UNIVERSITY OF OTAGO EXAMINATIONS 2019

Accountancy and Finance

FINC 302

APPLIED INVESTMENTS

MID-TERM EXAM — MAY 9, 2019

(TIME ALLOWED : TWO HOURS)

Name: _____ **Student I.D Number:**_____.

This examination paper comprises 19 pages including this cover page.

Candidates Should Answer Questions as Follows:

There are 50 questions. Each question is worth 1 point. Maximum score = 50 points. For each question, you get 1 point if you select the correct answer, otherwise you get 0 points.

Put all answers on the answer sheet provided. Choose the **BEST ANSWER** for each question; this requires that you **READ ALL CHOICES**. The number of choices may vary between THREE and FIVE depending upon the question.

You must **HAND IN EVERYTHING** at the end of the exam:

(i.e., Answer Sheet + Exam Questions + Equation Sheet).

Note that some mathematical answers may differ very slightly from your answer because of rounding errors and/or because of numerical inaccuracies in your computing device.

The Following Material is Provided:

- Questions on pages 2–19
- Equation Sheets on extra pages 1–3
- Answer Sheet

Candidates are Permitted:

Nil.

Use of Calculators:

No restriction on the model of calculator to be used, but no device with communication capability or unusual storage capability shall be accepted as a calculator.

PLEASE TURN OVER

1. Suppose that you are an N.Z. citizen, N.Z. resident, over the age of 18, but under the age of 65. Suppose that during the KiwiSaver year (i.e., July 1st to June 30th) you successfully deposit $1,000 into your KiwiSaver scheme, but no more. How much of a member tax credit will your contribution trigger?

   (a) $2,000.00
   (b) $1042.86
   (c) $1,000.00
   (d) $521.43
   (e) $500.00

2. Stock returns are so volatile that...

   (a) The annual return of the broad stock market is rarely close to the long-run average return.
   (b) Stock market returns suffer from mean blur (i.e., their standard deviation is typically much bigger than their mean).
   (c) It can be difficult to reject the null hypothesis that the mean return is zero for individual stocks.
   (d) More than 90% of the risk in a 60/40 stock/bond portfolio comes from the stocks.
   (e) All of the above.

3. Which one of the following represents the proportion of days where the S&P 500 index was up, down, and unchanged, respectively, over our 50-year sample from mid-1963 to mid-2013? Note that this question is about price level data only, and that dividends are ignored.

   (a) Up 27.5%, down 67.5%, unchanged 5.0%.
   (b) Up 52.7%, down 47.0%, unchanged 0.3%.
   (c) Up 75.2%, down 22.7%, unchanged 2.1%.
   (d) Up 66.0%, down 33.0%, unchanged 1.0%.
   (e) Up 33.0%, down 66.0%, unchanged 1.0%.

4. With stocks following different financial years, dividend payments on New Zealand stocks tend to cluster in which months?

   (a) Jan/July and Apr/Oct
   (b) Feb/Aug and May/Nov
   (c) Mar/Sept and Jun/Dec
   (d) Apr/Oct and Jun/Dec
   (e) None of the above.

5. We argued in class that if you held a passive S&P 500 investment for 50 years with dividends reinvested, but you missed out on the 10 best days in the market, your ending wealth would be cut in half relative to the ending wealth of a buy-and-hold investor. This empirical fact is an argument against what sort of strategy?

   (a) Actively trying to time the market by going to cash when you feel bearish.

   (b) Passively buying and holding the market.

   (c) Holding a broadly diversified ETF, because ETFs, unlike mutual funds, can be bought and sold during the trading day.

   (d) Actively stock picking while remaining fully invested.

   (e) A value strategy like the one used by Benjamin Graham.

6. Over the 50-year 1963–2013 sample of U.S. daily stock market data we discussed in class, the stocks returned $\bar{R}_S$ per annum, and the T-bills returned $\bar{R}_T$ per annum. The extra returns on stocks, over and above T-bills, $\bar{R}_S - \bar{R}_T$, is referred to as what?

   (a) The equity market default risk premium.

   (b) The equity market credit risk premium.

   (c) The equity market liquidity risk premium.

   (d) The equity market maturity risk premium.

   (e) The equity market risk premium.

7. For our 50-year sample of S&P 500 stock market index returns, from mid-1963 to mid-2013, we found that reinvested dividends accounted for roughly how much of the ending wealth of the buy-and-hold investor in the portfolio of S&P 500 stocks?

   (a) 3%

   (b) 21%

   (c) 33%

   (d) 49%

   (e) 79%

8. Excess kurtosis (i.e., leptokurtosis) in stock returns usually presents itself as what?

   (a) A higher proportion of observations near the mean of the distribution than would be observed in a normal distribution with the same mean and variance.

   (b) A higher proportion of observations in the tails of the distribution than would be observed in a normal distribution with the same mean and variance.

   (c) A higher proportion of observations in the flanks (or "shoulders") of the distribution than would be observed in a normal distribution with the same mean and variance.

