California Wildfire Predictor

By Aanvi Goel

Overview

- In 2021 there were 5267 wildfires started across the state of California, burning 204,921 acres of land, displacing locals from their homes, causing property destruction, poor air quality and other consequences

- Predicting the size of wildfire would help the fire departments and the Forest Services in deploying appropriate resources right at the time of fire discovery, leading to quicker containment times and reduced environmental and infrastructural damage

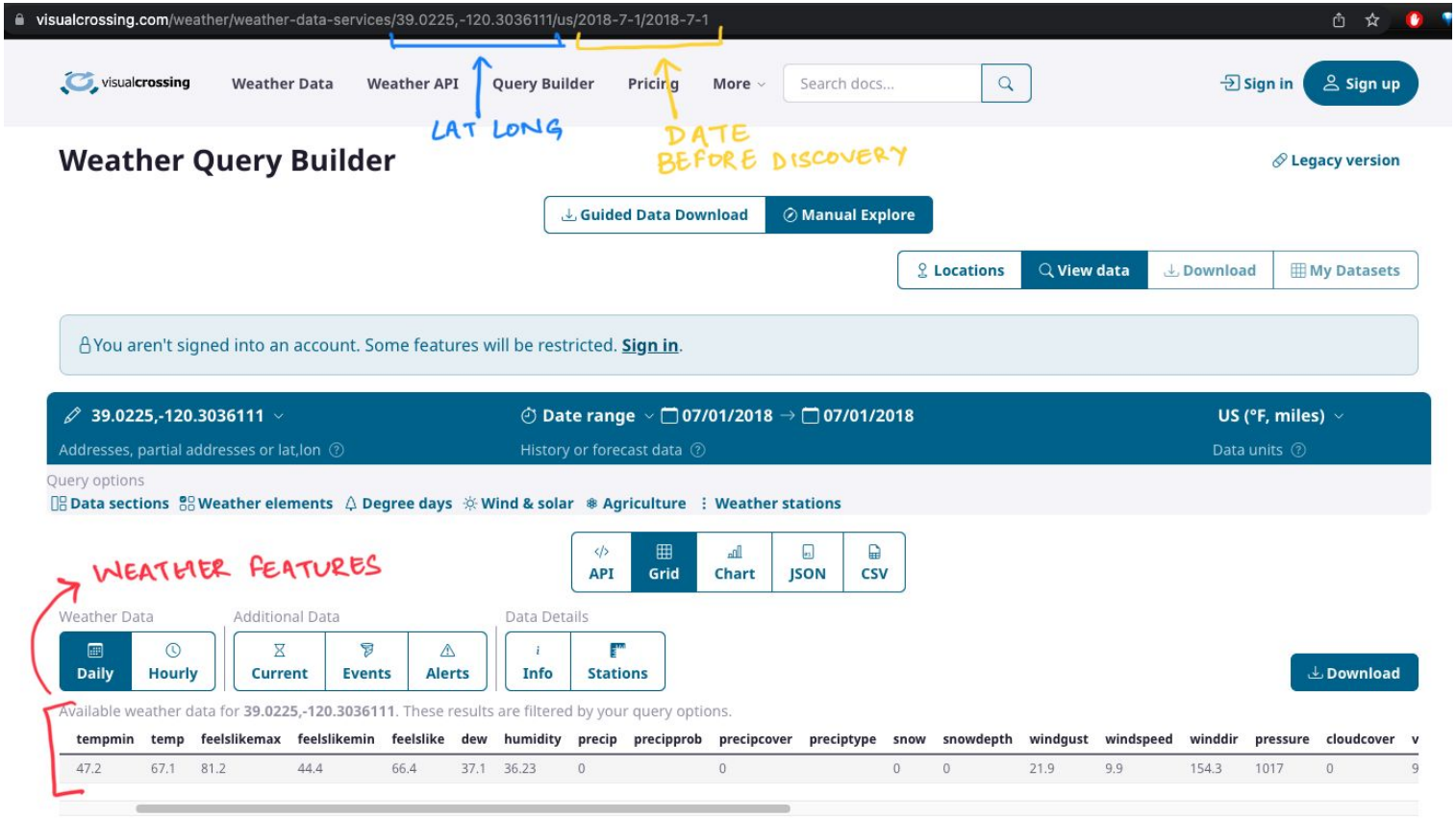
Project Objective:

Build a Linear Regression model to predict the size of wildfire for occurrences in the state of California based on weather conditions, location and cause factors

