

考試科目	經濟學	系所別	商學院共同科	考試時間	2 月 7 日 (五) 第二節
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### Multiple Choice (1 point each)

Identify the letter of the choice that best completes the statement or answers the question.

1. Suppose Ethan increases his working hours when obtaining higher hourly pay. Which of the following statement(s) is (are) correct?

- (i) Leisure could be an inferior good to Ethan.
- (ii) Leisure could be a normal good to Ethan.
- (iii) Leisure could be a Giffen good to Ethan.

- A. (i) and (iii)
- B. (ii)
- C. (i) and (ii)
- D. (i), (ii), and (iii)

2. Which of the following statement(s) is (are) correct when a government imposes tax on a good?

- (i) When supply is perfectly inelastic, imposing tax on consumers creates zero deadweight loss.
- (ii) When demand is perfectly elastic, imposing tax makes the market price of the good unchanged.
- (iii) When supply is perfectly elastic, and demand is perfect inelastic, imposing tax makes the market equilibrium quantity unchanged.

- A. (i) and (iii)
- B. (ii)
- C. (i) and (ii)
- D. (i), (ii), and (iii)

3. Which of the following statement(s) is(are) correct?

- (i) A monopoly firm can increase its revenue by raising the price when demand is perfectly inelastic.
- (ii) When marginal cost is zero and demand is linear, a monopolistic competitive firm will produce at the midpoint of the demand curve.
- (iii) A perfect competitive firm produces at the point that price elasticity of demand equals one.

- A. (i) and (iii)
- B. (ii)
- C. (i) and (ii)
- D. (i), (ii), and (iii)

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- 一、作答於試題上者，不予計分。
- 二、試題請隨卷繳交。

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4. Assume Ethan's preference on two goods,  $X$  and  $Y$ , follows typical assumptions in Economics. His budget constraint is  $2X + 4Y = 20$ , and his optimal consumption bundle is  $(2, 4)$ . Which of the following consumption bundles is possible to give the same utility level to Ethan as  $(2, 4)$ ?

- A.  $(3, 7)$
- B.  $(5, 2.5)$
- C.  $(0.5, 4)$
- D.  $(1, 7)$

5. Town A has only three residents. They are deciding whether to spend \$ 450 to provide a public good. The public good will only be provided when all of three residents agree to do it. The value of the public good to each resident is:

Resident A	Resident B	Resident C
i	ii	iii

What is a possible bundle of  $(i, ii, iii)$  that this public good will be provided?

- A.  $(0, 0, 460)$
- B.  $(100, 150, 130)$
- C.  $(120, 150, 160)$
- D.  $(140, 140, 140)$

6. When marginal cost exceeds average total cost,

- A. average fixed cost must be falling.
- B. average fixed cost must be rising.
- C. average total cost must be rising.
- D. average total cost is falling.

7. If a firm in a competitive market increases production and its marginal revenue remains positive, raising production will

- A. be profitable.
- B. cause the firm to incur losses.
- C. leave profit unchanged.
- D. It is impossible to tell from the information provided.

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8. When a natural monopoly exists, it is
- always more cost effective for two or more private firms to produce the product.
  - never more cost effective for two or more private firms to produce the product.
  - always more cost effective for government owned firms to produce the product.
  - never more cost effective for one firm to produce the product.
9. If identical products are sold by firms participating in a market, the market is
- perfectly competitive.
  - an oligopoly.
  - monopolistically competitive.
- (i) or (ii)
  - (ii) or (iii)
  - (i) or (iii)
  - (i) only
10. A profit-maximizing firm in a monopolistically competitive market is characterized by which of the following?
- Revenue is always maximized along with profit.
  - Average revenue exceeds marginal revenue.
  - Marginal revenue exceeds average revenue.
  - Average revenue is equal to marginal revenue.
11. Every year more and more purchases are made with credit cards on the Internet. Given this trend, all else equal, we would expect:
- the money demand curve to shift outward.
  - the money demand curve to shift inward.
  - a downward movement along a fixed money demand curve.
  - an upward movement along a fixed money demand curve.
12. As a result of a decrease in the value of the dollar in relation to other currencies, American imports decrease and exports increase. Consequently, there is a(n):
- increase in short-run aggregate supply.
  - decrease in the quantity of aggregate output supplied in the short run.
  - increase in aggregate demand.
  - decrease in the quantity of aggregate output demanded.

