

The first step of our EDA is exploring the shape of our data (6819, 96). We followed up by looking at all the 96 columns of data and checking for missing values. There are none. We then isolated the columns with two or fewer unique values, which were 'Bankrupt?', 'Liability-Assets Flag,' and 'Net Income Flag.' We determined that 'Bankrupt?' would be the dependent variable for our models. From the data, we calculated only 3.3% of companies were bankrupted, which shows an imbalance in the response variable. We observed 220 cases of bankruptcy (1) and 6,599 cases of non-bankruptcy (0), making it a relatively rare occurrence. We removed 'Net Income Flag' because it was uniform (every value was 1) and didn't provide any predictive value. We also removed 'Liability -Assets Flag' because only eight rows had values of 1 (the rest had 0), so it also would not provide a good predictive value for our models.

Our data preparation continued with additional feature selection. However prior to performing feature selection, we removed features that were showing collinearity from the dataset by calculating the VIF for each feature and removing any with a VIF value greater than 5. After dropping these features, we were left with 64 columns. Then we used SelectKBest from sklearn on these 64 features for our feature selection, selecting the 10 dependent variables the model determined to be the best predictors of the 'Bankrupt?' variable. These were ROA(C) before interest and depreciation before interest, Tax rate (A), Net Value Per Share (B), Operating Profit Per Share (Yuan ¥), Net worth/Assets, Retained Earnings to Total Assets, Total expense/Assets, Equity to Long-term Liability, Current Liability to Current Assets and Net Income to Stockholder's Equity.

Next, we used an isolation forest to remove 5% of the anomalies within the dataset using IsolationForest from sklearn. The isolation forest looked for anomalies across all potential independent (predictor) variables. After removing 5% of the rows with anomalies, the shape of our dataframe shrunk (6,478, 10). We split the remaining data into two sets: training (80%; 5,182 values) and testing (20%; 1,296 values). We followed by scaling the independent

variables for both datasets using StandardScaler from sklearn. Finally, we used SMOTE (Synthetic Minority Over-Sampling Technique) from imblearn to create an unbalanced number of 'Bankrupt?' rows in our training data. Oversampling from our training data allows us to better train our model for rare events, such as bankruptcy.

Using the k-fold cross-validation method, we built three machine learning models to test our dataset. We found that the naïve Bayes model best classified our testing value with an F1 score of 0.28. Our logistic regression model did similarly well classifying our testing data and received a marginally lower F1 score of 0.26. Both models also performed closely during their goodness of fit tests, receiving TPR (Recall) values of 0.82 and 0.80, FPR values of 0.13 and 0.14, precision values of 0.17 and 0.16, and accuracy values of 0.87 and 0.86. In comparison, our SVM had an F1 score of 0.11 after hyperparameter tuning, making it our worst performing model. It performed similarly to the previous two models on the goodness of fit tests with the exception of recall, where it got a score of 0.08. Hyperparameter tuning consists of using GridSearchCV to find the best hyperparameters for our model, which end up being  $C=10$  and  $\gamma=1$ . Accuracy for all three models ranged from 0.86 to 0.96; however, we expect high accuracy as most of the predicted values will be 0 (no bankruptcy). To see the complete results for each model, see our appendix.

We believe our models are overfitting the training data. We believe overfitting is plaguing our models because of the large drop in the goodness of fit tests between our training and testing sets. We tried to address this in several ways, including implementing SMOTE, stratifying our sample selection to account for representative portions of bankrupt properties, and k-folds. These changes only marginally improved our F scores, though we kept them where they made sense. Additional areas for exploration include the impact of isolation forests on the data (perhaps only removing non-bankrupt anomalies) and alternative methods of scaling and data selection.

## Appendix:

	Model	TPR	FPR	precision	recall	accuracy	f1-value
0	SVM	[0.99, 0.08]	[0.92, 0.01]	[0.97, 0.18]	[0.99, 0.08]	[0.96, 0.96]	0.11
1	Logistic Regression	[0.86, 0.8]	[0.2, 0.14]	[0.99, 0.16]	[0.86, 0.8]	[0.86, 0.86]	0.26
2	naive bayes	[0.87, 0.82]	[0.18, 0.13]	[0.99, 0.17]	[0.87, 0.82]	[0.87, 0.87]	0.28

# Intro

## Links

[https://canvas.northwestern.edu/courses/167719/assignments/1078603?module\\_item\\_id=2319248](https://canvas.northwestern.edu/courses/167719/assignments/1078603?module_item_id=2319248)

<https://www.kaggle.com/datasets/fedesoriano/company-bankruptcy-prediction>

## Modules

```
In [1]: #For data manipulation and visualization
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np
from numpy import array
from numpy import arange

#For Isolation Forest from sklearn
from sklearn.ensemble import IsolationForest
from enum import auto

#From sklearn (SVM, Logistic, Bayes)
from sklearn.svm import SVC
from sklearn import svm

from sklearn.linear_model import LogisticRegression
from sklearn.linear_model import ElasticNet
from sklearn.linear_model import ElasticNetCV

from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import RepeatedKFold
from sklearn.model_selection import train_test_split
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score

from sklearn.feature_selection import SelectKBest
from sklearn.feature_selection import f_classif

from sklearn.preprocessing import MinMaxScaler, StandardScaler

from sklearn.naive_bayes import GaussianNB

from sklearn import metrics

from sklearn.metrics import f1_score, classification_report, confusion_matrix
from sklearn.metrics import roc_curve, auc, roc_auc_score
from sklearn.metrics import PrecisionRecallDisplay
from sklearn.metrics import precision_score, recall_score, precision_recall_curve
from sklearn.metrics import mean_squared_error

#Other
from math import sqrt
```

# Import Files

```
In [2]: #Import data.csv from the Kaggle page linked above
# from google.colab import files
# uploaded = files.upload()
```

```
In [3]: df = pd.read_csv("data.csv")
```

## EDA

### Intro Stats

```
In [4]: df.shape
```

```
Out[4]: (6819, 96)
```

```
In [5]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6819 entries, 0 to 6818
Data columns (total 96 columns):
#   Column                                                                 Non-Null Count  Dtype
---  -
0   Bankrupt?                                                            6819 non-null  int64
1   ROA(C) before interest and depreciation before interest            6819 non-null  float64
2   ROA(A) before interest and % after tax                             6819 non-null  float64
3   ROA(B) before interest and depreciation after tax                  6819 non-null  float64
4   Operating Gross Margin                                              6819 non-null  float64
5   Realized Sales Gross Margin                                         6819 non-null  float64
6   Operating Profit Rate                                               6819 non-null  float64
7   Pre-tax net Interest Rate                                           6819 non-null  float64
8   After-tax net Interest Rate                                         6819 non-null  float64
9   Non-industry income and expenditure/revenue                       6819 non-null  float64
10  Continuous interest rate (after tax)                                6819 non-null  float64
11  Operating Expense Rate                                              6819 non-null  float64
12  Research and development expense rate                              6819 non-null  float64
13  Cash flow rate                                                      6819 non-null  float64
14  Interest-bearing debt interest rate                                 6819 non-null  float64
15  Tax rate (A)                                                         6819 non-null  float64
16  Net Value Per Share (B)                                             6819 non-null  float64
17  Net Value Per Share (A)                                             6819 non-null  float64
18  Net Value Per Share (C)                                             6819 non-null  float64
19  Persistent EPS in the Last Four Seasons                            6819 non-null  float64
20  Cash Flow Per Share                                                 6819 non-null  float64
21  Revenue Per Share (Yuan ¥)                                          6819 non-null  float64
22  Operating Profit Per Share (Yuan ¥)                                 6819 non-null  float64
23  Per Share Net profit before tax (Yuan ¥)                            6819 non-null  float64
24  Realized Sales Gross Profit Growth Rate                            6819 non-null  float64
25  Operating Profit Growth Rate                                        6819 non-null  float64
26  After-tax Net Profit Growth Rate                                    6819 non-null  float64
27  Regular Net Profit Growth Rate                                     6819 non-null  float64
28  Continuous Net Profit Growth Rate                                  6819 non-null  float64
29  Total Asset Growth Rate                                             6819 non-null  float64
30  Net Value Growth Rate                                              6819 non-null  float64
31  Total Asset Return Growth Rate Ratio                              6819 non-null  float64
```

32	Cash Reinvestment %	6819	non-null	float64
33	Current Ratio	6819	non-null	float64
34	Quick Ratio	6819	non-null	float64
35	Interest Expense Ratio	6819	non-null	float64
36	Total debt/Total net worth	6819	non-null	float64
37	Debt ratio %	6819	non-null	float64
38	Net worth/Assets	6819	non-null	float64
39	Long-term fund suitability ratio (A)	6819	non-null	float64
40	Borrowing dependency	6819	non-null	float64
41	Contingent liabilities/Net worth	6819	non-null	float64
42	Operating profit/Paid-in capital	6819	non-null	float64
43	Net profit before tax/Paid-in capital	6819	non-null	float64
44	Inventory and accounts receivable/Net value	6819	non-null	float64
45	Total Asset Turnover	6819	non-null	float64
46	Accounts Receivable Turnover	6819	non-null	float64
47	Average Collection Days	6819	non-null	float64
48	Inventory Turnover Rate (times)	6819	non-null	float64
49	Fixed Assets Turnover Frequency	6819	non-null	float64
50	Net Worth Turnover Rate (times)	6819	non-null	float64
51	Revenue per person	6819	non-null	float64
52	Operating profit per person	6819	non-null	float64
53	Allocation rate per person	6819	non-null	float64
54	Working Capital to Total Assets	6819	non-null	float64
55	Quick Assets/Total Assets	6819	non-null	float64
56	Current Assets/Total Assets	6819	non-null	float64
57	Cash/Total Assets	6819	non-null	float64
58	Quick Assets/Current Liability	6819	non-null	float64
59	Cash/Current Liability	6819	non-null	float64
60	Current Liability to Assets	6819	non-null	float64
61	Operating Funds to Liability	6819	non-null	float64
62	Inventory/Working Capital	6819	non-null	float64
63	Inventory/Current Liability	6819	non-null	float64
64	Current Liabilities/Liability	6819	non-null	float64
65	Working Capital/Equity	6819	non-null	float64
66	Current Liabilities/Equity	6819	non-null	float64
67	Long-term Liability to Current Assets	6819	non-null	float64
68	Retained Earnings to Total Assets	6819	non-null	float64
69	Total income/Total expense	6819	non-null	float64
70	Total expense/Assets	6819	non-null	float64
71	Current Asset Turnover Rate	6819	non-null	float64
72	Quick Asset Turnover Rate	6819	non-null	float64
73	Working capital Turnover Rate	6819	non-null	float64
74	Cash Turnover Rate	6819	non-null	float64
75	Cash Flow to Sales	6819	non-null	float64
76	Fixed Assets to Assets	6819	non-null	float64
77	Current Liability to Liability	6819	non-null	float64
78	Current Liability to Equity	6819	non-null	float64
79	Equity to Long-term Liability	6819	non-null	float64
80	Cash Flow to Total Assets	6819	non-null	float64
81	Cash Flow to Liability	6819	non-null	float64
82	CFO to Assets	6819	non-null	float64
83	Cash Flow to Equity	6819	non-null	float64
84	Current Liability to Current Assets	6819	non-null	float64
85	Liability-Assets Flag	6819	non-null	int64
86	Net Income to Total Assets	6819	non-null	float64
87	Total assets to GNP price	6819	non-null	float64
88	No-credit Interval	6819	non-null	float64
89	Gross Profit to Sales	6819	non-null	float64
90	Net Income to Stockholder's Equity	6819	non-null	float64
91	Liability to Equity	6819	non-null	float64
92	Degree of Financial Leverage (DFL)	6819	non-null	float64
93	Interest Coverage Ratio (Interest expense to EBIT)	6819	non-null	float64
94	Net Income Flag	6819	non-null	int64
95	Equity to Liability	6819	non-null	float64

dtypes: float64(93), int64(3)  
memory usage: 5.0 MB

```
In [6]: # check for missing values
print(df.isna().sum().sum())
print(np.isnan(df).sum().sum())
print(df.isnull().sum().sum())
```

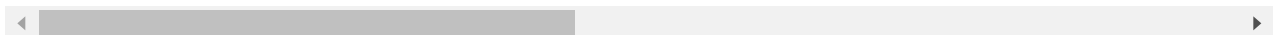
0  
0  
0

```
In [7]: df.head(10)
```

Out[7]:

	Bankrupt?	ROA(C) before interest and depreciation before interest	ROA(A) before interest and % after tax	ROA(B) before interest and depreciation after tax	Operating Gross Margin	Realized Sales Gross Margin	Operating Profit Rate	Pre-tax net Interest Rate	After- tax net Interest Rate
0	1	0.370594	0.424389	0.405750	0.601457	0.601457	0.998969	0.796887	0.808809
1	1	0.464291	0.538214	0.516730	0.610235	0.610235	0.998946	0.797380	0.809301
2	1	0.426071	0.499019	0.472295	0.601450	0.601364	0.998857	0.796403	0.808388
3	1	0.399844	0.451265	0.457733	0.583541	0.583541	0.998700	0.796967	0.808966
4	1	0.465022	0.538432	0.522298	0.598783	0.598783	0.998973	0.797366	0.809304
5	1	0.388680	0.415177	0.419134	0.590171	0.590251	0.998758	0.796903	0.808771
6	0	0.390923	0.445704	0.436158	0.619950	0.619950	0.998993	0.797012	0.808960
7	0	0.508361	0.570922	0.559077	0.601738	0.601717	0.999009	0.797449	0.809362
8	0	0.488519	0.545137	0.543284	0.603612	0.603612	0.998961	0.797414	0.809338
9	0	0.495686	0.550916	0.542963	0.599209	0.599209	0.999001	0.797404	0.809320

10 rows × 96 columns



```
In [8]: # create a for loop to get the categorical columns with 2 or less than 2 unique values
list_1=[]
for i in df.columns:
    x=df[i].value_counts()
    if len(x)<=2:
        list_1.append(i)
    else:
        continue
```

```
In [9]: # categorical variables (value_counts <= 2 )
list_1
```

Out[9]: ['Bankrupt?', ' Liability-Assets Flag', ' Net Income Flag']

## Checking [Bankrupt?]

```
In [10]: df['Bankrupt?'].unique()
```

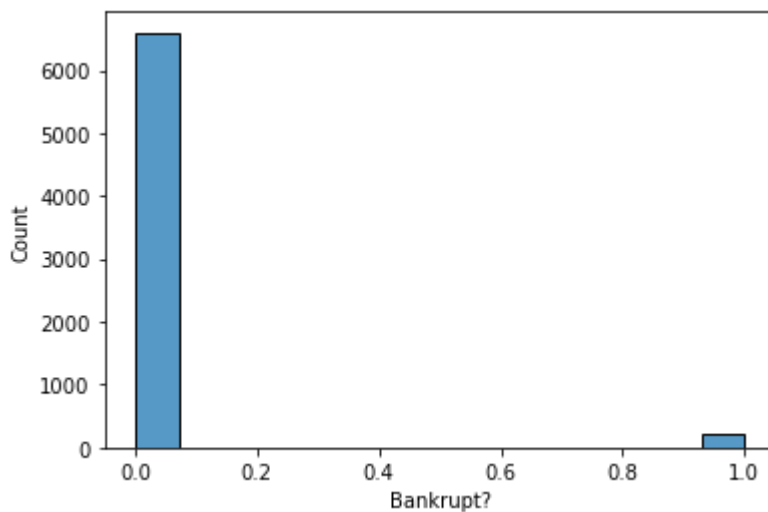
```
Out[10]: array([1, 0], dtype=int64)
```

```
In [11]: df['Bankrupt?'].value_counts()
```

```
Out[11]: 0    6599  
        1     220  
        Name: Bankrupt?, dtype: int64
```

```
In [12]: sns.histplot(x="Bankrupt?", data=df)
```

```
Out[12]: <AxesSubplot:xlabel='Bankrupt?', ylabel='Count'>
```



## Checking [Net Income Flag]

```
In [13]: df[' Net Income Flag'].unique()
```

```
Out[13]: array([1], dtype=int64)
```

```
In [14]: df[' Net Income Flag'].value_counts()
```

```
Out[14]: 1    6819  
        Name: Net Income Flag, dtype: int64
```

Every value is a 1 for this feature, so we can drop this column since it doesn't provide us any predictive value.

## Checking [ Liability-Assets Flag]

```
In [15]: df[' Liability-Assets Flag'].unique()
```

```
Out[15]: array([0, 1], dtype=int64)
```



```
In [16]: df[' Liability-Assets Flag'].value_counts()
```

```
Out[16]: 0    6811
         1      8
         Name: Liability-Assets Flag, dtype: int64
```

This feature may not provide good predictive value to the model since it has a large imbalance between the 0 and 1 classes. Therefore, we can also drop this column.

