SVM (ForestFire)

classify the Size_Categorie using SVM

month month of the year: 'jan' to 'dec'
day day of the week: 'mon' to 'sun'
FFMC FFMC index from the FWI system: 18.7 to 96.20
DMC DMC index from the FWI system: 1.1 to 291.3
DC DC index from the FWI system: 7.9 to 860.6
ISI ISI index from the FWI system: 0.0 to 56.10
temp temperature in Celsius degrees: 2.2 to 33.30
RH relative humidity in %: 15.0 to 100
wind wind speed in km/h: 0.40 to 9.40
rain outside rain in mm/m2 : 0.0 to 6.4
Size_Categorie the burned area of the forest (Small , Large)

1. Import Libs

In [55]:

```
import numpy as np
import pandas as pd
from sklearn import preprocessing
from sklearn import metrics
import seaborn as sns
from sklearn.svm import SVC
from sklearn.model_selection import train_test_split
from matplotlib import pyplot as plt
from sklearn.decomposition import PCA
from mlxtend.plotting import plot_decision_regions
from sklearn.metrics import confusion_matrix as cm
from sklearn.metrics import accuracy_score as ac
from sklearn.metrics import classification_report as report,roc_curve
from sklearn.metrics import roc_auc_score
```

2. Import Data

In [2]:

```
forest_fire = pd.read_csv('forestfires.csv')
forest_fire
```

Out[2]:

	month	day	FFMC	DMC	DC	ISI	temp	RH	wind	rain	...	monthfeb	monthjan	m
0	mar	fri	86.2	26.2	94.3	5.1	8.2	51	6.7	0.0	...	0	0	
1	oct	tue	90.6	35.4	669.1	6.7	18.0	33	0.9	0.0	...	0	0	
2	oct	sat	90.6	43.7	686.9	6.7	14.6	33	1.3	0.0	...	0	0	
3	mar	fri	91.7	33.3	77.5	9.0	8.3	97	4.0	0.2	...	0	0	
4	mar	sun	89.3	51.3	102.2	9.6	11.4	99	1.8	0.0	...	0	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	
512	aug	sun	81.6	56.7	665.6	1.9	27.8	32	2.7	0.0	...	0	0	
513	aug	sun	81.6	56.7	665.6	1.9	21.9	71	5.8	0.0	...	0	0	
514	aug	sun	81.6	56.7	665.6	1.9	21.2	70	6.7	0.0	...	0	0	
515	aug	sat	94.4	146.0	614.7	11.3	25.6	42	4.0	0.0	...	0	0	
516	nov	tue	79.5	3.0	106.7	1.1	11.8	31	4.5	0.0	...	0	0	

517 rows × 31 columns

3. EDA

In [3]:

```
forest_fire.isna().sum()
```

Out[3]:

```
month           0
day             0
FFMC            0
DMC             0
DC              0
ISI             0
temp            0
RH              0
wind            0
rain            0
area            0
dayfri          0
daymon          0
daysat          0
daysun          0
daythu          0
daytue          0
daywed          0
monthapr        0
monthaug        0
monthdec        0
monthfeb        0
monthjan        0
monthjul        0
monthjun        0
monthmar        0
monthmay        0
monthnov        0
monthoct        0
monthsep        0
size_category   0
dtype: int64
```

In [4]:

```
forest_fire.dtypes
```

Out[4]:

```
month             object
day               object
FFMC             float64
DMC              float64
DC               float64
ISI              float64
temp             float64
RH                 int64
wind             float64
rain             float64
area             float64
dayfri             int64
daymon             int64
daysat             int64
daysun             int64
daythu             int64
daytue             int64
daywed             int64
monthapr           int64
monthaug           int64
monthdec           int64
monthfeb           int64
monthjan           int64
monthjul           int64
monthjun           int64
monthmar           int64
monthmay           int64
monthnov           int64
monthoct           int64
monthsep           int64
size_category     object
dtype: object
```

In [5]:

```
forest_fire['size_category'].value_counts()
```

Out[5]:

```
small    378
large    139
Name: size_category, dtype: int64
```

In [6]:

```
forest_fire.describe().T
```

Out[6]:

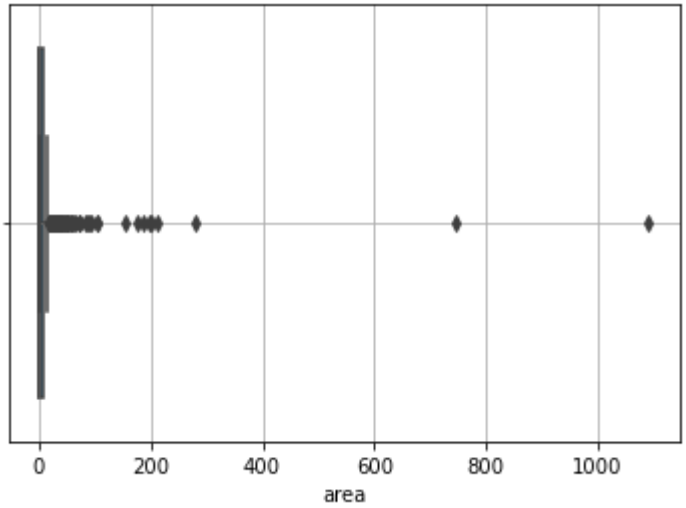
	count	mean	std	min	25%	50%	75%	max
FFMC	517.0	90.644681	5.520111	18.7	90.2	91.60	92.90	96.20
DMC	517.0	110.872340	64.046482	1.1	68.6	108.30	142.40	291.30
DC	517.0	547.940039	248.066192	7.9	437.7	664.20	713.90	860.60
ISI	517.0	9.021663	4.559477	0.0	6.5	8.40	10.80	56.10
temp	517.0	18.889168	5.806625	2.2	15.5	19.30	22.80	33.30
RH	517.0	44.288201	16.317469	15.0	33.0	42.00	53.00	100.00
wind	517.0	4.017602	1.791653	0.4	2.7	4.00	4.90	9.40
rain	517.0	0.021663	0.295959	0.0	0.0	0.00	0.00	6.40
area	517.0	12.847292	63.655818	0.0	0.0	0.52	6.57	1090.84
dayfri	517.0	0.164410	0.371006	0.0	0.0	0.00	0.00	1.00
daymon	517.0	0.143133	0.350548	0.0	0.0	0.00	0.00	1.00
daysat	517.0	0.162476	0.369244	0.0	0.0	0.00	0.00	1.00
daysun	517.0	0.183752	0.387657	0.0	0.0	0.00	0.00	1.00
daythu	517.0	0.117988	0.322907	0.0	0.0	0.00	0.00	1.00
daytue	517.0	0.123791	0.329662	0.0	0.0	0.00	0.00	1.00
daywed	517.0	0.104449	0.306138	0.0	0.0	0.00	0.00	1.00
monthapr	517.0	0.017408	0.130913	0.0	0.0	0.00	0.00	1.00
monthaug	517.0	0.355899	0.479249	0.0	0.0	0.00	1.00	1.00
monthdec	517.0	0.017408	0.130913	0.0	0.0	0.00	0.00	1.00
monthfeb	517.0	0.038685	0.193029	0.0	0.0	0.00	0.00	1.00
monthjan	517.0	0.003868	0.062137	0.0	0.0	0.00	0.00	1.00
monthjul	517.0	0.061896	0.241199	0.0	0.0	0.00	0.00	1.00
monthjun	517.0	0.032882	0.178500	0.0	0.0	0.00	0.00	1.00
monthmar	517.0	0.104449	0.306138	0.0	0.0	0.00	0.00	1.00
monthmay	517.0	0.003868	0.062137	0.0	0.0	0.00	0.00	1.00
monthnov	517.0	0.001934	0.043980	0.0	0.0	0.00	0.00	1.00
monthoct	517.0	0.029014	0.168007	0.0	0.0	0.00	0.00	1.00
monthsep	517.0	0.332689	0.471632	0.0	0.0	0.00	1.00	1.00

Checking Outlires

In [7]:

```
sns.boxplot(forest_fire['area'])
plt.grid()
```

```
C:\Users\shubham\anaconda3\lib\site-packages\seaborn\_decorators.py:36: Futu
reWarning: Pass the following variable as a keyword arg: x. From version 0.1
2, the only valid positional argument will be `data`, and passing other argu
ments without an explicit keyword will result in an error or misinterpretati
on.
  warnings.warn(
```

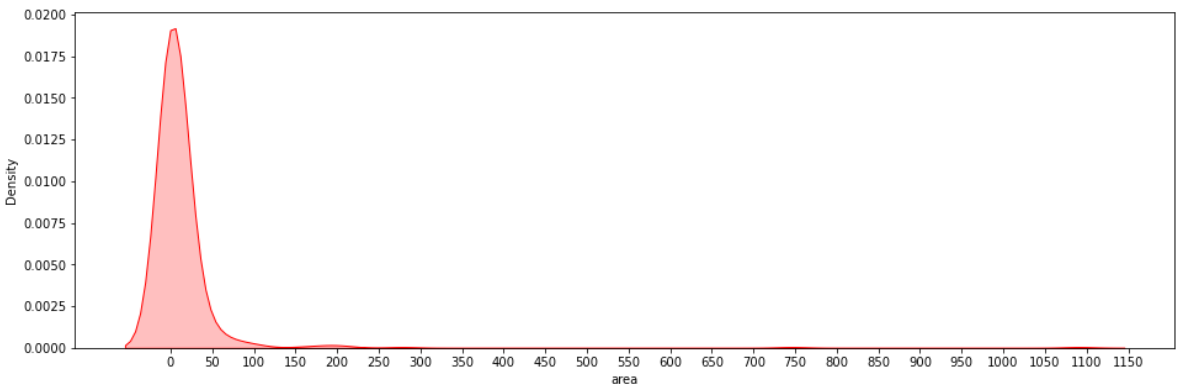


There are 3 Outlier instances in our data

In [8]:

```
plt.figure(figsize=(16,5))
print("Skewness =",forest_fire['area'].skew())
print("Kurtosis =",forest_fire['area'].kurtosis())
sns.kdeplot(forest_fire['area'],shade=True,color='r')
plt.xticks([i for i in range(0,1200,50)])
plt.show()
```

```
Skewness = 12.846933533934868
Kurtosis = 194.1407210942299
```