1. Methodology

- ➔ Web Scraping and Data Collection
- ➔ EDA and Feature Engineering
- ➔ Building a Baseline Model
- ➔ Applying Transformations
- ➔ Scaling Features and Reducing Model Complexity
- ➔ Regularization
- ➔ Finalize Model and Test

– Web Scraping



– Final Combined Data

Fire Occurrence + Corresponding Weather Data

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 3657 entries, 0 to 3811
Data columns (total 19 columns):
 #   Column                     Non-Null Count  Dtype
---  ------                     --------------  -----
 0   DISCOVERY_DATE             3657 non-null   object
 1   NWCG_CAUSE_CLASSIFICATION  3657 non-null   object
 2   CONT_DATE                  3657 non-null   object
 3   FIRE_SIZE                  3657 non-null   float64
 4   LATITUDE                   3657 non-null   float64
 5   LONGITUDE                  3657 non-null   float64
 6   LAT_LONG                   3657 non-null   object
 7   WEATHER_DATE               3657 non-null   object
 8   TEMP_MAX                   3657 non-null   float64
 9   TEMP_MIN                   3657 non-null   float64
 10  TEMP_AVG                   3657 non-null   float64
 11  DEW                        3657 non-null   float64
 12  HUMIDITY                   3657 non-null   float64
 13  PRECIP                     3657 non-null   float64
 14  WIND_SPEED                 3657 non-null   float64
 15  WIND_DIR                   3657 non-null   float64
 16  SEA_LEVEL_PRESSURE         3657 non-null   float64
 17  CLOUD_COVER                3657 non-null   float64
 18  VISIBILITY                 3657 non-null   float64
dtypes: float64(14), object(5)
memory usage: 571.4+ KB
```

– Baseline Model

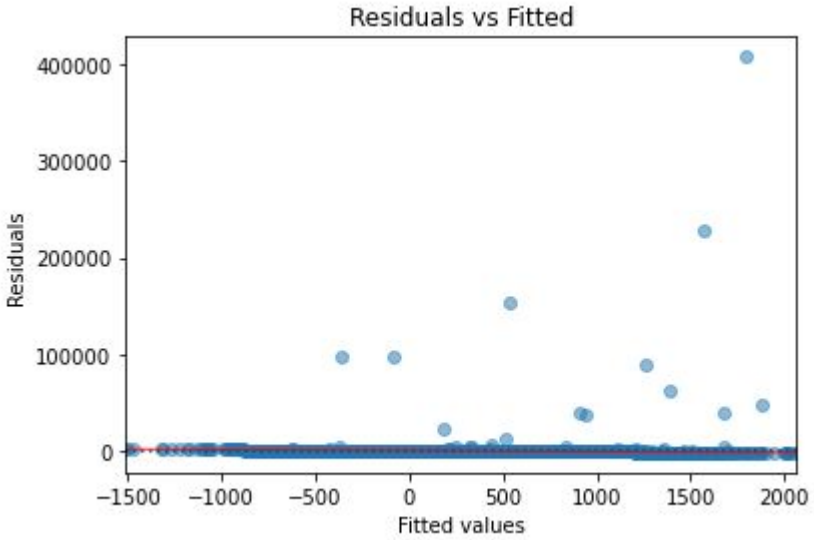
Dep. Variable:	FIRE_SIZE	**R-squared:**	0.004
Model:	OLS	**Adj. R-squared:**	-0.000
Method:	Least Squares	**F-statistic:**	0.9907
Date:	Tue, 09 Aug 2022	**Prob (F-statistic):**	0.460
Time:	19:23:29	**Log-Likelihood:**	-38395.
No. Observations:	3657	**AIC:**	7.682e+04
Df Residuals:	3642	**BIC:**	7.691e+04
Df Model:	14		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-3.029e+04	4.45e+04	-0.681	0.496	-1.17e+05	5.69e+04
LATITUDE	-152.8464	146.685	-1.042	0.297	-440.440	134.747
LONGITUDE	-362.1123	175.902	-2.059	0.040	-706.988	-17.237
TEMP_MAX	29.7761	61.357	0.485	0.627	-90.521	150.073
TEMP_MIN	-18.5941	61.980	-0.300	0.764	-140.113	102.925
