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GPS TRAJECTORY

PROBLEM STATEMENT:

Aim of this project is to statistically analyse the given go_track dataset of GPS Trajectory. In this project we predicted the rating of traffic using features like average speed, time, distance.

ATTRIBUTE INFORMATION:

(1) go_track_tracks.csv: a list of trajectories

id_android - it represents the device used to capture the instance;
speed - it represents the average speed (Km/H)
distance - it represent the total distance (Km)
rating - it is an evaluation parameter. Evaluating the traffic is a way to verify the volunteers perception about the traffic during the travel, in other words. If volunteers move to some place and face traffic jams , maybe they will evaluate 'bad'. (3- good, 2- normal, 1-bad).
rating_bus - it is other evaluation parameter. (1 - The amount of people inside the bus is little, 2 - The bus is not crowded, 3- The bus is crowded.)
rating_weather - it is another evaluation parameter. (2- sunny, 1- raining).
car_or_bus - (1 - car, 2-bus)
linha - information about the bus that does the pathway

(2) go_track_trackspoints.csv: localization points of each trajectory

id: unique key to identify each point
latitude: latitude from where the point is

longitude: longitude from where the point is
track_id: identify the trajectory which the point belong
time: datetime when the point was collected (GMT-3)

TASKS PERFORMED:

- Loading dataset .
- Null values check .
- Duplicates checking.
- Outliers checking.
- Normality checking .
- Apply ordinal regression model.
- Feature selection.
- Other models for accuracy check

    1. Apply logistic regression model.
    2. Apply Random Forest Classifier.
    3. Apply Randomized Search CV.

ANALYSIS:

- Dataset contains 2 files(go_track__tracks.csv,go_track_trackpoints.csv).
- Second file contains information about trackid,latitude,longitude.

PROCEDURE:

LOADING DATA SET:

	id	id_android	speed	time	distance	rating	rating_bus	rating_weather	car_or_bus	linha
0	1	0	19.210586	0.138049	2.652	3	0	0	1	NaN
1	2	0	30.848229	0.171485	5.290	3	0	0	1	NaN
2	3	1	13.560101	0.067699	0.918	3	0	0	2	NaN
3	4	1	19.766679	0.389544	7.700	3	0	0	2	NaN
4	8	0	25.807401	0.154801	3.995	2	0	0	1	NaN

NULL VALUES CHECK:

Linha column is removed as it has 80% null values.

SUMMARY OF DATA:

	id	id_android	speed	time	distance	rating	rating_bus	rating_weather	car_or_bus
count	163.000000	163.000000	163.000000	163.000000	163.000000	163.000000	163.000000	163.000000	163.000000
mean	15607.650307	7.386503	16.704738	0.264272	5.302411	2.515337	0.386503	0.515337	1.466258
std	18644.257138	7.348742	16.016168	0.292731	7.639011	0.679105	0.687859	0.841485	0.500397
min	1.000000	0.000000	0.009779	0.002175	0.001000	1.000000	0.000000	0.000000	1.000000
25%	48.500000	1.000000	1.591016	0.035978	0.034500	2.000000	0.000000	0.000000	1.000000
50%	158.000000	4.000000	16.685368	0.214466	3.995000	3.000000	0.000000	0.000000	1.000000
75%	37991.000000	10.000000	23.915760	0.390572	7.333000	3.000000	1.000000	1.000000	2.000000
max	38092.000000	27.000000	96.206029	1.942948	55.770000	3.000000	3.000000	2.000000	2.000000

- Speed,distance,time are Continuous variables
- Rating_bus,rating are ordinal
- Rating_weather,car_or_bus are categorical
-

So,categorical is converted using get_dummies of pandas.

