

政經院

考試科目	經濟學	所別	4111-4182-4121-4122 4171-4191-4194-4211	考試時間	2月22日(六)第一節
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Multiple Choice (1 point each)

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

- Which of the following is an advantage of tradable pollution permits?
 - Each firm is allowed to pollute exactly the same amount.
 - Revenue from the sale of permits is greater than revenue from a corrective tax.
 - The initial allocation of permits to firms does not affect the efficiency of the market.
 - Firms will engage in joint research efforts to reduce pollution.
- Alicia is a vegetarian, so she does not eat beef. That is, beef provides no additional utility to Alicia. She loves potatoes, however. If we illustrate Alicia's indifference curves by drawing beef on the horizontal axis and potatoes on the vertical axis, her indifference curves will
 - slope downward.
 - be vertical straight lines.
 - slope upward.
 - be horizontal straight lines.
- Which of the following demonstrates the law of demand?
 - After Jon got a raise at work, he bought more pretzels at \$1.50 per pretzel than he did before his raise.
 - Melissa buys fewer muffins at \$0.75 per muffin than at \$1 per muffin, other things equal.
 - Dave buys more donuts at \$0.25 per donut than at \$0.50 per donut, other things equal.
 - Kendra buys fewer Snickers at \$0.60 per Snickers after the price of Milky Ways falls to \$0.50 per Milky Way.
- Suppose researchers at the University of Wisconsin discover a new vitamin that increases the milk production of dairy cows. If the demand for milk is relatively inelastic, the discovery will
 - raise both price and total revenues.
 - lower both price and total revenues.
 - raise price and lower total revenues.
 - lower price and raise total revenues.

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註 試題隨卷繳交

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<p>5. When a tax is levied on buyers of tea,</p> <p>A. buyers of tea and sellers of tea both are made worse off.</p> <p>B. buyers of tea are made worse off, and the well-being of sellers is unaffected.</p> <p>C. buyers of tea are made worse off, and sellers of tea are made better off.</p> <p>D. the well-being of both buyers of tea and sellers of tea is unaffected.</p> <p>6. When a country allows trade and becomes an exporter of a good</p> <p>A. consumer surplus and producers surplus will increase.</p> <p>B. consumer surplus and producer surplus will decrease.</p> <p>C. consumer surplus will increase and producer surplus will increase.</p> <p>D. consumer surplus will decrease and producer surplus will increase.</p> <p>7. When a perfectly competitive firm makes a decision to shut down, it is most likely that</p> <p>A. marginal cost is above average variable cost.</p> <p>B. price is below the minimum of average variable cost.</p> <p>C. fixed costs exceed variable costs.</p> <p>D. average fixed costs are rising.</p> <p>8. Price discrimination is a rational strategy for a profit-maximizing monopolist when</p> <p>A. there is no opportunity for arbitrage across market segmentations.</p> <p>B. there is an opportunity for arbitrage across market segmentations.</p> <p>C. consumers are unable to be segmented into identifiable markets.</p> <p>D. they want to increase the deadweight loss that results from profit-maximizing behavior.</p> <p>9. As a group, oligopolists would always be better off if they would act collectively</p> <p>A. as a single monopolist.</p> <p>B. as a single competitor.</p> <p>C. as if they were each seeking to maximize their own profit.</p> <p>D. in a manner that would prohibit collusive agreements.</p> <p>10. If firms in a monopolistically competitive industry are making profits,</p> <p>A. firms will likely be subject to regulation.</p> <p>B. barriers to entry will be strengthened.</p> <p>C. new firms will enter the market.</p> <p>D. some firms must exit the market.</p>				
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11. A company uses 100 workers and 30 units of capital to produce 500 units of output. If this company increases its capital to 50 units and, as a result, its output increases by 300 units, the productivity of labor _____ to _____ units per worker.

