考試科目	經濟學	系所別	商學院共同科	考試時間	2 月 2 日(五)第一節

一、Multiple Choice (1 point each)

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

1. Beef is a normal good. You observe that both the equilibrium price and quantity of beef have fallen over time. Which of the following explanations would be most consistent with this observation?

A. Consumers have experienced an increase in income, and beef-production technology has improved.

B. The price of chicken has risen, and the price of steak sauce has fallen.

C. New medical evidence has been released that indicates a negative correlation between a person's beef consumption and life expectancy.

D. Beef producers, concerned about the health of their customers, decided to produce relatively less beef.

2. Suppose a tax of $4 per unit is imposed on a good, and the tax causes the equilibrium quantity of the good to decrease from 2,000 units to 1,700 units. The tax decreases consumer surplus by $3,000 and decreases producer surplus by $4,400. The deadweight loss of the tax is

A. $ 200.

B. $ 400.

C. $ 600.

D. $ 1,200.

3. When a tax is levied on sellers of tea, buyers of a good bear the larger share of the tax burden when the

(i) supply is more elastic than the demand for the product.

(ii) demand in more elastic than the supply for the product.

(iii) tax is placed on the sellers of the product.

(iv) tax is placed on the buyers of the product.

A. (i) only

B. (ii) only

C. (i) and (iii) only

D. (i) and (iv) only

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

考試科目	經濟學	系所別	商學院共同科	考試時間	2月2日(五)第一節

4. The substitution effect of an increase in the interest rate will result in an increase in
   A. consumption when young and increase in savings when young.
   B. consumption when old and an increase in savings when young.
   C. consumption when young and an increase in savings when old.
   D. savings when old and an increase in consumption when old.

5. Assume that goods X and Y are not Giffen goods. If the price of good X falls, a consumer will definitely
   A. consume more of good X because her budget constraint has rotated outward.
   B. consume more of good X because her budget constraint has shifted outward.
   C. consume more of good Y because her budget constraint has rotated outward.
   D. consume more of good Y because her budget constraint has shifted outward.

6. Thirsty Thelma owns and operates a small lemonade stand. When Thelma is producing a small quantity of lemonade she has few workers and her equipment is not being fully utilized. Because she can easily put her idle resources to use,
   A. the marginal cost of an extra worker is large.
   B. the marginal product of an extra worker is small.
   C. The marginal cost of one more glass of lemonade is small.
   D. Her lemonade stand is likely to be crowded with workers.

7. When total revenue is less than total variable cost, a firm in a competitive market will
   A. shut down.
   B. continue to operate as long as average revenue exceeds marginal cost.
   C. continue to operate as long as average revenue exceeds average fixed costs.
   D. always exit the industry.

8. In a competitive market, a firm's supply curve dictates the amount it will supply. In a monopoly market
   A. the same is true.
   B. the decision about how much to supply is impossible to separate from the demand curve it faces.

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

考試科目	經濟學	系所別	商學院共同科	考試時間	2 月 2 日(五)第一節

C. the supply curve conceptually makes sense, but in practice is never used.

D. the supply curve will have limited predictive capacity.

9. Equilibrium quantity in markets characterized by oligopoly are

A. lower than in monopoly markets and higher than in perfectly competitive markets.

B. lower than in monopoly markets and lower than in perfectly competitive markets.

C. higher than in monopoly markets and higher than in perfectly competitive markets.

D. higher than in monopoly markets and lower than in perfectly competitive markets.

10. In the long run, a profit-maximizing firm in a monopolistically competitive market operates at

A. efficient scale.

B. the point where demand equals marginal cost.

C. the point where revenue is also maximized.

D. some point along the downward sloping portion of its average total cost curve.

11. Which of the following statements is correct if a country has adopted fixed exchange rate regime?

A. If the currency is overvalued with respect to the fixed parity, the central bank has to intervene e.g. by increasing the interest rate.

B. The central bank has to offset the effects of capital outflow on the exchange rate e.g. by buying domestic currency and paying with foreign reserves.

C. If, in order to reduce excess supply of the domestic currency, the central bank buys domestic currency at the target exchange rate, this will necessarily cause inflation in the home country.

D. Measures taken by the central bank to keep the exchange rate fixed will not affect the domestic interest rate.

12. Take a graph with the unemployment rate on the horizontal axis and the inflation rate on the vertical axis. Which of the following will shift the Phillips curve towards the northeast?