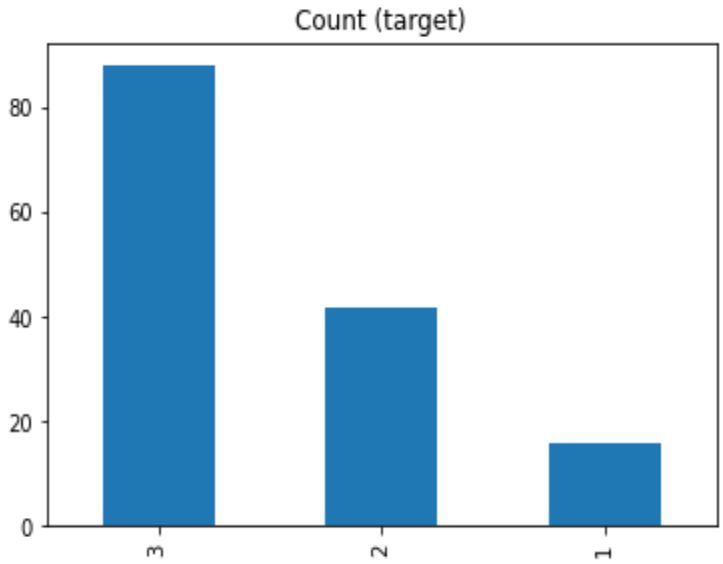
The dataset now becomes:

	speed	time	distance	rating	rating_bus	rating_weather_0	rating_weather_1	rating_weather_2	car_or_bus_1	car_or_bus_2
0	19.210586	0.138049	2.652	3	0	1	0	0	1	0
1	30.848229	0.171485	5.290	3	0	1	0	0	1	0
2	13.560101	0.067699	0.918	3	0	1	0	0	0	1
3	19.766679	0.389544	7.700	3	0	1	0	0	0	1
4	25.807401	0.154801	3.995	2	0	1	0	0	1	0

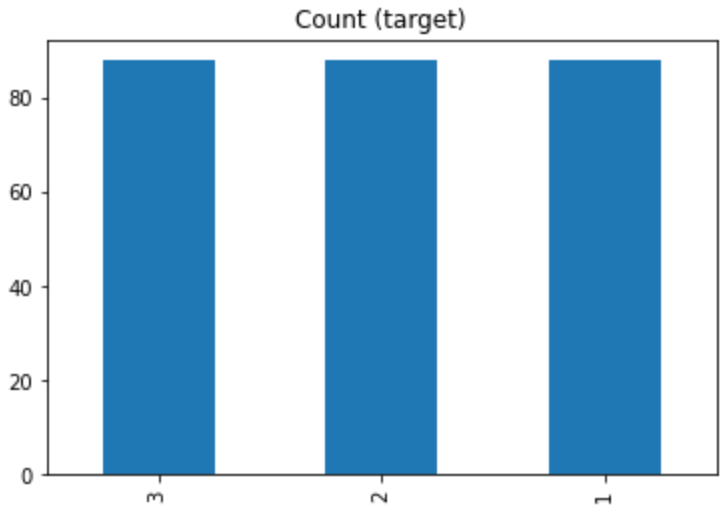
- Speed,distance,time,rating_bus,rating_weather_0,rating_weather_1,rating_weather_2,

car_or_bus_1,car_or_bus_2 are **Independent variables**

- Rating is **Dependent variable**
- **Drop duplicates**: Dataset contains duplicates .This is removed using pandas.drop_duplicates() function.
- **Imbalanced dataset**: The target variables is imbalanced,That is less number of rating1 compared to other 2 as shown



