36 USING MULTIFACTOR MODELS

1. Rob Tanner, portfolio manager at Alpha Inc. meets his old college friend Del Torres for lunch. Torres excitedly tells Tanner about his latest work with tracking and factor portfolios. Torres says he has developed a tracking portfolio to aid in speculating on oil prices and is working on a factor portfolio with a specific set of factor sensitivities to the Russell 2000.

   Did Torres correctly describe tracking and factor portfolios?

	Tracking	Factor
(A)	No	No
(B)	Yes	No
(C)	No	Yes

2. A portfolio with a specific set of factor sensitivities designed to replicate the factor exposures of a benchmark index is called a:

   (A) tracking portfolio.
   (B) arbitrage portfolio.
   (C) factor portfolio.

3. Summer Vista decides to develop a fundamental factor model. She establishes a proxy for the, market portfolio, and then considers the importance of various factors in determining stock returns. She decides to use the following factors in her model:

   - Changes in payout ratios.
   - Credit rating changes.
   - Companies' position in the business cycle.
   - Management tenure and qualifications."

   Which of the following factors is least appropriate for Vista's factor model?

   (A) Changes in payout ratios.
   (B) Management tenure and qualifications.
   (C) Companies' position in the business cycle.

4. Arbitrage pricing models assume which risk is priced?

   (A) Unsystematic.
   (B) Both systematic and unsystematic.
   (C) Systematic.

5. Which of the following does NOT describe the arbitrage pricing theory (APT)?

(A) There are assumed to be at least five factors that explain asset returns.

(B) It requires a weaker set of assumptions than the CAPM to derive.

(C) It is an equilibrium-pricing model like the CAPM.

6. Which of the following is an equilibrium-pricing model?

(A) The arbitrage pricing theory (APT).

(B) Fundamental factor model.

(C) Macroeconomic factor model.

7. Assume you are considering forming a common stock portfolio consisting of 25% Stonebrook Corporation (Stone) and 75% Rockway Corporation (Rock). As expressed in the two-factor returns models presented below, both of these stocks' returns are affected by two common factors: surprises in interest rates and surprises in the unemployment rate.

$R_{Stone} = 0.11 + 1.0F_{Int} + 1.2F_{Un} + \varepsilon_{Stone}$

$R_{Rock} = 0.13 + 0.8F_{Int}\ 3.5F_{Un} + \varepsilon_{Rock}$

Assume that at the beginning of the year, interest rates were expected to be 5.1% and unemployment was expected to be 6.8%. Further, assume that at the end of the year, interest rates were actually 5.3%, the actual unemployment rate was 7.2%, and there were no company-specific surprises in returns. This information is summarized in Table 1 below:

Table 1: Expected versus Actual Interest Rates and Unemployment Rates

	Actual	Expected	Company-specific returns surprises
Interest Rate	0.053	0.051	0.0
Unemployment Rate	0.072	0.068	0.0

What is the predicated return for Stonebrook if the return unexplained by the model was –1%.

(A) 10.68%.

(B) 12.00%

(C) 1.40%.

8. The macroeconomic factor models for the returns on Omni, Inc., (OM) and Garbo Manufacturing (GAR) are:

$R_{OM} = 20.0\% + 1.0(F_{GDP}) + 1.4(F_{QS}) + \varepsilon_{OM}$

$R_{GAR} = 15.0\% + 0.5(F_{GDP}) + 0.8(F_{QS}) + \varepsilon_{GAR}$

What is the expected return on a portfolio invested 60% in Omni and 40% in Garbo?

(A) 18.0%.

(B) 19.96%.

(C) 20.96%.

9. Identify the most accurate statement regarding multifactor models from among the following.

(A) Macroeconomic factor models include explanatory variables such as real GDP growth

and the price-to-earnings ratio and fundamental factor models include explanatory variables such as firm size and unexpected inflation.

(B) Macroeconomic factor models include explanatory variables such as firm size and the price-to-earnings ratio and fundamental factor models include explanatory variables such as real GDP growth and unexpected inflation.

(C) Macroeconomic factor models include explanatory variables such cycle, interest rates, and inflation, and fundamental factor models variables such as firm size and the price-to-earnings ratio.