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13. The money demand curve is:

A. downward-sloping because the opportunity cost of holding money is inversely related to the interest rate.

B. downward-sloping because the opportunity cost of holding money rises as the interest rate rises.

C. downward-sloping because the opportunity cost of holding money rises as the interest rate falls.

D. upward-sloping because the opportunity cost of holding money rises with the interest rate.

14. An example of the frictionally unemployed is a(n):

A. autoworker who is temporarily laid off because of a decline in sales.

B. geologist who is permanently laid off from an oil company due to a new technological advance.

C. worker at a fast-food restaurant who quits work and attends college.

D. real estate agent who leaves a job in Texas and searches for a similar, higher paying job in California.

15. Suppose that in year 1 an economy produces 100 baseballs that sell for \$3 each and 75 pizzas that sell for \$8 each. The next year the economy produces 110 baseballs that sell for \$3.25 each and 80 pizzas that sell for \$9 each. Using year 1 as the base year, the growth rate of real GDP from year 1 to Year 2 is:

A. 10%.

B. 7.8%.

C. 19.7%.

D. 8.8%.

16. Suppose the economy is in long-run equilibrium. Concerns about pollution cause the government to significantly restrict the production of electricity. At the same time, taxes fall. In the short-run

A. real GDP will rise, and the price level might rise, fall, or stay the same.

B. real GDP will fall, and the price level might rise, fall, or stay the same.

C. the price level will rise, and real GDP might rise, fall, or stay the same.

D. the price level will fall, and real GDP might rise, fall, or stay the same.

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17. Critics of stabilization policy argue that
- “animal spirits” must be offset by active monetary policy.
  - active monetary policy is necessary for steady economic growth.
  - the lag problem ends up being a cause of economic fluctuations.
  - active fiscal policy is required for steady economic growth.
18. Which of the following contains a list only of things that decrease when the budget deficit of the U.S. increases?
- U.S. net exports, U.S. domestic investment, U.S. net capital outflow
  - U.S. supply of loanable funds, U.S. interest rates, U.S. domestic investment
  - U.S. imports, U.S. interest rates, the real exchange rate of the dollar
  - U.S. interest rates, the real exchange rate of the dollar, U.S. domestic investment
19. If purchasing power parity holds, then if the price of a basket of goods in the U.S. rose from \$1,000 to \$1,200 and the price of the same basket in Poland rose from 6,400 Polish zloty to 8,000 zloty, then
- the nominal exchange rate would be unchanged and the real exchange rate would appreciate.
  - the U.S. dollar would appreciate and the real exchange rate would stay the same.
  - the nominal exchange rate would be unchanged and the real exchange rate would depreciate.
  - the U.S. dollar would depreciate and the real exchange rate would be unchanged.
20. Imagine the U.S. economy is in long-run equilibrium. Then suppose the value of the U.S. dollar decreases. At the same time, people in the U.S. revise their expectations so that the expected price level rises. We would expect that in the short-run
- real GDP will rise and the price level might rise, fall, or stay the same.
  - real GDP will fall and the price level might rise, fall, or stay the same.
  - the price level will rise, and real GDP might rise, fall, or stay the same.
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## Problems and Short-essay Questions

Please answer the following questions IN SEQUENCE. All questions may be answered in either Chinese or English.

1. Assume a government imposes a tax on the market of good  $A$ . The total tax revenue is \$500, and the quantity demanded is 100. Further, the demand is linear and has a slope of  $-\frac{1}{5}$ . The supply equation is  $Q^S = 2P$ .

- (4 points) What is the price that consumers pay after the tax?
- (4 points) What is the demand equation?
- (4 points) What is the size of the deadweight loss of the taxation?
- (4 points) What is the tax burden of consumers?
- (4 points) Additionally, assume the government imposes this tax to deal with externality efficiently. What is the size of the externality per output unit? Is this externality positive or negative?

2. Consider an endowment economy (an economy without production). The utility function of each consumer is  $U = D_x^{1/2} D_y^{1/2}$ , where  $D_x$  and  $D_y$  represent demand of  $x$  and  $y$  respectively. The endowment of  $x$  is 20 units and that of  $y$  is 30 units. Answer the following questions.

- (5 points) Show that the utility function is homothetic.
- (5 points) Derive the demand of  $x$  relative to  $y$  as a function of  $p_x/p_y$  where  $p$  represents price.
- (5 points) Derive the equilibrium level of  $p_x/p_y$ .
- (5 points) Suppose there is another economy, where consumers have the same utility function but both the endowment of  $x$  and  $y$  is 30 units. Derive the equilibrium level of  $p_x/p_y$  under free trade.

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3. Given the following information: bank deposits 350, currency-to-deposits ratio 0.20, required reserve ratio 0.15,

A. (15 points) solve for the monetary base level, the level of bank reserves, and the money supply level in this economy.

