Foundations of Finance Midterm

Name:__________________________________

Foundations of Finance B01.2311.60
Practice Midterm Exam

Prof. Anthony Lynch

First Name: _________________  Last Name: ____________________________

Student ID: _________________________

Stern Honor Code: “I pledge my honor that I have not violated the Stern Honor Code in the completion of this examination.”

Signature: __________________________________________________

Instructions: 90 minutes. Closed book. You are permitted use of a financial calculator and one sheet (8½" x 11") of notes. Starting on page 2, you will find 20 multiple choice questions which will be graded on a correct/incorrect basis. Answer all questions. Enter your final answer for all questions in the answer sheet on the last page of this exam which is page 14. Each question is worth 2 points so the maximum number of points you can earn is 40. If you get stuck on a question, guess, move on, and come back at the end if you have time. Use the backs of pages for calculations if you need to.

Write your name at the top of every page of the exam. Failure to do so will result in a 5 point penalty. You must hand in all 14 pages. Failure to hand in all 14 pages will result in failure of the exam. If you need less than 70 minutes, you can leave the exam room early. You cannot leave the room in the last 20 minutes of the exam. When time is up, stop writing, and remain silent.

Good luck!
1. Tom borrows $10000 from the bank at a 6% APR with monthly compounding and agrees to make monthly payments at the end of each month for the next 5 years. What will be his monthly repayment?
   A $196  
   B $2,374  
   C $619  
   D $143  
   E $193

2. Your local S&L provides you with the following information concerning a possible 1-year single repayment loan. You pay 2 “points” (1 point = 1%) up front of the amount borrowed, and the interest rate you are charged is 10%. If you borrow $4,000 for one year on these terms, at what rate are you actually borrowing.
   A 10.59%  
   B 11.04%  
   C 11.20%  
   D 12.24%  
   E 12.48%
3. The company Mr. Z works for will deposit $600 at the end of each month into his retirement fund. Interest is compounded monthly. Mr. Z plans to retire 15 years from now and estimate that he will need $2,000 per month out of the account for the next 20 years (after retirement). If the account pays 8.0% APR compounded monthly, how much does Mr. Z need to put into the account in addition to his company deposit in order to meet his objective?

A $0.00
B $57.59
C $90.99
D $95.88
E $104.49

4. If you deposit $2,500 at the end of each six months into an account which offers an APR of 5.5% interest compounded quarterly, how much will be in the account in 5 years?

A $13,953
B $16,931
C $26,605
D $28,357
E $32,188
5. When you were born, your dear old Aunt Minnie promised to deposit $1,000 into a savings account, bearing a 5% effective annual rate, on each birthday, beginning with your first. You have just turned 22 and want the dough. However, it turns out that dear old (forgetful) aunt Minnie made no deposits on your fifth and eleventh birthdays. How much is in the account right now?

A $31,976  
B $34,503  
C $43,888  
D $47,983  
E $51,889
6. An NYSE specialist’s order book and bid/ask prices for PQR stock are given by the following table:

<table>
<thead>
<tr>
<th>PQR Price</th>
<th>Limit Buy</th>
<th>Limit Sell</th>
<th>Specialist</th>
</tr>
</thead>
<tbody>
<tr>
<td>100.87</td>
<td></td>
<td>100 sh</td>
<td></td>
</tr>
<tr>
<td>100.75</td>
<td></td>
<td>100 sh</td>
<td></td>
</tr>
<tr>
<td>100.62</td>
<td></td>
<td></td>
<td>asked</td>
</tr>
<tr>
<td>100.50</td>
<td>100 sh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100.37</td>
<td>100 sh</td>
<td></td>
<td>bid</td>
</tr>
<tr>
<td>100.25</td>
<td>100 sh</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A market buy order or a market sell order, each for 100 shares, may come in. Then,

A a market buy will be executed at 100.87 and a market sell at 100.75
B a market buy will be executed at 100.87 and a market sell at 100.25
C a market buy will be executed at 100.62 and a market sell at 100.50
D a market buy will be executed at 100.62 and a market sell at 100.37
E a market buy will be executed at 100.50 and a market sell at 100.37
7. Exactly one year ago XYZ stock had just run up from $12 per share to $25 per share. Then, (one year ago) with a net worth of $20,000, you bought $40,000 worth of XYZ stock on margin at $25 per share. The rate at which your broker would lend to you was 8.5% (EAR). The stock recently declared its first dividend: $1 per share. (The dividend is payable in 10 days. The ex-dividend date is tomorrow.) The stock is presently trading at $27 per share. Commissions are $0.50 per share (each way, i.e., when buying and when selling a share), but paid when you close the position. If you close out your position today, what is your total profit or loss on the entire transaction?

