# Use Case

# Solar Battery Radiation Prediction

# Solar Battery Radiation Prediction

Pilot Guided Analytics

Tridiagonal® Solutions
compute | innovate | develop

**Objective**

- Prediction of the Radiation from Solar energy batteries. This will help us to determine whether it will be reasonable to use them for next few days or not.
- Determine the Important parameters which are influencing the Solar Radiation

**Data Aggregated – 4 Months Worth of Data**

- Datetime
- Temperature
- Pressure
- Humidity
- Wind Direction(Degrees)
- Wind Speed
- Sun Rise Time
- Sun Set Time
- Radiation

| date | Radiation | Temperature | Pressure | Humidity | WindDirection(Degrees) | Speed | date | Sun Duration |
|---|---|---|---|---|---|---|---|---|
| 2016-09-29 23:55:26 | 1.21 | 48 | 30.46 | 59 | 177.39 | 5.62 | 2016-09-29 23:55:26 | 12.000000 |
| 2016-09-29 23:50:23 | 1.21 | 48 | 30.46 | 58 | 176.78 | 3.37 | 2016-09-29 23:50:23 | 12.000000 |
| 2016-09-29 23:45:26 | 1.23 | 48 | 30.46 | 57 | 158.75 | 3.37 | 2016-09-29 23:45:26 | 12.000000 |
| 2016-09-29 23:40:21 | 1.21 | 48 | 30.46 | 60 | 137.71 | 3.37 | 2016-09-29 23:40:21 | 12.000000 |
| 2016-09-29 23:35:24 | 1.17 | 48 | 30.46 | 62 | 104.95 | 5.62 | 2016-09-29 23:35:24 | 12.000000 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 2016-12-01 00:20:04 | 1.22 | 44 | 30.43 | 102 | 145.42 | 6.75 | 2016-12-01 00:20:04 | 11.016667 |
| 2016-12-01 00:15:01 | 1.17 | 44 | 30.42 | 102 | 117.78 | 6.75 | 2016-12-01 00:15:01 | 11.016667 |
| 2016-12-01 00:10:01 | 1.20 | 44 | 30.42 | 102 | 145.19 | 9.00 | 2016-12-01 00:10:01 | 11.016667 |
| 2016-12-01 00:05:02 | 1.23 | 44 | 30.42 | 101 | 164.19 | 7.87 | 2016-12-01 00:05:02 | 11.016667 |
| 2016-12-01 00:00:02 | 1.20 | 44 | 30.43 | 101 | 83.59 | 3.37 | 2016-12-01 00:00:02 | 11.016667 |