A. A positive aggregate demand shock

B. Contractionary monetary policy

C. A negative aggregate supply shock

D. A decrease in expected inflation

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

考試科目	經濟學	系所別	商學院共同科	考試時間	2月2日(五)第一節

13. Which of the following statements is necessarily false:

A. Monetary policy can be conducted through open market operations, setting the minimum reserve requirement and through changing the refinancing rate at which banks can borrow money from the central bank.

B. In the short run, an increase in money supply causes a proportional increase in prices. Over time the latter decrease again.

C. Unemployment benefits are automatic stabilizers.

D. The positive effect of expansionary fiscal policy on production is reduced by crowding out.

14. According to the theory of sticky wages:

A. prices adjust slowly to a decrease in nominal wages. Firms face lower wages and since prices stay high they increase the level of production and thus employment. This results in higher aggregate supply.

B. wages adjust slowly to a decrease in prices. Firms face lower prices and since the costs of production stay high they have to decrease production and thus employment. This decreases aggregate supply.

C. not all firms immediately adjust their prices in reaction to a decrease in the price level. These firms face higher prices and thus they increase production, which increases aggregate supply.

D. prices react more than proportionally to increases in nominal wages. Producers face higher wages, but since prices increase more than wages they want to increase production. This results in higher aggregate supply.

15. According to the AS-AD model an increase of public investment

A. might decrease GDP in the short run because of crowding out.

B. decreases prices in the short run which stimulates an economic recovery.

C. does not change long run aggregate supply.

D. increases aggregate supply which is depicted as a shift of the AS curve to the right.

16. Which of the following is the most important variable for judging an economy's long-run performance?

A. growth in nominal GDP

B. growth in real GDP

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C. growth in real GDP per capita

D. growth in potential GDP

17. Assume that the currency-deposit ratio is 32%, the required reserve-deposit ratio is 7%, the excess reserve-deposit ratio is 1%, and total money supply is $1,320 billion. What is the amount of high-powered money?

A. $132 billion

B. $165 billion

C. $330 billion

D. $400 billion

18. When the central bank intervenes in the foreign exchange market by purchasing foreign currency, it also routinely engages in open market sales of government securities. Why?

A. it has to sell securities to acquire the necessary funds

B. to avoid a recession that may be caused by the reduction in money supply resulting from the purchase of foreign currency

C. to prevent its intervention in the foreign exchange market from having a direct effect upon the domestic money supply

D. it wants to isolate the domestic economy from foreign competition

19. According to the Baumol-Tobin transaction demand model, money demand for transactions

A. depends only on the level of income

B. depends only on the cost of illiquidity

C. varies inversely with both the interest rate and the level of income

D. increases as the interest rate decreases or income increases

20. Which are the three channels by which the Central Bank can reduce money supply?

A. buy government securities, lower reserve requirements, and lower the discount rate

B. buy government securities, raise reserve requirements, and raise the discount rate

C. buy government securities, lower reserve requirements, and raise the discount rate

D. sell government securities, raise reserve requirements, and raise the discount rate

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

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二、Problems and Short-essay Questions

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

1. Suppose there is a railway that runs coal-burning steam locomotives through a farming area and caused fires in the crop fields at harvest time. The crop damage from each train run is \$200. To run trains, the railway company incurs a private marginal cost of $\$100n$, where n denotes the number of train runs. For simplicity, assume there are no fixed costs. The revenue from a train run is \$400.

A. (4 points) What is the socially optimal number of train runs?

B. (4 points) How many trains would the railway company run if no compensation is required for crop damage and the transaction cost is high enough to prevent the parties from bargaining? How much profit does the company make?

C. (6 points) How many trains would the railway company run if no compensation is required for crop damage but the negotiations between the company and the farmers are free of any transaction costs? How much profit does the company make?

D. (6 points) Now assume the railway company is legally liable for the damage caused. That is, it is required to pay the farmer \$200 for each train run. How many trains would the company run? How much profit does it make?

