SYNOPSIS

Predict Power of Solar Generation

Climate Connect Technologies Ltd Assignment

Submitted By

Sanket Joshi

Table of Contents

Introduction

Humans have been harnessing solar energy for thousands of years—to grow crops, stay warm, and dry foods. According to the National Renewable Energy Laboratory, more energy from the sun falls on the earth in one hour than is used by everyone in the world in one year.

Photovoltaic systems have become an important source of renewable energy generation. Because solar power generation is intrinsically highly dependent on weather fluctuations, predicting power generation using weather information has several economic benefits, including reliable operation planning and proactive power trading. This sproject builds a model that predicts the amounts of solar power generation using weather information.

This project proposes a two-step modeling process that connect sun announced weather variables with announced weather forecasts. The empirical results show that this approach improves a base approach by wide margins, regardless of types of applied machine learning algorithms.

Statement of Problem

What is amount of solar energy generates?

How weather impact the generation of solar energy?

Which parameters important more in this weather forecasting?

Solution to increase the power generation of solar energy.

Objectives of Project

As the main importance of project is to find the amount of solar generation depends on the weather forecasting. Sources of weather information include both measured weather records and weather forecasts. The study proposes a novel two-step prediction process for power generation using both weather records and weather forecasts. This study demonstrates the philosophy of data-driven modelling with as much relevant data as possible to improve performance.

Description of data:

Weather Data

Unnamed - serial numbers

plant_id - Plant ID

datetime_utc - Coordinated Universal Time

datetime_local - Indian Standard Time

cloud_cover - Clouds when observed from a particular location

apparent_temperature - Temperature equivalent perceived by humans

temperature - Atmosphere Temperature

humidity - Humidity of Location

dew_point - Dew point is the temperature to which air must be cooled

wind_bearing - Indicates the direction of wind

wind_speed - Indicates speed of wind

wind_chill - Its lowering of body temperature due to the passing-flow of lower-temperature air

wind_gust - Its a brief increase in the speed of the wind

heat_index - Its combines air temperature and relative humidity

pressure - Atmospheric pressure

qpf - Quantitative precipitation forecast

uv_index - Ultraviolet index

snow - Indicates snow fall

pop - Probability of precipitation

fctcode - Its hourly forecast code

ozone - Indicates ozone

precip_accumulation - Hourly Precipitation

precip_intensity - Its amount of precipitation collected per unit time interval

precip_probability - Its referred to as chance of precipitation

precip_type - Its phase of the precipitation which is falling to ground level.

visibility - Its measure of the distance at which an object can be clearly discerned

sunrise - Sunrise time

sunset - Sunset time

icon - Details of atmosphere

summary - Summary of weather

updated_at - Data updated at time

Energy data

ghi - Global Horizontal Irradiance

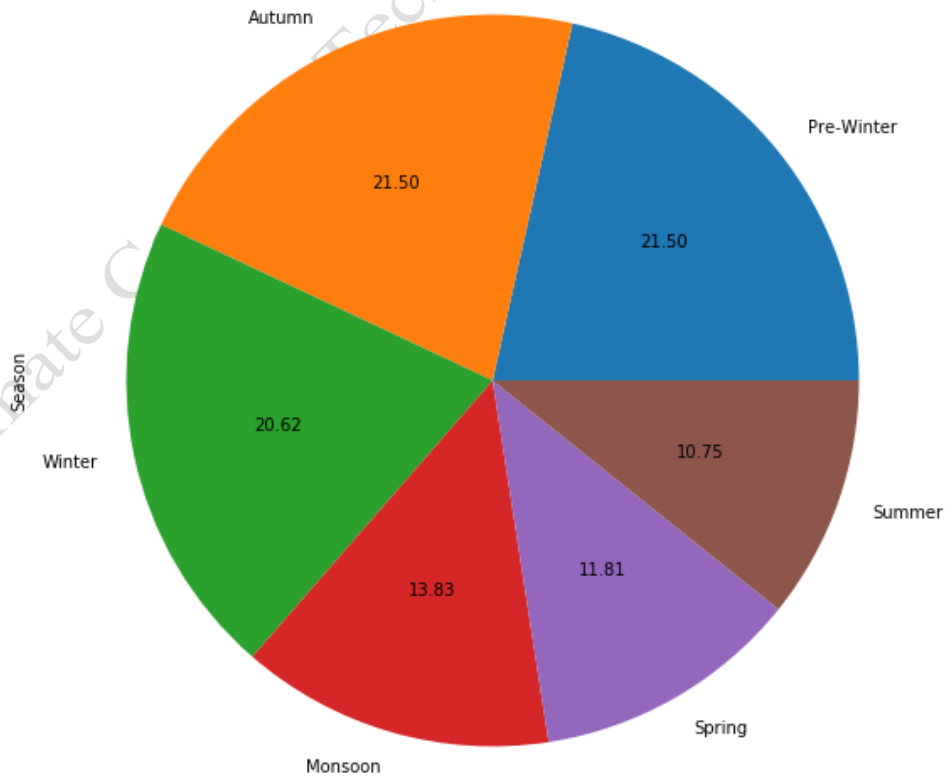
gti - Global Tilted Irradiation/Irradiance

