A. CASE STUDY: “Sustainable Investing at Generation Investment Management, 2016.”
Read the case study and briefly answer the following questions.

1. What is GIM’s investment philosophy?
2. Briefly describe GIM’s investment process.

B. FLIPPED CLASSROOM. Watch a video, posted on Canvas, of me presenting Lecture 0. In addition, read Lecture 0 very carefully on your own. A few notes:

- Going forward, I will assume that you understand everything in Lecture 0. We will build on it later on so you really need to understand it. The first review session after our first class (in Week 2) will be devoted to Lecture 0.
- Lecture 0 is the most mathematical lecture in this course. It contains many more equations than any other lecture you will see. That’s why I’m flipping it—it’s not well suited for the kind of two-way conversations that we will be having in class. This is the only lecture we are going to flip in this course. We will go through all remaining lectures together in class, step by step.
- Lecture 0 will help you solve Part C of this assignment.

C. DATA ANALYSIS. The purpose of this assignment is to examine the distributions of asset returns at different frequencies (daily, monthly, annual). Download three datasets, returns_daily.txt, returns_monthly.txt, and returns_annual.txt, from Canvas. Each dataset contains three columns: calendar date, returns on the Center for Research in Security Prices (CRSP) value-weighted stock market portfolio, and returns on a portfolio of long-term government bonds.

NOTE: I recommend that you use MATLAB to complete this assignment (as well as all future assignments). If you have not used MATLAB before, you can download my
“Introduction to MATLAB” from Canvas. You can also attend the MATLAB review session at the beginning of the quarter (see the syllabus for details). If you prefer to use R, that is fine; I will support R, too, though to a lesser extent.

1. Load the data into Matlab.¹

2. Estimate the means, variances, and standard deviations of returns, at all three frequencies. What are the covariances and correlations between the returns on stocks and bonds, at various frequencies?²

3. Estimate the skewness and kurtosis of returns.³ Based on these statistics, do returns appear to be drawn from a normal distribution?

4. Create the histograms of stock and bond returns at different frequencies.⁴ How close are the empirical distributions to the normal distribution?

In the remainder of the assignment, simply assume that the return distribution is normal at each return frequency, even if such an assumption seems imperfect. (In class, we will discuss how to get around the normality assumption.)

5. Compute the 95% confidence intervals for the stock (bond) return over the next period (day, month, year). Compute the 95% confidence interval for the arithmetic average stock (bond) return over the following 30 periods (days, months, years).

6. Compute the absolute shortfall probabilities for stocks and bonds. That is, for a cutoff level \( k \), compute the probability that the return over the next period (day, month, year) will be lower than \( k \). Plot this probability as a function of the threshold level \( k \), for \( k = -20\%, -10\%, 0, 10\%, 20\% \).⁵

7. Assuming that returns are i.i.d., compute the probability that the stock return over the next period (day, month, year) will be lower than the bond return.

¹ Matlab hint: Suppose the data is in the working Matlab directory. (You can find out what that directory is by typing `cd` in Matlab, and you can change it by typing `cd new_directory_name`.) One way to load the data is to type `x=load('returns_annual.txt')`. Matlab then creates a new variable \( x \) and sets it equal to the contents of the file. You can then define new variables for the calendar date, stocks, and bond returns: “`caldate=x(:,1);`” sets `caldate` equal to the first column of the data (the date), “`Rstock=x(:,2);`” and “`Rbond=x(:,3);`” set the two variables equal to the second and the third column of the data.

Matlab has an extensive help system. To get help on a given command, type `help` followed by the name of the command. For instance, `help whos` displays the description of the `whos` command. You can also search the help files for a keyword, by typing `lookfor` followed by the keyword. For instance, `lookfor mean` will display all commands whose help files contain the word “mean.” Try also `doc`.

² Matlab hint: Consider using the commands `mean`, `var`, `std`, `cov`, and `corrcoef`.

³ Matlab hint: The relevant commands are `skewness` and `kurtosis`.

⁴ Matlab hint: To create a histogram of data in vector \( X \), type `hist(X,n)`, where \( n \) is the desired number of bins. To superimpose the normal distribution, use the `histfit` command. For example, `histfit(X,25)` creates a histogram of \( X \) with 25 bins and a normal distribution on top of it. This way, you can compare the relative frequencies of returns observed in reality to those expected if the distribution is normal.

⁵ Matlab hint: Command `normcdf(k,m,s)` returns the probability that a normally distributed random variable with mean \( m \) and standard deviation \( s \) is lower than \( k \). Use the estimates of means and standard deviations computed earlier in question 2. The command `plot` might also be useful.