Predicting interest rates from Federal Reserve documents

Exploratory Data Analysis/ Feature Engineering (Vol. 4)

FE 690: Machine Learning in Finance

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Environment

```
import sys
import os
IN_COLAB = 'google.colab' in sys.modules
IN_COLAB
```

```
True
```

```
if IN_COLAB:
    from google.colab import drive
    drive.mount('/content/drive', force_remount=True)
```

```
Mounted at /content/drive
```

```
#if IN_COLAB:
#  # Uninstall existing versions:
#  !pip uninstall bs4 -y
#  !pip uninstall textract -y
#  !pip uninstall numpy -y
#  !pip uninstall pandas -y
#  !pip uninstall requests -y
#  !pip uninstall tqdm -y
#  !pip uninstall nltk -y
#  !pip uninstall quandl -y
#  !pip uninstall scikit-plot -y
#  !pip uninstall seaborn -y
#  !pip uninstall sklearn -y
#  !pip uninstall torch -y
#  !pip uninstall transformers -y
#  !pip uninstall wordcloud -y
#  !pip uninstall xgboost -y
#
#  # Install packages:
#  !pip install bs4==0.0.1
```

```
#  !pip install textract==1.6.3
#  !pip install numpy==1.19.4
#  !pip install pandas==1.1.4
#  !pip install requests==2.24.0
#  !pip install tqdm==4.51.0
#  !pip install nltk==3.5
#  !pip install quandl==3.5.3
#  !pip install scikit-plot==0.3.7
#  !pip install seaborn==0.11.0
#  !pip install sklearn==0.0
#  !pip install torch==1.7.1+cu101 torchvision==0.8.2+cu101 -f https://download.pytorch.org/whl/torch_stable.html
#  !pip install transformers==3.5.0
#  !pip install wordcloud==1.8.0
#  !pip install xgboost==1.2.1
#  os.kill(os.getpid(), 9)
#


if IN_COLAB:
  employment_data_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/MarketData/Employment/'
  cpi_data_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/MarketData/CPI/'
  fed_rates_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/MarketData/FEDRates/'
  fx_rates_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/MarketData/FXRates/'
  gdp_data_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/MarketData/GDP/'
  ism_data_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/MarketData/ISM/'
  sales_data_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/MarketData/Sales/'
  treasury_data_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/MarketData/Treasury/'
  fomc_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/FOMC/'
  preprocessed_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/preprocessed/'
  train_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/train_data/'
  output_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/result/'
  keyword_lm_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/LoughranMcDonald/'
  glove_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/GloVe/'
  model_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/models/'
  graph_dir = '/content/drive/My Drive/Colab Notebooks/proj2/src/data/graphs/'
else:
  employment_data_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/MarketData/Employment/'
  cpi_data_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/MarketData/CPI/'
  fed_rates_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/MarketData/FEDRates/'
  fx_rates_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/MarketData/FXRates/'
  gdp_data_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/MarketData/GDP/'
  ism_data_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/MarketData/ISM/'
  sales_data_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/MarketData/Sales/'
  treasury_data_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/MarketData/Treasury/'
  fomc_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/FOMC/'
  preprocessed_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/preprocessed/'
  train_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/train_data/'
  output_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/result/'
  keyword_lm_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/LoughranMcDonald/'
  glove_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/GloVe/'
  model_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/models/'
```

```
  graph_dir = 'C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/graphs/'



# Python libraries
import pprint
import datetime as dt
import re
import pickle
from tqdm.notebook import tqdm
import time
import logging
import random
from collections import defaultdict, Counter
import xgboost as xgb

# Data Science modules
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
plt.style.use('ggplot')
import seaborn as sns; sns.set(style='white', context='notebook', palette='deep')

# Import Scikit-learn models
from sklearn.feature_extraction.text import CountVectorizer, TfidfVectorizer
from sklearn.metrics import accuracy_score, f1_score, plot_confusion_matrix
from sklearn.pipeline import Pipeline, FeatureUnion
from sklearn.ensemble import RandomForestClassifier, AdaBoostClassifier, GradientBoostingClassifier, ExtraTreesClassifier, VotingClassifier
from sklearn.linear_model import LogisticRegression, Perceptron, SGDClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.tree import DecisionTreeClassifier
from sklearn.neural_network import MLPClassifier
from sklearn.svm import SVC, LinearSVC
from sklearn import model_selection
from sklearn.model_selection import GridSearchCV, cross_val_score, cross_validate, StratifiedKFold, learning_curve, RandomizedSearchCV
import scikitplot as skplt

# Import nltk modules and download dataset
import nltk
from nltk.corpus import stopwords
from nltk.util import ngrams
from nltk.tokenize import word_tokenize, sent_tokenize

# Import Pytorch modules
import torch
from torch import nn, optim
import torch.nn.functional as F
from torch.utils.data import (DataLoader, RandomSampler, SequentialSampler, TensorDataset)
from torch.autograd import Variable
from torch.optim import Adam, AdamW
```

```
from torch.optim import Adam, AdamW
plt.style.use('ggplot')
sns.set()


# Fiinalize nltk setup:
nltk.download('stopwords')
nltk.download('punkt')
nltk.download('wordnet')

stop = set(stopwords.words('english'))

# Test pprint
pprint.pprint(sys.path)
```

```
['',
 '/env/python',
 '/usr/lib/python36.zip',
 '/usr/lib/python3.6',
 '/usr/lib/python3.6/lib-dynload',
 '/usr/local/lib/python3.6/dist-packages',
 '/usr/lib/python3/dist-packages',
 '/usr/local/lib/python3.6/dist-packages/IPython/extensions',
 '/root/.ipython']
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package wordnet to /root/nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
```

```
## Use TPU Runtime:
#if IN_COLAB:
#  assert os.environ['COLAB_TPU_ADDR'], 'Make sure to select TPU from Edit > Notebook setting > Hardware accelerator'
#  VERSION = "20200220"
#  !curl https://raw.githubusercontent.com/pytorch/xla/master/contrib/scripts/env-setup.py -o pytorch-xla-env-setup.py
#  !python pytorch-xla-env-setup.py --version $VERSION


## Use GPU Runtime:
if IN_COLAB:
  if torch.cuda.is_available():
    torch.cuda.get_device_name(0)
    gpu_info = !nvidia-smi
    gpu_info = '\n'.join(gpu_info)
    print(gpu_info)
  else:
    print('Select the Runtime > "Change runtime type" menu to enable a GPU accelerator, and then re-execute this cell.')
    os.kill(os.getpid(), 9)
```

```
Mon Jan 25 11:52:06 2021
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 460.32.03    Driver Version: 418.67       CUDA Version: 10.1     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                               |                      |               MIG M. |
|===============================+======================+======================|
|   0  Tesla V100-SXM2...  Off  | 00000000:00:04.0 Off |                    0 |
| N/A   35C    P0    25W / 300W |     10MiB / 16130MiB |      0%      Default |
|                               |                      |                 ERR! |
+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                                  |
|  GPU   GI   CI        PID   Type   Process name                  GPU Memory |
|        ID   ID                                                   Usage      |
|=============================================================================|
|  No running processes found                                                 |
+-----------------------------------------------------------------------------+
```

```
# Load nontext data
if IN_COLAB:
  file = open('/content/drive/My Drive/Colab Notebooks/proj2/src/data/preprocessed/nontext_data.pickle', 'rb')
  nontext_data = pickle.load(file)
  file.close()
else:
  file = open('C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/preprocessed/nontext_data.pickle', 'rb')

print(nontext_data.shape)
nontext_data.head()
```

```
(390, 57)
```

date	unscheduled	forecast	confcall	ChairPerson	Rate	RateDiff	RateDecision	RateChanged	GDP_date	GDP_value	GDP_diff_prev	GDP_diff_year	GDPPOT_
1982-10-05	False	False	False	Paul Volcker	9.5	-0.5	-1	1	1982-04-01	6825.876	0.456197	-1.010549	1982-
1982-11-16	False	False	False	Paul Volcker	9.0	-0.5	-1	1	1982-07-01	6799.781	-0.382295	-2.555898	1982-
1982-12-21	False	False	False	Paul Volcker	8.5	0.0	0	0	1982-07-01	6799.781	-0.382295	-2.555898	1982-
1983-01-14	False	False	True	Paul Volcker	8.5	0.0	0	0	1982-07-01	6799.781	-0.382295	-2.555898	1982-
1983-01-21	False	False	True	Paul Volcker	8.5	0.0	0	0	1982-07-01	6799.781	-0.382295	-2.555898	1982-

```
if IN_COLAB:
  file = open('/content/drive/My Drive/Colab Notebooks/proj2/src/data/preprocessed/nontext_ma2.pickle', 'rb')
  nontext_ma2 = pickle.load(file)
  file.close()
  file = open('/content/drive/My Drive/Colab Notebooks/proj2/src/data/preprocessed/nontext_ma3.pickle', 'rb')
  nontext_ma3 = pickle.load(file)
  file.close()
  file = open('/content/drive/My Drive/Colab Notebooks/proj2/src/data/preprocessed/nontext_ma6.pickle', 'rb')
  nontext_ma6 = pickle.load(file)
  file.close()
  file = open('/content/drive/My Drive/Colab Notebooks/proj2/src/data/preprocessed/nontext_ma12.pickle', 'rb')
  nontext_ma12 = pickle.load(file)
  file.close()
else:
  file = open('C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/preprocessed/nontext_ma2.pickle', 'rb')
  nontext_ma2 = pickle.load(file)
  file.close()
  file = open('C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/preprocessed/nontext_ma3.pickle', 'rb')
  nontext_ma3 = pickle.load(file)
  file.close()
  file = open('C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/preprocessed/nontext_ma6.pickle', 'rb')
  nontext_ma6 = pickle.load(file)
  file.close()
  file = open('C:/Users/theon/GDrive/Colab Notebooks/proj2/src/data/preprocessed/nontext_ma12.pickle', 'rb')
  nontext_ma12 = pickle.load(file)
  file.close()
```

Non-text dataset analysis

```
nontext_data['prev_decision'] = nontext_data['RateDecision'].shift(1)
nontext_data['next_decision'] = nontext_data['RateDecision'].shift(-1)
nontext_data[['RateDecision', 'prev_decision', 'next_decision']].head()
```

date	RateDecision	prev_decision	next_decision
1982-10-05	-1	<NA>	-1
1982-11-16	-1	-1	0
1982-12-21	0	-1	0
1983-01-14	0	0	0
1983-01-21	0	0	0

```
nontext_data.describe()
```

	Rate	RateDiff	RateDecision	RateChanged	GDP_value	GDP_diff_prev	GDP_diff_year	GDPPOT_value	GDPPOT_diff_prev	GDPPOT_diff_year	PCE
count	390.000000	390.000000	390.000000	390.000000	390.00000	390.000000	390.000000	390.000000	390.000000	390.000000	390
mean	4.141346	-0.025641	-0.020513	0.348718	12450.45391	0.647576	2.594788	12647.034520	0.657539	2.675490	79
std	3.056928	0.239839	0.590925	0.477177	3542.17116	0.623227	1.954636	3563.685301	0.204059	0.829742	17
min	0.000000	-1.000000	-1.000000	0.000000	6799.78100	-2.163811	-3.924447	7224.140335	0.263026	1.080299	47
25%	1.250000	0.000000	0.000000	0.000000	9341.64200	0.396135	1.722931	9578.876710	0.484126	1.970276	66
50%	4.375000	0.000000	0.000000	0.000000	12345.14650	0.631956	2.694679	12142.911975	0.648491	2.672563	79
75%	6.187500	0.000000	0.000000	1.000000	15645.57475	0.970216	3.908121	15938.819440	0.822396	3.316956	94
max	11.500000	1.125000	1.000000	1.000000	19221.97000	2.275605	8.578274	19099.880000	1.064642	4.300945	112

```
nontext_data.isnull().sum()
```

```
forecast              0
confcall              0
ChairPerson           0
Rate                  0
RateDiff              0
RateDecision          0
RateChanged           0
GDP_date              0
GDP_value             0
GDP_diff_prev         0
GDP_diff_year         0
GDPPOT_date           0
GDPPOT_value          0
GDPPOT_diff_prev      0
GDPPOT_diff_year      0
PCE_date              0
PCE_value             0
PCE_diff_prev         0
PCE_diff_year         0
CPI_date              0
CPI_value             0
CPI_diff_prev         0
CPI_diff_year         0
Unemp_date            0
Unemp_value           0
Unemp_diff_prev       0
Unemp_diff_year       0
Employ_date           0
Employ_value          0
Employ_diff_prev      0
Employ_diff_year      0

PMI_date              0
```

```
PMI_value             0
PMI_diff_prev         0
PMI_diff_year         0
NMI_date            281
NMI_value           281
NMI_diff_prev       281
NMI_diff_year       295
Rsales_date         116
Rsales_value        116
Rsales_diff_prev    117
Rsales_diff_year    129
Hsales_date           0
Hsales_value          0
Hsales_diff_prev      0
Hsales_diff_year      0
Taylor                0
Balanced              0
Inertia               0
Taylor-Rate           0
Balanced-Rate         0
Inertia-Rate          0
Taylor_diff           1
Balanced_diff         1
Inertia_diff          1
prev_decision         1
next_decision         1
dtype: int64
```

```
x = nontext_data['RateDecision'].value_counts()
print("Count: ")
print(x)
print("Percent: ")
print(round(x/sum(x) * 100))
plt.figure(figsize=(8,5))
ax = sns.countplot(x='RateDecision', data=nontext_data)
ax.set_title('nontext_data')
```