A. Profit of $1500  
B. Profit of $1400  
C. Profit of $43,200  
D. Loss of $100  
E. Loss of $1600

8. What is the expected return on a two asset portfolio of assets A and B, where you borrow 50% of the portfolio’s value by selling short B, which has a mean return of 6%, and you use the proceeds from the short plus all the portfolio’s value to buy A, which has a mean return of 10%?

A. 8%  
B. 18%  
C. 120%  
D. 12%  
E. None of the above
9. Consider the following data for QRS stock, and its fourth quarter dividend (1/29 is Friday):

<table>
<thead>
<tr>
<th>Date</th>
<th>1/29</th>
<th>2/1</th>
<th>2/2</th>
<th>2/3</th>
<th>2/4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closing price</td>
<td>$41</td>
<td>$42.5</td>
<td>$41.125</td>
<td>$41.75</td>
<td>$43.25</td>
</tr>
</tbody>
</table>

The following information is available for a dividend per share of $0.50 for QRS stock:

<table>
<thead>
<tr>
<th>Declared</th>
<th>Ex-date</th>
<th>Record Date</th>
<th>Payable Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/20</td>
<td>2/1</td>
<td>2/3</td>
<td>3/5</td>
</tr>
</tbody>
</table>

The daily rates of return on QRS stock (buy at the close of the previous business day and sell on the close of the current day) for 2/1 and 2/2, respectively, are

A  3.66%, -3.24%
B  3.58%, -2.06%
C  4.88%, -2.06%
D  4.88%, -3.24%
E  3.66%, -2.08%
10. Mr. X, who has mean-variance preferences, considers the following two funds:

Sure-thing fund: Expected Return=16%, Standard Deviation of Return=15%
Sure-bet fund: Expected Return=12%, Standard Deviation of Return=8%

The correlation between the funds’ returns is 0.7, and T-bill rate is 8%. Mr. X forms portfolio Y using the two funds, and then combines Y with T-bills. The weights of the two funds in the portfolio Y are:

A 43.56% in Sure-thing fund and 56.44% in Sure-bet fund
B 56.44% in Sure-thing fund and 43.56% in Sure-bet fund
C 39.62% in Sure-thing fund and 60.38% in Sure-bet fund
D 60.38% in Sure-thing fund and 39.62% in Sure-bet fund
E 50.00% in Sure-thing fund and 50.00% in Sure-bet fund

11. For the portfolio Y in the previous question (the portfolio formed by Mr. X), the standard deviation of portfolio Y’s return is:

A 11.50%
B 11.16%
C 10.69%
D 10.43%
E 10.22%
12. Mrs. R is using a model of expected returns, where the expected return next year depends on the current value of the variable TRM (which measures a yield spread, defined as the yield on a 30-year T-bond minus the yield on a 1-year T-note). Given the value of TRM, the expected one-year return on stock i is

\[ \gamma_i + \delta_i \text{TRM}, \]

where TRM is in percentage points. For (risky) stocks A, B, and C, Mrs. R finds that \( \gamma_A = 1\% \), \( \gamma_B = 2\% \), \( \gamma_C = 3\% \), \( \delta_A = 2 \), \( \delta_B = 1 \), \( \delta_C = 3 \). When TRM’s current value is 1\% and the current 1-year riskless rate is 5\%, the expected returns on A and B satisfy:

A A is expected to have a higher return than B
B B is expected to have a higher return than A
C A and B are expected to have returns above 5\%
D A and B are expected to have the same return
E The model can be used only for one of the stocks but not for both A and B

13. Use the data in the previous question, and note that our risk averse Mrs. R (who uses the above model for conditional expectations) realizes that she has mean-variance preferences. She also has an investment horizon of one year and wants to construct a portfolio from either (i) a 1-year riskless asset and stock A only, or (ii) a 1-year riskless asset and stock C only.