## Feature Selection

```
In [17]: y = df['Bankrupt?']
```

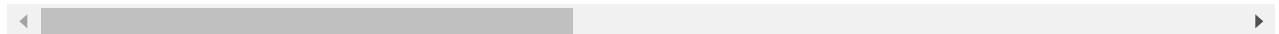
```
In [18]: X = df.drop(columns = ['Bankrupt?', ' Liability-Assets Flag', ' Net Income Flag'])
```

```
In [19]: X.head()
```

```
Out[19]:
```

	ROA(C) before interest and depreciation before interest	ROA(A) before interest and % after tax	ROA(B) before interest and depreciation after tax	Operating Gross Margin	Realized Sales Gross Margin	Operating Profit Rate	Pre-tax net Interest Rate	After- tax net Interest Rate	Nor in expenditur
0	0.370594	0.424389	0.405750	0.601457	0.601457	0.998969	0.796887	0.808809	
1	0.464291	0.538214	0.516730	0.610235	0.610235	0.998946	0.797380	0.809301	
2	0.426071	0.499019	0.472295	0.601450	0.601364	0.998857	0.796403	0.808388	
3	0.399844	0.451265	0.457733	0.583541	0.583541	0.998700	0.796967	0.808966	
4	0.465022	0.538432	0.522298	0.598783	0.598783	0.998973	0.797366	0.809304	

5 rows × 93 columns



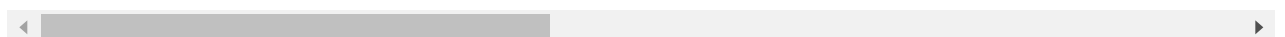
```
In [20]: cor_matrix = X.corr().abs()
         cor_matrix
```

```
Out[20]:
```

	ROA(C) before interest and depreciation before interest	ROA(A) before interest and % after tax	ROA(B) before interest and depreciation after tax	Operating Gross Margin	Realized Sales Gross Margin	Operating Profit Rate	Pre-tax net Interest Rate	After- tax net Interest Rate
--	--	---	---	------------------------------	--------------------------------------	-----------------------------	------------------------------------	---------------------------------------

	ROA(C) before interest and depreciation before interest	ROA(A) before interest and % after tax	ROA(B) before interest and depreciation after tax	Operating Gross Margin	Realized Sales Gross Margin	Operating Profit Rate	Pre-tax net Interest Rate	After- tax net Interest Rate
ROA(C) before interest and depreciation before interest	1.000000	0.940124	0.986849	0.334719	0.332755	0.035725	0.053419	0.049222
ROA(A) before interest and % after tax	0.940124	1.000000	0.955741	0.326969	0.324956	0.032053	0.053518	0.049474
ROA(B) before interest and depreciation after tax	0.986849	0.955741	1.000000	0.333749	0.331755	0.035212	0.053726	0.049952
Operating Gross Margin	0.334719	0.326969	0.333749	1.000000	0.999518	0.005745	0.032493	0.027175
Realized Sales Gross Margin	0.332755	0.324956	0.331755	0.999518	1.000000	0.005610	0.032232	0.026851
...	...	...	...	...	...	...	...	...
Net Income to Stockholder's Equity	0.274287	0.291744	0.280617	0.075304	0.074891	0.006216	0.011343	0.010648
Liability to Equity	0.143629	0.141039	0.142838	0.085434	0.085407	0.001541	0.004043	0.004390
Degree of Financial Leverage (DFL)	0.016575	0.011515	0.014663	0.011806	0.011268	0.000935	0.000855	0.000927
Interest Coverage Ratio (Interest expense to EBIT)	0.010573	0.013372	0.011473	0.001167	0.001158	0.000393	0.000984	0.000957
Equity to Liability	0.052416	0.057887	0.056430	0.120029	0.120196	0.017071	0.014559	0.010900

93 rows × 93 columns



From the correlation matrix, it appears that there are feature variables that are highly correlated

with one another. We will remove these features from the data set before perform any feature selection

In [21]:

```
# create function that calculates VIF and drops any columns that have a VIF greater than
from numpy.core.fromnumeric import shape
from statsmodels.stats.outliers_influence import variance_inflation_factor

def cal_vif(x):
    thresh = 5
    output = pd.DataFrame()
    k= x.shape[1]
    vif = [variance_inflation_factor(x.values, i) for i in range(x.shape[1])]
    for i in range(1, k):
        print('Iteration no ', i)
        print(vif)
        a = np.argmax(vif)
        print ('Max vif is for variable no : ',a)
        if(vif[a]<=thresh):
            break
        if(i==1):
            output = x.drop(x.columns[a], axis = 1)
            vif = [variance_inflation_factor(output.values, j) for j in range(output.shape[1])]
        elif(i>1):
            output = output.drop(output.columns[a], axis = 1)
            vif = [variance_inflation_factor(output.values, j) for j in range(output.shape[1])]
    return(output)
```

