**Chapter 08**

**Index Models**

**Multiple Choice Questions**  
 1. As diversification increases, the total variance of a portfolio approaches \_\_\_\_\_\_\_\_\_\_\_\_.   
A. 0  
B. 1  
**C.** the variance of the market portfolio  
D. infinity  
E. -1  
  
As more and more securities are added to the portfolio; unsystematic risk decreases and most of the remaining risk is systematic; as measured by the variance of the market portfolio.  
  
2. As diversification increases, the standard deviation of a portfolio approaches \_\_\_\_\_\_\_\_\_\_\_\_.   
A. 0  
B. 1  
C. infinity  
**D.** the standard deviation of the market portfolio  
E. -1  
  
As more and more securities are added to the portfolio; unsystematic risk decreases and most of the remaining risk is systematic, as measured by the variance (or standard deviation) of the market portfolio.  
  
 3. As diversification increases, the firm-specific risk of a portfolio approaches \_\_\_\_\_\_\_\_\_\_\_\_.   
**A.** 0  
B. 1  
C. infinity  
D. n-1 \* n  
E. -1  
  
As more and more securities are added to the portfolio; unsystematic risk decreases and most of the remaining risk is systematic; as measured by the variance (or standard deviation) of the market portfolio.

4. As diversification increases, the unsystematic risk of a portfolio approaches \_\_\_\_\_\_\_\_\_\_\_\_.   
A. 1  
**B.** 0  
C. infinity  
D. n-1 \* n  
E. -1

As more and more securities are added to the portfolio, unsystematic risk decreases and most of the remaining risk is systematic, as measured by the variance (or standard deviation) of the market portfolio.

5. As diversification increases, the unique risk of a portfolio approaches \_\_\_\_\_\_\_\_\_\_\_\_.   
A. 1  
**B.** 0  
C. infinity  
D. n-1 \* n  
E. -1

As more and more securities are added to the portfolio, unsystematic risk decreases and most of the remaining risk is systematic, as measured by the variance (or standard deviation) of the market portfolio.

 6. The index model was first suggested by \_\_\_\_\_\_\_\_\_\_\_\_.   
A. Graham  
B. Markowitz  
C. Miller  
**D.** Sharpe  
E. Jensen

William Sharpe, building on the work of Harry Markowitz, developed the index model.

7. A single-index model uses \_\_\_\_\_\_\_\_\_\_ as a proxy for the systematic risk factor.   
**A.** a market index, such as the S&P 500  
B. the current account deficit  
C. the growth rate in GNP  
D. the unemployment rate  
E. the inflation rate

The single-index model uses a market index, such as the S&P 500, as a proxy for the market, and thus for systematic risk.

8. Beta books typically rely on the \_\_\_\_\_\_\_\_\_\_ most recent monthly observations to calculate regression parameters.   
A. 12  
B. 36  
**C.** 60  
D. 120  
E. 6

Most published betas and other regression parameters are based on five years of monthly return data.

 9. The index model has been estimated for stocks A and B with the following results:   
RA= 0.03 + 0.7RM+ eA  
RB= 0.01 + 0.9RM+ eB  
σM= 0.35 σ(eA) = 0.20 σ(eB) = 0.10  
The covariance between the returns on stocks A and B is \_\_\_\_\_\_\_\_\_\_\_.   
A. 0.0384  
B. 0.0406  
C. 0.1920  
**D.** 0.0772  
E. 0.4000

Cov(RA,RB) = bAbBs2M = 0.7(0.9)(0.35)2 = 0.0772.

 10. According to the index model, covariances among security pairs are   
A. due to the influence of a single common factor represented by the market index return  
B. extremely difficult to calculate  
C. related to industry-specific events  
D. usually positive  
**E.** due to the influence of a single common factor represented by the market index return, they are usually positive

Most securities move together most of the time, and move with a market index, or market proxy.

 11. The intercept in the regression equations calculated by beta books is equal to   
A. α in the CAPM  
B. α + rf(1 + β)  
**C.** α + rf(1 - β)  
D. 1 - α  
E. 1

The intercept that beta books call alpha is really, using the parameters of the CAPM, an estimate of a + rf (1 − b). The apparent justification for this procedure is that, on a monthly basis, rf(1 − b) is small and is apt to be swamped by the volatility of actual stock returns.

12. Analysts may use regression analysis to estimate the index model for a stock. When doing so, the slope of the regression line is an estimate of \_\_\_\_\_\_\_\_\_\_\_\_\_\_.   
A. the α of the asset  
**B.** the β of the asset  
C. the σ of the asset  
D. the δ of the asset  
E. the ρ of the asset

The slope of the regression line, β, estimates the volatility of the stock versus the volatility of the market and the α estimates the intercept.

13. Analysts may use regression analysis to estimate the index model for a stock. When doing so, the intercept of the regression line is an estimate of \_\_\_\_\_\_\_\_\_\_\_\_\_\_.   
**A.** the α of the asset  
B. the β of the asset  
C. the σ of the asset  
D. the δ of the asset  
E. the ρ of the asset

The slope of the regression line, β, estimates the volatility of the stock versus the volatility of the market and the α estimates the intercept.