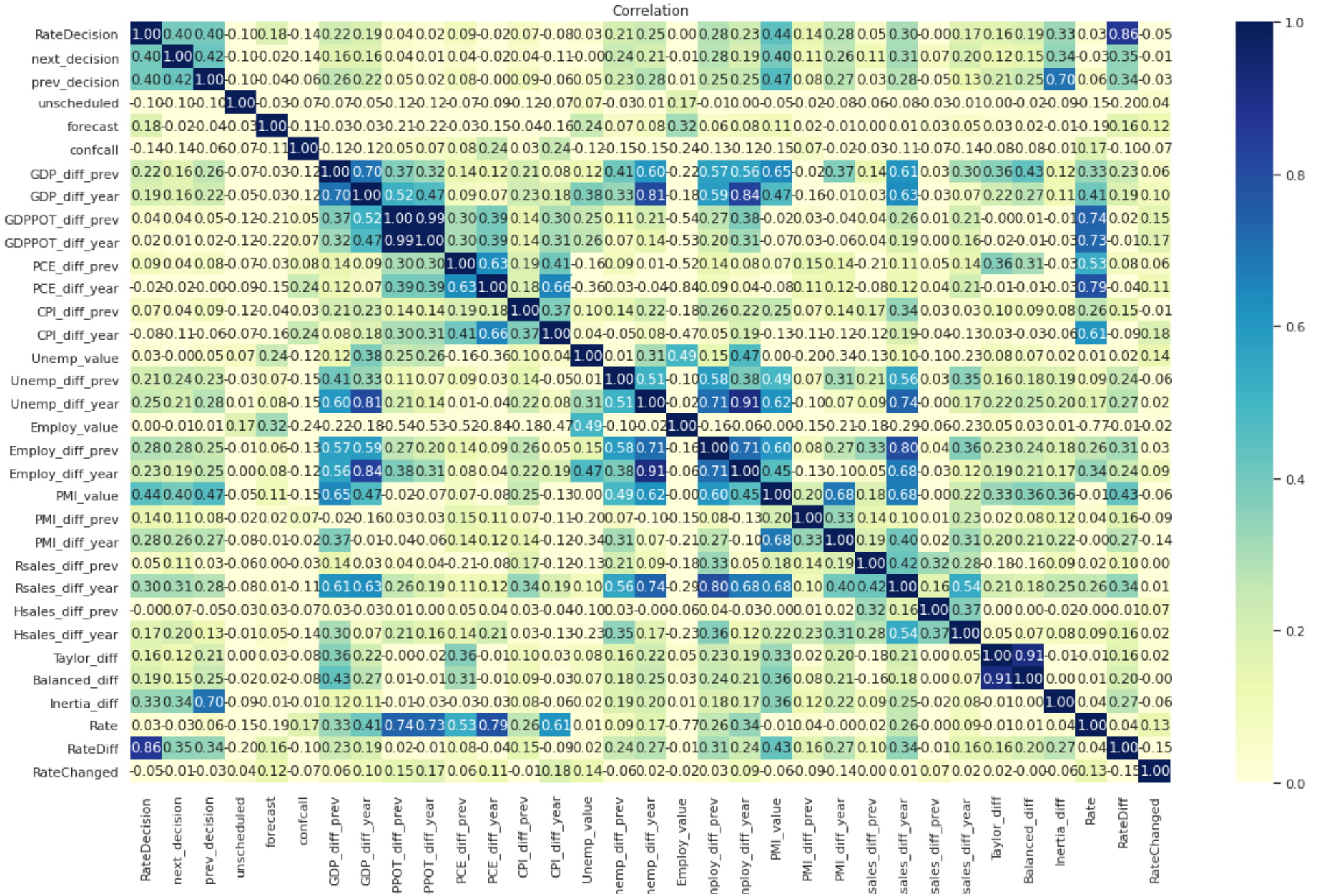
```
Count:
 0    254
-1     72
 1     64
Name: RateDecision, dtype: Int64
Percent:
 0    65.0
-1    18.0
 1    16.0
Name: RateDecision, dtype: float64
Text(0.5, 1.0, 'nontext_data')
```

Correlation

```
nontext_data.columns.values
```

```
array(['unscheduled', 'forecast', 'confcall', 'ChairPerson', 'Rate',
       'RateDiff', 'RateDecision', 'RateChanged', 'GDP_date', 'GDP_value',
       'GDP_diff_prev', 'GDP_diff_year', 'GDPPOT_date', 'GDPPOT_value',
       'GDPPOT_diff_prev', 'GDPPOT_diff_year', 'PCE_date', 'PCE_value',
       'PCE_diff_prev', 'PCE_diff_year', 'CPI_date', 'CPI_value',
       'CPI_diff_prev', 'CPI_diff_year', 'Unemp_date', 'Unemp_value',
       'Unemp_diff_prev', 'Unemp_diff_year', 'Employ_date',
       'Employ_value', 'Employ_diff_prev', 'Employ_diff_year', 'PMI_date',
       'PMI_value', 'PMI_diff_prev', 'PMI_diff_year', 'NMI_date',
       'NMI_value', 'NMI_diff_prev', 'NMI_diff_year', 'Rsales_date',
       'Rsales_value', 'Rsales_diff_prev', 'Rsales_diff_year',
       'Hsales_date', 'Hsales_value', 'Hsales_diff_prev',
       'Hsales_diff_year', 'Taylor', 'Balanced', 'Inertia', 'Taylor-Rate',
       'Balanced-Rate', 'Inertia-Rate', 'Taylor_diff', 'Balanced_diff',
       'Inertia_diff', 'prev_decision', 'next_decision'], dtype=object)
```

```
corr_columns = ['RateDecision', 'next_decision', 'prev_decision', 'unscheduled', 'forecast', 'confcall',
                'GDP_diff_prev', 'GDP_diff_year', 'GDPPOT_diff_prev', 'GDPPOT_diff_year',
                'PCE_diff_prev', 'PCE_diff_year', 'CPI_diff_prev', 'CPI_diff_year',
                'Unemp_value', 'Unemp_diff_prev', 'Unemp_diff_year',
                'Employ_value', 'Employ_diff_prev', 'Employ_diff_year',
                'PMI_value', 'PMI_diff_prev', 'PMI_diff_year',
                'Rsales_diff_prev', 'Rsales_diff_year', 'Hsales_diff_prev', 'Hsales_diff_year',
                'Taylor_diff', 'Balanced_diff', 'Inertia_diff', 'Rate', 'RateDiff', 'RateChanged']

fig, ax = plt.subplots(1, 1, figsize=(20, 12))

sns.heatmap(nontext_data[corr_columns].astype(float).corr(), cmap="YlGnBu", annot=True, fmt=".2f", vmin=0, vmax=1, ax=ax)
ax.set_title("Correlation")
plt.show()
```