   (d) (a) and (b) but not (c)

   (e) (b) and (c) but not (a)

9. In a March 2017 survey of workers in the U.S., 79% said that they expect to continue working in retirement, with a surprising number planning to work when aged well into their 70s. Ninety percent of these people planning to work into old age had at least one financial reason for doing so. So, let me assume that you have **50 years until retirement**. Assume that you are saving for retirement via a growing ordinary annuity (you save a proportion p of your income each year and your income grows at rate g per annum). What is the **impact on your final wealth** if you can earn an extra 1% return per annum over this 50-year horizon? Note that this is not a KiwiSaver question, so don't worry about a fixed-dollar government match here.

   Please assume your income grows as a steady rate of $g = 4\%$ per annum, and tell me the impact on your final wealth if you could earn $R = 9\%$ per annum rather than $R = 8\%$ per annum. Assume annual cash flows.

   (a) A 17.3% boost to your final wealth.

   (b) A 35.2% boost to your final wealth.

   (c) A 42.1% boost to your final wealth.

   (d) A 50.2% boost to your final wealth.

   (e) A 58.5% boost to your final wealth.

10. We argued that Benjamin Graham's defensive/passive value strategy was what?

   (a) An active strategy, because he picks only 10–30 stocks, and he cannot expect to include all industries and be diversified within each industry group.

   (b) A relatively passive strategy, because he argues that it is so very difficult to beat the market that we should instead focus on solid companies with little risk of underperformance.

   (c) The closest thing to a passive strategy in his day (recall that Graham died before diversified index funds were available to retail investors).

   (d) All of the above.

   (e) None of the above.

11. Benjamin Graham's equity screens come in two flavours. What are they?

   (a) Value screens to pick stocks with prices beaten down relative to fundamentals, and growth screens to identify stocks with strong prospects for growth in earnings.

   (b) Value screens to pick stocks with low prices relative to fundamentals, and additional screens to reduce the risk of misjudgement (e.g., the stock has to have paid dividends, and not made losses, and be of a large size, etc.).

   (c) Growth screens to identify stocks with strong prospects for growth in earnings, and momentum screens to identify stocks with good momentum prospects.

   (d) Growth screens to identify stocks with strong prospects for growth in earnings, and diversification screens to make sure that your portfolio is diversified.

   (e) None of the above is close to being correct.

12. We argued that investment-grade bonds should not be held to diversify stock positions, and that bonds should, instead, be held as part of the "second step of two-fund separation." Which ONE of the following best explains this further?

    (a) Bonds are risky right now, because it is difficult to forecast anything other than a 20-year secular rise in interest rates looking forward, and this will increase, rather than decrease, portfolio risk for anyone with a significant bond holding.

    (b) Ignoring TIPS (i.e., inflation-adjusted bonds), bonds are nominally denominated securities, paying a nominal coupon that is undermined by unexpected increases in inflation. Stocks, however, offer ownership of real assets that increase in nominal value terms when unexpected inflation occurs. So, bonds undermine the value of a stock-bond portfolio in the presence of unexpected inflation, and should not be included for diversification purposes.

    (c) Bonds are issued by the same corporations that issue stocks, so holding bonds does not diversify a stock portfolio, but rather provides claims on the cash flows generated by the same underlying assets.

    (d) True diversification comes from combining lightly correlated risky assets, rather than adding low-risk bonds to a risky stock portfolio. High-quality bonds are added only to reduce risk and thus cater to the degree of investor risk aversion, not to diversify a stock position.

    (e) We have no frame of reference to determine what should be the correlation between the returns to stocks and bonds. So, we cannot estimate covariances to include in the risk model needed for diversified portfolio formation.

13. In general, the price momentum strategy finds which stocks attractive? (This strategy formed part of our active alpha optimization strategy on PS3.)

    (a) Stocks that have gone up in price over the most recent six months.

    (b) Stocks that have been beaten down in price over the most recent six months.

    (c) Stocks that have outperformed their peers' price performance over the most recent six months.

    (d) Stocks with prices that have been beaten down over the last six months relative to fundamental variables like earnings or dividends.

    (e) All of the above.

14. Which one of the following tends to DECREASE the P/E ratio of a stock?

    (a) An increase in the forecast growth rate in earnings per share.

    (b) A drop in the expected riskiness of the future earnings per share.

    (c) An increase in the PVGO (i.e., present value of growth opportunities) of the stock as a proportion of price.

    (d) The passage of time, as a company matures.

    (e) More than one of the above.

This information is for the following FOUR questions (Q15–Q18).
Table 1 shows the centralized limit order book (CLOB) for Stock XYZ an hour before the close of business on May 9. Note that the first line of the CLOB is in **bold**.

BUY	Quotes		SELL
Buy Quantity	Prices	Prices	Sell Quantity
7,000	**$0.097**	**$0.099**	**88,150**
20,000	$0.092	$0.102	50,000
76,000	$0.090	$0.105	165,997
20,000	$0.085	$0.110	20,000
30,000	$0.060	$0.115	15,000

Table 1: XYZ Depth Summary at 4PM May 9

15. Suppose that you submit a **market order to buy** 20,000 shares of XYZ. Will your order be executed? If so, when and at what price(s) will it be executed? To answer this question, please assume that no other orders arrive (it is just your market order hitting the CLOB as shown in Table 1), and assume that partial fills of orders are feasible.