 14. In a factor model, the return on a stock in a particular period will be related to \_\_\_\_\_\_\_\_\_.   
A. firm-specific events  
B. macroeconomic events  
C. the error term  
**D.** both firm-specific events and macroeconomic events  
E. neither firm-specific events nor macroeconomic events

The return on a stock is related to both firm-specific and macroeconomic events.

15. Rosenberg and Guy found that \_\_\_\_\_\_\_\_\_\_ helped to predict a firm's beta.   
A. the firm's financial characteristics  
B. the firm's industry group  
C. firm size  
D. both the firm's financial characteristics and the firm's industry group  
**E.** the firm's financial characteristics, the firm's industry group and firm size

Rosenberg and Guy found that after controlling for the firm's financial characteristics, the firm's industry group was a significant predictor of the firm's beta.

16. If the index model is valid, \_\_\_\_\_\_\_\_\_ would be helpful in determining the covariance between assets GM and GE.   
A. βGM  
B. βGE  
C. σM  
**D.** βGM, βGE, and σM E. βGE, and σM

If the index model is valid A, B, and C are determinants of the covariance between GE and GM.

17. If the index model is valid, \_\_\_\_\_\_\_\_\_ would be helpful in determining the covariance between assets HPQ and KMP.   
A. βHPQ  
B. βKMP  
C. σM  
**D.** βHPQ, βKMP, and σM  
E. βHPQ, and βKMP

If the index model is valid A, B, and C are determinants of the covariance between HPQ and KMP.

18. If the index model is valid, \_\_\_\_\_\_\_\_\_ would be helpful in determining the covariance between assets K and L.   
A. βk  
B. βL  
C. σM  
**D.** βk, βL, and σM  
E. βk, and βL

If the index model is valid A, B, and C are determinants of the covariance between K and L.

19. Rosenberg and Guy found that \_\_\_\_\_\_\_\_\_\_\_ helped to predict firms' betas.   
A. debt/asset ratios  
B. market capitalization  
C. variance of earnings  
**D.** debt/asset ratios, market capitalization, and variance of earnings  
E. debt/asset ratios and variance of earnings only

Rosenberg and Guy found that A, B, and C were determinants of firms' betas.

20. If a firm's beta was calculated as 0.6 in a regression equation, a commonly used adjustment technique would provide an adjusted beta of   
A. less than 0.6 but greater than zero.  
**B.** between 0.6 and 1.0.  
C. between 1.0 and 1.6.  
D. greater than 1.6.  
E. zero or less.

Betas, on average, equal one; thus, betas over time regress toward the mean, or 1. Therefore, if historic betas are less than 1, adjusted betas are between 1 and the calculated beta.

 21. If a firm's beta was calculated as 0.8 in a regression equation, a commonly used adjustment technique would provide an adjusted beta of   
A. less than 0.8 but greater than zero.  
B. between 1.0 and 1.8.  
**C.** between 0.8 and 1.0.  
D. greater than 1.8.  
E. zero or less.

Betas, on average, equal one; thus, betas over time regress toward the mean, or 1. Therefore, if historic betas are less than 1, adjusted betas are between 1 and the calculated beta.

 22. If a firm's beta was calculated as 1.3 in a regression equation, a commonly used adjustment technique would provide an adjusted beta of   
A. less than 1.0 but greater than zero.  
B. between 0.3 and 0.9.  
**C.** between 1.0 and 1.3.  
D. greater than 1.3.  
E. zero or less.

Betas, on average, equal one; thus, betas over time regress toward the mean, or 1. Therefore, if historic betas are greater than 1, adjusted betas are between 1 and the calculated beta.

23. The beta of Exxon stock has been estimated as 1.6 using regression analysis on a sample of historical returns. A commonly used adjustment technique would provide an adjusted beta of \_\_\_\_\_\_\_\_\_\_\_.   
A. 1.20  
B. 1.32  
C. 1.13  
**D.** 1.40  
E. 1.65

Adjusted beta = 2/3 sample beta + 1/3(1); = 2/3(1.6) + 1/3 = 1.40.

24. The beta of Apple stock has been estimated as 2.3 using regression analysis on a sample of historical returns. A commonly used adjustment technique would provide an adjusted beta of \_\_\_\_\_\_\_\_\_\_\_.   
A. 2.20  
**B.** 1.87  
C. 2.13  
D. 1.66  
E. 1.93

Adjusted beta = 2/3 sample beta + 1/3(1); = 2/3(2.3) + 1/3 = 1.867.

 25. The beta of JCP stock has been estimated as 1.2 using regression analysis on a sample of historical returns. A commonly used adjustment technique would provide an adjusted beta of \_\_\_\_\_\_\_\_\_\_\_.   
A. 1.20  
B. 1.32  
**C.** 1.13  
D. 1.0  
E. 1.23

Adjusted beta = 2/3 sample beta + 1/3(1); = 2/3(1.2) + 1/3 = 1.13.

