Week3 project
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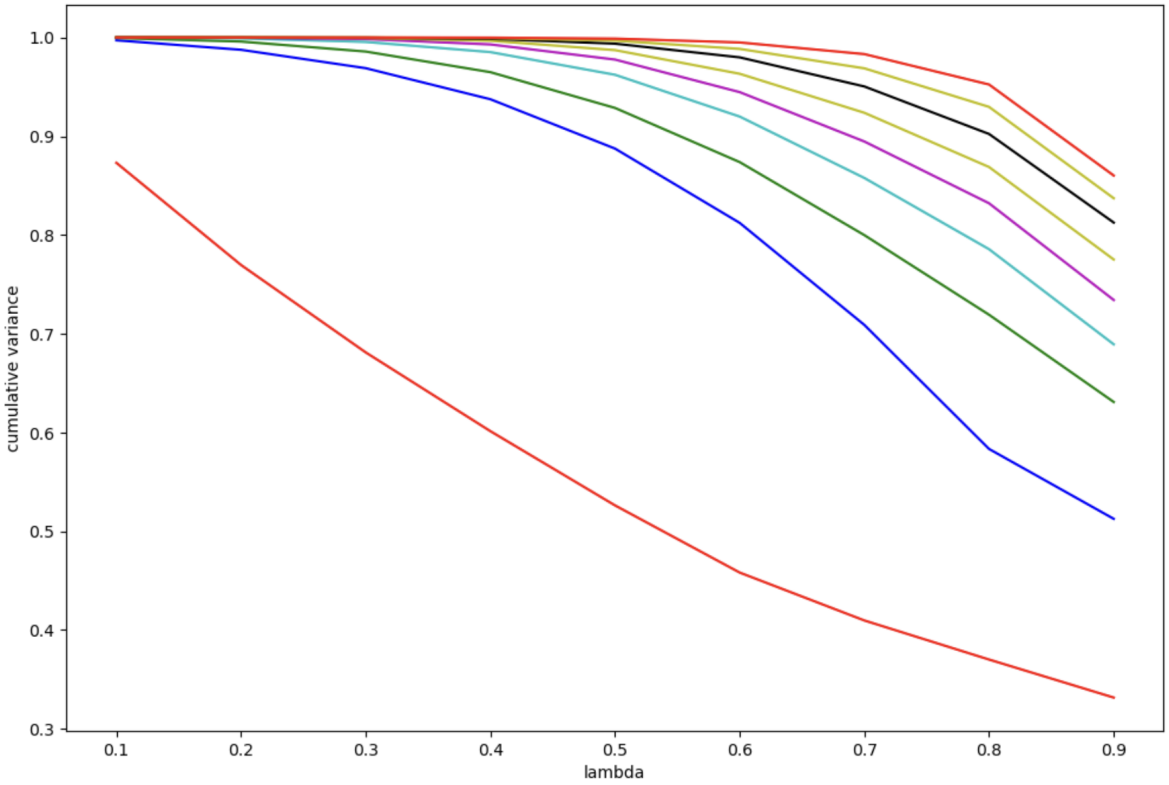
Q1:
We can see that, with the increasing lambda, the cumulative covariance is decreasing. Since with the increase of lambda, the weight of the current variable will be smaller.
There are a bunch of lines below, the most bottom one is a principal component variance contribution under different lambda values. The most top one is 9 principal components' variance contribution under different lambda values.



Q2:
Based on two different methods. I got those numbers out here. As we can see, the Cholesky method computes very fast. Even with 1000 size, it still computes within 1 second. However, the Higham method computes relatively slow, with the size increases, it takes longer and longer.
On the other hand, the Higham method computes more precisely than Cholesky. Even though the size doubled, the F norm still remains at the same level. But Cholesky method's F norms increase rapidly as the size increases.

```
Size is  500
Duration of Chloesky is  0:00:00.209020 Duration of Higham is  0:00:01.275974
F Norm of Chloesky is  0.6275226557659508 F Norm  of Higham is  (0.08964799632524456, 'fro')
Size is  600
Duration of Chloesky is  0:00:00.286990 Duration of Higham is  0:00:01.875891
F Norm of Chloesky is  0.6882026666308428 F Norm  of Higham is  (0.08986132327064164, 'fro')
Size is  700
Duration of Chloesky is  0:00:00.342976 Duration of Higham is  0:00:02.952299
F Norm of Chloesky is  0.7439495037336205 F Norm  of Higham is  (0.09001394198185893, 'fro')
Size is  800
Duration of Chloesky is  0:00:00.486832 Duration of Higham is  0:00:03.536592
F Norm of Chloesky is  0.7958006315839199 F Norm  of Higham is  (0.09012853893086391, 'fro')
Size is  900
Duration of Chloesky is  0:00:00.584460 Duration of Higham is  0:00:04.631598
F Norm of Chloesky is  0.8444739843546087 F Norm  of Higham is  (0.09021774889611904, 'fro')
Size is  1000
Duration of Chloesky is  0:00:00.749773 Duration of Higham is  0:00:06.245905
F Norm of Chloesky is  0.8904908160667164 F Norm  of Higham is  (0.09028916671758008, 'fro')
```

Q3:
These are two matrices about duration and F norms. The first column for each matrix represents direct simulation. Second, third, and fourth column represent 100% PCA explained, 75% PCA explained, and 50% PCA explained. We can see that as the percentages are reduced, the calculation time becomes faster and faster because less data needs to be calculated.

The 4 rows of the matrix represent the ordinary pearson correlation matrix with ordinary covariance matrix, ordinary Pearson correlation matrix with weighted covariance matrix, weighted Pearson correlation matrix with ordinary covariance matrix, weighted Pearson correlation matrix with weighted covariance matrix, respectively. As we can see, ordinary Pearson correlation matrix with weighted covariance matrix and weighted Pearson correlation matrix with weighted covariance matrix have big F norms. The ordinary Pearson correlation matrix with ordinary covariance matrix has the lowest F norm. On the opposite, weighted Pearson correlation matrix with weighted covariance matrix has the highest F norms.

```
Duration:
 [[0.19262981 0.10811806 0.03908896 0.02455115]
 [0.12866473 0.11414814 0.03879189 0.02496576]
 [0.13095617 0.11078811 0.03292012 0.02396107]
 [0.1296792  0.1156671  0.03336    0.02686501]]
F Norm:
 [[0.24892196 0.24852868 0.24946343 0.24562118]
 [2.04738624 2.04978516 2.08178788 2.03529651]
 [0.27708405 0.28319325 0.28273806 0.27911534]
 [2.20021484 2.20347876 2.24207756 2.19780041]]
```