1. Since the coupon rate is 3% and payments are annual, the stream of payments is $30 after 1 year and $1030 after two years. The purchase price is $998.86. Yield to Maturity is the interest rate at which the present discounted value of the stream of payments equals the purchase price:

\[
998.86 = \frac{30}{1 + r} + \frac{1030}{(1 + r)^2}
\]

Solving for \( r \) yields \( r = 3.06\% \). If, instead, the purchase price is $1002.30, then

\[
1002.30 = \frac{30}{1 + r} + \frac{1030}{(1 + r)^2}
\]

Solving for \( r \) yields \( r = 2.88\% \).

2. As above, the yield is the interest rate at which the present discounted value of the stream of payments equals the purchase price. The semiannual yield is half the annual yield. Hence if the annual yield were 10%:

\[
P = \sum_{t=1}^{10} \frac{25}{(1.05)^t} + \frac{1000}{(1.05)^{10}}
\]

So \( P = \$806.96 \). If the annual yield were 2% then

\[
P = \sum_{t=1}^{10} \frac{25}{(1.01)^t} + \frac{1000}{(1.01)^{10}}
\]

\[
P = 5 \left( \sum_{t=1}^{10} \frac{5}{(1.01)^t} + \frac{200}{(1.01)^{10}} \right) - 1000
\]

So \( P = \$1142.07 \).

3.

(a) Inconsistent. If this were the case, future prices could be predicted on the basis of past price patterns.

(b) Consistent. Even if mutual fund managers did not outperform the market on average, we would expect roughly half of them to beat the market in any given year.

(c) Consistent. The decline could not have been predicted on the basis of prior market data.
(d) Inconsistent. If this were the case, future prices could be predicted on the basis of past price patterns.

(e) Consistent. The rise could not have been predicted on the basis of prior market data.

4. The simplest way to show inconsistency with Arbitrage Pricing Theory is to compare the ratios of excess returns to the betas:

\[
\frac{E(r_P) - r_f}{\beta_P} = \frac{18 - 3}{1.30} = 11.54
\]

\[
\frac{E(r_Q) - r_f}{\beta_Q} = \frac{15 - 3}{1.00} = 12.00
\]

\[
\frac{E(r_Q) - r_f}{\beta_Q} = \frac{12 - 3}{0.75} = 12.00
\]

The Arbitrage Pricing Theory implies that these ratios should all be equal. Since they are not, the data is inconsistent with the theory. Consider portfolio S which consists of weight \(\frac{10}{13}\) in portfolio P and \(\frac{3}{13}\) in the risk free asset. Portfolio S has beta of 1 and expected return of \(\frac{189}{13} = 14.538\). Selling short portfolio S and buying long portfolio Q (which has the same beta but a higher expected return) yields sure profit with zero investment. (Note that by selling S short, the investor is borrowing at \(r_f\) and using these funds, together with the proceeds from selling P, to buy asset Q.)

5. The scatter plot (with \(r_g\) on the vertical axis and \(r_m\) on the horizontal) is as follows:
The regression coefficients are $\alpha = -0.0016$ and $\beta = 1.6191$. The estimate for variance of the residual is

$$\sigma^2(e) = \frac{1}{T - 2} \sum_{t=1}^{T} e_t = 0.0173$$

The estimate for variance of the return on the market is

$$\sigma^2_m = \frac{1}{T - 1} \sum_{t=1}^{T} (r_{mt} - \bar{r}_m)^2 = 0.0027$$

Systematic risk is

$$\beta^2 \sigma^2_m = 0.0071$$

The total variance of the return on the stock is given by

$$\sigma^2_g = \beta^2 \sigma^2_m + \sigma^2(e) = 0.0244$$

Therefore the percentage of total variance that is due to systematic risk is

$$\frac{0.0071}{0.0244} = 29\%$$

and the percentage of total variance that is due to firm-specific risk is

$$\frac{0.0173}{0.0244} = 71\%.$$. 