Homework 2: Return, risk, and correlation

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ESE 105

40 pts. total: 20 for programming and correct responses, 10 for programming style, 10 for presentation

Name: FILL IN HERE

Hours it took to complete assignment: FILL IN HERE

Instructions

Unzip all files within `Homework2.zip` to a single folder on your computer. Run the `Homework2.m` script. There are 3 parts in this assignment. Follow the instructions inside the "TODO: ***" labels below to complete each part: either write code or write your response to the question. For example:

```
% TODO: ************************************************************
% (Replace this comment with code)
% (Add response here)
% ************************************************************************
```

To turn in your assignment:

- Run the command `publish('Homework2.m','pdf')` in the *Command Window* to generate a PDF of your solution `Homework2.pdf`. If the PDF does not contain your plots, then run the command `publish('Homework2.m','doc')` in the *Command Window* instead.
- Submit *both* the code (`.m` file) and the published output (`.pdf` file or `.doc` file) to Canvas.

```
clear;
close all;  % comment out this line if you don't want MATLAB to erase
 all figure windows
```

Part 1: Calculate returns on investment

Import financial data contained in "fredgraph-returns.csv" into variable `finData`. The data file contains the percent yield per annum of the 10-year Treasury Note, the 1-year return on investment (percent) for the Russell 3000, Russell 1000, and Russell 2000 market indices, and the 1-year return on investment (percent) for gold bullion, given each month from January 2006 to December 2017.

- The 10-Year Treasury Note is an indicator of the U.S. government bond market.
- The Russell 3000 contains the 3000 largest U.S. companies and represents 98% of the equity market.
- The Russell 1000 index includes approximately 1000 of the largest securities representing approximately 92% of the U.S. equity market.
- The Russell 2000 index measures the performance of small-cap U.S. equities and includes approximately 2000 of the smallest securities.
- The London Bullion Market Association (LBMA) Gold Price informally provides a recognized rate that is used as a benchmark for pricing the majority of gold products.

Data in this assignment was retrieved from FRED, Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/.

Hint: the function `importdata()` could be useful. Once imported, take a look at the structure of `finData` in the MATLAB workspace.

```
% TODO: ************************************************************
importedData = importdata('fredgraph-returns.csv');
finData = importedData.data;
% ************************************************************************
```

(1 pt.) We wish to calculate the mean return during each calendar year for each market indicator in the dataset. First, construct a vector `group` to identify each of the groups within `finData.data`. `group` should contain the same number of rows as `finData.data` and should contain unique identifiers for entries that correspond to like years, e.g. 1 for each month of year 1, 2 for each month of year 2, etc.

```
% TODO: ************************************************************
group = ceil ([1:144]/12).';
% ************************************************************************
```

(2 pts.) Use the function `splitapply()` to compute the mean return on investment during each year for each market indicator. Store the returns in separate vectors, e.g. `returns_3000`, `returns_gold`, etc.

```
% TODO: ************************************************************
returns_10year = splitapply(@mean, finData(:,1), group);
returns_3000 = splitapply(@mean, finData(:,2), group);
returns_1000 = splitapply(@mean, finData(:,3), group);
returns_2000 = splitapply(@mean, finData(:,4), group);
returns_gold = splitapply(@mean, finData(:,5), group);
% ************************************************************************
```

(2 pts.) Plot the mean return of each market indicator as a percentage overlaid on a single plot. Label the curves and axes.

```
% TODO: ************************************************************
figure();
x = [2006:2017];
plot(x,returns_10year,x,returns_3000,x,returns_1000,x,returns_2000,x,returns_gold)
xlabel('Year');
ylabel('Percent Yield Per Annum');
legend('10-Year Treasury Note','Russell 3000','Russell 1000','Russell
 2000','LBMA Gold Price');
```