    (a) Yes, but there is not enough depth, so, it will have to wait.

    (b) No, there is not enough depth; the order will be killed.

    (c) Yes, the order will be filled immediately with 7,000 shares at $0.097 and 13,000 shares at $0.092.

    (d) Yes, the order will be filled immediately with 20,000 shares at $0.099.

    (e) None of the above answers is true.

16. Suppose you did not submit the order already mentioned in Question 15. Suppose instead that you submit a **limit order to buy** 1,000 shares at $0.099. Suppose, however, that another customer sent in a **market order to sell** 100,000 shares just a few seconds before you (it has not yet been reflected in the CLOB) and the other customer's order is going to be executed first. There are no other orders submitted; it is just these two orders hitting the CLOB as shown in Table 1. What price will your order be executed at and when will it be executed?

    (a) $0.102 per share, immediately after the 100,000 order is executed.

    (b) $0.099 per share, immediately after the 100,000 order is executed.

    (c) $0.099 per share, if other incoming order(s) can be crossed with it later (but it might not be executed at all).

    (d) $0.097 per share, immediately after the 100,000 order is executed.

    (e) $0.090 per share, if other incoming order(s) can be crossed with it later (but it might not be executed at all).

17. Suppose that the orders mentioned in Questions 15 and 16 were not submitted. Suppose instead that you submitted a **limit order to buy** 100,000 shares at \$0.099 per share. Tell me what the new first line of the CLOB looks like immediately after your order is reflected in the CLOB. To answer this question, please assume that no other orders arrive (it is just your limit order hitting the CLOB as shown in Table 1), and assume that partial fills of orders are feasible.

    (a) 7,000 \$0.097 \$0.102 38,150

    (b) 7,000 \$0.097 \$0.099 188,150

    (c) 11,850 \$0.099 \$0.102 zero

    (d) 11,850 \$0.099 \$0.102 50,000

    (e) 107,000 \$0.099 \$0.099 88,150

18. Suppose that the orders already mentioned in Questions 15, 16, and 17 were not submitted. Suppose instead that you submitted a **market order to sell** 10,000 shares. Will your market order experience any price impact, and if so, how much? To answer this question, please assume that no other orders arrive (it is just your market order hitting the CLOB as shown in Table 1).

    (a) No, there is no price impact; in fact, the order will be killed immediately because it cannot be filled.

    (b) No, there is no price impact; the order will wait to be executed in full.

    (c) Yes, there is price impact; 7,000 are executed at \$0.097 and 3,000 are executed at \$0.092.

    (d) No there is no price impact; all 10,000 are executed at \$0.099.

    (e) None of the above is correct.

19. We tried to simplify integral calculus by breaking down the integral into component parts, and associating these parts with a summation using a discrete approximation that employs thin slices of area under the function (these are slices of probability mass in the random variable case, but just slices of area in the general case). There were, however, two conditions that had to be satisfied for the approximation to be valid in the case of a convergent integral. What were they?

    (a) The widths of the thin slices must go to zero, and as they do so, the discrete sum must converge to a single value (and this latter result must be true no matter how the widths of the thin slices go to zero).

    (b) The heights and the widths of the thin slices under the function must both go to zero.

    (c) The heights of the thin slices under the function must go to zero, and the product of height times width (of these thin slices) must also go to zero.

    (d) The widths of the thin slices under the function must go to zero, and the product of height times width (of these thin slices) must equal probability mass, or area, no matter how the slices are formed.

    (e) In fact, each of the above is true.

This information is for the following FIVE questions (Q20–Q24).
Table 2 contains sample statistics for a time series of 239 realized continuously-compounded daily **active returns** to an actively managed portfolio. Note that the SKEW Z-statistic and the KURT Z-statistic are the ones you used on PS1, and they both appear on your equation sheet. **Please assume 251 trading days in a year if you annualize anything.**

Name of Statistic	Value
Number of Daily Returns	239
Sample Mean	0.0006081
Sample Standard Deviation (using n-1)	0.0076608
Sample Autocorrelation (lag 1)	0.010808
SKEW Z-Statistic	-7.2587
KURT Z-Statistic	2.6517

Table 2: Statistical Analysis of Time Series of Active Returns

20. Which are the three standard assumptions that go into any t-test of the mean? In answering this question, do not worry about whether the test is robust to violations of the assumption or not, just choose the option that names the assumptions.

    (a) The data are normally distributed, independent, and identically distributed.

    (b) The distribution of the data is stable, the parameters of the distribution are stable, and the data are independent.

    (c) The data are elliptically distributed, the parameters of the distribution are stable, and the data are independent.

    (d) The data are chi-square distributed, independent, and identically distributed.

    (e) None of the above is correct.

21. Are the data described in Table 2 normally distributed?

    (a) No, I think they are not normally distributed because there is too much skewness and kurtosis.

