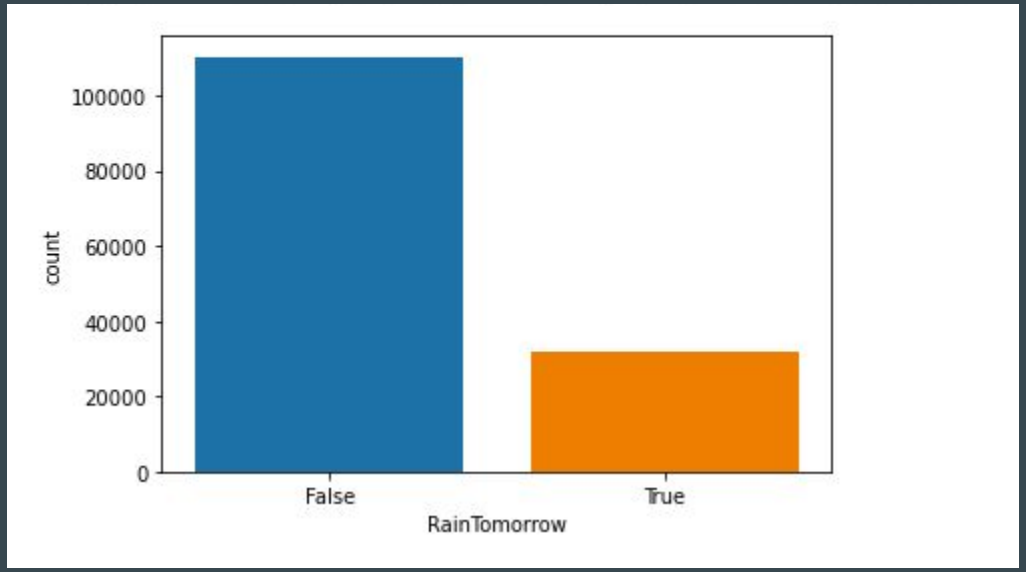
# Introduction

- The aim of the project is to predict if it will rain in Australia.
- The target audience is the general public of Australia.
- EDA (Exploratory Data Analysis) was performed to visualize various important trends.
- A logistic regression model was trained to predict rain.
- The model was evaluated using various classification metrics.