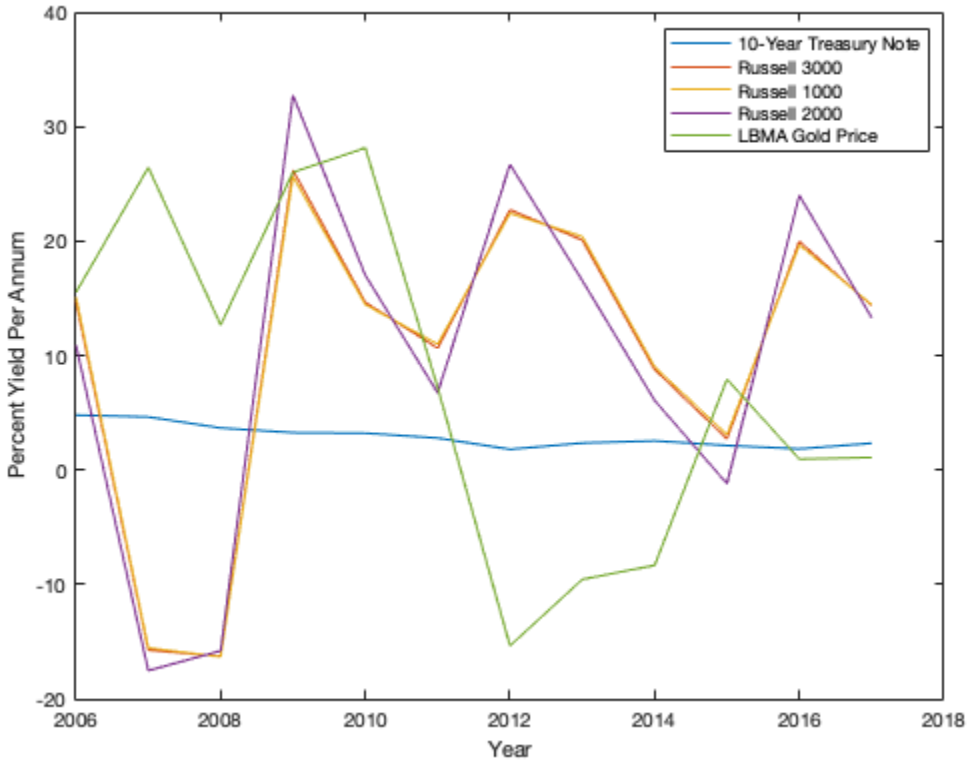
```
% ********************************************************************
```

(1 pt.) 1. In what year(s) did equity markets experience a sharp decline in value?

TODO: ********** Equity markets experienced a sharp decline in 2007, 2011, and 2015. **********

(1 pt.) 2. Did any market indicator(s) maintain a positive return during the market crash? If so, which one(s)?

TODO: ********** The 10-Year Treasury stays positive for the entire span of the graph and the LBMA Gold Price stayed postive during the 2008 crash. **********



Part 2: Risk-return over a 10-year period

(2 pts.) We now wish to quantify the risk and return of each market indicator over the 10-year period. For comparison, plot a single point for each market indicator on the risk (x axis)-return (y axis) plane, and label each appropriately. Use unique markers for each indicator. Label the axes.

```
% TODO: ************************************************************
risk_10year = std(returns_10year);
risk_3000 = std(returns_3000);
risk_2000 = std(returns_2000);
risk_1000 = std(returns_1000);
risk_gold = std(returns_gold);
```

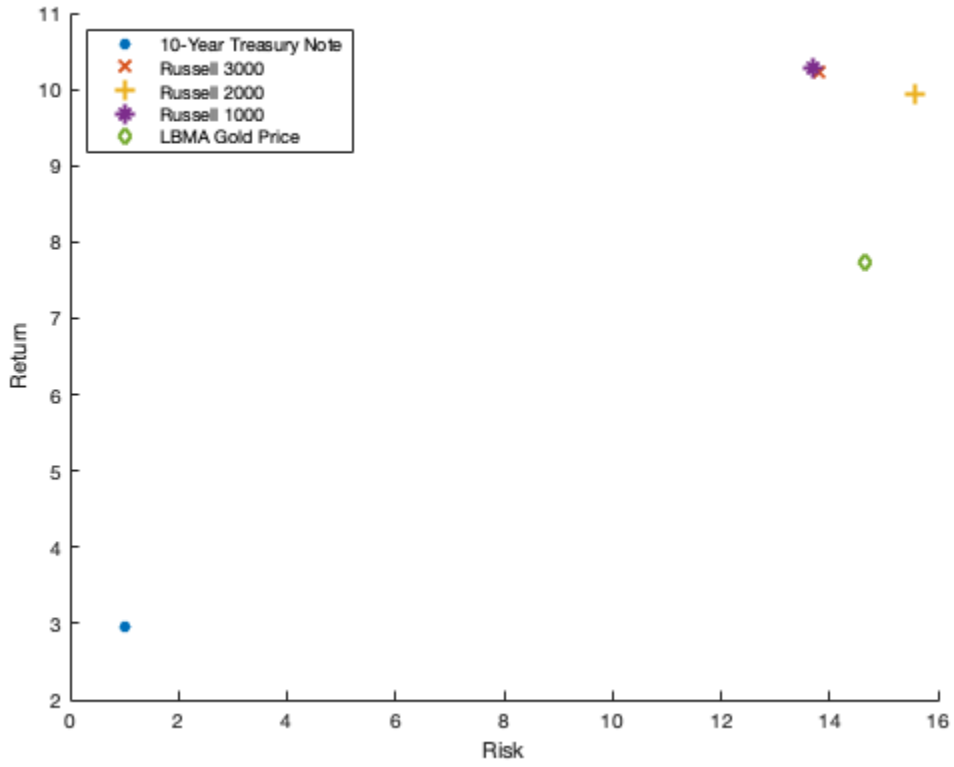
```
figure();
hold on;
scatter(risk_10year,mean(returns_10year),'filled');
scatter(risk_3000,mean(returns_3000),'x');
scatter(risk_2000,mean(returns_2000),'+');
scatter(risk_1000,mean(returns_1000),'*');
scatter(risk_gold,mean(returns_gold),'d');
hold off;
legend('10-Year Treasury Note','Russell 3000','Russell 2000','Russell
 1000','LBMA Gold Price','location','nw');
xlabel('Risk')
ylabel('Return')
% ************************************************************
```