2. There are two large countries H and F. Each country can choose its trade policy between free trade and protection. If both countries choose free trade, the welfare is (welfare of H, welfare of F)=$(20, 20)$. If H chooses free trade but F chooses protection, according to the optimal tariff theory, F can obtain more gains from trade at the expense of H, so that (welfare of H, welfare of F)=$(-20, 30)$. On the contrary if H chooses protection while F chooses free trade, the welfare is (welfare of H, welfare of F)=$(30, -20)$. However, if both countries choose protection, the welfare level moves down toward that near autarky. Therefore, (welfare of H, welfare of F)=$(-10, -10)$. Answer the following questions.

A. (10 points) If two countries choose trade policy simultaneously, what is the possible policy combination they will choose?

B. (10 points) What is the value of a bilateral trade agreement?

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

考試科目	經濟學	系所別	商學院英同科	考試時間	2 月 2 日(五) 第 一 節

3. Consider an economy with the following aggregate demand and aggregate supply functions:

$$\begin{cases} \text{Aggregate Demand function:} & Y = 100 + 0.5 \times \frac{M}{P}, \\ \text{Aggregate Supply function:} & Y = \bar{Y} + 25 \times (P - P^e), \end{cases}$$

where Y represents the output, $\bar{Y}$ is the potential output, P is the price level, P^e is the expected price level, M is the nominal money supply. Furthermore, assume that $M = 400$ and $\bar{Y} = 200$.

A. (6 points) Compute the equilibrium price and the equilibrium output, given that the expected price level is exactly equal to the actual price level.

B. (7 points) Suppose that the central bank dramatically increases the nominal money supply to 750 while the general public maintains exactly the same expected price level, what would be the new equilibrium price and the new equilibrium output?

C. (7 points) Compute the equilibrium price and the equilibrium output if the aforementioned expansionary monetary policy of the central bank is fully anticipated by the public.

4. Consider the following structural macroeconomic model:

- Production function: $Y = F(N, K)$; $F_N > 0$, $F_K > 0$.
- Labor demand: $\frac{W}{P} = F_N(N, K)$; $F_{NN} < 0$, $F_{KK} < 0$.
- Consumption: $C = C(Y - T, r)$; $1 > C_y > 0$, $C_r < 0$.
- Investment: $I = I(r, y)$; $I_y > 0$, $I_r < 0$.
- Goods market equilibrium: $Y = C + I + G$.
- Money market equilibrium: $\frac{M}{P} = m(r, y)$; $m_r < 0, m_y > 0$.

The terms Y(nominal GDP), y(real GDP), N(employment level), P(price level), C(consumption), r(interest rate), I(investment) are endogenous variables while K(capital stock), W(nominal wage), T(tax), G(government purchase), M(money supply) are exogenous variables.

A. (6 points) Is there an equilibrium in this model? If so, is it unique?

B. (7 points) Is there a stable equilibrium? If instability is possible, what is the sufficient condition for instability? (7%)

C. (7 points) What are the effects of an increase in government spending on y, r and P? What are the effects of an increase in money supply on y, r and P? (7%)

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

考試科目	財務管理	系所別	財務管理研究所	考試時間	2月2日(五) 第二節

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

1. The dividend yield based on year-ahead aggregate forecasted dividends is 2.1%, and the consensus on long-term earnings growth rate is 4%. Currently the 20-year U.S. government bond yield is 3%. The equity risk premium of this market is closest to
   A. 3.1%
   B. 5.1%
   C. 6.1%
   D. 7.0%

2. Assume that both X and Y are risky assets and the risk-free rate is 2%. X has a return of 14% and a beta of 1.5. Y has a return of 9.5% and a beta of 0.75. If X is on the security market line, then Y
   A. is also on the security market line.
   B. is underpriced.
   C. is overpriced.
   D. is uncertain because we don't have enough information.

3. Below is the income statement of the network company you are analyzing. Which of the following provides the strongest evidence that this company shows economies of scale?

