

考試科目	經濟學	系所別	商學院共同科	考試時間	2 月 6 日 (五) 第二節
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### I. Multiple Choice (1 points each)

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

- Suppose the introduction of new tariffs on imported ovens not only raises the prices of imported ovens but also those of domestic ovens. We can conclude that imported and domestic ovens are
  - substitutes.
  - complements.
  - unrelated.
  - None of the above is correct.
- According to consumer theory, "if consumers do not buy less of a commodity when their incomes rise, they will
  - surely buy less when the price of the commodity rises."
  - surely buy more when the price of the commodity rises."
  - surely buy less when the price of the commodity falls."
  - either buy more or less when the price of the commodity rises."
- People with hidden health problems are more likely to buy health insurance than are other people. This is an example of
  - moral hazard and makes the cost of health insurance higher than otherwise.
  - moral hazard and makes the cost of health insurance lower than otherwise.
  - adverse selection and makes the cost of health insurance higher than otherwise.
  - adverse selection and makes the cost of health insurance lower than otherwise.
- Ben has a concave utility function  $U(W) = W^{0.5}$ , where  $W$  denotes his wealth. His only asset is shares in a start-up company. Tomorrow he will learn the stock's value. He believes that it is worth \$144 with probability  $\frac{1}{2}$  and \$100 with probability  $\frac{1}{2}$ . What is the risk premium he would pay to avoid bearing this risk?
  - 1
  - 2
  - 10
  - 12
- Which of the following demonstrates the law of demand?
  - Ashlyn buys more apples at \$3 per pound than at \$5 per pound, other things equal.
  - Brian buys fewer croissants at \$1 per croissant than at \$2 per croissant, other things equal.
  - After Charles got a raise at work, he bought more pretzels at \$2 per pretzel than he did before his raise.

備

註

- 作答於試題上者，不予計分。
- 試題請隨卷繳交。

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- D. Danny buys fewer Snickers at \$1.5 per bar after the price of Skittles falls to \$1 per bag.
6. In the long run, the toothpaste market is monopolistically competitive, and WhiteMan is one of the firms. WhiteMan's long-run cost function is  $c(q) = q^3 - xq^2 + 14q$ . The firm faces demand  $q = 5 - \frac{1}{2}p$ . What is  $x$ ?
- A. 3  
B. 4  
C. 5  
D. 6
7. There are four residents  $i = 1, 2, 3,$  and  $4$  in a small village. If resident  $i$  donates  $d_i$  dollars, total public funding is  $D = \sum_{i=1}^4 d_i$ . Resident  $i$ 's utility is  $U_i = m_i - d_i + i \cdot \ln(D)$ , where  $m_i$  is the money resident  $i$  has and  $m_i > 6$  for all  $i$ . What is the socially optimal level of  $D$ ?
- A. 8  
B. 10  
C. 12  
D. 14
8. Demand for bubble tea is  $q_d = 42 - 2p$ , and supply is  $q_s = 0.5p - 2$ . Consumption causes an obesity external cost  $c_s = 3q^2$ . Which policy achieves the social optimum?
- A. Close the bubble tea market.  
B. For every bubble tea consumed, the customer pays the bubble store 12 dollars more.  
C. For every bubble tea produced, the bubble store pays 12 dollars to the government.  
D. Set a quota equal to  $q = 3$ .
9. Consider the game in the payoff matrix.

		Player 2	
		B	T
Player 1	B	(2, 1)	(0, 0)
	T	(0, 0)	(1, 2)

Which the following description is wrong?

- A. There are 3 Nash equilibria.  
B. In the mixed-strategy Nash equilibrium, all players get less than 1.  
C. If player 1 moves first, (2, 1) can be the Nash equilibrium payoff.  
D. If player 2 moves first, (2, 1) cannot be a Nash equilibrium payoff.