B. (5 points) Suppose there is a sudden rise in the currency-to-deposits ratio, from the original level of 0.2 to a new level of 0.4. If everything else remains unchanged, find the level of monetary base needed to keep money supply fixed at the same level.

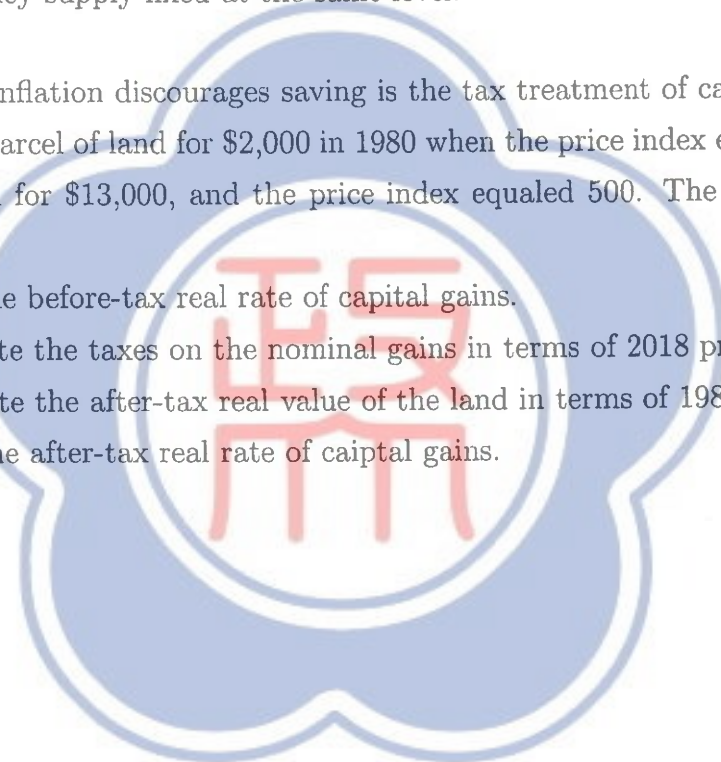
4. One example of how inflation discourages saving is the tax treatment of capital gains. Suppose that someone bought a parcel of land for \$2,000 in 1980 when the price index equaled 100. In 2018, the person sold the land for \$13,000, and the price index equaled 500. The tax rate on nominal gains was 20 percent.

A. (5 points) Find the before-tax real rate of capital gains.

B. (5 points) Compute the taxes on the nominal gains in terms of 2018 prices.

C. (5 points) Compute the after-tax real value of the land in terms of 1980 prices.

D. (5 points) Find the after-tax real rate of capital gains.



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**Part I. Multiple Choice Questions (40 points, 4 pts each):**

- A bond with a 9-year duration is worth \$1,080, and its yield to maturity is 8%. If the yield to maturity falls 160 bp, you would predict that the new value of the bond will be approximately \_\_\_\_\_ without convexity. Now we consider the convexity to be 140, your prediction would be \_\_\_\_\_ then.

A) \$1,085.12; \$1,084.80  
 B) \$1,085.12; \$1,088.43  
 C) \$1,094.40; \$1,094.29  
 D) \$1,094.40; \$1,094.59  
 E) \$1,078.34; \$1,078.69
- A perpetuity pays \$100 each and every year forever. The duration of this perpetuity will be \_\_\_\_\_ if its yield is 9%.

A) 7  
 B) 9  
 C) 9.39  
 D) 12.11  
 E) Infinity
- ART Co. has come out with a new and improved product. As a result, the firm projects a 5% growth rate on dividends. It maintains a dividend payout ratio of 0.80 and its earnings at the conclusion of this coming year is expected to be \$3 per share. Investors expect a 12% rate of return on the stock. At what P/E ratio would you expect ART to sell?

A) 8.33  
 B) 10.19  
 C) 11.43  
 D) 14.29  
 E) 15.25

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4. On Monday morning you sell one June T-bond futures contract at \$97,843.75. The contract's face value is \$100,000. The initial margin requirement is \$2,700, and the maintenance margin requirement is \$2,000 per contract. Use the following price data to answer the following questions.

Day	Settle
Monday	\$ 97,406.25
Tuesday	\$ 98,000.00
Wednesday	\$ 99,000.00
Thursday	\$ 99,050.00

On which of the following days do you get your first margin call?