The Data is highly skewed and has large kurtosis value

Majority of the forest fires do not cover a large area, most of the damaged area is under 100 hectares of land

In [9]:

```
dfa = forest_fire[forest_fire.columns[0:10]]
month_colum = dfa.select_dtypes(include='object')
month_colum
```

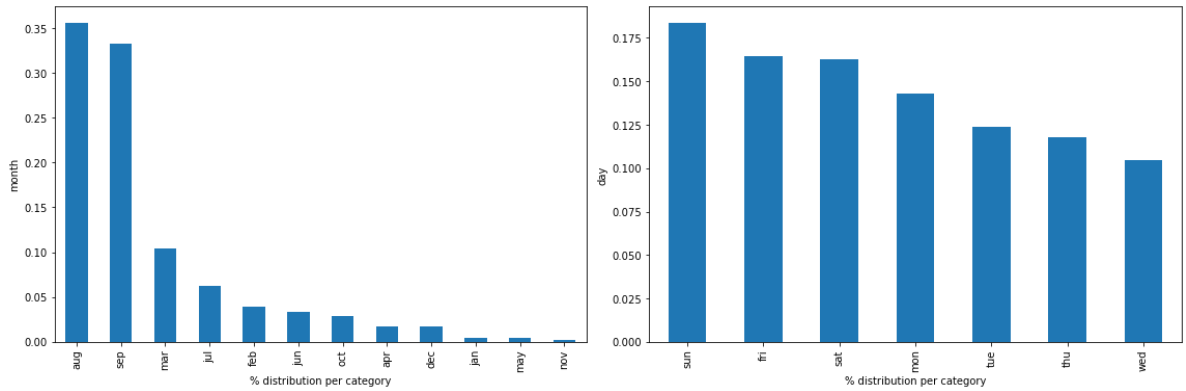
Out[9]:

	month	day
0	mar	fri
1	oct	tue
2	oct	sat
3	mar	fri
4	mar	sun
...	...	...
512	aug	sun
513	aug	sun
514	aug	sun
515	aug	sat
516	nov	tue

517 rows × 2 columns

In [10]:

```
plt.figure(figsize=(16,10))
for i,col in enumerate(month_colum,1):
    plt.subplot(2,2,i)
    forest_fire[col].value_counts(normalize=True).plot.bar()
    plt.ylabel(col)
    plt.xlabel('% distribution per category')
plt.tight_layout()
plt.show()
```



In [16]:

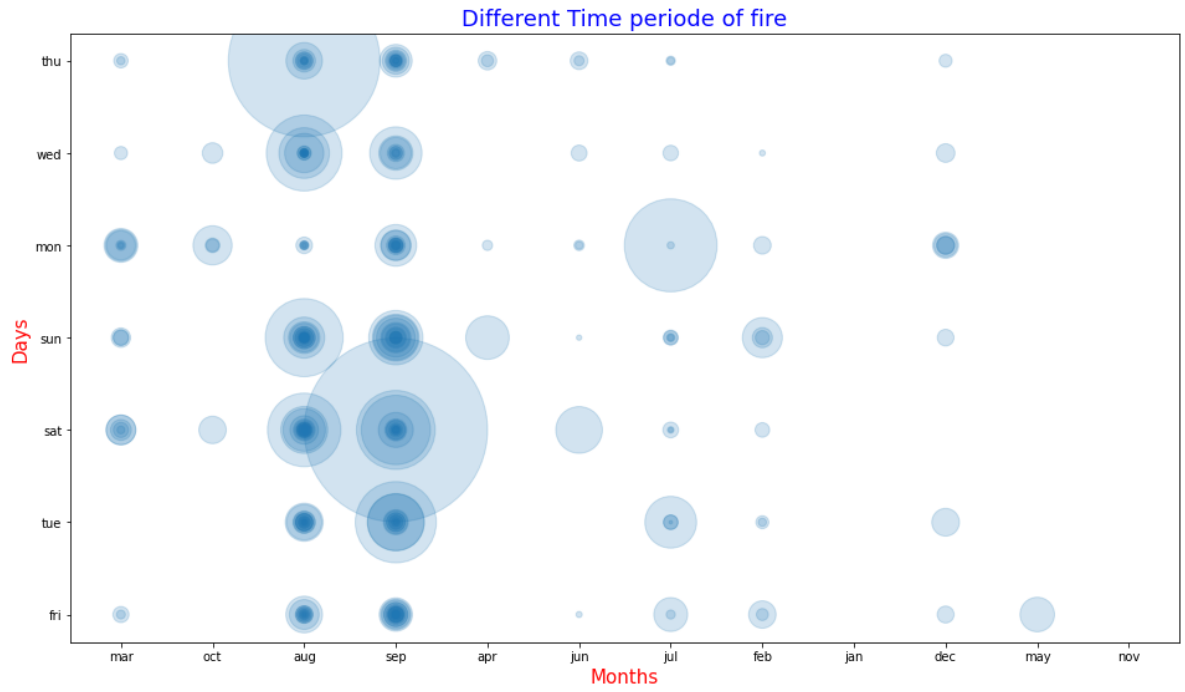
```
scL =forest_fire['size_category'] == 'large'
```