- A. increases; 1
- B. increases; 3
- C. increases; 8
- D. decreases; 4

12. Official unemployment statistics:

- A. understate unemployment because individuals receiving unemployment compensation are counted as employed.
- B. understate unemployment because discouraged workers are not counted as unemployed.
- C. include cyclical and structural unemployment, but not frictional unemployment.
- D. overstate unemployment because workers who are involuntarily working part time are counted as being employed.

13. A car that is produced in 2004 is not sold until 2005. According to the definition of GDP, in which year's GDP should it be counted?

- A. 2004.
- B. 2004 real GDP; 2005 nominal GDP.
- C. both years.
- D. 2005.

Total Population	30,000
Working-Age Population	25,000
Employment	11,000
Unemployment	1,000

14. Consider the data in the table above for a simple economy. The unemployment rate for this simple economy equals:

- A. 4.0%.
- B. 9.1%.
- C. 8.3%.
- D. 3.3%.

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15. Which of the following could cause nominal GDP to decrease, but real GDP to increase?
- The price level rises and the quantity of final goods and services produced falls.
 - The price level rises and the quantity of final goods and services produced rises.
 - The price level falls and the quantity of final goods and services produced falls.
 - The price level falls and the quantity of final goods and services produced rises.
16. When a member of the nonbank public withdraws currency from her bank account,
- both the monetary base and bank reserves rise.
 - bank reserves fall, but the monetary base remains unchanged.
 - both the monetary base and bank reserves fall.
 - the monetary base falls, but bank reserves remain unchanged.
17. When economists state that money is neutral in the long run, they mean that in the long run,
- the price level is independent of the nominal money supply.
 - the level of output is independent of the nominal money supply.
 - changes in the money supply have the same impact on the rich as they do on the poor.
 - fluctuations in the money supply are equally likely to lead to recessions as to expansions.
18. An expansionary monetary policy that successfully counteracts a recession has the side effect of
- lower investment spending than if no action had been taken.
 - lower output than if no action had been taken.
 - a higher price level than if no action had been taken.
 - a larger government deficit than if no action had been taken.
19. The less interest-sensitive is money demand, the
- steeper is the IS curve.
 - flatter is the LM curve.
 - more effective is monetary policy relative to fiscal policy.
 - more effective is fiscal policy relative to monetary policy.
20. The quantity theory of inflation indicates that the inflation rate equals
- the growth rate of the money supply minus the growth rate of aggregate output.
 - the level of the money supply plus the level of aggregate output.
 - the growth rate of the money supply plus the growth rate of aggregate output.
 - the level of the money supply minus the level of aggregate output.

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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. Suppose that a firm's fixed proportion production function is given by

$$q = \min(2k, 10l - 2).$$

The inputs are hired in perfectly competitive markets. The rental rates of capital (k) and labor (l) are v and w , respectively.

- (10 points) Calculate the firm's long-run total, average, and marginal cost functions.
- (10 points) Suppose that k is fixed at 9 in the short run. Calculate the firm's short-run total, average, and marginal cost functions.

2. (20 points) Consider the good x imported by the home country. To keep things simple, assume that x constitutes a homogeneous good and that the market for it is perfectly competitive. The demand for x at home is given by $Q_D = 200 - 4P$. The domestic market supply is given by $Q_S = 4P - 40$.

- Suppose that x can be imported at a fixed world price of \$20. Suppose that the home government imposes an import tariff of \$5 per unit of x . What is the total number of x imported from abroad?
- Suppose that, because of political-economy considerations, the home government sets its import tariff, t , in order to maximize:

$$\text{Consumer Surplus} + \text{Tariff Revenues} + A \times (\text{Producer Surplus}).$$

What is the value of A under which the home government would impose an import tariff of \$5?

3. Assume that firms care about their after-tax rate of return on investment projects. And, suppose the incumbent government has decided to raise taxes on corporations. Use the loanable funds model to explain the effect of the tax increase.

- (7 points) What effect will this have on the investment demand curve? Explain and graph the effect.
- (7 points) What effect will this have on national savings? Explain and graph the effect.
- (6 points) Consider both effects that you have described in parts **a** and **b**. What will happen to the real interest rate, national savings, and investment? Explain and graph the effect.