- A) Monday  
 B) Tuesday  
 C) Wednesday  
 D) Thursday  
 E) none of these options
5. Suppose two portfolios have the same average return and the same standard deviation of returns, but Buckeye Fund has a higher beta than Husker Fund. According to the Treynor measure, the performance of Buckeye Fund
- A) is poorer than the performance of Husker Fund.  
 B) is better than the performance of Husker Fund.  
 C) is the same as the performance of Husker Fund.  
 D) cannot be measured as there are no data on the alpha of the portfolio.  
 E) None of the options are correct.
6. Eliminating polluting or high carbon-emitting companies from the investment opportunity set will generally move the efficient frontier \_\_\_\_\_ and to the \_\_\_\_\_.
- A) down; right  
 B) down; left  
 C) up; right  
 D) up; left  
 E) none of the above because those socially inappropriate firms have no impact on future performance

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7. Which one of the following could probably increase investors' interest in an IPO?
- I. Reducing the lockup period
  - II. News release of very strong book building on the first day of the road show
  - III. Underpricing the IPO
  - IV. Increasing the magnitude of the Green Shoe option
- A) I and III
  - B) II and IV
  - C) II and III
  - D) II, III and IV
  - E) I, III and IV
8. Consider a portfolio comprised of four risky securities. Assume the economy has three economic states with varying probabilities of occurrence. Which one of the following will guarantee that the portfolio variance will equal zero?
- A) The portfolio beta must be 1.0.
  - B) The portfolio expected rate of return must be the same for each economic state.
  - C) The portfolio risk premium must equal zero.
  - D) The portfolio expected rate of return must equal the expected market rate of return.
  - E) There must be equal probabilities that the state of the economy will be a boom or a bust.
9. The net present value
- A) increases as the required rate of return decreases.
  - B) is equal to the initial investment when the internal rate of return is equal to the required return.
  - C) cannot be applied to mutually exclusive projects.
  - D) ignores cash flows that are distant in the future.
  - E) cannot be applied in the presence of non-conventional cash flows.

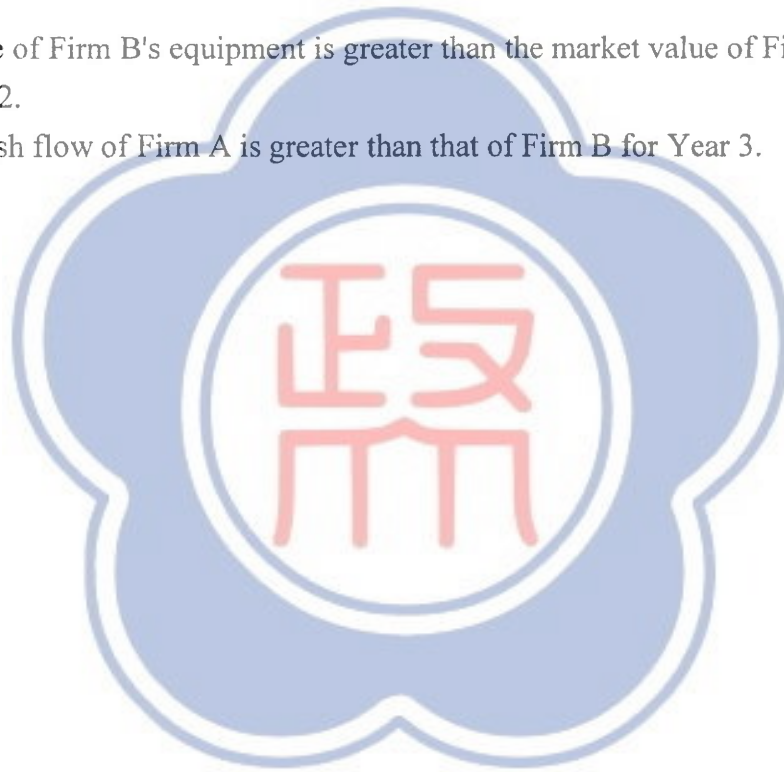
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10. Firm A uses straight-line depreciation. Firm B uses MACRS depreciation. Both firms bought \$75,000 worth of equipment last year that has a tax life of 5 years. The 5-year MACRS percentage rates, starting with Year 1, are: 20, 32, 19.2, 11.52, 11.52, and 5.76. Both firms have a marginal tax rate of 34 percent and identical operating cash flows except for the depreciation effects. Given this, you know the:
- A) depreciation expense for Firm A will be greater than Firm B's expense every year.
  - B) equipment has a higher value on Firm B's books than on Firm A's at the end of Year 2.
  - C) market value of Firm A's equipment is greater than the market value of Firm B's at end the first year.
  - D) market value of Firm B's equipment is greater than the market value of Firm A's equipment at the end of Year 2.
  - E) operating cash flow of Firm A is greater than that of Firm B for Year 3.