10. Janice Barefoot, CFA, has been managing a portfolio for a client who has asked Barefoot to use the Dow Jones Industrial Average (DJIA) as a benchmark. In her second year, Barefoot used 29 of the 30 DJIA stocks. She selected a non-DJIA stock in the same industry as the omitted DJIA stock to replace that stock. Compared to the DJIA, Barefoot placed a lower weight on the communication stocks and a higher weight on the other stocks still in the portfolio. Over that year, the non-DJIA stock in the portfolio had a positive and higher return than the omitted DJIA stock. The communication stocks had a negative return while all of the other stocks had a positive return. The portfolio managed by Barefoot outperformed the DJIA. Based on this we can say that the return from factor tilts and asset selection were:

(A) negative and positive respectively.

(B) positive and negative respectively.

(C) both positive.

11. Given a three-factor arbitrage pricing theory APT model, what is the expected return on the Freedom Fund?

- The factor risk premiums to factors 1, 2, and 3 are 10%, 7% and 6%, respectively.
- The Freedom Fund has sensitivities to the factors 1, 2, and 3 of 1.0, 2.0 and 0.0, respectively.
- The risk-free rate is 6.0%.

(A) 24.0%.

(B) 30.0%.

(C) 33.0%.

12. The Real Value Fund is designed to have zero exposure to inflation. However its current inflation factor sensitivity is 0.30. To correct for this, the portfolio manager should take a:

(A) 30% long position in the inflation factor portfolio.

(B) 30% short position in the inflation factor portfolio.

(C) 30% short position in the inflation tracking portfolio.

13. A portfolio manager uses a two-factor model to manage her portfolio. The two factors are confidence risk and time-horizon risk. If she wants to bet on an unexpected increase in the confidence risk factor (which has a positive risk premium), but hedge away her exposure to time-horizon risk (which has a negative risk premium), she should create a portfolio with a sensitivity of:

(A) –1.0 to the confidence risk factor and 1.0 to the time-horizon factor.

(B) 1.0 to the confidence risk factor and 0.0 to the time-horizon factor.

(C) 1.0 to the confidence risk factor and -1.0 to the time-horizon factor.

14. Janice Barefoot, CFA, has been managing a portfolio for a client who has asked Barefoot to use the Dow Jones Industrial Average (DJIA) as a benchmark. In her first year Barefoot managed the portfolio by choosing 29 of the 30 DJIA stocks. She selected a non-DJIA stock in the same industry as the omitted stock to replace that stock. Compared to the DJIA, Barefoot has placed a higher weight on the financial stocks and a lower weight on the other stocks still in the portfolio. Over that year, the non-DJIA stock in the portfolio had a negative return while the omitted DJIA stock had a positive return. The portfolio managed by Barefoot outperformed the DJIA. Based on this we can say that the return from factor tilts and asset selection were:

(A) positive and negative respectively.

(B) negative and positive respectively.

(C) both positive.

15. Portfolios A and B have an expected return of 4.4% and 5.3% respectively. Assume that a one-factor APT model is appropriate and the factor sensitivities of portfolios A and B are 0.8 and 1.1 respectively. The risk-free rate and factor risk premium are closest to:

	Risk Free Rate	Factor Risk Premium
(A)	3.00%	2.00%
(B)	2.50%	3.00%
(C)	2.00%	3.00%

16. A multi-factor model that uses unexpected changes (surprises) in macroeconomic variables (e.g., inflation and gross domestic product) as the factors to explain asset returns is called a:

(A) fundamental factor model.

(B) statistical factor model.

(C) marcoeconomic factor model.

17. Marcie Deiner is an investment manager with G&G Investment Corporation. She works with a variety of clients who differ in terms of experience, risk aversion and wealth. Deiner recently attended a seminar on multifactor analysis. Among other things, the seminar taught how they assumptions concerning the Arbitrage Pricing Theory (APT) model are different from those of the Capital Asset Pricing Model (CAPM). One of the examples used in the seminar is below.

$E(R_i) = R_f + f_1,Bi_1 + f_2B_{i2} + f_3,B_{i,3}$. Where $f_1 = 3.0\%$, $f_2 = -40.0\%$, and $f_3 = 50.0\%$.

Beta estimated for growth and Value funds for a three factor model			
	Factor 1	Factor 2	Factor 3
Betas for growth	0.5	0.7	1.2
Betas for Value	0.2	1.8	0.6

For the model used as an example in the seminar, if the T-bill rate is 3.5%, what are the expected returns for the Growth and Values Funds?

