2.) $p_a = E[m X_a]$

$$m_s = \frac{\delta U'(C_s^*)}{U'(C_0^*)} = \delta \frac{C_0^*}{C_s^*}$$

$$p_s = \delta \pi_s \frac{C_0^*}{C_s^*}$$

3.) $\varepsilon = \frac{R_s}{C_s/C_0} \frac{d(C_s/C_0)}{dR_s}$

$$m_{01} = \frac{\delta U'(C_1)}{U'(C_0)} = \delta (C_1/C_0)^{\gamma-1}$$

F.O.C. ; $1 = \pi_s \delta (C_s/C_0)^{\gamma-1} R_s$

Total diff ; $0 = \pi_s \delta (\gamma-1)(C_s/C_0)^{\gamma-2} R_s \, d(C_s/C_0) + \pi_s \delta (C_s/C_0)^{\gamma-1} dR_s$

$$\frac{R_s}{C_s/C_0} \frac{d(C_s/C_0)}{dR_s} = \frac{1}{1-\gamma}$$

4.) $p = \begin{bmatrix} \frac{1}{1.05} \\ 6 \end{bmatrix}$ $\quad X = \begin{bmatrix} 1 & 10 \\ 1 & 5 \end{bmatrix}$

$$X^{-1} = \begin{bmatrix} -1 & 2 \\ 0.2 & -0.2 \end{bmatrix}$$

a.) $[p_1 \; p_2] = p'X^{-1} = \begin{bmatrix} \frac{1}{1.05} & 6 \end{bmatrix} \begin{bmatrix} -1 & 2 \\ 0.2 & -0.2 \end{bmatrix}$

$$= \begin{bmatrix} 0.2476 & 0.7048 \end{bmatrix}$$

risk neutral probability are $p_1 R_f = 0.26$ and $p_2 R_f = 0.74$.

b.)

$$m_1 = \frac{p_1}{\pi_1} = 0.495$$

$$m_2 = \frac{p_2}{\pi_2} = 1.41$$

6.) a.) $0 = E[m(R_i - R_f)]$

$$0 = E[(a + bR_m)(R_i - R_f)]$$

$$0 = a[E[R_i] - R_f] + b(E[R_m]E[R_i] + \operatorname{cov}[R_m, R_i] - R_f E[R_m])$$

$$0 = (E[R_i] - R_f)(a + bE[R_m]) + b\operatorname{cov}[R_m, R_i]$$

$$E[R_i] - R_f = \frac{-b\operatorname{cov}[R_m, R_i]}{a + bE[R_m]}$$

$$E[R_i] - R_f = -\frac{\operatorname{cov}[R_m, R_i]}{\sigma_m} \cdot \frac{b\sigma_m^2}{a + bE[R_m]}$$

$$E[R_i] - R_f = -\beta \frac{b\sigma_m^2}{a + bE[R_m]}$$

$$\therefore \gamma = \frac{b\sigma_m^2}{a + bE(R_m)}$$

b.) $\frac{1}{R_f} = E[a + bR_m]$

$$a = \frac{1}{R_f} - bE(R_m) \qquad (1)$$

Mkt portfolio

$$1 = E[(a + bR_m)R_m]$$

$$= aE[R_m] + b(\sigma_m^2 + E[R_m]^2) \qquad (2)$$

substitute (1) in (2) ; $1 = \left(\frac{1}{R_f} - bE[R_m]\right)E[R_m] + b(\sigma_m^2 + E[R_m]^2)$

$$1 = \frac{E[R_m]}{R_f} + b\sigma_m^2$$

$$b = -\frac{E[R_m] - R_f}{R_f \sigma_m^2} \qquad (3)$$

sub (3) back in (1) ; $a = \frac{\sigma_m^2 + E[R_m](E[R_m] - R_f)}{R_f \sigma_m^2}$

c.) $a + bE[R_m] = \frac{\sigma_m^2 + E[R_m](E(R_m) - R_f) - (E[R_m] - R_f)}{R_f \sigma_m^2}$

$$= 1/R_f$$

$$\gamma = -\frac{b\sigma_m^2}{a + bE[R_m]}$$

$$= -b\sigma_m^2 R_f$$

$$= \frac{E[R_m] - R_f}{R_f \sigma_m^2} \sigma_m^2 R_f$$

$$= E[R_m] - R_f .$$