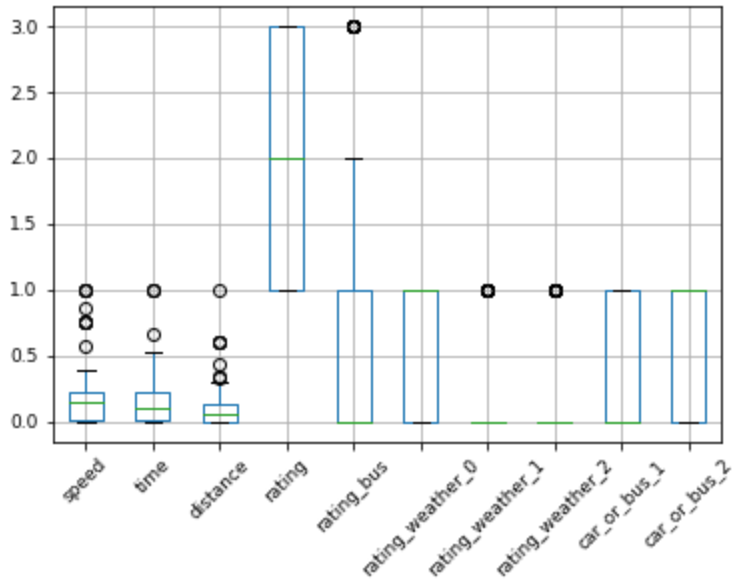
This problem is solved by oversampling the dataset using an imbalanced library of python .



OUTLIERS CHECKING:

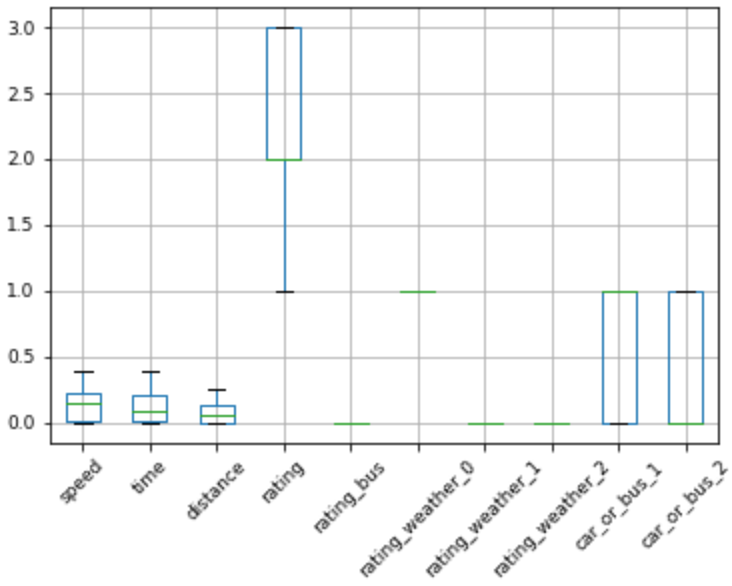
Outliers are extreme values that deviate from the other observations in the dataset.By checking and removing them we can have more accurate data.

We can observe outliers by plotting the boxplot as below:



The outliers are removed by finding IQR range(interquartile range) and removing points that are not in the IQR range
Where IQR=Q3-Q1

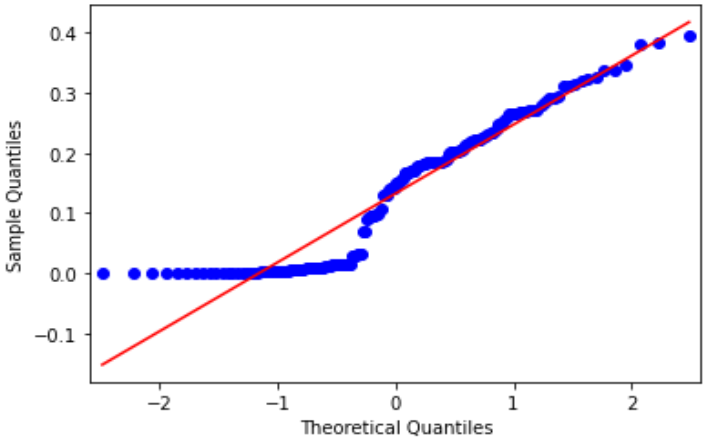
The boxplot is as follows now:



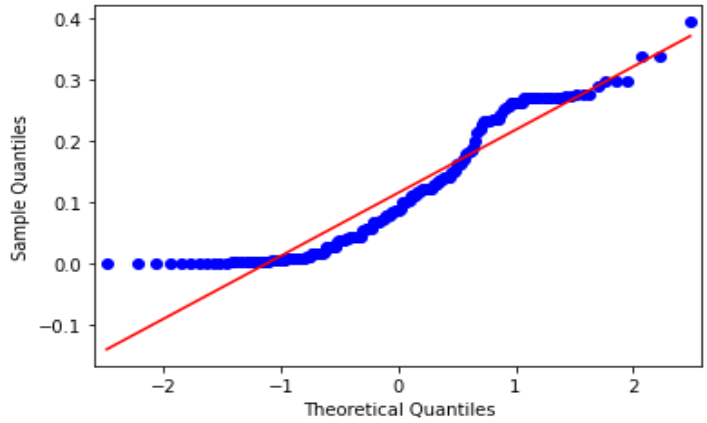
NORMALITY CHECKING:

To determine whether sample data has been drawn from a normally distributed population or not.

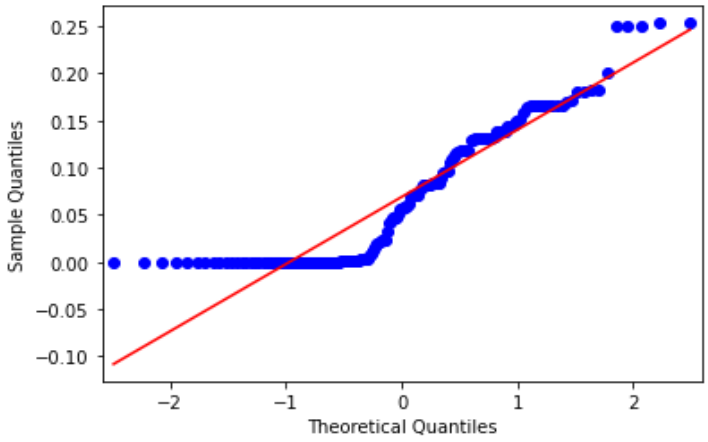
Q-Q Plots for speed:



Q-Q Plots for time:



Q-Q Plots for distance:



From above graphs we can see that these are not linear.But ordinal regression doesn't require data to be normally distributed.

APPLYING ORDINAL REGRESSION MODEL:

To identify the strength of the effect that the independent variables have on a dependent variable and to predict trends and future values this is done.

Ordinal Regression:

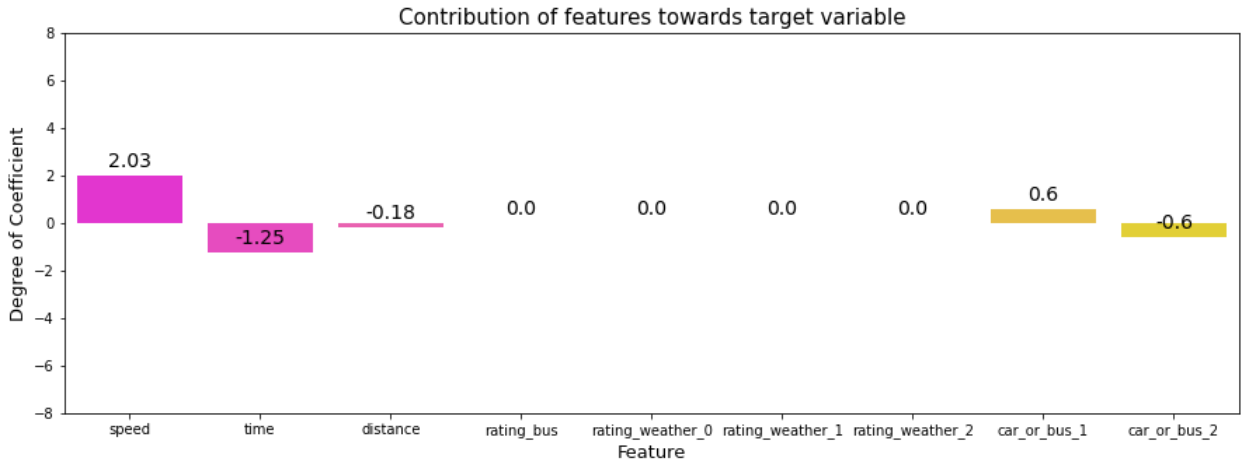
Ordinal regression is a statistical technique that is used to predict the behaviour of ordinal level Dependent variables with a set of independent variables.Ordinal regression can be performed using a generalized linear model(GLM) that fits both a coefficient vector and a set of thresholds to a dataset.

