Lecture 03: Matrices in Finance and Matlab

Economics of Finance

School of Economic, UNSW

Matlab

Assignment Project Exam Help

- CaPiTaLiSaTiOn matters
- Scripts and functions can are saved in separate .m files

https://powcoder.com

- Folder containing the scripts and functions must be Current Folder or you need to "Set Path"

Add WeChat powcoder

Tables as Matrices

It is often desirable to think of matrices as the "inside" of tables. For example, a matrix Q might contain the values of the following table

```
          Bond        Stock
Mon       54          21
Tue       55          18
Wed       56          27
```

This is a matrix with dimensions $days \times assets$, in this case 3×2. In MATLAB we'll write

```
>> Q = [54 21; 55 18; 56 27];
```

Example: Asset allocation with investment funds

Funds Allocation matrix **A**:

	Fund A	Fund B	Fund C	
Domestic Bonds	0.60	0.20	0.00	
Domestic Stocks	0.40	0.50	0.30	Current
Foreign Stocks	0.00	0.30	0.70	

Portfolio, vector **x**:

Fund A	0.20
Fund B	0.30
Fund C	0.50

Asset allocation

Question:

- What is the Investor's current allocation among the three major asset classes?

- We know that $A\mathbf{x} = \mathbf{b}$:

$$\begin{pmatrix} 0.6 & 0.2 & 0.0 \\ 0.4 & 0.5 & 0.3 \\ 0.0 & 0.3 & 0.1 \end{pmatrix} \begin{pmatrix} 0.2 \\ 0.3 \\ 0.5 \end{pmatrix} = \begin{pmatrix} 0.18 \\ 0.38 \\ 0.44 \end{pmatrix}$$

How do we interpret $\mathbf{b}$?

Fund Allocations

Funds Allocation, matrix $\mathbf{A}$:

	Fund A	Fund B	Fund C
Dom B	0.60	0.20	0.00
Dom S	0.40	0.50	0.30
For S	0.00	0.30	0.70

Desired Allocation, vector $\mathbf{b}$:

Dom B	0.15
Dom S	0.35
For S	0.50

Question:

- What should be the portfolio in terms of fund's investment to obtain the desired allocation?
- $\mathbf{Ax} = \mathbf{b} \Rightarrow \mathbf{A^{-1}Ax} = \mathbf{A^{-1}b} \Rightarrow \mathbf{x} = \mathbf{A^{-1}b}$

Desirable Portfolio

Now let's suppose there is only two funds in the market:

	Fund A	Fund B
Dom B	0.60	0.20
Dom S	0.40	0.50
For S	0.00	0.30

Desired Allocation/ vector $\mathbf{b}$:

Dom B	0.15
Dom S	0.35
For S	0.50

Question:

- What should be the portfolio in terms of fund's investment to obtain the desired allocation?

- not possible to answer: $\mathbf{A}$ is not square

Return and Variance

For a portfolio with each asset i weights W_i:

- Portfolio Return $= \sum_{i=1}^{\infty} W_i R_i = \mathbf{W^T R}$

- Portfolio Variance $= \sum_{i=1}^{\infty} \sum_{j=1} W_i W_j \sigma_{ij} = \mathbf{W^T} \sigma \mathbf{W}$

where

- σ_{ij} is covariance of asset i with asset j;

- R_i is the return of each asset

$$R_i = \ln(P_t) - 1$$

Example

An investor is constructing a 3-asset portfolio, denoted as X, with allocation of \$0.25 million, \$0.10 million and \$0.65 million on assets A, B and C respectively. The expected returns for A, B and C are 10%, 11% and 12% respectively.

The covariance matrix of the portfolio is given below:

$$\sigma =$$

Asset	A	B	C
A	0.25	0.078	0.09
B	0.078	0.35	0.053
C	0.09	0.053	0.48

Formulate a Matlab function to determine the portfolio return and standard deviation.

Vectors

Weight matrix and returns can be found as follows:

$$\mathbf{W^T} = \begin{pmatrix} 0.25 & 0.10 & 0.65 \end{pmatrix}$$

$$\mathbf{R} = \begin{pmatrix} 0.10 \\ 0.11 \\ 0.12 \end{pmatrix}$$

So, the return of portfolio:

$$R_X = \mathbf{W^T}\mathbf{R} = 0.114 = 11.4\% \tag{1}$$

Solution

Given that:

$$\sigma = \begin{pmatrix} 0.25 & 0.078 & 0.09 \\ 0.078 & 0.35 & 0.053 \\ 0.09 & 0.053 & 0.48 \end{pmatrix}$$

and

$$\mathbf{W} = \begin{pmatrix} 0.25 \\ 0.10 \\ 0.65 \end{pmatrix}$$

Variance of the portfolio can be found by:

$$\mathbf{W^T} \sigma \mathbf{W} = 0.2620$$

Homework: Use Matlab to express, and calculate these!