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Problem 1 (19 points)

Jerry purchases only two goods, apples (q_1) and oranges (q_2). He has an income, m , of 60 dollars. Suppose the price of an apple is \$4, and the price of an orange is \$2.

- (2 points) Write down Jerry's budget constraint and plot his budget set. What is the economic interpretation for the slope of the budget line?
- (4 points) Suppose Jerry's utility function is given by

$$U(q_1, q_2) = [(2\ln q_1 + \ln q_2)^2 + 6]^{1/3}$$

Can you find a simpler utility function that represents the same preferences? Explain why your proposal is valid.

- (2 points) Write down the formula for Jerry's MRS. Give an economic interpretation of the MRS.
- (6 points) What bundle of apples and oranges should Jerry purchase to maximize his utility?
- (2 points) Following d), how much money would Jerry spend on apples and oranges, respectively?
- (3 points) Suppose the price of an apple becomes \$5.5, and the price of an orange becomes \$2.5. How much money now would Jerry spend on apples and oranges, respectively?

Problem 2 (6 points)

Answer each of the following questions within 3 sentences. Please give the rationale behind your answers. You don't need to write down any equations.

- (3 points) When elasticity of demand is high, will a monopoly have a higher or lower margin (i.e., the difference between price and marginal cost)? Why?
- (3 points) "It is widely known that having a higher education is good for the person himself or herself, but also for the public in general." Based on this statement, suppose we leave the provision and funding of education entirely to the market. Should we expect a higher or lower average level of education? Why?

備

註

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Problem 3 (13 points)

We are in the World Cup, and the penalty kicks will now decide the game. The kicker (person 1) can kick the ball in 3 possible directions, $\{L, M, R\}$, and the goalie (person 2) needs to decide in which direction among $\{L, M, R\}$ he should dive for the ball. The following is the payoff matrix for the two players, and the numbers correspond to the probability that the players will succeed (i.e., the kickers will kick the ball in, or the goalie will make the save.)

1 \ 2	L	M	R
L	2/5, 3/5	4/5, 1/5	1, 0
M	3/5, 2/5	0, 1	3/5, 2/5
R	1, 0	4/5, 1/5	1/5, 4/5

- a) (5 points) Find the pure strategy Nash Equilibrium in this game, if any.
b) (8 points) Find the mixed strategy Nash Equilibrium in this game, if any.

Problem 4 (12 points)

A new neighborhood is developed on a new linear street, the interval $[0,1]$. Three convenience stores will open sequentially, with store 1 choosing its location first, then store 2 will select its site, and finally, store 3 will choose its location. Suppose the homogeneous customers are uniformly distributed on the linear street, and they will only go to the convenience store that is nearest to them.



Assume that all convenience stores want to maximize their customer bases. Now, store 1 has already chosen its location at $x_1=1/4$.

- a) (8 points) What locations will store 2 and store 3 pick, respectively?
b) (4 points) In the end, what is each store's market share?

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Problem 5 (25 points) Suppose that a couple's preferences can be represented by the joint utility function

$$U = \alpha_f \ln(l_f - \bar{l}) + \alpha_m \ln(l_m - \bar{l}) + (1 - \alpha_f - \alpha_m) \ln(x - \bar{x}),$$

where l_f is wife's non-market time; l_m is husband's non-market time; $\bar{l}$ is the minimum non-market time necessary for survival; x is family consumption of market goods; $\bar{x}$ is the subsistence level of market goods consumption; and $\alpha_f > 0$, $\alpha_m > 0$, and $\alpha_f + \alpha_m < 1$ because non-market time and market goods are "goods," not "bads." Clearly, U is defined only if $l_f > \bar{l}$, $l_m > \bar{l}$, and $x > \bar{x}$. The family's budget constraint is

$$px = w_f(T - l_f) + w_m(T - l_m) + y,$$

where p is the price of market goods, w_f and w_m are the wife's and husband's wage rates, T is each individual's time endowment, and y is the family's non-labor income.