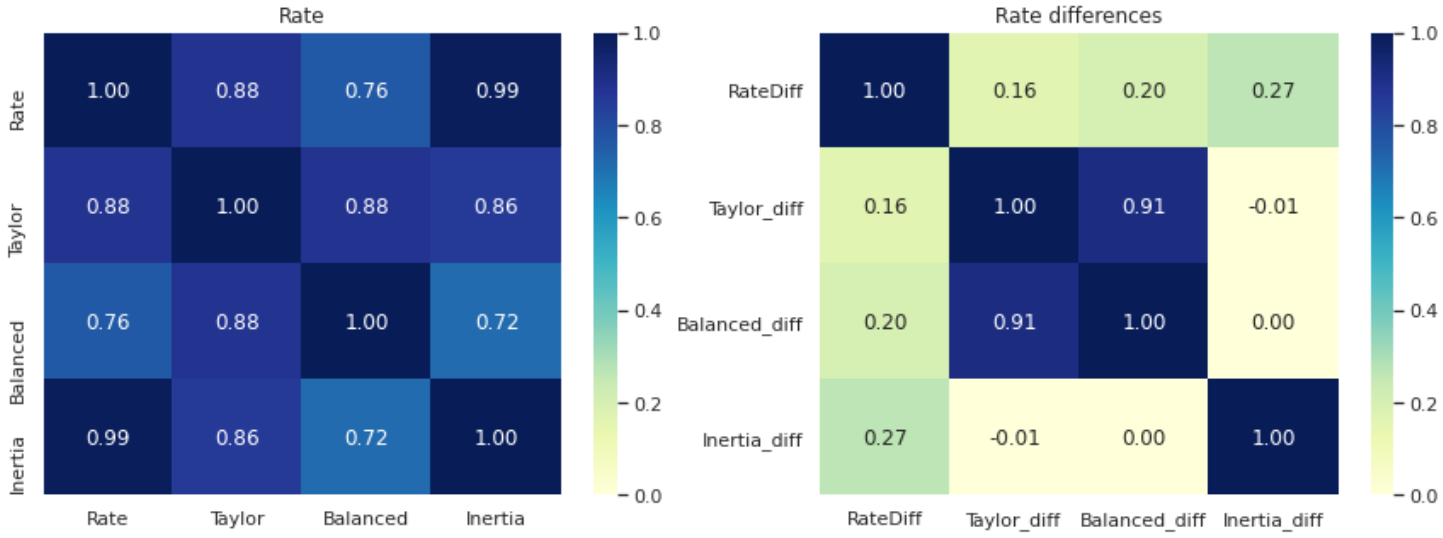


Moving average

```
corr_columns = ['RateDecision',
                'GDP_diff_prev', 'GDP_diff_year', 'GDPPOT_diff_prev', 'GDPPOT_diff_year',
                'PCE_diff_prev', 'PCE_diff_year', 'CPI_diff_prev', 'CPI_diff_year',
                'Unemp_value', 'Unemp_diff_prev', 'Unemp_diff_year',
                'Employ_value', 'Employ_diff_prev', 'Employ_diff_year',
                'PMI_value', 'PMI_diff_prev', 'PMI_diff_year',
```

```
                'PMI_value', 'PMI_diff_prev', 'PMI_diff_year',
                'Rsales_diff_prev', 'Rsales_diff_year', 'Hsales_diff_prev', 'Hsales_diff_year',
                'Taylor_diff', 'Balanced_diff', 'Inertia_diff', 'Taylor-Rate', 'Balanced-Rate', 'Inertia-Rate']


fig, (ax1, ax2, ax3, ax4, ax5) = plt.subplots(5, 1, figsize=(17,8))

sns.heatmap(nontext_data[corr_columns].astype(float).corr().iloc[:1], cmap="YlGnBu", annot=True, fmt=".2f", vmin=0, vmax=1, ax=ax1)
ax1.set_title("Correlation: Original")
ax1.set_xticks([])
ax1.set_yticks([])
sns.heatmap(nontext_ma2[corr_columns].astype(float).corr().iloc[:1], cmap="YlGnBu", annot=True, fmt=".2f", vmin=0, vmax=1, ax=ax2)
ax2.set_title("Correlation: Moving average of 2 periods")
ax2.set_xticks([])
ax2.set_yticks([])
sns.heatmap(nontext_ma3[corr_columns].astype(float).corr().iloc[:1], cmap="YlGnBu", annot=True, fmt=".2f", vmin=0, vmax=1, ax=ax3)
ax3.set_title("Correlation: Moving average of 3 periods")
ax3.set_xticks([])
ax3.set_yticks([])
sns.heatmap(nontext_ma6[corr_columns].astype(float).corr().iloc[:1], cmap="YlGnBu", annot=True, fmt=".2f", vmin=0, vmax=1, ax=ax4)
ax4.set_title("Correlation: Moving average of 6 periods")
ax4.set_xticks([])
ax4.set_yticks([])
sns.heatmap(nontext_ma12[corr_columns].astype(float).corr().iloc[:1], cmap="YlGnBu", annot=True, fmt=".2f", vmin=0, vmax=1, ax=ax5)
ax5.set_title("Correlation: Moving average of 12 periods")
ax5.set_yticks([])

fig.tight_layout(pad=1.0)
plt.show()
```


```
fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(15, 5))

corr_columns = ['Rate', 'Taylor', 'Balanced', 'Inertia']
sns.heatmap(nontext_data[corr_columns].astype(float).corr(), cmap="YlGnBu", annot=True, fmt=".2f", vmin=0, vmax=1, ax=ax1)
ax1.set_title("Rate")

corr_columns = ['RateDiff', 'Taylor_diff', 'Balanced_diff', 'Inertia_diff']
sns.heatmap(nontext_data[corr_columns].astype(float).corr(), cmap="YlGnBu", annot=True, fmt=".2f", vmin=0, vmax=1, ax=ax2)
ax2.set_title("Rate differences")

plt.show()
```




```
fig, ax = plt.subplots(figsize=(18, 10))
sns.lineplot(data=nontext_data[corr_columns], ax=ax)

decision_raise = nontext_data.loc[nontext_data['RateDecision'] == 1]
decision_hold = nontext_data.loc[nontext_data['RateDecision'] == 0]
decision_lower = nontext_data.loc[nontext_data['RateDecision'] == -1]

ax.plot(decision_raise.index.values, decision_raise['Rate'], 'o', color="g", label="Raise")
ax.plot(decision_hold.index.values, decision_hold['Rate'], 'o', color="grey", label="Hold")
ax.plot(decision_lower.index.values, decision_lower['Rate'], 'o', color="r", label="Lower")
```

```
[<matplotlib.lines.Line2D at 0x7fe77167a9b0>]
```

Check individual columns

```
def plot_distribution(df, columns):
    for col in columns:
        fig, ax = plt.subplots(figsize=(10, 5))
        g = sns.kdeplot(df[col][(df["RateDecision"] == -1) & (df[col].notnull())], color="Red", shade=True)
        g = sns.kdeplot(df[col][(df["RateDecision"] == 0) & (df[col].notnull())], ax=g, color="Blue", shade=True)
        g = sns.kdeplot(df[col][(df["RateDecision"] == 1) & (df[col].notnull())], ax=g, color="Green", shade=True)
        g.set_xlabel(col)
        g.set_ylabel("Frequency")
        g.set_title("Distribution for " + col, fontsize=14)
        g = g.legend(["Lower", "Hold", "Raise"])

        g = sns.FacetGrid(df, col='RateDecision', height=3, aspect=1)
```

```
        g.map(sns.distplot, col)

plot_distribution(nontext_data, ["GDP_diff_prev", "GDP_diff_year", "GDPPOT_diff_prev", "GDPPOT_diff_year"])
```

```
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
```