In [22]:

```
# select non-correlated features
select_features = cal_vif(X)
```

```
Iteration no 1
[69.01850223325629, 43.595467498059946, 102.89448309616877, 63784107.00172185, 1076.2927
070171597, 82724488.6699668, 31113694.835407037, 1822.4631663986613, 11440456.186908506,
337.99634964330147, 1.2612409105505844, 1.092355471002177, 7.558642941248357, 1.04160101
64740737, 1.3274514511808797, 782.0303535509482, 3911.8118072742327, 3126.1592381455343,
32.038789339109286, 4.187190702735464, 4.360882460291321, 637.9946060235118, 21.71372243
8768315, 1.0395640475297192, 1.9329780110347787, 133.49730672423615, 132.68280523255828,
1.023089394986167, 1.1253183182354223, 1.1245861424549934, 1.826570517281875, 3.64806105
38571487, 1.3580387765690056, 1.0598223919041465, 1.0089769111560956, 1.557035661827639
3, 2537479393.75135, 1151884255.8721192, 1.4719169862979808, 37.479577314825995, 9.11908
4282253652, 638.7817489939426, 30.099870538396818, 36.079332620209954, 5.90068744505700
2, 1.568334527356616, 1.3076566055626773, 1.1411513437741085, 1.3401406515691616, 6.3814
957656262425, 3.3370896492705473, 1.5984649281962882, 1.151680847434043, 8312138253.9460
25, 4.863768733631312, 8967464419.896431, 3.1145919262637225, 1.2531060287816265, 1.0655
728847958652, 2114448416.2389877, 8.623759081912636, 1.0899417821964243, 1.0741889852962
132, 434920292358.3289, 42.996715926290285, 9683442458.85514, 1.029557800052723, 3.79869
9602643246, 1.3418897111441632, 3.3378088704393223, 1.5157152200219561, 1.44058475309982
64, 86.72381556431932, 1.151810963594114, 26.558956154340503, 1.2166252388920598, 160501
777557.3512, 1986153299.4930298, 44.95782251671022, 4.633900338678031, 2.81804221958423
7, 7.4803865390129625, 3.2764813532019925, 3.099771595988936, 29.082462082248224, 1.0916
79437424625, 2620.003074424558, 52974519.67115891, 8.349087282557573, 464.9450812993252
4, 1.004899088279558, 1.0069812599816976, 3.0450084439958767]
Max vif is for variable no : 63
Iteration no 2
[69.01849691369395, 43.59547048292976, 102.8944865314102, 45578056.325474106, 1076.29083
49953073, 68308332.20316012, 46068881.32398531, 1822.4576227516136, 7136073.092476168, 3
37.99511970725786, 1.261240912451517, 1.0923554695906437, 7.558645384225325, 1.041601019
320039, 1.3274514539783513, 782.0301752237611, 3911.8108874884506, 3126.1588800846826, 3
2.03878883363618, 4.187190706401702, 4.360881713945248, 637.9943461281914, 21.7137215477
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01944, 1.0395640461995121, 1.9329778931122417, 133.49732377366854, 132.68279090823086, 1.0230893946861304, 1.1253182946254912, 1.1245861462000974, 1.8265709508961552, 3.648061118436004, 1.3580387738872863, 1.0598224170899029, 1.0089769097717793, 1.5570353627060198, 1211921977.3012173, 1246209950.0808964, 1.4719169448010654, 37.47957704835284, 9.119084481804702, 638.7817381667278, 30.0998743148141, 36.07932331548993, 5.900687470576614, 1.5683339437828248, 1.3076566061989865, 1.1411513439350474, 1.340140640292022, 6.381495866761502, 3.337073719766715, 1.5984650371176408, 1.1516808567785228, 6174376701.131676, 4.863768742509252, 13176896329.1313, 3.1145919377996094, 1.2531060320096226, 1.0655728803702742, 3787709310.6710753, 8.623760019443726, 1.089941866044864, 1.0741889774828752, 42.99671643059254, 3809215778.499866, 1.0295578084596269, 3.7986996206177217, 1.3418897100604439, 3.337808803397488, 1.5157152199107773, 1.4405847531006957, 86.72353249226317, 1.1518109644499996, 26.558954474115097, 1.2166252323527484, 8.619078994517915, 1257561748.9007561, 44.95781981933953, 4.633900332086082, 2.818041498472827, 7.480386547328878, 3.276480951776861, 3.0997713750114277, 29.082461043956084, 1.0916794219122588, 2620.003085798949, 32781497.65832567, 8.349082271787305, 464.9450602206384, 1.004899087309812, 1.0069812600425747, 3.0450082921478168]

Max vif is for variable no : 55

Iteration no 3

[69.01849452372532, 43.595470267106144, 102.8944888446852, 63526829.67938712, 1076.2895684104674, 67449322.50493494, 36668056.32584292, 1822.4639003690547, 13962690.489861302, 337.99573244484674, 1.2612409139579566, 1.092355470891468, 7.558644609569187, 1.041601013294724, 1.3274514634520032, 782.0300177438577, 3911.825952981428, 3126.1641226330944, 32.03878886176478, 4.187190703805333, 4.360882547422468, 637.9943904369215, 21.713722452505955, 1.0395640470138046, 1.93297801954716, 133.4973633149779, 132.68282884770704, 1.0230893978140831, 1.1253183218243321, 1.1245861455582309, 1.8265709289296184, 3.6480611377014553, 1.358038777343423, 1.0598224210093286, 1.008976915117549, 1.5570356017044513, 95757525.73492745, 35471693.21959462, 1.4719170222464582, 37.47957934088521, 9.119083504429282, 638.7816091840853, 30.099868096862995, 36.07932201100475, 5.900687643949427, 1.568334507096248, 1.3076566066955773, 1.14115132902465, 1.3401406537378822, 6.3814963100026985, 3.3370938322465635, 1.5984649052784057, 1.1516808641123286, 6.850010363090277, 4.863768796571675, 3.114591608609848, 1.2531060197421915, 1.0655728113977028, 33.718849639342636, 8.62375864304305, 1.0899418243434618, 1.0741889664733162, 42.996712953108954, 2835954732.3820934, 1.0295578042764377, 3.7986997364766046, 1.3418897086913806, 3.3378088720039956, 1.5157152126424858, 1.4405847481025786, 86.72252362201279, 1.151810960420001, 26.558951208266095, 1.2166252443327839, 8.619078154576739, 279969841.3454677, 44.95782181856884, 4.633900372795803, 2.8180408075072747, 7.480386604741033, 3.2764811675186443, 3.0997716201987635, 29.08243457587624, 1.0916794238140572, 1.015994196304741, 35683127.14422739, 8.34909029781619, 464.9450554611016, 1.0048990883202875, 1.0069812721710625, 3.04501064519454]

Max vif is for variable no : 63

Iteration no 4

[69.01849416878743, 43.59547129817059, 102.89447808824264, 56333875.92703587, 1076.290669948118, 97354701.53565718, 41532461.7135313, 1822.4609084693732, 6637921.079015497, 337.995151580485, 1.2612409031825165, 1.0923554765379158, 7.55864413925379, 1.0416010143744194, 1.327451456345836, 782.0306460293407, 3911.827075596561, 3126.167972099581, 32.03878951547213, 4.1871906720760155, 4.360906717210306, 637.9945313941229, 21.713722431736176, 1.0395640467403182, 1.9329777760305522, 133.49731870034776, 132.68281795657464, 1.023089397586892, 1.1253183566271887, 1.1245861462346474, 1.826570619302632, 3.6480610980882484, 1.358038777090801, 1.0598223181460762, 1.0089768985927776, 1.5570356384119086, 171642295.05580112, 160632429.69394273, 1.471916931811809, 37.47958075391307, 9.11908404295778, 638.7818101608594, 30.09987231068251, 36.07932717804895, 5.900687639026617, 1.5683331391096824, 1.307656606109157, 1.1411513341678727, 1.3401406461448464, 6.381495894525879, 3.3370799219583294, 1.5984650284629915, 1.1516808367327809, 6.850009916264347, 4.863768047863697, 3.114591662786962, 1.2531060128658835, 1.0655729014445212, 33.71884687275489, 8.623760503526261, 1.0899418376841932, 1.0741889966380838, 42.99671657014475, 1.029557804758303, 3.798699681012043, 1.341889710514457, 3.3378087891026316, 1.5157152139176482, 1.4405847568354493, 86.72306663342752, 1.1518109620617498, 26.558947152803444, 1.2166252497559482, 8.619079736381892, 292.1031351697963, 44.95782145390332, 4.633899365711682, 2.8180413259742267, 7.480386577295594, 3.276481126808994, 3.099771547682144, 29.08246814531047, 1.0916794107504266, 1.0159941834938921, 47258441.1994593, 8.349090458384103, 464.9450499451531, 1.0048990884392115, 1.0069812417982584, 3.0449961472066387]

Max vif is for variable no : 36

Iteration no 5

[69.01847762393106, 43.59545629125267, 102.89448898452184, 52333058.66342763, 1076.291057065112, 341.86853522587774, 2099.5261498713908, 1822.4156372873792, 89.10478775436573,

337.99688012573296, 1.2612409737848675, 1.0923554858548772, 7.558638598482653, 1.0416009  
502780854, 1.3274515150105766, 782.0321094108765, 3911.823467111887, 3126.1853163104315,  
32.03878771160532, 4.187190720013486, 4.3608926766893195, 637.9945685710077, 21.71372368  
094246, 1.039564045095158, 1.9329775421141169, 133.49736959611602, 132.68282126897205,  
1.0230894320420947, 1.1253182783212856, 1.124586104565759, 1.8265709189241315, 3.6480608  
302272017, 1.3580387726756127, 1.0598222947276759, 1.0089769466746221, 1.557035158922801  
3, 27.90003513018217, 1.4719167916608338, 37.47957857063784, 9.119081462277464, 638.7817  
152302136, 30.099869082602744, 36.079122241338034, 5.9006892036747915, 1.56833384791112  
2, 1.3076566137276333, 1.1411512362171545, 1.3401406769641084, 6.381497853757042, 3.3370  
90973766631, 1.598464557736682, 1.151680828058747, 6.850009417979535, 4.863769816416459,  
3.1145815221288236, 1.2531059465957277, 1.0655729200764783, 33.71883769246864, 8.6237487  
0253754, 1.08994175891492, 1.074188815422581, 42.996606938151416, 1.0295577898792077, 3.  
798699994342887, 1.3418897017748495, 3.337808872282332, 1.5157151902615524, 1.4405847323  
109686, 86.72312217134055, 1.9669767399687135, 26.558933905110095, 1.2166252207918875,  
8.619078805331862, 292.1031931048324, 44.95774248236059, 4.63389477365156, 2.81803932473  
67386, 7.480386700728255, 3.276474040047572, 3.099771563142134, 29.082466281481675, 1.09  
16794591181704, 1.0159942838802982, 43829817.44859567, 8.349081144384643, 464.9443469237  
583, 1.004899084961915, 1.006981380446472, 3.0450012847882006]

Max vif is for variable no : 3

Iteration no 6

[69.01843867910554, 43.59545155672999, 102.8944102797821, 1076.2428663838002, 341.867660  
0541442, 2099.5112510482295, 1822.432122978828, 89.10801894192626, 337.99679759847317,  
1.261241136214421, 1.0923559147560635, 7.558636455709332, 1.0416009967834616, 1.32745136  
05677942, 782.0324549132838, 3911.821395485279, 3126.1843379482093, 32.03876085247057,  
4.1871928234659395, 4.3608694560476255, 637.9944893905695, 21.713698273370486, 1.0395640  
239409107, 1.9329782325964255, 133.4973699620581, 132.68280169131896, 1.023089393909463  
9, 1.1253170607912437, 1.1245860240422372, 1.8265711137156035, 3.648059398345722, 1.3580  
381762903415, 1.0598228725557348, 1.0089769775690551, 1.55703726894736, 27.9000601537756  
66, 1.4719165524901863, 37.479578523191776, 9.119082640748614, 638.781778152115, 30.0998  
6594671374, 36.07910227807162, 5.900690100875294, 1.5683337255431786, 1.307657423274896,  
1.1411508012554488, 1.3401415388440343, 6.381495643813511, 3.3371155156563144, 1.5984657  
131466147, 1.1516811618248535, 6.850033627600692, 4.863767970788844, 3.11459933682107,  
1.253159002883342, 1.0655730197354143, 33.71893126219203, 8.623754050878121, 1.08994167  
17803085, 1.0741889930741357, 42.99662148073233, 1.0295582500737832, 3.7987046642321687,  
1.3418899038773715, 3.3378204841297334, 1.5157150902984617, 1.4405845608547672, 86.72209  
005391389, 1.9669772181726175, 26.558982723869715, 1.2166251760216373, 8.61910407274050  
7, 292.1036490320659, 44.957807354953296, 4.633893835101491, 2.8180456230496027, 7.48038  
2231327735, 3.276475997415841, 3.0997723952860623, 29.08245863777649, 1.091679396725050  
2, 1.0159939615629514, 1078.073456111489, 8.349086619171208, 464.9452748796325, 1.004899  
069268558, 1.0069814817649314, 3.0450037874832705]

Max vif is for variable no : 15

Iteration no 7

[69.01148842280259, 43.59543521273421, 102.87553947178513, 1076.2446883692207, 341.85259  
26976999, 2099.5172715558, 1822.4414028564318, 89.10205557786338, 337.96915800890457, 1.  
260743772250644, 1.0923551438771026, 7.5585593129109405, 1.041505641947889, 1.3274326845  
370847, 625.9314921082365, 627.3011997478857, 31.961787177022206, 4.187177922100799, 4.3  
60675007174375, 636.1790553280997, 21.7136569776252, 1.0395633907822985, 1.9327616248915  
893, 133.4973100434927, 132.6827872638896, 1.0230864954618184, 1.125075001003408, 1.1245  
227136372413, 1.825212159708601, 3.647927730629745, 1.3580297147721954, 1.05899507461525  
34, 1.008974509274567, 1.5570215510717864, 27.900050687332882, 1.4719118602277756, 37.47  
772848138426, 9.11907719666441, 637.1070167663637, 30.065426089794993, 36.0731512219868  
3, 5.900681717786368, 1.5682017179055168, 1.3076536389120572, 1.1411453218209113, 1.3401  
318292972995, 6.381096210416007, 3.337103653571233, 1.5983852964568894, 1.15168116857138  
26, 6.849779535022583, 4.863410116264991, 3.114286491986602, 1.2531053273130492, 1.06017  
67815577352, 33.71744480405118, 8.623742914311695, 1.0899244765596845, 1.074171236595820  
5, 42.99118403316912, 1.0294503080709454, 3.7909345606316607, 1.341883656399145, 3.33695  
54625851667, 1.5156684336974175, 1.4403989725519113, 86.72327558294819, 1.96648603462644  
3, 26.558343788519345, 1.216590530153356, 8.618798534232416, 291.93780350501953, 44.9305  
0396374942, 4.633893779395728, 2.8180110378080463, 7.480152165180083, 3.276096968973808,  
3.099716187128777, 29.081577383758294, 1.0916389436334015, 1.015968756131698, 1078.07393  
1115598, 8.34587046245242, 464.5290433862755, 1.0048937888718084, 1.0069728705209218, 3.  
0449112590933596]

Max vif is for variable no : 5

Iteration no 8

[68.4134734485659, 43.50972212672066, 102.26028805121341, 1061.4051760459301, 112.648927

93385806, 320.9750261043557, 20.55456430961513, 324.5451884837412, 1.2604069116862935, 1.092354407416861, 7.441135715626964, 1.0413139697900025, 1.3273330260209502, 625.913569 0291458, 627.2835138115104, 31.947674673173267, 4.187120336306441, 3.440443159376746, 63 6.1733725950429, 21.711527490581023, 1.0395610528743506, 1.9176657625480673, 133.4884085 1898368, 132.68235765504684, 1.023066268640549, 1.123926114863505, 1.1244039958736716, 1.8251757015491883, 3.6466770704806484, 1.3579656705773613, 1.0563196280089766, 1.008160 577571725, 1.5422944080737702, 27.849378926875012, 1.4673482481737667, 37.47607948444843 4, 9.113587994545734, 637.0940201941198, 30.048253536460063, 34.610647929066076, 5.87914 1484406465, 1.5636971290823176, 1.307653260322935, 1.140574743760343, 1.340051289710868, 6.374943560666061, 3.0478377805275345, 1.5956497529160363, 1.1512580486676558, 6.8180992 58265109, 4.856338596314535, 3.111267122040018, 1.2530465819443362, 1.0595722463106942, 33.71114405778911, 8.54649305362933, 1.086178967973029, 1.07195984240462, 41.33865791631 088, 1.0293210944258242, 3.789487912771961, 1.3418269452452112, 3.336276371299808, 1.515 6679426105317, 1.4397549897423902, 34.22732653956349, 1.9664653863434682, 26.17436973889 5027, 1.2160512727402109, 8.614818968360677, 288.7515049588338, 44.907585645793276, 4.59 4445279412396, 2.771155667319219, 7.4769560233315895, 3.240025192080528, 3.0995937045092 36, 29.072807693898916, 1.0910175321876878, 1.0159675548144578, 1062.372263166342, 8.309 310435690316, 464.5267743553508, 1.00489356697638, 1.006374734339555, 2.918589041638095 5]

Max vif is for variable no : 80

Iteration no 9

[68.39449609043916, 43.489822762874425, 102.25851367288533, 2.4245019553252987, 112.6166 8484903899, 320.12000193091797, 20.554523175033488, 324.04183196478425, 1.26039184033136 8, 1.0922793832998863, 7.439639212429367, 1.0412906721982869, 1.327255355909548, 625.88 83883648263, 627.2691219791429, 31.933715591824026, 4.186610873974044, 3.439015615913936 7, 636.1452568174832, 21.705971271149096, 1.0395274457211026, 1.9173763751741684, 133.48 836653763786, 132.68233610758452, 1.023060716926921, 1.1233539925854101, 1.1243898006347 193, 1.8251605616278601, 3.64536905243727, 1.3577891200354013, 1.0563040454039605, 1.008 095588381134, 1.542289124181311, 27.825610381740475, 1.4671772410083435, 37.474648141060 335, 9.113478244084284, 637.0916402315853, 30.043003812765132, 34.603979381599586, 5.878 945179804318, 1.5636809223981092, 1.3075744905884077, 1.1394610848676894, 1.339957907457 9542, 6.373687536799511, 3.0435157408863174, 1.5953389201452504, 1.1510776432585712, 6.8 17227452084542, 4.856084058078039, 3.108873678919052, 1.2530411759743194, 1.059501492740 904, 33.66408934982373, 8.545034396741992, 1.0861728261626475, 1.0719171561173453, 41.32 950432131996, 1.0291547261258673, 3.788649927627811, 1.3418254911217244, 3.330299793746 2, 1.515664007215092, 1.439747497443798, 34.194294358276586, 1.9659653451667396, 26.1743 58795537337, 1.2160364934240178, 8.588486876242918, 288.7244519753587, 44.8948456302564 9, 4.594122199110429, 2.770518214071917, 7.475521425740334, 3.2400216367215067, 3.098460 2399135475, 29.051858784311026, 1.091007322243369, 1.0159345960679802, 8.30886702738564 9, 464.3326112623763, 1.0046552658170353, 1.0063728841247264, 2.918032691797213]

Max vif is for variable no : 37

Iteration no 10

[68.07428602945784, 43.01754208962404, 100.93568450007014, 2.424501667477437, 112.573527 9084649, 320.1174160774162, 20.55043366312831, 323.98774273541113, 1.260369397800261, 1. 707511702570952, 7.439356103976971, 1.0390089040243449, 1.326995420710958, 625.801819313 0976, 627.1890381542659, 30.279887853090983, 4.185905527891765, 3.4389544894291117, 6.57 9045095312046, 21.59010861002325, 1.0395266229874272, 1.8742187905100824, 133.4880795468 61, 132.68204318267607, 1.0230434601513054, 1.1232703577991623, 1.1243570778959862, 1.41 46241889203581, 3.6453681343422497, 1.356975505154817, 1.056263730869551, 1.008092265352 924, 1.5422847664896155, 27.823664379458705, 1.4671484349296144, 37.420239884895494, 9.1 06796963428263, 26.644069718749638, 34.60287877260406, 5.87863410170114, 1.5633113385425 619, 1.3075089700251608, 1.139426507993833, 1.3399210971640154, 6.373568945925476, 3.043 4638492285733, 1.594838153091664, 1.1510765869049693, 6.81372530159987, 4.85411189988385 7, 3.1077067621187657, 1.2530327880481387, 1.0595002404635372, 33.663911138938, 8.544688 246348386, 1.0861386596757805, 1.0718921658754632, 41.32922520500351, 1.028717347420751 8, 3.7886349815137597, 1.3416233921050609, 3.327716078183802, 1.5156041694837823, 1.4396 902935794815, 34.19373781902523, 1.9659370327371373, 26.17415218125515, 1.21602900565235 7, 8.587552700416845, 288.7175188761239, 44.88877390139976, 4.53888356203088, 2.76829629 92396867, 7.47552065643155, 3.138511970247934, 3.092184248840577, 29.041082554209627, 1. 0909939274773663, 2619.758076364628, 8.307629157695919, 464.2730636830461, 1.00465109191 81137, 1.0063643224268382, 2.917915966566564]

Max vif is for variable no : 78

Iteration no 11

[68.0671708751222, 3161.0145433695734, 100.9290350607289, 3134.1205350917417, 111.168092 9406005, 320.03445542007415, 20.34226382816748, 323.4744145844528, 1.2603266015382024,

1.0919620955193658, 7.439186231811552, 1.062958577726563, 2.239648037447612, 21033.55865  
5599234, 20972.427304388315, 30.2750771901795, 4.185602249253705, 3.4403365179270575, 6.  
579015980033503, 688.1931398669997, 4.617288581547319, 11660.246326760267, 133.487442979  
95515, 132.681410242651, 1.0230428993045766, 1.123123223924885, 1.1245428860119775, 106  
5.7758417024213, 1225.8275681857187, 1.356704982059388, 1.0574095975908262, 1.0080921076  
124225, 1.5432730696634762, 27.823042855627733, 1.609942952988234, 37.41550995194915, 9.  
102402813200193, 965.3561427332245, 34.601585980078525, 5.8757578359138956, 1.5665535543  
02068, 1.3094285581886307, 1.1394255184317164, 1.3399060103854485, 13.42526454430752, 3.  
0388048787404407, 240.77103544305453, 1.1527582067970257, 1301.841159834393, 23.89348018  
501388, 5.575797326518829, 1.2533763974354695, 1.0651050409227334, 33.66292862492502, 8.  
543344823757291, 1.0861319093448913, 1.0817467646750039, 164144.96763492495, 1.037992811  
1189547, 3.7886165183575278, 1.4007211089378964, 3.3276815547813294, 1.5151710675085264,  
1.439252823336188, 34.193281588958214, 1.1510476300828114, 26.1702321797811, 1.216205923  
4204619, 8.587187852500454, 288.71038329195636, 44.88629980005726, 4.538641476735129, 66  
1.4109507206955, 775.1977318431635, 1863.9995603715747, 6.3160293891496035, 11678.789845  
856334, 1.093665667223448, 8.303850987692048, 464.26714912477377, 4.109120394339819, 1.0  
063627640389299, 5.556445161809211]

Max vif is for variable no : 57

Iteration no 12

[68.06364698817885, 3160.9989115896287, 100.88813564037439, 3130.3678198024268, 53.26353  
190206734, 256.94231907370875, 12.779158303245312, 321.6756258393183, 1.259297807670863  
6, 1.0911253558391656, 7.413554105288364, 1.0611238888017134, 2.2360668964547736, 625.44  
62388127977, 626.8031762423668, 30.270999809897226, 4.1810901866800725, 3.40777956270242  
3, 6.5585604301258265, 687.2069065312554, 1.0394447308224952, 11659.927182666444, 133.48  
32492076588, 132.6797469024261, 1.0230428938973282, 1.1206945109679765, 1.12364753264852  
65, 1063.6685608712905, 1202.1806624637154, 1.3549828728293933, 1.0572797127722842, 1.00  
78330478175284, 1.5410110116681806, 27.734048075099928, 1.608953631333057, 37.4003310520  
4169, 10.687801342080034, 963.8773265711395, 8430.037631771069, 5.766039451825087, 1.560  
1769293531467, 1.3092913254457281, 1.1393784622477339, 1.561801466097746, 13.07941098151  
3687, 3.0117049142092074, 240.76473117299963, 1.1524742704415225, 1258.9040427952527, 2  
1.509315736937577, 5.2777179199154745, 1.220898173794392, 1.0649981555915389, 33.6404318  
439812, 872.7949492116599, 1.085112411259928, 1.0808139542118673, 1.0378499748916983, 3.  
775278342779325, 1.3409469812889054, 3.3147692456088675, 1.5144888357051538, 1.436387251  
06447, 31.820638491012083, 1.1509721786880822, 26.16870957172786, 1.2162059209660576, 8.  
497940970193282, 252.15109486382318, 44.61217532908272, 836.7802767798829, 660.679925016  
1213, 770.5566061109564, 1545.9998817432102, 6.273450943837458, 11672.589579712996, 1.09  
35885841617397, 8.112888257570434, 462.6755947440985, 4.109006009581564, 1.0063493899188  
436, 5.515242677330463]

Max vif is for variable no : 75

Iteration no 13

[66.43139361028616, 1750.803660329809, 99.83907795111206, 3010.3937407150265, 53.2241181  
463765, 256.9172587150092, 12.713126899425626, 321.6597223600774, 1.247917826372504, 1.0  
909675930146927, 7.331948430393472, 1.0605082250446771, 2.2232421169411705, 625.25406252  
17648, 626.349916612107, 30.25943696064527, 4.173839142658836, 3.3988996848194493, 6.556  
06864099194, 21.548984064688202, 1.0389148552518102, 11658.867030312744, 133.45997333452  
542, 132.6636784396683, 1.0230172944353344, 1.0932503269504308, 1.123646495151337, 1060.  
6918170765875, 1186.1398058055418, 1.354981952922246, 1.057234588203875, 1.0077946823463  
43, 1.536444809201701, 27.21859674375319, 1.6082784481221408, 37.36767091789081, 10.4778  
6605079272, 963.8557119677059, 8251.252743988329, 16.985962454642483, 1.558819180510688  
8, 1.306664618269137, 1.1393291637306457, 1.5615863229883062, 13.078904737710829, 3.0041  
41721294353, 240.6842178635953, 1.1520980947331139, 1255.9192637926308, 21.5056219847331  
07, 5.273564952471922, 1.2181115609616462, 1.0649297647741218, 33.35877350888881, 871.59  
39324232014, 1.0851078947163642, 1.080777714928296, 1.036635881115165, 3.293050466883853  
4, 1.3399146442577885, 2.758303570691326, 1.5144700978097252, 1.434767270380947, 31.7258  
49178249824, 1.1489333332059115, 25.98174300988828, 1.2161701437178638, 8.45709112916959  
4, 251.05585452895343, 44.429643641945965, 836.7529456706098, 660.4616836537919, 756.137  
5003625011, 2.5987442794663314, 6.273428978901807, 1.0891416107248775, 7.62195236167420  