	$E(R_{Growth})$	$E(R_{Value})$
(A)	3.1%	–3.16%
(B)	33.5%	–41.4%
(C)	37.0%	–37.9%

18. A tracking portfolio is a portfolio with:
    (A) a specific set of factor sensitivities designed to replicate the factor exposures of a benchmark index.
    (B) a factor sensitivity of one to a particular factor in a multi-factor model and zero to all other factors.
    (C) factor sensitivities of zero to all factors, positive expected net cash flow, and an initial investment of zero.

19. Given a three-factor arbitrage pricing theory (APT) model, what is the expected return on the Premium Dividend Yield Fund?
    - The factor risk premiums to factors 1, 2 and 3 are 8%, 12% and 5%, respectively.
    - The fund has sensitivities to the factors 1, 2, and 3 of 2.0, 1.0 and 1.0, respectively.
    - The risk-free rate is 3.0%.

    (A) 50.0%.
    (B) 33.0%.
    (C) 36.0%.

20. Which of the following is not an assumption of the arbitrage pricing theory (APT)?
    (A) The market contains enough stocks so that unsystematic risk can be diversified away.
    (B) Security returns are normally distributed.
    (C) Returns on assets can be described by a multi-factor process.

21. In the context of multi-factor models, investors with lower-than-average exposure to recession risk (e.g. those without labor income) can earn a risk premium for holding dimensions of risk unrelated to market movements by creating equity portfolios with:
    (A) greater-than-average market risk exposure.
    (B) less-than-average exposure to the recession risk factor.
    (C) greater-than-average exposure to the recession risk factor.

22. One of the assumptions of the arbitrage pricing theory (APT) is that there are no arbitrage opportunities available. An arbitrage opportunity is:

(A) a portfolio with factor exposures that sum to one.

(B) an investment that has an expected positive net cash flow but requires no initial investment.

(C) a factor portfolio with a positive expected risk premium.

23. The Arbitrage Pricing Theory (APT) has all of the following characteristics EXCEPT it:

(A) assumes that asset returns are described by a factor model.

(B) assumes that arbitrage opportunities are available to investors.

(C) is an equilibrium pricing model.

24. Assume you are considering forming a common stock portfolio consisting of 25% Stonebrook Corporation (Stone) and 75% Rockway Corporation (Rock). As expressed in the two-factor returns models presented below, both of these stocks' returns are affected by two common factors: surprises in interest rates and surprises in the unemployment rate.

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Unemployment Rate	0.072	0.068	0.0

What is the expected return for Stonebrook in the absence of surprises?

(A) 11.0%

(B) 13.2%

(C) 13.0%.

25. Which of the following is NOT an assumption necessary to derive the arbitrage pricing theory (APT)?

(A) The priced factors risks can be hedged without taking short positions in any portfolios.

(B) A large number of assets are available to investors.

(C) Asset returns are described by a k-factor model.

26. Assume you are considering forming a common stock portfolio consisting of 25% Stonebrook Corporation (Stone) and 75% Rockway Corporation (Rock). As expressed in the two-factor returns models presented below, both of these stocks' returns are affected by two common factors: surprises in interest rates and surprises in the unemployment rate.

$R_{Stone} = 0.11 + 1.0F_{Int} + 1.2F_{Un} + \varepsilon_{Stone}$

$R_{Rock} = 0.13 + 0.8F_{Int} + 3.5F_{Un} + \varepsilon_{Rock}$

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	Actual	Expected	Company-specific returns surprises
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What is the portfolio's sensitivity to interest rate surprises?

(A) 0.95

(B) 0.85.

(C) 0.25.

27. Diversification can reduce:

(A) unsystematic risk.

(B) systematic risk.

(C) macroeconomic risks.

28. Assume you are attempting to estimate the equilibrium expected return for a portfolio using a two-factor arbitrage pricing theory (APT) model. Assume that you have estimated the risk premium for factor 1 to be 0.02, and the risk premium for factor 2 to be 0.03. The sensitivity of the portfolio to factor 1 is –1.2 and the portfolios sensitivity to factor 2 is 0.80. Given a risk free rate equal to 0.03, what is the expected return for the asset?

(A) 5.0%.

(B) 2.4%.

(C) 3.0%.

29. Janice Barefoot, CFA, has managed a portfolio where she used the Dow Jones Industrial Average (DJIA) as a benchmark. In the past two years the average monthly return on her portfolio has been higher than that of the DJIA. To get a measure of active return per unit of active risk Barefoot should compute the:

(A) information ratio, which is the standard deviation of the differences between the portfolio and benchmark returns divided by the average of those differences.

(B) information ratio, which is the average excess portfolio return over the benchmark divided by the standard deviation of the differences between the portfolio and benchmark returns.

(C) Sharpe ratio, which is the standard deviation of the differences between the portfolio and benchmark returns divided into the average of those differences.

30. A portfolio with a factor sensitivity of one to a particular factor in a multi-factor model and zero to all other factors is called a(n):

(A) arbitrage portfolio.

(B) tracking portfolio.
(C) factor portfolio.

31. A common strategy in bond portfolio management is enhanced indexing by matching primary risk factors. This strategy could be implemented by forming:
(A) a portfolio with factor sensitivities equal to that of the index.
(B) a portfolio with asset portfolio weights equal to that of the index.
(C) a portfolio with factor sensitivities that sum to one.

Marianne Belair, CFA, is a wealth manager for a well-known company in Paris, France. She has developed macroeconomic factor models on portfolios Alpha and Bravo.

Equations for the two portfolios:

$R_{Alpha} = 0.08 - 0.7\ F_{INFL} + 1.2\ F_{GDP}$

$R_{Bravo} = 0.13 + 0.6\ F_{INFL} + 2.3\ F_{GDP}$

Belair has asked her colleague Pierre Louboutin to calculate the return attributable to a 1.5% surprise in GDP for an equally weighted portfolio comprising Alpha and Bravo.

Meanwhile, Belair is looking at Merci, a beauty stock for which she has developed a macroeconomic factor model. The arbitrage-pricing model shows a required return of 10% and the company-specific surprise for the year was 2%. Exhibit 1 shows additional information on the model:

Exhibit 1:

variable	Actual Value (%)	Expected Value (%)	Factor Sensitivity
Interest Rate	3.5%	2.5%	–0.3
Unemployment Rate	6.5%	5.5%	–0.7

Emily Grant, a senior manager at the firm, asks Louboutin to analyze the performance of three managers using the information in Exhibit 2.

Exhibit 2: Decomposing Active Risk

Portfolio	Active factor risk squared (%)	Active specific risk squared (%)	Active risk squared (%)	Active factor risk (% of Total Active Risk)	Active specific risk (% of Total Active Risk)	Active risk (%)
EM	0.5	0.5	1	50	50	1
EC	25.2	10.8	36	70	30	6

EV	21.6	14.4	36	60	40	6

Finally, Belair would like to capitalize on her expectation that real business activity will increase over the next year. As a separate concern, she has some existing positive exposure to inflation risk, which she would like to hedge. To achieve her goals she can use the portfolios in the Exhibit 3 which show the five relevant factors and respective factor sensitivities:

Exhibit 3:

Risk Factor	A	B	C	D	E
Confidence	0.10	1.00	0.00	0.70	0.00
Time horizon	0.00	0.00	0.00	0.50	0.00
Inflation	1.00	0.00	0.00	0.30	1.00
Business cycle	0.90	1.00	1.00	0.00	0.00
Market timing	1.00	0.00	0.00	0.90	0.00

32. Which two portfolios from Exhibit 3 best achieve Belair's goals in relation to business activity and inflation risk?

(A) B and A.
(B) B and E.
(C) C and E.

33. Pierre's answer to Belair's first request regarding the equally weighted portfolio, is closest to:

(A) 1.75%.
(B) 2.13%.
(C) 2.63%.

34. Michael Paul, a portfolio manager, is screening potential investments and suspects that an arbitrage opportunity may be available. The three portfolios that meet his screening criteria are detailed below:

Portfolio	Expected Return	Beta
X	12%	1.0
Y	16%	1.3
Z	8%	0.9

Which of the following portfolio combinations produces the highest return while maintaining a beta of 1.00?

	Portfolio X	Portfolio Y	Portfolio Z
(A)	100%	0%	0%
(B)	50%	12%	38%

(C) 25% 50% 25%

35. The actual return of Merci is closest to:
    (A) 9%.
    (B) 10%.
    (C) 11%.

36. Which of the following is NOT an underlying assumption of the arbitrage pricing theory (APT)?
    (A) There are a sufficient number of assets for investors to create diversified portfolios in which firm-specific risk is eliminated.
    (B) Asset returns are described by a K factor model.
    (C) A market portfolio exists that contains all risky assets and is mean-variance efficient.

37. Using Exhibit 2, the portfolio that has the most exposure to asset selection risk is:
    (A) EM.
    (B) EC.
    (C) EV.