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10. Regarding the “tragedy of the commons,” which statement is incorrect?
- Rivalry in the use of the resource is the main cause of the problem.
  - It is an example of the prisoner’s dilemma.
  - Limiting access to the common resource can alleviate the problem.
  - The government may use a cap-and-trade policy to address the problem.
11. In the base year, consumers buy mostly beef. In the current year, beef prices rise sharply, so consumers switch to chicken (which did not rise in price). Assume the CPI is calculated using a fixed basket, while GDP deflator uses current quantities. Which statement is MOST likely true?
- CPI and GDP deflator both overstate inflation equally.
  - CPI overstates inflation more than GDP deflator.
  - GDP deflator overstates inflation more than CPI.
  - Both CPI and GDP deflator correctly measure inflation.
12. A country imports most of its consumer electronics. Due to a global chip shortage, import prices of electronics rise by 30%, while domestically produced goods barely change in price. No major change occurs in quantities produced. What happens?
- CPI rises significantly; GDP deflator rises little.
  - GDP deflator rises significantly; CPI rises little.
  - Both rise significantly.
  - Neither rises significantly.
13. In the simple Keynesian cross model with exogenous investment, the government requires households to deposit part of their income into restricted mutual-fund accounts for their children, and these funds are not used to finance any current domestic physical investment (they are held purely as financial assets for future use). What happens to current output?
- Current output rises because higher saving leads to higher investment.
  - Current output falls because consumption decreases and investment is exogenous.
  - Current output does not change because only government spending matters.
  - Current output rises because mutual-fund purchases count as investment in GDP.
14. U.S. inflation this year is 5%, and Taiwan’s inflation is 2%. Assume relative PPP holds, so the real exchange rate remains constant. What should happen to the nominal exchange rate? Let the exchange rate be quoted as NT dollars per U.S. dollar (NTD/USD).
- NTD/USD should rise by about 3%.
  - NTD/USD should fall by about 3%.
  - NTD/USD should not change.
  - The direction cannot be determined.

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15. Consider a small open economy with free capital mobility and a floating exchange rate. If the government increases its budget deficit (holding everything else constant), what is the most likely effect on the interest rate, net capital flows, and the real exchange rate?

- A. Domestic interest rate rises; capital inflow increases; domestic currency appreciates.
- B. Domestic interest rate rises; capital outflow increases; domestic currency depreciates.
- C. Domestic interest rate remains unchanged; capital inflow increases; domestic currency appreciates.
- D. Domestic interest rate remains unchanged; capital outflow increases; domestic currency depreciates.

16. Which of the following definitions is correct?

- A. Labor force = number of employed.
- B. Labor force = population - number of unemployed.
- C. Unemployment Rate = (number of unemployed ÷ adult population) × 100.
- D. Unemployment Rate = (number of unemployed ÷ [number of employed + number of unemployed]) × 100.

17. People will want to hold more money if the price level

- A. or the interest rate increases.
- B. or the interest rate decreases.
- C. increases or the interest rate decreases.
- D. decreases or the interest rate increases.

18. The Fisher equation states the long-run relationship between nominal interest rate, real interest rate, and the inflation rate. Suppose that the Fisher equation holds and that monetary policy is neutral in the sense that it has no impact on the real interest rate in the long run. Then given that the real interest rate is fixed over time, if the central bank increases the nominal interest rate target, how will the inflation rate respond in the long run?

- A. Increase
- B. Decrease
- C. Unchanged
- D. Uncertain

19. An increase in expected inflation shifts

- A. the long-run Phillips curve right.
- B. the short-run Phillips curve right.
- C. neither the short-run nor long-run Phillips curve right.
- D. both the short-run and long-run Phillips curve right.

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20. If the Fed conducts open-market operations and sells short-term government bonds, the money supply

- A. increases and aggregate demand shifts right.
- B. increases and aggregate demand shifts left.
- C. decreases and aggregate demand shifts right.
- D. decreases and aggregate demand shifts left.