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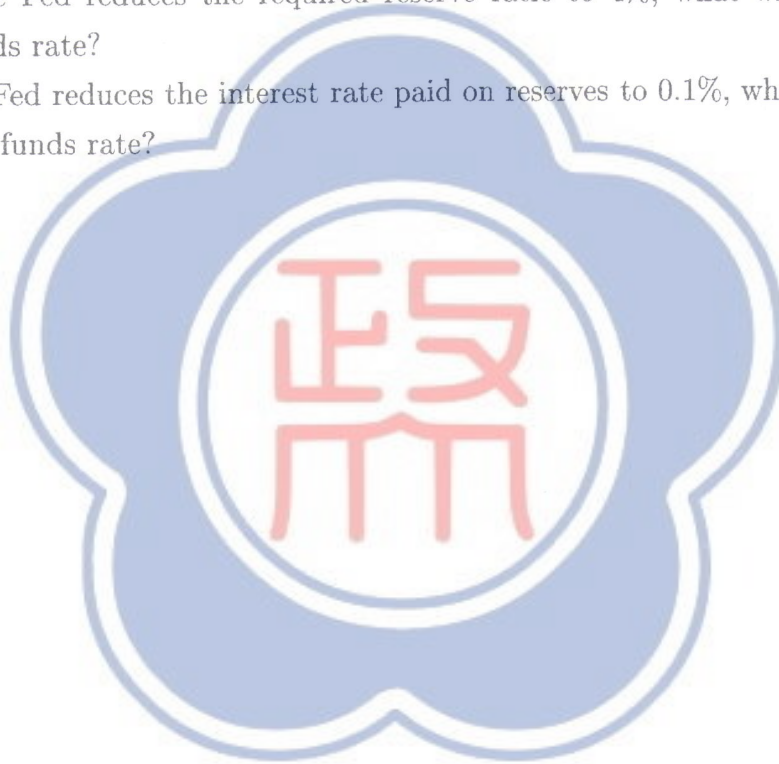
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4. Suppose currently the discount rate is 0.8%, the interest rate the Fed (the central bank) is paying for banks' excess reserves is 0.2%, the required reserve ratio is 5%, and the equilibrium federal funds rate is 0.2%.

a. (6 points) If the Fed reduces the discount rate to 0.6%, what will happen to the equilibrium federal funds rate?

b. (7 points) If the Fed reduces the required reserve ratio to 4%, what will happen to the equilibrium federal funds rate?

c. (7 points) If the Fed reduces the interest rate paid on reserves to 0.1%, what will happen to the equilibrium federal funds rate?



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Part I: Multiple choice (20 points)

1. Which of the following are true statements about the internal rate of return?
 - A. If A and B are two projects, then $IRR(A)+IRR(B)=IRR(A+B)$
 - B. If $IRR < WACC$, then $NPV < 0$
 - C. If $IRR > 0$, then $NPV > 0$
 - D. IRR are always unique
 - E. None of the above
2. Rank the following forms of business organization in terms of highest to lowest agency costs between owners and management.
 - I. Sole proprietorship, II. Corporation, III. General partnership
 - A. I, II, III
 - B. II, I, III
 - C. III, II, I
 - D. II, III, I
 - E. None of the above
3. Because of agency costs, which of the following can happen?
 - I. The corporation's capital structure can be affected
 - II. Management may accept projects with a negative net present value
 - III. Management may reject projects with a positive net present value
 - A. I only
 - B. II only
 - C. II and III only
 - D. I, II and III
 - E. None of the above
4. A firm in the extraction industry whose major assets are cash, equipment and a closed facility may appear to have extraordinary value. This value can be primarily attributed to:
 - A. the potential sale of the firm
 - B. the option to re-open the facility when prices rise dramatically
 - C. the low exercise price of the facility held by shareholders
 - D. The option to abandon the facility
 - E. None of the above
5. Which of the following are plausible reasons for firms paying dividends?
 - I. there is a clientele that prefers dividends
 - II. dividends provide a credible signal of future performance
 - III. firms that pay dividends are more valued by investors
 - A. I only

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- B. I and II only
- C. II and III only
- D. I, II and III
- E. None of the above

PART II: True/False (20 points); is each of the following statements true or false? Why? A one sentence explanation should be sufficient in each case. Note that a correct guess with no explanation will receive NO credit.