In [23]:

```
forest_fire.plot(kind='scatter', x='month', y='day', alpha=0.2, s=20*forest_fire['area'],fi
plt.xlabel('Months',color='red',fontsize=15)
plt.ylabel('Days',color='red',fontsize=15)
plt.title('Different Time periode of fire',color='blue',fontsize=18)
```

Out[23]:

```
Text(0.5, 1.0, 'Different Time periode of fire')
```



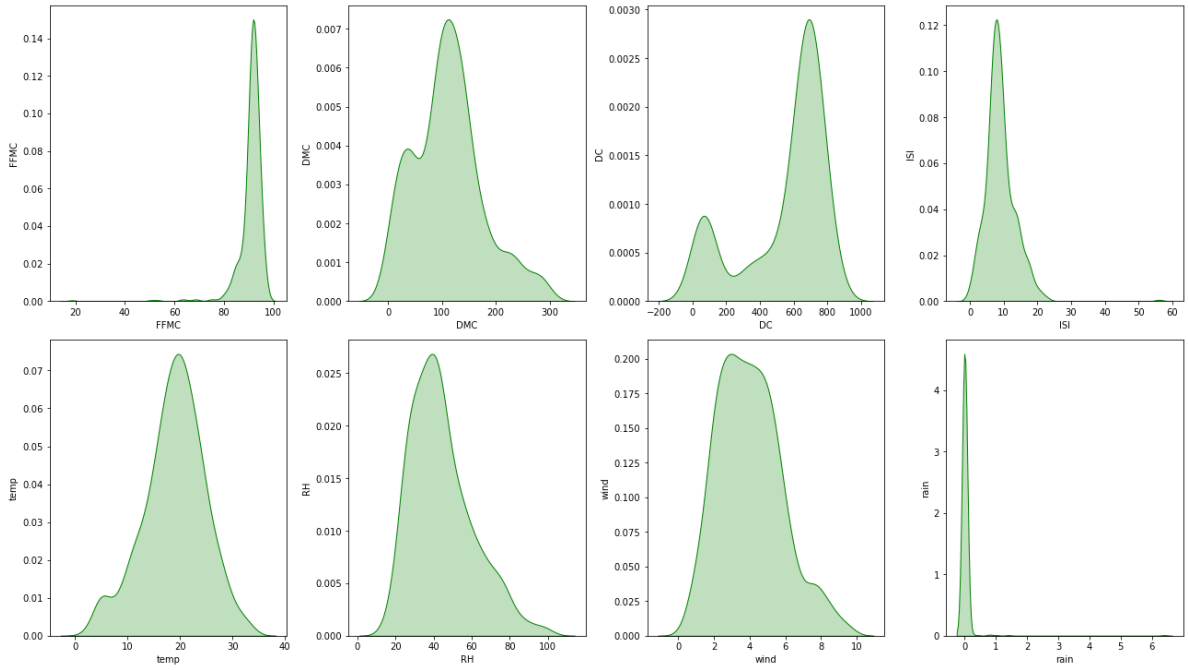
Majority of the fire accors in the month Aug and Sep || sunday and friday have recorded the most cases of fire

In [25]:

```
num_columns = dfa.select_dtypes(exclude='object')
```

In [26]:

```
plt.figure(figsize=(18,40))
for i,col in enumerate(num_columns,1):
    plt.subplot(8,4,i)
    sns.kdeplot(forest_fire[col],color='g',shade=True,legend=True)
    plt.ylabel(col)
plt.tight_layout()
plt.show()
```



In [27]:

```
pd.DataFrame(data=[num_columns.skew(),num_columns.kurtosis()],index=['skewness','kurtosis']
```

Out[27]:

	FFMC	DMC	DC	ISI	temp	RH	wind	rain
skewness	-6.575606	0.547498	-1.100445	2.536325	-0.331172	0.862904	0.571001	19.816344
kurtosis	67.066041	0.204822	-0.245244	21.458037	0.136166	0.438183	0.054324	421.295964

Finding Correlation

In [28]:

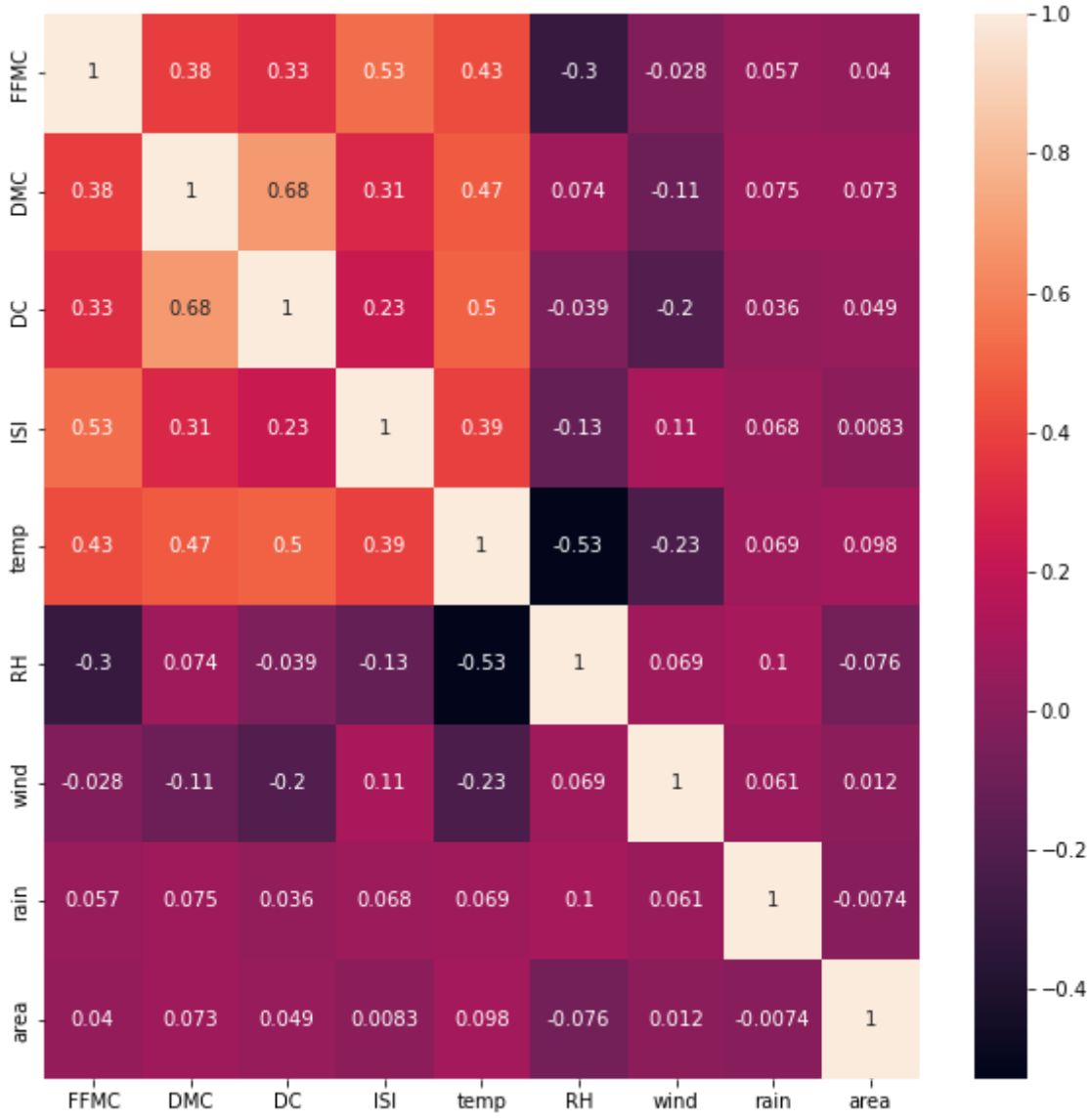
```
corr = forest_fire[forest_fire.columns[0:11]].corr()
```

In [29]:

```
plt.figure(figsize=(10,10))
sns.heatmap(corr,annot=True)
```

Out[29]:

<AxesSubplot:>



4. Model Building

SVM

In [31]:

```
X = forest_fire.iloc[:,2:30]
y = forest_fire.iloc[:,30]
```

In [32]:

```
X
```

Out[32]:

	FFMC	DMC	DC	ISI	temp	RH	wind	rain	area	dayfri	...	monthdec	monthfeb
0	86.2	26.2	94.3	5.1	8.2	51	6.7	0.0	0.00	1	...	0	0
1	90.6	35.4	669.1	6.7	18.0	33	0.9	0.0	0.00	0	...	0	0
2	90.6	43.7	686.9	6.7	14.6	33	1.3	0.0	0.00	0	...	0	0
3	91.7	33.3	77.5	9.0	8.3	97	4.0	0.2	0.00	1	...	0	0
4	89.3	51.3	102.2	9.6	11.4	99	1.8	0.0	0.00	0	...	0	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...
512	81.6	56.7	665.6	1.9	27.8	32	2.7	0.0	6.44	0	...	0	0
513	81.6	56.7	665.6	1.9	21.9	71	5.8	0.0	54.29	0	...	0	0
514	81.6	56.7	665.6	1.9	21.2	70	6.7	0.0	11.16	0	...	0	0
515	94.4	146.0	614.7	11.3	25.6	42	4.0	0.0	0.00	0	...	0	0
516	79.5	3.0	106.7	1.1	11.8	31	4.5	0.0	0.00	0	...	0	0

517 rows × 28 columns

In [33]:

```
y
```

Out[33]:

```
0      small
1      small
2      small
3      small
4      small
       ...
512    large
513    large
514    large
515    small
516    small
Name: size_category, Length: 517, dtype: object
```

In [34]:

```
mapping = {'small': 0, 'large': 1}
```

In [35]:

```
y = y.replace(mapping)
```

In [36]:

```
x_train,x_test,y_train,y_test = train_test_split(X,y,test_size = 0.20, stratify = y)
```