A In case (i) she will short A, in case (ii) she will short C
B In case (i) she will long A or buy A on margin, in case (ii) she will short C
C In case (i) she will short A, in case (ii) she will long C or buy C on margin
D In case (i) she will long A or buy A on margin, in case (ii) she will long C or buy C on margin
E Need to know more about Mrs. R’s preferences and to know the standard deviation of A and C to be able to describe Mrs. R’s portfolio strategy.
14. Consider the following W, X, Y, Z portfolios, formed from N risky assets. Which one of these 4 portfolios (if any) cannot lie on the efficient frontier for the N assets given what you know about the 4 portfolios?

A portfolio W with expected return 15%, standard deviation 36%
B portfolio X with expected return 12%, standard deviation 15%
C portfolio Z with expected return 5%, standard deviation 7%
D portfolio Y with expected return 9%, standard deviation 21%
E all the portfolios above can possibly lie on the efficient frontier

15. Stocks A, B, and C have the same expected returns and standard deviations. The following table shows the correlations between the returns on these stocks:

<table>
<thead>
<tr>
<th></th>
<th>Stock A</th>
<th>Stock B</th>
<th>Stock C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock A</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stock B</td>
<td>0.9</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Stock C</td>
<td>0.1</td>
<td>-0.4</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Given these correlations, which of the following portfolios have the lowest total risk?

A Equally invested in stocks A and B
B Equally invested in stocks A and C
C Equally invested in stocks B and C
D Totally invested in stock C
E All of the above have same total risk
Use the following information in questions 16, 17 and 18:
The expected rate of return on the market portfolio is 13%, and the standard deviation of market’s return is 10%. The riskless rate is 5%. Consider two assets, Q and V, for which you (correctly) estimated that $\sigma[R_Q] = 5\%$, $\beta_{QM} = 0.5$, $E[R_Q] = 9\%$, $\sigma[R_V] = 8\%$, $\beta_{VM} = 0.5$, $E[R_V] = 9\%$.

16. Compared to the implications of the CAPM,
   A asset Q is overpriced, asset V is underpriced
   B asset Q is underpriced, asset V is overpriced
   C both are fairly priced
   D both are overpriced
   E both are underpriced

17. Investors with mean-variance preferences (who behave according to the assumptions of the CAPM) could hold as their entire portfolio
   A asset Q, but not asset V
   B asset V, but not asset Q
   C either Q or V
   D neither Q nor V
   E cannot answer without specifying investors’ risk aversion
Use the following information in questions 16, 17 and 18:

The expected rate of return on the market portfolio is 13%, and the standard deviation of market’s return is 10%. The riskless rate is 5%. Consider two assets, Q and V, for which you (correctly) estimated that $\sigma_{RQ} = 5\%$, $\beta_{QM} = 0.5$, $E[R_Q] = 9\%$, $\sigma_{RV} = 8\%$, $\beta_{VM} = 0.5$, $E[R_V] = 9\%$.

18. Regarding the comovements of asset Q’s return and asset V’s return with the market, as measured by the correlation with the market’s return,

A asset Q has a lower correlation than asset V with the market
B asset V has a lower correlation than asset Q with the market
C both have same correlations with the market
D both are independent of the market
E cannot analyze correlation with the market without determining overpricing/underpricing
19. In a world where the CAPM assumptions hold for any stock \( j \), \( (j = 1, \ldots, n) \), and for any investor (“CAPM world”), you run the market-model regression using excess returns (returns in excess of the riskless rate):

\[
r_j = \alpha_j + \beta_j r_M + e_j.
\]

You find that:

A. \( \alpha_j \) varies across stocks, capturing firm specific variations, and can take any value

B. \( \alpha_j \) varies across stocks, capturing unique as well as systematic variations, and can take any value

C. \( \alpha_j \) is strictly positive for all stocks

D. \( \alpha_j \) is zero for all stocks

E. \( \alpha_j \) is strictly negative for all stocks

20. In a world where the CAPM assumptions hold (“CAPM world”), you meet an investor who holds asset Z as his total portfolio, where \( \text{E}[R_Z] = 12\% \), \( \sigma[R_Z] = 8\% \). \( R_f \) is 6\%, and \( \text{E}[R_{M}] = 15\% \). Asset Y has \( \beta_{YM} = 0.5 \) and \( \sigma[R_Y] = 8\% \). The correlation between asset’s Y return and the market return is

