Seminar 8
Solutions

A. Multiple Choice Questions

A1. Correct answer is "a". As the correlation between two assets *decreases*, the benefits of diversification increase. Combining assets that are not perfectly correlated reduces the risk of the portfolio, as measured by standard deviation.

A2. Correct answer is "c". The capital market line plots expected return against standard deviation of returns for efficient portfolios. The efficient frontier plots expected return against the standard deviation of return, a measure of total risk.

A3. Correct answer is "c". As randomly selected securities are added to a portfolio, the diversifiable (unsystematic) risk decreases, and the expected level of non-diversifiable (systematic) risk remains the same.

A4. Correct answer is "a". Based on the CAPM, the portfolio should earn:

$$E(R) = 0.05 + 1.5(0.15 - 0.05) = 0.20$$

On a risk-adjusted basis, this portfolio lies on the SML and is, thus, properly valued.

A5. Correct answer is "b". Points on the CML do not represent individual securities, but rather portfolios that contain a well-diversified portfolio (the tangency portfolio) combined with either lending or borrowing at the risk-free rate. The other statements are correct.

A6. Correct answer is "b". Time line = \$0 now; \$0 in year 1; \$0 in year 2; \$1 in year 3

$$P_2 = \frac{D_3}{(k-g)} = \frac{1}{(0.17-0.07)} = \$10$$

$$P_0 = \frac{\$10}{(1.17)^2} = \$7.31$$

Note that the price is always one year before the dividend date.

A7. Correct answer is "c"

$$P/E = \frac{dividend\ payout\ ratio}{k-g}$$

$$Dividend\ Payout\ ratio = 1 - retention\ ratio = 1 - 0.4 = 0.6$$

$$Growth\ rate\ (g) = retention\ rate \times ROE = 0.4 \times 15\% = 6\%$$

$$P/E = \frac{0.6}{0.14 - 0.06} = 7.5$$

A8. Correct answer is "c". This is the formula for the variance. The formula for the standard deviation is:

$$\sigma_p = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\sigma_1\sigma_2\rho_{1,2}}$$

A9. Correct answer is "b". Risk aversion implies that investors require a higher return to induce them to accept greater risk. Triple A-rated bonds are less risky than single A-rated bonds and, therefore, have lower yields.

A10. Correct answer is "a". Portfolio X has a lower expected return and a higher standard deviation than Portfolio Y. X must be inefficient.

A11. Correct answer is "b".

$$E(R_1) = 0.5(25) + 0.3(10) + 0.2(-25) = 10.5\%$$
$$E(R_2) = 0.5(1) + 0.3(-5) + 0.2(35) = 6.00\%$$
$$E(R_p) = w_1R_1 + w_1R_1 = 0.6(10.5) + 0.4(6.0) = 8.7\%$$

A12. Correct answer is "a".

$Stock\ A: K_A = 8\% + 1.5(7\%) = 18.5\%$ Because the estimated return of 18.1% is less than the required return of 18.5%, Stock A is *overvalued.*

$Stock\ B: K_B = 8\% + 1.1(7\%) = 15.7\%$ Because the estimated return of 15.7% equals the required return of 15.7%, Stock A is *properly valued.*

$Stock\ C: K_C = 8\% + 0.6(7\%) = 12.2\%$ Because the estimated return of 12.5% is greater than the required return of 12.2%, Stock C is *undervalued*

A13. Correct answer is "a".

The SML equation, $E(R_i) = R_F + \beta_i[E(R_M) - R_F]$, yields the following expected (required) rates of return for these three stocks.

$$R_x = 0.05 + 0.6 \times (0.12 - 0.05) = 0.092\ or\ 9.2\%$$
$$R_x = 0.05 + 1.2 \times (0.12 - 0.05) = 0.134\ or\ 13.4\%$$
$$R_z = 0.05 + 1.8 \times (0.12 - 0.05) = 0.176\ or\ 17.6\%$$

Stock	*Estimated Return*	*Required Return*	*Estimated Return-Required Return*	*Evaluation*
X	8.0%	9.2%	-1.2%	Overvalued
Y	18.0%	13.4%	4.6%	Undervalued
Z	22.5%	17.6%	4.9%	Undervalued

The analyses would not recommend buying the overvalued Stock X

A14. Correct answer is "c". This statement is not correct; the standard deviation of returns for the resulting portfolio is a weighted average of the returns standard deviation of the risk-free asset (zero) and the returns standard deviation of the risky-asset portfolio.

A15. Correct answer is "a". A risk-averse investor prefers less risk to more risk. The lower the correlation, the greater is the risk reduction. Thus, a risk-averse investor would most prefer the portfolio with the lowest correlation coefficient and least prefer the one with the highest. Of the choices given W and Y's correlation coefficient of +0.6 is the highest.

B. Long Answer Questions

B1. *The Fama-French Three-Factor Model changes the definition of alpha. Fama and French (1993) started with the observation that two classes of stocks have tended to do better than the market as a whole: (i) small caps and (ii) stocks with a high book-value-to-price ratio (also called "value" stocks; their opposites are called "growth" stocks – these will be discussed in greater detail in one of the following lectures). They then added two factors to CAPM to reflect a portfolio's exposure to these two classes as seen in the following equation:*

$$R_{pt} - r_{ft} = \alpha_p + \beta_{p,m}(R_{mt} - r_{ft}) + \beta_{SMB}\, SMB_t + \beta_{HML}\, HML_t + \varepsilon_{pt}$$

The "three factor" beta ($\beta_{p,m}$) is equivalent to the classical beta from the CAPM model, but not equal to it, since there are now two additional factors in the equation. SMB and HML stand for "small [cap] minus big" and "high [book/price] minus low"; they measure the historic excess returns of small caps (smallest 30% of stocks in month t) and value stocks (50% of stocks with highest book/price ratios in month t) over the large caps (largest 30% of stocks in that month) and growth stocks (50% of stocks with lowest book/price ratios in that month t). According to the one-factor CAPM, alpha is the amount by which an active money manager outperforms a broad market index. The Fama-French Three-Factor Model defines alpha for equities more precisely as the return an active manager achieves above the sum of the portfolio's expected return due to all three equity risk factors.

Carhart (1997) extended the Fama-French model to a four factor model by adding a momentum factor, so that equation becomes:

$$R_{pt} - r_{ft} = \alpha_p + \beta_{p,m}(R_{mt} - r_{ft}) + \beta_{SMB}\, SMB_t + \beta_{HML}\, HML_t + \beta_{WML_t} WML_t + \varepsilon_{pt}$$

Where WML (winner minus loser portfolio return) factor is constructed as the equally weighted average of top 30% of firms with highest 11-month returns lagged one month minus the equally weighted average of the 30% firms with the lowest 11-month returns lagged one month. Momentum is added as a fourth factor to allow persistence of the performance to be taken into account. Carhart alpha then represents excess return after market risk, small cap, value and

momentum associated performance is taken into account. The significance of this alpha is also tested using a t-test and its value will again be different to CAPM (Jensen's) or Fama-French three factor model alpha.