Application #1
Portfolio Calculations

1 Data

- On Chalk, download the file, "dataPort.mat".
- Be sure to save this data file into the current directory (or path) of Matlab.
- Use the command: "load dataPort". Upon running this command, you should see the variable, "prices" in your workspace.[1]
- In the matrix of prices, each row corresponds to a day. The columns correspond, (in order,) to the S&P 500 index, crude oil index, and U.S. 10-yr Treasury index.

2 Data manipulation

1. Create 3 column vectors—each containing the price history of one of the asset classes. Name the vectors sp500, oil, and bonds.

2. Create a row vector, pNow with the latest price of each security.

3. Calculate the number of days (Nt) and number of assets, (Nk).

4. Calculate the matrix of the history of returns for the three assets. Calculate both the *log*-return, (retsLog,) and the *level*-return, (rets). The log and level returns are defined as:

   - log-return, $\tilde{r}_t = \log\left(\frac{P_{t+1}}{P_t}\right)$.
   - level-return, $r_t = \frac{P_{t+1}}{P_t} - 1$.

[1] You will also find the variable, "dates", but you do not need it yet.

5. Calculate a matrix of cumulative returns of the assets, named retsCumLog and retsCum. Recall that the cumulative return is simply

   - log-return, $\tilde{r}_{t,t+h} = \log\left(\frac{P_{t+h}}{P_t}\right)$.
   - level-return, $r_{t,t+h} = \frac{P_{t+h}}{P_t} - 1$.

   Note that you may find the Matlab function repmat helpful here. It allows you to build an array where every row corresponds to P_t. You can then use this array in the denominator of array arithmetic and skip any need for coding loops.

3 Calculations

1. For how many days does the S&P500 log-return and level-return differ by more than 5 basis points? That is,
$$\|\tilde{r}_t - r_t\| > .0005$$

2. For which asset is there the biggest difference in the total cumulative *level*-return versus the total cumulative *log*-return?

3. Suppose an investor puts weights of 50%, 30%, and 20% in the S&P500, oil, and bonds. Calculate the history of portfolio returns, (level-returns). Call this vector retsPort.

4. What percentage of days does the portfolio have a positive return?

5. Calculate the history of cumulative returns of the portfolio. Call this retsCumPort. Feel free to do this as the cumulative log or cumulative level return. (In either case, try calculating the cumulative portfolio return by starting with the portfolio return series and using cumsum or cumprod.)

4 Plots

1. Create a plot of the price history of S&P500.

2. In a separate figure, create 4 sub-plots of cumulative returns. That is, plot the history

of cumulative returns for each of the 3 assets as well as the portfolio.

3. Finally, create another figure where you plot both the S&P500 cumulative return history as well as the portfolio cumulative return history in the same figure.

5 Extra

We will discuss these features afterward, but feel free to try them now.

1. Try plotting the dates against the cumulative returns. Search the help documentation for datetick, and try to use it in your figure.

2. Try using xlabel, ylabel, title. Search the help documentation for more.

3. Try calculating the basic statistics of the level returns. Get the mean, standard-deviation, skewness, and correlations.

4. The return matrices have one less row than the price matrix. Remedy this by adding a first row of NaN values to the return matrices.