A. 0.75

B. 1.00

C. 1.25

D. 0.25

E. –0.25
Foundations of Finance Midterm

Name:__________________________________

Answers

1. ________
2. ________
3. ________
4. ________
5. ________
6. ________
7. ________
8. ________
9. ________
10. ________
11. ________
12. ________
13. ________
14. ________
15. ________
16. ________
17. ________
18. ________
19. ________
20. ________
Foundations of Finance Practice Midterm Exam Solution

1. E.
10000 = C × [1-(1.005)^60]/0.005. So C = 193.

2. D.
Proceeds = $4,000 × 0.98 = $3,920.
3,920 = 4,000 × 1.1 / (1 + r ). So, r = 0.1224.

3. C.
Need = 2,000 × [(1-(1 + 0.08/12)-240) / (0.08/12) = $239,108.58
239,108.58 = C [(1+0.08/12)180 - 1] / (0.08/12).
So C=690.99, and Mr. Z must pay 690.99 – 600 = $90.99 more.

4. D.
EAR = (1 + 0.055/4)4 – 1 = 5.61%
Semiannual rate = 1.05610.5 – 1 = 2.77%, so FV = 2,500 × (1.027710 – 1) / 0.0277 = $28,357

5. B.
FV = 1,000 × (1.05^{22} – 1)/0.05 = $38,505.
38,505 – 1,000 × 1.05^{17} – 1,000 × 1.05^{11} = $34,503

6. C.
A market buy will be executed at 100.62, lower of asked and lowest limit sell.
A market sell will be executed at 100.50, higher of bid and highest limit buy.
7. D.
Dividend is not due to you until tomorrow and so is irrelevant. The price run-up prior to purchase is also irrelevant. Therefore,

- Borrow at 8.5% one year ago: +20,000
- Buy 1600 shares of XYZ, at $25 each, one year ago: -40,000
- Repay loan ($20,000 \times 1.085) today: -21,700
- Sell shares of XYZ, at $27 each, today: +43,200
- Commission (2 \times 1600 \times $0.50): -1,600

Total Profit

\[ \text{Total Profit} = -100 \]

8. D.

\[ E[R_p] = 1.5 \times 10\% + (-0.5 \times 6\%) = 12\% \]

9. D.

2/1 return: \[ \frac{(42.5 + 0.5 - 41)}{41} = 0.0488 \]
2/2 return: \[ \frac{(41.125 - 42.5)}{42.5} = -0.0324 \]

10. A.
Asset 1 is the Sure-thing fund, asset 2 is the sure-bet fund. \( \sigma[R_1,R_2] = 0.7 \times 15 \times 8 = 84 \).

\( \sigma^2[R_1] = 15 \times 15 = 225, \ E[R_1] = 16-8 = 8. \) \( \sigma^2[R_2] = 8 \times 8 = 64, \ E[R_2] = 12-8 = 4. \)

\[ w_{1,Y} = \frac{(64 \times 8 - 84 \times 4)}{(64 \times 8 - 84 \times 4 + 225 \times 4 - 84 \times 8)} = 0.4356. \] So \( w_{2,Y} = 0.5644. \)

11. E.

\[ \sigma^2[R_Y] = 0.43562 \times 225 + 0.56442 \times 64 + 2 \times 0.4356 \times 0.5644 \times 84 = 104.383. \]

\( \sigma[R_Y] = 10.2168 \)

12. D.

Conditional on TRM = 1: \( E[R_A] = 1 + 2 \times 1 = 3\%, \ E[R_B] = 2 + 1 \times 1 = 3\%. \)

13. C.
The riskless rate \( R_f = 5\%. \) Given TRM, \( E[R_c] = 3 + 3 \times 1 = 6\%. \) Mrs. R wants to choose a portfolio that lies on the positive-sloped portion of the portfolio possibility curve. Since, given TRM, \( E[R_A] < R_f \) but \( E[R_C] > R_f \), regardless of the (non-zero) standard deviation of A and C returns and the degree of risk aversion, in case (i) will short A but in case (ii) will long C or buy C on margin.
14. D.
Portfolio Y has a lower expected return and a higher standard deviation of return than portfolio X and so cannot lie on the efficient frontier.