## II. Problems and Short-essay Questions

1. Suppose that the inverse demand function is  $p = 10 - Q$  and the inverse supply function is  $p = 1 + 2Q$ .

- a. (8 points) Calculate the incidence of a specific tax of \$1 per unit falling on consumers.
- b. (8 points) What are the corresponding price elasticities of demand and supply in the pre-tax equilibrium?
- c. (4 points) Now suppose that the inverse demand function is given by  $p = 10 - bQ$  and the inverse supply function is  $p = 1 + dQ$ . Calculate the incidence of a specific tax of \$1 per unit falling on consumers as a function of  $b$  and  $d$ .

2. A monopolist firm has two identical factories, 1 and 2. Each factory has cost  $q_i^2$ , where  $q_i$  stands for factory  $i$ 's output,  $i = 1, 2$ . If a factory produces any positive output, the firm must pay a fixed tax of \$2 for that factory. Let total output be  $Q = q_1 + q_2$ .

- a. (10 points) What is the cost function of the firm?
- b. (10 points) Suppose the firm can identify two isolated markets,  $A$  and  $B$ , with demand functions

$$P_A = 5 - Q_A,$$

$$P_B = 5 - \frac{1}{2}Q_B.$$

Please calculate the equilibrium price and quantity in each market.

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3. Consider an open economy described by the following equations:

$$Y = C + I + G + NX$$

$$C = 180 + 0.65(Y - T)$$

$$I = 350 - 40r$$

$$G = 200$$

$$T = 150$$

$$NX = 120 - 0.1Y + 15q$$

where  $Y$  is GDP,  $C$  is consumption,  $I$  is investment,  $G$  is government purchases,  $T$  is taxes,  $r$  is the interest rate,  $NX$  is net exports, and  $q$  is the real exchange rate (an increase in  $q$  means a depreciation). Suppose the full-employment level of GDP is  $Y^* = 2000$ .

a. (10 points) Suppose the central bank keeps the interest rate fixed at  $r = 4$  and the real exchange rate is  $q = 1$ . Solve for equilibrium GDP. Is the economy above or below full employment? Please show your calculation.

b. (5 points) Assuming no change in monetary or exchange-rate policy, by how much would GDP have to change to restore full employment? Please show your calculation.

c. (5 points) Instead, suppose fiscal policy does not change. What change in the real exchange rate  $q$  would be required to restore full employment (interpret your result as appreciation or depreciation)? Please show your calculation.

4. Suppose that an economy has the Phillips curve

$$\pi_t = \pi_{t-1} - 0.5(u_t - 0.04)$$

where  $\pi_t$  is the inflation rate at time  $t$  and  $u_t$  is the unemployment rate at time  $t$ .

a. (3 points) What is the natural rate of unemployment? Briefly explain your answer.

b. (7 points) Graph the short-run and long-run relationships between inflation and unemployment implied by this Phillips curve. Clearly label: (i) the horizontal axis, (ii) the vertical axis, and (iii) the point at which the short-run Phillips curve intersects the long-run Phillips curve.

c. (5 points) Compute the sacrifice ratio in this economy. Clearly explain your calculations.

d. (5 points) Suppose the current inflation rate is 10 percent. The central bank aims to reduce inflation to 5 percent. How much cyclical unemployment is necessary to achieve this reduction in inflation? Clearly explain your calculations.

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考試科目	財務管理	系所別	金融學系	考試時間	2 月 6 日(五) 第三節
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**Part I: Short answer questions (40 points):**

1. Eugene Fama (1970) proposed the Efficient Market Hypothesis (EMH) and classified market efficiency into three forms based on the set of information reflected in security prices.

(a) (5 points) Please list three forms of market efficiency.

(b) (10 points) Suppose an investor exhaustively utilizes all publicly available information, incorporating both technical analysis (e.g., historical price and volume patterns) and fundamental analysis (e.g., financial statements and macroeconomic data). Assuming this investor has no access to any private information, under which form(s) of market efficiency can this investor potentially earn abnormal returns? Please justify your answer by evaluating all three forms.