# Solar Battery Radiation Prediction

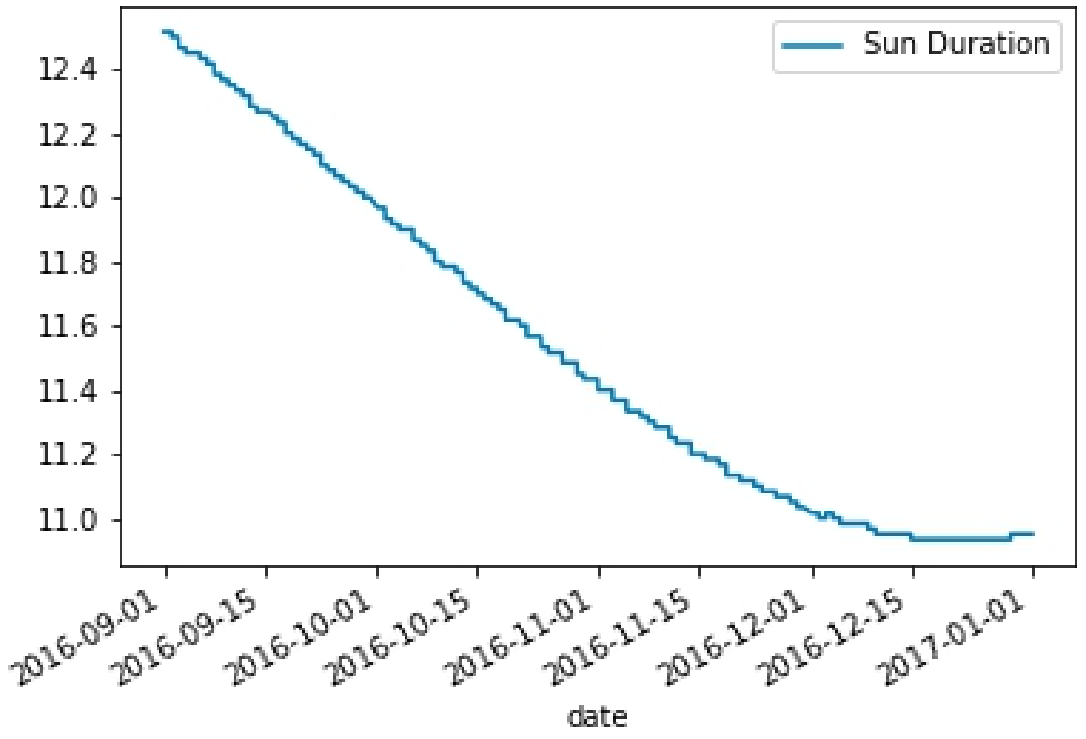
Pilot Guided Analytics

Tridiagonal® Solutions
compute | innovate | develop

## Data Cleaning & transformation

- All the necessary conversions were done in order to make the data more sensible
- Difference of Sun Rise & Sun Set was considered in order to estimate the total span of time when the Sun was up over the entire period of a day

| date | Radiation | Temperature | Pressure | Humidity | WindDirection(Degrees) | Speed | date | Sun Duration |
|---|---|---|---|---|---|---|---|---|
| 2016-09-29 23:55:26 | 1.21 | 48 | 30.46 | 59 | 177.39 | 5.62 | 2016-09-29 23:55:26 | 12.000000 |
| 2016-09-29 23:50:23 | 1.21 | 48 | 30.46 | 58 | 176.78 | 3.37 | 2016-09-29 23:50:23 | 12.000000 |
| 2016-09-29 23:45:26 | 1.23 | 48 | 30.46 | 57 | 158.75 | 3.37 | 2016-09-29 23:45:26 | 12.000000 |
| 2016-09-29 23:40:21 | 1.21 | 48 | 30.46 | 60 | 137.71 | 3.37 | 2016-09-29 23:40:21 | 12.000000 |
| 2016-09-29 23:35:24 | 1.17 | 48 | 30.46 | 62 | 104.95 | 5.62 | 2016-09-29 23:35:24 | 12.000000 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 2016-12-01 00:20:04 | 1.22 | 44 | 30.43 | 102 | 145.42 | 6.75 | 2016-12-01 00:20:04 | 11.016667 |
| 2016-12-01 00:15:01 | 1.17 | 44 | 30.42 | 102 | 117.78 | 6.75 | 2016-12-01 00:15:01 | 11.016667 |
| 2016-12-01 00:10:01 | 1.20 | 44 | 30.42 | 102 | 145.19 | 9.00 | 2016-12-01 00:10:01 | 11.016667 |
| 2016-12-01 00:05:02 | 1.23 | 44 | 30.42 | 101 | 164.19 | 7.87 | 2016-12-01 00:05:02 | 11.016667 |
| 2016-12-01 00:00:02 | 1.20 | 44 | 30.43 | 101 | 83.59 | 3.37 | 2016-12-01 00:00:02 | 11.016667 |