TEMP_AVG	17.8475	118.482	0.151	0.880	-214.451	250.146
DEW	-13.1248	56.464	-0.232	0.816	-123.829	97.579
HUMIDITY	-3.8237	37.098	-0.103	0.918	-76.558	68.910
PRECIP	428.6397	2456.670	0.174	0.861	-4387.946	5245.226
WIND_SPEED	-13.4792	37.380	-0.361	0.718	-86.767	59.808
WIND_DIR	-1.8674	2.620	-0.713	0.476	-7.005	3.270
SEA_LEVEL_PRESSURE	-7.8254	41.228	-0.190	0.849	-88.657	73.006
CLOUD_COVER	2.1035	9.296	0.226	0.821	-16.123	20.330
VISIBILITY	-32.2027	132.957	-0.242	0.809	-292.880	228.475
CAUSE	-227.6666	557.723	-0.408	0.683	-1321.147	865.814

For 80/20 test and validation data split:

Train score: 0.0066973648088055615
Val score: -0.0022044748479403964

Overfit Model



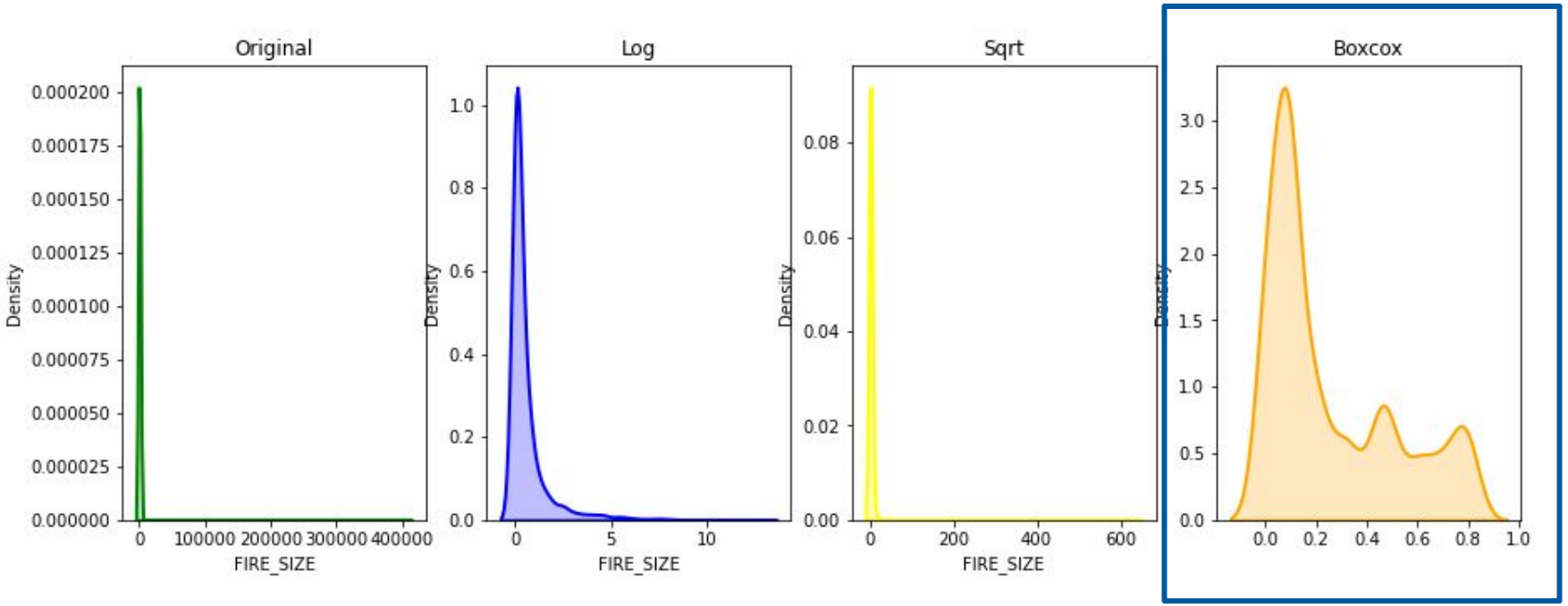
Observations:

1. Residuals are unbalanced along the Y-axis -> The data is not normally distributed

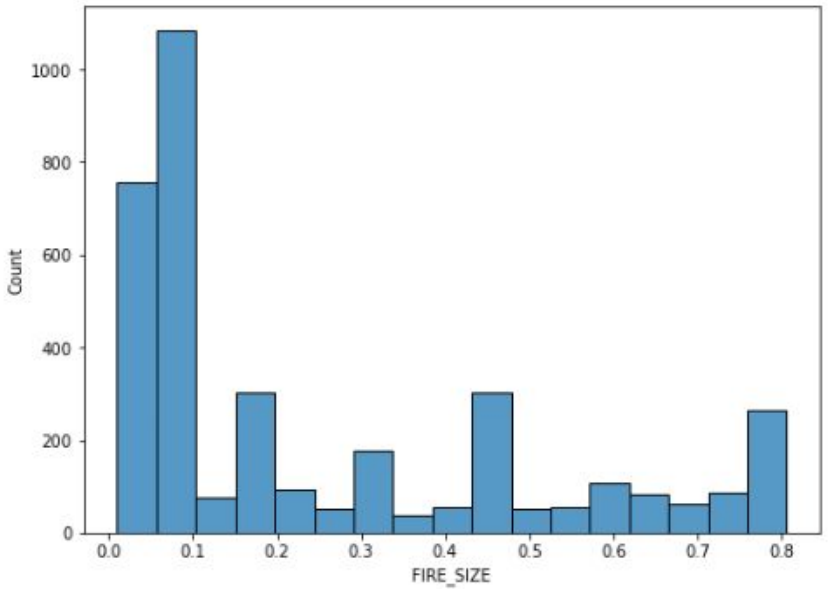
2. Target (y) is heavily right skewed -> Fire size values have outliers beyond the std deviation

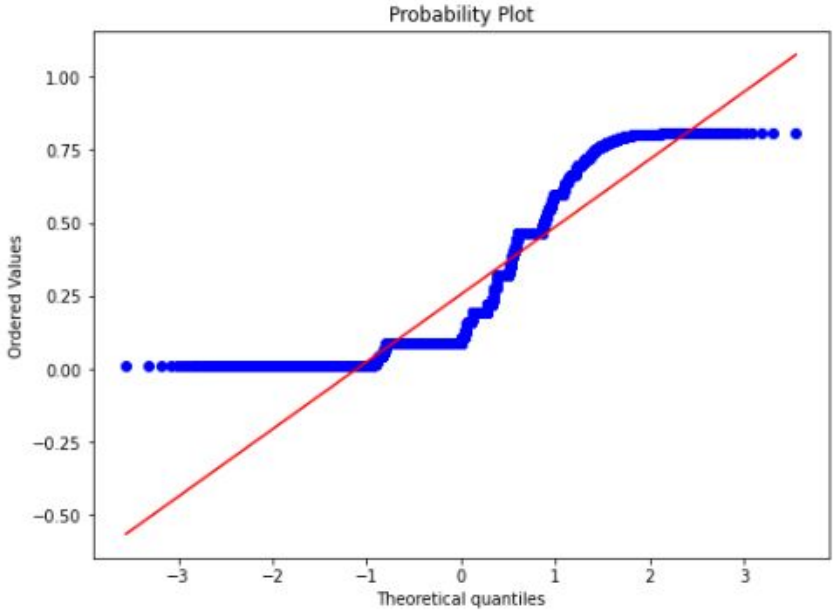
	FIRE_SIZE	LATITUDE	LONGITUDE	TEMP_MAX	TEMP_MIN	TEMP_AVG	DEW	HUMIDITY	PRECIP	WIND_SPEED	WIND_DIR
skew	35.204903	-0.190024	0.43162	-0.298382	-0.251725	-0.160159	-1.206296	0.314177	12.194452	0.856114	-0.012204

