Chapter 10 Suggested Problems Solutions

9. *a*. To find the average return, we sum all the returns and divide by the number of returns, so:
Arithmetic average return = (.27 +.13 + .18 – .14 + .09)/5 = .1060, or 10.60%

b. Using the equation to calculate variance, we find:
Variance = $1/4[(.27 – .106)^2 + (.13 – .106)^2 + (.18 – .106)^2 + (–.14 – .106)^2 + (.09 – .106)^2] = 0.023430$
So, the standard deviation is:
Standard deviation = $(0.023430)^{1/2} = 0.1531$, or 15.31%

10. *a*. To calculate the average real return, we can use the average return of the asset and the average inflation rate in the Fisher equation. Doing so, we find:
$(1 + R) = (1 + r)(1 + h)$ ➔ $\bar{r} = (1.1060/1.042) – 1 = .0614$, or 6.14%

b. The average risk premium is simply the average return of the asset, minus the average real risk-free rate, so, the average risk premium for this asset would be:
$\overline{RP} = \overline{R} - \overline{R}_f = .1060 – .0510 = .0550$, or 5.50%

11. We can find the average real risk-free rate using the Fisher equation. The average real risk-free rate was: $(1 + R) = (1 + r)(1 + h)$
➔ $\bar{r}_f = (1.051/1.042) – 1 =$ ..0086, or 0.86%

And to calculate the average real risk premium, we can subtract the average risk-free rate from the average real return. So, the average real risk premium was:
$\overline{rp} = \bar{r} - \bar{r}_f = 6.14\% – 0.86\% = 5.28\%$

12. Apply the five-year holding-period return formula to calculate the total return of the stock over the five-year period, we find:
5-year holding-period return = $[(1 + R_1)(1 + R_2)(1 + R_3)(1 + R_4)(1 + R_5)] – 1$
5-year holding-period return = [(1 + .1612)(1 + .1211)(1 + .0583)(1 + .2614)(1 – .1319)] – 1
5-year holding-period return = 0.5086, or 50.86%

21. To calculate the arithmetic and geometric average returns, we must first calculate the return for each year. The return for each year is:
R_1 = ($64.83 – 61.18 + 0.72) / $61.18 = .0714, or 7.14%
R_2 = ($72.18 – 64.83 + 0.78) / $64.83 = .1254, or 12.54%
R_3 = ($63.12 – 72.18 + 0.86) / $72.18 = –.1136, or –11.36%
R_4 = ($69.27 – 63.12 + 0.95)/ $63.12 = .1125, or 11.25%
R_5 = ($76.93 – 69.27 + 1.08) / $69.27 = .1262, or 12.62%

The arithmetic average return was:
R_A = (0.0714 + 0.1254 – 0.1136 + 0.1125 + 0.1262)/5 = 0.0644, or 6.44%

And the geometric average return was:
$R_G = [(1 + .0714)(1 + .1254)(1 – .1136)(1 + .1125)(1 + .1262)]^{1/5} – 1 = 0.0601$, or 6.01%

22. To find the real return we need to use the Fisher equation. Re-writing the Fisher equation to solve for the real return, we get $r = [(1 + R)/(1 + h)] – 1$
So, the real return each year was:

Year	T-bill return	Inflation	Real return
1973	0.0729	0.0871	–0.0131
1974	0.0799	0.1234	–0.0387
1975	0.0587	0.0694	–0.0100
1976	0.0507	0.0486	0.0020
1977	0.0545	0.0670	–0.0117
1978	0.0764	0.0902	–0.0127
1979	0.1056	0.1329	–0.0241
1980	0.1210	0.1252	–0.0037
	0.6197	0.7438	–0.1120

a. The average return for T-bills over this period was:
Average return = 0.6197 / 8 = .0775, or 7.75%

And the average inflation rate was:
Average inflation = 0.7438 / 8 = .0930, or 9.30%

b. Using the equation for variance, we find the variance for T-bills over this period was:
$$\text{Variance} = 1/7[(.0729 – .0775)^2 + (.0799 – .0775)^2 + (.0587 – .0775)^2 + (.0507 – .0775)^2 + (.0545 – .0775)^2 + (.0764 – .0775)^2 + (.1056 – .0775)^2 + (.1210 – .0775)^2]$$
Variance = 0.000616

And the standard deviation for T-bills was:
Standard deviation = $(0.000616)^{1/2} = 0.0248$, or 2.48%

The variance of inflation over this period was:
$$\text{Variance} = 1/7[(.0871 – .0930)^2 + (.1234 – .0930)^2 + (.0694 – .0930)^2 + (.0486 – .0930)^2 + (.0670 – .0930)^2 + (.0902 – .0930)^2 + (.1329 – .0930)^2 + (.1252 – .0930)^2]$$
Variance = 0.000971

And the standard deviation of inflation was:
Standard deviation = $(0.000971)^{1/2} = 0.0312$, or 3.12%

c. The average observed real return over this period was:
Average observed real return = –.1122 / 8 = –.0140, or –1.40%

d. The statement that T-bills have no risk refers to the fact that there is only an extremely small chance of the government defaulting, so there is little default risk. Since T-bills are short term, there is also very limited interest rate risk. However, as this example shows, there is inflation risk, i.e. the purchasing power of the investment can actually decline over time even if the investor is earning a positive return.

23. To find the return on the coupon bond, we first need to find the price of the bond today. Since one year has elapsed, the bond now has six years to maturity, so the price today is:

P_1 = \$70($PVIFA_{5.5\%,6}$) + \$1,000/1.055^6 = \$1,074.93

You received the coupon payments on the bond, so the nominal return was:

R = (\$1,074.93 – 1,080.50 + 70) / \$1,080.50 = .0596, or 5.96%

And using the Fisher equation to find the real return, we get:

r = (1.0596 / 1.032) – 1 = .0268, or 2.68%

24. Looking at the long-term government bond return history in Table 10.2, we see that the mean return was 6.1 percent, with a standard deviation of 9.8 percent. In the normal probability distribution, approximately 2/3 of the observations are within one standard deviation of the mean. This means that 1/3 of the observations are outside one standard deviation away from the mean. Or:

$\Pr(R < –3.7 \text{ or } R > 15.9) \approx {}^1/_3$

But we are only interested in one tail here, that is, returns less than –3.7 percent, so:

$\Pr(R < –3.7) \approx {}^1/_6$

You can use the z-statistic and the cumulative normal distribution table to find the answer as well. Doing so, we find:

$z = (X – \mu) / \sigma = (–3.7\% – 6.1) / 9.8\% = –1.00$

Looking at the z-table, this gives a probability of 15.87%, or:

$\Pr(R < –3.3) \approx .1587$, or 15.87%

The range of returns you would expect to see 95 percent of the time is the mean plus or minus 2 standard deviations, or:

95% level: $R \in \mu \pm 2\sigma = 6.1\% \pm 2(9.8\%) = –13.50\%$ to 25.70%

The range of returns you would expect to see 99 percent of the time is the mean plus or minus 3 standard deviations, or:

99% level: $R \in \mu \pm 3\sigma = 6.1\% \pm 3(9.8\%) = –23.30\%$ to 35.50%