26. Assume that stock market returns do not resemble a single-index structure. An investment fund analyzes 150 stocks in order to construct a mean-variance efficient portfolio constrained by 150 investments. They will need to calculate \_\_\_\_\_\_\_\_\_\_\_\_\_ expected returns and \_\_\_\_\_\_\_\_\_\_\_ variances of returns.   
**A.** 150, 150  
B. 150, 22500  
C. 22500, 150  
D. 22500, 22500  
E. 300, 300

The expected returns of each of the 150 securities must be calculated. In addition, the 150 variances around these returns must be calculated.

 27. Assume that stock market returns do not resemble a single-index structure. An investment fund analyzes 100 stocks in order to construct a mean-variance efficient portfolio constrained by 100 investments. They will need to calculate \_\_\_\_\_\_\_\_\_\_\_\_\_ expected returns and \_\_\_\_\_\_\_\_\_\_\_ variances of returns.   
**A.** 100, 100  
B. 100, 4950  
C. 4950, 100  
D. 4950, 4950  
E. 200, 200

The expected returns of each of the 100 securities must be calculated. In addition, the 100 variances around these returns must be calculated.

28. Assume that stock market returns do not resemble a single-index structure. An investment fund analyzes 150 stocks in order to construct a mean-variance efficient portfolio constrained by 150 investments. They will need to calculate \_\_\_\_\_\_\_\_\_\_\_\_ covariances.   
A. 12  
B. 150  
C. 22,500  
**D.** 11,175  
E. 300

(n2 − n)/2 = (22,500 − 150)/2 = 11,175 covariances must be calculated.

29. Assume that stock market returns do not resemble a single-index structure. An investment fund analyzes 125 stocks in order to construct a mean-variance efficient portfolio constrained by 125 investments. They will need to calculate \_\_\_\_\_\_\_\_\_\_\_\_ covariances.   
A. 125  
**B.** 7,750  
C. 15,625  
D. 11,750  
E. 250

(n2 − n)/2 = (15,625 − 125)/2 = 7,750 covariances must be calculated.

30. Assume that stock market returns do not resemble a single-index structure. An investment fund analyzes 100 stocks in order to construct a mean-variance efficient portfolio constrained by 100 investments. They will need to calculate \_\_\_\_\_\_\_\_\_\_\_\_ covariances.   
A. 45  
B. 100  
**C.** 4,950  
D. 10,000  
E. 200

(n2 − n)/2 = (10,000 − 100)/2 = 4,950 covariances must be calculated.

31. Assume that stock market returns do follow a single-index structure. An investment fund analyzes 175 stocks in order to construct a mean-variance efficient portfolio constrained by 175 investments. They will need to calculate \_\_\_\_\_\_\_\_ estimates of expected returns and \_\_\_\_\_\_\_\_ estimates of sensitivity coefficients to the macroeconomic factor.   
A. 175; 15,225  
**B.** 175; 175  
C. 15,225; 175  
D. 15,225; 15,225  
E. 350; 350

For a single-index model, n(175), expected returns and n(175) sensitivity coefficients to the macroeconomic factor must be estimated.

32. Assume that stock market returns do follow a single-index structure. An investment fund analyzes 125 stocks in order to construct a mean-variance efficient portfolio constrained by 125 investments. They will need to calculate \_\_\_\_\_\_\_\_ estimates of expected returns and \_\_\_\_\_\_\_\_ estimates of sensitivity coefficients to the macroeconomic factor.   
A. 125; 15,225  
B. 15,625; 125  
C. 7,750; 125  
**D.** 125; 125  
E. 250; 250

For a single-index model, n(125), expected returns and n(125) sensitivity coefficients to the macroeconomic factor must be estimated.

 33. Assume that stock market returns do follow a single-index structure. An investment fund analyzes 200 stocks in order to construct a mean-variance efficient portfolio constrained by 200 investments. They will need to calculate \_\_\_\_\_\_\_\_ estimates of expected returns and \_\_\_\_\_\_\_\_ estimates of sensitivity coefficients to the macroeconomic factor.   
A. 200; 19,900  
**B.** 200; 200  
C. 19,900; 200  
D. 19,900; 19.900  
E. 400; 400

For a single-index model, n(200), expected returns and n(200) sensitivity coefficients to the macroeconomic factor must be estimated.

34. Assume that stock market returns do follow a single-index structure. An investment fund analyzes 500 stocks in order to construct a mean-variance efficient portfolio constrained by 500 investments. They will need to calculate \_\_\_\_\_\_\_\_ estimates of firm-specific variances and \_\_\_\_\_\_\_\_ estimate/estimates for the variance of the macroeconomic factor.   
**A.** 500; 1  
B. 500; 500  
C. 124,750; 1  
D. 124,750; 500  
E. 250,000; 500

For the single-index model, n(500) estimates of firm-specific variances must be calculated and 1 estimate for the variance of the common macroeconomic factor.

35. Consider the single-index model. The alpha of a stock is 0%. The return on the market index is 16%. The risk-free rate of return is 5%. The stock earns a return that exceeds the risk-free rate by 11% and there are no firm-specific events affecting the stock performance. The β of the stock is \_\_\_\_\_\_\_.   
A. 0.67  
B. 0.75  
**C.** 1.0  
D. 1.33  
E. 1.50

11% = 0% + b(11%); b = 1.0.