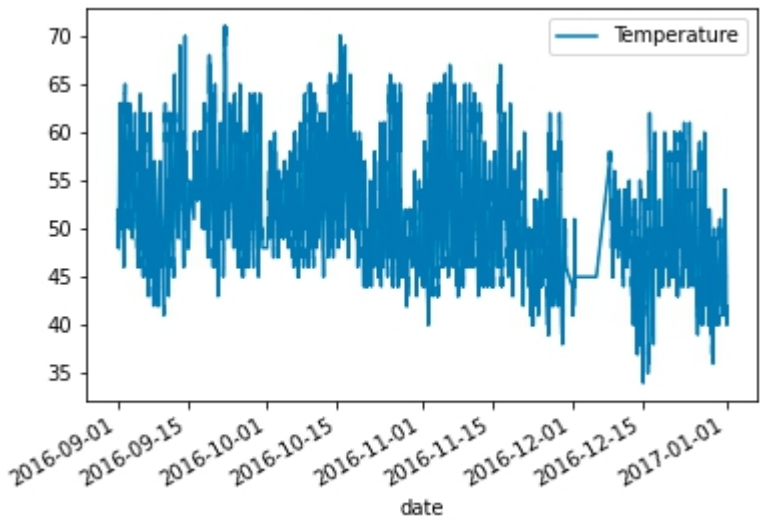


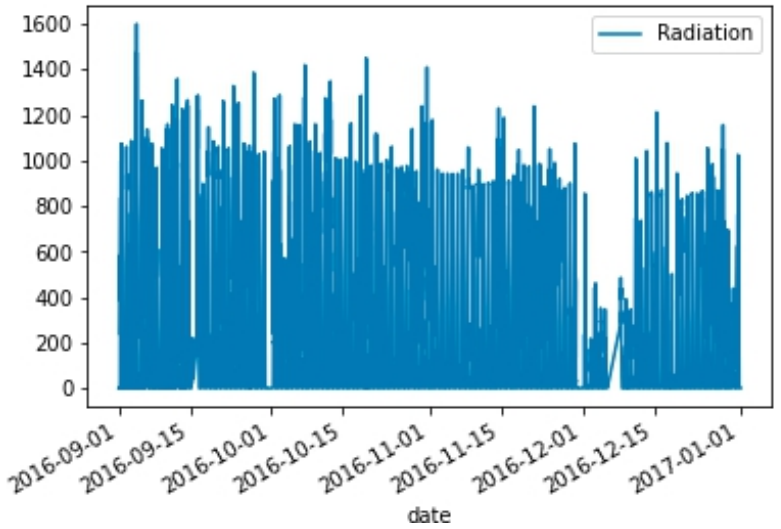
# Solar Battery Radiation Prediction

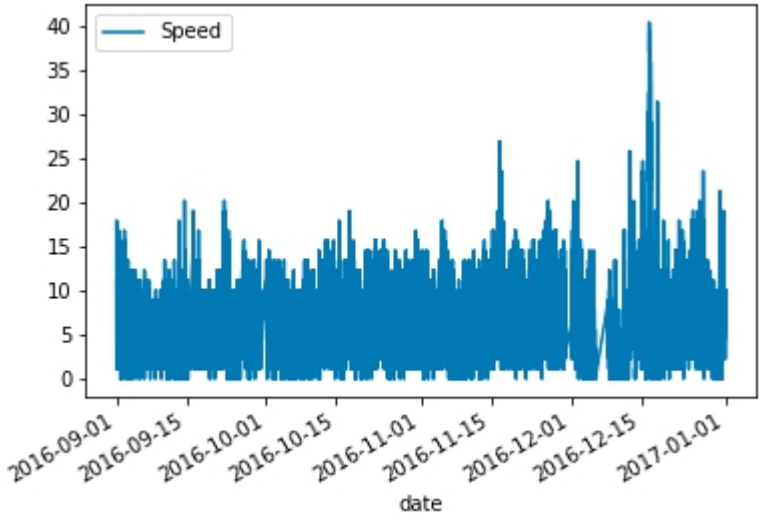
Pilot Guided Analytics

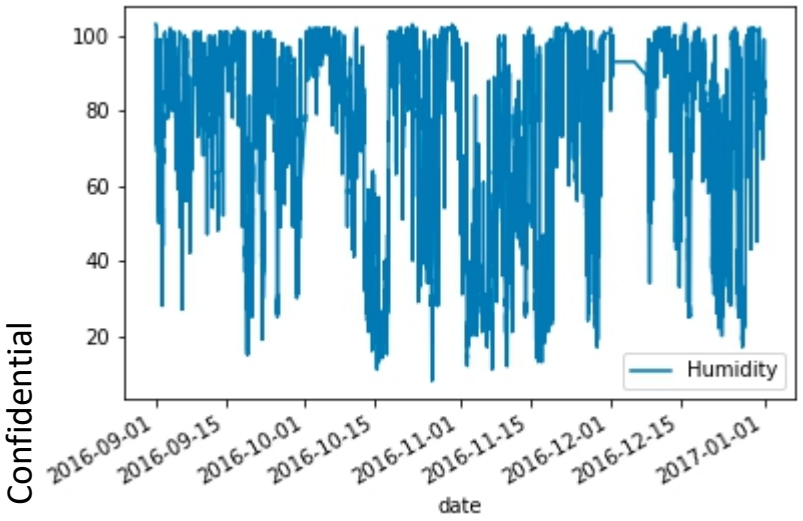
Tridiagonal® Solutions
compute | innovate | develop