4.1 Linear

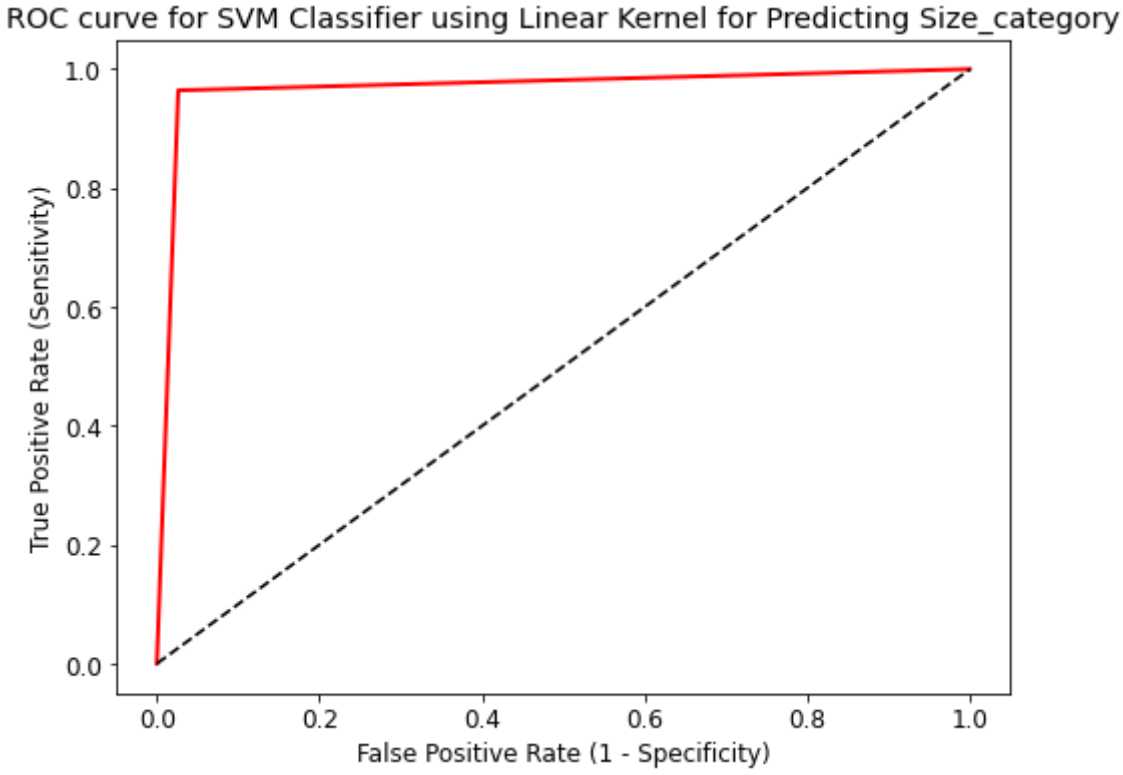
In [37]:

```
model_linear = SVC(kernel = "linear")
model_linear.fit(x_train,y_train)
pred_test_linear = model_linear.predict(x_test)
print("Accuracy:",metrics.accuracy_score(y_test, pred_test_linear))
```

```
Accuracy: 0.9711538461538461
```

In [110]:

```
fpr, tpr, thresholds = roc_curve(y_test, pred_test_linear)
plt.figure(figsize=(8,6))
plt.plot(fpr, tpr, linewidth=2, color='red')
plt.plot([0,1], [0,1], 'k--' )
plt.rcParams['font.size'] = 12
plt.title('ROC curve for SVM Classifier using Linear Kernel for Predicting Size_category')
plt.xlabel('False Positive Rate (1 - Specificity)')
plt.ylabel('True Positive Rate (Sensitivity)')
plt.show()
ROC_AUC = roc_auc_score(y_test, pred_test_linear)
print('ROC AUC : {:.4f}'.format(ROC_AUC))
```




```
ROC AUC : 0.9690
```

