Quantitative Portfolio Management

Solution to Assignment #1

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Instructions for each assignment . . . I

- Each assignment should be emailed as a Jupyter file
  - To Raman.Uppal@edhec.edu
  - The subject line of the email should be: "QPM: Assignment n," where $n = \{1, 2, \ldots, 8\}$.
  - Assignment n is due before Lecture n, where $n = \{1, 2, \ldots, 8\}$.
  - Assignments submitted late will not be accepted (grade $= 0$), so please do not email me assignments after the deadline.

Instructions for each assignment . . . II

- The Jupyter file should include the following (use Markdown):
  - Section "0" with information about your submission:
    - Line 1: QPM: Assignment *n*
    - Line 2: Group members: listed alphabetically by last name
    - Line 3: Any comments/challenges about the assignment
  - Section "*k*" where $k = \{1, 2, \ldots\}$.
    - First type Question *k* of Assignment *n*.
    - Then, below each question, provide your answer.
    - Your code should include any packages that need to be imported.

Questions for Assignment 1

- Consider a single risky asset (e.g., the market) whose initial price is EUR 100. Suppose that the returns of this asset have a Normal distribution with a mean of 10% and volatility of 20% *per year*.

  Q1.1 Use Python to generate random annual returns for 100 years for this asset. Compare the annual mean and volatility of returns from your random data to the true 10% mean and 20%.

  Q1.2 Now, generate random monthly returns for 100 years for this risky asset. Compare the annual mean and volatility of returns from your random data to the true 10% mean and 20%.

  Q1.3 Finally, generate random daily returns for 100 years for this risky asset. Compare the annual mean and volatility of returns from your random data to the true 10% mean and 20%.

  Q1.4 What do you conclude from the results of the three previous questions?

Discussion of Assignment 1: Initial setup

Load packages and initial definitions

```
import numpy as np
from numpy import random


# set initial price of the asset i
initial_price = 1 # dollar
mean_ret = 0.10   # (10%)
vol_ret = 0.20    # (20%)
```

Discussion of Assignment: Q1.1

Q1.1 Use Python to generate random annual returns for 100 years for this asset. Compare the annual mean and volatility of returns from your random data to the true 10% mean and 20%.

Code for Q1.1

```
# define the number of years
num_years = 100

# set the random generator seed (for reproducibility)
np.random.seed(1)
ret_100 = np.random.normal(mean_ret, vol_ret, num_years)


r_mean = ret_100.mean()
r_sd = ret_100.std()
print(round(r_mean,3))
print(round(r_sd,3))
```

	Parameter	
Frequency	Return mean	Return Volatility
Yearly	0.112	0.177
True value	0.100	0.200

Discussion of Assignment: Q1.2

Q1.2 Now, generate random monthly returns for 100 years for this risky asset. Compare the annual mean and volatility of returns from your random data to the true 10% mean and 20%.

Code for Q1.2

```
# compute monthly mean and vol
m = 12
mean_m = (1+mean_ret)**(1/m)-1
vol_ret_m = vol_ret/np.sqrt(m)

# select the same seed
np.random.seed(1)
ret_100_m = np.random.normal(mean_m, vol_ret_m,num_years * m)

r_mean_m_Annualized = (1+ret_100_m.mean())**m-1
r_sd_m_Annualized = ret_100_m.std()*np.sqrt(m)
print(round(r_mean_m_Annualized,6))
print(round(r_sd_m_Annualized,6))
```

	Parameter	
Frequency	Return mean	Return Volatility
Monthly	0.119	0.197
True value	0.100	0.200

Discussion of Assignment: Q1.3

Q1.3 Finally, generate random daily returns for 100 years for this risky asset. Compare the annual mean and volatility of returns from your random data to the true 10% mean and 20%.

Code for Q1.3

```
# compute daily mean and vol
d = 252
mean_d = (1+mean_ret)**(1/d)-1
vol_ret_d = vol_ret/np.sqrt(d)

# select the same seed
np.random.seed(1)
ret_100_d = np.random.normal(mean_d, vol_ret_d,num_years * d)

r_mean_d_Annualized = (1+ret_100_d.mean())**d-1
r_sd_d_Annualized = ret_100_d.std()*np.sqrt(d)
print(round(r_mean_d_Annualized,6))
print(round(r_sd_d_Annualized,6))
```

	Parameter	
Frequency	Return mean	Return Volatility
Daily	0.124	0.200
True value	0.100	0.200

Discussion of Assignment: Q1.4

Q1.4 What do you conclude from the results of the three previous questions?

	Parameter	
Frequency	Return mean	Return Volatility
Yearly	0.112	0.177
Monthly	0.119	0.197
Daily	0.124	0.200
True value	0.100	0.200

End of assignment