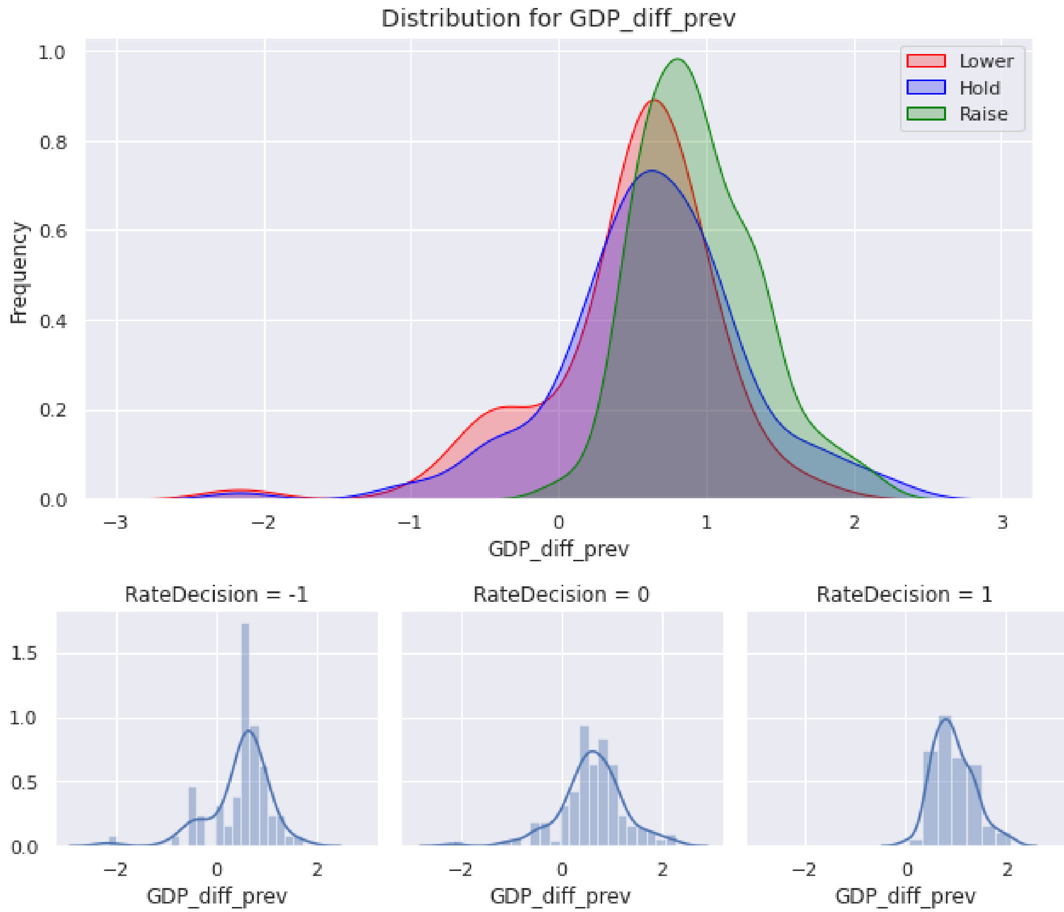

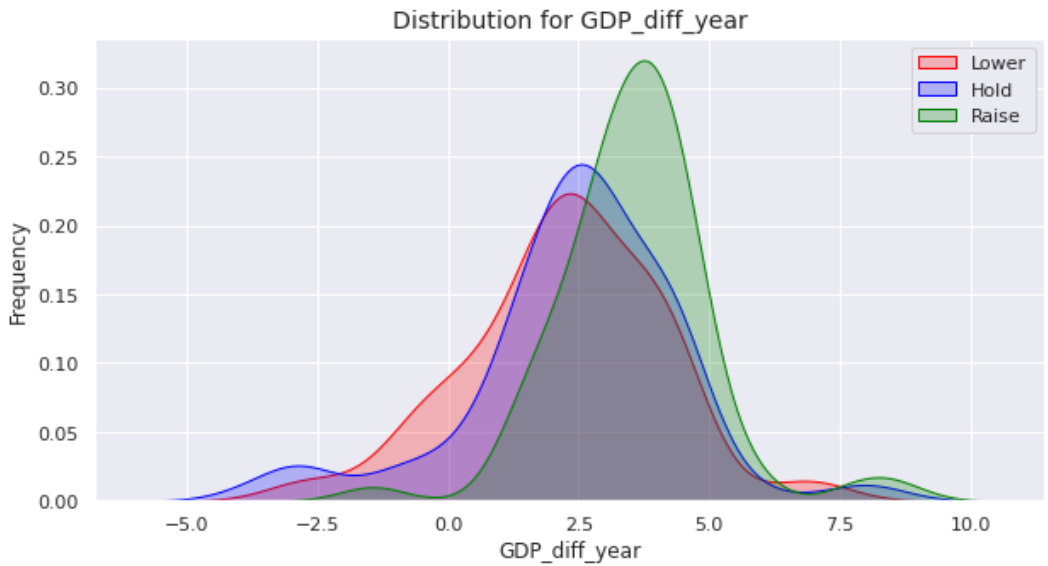

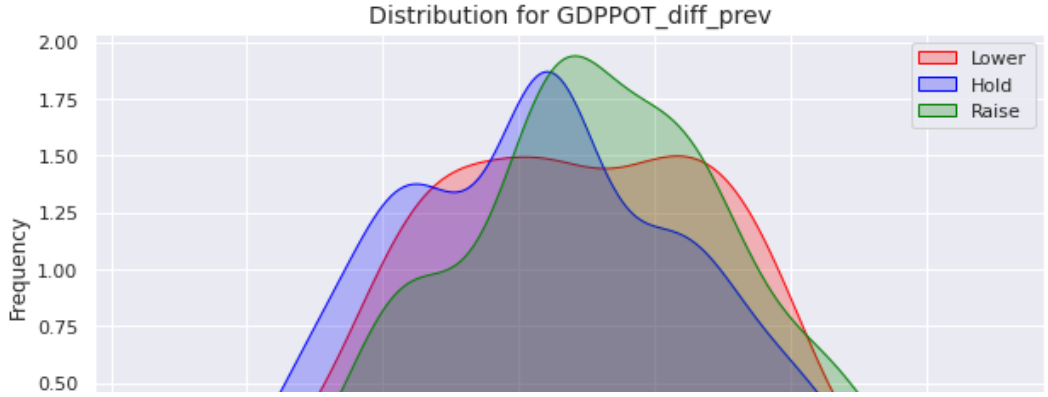


```
plot_distribution(nontext_data, ["PCE_diff_prev", "PCE_diff_year", "CPI_diff_prev", "CPI_diff_year"])
```

```
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
```
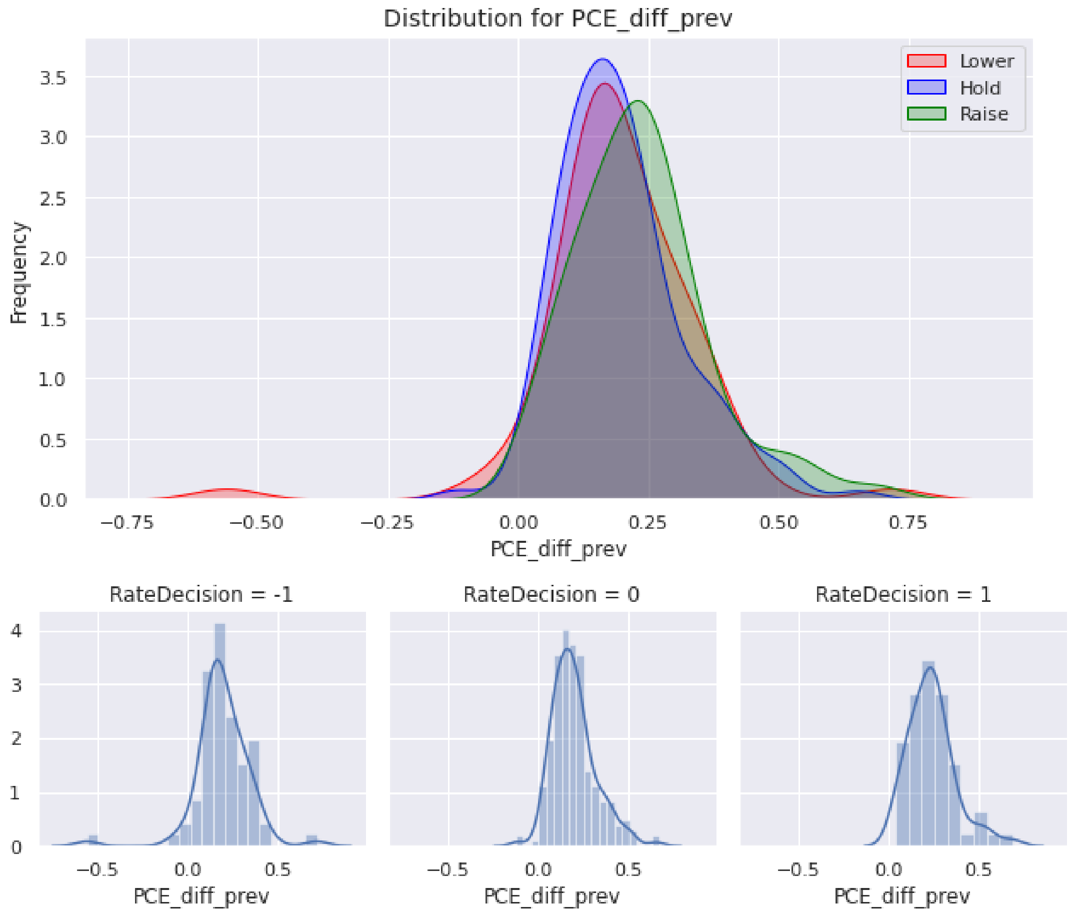
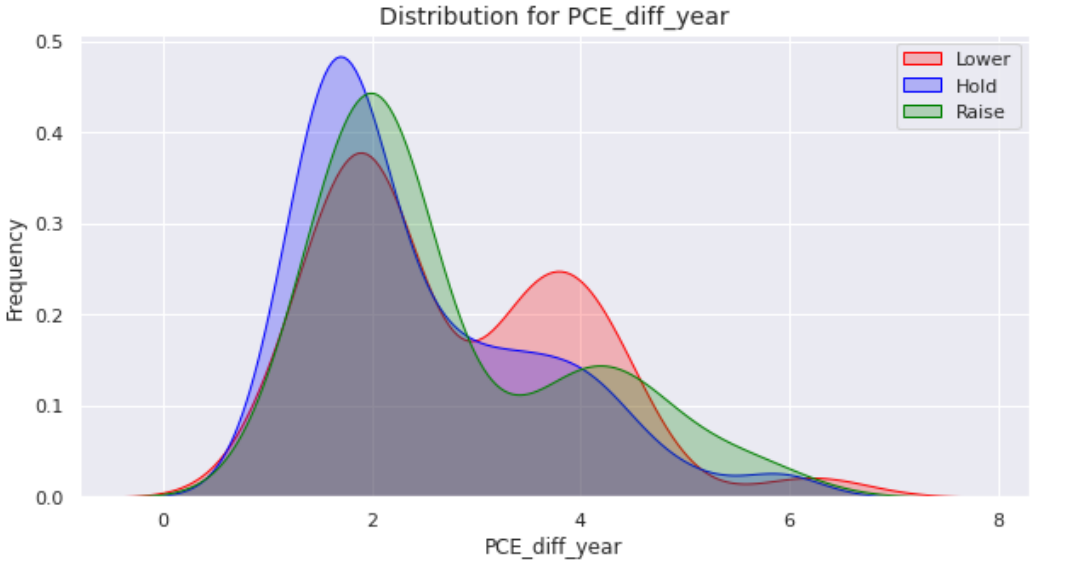
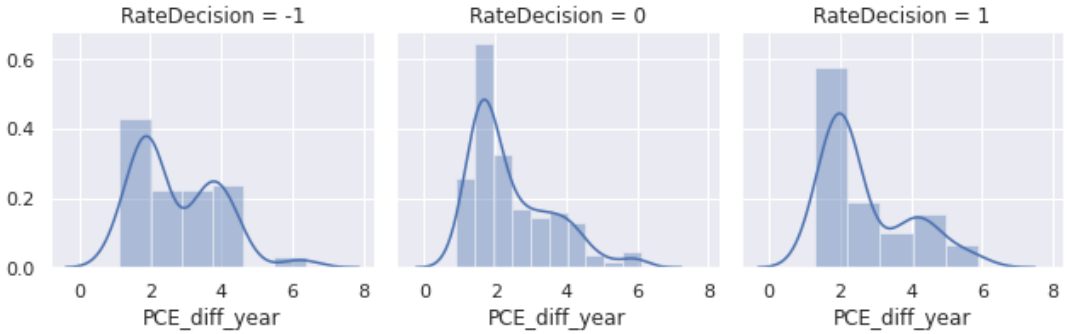
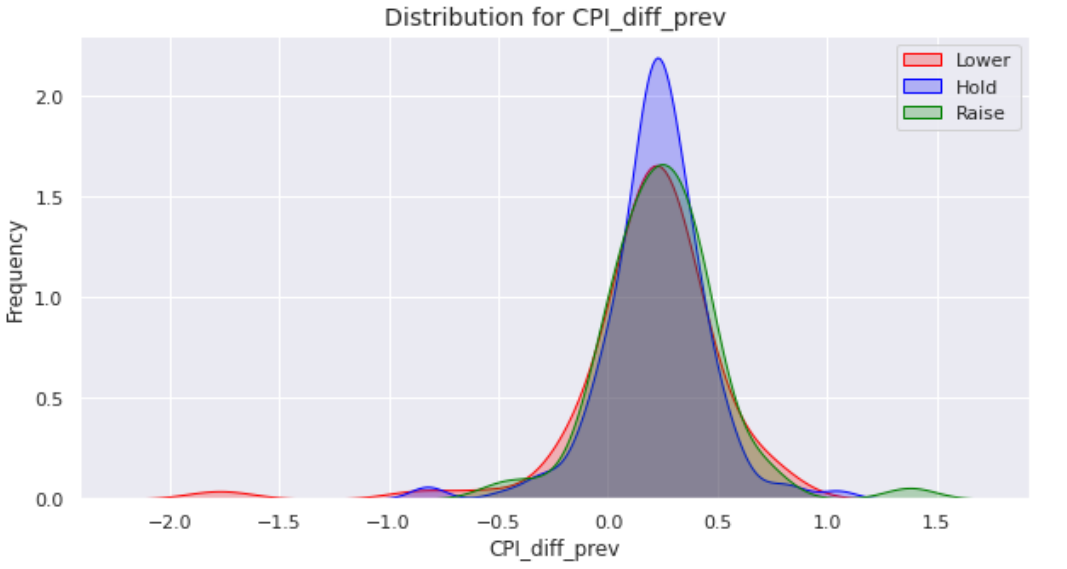
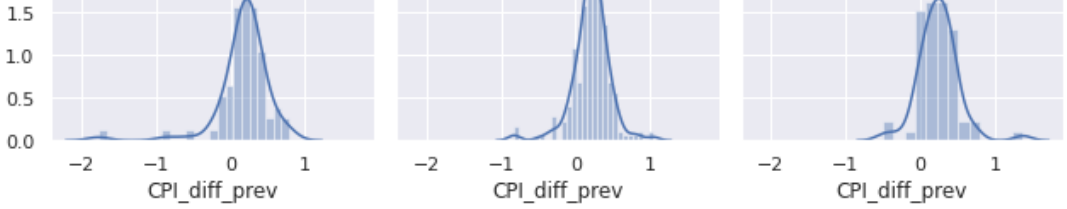



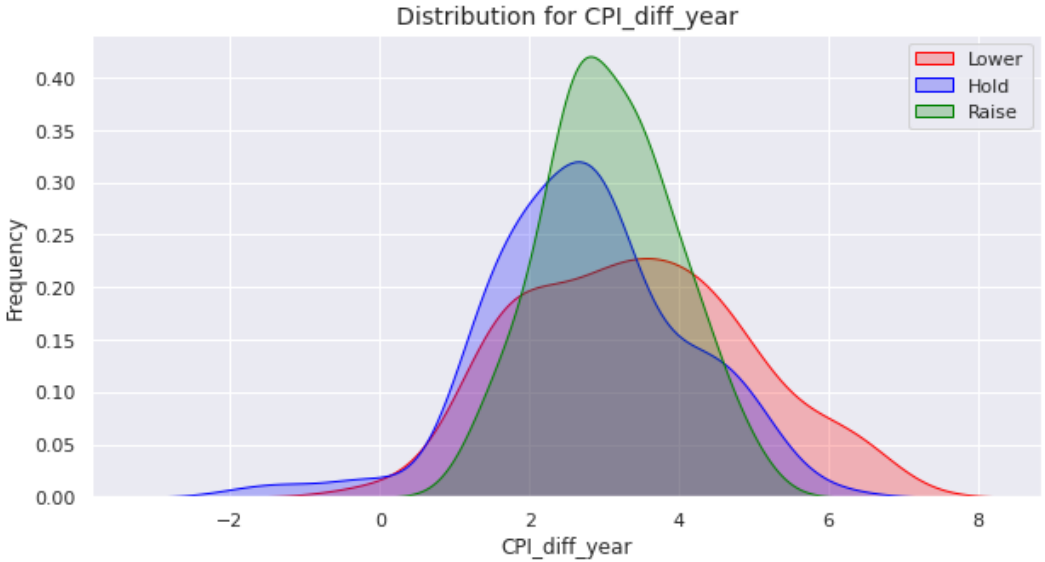

Distribution for PCE_diff_year
Lower
Hold
Raise
Frequency
PCE_diff_year


RateDecision = -1
RateDecision = 0
RateDecision = 1
PCE_diff_year
PCE_diff_year
PCE_diff_year