	2010	2011	2012
Net sales	56.7	60.6	64.1
Cost of sales	22.3	22.5	22.7
Gross profit	34.4	38.1	41.4
Selling, general, and administrative expenses	21.6	24.7	27.4
Operating income	12.8	13.4	14.0
Interest expense	0.6	0.7	0.6
Income before provision for income tax	12.2	12.7	13.4
Provision for income taxes	2.8	3.0	3.2
Net income	9.4	9.7	10.2

   A. Increasing net sales
   B. Profit margins increases as net sales increase
   C. Gross profit margins that are increasing with net sales
   D. Interest expense goes up in a slower pace than net sales

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

考試科目	財務管理	系所別	財務管理研究所	考試時間	2月2日(五) 第二節

4. Five years ago, Corsola Inc. invested $38 million - $30 million in fixed capital and another $8 million in working capital. Corsola Inc. decides to sell the fixed assets for $5 million today and liquidate the investment in working capital as well. The fixed capital falls in the 5-year MACRS depreciation class, and the depreciation rates are as following:

Year	Depreciation Rate
1	20.00%
2	32.00%
3	19.20%
4	11.52%
5	11.52%
6	5.76%

The marginal tax rate for the company is 40%. The fifth year's after-tax non-operating cash flow from these activities is *closest to* (note: the numbers are all rounded to millions):

A. $5 million
B. $8 million
C. $12 million
D. $13 million

5. Which of the following regarding fixed-income valuation is correct?
I. A bond price moves inversely with its yield-to-maturity.
II. The price of a lower-coupon bond is more volatile than the price of a higher-coupon bond, other things being equal.
III. A floating-rate note maintains a more volatile price than a fixed-rate note because its coupon rate varies.
IV. A more convex bond depreciates less when yields rise.

A. I and II only
B. II and III only
C. I, II and IV only
D. All of the above

6. Assume the probability of the underlying asset going bankruptcy is very high. Compared to the price of an American put option on the same underlying asset, the price of an equivalent European put option will most likely be:

A. lower.
B. higher.
C. the same because the probability of bankruptcy does not affect pricing.
D. uncertain.

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

考試科目	財務管理	系所別	財務管理研究所	考試時間	2月2日(五) 第二節

7. We have two assets with betas of 1.5 and 1.2 from the market model. The residual standard deviation from the market model is 2 for the first asset and 8 for the second. The market standard deviation is 6.
I. The correlation between these two assets is 0.65.
II. The fist asset has a higher systematic risk
III. The second asset has a higher total risk
IV. The correlation is too high to have any portfolio with these two assets that can have a lower total risk than both assets.
   A. Only II and III are correct.
   B. Only I, II, and III are correct.
   C. Only I and IV are correct.
   D. All of them are correct.

8. Assume a firm has positive net earnings. The operating cash flow of this firm:
   A. ignores both depreciation and taxes.
   B. is unaffected by the depreciation expense.
   C. increases when tax rates decrease.
   D. is equal to net income minus depreciation.

9. According to efficient market hypothesis, which of the following statements are correct?
I. Professional investors will earn no profits in the long-run.
II. We can find a resistance level and a support level for each stock in equilibrium
III. Fundamental analysis is often doomed to fail if we only use already filed financial reports to make stock forecast.
IV. A passive investment strategy often prevails because most actively managed funds cannot beat the market.
   A. I and III
   B. II and IV
   C. III and IV
   D. I and IV

10. Which one of the following will increase the value of a firm's net working capital?
   A. using cash to pay a supplier
   B. collecting an accounts receivable
   C. purchasing inventory on credit
   D. selling inventory at a profit

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

考試科目	財務管理	系所別	財務管理研究所	考試時間	2月2日(五) 第二節

Part II. Short Essay Questions (60 pts, 15 pts each):

1. Apple (AAPL) issued $17 billion corporate bonds in 2013 as part of the effort to finance its $100 billion payout to shareholders, which includes shares buyback and cash dividends. At the same time, Apple also had $145 billion cash on hand.
   A. (6 pts) The reason of the $100 billion payout program was to boost Apple's share price. Please explain why giving away money to shareholders can boost the stock prices.
   B. (6 pts) While this bond issuance and its usage are lauded by investors, this practice is at odds with one or some of the capital structure theories. Please name the theory and explain what Apple was supposed to do according to that theory.
   C. (3 pts) Can you explain the rationale that Apple chose to violate the theory you stated in B?

