CFRM 521, Spring 2020

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Final Project

1.0 Abstract

Stock Market predictions is one of the most research field in Finance. The main objective of such studies is predicting the price directions of specific stocks or market indexes. Per Reference 1, most of the research and corresponding analysis involves utilizing different measures for returns and volatility, namely, daily, 5-day moving average, volatility, etc.

The authors of Reference 1 claimed that there is seldom consideration for the comovement among stocks in the same market, and consequently a topic of research that deserves evaluation. The research conducted can not ascertain the validity of such claim. However, it is agreed that it is a well worth effort to conduct experiments to validate the usefulness of the consideration, and research if there is any positive impacts on forecasting market trends.

2.0 Project Objective

1. To validate that the Network Topology Characteristics of a set of related markets' indexes assist in forecasting the direction of price movements of an index in such network

- The underlying hypothesis of the authors consists of the treatment of a set of related markets, namely, S&P 500, Dow Jones Industrial, and Nasdaq Composite as components of a complex network. And most importantly, that the underlying network characteristics of such combine markets can assist and enhance the forecasting of individual stocks or a market index.
- The mathematics of Complex Networks, is a highly research field, and heavily utilized in the understanding of social media networks. An explanation of the mathematical concepts of Complex Networks is out-of-the scope of this project, the reader is refer to references (2-6) for further details.
- A brief explanation of the underlying network topology engineered measures used by the author's of reference 1 is described succinctly in this notebook, as well as the application to stock market financial data. The purpose is to provide reader a high level understanding of the derived measures, their corresponding formulas, and direct applicability.

2. Design, conduct, and execute empirical experiments that validate and add to existing knowledge stated by the authors of Reference 1

1. Validate results stated by Reference 1, by utilizing the same market indexes, time periods, and daily data, as well as the same exact network engineered measures and derivations employed.

    - Validation of derived Network Topology features by comparison to graphs of the same parameters presented in Reference 1
    - Execution of the same Statistical Tests against the Network Topology features to further validate the correct derivation of such parameters
    - Application of the same Machine Learning methods and cross validation with the same size Training and Test data sets

2. Additional experiments will be conducted to further validate or negate the results, including:

    - Conduct the same experiment as in 1. but against a complete different set of market indexes, and different time periods for the training and test sets
    - Evaluate the importance or lack-thereof of the derived Network Topology features
    - Explore the use of additional Machine Learning methods no used by Reference 1, as well as Neural Networks

3. Analyze the distribution of price movements of the studied markets to ensure that forecasting results provide ”learning” value

    - Histogram of Indexes’ Classifications
    - Indexes’ Classification vs Time Graphs
    - Summary Statistics for Transitions from one Classification to Another Classification
    - Pareto Charts for Transitions
    - Analysis of Daily Log Returns per Index Classification

4. In order to minimize duplication of code, and assist in different sets of permutations of the experiments, a few Python functions will be implemented to assist in the execution of the project.

    - The goal is to minimize code duplication and consequently human errors by such procedure.
    - The aim is to allow team members to easily perform, optimized and tune, create graphs, summary tables, and performance analysis for any condition, dataset, or Machine Learning method

3. Implementation of a complete machine learning project and draw conclusions

- All analysis and Machine Learning modeling is included and coded in Python.
- All financial measures and network topology measures will be directly coded in Python or via a standard Python library
- Based on the efficacy of the set of exploratory Machine Learning models selected for analysis, a subset will be optimized via hyper-parameter tunning. The two Machine Learning methods employed by Reference 1 will be optimized regardless of the results of exploratory analysis.
- Conclusions based on a comprehensive set of experiments will be summarized, as well as observations that are deemed to be important during the execution of the experiments

3.0 Concise Theoretical Summary

3.1 Network Topology

This section describes the formulas and network classification methodology for each stock index, concluding with the visual representation of a sample network to aid in the reader's understanding. The contents are exactly replicated from section 3.1 and 3.2 of Reference 1, and summarized and further explained here for convenience and clarification.

Step 1: Classification of each Stock Market Index

Step 2: Identification of the Nodes for a Network

- Once, each stock index has been classified per Step 1, the nodes for a network can be identified for a given day. This is achieved by combining the patterns of each stock index, then the corresponding combination symbolic pattern for each day is obtained.
- Assuming the study of three stock indexes, we can obtain a maximum of 64 (4^3) combination modes.
  - Where 4 is the the number of possible classificaitions for each index, and 3 is the number of different stock market indexes considered for the network.
- An example is further detailed for clarification.
  - Taking the daily combination patterns as the nodes of the network, the edges and weights of the network can be determined in time order. If the pattern on day t is S1S4S4 and that on day t+1 is S2S2S2, there is a directed edge from S1S4S4 to S2S2S2 with a weight of 1. If the conversion frequency from S1S4S4 to S2S2S2 is w, the weight of the directed edges from S1S4S4 to S2S2S2 is w. For example, if the current patterns of the S&P 500, NASDAQ, and DJIA are S1, S3, and , S4 respectively, the current price combination pattern is S1S3S4.
  - Suppose that the pattern transformation over a certain period of time is S1S4S4, S2S2S2, S1S1S1, S1S4S4, S3S1S4, S2S2S2, S1S1S1. Then, we can obtain the directed weighted network shown below.

Step 3: Creation of Sliding Windows (Network Size)

- The key to the sliding window selection problem is how to effectively keep the quality and quantity of original time series information while reducing the computational complexity to the most extent [34]. In the study conducted by Reference 1, a sliding window with a length of 30 days (about one month in daily life and half a quarter in the stock market) and a step of one day to the stock indexes time series. So we can obtain a pattern network every 30 days. The figure below shows the process of using the sliding window.

Step 4: Computing Network Topology Characteristic Variables for each Sliding Window

- There are four network topology measures calculated for each sliding window, see section 3.2 of Reference 1 and below for their definition per Reference 1.

- For a given set of 30 days, the four network measures are calculated and assigned to the last day of the sliding window (it is assumed the authors of Reference 1 assigned to the last day of the sliding window, this information was not specified)
  - For the experiments conducted in this project the network topology parameters are assigned two days past the end of the sliding window. This recommendation is per Professor Bahman Angoshtari to ensure there is not leaking of future information.

Network Topology Measures

1. Network Average Degree Centrality

   - Measures the ratio of the actual number of connections between nodes to the maximum number of potential connections, the edge density of the network.

2. Average Network Strength

3. Network Average Shortest Path Length

4. Network Closeness Centrality

3.2 Machine Learning Algorithms

- The following Machine Learning algorithms are evaluated in the project: SGD, SVC, KNN, Random Forest.
- For a comprehensive description of the algorithms see Reference 8

4.0 Rational

This section provides a summary of the rational for utilizing Complex Network Analysis Theory and Machine Learning methods for forecasting price movements. The content is accredited to the authors of Reference 1. The inclusion here is just to provide a quick reference to the most important points for the rational behind the use of Network Topology to understand the comovement of stocks and market indexes. The reader can refer to Reference 1 for the complete summary.

- *Stock price volatility patterns classification and prediction is a very important problem in stock market research. The prediction of stock price trends is actually a classified prediction of stock price fluctuation patterns. Literature showed that forecasting stock price patterns is sufficient to generate profitable trades and enable the execution of profitable trading strategies. Therefore, many studies have focused on predicting stock price patterns rather than predicting the absolute prices of stocks.*

- *To date, most studies have focused on the volatility patterns of a single stock based on its own historical attributes and have paid less attention to the comovement of related stocks and information pertaining to the overall market. A few studies have used historical information regarding related stocks as the input variables for prediction and shown that the price fluctuations in a single stock are not isolated and are often influenced by the trends of multiple related stocks. Thus, how to extract the comovement of multiple stocks and apply this information to the prediction of the fluctuation patterns of a single stock is a problem worth studying.*

- *Complex network analysis provides a new explanation for stock market behavior from a systematic perspective. Using complex network theory to study stock prices not only allows us to analyze the relationship between different stocks, but also allows us to explore the macroaspects of the comovement characteristics of the market in different periods. Of all the network construction methods, the symbolic pattern network is favored by many scholars because it can more accurately reflect the degree of correlation and direction of the primitive elements in a complex system [10, 20, 23, 24].*

- *In a stock price volatility pattern network, each volatility pattern is regarded as a network node, and the relationship between patterns is regarded as a connection between nodes [10]. By analyzing the topological properties of the network, the characteristics of stock price fluctuations can be better understood.*

- *Most of the existing studies on stock price volatility pattern networks have focused on univariate time series. On this basis, we propose a new network construction method to build the volatility pattern networks of the three most important indexes in the US stock market, namely, the Standard & Poor’s 500 Index (S&P 500), the NASDAQ Composite Index (NASDAQ), and the Dow Jones Industrial Average (DJIA). Firstly, the combination symbolic patterns for the three stock indexes are derived using a coarse-grained method. Then, the combination symbolic patterns are used as the nodes of the network, and the frequencies and directions of the conversion of the patterns are used as the weights and directions of the network connections. Finally, we construct directed and weighted networks for the US stock market. By analyzing the network topology properties, we can identify periods of sharp fluctuations in the market.*

5.0 Methodology For Predicting Stock Indexes Price Patterns

1. Load, Transform & Validate financial indexes datasets sourced from Bloomberg
2. Visualize Indexes' Price data
3. Create Financial Indexes derived parameters
4. Visualize Financial Indexes derived parameters
5. Create Stock Indexes' Classifications
6. Analyze and Visualize Stock Indexes Classifications Distributions
7. Create Network Topological Characteristics
8. Analysis of Network Topological Characteristics
    - Visualize each Network Topological measure in respect to the indexes
    - Validate correctness of each derived measured by comparing to the graphs provided by Reference 1, section 4.2
9. Next-Day Stock Pattern Predictions
    - Create Labels for ML Algorithms
    - Create Training & Test Sets for each dataset
    - Conduct exploratory analysis against each stock index on each dataset
        - Utilize several Machine Learning classification algorithms
        - Evaluate different sets of features and the impact of the networking derived measures on results
        - Conduct initial classification analysis via the Confusion Matrix and its underlying derived parameters, that is, Precision, Recall, and Accuracy.
    - Narrow selection of ML algorithms and conduct optimizaton
    - Run final analysis on optimized Machine Learning algorithms against validation and test sets
    - Summarize results in tables for all permutations of the experiments conducted
    - Analysis of results

6.0 Empirical Results and Analysis

6.0 Environment Setup

- All analysis is conducted in Python, the following libraries and versions are required:
  - Python version 3.5 or greater
  - sklearn version 0.20 or greater
  - tensorflow version 20 or greater
  - networkX version 2.4 or greater
  - Other libraries: numpy, pandas, matplotlib
- The Data for all indexes should be located in the same directory where this Jupyter Notebook is executed
- The first set of indexes (to re-create the white paper dataset) is expected to be: **IndexesDataForProject_Set_1.csv**
- The second set of indexes to validate against a complete set of indexes and time periods is: **IndexesDataForProject_Set_2.csv**
- The csv file format header column for the first set of indexes is: **Date, S&P_500, Nasdaq, DJI**
- The csv file format header column for the second set of indexes is: **Date, MXUS, MSDUUK, MSDUJN**
- The csv file data format is: Date in month/day/year-last-2-digits follow by daily closing prices
- All price data was sourced from Bloomberg

In [1]:

```
# Python ≥3.5 is required
import sys
assert sys.version_info >= (3, 5)

# Scikit-Learn ≥0.20 is required
import sklearn
assert sklearn.__version__ >= "0.20"

# Common imports
import numpy as np
import os

try:
    # %tensorflow_version only exists in Colab.
    %tensorflow_version 2.x
except Exception:
    pass

# TensorFlow ≥2.0 is required
import tensorflow as tf
assert tf.__version__ >= "2.0"

# networkX ≥ 2.4 is required
import networkx as nx
assert nx.__version__ >= "2.4"

# to make this notebook's output stable across runs
np.random.seed(42)

# To plot pretty figures
%matplotlib inline
import matplotlib as mpl
import matplotlib.pyplot as plt
mpl.rc('axes', labelsize=14)
mpl.rc('xtick', labelsize=12)
mpl.rc('ytick', labelsize=12)

# Ignore useless warnings (see SciPy issue #5998)
import warnings
warnings.filterwarnings(action="ignore", message="^internal gelsd")

from sklearn.metrics import accuracy_score
```

6.1 Data Processing

6.1.1 Load, Transform & Validate Indexes Data

Inputs for Analysis

In [2]:
```
import pandas as pd

index_data_file_set1 = "IndexesDataForProject_Set_1.csv"
index_data_file_set2 = "IndexesDataForProject_Set_2.csv"

indexes_set_1 = [ "Nasdaq", "S&P_500", "DJI"]
indexes_set_2 = [ "MXUS", "MSDUUK", "MSDUJN"]

indixes_data_set1 = pd.read_csv(index_data_file_set1, parse_dates=True).dropna()
indixes_data_set2 = pd.read_csv(index_data_file_set2, parse_dates=True).dropna()
```

In [3]:
```
indixes_data_set1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 5124 entries, 0 to 5123
Data columns (total 4 columns):
Date       5124 non-null object
S&P_500    5124 non-null float64
Nasdaq     5124 non-null float64
DJI        5124 non-null float64
dtypes: float64(3), object(1)
memory usage: 200.2+ KB
```

In [4]:
```
indixes_data_set2.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 3952 entries, 0 to 3951
Data columns (total 4 columns):
Date      3952 non-null object
MXUS      3952 non-null float64
MSDUUK    3952 non-null float64
MSDUJN    3952 non-null float64
dtypes: float64(3), object(1)
memory usage: 154.4+ KB
```

In [5]:
```
# convert date column from object type to Date format for indexing

def convertDatesAndFormat(df, datasetName):
    df["Date"] = pd.to_datetime( df["Date"],  errors="coerce", infer_datetime_format=True)
    df = df.dropna()
    print(datasetName)
    print(df.info())
    return df
```

In [6]:
```
indixes_data_set1 = convertDatesAndFormat(df = indixes_data_set1, datasetName = "Dataset 1: \n")
```

```
Dataset 1:

<class 'pandas.core.frame.DataFrame'>
Int64Index: 5124 entries, 0 to 5123
Data columns (total 4 columns):
Date       5124 non-null datetime64[ns]
S&P_500    5124 non-null float64
Nasdaq     5124 non-null float64
DJI        5124 non-null float64
dtypes: datetime64[ns](1), float64(3)
memory usage: 200.2 KB
None
```

In [7]:
```
indixes_data_set2 = convertDatesAndFormat(df = indixes_data_set2, datasetName = "Dataset 2: \n")
```

```
Dataset 2:

<class 'pandas.core.frame.DataFrame'>
Int64Index: 3952 entries, 0 to 3951
Data columns (total 4 columns):
Date      3952 non-null datetime64[ns]
MXUS      3952 non-null float64
MSDUUK    3952 non-null float64
MSDUJN    3952 non-null float64
dtypes: datetime64[ns](1), float64(3)
memory usage: 154.4 KB
None
```

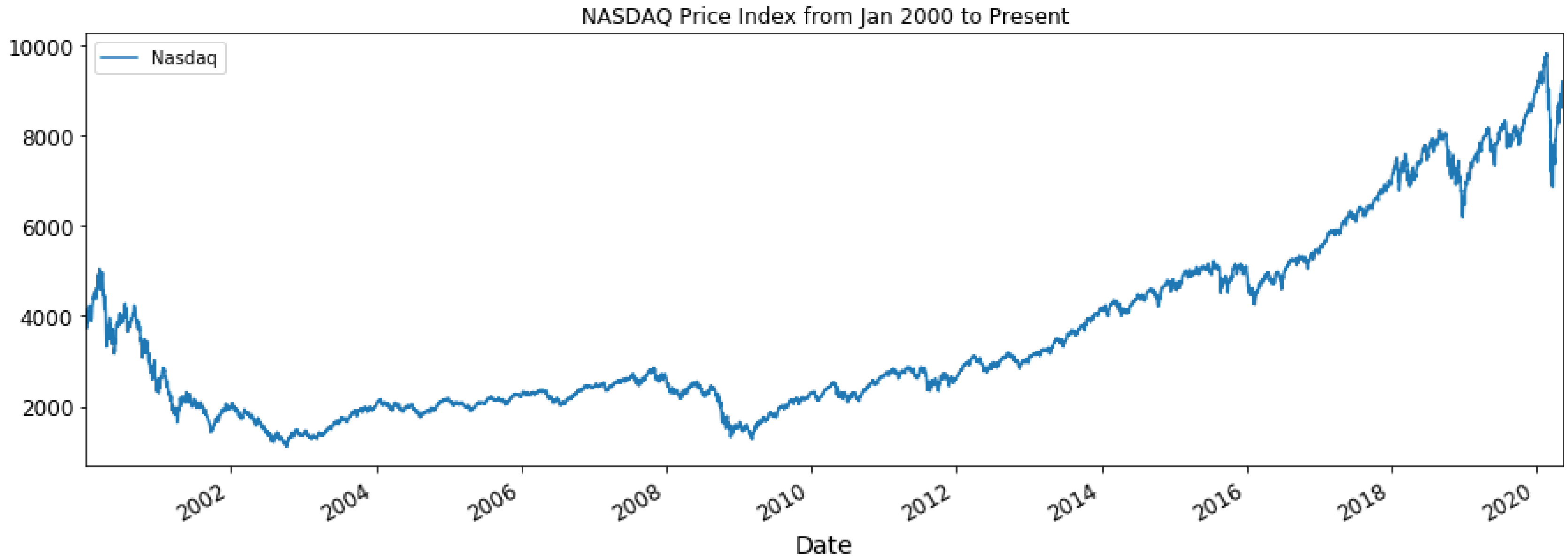
6.1.2 Visualize Indexes

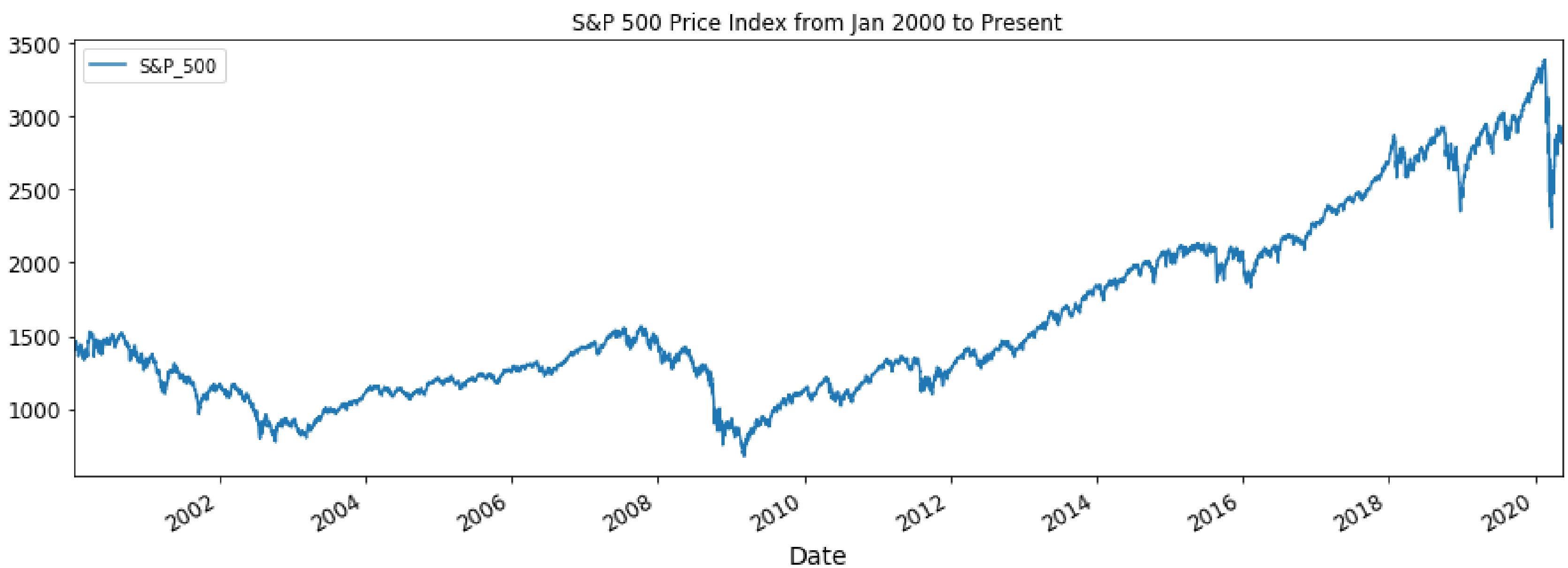
Dataset 1

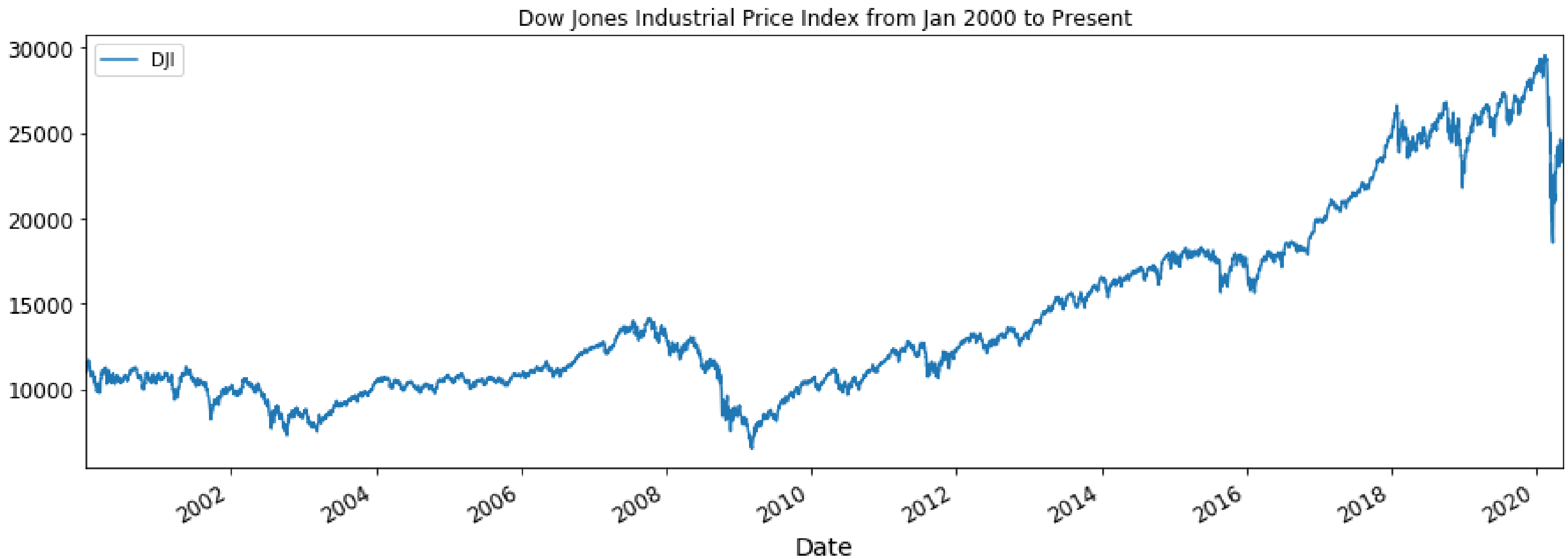
In [8]:

```
indixes_data_set1.plot( figsize=(15,5), x="Date", y="Nasdaq",
                  title="NASDAQ Price Index from Jan 2000 to Present")

indixes_data_set1.plot(figsize=(15,5), x="Date", y="S&P_500",
                  title="S&P 500 Price Index from Jan 2000 to Present")

indixes_data_set1.plot( figsize=(15,5), x="Date", y="DJI",
                  title="Dow Jones Industrial Price Index from Jan 2000 to Present")
```

```
Out[8]: <matplotlib.axes._subplots.AxesSubplot at 0x7faa68beb4d0>
```



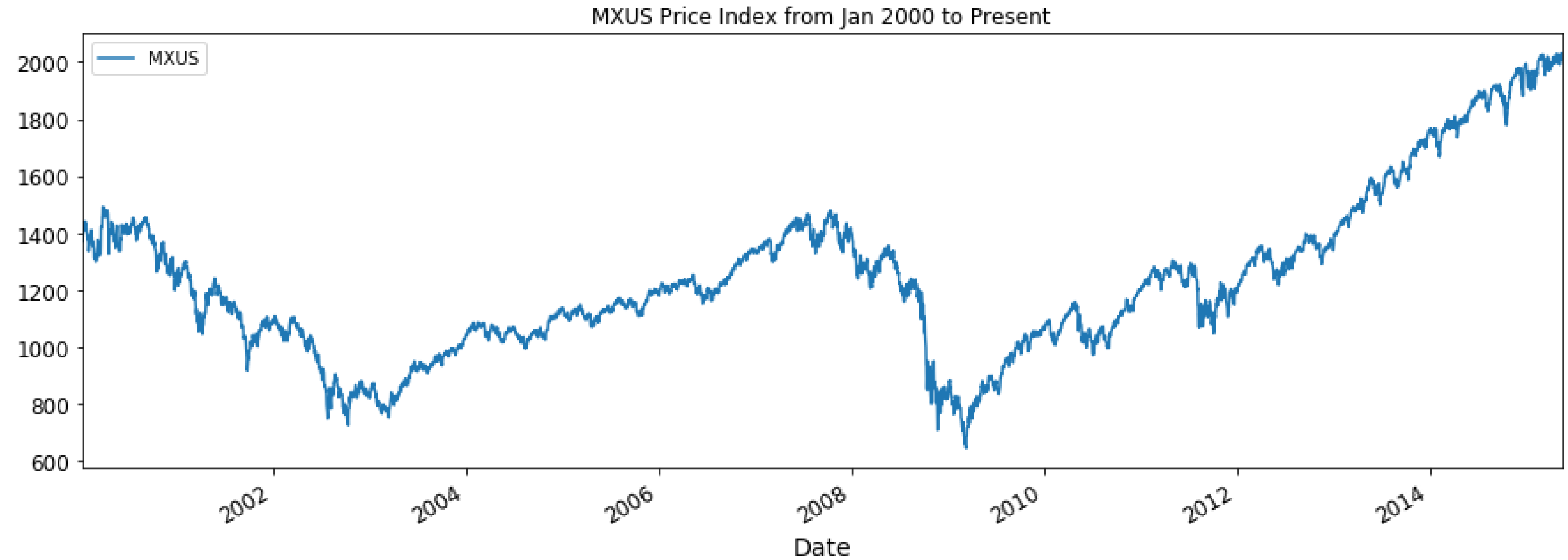


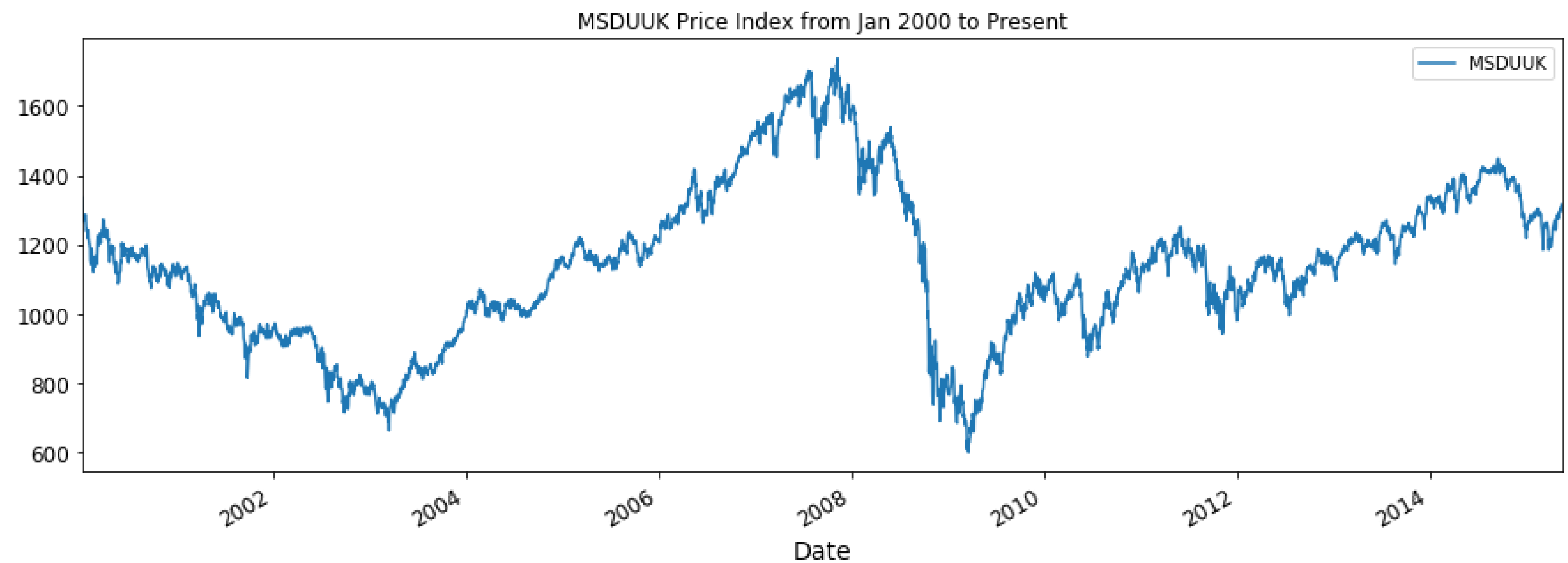

Dow Jones Industrial Price Index from Jan 2000 to Present
DJI
30000
25000
20000
15000
10000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Date

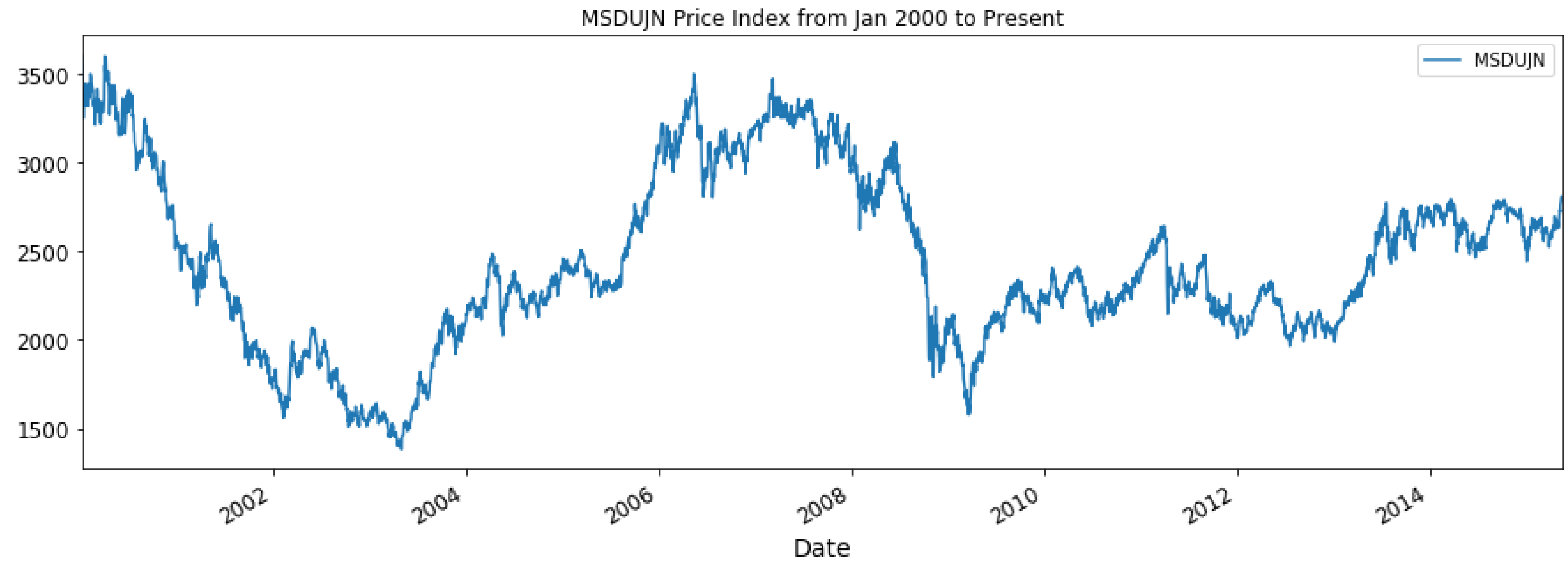
Dataset 2

In [9]:
```
indixes_data_set2.plot( figsize=(15,5), x="Date", y="MXUS",
                  title="MXUS Price Index from Jan 2000 to Present")

indixes_data_set2.plot(figsize=(15,5), x="Date", y="MSDUUK",
                  title="MSDUUK Price Index from Jan 2000 to Present")

indixes_data_set2.plot( figsize=(15,5), x="Date", y="MSDUJN",
                  title="MSDUJN Price Index from Jan 2000 to Present")
```

Out[9]: <matplotlib.axes._subplots.AxesSubplot at 0x7faa4897a150>







6.1.3 Create Financial Indexes Derived Parameters

In [10]:
```
indexes_set_1 = [ "Nasdaq", "S&P_500", "DJI"]
indexes_set_2 = [ "MXUS", "MSDUUK", "MSDUJN"]
```

In [11]:
```
# In order to align with the notation define in the formulas, the derived financial parameters will b
e named
# accordingly, i.e.
#
# r_index_name = daily log returns
# R_index_name = 5-day log returns
# V_index_name = 5-day volatility (based on daily log returns)
# V_Ave_index_name = 5-day volatility average
# V_Ave_All_Indexes = (V_index_name_1 ... V_index_name_N)/N

def createFinancialDerivedParameters(indexes_names, df):

    num_indexes = len(indexes_names)
    for i in range(num_indexes) :

        # *** Log Daily Returns for Index
        df['r_' + indexes_names[i]]  = np.log(df[indexes_names[i]] / df[indexes_names[i]].shift(1))

        # *** 5-day Log Returns for each Index
        df['R_' + indexes_names[i]]  = np.log(df[indexes_names[i]] / df[indexes_names[i]].shift(5))

        # *** 5-day Volatility of Log Returns for each Index
        df['V_' + indexes_names[i]]  = df['r_' + indexes_names[i] ].rolling(window=5).std() * np.sqrt
(5)

        # *** 5-day Volatility Average of V for each Index
        df['V_Ave_' + indexes_names[i]]  = df['V_' + indexes_names[i] ].rolling(window=5).mean()

    # Calculate Volatility Average for all Indexes

    v_ave_all_indexes = np.zeros( df['V_' + indexes_names[i]].shape, dtype="float64" )
    for j in range(num_indexes) :
        v_ave_all_indexes += df['V_' + indexes_names[j]].to_numpy()
        #v_ave_all_indexes += df['V_Ave_' + indexes_names[j]].to_numpy()

    df['V_Ave_All_Indexes'] = v_ave_all_indexes/num_indexes

    df.dropna(inplace = True)
    return df

indixes_data_set1 = createFinancialDerivedParameters( indexes_names = indexes_set_1, df =  indixes_da
ta_set1)
```

```
indixes_data_set2 = createFinancialDerivedParameters( indexes_names = indexes_set_2, df =  indixes_da
ta_set2)
```

In [12]:
```
indixes_data_set1[ ["Date", "r_DJI", "R_DJI", "V_DJI", "V_Ave_DJI", "V_Ave_All_Indexes"] ].head()
```

Out[12]:

	Date	r_DJI	R_DJI	V_DJI	V_Ave_DJI	V_Ave_All_Indexes
9	2000-01-14	0.012061	0.017244	0.013779	0.026648	0.037254
10	2000-01-18	-0.013937	-0.000992	0.021992	0.021544	0.036147
11	2000-01-19	-0.006192	-0.001889	0.022269	0.021237	0.027987
12	2000-01-20	-0.012090	-0.017449	0.024255	0.021249	0.022507
13	2000-01-21	-0.008811	-0.028969	0.023292	0.021117	0.019437

In [13]:
```
indixes_data_set1[ ["Date", "V_Nasdaq", "V_S&P_500", "V_DJI", "V_Ave_All_Indexes"] ].head()
```

Out[13]:

	Date	V_Nasdaq	V_S&P_500	V_DJI	V_Ave_All_Indexes
9	2000-01-14	0.072440	0.025542	0.013779	0.037254
10	2000-01-18	0.061509	0.024941	0.021992	0.036147
11	2000-01-19	0.042427	0.019264	0.022269	0.027987
12	2000-01-20	0.022656	0.020610	0.024255	0.022507
13	2000-01-21	0.018719	0.016299	0.023292	0.019437

In [14]:
```
indixes_data_set2[ ["Date", "r_MSDUUK", "R_MSDUUK", "V_MSDUUK", "V_Ave_MSDUUK" ] ].head()
```

Out[14]:

	Date	r_MSDUUK	R_MSDUUK	V_MSDUUK	V_Ave_MSDUUK
9	2000-01-14	0.010235	0.016236	0.018065	0.022793
10	2000-01-17	-0.000630	0.002539	0.013329	0.018163
11	2000-01-18	-0.018486	-0.009800	0.023134	0.017648
12	2000-01-19	-0.006837	-0.016347	0.023468	0.018770
13	2000-01-20	-0.012684	-0.028403	0.024829	0.020565

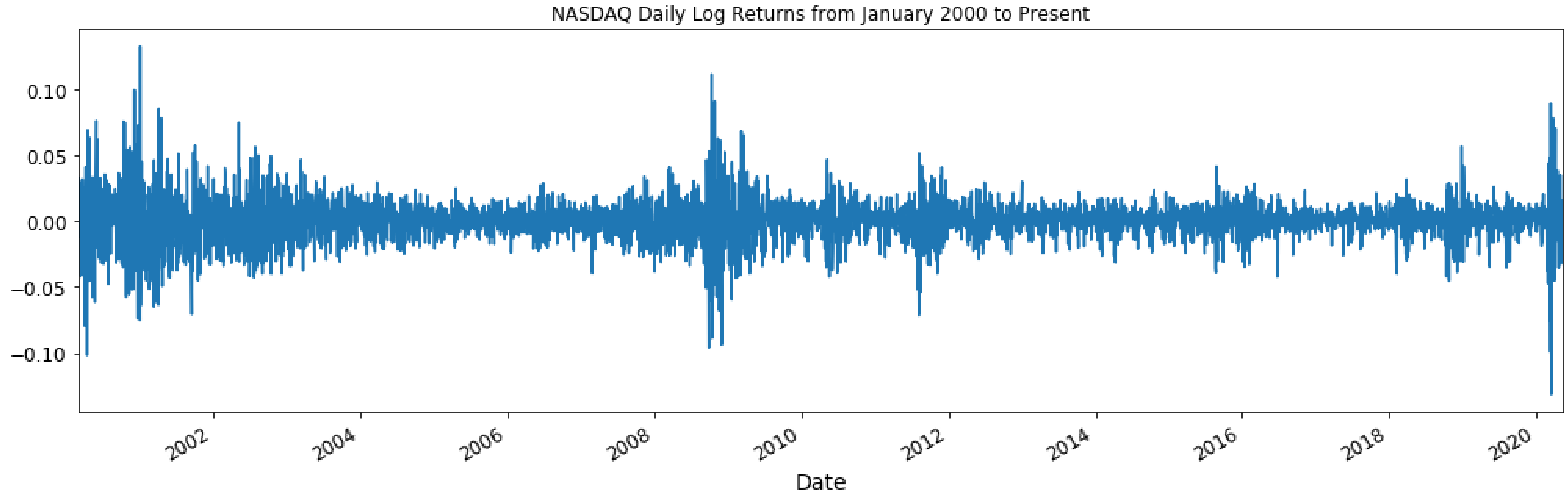
6.1.4 Visualize Indexes Derived Parameters

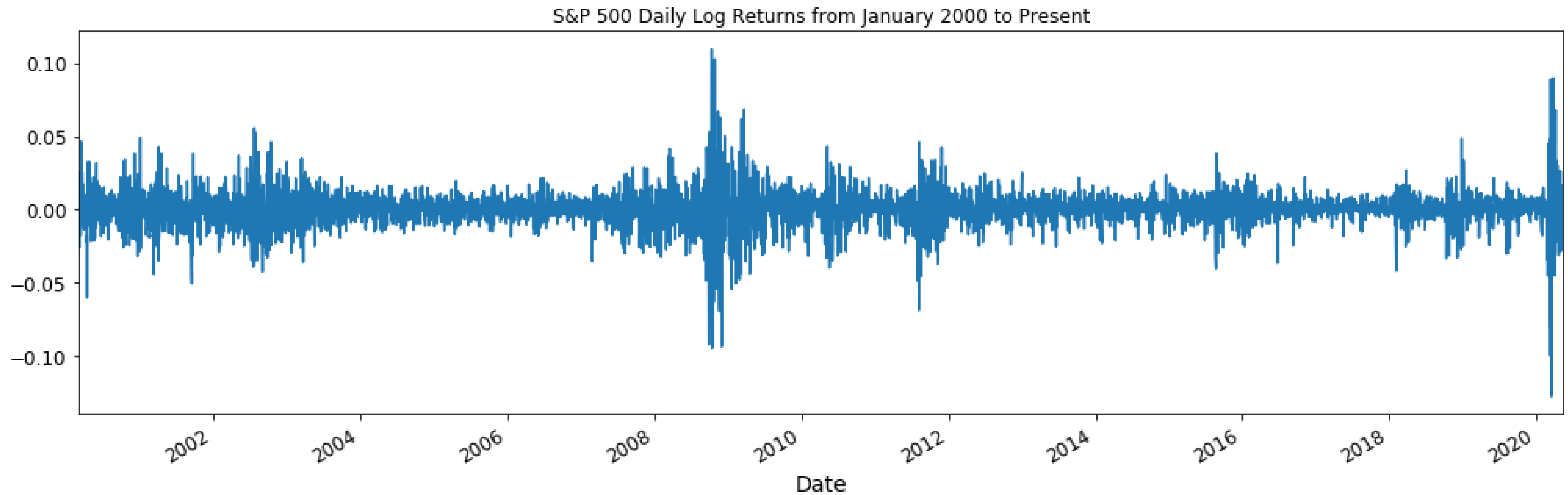
Indexes Daily Log Returns

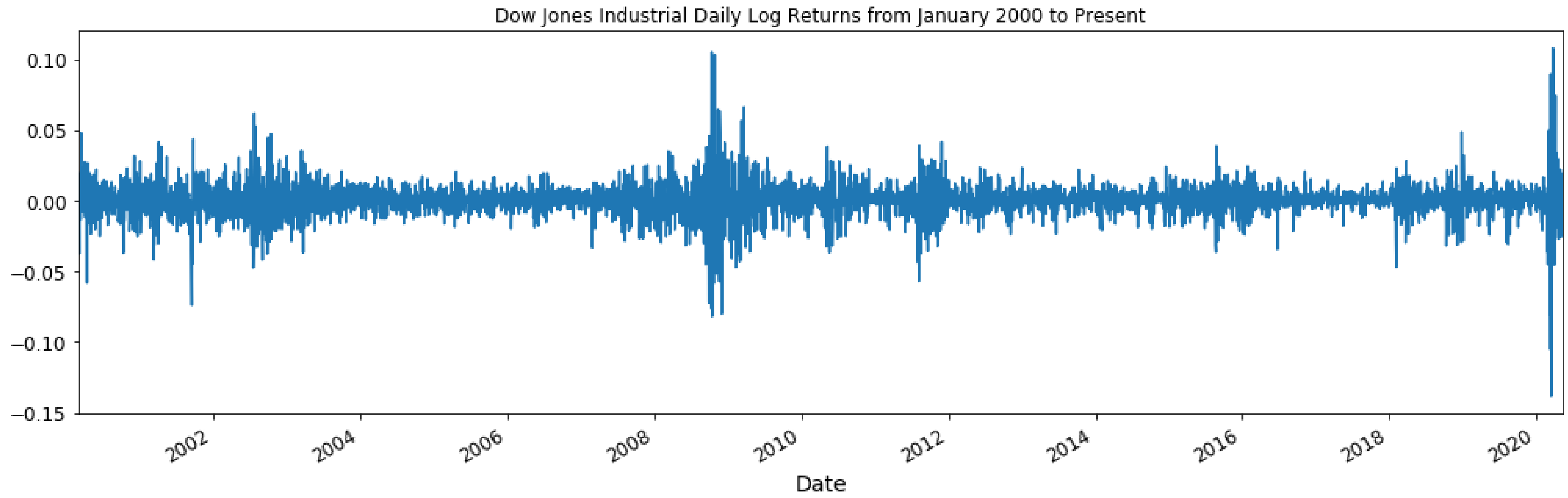
In [88]:

```
indixes_data_set1.plot(figsize=(17,5), x="Date", y="r_Nasdaq", legend=False,
                   title="NASDAQ Daily Log Returns from January 2000 to Present")

indixes_data_set1.plot(figsize=(17,5), x="Date", y="r_S&P_500", legend=False,
                   title="S&P 500 Daily Log Returns from January 2000 to Present")

indixes_data_set1.plot(figsize=(17,5), x="Date", y="r_DJI", legend=False,
                   title="Dow Jones Industrial Daily Log Returns from January 2000 to Present")
```

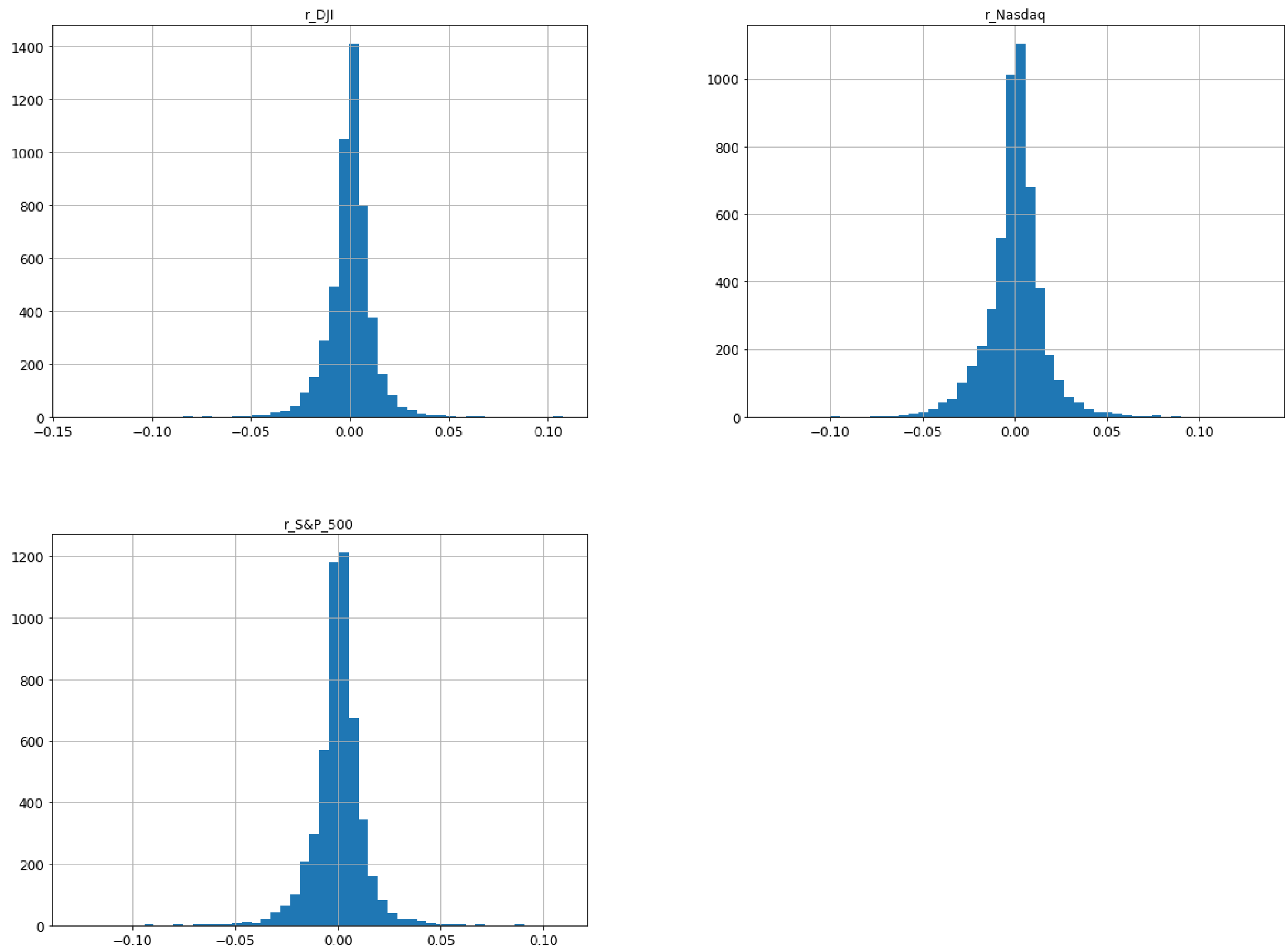
```
Out[88]: <matplotlib.axes._subplots.AxesSubplot at 0x7faa8d159ad0>
```






Dow Jones Industrial Daily Log Returns from January 2000 to Present
0.10
0.05
0.00
−0.05
−0.10
−0.15
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Date

```
In [16]: indixes_data_set1[ ["Date", "r_Nasdaq", "r_S&P_500", "r_DJI" ] ].hist(bins=50, figsize=(20,15))
         plt.show()
```

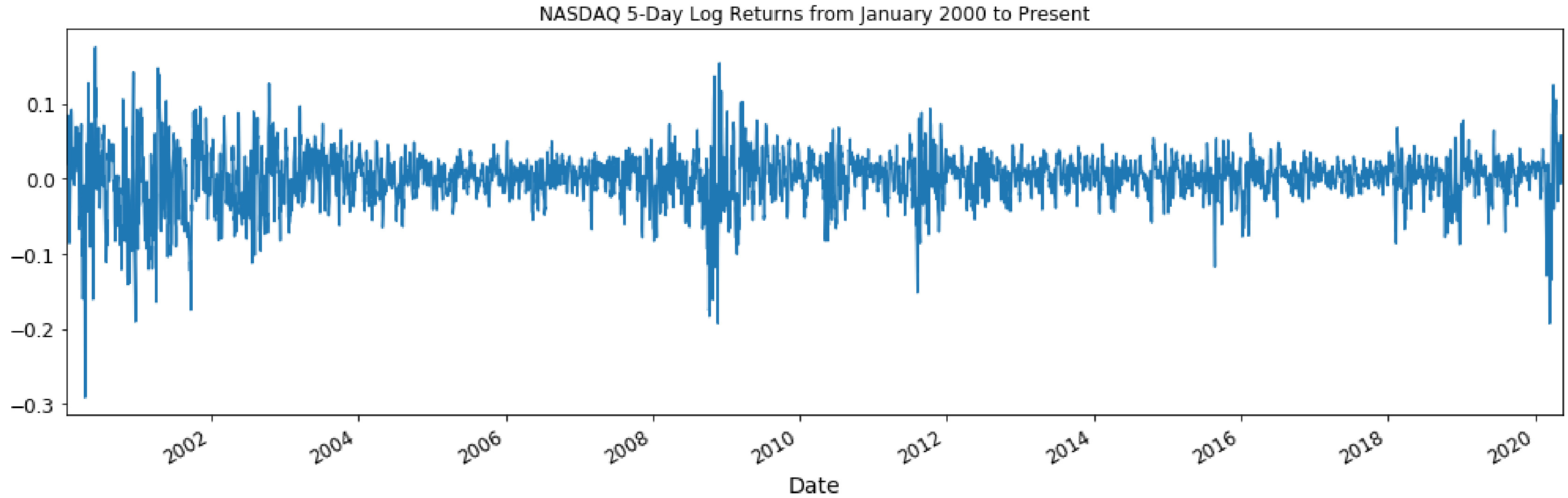


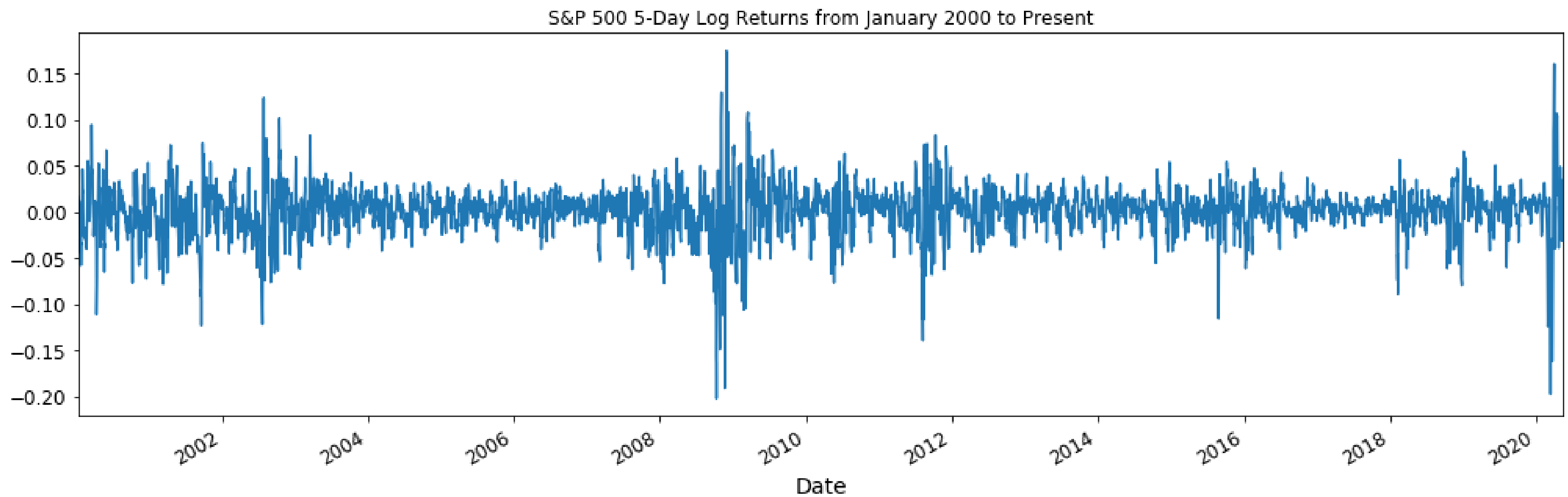
Indexes 5-day Log Returns

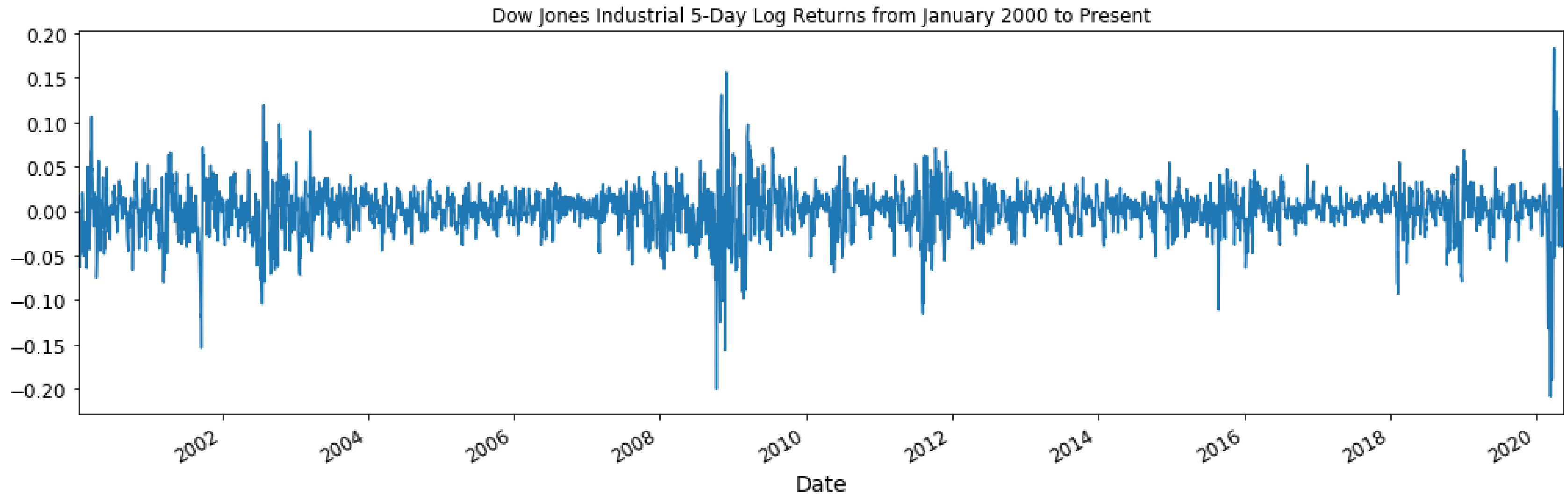
In [17]:

```
indixes_data_set1.plot(figsize=(17,5), x="Date", y="R_Nasdaq", legend=False,
                   title="NASDAQ 5-Day Log Returns from January 2000 to Present")

indixes_data_set1.plot(figsize=(17,5), x="Date", y="R_S&P_500", legend=False,
                   title="S&P 500 5-Day Log Returns from January 2000 to Present")

indixes_data_set1.plot(figsize=(17,5), x="Date", y="R_DJI", legend=False,
                   title="Dow Jones Industrial 5-Day Log Returns from January 2000 to Present")
```

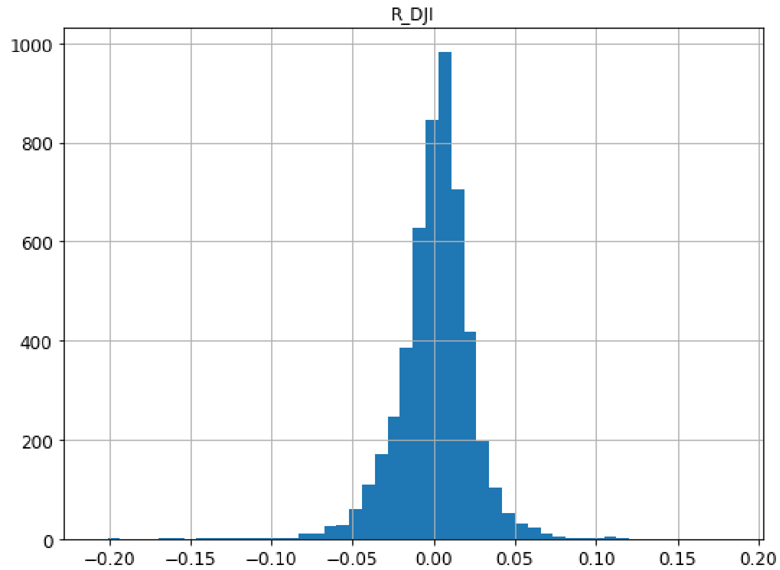
Out[17]: <matplotlib.axes._subplots.AxesSubplot at 0x7faa584256d0>

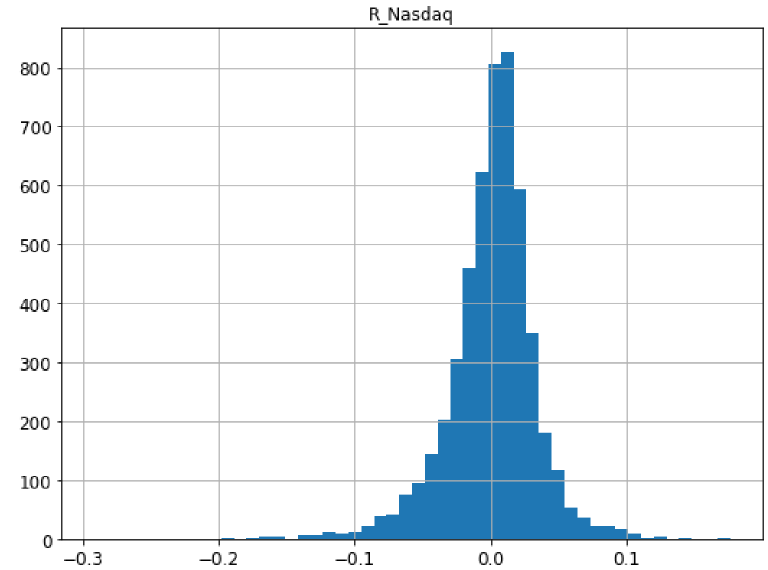


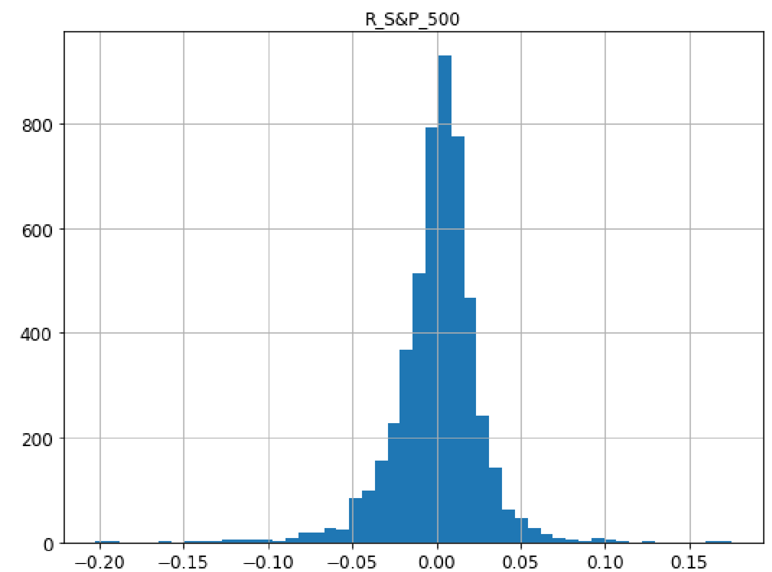



Dow Jones Industrial 5-Day Log Returns from January 2000 to Present
0.20
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Date

In [18]:
```
indixes_data_set1[ ["Date", "R_Nasdaq", "R_S&P_500", "R_DJI" ] ].hist(bins=50, figsize=(20,15))
plt.show()
```





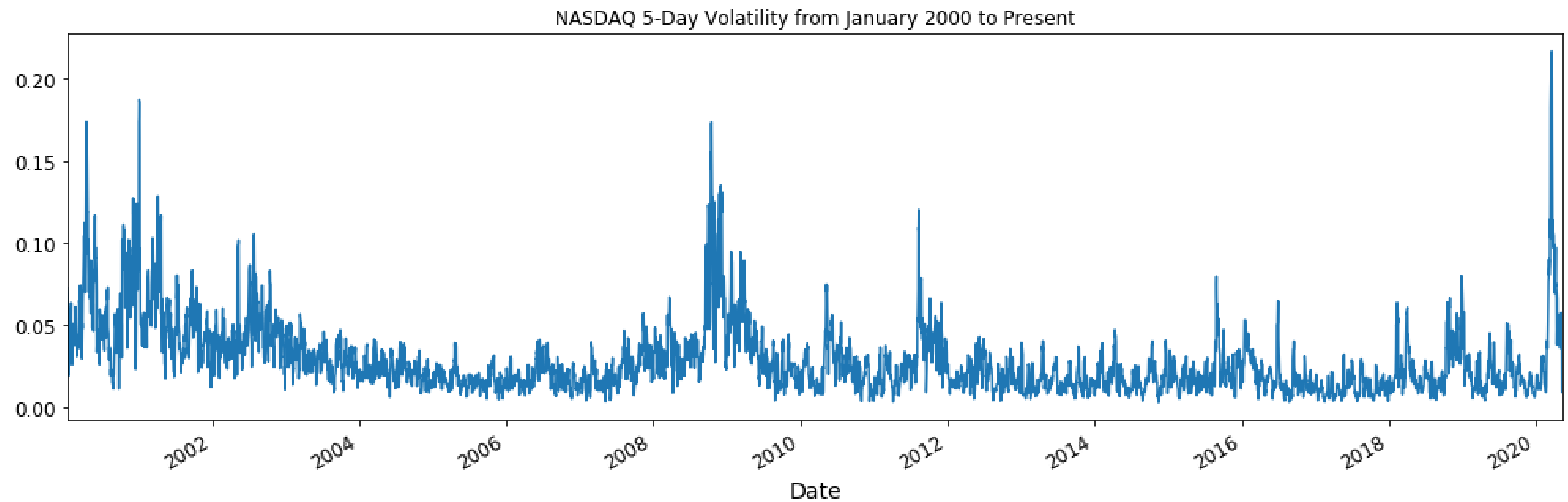


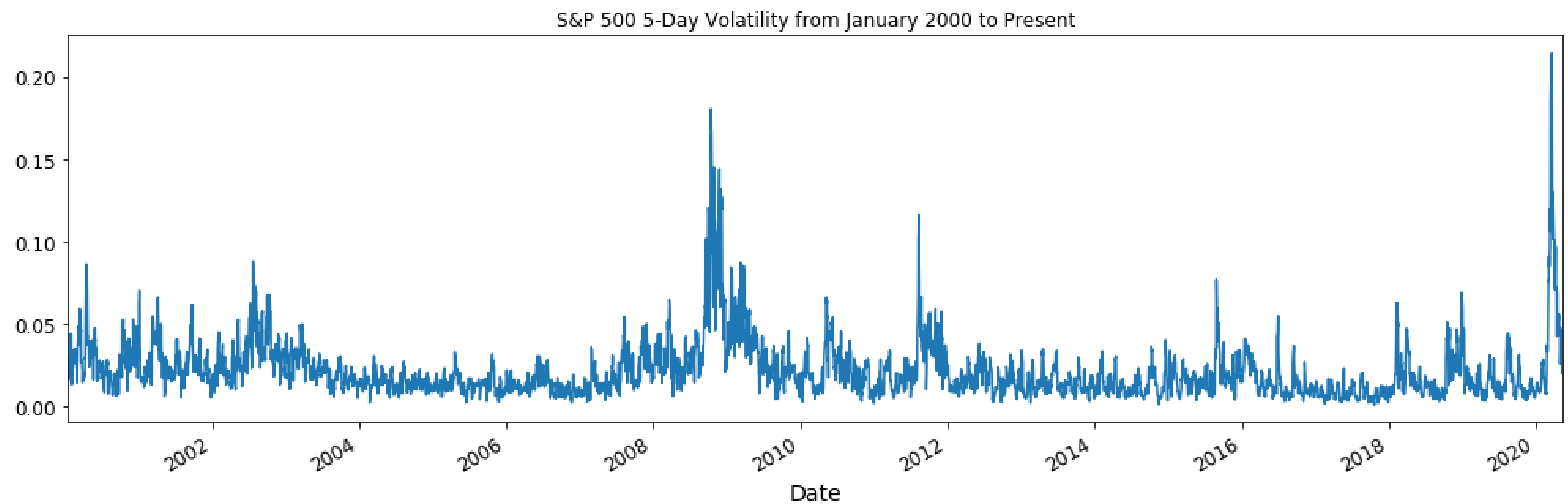
Indexes 5-day Volatility of Log Returns

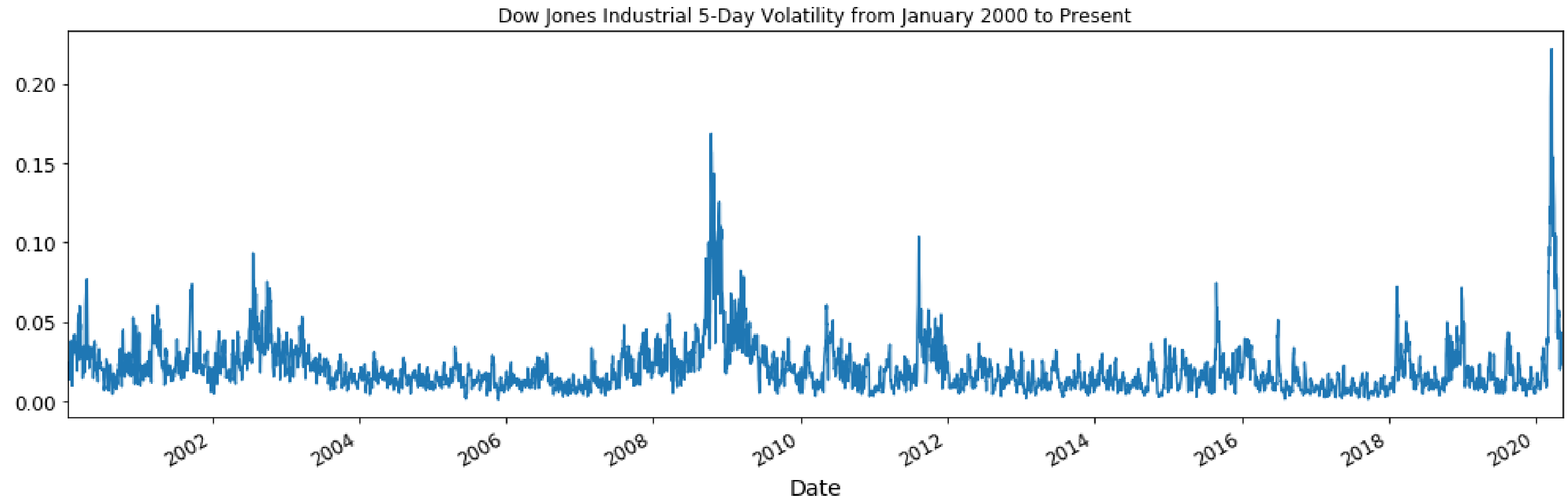
In [19]:

```
indixes_data_set1.plot(figsize=(17,5), x="Date", y="V_Nasdaq", legend=False,
                   title="NASDAQ 5-Day Volatility from January 2000 to Present")

indixes_data_set1.plot(figsize=(17,5), x="Date", y="V_S&P_500", legend=False,
                   title="S&P 500 5-Day Volatility from January 2000 to Present")

indixes_data_set1.plot(figsize=(17,5), x="Date", y="V_DJI", legend=False,
                   title="Dow Jones Industrial 5-Day Volatility from January 2000 to Present")
```

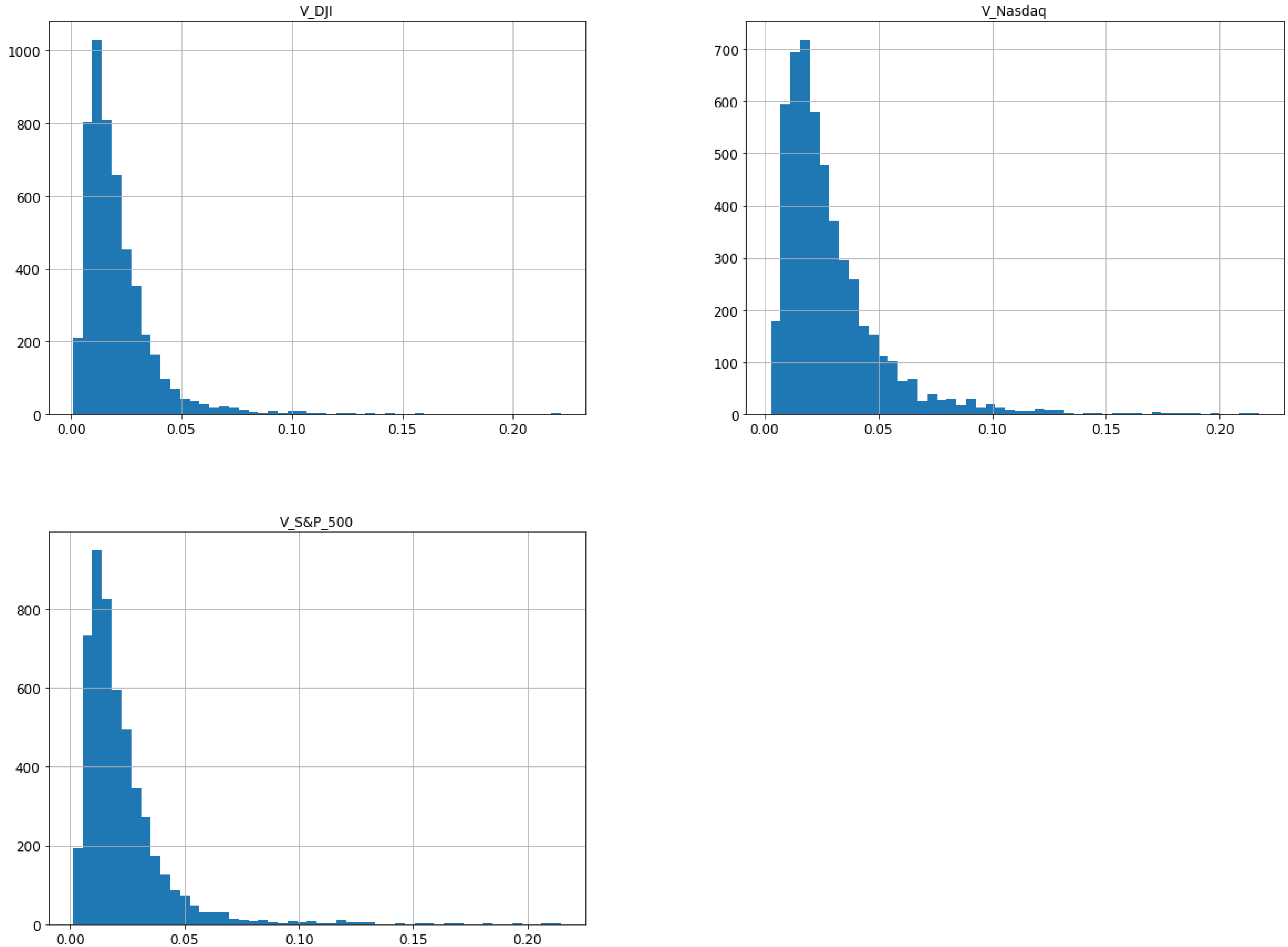
```
Out[19]: <matplotlib.axes._subplots.AxesSubplot at 0x7faa99fe17d0>
```






Dow Jones Industrial 5-Day Volatility from January 2000 to Present
0.20
0.15
0.10
0.05
0.00
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Date

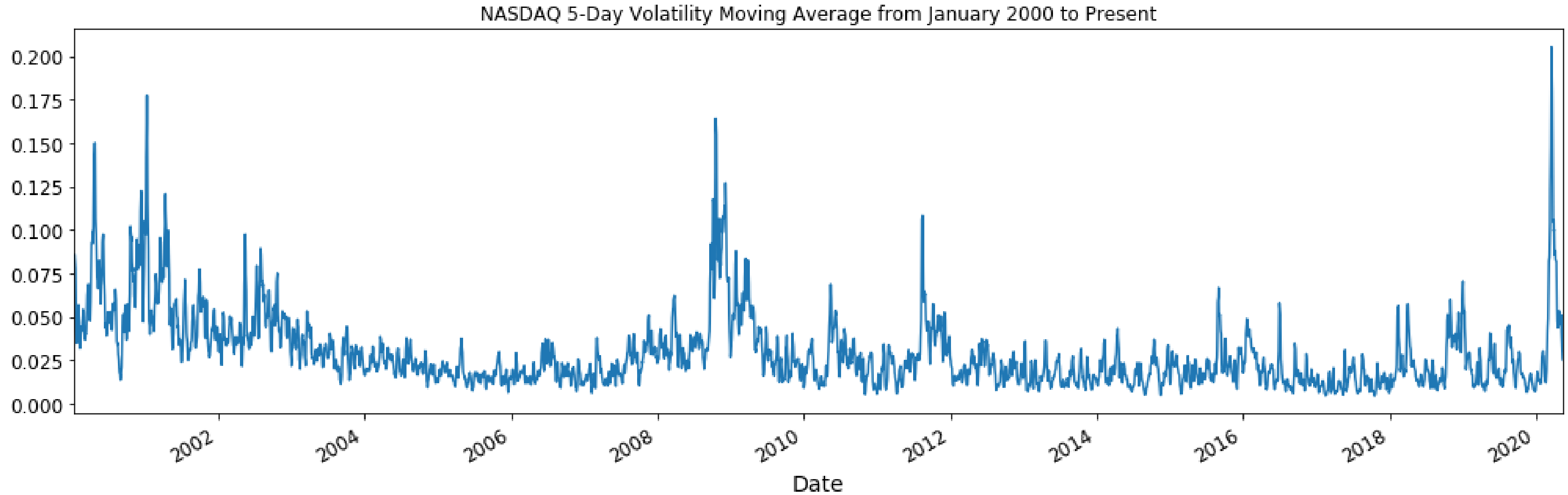
In [20]:
```
indixes_data_set1[ ["Date", "V_Nasdaq", "V_S&P_500", "V_DJI" ] ].hist(bins=50, figsize=(20,15))
plt.show()
```

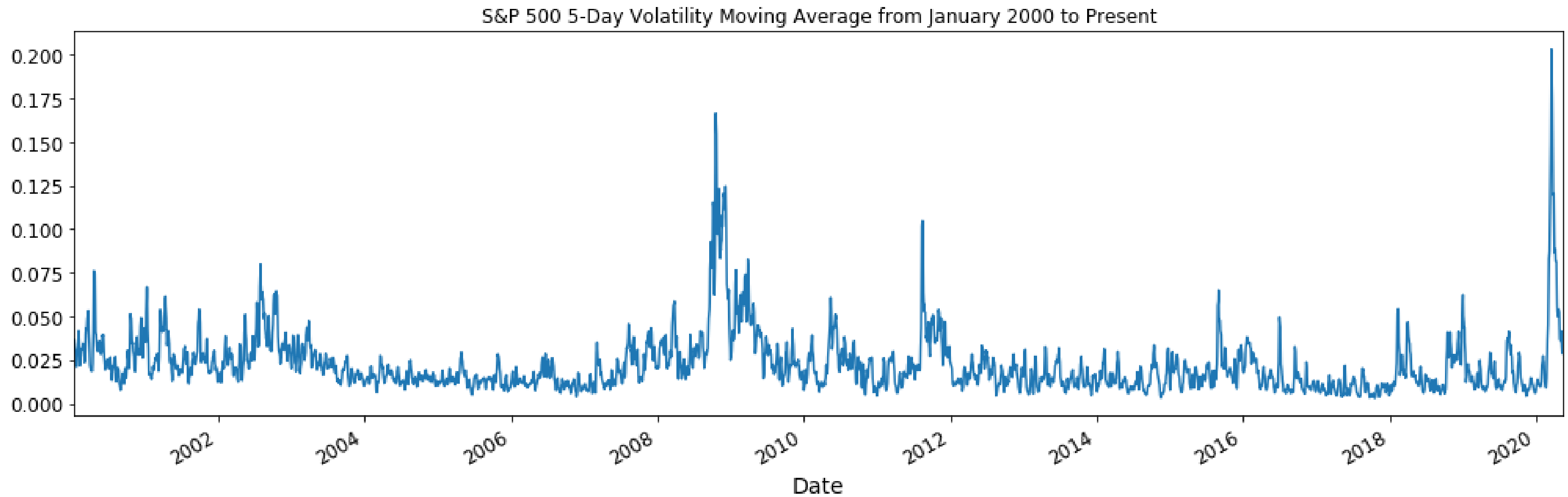


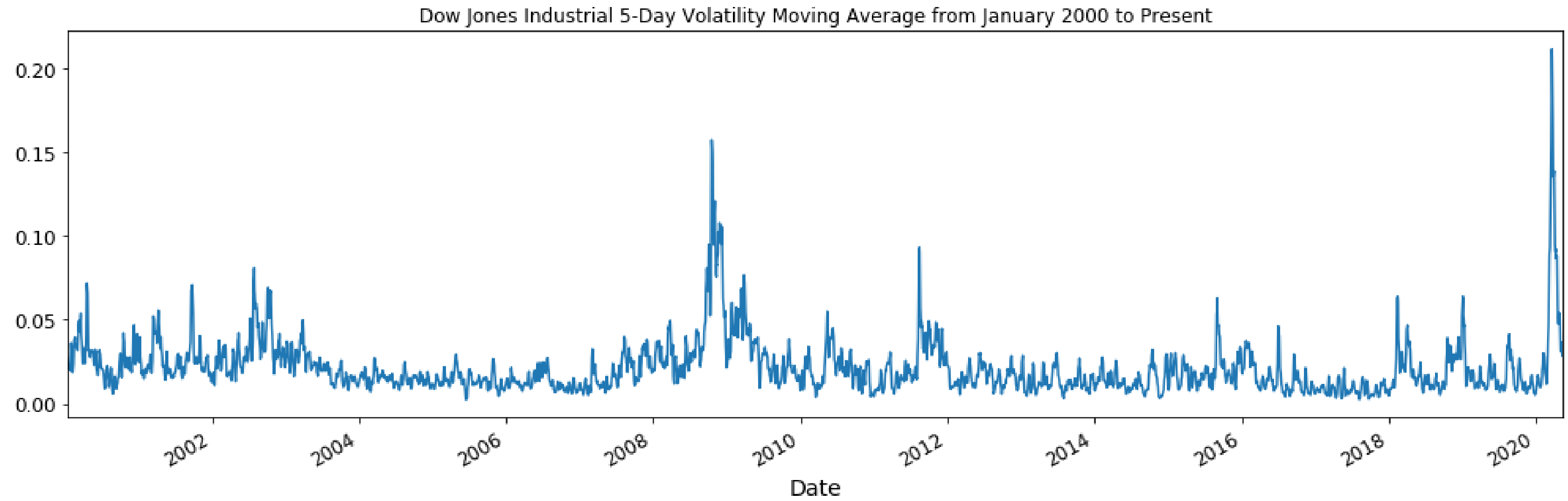
Indexes 5-day Moving Average for Volatility

In [21]:
```
indixes_data_set1.plot(figsize=(17,5), x="Date", y="V_Ave_Nasdaq", legend=False,
                   title="NASDAQ 5-Day Volatility Moving Average from January 2000 to Present")

indixes_data_set1.plot(figsize=(17,5), x="Date", y="V_Ave_S&P_500", legend=False,
                   title="S&P 500 5-Day Volatility Moving Average from January 2000 to Present")

indixes_data_set1.plot(figsize=(17,5), x="Date", y="V_Ave_DJI", legend=False,
                   title="Dow Jones Industrial 5-Day Volatility Moving Average from January 2000 to P
resent")
```

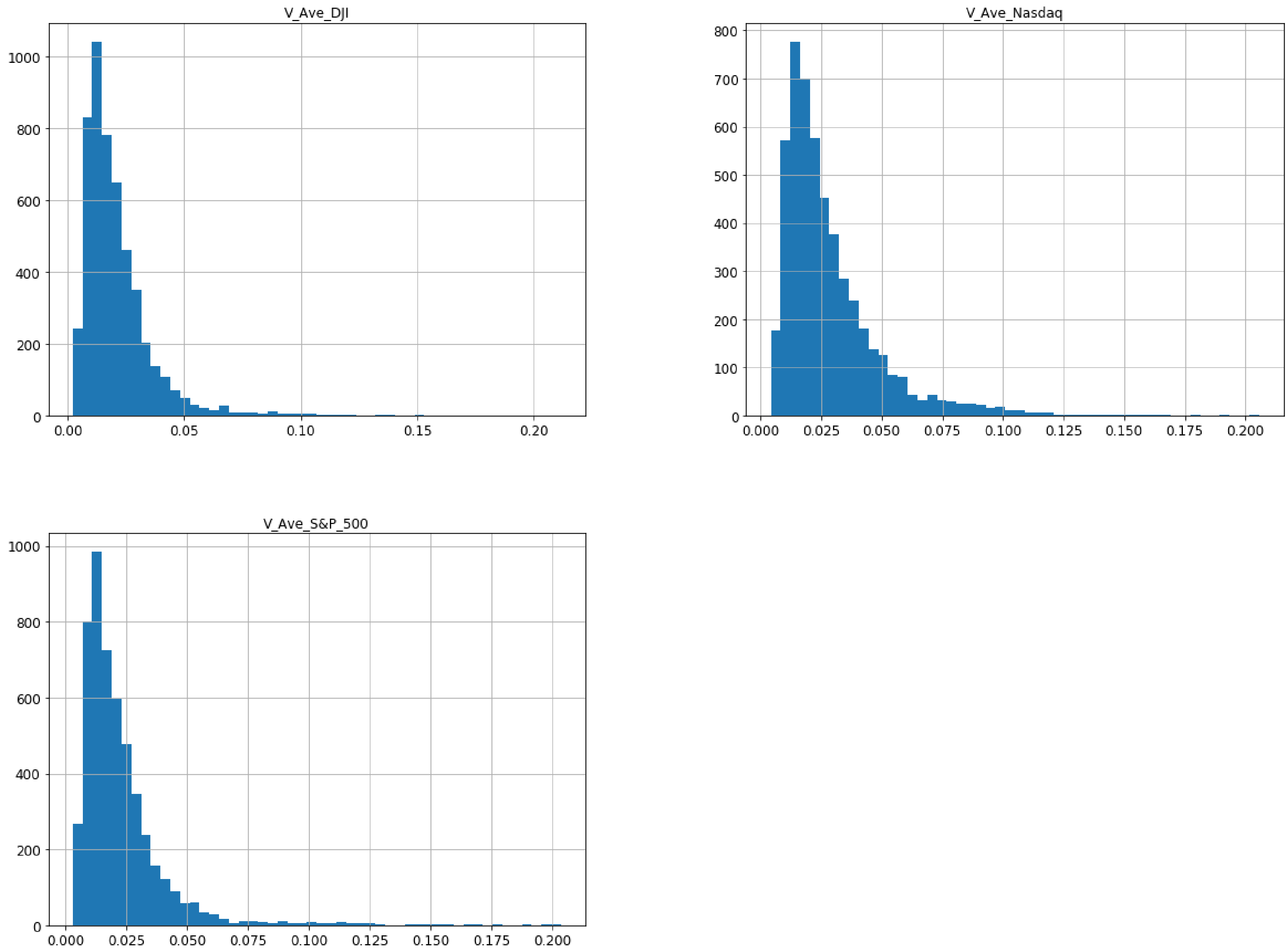
Out[21]: <matplotlib.axes._subplots.AxesSubplot at 0x7faa68bb7ed0>






Dow Jones Industrial 5-Day Volatility Moving Average from January 2000 to Present
0.20
0.15
0.10
0.05
0.00
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Date

In [22]:
```
indixes_data_set1[ ["Date", "V_Ave_Nasdaq", "V_Ave_S&P_500", "V_Ave_DJI" ] ].hist(bins=50, figsize=(2
0,15))
plt.show()
```



6.1.5 Create Stock Indexes' Classifications

In [23]:
```
# *** Classified the Stock Indixes, according to the rules in equation 13 of the white paper
# *** Classifications for each index will be in the format:
# *** f_IndexName

def getStockIndexClassForDay(R_day, V_day, V_Ave_day):
    if R_day >= 0 and V_day >= V_Ave_day :
        # Sharp Rise Day
        return "S1"
    elif R_day >= 0 and V_day < V_Ave_day :
        # Stable Rise Day
        return "S2"
    elif R_day < 0 and V_day < V_Ave_day :
        # Stable Decline
        return "S3"
    elif R_day < 0 and V_day >= V_Ave_day :
        # Sharp Decline
        return "S4"
    else :
        print("Error, this should not happen")
        return "Invalid"

def getStockIndexClass(IndexName, df):

    stock_index_Name = IndexName
    R_stock_index_col_name = "R_" + stock_index_Name
    V_stock_index_col_name = "V_" + stock_index_Name
    V_Ave_stock_index_col_name = "V_Ave_" + stock_index_Name
    V_Ave_All_Indexes_col_name = "V_Ave_All_Indexes"

    num_rows = df.shape[0]
    stock_class = np.empty( [df.shape[0], 1], dtype='<U2' )

    R     = df[R_stock_index_col_name].to_numpy()
    V     = df[V_stock_index_col_name].to_numpy()
    V_Ave = df[V_Ave_stock_index_col_name].to_numpy()
    V_Ave_AllIndexes = df[V_Ave_All_Indexes_col_name].to_numpy()

    for current_day in range(num_rows):
        stock_class[current_day] = getStockIndexClassForDay( R_day = R[current_day],
                                                              V_day = V[current_day],
                                                              #V_Ave_day = V_Ave[current_day],
                                                              V_Ave_day = V_Ave_AllIndexes[current_da
```

```
y]
                                                            )

    return stock_class

# *** Classify each stock Index

indixes_data_set1["f_Nasdaq"]  = getStockIndexClass(IndexName = "Nasdaq", df = indixes_data_set1)
indixes_data_set1["f_S&P_500"] = getStockIndexClass(IndexName = "S&P_500", df = indixes_data_set1)
indixes_data_set1["f_DJI"]     = getStockIndexClass(IndexName = "DJI", df = indixes_data_set1)

indixes_data_set2["f_MXUS"]  = getStockIndexClass(IndexName = "MXUS", df = indixes_data_set2)
indixes_data_set2["f_MSDUUK"] = getStockIndexClass(IndexName = "MSDUUK", df = indixes_data_set2)
indixes_data_set2["f_MSDUJN"]     = getStockIndexClass(IndexName = "MSDUJN", df = indixes_data_set2)
```

In [24]:

```
# *** Create Combination Symbolic Patter for each Day
#
#  That is: f_Index_1 + f_Index_2 + f_Index_N for a day
#  This combine symbolic information will constitude a node in the Network Topology that will be crea
t next

indixes_data_set1["Node"] = indixes_data_set1["f_Nasdaq"] + indixes_data_set1["f_S&P_500"] + \
                            indixes_data_set1["f_DJI"]

indixes_data_set2["Node"] = indixes_data_set2["f_MXUS"] + indixes_data_set2["f_MSDUUK"] + \
                            indixes_data_set2["f_MSDUJN"]
```

In [25]:

```
indixes_data_set1[ ["Date", "R_DJI", "V_DJI", "V_Ave_All_Indexes", "f_DJI", "f_Nasdaq", "f_S&P_500",
                    "Node"]].head()
```

Out[25]:

	Date	R_DJI	V_DJI	V_Ave_All_Indexes	f_DJI	f_Nasdaq	f_S&P_500	Node
9	2000-01-14	0.017244	0.013779	0.037254	S2	S1	S2	S1S2S2
10	2000-01-18	-0.000992	0.021992	0.036147	S3	S1	S3	S1S3S3
11	2000-01-19	-0.001889	0.022269	0.027987	S3	S1	S2	S1S2S3
12	2000-01-20	-0.017449	0.024255	0.022507	S4	S1	S2	S1S2S4
13	2000-01-21	-0.028969	0.023292	0.019437	S4	S2	S3	S2S3S4

In [26]:
```
indixes_data_set1[ ["Date", "f_Nasdaq", "f_S&P_500", "f_DJI", "Node"]].tail()
```

Out[26]:

	Date	f_Nasdaq	f_S&P_500	f_DJI	Node
5119	2020-05-08	S2	S1	S1	S2S1S1
5120	2020-05-11	S2	S1	S1	S2S1S1
5121	2020-05-12	S2	S1	S4	S2S1S4
5122	2020-05-13	S2	S3	S4	S2S3S4
5123	2020-05-14	S3	S3	S4	S3S3S4

In [27]:
```
indixes_data_set2[ ["Date", "f_MXUS", "f_MSDUUK", "f_MSDUJN", "Node"]].head()
```

Out[27]:

	Date	f_MXUS	f_MSDUUK	f_MSDUJN	Node
9	2000-01-14	S2	S2	S1	S2S2S1
10	2000-01-17	S2	S2	S1	S2S2S1
11	2000-01-18	S2	S3	S1	S2S3S1
12	2000-01-19	S2	S3	S4	S2S3S4
13	2000-01-20	S3	S3	S4	S3S3S4

In [28]:
```
indixes_data_set2[ ["Date", "f_MXUS", "f_MSDUUK", "f_MSDUJN", "Node"]].tail()
```

Out[28]:

	Date	f_MXUS	f_MSDUUK	f_MSDUJN	Node
3947	2015-05-08	S1	S2	S1	S1S2S1
3948	2015-05-11	S4	S2	S2	S4S2S2
3949	2015-05-12	S1	S2	S1	S1S2S1
3950	2015-05-13	S1	S2	S1	S1S2S1
3951	2015-05-14	S1	S2	S2	S1S2S2

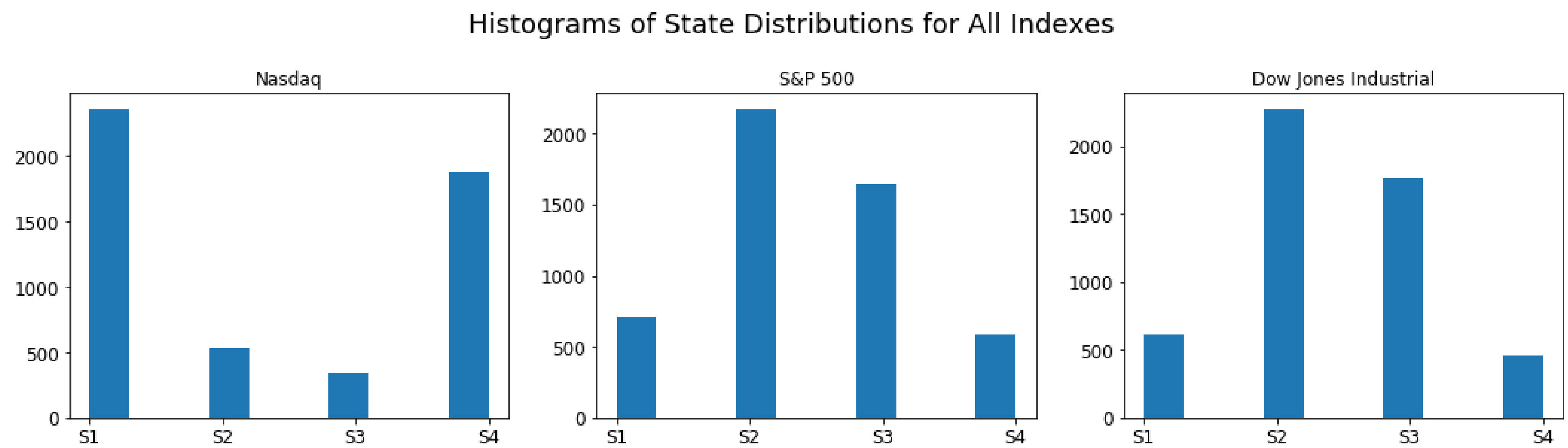
In [29]:
```
print("Number of Unique Nodes in dataset-1 = ", len(indixes_data_set1["Node"].unique()) )
print("Number of Unique Nodes in dataset-2 = ", len(indixes_data_set2["Node"].unique()) )
```

```
Number of Unique Nodes in dataset-1 =  48
Number of Unique Nodes in dataset-2 =  48
```

6.1.6 Analysis & Visualization of Stock Indexes Classifications' Distributions

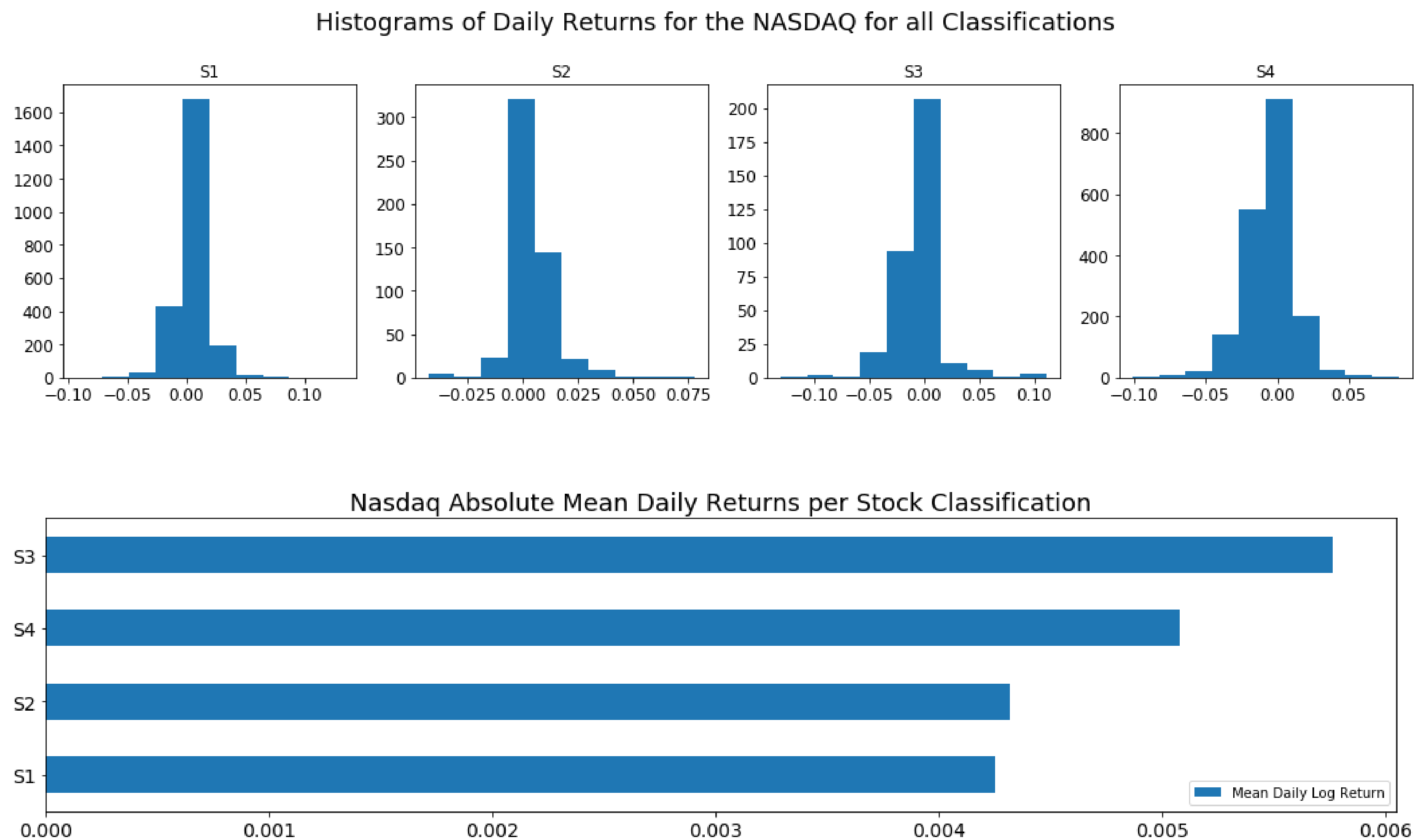
Dataset 1

In [30]:
```
fig, (ax1, ax2, ax3) = plt.subplots(1, 3, figsize=(18,4))
fig.suptitle('Histograms of State Distributions for All Indexes', fontsize=18, y=1.07)


ax1.hist(indixes_data_set1['f_Nasdaq'].sort_values())
ax1.set_title("Nasdaq" )

ax2.hist(indixes_data_set1['f_S&P_500'].sort_values())
ax2.set_title("S&P 500")

ax3.hist(indixes_data_set1['f_DJI'].sort_values())
ax3.set_title("Dow Jones Industrial")

plt.show()
```

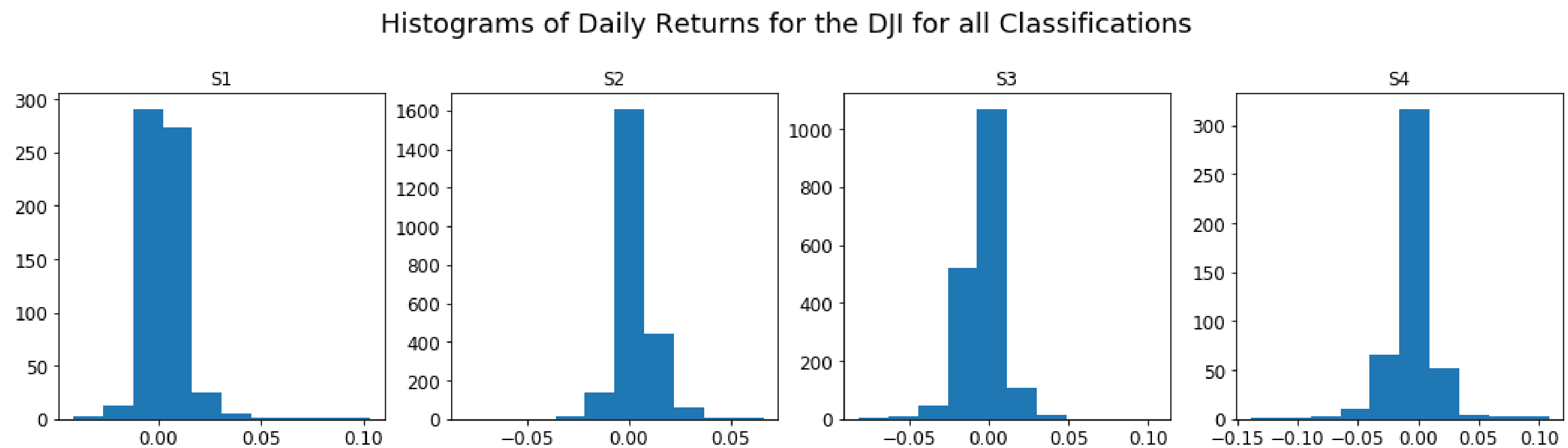


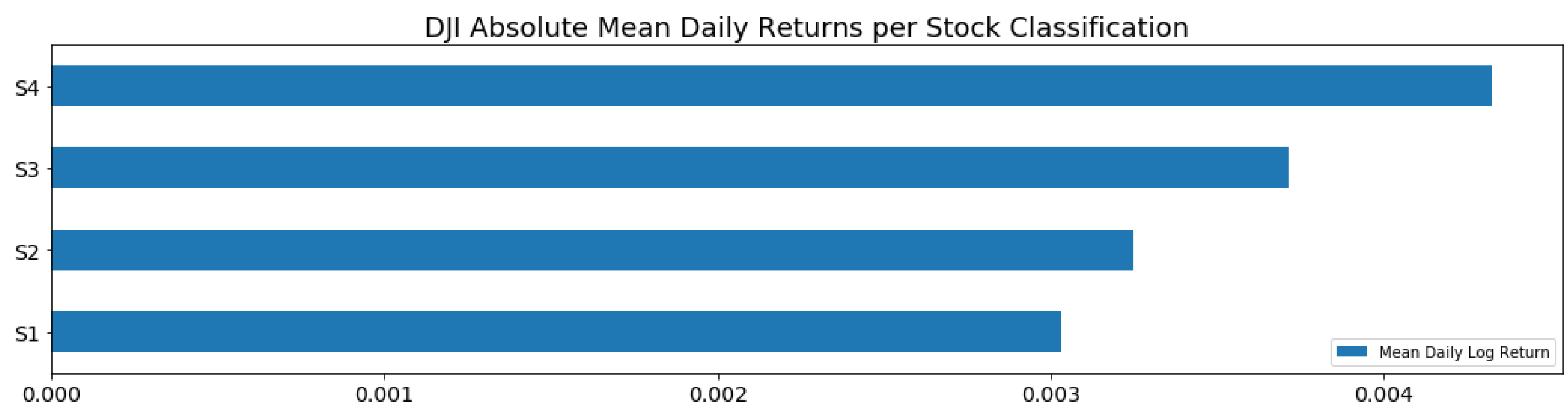
In [31]:
```
def createPlotsForStockClassification(indixes_data_set, index_name_var, title_1, title_2, index_col )
:
    fig, (ax1, ax2, ax3, ax4) = plt.subplots(1, 4, figsize=(18,4))
    fig.suptitle(title_1, fontsize=18, y=1.07)


    ax1.hist( indixes_data_set[ index_col == "S1" ][index_name_var] )
    ax1.set_title("S1" )

    ax2.hist( indixes_data_set[ index_col == "S2" ][index_name_var] )
    ax2.set_title("S2" )

    ax3.hist( indixes_data_set[ index_col == "S3" ][index_name_var] )
    ax3.set_title("S3" )

    ax4.hist( indixes_data_set[ index_col == "S4" ][index_name_var] )
    ax4.set_title("S4" )

    plt.show()
    print("\n")

    nasdaq_mean_ret = []
    nasdaq_mean_ret.append( np.mean( indixes_data_set[ index_col == "S1" ][index_name_var] ) )
    nasdaq_mean_ret.append( np.mean( indixes_data_set[ index_col == "S2" ][index_name_var] ) )
    nasdaq_mean_ret.append( np.mean( indixes_data_set[ index_col == "S3" ][index_name_var] ) )
    nasdaq_mean_ret.append( np.mean( indixes_data_set[ index_col == "S4" ][index_name_var] ) )

    nasdaq_mean_ret = np.abs(nasdaq_mean_ret)
    nasdaq_class_mean_ret_df = pd.DataFrame ( { 'Mean Daily Log Return' : nasdaq_mean_ret,
                                                'Stock Classification'  : [ "S1", "S2", "S3", "S4"]
},
                                               index = [ "S1", "S2", "S3", "S4"] )

    nasdaq_class_mean_ret_df = nasdaq_class_mean_ret_df.sort_values('Mean Daily Log Return')
    ax_nasdaq = nasdaq_class_mean_ret_df.plot.barh(y='Mean Daily Log Return', figsize=(18,4), fontsiz
e=14 )
    ax_nasdaq.set_title(title_2, fontsize=18)
```

In [32]:
```
ax_plot = createPlotsForStockClassification(indixes_data_set = indixes_data_set1,
              index_name_var = "r_Nasdaq",
              title_1 = 'Histograms of Daily Returns for the NASDAQ for all Classifications',
              title_2 = "Nasdaq Absolute Mean Daily Returns per Stock Classification",
              index_col = indixes_data_set1.f_Nasdaq)
ax_plot
```



In [33]:
```
ax_plot = createPlotsForStockClassification(indixes_data_set = indixes_data_set1,
            index_name_var = "r_DJI",
            title_1 = 'Histograms of Daily Returns for the DJI for all Classifications',
            title_2 = "DJI Absolute Mean Daily Returns per Stock Classification",
            index_col = indixes_data_set1.f_DJI)
ax_plot
```

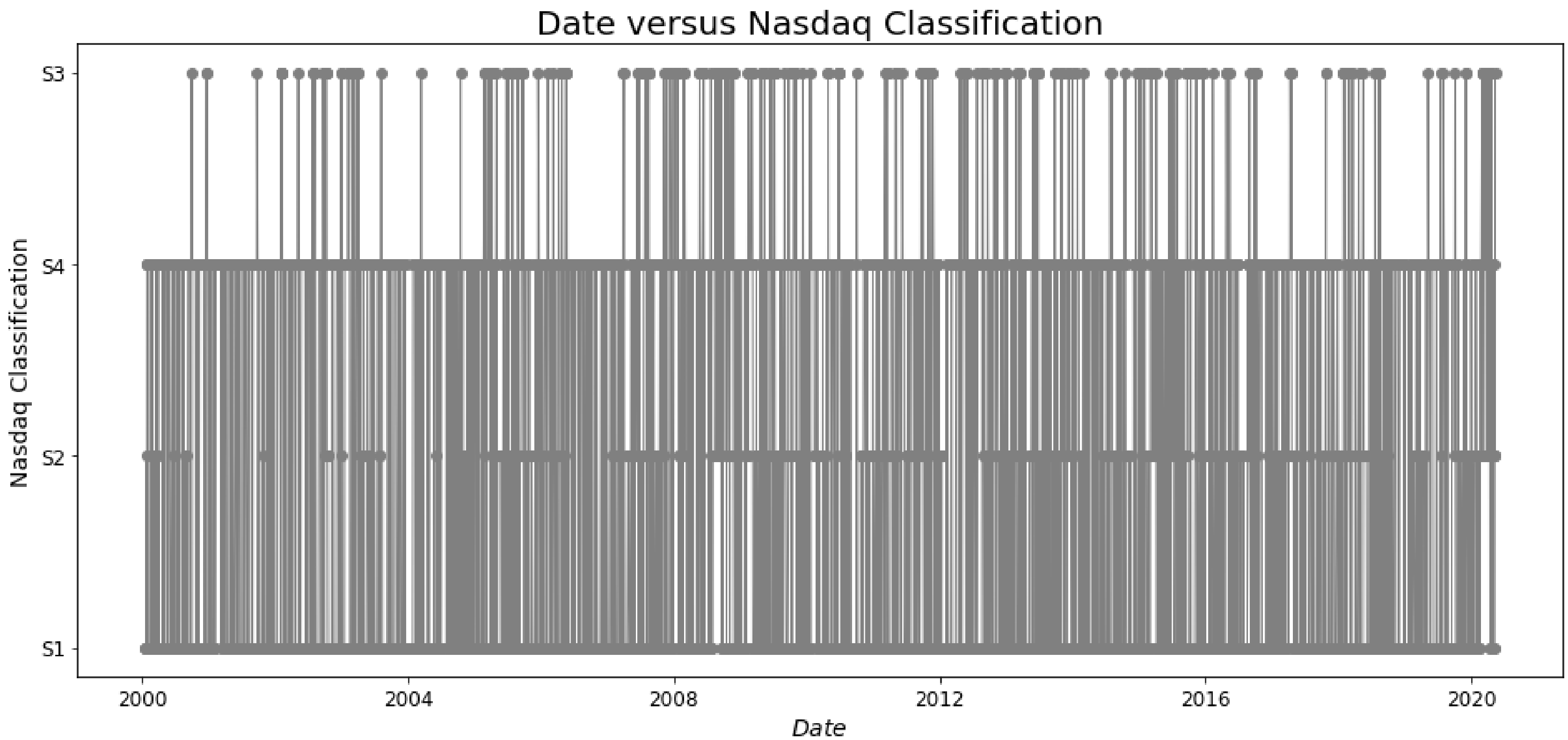


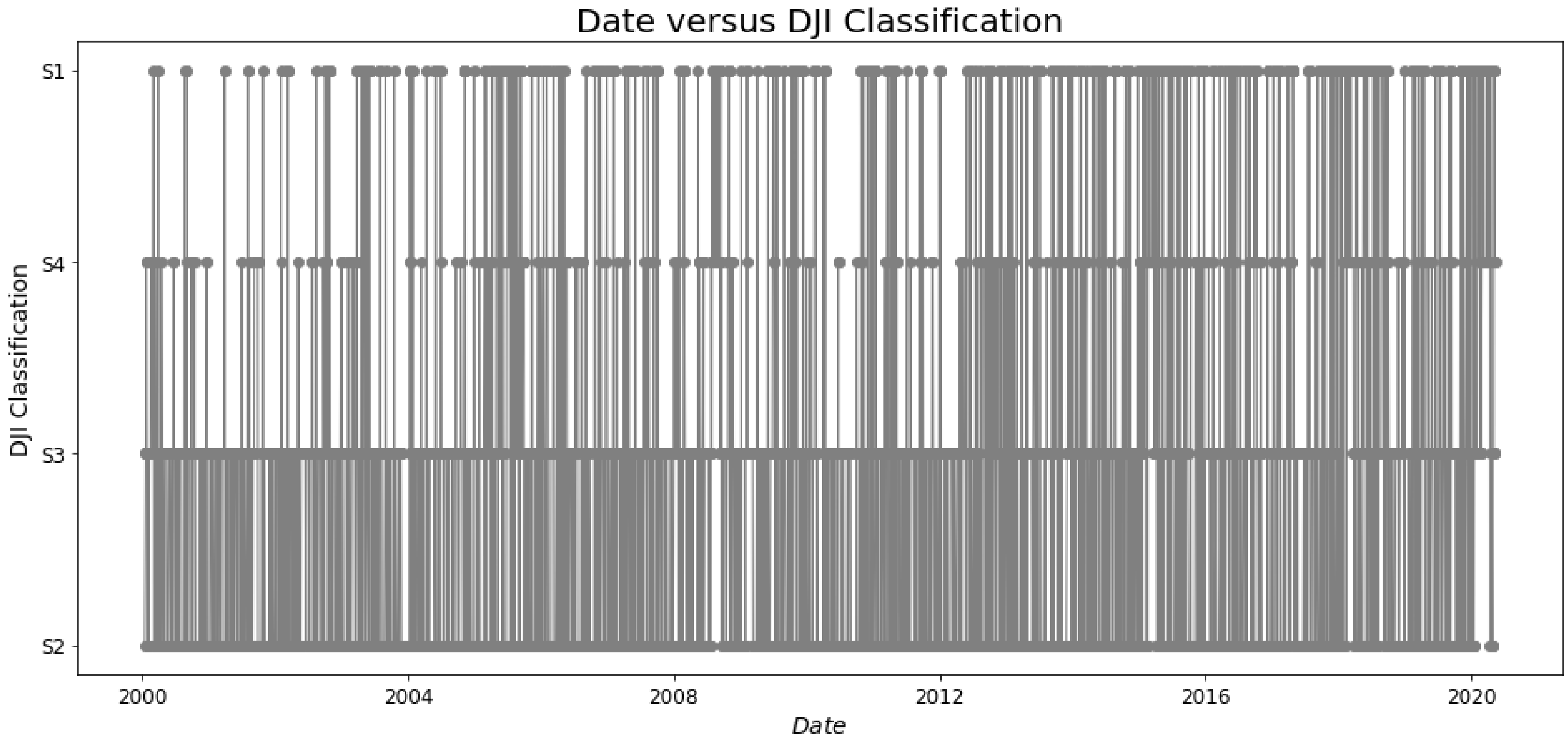


Stock Index Classification versus Date Plots

In [34]:

```
print("\n")
plt.figure(figsize=(16, 7))
plt.plot(indixes_data_set1['Date'], indixes_data_set1['f_Nasdaq'], "o-", color="gray", linewidth=1)
plt.title("Date versus Nasdaq Classification", fontsize=20)
plt.xlabel("$Date$", fontsize=14)
plt.ylabel("Nasdaq Classification", fontsize=14)
plt.show()

print("\n")
plt.figure(figsize=(16, 7))
plt.plot(indixes_data_set1['Date'], indixes_data_set1['f_DJI'], "o-", color="gray", linewidth=1)
plt.title("Date versus DJI Classification", fontsize=20)
plt.xlabel("$Date$", fontsize=14)
plt.ylabel("DJI Classification", fontsize=14)
plt.show()
```


Date versus Nasdaq Classification
S3
S4
S2
S1
Nasdaq Classification
2000
2004
2008
2012
2016
2020
Date



Summary Statistics for Transitions from one Classification to Another Classification

In [35]:
```python
indixes_classifications = ["f_DJI", "f_S&P_500", "f_Nasdaq"]

import pandas as pd
import matplotlib.pyplot as plt
from matplotlib.ticker import PercentFormatter


def _plot_pareto_by(df_, group_by, column, title):

    df = df_.groupby(group_by)[column].sum().reset_index()
    df = df.sort_values(by=column,ascending=False)

    df["cumpercentage"] = df[column].cumsum()/df[column].sum()*100


    fig, ax = plt.subplots(figsize=(20,5))
    ax.set_title(title, fontsize = 20 )
    ax.bar(df[group_by], df[column], color="C0")
    ax2 = ax.twinx()
    ax2.plot(df[group_by], df["cumpercentage"], color="C1", marker="D", ms=7)
    ax2.yaxis.set_major_formatter(PercentFormatter())

    ax.tick_params(axis="y", colors="C0")
    ax2.tick_params(axis="y", colors="C1")

    for tick in ax.get_xticklabels():
        tick.set_rotation(45)
    plt.show()

def calculateClassificationTransitions(df, f_index_name) :

    ndays = len(df)
    f_index = df[f_index_name].to_numpy().astype('<U2')

    num_transitions_index_S1S2_S1S2 = 0
    num_transitions_index_S1S2_S3S4 = 0
    num_transitions_index_S3S4_S3S4 = 0
    num_transitions_index_S3S4_S1S2 = 0


    num_transitions_index_S1_to_S1 = 0
    num_transitions_index_S1_to_S2 = 0
```

```
    num_transitions_index_S1_to_S3 = 0
    num_transitions_index_S1_to_S4 = 0

    num_transitions_index_S2_to_S2 = 0
    num_transitions_index_S2_to_S1 = 0
    num_transitions_index_S2_to_S3 = 0
    num_transitions_index_S2_to_S4 = 0

    num_transitions_index_S3_to_S3 = 0
    num_transitions_index_S3_to_S1 = 0
    num_transitions_index_S3_to_S2 = 0
    num_transitions_index_S3_to_S4 = 0

    num_transitions_index_S4_to_S4 = 0
    num_transitions_index_S4_to_S1 = 0
    num_transitions_index_S4_to_S2 = 0
    num_transitions_index_S4_to_S3 = 0

    for i in range(ndays-1) :

        if f_index[i] == "S1" :

            if f_index[i+1] == "S2" :
                num_transitions_index_S1_to_S2 += 1
            elif f_index[i+1] == "S3" :
                num_transitions_index_S1_to_S3 += 1
            elif f_index[i+1] == "S4" :
                num_transitions_index_S1_to_S3 += 1
            elif f_index[i+1] == "S1" :
                num_transitions_index_S1_to_S1 += 1

        elif f_index[i] == "S2" :

            if f_index[i+1] == "S1" :
                num_transitions_index_S2_to_S1 += 1
            elif f_index[i+1] == "S3" :
                num_transitions_index_S2_to_S3 += 1
            elif f_index[i+1] == "S4" :
                num_transitions_index_S2_to_S4 += 1
            elif f_index[i+1] == "S2" :
                num_transitions_index_S2_to_S2 += 1

        elif f_index[i] == "S3" :
```

```
        if f_index[i+1] == "S1" :
            num_transitions_index_S3_to_S1 += 1
        elif f_index[i+1] == "S2" :
            num_transitions_index_S3_to_S2 += 1
        elif f_index[i+1] == "S4" :
            num_transitions_index_S3_to_S4 += 1
        elif f_index[i+1] == "S3" :
            num_transitions_index_S3_to_S3 += 1

    elif f_index[i] == "S4" :

        if f_index[i+1] == "S1" :
            num_transitions_index_S4_to_S1 += 1
        elif f_index[i+1] == "S2" :
            num_transitions_index_S4_to_S2 += 1
        elif f_index[i+1] == "S3" :
            num_transitions_index_S4_to_S3 += 1
        elif f_index[i+1] == "S4" :
            num_transitions_index_S4_to_S4 += 1

    else :
        print("Error, unknown classifier value")

data = { 'index'    : [f_index_name],
         'num_days' : [ndays],
         'S1_to_S1%' : [100*num_transitions_index_S1_to_S1/ndays],
         'S1_to_S2%' : [100*num_transitions_index_S1_to_S2/ndays],
         'S1_to_S3%' : [100*num_transitions_index_S1_to_S3/ndays],
         'S1_to_S4%' : [100*num_transitions_index_S1_to_S4/ndays],

         'S2_to_S1%' : [100*num_transitions_index_S2_to_S1/ndays],
         'S2_to_S2%' : [100*num_transitions_index_S2_to_S2/ndays],
         'S2_to_S3%' : [100*num_transitions_index_S2_to_S3/ndays],
         'S2_to_S4%' : [100*num_transitions_index_S2_to_S4/ndays],

         'S3_to_S1%' : [100*num_transitions_index_S3_to_S1/ndays],
         'S3_to_S2%' : [100*num_transitions_index_S3_to_S2/ndays],
         'S3_to_S3%' : [100*num_transitions_index_S3_to_S3/ndays],
         'S3_to_S4%' : [100*num_transitions_index_S3_to_S4/ndays],

         'S4_to_S1%' : [100*num_transitions_index_S4_to_S1/ndays],
         'S4_to_S2%' : [100*num_transitions_index_S4_to_S2/ndays],
```

```
                'S4_to_S3%' : [100*num_transitions_index_S4_to_S3/ndays],
                'S4_to_S4%' : [100*num_transitions_index_S4_to_S4/ndays]
              }

    num_transitions_index_S1S2_S1S2 = num_transitions_index_S1_to_S1 + num_transitions_index_S1_to_S2
+ \
                                      num_transitions_index_S2_to_S1 + num_transitions_index_S2_to_S2

    num_transitions_index_S1S2_S3S4 = num_transitions_index_S1_to_S3 + num_transitions_index_S1_to_S4
+ \
                                      num_transitions_index_S2_to_S3 + num_transitions_index_S2_to_S4

    num_transitions_index_S3S4_S3S4 = num_transitions_index_S3_to_S3 + num_transitions_index_S3_to_S4
+ \
                                      num_transitions_index_S4_to_S3 + num_transitions_index_S4_to_S4

    num_transitions_index_S3S4_S1S2 = num_transitions_index_S3_to_S1 + num_transitions_index_S3_to_S2
+ \
                                      num_transitions_index_S4_to_S1 + num_transitions_index_S4_to_S2

    data_agg = { 'index'     : [f_index_name],
                'num_days' : [ndays],
                'S1S2_to_S1S2%' : [100*num_transitions_index_S1S2_S1S2/ndays],
                'S1S2_to_S3S4%' : [100*num_transitions_index_S1S2_S3S4/ndays],
                'S3S4_to_S3S4%' : [100*num_transitions_index_S3S4_S3S4/ndays],
                'S3S4_to_S1S2%' : [100*num_transitions_index_S3S4_S1S2/ndays] }

    return pd.DataFrame(data), pd.DataFrame(data_agg),


results_stats_df = pd.DataFrame()
results_stats_agg_df = pd.DataFrame()

first = True
for index_clf in indixes_classifications :

    curr_results_stats_df, curr_results_agg_stats_df = \
           calculateClassificationTransitions(df = indixes_data_set1, f_index_name = index_clf)
    results_stats_df = results_stats_df.append(curr_results_stats_df)
    results_stats_agg_df = results_stats_agg_df.append(curr_results_agg_stats_df)

results_stats_df = results_stats_df.reset_index(drop=True).T.reset_index(). \
    rename(columns={"index": "Transition", 0: "DJI", 1 : "S&P_500", 2 : "Nasdaq"})
```

```
results_stats_df =  results_stats_df.iloc[2: len(results_stats_df)]

results_stats_agg_df_T = results_stats_agg_df.reset_index(drop=True).T.reset_index(). \
    rename(columns={"index": "Transition", 0: "DJI", 1 : "S&P_500", 2 : "Nasdaq"}). \
    iloc[2: 6]
```

Detail Transition Classification Summary from any S classification to any S classification

In [36]:
```
results_stats_df
```

Out[36]:

	Transition	DJI	S&P_500	Nasdaq
2	S1_to_S1%	7.03812	8.25024	34.8387
3	S1_to_S2%	2.9521	2.8739	2.9521
4	S1_to_S3%	2.03324	2.8348	8.3871
5	S1_to_S4%	0	0	0
6	S2_to_S1%	3.0694	2.85435	2.93255
7	S2_to_S2%	33.392	32.219	6.00196
8	S2_to_S3%	7.25318	6.54936	0.762463
9	S2_to_S4%	0.762463	0.860215	0.684262
10	S3_to_S1%	0.664712	0.762463	0.625611
11	S3_to_S2%	7.23363	6.35386	0.821114
12	S3_to_S3%	24.477	23.089	3.51906
13	S3_to_S4%	2.18964	1.87683	1.75953
14	S4_to_S1%	1.25122	2.09189	7.76149
15	S4_to_S2%	0.879765	1.01662	0.606061
16	S4_to_S3%	2.09189	1.56403	1.66178
17	S4_to_S4%	4.69208	6.78397	26.6667

Aggregate Transition Classification Summary (S1S2 to S1S2, S1S2 to S3S4, S3S4 to S3S4, S3S4 to S2S1)

In [37]:
```
#results_stats_agg_df
results_stats_agg_df_T
```

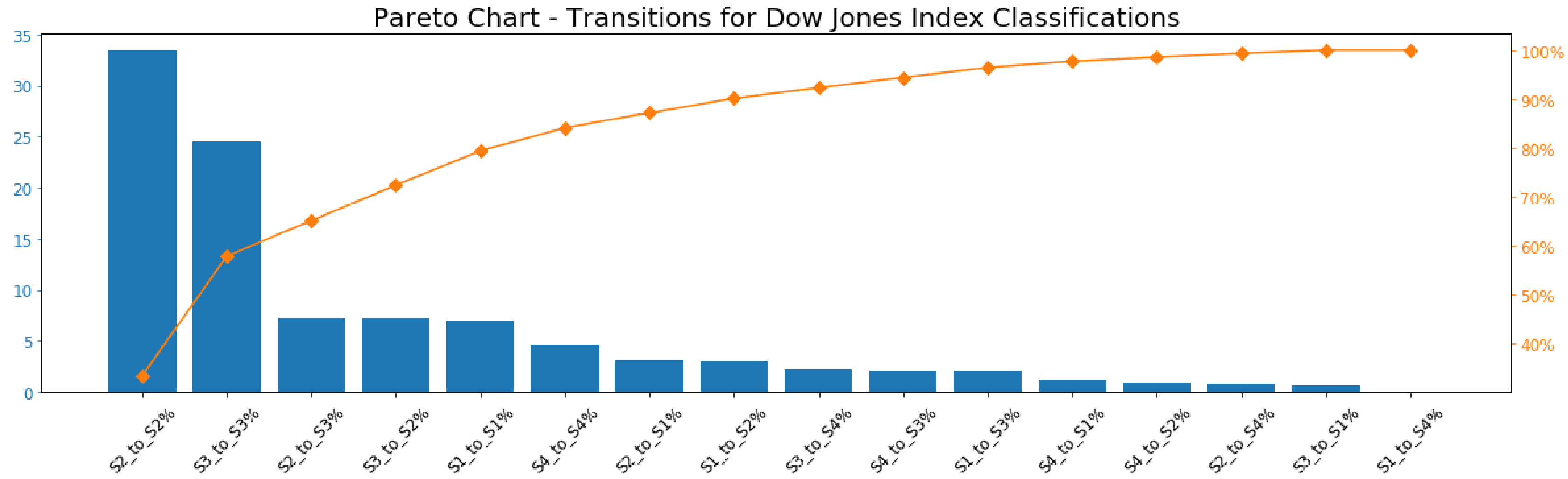
Out[37]:

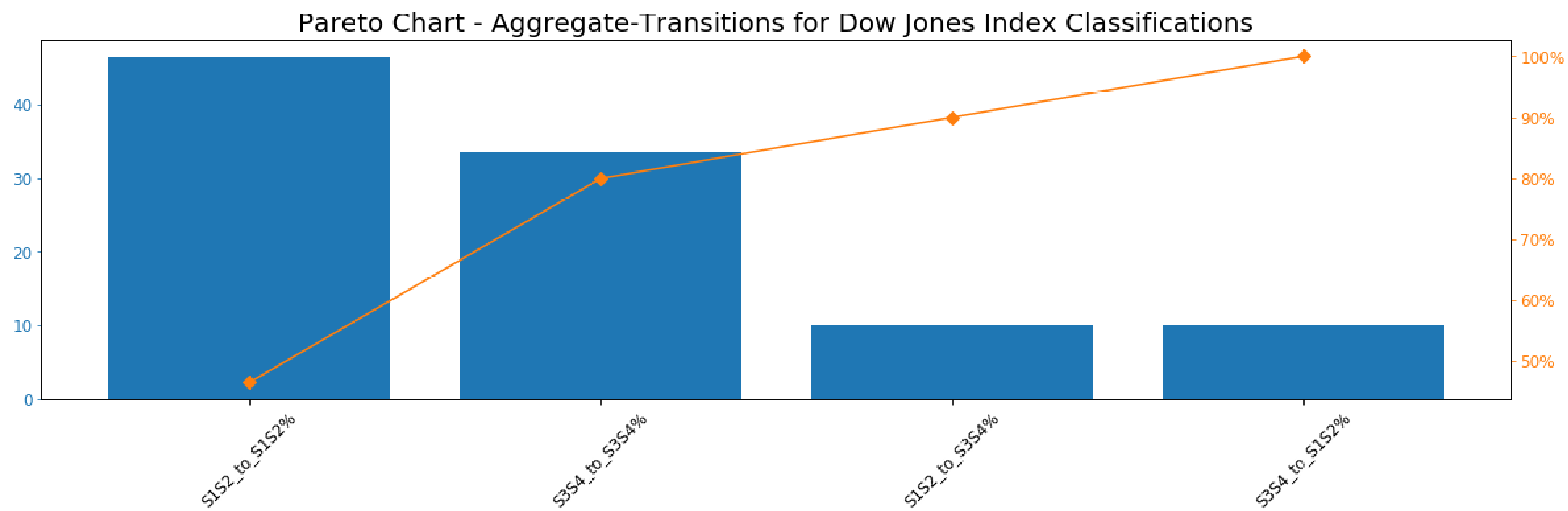
	Transition	DJI	S&P_500	Nasdaq
2	S1S2_to_S1S2%	46.4516	46.1975	46.7253
3	S1S2_to_S3S4%	10.0489	10.2444	9.83382
4	S3S4_to_S3S4%	33.4506	33.3138	33.607
5	S3S4_to_S1S2%	10.0293	10.2248	9.81427

Pareto Charts for Transitions Statistics from one Classificaiton to Another Classification

DJI

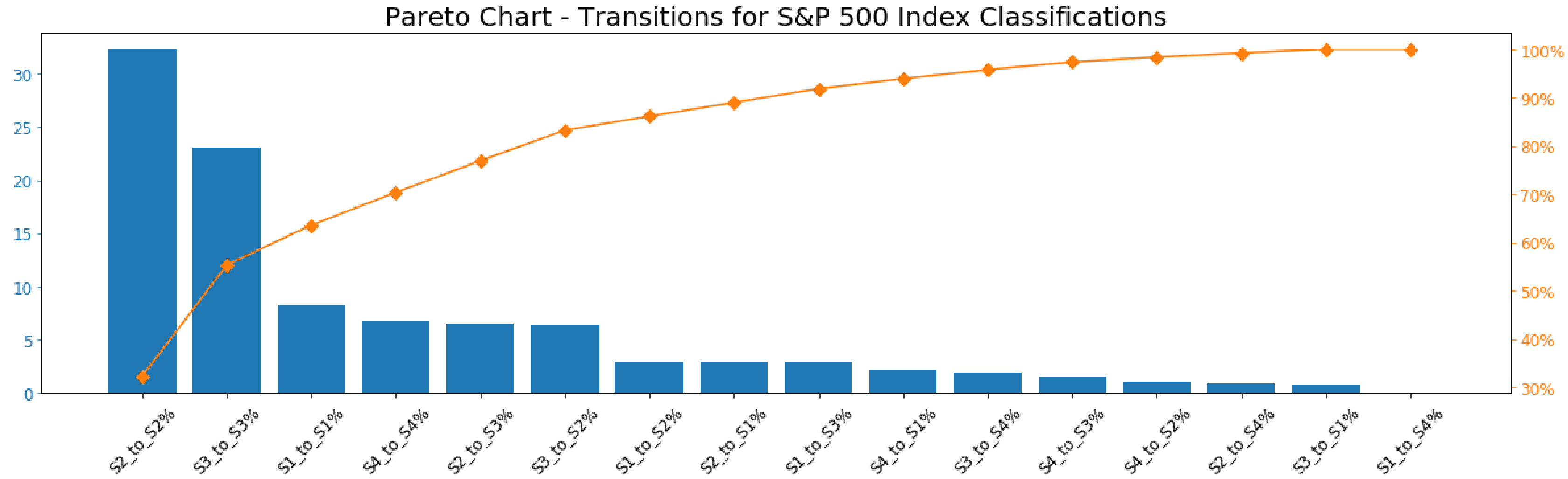
In [38]:
```
_plot_pareto_by(df_ = results_stats_df, group_by = "Transition", column = "DJI",
                title = "Pareto Chart - Transitions for Dow Jones Index Classifications")

_plot_pareto_by(df_ = results_stats_agg_df_T, group_by = "Transition", column = "DJI",
                title = "Pareto Chart - Aggregate-Transitions for Dow Jones Index Classifications")
```

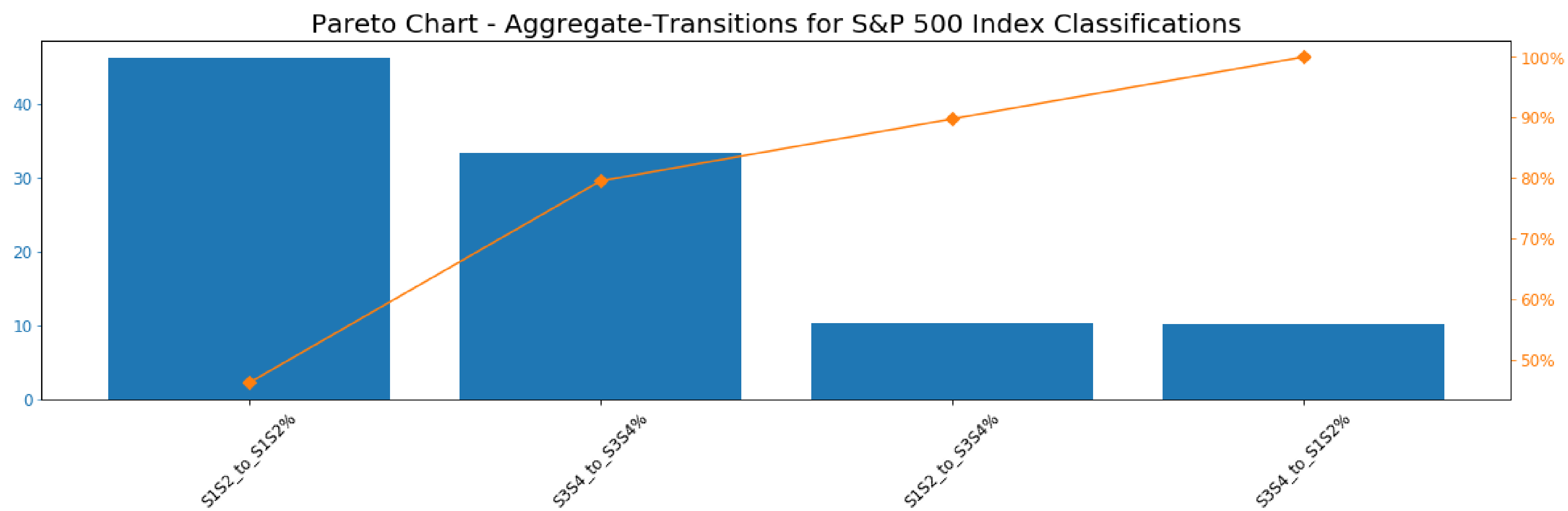




S&P 500

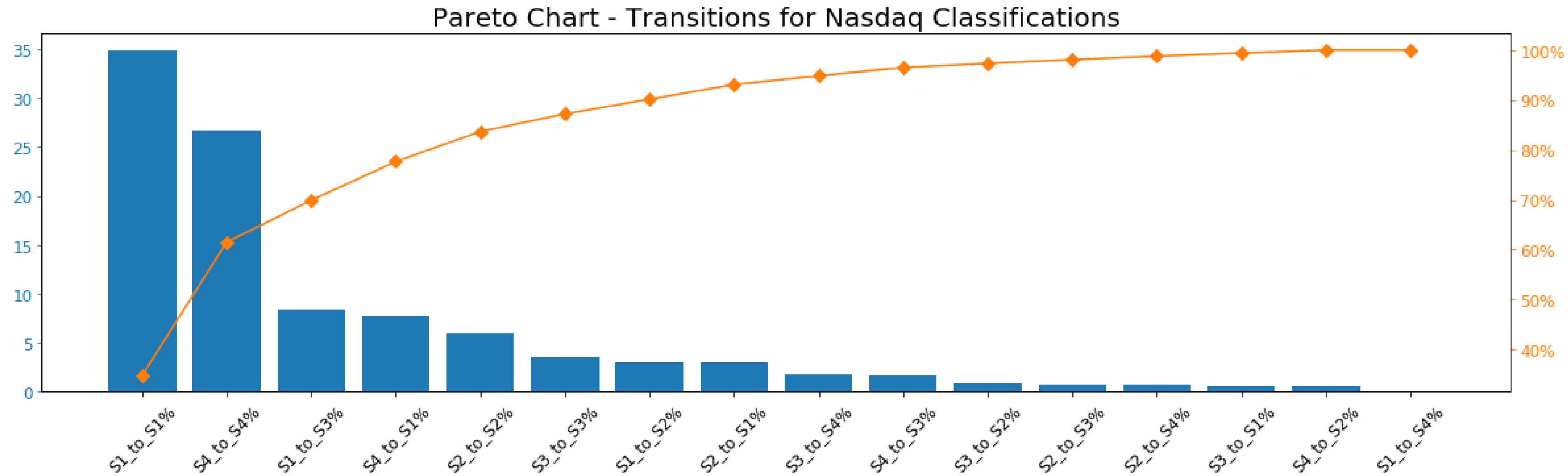
```
In [39]: _plot_pareto_by(df_ = results_stats_df, group_by = "Transition", column = "S&P_500",
                         title = "Pareto Chart - Transitions for S&P 500 Index Classifications")

         _plot_pareto_by(df_ = results_stats_agg_df_T, group_by = "Transition", column = "S&P_500",
                         title = "Pareto Chart - Aggregate-Transitions for S&P 500 Index Classifications")
```

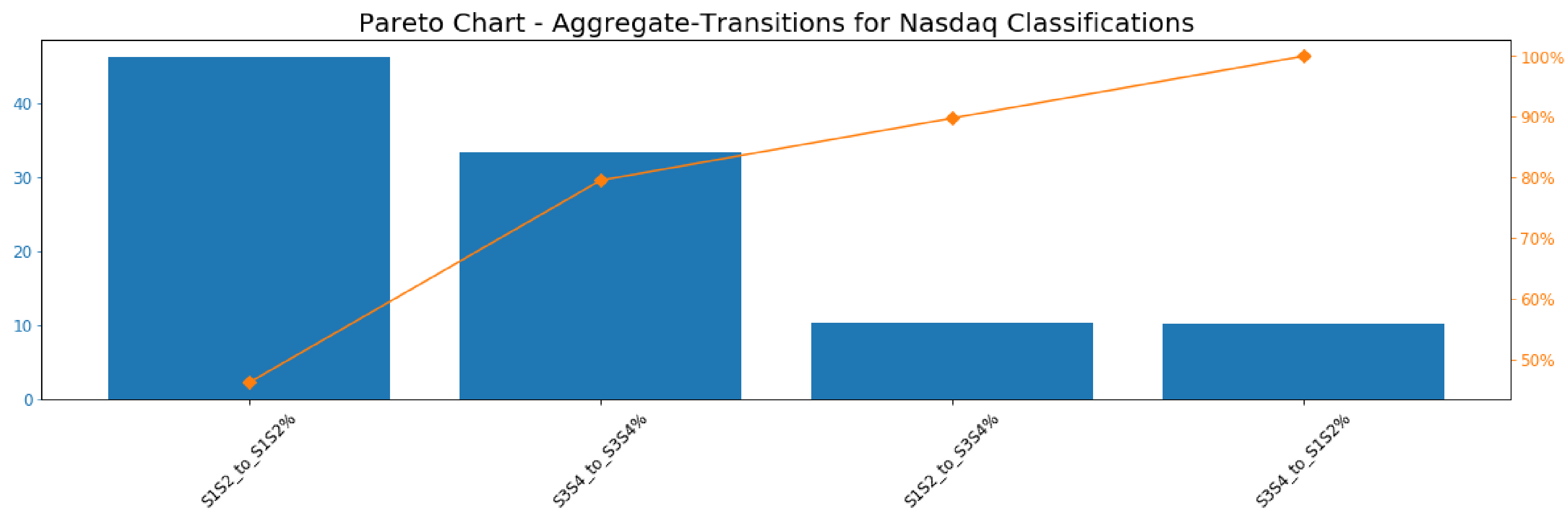




Nasdaq

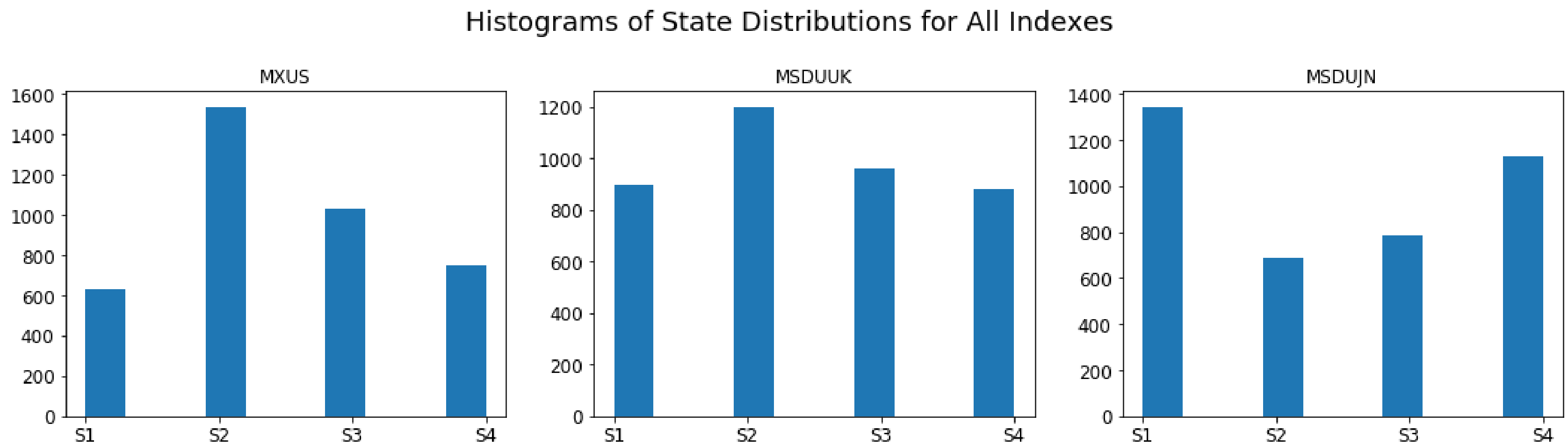
```
In [40]: _plot_pareto_by(df_ = results_stats_df, group_by = "Transition", column = "Nasdaq",
                title = "Pareto Chart - Transitions for Nasdaq Classifications")

         _plot_pareto_by(df_ = results_stats_agg_df_T, group_by = "Transition", column = "S&P_500",
                title = "Pareto Chart - Aggregate-Transitions for Nasdaq Classifications")
```





Dataset 2

In [41]:
```
fig, (ax1, ax2, ax3) = plt.subplots(1, 3, figsize=(18,4))
fig.suptitle('Histograms of State Distributions for All Indexes', fontsize=18, y=1.07)


ax1.hist(indixes_data_set2['f_MXUS'].sort_values())
ax1.set_title("MXUS" )

ax2.hist(indixes_data_set2['f_MSDUUK'].sort_values())
ax2.set_title("MSDUUK")

ax3.hist(indixes_data_set2['f_MSDUJN'].sort_values())
ax3.set_title("MSDUJN")

plt.show()
```



6.1.7 Create Network Topological Characteristics

In [42]:

```
import networkx as nx
import matplotlib.pyplot as plt
from collections import Counter
import statistics as stat

# The following function calculates the topology parameters
#       index_start : dataframe where to start calculations
#       sliding_window_size : size of sliding window, default = 30 (days)
#       save_results_end_of_window : [True, False], Day where to save the results in the window
#                                                  results should be saved at the end, to avoid
#                                                  looking in the future
#                                                  The option of "False" will save at the start of ea
ch window
#       save_results_ndays_pass_window : unsigned integer, default = 0
#              - This parameter is only applicable if save_results_end_of_window = True, it will save
#                the sliding window derived parameters, n days past the window. This suggestion was
#                recommended by Professor Bahman to ensure there is not leakage of looking into future
data.

def getNetworkTopologyParameters(df, index_start = 9,
                                 sliding_window_size = 30,
                                 save_results_end_of_window = True,
                                 save_results_ndays_pass_window = 0 ):

    # ***Create node pairs

    nodes1 = df["Node"]
    pairs_list = []
    for i in range(index_start, len(nodes1), 1):
        one = nodes1[i]
        two = nodes1[i + 1]
        pairs_list.append((one, two))

    # Arrays to save network parameters

    Ave_Deg_Centrality = np.empty( [df.shape[0], 1], dtype='double' )
    Ave_Deg_Centrality[:] = np.NaN
    Ave_Network_Strength = np.empty( [df.shape[0], 1], dtype='double' )
    Ave_Network_Strength[:] = np.NaN
    Ave_Shortest_PathLen = np.empty( [df.shape[0], 1], dtype='double' )
    Ave_Shortest_PathLen[:] = np.NaN
    Closenes_Centrality = np.empty( [df.shape[0], 1], dtype='double' )
```

```python
    Closenes_Centrality[:] = np.NaN

    # Iterate through All Dates - Creating Sliding Windows for Network Parameters
    # Each sliding window is one day apart, see table-1 of white paper

    num_rows = df.shape[0]

    for current_day in range(num_rows):

        # - Check There are still enough days for a 30 day window, if there are not, then stop
        #   creating sliding windows, and exit the loop
        # - Another exit of the loop, is, if there are not enough records to save the results, in
        #   case, the save_results_ndays_pass_window is specified

        if (current_day + sliding_window_size + save_results_ndays_pass_window ) > num_rows:
            break

        # Create Sliding Window Start and End positions, and Data

        window_start = current_day
        window_end = current_day + sliding_window_size
        curr_sliding_win_pairs = pairs_list[window_start : window_end]

        # Determine location where to save results from sliding widow

        loc_to_save_results = window_end - 1

        if save_results_end_of_window == False :
            loc_to_save_results = window_start
        elif save_results_ndays_pass_window > 0 :
            loc_to_save_results += save_results_ndays_pass_window

        # *** Create Network Graph & Compute network parameters for the current window

        H = nx.DiGraph()
        EDGES = curr_sliding_win_pairs

        # calculate the weight of DIGraph
        H = nx.DiGraph((x, y, {'weight': v}) for (x, y), v in Counter(EDGES).items())

        # (1) Average Degree Centrality
        Ave_Deg_Centrality[loc_to_save_results] = stat.mean( nx.degree_centrality(H).values() )/2.0 #
```

```
        # (2) Average Network Strength (Formula 16)
        Ave_Network_Strength[loc_to_save_results] = H.size(weight='weight')/H.number_of_nodes()

        # (3) Network Average Shortest Path Length (Formula 17)
        Ave_Shortest_PathLen[ loc_to_save_results] = nx.average_shortest_path_length(H)

        # (4) Network Average Closeness Centrality (Formula 18 & 19)
        Closenes_Centrality [ loc_to_save_results ] = stat.mean ( nx.closeness_centrality(H).values()
)

    return Ave_Deg_Centrality, Ave_Network_Strength, Ave_Shortest_PathLen, Closenes_Centrality


# ***Calculate Network Parameters & Save at the end of the window, for a window of 30 days
# ***
# ***  - To save at the start of the window (snooping in the future) set save_results_end_of_window =
False
# ***  - To change the number of days in the slide window size, set sliding_window_size = num of days
# ***  - Data frame index start position = index_start  ( will remove this in the future, or default
 to
# ***      the first index or date)
# ***  - save_results_ndays_pass_window, this parameter is set to 2, this means, the result of slidin
g
# ***.       window will be saved, at day 32, no the last day of the window. This was a recommendation
# ***        to make sure there is not leakage of future data in a given's day, per feedback from
# ***        Professor Bahman.
# ***        * If save_results_end_of_window is set to False, make sure to set save_results_ndays_pass
_window
# ***          to 0, or removed, the default is zero; then the results are saved on the first day of t
hee
# ***          window

Ave_Deg_Centrality, Ave_Network_Strength, Ave_Shortest_PathLen, Closenes_Centrality = \
    getNetworkTopologyParameters(df = indixes_data_set1,
                                 sliding_window_size = 30,
                                 save_results_end_of_window = True,
                                 save_results_ndays_pass_window = 2 )

Ave_Deg_Centrality_Set2, Ave_Network_Strength_Set2, Ave_Shortest_PathLen_Set2, Closenes_Centrality_Se
t2 = \
    getNetworkTopologyParameters(df = indixes_data_set2,
                                 sliding_window_size = 30,
```

```
                                  save_results_end_of_window = True,
                                  save_results_ndays_pass_window = 2 )
```

In [43]:
```
# *** Save Results in Data Frames with all financial metrics for each set

indixes_data_set1["Ave_Deg_Centrality"]   = Ave_Deg_Centrality
indixes_data_set1["Ave_Network_Strength"] = Ave_Network_Strength
indixes_data_set1["Ave_Shortest_PathLen"] = Ave_Shortest_PathLen
indixes_data_set1["Closenes_Centrality"]  = Closenes_Centrality

indixes_data_set2["Ave_Deg_Centrality"]   = Ave_Deg_Centrality_Set2
indixes_data_set2["Ave_Network_Strength"] = Ave_Network_Strength_Set2
indixes_data_set2["Ave_Shortest_PathLen"] = Ave_Shortest_PathLen_Set2
indixes_data_set2["Closenes_Centrality"]  = Closenes_Centrality_Set2

# Delete all dates with NaN, this will get rid of the first 29 days before doing the network calculat
ions,
# as the first sliding window results are saved the last day of the window

indixes_data_set1.dropna(inplace = True)
indixes_data_set2.dropna(inplace = True)
```

In [44]:
```
indixes_data_set1.head()
```

Out[44]:

	Date	S&P_500	Nasdaq	DJI	r_Nasdaq	R_Nasdaq	V_Nasdaq	V_Ave_Nasdaq	r_S&P_500	R_S&P_500	...	V_Ave_DJI	V_Ave_
40	2000-03-01	1379.19	4784.08	10137.93	0.018436	0.050094	0.030678	0.046648	0.009302	0.013504	...	0.034552	
41	2000-03-02	1381.76	4754.51	10164.92	-0.006200	0.029208	0.033670	0.041145	0.001862	0.020716	...	0.035364	
42	2000-03-03	1409.17	4914.79	10367.20	0.033155	0.068260	0.038893	0.037444	0.019643	0.055299	...	0.032763	
43	2000-03-06	1391.28	4904.85	10170.51	-0.002025	0.068995	0.038511	0.036634	-0.012777	0.031565	...	0.031754	
44	2000-03-07	1355.62	4847.84	9796.04	-0.011691	0.031675	0.042097	0.036770	-0.025965	-0.007935	...	0.034210	

5 rows × 25 columns

In [45]:
```
indixes_data_set2.head()
```

Out[45]:

	Date	MXUS	MSDUUK	MSDUJN	r_MXUS	R_MXUS	V_MXUS	V_Ave_MXUS	r_MSDUUK	R_MSDUUK	...	V_Ave_MSDUJN	V_A
40	2000-02-28	1314.81	1143.658	3357.611	0.011189	0.002681	0.023714	0.027985	-0.019126	0.007459	...	0.032564	
41	2000-02-29	1333.28	1161.518	3325.178	0.013950	0.013098	0.027366	0.027359	0.015496	0.012426	...	0.031059	
42	2000-03-01	1343.29	1188.530	3412.178	0.007480	0.012970	0.027337	0.026206	0.022989	0.019463	...	0.030321	
43	2000-03-02	1350.08	1197.153	3392.979	0.005042	0.022237	0.025985	0.024828	0.007229	0.039068	...	0.030586	
44	2000-03-03	1376.15	1211.296	3348.599	0.019126	0.056787	0.012350	0.023351	0.011745	0.038333	...	0.029884	

5 rows × 25 columns

Summary of Derived Network Topology metrics to Compare with White Paper Training Data

In [46]:
```
metrics = ["Ave_Deg_Centrality", "Ave_Network_Strength", "Ave_Shortest_PathLen", "Closenes_Centralit
y" ]
data_training = indixes_data_set1[ indixes_data_set1['Date'].dt.strftime('%Y-%m-%d') < '2015-01-01'].
dropna()

print("Number of records in training dataset = ", len(data_training) )
print("Number of Unique Nodes in training dataset = ", len(data_training['Node'].unique()) )

data_training[ metrics ].describe()
```

```
Number of records in training dataset =  3733
Number of Unique Nodes in training dataset =  48
```

Out[46]:

	Ave_Deg_Centrality	Ave_Network_Strength	Ave_Shortest_PathLen	Closenes_Centrality
count	3733.000000	3733.000000	3733.000000	3733.000000
mean	0.280017	3.526614	2.433852	0.376800
std	0.149958	1.222717	0.706530	0.113185
min	0.088235	1.666667	0.833333	0.149405
25%	0.181818	2.727273	1.928571	0.292942
50%	0.233333	3.333333	2.333333	0.358871
75%	0.357143	4.285714	2.818182	0.446723
max	2.000000	15.000000	6.400000	1.000000

Comparison of Training Records and Network Derived Data vs Reported in White Paper

- The number of training records derived is 3735 for the date arrange defined in the white paper (Jan 31, 2000 to Dec 31 2014). The paper reports the following in section 4.3 : *The training set and the testing set contained 3769 and 755 records*
  - The differences is due to the number of records that have NaN as a result of the calculation of the financial parameters and network topology, i.e.:
    - 1 day due to calculation of daily returns
    - 4 days due to the calculation of 5 day moving averages
    - 29 days due to the calculation of the network parameters with a sliding window of 30 days
    - 2 days due to saving 2 days past the window
    - Total : 36 records with blanks
    - 3733 + 36 = 3769, which matches the size of the training data set in the white paper, as referred above.

6.1.8 Cluster Analysis with Unsupervised Learning

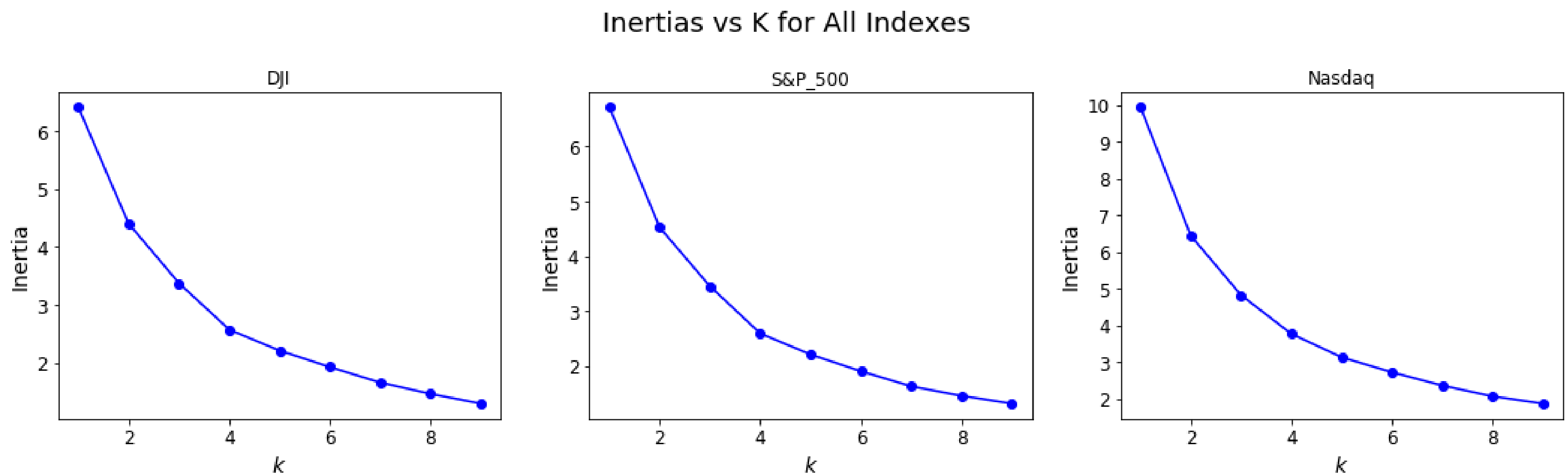
Create Clusters Per Index

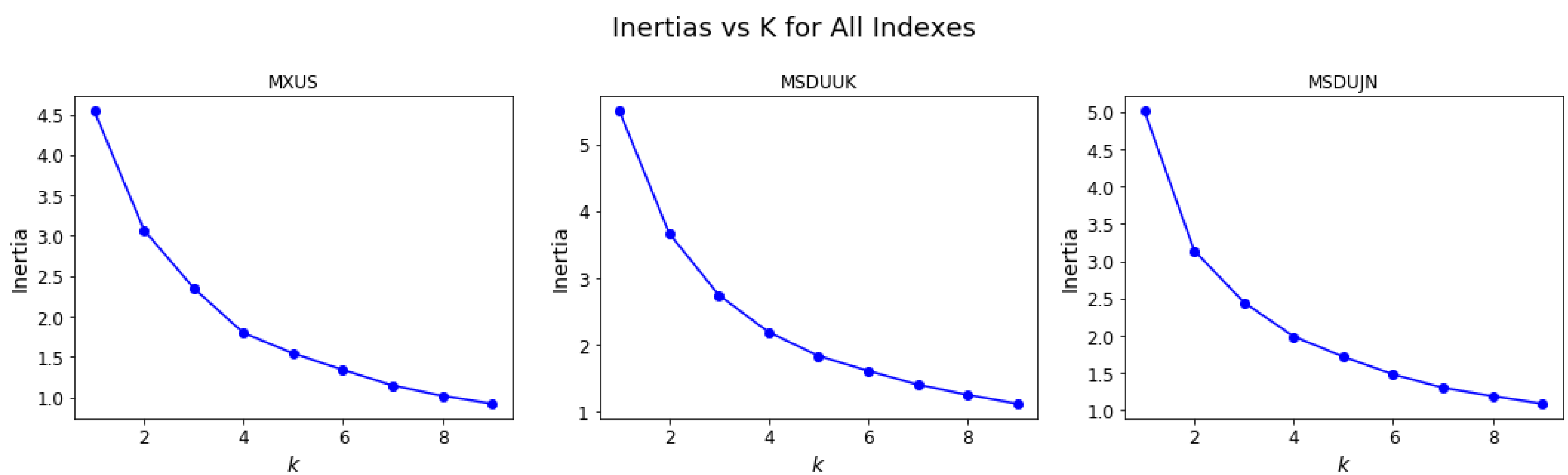
In [320]:
```
from sklearn.cluster import KMeans

def calculateClustersForIndexes(dataset, stock_indexes) :

    inertias_dict = {}
    kmeans_per_k_dict = {}

    for index in stock_indexes :

        X_train_cluster = dataset[ [ "R_" + index, "V_" + index, "V_Ave_All_Indexes"] ].to_numpy()
        kmeans_per_k = [KMeans(n_clusters=k, random_state=42).fit(X_train_cluster) for k in range(1,
10)]
        inertias = [model.inertia_ for model in kmeans_per_k]
        inertias_dict[index] = inertias
        kmeans_per_k_dict[index] = kmeans_per_k
    return inertias_dict, kmeans_per_k_dict

dat1_inertias_dict, dat1_kmeans_per_k_dict = calculateClustersForIndexes(dataset = indixes_data_set1,
                                                        stock_indexes = ["DJI", "S&P_500", "Nasdaq"]
)

dat2_inertias_dict, dat2_kmeans_per_k_dict = calculateClustersForIndexes(dataset = indixes_data_set2,
                                                        stock_indexes = ["MXUS", "MSDUUK", "MSDUJN"]
)
```

Plot Inertias vs K For All Indexes

In [322]:

```
def plotInertias_For_All_Indexes(inertias_dict, stock_indexes) :

    fig, (ax1, ax2, ax3) = plt.subplots(1, 3, figsize=(18,4))
    fig.suptitle('Inertias vs K for All Indexes', fontsize=18, y=1.07)

    ax1.plot( range(1, 10), inertias_dict[stock_indexes[0]], "bo-")
    ax1.set_xlabel("$k$", fontsize=14)
    ax1.set_ylabel("Inertia", fontsize=14)
    ax1.set_title( stock_indexes[0] )

    ax2.plot( range(1, 10), inertias_dict[ stock_indexes[1] ], "bo-")
    ax2.set_xlabel("$k$", fontsize=14)
    ax2.set_ylabel("Inertia", fontsize=14)
    ax2.set_title( stock_indexes[1] )

    ax3.plot( range(1, 10), inertias_dict[ stock_indexes[2] ], "bo-")
    ax3.set_xlabel("$k$", fontsize=14)
    ax3.set_ylabel("Inertia", fontsize=14)
    ax3.set_title(stock_indexes[2] )

    plt.show()

plotInertias_For_All_Indexes( inertias_dict = dat1_inertias_dict,
                              stock_indexes = ["DJI", "S&P_500", "Nasdaq"] )

plotInertias_For_All_Indexes( inertias_dict = dat2_inertias_dict,
                              stock_indexes = ["MXUS", "MSDUUK", "MSDUJN"]  )
```





Centroids for all Indexes for K=4

In [359]:

```
import numpy as np
import pandas as pd
from IPython.display import display_html

def displayCentroidsForAllIndexes(dat_kmeans_per_k_dict, stock_indexes, k) :

    html_dat = ""
    for index in stock_indexes:

        a = dat_kmeans_per_k_dict[ index ][k-1].cluster_centers_
        kmeans_opt_centroid = np.einsum('ij->ij', a[a[:,0].argsort(),:])
        df_a = pd.DataFrame(kmeans_opt_centroid).rename( columns={0: "R_" + index,
                                                                  1: "V_" + index,
                                                                  2 : "V_Ave_All_Indexes"} )

        df1_styler = df_a.style.set_table_attributes("style='display:inline'"). \
            set_caption(index + ' Centroids'). \
            set_table_styles([{
                'selector': 'caption',
                'props': [
                    ('color', 'blue'),
                    ('font-size', '16px'),
                    ('text-align', 'center') ]
            }])

        html_dat += df1_styler._repr_html_() + "        "

    print("\n")
    display_html(html_dat, raw=True)

displayCentroidsForAllIndexes(dat_kmeans_per_k_dict = dat1_kmeans_per_k_dict,
                              stock_indexes = ["DJI", "S&P_500", "Nasdaq"], k = 4 )

displayCentroidsForAllIndexes(dat_kmeans_per_k_dict = dat2_kmeans_per_k_dict,
                              stock_indexes = ["MXUS", "MSDUUK", "MSDUJN"], k = 4 )
```

DJI Centroids

	R_DJI	V_DJI	V_Ave_All_Indexes
0	-0.0492546	0.0941522	0.0983676
1	-0.0235677	0.0265586	0.030316
2	0.00677049	0.0129709	0.0148565
3	0.0298591	0.0365303	0.042341

S&P_500 Centroids

	R_S&P_500	V_S&P_500	V_Ave_All_Indexes
0	-0.0546674	0.101313	0.101457
1	-0.0245752	0.0291085	0.0316298
2	0.00691808	0.0135997	0.0149289
3	0.0330099	0.0399647	0.0431455

Nasdaq Centroids

	R_Nasdaq	V_Nasdaq	V_Ave_All_Indexes
0	-0.0757562	0.0810681	0.0660092
1	-0.024924	0.0323096	0.0269447
2	0.0124658	0.0175666	0.0151691
3	0.0473658	0.0588896	0.0474487

MXUS Centroids

	R_MXUS	V_MXUS	V_Ave_All_Indexes
0	-0.0605353	0.0896649	0.0800013
1	-0.0238612	0.0280177	0.0281822
2	0.0072913	0.0150212	0.0195132
3	0.0357966	0.0383795	0.0390106

MSDUUK Centroids

	R_MSDUUK	V_MSDUUK	V_Ave_All_Indexes
0	-0.0684867	0.0769637	0.0663507
1	-0.0240379	0.0281672	0.0271886
2	0.00798854	0.0173268	0.0193995
3	0.0403084	0.0406009	0.0367707

MSDUJN Centroids

	R_MSDUJN	V_MSDUJN	V_Ave_All_Indexes
0	-0.0437838	0.0771822	0.0739504
1	-0.0305874	0.0290289	0.0274579
2	0.00343401	0.0231735	0.0210083
3	0.0366376	0.0308732	0.0264983

6.2 Analysis of Network Topological Characteristics

Explanation of Similarities and Differences between this project and Reference 1

- The following section compares the network parameters derived with the ones published by Reference 1, for convenience their graphs are plotted next to one another to assist on the comparison
- All network parameters derived have about the same range of values as the ones published
- All network graphs have the same patterns, except with exceptions of some peaks, they are more pronounced in the reference implementations of the network measures.
- Even so Reference 1 uses the same Python library, NetworkX (Reference 7). Reference 1 was published (March 2019, most likely using version 2.2, version 2.3 was release on April 2019, version 2.4 October 2019. Significantly it should be noted that version 2.4 had a major number fixes, including new and updates to several of the networking measures derived with the package, see Pulls Requests in the 2.4 release (https://networkx.github.io/documentation/stable/release/release_2.4.html (https://networkx.github.io/documentation/stable/release/release_2.4.html))
- Another comparison of the similarities is the number of unique network nodes derived, Reference 1 publishes 47, and our analysis 48 for the same dataset and time period.
- Finally, as all numerical features will be standarized, it is not expected to cause differences in the Machine Learning modeling.

6.2.1 Visualization of Network Parameters

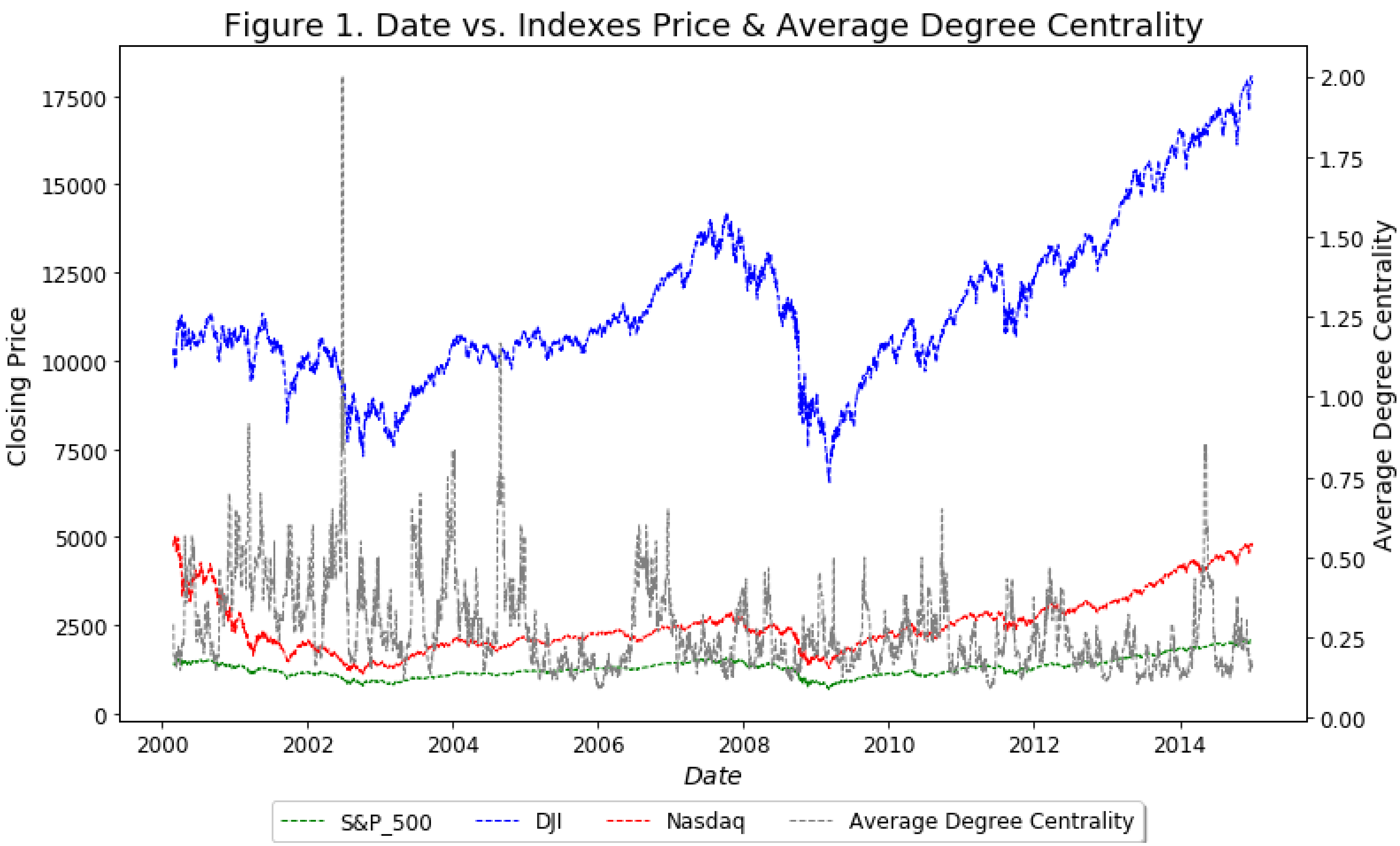
In [47]:
```
def plotNetworkParameterVsStockIndexes(df,
                                       index1_colname,
                                       index2_colname,
                                       index3_colname,
                                       network_parameter_column = "Ave_Deg_Centrality",
                                       network_parameter_column_name = "Average Degree Centrality",
                                       Figure_Num = "1",
                                       ) :
    data_training = df
    fig,ax = plt.subplots( figsize=(12,7) )
    #fig.set_figsize(figsize=(16, 7))
    ax.plot(data_training['Date'], data_training[index1_colname], "g--", linewidth=1 , label=index1_c
olname)
    ax.plot(data_training['Date'], data_training[index2_colname], "b--", linewidth=1 , label=index2_c
olname)
    ax.plot(data_training['Date'], data_training[index3_colname], "r--", linewidth=1 , label=index3_c
olname)
    ax.set_title("Figure " + Figure_Num + ". Date vs. Indexes Price & " + network_parameter_column_na
me,
                 fontsize="18")
    ax.set_xlabel("$Date$", fontsize=14)
    ax.set_ylabel("Closing Price", fontsize=14)
    #fig.legend(loc='upper left', shadow=False, fontsize='x-large')

    # twin object for two different y-axis on the sample plot
    ax2=ax.twinx()
    # make a plot with different y-axis using second axis object
    ax2.plot(data_training['Date'], data_training[network_parameter_column], "--", linewidth=1 ,
             label=network_parameter_column_name, color ="gray")
    ax2.set_ylabel(network_parameter_column_name, fontsize=14)

    # Put a legend below current axis
    fig.legend(loc='lower center', bbox_to_anchor=(0.465, -0.01),
               fancybox=True, shadow=True, ncol=4, fontsize=12)

    plt.show()

from IPython.core.display import HTML
def center_plot () :
    return HTML("""
    <style>
    .output_png {
```

```
        display: table-cell;
        text-align: center;
        horizontal-align: middle;
    }
    </style>
    """)
```

6.2.1.1 Dataset 1 (Dataset that matches the white paper)

Average Degree Centrality

In [48]:
```
plotNetworkParameterVsStockIndexes(df = data_training,
                                    network_parameter_column = "Ave_Deg_Centrality",
                                    network_parameter_column_name = "Average Degree Centrality",
                                    index1_colname = 'S&P_500', index2_colname = 'DJI', index3_colname = 'Nasd
aq',
                                    Figure_Num = "1")

center_plot()
```



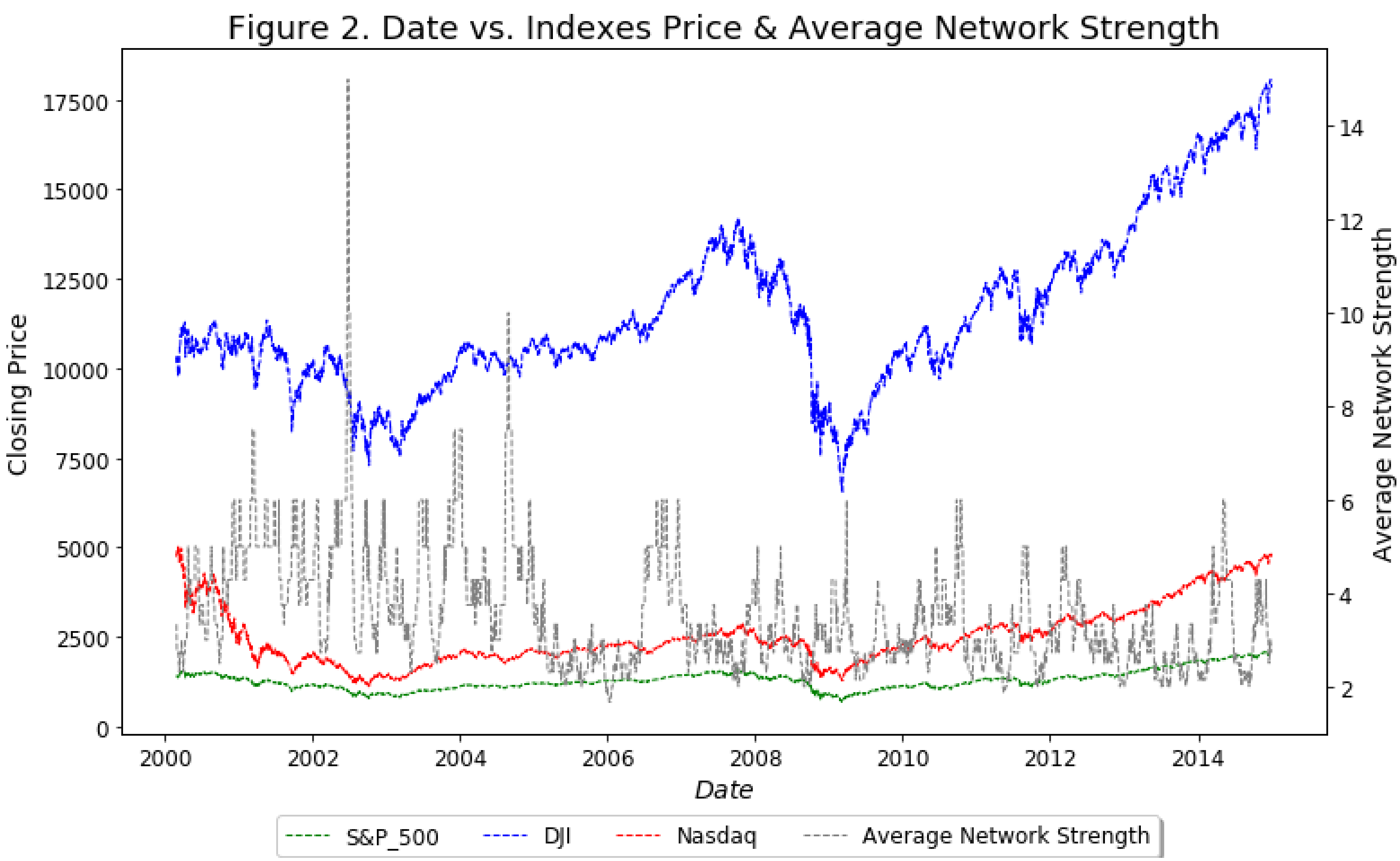
Out[48]:

Reference 1, Figure 7. Average Degree Centrality

Average Network Strength

In [49]:

```
print("\n")
plotNetworkParameterVsStockIndexes(df = data_training,
                                   network_parameter_column = "Ave_Network_Strength",
                                   network_parameter_column_name = "Average Network Strength",
                                   index1_colname = 'S&P_500', index2_colname = 'DJI', index3_colname = 'Nasd
aq',
                                   Figure_Num = "2")
center_plot()
```

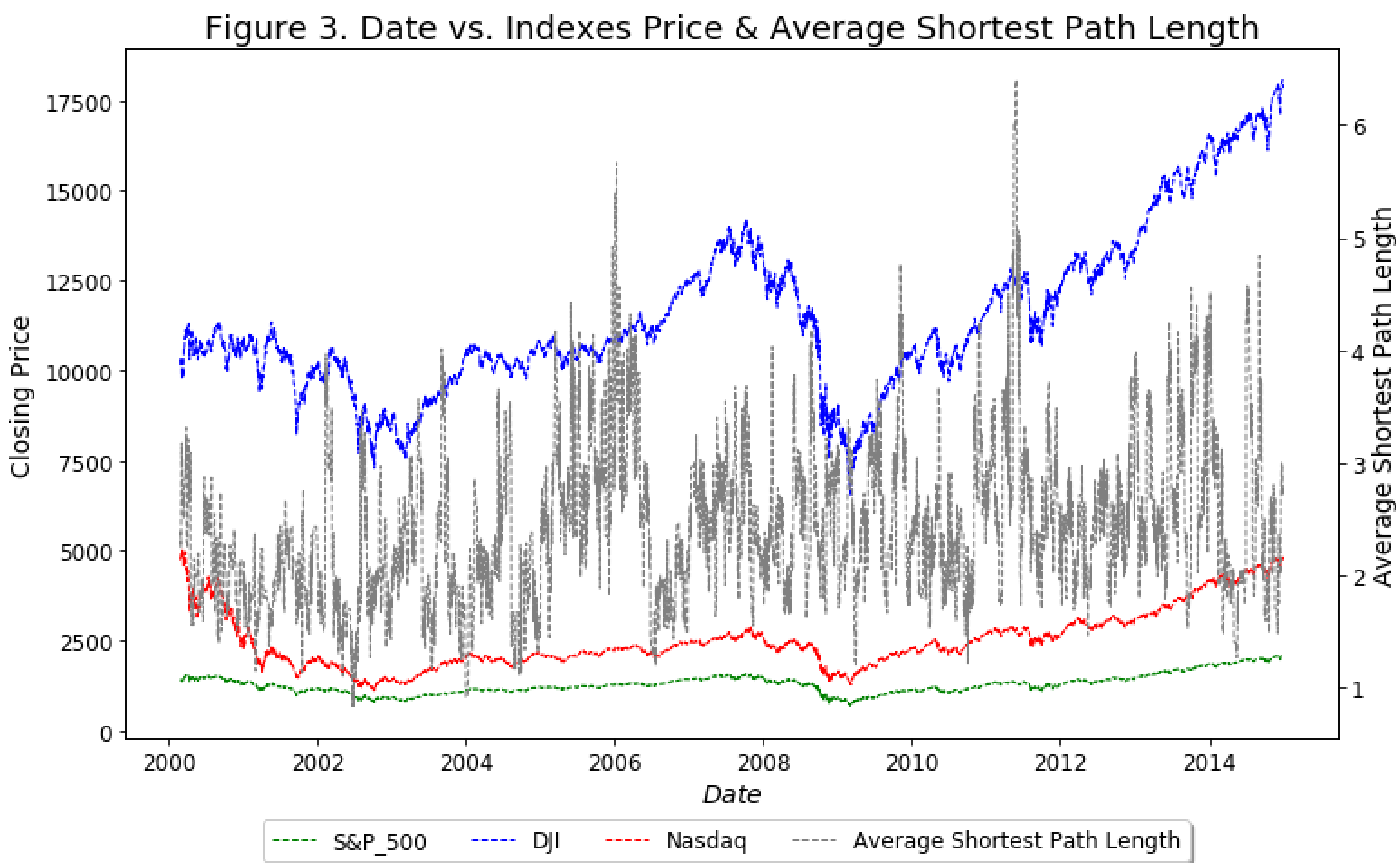


Out[49]:

Reference 1, Figure 4. Average Network Strength

Average Shortest Path Length

In [50]:
```
print("\n")
plotNetworkParameterVsStockIndexes(df = data_training,
                                   network_parameter_column = "Ave_Shortest_PathLen",
                                   network_parameter_column_name = "Average Shortest Path Length",
                                   index1_colname = 'S&P_500', index2_colname = 'DJI', index3_colname = 'Nasd
aq',
                                   Figure_Num = "3")
center_plot()
```

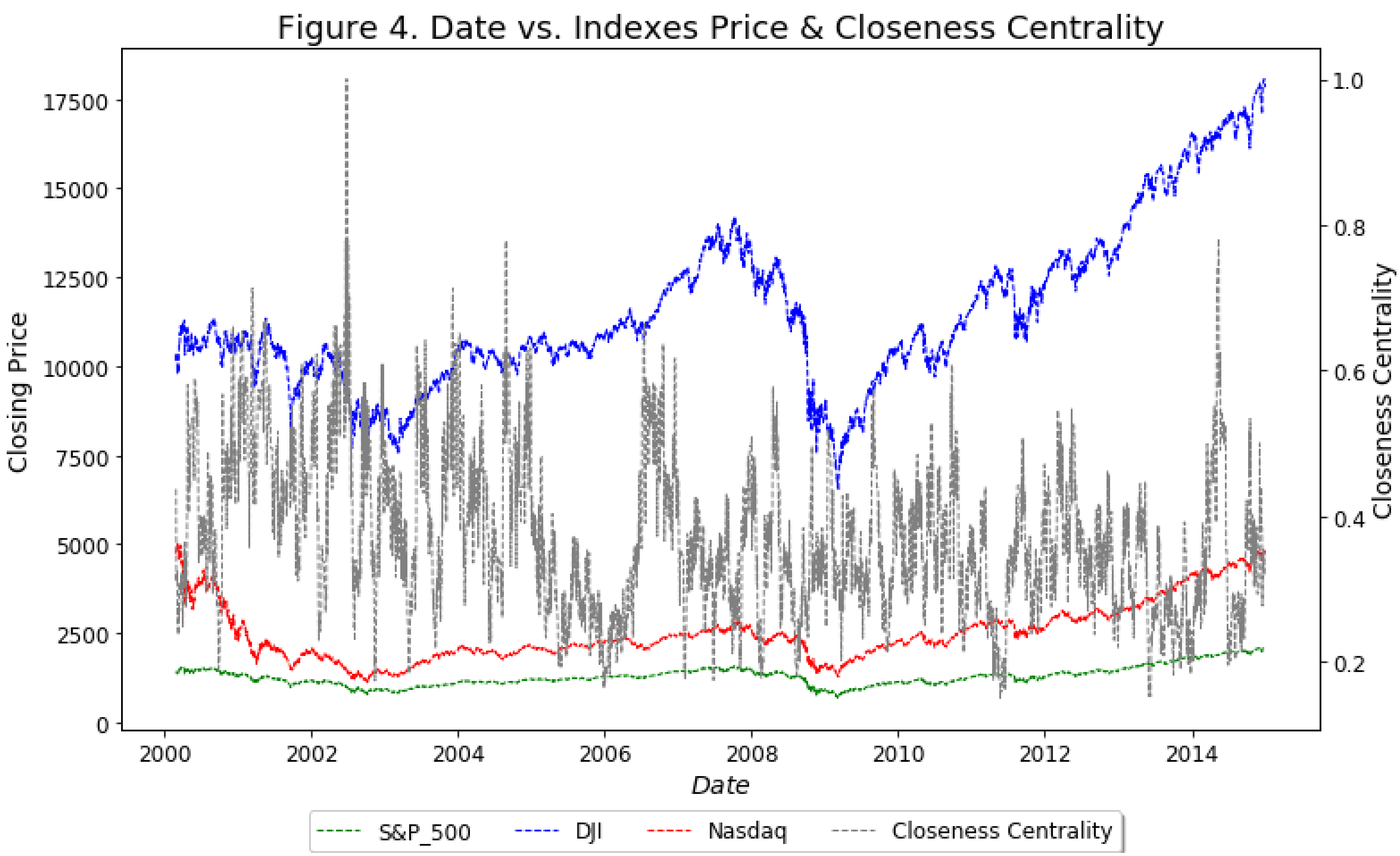


Out[50]:

Reference 1, Figure 5. Average Shortest Path Length

Closeness Centrality

In [51]:
```
print("\n")
plotNetworkParameterVsStockIndexes(df = data_training,
                                   network_parameter_column = "Closenes_Centrality",
                                   network_parameter_column_name = "Closeness Centrality",
                                   index1_colname = 'S&P_500', index2_colname = 'DJI', index3_colname = 'Nasd
aq',
                                   Figure_Num = "4")
center_plot()
```



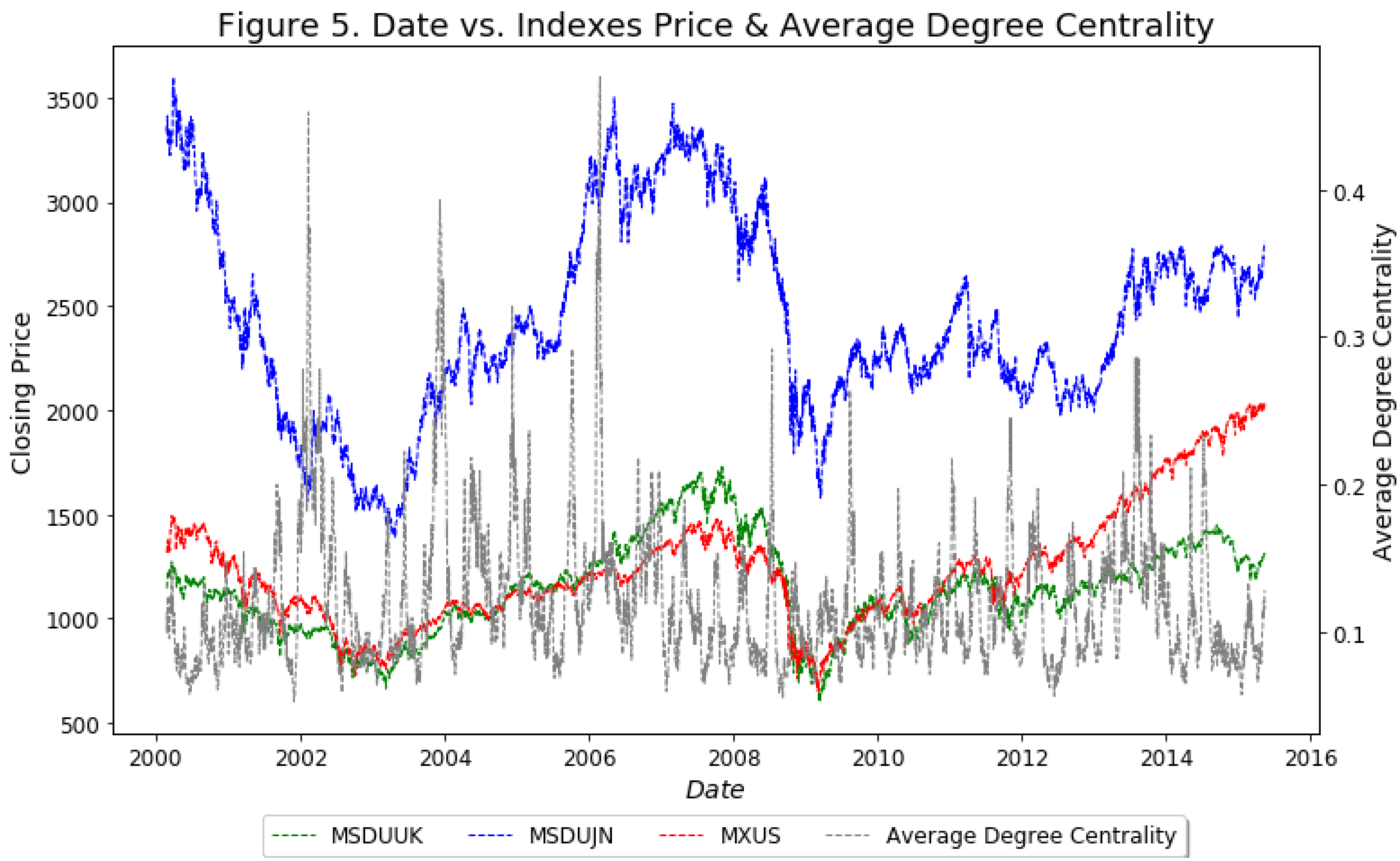
Out[51]:

Reference 1, Figure 6. Closeness Centrality

6.2.1.2 Dataset 2

Average Degree Centrality

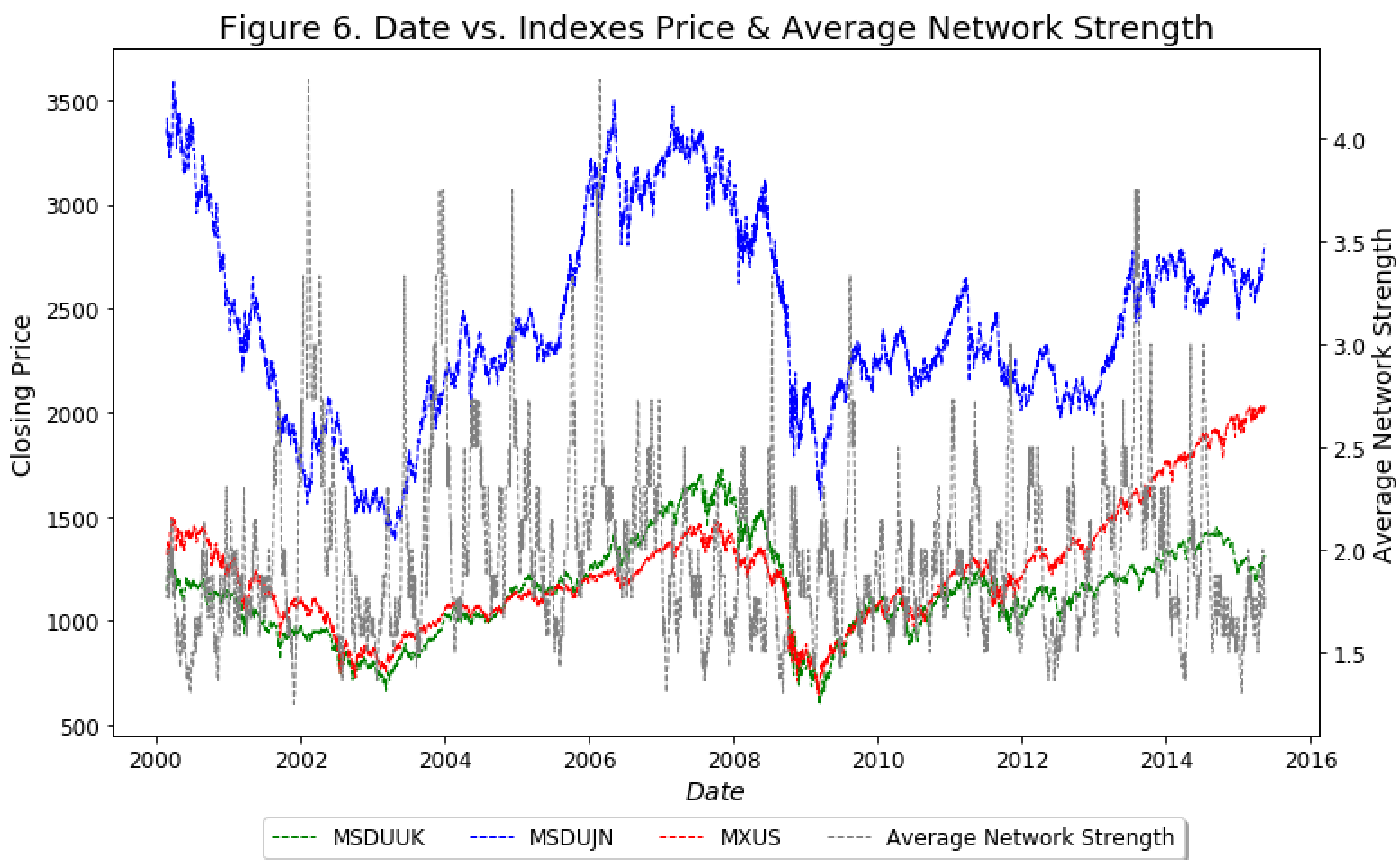
In [52]:
```
plotNetworkParameterVsStockIndexes(df = indixes_data_set2,
                                   network_parameter_column = "Ave_Deg_Centrality",
                                   network_parameter_column_name = "Average Degree Centrality",
                                   index1_colname = 'MSDUUK', index2_colname = 'MSDUJN', index3_colname = 'MX
US',
                                   Figure_Num = "5")
center_plot()
```



Out[52]:

Average Network Strength

In [53]:
```
print("\n")
plotNetworkParameterVsStockIndexes(df = indixes_data_set2,
                                   network_parameter_column = "Ave_Network_Strength",
                                   network_parameter_column_name = "Average Network Strength",
                                   index1_colname = 'MSDUUK', index2_colname = 'MSDUJN', index3_colname = 'MX
US',
                                   Figure_Num = "6")
center_plot()
```

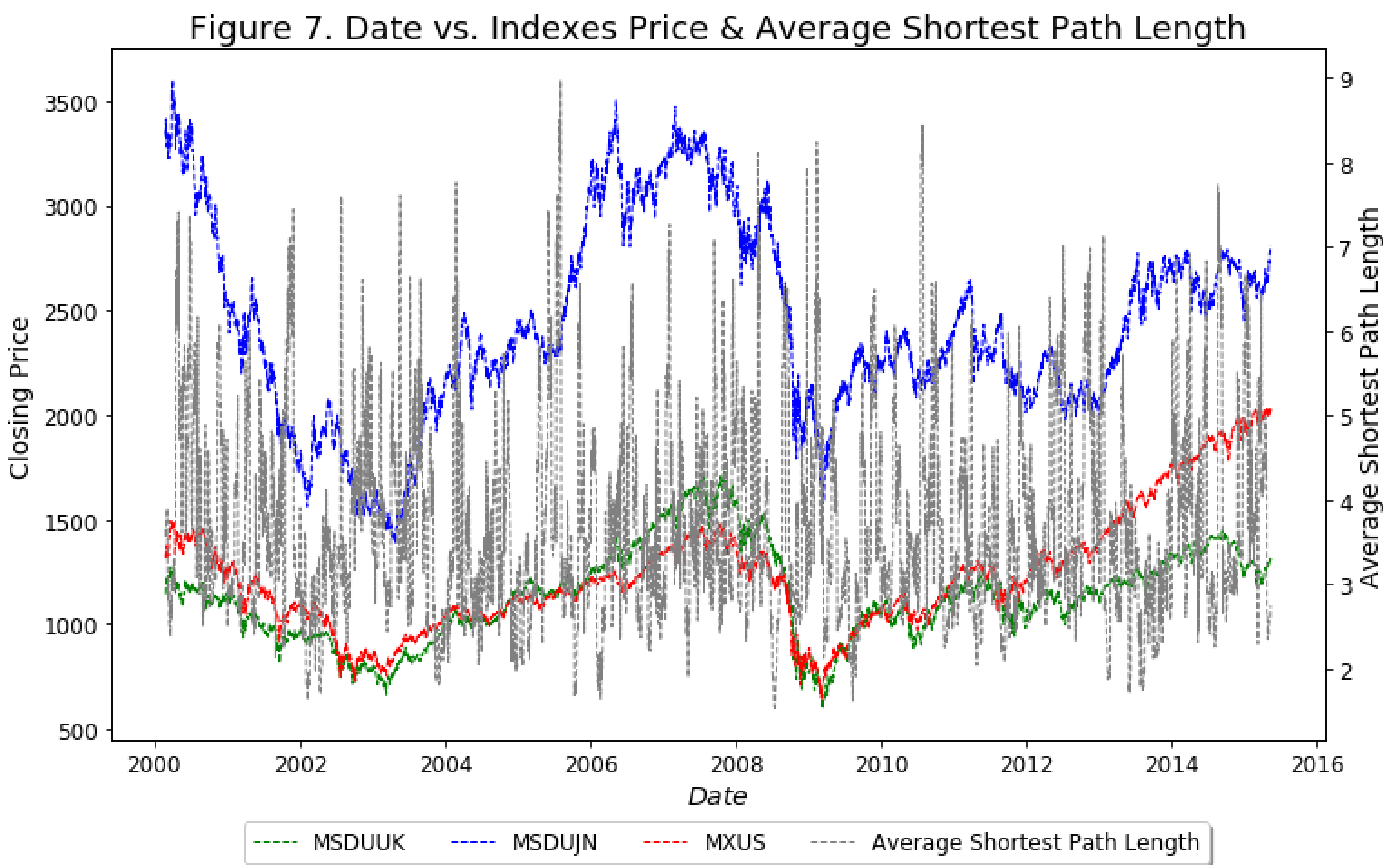


Out[53]:

Average Shortest Path Length

In [54]:

```
print("\n")
plotNetworkParameterVsStockIndexes(df = indixes_data_set2,
                                   network_parameter_column = "Ave_Shortest_PathLen",
                                   network_parameter_column_name = "Average Shortest Path Length",
                                   index1_colname = 'MSDUUK', index2_colname = 'MSDUJN', index3_colname = 'MX
US',
                                   Figure_Num = "7")
center_plot()
```

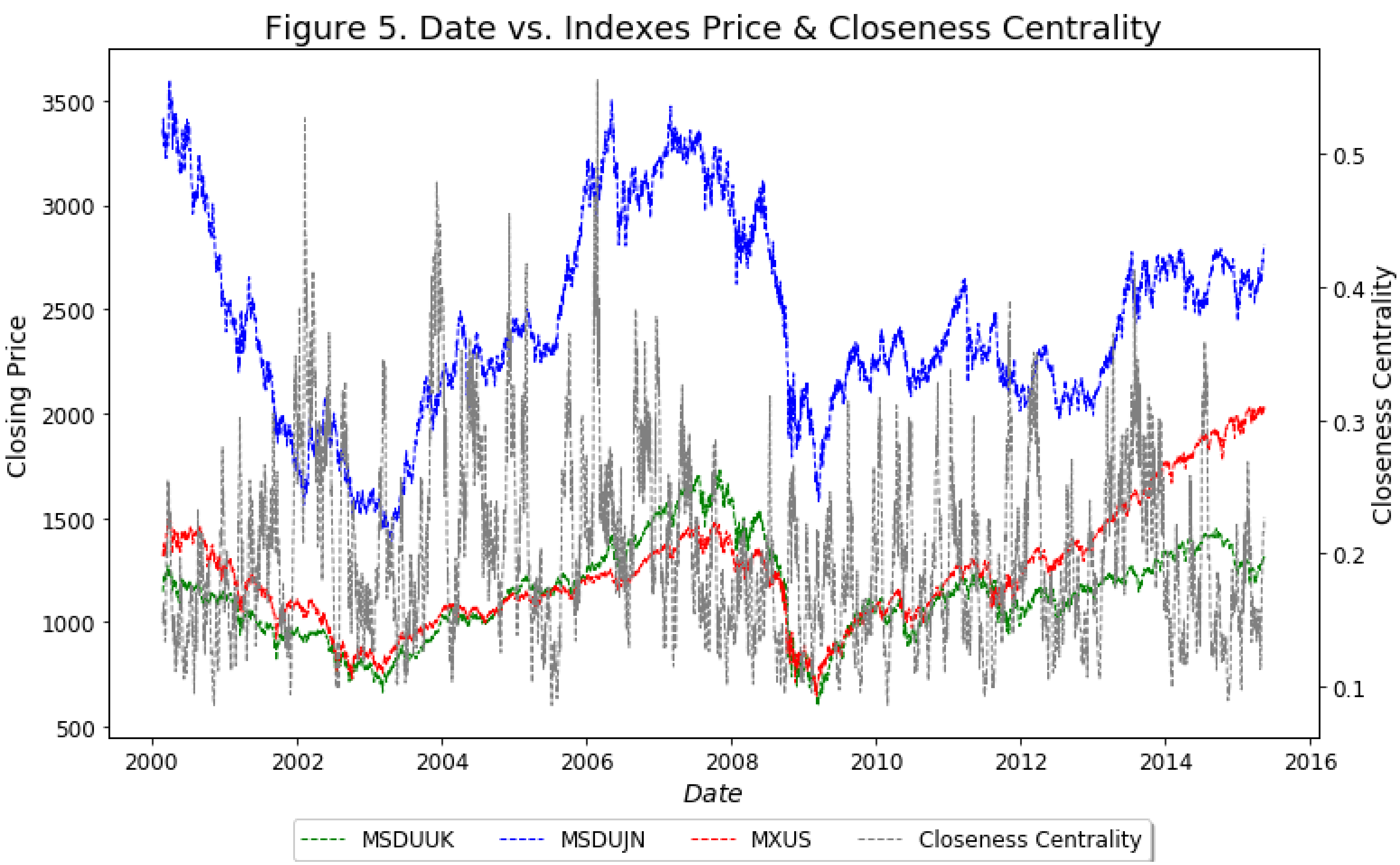


Out[54]:

Closeness Centrality

In [55]:

```
print("\n")
plotNetworkParameterVsStockIndexes(df = indixes_data_set2,
                                   network_parameter_column = "Closenes_Centrality",
                                   network_parameter_column_name = "Closeness Centrality",
                                   index1_colname = 'MSDUUK', index2_colname = 'MSDUJN', index3_colname = 'MX
US',
                                   Figure_Num = "5")
center_plot()
```



Out[55]:

6.3 Next-Day Stock Pattern Prediction Using Machine Learning Algorithms

6.3.1 Create Labels for ML Algorithms

- Per **section 4.3** of the white paper "*KNN and SVM algorithms are used to predict the next-day patterns of each stock index when the combination patterns of the three stock indexes and the corresponding 30-day network topological characteristics for the current day are known.*"
- Three binary labels will be created for classification, one for each index per dataset
- The binary labels for each index will have the following naming convention, and the value derived as follows:
  - label_IndexName = 0 or 1
    - If the daily return for the day is < 0, then then the stock index label is set to **0**
    - If the daily return for the day is >= 0, then then the stock index label is set to **1**
- Three multi-labels columns will be created for classification, one for each index per dataset
- The multi labels for each index will have the following naming convention, and the value derived as follows:
  - f_label_IndexName = One of { S1, S2, S3, S4 }
    - This is the index classificaition for the following day

```
In [56]: # returns two sets of labels for each day:
         #   label_Index    = [1,0]          ( 1 = next day's return is positive, 0 = next day's return is nega
         tive)
         #   label_f_Index = [S1,S2,S3,S4]  ( The index's network mode for the next day, this indicates the
         #                                   predicted behavior from the network topology parameters)

         def getStockIndexLabels(IndexName, df):

             stock_index_Name = IndexName
             r_stock_index_col_name = "r_" + stock_index_Name
             f_stock_index_col_name = "f_" + stock_index_Name

             num_rows = df.shape[0]
             labels = np.empty( [df.shape[0], 1], dtype='uint8' )
             f_labels_index = np.empty( [df.shape[0], 1], dtype='<U2' )

             r       = df[r_stock_index_col_name].to_numpy()
             f_index = df[f_stock_index_col_name].to_numpy()

             for current_day in range(num_rows):

                 if (current_day + 1 < num_rows) :

                     if r[current_day+1] >= 0.00000 :
                         labels[current_day] = 1
                     else :
                         labels[current_day] = 0

                     f_labels_index[current_day] = f_index[current_day+1]

                 else :
                     # Last day, set the last day to the same value, no the following day
                     f_labels_index[current_day] = f_index[current_day]

                     if r[current_day] >= 0.00000 :
                         labels[current_day] = 1
                     else :
                         labels[current_day] = 0

             return labels, f_labels_index

         # *** Classify each stock Index
```

```
indixes_data_set1["label_Nasdaq"], indixes_data_set1["f_label_Nasdaq"]  = \
                                      getStockIndexLabels(IndexName = "Nasdaq", df = indixes_data_set
1)
indixes_data_set1["label_S&P_500"], indixes_data_set1["f_label_S&P_500"] = \
                                      getStockIndexLabels(IndexName = "S&P_500", df = indixes_data_se
t1)
indixes_data_set1["label_DJI"], indixes_data_set1["f_label_DJI"] = \
                                      getStockIndexLabels(IndexName = "DJI", df = indixes_data_set1)


indixes_data_set2["label_MXUS"], indixes_data_set2["f_label_MXUS"]   = \
                                      getStockIndexLabels(IndexName = "MXUS", df = indixes_data_set2)
indixes_data_set2["label_MSDUUK"], indixes_data_set2["f_label_MSDUUK"] = \
                                      getStockIndexLabels(IndexName = "MSDUUK", df = indixes_data_set
2)
indixes_data_set2["label_MSDUJN"], indixes_data_set2["f_label_MSDUJN"] = \
                                      getStockIndexLabels(IndexName = "MSDUJN", df = indixes_data_set
2)
```

In [57]:
```
indixes_data_set1[ ["Date", "f_Nasdaq", "f_label_Nasdaq", "f_S&P_500", "f_label_S&P_500",
                    "f_DJI", "f_label_DJI"]].head()
```

Out[57]:

	Date	f_Nasdaq	f_label_Nasdaq	f_S&P_500	f_label_S&P_500	f_DJI	f_label_DJI
40	2000-03-01	S2	S1	S2	S2	S4	S1
41	2000-03-02	S1	S1	S2	S2	S1	S2
42	2000-03-03	S1	S1	S2	S2	S2	S2
43	2000-03-06	S1	S2	S2	S3	S2	S4
44	2000-03-07	S2	S2	S3	S3	S4	S4

In [58]:
```
indixes_data_set2[ ["Date", "f_MXUS", "f_label_MXUS", "f_MSDUUK", "f_label_MSDUUK",
                    "f_MSDUJN", "f_label_MSDUJN"]].head()
```

Out[58]:

	Date	f_MXUS	f_label_MXUS	f_MSDUUK	f_label_MSDUUK	f_MSDUJN	f_label_MSDUJN
40	2000-02-28	S2	S2	S1	S1	S2	S2
41	2000-02-29	S2	S2	S1	S1	S2	S2
42	2000-03-01	S2	S2	S1	S1	S2	S1
43	2000-03-02	S2	S2	S1	S1	S1	S1
44	2000-03-03	S2	S1	S1	S2	S1	S4

In [59]:
```
indixes_data_set1[ ["Date", "r_Nasdaq", "label_Nasdaq", "r_S&P_500", "label_S&P_500", "r_DJI", "label
_DJI"]].head()
```

Out[59]:

	Date	r_Nasdaq	label_Nasdaq	r_S&P_500	label_S&P_500	r_DJI	label_DJI
40	2000-03-01	0.018436	0	0.009302	1	0.000949	1
41	2000-03-02	-0.006200	1	0.001862	1	0.002659	1
42	2000-03-03	0.033155	0	0.019643	0	0.019704	0
43	2000-03-06	-0.002025	0	-0.012777	0	-0.019155	0
44	2000-03-07	-0.011691	1	-0.025965	1	-0.037514	1

In [60]:
```
indixes_data_set2[ ["Date", "r_MXUS", "label_MXUS", "r_MSDUUK", "label_MSDUUK", \
                    "r_MSDUJN", "label_MSDUJN"]].head()
```

Out[60]:

	Date	r_MXUS	label_MXUS	r_MSDUUK	label_MSDUUK	r_MSDUJN	label_MSDUJN
40	2000-02-28	0.011189	1	-0.019126	1	0.011675	0
41	2000-02-29	0.013950	1	0.015496	1	-0.009707	1
42	2000-03-01	0.007480	1	0.022989	1	0.025828	0
43	2000-03-02	0.005042	1	0.007229	1	-0.005643	0
44	2000-03-03	0.019126	0	0.011745	1	-0.013166	0

6.3.2 Create Training & Test Sets

Dataset 1

Split

- The training and testing sets are created according to the same time periods define in section 4.3 of the white paper
- Section 4.3 : *Based on the theory of cross-validation [42], and in order to keep the year intact and ensure the continuity of the years, we used the closing prices of the S&P 500, NASDAQ, and DJIA from 1 January 2000 to 31 December 2014 as the training sample data set. The testing sample data set used the closing prices of the three indices from 1 January 2015 to 31 December 2017.*

In [61]:
```
indixes_data_training_set_1 = \
        indixes_data_set1[ indixes_data_set1['Date'].dt.strftime('%Y-%m-%d') < '2015-01-01'].dropna()
indixes_data_testing_set_1 = \
        indixes_data_set1[ indixes_data_set1['Date'].dt.strftime('%Y-%m-%d') >= '2015-01-01']
indixes_data_testing_set_1 = \
      indixes_data_testing_set_1[ indixes_data_testing_set_1['Date'].dt.strftime('%Y-%m-%d') < '2018-
01-01']

print("Length of training set = ", len(indixes_data_training_set_1) )
print("Length of testing set = ", len(indixes_data_testing_set_1) )
print(np.unique( indixes_data_training_set_1['f_label_Nasdaq'], return_counts = True))
print(np.unique( indixes_data_training_set_1['f_label_DJI'], return_counts = True))
print(np.unique( indixes_data_training_set_1['f_label_S&P_500'], return_counts = True))
```

```
Length of training set =  3733
Length of testing set =  755
(array(['S1', 'S2', 'S3', 'S4'], dtype=object), array([1708,  328,  255, 1442]))
(array(['S1', 'S2', 'S3', 'S4'], dtype=object), array([ 338, 1754, 1367,  274]))
(array(['S1', 'S2', 'S3', 'S4'], dtype=object), array([ 559, 1488, 1178,  508]))
```

In [62]:
```
indixes_data_training_set_1.head()
```

Out[62]:

	Date	S&P_500	Nasdaq	DJI	r_Nasdaq	R_Nasdaq	V_Nasdaq	V_Ave_Nasdaq	r_S&P_500	R_S&P_500	...	Ave_Deg_Centrality
40	2000-03-01	1379.19	4784.08	10137.93	0.018436	0.050094	0.030678	0.046648	0.009302	0.013504	...	0.291667
41	2000-03-02	1381.76	4754.51	10164.92	-0.006200	0.029208	0.033670	0.041145	0.001862	0.020716	...	0.233333
42	2000-03-03	1409.17	4914.79	10367.20	0.033155	0.068260	0.038893	0.037444	0.019643	0.055299	...	0.190909
43	2000-03-06	1391.28	4904.85	10170.51	-0.002025	0.068995	0.038511	0.036634	-0.012777	0.031565	...	0.190909
44	2000-03-07	1355.62	4847.84	9796.04	-0.011691	0.031675	0.042097	0.036770	-0.025965	-0.007935	...	0.190909

5 rows × 31 columns

Dataset 2

Split

- The training and testing sets are created to be different than dataset 1 to test the methodology with different indexes and different time periods

In [63]:
```
indixes_data_training_set_2 = \
     indixes_data_set2[ ( indixes_data_set2['Date'].dt.strftime('%Y-%m-%d') >= '2002-01-01' ) & \
                        ( indixes_data_set2['Date'].dt.strftime('%Y-%m-%d') < '2013-01-01'  ) ].dropn
a()

indixes_data_testing_set_2 = \
     indixes_data_set2[ indixes_data_set2['Date'].dt.strftime('%Y-%m-%d') >= '2013-01-01'].dropna()

print("Length of training set = ", len(indixes_data_training_set_2) )
print("Length of testing set = ", len(indixes_data_testing_set_2) )
```

```
Length of training set =  2835
Length of testing set =  596
```

6.3.3 Re-usable Functions to Create and Execute Different Experiments

In [64]:
```python
from sklearn.preprocessing import StandardScaler, OneHotEncoder, MinMaxScaler, LabelEncoder
from sklearn.linear_model import SGDClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC
from sklearn.neighbors import KNeighborsClassifier
from sklearn.cluster import KMeans

from sklearn.model_selection import TimeSeriesSplit
from sklearn.metrics import precision_score, recall_score
from sklearn.model_selection import cross_val_predict
from sklearn.metrics import confusion_matrix

import warnings
warnings.filterwarnings('ignore')

# ***
# *** Function to create experiment datasets (X, y_binary_label, y_multi_lable)
# ***

def createExperimentDatasets (dataset, x_features_names, y_label_name, y_ml_label_name ) :

    X_train    = dataset[x_features_names]
    y_train    = dataset[y_label_name]
    y_train_ml = dataset[y_ml_label_name]

    X_train    = X_train.to_numpy()
    y_train    = y_train.to_numpy()
    y_train_ml = y_train_ml.to_numpy()

    #y_train.shape=(y_train.shape[0], 1)
    #y_test.shape=(y_test.shape[0],1)

    y_train_ml = y_train_ml.astype('<U2')

    return X_train, y_train, y_train_ml

# *** test function: createExperimentDatasets

x_features_names = ["Ave_Deg_Centrality", "Ave_Network_Strength", "Ave_Shortest_PathLen",
                    "Closenes_Centrality", "r_S&P_500", "R_S&P_500", "V_S&P_500" ]
y_label_name     = ["label_S&P_500"]
y_ml_label_name  = ["f_label_S&P_500"]
```

```
X_train, y_train, y_train_ml = \
      createExperimentDatasets(dataset = indixes_data_training_set_1,
                               x_features_names = x_features_names, y_label_name = y_label_name,
                               y_ml_label_name = y_ml_label_name)

# ***
# *** Function to transform experiment datasets
# ***

def transfromExperimentDatasets (X_train, y_train, y_train_ml) :

    scaler = MinMaxScaler()
    std_scaler = StandardScaler()
    str_encoder = LabelEncoder()

    X_train = std_scaler.fit_transform(X_train)
    y_train_ml = str_encoder.fit_transform(y_train_ml)
    y_train = y_train.reshape(-1,1)
    y_train_ml = y_train_ml.reshape(-1,1)

    return X_train, y_train, y_train_ml

# *** test function: transfromExperimentDatasets

X_train, y_train, y_train_ml = transfromExperimentDatasets (X_train, y_train, y_train_ml)

# ***
# *** This function takes a Confusion Matrix that is 4 x 4, and reduces it to a 2 x 2
# *** Combines S1 and S2 together, and S3 and S4 together
# ***

def calculateCombineClassificationsMeasures( confusion_matrix_4_by_4, print_results = False) :
    cm_ml = confusion_matrix_4_by_4
    s1_s2_q1 = cm_ml[0,0] + cm_ml[0,1] + cm_ml[1,0] + cm_ml[1,1]
    s3_s4_q3 = cm_ml[2,0] + cm_ml[3,0] + cm_ml[2,1] + cm_ml[3,1]
    s1_s2_q2 = cm_ml[0,2] + cm_ml[0,3] + cm_ml[1,2] + cm_ml[1,3]
    s3_s4_q4 = cm_ml[2,2] + cm_ml[2,3] + cm_ml[3,2] + cm_ml[3,3]
    compacted_confusion_matrix = np.array ( [s1_s2_q1, s1_s2_q2, s3_s4_q3, s3_s4_q4 ] )
    compacted_confusion_matrix = compacted_confusion_matrix.reshape(2,2)

    accuracy = ( (s1_s2_q1 + s3_s4_q4)/(s1_s2_q1 + s3_s4_q3 + s1_s2_q2 + s3_s4_q4 ) )
    precision = ( s3_s4_q4/( s3_s4_q4 + s1_s2_q2) )
```

```python
    recall = ( s3_s4_q4/( s3_s4_q4 + s3_s4_q3) )

    if print_results == True :
        print("\nCompacted CM: \n", compacted_confusion_matrix)
        print("S1S2 & S3S4 Accuracy  = ", accuracy )
        print("S1S2 & S3S4 Precision = ", precision )
        print("S1S2 & S3S4 Recall.   = ", recall )

    return compacted_confusion_matrix, accuracy, precision, recall

# ***
# *** Execute an experiment
# ***
# ***     Returns:  dataframe_results, dataframe_exp_details, confusion_matrix_for_binary_label
# ***               confusion_matrix_for_multi_label, confusion_matrix_for_combine_multi_label

def executeExperiment(model_clf, experiment_name, index_name, dataset_name,
                      dataset,
                      x_features_names, y_label_name, y_ml_label_name,
                      cv = 10, print_results = True, description = "") :

    # *** Create specific set of features for the experiment

    X_train, y_train, y_train_ml = createExperimentDatasets(dataset, x_features_names,
                                                            y_label_name, y_ml_label_name)

    # *** Transform features for the experiment

    X_train, y_train, y_train_ml = transfromExperimentDatasets (X_train, y_train, y_train_ml)

    # *** Cross Validate Analysis on Binary Label

    y_train_predict = cross_val_predict(model_clf, X_train, y_train, cv=cv, n_jobs = -1)
    cm = confusion_matrix(y_train, y_train_predict)

    if model_clf.__class__.__name__ != "KMeans"  :
        precision_score_bl = precision_score(y_train, y_train_predict)
        recall_score_bl    = recall_score(y_train, y_train_predict)
        accuracy_score_bl  = accuracy_score(y_train, y_train_predict)
    else :
        precision_score_bl = precision_score(y_train, y_train_predict, average="weighted")
        recall_score_bl    = recall_score(y_train, y_train_predict, average="weighted")
        accuracy_score_bl  = accuracy_score(y_train, y_train_predict)
```

```python
# Cross Validate Analysis Multi_Label

y_train_predict_ml = cross_val_predict(model_clf, X_train, y_train_ml, cv=cv, n_jobs = -1)
cm_ml = confusion_matrix(y_train_ml, y_train_predict_ml)
precision_score_ml = precision_score(y_train_ml, y_train_predict_ml, average="weighted")
recall_score_ml    = recall_score(y_train_ml, y_train_predict_ml, average="weighted")
accuracy_score_ml  = accuracy_score(y_train_ml, y_train_predict_ml)

# Compact ML results ( that is:  S1S2 & S3S4)
cm_ml_compact, accuracy_cp, precision_cp, recall_cp = \
                         calculateCombineClassificationsMeasures(cm_ml, print_results = False )

if print_results == True :
    print("*********** Results for Estimator: ", model_clf.__class__.__name__)

    print("\n\t*** Binary Label [0,1] Cross Validation Analysis Summary")
    print("\t\tConfusion Matrix: \n", cm)
    print("\t\tPrecision score: ", precision_score_bl )
    print("\t\tRecall score: ", recall_score_bl )
    print("\t\tAccuracy score: ", accuracy_score_bl )

    print("\n\t*** Multi Label [S1,S2,S3,S4] Cross Validation Analysis Summary")
    print("\t\tConfusion Matrix: \n", cm_ml)
    print("\t\tPrecision score: ", precision_score_ml )
    print("\t\tRecall score: ",  recall_score_ml)
    print("\t\tAccuracy score: ", accuracy_score_ml )

    print("\n\t*** Compacted Multi Label [S1S2, S3S4] Analysis Summary")
    print("\t\tConfusion Matrix: \n", cm_ml_compact)
    print("\t\tPrecision score: ", precision_cp )
    print("\t\tRecall score: ",  recall_cp)
    print("\t\tAccuracy score: ", accuracy_cp )

# Save results to a Data Frame

data = { 'Experiment Name' : [experiment_name],
         'Experiment Description' : [description],
         'Dataset' : [dataset_name],
         'Index' : [ index_name ],
         'Classifier' : [model_clf.__class__.__name__],
         'CV' : [cv],
         'BL_Precision' : [precision_score_bl], 'BL_Recall' : [recall_score_bl],
```

```
            'BL_Accuracy' : [accuracy_score_bl],
            'ML_Precision' : [precision_score_ml], 'ML_Recall' : [recall_score_ml],
            'ML_Accuracy' : [accuracy_score_ml],
            'Combine_ML_Precision' : [precision_cp], 'Combine_ML_Recall' : [recall_cp],
            'Combine_ML_Accuracy' : [accuracy_cp]
          }

    data_experiment_details = { 'Experiment Name' : [experiment_name],
                                'Description' : [description],
                                'Features' : [x_features_names],
                                'y_label_col' : [y_label_name],
                                'y_ml_label_col' : [y_ml_label_name]
                              }

    return pd.DataFrame(data), pd.DataFrame(data_experiment_details), cm, cm_ml, cm_ml_compact, model
_clf


# *** test function: executeExperiment

index_name = "S&P_500"
experiment_name = "Experiment 1"
dataset_name    = "US Market Indexes"
dataset = indixes_data_training_set_1

x_features_names = ["Ave_Deg_Centrality", "Ave_Network_Strength", "Ave_Shortest_PathLen",
                    "Closenes_Centrality", "r_" + index_name, "R_" + index_name, "V_" + index_name ]
y_label_name     = ["label_" + index_name]
y_ml_label_name  = ["f_label_" + index_name]

# *** SGD Classifier
results_df_1, results_df_exp_details, cm_1, cm_ml_1, cm_ml_compact_1, model_clf_fitted =\
      executeExperiment(model_clf = SGDClassifier(random_state=42), experiment_name = experiment_name
,
                        index_name = index_name, dataset_name = dataset_name,
                        dataset = dataset,
                        x_features_names = x_features_names, y_label_name = y_label_name,
                        y_ml_label_name = y_ml_label_name, cv = 10, print_results = False,
                        description = "some random experiment")
# ***
# *** Execute a set of experiments
# ***
# ***     The f() executes the same of permutations pass in the dictionary variable, experiments
```

```python
# ***         permutation variables for each experiments:
# ***             indexes, models, datasets
# ***     Returns:  dataframe_results, dataframe_result_details
# ***

def executeExperimentSet ( experiments ) :

    i = 1;
    results_df = pd.DataFrame()
    results_df_details = pd.DataFrame()
    models_dict = {}

    for experiment in experiments :
        for index_name in experiment.get("indexes") :

            # *** Update Parametized Parameters with index_name
            y_label_name = experiment.get("y_label_name").format(index_name)
            y_ml_label_name = experiment.get("y_ml_label_name").format(index_name)

            x_features_names = experiment.get("x_features_names")
            upd_x_features_names = []
            for feature_name in x_features_names :
                upd_x_features_names.append( feature_name.format(index_name) )

            #print("y_label_name : ", y_label_name, " y_ml_label_name : ", y_ml_label_name)
            #print("Orig x_features_names : ", experiment.get("x_features_names") )
            #print("Update x_features_names : ", upd_x_features_names)

            for model_clf in experiment.get("models") :
                print("Job #", i,
                      " \tExecuting Experiment = ", experiment.get("experiment_name"),
                      " Index_Name = ", index_name,
                      " ML Model = ", model_clf.__class__.__name__,
                      "\n\t\tDataset = ", experiment.get("dataset_name") )

                curr_results_df, curr_results_df_exp_details, cm_bl, cm_ml, cm_ml_compact, \
                model_clf_fitted = executeExperiment(model_clf = model_clf,
                                       experiment_name = experiment.get("experiment_name"),
                                       index_name = index_name,
                                       dataset_name = experiment.get("dataset_name"),
                                       dataset = experiment.get("dataset"),
                                       x_features_names = upd_x_features_names,
                                       y_label_name = y_label_name,
```

```
                                        y_ml_label_name = y_ml_label_name,
                                        cv = experiment.get("cv"),
                                        print_results = False,
                                        description = experiment.get("description"))

                    curr_results_df["Model_Params"] = str( model_clf.get_params() )
                    curr_results_df["Job_ID"] = i
                    results_df = results_df.append(curr_results_df)
                    results_df_details = results_df_details.append(curr_results_df_exp_details)
                    models_dict[i] = model_clf_fitted
                    i += 1

    return results_df, results_df_details, models_dict


def getBestClassifiersForEachIndex (results_df, metric = "Combine_ML_Accuracy") :
    results_df_reindex = results_df.reset_index(drop=True)
    idx = results_df_reindex. \
          groupby(['Classifier', 'Index'])[metric]. \
          transform(max) == results_df_reindex[metric]
    #print(results_df_reindex[idx] )
    #print("len after drop: " , len(  results_df_reindex[idx].drop_duplicates(subset = ['Index']) ) )
    return results_df_reindex[idx].drop_duplicates(subset = ['Index'])


def getOptimizedModelsDict (results_df, models_fitted, metric = "Combine_ML_Accuracy" ) :

    # *** Find best classifiers per Index
    optimum_models_metrics_df = getBestClassifiersForEachIndex(results_df, metric)

    # *** Create Each Model and Save in a Dictionary

    models_dict = {}
    nmodels = len(optimum_models_metrics_df)

    #classifier_name = optimum_models_metrics_knn_df["Classifier"].to_numpy()
    #index = optimum_models_metrics_knn_df["Index"].to_numpy()
    #model_params = optimum_models_metrics_knn_df["Model_Params"].to_numpy()
    #for n in range(nmodels) :
    #    #print("Loaded Params: \n", model_params[n])
    #    params = eval( model_params[n] )
    #    model_clf = eval(classifier_name[n])()
    #    model_clf.set_params( **params )
```

```python
    #   #print("Re-loaded from created model: \n", model_clf.get_params())
    #    models_dict[index[n]] = model_clf

    # Create dictionary of fitted models

    indexes = optimum_models_metrics_df["Index"].to_numpy()
    job_key = optimum_models_metrics_df["Job_ID"].to_numpy()

    for n in range(nmodels) :
        #print("Index : ", indexes[n], "Job = ", job_key[n] )
        models_dict[ indexes[n] ] = models_fitted[ job_key[n] ]

    # return fit models & summary of their metrics

    return models_dict, optimum_models_metrics_df


def executePrediction(model_clf,
                      FitModels,
                      prediction_name,
                      index_name,
                      dataset_name,
                      dataset,
                      x_features_names,
                      y_label_name,
                      y_ml_label_name,
                      print_results = False,
                      description = " " ) :

    # *** Create specific set of features for the experiment

    X_train, y_train, y_train_ml = createExperimentDatasets(dataset, x_features_names,
                                                            y_label_name, y_ml_label_name)
    # *** Transform features for the experiment

    X_train, y_train, y_train_ml = transfromExperimentDatasets (X_train, y_train, y_train_ml)

    # Predict Using Multi_Label
    if FitModels == True :
        model_clf.fit(X_train, y_train_ml)
    y_train_predict_ml = model_clf.predict(X_train)
    cm_ml              = confusion_matrix(y_train_ml, y_train_predict_ml)
    precision_score_ml = precision_score(y_train_ml, y_train_predict_ml, average="weighted")
```

```python
recall_score_ml    = recall_score(y_train_ml, y_train_predict_ml, average="weighted")
accuracy_score_ml  = accuracy_score(y_train_ml, y_train_predict_ml)

# Compact ML results ( that is:  S1S2 & S3S4)
cm_ml_compact, accuracy_cp, precision_cp, recall_cp = \
                         calculateCombineClassificationsMeasures(cm_ml, print_results = False )

# Save results to a Data Frame

data1 = { 'Classifier' : [model_clf.__class__.__name__],
          'Model'      : ["Combine ML"],
          'Metric'     : ["Accuracy"],
           index_name  : [ accuracy_cp ] }

data2 = { 'Classifier' : [model_clf.__class__.__name__],
          'Model'      : ["Combine ML"],
          'Metric'     : ["Precision"],
           index_name  : [ precision_cp ] }

data3 = { 'Classifier' : [model_clf.__class__.__name__],
          'Model'      : ["Combine ML"],
          'Metric'     : ["Recall"],
           index_name  : [ recall_cp ] }

data4 = { 'Classifier' : [model_clf.__class__.__name__],
          'Model'      : ["Multi Label"],
          'Metric'     : ["Accuracy"],
           index_name  : [ accuracy_score_ml ] }

data5 = { 'Classifier' : [model_clf.__class__.__name__],
          'Model'      : ["Multi Label"],
          'Metric'     : ["Precision"],
           index_name  : [ precision_score_ml ] }

data6 = { 'Classifier' : [model_clf.__class__.__name__],
          'Model'      : ["Multi Label"],
          'Metric'     : ["Recall"],
           index_name  : [ recall_score_ml ] }

results_df  = pd.DataFrame(data1)
results_df = results_df.append(  pd.DataFrame(data2) )
results_df = results_df.append( pd.DataFrame(data3) )
results_df = results_df.append( pd.DataFrame(data4) )
```

```python
    results_df = results_df.append( pd.DataFrame(data5) )
    results_df = results_df.append( pd.DataFrame(data6) )

    return results_df, model_clf, cm_ml, cm_ml_compact


def executePredictionsSet ( predictions, FitModels ) :

    results_df = pd.DataFrame()
    models_dict = {}
    cm_ml_dict = {}
    cm_ml_compact_dict = {}

    job = 0
    for prediction in predictions :

        n = 0
        for index_name in prediction.get("indexes")  :

            # *** Get model corresponding to the Index, Critical this is aligned!
            # *** Each index has his optimized model for a given classifier

            model_clf = prediction.get("models")[n]

            # *** Update Parametized Parameters with index_name
            y_label_name = prediction.get("y_label_name").format(index_name)
            y_ml_label_name = prediction.get("y_ml_label_name").format(index_name)

            x_features_names = prediction.get("x_features_names")
            upd_x_features_names = []

            for feature_name in x_features_names :
                upd_x_features_names.append( feature_name.format(index_name) )

            curr_results_df, model_clf_return, cm_ml, cm_ml_compact = \
                     executePrediction(model_clf = model_clf,
                                       FitModels = FitModels,
                                       prediction_name = prediction.get("prediction_name"),
                                       index_name = index_name,
                                       dataset_name = prediction.get("dataset_name"),
                                       dataset = prediction.get("dataset"),
                                       x_features_names = upd_x_features_names,
                                       y_label_name = y_label_name,
```

```
                                        y_ml_label_name = y_ml_label_name,
                                        print_results = False,
                                        description = prediction.get("description"))
            if job == 0 :
                results_df = results_df.append(curr_results_df)
            else :
                results_df[index_name] = curr_results_df[index_name].to_numpy()

            # Save Model, Confusion Matrix for ML, Confusion Matrix Combine ML in a dictionary
            # dict key = {classifier_name}_{index_name}
            models_dict[model_clf_return.__class__.__name__ + index_name ] = model_clf_return
            cm_ml_dict[model_clf_return.__class__.__name__ + index_name ] = cm_ml
            cm_ml_compact_dict[model_clf_return.__class__.__name__ + index_name ] = cm_ml_compact

            n += 1
            job += 1

    return results_df, models_dict, cm_ml_dict, cm_ml_compact_dict
```

6.3.4 Initial Exploratiory Modeling for Analysis

6.3.4.1 Execute Experiments against Several Machine Learning Models, Datasets, Features' Set

- **Description of Experiments**
  - Each experiment consists of:
    - Evaluating a set of features against a set of models, classifiers, two distinct datasets with different time periods, and three different stock indexes per training dataset.
    - Run five different classifiers: SGD, SVC, KNN, Random Forest
    - Classification analysis against two distinct labels:
      - Binary Label: [0,1], 0 = Next Day Closing Price will be lower, 1 = Next Day Price will be higher
      - Multi Label: [S1, S2, S3, S4], These labels are indications of the magnitude of price changes, either up or down. S1 & S2 are associated with a next day higher closing price, and S3 & S4 with next day lower price.
    - Cross validation analysis:
      - Apply each classifier against a Binary Label for predicting price change using a ten-fold cross validation against entire dataset
      - Apply each classifier against a Multi Label for predicting price movement using a ten-fold cross validation against entire dataset
    - Derive Combine results of Multi Label Analysis, merging S1 & S2 labels, and S3 & S4 labels
  - Experiment 1:
    - Purpose: Evaluate all Network Derived Features & all Financial Index Measures
    - Evaluate three different market indexes: S&P 500, Nasdaq, DJI
  - Experiment 2:
    - Purpose: Evaluate Only Network Features
    - Evaluate three different market indexes: S&P 500, Nasdaq, DJI
  - Experiment 3:
    - Purpose: Evaluate Only Financial Index Features
    - Evaluate three different market indexes: S&P 500, Nasdaq, DJI
  - Experiment 4:
    - Purpose: Evaluate all Network Derived Features & all Financial Index Measures
    - Evaluate three different market indexes: MXUS, MSDUUK, MSDUJN
  - Experiment 5:
    - Purpose: Evaluate Only Network Features
    - Evaluate three different market indexes: MXUS, MSDUUK, MSDUJN
  - Experiment 6:
    - Purpose: Evaluate Only Financial Index Features
    - Evaluate three different market indexes: MXUS, MSDUUK, MSDUJN

```
In [109]: models = [ SGDClassifier(random_state=42), SVC(random_state=42, kernel="rbf"), KNeighborsClassifier(n
_jobs=-1),
           RandomForestClassifier(n_jobs=-1, random_state=42, max_depth = 40, oob_score = True) ]


experiment_1 = { 'experiment_name'  : "Experiment 1",
                 'description'      : "Evaluate all Network Features & all Financial Index Measures",
                 #'indexes'           : ["S&P_500" ],
                 'indexes'          : ["S&P_500", "Nasdaq", "DJI"],
                 'dataset_name'     : "US Market Indexes",
                 'x_features_names' : ["Ave_Deg_Centrality", "Ave_Network_Strength", "Ave_Shortest_Pa
thLen",
                                        "Closenes_Centrality", "r_{}", "R_{}",
                                        "V_{}" ] ,
                 'y_label_name'     : "label_{}",
                 'y_ml_label_name'  : "f_label_{}",
                 'cv'               : 10,
                 'models'           : models,
                 'dataset'          : indixes_data_training_set_1 }

experiment_2 = { 'experiment_name'  : "Experiment 2",
                 'description'      : "Evaluate Only Network Features",
                 'indexes'          : ["S&P_500", "Nasdaq", "DJI"],
                 'dataset_name'     : "US Market Indexes",
                 'x_features_names' : ["Ave_Deg_Centrality", "Ave_Network_Strength", "Ave_Shortest_Pa
thLen",
                                        "Closenes_Centrality" ] ,
                 'y_label_name'     : "label_{}",
                 'y_ml_label_name'  : "f_label_{}",
                 'cv'               : 10,
                 'models'           : models,
                 'dataset'          : indixes_data_training_set_1 }

experiment_3 = { 'experiment_name'  : "Experiment 3",
                 'description'      : "Evaluate Only Financial Index Features",
                 'indexes'          : ["S&P_500", "Nasdaq", "DJI"],
                 'dataset_name'     : "US Market Indexes",
                 'x_features_names' : [ "r_{}", "R_{}", "V_{}" ] ,
                 'y_label_name'     : "label_{}",
                 'y_ml_label_name'  : "f_label_{}",
                 'cv'               : 10,
                 'models'           : models,
```

```
                 'dataset'          : indixes_data_training_set_1 }

experiment_4 = { 'experiment_name'  : "Experiment 4",
                 'description'      : "Evaluate all Network Features & all Financial Index Measures",
                 'indexes'          : ["MXUS", "MSDUUK", "MSDUJN"],
                 'dataset_name'     : "MSUS-MSDUUK-MSDUJN Market Indexes",
                 'x_features_names' : ["Ave_Deg_Centrality", "Ave_Network_Strength", "Ave_Shortest_Pa
thLen",
                                          "Closenes_Centrality", "r_{}", "R_{}",
                                          "V_{}" ] ,
                 'y_label_name'     : "label_{}",
                 'y_ml_label_name'  : "f_label_{}",
                 'cv'               : 10,
                 'models'           : models,
                 'dataset'          : indixes_data_training_set_2 }

experiment_5 = { 'experiment_name'  : "Experiment 5",
                 'description'      : "Evaluate Only Network Features",
                 'indexes'          : ["MXUS", "MSDUUK", "MSDUJN"],
                 'dataset_name'     : "MSUS-MSDUUK-MSDUJN Market Indexes",
                 'x_features_names' : ["Ave_Deg_Centrality", "Ave_Network_Strength", "Ave_Shortest_Pa
thLen",
                                          "Closenes_Centrality" ] ,
                 'y_label_name'     : "label_{}",
                 'y_ml_label_name'  : "f_label_{}",
                 'cv'               : 10,
                 'models'           : models,
                 'dataset'          : indixes_data_training_set_2 }

experiment_6 = { 'experiment_name'  : "Experiment 6",
                 'description'      : "Evaluate Only Financial Index Features",
                 'indexes'          : ["MXUS", "MSDUUK", "MSDUJN"],
                 'dataset_name'     : "MSUS-MSDUUK-MSDUJN Market Indexes",
                 'x_features_names' : [ "r_{}", "R_{}", "V_{}" ] ,
                 'y_label_name'     : "label_{}",
                 'y_ml_label_name'  : "f_label_{}",
                 'cv'               : 10,
                 'models'           : models,
                 'dataset'          : indixes_data_training_set_2 }

results_df, results_df_details, models_fitted_dict = \
                 executeExperimentSet ( experiments = [experiment_1, experiment_2,
```

```
experiment_3, experiment_4,
experiment_5, experiment_6] )
```

```
Job # 1         Executing Experiment =  Experiment 1  Index_Name =  S&P_500  ML Model =  SGDClassifi
er
                Dataset =  US Market Indexes
Job # 2         Executing Experiment =  Experiment 1  Index_Name =  S&P_500  ML Model =  SVC
                Dataset =  US Market Indexes
Job # 3         Executing Experiment =  Experiment 1  Index_Name =  S&P_500  ML Model =  KNeighborsC
lassifier
                Dataset =  US Market Indexes
Job # 4         Executing Experiment =  Experiment 1  Index_Name =  S&P_500  ML Model =  RandomFores
tClassifier
                Dataset =  US Market Indexes
Job # 5         Executing Experiment =  Experiment 1  Index_Name =  Nasdaq  ML Model =  SGDClassifie
r
                Dataset =  US Market Indexes
Job # 6         Executing Experiment =  Experiment 1  Index_Name =  Nasdaq  ML Model =  SVC
                Dataset =  US Market Indexes
Job # 7         Executing Experiment =  Experiment 1  Index_Name =  Nasdaq  ML Model =  KNeighborsCl
assifier
                Dataset =  US Market Indexes
Job # 8         Executing Experiment =  Experiment 1  Index_Name =  Nasdaq  ML Model =  RandomForest
Classifier
                Dataset =  US Market Indexes
Job # 9         Executing Experiment =  Experiment 1  Index_Name =  DJI  ML Model =  SGDClassifier
                Dataset =  US Market Indexes
Job # 10        Executing Experiment =  Experiment 1  Index_Name =  DJI  ML Model =  SVC
                Dataset =  US Market Indexes
Job # 11        Executing Experiment =  Experiment 1  Index_Name =  DJI  ML Model =  KNeighborsClass
ifier
                Dataset =  US Market Indexes
Job # 12        Executing Experiment =  Experiment 1  Index_Name =  DJI  ML Model =  RandomForestCla
ssifier
                Dataset =  US Market Indexes
Job # 13        Executing Experiment =  Experiment 2  Index_Name =  S&P_500  ML Model =  SGDClassifi
er
                Dataset =  US Market Indexes
Job # 14        Executing Experiment =  Experiment 2  Index_Name =  S&P_500  ML Model =  SVC
                Dataset =  US Market Indexes
Job # 15        Executing Experiment =  Experiment 2  Index_Name =  S&P_500  ML Model =  KNeighborsC
lassifier
                Dataset =  US Market Indexes
Job # 16        Executing Experiment =  Experiment 2  Index_Name =  S&P_500  ML Model =  RandomFores
tClassifier
                Dataset =  US Market Indexes
```

```
Job # 17        Executing Experiment =  Experiment 2  Index_Name =  Nasdaq  ML Model =  SGDClassifie
r
                Dataset =  US Market Indexes
Job # 18        Executing Experiment =  Experiment 2  Index_Name =  Nasdaq  ML Model =  SVC
                Dataset =  US Market Indexes
Job # 19        Executing Experiment =  Experiment 2  Index_Name =  Nasdaq  ML Model =  KNeighborsCl
assifier
                Dataset =  US Market Indexes
Job # 20        Executing Experiment =  Experiment 2  Index_Name =  Nasdaq  ML Model =  RandomForest
Classifier
                Dataset =  US Market Indexes
Job # 21        Executing Experiment =  Experiment 2  Index_Name =  DJI  ML Model =  SGDClassifier
                Dataset =  US Market Indexes
Job # 22        Executing Experiment =  Experiment 2  Index_Name =  DJI  ML Model =  SVC
                Dataset =  US Market Indexes
Job # 23        Executing Experiment =  Experiment 2  Index_Name =  DJI  ML Model =  KNeighborsClass
ifier
                Dataset =  US Market Indexes
Job # 24        Executing Experiment =  Experiment 2  Index_Name =  DJI  ML Model =  RandomForestCla
ssifier
                Dataset =  US Market Indexes
Job # 25        Executing Experiment =  Experiment 3  Index_Name =  S&P_500  ML Model =  SGDClassifi
er
                Dataset =  US Market Indexes
Job # 26        Executing Experiment =  Experiment 3  Index_Name =  S&P_500  ML Model =  SVC
                Dataset =  US Market Indexes
Job # 27        Executing Experiment =  Experiment 3  Index_Name =  S&P_500  ML Model =  KNeighborsC
lassifier
                Dataset =  US Market Indexes
Job # 28        Executing Experiment =  Experiment 3  Index_Name =  S&P_500  ML Model =  RandomFores
tClassifier
                Dataset =  US Market Indexes
Job # 29        Executing Experiment =  Experiment 3  Index_Name =  Nasdaq  ML Model =  SGDClassifie
r
                Dataset =  US Market Indexes
Job # 30        Executing Experiment =  Experiment 3  Index_Name =  Nasdaq  ML Model =  SVC
                Dataset =  US Market Indexes
Job # 31        Executing Experiment =  Experiment 3  Index_Name =  Nasdaq  ML Model =  KNeighborsCl
assifier
                Dataset =  US Market Indexes
Job # 32        Executing Experiment =  Experiment 3  Index_Name =  Nasdaq  ML Model =  RandomForest
Classifier
                Dataset =  US Market Indexes
```

```
Job # 33        Executing Experiment =  Experiment 3  Index_Name =  DJI  ML Model =  SGDClassifier
                Dataset =  US Market Indexes
Job # 34        Executing Experiment =  Experiment 3  Index_Name =  DJI  ML Model =  SVC
                Dataset =  US Market Indexes
Job # 35        Executing Experiment =  Experiment 3  Index_Name =  DJI  ML Model =  KNeighborsClass
ifier
                Dataset =  US Market Indexes
Job # 36        Executing Experiment =  Experiment 3  Index_Name =  DJI  ML Model =  RandomForestCla
ssifier
                Dataset =  US Market Indexes
Job # 37        Executing Experiment =  Experiment 4  Index_Name =  MXUS  ML Model =  SGDClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 38        Executing Experiment =  Experiment 4  Index_Name =  MXUS  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 39        Executing Experiment =  Experiment 4  Index_Name =  MXUS  ML Model =  KNeighborsClas
sifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 40        Executing Experiment =  Experiment 4  Index_Name =  MXUS  ML Model =  RandomForestCl
assifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 41        Executing Experiment =  Experiment 4  Index_Name =  MSDUUK  ML Model =  SGDClassifie
r
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 42        Executing Experiment =  Experiment 4  Index_Name =  MSDUUK  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 43        Executing Experiment =  Experiment 4  Index_Name =  MSDUUK  ML Model =  KNeighborsCl
assifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 44        Executing Experiment =  Experiment 4  Index_Name =  MSDUUK  ML Model =  RandomForest
Classifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 45        Executing Experiment =  Experiment 4  Index_Name =  MSDUJN  ML Model =  SGDClassifie
r
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 46        Executing Experiment =  Experiment 4  Index_Name =  MSDUJN  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 47        Executing Experiment =  Experiment 4  Index_Name =  MSDUJN  ML Model =  KNeighborsCl
assifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 48        Executing Experiment =  Experiment 4  Index_Name =  MSDUJN  ML Model =  RandomForest
Classifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 49        Executing Experiment =  Experiment 5  Index_Name =  MXUS  ML Model =  SGDClassifier
```

```
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 50           Executing Experiment =  Experiment 5  Index_Name =  MXUS  ML Model =  SVC
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 51           Executing Experiment =  Experiment 5  Index_Name =  MXUS  ML Model =  KNeighborsClas
sifier
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 52           Executing Experiment =  Experiment 5  Index_Name =  MXUS  ML Model =  RandomForestCl
assifier
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 53           Executing Experiment =  Experiment 5  Index_Name =  MSDUUK  ML Model =  SGDClassifie
r
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 54           Executing Experiment =  Experiment 5  Index_Name =  MSDUUK  ML Model =  SVC
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 55           Executing Experiment =  Experiment 5  Index_Name =  MSDUUK  ML Model =  KNeighborsCl
assifier
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 56           Executing Experiment =  Experiment 5  Index_Name =  MSDUUK  ML Model =  RandomForest
Classifier
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 57           Executing Experiment =  Experiment 5  Index_Name =  MSDUJN  ML Model =  SGDClassifie
r
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 58           Executing Experiment =  Experiment 5  Index_Name =  MSDUJN  ML Model =  SVC
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 59           Executing Experiment =  Experiment 5  Index_Name =  MSDUJN  ML Model =  KNeighborsCl
assifier
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 60           Executing Experiment =  Experiment 5  Index_Name =  MSDUJN  ML Model =  RandomForest
Classifier
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 61           Executing Experiment =  Experiment 6  Index_Name =  MXUS  ML Model =  SGDClassifier
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 62           Executing Experiment =  Experiment 6  Index_Name =  MXUS  ML Model =  SVC
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 63           Executing Experiment =  Experiment 6  Index_Name =  MXUS  ML Model =  KNeighborsClas
sifier
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 64           Executing Experiment =  Experiment 6  Index_Name =  MXUS  ML Model =  RandomForestCl
assifier
                   Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 65           Executing Experiment =  Experiment 6  Index_Name =  MSDUUK  ML Model =  SGDClassifie
r
```

```
                    Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 66            Executing Experiment =  Experiment 6  Index_Name =  MSDUUK  ML Model =  SVC
                    Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 67            Executing Experiment =  Experiment 6  Index_Name =  MSDUUK  ML Model =  KNeighborsCl
assifier
                    Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 68            Executing Experiment =  Experiment 6  Index_Name =  MSDUUK  ML Model =  RandomForest
Classifier
                    Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 69            Executing Experiment =  Experiment 6  Index_Name =  MSDUJN  ML Model =  SGDClassifie
r
                    Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 70            Executing Experiment =  Experiment 6  Index_Name =  MSDUJN  ML Model =  SVC
                    Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 71            Executing Experiment =  Experiment 6  Index_Name =  MSDUJN  ML Model =  KNeighborsCl
assifier
                    Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 72            Executing Experiment =  Experiment 6  Index_Name =  MSDUJN  ML Model =  RandomForest
Classifier
                    Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

In [110]:

```
results_df.sort_values(by=['Classifier', 'Experiment Name', 'Index']).head(20)
```

Out[110]:

	Experiment Name	Experiment Description	Dataset	Index	Classifier	CV	BL_Precision	BL_Recall	BL_Accuracy	ML_Precision	ML_I
0	Experiment 1	Evaluate all Network Features & all Financial ...	US Market Indexes	DJI	KNeighborsClassifier	10	0.504085	0.531678	0.476025	0.548250	0.5
0	Experiment 1	Evaluate all Network Features & all Financial ...	US Market Indexes	Nasdaq	KNeighborsClassifier	10	0.496451	0.526606	0.462363	0.523254	0.5
0	Experiment 1	Evaluate all Network Features & all Financial ...	US Market Indexes	S&P_500	KNeighborsClassifier	10	0.500732	0.513771	0.465845	0.454748	0.4
0	Experiment 2	Evaluate Only Network Features	US Market Indexes	DJI	KNeighborsClassifier	10	0.485615	0.496199	0.455934	0.350756	0.3
0	Experiment 2	Evaluate Only Network Features	US Market Indexes	Nasdaq	KNeighborsClassifier	10	0.486111	0.509538	0.450844	0.341632	0.3
0	Experiment 2	Evaluate Only Network Features	US Market Indexes	S&P_500	KNeighborsClassifier	10	0.505351	0.543816	0.471203	0.271092	0.2
0	Experiment 3	Evaluate Only Financial Index Features	US Market Indexes	DJI	KNeighborsClassifier	10	0.528707	0.536746	0.502277	0.553134	0.6
0	Experiment 3	Evaluate Only Financial Index Features	US Market Indexes	Nasdaq	KNeighborsClassifier	10	0.524786	0.552711	0.494241	0.566910	0.6

	Experiment Name	Experiment Description	Dataset	Index	Classifier	CV	BL_Precision	BL_Recall	BL_Accuracy	ML_Precision	ML_I
0	Experiment 3	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	KNeighborsClassifier	10	0.532573	0.560841	0.501741	0.482158	0.5
0	Experiment 4	Evaluate all Network Features & all Financial ...	MSUS-MSDUUK-MSDUJN Market Indexes	MSDUJN	KNeighborsClassifier	10	0.479605	0.502412	0.466314	0.403252	0.4
0	Experiment 4	Evaluate all Network Features & all Financial ...	MSUS-MSDUUK-MSDUJN Market Indexes	MSDUUK	KNeighborsClassifier	10	0.523553	0.521448	0.498413	0.480437	0.4
0	Experiment 4	Evaluate all Network Features & all Financial ...	MSUS-MSDUUK-MSDUJN Market Indexes	MXUS	KNeighborsClassifier	10	0.546603	0.585696	0.507231	0.489485	0.5
0	Experiment 5	Evaluate Only Network Features	MSUS-MSDUUK-MSDUJN Market Indexes	MSDUJN	KNeighborsClassifier	10	0.498321	0.511371	0.486420	0.242809	0.2
0	Experiment 5	Evaluate Only Network Features	MSUS-MSDUUK-MSDUJN Market Indexes	MSDUUK	KNeighborsClassifier	10	0.531150	0.554290	0.507937	0.231626	0.2
0	Experiment 5	Evaluate Only Network Features	MSUS-MSDUUK-MSDUJN Market Indexes	MXUS	KNeighborsClassifier	10	0.537628	0.575387	0.496649	0.246437	0.2
0	Experiment 6	Evaluate Only Financial Index Features	MSUS-MSDUUK-MSDUJN Market Indexes	MSDUJN	KNeighborsClassifier	10	0.495935	0.504480	0.483951	0.439151	0.4

	Experiment Name	Experiment Description	Dataset	Index	Classifier	CV	BL_Precision	BL_Recall	BL_Accuracy	ML_Precision	ML_I
0	Experiment 6	Evaluate Only Financial Index Features	MSUS-MSDUUK-MSDUJN Market Indexes	MSDUUK	KNeighborsClassifier	10	0.529831	0.547587	0.506173	0.512925	0.5
0	Experiment 6	Evaluate Only Financial Index Features	MSUS-MSDUUK-MSDUJN Market Indexes	MXUS	KNeighborsClassifier	10	0.530348	0.579897	0.488889	0.526871	0.5
0	Experiment 1	Evaluate all Network Features & all Financial ...	US Market Indexes	DJI	RandomForestClassifier	10	0.486850	0.403447	0.459952	0.550732	0.5
0	Experiment 1	Evaluate all Network Features & all Financial ...	US Market Indexes	Nasdaq	RandomForestClassifier	10	0.481697	0.416165	0.449504	0.540342	0.5

In [111]:
```
results_df_details.head()
```

Out[111]:

	Experiment Name	Description	Features	y_label_col	y_ml_label_col
0	Experiment 1	Evaluate all Network Features & all Financial ...	[Ave_Deg_Centrality, Ave_Network_Strength, Ave...	label_S&P_500	f_label_S&P_500
0	Experiment 1	Evaluate all Network Features & all Financial ...	[Ave_Deg_Centrality, Ave_Network_Strength, Ave...	label_S&P_500	f_label_S&P_500
0	Experiment 1	Evaluate all Network Features & all Financial ...	[Ave_Deg_Centrality, Ave_Network_Strength, Ave...	label_S&P_500	f_label_S&P_500
0	Experiment 1	Evaluate all Network Features & all Financial ...	[Ave_Deg_Centrality, Ave_Network_Strength, Ave...	label_S&P_500	f_label_S&P_500
0	Experiment 1	Evaluate all Network Features & all Financial ...	[Ave_Deg_Centrality, Ave_Network_Strength, Ave...	label_Nasdaq	f_label_Nasdaq

#

6.3.4.2 Analyze Experiment's Results

6.3.4.2.1 Compare Performance between Datasets

In [112]:
```
dataset_1_results = results_df[ results_df.Dataset == "US Market Indexes" ]
dataset_2_results = results_df[ results_df.Dataset != "US Market Indexes" ]
analysis_columns = ["Experiment Description", "Classifier",
                    "Combine_ML_Precision", "Combine_ML_Recall", "Combine_ML_Accuracy"]

dat1_results_stats = \
       dataset_1_results[analysis_columns].groupby(['Experiment Description', 'Classifier']).mean()
dat2_results_stats = \
       dataset_2_results[analysis_columns].groupby(['Experiment Description', 'Classifier']).mean()
```

Dataset 1: Mean Values of Precision, Recall, and Accuracy for Combine ML Model

(Results are group by: Experiment Type and Classifier)

In [113]:
```
dat1_results_stats.style.format("{:.2%}")
```

Out[113]:

Experiment Description	Classifier	Combine_ML_Precision	Combine_ML_Recall	Combine_ML_Accuracy
Evaluate Only Financial Index Features	KNeighborsClassifier	76.37%	67.36%	76.02%
	RandomForestClassifier	75.49%	69.84%	76.30%
	SGDClassifier	78.28%	71.22%	78.22%
	SVC	78.62%	73.32%	79.11%
Evaluate Only Network Features	KNeighborsClassifier	41.42%	33.89%	48.83%
	RandomForestClassifier	40.10%	36.18%	47.05%
	SGDClassifier	41.96%	29.66%	50.08%
	SVC	22.46%	2.02%	52.84%
Evaluate all Network Features & all Financial Index Measures	KNeighborsClassifier	73.11%	62.67%	72.90%
	RandomForestClassifier	74.28%	67.74%	75.01%
	SGDClassifier	74.93%	69.61%	75.88%
	SVC	76.79%	71.11%	77.40%

Dataset 2: Mean Values of Precision, Recall, and Accuracy for Combine ML Model

(Results are group by: Experiment Type and Classifier)

```
In [116]: dat2_results_stats.style.format("{:.2%}")
```

Out[116]:

Experiment Description	Classifier	Combine_ML_Precision	Combine_ML_Recall	Combine_ML_Accuracy
Evaluate Only Financial Index Features	KNeighborsClassifier	76.41%	67.81%	75.46%
	RandomForestClassifier	74.90%	70.32%	75.41%
	SGDClassifier	77.62%	68.48%	76.21%
	SVC	78.64%	73.42%	78.52%
Evaluate Only Network Features	KNeighborsClassifier	45.67%	34.78%	50.97%
	RandomForestClassifier	47.24%	42.01%	51.62%
	SGDClassifier	46.07%	32.64%	51.30%
	SVC	43.17%	18.44%	53.12%
Evaluate all Network Features & all Financial Index Measures	KNeighborsClassifier	75.57%	64.44%	73.96%
	RandomForestClassifier	75.33%	69.89%	75.53%
	SGDClassifier	74.69%	67.99%	74.59%
	SVC	77.74%	73.16%	77.94%

Percent Differences between Datasets for Combine ML Models

(Results are group by: Experiment Type and Classifier)

```
In [159]: (dat1_results_stats.sub(dat2_results_stats)/dat1_results_stats).style.format("{:.2%}")
```

Out[159]:

Experiment Description	Classifier	Combine_ML_Precision	Combine_ML_Recall	Combine_ML_Accuracy
Evaluate Only Financial Index Features	KNeighborsClassifier	-0.05%	-0.66%	0.73%
	RandomForestClassifier	0.78%	-0.69%	1.16%
	SGDClassifier	0.83%	3.85%	2.57%
	SVC	-0.02%	-0.14%	0.74%
Evaluate Only Network Features	KNeighborsClassifier	-10.25%	-2.62%	-4.39%
	RandomForestClassifier	-17.78%	-16.12%	-9.71%
	SGDClassifier	-9.79%	-10.06%	-2.42%
	SVC	-92.19%	-812.72%	-0.54%
Evaluate all Network Features & all Financial Index Measures	KNeighborsClassifier	-3.36%	-2.82%	-1.45%
	RandomForestClassifier	-1.41%	-3.17%	-0.70%
	SGDClassifier	0.32%	2.33%	1.70%
	SVC	-1.24%	-2.87%	-0.70%

Summary of Analysis

- **Differences between the datasets is mostly small, except for SVC with Only Network Features, the other experiment type differences are less than 4%**

6.3.4.2.2 Compare Performance Between Experiment Types (different feature sets)

```
In [118]: analysis_columns = ["Experiment Description",
                              "Combine_ML_Precision", "Combine_ML_Recall", "Combine_ML_Accuracy"]

          results_stats = results_df[analysis_columns].groupby(['Experiment Description']).mean()
```

Mean Values of Precision, Recall, and Accuracy for Combine ML Model all datasets

(Results are group by: Experiment Type)

In [119]:
```
results_stats.style.format("{:.2%}")
```

Out[119]:

Experiment Description	Combine_ML_Precision	Combine_ML_Recall	Combine_ML_Accuracy
Evaluate Only Financial Index Features	77.04%	70.22%	76.91%
Evaluate Only Network Features	41.01%	28.70%	50.73%
Evaluate all Network Features & all Financial Index Measures	75.30%	68.33%	75.40%

Summary of Analysis

- **The experiments with only financial index features provide the best results overall across all conducted experiements, 76.91% mean accuracy, slightly higher than 75.40% when using all Network & Financial index features**

6.3.4.2.3 Compare Performance Between Classifiers for best Experiment Type (Evaluate Only Financial Index Features)

In [120]:
```
analysis_columns = ["Classifier",
                    "Combine_ML_Precision", "Combine_ML_Recall", "Combine_ML_Accuracy"]

results_df_subset = results_df[ results_df["Experiment Description"] == \
                                           "Evaluate Only Financial Index Features"]
results_stats = results_df_subset[analysis_columns].groupby(['Classifier']).mean()
```

Mean Values of Precision, Recall, and Accuracy for Combine ML Model all datasets

- Results are group by: Classifier & derived only for the best Experiment Type

```
In [126]: results_stats.sort_values(['Combine_ML_Accuracy'], ascending=False).style.format("{:.2%}")
```

Out[126]:

Classifier	Combine_ML_Precision	Combine_ML_Recall	Combine_ML_Accuracy
SVC	78.63%	73.37%	78.81%
SGDClassifier	77.95%	69.85%	77.22%
RandomForestClassifier	75.20%	70.08%	75.86%
KNeighborsClassifier	76.39%	67.58%	75.74%

Summary of Analysis

- **The best classifiers from all the experiments are: SVC and SGD**

6.3.4.2.4 Summary of Experiments

- There are only minor differences due to difference datasets, that is, different market indexes, and different time periods
- The best label to use for predicting price movement pattern, it is the Multi Label, combining the S1 and S2, and S3 and S4 via the confusion matrix
- The best experiment type is the one including only Financial Indexes derived features
- The best performing models across all evaluated classifiers are: SGD and SVC
- The performance of KNN and Random Forest classifiers are very close to the SGD and SVC algorithms
- It is recommended to optimize KNN and Random Forest with SGD and SVC to utilized them all in emsemble classifiers, which may provide better overall results than a single classifier

6.3.5 Models Optimization

6.3.5.1 Models Optimization

6.3.5.1.1 KNN Optimization

In [127]:
```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import ParameterGrid

# ***
# *** Each classifier, needs to be optimzed for each Stock Index
# ***
# ***    Note: This is a customized optimization, since we are optimizing the accuracy of the
# ***          Combine Multi-Label, which can only be infered after evaluating the Multi_Label case
# ***


param_grid_knn = ParameterGrid( {'n_neighbors': [3, 4, 5, 7, 10, 15, 20 ],
                                 'weights'    : ["uniform", "distance"],
                                 'algorithm'  : ["auto", "ball_tree", "kd_tree"],
                                 'leaf_size'  : [25, 30, 40, 60, 80]} )

#param_grid_knn = ParameterGrid( {'n_neighbors': [5, 10, 15, 20, 30, 40, 50] } )
models = []

for i, params in enumerate(param_grid_knn):
    knn_clf = KNeighborsClassifier(**params, n_jobs = -1)
    models.append(knn_clf)

optimization_eval_1   = {'experiment_name'  : "Evaluate KNN Models",
                         'description'      : "Evaluate Only Financial Index Features",
                         'indexes'          : ["S&P_500", "Nasdaq", "DJI"],
                         'dataset_name'     : "US Market Indexes",
                         'x_features_names' : [ "r_{}", "R_{}", "V_{}" ] ,
                         'y_label_name'     : "label_{}",
                         'y_ml_label_name'  : "f_label_{}",
                         'cv'               : 10,
                         'models'           : models,
                         'dataset'          : indixes_data_training_set_1 }

optimization_eval_2   = {'experiment_name'  : "Evaluate KNN Models",
                         'description'      : "Evaluate Only Financial Index Features",
                         'indexes'          : ["MXUS", "MSDUUK", "MSDUJN"],
                         'dataset_name'     : "MSUS-MSDUUK-MSDUJN Market Indexes",
                         'x_features_names' : [ "r_{}", "R_{}", "V_{}" ] ,
                         'y_label_name'     : "label_{}",
                         'y_ml_label_name'  : "f_label_{}",
                         'cv'               : 10,
```

```
                        'models'           : models,
                        'dataset'          : indixes_data_training_set_2 }

results_df_knn, results_df_details_knn, models_fitted_dict_knn = \
                    executeExperimentSet ( experiments = [optimization_eval_1, optimization_eval_2] )
```

```
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                Dataset =  US Market Indexes
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ghborsClassifier
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Job # 143       Executing Experiment =  Evaluate KNN Models  Index_Name =  S&P_500  ML Model =  KNei
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Job # 144       Executing Experiment =  Evaluate KNN Models  Index_Name =  S&P_500  ML Model =  KNei
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Job # 297          Executing Experiment =  Evaluate KNN Models  Index_Name =  Nasdaq  ML Model =  KNeig
hborsClassifier
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Job # 298          Executing Experiment =  Evaluate KNN Models  Index_Name =  Nasdaq  ML Model =  KNeig
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Job # 301          Executing Experiment =  Evaluate KNN Models  Index_Name =  Nasdaq  ML Model =  KNeig
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Job # 316       Executing Experiment =  Evaluate KNN Models  Index_Name =  Nasdaq  ML Model =  KNeig
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hborsClassifier
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```

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Job # 359       Executing Experiment =  Evaluate KNN Models  Index_Name =  Nasdaq  ML Model =  KNeig
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hborsClassifier
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Job # 360       Executing Experiment =  Evaluate KNN Models  Index_Name =  Nasdaq  ML Model =  KNeig
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hborsClassifier
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Job # 387       Executing Experiment =  Evaluate KNN Models  Index_Name =  Nasdaq  ML Model =  KNeig
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                Dataset =  US Market Indexes
```

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Job # 388       Executing Experiment =  Evaluate KNN Models  Index_Name =  Nasdaq  ML Model =  KNeig
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Job # 402       Executing Experiment =  Evaluate KNN Models  Index_Name =  Nasdaq  ML Model =  KNeig
```

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hborsClassifier
                    Dataset =  US Market Indexes
Job # 403           Executing Experiment =  Evaluate KNN Models  Index_Name =  Nasdaq  ML Model =  KNeig
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Job # 421       Executing Experiment =  Evaluate KNN Models  Index_Name =  DJI  ML Model =  KNeighbo
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Job # 422       Executing Experiment =  Evaluate KNN Models  Index_Name =  DJI  ML Model =  KNeighbo
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Job # 431	Executing Experiment = Evaluate KNN Models Index_Name = DJI ML Model = KNeighbo
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Dataset = US Market Indexes
Job # 432	Executing Experiment = Evaluate KNN Models Index_Name = DJI ML Model = KNeighbo
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Dataset = US Market Indexes
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Dataset = US Market Indexes
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Dataset = US Market Indexes
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Dataset = US Market Indexes
Job # 439	Executing Experiment = Evaluate KNN Models Index_Name = DJI ML Model = KNeighbo
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Dataset = US Market Indexes
Job # 441	Executing Experiment = Evaluate KNN Models Index_Name = DJI ML Model = KNeighbo
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Dataset = US Market Indexes
Job # 442	Executing Experiment = Evaluate KNN Models Index_Name = DJI ML Model = KNeighbo
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Job # 443	Executing Experiment = Evaluate KNN Models Index_Name = DJI ML Model = KNeighbo
rsClassifier
Dataset = US Market Indexes
Job # 444	Executing Experiment = Evaluate KNN Models Index_Name = DJI ML Model = KNeighbo
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Dataset = US Market Indexes
Job # 445	Executing Experiment = Evaluate KNN Models Index_Name = DJI ML Model = KNeighbo

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rsClassifier
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Job # 459           Executing Experiment =  Evaluate KNN Models  Index_Name =  DJI  ML Model =  KNeighbo
rsClassifier
```

Dataset = US Market Indexes
Job # 460 Executing Experiment = Evaluate KNN Models Index_Name = DJI ML Model = KNeighborsClassifier
Dataset = US Market Indexes
Job # 461 Executing Experiment = Evaluate KNN Models Index_Name = DJI ML Model = KNeighborsClassifier
Dataset = US Market Indexes
Job # 462 Executing Experiment = Evaluate KNN Models Index_Name = DJI ML Model = KNeighborsClassifier
Dataset = US Market Indexes
Job # 463 Executing Experiment = Evaluate KNN Models Index_Name = DJI ML Model = KNeighborsClassifier
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Job # 474 Executing Experiment = Evaluate KNN Models Index_Name = DJI ML Model = KNeighbo
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Job # 488 Executing Experiment = Evaluate KNN Models Index_Name = DJI ML Model = KNeighbo

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Job # 502         Executing Experiment =  Evaluate KNN Models  Index_Name =  DJI  ML Model =  KNeighbo
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Job # 531 Executing Experiment = Evaluate KNN Models Index_Name = DJI ML Model = KNeighbo

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Job # 588       Executing Experiment =  Evaluate KNN Models  Index_Name =  DJI  ML Model =  KNeighbo
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Dataset = US Market Indexes

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rsClassifier
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Job # 631   Executing Experiment = Evaluate KNN Models Index_Name = MXUS ML Model = KNeighb
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Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 632 Executing Experiment = Evaluate KNN Models Index_Name = MXUS ML Model = KNeighborsClassifier
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Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
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Dataset = MSUS-MSDUUK-MSDUJN Market Indexes

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Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 801 Executing Experiment = Evaluate KNN Models Index_Name = MXUS ML Model = KNeighb
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Job # 832 Executing Experiment = Evaluate KNN Models Index_Name = MXUS ML Model = KNeighb

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Job # 875 Executing Experiment = Evaluate KNN Models Index_Name = MSDUUK ML Model = KNeig

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Job # 951       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
hborsClassifier
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Job # 952       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 960       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 961       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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hborsClassifier
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Job # 962       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 963       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 964       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 975       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 989 Executing Experiment = Evaluate KNN Models Index_Name = MSDUUK ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes

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Job # 990       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 991       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 993       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 1000      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 1002      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 1003      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 1004      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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hborsClassifier
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Job # 1005      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 1006      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 1007      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 1008      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 1018      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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```

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Job # 1019      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 1031      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 1032      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Job # 1033 Executing Experiment = Evaluate KNN Models Index_Name = MSDUUK ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1034 Executing Experiment = Evaluate KNN Models Index_Name = MSDUUK ML Model = KNeighborsClassifier
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Job # 1035 Executing Experiment = Evaluate KNN Models Index_Name = MSDUUK ML Model = KNeighborsClassifier
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Job # 1036 Executing Experiment = Evaluate KNN Models Index_Name = MSDUUK ML Model = KNeighborsClassifier
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Job # 1037 Executing Experiment = Evaluate KNN Models Index_Name = MSDUUK ML Model = KNeighborsClassifier
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Job # 1038 Executing Experiment = Evaluate KNN Models Index_Name = MSDUUK ML Model = KNeighborsClassifier
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Job # 1044 Executing Experiment = Evaluate KNN Models Index_Name = MSDUUK ML Model = KNeighborsClassifier
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Job # 1045 Executing Experiment = Evaluate KNN Models Index_Name = MSDUUK ML Model = KNeighborsClassifier
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Job # 1046 Executing Experiment = Evaluate KNN Models Index_Name = MSDUUK ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1047 Executing Experiment = Evaluate KNN Models Index_Name = MSDUUK ML Model = KNeig

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hborsClassifier
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Job # 1048      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUUK  ML Model =  KNeig
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Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
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Dataset = MSUS-MSDUUK-MSDUJN Market Indexes

Job # 1076 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
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Job # 1090 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeig

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hborsClassifier
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                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1094      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1095      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1096      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1097      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1098      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1099      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1100      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1101      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1102      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1103      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1104      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
```

Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1105   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1106   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1107   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1108   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1109   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1110   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1111   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1112   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1113   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1114   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1115   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1116   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1117   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1118   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes

```
Job # 1119      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1120      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1121      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1122      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1123      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1124      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1125      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1126      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1127      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1128      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1129      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1130      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1131      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1132      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1133      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
```

```
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1134      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1135      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1136      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1137      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1138      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1139      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1140      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1141      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1142      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1143      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1144      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1145      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1146      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1147      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
```

Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1148   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1149   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1150   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1151   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1152   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1153   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1154   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1155   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1156   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1157   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1158   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1159   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1160   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1161   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes

```
Job # 1162      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1163      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1164      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1165      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1166      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1167      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1168      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1169      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1170      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1171      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1172      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1173      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1174      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1175      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1176      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
```

```
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1177      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1178      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1179      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1180      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
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Job # 1181      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1182      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1183      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1184      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1185      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1186      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1187      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1188      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1189      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1190      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
```

```
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1191       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1192       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1193       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1194       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1195       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1196       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1197       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1198       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1199       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1200       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1201       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1202       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1203       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1204       Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

Job # 1205 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1206 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1207 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1208 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1209 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1210 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1211 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1212 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1213 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1214 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1215 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1216 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1217 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1218 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1219 Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeig

```
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1220      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1221      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1222      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1223      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1224      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1225      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1226      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1227      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1228      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1229      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1230      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1231      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1232      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1233      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
```

Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1234   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1235   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1236   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1237   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1238   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1239   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1240   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1241   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1242   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1243   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1244   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1245   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1246   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1247   Executing Experiment = Evaluate KNN Models Index_Name = MSDUJN ML Model = KNeighborsClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes

```
Job # 1248      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1249      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1250      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1251      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1252      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1253      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1254      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1255      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1256      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1257      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1258      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1259      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1260      Executing Experiment =  Evaluate KNN Models  Index_Name =  MSDUJN  ML Model =  KNeig
hborsClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

Permutations Executed for KNN Model

In [128]:
```python
print("Total number of KNN models evaluated for optimization = ", len(results_df_knn))
results_df_knn.head() # Just display the top 5
```

```
Total number of KNN models evaluated for optimization =  1260
```

Out[128]:

	Experiment Name	Experiment Description	Dataset	Index	Classifier	CV	BL_Precision	BL_Recall	BL_Accuracy	ML_Precision	ML_Recall
0	Evaluate KNN Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	KNeighborsClassifier	10	0.538351	0.562344	0.507902	0.454545	0.454326
0	Evaluate KNN Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	KNeighborsClassifier	10	0.534433	0.551828	0.503081	0.445812	0.457541
0	Evaluate KNN Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	KNeighborsClassifier	10	0.522909	0.360040	0.481918	0.474580	0.486740
0	Evaluate KNN Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	KNeighborsClassifier	10	0.539093	0.559339	0.508438	0.461532	0.481114
0	Evaluate KNN Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	KNeighborsClassifier	10	0.532573	0.560841	0.501741	0.482158	0.505759

Select Best Models for each Index for KNN

In [129]:

```
analysis_columns = ["Classifier", "Job_ID", "Index",
                    "Combine_ML_Precision", "Combine_ML_Recall", "Combine_ML_Accuracy"]


best_knn_models_dict, optimum_models_metrics_knn_df = \
              getOptimizedModelsDict(results_df = results_df_knn,
                                     models_fitted = models_fitted_dict_knn,
                                     metric = "Combine_ML_Accuracy")

optimum_models_metrics_knn_df[analysis_columns]
```

Out[129]:

	Classifier	Job_ID	Index	Combine_ML_Precision	Combine_ML_Recall	Combine_ML_Accuracy
10	KNeighborsClassifier	11	S&P_500	0.781270	0.722420	0.783284
222	KNeighborsClassifier	223	Nasdaq	0.796215	0.743665	0.796946
432	KNeighborsClassifier	433	DJI	0.770588	0.718464	0.782213
640	KNeighborsClassifier	641	MXUS	0.797954	0.728972	0.793651
852	KNeighborsClassifier	853	MSDUUK	0.787182	0.741486	0.790829
1062	KNeighborsClassifier	1063	MSDUJN	0.778140	0.707191	0.764727

Validate Best Models For Each Index With Training Set for QA

```
In [130]: models_1 = [ best_knn_models_dict.get('S&P_500'), best_knn_models_dict.get('Nasdaq'),
                       best_knn_models_dict.get('DJI') ]

          models_2 = [ best_knn_models_dict.get('MXUS'), best_knn_models_dict.get('MSDUUK'),
                       best_knn_models_dict.get('MSDUJN') ]

          predictions_eval_1   =  {'prediction_name'   : "Predict KNN Models",
                                   'description'       : "Evaluate Only Financial Index Features",
                                   'indexes'           : ["S&P_500", "Nasdaq", "DJI"],
                                   'dataset_name'      : "US Market Indexes",
                                   'x_features_names'  : [ "r_{}", "R_{}", "V_{}" ] ,
                                   'y_label_name'      : "label_{}",
                                   'y_ml_label_name'   : "f_label_{}",
                                   'cv'                : 10,
                                   'models'            : models_1,
                                   'dataset'           : indixes_data_training_set_1 }

          predictions_eval_2   = {'prediction_name'    : "Predict KNN Models",
                                   'description'       : "Evaluate Only Financial Index Features",
                                   'indexes'           : ["MXUS", "MSDUUK", "MSDUJN"],
                                   'dataset_name'      : "MSUS-MSDUUK-MSDUJN Market Indexes",
                                   'x_features_names'  : [ "r_{}", "R_{}", "V_{}" ] ,
                                   'y_label_name'      : "label_{}",
                                   'y_ml_label_name'   : "f_label_{}",
                                   'cv'                : 10,
                                   'models'            : models_2,
                                   'dataset'           : indixes_data_training_set_2 }

          predictions_knn_df, models_knn_fitted_dict, cm_ml_knn_dict, cm_ml_compact_knn_dict = \
                    executePredictionsSet ( predictions = [predictions_eval_1, predictions_eval_2], FitModels =
          True )
```

In [131]:
```
knn_training_results_df = predictions_knn_df[ predictions_knn_df.Model == "Combine ML" ]
analysis_columns = ["Classifier", "Metric", "DJI", "S&P_500", "Nasdaq", "MXUS", "MSDUUK", "MSDUJN"]

knn_training_results_stats_df = \
        knn_training_results_df[analysis_columns].groupby(['Classifier', 'Metric']).max()

knn_training_results_stats_df.style.format("{:.2%}")
```

Out[131]:

		DJI	S&P_500	Nasdaq	MXUS	MSDUUK	MSDUJN
Classifier	**Metric**						
KNeighborsClassifier	**Accuracy**	80.74%	80.55%	81.60%	80.95%	80.67%	78.41%
	Precision	79.90%	80.85%	81.80%	82.01%	80.15%	80.13%
	Recall	75.08%	74.61%	76.55%	74.22%	76.55%	72.65%

6.3.5.1.2 Random Forest Optimization

In [132]:
```python
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import ParameterGrid

# ***
# *** Each classifier, needs to be optimzed for each Stock Index
# ***
# ***    Note: This is a customized optimization, since we are optimizing the accuracy of the
# ***          Combine Multi-Label, which can only be infered after evaluating the Multi_Label case
# ***

param_grid_rf = ParameterGrid( {'n_estimators' : [3, 6, 10, 20, 40, 70, 100, 130 ],
                                'max_depth'    : [None, 5, 10, 20, 50],
                                'max_features' : ["auto", "log2", None],
                                'bootstrap'    : [True, False]                          } )
models = []

for i, params in enumerate(param_grid_rf):
    rf_clf = RandomForestClassifier(**params, n_jobs = -1, random_state = 42)
    models.append(rf_clf)

optimization_eval_1   = {'experiment_name'  : "Evaluate Random Forest Models",
                         'description'      : "Evaluate Only Financial Index Features",
                         'indexes'          : ["S&P_500", "Nasdaq", "DJI"],
                         'dataset_name'     : "US Market Indexes",
                         'x_features_names' : [ "r_{}", "R_{}", "V_{}" ] ,
                         'y_label_name'     : "label_{}",
                         'y_ml_label_name'  : "f_label_{}",
                         'cv'               : 10,
                         'models'           : models,
                         'dataset'          : indixes_data_training_set_1 }

optimization_eval_2   = {'experiment_name'  : "Evaluate Random Forest Models",
                         'description'      : "Evaluate Only Financial Index Features",
                         'indexes'          : ["MXUS", "MSDUUK", "MSDUJN"],
                         'dataset_name'     : "MSUS-MSDUUK-MSDUJN Market Indexes",
                         'x_features_names' : [ "r_{}", "R_{}", "V_{}" ] ,
                         'y_label_name'     : "label_{}",
                         'y_ml_label_name'  : "f_label_{}",
                         'cv'               : 10,
                         'models'           : models,
                         'dataset'          : indixes_data_training_set_2 }
```

```
results_df_rf, results_df_details_rf, models_fitted_dict_rf = \
                    executeExperimentSet ( experiments = [optimization_eval_1, optimization_eval_2] )
```

```
Job # 1         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 2         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 3         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 4         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 5         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 6         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 7         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 8         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 9         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 10        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 11        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 12        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 13        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 14        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 15        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
```

```
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 16        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 17        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 18        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 19        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 20        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 21        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 22        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 23        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 24        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 25        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 26        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 27        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 28        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 29        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
```

```
                Dataset =  US Market Indexes
Job # 30        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 31        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 32        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 33        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 34        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 35        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 36        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 37        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 38        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 39        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 40        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 41        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 42        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 43        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
```

```
Job # 44        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 45        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 46        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 47        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 48        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 49        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 50        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 51        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 52        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 53        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 54        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 55        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 56        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 57        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 58        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
```

```
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 59        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 60        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 61        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 62        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 63        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 64        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 65        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 66        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 67        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 68        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 69        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 70        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 71        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 72        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
```

```
                Dataset =  US Market Indexes
Job # 73        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 74        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 75        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 76        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 77        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 78        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 79        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 80        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 81        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 82        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 83        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 84        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 85        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 86        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
```

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Job # 87        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 88        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 89        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 90        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 91        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 92        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 93        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 94        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 95        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 96        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 97        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 98        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 99        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 100       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 101       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
```

```
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 102       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 103       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 104       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 105       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 106       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 107       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 108       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 109       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 110       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 111       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 112       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 113       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 114       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 115       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
```

```
                Dataset =  US Market Indexes
Job # 116       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 117       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 118       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 119       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 120       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 121       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 122       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 123       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 124       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 125       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 126       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 127       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 128       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 129       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
```

```
Job # 130       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 131       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 132       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 133       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 134       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 135       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 136       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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el =  RandomForestClassifier
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Job # 138       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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el =  RandomForestClassifier
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Job # 140       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 141       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 142       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 143       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 144       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
```

```
el =  RandomForestClassifier
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Job # 145       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 146       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 147       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 148       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 149       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 150       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 151       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 152       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 153       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 154       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 155       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 156       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 157       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 158       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
```

```
                Dataset =  US Market Indexes
Job # 159       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 160       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 161       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 162       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 163       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 164       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 165       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 166       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 167       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 168       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 169       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 170       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 171       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 172       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
```

```
Job # 173       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 174       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 175       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 176       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 177       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 178       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 179       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 180       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 181       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 182       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 183       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 184       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 185       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 186       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 187       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
```

```
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 188       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 189       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 190       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 191       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 192       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 193       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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el =  RandomForestClassifier
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Job # 195       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 196       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 197       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 198       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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el =  RandomForestClassifier
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Job # 200       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 201       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
```

```
                Dataset =  US Market Indexes
Job # 202       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 203       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 204       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 205       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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el =  RandomForestClassifier
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Job # 209       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 210       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 211       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 212       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 213       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 214       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 215       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
                Dataset =  US Market Indexes
```

```
Job # 216       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 217       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 218       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 219       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 221       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 222       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 223       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 224       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 225       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 226       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 227       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 228       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 229       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 230       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
```

```
el =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 231       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 232       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 233       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 234       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 235       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 236       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 237       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 238       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 239       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
el =  RandomForestClassifier
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Job # 240       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  S&P_500  ML Mod
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Job # 241       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 242       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 243       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 244       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
```

```
                  Dataset =  US Market Indexes
Job # 245         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                  Dataset =  US Market Indexes
Job # 246         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                  Dataset =  US Market Indexes
Job # 247         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                  Dataset =  US Market Indexes
Job # 248         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                  Dataset =  US Market Indexes
Job # 249         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                  Dataset =  US Market Indexes
Job # 250         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                  Dataset =  US Market Indexes
Job # 251         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                  Dataset =  US Market Indexes
Job # 252         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                  Dataset =  US Market Indexes
Job # 253         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                  Dataset =  US Market Indexes
Job # 254         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                  Dataset =  US Market Indexes
Job # 255         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                  Dataset =  US Market Indexes
Job # 256         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                  Dataset =  US Market Indexes
Job # 257         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                  Dataset =  US Market Indexes
Job # 258         Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                  Dataset =  US Market Indexes
```

```
Job # 259       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 260       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 261       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 262       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 263       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 264       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 265       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 266       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 267       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 268       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 269       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 270       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 271       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 272       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 273       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
```

```
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 274       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 275       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 276       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 277       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 278       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 279       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 280       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 281       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 282       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 283       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 284       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 285       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 286       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 287       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
```

```
                Dataset =  US Market Indexes
Job # 288       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 289       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 290       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 291       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 292       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 293       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 294       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 295       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 296       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 297       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 298       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 299       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 300       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 301       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
```

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Job # 302       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 303       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 304       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 305       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 306       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 307       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 308       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 309       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 310       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 311       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 312       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 313       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 314       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 315       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 316       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
```

```
l =  RandomForestClassifier
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Job # 317       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 318       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 319       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 320       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 321       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 322       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 323       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 324       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 325       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 326       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 327       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 328       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 329       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 330       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
```

```
                 Dataset =  US Market Indexes
Job # 331        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 332        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 333        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 334        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 335        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 336        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 337        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 338        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 339        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 340        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 341        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 342        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 343        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 344        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                 Dataset =  US Market Indexes
```

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Job # 345       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 346       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 347       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 348       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 349       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 350       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 351       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 352       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 353       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 354       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 355       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 356       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 357       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 358       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 359       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
```

```
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 360       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 361       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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l =  RandomForestClassifier
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Job # 363       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 364       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 365       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 366       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 367       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 368       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 369       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 370       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 371       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 372       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 373       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
```

```
                Dataset =  US Market Indexes
Job # 374       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 375       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 376       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 377       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 378       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 379       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 380       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 381       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 382       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 384       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 385       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 386       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 387       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
```

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Job # 388       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 389       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 390       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 391       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 392       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 393       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 394       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 395       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 396       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 397       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 398       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 399       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 400       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 401       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 402       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
```

```
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 403       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 404       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 405       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 406       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 407       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 408       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 409       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 410       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 411       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 412       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 413       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 414       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 415       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
Job # 416       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
```

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                Dataset =  US Market Indexes
Job # 417       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 418       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 419       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 422       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 423       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 424       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 429       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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Job # 430       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                Dataset =  US Market Indexes
```

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Job # 431       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 432       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 439       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 440       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 445       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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Job # 459       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
```

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Job # 462        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
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l =  RandomForestClassifier
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Job # 464        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
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l =  RandomForestClassifier
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Job # 473        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  Nasdaq  ML Mode
l =  RandomForestClassifier
                 Dataset =  US Market Indexes
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Job # 474   Executing Experiment = Evaluate Random Forest Models Index_Name = Nasdaq ML Mode
l = RandomForestClassifier
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Job # 476   Executing Experiment = Evaluate Random Forest Models Index_Name = Nasdaq ML Mode
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Job # 477   Executing Experiment = Evaluate Random Forest Models Index_Name = Nasdaq ML Mode
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Job # 478   Executing Experiment = Evaluate Random Forest Models Index_Name = Nasdaq ML Mode
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Job # 479   Executing Experiment = Evaluate Random Forest Models Index_Name = Nasdaq ML Mode
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Job # 480   Executing Experiment = Evaluate Random Forest Models Index_Name = Nasdaq ML Mode
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Job # 481   Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model =
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RandomForestClassifier
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Job # 487   Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model =
RandomForestClassifier
                Dataset = US Market Indexes
Job # 488   Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model =

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RandomForestClassifier
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Job # 489       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 497       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
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Job # 502       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
```

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Job # 504       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
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Job # 514       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
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Job # 515       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
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Job # 516       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
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```

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Job # 517       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
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Job # 530       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 531       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
```

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RandomForestClassifier
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Job # 532       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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```

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```

Job # 560 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 561 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 562 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
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Dataset = US Market Indexes
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Dataset = US Market Indexes
Job # 565 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
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Job # 566 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
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Dataset = US Market Indexes
Job # 568 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 569 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
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Job # 570 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 571 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 572 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 573 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 574 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model =

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RandomForestClassifier
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RandomForestClassifier
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Job # 586       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                    Dataset =  US Market Indexes
Job # 587       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                    Dataset =  US Market Indexes
Job # 588       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
```

```
                Dataset =  US Market Indexes
Job # 589       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 590       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 591       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 592       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 593       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 594       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 595       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 596       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 597       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 598       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 599       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 600       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 601       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 602       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
```

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Job # 603       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 604       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 605       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 606       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 607       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 608       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 609       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 610       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 611       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 612       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 613       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 614       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 615       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 616       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 617       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
```

```
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 618       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 619       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 620       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 621       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 622       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 623       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 624       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 625       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 626       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 627       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 628       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 629       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 630       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 631       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
```

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                 Dataset =  US Market Indexes
Job # 632        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 633        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 634        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 635        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 636        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 637        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 638        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 639        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 640        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 641        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 642        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 643        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 644        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                 Dataset =  US Market Indexes
Job # 645        Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                 Dataset =  US Market Indexes
```

Job # 646 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 647 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 648 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 649 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 650 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 651 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 652 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 653 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 654 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 655 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 656 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 657 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 658 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 659 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 660 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model =

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RandomForestClassifier
                    Dataset =  US Market Indexes
Job # 661       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 662       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 663       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 664       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 665       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                    Dataset =  US Market Indexes
Job # 666       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 667       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 668       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 669       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                    Dataset =  US Market Indexes
Job # 670       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                    Dataset =  US Market Indexes
Job # 671       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                    Dataset =  US Market Indexes
Job # 672       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                    Dataset =  US Market Indexes
Job # 673       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                    Dataset =  US Market Indexes
Job # 674       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
```

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                Dataset =  US Market Indexes
Job # 675       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 676       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 677       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 678       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 679       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
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Job # 680       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
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Job # 681       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 682       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 683       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
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Job # 684       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 685       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 686       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 687       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 688       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
```

Job # 689 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 690 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 691 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 692 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 693 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 694 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 695 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 696 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 697 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 698 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 699 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 700 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 701 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 702 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model = RandomForestClassifier
Dataset = US Market Indexes
Job # 703 Executing Experiment = Evaluate Random Forest Models Index_Name = DJI ML Model =

```
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 704       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 705       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 706       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 707       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
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Job # 708       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 709       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 710       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 711       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 712       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 713       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 714       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 715       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 716       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 717       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
```

```
                Dataset =  US Market Indexes
Job # 718       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 719       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 720       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  DJI  ML Model =
RandomForestClassifier
                Dataset =  US Market Indexes
Job # 721       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 722       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 723       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 724       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 725       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 726       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 727       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 728       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 729       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 730       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 731       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

Job # 732 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 733 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 734 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 735 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 736 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 737 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 738 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 739 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 740 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 741 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 742 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 743 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 744 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 745 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 746 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model

```
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 747       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 748       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 749       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 750       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 751       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 752       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 753       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 754       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 755       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 756       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 757       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 758       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 759       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 760       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
```

Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 761   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 762   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 763   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 764   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 765   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 766   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 767   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 768   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 769   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 770   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 771   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 772   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 773   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 774   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes

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Job # 775       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 776       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 777       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 778       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 779       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 780       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 781       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
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Job # 782       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
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Job # 783       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
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Job # 784       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
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Job # 785       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 786       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
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Job # 787       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 788       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 789       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
```

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 =  RandomForestClassifier
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Job # 790       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
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Job # 791       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
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Job # 792       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
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Job # 793       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
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Job # 794       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
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Job # 795       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
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Job # 796       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 797       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
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Job # 798       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
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Job # 799       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
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Job # 800       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 801       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 802       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 803       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 804 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 805 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 806 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 807 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 808 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 809 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 810 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 811 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 812 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 813 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 814 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 815 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 816 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 817 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes

```
Job # 818       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 819       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 820       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 821       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 822       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 823       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 824       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 825       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 826       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 827       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 828       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 829       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 830       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 831       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 832       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
```

= RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 833 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 834 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 835 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 836 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 841 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 843 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 844 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 845 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 846 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier

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Job # 859   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 860   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes

Job # 861 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 866 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 872 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 873 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 874 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 875 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model

```
 =  RandomForestClassifier
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Job # 876       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 877       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 878       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
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Job # 879       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 880       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 881       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 886       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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 =  RandomForestClassifier
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Job # 888       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
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Job # 889       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
```

Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 890   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
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Job # 900   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 901   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 903   Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes

Job # 904 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 907 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 911 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 912 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 914 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 915 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 916 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
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Job # 917 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 918 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model

= RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 919 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 920 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 921 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 922 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 923 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 924 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 925 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 926 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 927 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 928 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 929 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 930 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 931 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 932 Executing Experiment = Evaluate Random Forest Models Index_Name = MXUS ML Model = RandomForestClassifier

```
               Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 933      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
               Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 934      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
               Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 935      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
               Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 936      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
               Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 937      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
               Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 938      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
               Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 939      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
               Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 940      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
               Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 941      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
               Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 942      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
               Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 943      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
               Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 944      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
               Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 945      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
               Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 946      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
               Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

```
Job # 947       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 948       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 949       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 950       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 951       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 952       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 953       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 954       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 955       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 956       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 957       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 958       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 959       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 960       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MXUS  ML Model
 =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 961       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
```

```
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 962       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 963       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 964       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 965       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 966       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 967       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 968       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 969       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 970       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 971       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 972       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 973       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 974       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 975       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
```

```
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 976       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 977       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 978       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 979       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 980       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 981       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 982       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 983       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 984       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 985       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 986       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 987       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 988       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 989       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

```
Job # 990       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 991       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 992       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 993       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 994       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 995       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 996       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 997       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 998       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 999       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1000      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1001      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1002      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1003      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1004      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
```

```
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1005      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1006      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1007      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1008      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1009      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1010      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1011      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1012      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1013      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1014      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1015      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1016      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1017      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1018      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
```

```
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1019      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1020      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1021      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1022      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1023      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1024      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1025      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1026      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1027      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1028      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1029      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1030      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1031      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1032      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

```
Job # 1033      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1034      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1035      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1036      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1037      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1038      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1039      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1040      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1041      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1042      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1043      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1044      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1045      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1046      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1047      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
```

```
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1048      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1049      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1050      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1051      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1052      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1053      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1054      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1055      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1056      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1057      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1058      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1059      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1060      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1061      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
```

```
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1062      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1063      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1064      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1065      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1066      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1067      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1068      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1069      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1070      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1071      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1072      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1073      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1074      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1075      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

```
Job # 1076      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1077      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1078      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1079      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1080      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1081      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1082      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1083      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1084      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1085      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1086      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1087      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1088      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1089      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1090      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
```

```
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1091      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1092      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1093      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1094      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1095      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1096      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1097      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1098      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1099      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1100      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1101      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1102      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1103      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1104      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
```

```
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1105      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1106      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1107      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1108      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1109      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1110      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1111      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1112      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1113      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1114      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1115      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1116      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1117      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1118      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

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Job # 1119      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1120      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1121      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1122      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1123      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1124      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1125      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1126      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1127      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1128      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1129      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1130      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1131      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1132      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1133      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
```

```
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1134      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1135      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1136      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1137      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1138      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1139      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1140      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1141      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1142      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1143      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1144      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1145      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1146      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1147      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
```

```
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1148      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1149      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1150      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1151      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1152      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1153      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1154      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1155      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1156      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1157      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1158      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1159      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1160      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1161      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

```
Job # 1162      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1163      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1164      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1165      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1166      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1167      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1168      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1169      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1170      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1171      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1172      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1173      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1174      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1175      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1176      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
```

```
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1177      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1178      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1179      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1180      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1181      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1182      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1183      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1184      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1185      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1186      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1187      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1188      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1189      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1190      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
```

```
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1191      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1192      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1193      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1194      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1195      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1196      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1197      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1198      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1199      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1200      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUUK  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1201      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1202      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1203      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1204      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

```
Job # 1205      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1206      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1207      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1208      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1209      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1210      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1211      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1212      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1213      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1214      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1215      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1216      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1217      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1218      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1219      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
```

```
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1220      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1221      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1222      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1223      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1224      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1225      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1226      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1227      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1228      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1229      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1230      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1231      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1232      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1233      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
```

```
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1234      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1235      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1236      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1237      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1238      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1239      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1240      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1241      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1242      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1243      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1244      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1245      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1246      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1247      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

```
Job # 1248      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1249      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1250      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1251      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1252      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1253      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1254      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1255      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1256      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1257      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1258      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1259      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1260      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1261      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1262      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
```

```
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1263      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1264      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1265      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1266      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1267      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1268      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1269      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1270      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1271      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1272      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1273      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1274      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1275      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1276      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
```

```
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1277      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1278      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1279      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1280      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1281      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1282      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1283      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1284      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1285      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1286      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1287      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1288      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1289      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1290      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

```
Job # 1291      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1292      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1293      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1294      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1295      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1296      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1297      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1298      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1299      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1300      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1301      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1302      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1303      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1304      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1305      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
```

```
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1306       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1307       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1308       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1309       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1310       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1311       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1312       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1313       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1314       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1315       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1316       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1317       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1318       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1319       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
```

```
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1320      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1321      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1322      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1323      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1324      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1325      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1326      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1327      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1328      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1329      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1330      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1331      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1332      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1333      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

```
Job # 1334      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1335      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1336      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1337      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1338      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1339      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1340      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1341      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1342      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1343      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1344      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1345      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1346      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1347      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1348      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
```

```
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1349      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1350      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1351      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1352      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1353      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1354      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1355      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1356      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1357      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1358      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1359      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1360      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1361      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1362      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
```

```
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1363      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1364      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1365      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1366      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1367      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1368      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1369      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1370      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1371      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1372      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1373      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1374      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1375      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1376      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

```
Job # 1377      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1378      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1379      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1380      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1381      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1382      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1383      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1384      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1385      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1386      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1387      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1388      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1389      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1390      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1391      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
```

```
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1392      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1393      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1394      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1395      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1396      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1397      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1398      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1399      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1400      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1401      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1402      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1403      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1404      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1405      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
```

```
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1406       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1407       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1408       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1409       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1410       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1411       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1412       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1413       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1414       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1415       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1416       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1417       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1418       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1419       Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                 Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

```
Job # 1420      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1421      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1422      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1423      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1424      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1425      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1426      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1427      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1428      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1429      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1430      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1431      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1432      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1433      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1434      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
```

```
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1435      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1436      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1437      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1438      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1439      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 1440      Executing Experiment =  Evaluate Random Forest Models  Index_Name =  MSDUJN  ML Mode
l =  RandomForestClassifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

Permutations Executed for Random Forest Model

In [133]:
```
print("Total number of Random Forest models evaluated for optimization = ", len(results_df_rf))
results_df_rf.head() # Just display the top 5
```

```
Total number of Random Forest models evaluated for optimization =  1440
```

Out[133]:

	Experiment Name	Experiment Description	Dataset	Index	Classifier	CV	BL_Precision	BL_Recall	BL_Accuracy	ML_Precision	ML_Re
0	Evaluate Random Forest Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	RandomForestClassifier	10	0.536623	0.528292	0.503616	0.445693	0.440
0	Evaluate Random Forest Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	RandomForestClassifier	10	0.531188	0.405108	0.490490	0.461260	0.473
0	Evaluate Random Forest Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	RandomForestClassifier	10	0.535591	0.467201	0.498259	0.467460	0.495
0	Evaluate Random Forest Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	RandomForestClassifier	10	0.526870	0.500751	0.492365	0.468518	0.504
0	Evaluate Random Forest Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	RandomForestClassifier	10	0.537475	0.545819	0.505759	0.470998	0.514

Select Best Models for each Index for Random Forest

In [134]:
```
analysis_columns = ["Classifier", "Job_ID", "Index",
                    "Combine_ML_Precision", "Combine_ML_Recall", "Combine_ML_Accuracy"]


best_rf_models_dict, optimum_models_metrics_rf_df = \
              getOptimizedModelsDict(results_df = results_df_rf,
                                     models_fitted = models_fitted_dict_rf,
                                     metric = "Combine_ML_Accuracy")

optimum_models_metrics_rf_df[analysis_columns]
```

Out[134]:

	Classifier	Job_ID	Index	Combine_ML_Precision	Combine_ML_Recall	Combine_ML_Accuracy
27	RandomForestClassifier	28	S&P_500	0.791250	0.750890	0.798018
390	RandomForestClassifier	391	Nasdaq	0.784417	0.789039	0.805518
521	RandomForestClassifier	522	DJI	0.775111	0.747715	0.793732
746	RandomForestClassifier	747	MXUS	0.798203	0.760903	0.804586
989	RandomForestClassifier	990	MSDUUK	0.768773	0.800310	0.799295
1245	RandomForestClassifier	1246	MSDUJN	0.787589	0.733877	0.779189

Validate Best Models For Each Index With Training Set for QA

In [135]:
```
models_1 = [ best_rf_models_dict.get('S&P_500'), best_rf_models_dict.get('Nasdaq'),
             best_rf_models_dict.get('DJI') ]

models_2 = [ best_rf_models_dict.get('MXUS'), best_rf_models_dict.get('MSDUUK'),
             best_rf_models_dict.get('MSDUJN') ]

predictions_eval_1   =  {'prediction_name'  : "Predict Random Forest Models",
                         'description'      : "Evaluate Only Financial Index Features",
                         'indexes'          : ["S&P_500", "Nasdaq", "DJI"],
                         'dataset_name'     : "US Market Indexes",
                         'x_features_names' : [ "r_{}", "R_{}", "V_{}" ] ,
                         'y_label_name'     : "label_{}",
                         'y_ml_label_name'  : "f_label_{}",
                         'cv'               : 10,
                         'models'           : models_1,
                         'dataset'          : indixes_data_training_set_1 }

predictions_eval_2   = {'prediction_name'   : "Predict Random Forest Models",
                         'description'      : "Evaluate Only Financial Index Features",
                         'indexes'          : ["MXUS", "MSDUUK", "MSDUJN"],
                         'dataset_name'     : "MSUS-MSDUUK-MSDUJN Market Indexes",
                         'x_features_names' : [ "r_{}", "R_{}", "V_{}" ] ,
                         'y_label_name'     : "label_{}",
                         'y_ml_label_name'  : "f_label_{}",
                         'cv'               : 10,
                         'models'           : models_2,
                         'dataset'          : indixes_data_training_set_2 }

predictions_rf_df, models_rf_fitted_dict, cm_ml_rf_dict, cm_ml_compact_rf_dict = \
          executePredictionsSet ( predictions = [predictions_eval_1, predictions_eval_2], FitModels =
True )
```

In [136]:
```
rf_training_results_df = predictions_rf_df[ predictions_rf_df.Model == "Combine ML" ]
analysis_columns = ["Classifier", "Metric", "DJI", "S&P_500", "Nasdaq", "MXUS", "MSDUUK", "MSDUJN"]

rf_training_results_stats_df = \
       rf_training_results_df[analysis_columns].groupby(['Classifier', 'Metric']).max()

rf_training_results_stats_df.style.format("{:.2%}")
```

Out[136]:

Classifier	Metric	DJI	S&P_500	Nasdaq	MXUS	MSDUUK	MSDUJN
RandomForestClassifier	Accuracy	81.44%	80.85%	81.54%	81.66%	81.59%	79.12%
	Precision	80.04%	80.29%	79.47%	81.31%	78.77%	80.35%
	Recall	76.97%	76.33%	80.08%	77.26%	81.58%	74.28%

6.3.5.2 Additional Models Optimization

6.3.5.2.1 SVC Classifier

In [137]:
```python
from sklearn.svm import SVC
from sklearn.model_selection import ParameterGrid

# ***
# *** Each classifier, needs to be optimzed for each Stock Index
# ***
# ***    Note: This is a customized optimization, since we are optimizing the accuracy of the
# ***          Combine Multi-Label, which can only be infered after evaluating the Multi_Label case
# ***

param_grid_svc = ParameterGrid( { 'gamma': [1e-1, 1e-2, 1e-3],
                                  'C': [1, 10, 50, 100]} )

models = []

for i, params in enumerate(param_grid_svc):
    SVC_clf = SVC(**params, kernel="rbf", random_state=42)
    models.append(SVC_clf)

optimization_eval_svc_1   = {'experiment_name'  : "Evaluate SVC Models",
                             'description'      : "Evaluate Only Financial Index Features",
                             'indexes'          : ["S&P_500", "Nasdaq", "DJI"],
                             'dataset_name'     : "US Market Indexes",
                             'x_features_names' : [ "r_{}", "R_{}", "V_{}" ] ,
                             'y_label_name'     : "label_{}",
                             'y_ml_label_name'  : "f_label_{}",
                             'cv'               : 10,
                             'models'           : models,
                             'dataset'          : indixes_data_training_set_1 }

optimization_eval_svc_2   = {'experiment_name'  : "Evaluate SVC Models",
                             'description'      : "Evaluate Only Financial Index Features",
                             'indexes'          : ["MXUS", "MSDUUK", "MSDUJN"],
                             'dataset_name'     : "MSUS-MSDUUK-MSDUJN Market Indexes",
                             'x_features_names' : [ "r_{}", "R_{}", "V_{}" ] ,
                             'y_label_name'     : "label_{}",
                             'y_ml_label_name'  : "f_label_{}",
                             'cv'               : 10,
                             'models'           : models,
                             'dataset'          : indixes_data_training_set_2 }
```

```
results_df_svc, results_df_details_svc, models_fitted_dict_svc = \
                    executeExperimentSet ( experiments = [optimization_eval_svc_1, optimization_eval_
svc_2
                                                          ] )
```

```
Job # 1          Executing Experiment =  Evaluate SVC Models  Index_Name =  S&P_500  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 2          Executing Experiment =  Evaluate SVC Models  Index_Name =  S&P_500  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 3          Executing Experiment =  Evaluate SVC Models  Index_Name =  S&P_500  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 4          Executing Experiment =  Evaluate SVC Models  Index_Name =  S&P_500  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 5          Executing Experiment =  Evaluate SVC Models  Index_Name =  S&P_500  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 6          Executing Experiment =  Evaluate SVC Models  Index_Name =  S&P_500  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 7          Executing Experiment =  Evaluate SVC Models  Index_Name =  S&P_500  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 8          Executing Experiment =  Evaluate SVC Models  Index_Name =  S&P_500  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 9          Executing Experiment =  Evaluate SVC Models  Index_Name =  S&P_500  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 10         Executing Experiment =  Evaluate SVC Models  Index_Name =  S&P_500  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 11         Executing Experiment =  Evaluate SVC Models  Index_Name =  S&P_500  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 12         Executing Experiment =  Evaluate SVC Models  Index_Name =  S&P_500  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 13         Executing Experiment =  Evaluate SVC Models  Index_Name =  Nasdaq  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 14         Executing Experiment =  Evaluate SVC Models  Index_Name =  Nasdaq  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 15         Executing Experiment =  Evaluate SVC Models  Index_Name =  Nasdaq  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 16         Executing Experiment =  Evaluate SVC Models  Index_Name =  Nasdaq  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 17         Executing Experiment =  Evaluate SVC Models  Index_Name =  Nasdaq  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 18         Executing Experiment =  Evaluate SVC Models  Index_Name =  Nasdaq  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 19         Executing Experiment =  Evaluate SVC Models  Index_Name =  Nasdaq  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 20         Executing Experiment =  Evaluate SVC Models  Index_Name =  Nasdaq  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 21         Executing Experiment =  Evaluate SVC Models  Index_Name =  Nasdaq  ML Model =  SVC
                 Dataset =  US Market Indexes
Job # 22         Executing Experiment =  Evaluate SVC Models  Index_Name =  Nasdaq  ML Model =  SVC
```

```
                  Dataset =  US Market Indexes
Job # 23          Executing Experiment =  Evaluate SVC Models  Index_Name =  Nasdaq  ML Model =  SVC
                  Dataset =  US Market Indexes
Job # 24          Executing Experiment =  Evaluate SVC Models  Index_Name =  Nasdaq  ML Model =  SVC
                  Dataset =  US Market Indexes
Job # 25          Executing Experiment =  Evaluate SVC Models  Index_Name =  DJI  ML Model =  SVC
                  Dataset =  US Market Indexes
Job # 26          Executing Experiment =  Evaluate SVC Models  Index_Name =  DJI  ML Model =  SVC
                  Dataset =  US Market Indexes
Job # 27          Executing Experiment =  Evaluate SVC Models  Index_Name =  DJI  ML Model =  SVC
                  Dataset =  US Market Indexes
Job # 28          Executing Experiment =  Evaluate SVC Models  Index_Name =  DJI  ML Model =  SVC
                  Dataset =  US Market Indexes
Job # 29          Executing Experiment =  Evaluate SVC Models  Index_Name =  DJI  ML Model =  SVC
                  Dataset =  US Market Indexes
Job # 30          Executing Experiment =  Evaluate SVC Models  Index_Name =  DJI  ML Model =  SVC
                  Dataset =  US Market Indexes
Job # 31          Executing Experiment =  Evaluate SVC Models  Index_Name =  DJI  ML Model =  SVC
                  Dataset =  US Market Indexes
Job # 32          Executing Experiment =  Evaluate SVC Models  Index_Name =  DJI  ML Model =  SVC
                  Dataset =  US Market Indexes
Job # 33          Executing Experiment =  Evaluate SVC Models  Index_Name =  DJI  ML Model =  SVC
                  Dataset =  US Market Indexes
Job # 34          Executing Experiment =  Evaluate SVC Models  Index_Name =  DJI  ML Model =  SVC
                  Dataset =  US Market Indexes
Job # 35          Executing Experiment =  Evaluate SVC Models  Index_Name =  DJI  ML Model =  SVC
                  Dataset =  US Market Indexes
Job # 36          Executing Experiment =  Evaluate SVC Models  Index_Name =  DJI  ML Model =  SVC
                  Dataset =  US Market Indexes
Job # 37          Executing Experiment =  Evaluate SVC Models  Index_Name =  MXUS  ML Model =  SVC
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 38          Executing Experiment =  Evaluate SVC Models  Index_Name =  MXUS  ML Model =  SVC
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 39          Executing Experiment =  Evaluate SVC Models  Index_Name =  MXUS  ML Model =  SVC
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 40          Executing Experiment =  Evaluate SVC Models  Index_Name =  MXUS  ML Model =  SVC
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 41          Executing Experiment =  Evaluate SVC Models  Index_Name =  MXUS  ML Model =  SVC
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 42          Executing Experiment =  Evaluate SVC Models  Index_Name =  MXUS  ML Model =  SVC
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 43          Executing Experiment =  Evaluate SVC Models  Index_Name =  MXUS  ML Model =  SVC
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

```
Job # 44        Executing Experiment =  Evaluate SVC Models  Index_Name =  MXUS  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 45        Executing Experiment =  Evaluate SVC Models  Index_Name =  MXUS  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 46        Executing Experiment =  Evaluate SVC Models  Index_Name =  MXUS  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 47        Executing Experiment =  Evaluate SVC Models  Index_Name =  MXUS  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 48        Executing Experiment =  Evaluate SVC Models  Index_Name =  MXUS  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 49        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUUK  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 50        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUUK  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 51        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUUK  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 52        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUUK  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 53        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUUK  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 54        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUUK  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 55        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUUK  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 56        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUUK  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 57        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUUK  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 58        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUUK  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 59        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUUK  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 60        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUUK  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 61        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUJN  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 62        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUJN  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 63        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUJN  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 64        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUJN  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 65        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUJN  ML Model =  SVC
```

```
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 66        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUJN  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 67        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUJN  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 68        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUJN  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 69        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUJN  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 70        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUJN  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 71        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUJN  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 72        Executing Experiment =  Evaluate SVC Models  Index_Name =  MSDUJN  ML Model =  SVC
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

Permutations Executed for SVC Model

In [138]:

```
print("Total number of SVC models evaluated for optimization = ", len(results_df_svc))
results_df_svc.head(108) # Just display the top 5
```

Total number of SVC models evaluated for optimization = 72

Out[138]:

	Experiment Name	Experiment Description	Dataset	Index	Classifier	CV	BL_Precision	BL_Recall	BL_Accuracy	ML_Precision	ML_Recall	ML_/
0	Evaluate SVC Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	SVC	10	0.528217	0.937406	0.518618	0.498028	0.572462	
0	Evaluate SVC Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	SVC	10	0.532845	0.982974	0.529869	0.515678	0.572462	
0	Evaluate SVC Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	SVC	10	0.534853	0.998998	0.534691	0.539098	0.540852	
0	Evaluate SVC Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	SVC	10	0.531295	0.922384	0.523172	0.490534	0.569247	
0	Evaluate SVC Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	SVC	10	0.530807	0.974962	0.525583	0.488412	0.571926	
...	...	...	...	...	...	...	...	...	...	...	...	
0	Evaluate SVC Models	Evaluate Only Financial Index Features	MSUS-MSDUUK-MSDUJN Market Indexes	MSDUJN	SVC	10	0.512440	0.951068	0.511817	0.431238	0.473369	
0	Evaluate SVC Models	Evaluate Only Financial Index Features	MSUS-MSDUUK-MSDUJN Market Indexes	MSDUJN	SVC	10	0.511817	1.000000	0.511817	0.390730	0.481834	

	Experiment Name	Experiment Description	Dataset	Index	Classifier	CV	BL_Precision	BL_Recall	BL_Accuracy	ML_Precision	ML_Recall	ML_/
0	Evaluate SVC Models	Evaluate Only Financial Index Features	MSUS-MSDUUK-MSDUJN Market Indexes	MSDUJN	SVC	10	0.519091	0.740179	0.516049	0.494079	0.496649	
0	Evaluate SVC Models	Evaluate Only Financial Index Features	MSUS-MSDUUK-MSDUJN Market Indexes	MSDUJN	SVC	10	0.513168	0.940041	0.512875	0.445252	0.474780	
0	Evaluate SVC Models	Evaluate Only Financial Index Features	MSUS-MSDUUK-MSDUJN Market Indexes	MSDUJN	SVC	10	0.511825	0.999311	0.511817	0.581739	0.483951	

72 rows × 17 columns

Select Best Models for each Index for SVC

In [139]:
```
analysis_columns = ["Classifier", "Job_ID", "Index",
                    "Combine_ML_Precision", "Combine_ML_Recall", "Combine_ML_Accuracy"]

best_svc_models_dict, optimum_models_metrics_svc_df = \
              getOptimizedModelsDict(results_df = results_df_svc,
                                     models_fitted = models_fitted_dict_svc,
                                     metric = "Combine_ML_Accuracy")

optimum_models_metrics_svc_df[analysis_columns]
```

Out[139]:

	Classifier	Job_ID	Index	Combine_ML_Precision	Combine_ML_Recall	Combine_ML_Accuracy
8	SVC	9	S&P_500	0.797811	0.734875	0.796143
23	SVC	24	Nasdaq	0.815324	0.733648	0.803375
29	SVC	30	DJI	0.800827	0.708105	0.794267
40	SVC	41	MXUS	0.795082	0.755452	0.801058
53	SVC	54	MSDUUK	0.819298	0.722910	0.801058
64	SVC	65	MSDUJN	0.795885	0.716827	0.777778

Validate Best Models For Each Index With Training Set for QA

```
In [140]: models_1 = [ best_svc_models_dict.get('S&P_500'), best_svc_models_dict.get('Nasdaq'),
                       best_svc_models_dict.get('DJI') ]

          models_2 = [ best_svc_models_dict.get('MXUS'), best_svc_models_dict.get('MSDUUK'),
                       best_svc_models_dict.get('MSDUJN') ]

          predictions_eval_svc_1   =  {'prediction_name'   : "Predict SVC Models",
                                        'description'       : "Evaluate Only Financial Index Features",
                                        'indexes'           : ["S&P_500", "Nasdaq", "DJI"],
                                        'dataset_name'      : "US Market Indexes",
                                        'x_features_names'  : [ "r_{}", "R_{}", "V_{}" ] ,
                                        'y_label_name'      : "label_{}",
                                        'y_ml_label_name'   : "f_label_{}",
                                        'cv'                : 10,
                                        'models'            : models_1,
                                        'dataset'           : indixes_data_training_set_1 }

          predictions_eval_svc_2  = {'prediction_name'    : "Predict SVC Models",
                                      'description'        : "Evaluate Only Financial Index Features",
                                      'indexes'            : ["MXUS", "MSDUUK", "MSDUJN"],
                                      'dataset_name'       : "MSUS-MSDUUK-MSDUJN Market Indexes",
                                      'x_features_names'   : [ "r_{}", "R_{}", "V_{}" ] ,
                                      'y_label_name'       : "label_{}",
                                      'y_ml_label_name'    : "f_label_{}",
                                      'cv'                 : 10,
                                      'models'             : models_2,
                                      'dataset'            : indixes_data_training_set_2 }


          predictions_svc_df, models_svc_fitted_dict, cm_ml_svc_dict, cm_ml_compact_svc_dict = \
                    executePredictionsSet ( predictions = [predictions_eval_svc_1, predictions_eval_svc_2],
                                                                FitModels = True )
```

In [141]:

```
svc_training_results_df = predictions_svc_df[ predictions_svc_df.Model == "Combine ML" ]
analysis_columns = ["Classifier", "Metric", "DJI", "S&P_500", "Nasdaq", "MXUS", "MSDUUK", "MSDUJN"]

svc_training_results_stats_df = \
        svc_training_results_df[analysis_columns].groupby(['Classifier', 'Metric']).max()

svc_training_results_stats_df
```

Out[141]:

		DJI	S&P_500	Nasdaq	MXUS	MSDUUK	MSDUJN
Classifier	**Metric**						
SVC	**Accuracy**	0.796678	0.797750	0.803643	0.800705	0.803175	0.779189
	Precision	0.804558	0.797825	0.815033	0.793469	0.819686	0.798021
	Recall	0.709933	0.739620	0.734826	0.757009	0.728328	0.717569

6.3.5.2.2 SGD Classifier

In [142]:

```python
from sklearn.linear_model import SGDClassifier
from sklearn.model_selection import ParameterGrid

# ***
# *** Each classifier, needs to be optimzed for each Stock Index
# ***
# ***    Note: This is a customized optimization, since we are optimizing the accuracy of the
# ***          Combine Multi-Label, which can only be infered after evaluating the Multi_Label case
# ***

param_grid_sgd = ParameterGrid( { "loss"    : ["hinge", "log", "squared_hinge", "modified_huber"],
                                  "alpha"   : [0.0001, 0.001, 0.01, 0.1],
                                  "penalty" : ["l2", "l1", "none"]})

models = []

for i, params in enumerate(param_grid_sgd):
    SGD_clf = SGDClassifier(**params, max_iter=1000, tol=1e-3, random_state=42)
    models.append(SGD_clf)

optimization_eval_sgd_1   = {'experiment_name'  : "Evaluate SGD Models",
                             'description'      : "Evaluate Only Financial Index Features",
                             'indexes'          : ["S&P_500", "Nasdaq", "DJI"],
                             'dataset_name'     : "US Market Indexes",
                             'x_features_names' : [ "r_{}", "R_{}", "V_{}" ] ,
                             'y_label_name'     : "label_{}",
                             'y_ml_label_name'  : "f_label_{}",
                             'cv'               : 10,
                             'models'           : models,
                             'dataset'          : indixes_data_training_set_1 }

optimization_eval_sgd_2   = {'experiment_name'  : "Evaluate SGD Models",
                             'description'      : "Evaluate Only Financial Index Features",
                             'indexes'          : ["MXUS", "MSDUUK", "MSDUJN"],
                             'dataset_name'     : "MSUS-MSDUUK-MSDUJN Market Indexes",
                             'x_features_names' : [ "r_{}", "R_{}", "V_{}" ] ,
                             'y_label_name'     : "label_{}",
                             'y_ml_label_name'  : "f_label_{}",
                             'cv'               : 10,
                             'models'           : models,
                             'dataset'          : indixes_data_training_set_2 }
```

```
results_df_sgd, results_df_details_sgd, models_fitted_dict_sgd = \
                    executeExperimentSet ( experiments = [optimization_eval_sgd_1, optimization_eval_
sgd_2] )
```

```
Job # 1         Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 2         Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 3         Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 4         Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 5         Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 6         Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 7         Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 8         Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 9         Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 10        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 11        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 12        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 13        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 14        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 15        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
```

```
lassifier
                Dataset =  US Market Indexes
Job # 16        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 17        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 18        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 19        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 20        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
                Dataset =  US Market Indexes
Job # 21        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
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Job # 22        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
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Job # 23        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
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Job # 25        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
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Job # 26        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
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Job # 27        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
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Job # 28        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
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Job # 29        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
lassifier
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Job # 30         Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
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Job # 32         Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
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Job # 33         Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
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Job # 43         Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
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Job # 44        Executing Experiment =  Evaluate SGD Models  Index_Name =  S&P_500  ML Model =  SGDC
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Job # 97        Executing Experiment =  Evaluate SGD Models  Index_Name =  DJI  ML Model =  SGDClass
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Job # 99        Executing Experiment =  Evaluate SGD Models  Index_Name =  DJI  ML Model =  SGDClass
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Job # 101       Executing Experiment =  Evaluate SGD Models  Index_Name =  DJI  ML Model =  SGDClass
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Job # 102        Executing Experiment =  Evaluate SGD Models  Index_Name =  DJI  ML Model =  SGDClass
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Job # 115        Executing Experiment =  Evaluate SGD Models  Index_Name =  DJI  ML Model =  SGDClass
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Dataset = US Market Indexes
Job # 116	Executing Experiment = Evaluate SGD Models Index_Name = DJI ML Model = SGDClass
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Dataset = US Market Indexes
Job # 117	Executing Experiment = Evaluate SGD Models Index_Name = DJI ML Model = SGDClass
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Dataset = US Market Indexes
Job # 118	Executing Experiment = Evaluate SGD Models Index_Name = DJI ML Model = SGDClass
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Dataset = US Market Indexes
Job # 119	Executing Experiment = Evaluate SGD Models Index_Name = DJI ML Model = SGDClass
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Dataset = US Market Indexes
Job # 120	Executing Experiment = Evaluate SGD Models Index_Name = DJI ML Model = SGDClass
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Dataset = US Market Indexes
Job # 121	Executing Experiment = Evaluate SGD Models Index_Name = DJI ML Model = SGDClass
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Dataset = US Market Indexes
Job # 122	Executing Experiment = Evaluate SGD Models Index_Name = DJI ML Model = SGDClass
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Dataset = US Market Indexes
Job # 123	Executing Experiment = Evaluate SGD Models Index_Name = DJI ML Model = SGDClass
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Dataset = US Market Indexes
Job # 124	Executing Experiment = Evaluate SGD Models Index_Name = DJI ML Model = SGDClass
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Dataset = US Market Indexes
Job # 125	Executing Experiment = Evaluate SGD Models Index_Name = DJI ML Model = SGDClass
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Dataset = US Market Indexes
Job # 126	Executing Experiment = Evaluate SGD Models Index_Name = DJI ML Model = SGDClass
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Dataset = US Market Indexes
Job # 127	Executing Experiment = Evaluate SGD Models Index_Name = DJI ML Model = SGDClass
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Dataset = US Market Indexes
Job # 128	Executing Experiment = Evaluate SGD Models Index_Name = DJI ML Model = SGDClass
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Dataset = US Market Indexes
Job # 129	Executing Experiment = Evaluate SGD Models Index_Name = DJI ML Model = SGDClass
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Dataset = US Market Indexes

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Job # 130       Executing Experiment =  Evaluate SGD Models  Index_Name =  DJI  ML Model =  SGDClass
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Job # 144       Executing Experiment =  Evaluate SGD Models  Index_Name =  DJI  ML Model =  SGDClass
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Job # 158       Executing Experiment =  Evaluate SGD Models  Index_Name =  MXUS  ML Model =  SGDClas
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Job # 159         Executing Experiment =  Evaluate SGD Models  Index_Name =  MXUS  ML Model =  SGDClas
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Job # 163         Executing Experiment =  Evaluate SGD Models  Index_Name =  MXUS  ML Model =  SGDClas
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Job # 171         Executing Experiment =  Evaluate SGD Models  Index_Name =  MXUS  ML Model =  SGDClas
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Job # 172         Executing Experiment =  Evaluate SGD Models  Index_Name =  MXUS  ML Model =  SGDClas
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                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
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Job # 185       Executing Experiment =  Evaluate SGD Models  Index_Name =  MXUS  ML Model =  SGDClas
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                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 186       Executing Experiment =  Evaluate SGD Models  Index_Name =  MXUS  ML Model =  SGDClas
sifier
                Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 187       Executing Experiment =  Evaluate SGD Models  Index_Name =  MXUS  ML Model =  SGDClas
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Dataset = MSUS-MSDUUK-MSDUJN Market Indexes

Job # 188 Executing Experiment = Evaluate SGD Models Index_Name = MXUS ML Model = SGDClassifier

Dataset = MSUS-MSDUUK-MSDUJN Market Indexes

Job # 189 Executing Experiment = Evaluate SGD Models Index_Name = MXUS ML Model = SGDClassifier

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Job # 193 Executing Experiment = Evaluate SGD Models Index_Name = MSDUUK ML Model = SGDClassifier

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Job # 202        Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUUK  ML Model =  SGDCl
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Job # 216 Executing Experiment = Evaluate SGD Models Index_Name = MSDUUK ML Model = SGDClassifier
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Job # 245   Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
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Job # 246   Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
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Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
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Job # 253   Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 254   Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 255   Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 256   Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
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Job # 257   Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
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Dataset = MSUS-MSDUUK-MSDUJN Market Indexes

Job # 259 Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
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Job # 260 Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
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Job # 263 Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 264 Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
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Job # 265 Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 266 Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
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Job # 268 Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 269 Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 270 Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 271 Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 272 Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDClassifier
Dataset = MSUS-MSDUUK-MSDUJN Market Indexes
Job # 273 Executing Experiment = Evaluate SGD Models Index_Name = MSDUJN ML Model = SGDCl

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                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 274         Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUJN  ML Model =  SGDCl
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                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 275         Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUJN  ML Model =  SGDCl
assifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 276         Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUJN  ML Model =  SGDCl
assifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 277         Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUJN  ML Model =  SGDCl
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                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 278         Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUJN  ML Model =  SGDCl
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Job # 279         Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUJN  ML Model =  SGDCl
assifier
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Job # 280         Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUJN  ML Model =  SGDCl
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Job # 281         Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUJN  ML Model =  SGDCl
assifier
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Job # 282         Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUJN  ML Model =  SGDCl
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Job # 283         Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUJN  ML Model =  SGDCl
assifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 284         Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUJN  ML Model =  SGDCl
assifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 285         Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUJN  ML Model =  SGDCl
assifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 286         Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUJN  ML Model =  SGDCl
assifier
                  Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 287         Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUJN  ML Model =  SGDCl
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```
                    Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
Job # 288           Executing Experiment =  Evaluate SGD Models  Index_Name =  MSDUJN  ML Model =  SGDCl
assifier
                    Dataset =  MSUS-MSDUUK-MSDUJN Market Indexes
```

Permutations Executed for SGD Model

In [143]:
```python
print("Total number of SGD models evaluated for optimization = ", len(results_df_sgd))
results_df_sgd.head() # Just display the top 5
```

```
Total number of SGD models evaluated for optimization =  288
```

Out[143]:

	Experiment Name	Experiment Description	Dataset	Index	Classifier	CV	BL_Precision	BL_Recall	BL_Accuracy	ML_Precision	ML_Recall	ML_
0	Evaluate SGD Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	SGDClassifier	10	0.525988	0.719579	0.503081	0.478674	0.548620	
0	Evaluate SGD Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	SGDClassifier	10	0.536946	0.491237	0.501205	0.474209	0.547549	
0	Evaluate SGD Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	SGDClassifier	10	0.533000	0.748122	0.514600	0.464737	0.549424	
0	Evaluate SGD Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	SGDClassifier	10	0.529079	0.701552	0.506295	0.470422	0.556389	
0	Evaluate SGD Models	Evaluate Only Financial Index Features	US Market Indexes	S&P_500	SGDClassifier	10	0.513037	0.364547	0.474953	0.503834	0.559068	

Select Best Models for each Index for SGD

In [144]:
```
analysis_columns = ["Classifier", "Job_ID", "Index",
                    "Combine_ML_Precision", "Combine_ML_Recall", "Combine_ML_Accuracy"]

best_sgd_models_dict, optimum_models_metrics_sgd_df = \
              getOptimizedModelsDict(results_df = results_df_sgd,
                                     models_fitted = models_fitted_dict_sgd,
                                     metric = "Combine_ML_Accuracy")

optimum_models_metrics_sgd_df[analysis_columns]
```

Out[144]:

	Classifier	Job_ID	Index	Combine_ML_Precision	Combine_ML_Recall	Combine_ML_Accuracy
29	SGDClassifier	30	S&P_500	0.816940	0.709371	0.796946
77	SGDClassifier	78	Nasdaq	0.815274	0.736005	0.804179
125	SGDClassifier	126	DJI	0.799043	0.712371	0.794803
161	SGDClassifier	162	MXUS	0.817235	0.672118	0.783422
207	SGDClassifier	208	MSDUUK	0.807260	0.722910	0.795062
255	SGDClassifier	256	MSDUJN	0.807890	0.698295	0.777425

Validate Best Models For Each Index With Training Set for QA

In [145]:
```
models_1 = [ best_sgd_models_dict.get('S&P_500'), best_sgd_models_dict.get('Nasdaq'),
             best_sgd_models_dict.get('DJI') ]

models_2 = [ best_sgd_models_dict.get('MXUS'), best_sgd_models_dict.get('MSDUUK'),
             best_sgd_models_dict.get('MSDUJN') ]

predictions_eval_sgd_1   =  {'prediction_name'   : "Predict SGD Models",
                             'description'       : "Evaluate Only Financial Index Features",
                             'indexes'           : ["S&P_500", "Nasdaq", "DJI"],
                             'dataset_name'      : "US Market Indexes",
                             'x_features_names'  : [ "r_{}", "R_{}", "V_{}" ] ,
                             'y_label_name'      : "label_{}",
                             'y_ml_label_name'   : "f_label_{}",
                             'cv'                : 10,
                             'models'            : models_1,
                             'dataset'           : indixes_data_training_set_1 }

predictions_eval_sgd_2  = {'prediction_name'    : "Predict SGD Models",
                           'description'        : "Evaluate Only Financial Index Features",
                           'indexes'            : ["MXUS", "MSDUUK", "MSDUJN"],
                           'dataset_name'       : "MSUS-MSDUUK-MSDUJN Market Indexes",
                           'x_features_names'   : [ "r_{}", "R_{}", "V_{}" ] ,
                           'y_label_name'       : "label_{}",
                           'y_ml_label_name'    : "f_label_{}",
                           'cv'                 : 10,
                           'models'             : models_2,
                           'dataset'            : indixes_data_training_set_2 }

predictions_sgd_df, models_sgd_fitted_dict, cm_ml_sgd_dict, cm_ml_compact_sgd_dict = \
          executePredictionsSet ( predictions = [predictions_eval_sgd_1, predictions_eval_sgd_2],
                                       FitModels = True )
```

In [146]:
```
sgd_training_results_df = predictions_sgd_df[ predictions_sgd_df.Model == "Combine ML" ]
analysis_columns = ["Classifier", "Metric", "DJI", "S&P_500", "Nasdaq", "MXUS", "MSDUUK", "MSDUJN"]

sgd_training_results_stats_df = \
       sgd_training_results_df[analysis_columns].groupby(['Classifier', 'Metric']).max()

sgd_training_results_stats_df
```

Out[146]:

Classifier	Metric	DJI	S&P_500	Nasdaq	MXUS	MSDUUK	MSDUJN
SGDClassifier	**Accuracy**	0.797214	0.799357	0.802572	0.781305	0.802116	0.774603
	Precision	0.810830	0.816768	0.812094	0.839468	0.799345	0.801871
	Recall	0.702620	0.716489	0.736005	0.639408	0.755418	0.699036

6.3.6 Summary of Results For Optimized Classifiers against the Training Sets Using Cross Validation

In [147]:
```
# Aggregate all results from all optimized classifiers

summary_optimized_classifiers_training_set_df = knn_training_results_stats_df
summary_optimized_classifiers_training_set_df = \
        summary_optimized_classifiers_training_set_df.append(rf_training_results_stats_df)
summary_optimized_classifiers_training_set_df = \
        summary_optimized_classifiers_training_set_df.append(svc_training_results_stats_df)
summary_optimized_classifiers_training_set_df = \
        summary_optimized_classifiers_training_set_df.append(sgd_training_results_stats_df)

summary_optimized_classifiers_training_set_df.style.format("{:.2%}")
```

Out[147]:

Classifier	Metric	DJI	S&P_500	Nasdaq	MXUS	MSDUUK	MSDUJN
KNeighborsClassifier	Accuracy	80.74%	80.55%	81.60%	80.95%	80.67%	78.41%
	Precision	79.90%	80.85%	81.80%	82.01%	80.15%	80.13%
	Recall	75.08%	74.61%	76.55%	74.22%	76.55%	72.65%
RandomForestClassifier	Accuracy	81.44%	80.85%	81.54%	81.66%	81.59%	79.12%
	Precision	80.04%	80.29%	79.47%	81.31%	78.77%	80.35%
	Recall	76.97%	76.33%	80.08%	77.26%	81.58%	74.28%
SVC	Accuracy	79.67%	79.77%	80.36%	80.07%	80.32%	77.92%
	Precision	80.46%	79.78%	81.50%	79.35%	81.97%	79.80%
	Recall	70.99%	73.96%	73.48%	75.70%	72.83%	71.76%
SGDClassifier	Accuracy	79.72%	79.94%	80.26%	78.13%	80.21%	77.46%
	Precision	81.08%	81.68%	81.21%	83.95%	79.93%	80.19%
	Recall	70.26%	71.65%	73.60%	63.94%	75.54%	69.90%

6.3.7 Evaluate Performance with Test Datasets

6.3.7.1 Run Predictions against all indexes across datasets

6.3.7.1.1 KNN

In [148]:
```
models_1 = [ best_knn_models_dict.get('S&P_500'), best_knn_models_dict.get('Nasdaq'),
             best_knn_models_dict.get('DJI') ]

models_2 = [ best_knn_models_dict.get('MXUS'), best_knn_models_dict.get('MSDUUK'),
             best_knn_models_dict.get('MSDUJN') ]

predictions_eval_1   =  {'prediction_name'   : "Predict KNN Models",
                         'description'       : "Evaluate Only Financial Index Features",
                         'indexes'           : ["S&P_500", "Nasdaq", "DJI"],
                         'dataset_name'      : "US Market Indexes",
                         'x_features_names'  : [ "r_{}", "R_{}", "V_{}" ] ,
                         'y_label_name'      : "label_{}",
                         'y_ml_label_name'   : "f_label_{}",
                         'cv'                : 10,
                         'models'            : models_1,
                         'dataset'           : indexes_data_testing_set_1 }

predictions_eval_2   = {'prediction_name'    : "Predict KNN Models",
                         'description'       : "Evaluate Only Financial Index Features",
                         'indexes'           : ["MXUS", "MSDUUK", "MSDUJN"],
                         'dataset_name'      : "MSUS-MSDUUK-MSDUJN Market Indexes",
                         'x_features_names'  : [ "r_{}", "R_{}", "V_{}" ] ,
                         'y_label_name'      : "label_{}",
                         'y_ml_label_name'   : "f_label_{}",
                         'cv'                : 10,
                         'models'            : models_2,
                         'dataset'           : indexes_data_testing_set_2 }

predictions_test_knn_df, models_knn_fitted_dict, cm_ml_knn_dict, cm_ml_compact_knn_dict = \
          executePredictionsSet ( predictions = [predictions_eval_1, predictions_eval_2], FitModels =
False )
```

In [149]:
```
knn_testing_results_df = predictions_test_knn_df[ predictions_test_knn_df.Model == "Combine ML" ]
analysis_columns = ["Classifier", "Metric", "DJI", "S&P_500", "Nasdaq", "MXUS", "MSDUUK", "MSDUJN"]

knn_testing_results_stats_df = \
       knn_testing_results_df[analysis_columns].groupby(['Classifier', 'Metric']).max()

knn_testing_results_stats_df.style.format("{:.2%}")
```

Out[149]:

		DJI	S&P_500	Nasdaq	MXUS	MSDUUK	MSDUJN
Classifier	**Metric**						
	Accuracy	76.42%	75.10%	78.68%	78.02%	79.87%	76.01%
KNeighborsClassifier	**Precision**	69.85%	68.00%	71.90%	67.82%	78.21%	71.71%
	Recall	73.94%	68.92%	74.58%	79.02%	75.85%	72.55%

6.3.7.1.2 Random Forest

```
In [150]: models_1 = [ best_rf_models_dict.get('S&P_500'), best_rf_models_dict.get('Nasdaq'),
                       best_rf_models_dict.get('DJI') ]

          models_2 = [ best_rf_models_dict.get('MXUS'), best_rf_models_dict.get('MSDUUK'),
                       best_rf_models_dict.get('MSDUJN') ]

          predictions_eval_1   =  {'prediction_name'   : "Predict Random Forest Models",
                                   'description'       : "Evaluate Only Financial Index Features",
                                   'indexes'           : ["S&P_500", "Nasdaq", "DJI"],
                                   'dataset_name'      : "US Market Indexes",
                                   'x_features_names' : [ "r_{}", "R_{}", "V_{}" ] ,
                                   'y_label_name'      : "label_{}",
                                   'y_ml_label_name'   : "f_label_{}",
                                   'cv'                : 10,
                                   'models'            : models_1,
                                   'dataset'           : indixes_data_testing_set_1 }

          predictions_eval_2   = {'prediction_name'    : "Predict Random Forest Models",
                                   'description'       : "Evaluate Only Financial Index Features",
                                   'indexes'           : ["MXUS", "MSDUUK", "MSDUJN"],
                                   'dataset_name'      : "MSUS-MSDUUK-MSDUJN Market Indexes",
                                   'x_features_names' : [ "r_{}", "R_{}", "V_{}" ] ,
                                   'y_label_name'      : "label_{}",
                                   'y_ml_label_name'   : "f_label_{}",
                                   'cv'                : 10,
                                   'models'            : models_2,
                                   'dataset'           : indixes_data_testing_set_2 }

          predictions_test_rf_df, models_rf_fitted_dict, cm_ml_rf_dict, cm_ml_compact_rf_dict = \
                    executePredictionsSet ( predictions = [predictions_eval_1, predictions_eval_2], FitModels =
          False )
```

In [151]:
```
rf_testing_results_df = predictions_test_rf_df[ predictions_test_rf_df.Model == "Combine ML" ]
analysis_columns = ["Classifier", "Metric", "DJI", "S&P_500", "Nasdaq", "MXUS", "MSDUUK", "MSDUJN"]

rf_testing_results_stats_df = \
        rf_testing_results_df[analysis_columns].groupby(['Classifier', 'Metric']).max()

rf_testing_results_stats_df.style.format("{:.2%}")
```

Out[151]:

Classifier	Metric	DJI	S&P_500	Nasdaq	MXUS	MSDUUK	MSDUJN
RandomForestClassifier	Accuracy	77.88%	75.23%	78.54%	77.35%	80.37%	76.01%
	Precision	72.29%	67.30%	69.50%	67.18%	75.87%	71.05%
	Recall	73.94%	71.62%	80.34%	77.68%	81.89%	74.12%

6.3.7.1.3 SVC

In [152]:
```
models_1 = [ best_svc_models_dict.get('S&P_500'), best_svc_models_dict.get('Nasdaq'),
             best_svc_models_dict.get('DJI') ]

models_2 = [ best_svc_models_dict.get('MXUS'), best_svc_models_dict.get('MSDUUK'),
             best_svc_models_dict.get('MSDUJN') ]

predictions_eval_svc_1   =  {'prediction_name'   : "Predict SVC Models",
                             'description'       : "Evaluate Only Financial Index Features",
                             'indexes'           : ["S&P_500", "Nasdaq", "DJI"],
                             'dataset_name'      : "US Market Indexes",
                             'x_features_names'  : [ "r_{}", "R_{}", "V_{}" ] ,
                             'y_label_name'      : "label_{}",
                             'y_ml_label_name'   : "f_label_{}",
                             'cv'                : 10,
                             'models'            : models_1,
                             'dataset'           : indixes_data_testing_set_1 }

predictions_eval_svc_2  = {'prediction_name'    : "Predict SVC Models",
                           'description'        : "Evaluate Only Financial Index Features",
                           'indexes'            : ["MXUS", "MSDUUK", "MSDUJN"],
                           'dataset_name'       : "MSUS-MSDUUK-MSDUJN Market Indexes",
                           'x_features_names'   : [ "r_{}", "R_{}", "V_{}" ] ,
                           'y_label_name'       : "label_{}",
                           'y_ml_label_name'    : "f_label_{}",
                           'cv'                 : 10,
                           'models'             : models_2,
                           'dataset'            : indixes_data_testing_set_2 }


predictions_test_svc_df, models_svc_fitted_dict, cm_ml_svc_dict, cm_ml_compact_svc_dict = \
          executePredictionsSet ( predictions = [predictions_eval_svc_1, predictions_eval_svc_2],
                                  FitModels = False )
```

In [153]:
```
svc_testing_results_df = predictions_test_svc_df[ predictions_svc_df.Model == "Combine ML" ]
analysis_columns = ["Classifier", "Metric", "DJI", "S&P_500", "Nasdaq", "MXUS", "MSDUUK", "MSDUJN"]

svc_testing_results_stats_df = \
       svc_testing_results_df[analysis_columns].groupby(['Classifier', 'Metric']).max()

svc_testing_results_stats_df
```

Out[153]:

Classifier	Metric	DJI	S&P_500	Nasdaq	MXUS	MSDUUK	MSDUJN
SVC	Accuracy	0.772185	0.749669	0.788079	0.791946	0.817114	0.761745
	Precision	0.719870	0.677741	0.717042	0.704918	0.814516	0.725100
	Recall	0.719870	0.689189	0.755932	0.767857	0.762264	0.713725

6.3.7.1.4 SGD

In [154]:
```
models_1 = [ best_sgd_models_dict.get('S&P_500'), best_sgd_models_dict.get('Nasdaq'),
             best_sgd_models_dict.get('DJI') ]

models_2 = [ best_sgd_models_dict.get('MXUS'), best_sgd_models_dict.get('MSDUUK'),
             best_sgd_models_dict.get('MSDUJN') ]

predictions_eval_sgd_1   =  {'prediction_name'   : "Predict SGD Models",
                             'description'       : "Evaluate Only Financial Index Features",
                             'indexes'           : ["S&P_500", "Nasdaq", "DJI"],
                             'dataset_name'      : "US Market Indexes",
                             'x_features_names'  : [ "r_{}", "R_{}", "V_{}" ] ,
                             'y_label_name'      : "label_{}",
                             'y_ml_label_name'   : "f_label_{}",
                             'cv'                : 10,
                             'models'            : models_1,
                             'dataset'           : indexes_data_testing_set_1 }

predictions_eval_sgd_2  = {'prediction_name'    : "Predict SGD Models",
                           'description'        : "Evaluate Only Financial Index Features",
                           'indexes'            : ["MXUS", "MSDUUK", "MSDUJN"],
                           'dataset_name'       : "MSUS-MSDUUK-MSDUJN Market Indexes",
                           'x_features_names'   : [ "r_{}", "R_{}", "V_{}" ] ,
                           'y_label_name'       : "label_{}",
                           'y_ml_label_name'    : "f_label_{}",
                           'cv'                 : 10,
                           'models'             : models_2,
                           'dataset'            : indexes_data_testing_set_2 }

predictions_test_sgd_df, models_sgd_fitted_dict, cm_ml_sgd_dict, cm_ml_compact_sgd_dict = \
          executePredictionsSet ( predictions = [predictions_eval_sgd_1, predictions_eval_sgd_2],
                                  FitModels = False )
```

In [155]:

```
sgd_testing_results_df = predictions_test_sgd_df[ predictions_test_sgd_df.Model == "Combine ML" ]
analysis_columns = ["Classifier", "Metric", "DJI", "S&P_500", "Nasdaq", "MXUS", "MSDUUK", "MSDUJN"]

sgd_testing_results_stats_df = \
       sgd_testing_results_df[analysis_columns].groupby(['Classifier', 'Metric']).max()

sgd_testing_results_stats_df
```

Out[155]:

Classifier	Metric	DJI	S&P_500	Nasdaq	MXUS	MSDUUK	MSDUJN
SGDClassifier	**Accuracy**	0.789404	0.756291	0.794702	0.805369	0.820470	0.756711
	Precision	0.755172	0.710526	0.755474	0.757143	0.831933	0.725410
	Recall	0.713355	0.638514	0.701695	0.709821	0.747170	0.694118

6.3.7.2 Summary of Results For Optimized Classifiers against the Testing Sets

In [158]:

```
# Aggregate all results from all optimized classifiers

summary_optimized_classifiers_testing_set_df = knn_testing_results_stats_df
summary_optimized_classifiers_testing_set_df = \
        summary_optimized_classifiers_testing_set_df.append(rf_testing_results_stats_df)
summary_optimized_classifiers_testing_set_df = \
        summary_optimized_classifiers_testing_set_df.append(svc_testing_results_stats_df)
summary_optimized_classifiers_testing_set_df = \
        summary_optimized_classifiers_testing_set_df.append(sgd_testing_results_stats_df)

summary_optimized_classifiers_testing_set_df.style.format("{:.2%}")
```

Out[158]:

Classifier	Metric	DJI	S&P_500	Nasdaq	MXUS	MSDUUK	MSDUJN
KNeighborsClassifier	Accuracy	76.42%	75.10%	78.68%	78.02%	79.87%	76.01%
	Precision	69.85%	68.00%	71.90%	67.82%	78.21%	71.71%
	Recall	73.94%	68.92%	74.58%	79.02%	75.85%	72.55%
RandomForestClassifier	Accuracy	77.88%	75.23%	78.54%	77.35%	80.37%	76.01%
	Precision	72.29%	67.30%	69.50%	67.18%	75.87%	71.05%
	Recall	73.94%	71.62%	80.34%	77.68%	81.89%	74.12%
SVC	Accuracy	77.22%	74.97%	78.81%	79.19%	81.71%	76.17%
	Precision	71.99%	67.77%	71.70%	70.49%	81.45%	72.51%
	Recall	71.99%	68.92%	75.59%	76.79%	76.23%	71.37%
SGDClassifier	Accuracy	78.94%	75.63%	79.47%	80.54%	82.05%	75.67%
	Precision	75.52%	71.05%	75.55%	75.71%	83.19%	72.54%
	Recall	71.34%	63.85%	70.17%	70.98%	74.72%	69.41%

6.3.7.3 Comparison of Testing and Training Sets

In [168]:
```
(summary_optimized_classifiers_testing_set_df. \
   sub(summary_optimized_classifiers_training_set_df) ). \
 style.format("{:.2%}")
```

Out[168]:

Classifier	Metric	DJI	S&P_500	Nasdaq	MXUS	MSDUUK	MSDUJN
KNeighborsClassifier	Accuracy	-4.32%	-5.45%	-2.92%	-2.93%	-0.80%	-2.41%
	Precision	-10.05%	-12.85%	-9.91%	-14.20%	-1.94%	-8.43%
	Recall	-1.13%	-5.70%	-1.97%	4.80%	-0.70%	-0.10%
RandomForestClassifier	Accuracy	-3.56%	-5.61%	-3.00%	-4.31%	-1.22%	-3.11%
	Precision	-7.75%	-12.99%	-9.97%	-14.13%	-2.90%	-9.30%
	Recall	-3.02%	-4.71%	0.26%	0.42%	0.31%	-0.16%
SVC	Accuracy	-2.45%	-4.81%	-1.56%	-0.88%	1.39%	-1.74%
	Precision	-8.47%	-12.01%	-9.80%	-8.86%	-0.52%	-7.29%
	Recall	0.99%	-5.04%	2.11%	1.08%	3.39%	-0.38%
SGDClassifier	Accuracy	-0.78%	-4.31%	-0.79%	2.41%	1.84%	-1.79%
	Precision	-5.57%	-10.62%	-5.66%	-8.23%	3.26%	-7.65%
	Recall	1.07%	-7.80%	-3.43%	7.04%	-0.82%	-0.49%

- **There is overfit across most Classifiers except for SGD (MXUS, MSDUUK) and SVC (MSDUUK)**
- **The range of overfit in percentages is between -0.80% to -5.61% in terms of accuracy**

6.3.7.4 Testing set Confusion Matrixes for Best Classifier across Stock Indexes modeled

In [186]:
```
# Find the Best Classifier Per Index based on Accuracy

test_set_results = knn_testing_results_df
test_set_results = test_set_results.append(rf_testing_results_df)
test_set_results = test_set_results.append(svc_testing_results_df)
test_set_results = test_set_results.append(sgd_testing_results_df)
test_set_results = test_set_results[test_set_results.Metric == "Accuracy" ].set_index('Classifier')
test_set_results
```

Out[186]:

Classifier	Model	Metric	S&P_500	Nasdaq	DJI	MXUS	MSDUUK	MSDUJN
KNeighborsClassifier	Combine ML	Accuracy	0.750993	0.786755	0.764238	0.780201	0.798658	0.760067
RandomForestClassifier	Combine ML	Accuracy	0.752318	0.785430	0.778808	0.773490	0.803691	0.760067
SVC	Combine ML	Accuracy	0.749669	0.788079	0.772185	0.791946	0.817114	0.761745
SGDClassifier	Combine ML	Accuracy	0.756291	0.794702	0.789404	0.805369	0.820470	0.756711

Best Stock Index for a given classifier

In [223]:
```
best_classifiers_across_index = test_set_results[ ['S&P_500', 'Nasdaq', 'DJI', 'MXUS', 'MSDUUK', 'MSD
UJN'] ]. \
    idxmax(axis=1)

best_classifiers_names = best_classifiers_across_index.index.to_numpy().astype('str')
best_classified_index = best_classifiers_across_index.to_numpy().astype('<U6')

best_classifiers_across_index
```

Out[223]:
```
Classifier
KNeighborsClassifier       MSDUUK
RandomForestClassifier     MSDUUK
SVC                        MSDUUK
SGDClassifier              MSDUUK
dtype: object
```

Confusion Matrixes for Best Modeled Stock Indexes

In [277]:
```
from IPython.display import display, HTML

dict_confusion_matrixes_ml = {**cm_ml_knn_dict, **cm_ml_svc_dict, **cm_ml_rf_dict, **cm_ml_sgd_dict}
dict_confusion_matrixes_ml_compact = {**cm_ml_compact_knn_dict, **cm_ml_compact_svc_dict,
                                      **cm_ml_compact_rf_dict, **cm_ml_compact_sgd_dict}

for i in range( len(best_classifiers_names) ) :

    display(HTML("<br>"))
    msg = "*********** Confusion Matrix for Classifier : " + best_classifiers_names[i] +  \
          "  for stock index : " +  best_classified_index[i] +  " ***********"
    display(HTML(msg))
    display( HTML("4x4 C.M. For Multi Label (S1,S2,S3,S4)") )

    df = pd.DataFrame(dict_confusion_matrixes_ml[ best_classifiers_names[i] + best_classified_index[i
] ],
                      index = ['S1', 'S2', 'S3', 'S4'] ). \
         rename( columns={0: "S1", 1: "S2", 2 : "S3", 3 : "S4"} )
    display(HTML(df.to_html()))

    display( HTML("2x2 C.M. For Merge Multi Label (S1S2, S3S4)") )
    df_compact = pd.DataFrame(dict_confusion_matrixes_ml_compact[ best_classifiers_names[i] + \
                                                                  best_classified_index[i] ], \
                              index = ['S1S2', 'S3S4'] ). \
                              rename( columns={0: "S1S2", 1: "S3S4"} )
    display(HTML(df_compact.to_html()))
```

*********** Confusion Matrix for Classifier : KNeighborsClassifier for stock index : MSDUUK ***********

4x4 C.M. For Multi Label (S1,S2,S3,S4)

	S1	S2	S3	S4
S1	71	8	6	13
S2	135	61	16	21
S3	28	17	62	69
S4	17	2	15	55

2x2 C.M. For Merge Multi Label (S1S2, S3S4)

	S1S2	S3S4
S1S2	275	56
S3S4	64	201

*********** Confusion Matrix for Classifier : RandomForestClassifier for stock index : MSDUUK ***********

4x4 C.M. For Multi Label (S1,S2,S3,S4)

	S1	S2	S3	S4
S1	55	15	6	22
S2	89	103	26	15
S3	16	16	74	70
S4	11	5	19	54

2x2 C.M. For Merge Multi Label (S1S2, S3S4)

	S1S2	S3S4
S1S2	262	69
S3S4	48	217

*********** Confusion Matrix for Classifier : SVC for stock index : MSDUUK ***********

4x4 C.M. For Multi Label (S1,S2,S3,S4)

	S1	S2	S3	S4
S1	55	26	4	13
S2	40	164	18	11
S3	14	29	78	55
S4	9	11	26	43

2x2 C.M. For Merge Multi Label (S1S2, S3S4)

	S1S2	S3S4
S1S2	285	46
S3S4	63	202

*********** Confusion Matrix for Classifier : SGDClassifier for stock index : MSDUUK ***********

4x4 C.M. For Multi Label (S1,S2,S3,S4)

	S1	S2	S3	S4
S1	80	1	4	13
S2	190	20	11	12
S3	36	6	74	60
S4	24	1	22	42

2x2 C.M. For Merge Multi Label (S1S2, S3S4)

	S1S2	S3S4
S1S2	291	40
S3S4	67	198

7.0 Conclusions

- The results presented by Refence 1 have been validated as demonstrated by comparison of Testing Sets' results.
  - (section 6.3.7.2 of Jupyter Notebook and Reference 1, Table 3)

- Derived financial Engineered Network Parameters were found NOT to improve forecasting results
  - (section 6.3.4.2.2 of Jupyter Notebook)

- The daily log returns, five-day moving average return, five-day rolling volatility, average 5-day volatility between markets, and the engineered stock index classifications were determined to be the critical features in forecasting a market's next day price pattern
  - (6.3.4.2.2 Compare Performance Between Experiment Types (different feature sets))

- The number stock index classifications levels (S1, S2, S3, S4) derived from the Engineered Formulas in Reference 1 were validated via clustering analysis using K-Means.
  - For all stock indexes, the optimum number of clusters/classifications per index is four using the inertia method.
  - In all cases, two clusters' centroid have a positive 5-day average log returns, and two a negative one, matching Ref 1 formula
  - Volatility values for each cluster centroids matches closely the logic use in Reference 1
  - (section 6.1.8 Cluster Analysis with Unsupervised Learning)

- The results were determined to be applicable to different markets and time periods
  - (6.3.4.2.1 Compare Performance between Datasets)

- Four independent Machine Learning algorithms were determined to provide forecasting accuracy between 75 to 82% depending on the market index
- Inspection of the Precision and Recall metrics and Confusion Matrix for each classifier further demonstrate the validity of the results.
  - (section 6.3.7.4 Testing set Confusion Matrixes for Best Classifier across Stock Indexes modeled)

- Analysis of Price Movements for Analyzed Markets with respect to Indexes' Classification further validate the results.
  - Transition's frequencies from one level to another were found to be lower than the accuracy rate of the classifiers.
  - (section 6.1.6 Analysis & Visualization of Stock Indexes Classifications' Distributions / Dataset 1)

8.0 Recommendations

- Evaluate the impact of different rolling volatility windows on forecasting results, that is: 20-day, 10-day, and 3-day
- Since the Derived financial Engineered Network Parameters were found NOT to improve forecasting results, evaluate if longer sliding windows can captured additional forecasting knowledge.
  - Evaluate 60, 90, 120, and 200 days sliding windows

- Evaluate Ensemble Methods
- Evaluate Deep Neural Networks
- Define a set of trading strategies and evaluate each in relation to the forecasting predictions
  - Across different sets of indexes, time periods

- Evaluate applicability of the forecasting method to different sectors within a market, and/or sectors across markets
- Use derived index classification via unsupervised learning for forecasting next day price movement for each stock index
  - Evaluate clusters with 4, 5, and 6 different levels
  - Compare results to engineered index classifications & against trading strategies

9.0 Acknowledgments

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10.0 References

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