    (b) Yes, they are normally distributed because the sample size is larger than 200.

    (c) I do not have enough information to form an opinion on whether the data are normally distributed or not.

22. Which of the following is the calculated t-statistic for the test of the null hypothesis that the true mean continuously-compounded daily active return is zero? For this question, please ignore any possible violations of the assumptions of the test.

    (a) 19.9239

    (b) 18.9714

    (c) 1.2576

    (d) 1.2272

    (e) None of the above.

23. If we assume that the beta of our portfolio is one (i.e., $\beta_P = 1$), then the information ratio of our portfolio is given by $IR_P = \frac{\alpha_P}{\omega_P}$. This ratio is what?

    (a) A Sharpe ratio in active space.

    (b) The ratio of return per unit risk in active space.

    (c) The ratio of active return per unit of active risk.

    (d) All of the above.

    (e) both (a) and (b), but neither (c) nor (d).

24. Which of the following is the annualized information ratio (IR) based on the numbers in Table 2? You may assume that $\beta = 1$.

    (a) 19.9239

    (b) 18.9714

    (c) 1.2576

    (d) 1.2272

    (e) None of the above.

25. You take a sample of 20 stock returns to IBM and 20 stock returns to MSFT. You calculate the correlation between their returns as $\hat{\rho} = 0.55$. What is the t-statistic for the correlation to two decimal places? (Assume null hypothesis $H_0 : \rho = 0$. Assume $\hat{\sigma} = 0.07$ for each stock. Assume all assumptions of the test are satisfied.)

    (a) 2.46

    (b) 2.79

    (c) 35.14

    (d) We do not have enough information to work out the t-statistic.

    (e) None of the above is correct.

26. We explored a stylized fact concerning the relationship between relative bid-ask spread and market capitalization of stocks. Our daily stock market data supported which ONE of the following?

    (a) Looking across stocks, as market capitalization increases, relative bid-ask spread of stock returns tends to decrease, and the relationship is non-linear.

    (b) Looking across stocks, as market capitalization increases, relative bid-ask spread of stock returns tends to increase, and the relationship is non-linear.

    (c) Looking across stocks, as market capitalization increases, relative bid-ask spread of stock returns tends to decrease, and the relationship is roughly linear.

    (d) Looking across stocks, as market capitalization increases, relative bid-ask spread of stock returns tends to increase, and the relationship is roughly linear.

    (e) None of the above. In fact, the relationships mentioned are too varied to pin down so easily.

27. Assume that you have two independent samples of data, each of which is IID normally distributed. Let s_i^2 be the sample variance estimator, estimating σ_i^2, for sample i, for $i = 1, 2$. Which one of the following looks like an F-statistic to test for differences in dispersion under the null hypothesis $H_0 : \sigma_1 = \sigma_2$?

    (a) $F = s_1/s_2$

    (b) $F = s_1 - s_2$

    (c) $F = s_1^2 - s_2^2$

    (d) $F = s_1^2/s_2^2$

    (e) $F = \frac{s_1^2/(N_1-1)}{s_2^2/(N_2-1)}$

28. You download a sample of 300 daily stock returns for a small-cap stock. The standard t-statistic to test the null hypothesis that the population mean is zero (i.e., $H_0 : \mu = 0$) takes the value $t = 2.2$, which is beyond the critical value for a two-sided 5% t-test. You test for skewness and kurtosis and find no significant departures from normality. You test for dependence, however, and find significant autocorrelation of $\hat{\rho} = -0.15$. You also conduct an F-test to see whether the dispersion is the same in the first and second halves of the sample (i.e., $H_0 : \sigma_1 = \sigma_2$, where σ_1^2 and σ_2^2 are the true variances in the first and second halves of the sample, respectively). The standard F-statistic for equality of variances takes the value $F = 1.02$, which is well within the critical values for a two-sided 5% F-test. Can you reject the null hypothesis that the true mean return is zero?

    (a) Yes, we can reject $H_0 : \mu = 0$ immediately, and we may use the original $t = 2.2$ value to determine our p-value.

    (b) No, we cannot reject $H_0 : \mu = 0$ immediately, because we need to shuffle the data randomly to remove the autocorrelation, and then we need to recalculate the t-statistic value to see whether we reject or not. We might not reject.

    (c) Yes, we can reject $H_0 : \mu = 0$, but we need to adjust the $t = 2.2$ value to account for autocorrelation first, and I can see that I will still get a rejection.

    (d) No, we cannot reject $H_0 : \mu = 0$. I can see that if I adjust the $t = 2.2$ value for autocorrelation, I do not get a rejection.

    (e) No, we cannot reject $H_0 : \mu = 0$ because the presence of autocorrelation means that the t-test for the mean is invalid.

29. Figure 1 looks similar to Figure 1.14 in the text book, with the simulated daily prices of two stocks over a year. What is the correlation between the daily returns to the two stocks?

    (a) Positive, large, and close to 1.

    (b) Positive, small, but not close to zero.

    (c) Negative, small, but not close to zero.

    (d) Negative, large, and close to -1.