Distribution for CPI_diff_prev
Lower
Hold
Raise
Frequency
CPI_diff_prev


RateDecision = -1
RateDecision = 0
RateDecision = 1






```
plot_distribution(nontext_data, ["Unemp_value", "Unemp_diff_prev", "Unemp_diff_year", "Employ_value", "Employ_diff_prev", "Employ_diff_year"])
```

```
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
```
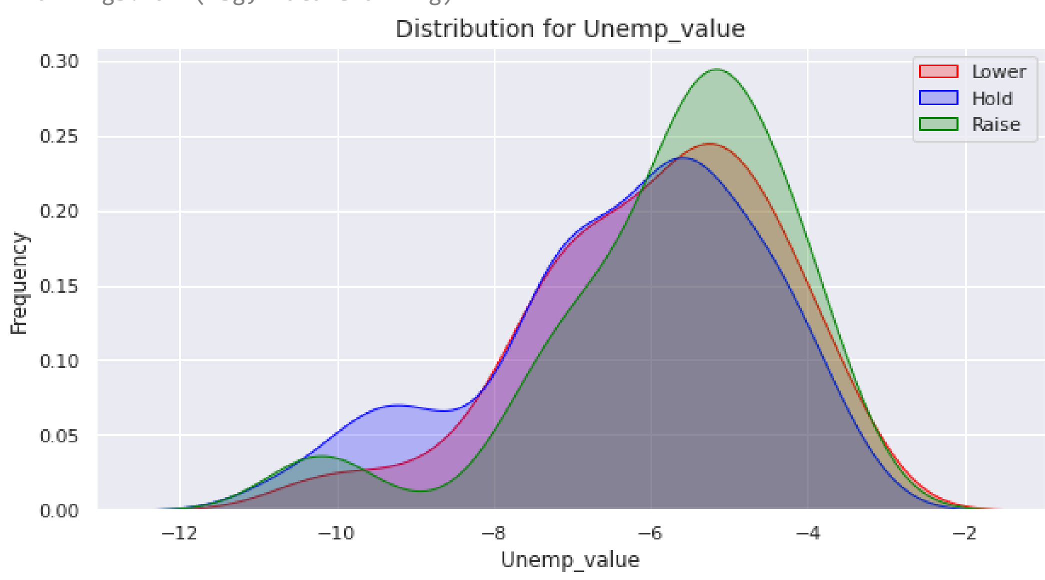
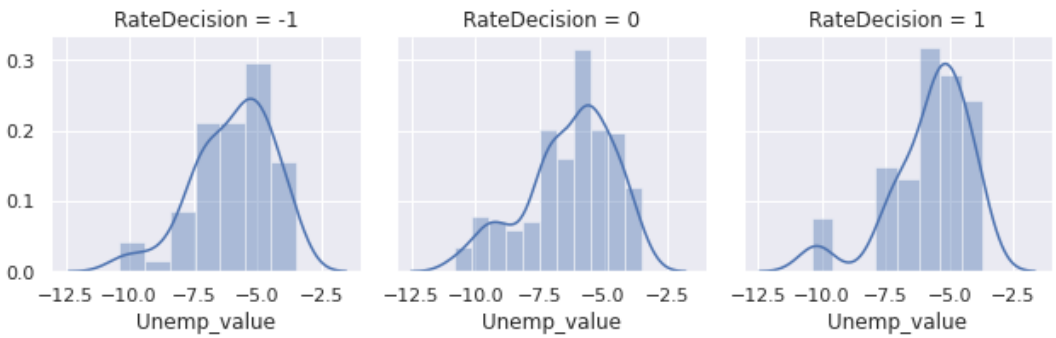
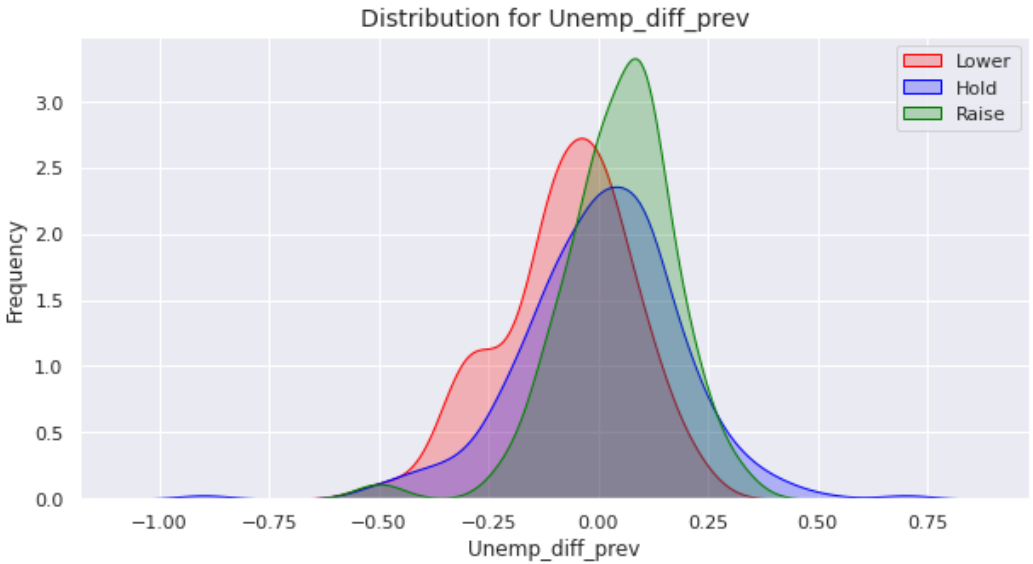
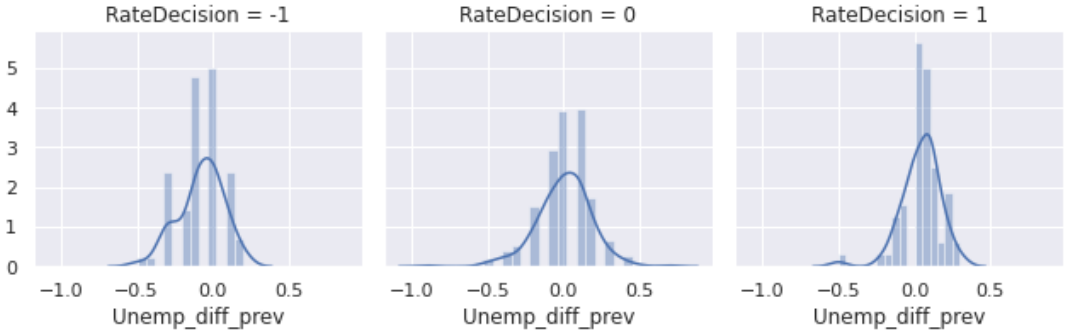
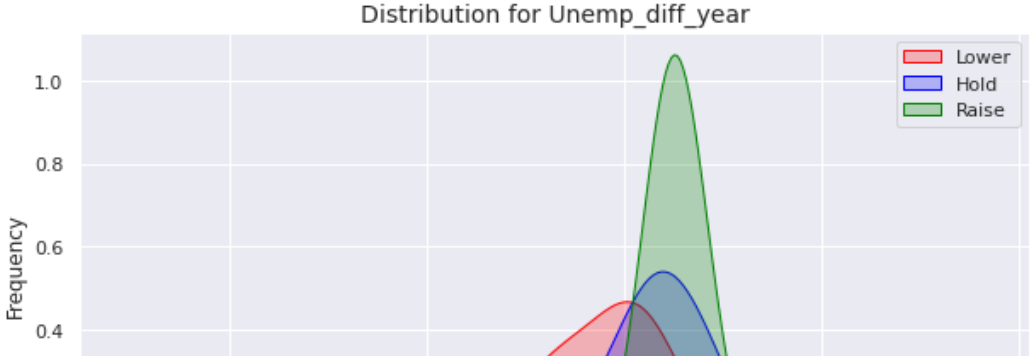
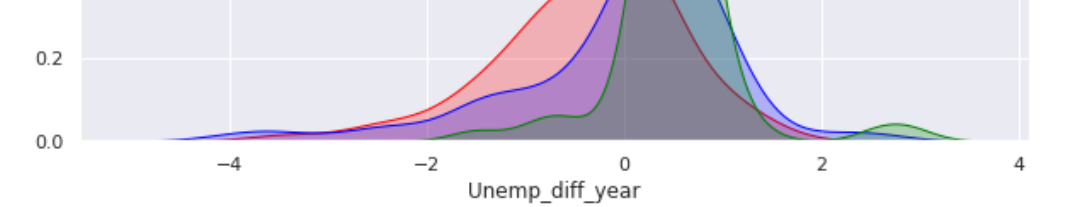



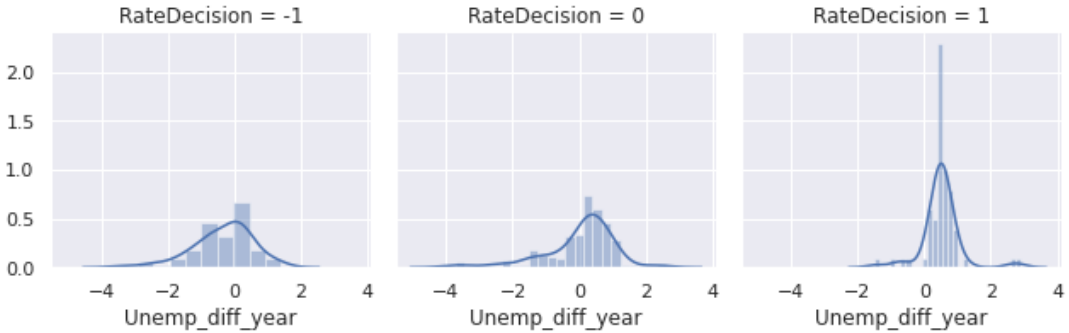

RateDecision = -1
RateDecision = 0
RateDecision = 1
0.3
0.2
0.1
0.0
−12.5 −10.0 −7.5 −5.0 −2.5
Unemp_value


Distribution for Unemp_diff_prev
Lower
Hold
Raise
Frequency
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−1.00 −0.75 −0.50 −0.25 0.00 0.25 0.50 0.75
Unemp_diff_prev

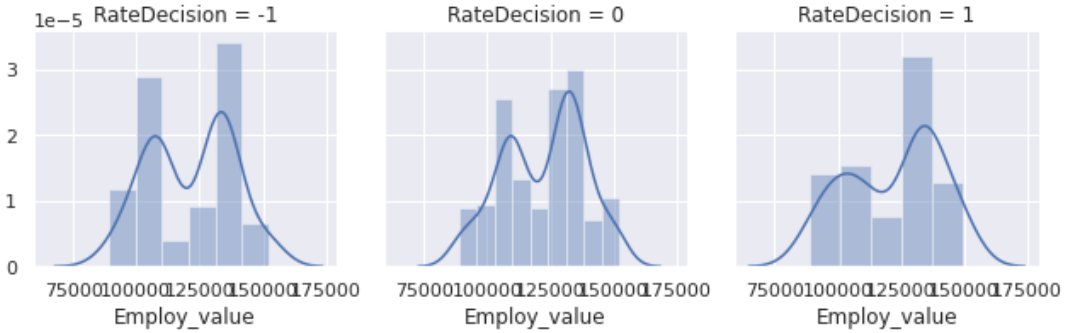

RateDecision = -1
RateDecision = 0
RateDecision = 1
5
4
3
2
1
0
−1.0 −0.5 0.0 0.5
Unemp_diff_prev


Distribution for Unemp_diff_year
Lower
Hold
Raise
Frequency
1.0
0.8
0.6
0.4

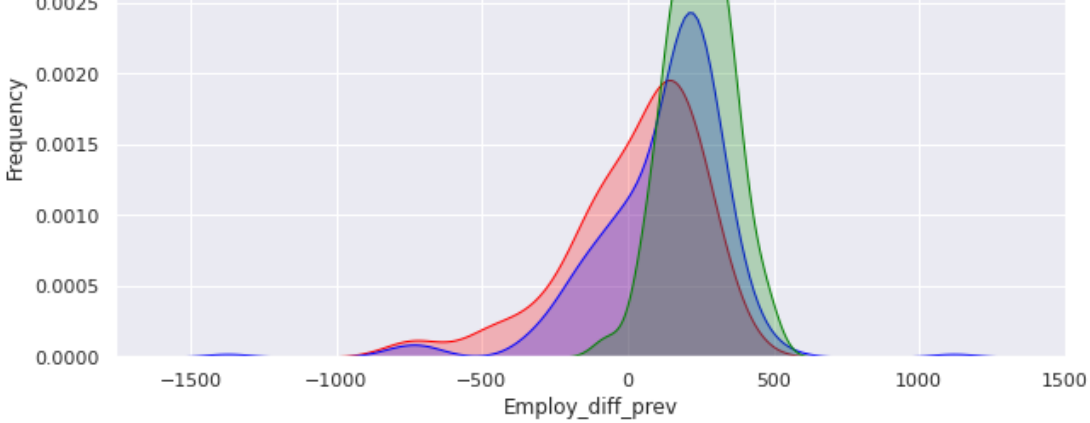

0.2
0.0
−4
−2
0
2
4
Unemp_diff_year


RateDecision = -1
RateDecision = 0
RateDecision = 1
2.0
1.5
1.0
0.5
0.0
−4
−2
0
2
4
Unemp_diff_year


Distribution for Employ_value
1e−5
Lower
Hold
Raise
Frequency
2.5
2.0
1.5
1.0
0.5
0.0
60000
80000
100000
120000
140000
160000
Employ_value


1e−5
RateDecision = -1
RateDecision = 0
RateDecision = 1
3
2
1
0
75000
100000
125000
150000
175000
Employ_value


Distribution for Employ_diff_prev
Lower
Hold
Raise
0.0030




```
plot_distribution(nontext_data, ["PMI_value", "PMI_diff_prev", "PMI_diff_year"])
```

```
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
```