2. You are an assistant stock analyst and you want to determine whether you should give NVIDIA (NASDAQ: NVDA) a buy/hold/sell recommendation right now. NVIDIA is a technology company that designs graphics processing units (GPU) for gaming, artificial intelligence computing and cryptocurrency markets. Below is some of its current information pulled from NASDAQ website:

Data as of January 9th, 2018 (TTM means trailing twelve months)

Price Close	$221.94	P/E Ratio	55.07
52 Week High/Low	$225/$95.17	Earnings Per Share (TTM)	$4.03
Market Cap	134,495,640,000	Annualized Dividend (TTM)	$0.60
Average Volume	13,559,535	Ex Dividend Date	11/22/2017
Beta	2.4	Dividend Payment Date	12/15/2017
		Current Yield	0.28%

Analysts following this company are expecting it to grow earnings at an average annual rate of 10.25% over the next 5 years. The earnings growth next year is expected to be 11.41%. The current long-term Treasury Bond rate is 2.87%, and the market premium is 5.5%. Please also see the EPS forecasts below.

Fiscal Year End	Consensus EPS Forecast	High EPS Forecast	Low EPS Forecast
Jan 2018	4.19	4.30	4.14
Jan 2019	4.67	5.01	4.29
Jan 2020	5.72	6.46	5.01

Of course these information is enough. If there is anything you can reasonably access, you can include it in your analysis and state clearly how you are going to use it. Make assumptions if you need, but do so with good reasons. There is no "correct" answer to this question, only the thought process matters.

Please tell me what your recommendation is.

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

考試科目	財務管理	系所別	財務管理研究所	考試時間	2月2日(五) 第二節

3. Roselia Inc. is considering a two-year project to improve its production efficiency. Buying a new machine for $300,000 will result in $100,000 in annual pretax cost savings. The machine applies a straight-line depreciation in five years, and Roselia Inc. will be able to resell it for $200,000 in the end of the project. The machine also requires an extra initial investment in net working capital of $30,000 and it remains the same amount over the life of the project. This extra net working capital can be liquidated after the two-year project is done. The marginal tax rate is 40% and the discount rate is 10%.
   A. (7 pts) Do you think this company should pursue this project?
   B. (8 pts) If the firm's marginal tax rate drops from 40% to 30% because of the new tax reform. Would Roselia Inc. change its mind about the project? In which areas can Roselia save/make more money by the tax break?

4. Ledian, a manufacturer of consumer cleaning products, is evaluating its capital structure. The current balance sheet of the company is (in millions):

Assets		**Liabilities**	
Current assets	$1,000	Debt	$2,000
Fixed assets	$3,000	Equity	$2,000

The debt is in the form of 3% coupon rate long-term bonds currently rated AA and the YTM is 6%, the market value is 80% of the face value.
Ledian has 50 million shares outstanding and its shares sell at $60. The stock has a beta of 1.2 and the market risk premium is 5.5%.
The risk-free rate at this moment is 3%. The marginal tax rate for the firm is 40%.

They are pondering two possible approaches to change the capital structure:
Option I. Issue $800 million new stocks and repurchase half of its outstanding debt. This makes it an AAA-rated firm that would have 5% YTM.

Option II. Issue $800 million in new debt and buy back shares. The rating would drop to A- and have 7% YTM afterwards.

Note: Since the full terms of the corporate bonds are not given, please consider the price of bonds unchanged when calculating D/E and their relative weights.

   A. (5 pts) What is the cost of equity under each option?
   B. (5 pts) What is the after-tax cost of debt under each option?
   C. (5 pts) Which option will you choose and why?

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

考試科目	統計學	系所別	財管	考試時間	2月2日(五)第三節

Single choice questions (4 points each, 100 points in total) 選擇題請在答案卡上作答，否則不予計分。

1. Which of the following variables is interval-scaled?
   (a) Jersey numbers of soccer players
   (b) Phone numbers
   (c) Temperature
   (d) None of the above

2. Below are summary statistics of the commissions earned (in thousand) by a sample of 15 salespersons at Super Company.

min	Q1	Q2	mean	Q3	max
20	24	31	34	41	55

   Which of the following is *not* a statistic?
   (a) mean = 34
   (b) median = 31
   (c) (max+min)/2 = 37.5
   (d) None of the above.

3. Consider the experiment of rolling a fair die. The possible outcomes are $\{1,2,3,4,5,6\}$. Consider the events $A = \{1,3,5\}$, $B = \{4,6\}$, $C = \{1,2\}$. Which of the following statements is correct?
   (a) Events A and C are mutually exclusive.
   (b) Events A and B are collectively exhaustive.
   (c) Events A and C are dependent.
   (d) None of the above.