    (e) We cannot tell from the picture.

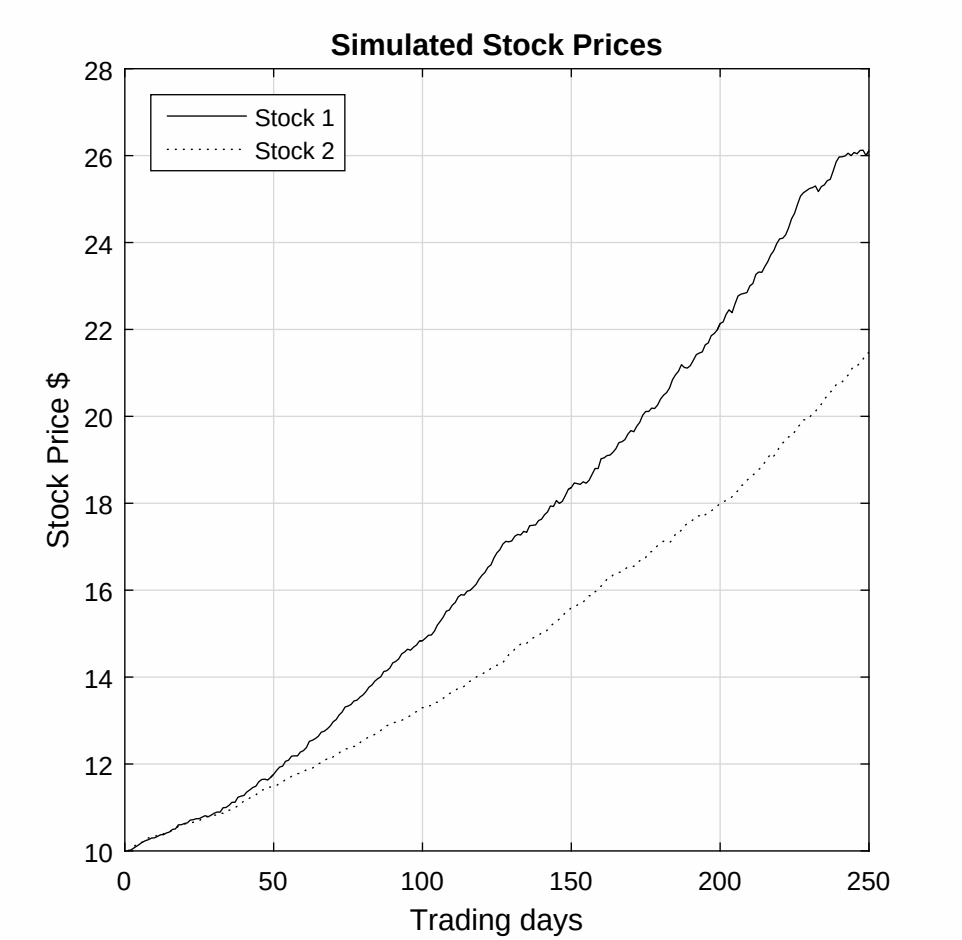

Figure 1: Simulated Stock Prices

The figure plots the simulated prices of two stocks over 250 trading days. The prices of Stock 1 and Stock 2 have similar volatility, but Stock 1's price grows at a higher rate.

30. You bought 100 shares of Snapchat (SNAP) during its first day of trading. It went public at \$17 per share, opened at \$24.00 a share and closed at \$24.48. You bought SNAP at the high of the first day: you paid \$26.05 per share. There were 217,109,769 shares traded this day. The bid-ask spread when you bought SNAP was \$26.00–\$26.05. You also paid a commission of \$10.00. What are your T-costs as a proportion of the total stock price you paid? Note that the commission is part of the T-costs, but it is not part of the price. Round your answer to the nearest bp.

    (a) 38 bps

    (b) 48 bps.

    (c) 58 bps

    (d) 480 bps

    (e) 576 bps

31. Read the following two statements and choose the best answer from (a)–(d).
    (i) A very-large-sample t-test for a mean is distributionally non-parametric.
    (ii) The Spearman rank-order correlation coefficient (SROCC) is functionally non-parametric.

    (a) **(i)** is TRUE, and **(ii)** is TRUE.

    (b) **(i)** is TRUE, and **(ii)** is FALSE.

    (c) **(i)** is FALSE, and **(ii)** is TRUE.

    (d) **(i)** is FALSE, and **(ii)** is FALSE.

32. In the CLOB on the NZX, a "marketable limit order" to BUY is a limit order that is what?

    (a) A limit order with a limit price that is better than the best bid, and therefore jumps to the top of the bid side of the book via price priority, where it waits/rests, but it will be first to be executed if an opposing market order arrives next.

    (b) A limit order with a limit price that is better than the best ask, and therefore jumps to the top of the ask side of the book via price priority, where it waits/rests, but it will be first to be executed if an opposing market order arrives next.

    (c) A limit order with a limit price that is superior to the best bid, and therefore jumps to the top of the bid side of the book via time priority, where it waits/rests, but it will be first to be executed if an opposing market order arrives next.