7, 456.2267082304405, 4.108935849434929, 1.006313368992015, 5.514368522839727]

Max vif is for variable no : 21

Iteration no 14

[66.39970833523162, 1750.7780383259433, 99.7781672297016, 2.3279529799937952, 52.2076109  
1303561, 253.60821117224984, 12.629923997321434, 320.88735919389865, 1.2471599254612933,  
1.0909651365344526, 7.327054822686703, 1.0605051878314147, 2.222992613038069, 625.250477  
3435616, 626.3481523240276, 30.25943777125143, 4.124878243533241, 3.3987421316340796, 6.  
555953750670392, 21.451563716188353, 1.03879484871023, 132.69673381732207, 132.661743003

79208, 1.0216569111384064, 1.0931430966311486, 1.1236246179578966, 1.3009076140769134, 1.182.9283902294392, 1.354972788169064, 1.0571868150051944, 1.0077555944884016, 1.536129553953903, 27.212933436670724, 1.608273809125445, 37.305272888905776, 10.47561246623, 26.564556931244958, 8250.805195690398, 16.98595196730626, 1.5578480650208966, 1.3066314367457972, 1.139316326800839, 1.5615633275746978, 13.07064493414851, 3.004074592255722, 240.6806823239225, 1.1520954946328381, 1255.3802633944526, 21.496859989163646, 5.27336123556098, 1.2180476057527334, 1.0649297644112807, 33.351260955753474, 871.2330551419003, 1.0850439715346913, 1.0805804213827548, 1.036615657840119, 3.290736240337398, 1.339895085012062, 2.7582911194452886, 1.514450474506632, 1.4347450469488832, 31.63912447042936, 1.9620623907532655, 25.975883891516684, 1.216166453812057, 8.456826514337886, 251.05577339115214, 44.42794437207707, 835.7140118912125, 660.2001795600042, 755.9742734617693, 2.589045738327255, 6.273347439798792, 1.0891159079365558, 7.621299990573801, 456.1495064437128, 4.108933481609017, 1.0062981212589903, 5.511741204113986]

Max vif is for variable no : 37

Iteration no 15

[66.35085436113991, 1746.7146062672582, 99.71089206809357, 2.3279374720952934, 48.71644986007227, 249.47534652598182, 11.958164551124591, 320.65330575045675, 1.2458010316988586, 1.0891799538722617, 7.323137337481381, 1.0586859416252266, 2.221153085543704, 21014.665441316818, 20944.30281515191, 1461.4319778590402, 4.071355896014691, 3.393077356414572, 6.555516665403206, 683.7853295086454, 1.0387465855165987, 132.696417015344, 132.66132411351333, 1.0216453705402677, 1.092692527229627, 1.1022621888138602, 977.5178922153985, 3.419117656581771, 1.3530479334785632, 1.0571790876287803, 1.0075579826286076, 1.5353634448529678, 25.55776821632492, 1.6076206298859699, 19588.33121451233, 4.6988668957042155, 962.4084295039324, 5.521119527434895, 1.5250591459777978, 1.306389111076366, 1.1391105019027652, 1.3394711991888317, 5.544968921930741, 3.00265870219069, 240.6684161653598, 1.1520195951887047, 1010.6048693061412, 20.85614440550964, 4.975729479485475, 1.191706069990877, 1.0646213863264373, 30.470189919631864, 8.511093871043398, 1.084434650432618, 1.0805757373093918, 1.0365246258759626, 3.271773752157223, 1.3985632633338927, 2.7579025902212293, 1.514317674085993, 1.4332101057935227, 31.497892728244487, 1.960936884319622, 25.969177004420008, 1.2161599471058626, 8.332948730022705, 250.89174934161582, 44.29592936838657, 4.275523644985996, 2.7617594715385247, 7.090433654963933, 1325.8990939707535, 3.0629464419236547, 1.087486135332116, 5.205323555281466, 437.7216098787201, 4.108603209478164, 1.006194989278596, 5.48831649472902]

Max vif is for variable no : 13

Iteration no 16

[66.34965234981247, 1746.4257245109932, 99.70434012327502, 2.3279289959538723, 48.71265223236871, 249.47429321938333, 11.954589153515556, 320.6522881068839, 1.2451159829461929, 1.0873388030605062, 7.323119786606868, 1.0586774026311114, 2.2203997967474134, 109.20643568381601, 30.209217980543038, 4.069944149390069, 3.3930607032234716, 6.555509256503007, 21.44787882437558, 1.0387257775890355, 132.69639036255757, 132.6613888476939, 1.0216368876517647, 1.0925526203864722, 1.1021894761710866, 977.2846930377124, 3.4191157054238177, 1.353042945502976, 1.0569568496189823, 1.0075574943381054, 1.5353633588458568, 25.557224035537185, 1.6076148883745738, 19570.505216776564, 4.697766512622495, 26.47638898231568, 5.516527333758296, 1.5236755528526127, 1.3063039276193944, 1.138906679291027, 1.3394604106841432, 5.540585953987967, 3.002393787797348, 240.63639184769545, 1.1520194222218323, 1009.8867606399065, 20.846234494630544, 4.9753643521840685, 1.1916720024698093, 1.0615740589331863, 30.470181330956287, 8.511060603320061, 1.0843573471907673, 1.0804878479298112, 1.0364648983268538, 3.2634070114388742, 1.3390260578476947, 2.752488386867533, 1.5137607041900192, 1.4327751739668322, 31.497932068866604, 1.9599521435796827, 25.96845100731589, 1.2161511480947906, 8.33154951620421, 250.58174249204188, 44.27483640982572, 4.274106984587284, 2.7616206182879997, 7.090427530203092, 2.232212390009341, 6.259142644332761, 1.0872598365652564, 5.198034187332672, 437.41269391843275, 4.108437811415779, 1.006159903190288, 5.488311339807558]

Max vif is for variable no : 33

Iteration no 17

[66.34315772274273, 1746.3189538023519, 99.70082832873351, 2.327818258843756, 48.6104106489278, 249.2728301975468, 11.95362810421759, 320.10218839520394, 1.2450899767363937, 1.083551196502853, 7.323086598723832, 1.0586499037919503, 2.219002665070272, 109.00183330609636, 30.139124522841804, 3.981383385647353, 3.3930101713073597, 6.502490337002233, 21.44410789130667, 1.037652268505332, 132.68950534397592, 132.6422172739279, 1.0216367763751104, 1.0900079558581237, 1.0996564186832292, 972.9903832230781, 3.3801411585288634, 1.3530378522329058, 1.0569497060279374, 1.007554283585057, 1.5352173175527157, 25.55657503075211, 1.6076008870547194, 2.4372599293000636, 26.473328832245823, 5.496256888244357, 1.491174088253438, 1.3062695364113381, 1.1389037590925732, 1.3379586417670575, 5.082916017424193, 3.000916140270502, 240.61609425983016, 1.1518616324162196, 1009.5311260668692, 2



0.665847904155374, 4.970925262533904, 1.1905416252572583, 1.0604394710866707, 30.4575933592071, 8.511004680641703, 1.081856041325787, 1.080419293222878, 1.0363450672460583, 3.2549152550772606, 1.3389068336760348, 2.7432295744845905, 1.5124641977774627, 1.4327564407295201, 31.49267992265153, 1.9559025829096754, 25.955853499290257, 1.216015420161508, 8.324768724672195, 247.71860286363446, 41.678062770781274, 4.269470064817962, 2.760984287533018, 7.041803232012508, 2.198713501562878, 6.257541815126813, 1.0849338740394645, 5.189734838655124, 420.1274064615546, 4.107336100147606, 1.0057851411091123, 5.48785983361123]

Max vif is for variable no : 1

Iteration no 18

[4263.390658706101, 60.87529024858191, 2.278316090938073, 48.529283730927936, 247.26269595460911, 11.946144162765364, 318.7126467186556, 1.2444558729891892, 1.0835015149225022, 7.271646290245779, 1.0585716950896387, 2.202717648632958, 108.68085242902627, 1279.029016389257, 3.950661757873737, 3.377554454792934, 6.2398234294170685, 650.1946128503014, 1.037404157138327, 132.62601196758018, 132.5620711204406, 1.0214988219641623, 1.0890291109298735, 1.0918004451688368, 972.0186935042201, 3.356740491585134, 1.3530363355676065, 1.05691229821832, 1.007507077448131, 1.5306487957740513, 25.52983156070749, 1.6075955825946286, 2.4356831968312034, 832.0020692581152, 5.478388208042595, 1.4909089157531554, 1.306199671799034, 1.1386720899654899, 1.2958024361105154, 5.082699366034001, 2.997189356094992, 240.01036157043208, 1.1517570361050629, 996.0152184952541, 20.66516854001724, 4.960871344429794, 1.1903332489096543, 1.060393510554361, 30.405564264460708, 8.458872583387201, 1.0814442920078227, 1.0803662458587748, 1.0361830529220881, 3.161714092186006, 1.3983124868850885, 2.694270203269081, 1.5121318679808007, 1.4326777449494323, 31.259053081493988, 1.1453195953721313, 25.89014115380038, 1.2160046255885002, 8.319582530571493, 245.68234902491955, 41.21869496576385, 4.252033214325837, 2.758485263950586, 7.032413255095869, 2.19314448725786, 6.25754064588765, 1.0845854612734853, 5.1712245826192875, 416.0555921568141, 4.105433684876852, 1.0057831525880896, 5.485975790367248]

Max vif is for variable no : 0

Iteration no 19

[5.625326310512537, 2.277574422615041, 48.39150071662698, 247.0006305573302, 11.935042996644588, 318.6830661353952, 1.2444191169377559, 1.0803762514708612, 7.271608634137624, 1.057999509894599, 1.9734963957472302, 108.66497760638072, 24.1848346630639, 3.9291088155173983, 3.3775483647026823, 6.17191814631024, 19.41833486661911, 1.0370060396018201, 132.62526341334964, 132.5618236947697, 1.021482698510292, 1.0889924915798495, 1.0886964997718989, 969.8446818261688, 3.353655408891818, 1.3530312287525537, 1.056911033631205, 1.0071220252451791, 1.5306265490114628, 25.52929608381105, 1.6074762820258346, 2.4341510185757205, 809.2974369795396, 5.474913344544275, 1.4909022543043728, 1.3060364190903508, 1.1373676468300602, 1.2947620825759532, 5.0814612119039975, 2.9968478983172595, 239.98095865944194, 1.1517508471772417, 993.6995757364742, 20.643473007220667, 4.956703640459278, 1.1902995915880958, 1.0602869339388843, 30.39472311454038, 8.455514140987018, 1.0813378684709896, 1.0803424052608759, 1.0360465427701673, 3.098347498119244, 1.3983106682779376, 2.6929663287302317, 1.5121313651367962, 1.4326410008914043, 31.246537750781425, 1.1452947966466196, 25.890115118098105, 1.2158866527158962, 8.318940779249024, 245.6443547967273, 41.199919357930376, 4.249704094268393, 2.7584348632793523, 6.936908275138071, 2.1870952477818366, 6.256746724535684, 1.075836277551419, 5.162046598879537, 415.9068517829457, 4.105161031789799, 1.0054993759737452, 5.483897703504229]

Max vif is for variable no : 42

Iteration no 20

[5.611627129407225, 2.277255429201203, 47.8436844568995, 246.02320131917784, 11.860776401697349, 318.59535474171213, 1.2410022479973253, 1.0695374580922206, 7.270644073486629, 1.0576245048401673, 1.9685473045715758, 107.89476739351048, 1167.3840121558317, 3.9190876582341794, 3.3763068993007277, 6.115310875152753, 618.8422948105656, 4.60578566737211, 132.6223287325534, 132.5555178196256, 1.0214820601599428, 5.023093457668223, 1.0877862519961372, 969.8446716054382, 3.351563789987036, 1.3044543944313087, 1.053165959778511, 1.0067616821110674, 1.5239915953165228, 25.52220072367134, 1.606968734385196, 2.4336552927900756, 808.185221760368, 5.418985886078235, 1.488015987463004, 1.3057337240057822, 1.1065745457922553, 1.271289348161954, 5.080369281913142, 2.993872480299661, 224.93798571177217, 1.1514722754828182, 15.683381884371931, 4.849775488335277, 1.170935274135407, 1.058508871022112, 29.22443121095867, 8.45549440662463, 1.080396971861612, 1.0800826572338396, 1.035744001473718, 3.0954289417422194, 1.3981048334568889, 2.6877069919566483, 1.4822488156524367, 1.430224927902393, 31.220224297599078, 1.1451024317256033, 25.883481096544934, 1.2136118585416158, 8.209936594908376, 245.64437692089462, 41.18744230019773, 4.245476983467182, 2.7584147693632732, 6.932163075695102, 2.184928265439487, 5.117044745098792, 1.075714129150089, 5.160371675271318, 415.90270128264103, 4.1042475571884784, 1.0054272220203624, 5.483838494895911]

Max vif is for variable no : 12

Iteration no 21

[4.6073367925993685, 2.273752715164835, 47.80612700044493, 244.70686854131924, 11.851873600798886, 316.97531468205784, 1.2403143078620766, 1.6720400815942416, 7.270310568632802, 1.056994557193586, 1.9206806520422215, 88.38774644948289, 3.861201631174597, 3.3723950599299943, 5.835841995153146, 17.554813021838317, 1.0365798330541285, 132.62171405356645, 132.55528839043862, 1.0210900821110078, 1.0884824676168476, 1.083323703767467, 969.8437221748172, 3.329613435098038, 1.3042239887373712, 1.053115687809663, 1.0065256813195205, 1.5239820020151618, 25.479115064840986, 1.6065484637692238, 2.4328649183111484, 19.072917686912575, 5.41878303936455, 1.4878826874927735, 1.3054868764131655, 1.106554179816025, 1.2664396961472515, 5.07695726685944, 2.988325941049879, 224.47078469918932, 1.1514720844843649, 15.677603135992735, 4.845813339292774, 1.170934371000924, 1.0584575456415573, 29.122393642151835, 8.451394572942142, 1.0802164931207274, 1.0794231847783107, 1.0330473384365122, 2.9984347816760635, 1.3384859105688238, 2.687670166405341, 1.4822430806715636, 1.4301096735069558, 31.13636774324512, 1.1450263567424848, 25.869121815920018, 1.2134169248038467, 8.2048058735095, 245.3835486516064, 41.15377871609931, 4.242035398714979, 2.758311202740594, 6.926435938644666, 2.182347423861119, 5.115449092448594, 1.0754500695655302, 5.155699328309393, 415.40178762057195, 4.104246467657069, 1.0053625711993228, 5.483815411410104]

Max vif is for variable no : 22

Iteration no 22

[4.602471814316678, 2.2735298984881234, 47.600114627398604, 244.2422055245391, 11.828005093059963, 316.898070067725, 1.2402367396493272, 1.6712246893626705, 7.268745862840594, 1.0568504622293207, 1.9186078101209065, 88.36752412813625, 3.3830207051545647, 3.3722781175315664, 5.789145614951657, 16.445108146306154, 1.0347824511206738, 132.57050304282745, 132.55513889143185, 1.0209763255736002, 5.0215819845132215, 1.0832723564974789, 3.3158354996380908, 1.3042024459524348, 1.053062796255451, 1.0065239054253319, 1.5239582164305023, 25.47890332599904, 1.6063990400069126, 2.4328578210367966, 18.340929733621312, 5.405246995692816, 1.4876413236322412, 1.3054186097481364, 1.1061692031008106, 1.2663474596049298, 5.056494391165809, 2.98831458216716, 224.0351030983636, 1.1514490629030547, 15.672571826454131, 4.842375196258827, 1.1708899705983813, 1.0584106558595598, 29.118851289157735, 8.440505859223503, 1.0802164917105952, 1.07941623434694, 1.0326493209661987, 2.9909034531255956, 1.338422917930826, 2.6875377510526643, 1.4818356815256597, 1.429874244583056, 31.118015008310998, 1.1445111468280667, 25.86910935904626, 1.2134157633042946, 8.203501514086884, 245.3739123773641, 41.15112377236272, 4.23626717427274, 2.758141715065085, 6.794713575771363, 2.165731346169098, 5.1146967193041535, 1.0752818029898106, 5.1556993897695405, 415.40139660754284, 4.1042395538084735, 1.0053618529937147, 5.483397898783263]

Max vif is for variable no : 68

Iteration no 23

[376.3260055548305, 2.273529307302779, 47.02189187343344, 244.1375943838455, 11.740695597888568, 316.05125965444694, 1.2401994770143343, 1.0673968245334338, 7.2656522981412, 1.033008673550566, 1.136161641651308, 88.2489794381257, 3.3764907116549567, 3.369709214170665, 5.7728264069476305, 16.441706342478874, 1.0347775689281293, 132.57048906444942, 132.5550980525664, 1.0209151004697201, 5.020751362321105, 1.0765666735835113, 3.280514436796686, 1.299234798908615, 1.05177388398743, 1.0064980015007834, 1.522302657014947, 25.10203325816277, 1.463839341314538, 2.410843716812431, 18.299494118882915, 5.39959618790192, 1.4828182276566624, 1.3054100001111935, 1.1060868283265828, 1.2641340232913296, 5.055791269739354, 2.977146571374702, 1.4836181913141948, 1.1496580080646486, 3.177233846815602, 2.6960555454470043, 1.170127756470496, 1.052811990248258, 28.862098831964634, 8.4395142125928, 1.080151837202097, 1.069297375593684, 1.0231270383537474, 2.9800580460543293, 1.3376205754915078, 2.686659898276429, 1.4814760979326478, 1.4288036506965605, 31.116189635811295, 1.1443535811023293, 25.866234047479846, 1.2132174885218134, 8.203412589633242, 6.2858878958432465, 3.153061110079778, 4.230277052128129, 2.7580245821659424, 6.792571537376457, 2.1519631347750314, 5.040637814248862, 1.072006829282792, 4.526360148583081, 1.0033848691335083, 1841.522864286476, 2.8744814404723527]

Max vif is for variable no : 69

Iteration no 24

[4.601066028698241, 2939.0522604534103, 272764.2827049546, 243.3815147035126, 11.639700078742061, 316.0369378895622, 1.240199295709237, 1.668795332763843, 5478.2152482267975, 1.033008177297762, 1.1354661523510619, 2.6390673925254498, 1142.7249029501152, 3.3692072483906563, 93.7767559304802, 524.1190872932617, 4.596210867081719, 132.57046112380752, 132.55510522825742, 478.6318613194022, 1.0882215872602434, 1.0765663957842755, 1103.1968592334106, 1.2992347873144947, 1.0530064907750678, 1.0051729639705247, 1.5223010457255468, 6814.826437674142, 1.6063193471096702, 2.4108279137006443, 663.0284658583039, 5.39955

1186871383, 1.4857981022841484, 1.3034892600672507, 1.1060781706883984, 1.264064747972937, 5.055779155082336, 2.9761016639537963, 1.483609970949243, 1.151337055568076, 3.176821642428739, 2.696045509942437, 1.1696138604302022, 1.058379606790774, 122.65712852459883, 863.8327420632409, 759.0505951333982, 1.0692682683771229, 1.0231150592667824, 2.979987855018743, 1.397053743768552, 5.791662254690663, 1.4804188133685887, 1.4277373694310942, 3.1.089702727289453, 1.1443104311725245, 25.866192548261925, 1.213383770300042, 119.59709716797055, 3801.697780357412, 113.73352340284345, 4.230243116239867, 2.757988266402775, 6.792220426195524, 1278.1556239019258, 2.4666447353035297, 1.0720010759592713, 15164.525629650054, 1.0030902970384417, 2.874479086100448]

Max vif is for variable no : 2

Iteration no 25

[4.390872069460477, 2920.58960722711, 222.7094642867551, 5.017904793129847, 207.53263797090443, 1.2385410462265982, 1.6672249642800792, 5440.041027731315, 1.0568195310938324, 1.9129655751245642, 2.6382447688832835, 1138.1714135310983, 2.980049922991367, 93.77254688589977, 523.7887212990489, 4.59614450494971, 132.51075922471412, 132.5541744061083, 47.7.89276144539383, 5.018916986698681, 1.0723665399952123, 1074.116880307898, 1.2831560017356354, 1.0529586873538128, 0.975006337052288, 1.510148740596642, 5895.564033839488, 1.6060590539602564, 2.145958246320272, 662.6945382421424, 5.1695901201535035, 1.4580531479835375, 1.3030944633980568, 1.105244879579435, 1.2640574595193954, 4.526978960096855, 2.7178091649788736, 1.4834510833390835, 1.1511846153052279, 15.598567307289677, 4.829443112122823, 1.1606274895810078, 1.0583780918680348, 26.36078915119787, 863.3623996761082, 75.4.630049025796, 1.0730817198218432, 1.032169085014568, 2.9242463517693635, 1.395980316487893, 5.746434411578016, 1.4801778439047546, 1.427724005277637, 29.100819803368477, 1.1441241221043943, 25.24118567620251, 1.2132713702075208, 109.91953079029422, 2825.913352864268, 100.06588221083948, 4.199250759936699, 2.7402121336182526, 6.694409767393865, 124.7.3946050278112, 2.3235077204877936, 1.0695696633135259, 2.9859498407651572, 4.102948998172745, 5.47455050200938]

Max vif is for variable no : 26

Iteration no 26

[359.0404538195751, 2914.8501366032756, 205.11409641357145, 5.014986319652984, 190.14923739531412, 1.7085342557370873, 1.0660053621548657, 6.844710660228776, 1.056176738077571, 1.9099742960369404, 88.21295138553351, 1137.328200035688, 2.8248122825985154, 92.56193164968306, 523.6997212739535, 4.595959658720732, 132.51060947069368, 132.54568777256293, 4.77.4355405308817, 5.018396969894794, 1.0581324307353295, 3.1891589662621858, 1.2808353875971892, 1.0527846128584735, 0.9729968656521395, 1.4881666498190198, 1.6060431255611511, 2.1385144003230927, 660.0342576557206, 5.167739160913949, 1.4574630915571285, 1.3048689934918332, 1.1047187872813353, 1.2640225212981544, 4.524437793501285, 2.6628756939712415, 223.94921091421537, 1.1510586125878768, 15.563099620118042, 4.828235758710412, 1.15541010732824, 1.0578793345721866, 18.843287115569975, 8.170129473149197, 1.0712786918832216, 1.0730666331152219, 1.032131357835231, 2.914773393091153, 1.3959706216326968, 2.6610357986620516, 1.480170374959413, 1.424636185675618, 27.909525214728916, 1.144069317148271, 2.5.02601668630198, 1.213222133330785, 33.763447099441784, 2782.8925630623303, 90.5799572410578, 4.197463497033514, 2.7402079943040127, 6.694175336137697, 2.0960331446460376, 2.2.996172716405456, 1.072149528375704, 2.9846905999155866, 4.1029472693617315, 5.250825612493061]

Max vif is for variable no : 1

Iteration no 27

[338.49960471465533, 204.9994797273494, 4.778114938492993, 190.13211022167786, 1.2232206984528773, 1.0621864117828297, 5.607462788522864, 1.0561762975531892, 1.9046617060489583, 88.15863999295404, 1135.7883775256519, 2.759843166278329, 92.09937927629295, 523.6593297084688, 4.594792024035619, 132.50157619610107, 132.54207708075035, 477.4041632073787, 5.016609177483754, 1.0570765766637635, 3.184573273682152, 1.280186816613409, 1.0515144635667366, 0.9727887991282747, 1.4463662291817165, 1.6051505328256848, 2.137620811346156, 659.5898452907907, 4.900636522669029, 1.456956280111917, 1.303430149746945, 1.1044135904015215, 1.257979001694789, 4.515457888009489, 2.5699930033831864, 217.77607676276267, 1.1510558624288152, 15.414605022421602, 4.823129861662074, 1.1552519651320394, 1.0576826234933314, 18.743322178974676, 7.512483672086203, 1.0679096399936892, 1.0713900849469984, 1.0320402689664034, 2.843516545216141, 1.3929451855772053, 4.5939289448289085, 1.480099127708219, 1.4246218583478858, 26.27759706302779, 1.1440377239600437, 21.945232210282718, 1.2125630407292876, 33.39000570557271, 2767.870884342119, 2.5110262109006793, 4.195241329393318, 2.7394104287113445, 6.686644373258239, 2.0955194360570935, 2.2994481808884784, 1.068004677486247, 2.962867768951712, 4.102823640998212, 5.25073515524447]

Max vif is for variable no : 56

Iteration no 28

[338.46931784423043, 160.32165494067266, 4.776348538598456, 146.0844471500931, 1.2222989

031844018, 1.0616677676621489, 5.547678298647474, 1.0559516005614569, 1.903845855969236  
6, 87.65616170611682, 1114.553771448756, 2.505540968760031, 92.04559733535389, 523.22217  
2243903, 4.594038216024725, 132.48584650599966, 132.5419214516041, 476.95808436541944,  
5.016233649296594, 1.055566616688933, 3.0347019079447004, 1.2789853407143672, 1.05148550  
00368577, 0.9581184933061588, 1.4405941349799536, 1.6051476020654123, 1.442710158206085  
5, 658.220279037809, 4.833526545782011, 1.446882240111153, 1.3034222132498186, 1.1042789  
69730538, 1.466321102263164, 4.388385924593122, 2.4636937643877803, 217.5245629317649,  
1.1510022083608373, 15.41218297184783, 4.819899708809678, 1.1152806654151077, 1.05768167  
30631156, 16.371663845739157, 7.466571183005133, 1.0633117880848124, 1.071382697176211,  
1.0318182005063867, 2.743344229106422, 1.3928630856624205, 4.591386986143127, 1.48009877  
19533394, 1.424196941985951, 23.744724535531773, 1.14350580484236, 21.69903826010551, 1.  
2125456050364511, 33.378247937080445, 2.4910248283579373, 4.175512317300447, 2.739365135  
717147, 6.676185450822046, 2.0858238928986963, 2.2830102176972025, 1.0676885396300828,  
1.8871968479173247, 4.1027414500184705, 5.216574103097952]

Max vif is for variable no : 10

Iteration no 29

[328.4165823617992, 157.95332380103432, 4.775121259647156, 143.7859648108836, 1.22199673  
7856198, 1.0616365714079012, 5.541415755688212, 1.0557104862049358, 1.898215329615006, 8  
6.9004470750717, 2.4982449352156557, 5.611244070921026, 16.359089142166475, 4.5375693845  
25504, 132.4826233489204, 132.53853472230514, 1.0173427414372147, 5.010540428222744, 1.0  
553430729965783, 2.8373532710026317, 1.2788334090940396, 1.051184858747885, 0.9577155475  
216537, 1.4402683030943213, 1.6045371838632192, 1.4374439653456261, 18.07148084019496,  
4.728883866420751, 1.4462320215294087, 1.303075769757576, 1.1042480289387941, 1.46439307  
0164039, 4.222803854781857, 2.4549967338683234, 216.63376917892853, 1.1509442297249703,  