(2 pts.) 3. Generally, how are risk and return correlated with one another?

TODO: ********** Higher risk results in a more spread out return so the return can be very high or very low. Lower risk results in a more concentrated return so it can't be very high or low. High risk leadds to higher return and vice versa. **********

(2 pts.) 4. Which market indicator gives the greatest return? Which market indicator has the least risk?

TODO: ********** The market indicator with the greatest return is the Russell 1000 and the indicator with the least risk is the 10 Year Treasury note. **********



Part 3: Quantify correlations

(2 pts.) Compute the 4 correlation coefficients between the Russell 3000 index and the other 4 market indicators. Using the function `bar()`, plot these coefficients.

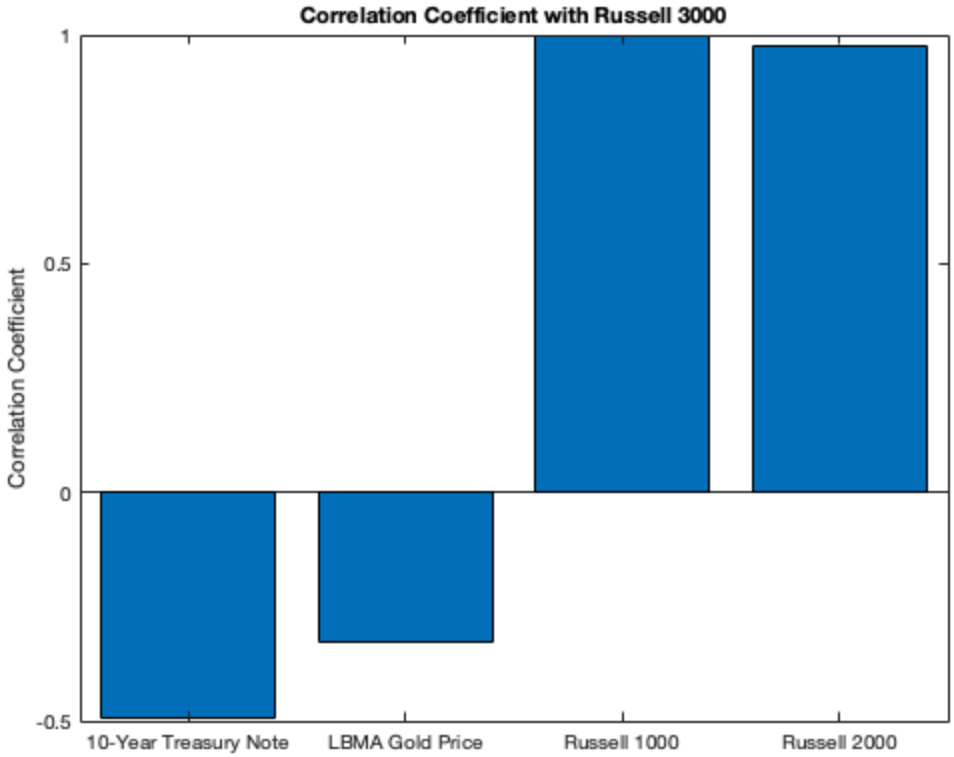
```
% TODO: ************************************************************
corr_matrix =
 corrcoef([returns_3000,returns_2000,returns_1000,returns_gold,returns_10year]);

x = categorical({'Russell 2000','Russell 1000','LBMA Gold Price','10-
Year Treasury Note'});
figure();
bar(x,corr_matrix(1,2:5));
title('Correlation Coefficient with Russell 3000');
ylabel('Correlation Coefficient');
%
% ******************************************************************
```

