**Value at risk**

a) If CAPM holds:

b) Assume stock return is log-normally distributed, the var can be calculated:

1% tail for normal distribution = -2.326 standard deviation;

VaR for managed portfolio = $1M - $1M \* exp[(0.2-0.5\*0.6^2) – 0.6\*2.3326] = $0.75M

VaR for market index = $ 1M - $ 1M \* exp[(0.13 – 0.5\*0.2^2) – 0.2\*2.3326] = $0.30M

c)

5% tail for normal distribution = -1.645 standard deviation.

Mean return for 2-year managed portfolio = 2 \* 20% = 40%

Standard deviation for 2-year managed portfolio = sqrt(2) \* 60% = 84.85%

VaR for managed portfolio = $1M - $1M \* exp[(0.2 – 0.5\*0.6^2)\*2 – 1.645\*0.6\*sqrt(2)] = $0.74M

Using similar procedure, VaR for market portfolio =$1M - $ 1M \* exp[(0.13 – 0.5\*0.2^2) \*2– 0.2\*1.645\*sqrt(2)] = $0.22M

**Cost of Capital and Hidden Balance Sheet Effects**

a)

b)

Total Asset Beta = Total Liability & Equity Beta =

i. If invest in long term bond

ii. If invest in market index

iii. The result should be the same as ii since the two pension plans has exactly the same risk and payoff structure.

**VaR of the Firm’s Assets as an Approach to Risk Accounting**

a) If pension asset invested in market index:

Assume log-normal distribution:

VaR = $200M - $200M\* exp[(8.75%-0.5\*8.66%^2) -2.326 \* 8.66%] = $22.2M

b) If pension asset invested in long term bonds:

since pension asset does not have risk and devation

VaR = $200M - $200M\* exp[(8.75%-0.5\*15%^2) -2.326 \* 15%] = $47.73M

c)

I do not think I perfectly understand the question well, but I will analyze the allocation of risk capital in the perspective of beta (market exposure).

Given that the same balance sheet size, pension liability beta, debt beta, and equity beta, the total beta of the right hand side remains 0.375 by 2b). As a result, the company’s total asset beta is 0.375. Its asset is equivalent to holding 0.375 \* $200 M = $75M market index and the rest $125M risk-free bond. In (a) the company is investing $50M pension asset in market index, which leaves $25M “risk capital”(equivalent to market index) in operating asset; in (b) the company is investing 0 pension asset in market index and leaves $75M risk capital in operating asset.