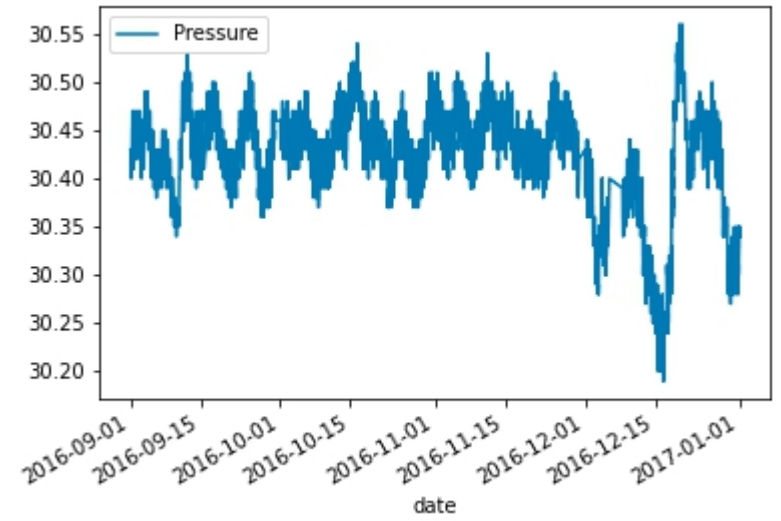
Exploratory Data Analysis: Raw trends – Heavy fluctuations are observed in all the parameters except for the Pressure. The Wind Speed and Wind Direction seems to be dictating the Solar Radiation