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## Part II Short Essay Questions (60 pts)

1. Bill Gates (age 64 years) owned 44.8% of Microsoft (MSFT) stocks right after its IPO in 1986. He hired a money manager Michael Larson in 1993 to manage his money. Larson started by liquidating some of Gates' Microsoft shares and invested the proceedings on other stocks. He delivered a compound annual return of 11% since 1995, outperforming the S&P 500 by more than 1%. In 2019, Gates only owns a little more than 1% of Microsoft shares, which accounts for about 10% of his wealth. However, if Gates held on to his Microsoft shares, he would have broken the \$100 billion mark last century instead of last year, and he'll have more than \$500 billion's worth MSFT stocks at his disposal. Gates have 80% of his wealth on stocks in 2019, the leading one is Berkshire Hathaway, an American multinational conglomerate holding company run by Warren Buffet. This stock alone accounts for 40% of his wealth. Please answer the following two questions with finance theories, stylized facts and your knowledge on the real world.
- A) (6pts) Without perfect hindsight, would you sell that much Microsoft shares if you oversaw Bill Gates' wealth and why?
- B) (6pts) Would you suggest a different asset allocation if you are making a decision today and why?
2. Aberdeen Wholesale Company is an all-equity firm which has an expected ROE of 12% for 2020. Its expected EPS in the end of 2020 is \$5 and it has a plowback ratio at 60%. The firm will only use the retained earnings for investment without issuing new stocks or bonds during the year. The current risk-free rate is 2% and the equity risk premium is 8%. The beta of the firm is equal to 1.
- A) (6pts) What is the fair price of the stock in the end of 2019 and the present value of growth opportunities in it?
- B) (6pts) Suppose the risk-free rate goes up to 5% sharply in the end of 2020, while market risk premium and the firm's beta remain the same. Aberdeen Wholesale Company still achieves its earning target during the year with the same expected ROE for the following years. The firm also plans to keep the same dividend policy. What is the fair price of the stock in the end of 2020 with the updated information (we consider ex-dividend price in this question)?
- C) (6pts) You are a member of the board of directors in the end of 2020. Do you think this company should change its dividend policy moving forward under the new interest rate environment? What do you propose and why?

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3. Two risky assets, A and B, are both on the efficient frontier. The standard deviation of return on A is 24%, while the standard deviation on B is 12%. The correlation coefficient between the returns on A and B is 0. The expected return on A is 12%, while on B it is 2%.
- A) (6pts) The global minimum-variance portfolio can be constructed by these two assets. Please show its weights on A and B, as well as its expected return and standard deviation.
- B) (6pts) The return on the risk-free asset is also 2%. Please tell me which asset or portfolio in this question would be your investment choice and why.
4. You are analyzing a 3-year project and have developed the following estimates. The initial capital spending is \$150,000 with 5-year straight line depreciation. The salvage value at the end of the project is \$100,000 and the tax rate is 35 percent. The project requires a \$20,000 net working capital. The required return of the project is 15%.

	Base-Case	Lower Bound	Upper Bound
Unit sales	11,300	9,800	12,800
Sales price per unit	\$ 39	\$ 34	\$ 44
Variable cost per unit	\$ 25	\$ 24	\$ 26
Fixed costs	\$ 9,700	\$ 9,200	\$ 10,200

- A)(6pts) What is the worst-case operating cash flow (pick the worst possible scenario from the above table for each variable disregarding their correlation)?
- B)(6pts) What is the aftertax salvage value?
- C)(6pts) The board will only approve the project if it can still make money even in the worst case scenario. Do you think this should be approved?

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1. (3pt) If a test of hypothesis has a Type I error probability of 0.05, this means that:
  - A. if the null hypothesis is true, we don't reject it 5% of the time
  - B. if the null hypothesis is true, we reject it 5% of the time
  - C. if the null hypothesis is false, we don't reject it 5% of the time
  - D. if the null hypothesis is false, we reject it 5% of the time
  
2. (3pt) Suppose we wish to test  $H_0: \mu = 23$  vs.  $H_1: \mu < 23$ . Which of the following possible sample results gives the most evidence to support  $H_1$ ?
  - A. sample mean is 19 and standard error is 5
  - B. sample mean is 20 and standard error is 8
  - C. sample mean is 21 and standard error is 6
  - D. sample mean is 19 and standard error is 11
  
