bcrist_week3_assignment

September 21, 2021

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Financial Economics - Week 3 Assignment

Question 1 Consider a risky asset with the following string of rates of returns in the previous 5 years. 5 years ago it returned -10%, 4 years ago -20%, 3 years ago 30%, 2 years ago 0%, and 1 year ago 5%. In addition, there is a safe asset with a constant rate of return of 1% in each year. For the risky asset please compute and provide your computations.

[1]:
```
import numpy as np
import pandas as pd
```

[2]:
```
data = np.array([[-0.1,0.01],[-0.2,0.01],[0.3,0.01],[0.0,0.01],[0.05,0.01]])
years = ["5","4","3","2","1"]
asset = ["Risky Asset","Safe Asset"]
df = pd.DataFrame(data, index=years, columns=asset)
df
```

[2]:

	Risky Asset	Safe Asset
5	-0.10	0.01
4	-0.20	0.01
3	0.30	0.01
2	0.00	0.01
1	0.05	0.01

a. Arithmetic average of returns and returns' standard deviation.

$$Arithmetic\ average\ return = \bar{r} = \frac{1}{n}\sum_{s=1}^{n} r(s)$$

Where *r(s)* is the rate of return for period *s*.

Because these are historical returns the unbiased estimated standard deviation will be used.

$$Unbiased\ estimated\ standard\ deviation = \hat{\sigma} = \sqrt{\frac{1}{n-1}\sum_{s=1}^{n}[r(s) - \bar{r}]^2}$$

[3]:
```python
print("The arithmetic average return of the risky asset is:")
print(round(df["Risky Asset"].mean(),4))

print("The unbiased estimated standard deviation of the risky asset is:")
# ddof = delta degrees of freedom
print(round(np.std(df['Risky Asset'], ddof=1),4))
```

```
The arithmetic average return of the risky asset is:
0.01
The unbiased estimated standard deviation of the risky asset is:
0.1884
```

b. Geometric average of returns.

$$Geometric\ average\ return = \left[\prod_{s=1}^{n} 1 + r(s)\right]^{\frac{1}{n}} - 1$$

[4]:
```python
RA = df['Risky Asset']
prod = 1
for i in RA:
    temp = i + 1
    prod = temp * prod

GAM = round(prod**(1/RA.count()) - 1, 4)
print("The geometric average return for the risky asset is:")
GAM
```

```
The geometric average return for the risky asset is:
```

[4]:
```
-0.0035
```

c. Excess returns in each year and risk premium.

The risk premium is the difference between the expected holding period return and the risk-free rate. Excess returns are the difference between the actual rate of return on a risky asset and the actual risk-free rate. Because this analysis is on historical data, the excess returns are calculated.

$$Excess\ return = Risky\ asset\ return - Safe\ asset\ return$$

[5]:
```python
df['excess'] = df['Risky Asset'] - df['Safe Asset']
print("The excess returns for each year are:")
df['excess']
```

```
The excess returns for each year are:
```

[5]:
```
5   -0.11
4   -0.21
```

```
3    0.29
2   -0.01
1    0.04
Name: excess, dtype: float64
```

d. Sharpe ratio.

$$Sharpe\ ratio = \frac{Risk\ premium}{SD\ of\ excess\ return}$$

[6]:
```python
SR = round(df['excess'].mean()/np.std(df['excess'], ddof=1),4)
SR
```

[6]:
```
-0.0
```

Question 2 For the four Fama-French portfolios (big/value, big/growth, small/value, small/growth) please compute:

[7]:
```python
FFp = pd.read_csv('/home/brian/documents/financial.economics/week3/FFportfolios.
↪csv')
```

a. Arithmetic average of returns

[8]:
```python
print('The arithmetic average of returns are, ')
print('Big/growth:', round(FFp["Big_growth"].mean(),4))
print('Big/value:', round(FFp["Big_value"].mean(),4))
print('Small/growth:', round(FFp["Small_growth"].mean(),4))
print('Small/value:', round(FFp["Small_value"].mean(),4))
```

```
The arithmetic average of returns are,
Big/growth: 0.6229
Big/value: 0.8973
Small/growth: 0.6844
Small/value: 1.1786
```

b. Standard deviation

[9]:
```python
print('The unbiased estimated standard deviations are:')
print('Big/growth:', round(np.std(FFp['Big_growth'], ddof=1),4))
print('Big/value:', round(np.std(FFp['Big_value'], ddof=1),4))
print('Small/growth:', round(np.std(FFp['Small_growth'], ddof=1),4))
print('Small/value:', round(np.std(FFp['Small_value'], ddof=1),4))
```

```
The unbiased estimated standard deviations are:
Big/growth: 5.3401
Big/value: 7.1064
Small/growth: 7.5663
Small/value: 8.1876
```

c. Risk premia

[10]:
```
FFp['BG_rp'] = FFp['Big_growth'] - FFp['T-bill']
FFp['BV_rp'] = FFp['Big_value'] - FFp['T-bill']
FFp['SG_rp'] = FFp['Small_growth'] - FFp['T-bill']
FFp['SV_rp'] = FFp['Small_value'] - FFp['T-bill']

print('The average risk premia are:')
print('Big/growth:', round(FFp["BG_rp"].mean(),4))
print('Big/value:', round(FFp["BV_rp"].mean(),4))
print('Small/growth:', round(FFp["SG_rp"].mean(),4))
print('Small/value:', round(FFp["SV_rp"].mean(),4))
```

```
The average risk premia are:
Big/growth: 0.3436
Big/value: 0.618
Small/growth: 0.4051
Small/value: 0.8994
```

d. Standard deviations of excess returns

[11]:
```
print("The unbiased estimated standard deviation of excess returns are:")
print('Big/growth:', round(np.std(FFp['BG_rp'], ddof=1),4))
print('Big/value:', round(np.std(FFp['BV_rp'], ddof=1),4))
print('Small/growth:', round(np.std(FFp['SG_rp'], ddof=1),4))
print('Small/value:', round(np.std(FFp['SV_rp'], ddof=1),4))
```

```
The unbiased estimated standard deviation of excess returns are:
Big/growth: 5.363
Big/value: 7.1228
Small/growth: 7.5902
Small/value: 8.2063
```

e. Sharpe ratios. When looking at Sharpe ratios, please indicate which of the portfolios is the most and which is the lease attractive.

From *Reproducible Finance with R* p.109,

"The Sharpe Ratio equation is as follows:

$$Sharpe\ Ratio = \frac{\overline{(R_p - R_f)}}{\sigma_{excess}}$$

The numerator is the mean excess return above the risk-free rate and the denominator is the standard deviation of those excess returns".

[12]:
```
BG_sharpe = FFp["BG_rp"].mean()/np.std(FFp['BG_rp'], ddof=1)
BV_sharpe = FFp["BV_rp"].mean()/np.std(FFp['BV_rp'], ddof=1)
SG_sharpe = FFp["SG_rp"].mean()/np.std(FFp['SG_rp'], ddof=1)
SV_sharpe = FFp["SV_rp"].mean()/np.std(FFp['SV_rp'], ddof=1)

print("The big/growth Sharpe Ratio is:", round(BG_sharpe, 4))
```

```python
print("The big/value Sharpe Ratio is:", round(BV_sharpe,4))
print("The small/growth Sharpe Ratio is:", round(SG_sharpe,4))
print("The small/value Sharpe Ratio is:", round(SV_sharpe,4))
```

```
The big/growth Sharpe Ratio is: 0.0641
The big/value Sharpe Ratio is: 0.0868
The small/growth Sharpe Ratio is: 0.0534
The small/value Sharpe Ratio is: 0.1096
```

The most attractive portfolio is the small/value, and the least attractive is the small/growth.