```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
```

```
# Mengimpor library
```

```
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.preprocessing import OneHotEncoder
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.metrics import accuracy_score, classification_report,confusion_matrix, ConfusionMatrixDisplay
from sklearn.metrics import mean_squared_error, r2_score
import pandas as pd
```

```
# import dataset kedalam pandas dataframe
df = pd.read_csv('drive/MyDrive/dataset/Storms_2020.csv')
```

```
<ipython-input-5-ed4cb0b307e4>:2: DtypeWarning: Columns (21,22,25) have mixed types. Specify dtype option on import or set low_memor
  df = pd.read_csv('drive/MyDrive/dataset/Storms_2020.csv')
```

```
# Menampilkan attribut dari dataset

df.columns
```

```
Index(['episode_id', 'event_id', 'state', 'state_fips_code', 'event_type',
       'cz_type', 'cz_fips_code', 'cz_name', 'wfo', 'event_begin_time',
       'event_timezone', 'event_end_time', 'injuries_direct',
       'injuries_indirect', 'deaths_direct', 'deaths_indirect',
       'damage_property', 'damage_crops', 'source', 'magnitude',
       'magnitude_type', 'flood_cause', 'tor_f_scale', 'tor_length',
       'tor_width', 'tor_other_wfo', 'location_index', 'event_range',
       'event_azimuth', 'reference_location', 'event_latitude',
       'event_longitude', 'event_point'],
      dtype='object')
```

```
df['event_type'].unique()
```

```
array(['hail', 'heat', 'flood', 'sleet', 'drought', 'tornado', 'blizzard',
       'wildfire', 'avalanche', 'dense fog', 'high surf', 'high wind',
       'hurricane', 'ice storm', 'lightning', 'dust devil', 'dust storm',
       'heavy rain', 'heavy snow', 'waterspout', 'debris flow',
       'flash flood', 'marine hail', 'rip current', 'strong wind',
       'freezing fog', 'frost/freeze', 'funnel cloud', 'winter storm',
       'coastal flood', 'excessive heat', 'tropical storm',
       'winter weather', 'cold/wind chill', 'lakeshore flood',
       'lake-effect snow', 'marine dense fog', 'marine high wind',
       'storm surge/tide', 'thunderstorm wind', 'marine strong wind',
       'tropical depression', 'astronomical low tide',
       'marine tropical storm', 'extreme cold/wind chill',
       'marine hurricane/typhoon', 'marine thunderstorm wind'],
      dtype=object)
```

```
# Menghapus attribute yang tidak perlukan

df = df.drop([
    "episode_id",
    "event_id",
    "cz_name",
    "wfo",
    "cz_type",
    "event_begin_time",
    "event_timezone",
    "event_end_time",
    "injuries_direct",
    "injuries_indirect",
    "deaths_direct",
    "deaths_indirect",
    "damage_crops",
    "flood_cause",
    "tor_f_scale",
    "tor_length",
    "tor_width",
    "tor_other_wfo",
    "event_point",
    "location_index",
    ], axis=1)
```

```
# Menampilkan attribut yang sudah dibersihkan

df.columns
```

```
Index(['state', 'state_fips_code', 'event_type', 'cz_fips_code',
       'damage_property', 'source', 'magnitude', 'magnitude_type',
       'event_range', 'event_azimuth', 'reference_location', 'event_latitude',
       'event_longitude'],
      dtype='object')
```

```
df.columns
```

```
Index(['state', 'state_fips_code', 'event_type', 'cz_fips_code',
       'damage_property', 'source', 'magnitude', 'magnitude_type',
       'event_range', 'event_azimuth', 'reference_location', 'event_latitude',
       'event_longitude'],
      dtype='object')
```

```
# menfilter attribute eventy_type yang berisi thunderstorm wind
df = df.loc[df['event_type'] == 'thunderstorm wind']
df = df.drop(["event_type"], axis=1)
```

```
# drop data dengan value NaN
df = df.dropna()
```

```
df
```

	state	state_fips_code	cz_fips_code	damage_property	source	magnitu
23374	Oklahoma	40	135	2000.0	Emergency Manager	61
23375	Ohio	39	1	1000.0	Emergency Manager	50
23376	Ohio	39	145	20000.0	Emergency Manager	60
23377	Ohio	39	25	3000.0	Law Enforcement	50
23378	Ohio	39	1	4000.0	Law Enforcement	50
...	...	...	...	...	...	
37829	Illinois	17	19	0.0	Emergency Manager	52
37830	Illinois	17	167	100000.0	Emergency Manager	61
37831	Illinois	17	19	175000.0	Emergency Manager	52
37832	Illinois	17	167	70000.0	Emergency Manager	61
37833	Illinois	17	21	0.0	Public	52

9723 rows × 12 columns

```
df.dtypes
```

```
state                 object
state_fips_code        int64
cz_fips_code           int64
damage_property      float64
source                object
magnitude            float64
magnitude_type        object
event_range          float64
event_azimuth         object
reference_location    object
event_latitude       float64
event_longitude      float64
dtype: object
```

```
df['state'].unique()
```

```
array(['Oklahoma', 'Ohio', 'Kentucky', 'Tennessee', 'Indiana', 'Texas',
       'Alabama', 'North carolina', 'South carolina', 'West virginia',
       'Virginia', 'Arkansas', 'Missouri', 'Illinois', 'Louisiana',
       'Florida', 'Georgia', 'Pennsylvania', 'Maryland', 'Delaware',
       'New jersey', 'Vermont', 'New york', 'Mississippi', 'North dakota',
       'New mexico', 'Massachusetts', 'Rhode island', 'Wisconsin',
       'Michigan', 'Montana', 'Oregon', 'Kansas', 'Colorado', 'Utah',
       'Washington', 'Connecticut', 'Minnesota', 'District of columbia',
       'South dakota', 'Arizona', 'Nebraska', 'Nevada', 'Iowa',
       'California', 'Idaho', 'Wyoming', 'New hampshire', 'Puerto rico',
       'Maine'], dtype=object)
```

```
a = df['state'].astype('category')
b = df['source'].astype('category')
c = df['magnitude_type'].astype('category')
d = df['event_azimuth'].astype('category')
e = df['reference_location'].astype('category')
df['state'] = df['state'].astype('category')
df['source'] = df['source'].astype('category')
df['magnitude_type'] = df['magnitude_type'].astype('category')
df['event_azimuth'] = df['event_azimuth'].astype('category')
df['reference_location'] = df['reference_location'].astype('category')

cat_columns = df.select_dtypes(['category']).columns
df[cat_columns] = df[cat_columns].apply(lambda x: x.cat.codes)
```

```
category_mapping = dict(zip(a, df['state']))
print(category_mapping)

category_mapping = dict(zip(b, df['source']))
print(category_mapping)

category_mapping = dict(zip(c, df['magnitude_type']))
print(category_mapping)

category_mapping = dict(zip(d, df['event_azimuth']))
print(category_mapping)

category_mapping = dict(zip(e, df['reference_location']))
print(category_mapping)
```

```
YNE': 6023, '(HBR)HOBART AIRPORT': 86, 'AMBER': 311, 'WYNNEWOOD': 6295, 'REAGAN': 4799, 'THERESSA': 5683, 'SAPPVILLE': 5090, 'SAINT
```

```
df.dtypes
```

```
state                    int8
state_fips_code         int64
cz_fips_code            int64
damage_property       float64
source                   int8
magnitude             float64
magnitude_type           int8
event_range           float64
event_azimuth            int8
reference_location      int16
event_latitude        float64
event_longitude       float64
dtype: object
```

```
df
```

	state	state_fips_code	cz_fips_code	damage_property	source	magnitude	magn
23374	34	40	135	2000.0	12	61.0	
23375	33	39	1	1000.0	12	50.0	
23376	33	39	145	20000.0	12	60.0	
23377	33	39	25	3000.0	15	50.0	
23378	33	39	1	4000.0	15	50.0	
...	...	...	...	...	...	...	
37829	11	17	19	0.0	12	52.0	
37830	11	17	167	100000.0	12	61.0	
37831	11	17	19	175000.0	12	52.0	
37832	11	17	167	70000.0	12	61.0	
37833	11	17	21	0.0	26	52.0	

9723 rows × 12 columns

```
bins = [0, 1000.0, 10000.0, 100000.0, 8000000.0]
labels = ["Minor", "Moderate", "Severe", "Catastrophic"]
df['damage_property'] = pd.cut(df['damage_property'], bins=bins, labels=labels, include_lowest=True)
```

```
df['damage_property'].value_counts()
```

```
Minor           6177
Moderate        2621
Severe           814
Catastrophic     111
Name: damage_property, dtype: int64
```

```
df
```

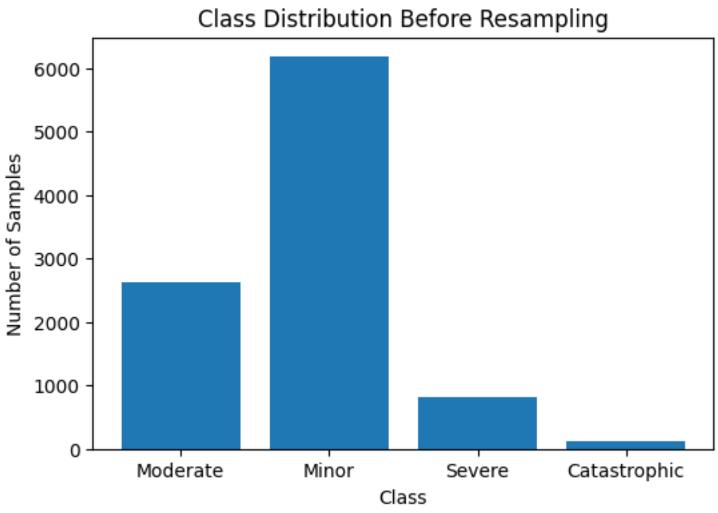
	state	state_fips_code	cz_fips_code	damage_property	source	magnitude	magn
23374	34	40	135	Moderate	12	61.0	
23375	33	39	1	Minor	12	50.0	
23376	33	39	145	Severe	12	60.0	
23377	33	39	25	Moderate	15	50.0	
23378	33	39	1	Moderate	15	50.0	
...	...	...	...	...	...	...	
37829	11	17	19	Minor	12	52.0	
37830	11	17	167	Severe	12	61.0	
37831	11	17	19	Catastrophic	12	52.0	
37832	11	17	167	Severe	12	61.0	
37833	11	17	21	Minor	26	52.0	

9723 rows × 12 columns

```
X = df.drop(['damage_property'],axis=1).values
y = df['damage_property'].values
```

```
from collections import Counter

plt.figure(figsize=(6, 4))
plt.bar(Counter(y).keys(), Counter(y).values())
plt.title('Class Distribution Before Resampling')
plt.xlabel('Class')
plt.ylabel('Number of Samples')
plt.show()
```



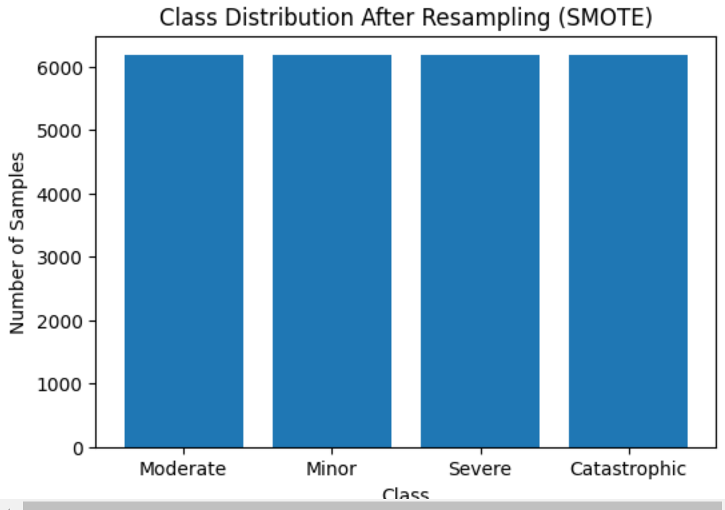
```
from imblearn.over_sampling import SMOTE

# Melakukan oversampling menggunakan SMOTE
smote = SMOTE(sampling_strategy='auto', random_state=42)
X_resampled, y_resampled = smote.fit_resample(X, y)

print('After resampling:', Counter(y_resampled))

# Menunjukkan distribusi kelas setelah resampling
plt.figure(figsize=(6, 4))
plt.bar(Counter(y_resampled).keys(), Counter(y_resampled).values())
plt.title('Class Distribution After Resampling (SMOTE)')
plt.xlabel('Class')
plt.ylabel('Number of Samples')
plt.show()
```

```
After resampling: Counter({'Moderate': 6177, 'Minor': 6177, 'Severe': 6177, 'Catastro
```



```
X_train,X_test,y_train,y_test = train_test_split(
                                                  X_resampled,
                                                  y_resampled,
                                                  test_size=0.3,
                                                  shuffle=True,
                                                 )
```

```
model1 = RandomForestClassifier()
model1.fit(X_train, y_train)
```

```
▾ RandomForestClassifier
RandomForestClassifier()
```

```
damage_pred = model1.predict(X_test)
```

```
accuracy = accuracy_score(y_test, damage_pred)
print(accuracy)
```

```
0.8506677458518819
```

```
print(classification_report(y_test, damage_pred))
```

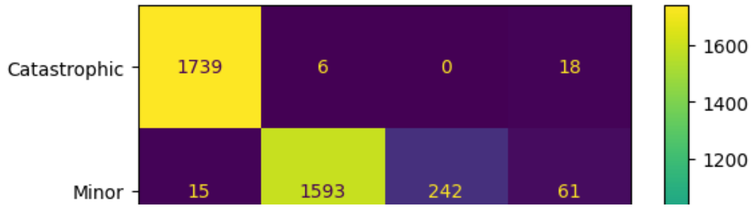
```
              precision    recall  f1-score   support

Catastrophic       0.95      0.99      0.97      1763
       Minor       0.85      0.83      0.84      1911
    Moderate       0.76      0.77      0.77      1855
      Severe       0.84      0.82      0.83      1884

    accuracy                           0.85      7413
   macro avg       0.85      0.85      0.85      7413
weighted avg       0.85      0.85      0.85      7413
```

```
cm1 = confusion_matrix(y_test,damage_pred,labels=model1.classes_)
```

```
disp1 = ConfusionMatrixDisplay(confusion_matrix=cm1,display_labels=model1.classes_)
disp1.plot()
plt.show()
```



```
#Feature Importances

importances = model1.feature_importances_
cols = df.columns.tolist()
del cols[3]
f_importances = pd.Series(importances,cols)
f_importances.sort_values(ascending=False, inplace=True)
f_importances[:11].plot(x='Features', y='Importance', kind='bar', figsize=(16,9), rot=90, fontsize=12)
plt.tight_layout()
plt.show()
```