1. According to the pecking theory of financing, long-term debt is preferred to external equity because the cost of capital for debt is lower than the cost of capital for equity.
2. Ignoring financial distress costs, agency costs, and other market imperfections, the risk of a company's debt, regardless of the level of leverage, can never be higher than the level of risk faced by equity holders in an unlevered company with identical business risk.
3. In general, expected earnings per share (EPS) are maximized at the same level of debt that maximizes stock price.
4. The fact that announcements of dividend increases often cause stock prices to rise is evidence that investors prefer high dividend paying stocks to low dividend paying stocks.

PART III: Problems (60 points); show your work, including intermediate calculations and formulas. Correct answers, with no work shown, will receive NO credit. Please keep your discussions brief.

1. Greff Inc. is interested in the impact that increasing its leverage may have on its WACC. It is currently an all-equity firm with $\beta = 1.2$. The market value of its equity is \$10 million. After discussions with an investment bank, it estimates that if it takes on \$5 million in debt its cost of debt will be 13%, while if it takes on \$6 million in debt, its cost of debt will be 14%. The debt would be used to repurchase shares. (Assume that one dollar of debt will retire one dollar of equity.) What level of leverage will minimize Greff's WACC? Assume: R_F (risk-free rate) = 5%; R_M (expected market return) = 12%; tax rate = 40%. (10 points)

2. Hot Inc. and Cold Inc. are planning to merge without refinancing. The following financial data are available (all values are market values.)

Expected market return = 11%; risk-free rate = 5%

	Hot	Cold
Beta	1	2
Debt	0	10
Equity	10	10

What will the merged firm's cost of equity be? Assume all tax rates are 40%. (10 points)

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3. ABC Inc. currently has \$1 million in equity and \$2 million in debt. Its tax rate is 40%. Its cost of debt is 10%, and its cost of equity is 20%. What is ABC's unlevered cost of equity? Assuming the MM formula and no growth, what is ABC's expected after-tax net operating income (free cash flow)? (20 points)

4. XYZ Inc. is considering investment in producing steam-powered boats. The cash flows associated with this project are as follows:

<u>0</u>	<u>Demand</u>	<u>Probability</u>	<u>1</u>	<u>2</u>	<u>3</u>	...
-100	High	1/3	24	24	24	...
	Low	2/3	1.5	1.5	1.5	...

If the demand is high, XYZ can add a second factory at the end of the first year, which will also operate at full capacity. If the discount rate for this project is 10% and the annual risk-free rate is 2%, please derive the expansion option (the option to add a second factory at the end of the first year) value using the binomial option pricing approach. What is the appropriate (expected) discount rate for this expansion option under the binomial approach? (20 points)



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一、 單選題 (每題 2 分，共 50 分)

選擇題請在答案卡上作答，否則不予計分。

1. The principal of a school wants to know the average number of sick days taken per student in 2013. Office of Student Affairs collects records on all the students and averages the number of sick days taken in 2013 by each student. The above process is using _____.

- (a) a cluster sampling (b) a stratified sampling
(c) a sampling survey (d) a census

2. Methods for developing useful decision-making information from large data bases is known as

- (a) data monitoring (b) data mining
(c) data manipulation (d) data base conversion

3. A measure of dispersion that is influenced most by extreme values is

- (a) the interquartile range (b) the range
(c) the variance (d) the standard deviation

4. A return data is positively skewed, which of the following statement is always true?

- (a) The mean is less than the median. (b) The median is less than the mode.
(c) The mean is greater than the mode. (d) The mean and mode are the same.

