* Checkpoints is a list of integer of sample counts at which you have to return the running total, a running mean, standard deviation, and estimated error. So you have to iterate through those numbers one by one using for or while loop after under a code block to calculate the running total, a running mean, standard deviation, and estimated error will be passed. Checkpoints data structure is either a NumPy array or a list in which you will pass a number of samples in which your code should be run to calculate all that statistics. Eg, checkpoints = [100 200 300 400 1000000], so first you will calculate those statistics for 100 sample points that are mean of prices using first 100 z's (random normal number of shape (total\_samples,1), then for 200 sample points, and so on. If your sample variable = None, then the last number in the list will be the total number of sample prices. rateCurve: you have to download Treasury Yield Data and that will have treasury yields for 1month, 2m, 3m, 6m, 1yr, 2y, 5 yr, and so on. So if you want to find the rate, r, variable for say 10 months you have to linearly interpolate the rate values between 6m and 1y. You should be able to do that using np.interp function wherein you can pass the number of months (in terms of years) and yield series from Treasury yield dataset. Yes, it replaces the r variable and in this case, you will need to find the estimate r based on Treasure yield dataset. M is either the last element of the checkPoints list if sample == None or it is equal to the values you pass in the sample variable. Samples variable either None or the total number of samples (M). Checkpoints variable is a list or NumPy array. t is an array of timestep variable, t = T/M, where M is the number of paths in the sample matrix. You are right that t is incremental fraction of the “T” (i.e. 1\*(T/N), 2\*(T/N), 3\*(T/N),….T). Eg.: It could look like if M = 100, and T = 1, t = [0.01 0.02 ...1.0], where size of t = (1, 100)
* Rajat Dua

**05:50**

There are many ways of solving this problem. Ultimately what you want is to get the rate, r, based on your T variable. I can only suggest how I went through the problem. I downloaded the treasury yield data and then I have imported that .csv file in Python as a Pandas data frame. You can use np.ravel to flatten the yield data from dataframe. That worked for me. In order to call the function I used the following line: if \_\_name\_\_ == '\_\_main\_\_': checkpoints = [100, 200, 300, 400, 1000000] print(BSMonteCarlo(95., 100., 1.0, 0.25, checkpoints, 0., samples = None )) As you can see, I passed 0. for the rateCurve variable because I have already defined the InterestRateCurve inside the function. Again that is one way of approaching this problem. You can try any other way that you might seem fit. Ultimately I am only concerned with the logic of the code and output. I hope this helps. I suggest you to attend today's office hour if you have any other questions or if you want to further clarify your existing questions.

* Xiangpei Kong

**08:23**

Is T always equal to t[-1] in problem 3?

* Matthew Connelly

**09:50**

so the rate curve will basically be an mx2 array with the first column being the months and the second column being the rates? and then we basically use np.interp( T, months, rates) to find r?

* Rajat Dua

**09:52**

T = choice(t)

* Matthew Connelly

**10:44**

thanks!

* Rajat Dua

**11:25**

rate = pd.read\_csv("/Users/rajatdua/Documents/Illinois Institute of Technology/Fall 2019 Semester/Computational Finance/Homework/Treasury Yield Data.csv", sep=',', header = None) rate\_data = np.delete(rate.values, [0], axis = 1) date = np.delete(rate\_data, np.s\_[1:], 0) rateCurve = np.delete(rate\_data, np.s\_[0:-1], 0) date = np.ravel(np.array(date, dtype = np.float32)) rateCurve = np.ravel(np.array(rateCurve, dtype = np.float32))

* William D Roller

**12:41**

how are we combining #1 and #2 for problem 3? The function from #1 generates underlying prices to compute option prices. The function from #2 generates the underlying price paths. I'm not sure how these can be combined to answer #3 since one cannot be an input for the other.

* William D Roller

**14:37**

That's what I would do but #3 says to combine them. I'll ask prof. Dixon