15. C.
Can use the following formula for equal-weighted portfolios with all assets having the same standard deviation and set N=2:

\[ \sigma^2[R_p(t)] = \sigma^2 \left[ \frac{1}{N} \frac{1}{1 + \frac{1}{N}} \right] \]

It follows that the equally weighted portfolio of the two stocks with the lowest correlation, B and C, has the lowest standard deviation.

16. C.
SML: 5 + 0.5(13 – 5) = 5 + 4 = 9 for both Q and V

17. A.
0.05 + [(0.13 – 0.05) / 0.1] × 0.05 = 0.09, so Q lies on the CML and the SML.
0.05 + [(0.13 – 0.05) / 0.1] × 0.08 = 0.114 > 0.09, so V does not lie on the CML.
In other words, V is not mean-variance efficient.

18. B.
Recall, \( \rho[R_p, R_M] = \beta_{p,M} \frac{\sigma[R_M]}{\sigma[R_p]} \).
So, \( \rho[R_Q, R_M] = 0.5 \times 0.1 / 0.05 = 1 \), which is greater than \( \rho[R_V, R_M] = 0.5 \times 0.1 / 0.08 = 0.625 \).

19. D.
The excess return market model \( r_j = \alpha_j + \beta_{j,M} r_M + e_j \) implies \( E[e_j] = 0 \) and so \( E[r_j] = \alpha_j + \beta_{j,M} E[r_M] \).
On the other hand, the CAPM states that all assets lie on the SML: \( E[r_j] = \beta_j E[r_M] \). Hence for both to be consistent, must have \( \alpha_j = 0 \).

20. A.
Since Z is held by an investor as a total (complete) portfolio, Z must lie on the CML.
So 12 = 6 + (15 – 6) × 8 / \( \sigma[R_M] \). And so, \( \sigma[R_M] = 12\% \).
Then know \( \rho[R_Y, R_M] = \beta_{YM} \frac{\sigma[R_M]}{\sigma[R_Y]} = 0.5 \times 12 / 8 = 0.75 \).
1. Consider a single premium deferred annuity (SPDA), which costs $28,765.5 and promises annual payments of $20,000 beginning 21 years from now. If the advertised effective annual rate EAR for the SPDA is 9%, how many payments must the SPDA make?
   A  11  
   B  12  
   C  13  
   D  14  
   E  15

2. Security A has a higher equilibrium price volatility than security B. Assuming all else is equal, the equilibrium bid-ask spread of A would be expected to be:
   A  Greater than B  
   B  Less than B  
   C  Equal to B  
   D  It is impossible to tell  
   E  Depends on the time of day

3. Security A has a higher trading volume than security B. Assuming all else is equal, the equilibrium bid-ask spread of A would be expected to be:
   A  Greater than B  
   B  Less than B  
   C  Equal to B  
   D  It is impossible to tell  
   E  Depends on the time of day

4. A riskfree security pays a dividend of 200$ after one year, 400$ after two years, 800$ after three years, and thereafter it never pays dividends again. The riskfree interest rate is 3% per annum. What is the current price of the security:
   A  1203.3  
   B  1303.3  
   C  1345.2  
   D  1400.0  
   E  1342.4
5. Which of the following statements about short selling a risk-free security is true:
   A  It is impossible to short sell risk-free securities
   B  Even combined with other securities, the short sale makes no sense
   C  This transaction is in principle equivalent to borrowing money
   D  This transaction is in principle equivalent to lending money
   E  There are not any margin requirements associated with shorting a risk-free security.

6. Which of the following is not possible when two securities are positively correlated:
   A  Asset A's mean return is negative while asset B's is positive
   B  Asset A's return is sometimes below its mean when asset B's is above its mean
   C  Asset A's mean return is negative while asset B's mean return is also negative
   D  Asset A has a higher mean return but a lower standard deviation of return than asset C
   E  All are possible

7. A security can be in one of four states next year:

   i) a good state with a return of 35% (this happens with probability = 0.30);
   ii) a normal state with a return of 15% (this happens with probability = 0.50); and
   iii) a bad state with a return of 0% (this happens with probability = 0.15).
   iv) a disaster state with a return of -50% (this happens with probability = 0.05).