15.385535960552208, 4.793959437168132, 1.1139652752636107, 1.0575305237254826, 16.328583  
528452125, 7.368121306718486, 1.0631711663690555, 1.0713235636330598, 1.031494325231898  
7, 2.739393392114565, 1.3926919038088112, 4.571072721182908, 1.479301601235644, 1.424196  
3800315933, 23.609334464498968, 1.1433821819175056, 21.691657299866577, 1.21252734223909  
14, 33.361418966930415, 2.476290294340151, 4.136043593171529, 2.7353746243346584, 5.5154  
15004888431, 2.045451691818112, 2.2813628993283177, 1.0673785908809477, 1.87570541831071  
78, 4.102709814386062, 5.215686863953837]

Max vif is for variable no : 0

Iteration no 30

[155.2323644536732, 4.7604860631069394, 141.3592348478903, 1.2216691778441484, 1.0593232  
49396747, 5.528472734159787, 1.0556193133381917, 1.8980857082424056, 81.7838923214519,  
2.4866005498592867, 91.08948693570807, 500.9197613252187, 4.537114563659522, 132.4792419  
625271, 132.5377763376055, 476.94925424332234, 5.006338577373165, 1.0540178198548464, 2.  
8339086464308307, 1.278022015946004, 1.0510783589496628, 0.9563877452348855, 1.439566749  
2233684, 1.601507793291198, 1.4373855273890024, 650.8907531209678, 4.5531019625956475,  
1.4461981613501722, 1.3028711846789462, 1.1041704232903105, 1.2506434362526662, 4.159668  
859777641, 2.4389775010572556, 214.6294354054244, 1.1509440091693477, 15.38550821104702  
3, 4.788775031172034, 1.1137482466052655, 1.0574979863018827, 15.97902694680091, 7.29027  
2994680412, 747.5266388627774, 1.0702742510507022, 1.031283139101325, 2.405780674142793  
6, 1.3919916350882917, 2.0887119157518077, 1.4734972836120024, 1.4240196430724281, 23.44  
054108967337, 1.9525720697046762, 21.68960581595725, 1.2116362372849, 33.32088082787743,  
2.4492597445359054, 4.135497020354051, 2.735314610930994, 5.430477460691674, 1214.867217  
3942118, 2.2726973606251155, 1.0673776139335989, 1.853478127899001, 4.102661965664564,  
5.197122041071145]

Max vif is for variable no : 58

Iteration no 31

[151.84691234038374, 4.751306036204824, 138.19114684069234, 1.2213354433500663, 1.059276  
4779280937, 5.522703824566512, 1.0556133949978237, 1.8980215470773834, 81.7259155188483  
8, 2.480754019309727, 91.08241608315481, 489.95402042177085, 4.537082605980154, 132.4790  
3155933284, 132.53738728364056, 476.93425719369657, 1.0848631465565486, 1.05355067095389  
64, 2.758621970642782, 1.2779556583864378, 1.0510086093798379, 0.9559628978306931, 1.439  
099701004403, 1.6014920116114328, 1.3307079619909001, 640.6714031877855, 4.4354184683782  
15, 1.4461559565909952, 1.3027844550540164, 1.1040176272468107, 1.4578986096162247, 3.94  
130572148501, 2.421473257213252, 214.06464923763153, 1.1509300805036566, 15.365906682788  
161, 4.786235906908415, 1.1092223271748085, 1.0574968008608283, 15.97024686219733, 7.278  
882490000493, 1.0627264407580959, 1.0702353854349835, 1.0310894913942958, 2.405514460946  
0015, 1.3918557756767902, 2.0869525538655687, 1.4734853258866907, 1.4238641497146578, 2  
3.246161463899966, 1.1428599843427443, 21.684251968690784, 1.2114597854017768, 33.320598  
203907444, 2.4055740175001947, 559.11028649222, 631.8249994891019, 5.382337994806531, 4.  
643634209339676, 1.0665112504302312, 1.84834627813383, 4.102660306758133, 5.197121644097  
68]

Max vif is for variable no : 25

Iteration no 32

[151.83672613500767, 4.745071180377487, 138.16917585522307, 1.2213112443448004, 1.059268825347307, 5.5220694208063055, 1.0554616720976968, 1.8979548785196538, 81.72236844799907, 2.479888059819891, 74.38389412894499, 178.03785896786334, 4.53688376125086, 132.47686438393873, 132.53277753585962, 476.8744874268916, 1.0791544850780834, 1.053390332001314, 2.7235804223121773, 1.277861565511407, 1.0510079918765094, 0.9559443428171693, 1.4390811349828105, 1.6009154675127861, 1.330542909647196, 4.428817899426784, 1.4458502173136467, 1.3025624918108953, 1.1033551153574574, 1.4541799072105168, 3.941073025138057, 2.4210108948836306, 213.86878578157794, 1.1509203885621633, 15.361210145205076, 4.783816660464702, 1.1092010590502768, 1.0573641876248956, 15.96109188713119, 7.274165498783519, 1.0627155382793356, 1.0700861278077087, 1.0254997305061466, 2.404800333044451, 1.3918324239363415, 4.444923598669975, 1.4728024807023659, 1.4238234140865917, 23.24614853601183, 1.1425344947800646, 21.682785564206014, 1.2112616433386654, 33.32042930586259, 2.405338912631262, 558.0520430613532, 631.239792852559, 5.357073544225873, 4.643584203511524, 1.0655955886228876, 1.8480272096490464, 4.102569235778861, 5.196588876544596]

Max vif is for variable no : 55

Iteration no 33

[151.7004696562861, 4.7047536519307265, 138.1141624891725, 1.2209339056524438, 1.0592227728906356, 4154.629501102576, 1.0554495943104836, 1.8955668236824395, 2.4439014907195267, 2.4313138740034472, 74.32704771851735, 178.00949635271087, 4.536813579379635, 132.47505454450283, 132.52992315929743, 476.8717372140838, 1.0787948453924896, 1.0531779934161705, 2.7194436459390428, 1.2773813422973477, 1.050947161807517, 0.9557153613646017, 1.4277813126797507, 1.6005179361215247, 1.6495697197651598, 4.428553946054909, 1.4458172269399865, 1.3006336322081231, 1.103334061889532, 1.2472925589479003, 3.939349322326562, 2.401907988732363, 213.86688283515548, 1.1509077992713388, 3.1191604079215662, 2.6660655457243587, 1.108680839494829, 1.0572595979132173, 3.736706139951873, 6.950884680978339, 747.3057825462251, 1.0700227949670382, 1.0254992887554293, 2.403884956792727, 1.391642889581367, 2.0563836952884342, 1.4719060556138464, 1.4228983292594273, 23.24148005493073, 1.1422013849843875, 21.66290492558949, 1.2112060833536582, 33.19512637848298, 2.4039076092260685, 1.5770497701219997, 5.07278363884151, 2.2699544764327477, 1.0629911116390125, 1.8464282397777223, 1.0029954237179421, 5.102183477037892]

Max vif is for variable no : 5

Iteration no 34

[144.475773168685, 4.628092236677825, 131.6513123783874, 1.2196434993383911, 1.059160035458322, 1.0553965679833786, 1.8945822308958074, 81.67970359535207, 2.400392179818706, 74.15672826792085, 177.98763703407397, 4.5362092670046215, 132.46414524988282, 132.52885407265862, 476.7402641860449, 1.0782630313431103, 1.0529720769212723, 2.717539971711098, 1.2775651958225838, 1.0507779881494934, 0.9536498249991537, 1.2966857881246512, 1.6004110147309816, 1.6477220617140589, 4.419393719851699, 1.4444562044925222, 1.3005981042987276, 1.103249491520713, 1.2466029600698547, 3.9336263205593287, 2.3027962575878176, 210.31813778214078, 1.1509077251198663, 15.353707564162551, 4.783517581004091, 1.1086741992010563, 1.0571676308532576, 15.809229060004913, 2.9104932119337255, 746.4212392825114, 1.0697240665760515, 1.0254786896230463, 2.3990875377667487, 1.3913836009926832, 2.0495549932049055, 1.4715417242444766, 1.4228889626521402, 22.898429370008024, 1.1410475370648445, 21.658268172993523, 1.211196410761175, 32.490058660972736, 2.4003970731788655, 298.170902733994, 5.0715117587917895, 2.2699172407803823, 1.064221972915382, 1.8451130488808014, 4.102559078511201, 4.937284392095374]

Max vif is for variable no : 39

Iteration no 35

[142.1224231805407, 4.6115042603108956, 129.4724363982263, 1.2196433953477275, 1.0591026407929682, 1.0553959592324837, 1.894428669516326, 81.67219030899699, 2.3663229485181403, 74.15670168503331, 177.98084939020976, 4.536207111802764, 132.45929756058516, 132.5272239199859, 474.3617761028861, 4.973422492873519, 1.0529720347492364, 2.717209339797263, 1.2775642310913156, 1.0507645334817133, 0.9526081824829112, 1.296461921496262, 1.6002760451583304, 1.3287225845827282, 4.417527795856352, 1.3671743040046132, 1.3022605360194015, 1.1032365433540956, 1.453195234806991, 3.9320266305321314, 2.2938325133486024, 210.26196536974436, 1.1509029845079564, 15.329531383042305, 4.783361728869135, 1.1091518996968557, 1.0570370256761197, 15.806871382368644, 2.9103242653214787, 1.0693413624958517, 1.02547851284955, 2.3983955733956743, 1.391326801835978, 2.04923573067744, 1.4713991150304442, 1.4228654781685692, 22.69026743892622, 1.1410310031895694, 21.645362437140786, 1.2111833719526246, 32.48960364621818, 2.398091480724748, 298.0872580012233, 5.070171290544612, 4.6386107476864735, 1.0634815372096575, 1.8427029136670938, 4.1025408497783316, 4.936577332365134]

Max vif is for variable no : 14

Iteration no 36

[141.08553789997785, 4.611204797784756, 128.46050841322958, 1.2195380268908855, 1.0590835222598263, 1.055373440106775, 1.8942554116574302, 81.55413340201608, 2.3617678451720283, 74.14905271433172, 177.97869312933307, 4.536205509595707, 132.4504487801231, 132.52575869002283, 4.972906213047227, 1.0529702515582486, 2.7172012053183434, 1.2775470002463718, 1.0507634153093033, 0.9523481174618491, 1.2963865330478255, 1.6002744569588208, 1.3287183946269572, 4.417506435984275, 1.3670316368045623, 1.3022588137036217, 1.1031240944547744, 1.4531653612243154, 3.93201157688317, 2.291259436348037, 210.26159864210632, 1.1509023431841925, 15.32911179541859, 4.782695060366597, 1.1091453610406912, 1.0570370255664794, 15.806785530849307, 2.9103225790770937, 1.0693395818025933, 1.025474620386796, 2.398362475990057, 1.3913247631555477, 4.4174623371448805, 1.4713976715442254, 1.4227965806940253, 22.63360587474992, 1.1409501234845627, 21.641658532845906, 1.211183064482529, 32.4852401432528, 2.3978053183633796, 298.06919510838037, 5.070134980960648, 4.638489658953331, 1.063469751296863, 1.8417691996668204, 4.102537947703456, 4.936191625409167]

Max vif is for variable no : 51

Iteration no 37

[140.40527329032633, 4.6051373473589825, 127.85829402673865, 1.2191012130751917, 1.058466117477572, 1.0548550221765558, 1.8940729361999045, 81.3055812840762, 2.361766557855648, 74.099998375445, 177.1635648978775, 4.535281776502886, 132.4504342128022, 132.52522420215053, 4.904529426478765, 1.0528361768390775, 2.708803059134273, 1.2775401263780675, 1.0507605191746423, 0.9523432009629057, 1.2957284615125606, 1.6002101806193665, 1.3282738752893275, 4.410161778908017, 1.3667531021416528, 1.3020339543751513, 1.1025521971476435, 1.4524798229544023, 3.9297204220186224, 2.2837339689181833, 210.2415243103239, 1.1508776519500055, 15.318738426426878, 3.9802272305922086, 1.1090608898876346, 1.057036959393647, 15.664849496007571, 2.900839069113238, 1.0693309647987614, 1.0253988678283277, 2.3981847358472286, 1.3913020692007736, 4.238161706142234, 1.4703101684433986, 1.4227864780709383, 22.63321644998841, 1.1409191307814623, 21.585207593916966, 1.211182408890382, 32.27162922244017, 2.3976825946449716, 5.052232397925019, 4.6383682789116305, 1.0634679585279605, 1.839980974523494, 4.1024731321428565, 4.907620720011942]

Max vif is for variable no : 30

Iteration no 38

[140.11939995004977, 4.601106433442636, 127.55618183417481, 1.21146015274957, 1.0551661716947487, 1.0548195861500644, 1.8939479280409544, 81.29620488894899, 2.3523006696934026, 71.14271250246745, 177.07087892885355, 4.534832153884109, 132.45042094434734, 132.52442025275423, 4.903903884018181, 1.0526611394446854, 2.6977684311547874, 1.265726532871995, 1.0485016876810633, 0.9521767481599955, 1.2932559902707872, 1.5377444698290523, 1.3282730221351673, 4.403323867922017, 1.3655985975104614, 1.3010156381288744, 1.0977051240362086, 1.4507611036793788, 3.927829521123713, 2.2837223299509444, 1.1469416009516633, 14.994229110821493, 3.96292646957852, 1.1053104480982365, 1.054873780929517, 15.477139487927817, 2.8811827519316418, 1.0688802310671386, 1.0253327905105936, 2.3871437252815877, 1.3745214329397166, 1.9646911527812565, 1.4700948597180166, 1.4217689869210426, 22.628216989277195, 1.140734608613394, 21.58012964170364, 1.1993485278749376, 32.10887321181718, 2.3939760984849934, 5.049792130472859, 4.553984762246713, 1.0629038937929458, 1.8349050326608873, 4.102439250731136, 4.904253512885846]

Max vif is for variable no : 10

Iteration no 39

[139.59260328944234, 4.578676354196356, 127.15500213566654, 1.2113392831144545, 1.0548842106787213, 1.0496809479221423, 1.8869391411618937, 65.48952230173883, 2.350847449612661, 33.00166223263941, 4.534539384689382, 132.4353890758351, 132.49521488264685, 4.882017110049711, 1.0515031384919225, 2.6938101489596544, 1.265703881793827, 1.0484786163815263, 0.9521650165942495, 1.2931371465709744, 1.5376732729503997, 1.3272105093116948, 4.400955693389555, 1.364460310897829, 1.3010151516814534, 1.097041142715842, 1.4456895480394099, 3.9277193744267436, 2.277533022172979, 1.1468929630488385, 14.987150805908279, 3.9617171357668184, 1.1053061940014823, 1.05472065825347, 15.46876145016925, 2.8762213249745767, 1.0677319238541172, 1.0202341229527159, 2.38408640890488, 1.374511908832366, 4.229304865124899, 1.469779029966537, 1.4200839421014502, 22.59621246123255, 1.1407105268794993, 21.577972117054173, 1.1993366301493829, 32.10854662929785, 2.393669844902885, 5.042237944656984, 4.552737380089638, 1.0608709709098976, 1.8200600160951408, 4.102438188932947, 4.903969892525972]

Max vif is for variable no : 0

Iteration no 40

[4.560747289284023, 2.360186594097417, 1.2094076421285975, 1.0547783343135833, 1.0258570005381349, 1.1165433649026884, 1.9582883222537713, 2.026570509419154, 2.017164400314814, 1.020883482428637, 132.37689962861157, 132.49403718656808, 1.0570758970992102, 1.0512537441685235, 2.68759282741389, 1.2598839854156503, 1.0471672868815838, 0.8747707010728596,

1.2922470807736193, 1.4012771177264804, 1.3271725400016559, 4.3948232858828025, 1.3531613582784892, 1.2986273545212061, 1.0969129187495226, 1.2401191648725158, 3.8675583935917826, 1.5847285882338016, 1.1452198018249504, 3.042635192051277, 2.2075081044015854, 1.1044041255260975, 1.0490743896994341, 3.6299561895039325, 2.872240899638815, 1.0579987257717678, 1.0111094461850751, 2.2697215795128973, 1.315773539090851, 1.8771962081708904, 1.4696441366452682, 1.4200804738790276, 18.85914915624768, 1.1402706459181005, 21.339142893285025, 1.1990834664378094, 2.2000168874289465, 2.1944020926665186, 5.030591357605938, 2.183869826597191, 1.057706776779289, 1.49777085930682, 1.0029464947811595, 2.5671679070030398]

Max vif is for variable no : 11

Iteration no 41

[4.560692255287168, 2.360175886704157, 1.2086742138300173, 1.0546845764504607, 1.0258553114194229, 1.1165420858671902, 1.9581425099600462, 2.0265552712325845, 2.0171237848893293, 1.020880152483665, 0.9239684698310372, 1.0569828718949275, 1.0512536677996096, 2.6875629587484156, 1.2598580243649435, 1.0471627581143603, 0.8747690322576891, 1.2922410515508518, 1.4012702037962639, 1.327159389775372, 4.3943009136355, 1.3531613525871042, 1.2906433260473016, 1.0969115618278884, 1.2399832099649584, 3.8674410399825314, 1.584671100106674, 1.1452191209324927, 3.0424916991053594, 2.207328346111428, 1.1044041140456968, 1.0490712568399436, 3.62962782574712, 2.8720806217166692, 1.0579965311923805, 1.011101874021881, 2.269614829749359, 1.3141948055459185, 1.877168142406708, 1.4696195172515287, 1.4200503721963131, 18.859148977957403, 1.1401726577043811, 21.339126185650954, 1.1990834661848118, 2.199998659218971, 2.1943852733906803, 5.029103306447686, 2.183665989103417, 1.0577053572130306, 1.49775548628343, 1.0029462749946871, 2.567164986423855]

Max vif is for variable no : 43

Iteration no 42

[4.143177519600006, 1.4479020638877995, 1.208619248625275, 1.0545618632576084, 1.025837778081335, 1.1164173531547015, 1.9578800404261392, 1.3752768589212034, 2.0171116042494646, 1.0208527562046625, 0.9220436864381416, 1.0563168009864023, 1.051253021492836, 2.687405858404476, 1.2598171264955709, 1.0463412928034967, 0.8743371443780552, 1.2909701899351207, 1.4003796595450428, 1.3271458842852464, 4.3930947677999415, 1.3418420886778837, 1.2906355083255658, 1.096730327864608, 1.2399539698830877, 3.867233852577633, 1.3447672373421442, 1.1451383392960144, 3.0424901287736335, 2.207013556832733, 1.1043999987065922, 1.049052996577832, 3.628581855158984, 2.8671365308971506, 1.0576334985188767, 1.011100757998594, 2.2692462565898865, 1.3141845195072142, 1.8771677058076492, 1.469619513024143, 1.4200252510248765, 1.4423.086837714542, 1.1399162525353135, 1.1988594602803568, 2.1976345797221093, 2.1939865226724513, 5.027536017982444, 2.1835247534719593, 1.0575701375173363, 1.4962275105035217, 1.002945076862517, 2.567078833789251]

Max vif is for variable no : 41

Iteration no 43

[1.1470416520817353, 0.8818228288843423, 1.2085485739188282, 1.0545339713116622, 1.0495140109082357, 1.88405999509054, 65.40636483904707, 1.3755279387323007, 32.752326832531914, 1.0208501296789076, 0.9192977741073698, 1.0562176830049543, 1.0512113230108893, 2.6848992713066697, 1.256907083547614, 1.041978880122135, 0.8642609042352009, 1.2888240918542437, 1.5326658480288124, 1.3264590766112556, 4.392677459246204, 1.1944202412524798, 1.2922882900936554, 1.0967300835869982, 1.444999373534515, 3.8570438268233467, 1.2054862096354844, 1.1463547658854127, 14.98247920178043, 3.9547069276647706, 1.103533949183173, 1.05458443262095, 15.09283234431665, 2.862776672594182, 1.0646357637976065, 1.0202195476093645, 2.2549871250372937, 1.3721584760158185, 4.003458213670861, 1.4689319346263252, 1.420024192488655, 1.1399128443998996, 1.1986058504933599, 31.842335154936254, 2.165217437579002, 5.022702366770009, 4.388413353593363, 1.057181760485908, 1.4503423255471863, 4.1022831659953285, 4.790025980178837]

Max vif is for variable no : 6

Iteration no 44

[1.1468768878622662, 0.8815779693474786, 1.202603034159136, 1.0516847303565569, 1.0478795387703677, 1.8839317710289856, 1.3754626173376434, 23.675604977071544, 4.534133573141216, 0.9192797488392095, 1.0550840875143477, 1.051178888741455, 2.679793193799081, 1.2569070830512976, 1.0419771487586404, 0.8640175402345628, 1.2883837269935468, 1.5307037220394715, 1.3257034160893029, 4.382834738274568, 1.1943584570985937, 1.2921667544592716, 1.0905588791752023, 1.442859636715871, 3.854631712418256, 1.2054796595947481, 1.1461969598861548, 14.940119239360286, 3.9442976992287204, 1.1033341045363014, 1.0544630554712264, 14.823915430077134, 2.862776081373064, 1.0632992068014975, 1.0201381636527143, 2.134686385768237, 1.3721204932058, 1.8527786615606778, 1.4687989699790276, 1.419664356047946, 1.1386615675276917, 1.1984157650026799, 31.746745423597293, 2.157534814589375, 5.015642633266676, 4.3882288370794695, 1.057051599937959, 1.4439306370430585, 4.101549257900018, 4.788827285972028]

Max vif is for variable no : 42

Iteration no 45

[1.1455954189435353, 0.8802477746510878, 1.2017764996635094, 1.0514811553203645, 1.0434834957054306, 1.8838448909389396, 1.3467126756844925, 23.665987024031327, 4.533945378601555, 0.9191516531682057, 1.0549231650989161, 1.0505912236550132, 2.6742454814263334, 1.2568619461853385, 1.0406218126419136, 0.8639568638828956, 1.2572279667533703, 1.530417373669316, 1.3184152346366407, 4.314841323870838, 1.1943323050924795, 1.2921088084306966, 1.087666508555954, 1.423511429810457, 3.7555296193859316, 1.2037451966166741, 1.1459882966594677, 14.581609811584745, 3.9210602622276167, 1.1019149976600784, 1.0544380461144305, 10.78566839012119, 2.8586834954904226, 1.0624756244048532, 1.0182458270440238, 2.087982235288998, 1.371816264061848, 1.8330343487744731, 1.4666743486684493, 1.4195617556744773, 1.1384893259924618, 1.1984154844180683, 2.063557942976764, 5.0134714610754445, 4.385845094301268, 1.057039065234694, 1.4270641647378293, 4.101543589229231, 4.1029029267222]

Max vif is for variable no : 7

Iteration no 46

[1.1404561140204978, 0.871050254730208, 1.1990946416446107, 1.050368348799786, 1.0433849501419667, 1.8659166926054012, 1.3465328439553812, 4.532295380605765, 0.9190201399036132, 1.04749813747718, 1.0505853293743046, 895.5410679930741, 1.2558142944685728, 1.0403123179220883, 0.860843857167957, 1.2572063129758129, 1.5268604946274797, 1.6330378455761105, 4.2653809320747, 1.193579081739733, 1.2919066776170447, 1.0876558684363076, 1.2204021086785894, 3.755456039246217, 1.2031509613541895, 1.1446993484727146, 14.57986132254617, 3.8915014727806105, 1.1013527707309658, 1.054310673031354, 10.773316125913466, 2.8586574965467246, 1.0599387306366526, 1.0180516160226374, 1.9638006675463187, 1.370989113525584, 1.824705011049574, 1.461172569051026, 1.41945192162326, 1.137965148336148, 1.1981584931248805, 2.063183107317838, 509.1057489770541, 4.370302073269095, 1.056720975120328, 1.4262378600375327, 4.101530566695989, 4.09496944422433]

Max vif is for variable no : 11

Iteration no 47

[1.140182694332601, 0.8703059990821341, 1.1988196704316, 1.0501774889337223, 1.0422733476178148, 1.8649637905127978, 1.3448923529747092, 4.529812942190834, 0.916310293235503, 1.0474801424791345, 1.0491410445920308, 1.2557940686028086, 1.040300293271724, 0.8597401947353208, 1.2524371111934312, 1.52615773960554, 1.3158895405472075, 12.406059902879738, 1.1934262672055609, 1.2912095068476293, 1.0873934360078803, 1.422554892803882, 7.453782999134831, 1.20310668490865, 1.1444886983778833, 14.569401334162443, 3.8791516769378833, 1.0966661541872404, 1.0542012842061266, 1.076428311108788, 276.42631020309824, 1.0598793652331127, 1.017886397104867, 1.9459269208559975, 1.3708327568870873, 3.9301395741998877, 1.461033999644815, 1.4193683188645967, 1.1379644072506754, 1.1978868452783311, 2.058724245537881, 262.1677470424688, 4.368099094719859, 1.056661065756184, 1.3487307014805567, 4.101328111576599, 4.086417002125572]

Max vif is for variable no : 30

Iteration no 48

[1.1398263434269493, 0.8702026790322492, 1.1988178326616676, 1.0501289124734552, 1.04224454852501, 1.8649355223961919, 1.3315858413938906, 4.529170248600158, 0.9156317062712814, 1.0473379937126968, 1.0487896298127668, 1.2556316439181945, 1.0402859210450115, 0.8596403985486764, 1.1840644005914431, 1.5261189794706262, 1.3158562463920678, 12.401087906580965, 1.1933336737794649, 1.291179265441741, 1.0872183152491408, 1.4222690299975047, 7.448422591027696, 1.2022827042210185, 1.1444064206863016, 14.550509261190818, 3.866817508804468, 1.0964475267424407, 1.0541848279894508, 10.691168989607489, 1.0595189159395477, 1.0166897184777803, 1.9437186934439143, 1.369561956653677, 3.927928343861989, 1.460338426707351, 1.4193601260141133, 1.1377216961900949, 1.1977691013283602, 2.0573029551275743, 138.9566159849309, 4.3657543909940495, 1.0557104489978535, 1.3484782581216739, 4.101320930706265, 3.7059496582832403]

Max vif is for variable no : 40

Iteration no 49

[1.139635943622052, 0.8701716863355428, 1.1983506901312617, 1.0471433608831844, 1.042244546671308, 1.8592105245869246, 1.3314226641191744, 4.519251536051953, 0.9148161071546048, 1.0408217618284887, 1.0486387674296445, 1.2547539058237493, 1.0402575047658225, 0.8596317447803349, 1.1824243822007012, 1.524296855058618, 1.6312348456306511, 12.401039683362852, 1.1933329585796517, 1.2911738323785444, 1.0867963845530717, 1.4182682330487626, 7.445095529509006, 1.202177602133285, 1.144265239456413, 14.492664044673903, 3.6460469952245234, 1.0961023040494497, 1.054124748479571, 10.524844467489956, 1.0588852706967933, 1.0151160986841852, 1.785745003160463, 1.3694693722049127, 3.9136410669602126, 1.4558929694417413, 1.4191806416710429, 1.1377016614565758, 1.1977680405750484, 2.055730727087383, 4.354455148190653, 1.0554133040623057, 1.3481403573368667, 4.1011311305265385, 3.6999294286565925]



