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.

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.

3-3
Year Scientific Atlanta AT&T
1989 80.95 58.26
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 
\((0.5)^2(51.36)^2+(0.5)^2(27.89)^2+2(0.5)(0.5)(27.89)(0.5)(0.54) = 1240.68\%^2\); the
standard deviation is 35.22%. In decimal terms, the variance = 0.1240 and the
standard deviation is 0.3522.

3-4
a. You’d pick the stock market portfolio, since it dominates gold on both average return
(with a higher average) and standard deviation (a lower value).
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.
Not that your friend may be making a point (albeit in an indirect way about the dangers
of the mean variance framework and arguing that investors like big positive payoffs
(skewness).
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 to
diversified investors, since it does not help as much in reducing portfolio variance. The
optimal amount to invest in gold would drop.

3-5
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
\[w_{CC} = \frac{22^2-(22)(36)(0.28))}{[22^2+36^2-2(22)(36)(0.28)]} = 0.1962; \text{ the weight in Texas Utilities is } 1-0.1962 = 0.8038.\]
3-6

<table>
<thead>
<tr>
<th>Times Mirror $\sigma$</th>
<th>25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unilever $\sigma$</td>
<td>40%</td>
</tr>
<tr>
<td>correlation</td>
<td></td>
</tr>
<tr>
<td>Portfolio Variance</td>
<td></td>
</tr>
<tr>
<td>s.d.</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td>56.25</td>
</tr>
<tr>
<td>-0.8</td>
<td>156.25</td>
</tr>
<tr>
<td>-0.6</td>
<td>256.25</td>
</tr>
<tr>
<td>-0.4</td>
<td>356.25</td>
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<tr>
<td>-0.2</td>
<td>456.25</td>
</tr>
<tr>
<td>0</td>
<td>556.25</td>
</tr>
<tr>
<td>0.2</td>
<td>656.25</td>
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<tr>
<td>0.4</td>
<td>756.25</td>
</tr>
<tr>
<td>0.6</td>
<td>856.25</td>
</tr>
<tr>
<td>0.8</td>
<td>956.25</td>
</tr>
<tr>
<td>1.0</td>
<td>1056.25</td>
</tr>
</tbody>
</table>

3-7

The portfolio variance equals

$\frac{1}{3}(23)^2 + \frac{1}{3}(27)^2 + \frac{1}{3}(50)^2 + 2 \frac{1}{3} \frac{1}{3} (23)(27)(-0.15) + 2 \frac{1}{3} \frac{1}{3} (27)(50)(-0.25) + 2 \frac{1}{3} \frac{1}{3} (23)(50)(0.2) = 372.97$

The standard deviation = 19%

3-8

I would need to compute 1250 expected returns and 1250 variances.

b. I would need to compute $1250(1249)/2 = 780625$ distinct covariances.

3-9

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

<table>
<thead>
<tr>
<th>Number of securities in portfolio (N)</th>
<th>Estimated portfolio variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>50</td>
<td>10.8</td>
</tr>
<tr>
<td>100</td>
<td>10.4</td>
</tr>
</tbody>
</table>

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

3-10

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

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

The standard deviation of the risk-free investment return is zero and it is uncorrelated with other investments.
3-11
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.

3-12
a. The covariance of returns between Microsoft and the market portfolio = -11.77
b. The variance of returns is 2637.56 for Microsoft and 209.88 for the market portfolio
c. The beta of Microsoft equals $-13.07/209.88 = -0.0623$

3-13
a. Solve $1.5 = \text{Covariance}(R_{UA}, R_{mkt})/22^2$. Hence the covariance equals 726. The correlation between United Airlines and the market can be computed as $726/(22\times66) = 0.5$

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

3-14
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.

3-15
The expected return on Emerson Electric would be $6 + 0.5(1.8) + 1.4(0.6) + 1.2(1.5) + 1.8(4.2) = 17.1\%$

3-16
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.
c. 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.