    (d) A limit order with a limit price that is equivalent to the best bid, and therefore jumps to the top of the bid side of the book via price priority, but is made to wait/rest for execution only because previous limit orders at the same price have time priority.

    (e) None of the above is correct.

33. We talked about $E(X)$ as a probability-weighted sum of possible values of the random variable X. Suppose that $f(x)$ is the probability density function (pdf) of X. We talked about small slices of probability mass under the pdf and a limiting argument. Which bit of Equation (1) represents the small slices of probability mass under the pdf in the limit, according to our limiting argument?

$$E(X) = \int_{x=-\infty}^{x=+\infty} xf(x)dx. \tag{1}$$

(a) $E(X)$
(b) $\int_{x=-\infty}^{x=+\infty}$
(c) x
(d) $xf(x)$
(e) $f(x)dx$

34. Michaud (1989) describes mean-variance optimizers as "estimation error maximizers" because they overweight (underweight) stocks with

(a) relatively high (low) estimated returns, negative (positive) covariance of returns with other stocks' returns, and relatively low (high) variances.
(b) relatively low (high) estimated returns, positive (negative) covariance of returns with other stocks' returns, and relatively high (low) variances.
(c) relatively low (high) estimated returns, negative (positive) covariance of returns with other stocks' returns, and relatively low (high) variances.
(d) relatively high (low) estimated returns, positive (negative) covariance of returns with other stocks' returns, and relatively low (high) variances.
(e) relatively high (low) estimated returns, negative (positive) covariance of returns with other stocks' returns, and relatively high (low) variances.

35. Which one of the following statements about shrinkage estimators of variance-covariance (VCV) matrices is FALSE?

(a) Extreme estimates of covariances are likely to contain extreme estimation error.
(b) Shrinking extreme estimates toward some sort of average value is likely to reduce specification error.
(c) Shrinking extreme estimates toward some sort of average value is likely to reduce estimation error.
(d) Large positive estimated covariances are likely to be larger than the true population values and large negative estimated covariances are likely to be larger in magnitude than the true population values.
(e) The Ledoit-Wolf (2004) VCV estimator takes an average of two VCV estimators, one of which has lots of specification error and little estimation error, and the other of which has lots of estimation error and little specification error.

36. We discussed numerical techniques versus analytical techniques in several contexts. For example, we discussed these for the simple integral problem $E(X^2)$ when $X \sim N(\mu, \sigma^2)$, for evaluation of $E[g(W)]$ where $g(\cdot)$ is the weird function and W is distributed standard normal, for valuing a European-style call option, and for numerical optimization. We said that one hallmark of a numerical technique is that it gives no analytical formula. We also said that numerical techniques are

    (a) Easy to check, and easy to change.

    (b) Dangerous, because they can behave in misleading ways (e.g., a numerical optimizer sticking at a local maximum or minimum).

    (c) Widely accessible, because you do not need to master high-level analytical mathematics to use them.

    (d) Often used to check analytical work.

    (e) All of the above.

37. We have the following parameterization of the active alpha objective function from PS3. All notation is as used your PS3 implementation. Which answer is FALSE?

$$RTAA \;=\; \underbrace{\vec{h}_P'\vec{\alpha}}_{\text{A}} - \lambda \underbrace{\left[\vec{h}_P' V \vec{h}_P - \vec{h}_B' V \vec{h}_B\right]}_{\text{B}} - F \cdot \underbrace{\frac{1}{2}}_{\text{C}} \left| \underbrace{\vec{h}_B - \vec{h}_P}_{\text{D}} \right|' \underbrace{\vec{\gamma}}_{\text{E}}$$

    (a) A is the alpha of portfolio P.

    (b) B is the active risk of portfolio P relative to B.

    (c) C represents the half-spread distance of fair value from the best bid and ask prices.

    (d) D is a vector of the active return of portfolio P relative to B.

    (e) E is a vector of estimated relative bid-ask spreads.

38. The spreadsheet MIN-VAR-OBJ.XLS uses minimization of an objective function that is simply portfolio variance, σ_P^2, subject to the constraint that we be fully invested and that we do not allow short selling. We discussed the spreadsheet MAX-UTIL-OBJ.XLS which uses, instead, maximisation of an objective function that is utility: $E(R_P) - \lambda\sigma_P^2$, subject to the same two constraints. Which of the following is TRUE regarding the utility maximization?

    (a) Very high levels of risk aversion (e.g., $\lambda = 1,000,000$) lead to optimal portfolios on the Markowitz frontier near the global minimum-variance portfolio.

    (b) Assuming risk neutrality (i.e., $\lambda = 0$) leads us to an optimal portfolio on the Markowitz frontier at the individual asset with the highest return.

    (c) The higher is λ, the more assets tend to be included in the optimal portfolio.

    (d) Varying λ from 0 to 1,000,000 traces out solutions on the upper portion only of the Markowitz frontier.

    (e) All of the above are correct.