```
Max vif is for variable no : 25
Iteration no 50
[1.1363209694977277, 0.8678139044557892, 1.1979572732217978, 1.0406353706782496, 1.04147
22204657114, 1.8532329631591835, 1.329397624979743, 4.5134307154712605, 0.91480890060497
08, 1.0408216729864375, 1.0482580866701883, 1.2392803016927216, 1.0351384419867329, 0.85
95130588830354, 1.180685953120282, 1.5225439508561855, 1.631172561135836, 3.900136698897
3363, 1.1872725783619105, 1.2822892678714226, 1.078495319235163, 1.3910736761743796, 7.4
449948113864215, 1.2013768142761998, 1.1424091812322046, 2.6174436992250785, 1.095845952
1282007, 1.0531393747095508, 9.572337420532211, 1.0523401602599511, 1.0147866325467934,
1.7780324162696965, 1.3640031229435157, 3.837897717377776, 1.441365786789446, 1.3368609
402496576, 1.1364536888476262, 1.197259135167034, 2.0556955758819635, 3.989019331738341,
1.0548674755624834, 1.346804992679108, 4.101042118121842, 3.6566525470611984]
Max vif is for variable no : 28
Iteration no 51
[1.131428559905233, 0.8480686878944798, 1.195880990675289, 1.0393475471622737, 1.0380929
585710803, 1.8527654243485023, 1.3243275548475382, 4.512618028792034, 0.914142615268702
9, 1.0398320243346806, 1.0444837746708862, 1.2131458440371274, 1.0315813677619292, 0.854
795608476406, 1.1611017481802772, 1.5145998452677065, 1.6284706616609472, 3.881546868333
0883, 1.1868590405051214, 1.281517583292478, 1.0784906012294322, 1.3639554537285954, 6.8
38535537281655, 1.2012353923935466, 1.1423348717292106, 2.6079001691709234, 1.0914826929
600652, 1.0476266863146662, 1.0522758113017905, 1.013044731136438, 1.7520967090325936,
1.3579806829131573, 3.83776820521023, 1.4069460101266398, 1.3368606387505246, 1.1343894
945744248, 1.1971029328615772, 1.9905185879079403, 3.576167419494417, 1.054641063358826
3, 1.335833539719264, 4.10102251562703, 3.0697089410515033]
Max vif is for variable no : 22
Iteration no 52
[1.131420994620163, 0.847716155391259, 1.1956947325438037, 1.0381284830372268, 1.0362783
011401788, 1.852760078511525, 1.324265023406027, 4.509253198335249, 0.9127060717865682,
1.0393014337465363, 1.034106739236278, 1.2064433460570547, 1.0314604886025585, 0.853584
9650593519, 1.1610271018357354, 1.5143553524287787, 1.621352127073525, 1.648032374084769
8, 1.186264115856146, 1.2814584691829851, 1.0783697579312659, 1.1700181463510184, 1.2005
31550724374, 1.1423332081347664, 2.603600539503169, 1.0697897668799576, 1.04757057651568
64, 1.050962915207719, 1.0129641265689058, 1.7049886296133512, 1.357096389416391, 1.7625
557470717832, 1.4022337796303532, 1.3361348382216955, 1.1332464070440098, 1.196985123367
3867, 1.7156163903879522, 1.6827606483661766, 1.054343310887894, 1.306856065999612, 4.10
1022470449611, 3.0694299717394227]
Max vif is for variable no : 7
```

In [23]:

select\_features.head()

Out[23]:

	Non-industry income and expenditure/revenue	Continuous interest rate (after tax)	Operating Expense Rate	Research and development expense rate	Interest- bearing debt interest rate	Tax rate (A)	Revenue Per Share (Yuan ¥)	Realized Sales Gross Profit Growth Rate	t
0	0.302646	0.780985	1.256969e-04	0.0	0.000725	0.0	0.017560	0.022102	0.0
1	0.303556	0.781506	2.897851e-04	0.0	0.000647	0.0	0.021144	0.022080	0.0
2	0.302035	0.780284	2.361297e-04	25500000.0	0.000790	0.0	0.005944	0.022760	0.0
3	0.303350	0.781241	1.078888e-04	0.0	0.000449	0.0	0.014368	0.022046	0.0
4	0.303475	0.781550	7.890000e+09	0.0	0.000686	0.0	0.029690	0.022096	0.0

5 rows × 42 columns

In [24]:

X = select\_features