3. (3pt) If a random sample of size  $n=100$  fine-dining restaurants is selected and it is found that 45 restrict the use of the cell phones, give a 99% confidence interval for the true proportion of fine-dining restaurants that restrict the use of cell phone.
  - A. (0.3219, 0.5781)
  - B. (0.3525, 0.5475)
  - C. (0.2378, 0.4222)
  - D. (0.2526, 0.4073)
  
4. (3pt) Which of the following does the Central Limit Theorem allow us to disregard when working with the sampling distribution of the sample mean?
  - A. the standard deviation of the population distribution
  - B. the shape of the population distribution
  - C. the mean of the population distribution
  - D. all of the above can be disregarded when the Central Limit Theorem is used
  
5. (3pt) A man with 10 keys wants to open his door and tries the keys at random. Suppose there is exactly one key will open the door. If unsuccessful keys are eliminated from further selections. Let  $X$  be the number of trials to find the right key. What is the distribution of  $X$ ?
  - A. Uniform distribution
  - B. Geometric distribution
  - C. Binomial distribution
  - D. Negative binomial distribution

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- 二、試題請隨卷繳交。

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<p>6. (3pt) The seasonal output of a new experimental strain of pepper plants was carefully weighed. The mean weight per plant is 15.0 pounds, and the standard deviation of the normally distributed weights is 1.75 pounds. Of the 200 plants in the experiment, how many produced peppers weighing between 13 and 16 pounds?</p> <p>A. 100 B. 118 C. 197 D. 53</p> <p>7. (3pt) Which of the following tests is appropriate for data if the problem objective is to compare two populations and there are exactly 2 categories?</p> <p>A. The z-test for the difference of two proportions B. The chi-squared test of a contingency table C. Both A and B D. None of these choices</p> <p>8. (3pt) In testing the hypothesis <math>H_0: \mu = 100</math> vs. <math>H_1: \mu &gt; 100</math>, the p-value is found to be 0.074, and the sample mean is 105. Which of the following statements is true?</p> <p>A. The probability of observing a sample mean at least as large as 105 from a population whose mean is 100 is 0.074 B. The probability of observing a sample mean smaller than 105 from a population whose mean is 100 is 0.074 C. The probability that the population mean is larger than 100 is 0.074 D. None of these choices</p> <p>9. (3pt) The sample size needed to within 10 units of the population mean was found to be 68. If the population standard deviation was 50, then the confidence level used was</p> <p>A. 99% B. 95% C. 90% D. 98%</p> <p>10. (3pt) The SAT scores of entering freshmen at a certain university have mean 1215 and standard deviation 110. A random sample of 100 freshmen is taken and <math>\bar{X}</math> is computed. The probability that <math>\bar{X}</math> less than 1190 is</p> <p>A. 0.2272 B. 0.1335 C. 0.4090 D. 0.0116</p>					

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11. (15%) The weekly oil demand  $X$  (in tons) follows the pdf

$$f(x) = \frac{1}{\theta} e^{-x/\theta}, 0 < x < \infty.$$

However, the company can produce at most only 4 tons of the oil per week. Let  $Y$  be the oil sold per week.

- (a) (3%) Find the probability that the oil will be sold out per week
- (b) (7%) Find the cumulative distribution function of  $Y$
- (c) (5%) Find  $E(Y)$

12. (20%) Suppose that a random sample of 60 observations was drawn from a normal population. Suppose that we would like to infer whether or not the observations come from a zero mean and variance one. After drawing observations randomly, the number of observations in each of the intervals below was counted. Can we infer at the 5% significance level that the data were drawn from a hypothesized population? Ps. your answer should include:

- (i) the null/alternative hypothesis; (ii) the test statistic; (iii) the decision rule; (iv) the conclusion of the test

intervals	Frequency
$(-\infty, -1]$	8
$(-1, 0]$	30
$(0, 1]$	17
$(1, \infty)$	5

13. (15%) Three different models of automobiles (A, B, and C) were compared for gasoline consumption. For each model of car, 15 cars were randomly selected and subjected to standard driving procedures. The average miles/gallon obtained for each model of car and sample standard deviations are shown below. Suppose that the population variances ( $\sigma_A^2 = \sigma_B^2 = \sigma_C^2 = \sigma^2$ ) are equal.

	Car A	Car B	Car C
Average Mile/Gallon	42	49	44
Sample Standard Deviation	4	5	3

- (a) (10%) Let  $\alpha = 0.05$ , and see if the mean gasoline consumption for all three models of cars is the same
- (b) (5%) Find a 95% confidence interval for  $(\mu_C - \mu_A)$ . Please use  $Q_{\alpha, d.f.}$  to denote the critical value. (you must specify the distribution  $Q$  and value of d.f.)