4. The manager of a toy store found that 70% of its customers shopped online and 30% shopped in physical stores. The manager also found that 60% of the online shoppers are female, and that 80% of the shoppers in physical stores are female. What is the probability that a randomly selected customer is a female who shops online?
   (a) 6/25
   (b) 7/11
   (c) 3/5
   (d) None of the above.

5. The Business Bureau conducts a survey of the quality of service offered by a sample of 155 hedge fund managers in Emerald City. The results on Service and Gender are summarized in the following table.

	Service		
Gender	Fair	Good	Excellent
female	19	21	25
male	32	28	30

   Use a χ^2 statistic to test whether Service and Gender are independent. At $\alpha = 0.05$, the critical value and test statistic are
   (a) critical value = $\chi^2_{2,0.05}$; test statistic is 0.76
   (b) critical value = $\chi^2_{2,0.025}$; test statistic is 0.76
   (c) critical value = $\chi^2_{2,0.05}$; test statistic is 1.25
   (d) critical value = $\chi^2_{2,0.025}$; test statistic is 1.25

6. A random variable X is said to follow Lognormal(μ,σ^2) if $\log_e(X)$ follows $N(\mu,\sigma^2)$ distribution. The probability density function of Lognormal(μ,σ^2) is
   (a) $\frac{x}{\sqrt{2\pi}\sigma}\exp(-\frac{(x-\mu)^2}{2\sigma^2})$
   (b) $\frac{1}{\sqrt{2\pi}\sigma x}\exp(-\frac{(x-\mu)^2}{2\sigma^2})$
   (c) $\frac{x}{\sqrt{2\pi}\sigma}\exp(-\frac{(\log_e(x)-\mu)^2}{2\sigma^2})$
   (d) $\frac{1}{\sqrt{2\pi}\sigma x}\exp(-\frac{(\log_e(x)-\mu)^2}{2\sigma^2})$
   (e) None of the above.

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

考試科目	統計學	系所別	財管	考試時間	2月2日(五)第三節

7. Let the joint probability density function of (X, Y) be $f(x, y) = ce^{-y/2}$, $0 < x < y < \infty$. What is the value of c?
   (a) 2
   (b) 1
   (c) 1/2
   (d) 1/4
   (e) None of the above.
8. (cont'd) Obtain $f(x|y)$, the conditional probability density of X given Y.
   (a) $\frac{1}{2}e^{-x/2}$, $x > 0$.
   (b) $\frac{1}{2}e^{-(y-x)/2}$, $0 < x < y < \infty$.
   (c) $\frac{1}{y}$, $0 < x < y < \infty$.
   (d) None of the above.
9. Super Mobile wishes to set a minimum life guarantee on its new adapter. Quality testing on 10,000 randomly selected items shows that 50 are not working at all, and the time to failure for the remaining items follows an exponential distribution with a mean of 5,000 hours. Super Mobile wants to set a warranty period such that only 5% of the adapter fail during that period. The warranty period should be set as
   (a) $-5000 * \log_e(0.055)$
   (b) $-5000 * \log_e(0.045)$
   (c) $-5000 * \log_e(0.945)$
   (d) $-5000 * \log_e(0.955)$
   (e) None of the above.
10. The manager of a shoe store designed an incentive plan for salespeople. To test whether the incentive plan helps to increase the salesperson's mean weekly income, 20 salespeople were randomly selected and their weekly incomes before and after the plan were recorded. Let $X_1, ..., X_{20}$ be the incomes before the plan and $Y_1, ..., Y_{20}$ be the incomes after the plan. Let $D_i = X_i - Y_i$ for $i = 1, ..., 20$. What assumptions are needed to conduct a paired t-test?
    (a) X_i's are i.i.d. $N(\mu_x, \sigma_x^2)$ and Y_i's are i.i.d. $N(\mu_y, \sigma_y^2)$.
    (b) X_i's are i.i.d. $N(\mu_x, \sigma^2)$ and Y_i's are i.i.d. $N(\mu_y, \sigma^2)$.
    (c) D_i's are i.i.d. $N(\mu_d, \sigma_d^2)$.
    (d) None of the above.
11. The owner of Super Call Center wants to investigate whether the mean waiting times (in seconds) at stores A, B and C are the same. Suppose that the waiting times at A, B and C are independent and follow $N(\mu_a, \sigma^2)$, $N(\mu_b, \sigma^2)$, and $N(\mu_c, \sigma^2)$. The results of a random sample of 12 customers are below. What are the test statistic and critical value at level α?