2. According to the Pecking Order Theory, companies follow a specific order (hierarchy) when they need to raise money for new projects.

(a) (5 points) Please list the three main sources of financing in the specific order that a company would prefer to use them.

(b) (10 points) Explain the logic behind this order. In particular, why is the third (last) source of financing you listed in part (a) usually considered the least desirable choice for a company?

3. (10 points) How should a Board of Directors structure a CEO's compensation package to align their personal financial incentives with those of the shareholders and mitigate agency conflicts?

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**Part II: Calculation Questions. All calculation steps and processes must be shown to receive full credit . Please round your final answers to two decimal places (60 points)**

4. (10 points) You are evaluating two competing job offers from the investment banking firms Hachi and Usagi. Hachi offers you a salary of \$96,000 per year for the next two years, while Usagi offers a salary of \$78,000 per year for the next two years along with a \$25,000 signing bonus payable today. For both offers, the annual salary is paid in equal monthly installments at the end of each month, and the signing bonus is paid immediately. If the interest rate is 0.5 percent per month, which offer do you prefer based on the present value of the total compensation?

2. (15 points) Yoroi Co. has just arranged a \$3.6 million mortgage to finance the purchase of a commercial land tract. The mortgage has an annual percentage rate of 6.0 percent and calls for equal monthly payments based on a 30-year amortization schedule. However, the loan includes a ten-year balloon payment provision. A balloon payment is a large, final installment due at the end of a loan term that pays off the entire remaining principal balance that has not yet been amortized. In this case, Yoroi Co. will make regular monthly payments for 10 years, and at the end of the tenth year, the company must pay off the entire remaining balance in one lump sum. Calculate the size of this final balloon payment.

6. (15 points) Shisa Co. is considering a cost-saving project that is expected to generate an initial aftertax cash saving of \$2 million at the end of the first year, with these savings projected to grow at a constant rate of 2 percent per year indefinitely. The firm maintains a target debt-equity ratio of 1.5, and preferred stock accounts for 10 percent of its total capital structure. The cost of equity is 13 percent, the after-tax cost of debt is 5 percent, and the cost of preferred stock is 3 percent. Because management believes this project is riskier than the firm's typical operations, it applies a +2.32 percent subjective risk adjustment factor to the cost of capital for such investments. Calculate the maximum initial investment Shisa Co. should be willing to pay for this project such that it maintains a non-negative Net Present Value (NPV).

7. (20 points) Suppose you observe the following situation in a market where the Capital Asset Pricing Model (CAPM) holds: Rakko Corp. has a beta of 1.2 and an expected return of 10.2 percent, while Chii Co. has a beta of 0.8 and an expected return of 7.8 percent. Assume these securities are correctly priced and lie on the security market line, which implies that all assets must provide the same reward-to-risk ratio. Based on this information, what is the expected return on the market and what is the risk-free rate?

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- (20 points) Let the random variable  $N$  be the number of defaults in a bond portfolio for a given fiscal year. Assume that  $\mathbb{P}(N = n + 1) = 0.2 \cdot \mathbb{P}(N = n)$ .
  - (10 points) Find the probability of no default,  $\mathbb{P}(N = 0)$ .
  - (10 points) Find the probability of more than one default,  $\mathbb{P}(N > 1)$ .
- (20 points) There are 5 bonds in a portfolio. At the end of a specific time period, each bond will have a value of \$100 with probability 0.5 and  $\$(100 - K)$  with probability 0.5.  $K$  is the loss that a bond would suffer if there is a default. The bond payoffs and the default events are independent. Find the *maximum* value of  $K$  such that the probability of portfolio value dropping to below \$450 is less than 10%.
- (10 points) The two independent random variables  $x$  and  $y$  have Uniform(0, 1) distribution. Let  $z = \max(x, y)$ . Find the probability density function of  $z$ .
- (35 points) Suppose we specify a linear regression model,
 