```
In [25]: from sklearn.feature_selection import SelectKBest, mutual_info_classif, f_regression, c

# define feature selection
fs = SelectKBest(score_func=f_regression, k=10)
# apply feature selection
X_selected = fs.fit_transform(X, y)
print(X_selected.shape)
```

(6819, 10)

```
In [26]: # create filter mask to identify feature names
filter = fs.get_support()
features = array(X.columns)
print(features[filter])

[' Tax rate (A)' ' Fixed Assets Turnover Frequency' ' Cash/Total Assets'
 ' Cash/Current Liability' ' Retained Earnings to Total Assets'
 ' Total expense/Assets' ' Equity to Long-term Liability'
 ' Current Liability to Current Assets'
 " Net Income to Stockholder's Equity" ' Equity to Liability']
```

```
In [27]: # create list of columns to drop from df
columns_to_remove = X.columns.values[np.logical_not(filter)]
columns_to_remove
```

```
Out[27]: array([' Non-industry income and expenditure/revenue',
 ' Continuous interest rate (after tax)', ' Operating Expense Rate',
 ' Research and development expense rate',
 ' Interest-bearing debt interest rate',
 ' Revenue Per Share (Yuan ¥)',
 ' Realized Sales Gross Profit Growth Rate',
 ' After-tax Net Profit Growth Rate', ' Total Asset Growth Rate',
 ' Net Value Growth Rate', ' Current Ratio', ' Quick Ratio',
 ' Interest Expense Ratio', ' Total debt/Total net worth',
 ' Long-term fund suitability ratio (A)',
 ' Contingent liabilities/Net worth', ' Total Asset Turnover',
 ' Accounts Receivable Turnover', ' Average Collection Days',
 ' Inventory Turnover Rate (times)', ' Revenue per person',
 ' Allocation rate per person', ' Quick Assets/Current Liability',
 ' Inventory/Current Liability',
 ' Long-term Liability to Current Assets',
 ' Total income/Total expense', ' Current Asset Turnover Rate',
 ' Quick Asset Turnover Rate', ' Cash Turnover Rate',
 ' Fixed Assets to Assets', ' Total assets to GNP price',
 ' Degree of Financial Leverage (DFL)'], dtype=object)
```

```
In [28]: # remove features from data
df1 = X.drop(columns=columns_to_remove)
df1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6819 entries, 0 to 6818
Data columns (total 10 columns):
#   Column                                Non-Null Count  Dtype
---  -
0   Tax rate (A)                          6819 non-null   float64
1   Fixed Assets Turnover Frequency        6819 non-null   float64
2   Cash/Total Assets                      6819 non-null   float64
```

```

3    Cash/Current Liability      6819 non-null float64
4    Retained Earnings to Total Assets  6819 non-null float64
5    Total expense/Assets        6819 non-null float64
6    Equity to Long-term Liability  6819 non-null float64
7    Current Liability to Current Assets  6819 non-null float64
8    Net Income to Stockholder's Equity  6819 non-null float64
9    Equity to Liability          6819 non-null float64
dtypes: float64(10)
memory usage: 532.9 KB

```

## Removing Anomalies with Isolation Forests

In [29]:

```
df2 = df1
```

In [30]:

```

#Isolation Forest Identifies anomalies
model=IsolationForest(n_estimators=100, contamination=float(.05), random_state=42)

model.fit(df1)

```

C:\Users\sjue\Anaconda3\lib\site-packages\sklearn\base.py:450: UserWarning: X does not have valid feature names, but IsolationForest was fitted with feature names  
warnings.warn(

Out[30]:

```

▼ IsolationForest
IsolationForest(contamination=0.05, random_state=42)

```

In [31]:

```

df2['scores'] = model.decision_function(df1)
df1 = X.drop(columns=columns_to_remove)

```

In [32]:

```

#Removing anomalies from the dataset

df2['anomaly_score'] = model.predict(df1)

df3 = pd.concat([y, df2], axis=1)

df4 = df3[df3['anomaly_score']!=-1]

df5 = df4.drop(columns = ['scores', 'anomaly_score'])
df5.head(10)

```

Out[32]:

	Bankrupt?	Tax rate (A)	Fixed Assets Turnover Frequency	Cash/Total Assets	Cash/Current Liability	Retained Earnings to Total Assets	Total expense/Assets	Equity to Long-term Liability	
0	1	0.000000	1.165007e-04	0.004094	0.000147	0.903225	0.064856	0.126549	C
1	1	0.000000	7.190000e+08	0.014948	0.001384	0.931065	0.025516	0.120916	C
3	1	0.000000	9.150000e+09	0.018851	0.001011	0.906902	0.024161	0.120760	C
4	1	0.000000	2.935211e-04	0.014161	0.000680	0.913850	0.026385	0.110933	C
6	0	0.000000	1.452476e-04	0.022989	0.001050	0.911441	0.092802	0.120561	C

	Bankrupt?	Tax rate (A)	Fixed Assets Turnover Frequency	Cash/Total Assets	Cash/Current Liability	Retained Earnings to Total Assets	expense/Assets	Total Assets	Equity to Long- term Liability	
7	0	0.157607	5.182010e-04	0.014616	0.000888	0.935449	0.025482	0.114508	C	
8	0	0.005871	2.458618e-04	0.145189	0.013190	0.935200	0.029884	0.110933	C	
9	0	0.392449	7.383418e-04	0.008773	0.000491	0.938290	0.035891	0.115499	C	
10	0	0.000000	1.747510e-04	0.002057	0.000336	0.942829	0.028802	0.120943	C	
11	0	0.000000	1.066662e-04	0.020542	0.002254	0.932955	0.056952	0.116459	C	
<div><div></div><div></div><div></div></div>										

```
In [33]: X = df5.drop(columns=['Bankrupt?'], axis=1)
X.shape
y = df5['Bankrupt?']
```

## Data Prep

### Split the Data for Training

```
In [34]: X = df5.drop(columns=['Bankrupt?'], axis=1)
X.shape
```

```
Out[34]: (6478, 10)
```

```
In [35]: y = df5['Bankrupt?']
```

```
In [36]: # split data in to training and test data
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=4)
```

### Scale the Data

```
In [37]: # use StandardScaler to scale features
scaler = StandardScaler()

#scale the training data
X_train_scaled = scaler.fit_transform(X_train)
X_train = pd.DataFrame(X_train_scaled, columns = X_train.columns)
# scale test data for model testing
X_test_scaled = scaler.fit_transform(X_test)
X_test = pd.DataFrame(X_test_scaled, columns = X_test.columns)
```

### SMOTE for Training Data

```
In [38]: from imblearn.over_sampling import SMOTE
```

```
In [39]: sm = SMOTE(sampling_strategy='minority', random_state=42)
X_train, y_train = sm.fit_resample(X_train, y_train)
```

## Models

### Support Vector Machine (SVM)

```
In [40]: ## SVM Classifier model
svm_clf = SVC(kernel="rbf", C=1, probability=True)
svm_clf.fit(X_train, y_train)
svm_model = svm_clf.fit(X_train, y_train)
```

```
In [41]: # kfold cross validation
score = cross_val_score(svm_model, X_train, y_train, cv=10, verbose=3)
score.mean()
```

```
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[CV] END ..... score: (test=0.902) total time= 7.4s
[Parallel(n_jobs=1)]: Done 1 out of 1 | elapsed: 7.4s remaining: 0.0s
[CV] END ..... score: (test=0.873) total time= 7.2s
[Parallel(n_jobs=1)]: Done 2 out of 2 | elapsed: 14.7s remaining: 0.0s
[CV] END ..... score: (test=0.897) total time= 8.4s
[CV] END ..... score: (test=0.906) total time= 7.6s
[CV] END ..... score: (test=0.892) total time= 7.3s
[CV] END ..... score: (test=0.897) total time= 7.2s
[CV] END ..... score: (test=0.898) total time= 6.7s
[CV] END ..... score: (test=0.897) total time= 6.7s
[CV] END ..... score: (test=0.910) total time= 6.9s
[CV] END ..... score: (test=0.894) total time= 6.7s
[Parallel(n_jobs=1)]: Done 10 out of 10 | elapsed: 1.2min finished
```

```
Out[41]: 0.8966787276715028
```

```
In [42]: # predictions
y_pred = svm_model.predict(X_test)
```

```
In [43]: # precision and recall scores
print("Precision: {:.2f}%".format(100 * precision_score(y_test, y_pred)))
print("Recall: {:.2f}%".format(100 * recall_score(y_test, y_pred)))
```

```
Precision: 15.18%
Recall: 82.86%
```

```
In [44]: # f1 score
f1_score(y_test, y_pred)
```

```
Out[44]: 0.2566371681415929
```

### Tuning SVM Model Hyperparameters

In [45]:

```
# create grid search cross validation to tunr hyperparameters of SVC model
param_grid = {'C': [0.1, 1, 10, 100], 'gamma': [1,0.1,0.01,0.001]}

grid = GridSearchCV(SVC(probability=True, kernel='rbf'),param_grid,refit=True,verbose=2
grid.fit(X_train,y_train);
```

Fitting 5 folds for each of 16 candidates, totalling 80 fits

```
[CV] END .....C=0.1, gamma=1; total time= 9.7s
[CV] END .....C=0.1, gamma=1; total time= 9.7s
[CV] END .....C=0.1, gamma=1; total time= 9.7s
[CV] END .....C=0.1, gamma=1; total time= 9.9s
[CV] END .....C=0.1, gamma=1; total time= 11.4s
[CV] END .....C=0.1, gamma=0.1; total time= 7.8s
[CV] END .....C=0.1, gamma=0.1; total time= 9.5s
[CV] END .....C=0.1, gamma=0.1; total time= 8.3s
[CV] END .....C=0.1, gamma=0.1; total time= 7.5s
[CV] END .....C=0.1, gamma=0.1; total time= 7.8s
[CV] END .....C=0.1, gamma=0.01; total time= 9.0s
[CV] END .....C=0.1, gamma=0.01; total time= 8.1s
[CV] END .....C=0.1, gamma=0.01; total time= 8.2s
[CV] END .....C=0.1, gamma=0.01; total time= 8.2s
[CV] END .....C=0.1, gamma=0.01; total time= 8.2s
[CV] END .....C=0.1, gamma=0.001; total time= 11.4s
[CV] END .....C=0.1, gamma=0.001; total time= 11.5s
[CV] END .....C=0.1, gamma=0.001; total time= 11.3s
[CV] END .....C=0.1, gamma=0.001; total time= 11.4s
[CV] END .....C=0.1, gamma=0.001; total time= 11.4s
[CV] END .....C=1, gamma=1; total time= 6.0s
[CV] END .....C=1, gamma=1; total time= 6.1s
[CV] END .....C=1, gamma=1; total time= 6.2s
[CV] END .....C=1, gamma=1; total time= 6.2s
[CV] END .....C=1, gamma=1; total time= 6.6s
[CV] END .....C=1, gamma=0.1; total time= 5.2s
[CV] END .....C=1, gamma=0.1; total time= 5.2s
[CV] END .....C=1, gamma=0.1; total time= 5.1s
[CV] END .....C=1, gamma=0.1; total time= 5.2s
[CV] END .....C=1, gamma=0.1; total time= 5.3s
[CV] END .....C=1, gamma=0.01; total time= 6.5s
[CV] END .....C=1, gamma=0.01; total time= 6.6s
[CV] END .....C=1, gamma=0.01; total time= 6.6s
[CV] END .....C=1, gamma=0.01; total time= 6.6s
[CV] END .....C=1, gamma=0.01; total time= 6.7s
[CV] END .....C=1, gamma=0.001; total time= 8.2s
[CV] END .....C=1, gamma=0.001; total time= 8.2s
[CV] END .....C=1, gamma=0.001; total time= 8.3s
[CV] END .....C=1, gamma=0.001; total time= 8.3s
[CV] END .....C=1, gamma=0.001; total time= 8.3s
[CV] END .....C=10, gamma=1; total time= 5.3s
[CV] END .....C=10, gamma=1; total time= 5.3s
[CV] END .....C=10, gamma=1; total time= 5.9s
[CV] END .....C=10, gamma=1; total time= 5.4s
[CV] END .....C=10, gamma=1; total time= 5.3s
[CV] END .....C=10, gamma=0.1; total time= 4.2s
[CV] END .....C=10, gamma=0.1; total time= 4.4s
[CV] END .....C=10, gamma=0.1; total time= 4.3s
[CV] END .....C=10, gamma=0.1; total time= 4.3s
[CV] END .....C=10, gamma=0.1; total time= 4.3s
[CV] END .....C=10, gamma=0.01; total time= 5.7s
[CV] END .....C=10, gamma=0.01; total time= 5.9s
[CV] END .....C=10, gamma=0.01; total time= 5.8s
[CV] END .....C=10, gamma=0.01; total time= 5.9s
[CV] END .....C=10, gamma=0.01; total time= 5.9s
[CV] END .....C=10, gamma=0.001; total time= 7.0s
```

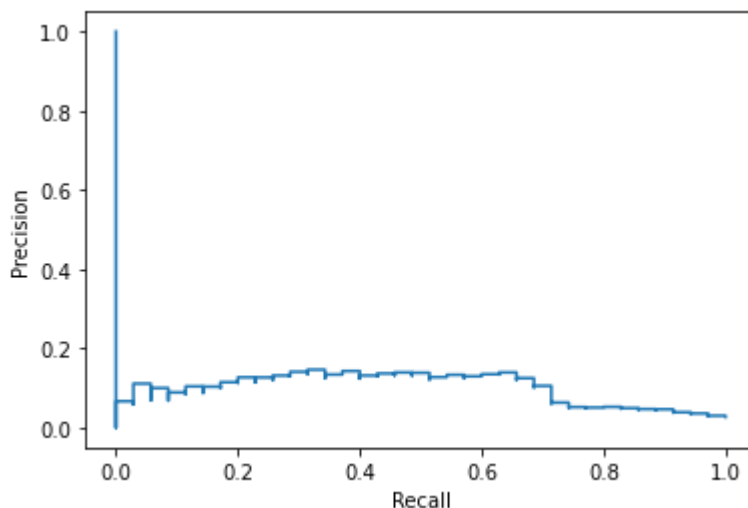
```
[CV] END .....C=10, gamma=0.001; total time= 6.9s
[CV] END .....C=10, gamma=0.001; total time= 7.1s
[CV] END .....C=10, gamma=0.001; total time= 6.9s
[CV] END .....C=10, gamma=0.001; total time= 7.0s
[CV] END .....C=100, gamma=1; total time= 5.1s
[CV] END .....C=100, gamma=1; total time= 5.5s
[CV] END .....C=100, gamma=1; total time= 5.5s
[CV] END .....C=100, gamma=1; total time= 5.6s
[CV] END .....C=100, gamma=1; total time= 5.6s
[CV] END .....C=100, gamma=0.1; total time= 5.1s
[CV] END .....C=100, gamma=0.1; total time= 5.4s
[CV] END .....C=100, gamma=0.1; total time= 5.4s
[CV] END .....C=100, gamma=0.1; total time= 5.2s
[CV] END .....C=100, gamma=0.1; total time= 5.4s
[CV] END .....C=100, gamma=0.01; total time= 6.4s
[CV] END .....C=100, gamma=0.01; total time= 6.3s
[CV] END .....C=100, gamma=0.01; total time= 6.3s
[CV] END .....C=100, gamma=0.01; total time= 6.5s
[CV] END .....C=100, gamma=0.01; total time= 6.3s
[CV] END .....C=100, gamma=0.001; total time= 6.5s
[CV] END .....C=100, gamma=0.001; total time= 6.6s
[CV] END .....C=100, gamma=0.001; total time= 6.6s
[CV] END .....C=100, gamma=0.001; total time= 6.6s
[CV] END .....C=100, gamma=0.001; total time= 6.6s
```