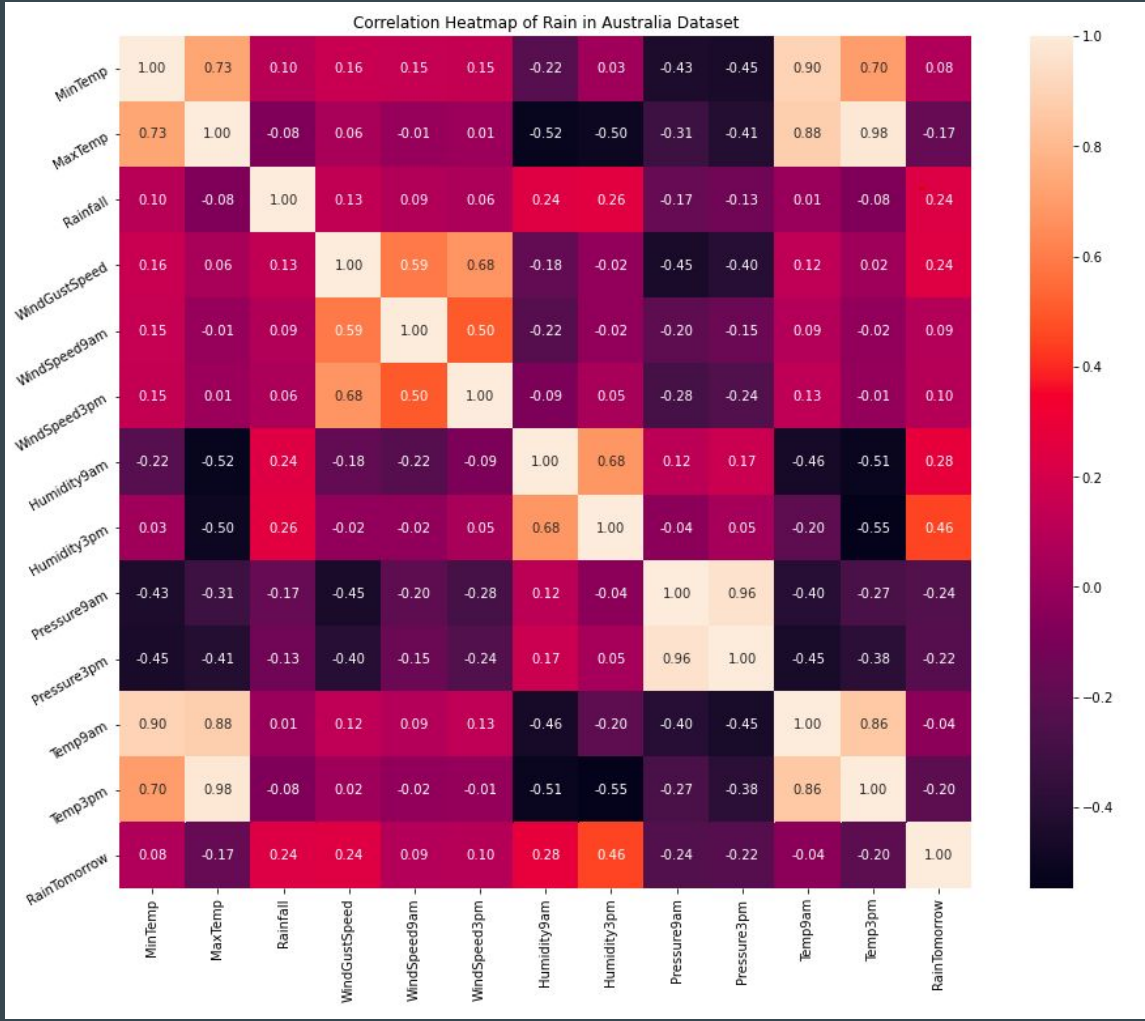
# About the Dataset

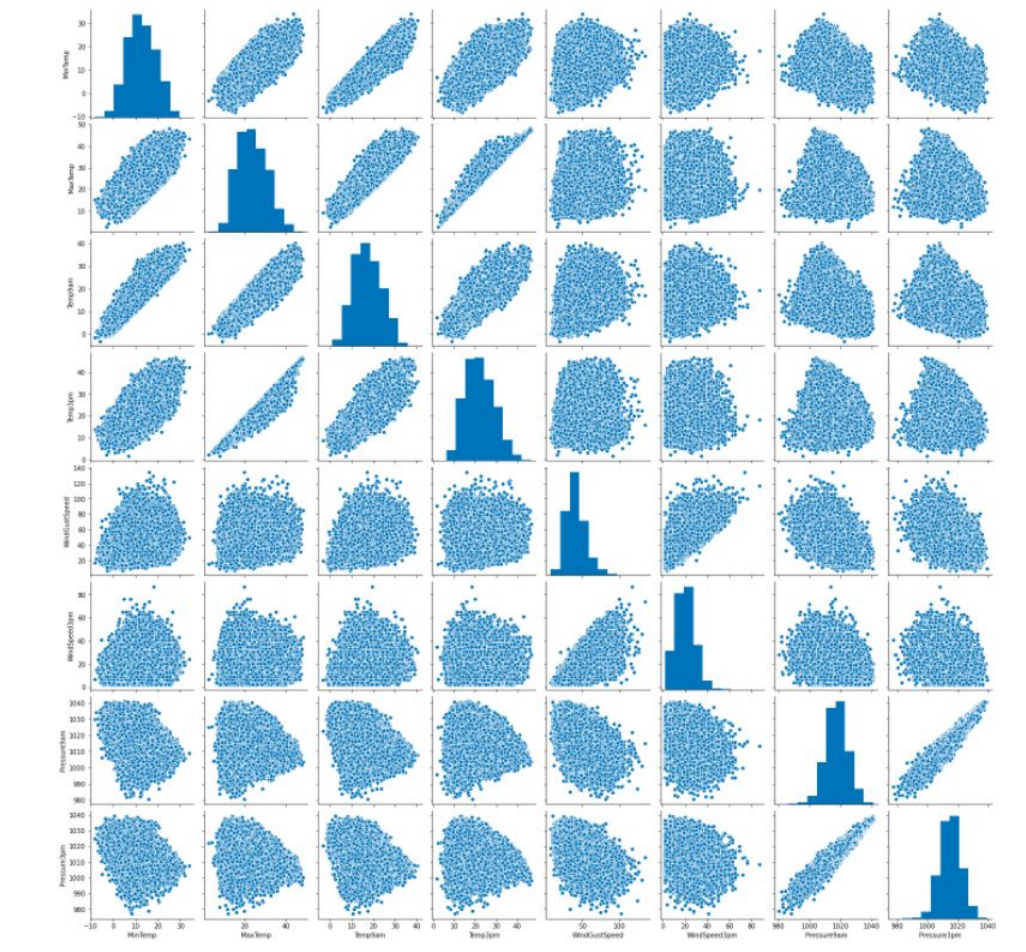
- This dataset contains about 10 years of daily weather observations from numerous Australian weather stations.
- It consists of 24 columns and 142193 rows. It has numerical, categorical and boolean data.
- It is an unbalanced dataset, as the target column RainTomorrow has 110316 "No" entries and 31877 "Yes" entries.

# Visualizations

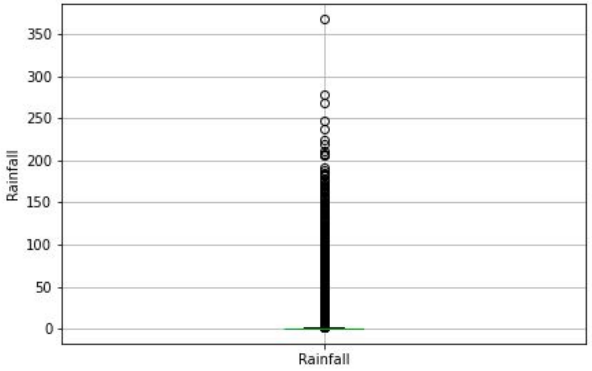


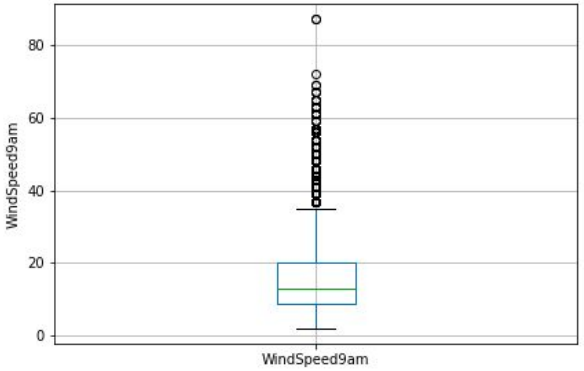

Visualizing the Target Variable

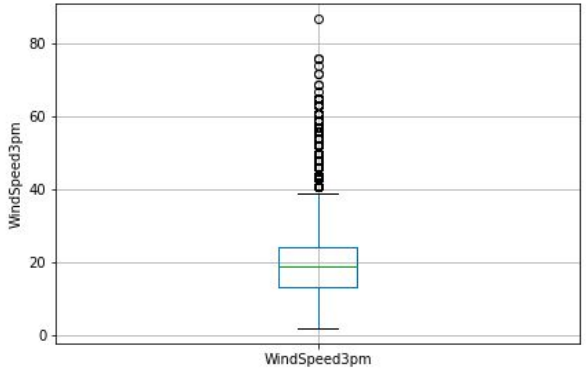

Correlation Heatmap of Rain in Australia Dataset
MinTemp 1.00 0.73 0.10 0.16 0.15 0.15 -0.22 0.03 -0.43 -0.45 0.90 0.70 0.08
MaxTemp 0.73 1.00 -0.08 0.06 -0.01 0.01 -0.52 -0.50 -0.31 -0.41 0.88 0.98 -0.17
Rainfall 0.10 -0.08 1.00 0.13 0.09 0.06 0.24 0.26 -0.17 -0.13 0.01 -0.08 0.24
WindGustSpeed 0.16 0.06 0.13 1.00 0.59 0.68 -0.18 -0.02 -0.45 -0.40 0.12 0.02 0.24
WindSpeed9am 0.15 -0.01 0.09 0.59 1.00 0.50 -0.22 -0.02 -0.20 -0.15 0.09 -0.02 0.09
WindSpeed3pm 0.15 0.01 0.06 0.68 0.50 1.00 -0.09 0.05 -0.28 -0.24 0.13 -0.01 0.10
Humidity9am -0.22 -0.52 0.24 -0.18 -0.22 -0.09 1.00 0.68 0.12 0.17 -0.46 -0.51 0.28
Humidity3pm 0.03 -0.50 0.26 -0.02 -0.02 0.05 0.68 1.00 -0.04 0.05 -0.20 -0.55 0.46
Pressure9am -0.43 -0.31 -0.17 -0.45 -0.20 -0.28 0.12 -0.04 1.00 0.96 -0.40 -0.27 -0.24
Pressure3pm -0.45 -0.41 -0.13 -0.40 -0.15 -0.24 0.17 0.05 0.96 1.00 -0.45 -0.38 -0.22
Temp9am 0.90 0.88 0.01 0.12 0.09 0.13 -0.46 -0.20 -0.40 -0.45 1.00 0.86 -0.04
Temp3pm 0.70 0.98 -0.08 0.02 -0.02 -0.01 -0.51 -0.55 -0.27 -0.38 0.86 1.00 -0.20
RainTomorrow 0.08 -0.17 0.24 0.24 0.09 0.10 0.28 0.46 -0.24 -0.22 -0.04 -0.20 1.00
MinTemp MaxTemp Rainfall WindGustSpeed WindSpeed9am WindSpeed3pm Humidity9am Humidity3pm Pressure9am Pressure3pm Temp9am Temp3pm RainTomorrow
1.0 0.8 0.6 0.4 0.2 0.0 −0.2 −0.4


MinTemp
MaxTemp
Temp9am
Temp3pm
WindGustSpeed
WindSpeed3pm
Pressure9am
Pressure3pm

```
Text(0, 0.5, 'WindSpeed3pm')
```




# Checking for Outliers

# Data Preprocessing

- The dataset is stored in BigQuery.
- The preprocessing is done using Jupyter Notebooks in AI Platform
- The datatypes of the columns are corrected.
- The columns that have less than 60% of data are dropped.
- The rows that consist of missing values in any of the columns are dropped.
- Outliers are handled using top-coding approach.
- Categorical data is encoded using One Hot Encoding as Logistic Regression cannot handle categorical data.

# Machine Learning Model

- A Logistic Regression model is trained using BigQuery ML.
- The query used to create the model is :

```
CREATE OR REPLACE MODEL
 `thematic-flash-266714.australia_weather.model`
OPTIONS
 ( model_type="logistic_reg",
  input_label_cols=["RainTomorrow"] ) AS
SELECT * FROM
  `thematic-flash-266714.australia_weather.preprocessed`
```

## Aggregate metrics

| | |
|---|---|
| Log loss | 0.3638 |
| ROC AUC | 0.8663 |

## Score threshold

Positive class threshold 0.5542

| | |
|---|---|
| Positive class | true |
| Negative class | false |
| Precision | 0.7913 |
| Recall | 0.3882 |
| Accuracy | 0.8400 |
| F1 score | 0.5208 |

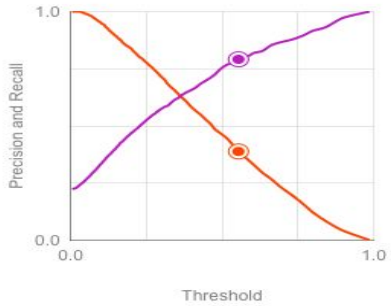
Use this slider above to see which score threshold works best for your model.