4.2 Poly

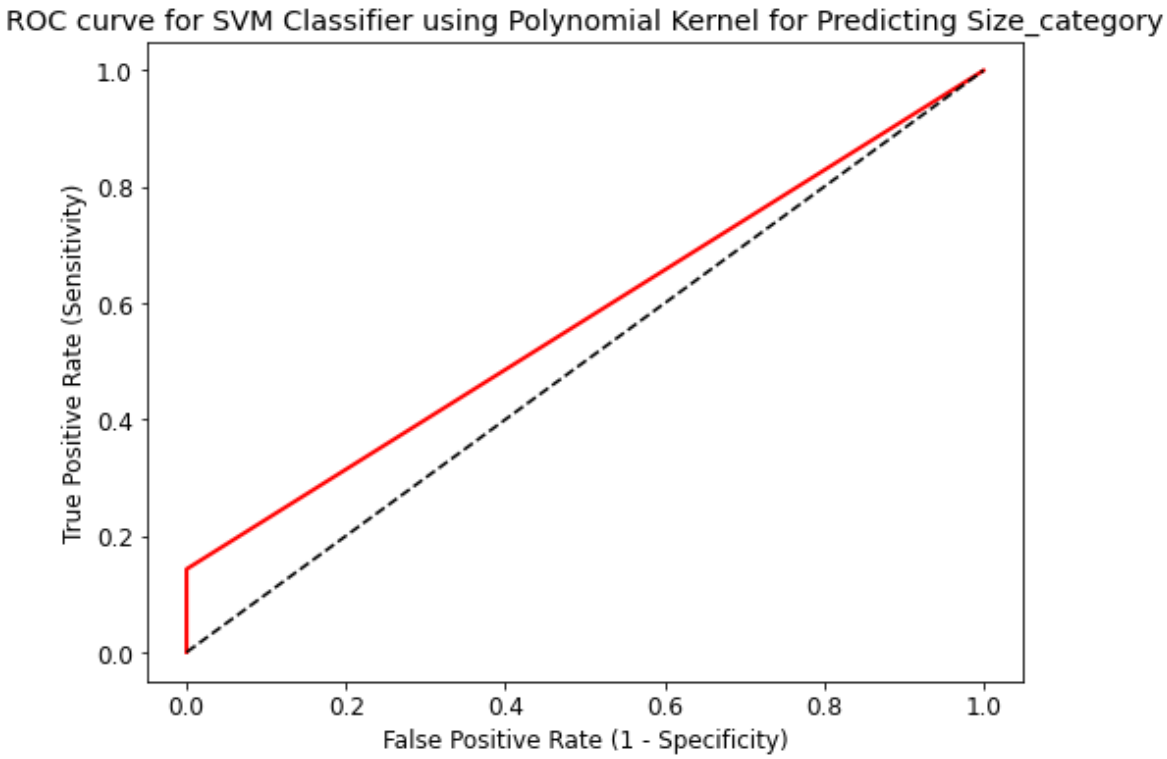
In [38]:

```
model_poly = SVC(kernel = "poly")
model_poly.fit(x_train,y_train)
pred_test_poly = model_poly.predict(x_test)
print("Accuracy:",metrics.accuracy_score(y_test, pred_test_poly))
```

```
Accuracy: 0.7692307692307693
```

In [109]:

```
fpr, tpr, thresholds = roc_curve(y_test, pred_test_poly)
plt.figure(figsize=(8,6))
plt.plot(fpr, tpr, linewidth=2, color='red')
plt.plot([0,1], [0,1], 'k--' )
plt.rcParams['font.size'] = 12
plt.title('ROC curve for SVM Classifier using Polynomial Kernel for Predicting Size_categor
plt.xlabel('False Positive Rate (1 - Specificity)')
plt.ylabel('True Positive Rate (Sensitivity)')
plt.show()
ROC_AUC = roc_auc_score(y_test, pred_test_poly)
print('ROC AUC : {:.4f}'.format(ROC_AUC))
```




```
ROC AUC : 0.5714
```

4.3 RBF

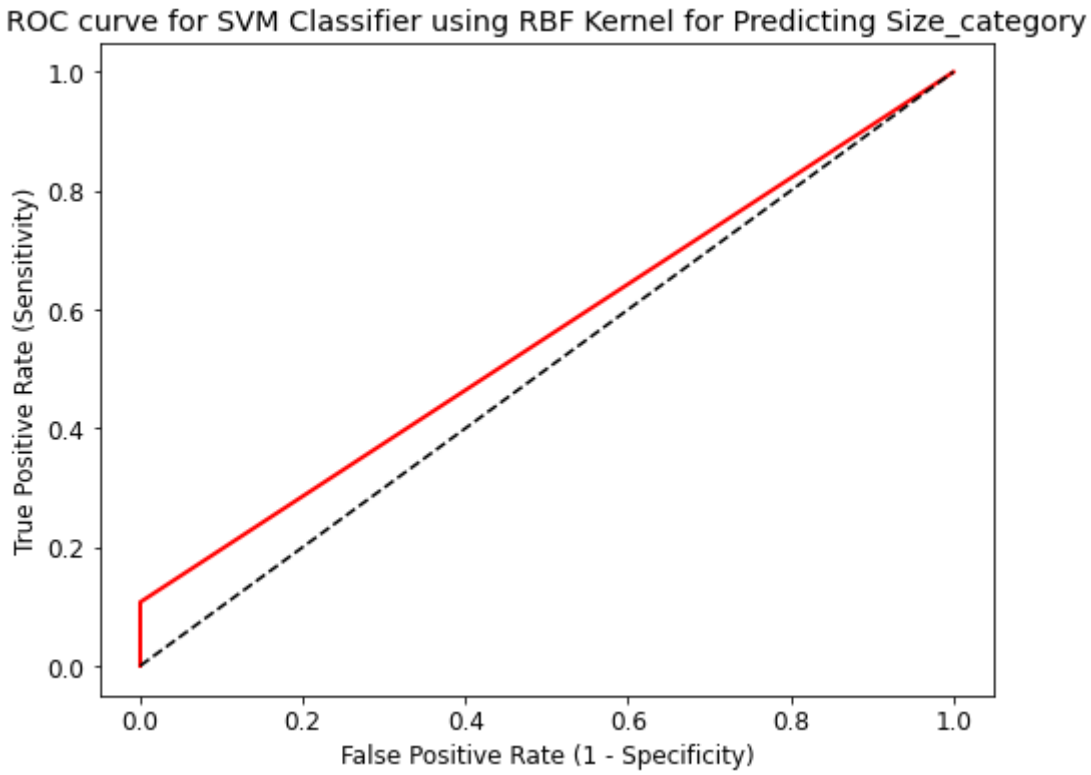
In [39]:

```
model_rbf = SVC(kernel = "rbf")
model_rbf.fit(x_train,y_train)
pred_test_rbf = model_rbf.predict(x_test)
print("Accuracy:",metrics.accuracy_score(y_test, pred_test_rbf))
```

```
Accuracy: 0.7596153846153846
```