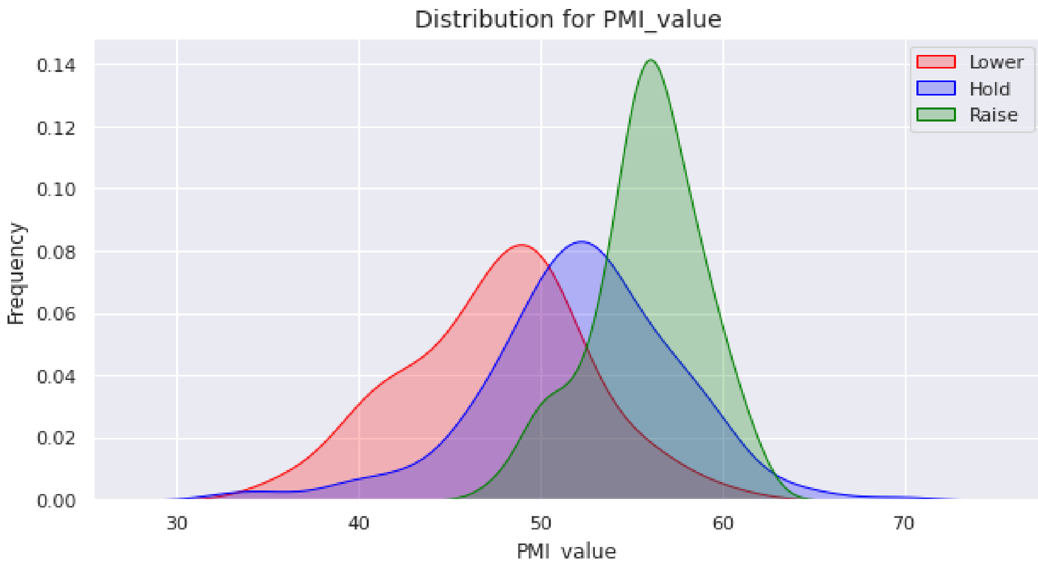

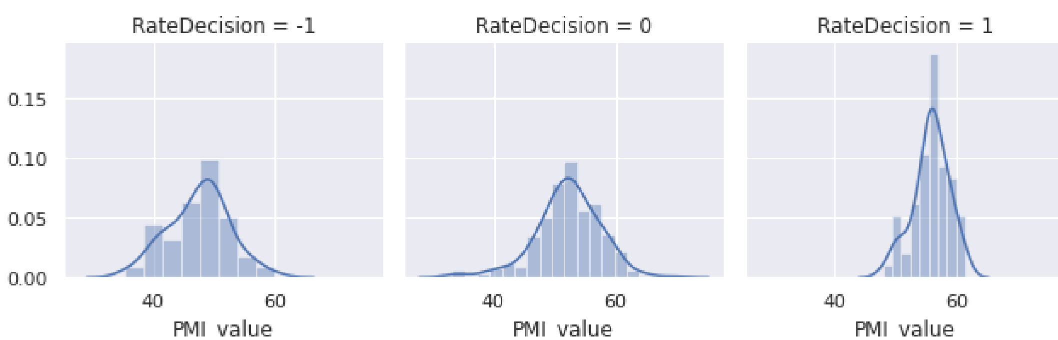

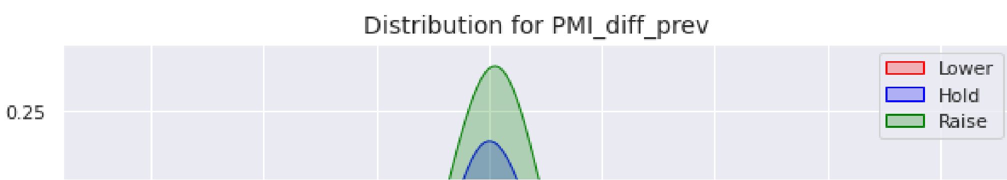

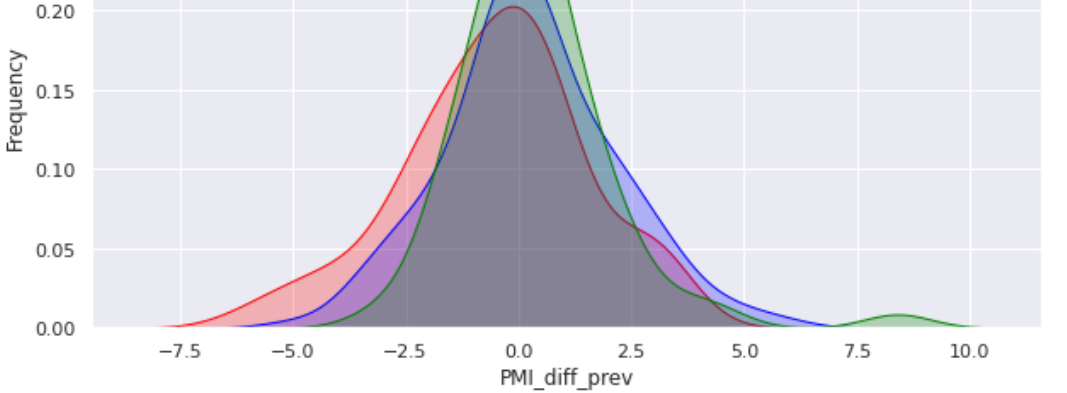

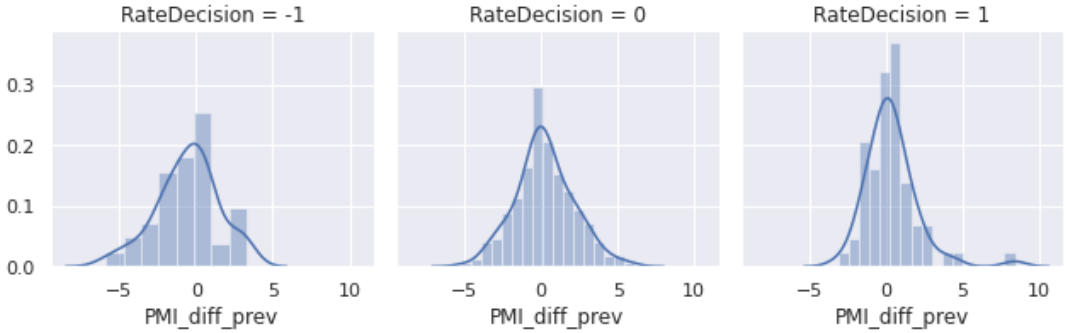

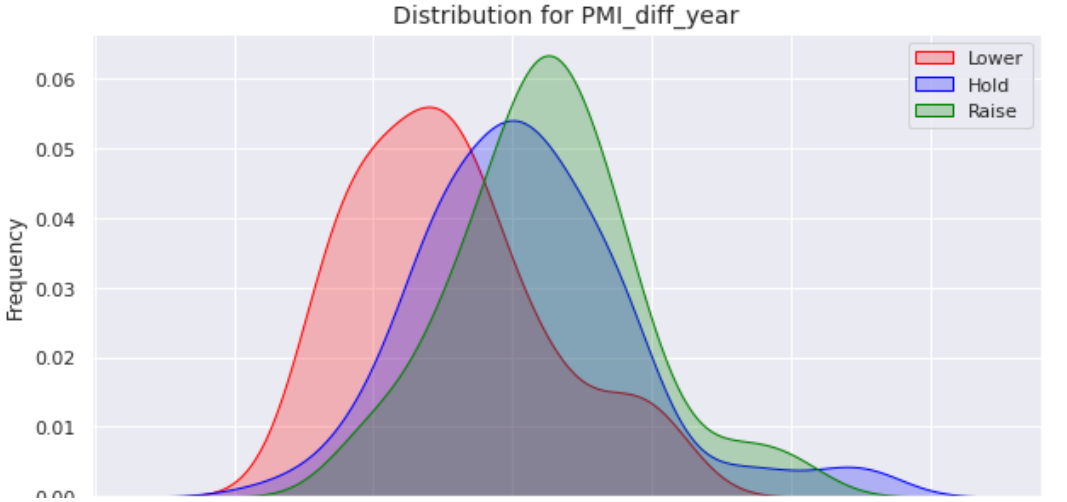


```
plot_distribution(nontext_data, ["Rsales_diff_prev", "Rsales_diff_year", "Hsales_diff_prev", "Hsales_diff_year"])
```

```
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
```
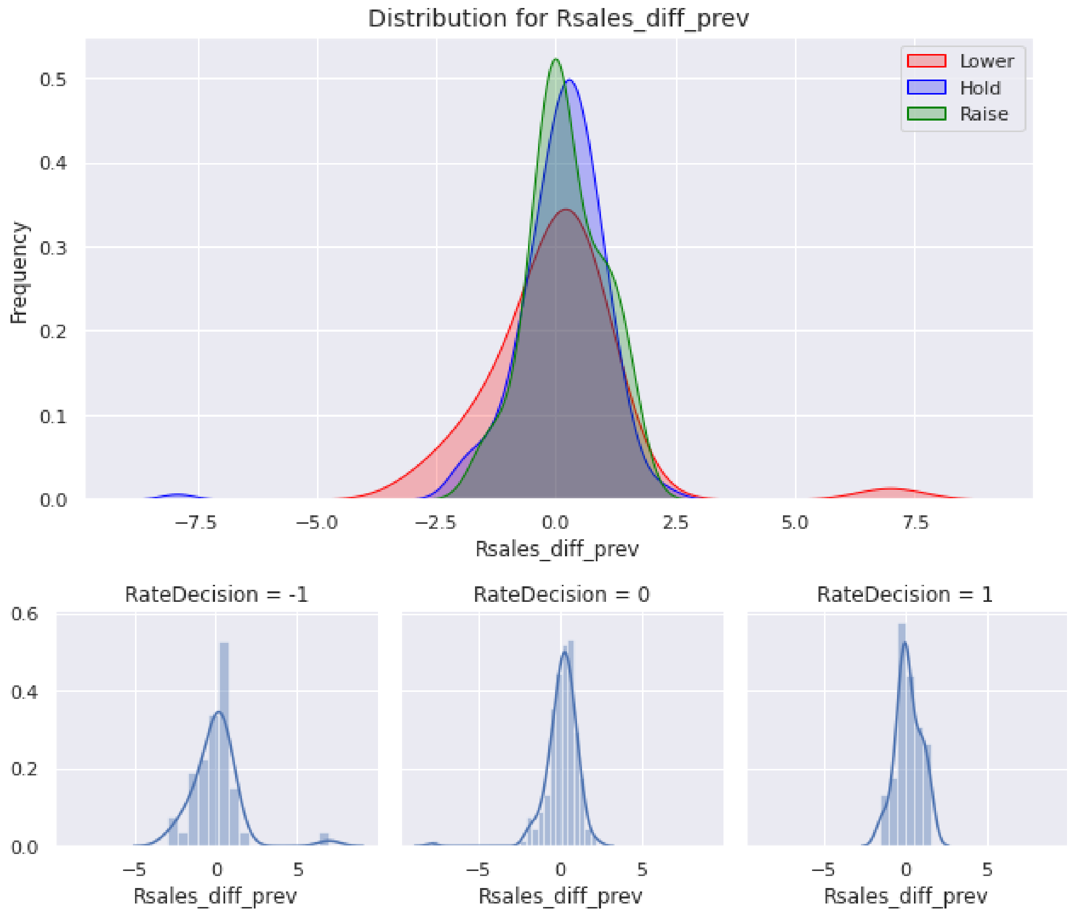
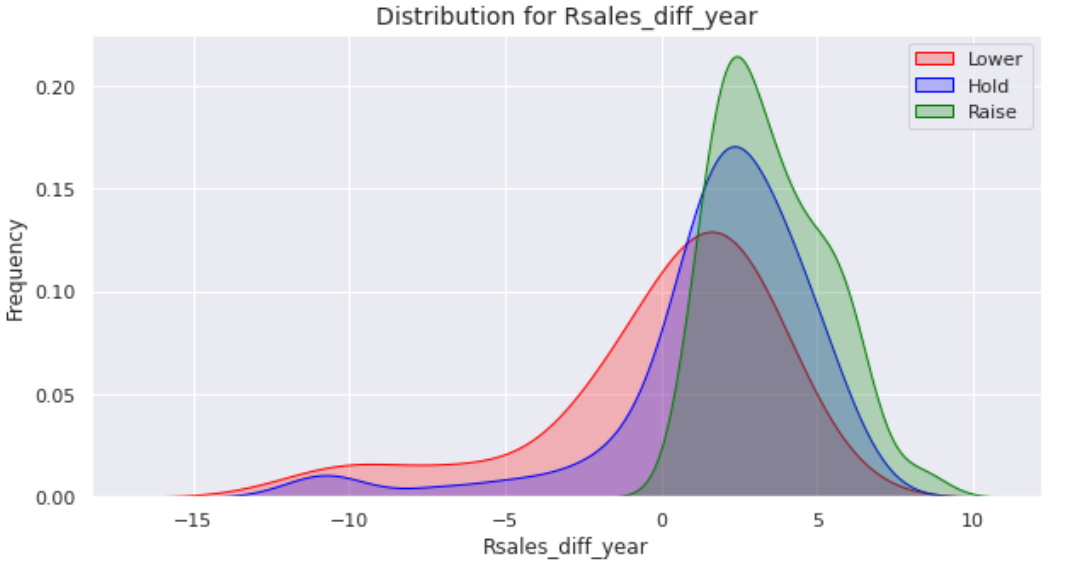
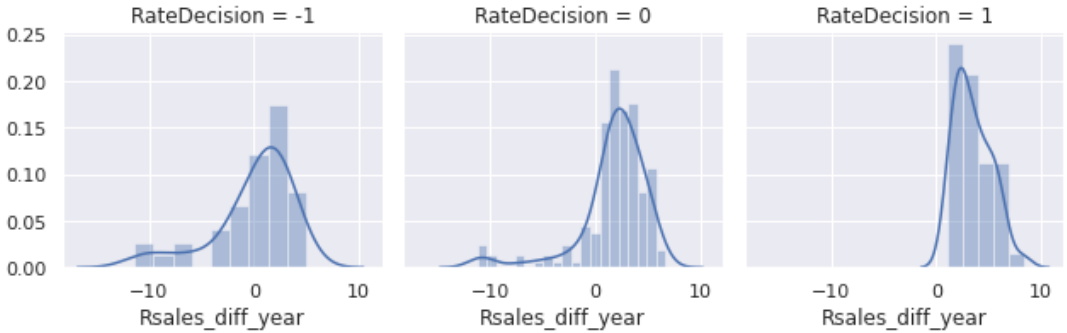
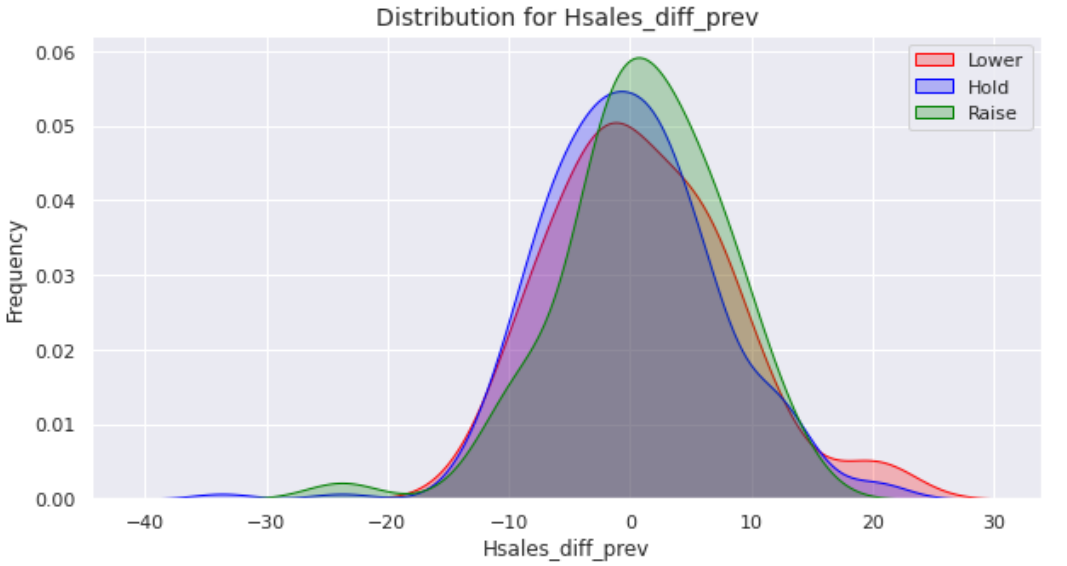
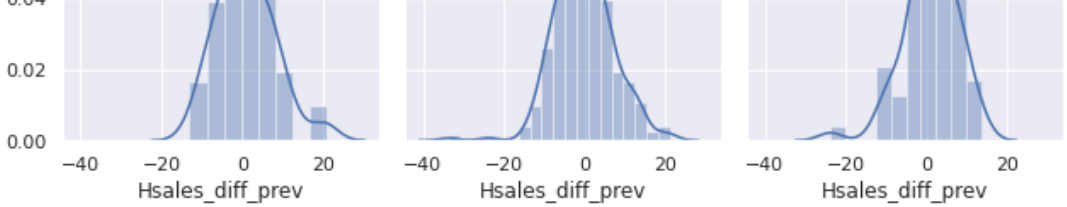



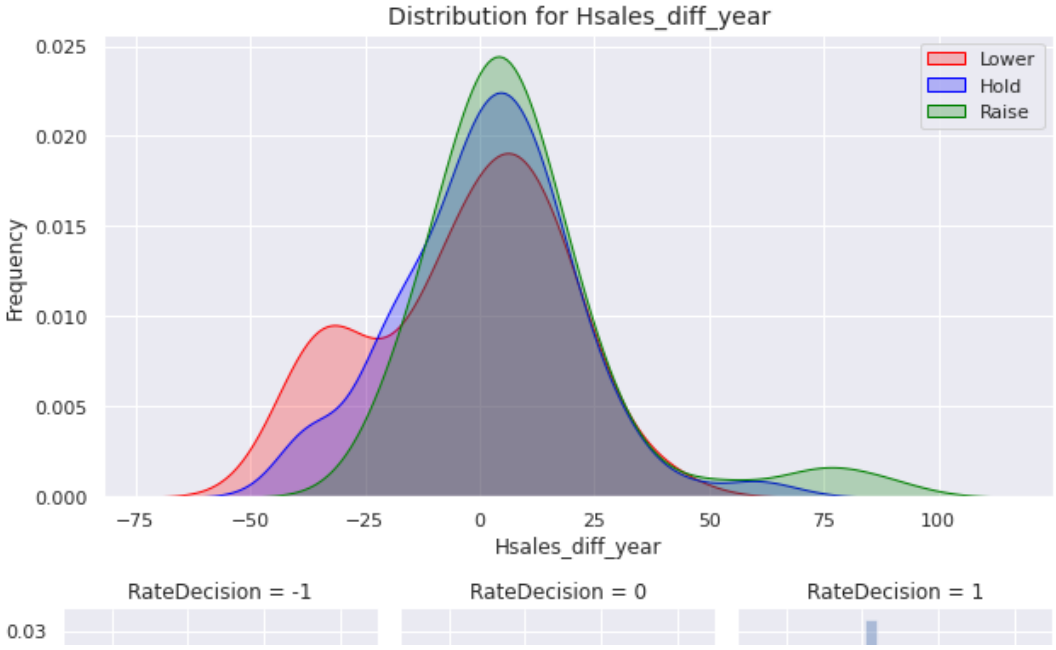

Distribution for Rsales_diff_year
Lower
Hold
Raise
Frequency
0.20
0.15
0.10
0.05
0.00
−15
−10
−5
0
5
10
Rsales_diff_year


RateDecision = -1
RateDecision = 0
RateDecision = 1
0.25
0.20
0.15
0.10
0.05
0.00
−10
0
10
Rsales_diff_year


Distribution for Hsales_diff_prev
Lower
Hold
Raise
Frequency
0.06
0.05
0.04
0.03
0.02
0.01
0.00
−40
−30
−20
−10
0
10
20
30
Hsales_diff_prev


RateDecision = -1
RateDecision = 0
RateDecision = 1
0.06
0.04






```
plot_distribution(nontext_data, ["Taylor_diff", "Balanced_diff", "Inertia_diff"])
```

```
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
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/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2551: FutureWarning: `distplot` is a deprecated function and will be removed in a future
  warnings.warn(msg, FutureWarning)
```
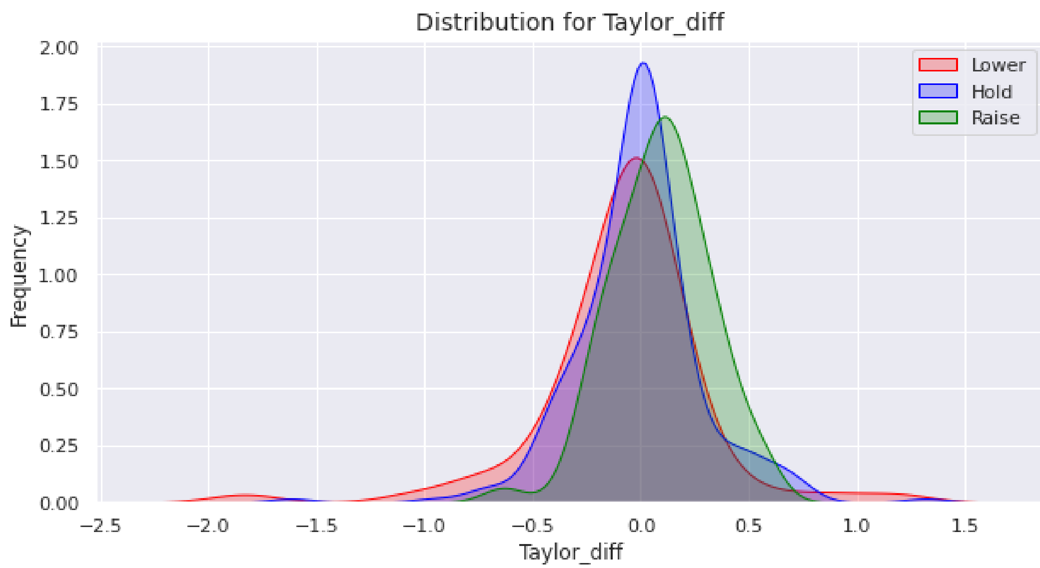
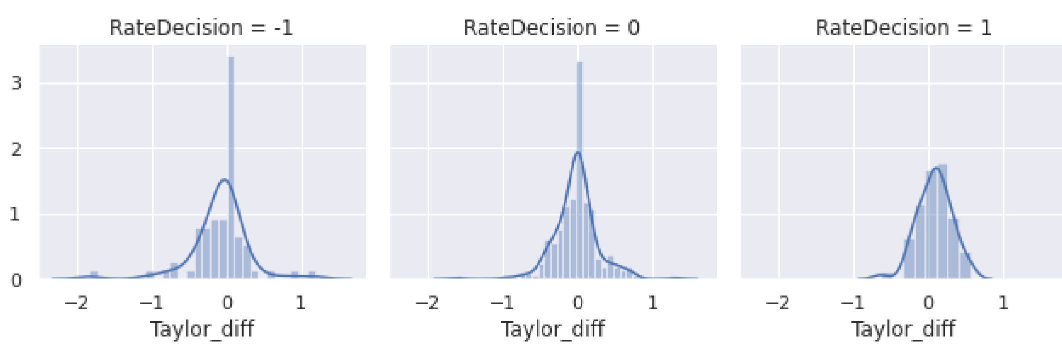
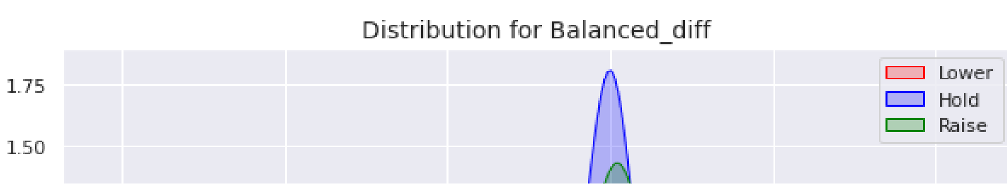
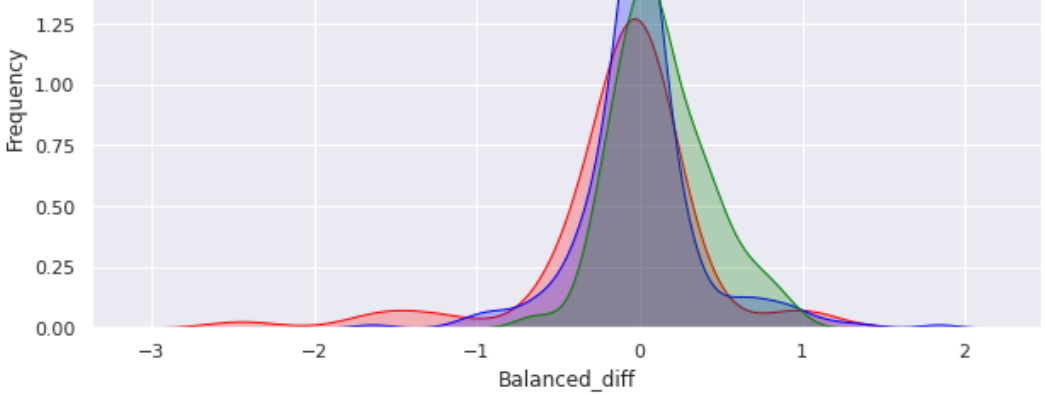









Create Training Data Set

```
nontext_train_small = pd.concat([nontext_data[['RateDecision', 'prev_decision', 'GDP_diff_prev', 'PMI_value']],
                                 nontext_ma2[['Employ_diff_prev', 'Rsales_diff_year']],
                                 nontext_ma3[['Unemp_diff_prev', 'Inertia_diff']],
                                 nontext_ma12[['Hsales_diff_year', 'Balanced_diff']]], axis=1)
nontext_train_small.rename(columns={'RateDecision': 'target'}, inplace=True)
```

```
nontext_train_small.isnull().sum()
```

```
target               0
prev_decision        1
GDP_diff_prev        0
PMI_value            0
Employ_diff_prev     0
Rsales_diff_year   131
Unemp_diff_prev      0
```

```
Inertia_diff          4
Hsales_diff_year      0
Balanced_diff        15
dtype: int64
```

```
latest_columns = ['RateDecision',
                  'prev_decision',
                  'GDP_diff_prev',
                  'GDP_diff_year',
                  'GDPPOT_diff_prev',
                  'GDPPOT_diff_year',
                  'PCE_diff_prev',
                  'PCE_diff_year',
                  'CPI_diff_prev',
                  'CPI_diff_year',
                  'Unemp_value',
                  'Unemp_diff_prev',
                  'Unemp_diff_year',
                  'Employ_value',
                  'Employ_diff_prev',
                  'Employ_diff_year',
                  'PMI_value',
                  'PMI_diff_prev',
                  'PMI_diff_year',
                  'Rsales_diff_prev',
                  'Rsales_diff_year',
                  'Hsales_diff_prev',
                  'Hsales_diff_year',
                  'Taylor-Rate',
                  'Balanced-Rate',
                  'Inertia-Rate',
                  'Taylor_diff',
                  'Balanced_diff',
                  'Inertia_diff']

ma3_columns = [
                'GDP_diff_prev',
                'GDP_diff_year',
                'GDPPOT_diff_prev',
                'GDPPOT_diff_year',
                'PCE_diff_prev',
                'PCE_diff_year',
                'CPI_diff_prev',
                'CPI_diff_year',
                'Unemp_value',
                'Unemp_diff_prev',
                'Unemp_diff_year',
                'Employ_value',
                'Employ_diff_prev',
                'Employ_diff_year',
```

```
                'PMI_value',
                'PMI_diff_prev',
                'PMI_diff_year',
                'Rsales_diff_prev',
                'Rsales_diff_year',
                'Hsales_diff_prev',
                'Hsales_diff_year',
                'Taylor-Rate',
                'Balanced-Rate',
                'Inertia-Rate',
                'Taylor_diff',
                'Balanced_diff',
                'Inertia_diff'
                ]

nontext_train_large = pd.concat([nontext_data[latest_columns], nontext_ma3[ma3_columns].add_suffix('_ma3')], axis=1)
nontext_train_large.rename(columns={'RateDecision': 'target'}, inplace=True)
print(nontext_data[latest_columns].shape)
print(nontext_ma3[ma3_columns].shape)
print(nontext_train_large.shape)
```

```
(390, 29)
(390, 27)
(390, 56)
```

```
nontext_train_large.isnull().sum()
```

```
target                  0
prev_decision           1
GDP_diff_prev           0
GDP_diff_year           0
GDPPOT_diff_prev        0
GDPPOT_diff_year        0
PCE_diff_prev           0
PCE_diff_year           0
CPI_diff_prev           0
CPI_diff_year           0
Unemp_value             0
Unemp_diff_prev         0
Unemp_diff_year         0
Employ_value            0
Employ_diff_prev        0
Employ_diff_year        0
PMI_value               0
PMI_diff_prev           0
PMI_diff_year           0
Rsales_diff_prev      117
Rsales_diff_year      129
Hsales_diff_prev        0
Hsales_diff_year        0
Taylor-Rate             0
Balanced-Rate           0
Inertia-Rate            0
```

```
Taylor_diff              1
Balanced_diff            1
Inertia_diff             1
GDP_diff_prev_ma3        0
GDP_diff_year_ma3        0
GDPPOT_diff_prev_ma3     0
GDPPOT_diff_year_ma3     0
PCE_diff_prev_ma3        0
PCE_diff_year_ma3        0
CPI_diff_prev_ma3        0
CPI_diff_year_ma3        0
Unemp_value_ma3          0
Unemp_diff_prev_ma3      0
Unemp_diff_year_ma3      0
Employ_value_ma3         0
Employ_diff_prev_ma3     0
Employ_diff_year_ma3     0
PMI_value_ma3            0
PMI_diff_prev_ma3        0
PMI_diff_year_ma3        0
Rsales_diff_prev_ma3   119
Rsales_diff_year_ma3   132
Hsales_diff_prev_ma3     0
Hsales_diff_year_ma3     0
Taylor-Rate_ma3          3
Balanced-Rate_ma3        3
Inertia-Rate_ma3         3
Taylor_diff_ma3          4
Balanced_diff_ma3        4
Inertia_diff_ma3         4
dtype: int64
```

Missing Values

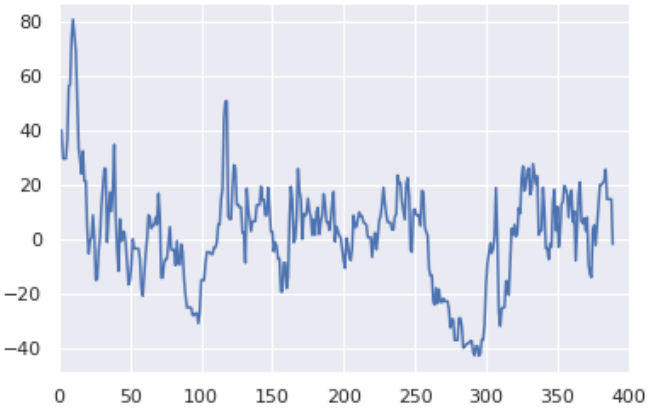
```
nontext_train_small['prev_decision'].fillna(0, inplace=True)
nontext_train_large['prev_decision'].fillna(0, inplace=True)
```

```
ax = sns.lineplot(data=nontext_train_small['Rsales_diff_year'].values)
ax.set_xlim(0, 400)
```

```
(0.0, 400.0)
```


```
ax = sns.lineplot(data=nontext_ma2['Hsales_diff_year'].values)
ax.set_xlim(0, 400)
```

```
(0.0, 400.0)
```




```
nontext_train_small['Rsales_diff_year'].fillna(nontext_train_small['Rsales_diff_year'].mean(), inplace=True)
nontext_train_large['Rsales_diff_prev'].fillna(nontext_train_large['Rsales_diff_prev'].mean(), inplace=True)
nontext_train_large['Rsales_diff_year'].fillna(nontext_train_large['Rsales_diff_year'].mean(), inplace=True)

nontext_train_small['Inertia_diff'].fillna(nontext_train_small['Inertia_diff'].mean(), inplace=True)
nontext_train_small['Balanced_diff'].fillna(nontext_train_small['Balanced_diff'].mean(), inplace=True)
nontext_train_large['Inertia_diff'].fillna(nontext_train_large['Inertia_diff'].mean(), inplace=True)
nontext_train_large['Balanced_diff'].fillna(nontext_train_large['Balanced_diff'].mean(), inplace=True)
nontext_train_large['Taylor_diff'].fillna(nontext_train_large['Taylor_diff'].mean(), inplace=True)

nontext_train_large['Rsales_diff_prev_ma3'].fillna(nontext_train_large['Rsales_diff_prev_ma3'].mean(), inplace=True)
nontext_train_large['Rsales_diff_year_ma3'].fillna(nontext_train_large['Rsales_diff_year_ma3'].mean(), inplace=True)

nontext_train_large['Inertia_diff_ma3'].fillna(nontext_train_large['Inertia_diff_ma3'].mean(), inplace=True)
nontext_train_large['Balanced_diff_ma3'].fillna(nontext_train_large['Balanced_diff_ma3'].mean(), inplace=True)
nontext_train_large['Taylor_diff_ma3'].fillna(nontext_train_large['Taylor_diff_ma3'].mean(), inplace=True)
nontext_train_large['Inertia-Rate_ma3'].fillna(nontext_train_large['Inertia-Rate_ma3'].mean(), inplace=True)
nontext_train_large['Balanced-Rate_ma3'].fillna(nontext_train_large['Balanced-Rate_ma3'].mean(), inplace=True)
nontext_train_large['Taylor-Rate_ma3'].fillna(nontext_train_large['Taylor-Rate_ma3'].mean(), inplace=True)



nontext_train_small.isnull().sum()
```

```
target              0
prev_decision       0
```

```
GDP_diff_prev       0
PMI_value           0
Employ_diff_prev    0
Rsales_diff_year    0
Unemp_diff_prev     0
Inertia_diff        0
Hsales_diff_year    0
Balanced_diff       0
dtype: int64
```

```
nontext_train_large.isnull().sum()
```

```
target                  0
prev_decision           0
GDP_diff_prev           0
GDP_diff_year           0
GDPPOT_diff_prev        0
GDPPOT_diff_year        0
PCE_diff_prev           0
PCE_diff_year           0
CPI_diff_prev           0
CPI_diff_year           0
Unemp_value             0
Unemp_diff_prev         0
Unemp_diff_year         0
Employ_value            0
Employ_diff_prev        0
Employ_diff_year        0
PMI_value               0
PMI_diff_prev           0
PMI_diff_year           0
Rsales_diff_prev        0
Rsales_diff_year        0
Hsales_diff_prev        0
Hsales_diff_year        0
Taylor-Rate             0
Balanced-Rate           0
Inertia-Rate            0
Taylor_diff             0
Balanced_diff           0
Inertia_diff            0
GDP_diff_prev_ma3       0
GDP_diff_year_ma3       0
GDPPOT_diff_prev_ma3    0
GDPPOT_diff_year_ma3    0
PCE_diff_prev_ma3       0
PCE_diff_year_ma3       0
CPI_diff_prev_ma3       0
CPI_diff_year_ma3       0
Unemp_value_ma3         0
Unemp_diff_prev_ma3     0
Unemp_diff_year_ma3     0
Employ_value_ma3        0
Employ_diff_prev_ma3    0
```

```
Employ_diff_year_ma3    0
PMI_value_ma3           0
PMI_diff_prev_ma3       0
PMI_diff_year_ma3       0
Rsales_diff_prev_ma3    0
Rsales_diff_year_ma3    0
Hsales_diff_prev_ma3    0
Hsales_diff_year_ma3    0
Taylor-Rate_ma3         0
Balanced-Rate_ma3       0
Inertia-Rate_ma3        0
Taylor_diff_ma3         0
Balanced_diff_ma3       0
Inertia_diff_ma3        0
dtype: int64
```

One-hot encoding

```
# nontext_train['Lower'] = nontext_train['RateDecision'].apply(lambda x: 1 if x == -1 else 0)
# nontext_train['Hold'] = nontext_train['RateDecision'].apply(lambda x: 1 if x == 0 else 0)
# nontext_train['Raise'] = nontext_train['RateDecision'].apply(lambda x: 1 if x == 1 else 0)
# nontext_train
```

Save Data

```
if IN_COLAB:
  def save_data(df, file_name, dir_name=preprocessed_dir, index_csv=True):
    if not os.path.exists(dir_name):
      os.mkdir(dir_name)
    # Save results to a picke file
    file = open(dir_name + file_name + '.pickle', 'wb')
    pickle.dump(df, file)
    file.close()
    print('Successfully saved {}.pickle. in {}'.format(file_name, dir_name + file_name + '.pickle'))
    # Save results to a csv file
    df.to_csv(dir_name + file_name + '.csv', index=index_csv)
    print('Successfully saved {}.csv. in {}'.format(file_name, dir_name + file_name + '.csv'))

else:
  def save_data(df, file_name, dir_name=preprocessed_dir, index_csv=True):
    # Save results to a .picke file
    file = open(dir_name + file_name + '.pickle', 'wb')
    pickle.dump(df, file)
    file.close()
    print('Successfully saved {}.pickle. in {}'.format(file_name, dir_name + file_name + '.pickle'))
    # Save results to a .csv file
    df.to_csv(dir_name + file_name + '.csv', index=index_csv)
```

```
    print('Successfully saved {}.csv. in {}'.format(file_name, dir_name + file_name + '.csv'))


# Save non-text data
save_data(nontext_train_small, 'nontext_train_small')
save_data(nontext_train_large, 'nontext_train_large')
```

```
Successfully saved nontext_train_small.pickle. in /content/drive/My Drive/Colab Notebooks/proj2/src/data/preprocessed/nontext_train_small.pickle
Successfully saved nontext_train_small.csv. in /content/drive/My Drive/Colab Notebooks/proj2/src/data/preprocessed/nontext_train_small.csv
Successfully saved nontext_train_large.pickle. in /content/drive/My Drive/Colab Notebooks/proj2/src/data/preprocessed/nontext_train_large.pickle
Successfully saved nontext_train_large.csv. in /content/drive/My Drive/Colab Notebooks/proj2/src/data/preprocessed/nontext_train_large.csv
```