Applying Transformation to Y



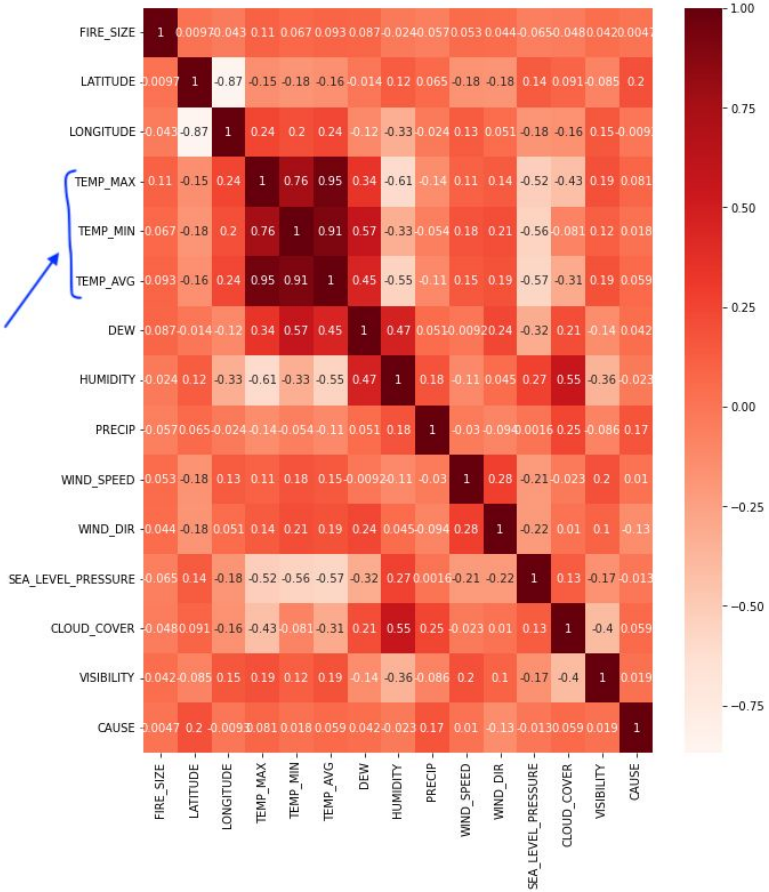
Skew: 0.914





Y data is still not ideal. Fire Size distribution has LIGHT TAIL

– Handling MultiCollinearity



– Scaling the Data

	Model	Train_Score	Val_Score	Test_Score
1	Baseline Model	0.006697	-0.002204	-
2	Y Transformed Model	0.026182	0.042815	-
3	Simplified Model	0.024159	0.029803	-
4	Scaled Model	0.029192	0.014666	0.0257

– Regularization

	Model	Test_Score
1	Lasso Model	0.026562
2	Ridge Model	0.025944
3	Elastic Net Model	0.026485
4	Polynomial + Lasso Model	0.03436
5	Polynomial + Ridge Model	0.038441
6	Polynomial + Elastic Net Model	0.032941

– Final Model

Evaluating Performance of Final Model:

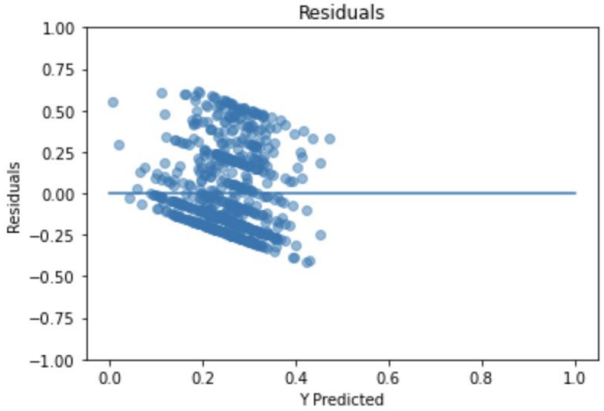
R2 score: 0.04

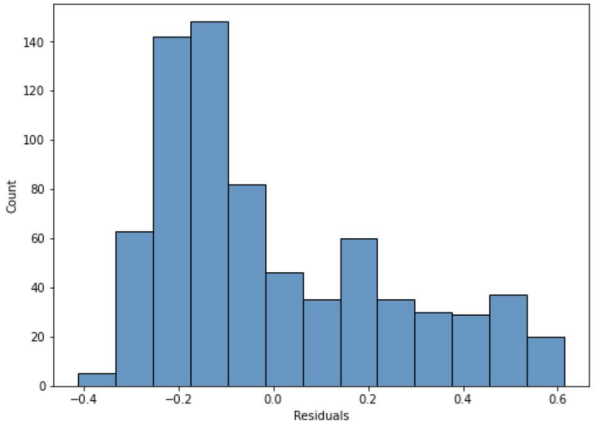
Mean absolute error: 0.21
Mean squared error: 0.06
Root mean squared error: 0.24

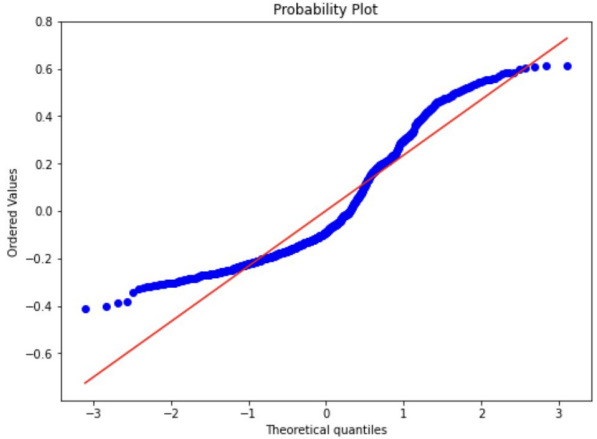
Comparing R2 Scores:

Baseline model R2 score: 0.007 → **Final model R2 score:** 0.04

There is still scope for improvement!







Future Improvements

Getting average weather data across multiple days

Get data points across different years

Combine Fire data points from same date and neighbourhood