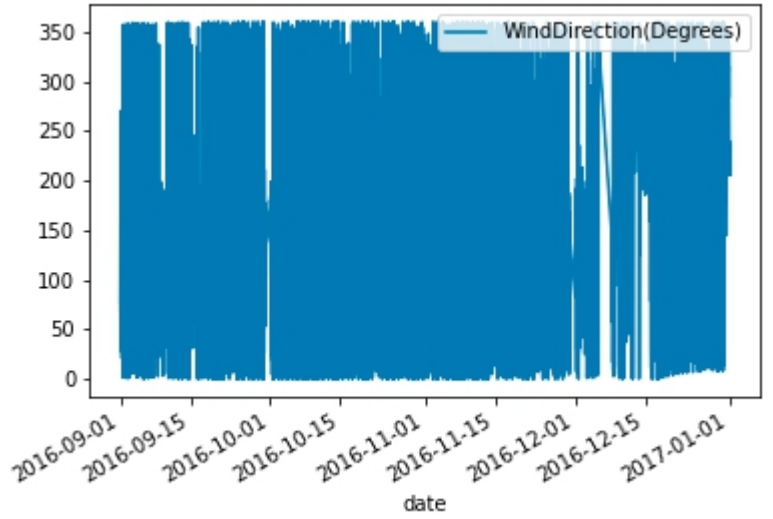


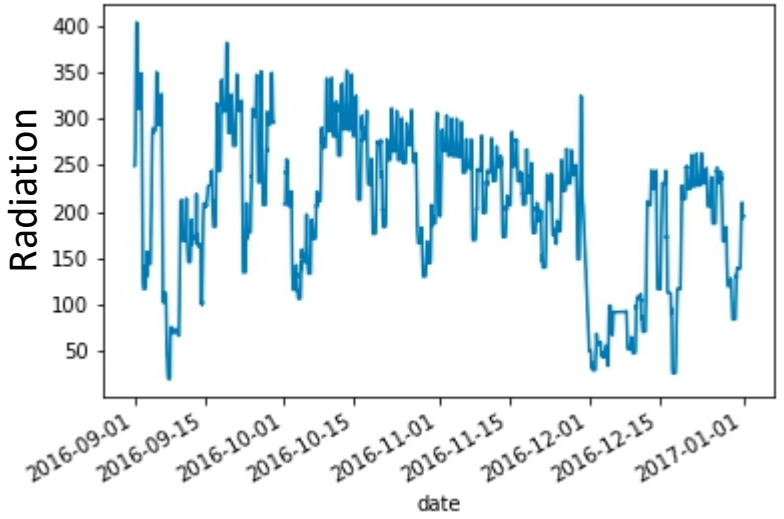



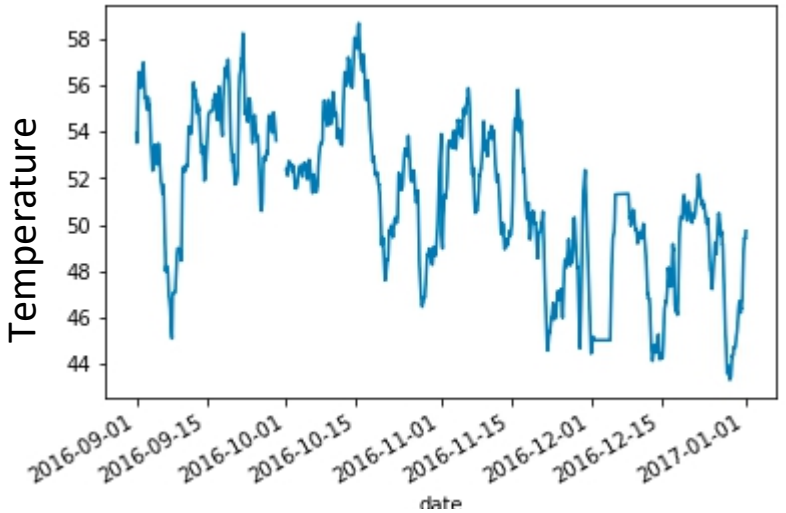
# Solar Battery Radiation Prediction

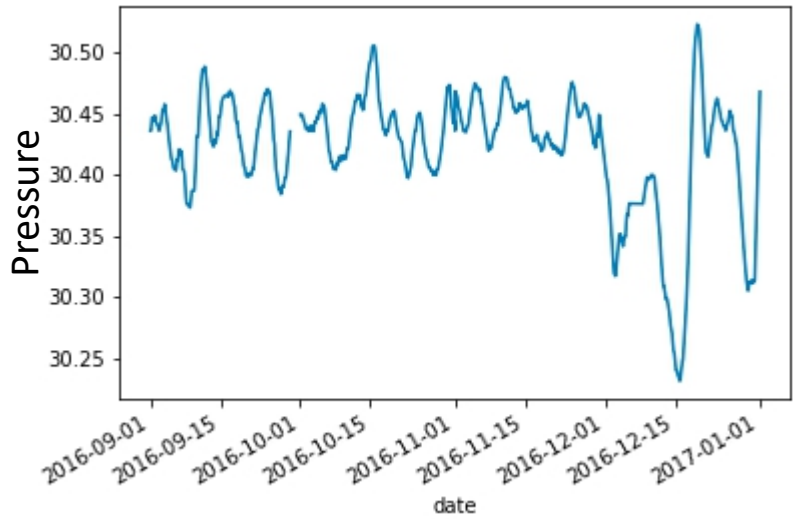
Pilot Guided Analytics

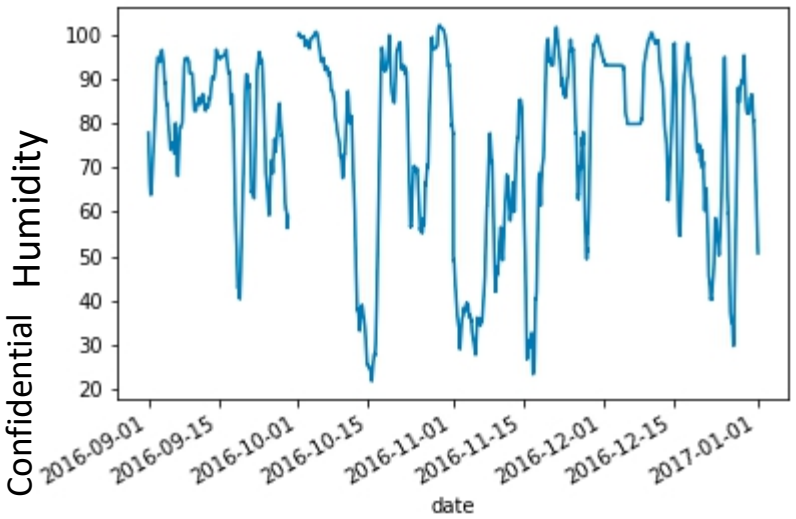
Tridiagonal® Solutions
compute | innovate | develop

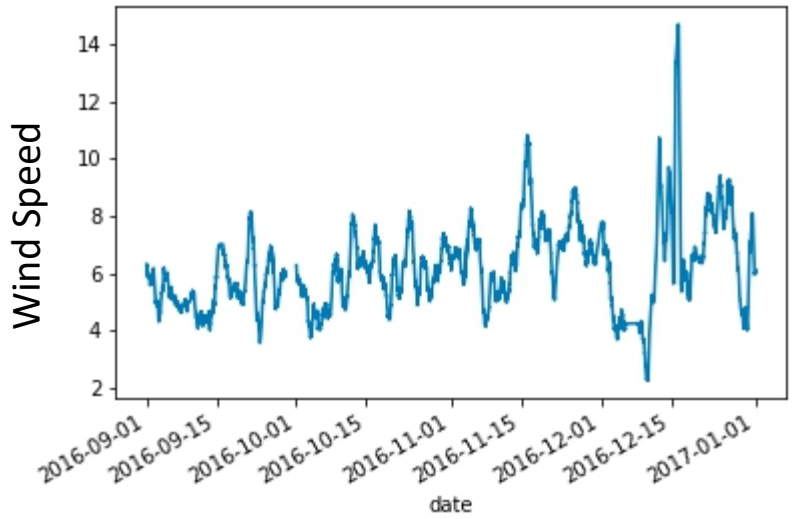
Rolling Mean of 300 Samples (1 Day) – Shows that Wind Speed was too high and Pressure was too low which caused the Radiation to be less in the period between – 2016-12-01 to 2016-12-16

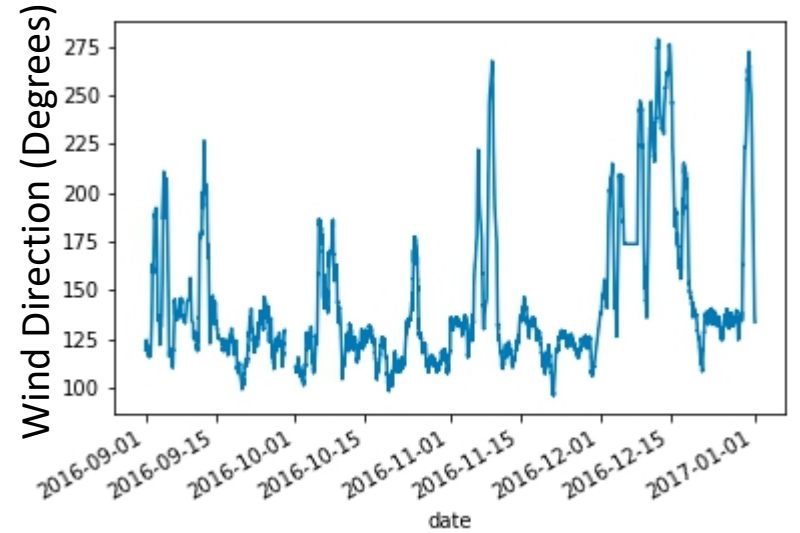


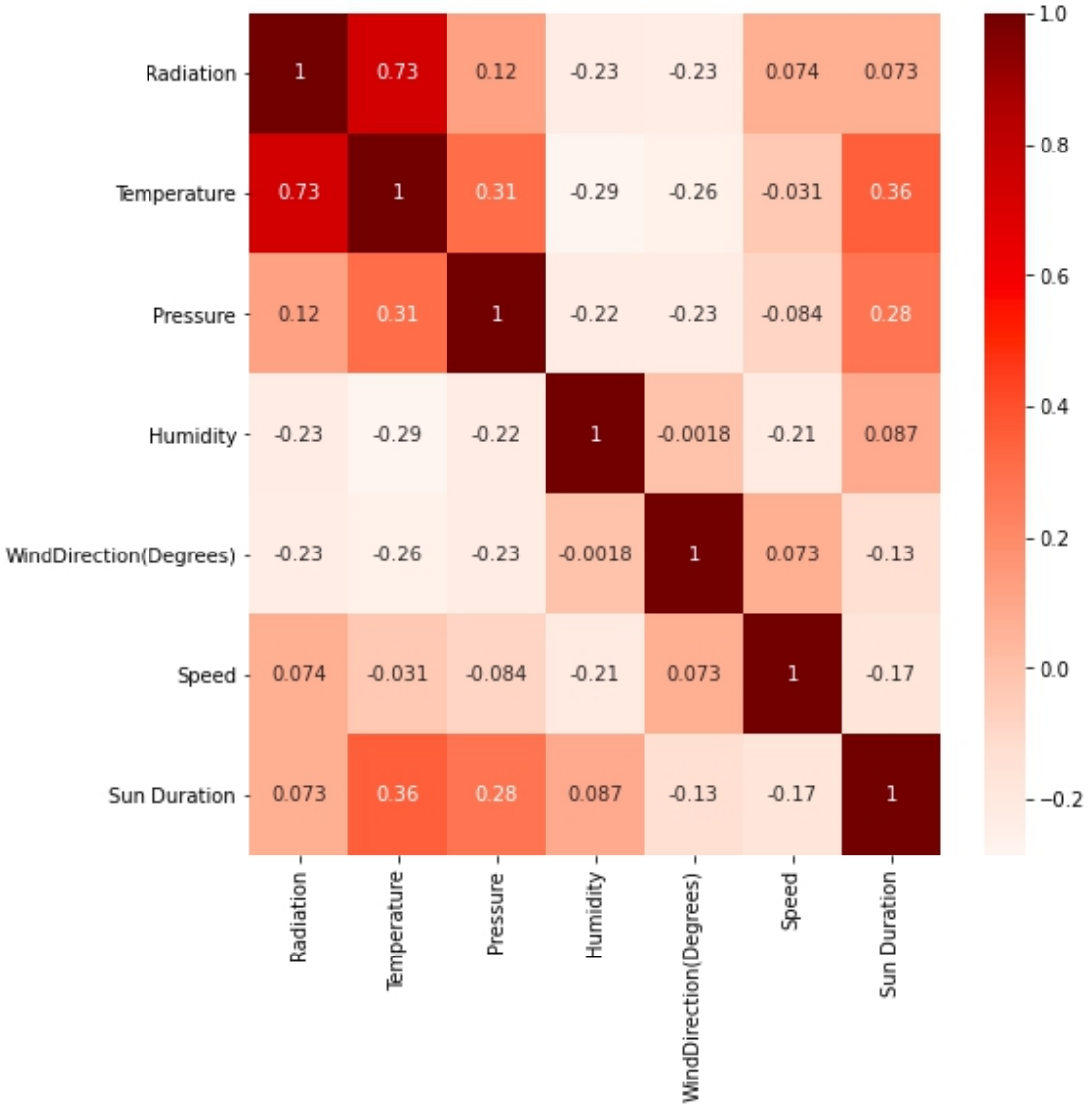
# Solar Battery Radiation Prediction

Pilot Guided Analytics

Tridiagonal® Solutions
compute | innovate | develop

Correlation and Heat Map:

| | Radiation | Temperature | Pressure | Humidity | WindDirection(Degrees) | Speed | Sun Duration |
|---|---|---|---|---|---|---|---|
| Radiation | 1.000000 | 0.734955 | 0.119016 | -0.226171 | -0.230324 | 0.073627 | 0.073456 |
| Temperature | 0.734955 | 1.000000 | 0.311173 | -0.285055 | -0.259421 | -0.031458 | 0.355509 |
| Pressure | 0.119016 | 0.311173 | 1.000000 | -0.223973 | -0.229010 | -0.083639 | 0.278614 |
| Humidity | -0.226171 | -0.285055 | -0.223973 | 1.000000 | -0.001833 | -0.211624 | 0.087356 |
| WindDirection(Degrees) | -0.230324 | -0.259421 | -0.229010 | -0.001833 | 1.000000 | 0.073092 | -0.129434 |
| Speed | 0.073627 | -0.031458 | -0.083639 | -0.211624 | 0.073092 | 1.000000 | -0.174944 |
| Sun Duration | 0.073456 | 0.355509 | 0.278614 | 0.087356 | -0.129434 | -0.174944 | 1.000000 |



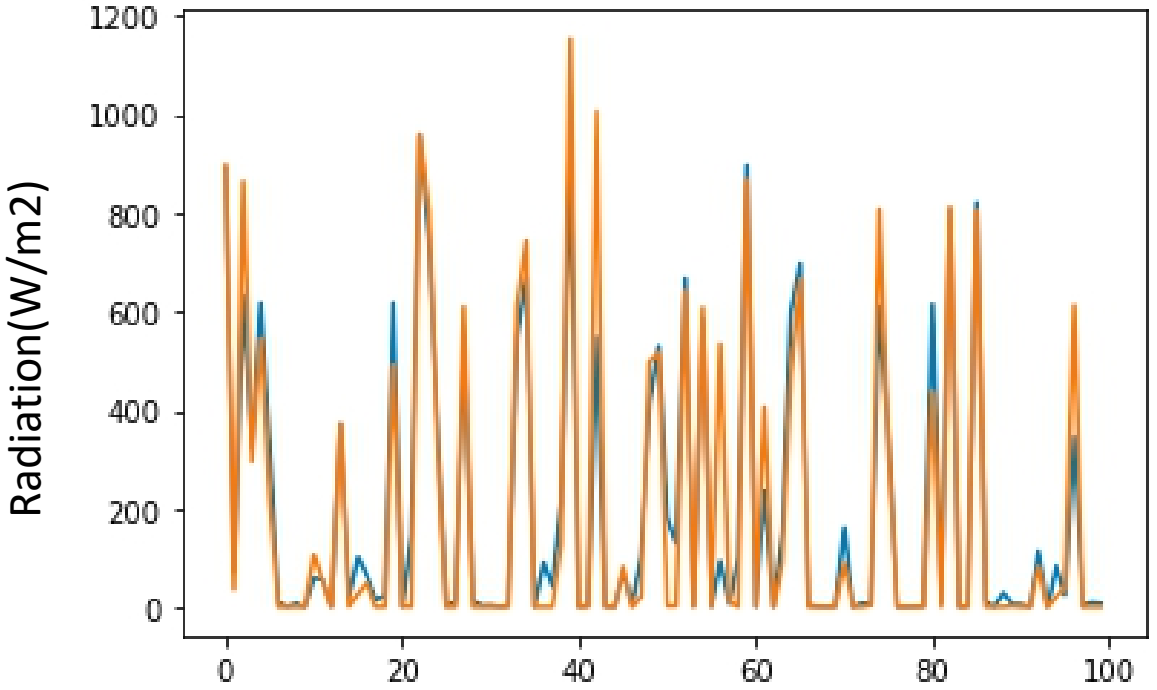

- The correlation matrix shows that Radiation is dependent of Temperature with a linear factor
- No other parameters show any linear correlation – Which means that there should be no multi-collinearty issues and there is a non-linear relationship which needs to be considered.

# Solar Battery Radiation Prediction

**Prediction:**

```
The RF model performance for training set
--------------------------------------
RMSE is 41.96085176266234
R2 score is 0.9823154040445468


The RF model performance for testing set
--------------------------------------
RMSE is 114.24814040301928
R2 score is 0.8704145035480133
```




- Polynomial, Random Forest & Support Vector Regressor were selected for Modeling the Solar Radiation.
- Random Forest Gave the best accuracy in terms of MSE, RMSE and R2 value.
- Using random forest prediction model one can predict the value of the radiation based on the atmospheric condition – Temperature, Humidity and Wind Speed. The will enable the operator to take the decisions for when to operate the solar batteries for effective operations.