CHAPTER 4

THE BASICS OF RISK

Problem 1

Year	Price	Annual Return
1989	1.2	
1990	2.09	0.741667
1991	4.64	1.220096
1992	5.34	0.150862
1993	5.05	-0.05431
1994	7.64	0.512871
1995	10.97	0.435864
1996	20.66	0.883318
1997	32.31	0.563892
1998	69.34	1.146085
	average	0.622261

a. The average annual return is 62.23%

b. The standard deviation is 42.49%

The variance is 0.1805

c. No. The firm is changing its business mix, is under increasing assault for monopolistic practices and is accumulating cash. I would expect all of these factors to change its risk profile.

Problem 2

Year	Price	Dividends	Return
1989	36.1	3	
1990	33.6	3	1.39%

1991	37.8	3	21.43%
1992	30.9	2.3	-12.17%
1993	26.8	1.6	-8.09%
1994	24.8	1.6	-1.49%
1995	31.6	1.6	33.87%
1996	28.5	1.6	-4.75%
1997	24.25	1.6	-9.30%
1998	35.6	1.6	53.40%
	average		8.25%
	std		22.84%
	variance		0.0521

a. The average annual return is 8.25%

b. The standard deviation is 22.84%, and the variance is 0.0521

c. I would not expect the same variance and standard deviation of returns because utilities have become much more deregulated today and face a lot of competition.

Problem 3

Year	*Scientific Atlanta*	*AT&T*
1989	80.95	58.26
1990	-47.37	-33.79
1991	31	29.88
1992	132.44	30.35
1993	32.02	2.94
1994	25.37	-4.29
1995	-28.57	28.86
1996	0	-6.36
1997	11.67	48.64
1998	36.19	23.55
average	27.37	17.804
s.d.	51.36	27.89
covariance	774.48	

correlation	0.54

a. The average return over the ten years is 27.37% for Scientific Atlanta and 17.8% for AT&T. The standard deviations are 51.36% and 27.89% respectively.
b. The covariance is 774.48, while the correlation coefficient 0.54.
c. The variance of a portfolio composed equally of the two investments equals $(0.5)^2(51.36)^2+(0.5)^2(27.89)^2+2(51.36)(27.89)(0.5)(0.5)(0.54) = 1240.68$; the standard deviation is 35.22%

Problem 4

a. You'd pick the stock market portfolio, since it dominates gold on both average return and standard deviation.

b. The higher possible returns on gold are balanced by the lower possible returns at other times. Note that the average return on gold is much less than that on the stock market.

c. The expected return on this portfolio would be (8+20)/2 = 14%. The variance would equal $(0.5)^2(25)^2 + (0.5)^2(22)^2 - 2(0.5)(0.5)(25)(22)(0.4) = 167.25$; the standard deviation equals 12.93%

d. If the supply of gold is negatively correlated with the level of the market, and the price of gold is inversely related to the supply of gold, we have a positive correlation between the return on the market and the return on gold. This would make gold less desirable, since it does not help as much in reducing portfolio variance. The optimal amount to invest in gold would drop.

Problem 5

a. The average return on the portfolio equals (0.6)25 + (0.4)12 = 19.8%

The variance of returns equals $(0.6)^2(36)^2 +(0.4)^2(22^2) + 2(0.4)(0.6)(36)(22)(0.28) = 650.44$; the standard deviation of returns = 25.5%

b. The minimum variance portfolio is given by

$w_{CC} = [22^2-(22)(36)(0.28)]/[22^2+36^2-2(22)(36)(0.28)] = 262.24/1336.48 = 0.1962$; the weight in Texas Utilities is 1-0.1962 = 0.8038.

Problem 6

Times Mirror σ	25%	
Unilever σ	40%	
correlation	Portfolio Variance	s.d.
-1	56.25	7.50%
-0.8	156.25	12.50%
-0.6	256.25	16.01%
-0.4	356.25	18.87%
-0.2	456.25	21.36%
0	556.25	23.58%
0.2	656.25	25.62%
0.4	756.25	27.50%
0.6	856.25	29.26%
0.8	956.25	30.92%
1	1056.25	32.50%

Problem 7

The portfolio variance equals

$(1/3)^2(23)^2+(1/3)^2(27)^2+(1/3)^2(50)^2 +2(1/3)(1/3)(23)(27)(-0.15)$

$+2(1/3)(1/3)(27)(50)(-0.25)+ 2(1/3)(1/3)(23)(50)(0.2) = 360.97$

The standard deviation = 19%

Problem 8

The variance of a portfolio consisting of N securities can be estimated as (1/N)(average variance) + (1-1/N)(average covariance) = 10 + (50-10)/N.

Number of securities in portfolio (N)	Estimated portfolio variance
5	18
10	14
20	12
50	10.8
100	10.4

We must solve 10 + 40/N = 1.1(10) = 11, or N = 40

Problem 9

The expected return on the new portfolio = 0.2(5) + (0.8)12 = 10.6%

The standard deviation of returns on the new portfolio = 0.8(25) = 20%

Problem 10

a. Invest everything in the riskless asset.
b. Solve 0.15 = w(0.3) to get w =0.5; invest 50% in each asset.
c. Invest everything in the market portfolio
d. Solve 0.45 w(0.3) to get w =1.5; the investor should borrow 50% of his own outlay at the riskfree rate and invest the borrowing as well as his own outlay in the market portfolio.
e. Solve w(15) + (1-w)5 = 12 to get w = 0.7; invest 70% in the market portfolio and the rest in the riskfree asset.

Problem 11

a. The covariance of returns between Scientific Atlanta and the market portfolio = -13.07

b. The variance of returns is 2637.56 for Scientific Atlanta and 209.88 for the market portfolio

c. The beta of Scientific Atlanta equals -13.07/209.88 = -0.0623

Problem 12

a. Solve 1.5 = Covariance(R_{UA}, R_{mkt})/22^2. Hence the covariance equals 726. The correlation between United Airlines and the market can be computed as 726/(22x66) = 0.5

b. The share of market risk in United Airlines risk is $(0.5)^2$ or 25%.

Problem 13

a. Bethlehem Steel is most exposed to the fourth factor. One can try to identify the factors by regressing the estimated factors on various macroeconomic variables. The APT, itself, does not identify the factors.

b. If the riskfree rate is 5%, the expected return on Bethlehem Steel would be 5 + 1.2(2.5) + 0.6(1.5) + 1.5(1) + 2.2(0.8) + 0.5(1.2) = 12.76%

c. Using the CAPM, the expected return would be 5 + 1.1(5) = 10.5%

d. The expected returns could be different if there are other risks that the market deems relevant that are not adequately captured in the market portfolio.

Problem 14

The expected return on Emerson Electric would be 6 + 0.5(1.8) + 1.4(0.6) + 1.2(1.5) + 1.8(4.2) = 17.1%

Problem 15

a. The expected annual return on Lucent Technologies would be 1.77 - 0.11(ln 1800) +0.35(ln(735/1800), which works out to 0.63% per month. On an annual basis,

this would work out to 7.58% without compounding and 7.85% with compounding ($(1.0063^{12}-1)$)

b. Under the CAPM, the expected return is 6% + 1.55(5.5) = 14.525% per annum.

The two approaches differ because they use different measures of risk. The first one uses an empirical proxy, while the second one uses a measure derived from theory.