Since rating here is ordinal ,the ordinal regression is done using mord ligisticat function in python. Results are as follows:

Goodness of fit :measured in terms of accuracy -0.41935483870967744

Coefficients: [2.13960580e+00 -1.02190818e+00 -1.37202194e-02 0.00000000e+00 -1.43958306e-06 0.00000000e+00 0.00000000e+00 4.81319826e-01 -4.81321265e-01]

Confusion matrix:
[[0 0 0]
[6 12 12]
[0 0 1]]



FEATURE SELECTION:

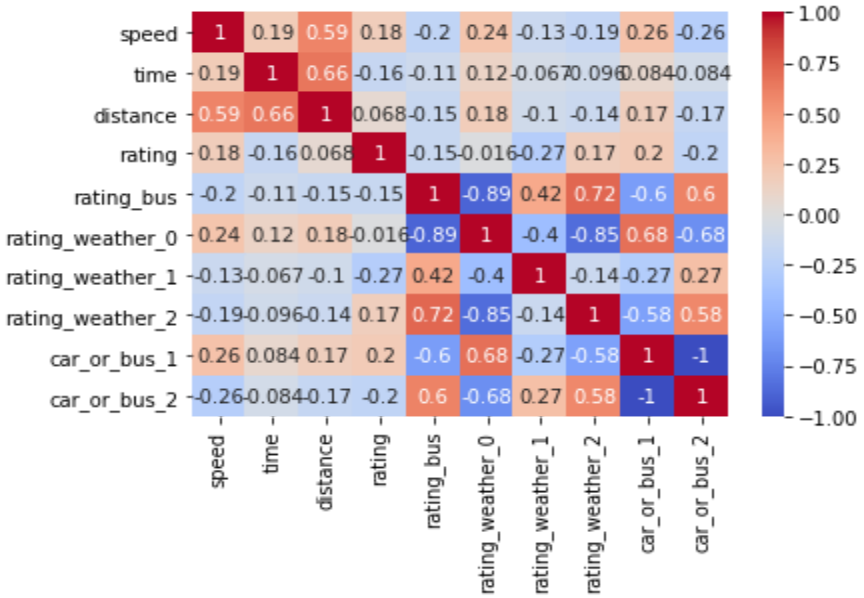
This is done to construct the models in a simple way and to make interpretation simpler.

- From the above results,we see the coefficients of rating_bus,rating_weather_1,rating_weather_2 are zeros.
- We used inbuilt recursive feature elimination from sklearn which gives the results if the features are to selected or not.
- Selected features:[True True True False False False False True]
- Order is speed,time,distance,rating_bus,rating_weather_0,rating_weather_1,rating_wrather_2,car_or_bus_ 1,car_or_bus_2.
- So from above results we can remove rating_bus,rating_weather_0,rating_weather_1,rating_wrather_2

Note:logistic regression does not require a linear relationship between the dependent and independent variables. Second, the error terms (residuals) do not need to be normally distributed. Third, homoscedasticity is not required.

