CHAPTER 4

THE RANDOM BEHAVIOUR OF ASSETS

1. A share has an expected return of 12% per annum (with continuous compounding) and a volatility of 20% per annum. Changes in the share price satisfy $dS = \mu S\, dt + \sigma S\, dX$. Simulate the movement of the share price, currently \$100, over a year, using a time interval of one week.

We must simulate a movement of

$$dS = \left(\frac{12}{5200} + \frac{1}{5}dX\right) S = (.0023 + .2dX)S,$$

with a time step of $1/52$, where dX is drawn from a Normal distribution with mean 0 and variance $1/52$. Figure 4.1 shows a simulated path for the asset price.

2. What is the distribution of the price increase for the share movement described in Question 1?

The price increase is Normally distributed. The mean is given by

$$\text{expected return per annum} \times \text{time step} = 0.12/52 = 0.0023,$$

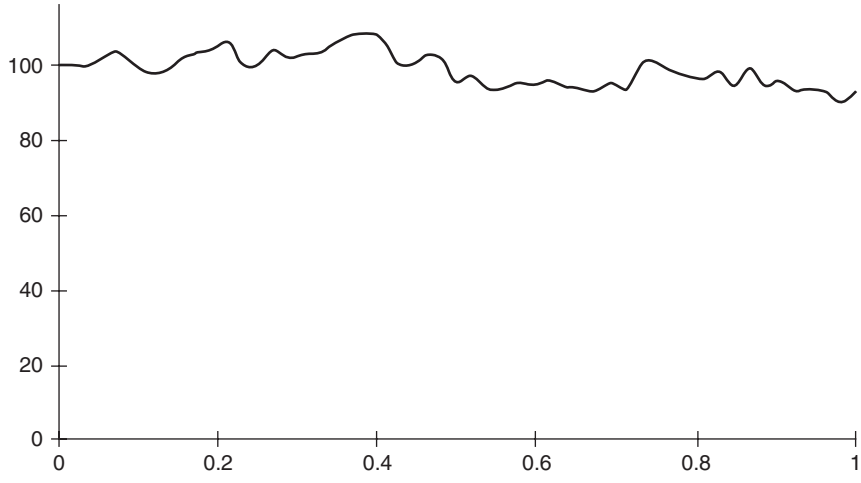

Figure 4.1 A simulation of the asset price random walk.

and the variance is given by

$$(\text{volatility per annum})^2 \times \text{time step} = 0.2^2/52 = 0.0008.$$

3. Using daily share price data, find and plot returns for the asset. What are the mean and standard deviation for the sample you have chosen?

The returns can be calculated using

$$R_i = \frac{S_{i+1} - S_i}{S_i}.$$

	A	B	C	D	E	F	G
1	**Date**	**Perez**	**Return**				
2	01-Mar-95	2.11			**Average return**	0.002916	
3	02-Mar-95	1.90	–0.1		**Standard deviation**	0.024521	
4	03-Mar-95	2.18	0.149906				
5	06-Mar-95	2.16	–0.010809				
6	07-Mar-95	1.91	–0.112583	= AVERAGE(C3:C463)			
7	08-Mar-95	1.86	–0.029851				
8	09-Mar-95	1.97	0.061538				
9	10-Mar-95	2.27	0.15		= STDEVP(C3:C463)		
10	13-Mar-95	2.49	0.099874				
11	14-Mar-95	2.76	0.108565				
12	15-Mar-95	2.61	–0.054264				
13	16-Mar-95	2.67	0.021858				
14	17-Mar-95	2.64	–0.010695				
15	20-Mar-95	2.60	–0.016216	= (B13-B12)B12			
16	21-Mar-95	2.59	–0.002747				
17	22-Mar-95	2.59	–0.002755				
18	23-Mar-95	2.55	–0.012321				
19	24-Mar-95	2.73	0.069307				
20	27-Mar-95	2.91	0.064815				
21	28-Mar-95	2.92	0.002899				
22	29-Mar-95	2.92	0				
23	30-Mar-95	3.12	0.069364				
24	31-Mar-95	3.14	0.005405				
25	03-Apr-95	3.13	–0.002688				
26	04-Apr-95	3.24	0.037736				
27	05-Apr-95	3.25	0.002597				
28	06-Apr-95	3.28	0.007772				
29	07-Apr-95	3.21	–0.020566				
30	10-Apr-95	3.02	–0.060367				
31	11-Apr-95	3.08	0.019553				
32	12-Apr-95	3.19	0.035616				
33	17-Apr-95	3.21	0.007936				
34	18-Apr-95	3.17	–0.013123				
35	19-Apr-95	3.24	0.021277				

Figure 4.2 A spreadsheet for calculating returns.

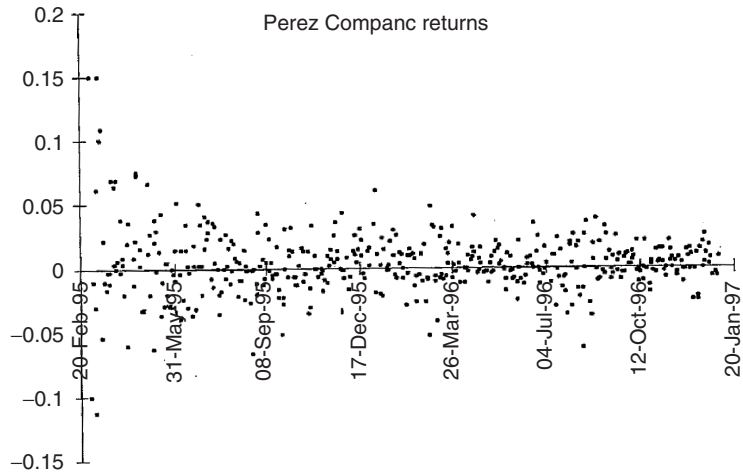

Figure 4.3 Returns on an asset.

Figure 4.2 shows a spreadsheet used to calculate returns. A sample plot of returns is shown in Figure 4.3.

You may find it instructive to split the data into sections and perform the same tests on these separate samples. Do you find the same results?

4. Compare interest rate data to your share price data. Are there any major differences? Is the asset price model

$$dS = \mu S\, dt + \sigma S\, dX$$

also suitable for modeling interest rates?

There are significant differences between share price and interest rate movements. The most obvious is that interest rates appear to be mean reverting. This feature cannot be captured by our asset price model and consequently, it is not a good model for interest rates.