A	10	9	14	11
B	11	21	12	16
C	12	16	11	13

    (a) test statistic is F; critical value is $F_{\frac{\alpha}{2},2,9}$.
    (b) test statistic is F; critical value is $F_{\alpha,2,9}$.
    (c) test statistic is χ^2; critical value is $\chi^2_{\frac{\alpha}{2},6}$.
    (d) test statistic is χ^2; critical value is $\chi^2_{\alpha,6}$.
12. (cont'd) The observed test statistic is
    (a) 1.6
    (b) 1.78
    (c) 2.5
    (d) 3.68
    (e) None of the above.

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

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13. (cont'd) The estimate of σ^2 is
    (a) 10
    (b) 3.16
    (c) 2.5
    (d) 0.35
    (e) None of the above.

14. Super Software purchases DVDs from DVD Global. They have agreed that the acceptable quality level is 1% defectives and the unacceptable level is 4%. They have also decided to sample 100 DVDs at random from each large batch and to reject the batch if more than 2 defectives are found. Let π be the true defective rate and X be the number of defective DVDs found in the 100 DVDs.
    (a) The producer's risk is $P(X \geq 2|\pi = 0.01)$.
    (b) The consumer's risk is $P(X \geq 2|\pi = 0.01)$.
    (c) The producer's risk is Type II Error.
    (d) None of the above.

15. The Department of Labor reports that the median monthly salary of new college graduates is 25,000 NTD. A group of recent graduates believe this amount is too low. To conduct a statistical test, they take a random sample of 200 new college graduates and find that 112 began with a monthly salary of more than 25,000 NTD, four with exactly 25,000 NTD. Which of the following statements is correct?
    (a) H_0 : median $= 25,000$ vs H_1 : median $< 25,000$
    (b) The observed test statistic is $z = \frac{112-98+0.5}{0.5*\sqrt{196}}$.
    (c) The observed test statistic is $z = \frac{112-100-0.5}{0.5*\sqrt{200}}$.
    (d) None of the above.

16. The manager of a large coffee shop chain studied the relation between sales (y) and the following variables: x_1 = population of the region, x_2 = advertising expense, x_3 = number of competitors in the region, x_4 = average income of the region. Consider the regression model: $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + e$, where $e \sim N(0, \sigma^2)$. Part of the regression output based on a random sample of 25 stores is given below. The manager also found that the sum of squares due to regression is 124, and the sum of squares due to residuals is 40. What is the regression equation?

	Coef	SE Coef	t
Intercept		7.15	9.80
x_1		0.02	6.50
x_2		0.58	2.50
x_3	-0.12	0.07	
x_4	1.84	0.60	

    (a) $\hat{y} = 70.07 + 0.13x_1 + 1.45x_2 - 1.71x_3 + 3.06x_4$
    (b) $\hat{y} = 70.07 + 0.13x_1 + 1.45x_2 - 0.12x_3 + 1.84x_4$
    (c) $\hat{y} = 9.80 + 6.50x_1 + 2.50x_2 - 1.71x_3 + 3.06x_4$
    (d) $\hat{y} = 7.15 + 0.02x_1 + 0.58x_2 + 0.07x_3 + 0.60x_4$
    (e) None of the above.

17. (cont'd) We want to test whether β_1 is greater than zero. At $\alpha = 0.01$, what is the critical value of this test?
    (a) $t_{0.01,20}$
    (b) $t_{0.01,24}$
    (c) $t_{0.005,20}$
    (d) $t_{0.005,24}$
    (e) None of the above.

18. (cont'd) Consider $H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ vs H_1 : not all β_i's are zero. The p-value and observed test statistic are
    (a) p-value$=P(F_{5,20} > F_{obs})$ with F_{obs}=12.4
    (b) p-value$=P(F_{4,20} > F_{obs})$ with F_{obs}=15.5
    (c) p-value$=2P(F_{5,20} > F_{obs})$ with F_{obs}=12.4
    (d) p-value$=2P(F_{4,20} > F_{obs})$ with F_{obs}=15.5
    (e) None of the above.

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

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19. (cont'd) What is the proportion of variation in sales that can be explained by the four explanatory variables ?
    (a) 0.34
    (b) 0.65
    (c) 0.86
    (d) None of the above.