14. (20%) An insurance company is considering opening a new branch in Lansing. The company will choose the final location from two locations within the city. One of the factors in the decision is the annual family income (in thousands of dollars) from the potential locations.

Suppose that they randomly selected  $n$  families from each location (so the sample size is  $2n$ ). Let  $\bar{X}_A$  and

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$S_A$  be the sample mean and the sample standard deviation of location A, respectively. Similarly,  $\bar{X}_B$  and  $S_B$  are the corresponding statistics from location B.

Use  $\alpha = 0.05$  to answer the following questions. Please state your answer step-by step, including: (i) the null/alternative hypothesis; (ii) the test statistic(use  $\bar{X}$  And  $S$  to define your test statistic); (iii) the decision rule(including the distribution and critical value)

- (a) (5%) Suppose that we have no idea whether the variances are equal or not. So how to use a statistical method to determine the variances are equal or not?
- (b) (5%) Suppose that the variances are the same. Perform a hypothesis testing to determine whether the population means differ significantly.
- (c) (10%) Let  $Z$  be 1 if it comes from location B and 0 otherwise. And  $Y$  be the income. We fit a simple linear regression model to this dataset  $\{(Z_i, Y_i)\}_{i=1, \dots, 2n}$  and use the least squares method to get the estimated regression equation. Show that the least squares estimates of intercept and slope parameters are  $\bar{X}_A$  and  $\bar{X}_B - \bar{X}_A$ , respectively.

Table I: Chi-square table

Upper tail	0.3	0.2	0.1	0.05	0.02	0.01	0.005	0.001	
df	2	2.41	3.22	4.61	5.99	7.82	9.21	10.60	13.82
	3	3.66	4.64	6.25	7.81	9.84	11.34	12.84	16.27
	4	4.88	5.99	7.78	9.49	11.67	13.28	14.86	18.47
	5	6.06	7.29	9.24	11.07	13.39	15.09	16.75	20.52
	6	7.23	8.56	10.64	12.59	15.03	16.81	18.55	22.46
	7	8.38	9.80	12.02	14.07	16.62	18.48	20.28	24.32
	8	9.52	11.03	13.36	15.51	18.17	20.09	21.95	26.12
	9	10.66	12.24	14.68	16.92	19.68	21.67	23.59	27.88
	10	11.78	13.44	15.99	18.31	21.16	23.21	25.19	29.59
	11	12.90	14.63	17.28	19.68	22.62	24.72	26.76	31.26
	12	14.01	15.81	18.55	21.03	24.05	26.22	28.30	32.91
	13	15.12	16.98	19.81	22.36	25.47	27.69	29.82	34.53
	14	16.22	18.15	21.06	23.68	26.87	29.14	31.32	36.12
	15	17.32	19.31	22.31	25.00	28.26	30.58	32.80	37.70
	16	18.42	20.47	23.54	26.30	29.63	32.00	34.27	39.25
	17	19.51	21.61	24.77	27.59	31.00	33.41	35.72	40.79
	18	20.60	22.76	25.99	28.87	32.35	34.81	37.16	42.31
	19	21.69	23.90	27.20	30.14	33.69	36.19	38.58	43.82
	20	22.77	25.04	28.41	31.41	35.02	37.57	40.00	45.31
	25	28.17	30.68	34.38	37.65	41.57	44.31	46.93	52.02
	30	33.53	36.25	40.26	43.77	47.96	50.89	53.67	59.70
	40	44.16	47.27	51.81	55.76	60.44	63.69	66.77	73.40
	50	54.72	58.16	63.17	67.50	72.61	76.15	79.49	86.66



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Table III: F table with  $\alpha = 0.05$