```
In [46]: # print optimal values for C and gamma
print(grid.best_estimator_)
```

```
SVC(C=10, gamma=1, probability=True)
```

```
In [47]: y_pred = grid.predict(X_test)
y_pred_proba = grid.predict_proba(X_test)
y_score = grid.decision_function(X_test)
```

```
In [48]: #Precision/Recall
prec, recall, _ = precision_recall_curve(y_test, y_score, pos_label=grid.classes_[1])
pr_display = PrecisionRecallDisplay(precision=prec, recall=recall).plot()
```



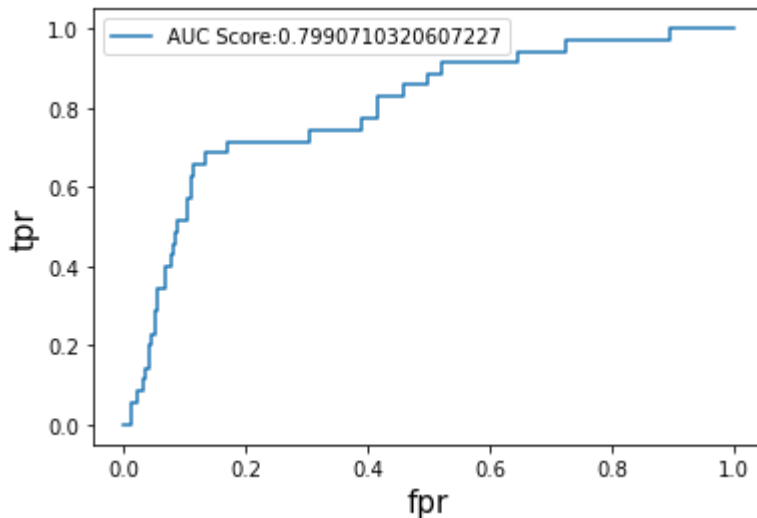
```
In [49]: #Plot the ROC curve
fpr, tpr, ths = roc_curve(y_test, y_pred_proba[:,1])
```

```

auc_score = auc(fpr, tpr)
plt.plot(fpr, tpr, label="AUC Score:" + str(auc_score))
plt.xlabel('fpr', fontsize='15')
plt.ylabel('tpr', fontsize='15')
plt.legend(loc='best')

```

Out[49]: <matplotlib.legend.Legend at 0x174af22aa90>



In [50]:

```

cnf_matrix = confusion_matrix(y_test, y_pred)

FP = cnf_matrix.sum(axis=0) - np.diag(cnf_matrix)
FN = cnf_matrix.sum(axis=1) - np.diag(cnf_matrix)
TP = np.diag(cnf_matrix)
TN = cnf_matrix.sum() - (FP + FN + TP)

FP = FP.astype(float)
FN = FN.astype(float)
TP = TP.astype(float)
TN = TN.astype(float)

# Sensitivity, hit rate, recall, or true positive rate
TPR = TP / (TP + FN)
# Specificity or true negative rate
TNR = TN / (TN + FP)
# Precision or positive predictive value
PPV = TP / (TP + FP)
# Negative predictive value
NPV = TN / (TN + FN)
# Fall out or false positive rate
FPR = FP / (FP + TN)
# False negative rate
FNR = FN / (TP + FN)
# False discovery rate
FDR = FP / (TP + FP)
# Overall accuracy
ACC = (TP + TN) / (TP + FP + FN + TN)

results = pd.DataFrame(columns = ['Model', 'TPR', 'FPR', 'precision', 'recall', 'accuracy'])

#eval
Model = 'SVM'
TPR = [round(num, 2) for num in TPR]

```



```

FPR = [round(num, 2) for num in FPR]
precision = [round(num, 2) for num in PPV]
recall = [round(num, 2) for num in TPR]
accuracy = [round(num, 2) for num in ACC]
f1_value = round(f1_score(y_pred, y_test), 2)
row = [Model, TPR, FPR, precision, recall, accuracy, f1_value]
results = results.append(pd.DataFrame([row], columns=results.columns), ignore_index=True)
results

```

```

Out[50]:

```

	Model	TPR	FPR	precision	recall	accuracy	f1-value
0	SVM	[0.97, 0.09]	[0.91, 0.03]	[0.97, 0.08]	[0.97, 0.09]	[0.95, 0.95]	0.08

## Logistic Regression Model

```

In [51]:
# create logistic model
log_clf = LogisticRegression(C=1.0, penalty='l2', solver='newton-cg')

log_model = log_clf.fit(X_train, y_train)

```

```

In [52]:
# kfold validation
score = cross_val_score(log_clf, X_train, y_train, cv=3, verbose=3)
score.mean()

```

```

[CV] END ..... score: (test=0.850) total time= 0.0s
[CV] END ..... score: (test=0.845) total time= 0.0s
[CV] END ..... score: (test=0.855) total time= 0.0s
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done 1 out of 1 | elapsed: 0.0s remaining: 0.0s
[Parallel(n_jobs=1)]: Done 2 out of 2 | elapsed: 0.0s remaining: 0.0s
[Parallel(n_jobs=1)]: Done 3 out of 3 | elapsed: 0.0s finished

```

```

Out[52]: 0.8501087474292569

```

```

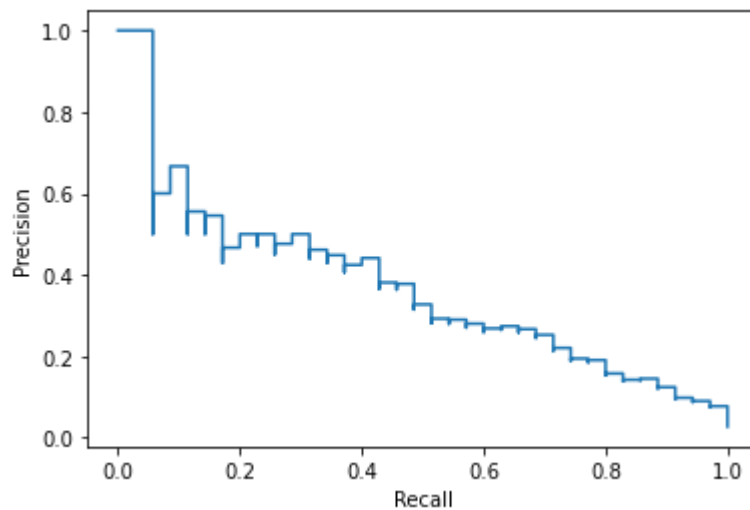
In [53]:
y_pred = log_model.predict(X_test)
y_pred_proba = log_clf.predict_proba(X_test)
y_score = log_clf.decision_function(X_test)

```

```

In [54]:
#Precision/Recall
prec, recall, _ = precision_recall_curve(y_test, y_score, pos_label=log_clf.classes_[1])
pr_display = PrecisionRecallDisplay(precision=prec, recall=recall).plot()

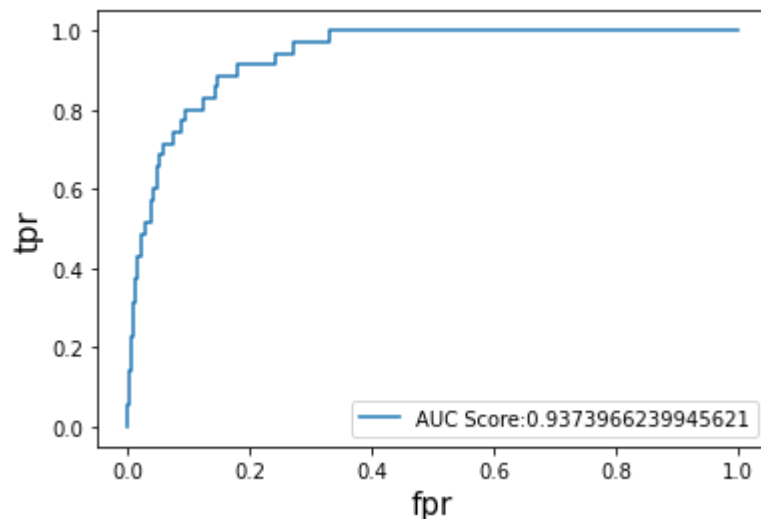
```



```
In [55]: fpr, tpr, ths = roc_curve(y_test, y_pred_proba[:,1])

auc_score = auc(fpr,tpr)
plt.plot(fpr,tpr,label="AUC Score:" + str(auc_score))
plt.xlabel('fpr',fontsize='15')
plt.ylabel('tpr',fontsize='15')
plt.legend(loc='best')
```

Out[55]: <matplotlib.legend.Legend at 0x174afc71850>



```
In [56]: cnf_matrix = confusion_matrix(y_test,y_pred)

FP = cnf_matrix.sum(axis=0) - np.diag(cnf_matrix)
FN = cnf_matrix.sum(axis=1) - np.diag(cnf_matrix)
TP = np.diag(cnf_matrix)
TN = cnf_matrix.sum() - (FP + FN + TP)

FP = FP.astype(float)
FN = FN.astype(float)
TP = TP.astype(float)
TN = TN.astype(float)

# Sensitivity, hit rate, recall, or true positive rate
TPR = TP/(TP+FN)
```

```

# Specificity or true negative rate
TNR = TN/(TN+FP)
# Precision or positive predictive value
PPV = TP/(TP+FP)
# Negative predictive value
NPV = TN/(TN+FN)
# Fall out or false positive rate
FPR = FP/(FP+TN)
# False negative rate
FNR = FN/(TP+FN)
# False discovery rate
FDR = FP/(TP+FP)
# Overall accuracy
ACC = (TP+TN)/(TP+FP+FN+TN)

#eval
Model = 'Logistic Regression'
TPR = [round(num, 2) for num in TPR]
FPR = [round(num, 2) for num in FPR]
precision = [round(num, 2) for num in PPV]
recall = [round(num, 2) for num in TPR]
accuracy = [round(num, 2) for num in ACC]
f1_value = round(f1_score(y_pred, y_test),2)
row = [Model, TPR, FPR, precision, recall, accuracy, f1_value]
results = results.append(pd.DataFrame([row], columns=results.columns), ignore_index=True)
results

```

Out[56]:

	Model	TPR	FPR	precision	recall	accuracy	f1-value
0	SVM	[0.97, 0.09]	[0.91, 0.03]	[0.97, 0.08]	[0.97, 0.09]	[0.95, 0.95]	0.08
1	Logistic Regression	[0.83, 0.89]	[0.11, 0.17]	[1.0, 0.13]	[0.83, 0.89]	[0.83, 0.83]	0.22

## Naïve Bayes model

In [57]:

```

# create naive bayes model
nb_clf = GaussianNB()
nb_model = nb_clf.fit(X_train, np.ravel(y_train))

```

In [58]:

```

# kfold cross validation
score = cross_val_score(nb_clf, X_train, y_train, cv=3, verbose=3)
score.mean()

```

```

[CV] END ..... score: (test=0.832) total time= 0.0s
[CV] END ..... score: (test=0.821) total time= 0.0s
[CV] END ..... score: (test=0.842) total time= 0.0s
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done 1 out of 1 | elapsed: 0.0s remaining: 0.0s
[Parallel(n_jobs=1)]: Done 2 out of 2 | elapsed: 0.0s remaining: 0.0s
[Parallel(n_jobs=1)]: Done 3 out of 3 | elapsed: 0.0s finished

```

Out[58]: 0.8315206611318201

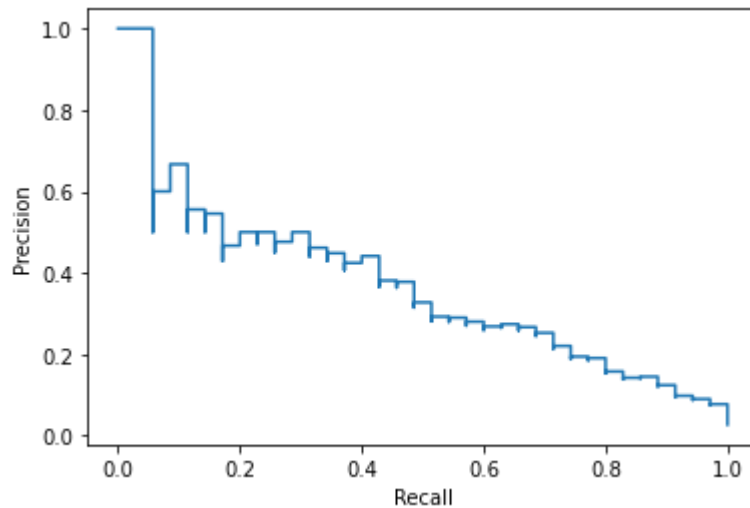
In [59]:

```

y_pred = nb_model.predict(X_test)
y_pred_proba = nb_clf.predict_proba(X_test)

```

```
In [60]: #Precision/Recall
prec, recall, _ = precision_recall_curve(y_test, y_score, pos_label=nb_clf.classes_[1])
pr_display = PrecisionRecallDisplay(precision=prec, recall=recall).plot()
```

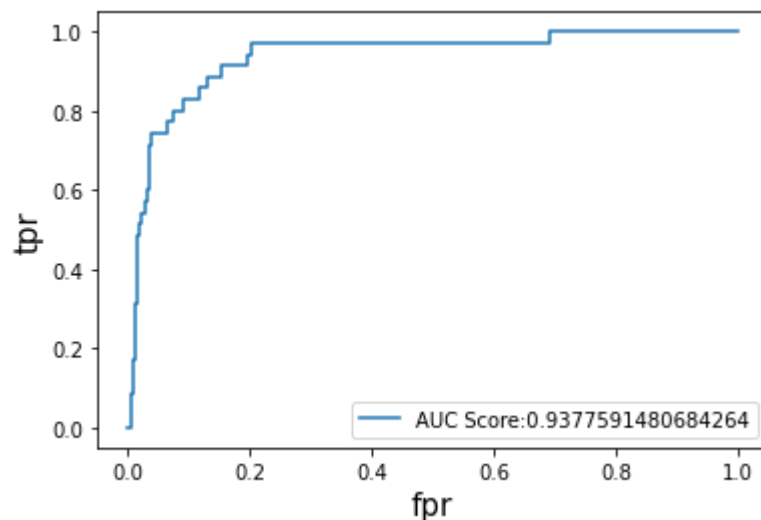


```
In [61]: import matplotlib.pyplot as plt
from sklearn.metrics import roc_curve, auc, roc_auc_score

fpr, tpr, ths = roc_curve(y_test, y_pred_proba[:,1])

auc_score = auc(fpr,tpr)
plt.plot(fpr,tpr,label="AUC Score:" + str(auc_score))
plt.xlabel('fpr',fontsize='15')
plt.ylabel('tpr',fontsize='15')
plt.legend(loc='best')
```

Out[61]: <matplotlib.legend.Legend at 0x174afc45610>



```
In [62]: cnf_matrix = confusion_matrix(y_test,y_pred)
FP = cnf_matrix.sum(axis=0) - np.diag(cnf_matrix)
FN = cnf_matrix.sum(axis=1) - np.diag(cnf_matrix)
TP = np.diag(cnf_matrix)
TN = cnf_matrix.sum() - (FP + FN + TP)
```

```

FP = FP.astype(float)
FN = FN.astype(float)
TP = TP.astype(float)
TN = TN.astype(float)

# Sensitivity, hit rate, recall, or true positive rate
TPR = TP/(TP+FN)
# Specificity or true negative rate
TNR = TN/(TN+FP)
# Precision or positive predictive value
PPV = TP/(TP+FP)
# Negative predictive value
NPV = TN/(TN+FN)
# Fall out or false positive rate
FPR = FP/(FP+TN)
# False negative rate
FNR = FN/(TP+FN)
# False discovery rate
FDR = FP/(TP+FP)
# Overall accuracy
ACC = (TP+TN)/(TP+FP+FN+TN)

#eval
Model = 'naive bayes'
TPR = [round(num, 2) for num in TPR]
FPR = [round(num, 2) for num in FPR]
precision = [round(num, 2) for num in PPV]
recall = [round(num, 2) for num in TPR]
accuracy = [round(num, 2) for num in ACC]
f1_value = round(f1_score(y_pred, y_test),2)
row3 = [Model, TPR, FPR, precision, recall, accuracy, f1_value]
results = results.append(pd.DataFrame([row3], columns=results.columns), ignore_index=True)
results

```

Out[62]:

	Model	TPR	FPR	precision	recall	accuracy	f1-value
0	SVM	[0.97, 0.09]	[0.91, 0.03]	[0.97, 0.08]	[0.97, 0.09]	[0.95, 0.95]	0.08
1	Logistic Regression	[0.83, 0.89]	[0.11, 0.17]	[1.0, 0.13]	[0.83, 0.89]	[0.83, 0.83]	0.22
2	naive bayes	[0.87, 0.86]	[0.14, 0.13]	[1.0, 0.16]	[0.87, 0.86]	[0.87, 0.87]	0.27