39. We looked in class at several variance minimization exercises where the choice variables were a vector of portfolio holdings, say, $\vec{h}_P$. When drawing a picture of the minimum-risk frontier in mean-variance space, the choice variables were where?

    (a) Explicitly on one axis only.

    (b) Explicitly on both axes.

    (c) Implicitly on both axes, but embedded within summary statistic formulae driving the axis values.

    (d) On neither axis, and nowhere to be seen either implicitly or explicitly on either axis because the dimensionality of the problem was too high for them to appear on these axes.

    (e) None of the above.

40. The Markowitz frontier analytical solution you used in PS2 is given by:

$$\vec{h}_P = \vec{h}_P(\mu_P, \vec{\mu}, V) = \vec{H}\mu_P + \vec{G}, \quad \text{where} \tag{2}$$

$$\vec{H} = \frac{1}{D}\left\{\left[C(V^{-1}\vec{\mu}) - A(V^{-1}\vec{\iota})\right]\right\}, \tag{3}$$

$$\vec{G} = \frac{1}{D}\left\{\left[B(V^{-1}\vec{\iota}) - A(V^{-1}\vec{\mu})\right]\right\}, \tag{4}$$

$$A = \vec{\iota}\,'V^{-1}\vec{\mu},\ B = \vec{\mu}\,'V^{-1}\vec{\mu},\ C = \vec{\iota}\,'V^{-1}\vec{\iota}, \quad \text{and } D = BC - A^2, \tag{5}$$

    where $\vec{h}_P$ is the argmin. In this case, $\vec{h}_P$ represents what?

    (a) $\vec{h}_P$ is the vector of holdings in the minimum-variance portfolio of risky assets that has the least risk of all possible fully-invested risky asset portfolios.

    (b) $\vec{h}_P$ is the vector of holdings in the tangency portfolio that sits on both the Markowitz and Tobin frontiers.

    (c) $\vec{h}_P$ is the vector of holdings in the fully-invested risky asset portfolio that has $\beta = 1$ relative to the tangency portfolio.

    (d) $\vec{h}_P$ is the vector of holdings in the portfolio of risky assets that has least risk among all fully-invested risky asset portfolios with return μ_P.

    (e) $\vec{h}_P$ is the vector of holdings in the fully-invested portfolio of risky assets with the highest mean return, assuming no short selling.

41. The textbook analytical solution to the Markowitz/Tobin problem you used in PS2 allowed you to plot a tangency portfolio T. Can T contain any short positions?

    (a) Yes, because there is no constraint on short selling in either the Markowitz or Tobin frontiers.

    (b) No, because T is on the Markowitz frontier and assets on the Markowitz frontier do not involve short selling.

    (c) No, because T is fully invested.

    (d) No, because assets on the Tobin frontier do not involve short selling.

    (e) None of the above is true.

42. Assume that you have already solved for A, B, C, D, $\vec{H}$, and $\vec{G}$ in Question 40. Now you want to locate the minimum-variance portfolio on the Markowitz frontier with the same return as the benchmark. So, you plug $\mu_P = \mu_B$ into the formula for $\vec{h}_P$. Now what formulas do you put $\vec{h}_P$ into to get the mean and standard deviation of that frontier portfolio at this level of return? Assume the notation used in class.

    (a) $\vec{h}'_P\vec{\iota}$ and $\vec{h}'_P V\vec{h}_P$, respectively.

    (b) $\vec{h}'_P\vec{\mu}$ and $\sqrt{\vec{h}'_P V\vec{h}_P}$, respectively.

    (c) $\vec{h}'_P\vec{\mu}$ and $\vec{h}'_P V\vec{h}_P$, respectively.

    (d) $\vec{h}'_P\vec{\mu}$ and $\vec{h}'_P V\vec{h}_B$, respectively.

    (e) $\sqrt{\vec{h}'_P\vec{\mu}}$ and $\vec{h}'_P V\vec{h}_P$, respectively.

    (f) None of the above.

43. Suppose that portfolio P contains only a **single stock** selected from the 19 stocks in PS2 or PS3. If you write the vector of holdings $\vec{h}_P$ using the usual notation from class, what form does $\vec{h}_P$ take?

    (a) $\vec{h}_P$ is a 19×1 column vector of ones.

    (b) $\vec{h}_P$ is a 1×19 row vector of ones.

    (c) $\vec{h}_P$ is a 19×1 column vector of zeroes.

    (d) $\vec{h}_P$ is the 19×19 identity matrix.

    (e) None of the above is correct.

44. Today is the birthday of Yamamoto Tsunetomo. Yamamoto is 60 years old. Yamamoto already has \$10 million in the bank (he is a famous former Japanese samurai). The life expectancy for a 60-year-old Japanese male is almost exactly 25 years. Yamamoto has decided to give all his money to charity except for just enough to buy an annuity. Yamamoto wants to buy an annuity that will make a payment to him today (to live on over the next year). He then wants a payment a year from now, and then a payment on every birthday up to and including his 85th birthday 25 years from now. If Yamamoto wants to get a \$200,000 payment on each birthday starting today, how much money does he need to spend today to buy the annuity if the interest rate is 5% per annum? Round to the nearest dollar. Ignore taxes/fees.