power - Power generated from the plant

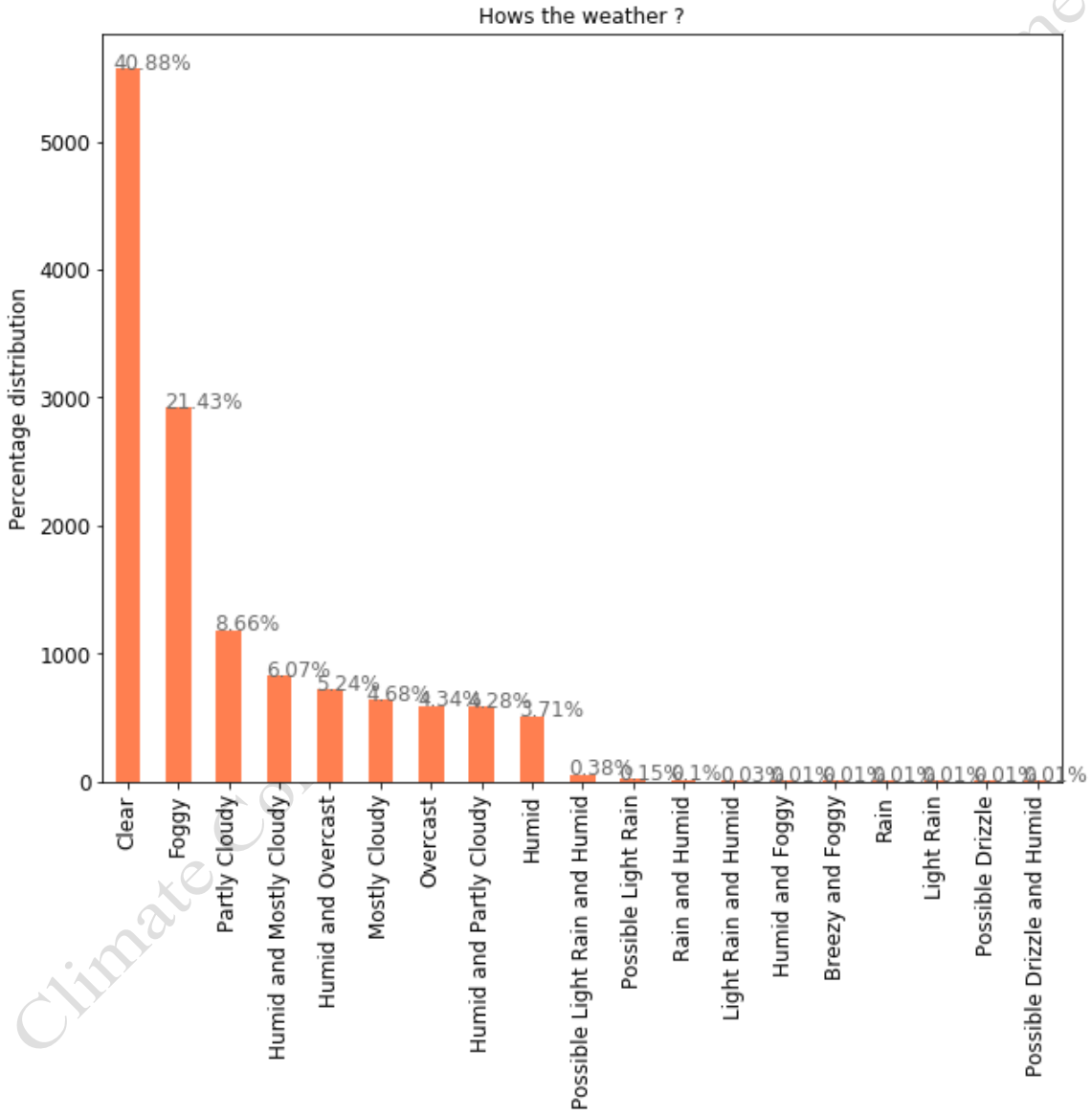
Feature Engineering & Data processing:

The data provides wide range of data information, its difficult to find easy way of information to understand the data, to solve this issue we create feature variable base on current data to clarify in easy way of process.

The first variable we create is session base on the month information which separates data into different segment which clarify the information wisely. Creating new feature Season on the base of month data, this feature helps to specify weather season, as it not mention location, we consider our location as India. so, we implement Indian season methods the second feature variable is the sunlight time in minutes to represent the time of sunlight to generates energy. Creating feature, the difference of sunset time and sunrise time, we get the duration of sunlight in minutes.



The use recorded weather observations as key predictors. In the case of using current weather as predictors, an implied hypothesis is that future generation are related to the current weather. When the time span of recorded weather observations is expanded, time-series analysis approaches are adopted. This process has shown significant predictability.



As the data processing part, we must deal with data missing part. There are several variables have more then 70% data is missing, its work on the data to work on the actual modelling part by implementing several methods to fill this gap. On the find the relationship between various variable by visualisation of charts, by representation of data to find the hidden insights & pattern of data which helps to solve the problem.

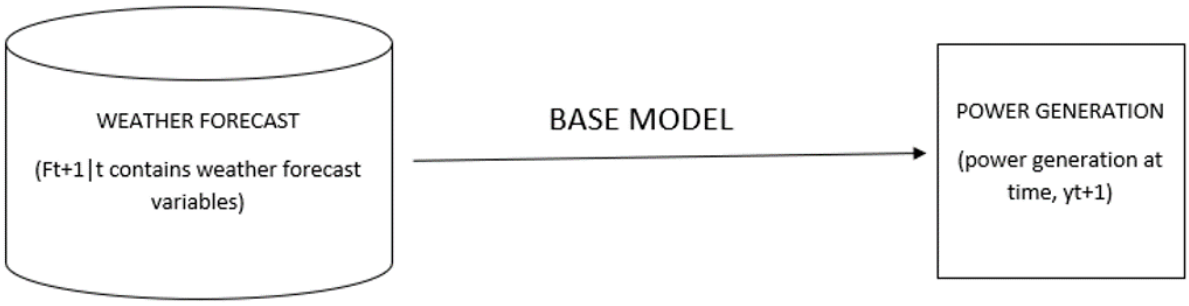
The pre-processing task prepared the data into the structure suitable for quantitative modelling. Categorical variables in the weather forecasts, such as Rainfall Type, Sky Type, and Wind Direction, were converted to multiple binary variables through dummy variables

Machine Learning Modelling

In the project, we aimed to build a model that predicts solar power generation one day ahead of the actual operation. The base model identified the best function which the predictors were limited to the weather forecast variables. In the model making we use two approach first is base model, which use on the weather forecast data to predict power generation.

first built a base model that uses weather forecasts to predict solar power generation.

Base Model

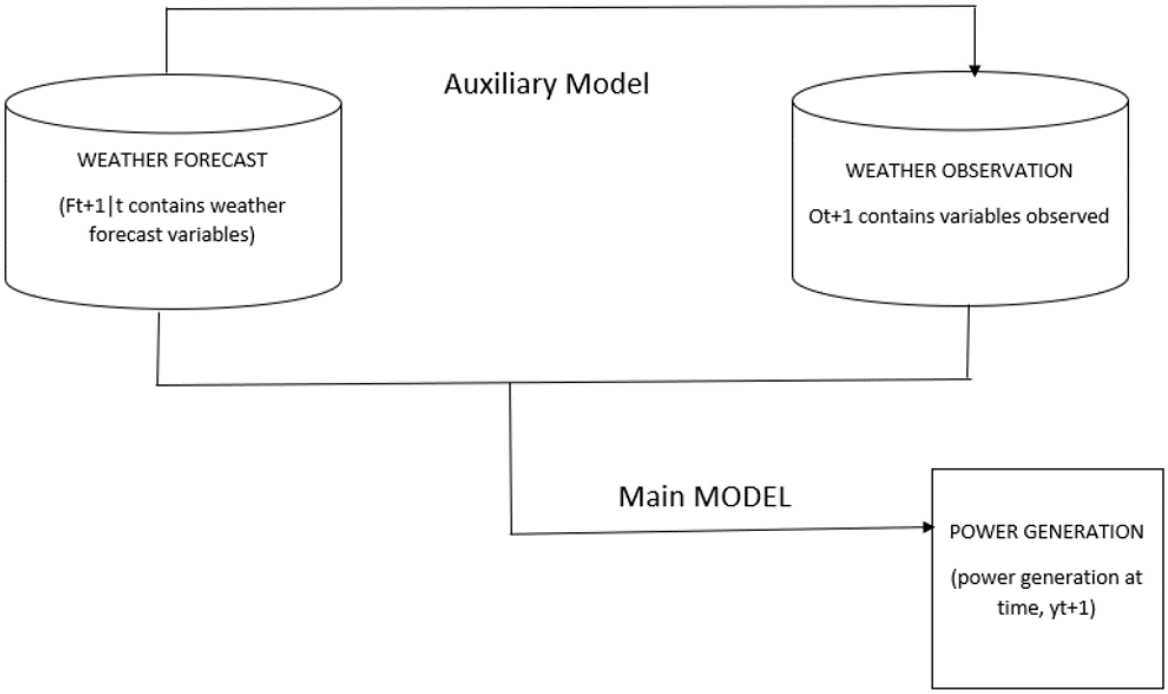


In the language of statistical learning, the base model aims to identify a regression function that relates the weather forecast variables and the solar power generation. The main model additionally incorporates the identified relationship between the weather forecast variables and the auxiliary variables into the process of training another function.

Auxiliary Model

The focus was then moved to the existence of a set of the variables, which we call auxiliary variables, an auxiliary model identifies the relationship between weather forecast variables and the auxiliary variables the main model for solar power uses both weather forecast variables and the auxiliary variables generated by the auxiliary model.

We work on auxiliary model by combining weather forecast variables and weather observation variables



Result of model

R^2 Training Score: 0.9144819248009768

R^2 Validation Score: 0.48247716922550854