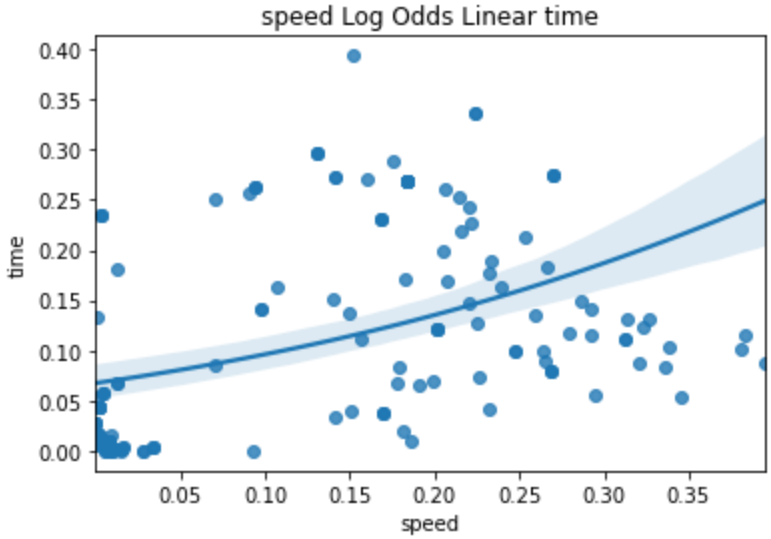
1. ordinal logistic regression requires the dependent variable to be ordinal. This is satisfied since rating is ordinal data.
2. It requires there to be little or no multicollinearity among the independent variables. This means that the independent variables should not be too highly correlated with each other.

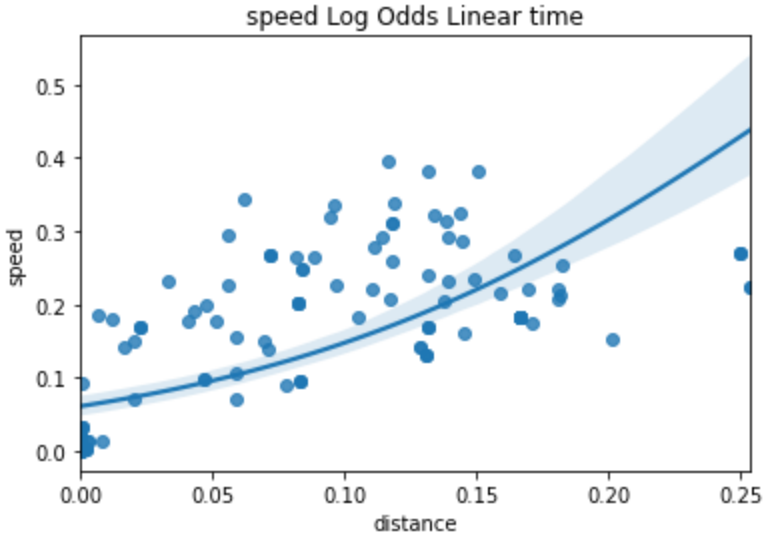
Correlation plot:

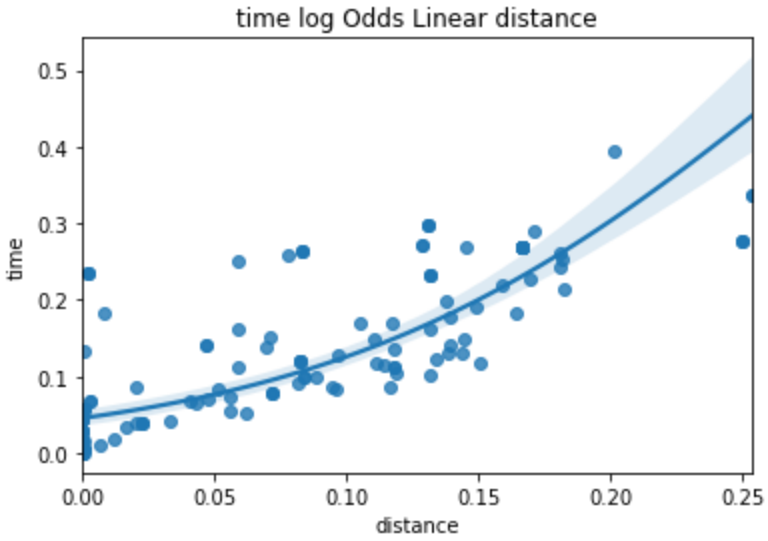


From the above correlation,we can see that car_or_bus_1,car_or_bus_2 are highly correlated.So remove car_or_bus_1.

3. It assumes linearity of continuous independent variables and log odds. although this analysis does not require the dependent and independent variables to be related linearly, it requires that the independent variables are linearly related to the log odds. That is by plotting log linear graphs if we observe some curve(S shape) this satisfies the assumption.


speed Log Odds Linear time
time
speed
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35


speed Log Odds Linear time
speed
distance
0.5
0.4
0.3
0.2
0.1
0.0
0.00
0.05
0.10
0.15
0.20
0.25



So,from above graphs we can see that logodd test is satisfied.So, we can say that after test of assumptions and feature selection we can remove rating_bus,rating_weather_1,rating_weather_2 ,car_or_bus_

1.Results using ordinal regression are:

Accuracy:0.44

Coefficients:[2.06133899e+00 -1.21864298e+00 -1.57543593e-01 1.51312682e-06 -1.12726270e+00]

Confusion matrix:[[0 0 0] [6 12 12] [0 0 1]]
We can see that even after doing a test of assumptions we found that accuracy is very less.
So applied different models like LogisticRegression CV,Random Forest classifier.

OTHER METHODS FOR ACCURACY CHECK:

1.Results using logistic regression CV are:

Accuracy:0.6580645161290323

Coefficients:
[[-5.52822551e+00 3.50113465e+00 3.17647802e+00 0.00000000e+00 6.16715464e-04 0.00000000e+00 0.00000000e+00 -5.08959471e-01 5.09576187e-01]
[-2.09515539e+00 9.53578685e-02 -1.04287583e+00 0.00000000e+00 -3.86861143e-03

0.00000000e+00 0.00000000e+00 -2.26950331e-02 1.88264216e-02]
 [7.62338090e+00 -3.59649252e+00 -2.13360218e+00 0.00000000e+00 3.25189597e-03
0.00000000e+00 0.00000000e+00 5.31654504e-01 -5.28402608e-01]]

Intercepts:
 [-0.59932287 1.14069747 -0.54137459]

2.Again performing feature selection and removing features having coefficient 0.The results we get using logistic regression CV are as follows:

Accuracy:0.6580645161290323

Coefficients:
[[-5.53074622e+00 3.49323103e+00 3.17347507e+00 5.11084927e-03 1.01217584e+00]
[-2.09559423e+00 9.71864392e-02 -1.04234458e+00 -6.62311676e-06 4.17469559e-02]
[7.62634046e+00 -3.59041747e+00 -2.13113049e+00 -5.10422615e-03 -1.05392279e+00]]

Intercepts:[-1.1085018 1.11311259 -0.00461079]

3.Results using random forest classifier:

Accuracy:0.8064516129032258

Coefficients:[0.36447909 0.24805381 0.24221074 0. 0. 0. 0. 0.08956213 0.05569424]

4.Performing feature selection and again applying randomized search cv, the results are as follows:

Accuracy:0.9032258064516129

confusion matrix:
[[9 0 0]
 [0 14 2]
 [0 1 5]]

We got better results.(90% accuracy) by using randomized search CV

SUMMARY:

From the above results, we can see that randomizedsearchcv performs best for this dataset.

Model Accuracy	Accuracy
Ordinal Regression	44%
Logistic RegressionCV	65.8%
RandomForest	80.6%
Randomised search CV	90%