$$y = \beta_0 + \beta_1 x + \beta_2 z + \varepsilon,$$
 and obtain the estimated parameters  $\hat{\beta}_0$ ,  $\hat{\beta}_1$ , and  $\hat{\beta}_2$  with ordinary least squares (OLS).
  - (10 points) Write down the relevant assumptions so that  $\hat{\beta}_1$ , and  $\hat{\beta}_2$  are *unbiased* estimators. No points will be given if any irrelevant assumptions are also provided.
  - (5 points) Explain why  $\hat{\beta}_0$  will also be biased if  $\hat{\beta}_1$  is biased.
  - (20 points) Explain the procedure to test the hypothesis  $H_0 : \beta_1 = 0$  and  $\beta_2 = 1$ . Please elaborate on how to compute the test statistic and what the critical value is.
- (15 points) Let  $H_0$  and  $H_a$  denote the usual null and alternative hypotheses, respectively.  $T$  is the test statistic under the null hypothesis. We reject  $H_0$  if the calculated test statistic  $\hat{T}$  is greater than the corresponding critical value  $t_c$ . Based on these notations, define
  - (5 points) Type I error,
  - (5 points) Type II error,
  - (5 points) and  $p$ -value.

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Please describe the notation and the definition in detail.

1. 【40%】 *Binomial Model*

There is an option with an initial stock price  $S_0$ , a strike price  $K$ , a risk-free rate  $r$ , and a maturity date  $T$ . Assume that option lasts for time  $T$  and that during the life of the option, the stock price can move up from  $S_0$  to  $uS_0$ , or down from  $S_0$  to  $dS_0$ , where  $u > (1+r) > d$  and  $ud = 1$ .

- 1.1. 【10%】 Derive the pricing formula of a standard European Call option under a two-period Binomial model for the previous information.
- 1.2. 【10%】 If  $(1+r)$  is not at the interval  $[u, d]$ , what do you think will happen in the market?
- 1.3. 【10%】 Please derive the pricing formula of a standard European Call option under a  $n$ -period Binomial model. (Hint: let  $m$  be the minimum non-negative integer and derive the value of with inequality equation.)
- 1.4. 【10%】 Please derive European call option pricing formula when  $n$  converge to infinity.

2. 【40%】 *Black-Scholes Pricing Formula*

Let  $X_t$  be a return and follow a normally distributed random variable with mean  $\left(r - \frac{1}{2}\sigma^2\right)t$  and variance  $\sigma^2t$  under  $Q$  measure, i.e.  $X_t \sim N\left(\left(r - \frac{1}{2}\sigma^2\right)t, \sigma^2t\right)$ . If  $S_t = S_0 e^{X_t}$  where  $S_t$  denotes the stock price at time  $t$ , then the stock price  $S_t$  is said to be lognormally distributed random variable.

- (1). 【10%】 Please find the price of the futures at time 0 under  $Q$  measure. (i.e., what is  $E(S_t)$  )
- (2). 【10%】 Please derive the price of the call option under  $Q$  measure,  $E\left(e^{-rt} (S_t - K) 1_{\{S_t > K\}}\right)$ , where  $1_{\{S_t > K\}}$  denotes the indicator function. (i.e., the expectation of the profit  $(S_t - K)$  when the stock price exceeds  $K$  at time  $t$ ).
- (3). 【10%】 Please derive the delta of the call option and explain what is the mean of the delta.
- (4). 【10%】 If the answer of the problem (2) is the pricing formula of the call option with the underlying stock, please find five parameters for the pricing formula, which parameter have to estimate, and how to estimate the parameter.

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3. 【20%】 *Problem: Fintech and Machine Learning*

3.1 【10%】 You think what is Fintech.

3.2 【10%】 What kinds of problems do you think machine learning is designed to solve?



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