20. A smartphone manufacturer would like to study the relation between sales (y) and seasons (Q1, Q2, Q3, and Q4), where Qi represents the ith quarter. Which of the following model specifications is appropriate?
    (a) $y = \beta_0 + \beta_1 x + e$, where $x = 1, 2, 3, 4$ for Q1, Q2, Q3, and Q4, respectively
    (b) $y = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + e$, where (1) $x_1 = 1$ for Q1, and 0 otherwise, (2) $x_2 = 1$ for Q2, and 0 otherwise, (3) $x_3 = 1$ for Q3, and 0 otherwise.
    (c) $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + e$, where (1) $x_1 = 1$ for Q2, and 0 otherwise, (2) $x_2 = 1$ for Q3, and 0 otherwise, (3) $x_3 = 1$ for Q4, and 0 otherwise.
    (d) $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + e$, where (1) $x_1 = 1$ for Q1, and 0 otherwise, (2) $x_2 = 1$ for Q2, and 0 otherwise, (3) $x_3 = 1$ for Q3, and 0 otherwise, (4) $x_4 = 1$ for Q4, and 0 otherwise.

21. The manager of an Internet company wants to conduct A/B testing to increase the amount of time users spend on their website. The team created a modified version of the original page. Then, the original webpage and the modified one (called A and B, respectively) are shown to similar users. The manager would like to test whether the modified version keeps users on the website longer. The following table shows the amount of time (in seconds) a random sample of 24 users spend on their website. Are these two samples independent or paired?

A (original)	320	290	421	510	210	402	625	560	360	431	506	505
B (modified)	340	285	475	510	210	500	631	560	365	431	525	619

    (a) independent
    (b) paired

22. (cont'd) Assume that the two populations are normally distributed. The sample standard deviations for these two samples are $s_a = 120$ and $s_b = 131$, respectively. Suppose that we are to test whether there is a significant difference in the variances of the two populations; that is, $H_0 : \sigma_a = \sigma_b$ vs $H_1 : \sigma_a \neq \sigma_b$. The observed test statistic is $F_{\text{obs}} = s_b^2/s_a^2 = 1.19$. At $\alpha = 0.05$, which of the following statements is correct?
    (a) Reject H_0 if $\{F_{\text{obs}} > F_{0.975,11,11}\}$.
    (b) Reject H_0 if $\{F_{\text{obs}} < F_{0.025,11,11}\}$.
    (c) Reject H_0 if $\{F_{\text{obs}} > F_{0.95,11,11}\}$.
    (d) Reject H_0 if $\{F_{\text{obs}} > F_{0.975,2,22}\}$.
    (e) Reject H_0 if $\{F_{\text{obs}} < F_{0.025,2,22}\}$.

23. (cont'd) Now we construct an one-way ANOVA table for this data. What is the computed F value?
    (a) 0.25
    (b) 0.58
    (c) 0.95
    (d) 1.65

24. (cont'd) For this one-way ANOVA table, what hypothesis testing is this F value for?
    (a) $H_0 : \sigma_a = \sigma_b$ vs $H_1 : \sigma_a \neq \sigma_b$
    (b) $H_0 : \sigma_a \leq \sigma_b$ vs $H_1 : \sigma_a > \sigma_b$
    (c) $H_0 : \mu_a = \mu_b$ vs $H_1 : \mu_a \neq \mu_b$
    (d) $H_0 : \mu_a \leq \mu_b$ vs $H_1 : \mu_a > \mu_b$

25. The table below shows the actual sales ($ million) in 2017 and the Seasonal Index of the sales based on the past 5 years for DVD Global. Which of the following statements is correct?

Quarter	Q1	Q2	Q3	Q4
2017 sales	5.9	7.2	10.3	8.5
Seasonal Index	0.70	0.98	1.41	0.91

    (a) The deseasonalized sales for Q1 of 2017 is 5.9+0.7 (=6.6).
    (b) The deseasonalized sales for Q1 of 2017 is 5.9-0.7 (=5.2).
    (c) The deseasonalized sales for Q1 of 2017 is 5.9*0.7 (=4.13).
    (d) The deseasonalized sales for Q1 of 2017 is 5.9/0.7 ($\approx$ 8.43).

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。