36. Suppose you held a well-diversified portfolio with a very large number of securities, and that the single index model holds. If the σ of your portfolio was 0.20 and σMwas 0.16, the β of the portfolio would be approximately \_\_\_\_\_\_\_\_.   
A. 0.64  
B. 0.80  
**C.** 1.25  
D. 1.56  
E. 1.42

s2p/s2m = b2; (0.2)2/(0.16)2 = 1.56; b = 1.25.

37. Suppose you held a well-diversified portfolio with a very large number of securities, and that the single index model holds. If the σ of your portfolio was 0.22 and σMwas 0.19, the β of the portfolio would be approximately \_\_\_\_\_\_\_\_.   
A. 1.34  
**B.** 1.16  
C. 1.25  
D. 1.56  
E. 1.21

s2p/s2m = b2; (0.22)2/(0.19)2 = 1.34; b = 1.16.

 38. Suppose you held a well-diversified portfolio with a very large number of securities, and that the single index model holds. If the σ of your portfolio was 0.18 and σMwas 0.24, the β of the portfolio would be approximately \_\_\_\_\_\_\_\_.   
**A.** 0.75  
B. 0.56  
C. 0.07  
D. 1.03  
E. 0.86

s2p/s2m = b2; (0.18)2/(0.24)2 = 0.5625; b = 0.75.

 39. Suppose the following equation best describes the evolution of β over time:   
βt= 0.25 + 0.75βt-1  
If a stock had a β of 0.6 last year, you would forecast the β to be \_\_\_\_\_\_\_ in the coming year.   
A. 0.45  
B. 0.60  
**C.** 0.70  
D. 0.75  
E. 0.55

0.25 + 0.75(0.6) = 0.70.

40. Suppose the following equation best describes the evolution of β over time:   
βt= 0.31 + 0.82βt-1  
If a stock had a β of 0.88 last year, you would forecast the β to be \_\_\_\_\_\_\_ in the coming year.   
A. 0.88  
B. 0.82  
C. 0.31  
**D.** 1.03  
E. 1.12

0.31 + 0.82(0.88) = 1.0316.

41. Suppose the following equation best describes the evolution of β over time:   
βt= 0.18 + 0.63βt-1  
If a stock had a β of 1.09 last year, you would forecast the β to be \_\_\_\_\_\_\_ in the coming year.   
**A.** 0.87  
B. 0.18  
C. 0.63  
D. 0.81  
E. 0.96

0.18 + 0.63(1.09) = 0.8667.

42. An analyst estimates the index model for a stock using regression analysis involving total returns. The estimated the intercept in the regression equation is 6% and the β is 0.5. The risk-free rate of return is 12%. The true β of the stock is \_\_\_\_\_\_\_\_.   
**A.** 0%  
B. 3%  
C. 6%  
D. 9%  
E. -1%

6% = a + 12% (1 − 0.5); a = 0%.

 43. The index model for stock A has been estimated with the following result:   
RA= 0.01 + 0.9RM+ eA  
If σM= 0.25 and R2A= 0.25, the standard deviation of return of stock A is \_\_\_\_\_\_\_\_\_.   
A. 0.2025  
B. 0.2500  
**C.** 0.4500  
D. 0.8100  
E. 0.5460

R2 = b2s2M/s2;0.25 = [(0.81)(0.25)2]/s2; s = 0.4500.

44. The index model for stock B has been estimated with the following result:   
RB= 0.01 + 1.1RM+ eB  
If σM= 0.20 and R2B= 0.50, the standard deviation of the return on stock B is \_\_\_\_\_\_\_\_\_.   
A. 0.1111  
B. 0.2111  
**C.** 0.3111  
D. 0.4111  
E. 0.1311

R2 = b2s2M/s2; 0.5 = [(1.1)2(0.2)2]/s2; s = 0.3111.

45. Suppose you forecast that the market index will earn a return of 15% in the coming year. Treasury bills are yielding 6%. The unadjusted β of Mobil stock is 1.30. A reasonable forecast of the return on Mobil stock for the coming year is \_\_\_\_\_\_\_\_\_ if you use a common method to derive adjusted betas.   
A. 15.0%  
B. 15.5%  
C. 16.0%  
**D.** 16.8%  
E. 17.4%

Adjusted beta = 2/3(1.3) + 1/3 = 1.20; E(rM) = 6% + 1.20(9%) = 16.8%.

 46. The index model has been estimated for stocks A and B with the following results:   
RA= 0.01 + 0.5RM+ eA  
RB= 0.02 + 1.3RM+ eB  
σM= 0.25 σ(eA) = 0.20 σ(eB) = 0.10  
The covariance between the returns on stocks A and B is \_\_\_\_\_\_\_\_\_\_\_.   
A. 0.0384  
**B.** 0.0406  
C. 0.1920  
D. 0.0050  
E. 0.4000

Cov(RA,RB) = bAbBs2M = 0.5(1.3)(0.25)2 = 0.0406.