5. If you were interested in comparing the EPS for Apple with the EPS for Samsung, it would be better to use a

- (a) bar graph (b) line graph (c) histogram (d) pie chart

6. President of DaDa Security is exploring the characteristics of stock market investors. He found that 50% of all investors have a net worth exceeding \$1,000,000; 40% of all investors use the online trading system; and 35% of all investors have net worth exceeding \$1,000,000 and use an online trading system. Let W denote the event "net worth exceeds \$1,000,000", and T denote the event "using online trading system". W and T are _____.

- (a) independent (b) disjoint (c) dependent (d) complement

7. (continued) $P(W \cup T) =$ _____.

- (a) 0.90 (b) 0.20 (c) 0.15 (d) 0.55

8. (continued) $P(W^c|T) =$ _____.

- (a) 0.875 (b) 0.50 (c) 0.125 (d) 0.05

9. (continued) $P(W^c|T^c) =$ _____.

- (a) 0.875 (b) 0.75 (c) 0.917 (d) 0.25

10. 200 policyholders file claims with First Insurance in 2013. 20 of these claims are fraudulent. Claims manager randomly selects 10 out of all claims for thorough investigation. Let x denotes the number of fraudulent claims being sampled, then x has a _____ distribution.

- (a) discrete uniform (b) binomial (c) hypergeometric (d) Poisson

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<p>11. Other things being unchanged, if a 95% confidence interval estimate is changed to be a 99% confidence interval estimate, the length of the confidence interval (a) increases (b) decreases (c) remains the same (d) All are wrong</p> <p>12. In a two-tailed hypothesis test situation, the test statistic is determined to be $t = -2.423$. The sample size has been 40. The p-value for this test is (a) 0.99 (b) 0.01 (c) 0.98 (d) 0.02</p> <p>13. Other things being unchanged, if a hypothesis is not rejected at the 2% level of significance, it (a) may be rejected at the 1% level (b) will not be rejected at the 3% level (c) may be rejected at the 5% level (d) will not be rejected at the 5% level</p> <p>14. The marketing department of a food company wants to determine which of the 3 flavors of potato chips will have the largest amount of sales. 4 stores are randomly selected, and each flavor will be sold in all of these stores for 15 days. What is the design for this experiment? (a) Completely randomized design (b) Randomized block design (c) Factorial design (d) None of these alternatives is correct.</p> <p>15. (Continued) Which one is the main null hypothesis to be tested? (a) Store effect doesn't exist. (b) Exists some store effect. (c) Flavor effect doesn't exist. (d) Exists some flavor effect.</p> <p>16. (continued) What is the degrees of freedom for the Error? (a) 6 (b) 10 (c) 11 (d) 168</p> <p>17. (continued) If $\alpha = 0.05$, and p-value for testing about flavors is 0.02, then there is a strong evidence that (a) all flavor effects are different. (b) all flavor effects are the same. (c) flavor effects are not all the same. (d) None of these alternatives is correct.</p> <p>18. Which of the following is a nonparametric version of the parametric analysis of variance? (a) sign test (b) Wilcoxon Signed-rank test (c) Mann-Whitney-Wilcoxon test (d) Kruskal-Wallis Test</p> <p>19. For quantitative data, which of the following is a nonparametric method for determining the differences between two populations based on matched samples? (a) sign test (b) Wilcoxon Signed-rank test (c) Mann-Whitney-Wilcoxon test (d) Kruskal-Wallis test</p> <p>20. If the variances of the two populations are neither equal nor known, to compute the t-statistic to test the difference in the two population means, it is appropriate to (a) pool the two sample means (b) pool the two sample variances (c) unpool the two sample variances (d) match the two samples</p>					
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21. For time series data, which of the following treats the actual value as the product of its components?

- (a) autoregressive regression model (b) multiplicative time series model
(c) additive time series model (d) None of these alternatives is correct.

22. An analyst performs the time series analysis for the quarterly revenue from the 1st quarter of 2010 to the 4th quarter of 2013. He obtains the seasonal indexes as

Quarter	1	2	3	4
Seasonal Index	1.12	0.97	0.93	0.98

and estimates the trend line of the deseasonalized time series by

$$T_t = 14.75 + 0.25t.$$

The trend forecast for the revenue of the 1st quarter of Year 2014 is

- (a) 15 (b) 16.8 (c) 19 (d) 21.28

23. (Continued) The forecast for the revenue of the 2nd quarter of Year 2014 is

- (a) 18.6725 (b) 19.25 (c) 14.7925 (d) 15.25

24. (Continued) The trend forecast for the revenue of the 4th quarter of Year 2014 is

- (a) 15.75 (b) 15.434 (c) 19.75 (d) 19.355

25. (Continued) The forecast for the revenue for Year 2014 is

- (a) 61.5 (b) 61.4425 (c) 77.5 (d) 77.4425

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二、非選擇題(共 50 分)

1. A bank takes a random sample of 100 two-minute periods to count the number of customer arrivals. Shown below are the observed frequencies.

Number of Arrivals in a 2-minute period	Observed frequency
0	38
1	34
2	20
3	6
4	2
Total	100

- (a) Provide an approximate 90% confidence interval for the mean number of arrivals in a 2-minute period. (8%)
- (b) Regroup the number of arrivals into 4 categories as: 0, 1, 2, ≥ 3 , then use the observed frequencies to test whether the number of arrivals follows a Poisson distribution at $\alpha=0.05$. (12%)
- (c) Estimate the probability that the waiting time for the next customer will be between 1 and 2 minutes. (5%)

2. The following table gives the monthly sales (Y in \$1,000,000) and the monthly advertising expenditure (X in \$10,000).

x	3	4	5	7	8	9	9	11	21	15	18	9	12	14	16	16	3	1	2	1
y	10	12	12	20	25	25	35	35	45	40	60	30	40	60	65	65	20	7	10	10

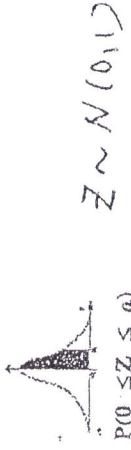
- (a) At $\alpha=0.05$, test whether the regression coefficient is positive. (16%)
- (b) The advertising expenditure for next month will be \$150,000. Develop a 95% interval estimate for next month's sales. (9%)

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Upper tail values of Student's t distribution: $t_p(df)$

Area in the Upper Tail

df	0.10	0.05	0.025	0.01	0.005	0.001
1	3.078	6.314	12.706	31.821	63.657	318.313
2	1.886	2.920	4.303	6.965	9.925	22.327
3	1.638	2.353	3.182	4.541	5.841	10.215
4	1.533	2.132	2.776	3.747	4.604	7.173
5	1.476	2.015	2.571	3.365	4.032	5.893
6	1.440	1.943	2.447	3.143	3.707	5.208
7	1.415	1.895	2.365	2.998	3.499	4.782
8	1.397	1.860	2.306	2.895	3.355	4.499
9	1.383	1.833	2.262	2.821	3.250	4.296
10	1.372	1.812	2.228	2.764	3.169	4.143
11	1.363	1.796	2.201	2.718	3.106	4.024
12	1.356	1.782	2.179	2.681	3.055	3.929
13	1.350	1.771	2.160	2.650	3.012	3.852
14	1.345	1.761	2.145	2.624	2.977	3.787
15	1.341	1.753	2.131	2.602	2.947	3.733
16	1.337	1.746	2.120	2.583	2.921	3.686
17	1.333	1.740	2.110	2.567	2.898	3.646
18	1.330	1.734	2.101	2.552	2.878	3.610
19	1.328	1.729	2.093	2.539	2.861	3.579
20	1.325	1.725	2.086	2.528	2.845	3.552
21	1.323	1.721	2.080	2.518	2.831	3.527
22	1.321	1.717	2.074	2.508	2.819	3.505
23	1.319	1.714	2.069	2.500	2.807	3.485
24	1.318	1.711	2.064	2.492	2.797	3.467
25	1.316	1.708	2.060	2.485	2.787	3.450
26	1.315	1.706	2.056	2.479	2.779	3.435
27	1.314	1.703	2.052	2.473	2.771	3.421
28	1.313	1.701	2.048	2.467	2.763	3.408
29	1.311	1.699	2.045	2.462	2.756	3.396
30	1.310	1.697	2.042	2.457	2.750	3.385
31	1.309	1.696	2.040	2.453	2.744	3.375
32	1.309	1.694	2.037	2.449	2.738	3.365
33	1.308	1.692	2.035	2.445	2.733	3.356
34	1.307	1.691	2.032	2.441	2.728	3.348
35	1.306	1.690	2.030	2.438	2.724	3.340
36	1.306	1.688	2.028	2.434	2.719	3.333
37	1.305	1.687	2.026	2.431	2.715	3.326
38	1.304	1.686	2.024	2.429	2.712	3.319
39	1.304	1.685	2.023	2.425	2.708	3.313
40	1.303	1.684	2.021	2.423	2.704	3.307
100	1.290	1.660	1.984	2.364	2.626	3.174
∞	1.282	1.645	1.960	2.326	2.576	3.090



備註 試題隨卷繳交

考試科目 統計學 所別 財務管理學系 4121 考試時間 2月22日(六) 第三節

Upper tail values of chi-square distribution

Area in the Upper Tail

df	0.990	0.975	0.95	0.9	0.1	0.05	0.025	0.01
1	0.000	0.001	0.004	0.016	2.706	3.841	5.024	6.635
2	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210
3	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345
4	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277
5	0.554	0.851	1.145	1.610	9.236	11.070	12.832	15.086
6	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812
7	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475
8	1.647	2.180	2.733	3.490	13.362	15.507	17.535	20.090
9	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666
10	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209
11	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.752
12	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217
13	4.107	5.009	5.892	7.041	19.812	22.362	24.736	27.688
14	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141
15	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578
16	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000
17	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409
18	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805
19	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191
20	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566
21	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932
22	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289
23	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638
24	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980
25	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314
26	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642
27	12.878	14.573	16.151	18.114	36.741	40.113	43.195	46.963
28	13.565	15.308	16.928	18.938	37.916	41.337	44.461	48.278
29	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588
30	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892
31	15.655	17.539	19.281	21.434	41.422	44.985	48.232	52.191
32	16.362	18.291	20.072	22.271	42.585	46.194	49.480	53.486
33	17.073	19.047	20.867	23.110	43.745	47.400	50.725	54.775
34	17.789	19.806	21.664	23.952	44.903	48.602	51.966	56.061
35	18.509	20.569	22.465	24.797	46.059	49.802	53.203	57.342
36	19.233	21.336	23.269	25.643	47.212	50.998	54.437	58.619
37	19.960	22.106	24.075	26.492	48.363	52.192	55.668	59.893
38	20.691	22.878	24.884	27.343	49.513	53.384	56.895	61.162
39	21.426	23.654	25.685	28.196	50.660	54.572	58.120	62.428
40	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691
50	29.707	32.357	34.764	37.689	63.167	67.505	71.420	76.154
60	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379
70	45.442	48.758	51.739	55.329	85.527	90.531	95.023	100.425
80	53.540	57.153	60.391	64.278	96.578	101.879	105.629	112.329
90	61.754	65.647	69.126	73.291	107.565	113.145	118.136	124.116

Upper critical values of the F distribution

for v_1 numerator degrees of freedom and v_2 denominator degrees of freedom

5% significance level

$F_{\alpha}(v_1, v_2)$

$v_2 \backslash v_1$	1	2	3	4	5	6	7	8	9	10
1	161.448	199.503	215.707	224.583	230.162	233.986	236.768	238.882	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	9.532	9.277	9.117	9.013	8.941	8.887	8.845	8.812	8.786
4	6.608	5.786	5.409	5.192	5.050	4.950	4.876	4.818	4.772	4.735
5	5.987	5.143	4.757	4.534	4.387	4.284	4.207	4.147	4.099	4.060
6	5.591	4.737	4.347	4.120	3.972	3.866	3.787	3.726	3.677	3.637
7	5.318	4.459	4.066	3.838	3.687	3.581	3.500	3.438	3.388	3.347
8	5.117	4.256	3.863	3.633	3.482	3.374	3.293	3.230	3.179	3.137
9	4.965	4.103	3.708	3.478	3.326	3.217	3.135	3.072	3.020	2.978
10	4.844	3.982	3.587	3.357	3.204	3.095	3.012	2.948	2.896	2.854
11	4.747	3.885	3.490	3.259	3.106	2.996	2.913	2.849	2.796	2.753
12	4.667	3.806	3.411	3.179	3.025	2.915	2.832	2.767	2.714	2.671
13	4.600	3.739	3.344	3.112	2.958	2.848	2.764	2.699	2.646	2.602
14	4.543	3.682	3.287	3.055	2.901	2.790	2.707	2.641	2.588	2.544
15	4.494	3.634	3.239	3.007	2.852	2.741	2.657	2.591	2.538	2.494
16	4.451	3.592	3.197	2.965	2.810	2.699	2.614	2.548	2.494	2.450
17	4.414	3.555	3.160	2.928	2.773	2.661	2.577	2.510	2.456	2.412
18	4.381	3.522	3.127	2.895	2.740	2.628	2.544	2.477	2.423	2.378
19	4.351	3.493	3.098	2.866	2.711	2.599	2.514	2.447	2.393	2.348
20	4.325	3.467	3.072	2.840	2.685	2.573	2.488	2.421	2.366	2.321
21	4.301	3.443	3.049	2.817	2.661	2.549	2.464	2.397	2.342	2.297
22	4.279	3.422	3.028	2.796	2.640	2.528	2.442	2.375	2.320	2.275
23	4.260	3.403	3.009	2.776	2.621	2.508	2.423	2.355	2.300	2.255
24	4.242	3.385	2.991	2.759	2.603	2.490	2.405	2.337	2.282	2.236
25	4.225	3.369	2.975	2.743	2.587	2.474	2.388	2.321	2.265	2.220
26	4.210	3.354	2.960	2.728	2.572	2.459	2.373	2.305	2.250	2.204
27	4.196	3.340	2.947	2.714	2.558	2.445	2.359	2.291	2.236	2.190
28	4.183	3.328	2.934	2.701	2.545	2.432	2.346	2.278	2.223	2.177
29	4.171	3.316	2.922	2.690	2.534	2.421	2.334	2.266	2.211	2.165
30	4.160	3.305	2.911	2.679	2.523	2.409	2.323	2.255	2.199	2.153
31	4.149	3.295	2.901	2.668	2.512	2.399	2.313	2.244	2.189	2.143
32	4.139	3.285	2.892	2.659	2.503	2.389	2.303	2.235	2.179	2.133
33	4.130	3.276	2.883	2.650	2.494	2.380	2.294	2.225	2.170	2.124
34	4.121	3.267	2.874	2.641	2.485	2.372	2.285	2.217	2.161	2.114
35	4.113	3.259	2.866	2.634	2.477	2.364	2.277	2.209	2.153	2.106
36	4.105	3.251	2.859	2.626	2.470	2.356	2.269	2.201	2.145	2.098
37	4.098	3.245	2.852	2.619	2.463	2.349	2.262	2.194	2.138	2.091
38	4.091	3.238	2.845	2.612	2.456	2.342	2.255	2.187	2.131	2.084
39	4.085	3.232	2.839	2.606	2.449	2.336	2.249	2.180	2.124	2.077

備註 試題隨卷繳交