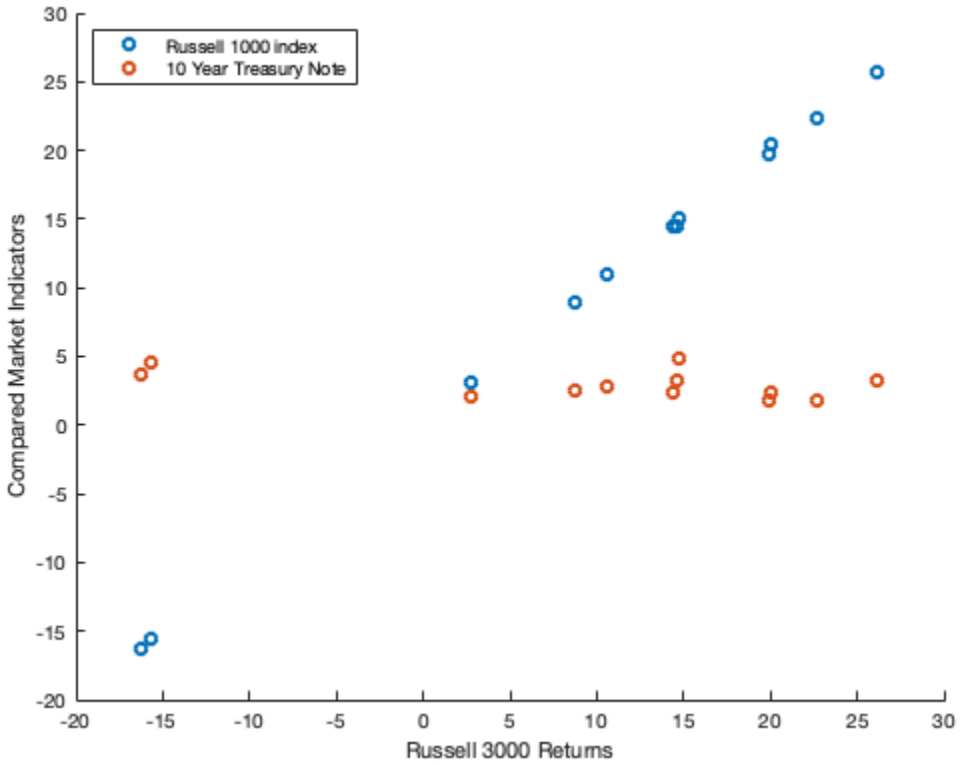
(2 pts.) 5. Which indicator is most strongly positively correlated with the Russell 3000 index? Which indicator is most strongly negatively correlated with the Russell 3000 index?

TODO: ********** The Russell 1000 is most strongly positively correlated with the Russell 3000 index. The 10-Year Treasury Note is most strongly negatively correlated with the Russell 3000 index. **********

(2 pts.) As a scatter plot, plot the returns for the Russell 3000 along the x-axis and the returns for the two indicators you gave in question 5 above along the y-axis. Check that the correlation coefficients make sense.

```
% TODO: ************************************************************
figure();
hold on;
scatter(returns_3000,returns_1000);
scatter(returns_3000,returns_10year);
hold off;
legend('Russell 1000 index','10 Year Treasury Note','location','nw');
xlabel('Russell 3000 Returns');
ylabel('Compared Market Indicators');
% ******************************************************************
```


Correlation Coefficient with Russell 3000
Correlation Coefficient
1
0.5
0
-0.5
10-Year Treasury Note
LBMA Gold Price
Russell 1000
Russell 2000


Russell 1000 index
10 Year Treasury Note
Compared Market Indicators
Russell 3000 Returns
30
25
20
15
10
5
0
-5
-10
-15
-20

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