 47. The index model has been estimated for stocks A and B with the following results:   
RA= 0.01 + 0.8RM+ eA  
RB= 0.02 + 1.2RM+ eB  
σM= 0.20 σ(eA) = 0.20 σ (eB) = 0.10  
The standard deviation for stock A is \_\_\_\_\_\_\_\_\_\_.   
A. 0.0656  
B. 0.0676  
**C.** 0.2561  
D. 0.2600  
E. 0.3564

σA = [(0.8)2(0.2)2 + (0.2)2]1/2 = 0.2561.

 48. The index model has been estimated for stock A with the following results:   
RA= 0.01 + 0.8RM+ eA  
σM= 0.20 σ(eA) = 0.10  
The standard deviation of the return for stock A is \_\_\_\_\_\_\_\_\_\_.   
A. 0.0356  
**B.** 0.1886  
C. 0.1600  
D. 0.6400  
E. 0.2153

σB = [(.8)2(0.2)2 + (0.1)2]1/2 = 0.1886.

49. Security returns   
A. are based on both macro events and firm-specific events.  
B. are based on firm-specific events only.  
C. are usually positively correlated with each other.  
D. are based on both macro events and firm-specific events and are usually negatively correlated with each other.  
**E.** are based on both macro events and firm-specific events and are usually positively correlated with each other.

Stock returns are usually highly positively correlated with each other. Stock returns are affected by both macro economic events and firm-specific events.

 50. The single-index model   
A. greatly reduces the number of required calculations, relative to those required by the Markowitz model.  
B. enhances the understanding of systematic versus nonsystematic risk.  
C. greatly increases the number of required calculations, relative to those required by the Markowitz model.  
**D.** greatly reduces the number of required calculations, relative to those required by the Markowitz model and enhances the understanding of systematic versus nonsystematic risk.  
E. enhances the understanding of systematic versus nonsystematic risk and greatly increases the number of required calculations, relative to those required by the Markowitz model.

The single index model both greatly reduces the number of calculations and enhances the understanding of the relationship between systematic and unsystematic risk on security returns.

51. The Security Characteristic Line (SCL)   
A. plots the excess return on a security as a function of the excess return on the market.  
B. allows one to estimate the beta of the security.  
C. allows one to estimate the alpha of the security.  
**D.** plots the excess return on a security as a function of the excess return on the market, allows one to estimate the beta of the security, allows one to estimate the alpha of the security  
E. allows one to estimate the gamma of the security.

The security characteristic line, which plots the excess return of the security as a function of the excess return of the market allows one to estimate both the alpha and the beta of the security.

52. The **expected** impact of unanticipated macroeconomic events on a security's return during the period is   
A. included in the security's expected return.  
**B.** zero.  
C. equal to the risk free rate.  
D. proportional to the firm's beta.  
E. infinite.

The expected value of unanticipated macroeconomic events is zero, because by definition it must average to zero or it would be incorporated into the expected return.

 53. Covariances between security returns tend to be   
A. positive because of SEC regulations.  
B. positive because of Exchange regulations.  
**C.** positive because of economic forces that affect many firms.  
D. negative because of SEC regulations.  
E. negative because of economic forces that affect many firms.

Economic forces such as business cycles, interest rates, and technological changes tend to have similar impacts on many firms.

 54. In the single-index model represented by the equation ri = E(ri) + βiF + ei, the term ei represents   
A. the impact of unanticipated macroeconomic events on security i's return.  
**B.** the impact of unanticipated firm-specific events on security i's return.  
C. the impact of anticipated macroeconomic events on security i's return.  
D. the impact of anticipated firm-specific events on security i's return.  
E. the impact of changes in the market on security i's return.

The textbook discusses a model in which macroeconomic events are used as a single index for security returns. The ei term represents the impact of unanticipated firm-specific events. The ei term has an expected value of zero. Only unanticipated events would affect the return.

 55. Suppose you are doing a portfolio analysis that includes all of the stocks on the NYSE. Using a single-index model rather than the Markowitz model \_\_\_\_\_\_\_ the number of inputs needed from \_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_.   
A. increases, about 1,400, more than 1.4 million  
B. increases, about 10,000, more than 125,000  
C. reduces, more than 125,000, about 10,000  
**D.** reduces, more than 4 million, about 9,000  
E. increases, about 150, more than 1,500

This example is discussed in the textbook. The main point for the students to remember is that the single-index model drastically reduces the number of inputs required.

 56. One "cost" of the single-index model is that it   
A. is virtually impossible to apply.  
B. prohibits specialization of efforts within the security analysis industry.  
C. requires forecasts of the money supply.  
D. is legally prohibited by the SEC.  
**E.** allows for only two kinds of risk - macro risk and micro risk.

One "cost" of the single-index model is that it allows for only two kinds of risk—macro risk and micro risk.

57. The Security Characteristic Line (SCL) associated with the single-index model is a plot of   
A. the security's returns on the vertical axis and the market index's returns on the horizontal axis.  
B. the market index's returns on the vertical axis and the security's returns on the horizontal axis.  
**C.** the security's excess returns on the vertical axis and the market index's excess returns on the horizontal axis.  
D. the market index's excess returns on the vertical axis and the security's excess returns on the horizontal axis.  
E. the security's returns on the vertical axis and Beta on the horizontal axis.

The student needs to remember that it is the excess returns that are plotted and that the security's returns are plotted as a dependent variable.

 58. The idea that there is a limit to the reduction of portfolio risk due to diversification is   
A. contradicted by both the CAPM and the single-index model.  
B. contradicted by the CAPM.  
C. contradicted by the single-index model.  
D. supported in theory, but not supported empirically.  
**E.** supported both in theory and by empirical evidence.

The benefits of diversification are limited to the level of systematic risk.

 59. In their study about predicting beta coefficients, which of the following did Rosenberg and Guy find to be factors that influence beta?   
I) Industry group  
II) Variance of cash flow  
III) Dividend yield  
IV) Growth in earnings per share   
A. I and II  
B. I and III  
C. I, II, and III  
D. I, II, and IV  
**E.** I, II, III, and IV

All of the factors mentioned, as well as variance of earnings, firm size, and debt-to-asset ratio, were found to help predict betas.

60. If a firm's beta was calculated as 1.6 in a regression equation, a commonly used adjustment technique would provide an adjusted beta of   
A. less than 0.6 but greater than zero.  
B. between 0.6 and 1.0.  
**C.** between 1.0 and 1.6.  
D. greater than 1.6.  
E. zero or less.

Betas, on average, equal one; thus, betas over time regress toward the mean, or 1. Therefore, if historic betas are more than 1, adjusted betas are between 1 and the calculated beta.

 61. The beta of a stock has been estimated as 1.8 using regression analysis on a sample of historical returns. A commonly used adjustment technique would provide an adjusted beta of \_\_\_\_\_\_\_\_\_\_\_.   
A. 1.20  
**B.** 1.53  
C. 1.13  
D. 1.0  
E. 1.76

Adjusted beta = 2/3 sample beta + 1/3(1); = 2/3(1.8) + 1/3 = 1.53.

 62. Assume that stock market returns do not resemble a single-index structure. An investment fund analyzes 40 stocks in order to construct a mean-variance efficient portfolio constrained by 40 investments. They will need to calculate \_\_\_\_\_\_\_\_\_\_\_\_\_ expected returns and \_\_\_\_\_\_\_\_\_\_\_ variances of returns.   
A. 100, 100  
**B.** 40, 40  
C. 4950, 100  
D. 4950, 4950  
E. 80; 80

The expected returns of each of the 40 securities must be calculated. In addition, the 40 variances around these returns must be calculated.

 63. Assume that stock market returns do not resemble a single-index structure. An investment fund analyzes 40 stocks in order to construct a mean-variance efficient portfolio constrained by 40 investments. They will need to calculate \_\_\_\_\_\_\_\_\_\_\_\_ covariances.   
A. 45  
**B.** 780  
C. 4,950  
D. 10,000  
E. 80

(n2 − n)/2 = (1,600 − 40)/2 = 780 covariances must be calculated.

 64. Assume that stock market returns do follow a single-index structure. An investment fund analyzes 60 stocks in order to construct a mean-variance efficient portfolio constrained by 60 investments. They will need to calculate \_\_\_\_\_\_\_\_ estimates of expected returns and \_\_\_\_\_\_\_\_ estimates of sensitivity coefficients to the macroeconomic factor.   
A. 200; 19,900  
B. 200; 200  
**C.** 60; 60  
D. 19,900; 19.900  
E. 120; 120

For a single-index model, n(60), expected returns and n(60) sensitivity coefficients to the macroeconomic factor must be estimated.

65. Consider the single-index model. The alpha of a stock is 0%. The return on the market index is 10%. The risk-free rate of return is 3%. The stock earns a return that exceeds the risk-free rate by 11% and there are no firm-specific events affecting the stock performance. The β of the stock is \_\_\_\_\_\_\_.   
**A.** 0.64  
B. 0.75  
C. 1.17  
D. 1.33  
E. 1.50

7% = 0% + b(11%); b = 0.636.

 66. Suppose you held a well-diversified portfolio with a very large number of securities, and that the single index model holds. If the σ of your portfolio was 0.25 and σMwas 0.21, the β of the portfolio would be approximately \_\_\_\_\_\_\_\_.   
A. 0.64  
**B.** 1.19  
C. 1.25  
D. 1.56  
E. 0.87

s2p/s2m = b2; (0.25)2/(0.21)2 = 1.417; b = 1.19.

 67. Suppose you held a well-diversified portfolio with a very large number of securities, and that the single index model holds. If the σ of your portfolio was 0.18 and σMwas 0.22, the β of the portfolio would be approximately \_\_\_\_\_\_\_\_.   
A. 0.64  
B. 1.19  
**C.** 0.82  
D. 1.56  
E. 0.99

s2p/s2m = b2; (0.18)2/(0.22)2 = 0.669; b = 0.82.

 68. Suppose the following equation best describes the evolution of β over time:   
βt= 0.4 + 0.6βt-1  
If a stock had a β of 0.9 last year, you would forecast the β to be \_\_\_\_\_\_\_ in the coming year.   
A. 0.45  
B. 0.60  
C. 0.70  
**D.** 0.94  
E. 1.02

0.4 + 0.6(0.9) = 0.94.

69. Suppose the following equation best describes the evolution of β over time:   
βt= 0.3 + 0.2βt-1  
If a stock had a β of 0.8 last year, you would forecast the β to be \_\_\_\_\_\_\_ in the coming year.   
**A.** 0.46  
B. 0.60  
C. 0.70  
D. 0.94  
E. 0.37

0.3 + 0.2(0.8) = 0.46.

70. The index model for stock A has been estimated with the following result:   
RA= 0.01 + 0.94RM+ eA  
If σM= 0.30 and R2A= 0.28, the standard deviation of return of stock A is \_\_\_\_\_\_\_\_\_.   
A. 0.2025  
B. 0.2500  
C. 0.4500  
**D.** 0.5329  
E. 0.6671

R2 = b2s2M/s2; s2 = [(0.94) 2(0.30) 2]/.28; s2 = 0.284; s = 0.5329.

 71. Suppose you forecast that the market index will earn a return of 12% in the coming year. Treasury bills are yielding 4%. The unadjusted β of Mobil stock is 1.30. A reasonable forecast of the return on Mobil stock for the coming year is \_\_\_\_\_\_\_\_\_ if you use a common method to derive adjusted betas.   
A. 15.0%  
B. 15.5%  
C. 16.0%  
**D.** 14.6%  
E. 13.2%

Adjusted beta = 2/3(1.5) + 1/3 = 1.33; E(rM) = 4% + 1.33(8%) = 14.6%.

72. The index model has been estimated for stocks A and B with the following results:   
RA= 0.01 + 0.8RM+ eA  
RB= 0.02 + 1.1RM+ eB  
σM= 0.30 σ (eA) = 0.20 σ (eB) = 0.10  
The covariance between the returns on stocks A and B is \_\_\_\_\_\_\_\_\_\_\_.   
A. 0.0384  
B. 0.0406  
C. 0.1920  
D. 0.0050  
**E.** 0.0792

Cov(RA,RB) = bAbBs2M = 0.8(1.1)(0.30)2 = 0.0792.

73. If a firm's beta was calculated as 1.35 in a regression equation, a commonly used adjustment technique would provide an adjusted beta of.SSS   
A. less than 1.35.  
B. between 0.0 and 1.0.  
**C.** between 1.0 and 1.35.  
D. greater than 1.35.  
E. zero or less.

Betas, on average, equal one; thus, betas over time regress toward the mean, or 1. Therefore, if historic betas are more than 1, adjusted betas are between 1 and the calculated beta.

74. The beta of a stock has been estimated as 1.4 using regression analysis on a sample of historical returns. A commonly used adjustment technique would provide an adjusted beta of \_\_\_\_\_\_\_\_\_\_\_.   
**A.** 1.27  
B. 1.32  
C. 1.13  
D. 1.0  
E. 1.45

Adjusted beta = 2/3 sample beta + 1/3(1); = 2/3(1.4) + 1/3 = 1.27.

75. The beta of a stock has been estimated as 0.85 using regression analysis on a sample of historical returns. A commonly used adjustment technique would provide an adjusted beta of \_\_\_\_\_\_\_\_\_\_\_.   
A. 1.01  
B. 0.95  
C. 1.13  
**D.** 0.90  
E. 0.88

Adjusted beta = 2/3 sample beta + 1/3(1); = 2/3(0.85) + 1/3 = 0.90.

76. Assume that stock market returns do not resemble a single-index structure. An investment fund analyzes 125 stocks in order to construct a mean-variance efficient portfolio constrained by 125 investments. They will need to calculate \_\_\_\_\_\_\_\_\_\_\_\_\_ expected returns and \_\_\_\_\_\_\_\_\_\_\_ variances of returns.   
**A.** 125, 125  
B. 125, 15,625  
C. 15,625, 125  
D. 15,625, 15,625  
E. 250; 250

The expected returns of each of the 125 securities must be calculated. In addition, the 125 variances around these returns must be calculated.

77. Assume that stock market returns do not resemble a single-index structure. An investment fund analyzes 125 stocks in order to construct a mean-variance efficient portfolio constrained by 125 investments. They will need to calculate \_\_\_\_\_\_\_\_\_\_\_\_ covariances.   
A. 90  
B. 125  
**C.** 7,750  
D. 15,625  
E. 250

(n2 − n)/2 = (15,625 − 125)/2 = 7,750 covariances must be calculated.

 78. Assume that stock market returns do not resemble a single-index structure. An investment fund analyzes 132 stocks in order to construct a mean-variance efficient portfolio constrained by 132 investments. They will need to calculate \_\_\_\_\_\_\_\_\_\_\_\_ covariances.   
A. 100  
B. 132  
C. 4,950  
**D.** 8,646  
E. 264

(n2 − n)/2 = (17,424 − 132)/2 = 8,646 covariances must be calculated.

 79. Assume that stock market returns do follow a single-index structure. An investment fund analyzes 217 stocks in order to construct a mean-variance efficient portfolio constrained by 217 investments. They will need to calculate \_\_\_\_\_\_\_\_ estimates of expected returns and \_\_\_\_\_\_\_\_ estimates of sensitivity coefficients to the macroeconomic factor.   
A. 217; 47,089  
**B.** 217; 217  
C. 47,089; 217  
D. 47,089; 47,089  
E. 434; 434

For a single-index model, n(217), expected returns and n(217) sensitivity coefficients to the macroeconomic factor must be estimated.

 80. Assume that stock market returns do follow a single-index structure. An investment fund analyzes 750 stocks in order to construct a mean-variance efficient portfolio constrained by 750 investments. They will need to calculate \_\_\_\_\_\_\_\_ estimates of firm-specific variances and \_\_\_\_\_\_\_\_ estimate/estimates for the variance of the macroeconomic factor.   
**A.** 750; 1  
B. 750; 750  
C. 124,750; 1  
D. 124,750; 750  
E. 562,500; 750

For the single-index model, n(750) estimates of firm-specific variances must be calculated and 1 estimate for the variance of the common macroeconomic factor.

81. Consider the single-index model. The alpha of a stock is 0%. The return on the market index is 10%. The risk-free rate of return is 5%. The stock earns a return that exceeds the risk-free rate by 5% and there are no firm-specific events affecting the stock performance. The β of the stock is \_\_\_\_\_\_\_.   
A. 0.67  
B. 0.75  
**C.** 1.0  
D. 1.33  
E. 1.50

5% = 0% + b(5%); b = 1.0.

82. Suppose you held a well-diversified portfolio with a very large number of securities, and that the single index model holds. If the σ of your portfolio was 0.24 and σMwas 0.18, the β of the portfolio would be approximately \_\_\_\_\_\_\_\_.   
A. 0.64  
**B.** 1.33  
C. 1.25  
D. 1.56  
E. 1.41

s2p/s2m = b2; (0.24)2/(0.18)2 = 1.78; b = 1.33.

 83. Suppose you held a well-diversified portfolio with a very large number of securities, and that the single index model holds. If the σ of your portfolio was 0.14 and σMwas 0.19, the β of the portfolio would be approximately \_\_\_\_\_\_\_\_.   
**A.** 0.74  
B. 0.80  
C. 1.25  
D. 1.56  
E. 0.64

s2p/s2m = b2; (0.14)2/(0.19)2 = 0.54; b = 0.74.

 84. Suppose the following equation best describes the evolution of β over time:   
βt= 0.30 + 0.70βt-1  
If a stock had a β of 0.82 last year, you would forecast the β to be \_\_\_\_\_\_\_ in the coming year.   
A. 0.91  
B. 0.77  
C. 0.63  
**D.** 0.87  
E. 0.95

0.30 + 0.70(0.82) = 0.874.

**Short Answer Questions**

85. Discuss the advantages of the **single-index model** over the **Markowitz model** in terms of **numbers of variable estimates required** and in terms of **understanding risk relationships**.

For a 50 security portfolio, the **Markowitz model** requires the following parameter estimates:  
**n** = 50 estimates of expected returns;  
**n** = 50 estimates of variances;  
**(n2- n)/2** = 1,225 estimates of covariances;  
**1,325** estimates.  
For a 50 security portfolio, the **single-index model** requires the following parameter estimates:  
**n** = 50 estimates of expected excess returns, E(R);  
**n** = 50 estimates of sensitivity coefficients, βi;  
**n** = 50 estimates of the firm-specific variances, σ2(ei);  
**1** estimate for the variance of the common macroeconomic factor, σ2M;  
or **(3n + 1 = 151)** estimates.  
In addition, the single-index model provides further insight by recognizing that different firms have different sensitivities to macroeconomic events. The model also summarizes the distinction between macroeconomic and firm-specific risk factors.  
  
Feedback: This question is designed to ascertain that the student understands the significant simplifications and improvements offered by the single-index model over the Markowitz model.

 86. Discuss the **security characteristic line (SCL)**.

The **security characteristic line (SCL)** is the result of estimating the regression equation of the single-index model. The SCL is a plot of the typical excess returns on a security over the risk-free rate as a function of the excess return on the market. The slope of the SCL is the beta of the security, and the intercept (alpha) is the excess return on the security when the excess market return is zero.  
  
Feedback: This question is designed to ascertain that the student understands how the SCL is obtained, as this relationship is the one that is most frequently used by published information services for the estimation of the regression parameters, alpha and beta.

87. Discuss a commonly used adjustment technique to provide an adjusted beta.

Over time, security betas move toward 1, as the average beta of all securities is 1 and variables regress toward the mean. Thus, if a historic beta has been greater than 1, the chances are that in the future, this beta will be less than the historic beta. The opposite relationship will be observed if the historic beta has been less than one. A commonly used adjustment technique would provide an adjusted beta of 2/3 (sample beta) + 1/3 (1).  
  
Feedback: This question is important, as many published sources quote an "adjusted beta" with no explanation as to how such a number was obtained. The regression toward the mean is a valid statistical concept and it is important that the student understands that this concept represents the theory behind the possibly undocumented "adjusted betas".