   What are, respectively, the mean rate of return and the standard deviation of the rate of return?
   A  E[R] = 17.5% ; σ[R] = 16%
   B  E[R] = 15.5%; σ[R] = 19%
   C  E[R] = 15.5%; σ[R] = 16%
   D  E[R] = 17.5%; σ[R] = 15%
   E  E[R] = 15.5%; σ[R] = 3.4%
8. What is the effective annual rate corresponding to an APR of 40% with weekly compounding?
A 34.23%
B 52.12%
C 42.88%
D 48.95%
E 40.00%

9. If a Treasury bill pays 5%, which of the following would definitely not be chosen by a risk averse investor as her total portfolio:
A An asset paying 10%, with probability 0.6 or 2% with probability 0.4
B An asset paying 10% with probability 0.4 or 2% with probability 0.6
C An asset paying 10% with probability 0.2 or 3.75% with probability 0.8
D An asset paying 10% with probability 0.3 or 3.75% with probability 0.7
E Any of these could be chosen

10. Assume $\sigma[R_1] = 10\%$ and $\sigma[R_2] = 30\%$. Under what circumstances will a portfolio allocation of 25% in asset 1 and 75% in asset 2 produce a $\sigma[R]$ for the combined portfolio equal to 25%?
A $\rho[R_1, R_2] = 0$
B $\rho[R_1, R_2] = 1$
C $\rho[R_1, R_2] = -1$
D $\rho[R_1, R_2] = 0.5$
E None of the above.

11. Suppose Kim and Susan care only about the mean and standard deviation of their portfolio return. Kim is less risk averse than Susan. Suppose that Susan holds the tangency portfolio. Which portfolio might Kim hold?
A The riskfree asset
B The tangency portfolio
C Buy the tangency portfolio on margin
D A portfolio with positive weights in the riskfree asset and the tangency portfolio
E None of the above
12. Assume the variance of IBM is 0.16 and the variance of Microsoft is 0.25. If the variance of an equally weighted portfolio of these stocks is 0.0525, then the covariance between these stock is:
   A  0.10
   B  0.20
   C  0.25
   D -0.18
   E -0.10

13. John and Jim are both risk averse and only care about the mean and standard deviation of their portfolio return. They agree on the opportunity set available. There are N risky assets and a riskless asset. Which of the following statements is correct?
   A John and Jim must hold the same portfolio of all assets.
   B John and Jim may hold completely different portfolios of risky assets.
   C When choosing between 2 portfolios, John and Jim always prefer the one with the lowest standard deviation.
   D When choosing between 2 portfolios, John and Jim always prefer the one with the highest expected return.
   E John holds any two risky assets in the same ratio as Jim does in his portfolio.

14. Which of the following best explains a decline in a dealer's inventory:
   A bid price and asked price are too high
   B bid price is too high and asked price is too low
   C bid price is too low and asked price is too high
   D bid price and asked price are too low
   E the decline has nothing to do with the bid and asked prices

15. According to the CAPM, if a security's beta is negative, then its expected return must be
   A The market rate of return
   B Zero
   C A negative rate of return
   D The risk free rate
   E None of the above
16. Suppose the expected return on stock ABC is 14%. Suppose \( R_f = 3\% \), \( E[R_m] = 10\% \) and \( \beta_{ABC,M} = 1.45 \). Then the Jensen’s alpha on ABC is

A 0.85  
B -0.50  
C 3.85  
D Zero  
E Not enough information to answer

17. According to CAPM, if the expected return on asset 1, \( E[R_1] \), is greater than the expected return on asset 2, \( E[R_2] \), then:

A \( R_1 \) must always be greater than \( R_2 \)  
B \( \sigma[R_1] \) must be greater than \( \sigma[R_2] \)  
C \( \beta_{1,M} \) must be greater than \( \beta_{2,M} \)  
D \( \rho[R_1, R_M] \) must be greater than \( \rho[R_2, R_M] \)  
E all of the above must be true
Answers to Additional Practice Questions

1. E.
   \[ V_{20} = 28765.5 \times \text{FVIF}(0.09, 20) = 161,213.68 \]
   \[ V_{20} = 20,000 \times \text{APVF}(0.09, t) = 20,000 \times \frac{1-(1.09)^{-N}}{0.09}. \]
   Then: \[ N = -\ln(\frac{1-161,213.68 \times 0.09}{20,000})/\ln(1.09) = 15 \]

2. A.
3. B.
4. B.
5. C.
6. E.
7. B.
8. D.
9. C.
10. B.
11. C.
12. E.
13. E
14. D.
15. E.
16. A.
17. C.