In [107]:

```
fpr, tpr, thresholds = roc_curve(y_test, pred_test_rbf)
plt.figure(figsize=(8,6))
plt.plot(fpr, tpr, linewidth=2, color='red')
plt.plot([0,1], [0,1], 'k--' )
plt.rcParams['font.size'] = 12
plt.title('ROC curve for SVM Classifier using RBF Kernel for Predicting Size_category')
plt.xlabel('False Positive Rate (1 - Specificity)')
plt.ylabel('True Positive Rate (Sensitivity)')
plt.show()
ROC_AUC = roc_auc_score(y_test, pred_test_rbf)
print('ROC AUC : {:.4f}'.format(ROC_AUC))
```




```
ROC AUC : 0.5536
```

4.4 Sigmoid

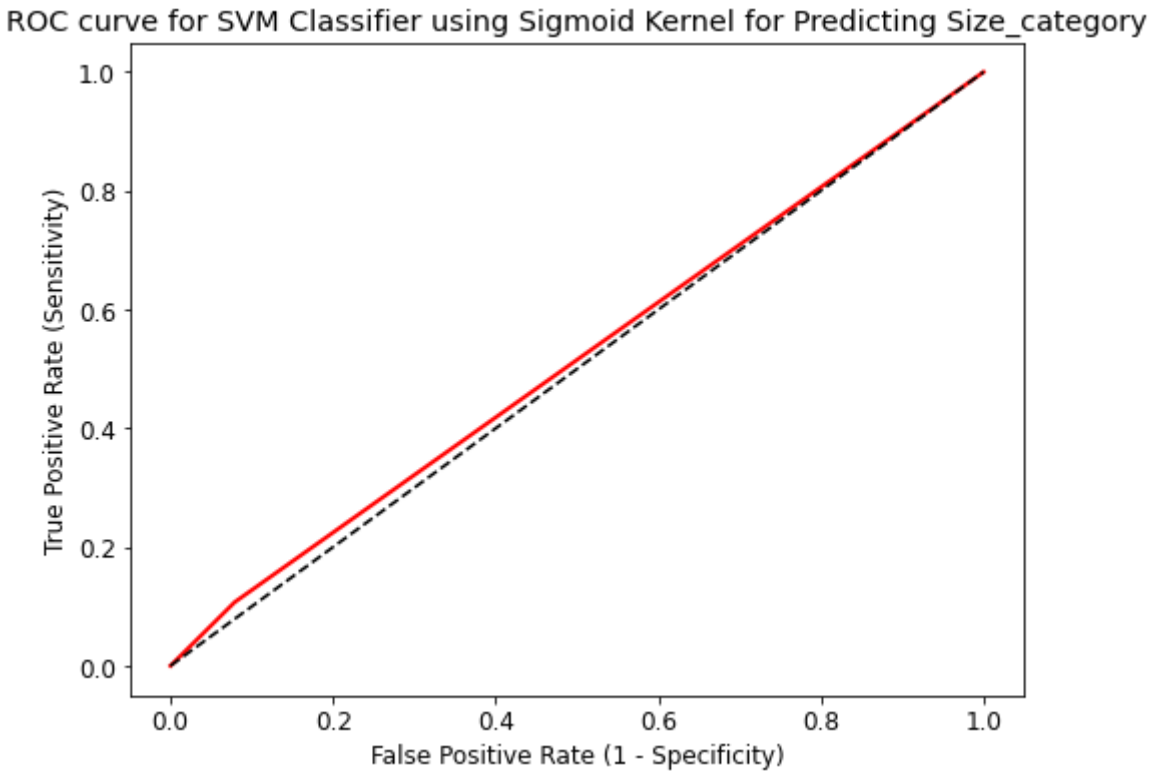
In [40]:

```
model_sigmoid = SVC(kernel = "sigmoid")
model_sigmoid.fit(x_train,y_train)
pred_test_sigmoid = model_sigmoid.predict(x_test)
print("Accuracy:",metrics.accuracy_score(y_test, pred_test_sigmoid))
```

```
Accuracy: 0.7019230769230769
```

In [108]:

```
fpr, tpr, thresholds = roc_curve(y_test, pred_test_sigmoid)
plt.figure(figsize=(8,6))
plt.plot(fpr, tpr, linewidth=2, color='red')
plt.plot([0,1], [0,1], 'k--' )
plt.rcParams['font.size'] = 12
plt.title('ROC curve for SVM Classifier using Sigmoid Kernel for Predicting Size_category')
plt.xlabel('False Positive Rate (1 - Specificity)')
plt.ylabel('True Positive Rate (Sensitivity)')
plt.show()
ROC_AUC = roc_auc_score(y_test, pred_test_sigmoid)
print('ROC AUC : {:.4f}'.format(ROC_AUC))
```




```
ROC AUC : 0.5141
```

The Linear Model has best accuracy compare to other Models

In [ ]: