

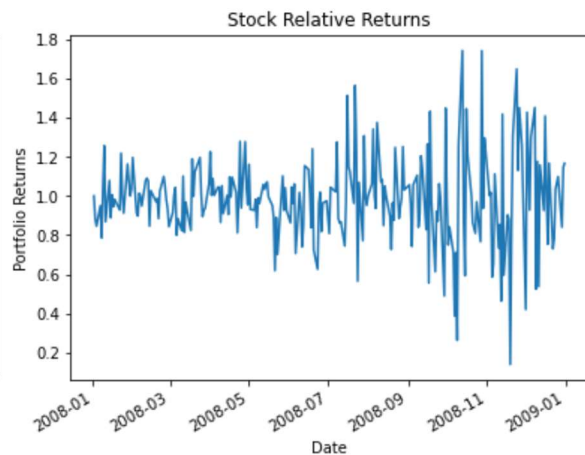
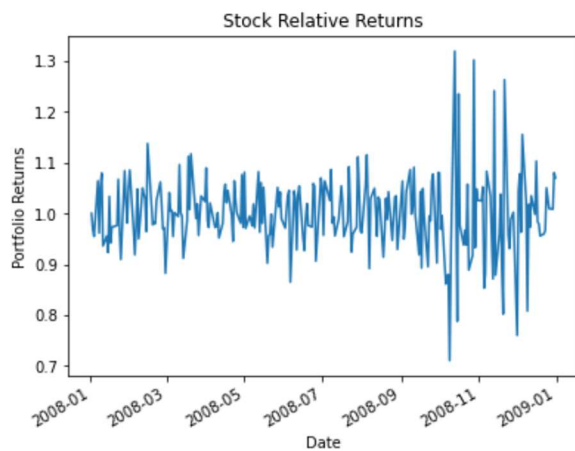
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### Portfolio Return Analysis

Companies that survive recessions tend to have the necessities needed by consumers. The reason for this is the constant consumer demand for staples and food. Examples of companies that tend to fare better than the stock market (S&P 500) include the likes of Walmart and General Mills, as opposed to companies whose industries tend to be much more sensitive to economic turmoil, such as Ford and Boeing.

	Portfolio	Values		Portfolio	Values
0	# of Securities	5	0	# of Securities	5
1	Relative Return	0.999978	1	Relative Return	0.997296
2	Annualized return	1.130057	2	Annualized return	1.126941
3	Volatility	0.075247	3	Volatility	0.222837
4	Sharpe	1.692923	4	Sharpe	1.088433
5	Drawdown	-0.072852	5	Drawdown	-0.290265



The data frame on the left represents resilient companies, while the one on the right represents the more sensitive ones. Though the relative and annualized returns show marginally better performance by the resilient companies, the increased resilience to economic turmoil can be more clearly seen in the volatility of the companies. The more resilient companies have much lower volatility compared to the more sensitive companies. We also observe the magnitude of the drawdown being much greater for the sensitive companies than it is for the resilient ones.

The Sharpe ratio is a very helpful number that can help quantify how risky a portfolio is. It ratio represents the average return earned in excess of the risk-free rate, divided by the volatility of the account. As the Sharpe ratio increases, the quality of a portfolio return's relative to risk also increases. In the scenario we are examining, the 'resilient' portfolio had a Sharpe ratio of much greater magnitude than those of the 'sensitive' portfolio, further showcasing the disparity in the two portfolio's

These data frames were made through the use of python. By importing the required libraries such as Pandas and Matplotlib, we can not only create functions to create all the necessary instruments, but we can also plot the returns of specific companies using real-time data of their respective stock prices.

### Step-By-Step Process of Portfolio Analysis Using Python:

To do so, we start with the importation of the required libraries:

```
from pandas_datareader import data
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
from datetime import datetime
from dateutil import relativedelta
%matplotlib inline
```

We then create a function to import all of the financial data we need in the form of a data frame.

We also reformat the data frame to make it easier to read.

```
#Function to provide financial data when called
def readmydata(tickers, start_date, end_date):
    financial_data = data.DataReader(tickers, 'yahoo',
                                     start_date, end_date)
    df = pd.DataFrame(financial_data)
    output = df.stack(level=-1)
    return output
```

We then create a 'pickmydata' function to select a user-requested symbol and date range. The stock prices of the specific symbols are then plotted whenever the 'pickmydata' function is called.

```
#Function takes as input dataframe and picks columns
def pickmydata(data_pack, attributes, num_days):
    col = data_pack[attributes]
    col.head()
    mytickers_name = data_pack.index.get_level_values('Symbols')
    mytickers_name = mytickers_name.unique()
    for x in mytickers_name:
        #Query dataframe for the columns user asked for
        data_ticker = data_pack[data_pack.index.get_level_values('Symbols') == x]
        #Object series indexed by date
        data_ticker_attributes = col.loc[:, x]
        #20-day moving average
        short_rolling_tickers = data_ticker_attributes.rolling(window = num_days).mean()
        #Plot num_days referring to how many days are in a unit of rolling average
        fig, ax = plt.subplots(figsize=(9,5))
        ax.plot(data_ticker_attributes.index, data_ticker_attributes, label=x)
        ax.plot(short_rolling_tickers.index, short_rolling_tickers, label= 'Rolling average')
        ax.set_xlabel('Date')
        #Find only requested ticker
        ax.set_ylabel(attributes + ' Price ($)')
        ax.legend()
        output = data_ticker_attributes.describe()
    return output
```

We follow this up with a 'stock returns' function, to calculate the daily returns of each stock in two different ways, one using pct\_change and the other by calculating its log.

```
#Function to calculate daily returns of each stock (Difference/og Price or Log(D/OG))
def stockreturns(data_pack, type_return):
    adjclose = pd.DataFrame(data_pack['Adj Close'])
    adjclose = adjclose.unstack()
    #if loop for log or relative
    if type_return == 'log' or 'logarithm':
        adjclose_ret = np.log(adjclose).diff()
    else:
        adjclose_ret = adjclose.pct_change()
    output = adjclose_ret
    return output
```

With our 'return\_plot' function, we can finally plot our return data frame. We have two different plot layouts, one with the stock prices being cumulative and the reading of the stock prices independent of each other.

```
#Cumulative/Daily return plot
def return_plot(dataframe, type_plot):
    if type_plot == 'cumulative':
        cumulative_return = dataframe.cumsum()
        fig = plt.figure()
        ax1 = fig.add_axes([0.1,0.1,0.8,0.8])
        ax1.plot(cumulative_return)
        ax1.set_xlabel('Date')
        ax1.set_ylabel("Cumulative Returns")
        ax1.set_title("Stock Cumulative Returns")
        plt.gcf().autofmt_xdate()
        plt.show();
    else:
        fig = plt.figure()
        ax1 = fig.add_axes([0.1,0.1,0.8,0.8])
        ax1.plot(dataframe)
        ax1.set_xlabel('Date')
        ax1.set_ylabel("Relative Returns")
        ax1.set_title("Stock Relative Returns")
        plt.gcf().autofmt_xdate()
        ax1.legend()
        plt.show();
```

The portfolio\_ret function is used to calculate the different metrics that are useful in interpreting the performance of a particular portfolio.

```

def portfolio_ret(dataframe, dataframe1, start_date = sd, end_date = ed ):
    #Plotting Portfolio Returns
    start_price = [1]
    weighted_df = dataframe
    ret_total = weighted_df.sum(axis=1) + start_price
    fig = plt.figure()
    ax = fig.add_axes([0.1,0.1,0.8,0.8])
    ax.plot(ret_total)
    ax.set_xlabel('Date')
    ax.set_ylabel("Portfolio Returns")
    ax.set_title("Stock Relative Returns")
    plt.gcf().autofmt_xdate()
    plt.show();
    |
    #Relative Returns
    df = dataframe.stack(level=-1)
    df = df.mean(axis=0)
    df = start_price + df
    df = round(df, 6)
    value = df.values
    ret = ','.join([str(i) for i in value])

    #Annualized Returns
    d1 = sd
    d2 = ed
    start_date = datetime.strptime(d1, "%Y-%m-%d")
    end_date = datetime.strptime(d2, "%Y-%m-%d")
    delta = relativedelta.relativedelta(end_date, start_date)
    months = delta.months
    ann_ret = (([1] + df) ** (12 / months)) - 1
    ann_ret = round(ann_ret, 6)
    value = ann_ret.values
    ann_ret = ','.join([str(i) for i in value])

    #Volatility
    dif = ret_total - ret_total.mean(axis=0)
    square = dif**2
    sum = square.sum() / len(square)
    standard_dev = np.sqrt(sum)

    #Sharpe
    adjclose = data_pack['Adj Close']
    adjclose_ret = np.log(adjclose).diff()
    sharpe = data_pack['Adj Close'].mean() / data_pack['Adj Close'].std()

    #Drawdown
    adjclose = pd.DataFrame(data_pack['Adj Close'])
    adjclose = adjclose.unstack()
    rolling_max = adjclose.cummax()
    df = (adjclose - rolling_max) / rolling_max
    df = df.stack(level=-1)
    df = df.mean(axis=0)
    drawdowns = round(df, 6)
    value = drawdowns.values
    drawdown = ','.join([str(i) for i in value])

    #Dataframe
    data = [['# of Securities', 6], ['Relative Return', ret],
            ['Annualized return', ann_ret], ['Volatility', standard_dev], ['Sharpe', sharpe],
            ['Drawdown', drawdown]]
    output = pd.DataFrame(data, columns=['Portfolio', "John Doe's Portfolio"]) #,ret_total

    return output