## Confusion matrix

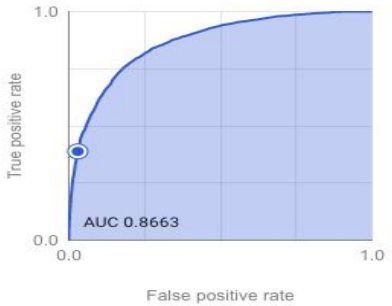
| Actual labels \ Predicted labels | true | false |
|---|---|---|
| true | 38.82% | 61.18% |
| false | 2.96% | 97.04% |

## Precision-Recall curve


## Precision and Recall vs Threshold




## ROC curve



# Predictions Using the Model

- We use the following query to evaluate the model

```
SELECT * FROM ML.PREDICT (MODEL `thematic-flash-266714.australia_weather.log_reg_model`,(
  SELECT  *  EXCEPT(YEAR) FROM
   `thematic-flash-266714.australia_weather.preprocessed_new`
  WHERE YEAR < 2011 ))
```

Predict Query Edited

LINK SHARING | + COMPOSE NEW QUERY | HIDE EDITOR | FULL SCREEN

```
SELECT * FROM ML.PREDICT (MODEL `thematic-flash-266714.australia_weather.log_reg_model`,(
    SELECT  *  EXCEPT(YEAR) FROM
      `thematic-flash-266714.australia_weather.preprocessed_new`
    WHERE YEAR < 2011 ))
```

Run | Save query | Save view | Schedule query | More

This query will process 92.3 MB when run.

## Query results

SAVE RESULTS | EXPLORE DATA

Query complete (2.8 sec elapsed, 92.3 MB processed)

Job information | Results | JSON | Execution details

| Row | predicted_RainTomorrow | predicted_RainTomorrow_probs.label | predicted_RainTomorrow_probs.prob | MinTemp | MaxTemp | Rainfall | WindGustSpeed | WindSpeed9am | WindSpeed3pm | Hu |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | false | true | 0.12808793434238738 | -0.8 | 12.9 | 3.2 | 24.0 | 6.0 | 6.0 | |
| | | false | 0.8719120656576126 | | | | | | | |
| 2 | true | true | 0.5297993431692399 | 20.2 | 25.3 | 2.2 | 43.0 | 2.0 | 13.0 | |
| | | false | 0.47020065683076007 | | | | | | | |
| 3 | false | true | 0.48164343216357963 | 16.2 | 21.0 | 3.2 | 65.0 | 44.0 | 41.0 | |
| | | false | 0.5183565678364204 | | | | | | | |
| 4 | false | true | 0.2119057304407178 | 18.7 | 25.4 | 1.2 | 39.0 | 19.0 | 20.0 | |
| | | false | 0.7880942695592822 | | | | | | | |
| 5 | false | true | 0.369439295879749 | 18.5 | 26.4 | 3.2 | 37.0 | 6.0 | 11.0 | |
| | | false | 0.630560704120251 | | | | | | | |
| 6 | false | true | 0.37659448765017495 | 15.0 | 21.7 | 3.2 | 52.0 | 30.0 | 24.0 | |
| | | false | 0.623405512349825 | | | | | | | |
| 7 | false | true | 0.4393126975143989 | 1.4 | 12.9 | 1.6 | 26.0 | 9.0 | 9.0 | |

Rows per page: 100 | 1 - 100 of 27902 | First page | Last page

# Evaluating the Model

- We use the following query to evaluate the model

SELECT * FROM ML.EVALUATE(MODEL `thematic-flash-266714.australia_weather.log_reg_model`)

```
1 SELECT * FROM ML.EVALUATE (MODEL `thematic-flash-266714.australia_weather.log_reg_model`)
```

Run | Save query | Save view | Schedule query | More

Query results | SAVE RESULTS | EXPLORE DATA

Query complete (0.2 sec elapsed, 0 B processed)

Job information | Results | JSON | Execution details

| Row | precision | recall | accuracy | f1_score | log_loss | roc_auc |
|---|---|---|---|---|---|---|
| 1 | 0.7544738725841088 | 0.4612691466083151 | 0.8456711442298265 | 0.5725149375339489 | 0.36384063927514204 | 0.8663436563436564 |

# Conclusion

- The accuracy of the model is 0.85 and precision is 0.75 which is good for a classification model.
- But the recall and f1-score is low, which implies that the model needs improvement.
- The performance of the model suffers due to the unbalanced dataset.

# THANK YOU!