    (a) \$3,018,789

    (b) \$2,875,037

    (c) \$2,959,728

    (d) \$2,818,789

    (e) None of the above.

45. Suppose that you re-run the active alpha optimization from PS3, but that you do so with no T-costs and with no constraint on turnover. If you run the optimization using both $\lambda = 5$ and $\lambda = 10$, respectively, for risk aversion, you would generally expect to see optimal solutions for the $\lambda = 5$ case that have...

    (a) different alpha and residual risk ω, but essentially the same risk-adjusted alpha (RAA) as with $\lambda = 10$.

    (b) lower alpha, lower ω, and lower RAA, than with $\lambda = 10$.

    (c) higher alpha, higher ω, and higher RAA, than with $\lambda = 10$.

    (d) essentially the same alpha and ω, but a higher RAA than with $\lambda = 10$.

    (e) It is impossible to say without running the optimization.

46. Suppose $\sigma_B = 0.119$ (benchmark annualized standard deviation), $\sigma_P = 0.122$ (portfolio annualized standard deviation), $\beta_P = 1$ (portfolio beta), $\alpha_P = 0.02141$ (forward looking annualized portfolio alpha), and $\lambda = 10$ (residual risk aversion assuming return and risk are in decimals). What is the forward looking RAA (risk-adjusted alpha) **ignoring T-costs**?

    (a) -0.247477

    (b) 0.014180

    (c) -0.008590

    (d) 0.020687

    (e) None of the above is correct.

47. I have just calculated the mean daily continuously-compounded return to the S&P 500 broad market index in the U.S. using 9,000 observations (I used daily data from 1974 to 2009). I calculated the mean as $\bar{R} = 0.000307$. Gosh, that seems close to zero! **Roughly how big is the t-statistic** for testing the null hypothesis that the mean daily return to the S&P500 actually equals zero? Note that the t-statistic is positive because the sample average $\bar{R}$ is positive, that I have called the t-statistic "t" for short below, and that the following ranges are NOT confidence intervals. Please ignore any and every possible violation of the assumptions underlying the t-statistic calculation.

    (a) $0.00 \leq t \leq 1.96$

    (b) $1.97 \leq t \leq 2.50$

    (c) $2.60 \leq t \leq 2.95$

    (d) $t \geq 3.00$

    (e) I need more information to be able to work out the t-statistic.

48. ◇ When we introduced transaction costs of 25 bps per trade to the perfect foresight strategy, we found that we did not need to look beyond $N = 12$ days to determine an optimal investment strategy because of what?

    (a) Beyond a one-day horizon, initial T-costs matter only because you might wish to capitalize on runs, but runs of more than 12 days are almost unheard of.

    (b) Nobody can predict the market beyond 12 days (just like we rarely see meaningful weather forecasts at this horizon).

    (c) The computational complexity required to solve the problem means that beyond 12 days, no computer can resolve differences in the solution.

    (d) Accumulated wealth accrues only slowly over time, so the first 10–12 days are simply not relevant. It is compounding *after* this horizon that leads to the massive ending wealth of the perfect foresight investor.

    (e) From a time value of money (TVM) perspective, an initial T-cost of 25 bps is magnified so much after 12 days, that it swamps any possible stock market move beyond that horizon.

49. ◇ Recall the Markowitz-Tobin-Tangency analysis from PS2. Assume that there are N risky assets and one riskless asset. Restrict our attention to betas calculated relative to the tangency portfolio. Restrict our attention to fully invested portfolios (i.e., all money is in the N risky assets and none is in the riskless asset). Among these risky fully-invested portfolios, some portfolios will have a zero beta relative to the tangency portfolio. Whereabouts in the Markowitz-Tobin-Tangency picture is the least-risky fully-invested zero-beta portfolio?

    (a) It is at the tangency point between the Markowitz and Tobin frontiers.

    (b) It is at the global minimum variance point on the Markowitz frontier.

    (c) It is at the point on the Markowitz frontier that has the same return as the benchmark portfolio.

    (d) It is at the point on the Markowitz frontier that has the same return as the riskless asset.

    (e) It is strictly within the interior of the Markowitz frontier (i.e., it lies strictly to the right of the Markowitz hyperbola).

50. ◇◇ Let RS denote relative bid-ask spread. Let DTV denote dollar trading volume. Economist A suggests to you that lower spreads attract and drive dollar trading volume, and so the linear regression model

$$DTV = \alpha + \beta \cdot RS + \epsilon$$

makes sense. Economist B argues that, in fact, higher dollar trading volumes force down relative spreads, and so the linear regression model

$$RS = \alpha + \beta \cdot DTV + \epsilon$$

makes sense. Economist C argues that you can sensibly pick between the above two models by choosing the regression with the highest R^2. Which of the three economists do we know to be definitely incorrect?

(a) Economist A.

(b) Economist B.

(c) Economist C.

(d) No, in fact, each economist's argument seems reasonable.

(e) I need more information in order to be able to answer this question.

END OF QUESTIONS