```

Moving on to the actual applications of these functions:

We start by first establishing a date range. We choose the entirety of the year 2008 which encompassed most of the great recession in the United States. It serves as a real-life example of how resilient companies fare compared to sensitive ones.

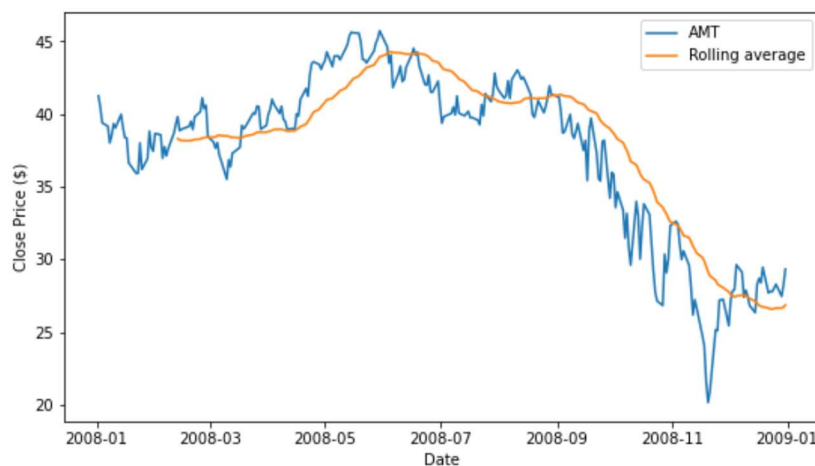
```
sd = '2008-01-01'  
ed = '2008-12-31'
```

We call the 'readmydata' function to get the requested companies and also input our requested date range. We later call the 'pickmydata' function to get the desired columns and the 'stockreturns' function to specify which type of calculation we will use to find the returns of the requested stocks and plot the results.

```
data_pack = readmydata(tickers=['WMT', 'KR', 'GIS', 'HRL', 'CPB'], start_date = sd, end_date = ed)  
#data_pack.head(10), ^GSPC
```

```
pickmydata(data_pack, "Close", 30)  
data_plot = stockreturns(data_pack, 'relative')
```

The 'pickmydata' function plots the stock prices over time and produces another line to represent the rolling average over a certain number of days. In this case, the rolling average is established over 30 days.



The 'return\_plot' function plots the aforementioned calculations but applies them to the returns of their respective stocks.

```
return_plot(data_plot, 'cumulative')  
return_plot(data_plot, 'relative')
```

We finally use 'portfolio\_ret' function to find get the data frame produced at the top of this analysis and plot showcasing the returns over time.

```
portfolio_ret(data_plot, data_pack, start_date = sd, end_date = ed)|
```

The process to call the correct functions for the sensitive function is essentially the same, the only difference being the actual companies called.

‘’

Looking at the returns of these companies, we notice that they tend to fare much better during tough financial times compared to their counterparts.

Calculating returns and visualizing the data. We can see a much more consistent return in the companies deemed resilient than those whose stock price was deemed more volatile.

Looking for trends, we can see that retail company stocks would hit a dip during the recession, but the percentage of the dip would be less extreme than that of the S&P.

Companies that tend to underperform are those that depend on consumers being able to afford big ticket items, such as cars, housing, and plane tickets. The reasons depend on the industry, for example, though the car industry is quickly becoming a necessity, is quite expensive and that alone makes the demand fall during economic downturns.

To understand which future companies are at a greater risk than average during economical downturns, it is important to look back in history and see which industries tend to suffer the most during such events.

These companies have got a dip that is either as sharp or worse than the S&P 500. Unlike the discount retail companies, the industries that these companies belong to rely on consumers spending large amounts of money, a feature that is stressed during economic downturns. Of course, it is extremely difficult to predict what type of disaster could impact the stock market tomorrow, it is still a great exercise to understand which businesses tend to weather harsh economical storms versus those that don't.