Denominator DF	Numerator DF									
	1	2	3	4	5	6	7	8	9	10
1	161.448	199.500	215.707	224.583	230.162	233.986	236.768	238.883	240.543	241.882
2	18.513	19.000	19.164	19.247	19.296	19.330	19.353	19.371	19.385	19.396
3	10.128	9.552	9.277	9.117	9.013	8.941	8.887	8.845	8.812	8.786
4	7.709	6.944	6.591	6.388	6.256	6.163	6.094	6.041	5.999	5.964
5	6.608	5.786	5.409	5.192	5.050	4.950	4.876	4.818	4.772	4.735
6	5.987	5.143	4.757	4.534	4.387	4.284	4.207	4.147	4.099	4.060
7	5.591	4.737	4.347	4.120	3.972	3.866	3.787	3.726	3.677	3.637
8	5.318	4.459	4.066	3.838	3.687	3.581	3.500	3.438	3.388	3.347
9	5.117	4.256	3.863	3.633	3.482	3.374	3.293	3.230	3.179	3.137
10	4.965	4.103	3.708	3.478	3.326	3.217	3.135	3.072	3.020	2.978
11	4.844	3.982	3.587	3.357	3.204	3.095	3.012	2.948	2.896	2.854
12	4.747	3.885	3.490	3.259	3.106	2.996	2.913	2.849	2.796	2.753
13	4.667	3.806	3.411	3.179	3.025	2.915	2.832	2.767	2.714	2.671
14	4.600	3.739	3.344	3.112	2.958	2.848	2.764	2.699	2.646	2.602
15	4.543	3.682	3.287	3.056	2.901	2.790	2.707	2.641	2.588	2.544
16	4.494	3.634	3.239	3.007	2.852	2.741	2.657	2.591	2.538	2.494
17	4.451	3.592	3.197	2.965	2.810	2.699	2.614	2.548	2.494	2.450
18	4.414	3.555	3.160	2.928	2.773	2.661	2.577	2.510	2.456	2.412
19	4.381	3.522	3.127	2.895	2.740	2.628	2.544	2.477	2.423	2.378
20	4.351	3.493	3.098	2.866	2.711	2.599	2.514	2.447	2.393	2.348
21	4.325	3.467	3.072	2.840	2.685	2.573	2.488	2.420	2.366	2.321
22	4.301	3.443	3.049	2.817	2.661	2.549	2.464	2.397	2.342	2.297
23	4.279	3.422	3.028	2.796	2.640	2.528	2.442	2.375	2.320	2.275
24	4.260	3.403	3.009	2.776	2.621	2.508	2.423	2.355	2.300	2.255
25	4.242	3.385	2.991	2.759	2.603	2.490	2.405	2.337	2.282	2.236
26	4.225	3.369	2.975	2.743	2.587	2.474	2.388	2.321	2.265	2.220
27	4.210	3.354	2.960	2.728	2.572	2.459	2.373	2.305	2.250	2.204
28	4.196	3.340	2.947	2.714	2.558	2.445	2.359	2.291	2.235	2.190
29	4.183	3.328	2.934	2.701	2.545	2.432	2.346	2.278	2.223	2.177
30	4.171	3.316	2.922	2.690	2.534	2.421	2.334	2.266	2.211	2.165
31	4.160	3.305	2.911	2.679	2.523	2.409	2.323	2.255	2.199	2.153
32	4.149	3.295	2.901	2.668	2.512	2.399	2.313	2.244	2.189	2.142
33	4.139	3.285	2.892	2.659	2.503	2.389	2.303	2.235	2.179	2.133
34	4.130	3.276	2.883	2.650	2.494	2.380	2.294	2.225	2.170	2.123
35	4.121	3.267	2.874	2.641	2.485	2.372	2.285	2.217	2.161	2.114
36	4.113	3.259	2.866	2.634	2.477	2.364	2.277	2.209	2.153	2.106
37	4.105	3.252	2.859	2.626	2.470	2.356	2.270	2.201	2.145	2.098
38	4.098	3.245	2.852	2.619	2.463	2.349	2.262	2.194	2.138	2.091
39	4.091	3.238	2.845	2.612	2.456	2.342	2.255	2.187	2.131	2.084
40	4.085	3.232	2.839	2.606	2.449	2.336	2.249	2.180	2.124	2.077
41	4.079	3.226	2.833	2.600	2.443	2.330	2.243	2.174	2.118	2.071
42	4.073	3.220	2.827	2.594	2.438	2.324	2.237	2.168	2.112	2.065
43	4.067	3.214	2.822	2.589	2.432	2.318	2.232	2.163	2.106	2.059
44	4.062	3.209	2.816	2.584	2.427	2.313	2.226	2.157	2.101	2.054
45	4.057	3.204	2.812	2.579	2.422	2.308	2.221	2.152	2.096	2.049
46	4.052	3.200	2.807	2.574	2.417	2.304	2.216	2.147	2.091	2.044
47	4.047	3.195	2.802	2.570	2.413	2.299	2.212	2.143	2.086	2.039
48	4.043	3.191	2.798	2.565	2.409	2.295	2.207	2.138	2.082	2.035
49	4.038	3.187	2.794	2.561	2.404	2.290	2.203	2.134	2.077	2.030
50	4.034	3.183	2.790	2.557	2.400	2.286	2.199	2.130	2.073	2.026

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- 一、作答於試題上者，不予計分。
- 二、試題請隨卷繳交。