- a) Show that the utility function can be written as

$$U = \alpha_f \ln(\bar{h} - h_f) + \alpha_m \ln(\bar{h} - h_m) + (1 - \alpha_f - \alpha_m) \ln(x - \bar{x}),$$

where $h_f = T - l_f$ and $h_m = T - l_m$ are the wife's and husband's work time and $\bar{h}$ is each individual's maximum possible work time. (5 points)

- b) Assuming an interior solution, use the first-order conditions for utility maximization to derive the wife's labor supply function. (5 points)

- c) Show that the family's marginal propensity to consume wife's leisure,

$$w_f \partial l_f / \partial y = -w_f \partial h_f / \partial y, \text{ is equal to } \alpha_f. \text{ (5 points)}$$

- d) Derive the slope of the wife's labor supply function with respect to the husband's wage rate, $\partial h_f / \partial w_m$, and see if you can ascertain its sign. (5 points)

- e) Use the Slutsky equation to derive the substitution effect of a change in husband's wage rate on wife's labor

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supply. What is the sign of this cross-substitution effect? (5 points)

Problem 6 (25 points) The NCCU Coal Company is the only hirer of labor in its area. It can hire any number of female workers or male workers it wishes. The supply curve for women is given by

$$l_f = 100w_f$$

and for men is given by

$$l_m = 9w_m^2$$

where w_f and w_m are the hourly wage rates paid to female and male workers, respectively. Assume that NCCU sells its coal in a perfectly competitive market at \$5 per ton and that each worker hired (both men and women) can mine 2 tons per hour.

- a) If the firm wishes to maximize profits, how many female and workers should be hired, and what will the wage rates be for those two groups? How much will NCCU earn in profits per hour on its machinery? (15 points)
- b) How will that result compare to one in which NCCU was constrained to pay all workers the same wage based on the value of their marginal product? (10 points)

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總體經濟學

Q1. 一般均衡模型 (合計 30 分)

假定某經濟體存在 100 個完全相同的家計單位與唯一一個代表性廠商。

每家計單位可將一單位時間稟賦配置在工作與休閒，每單位工作時間將產生 w 工資率。每家計單位另有一單位資本稟賦，可出租給廠商並獲取 r 單位租金率。當所有家計單位做決策時，將 w 和 r 視為給定。此外，每家計單位持有 1% 的廠商股份，並據此向廠商索取 1% 的獲利，廠商總獲利表示為 π 。根據以上設定可知，家計單位共有三項所得來源，分別是：勞動薪資所得、資本租金、以及廠商獲利份額。

每家計單位可以從消費商品 (c) 及休閒 ($1-l$) 獲得效用 (l 代表工作時數)，商品價格單位化為 1。家計單位利用上述所得購買商品，各個家計單位的效用函數可以用以下函數表示：

$$u(c, l) = \phi \ln(c) + (1 - \phi) \ln(1 - l),$$

其中 ϕ 表示家計單位對消費及休閒的相對喜好程度。

(i) (10分) 請設定一個家計單位效用極大化問題，並求解 c 和 l 是 r ， w ，和 π 的函數。

以下討論廠商問題。代表性廠商雇用勞動及資本進行生產，假設此廠商生產函數為 CRTS 形式：

$$y = F(L, K) = AL^\alpha K^{1-\alpha},$$

其中， y 是產出， L 和 K 分別是總勞動與總資本投入， A 是總要素生產力 (假定為常數)， α 代表勞動份額。廠商選擇要素投入 L 和 K 以極大化利潤 π ，在做決策時同樣將 w ， r 以及商品價格視為給定。

(ii) (5分) 請設定代表性廠商利潤極大化問題，並求解一階最適條件。

(iii) (5分) 根據以上家計單位問題和廠商問題的設定，請簡單定義或描述一般均衡，特別是，如何表示商品市場，勞動市場，以及資本市場結清 (或均衡) 條件？

(iv) (10分) 請根據由(i)、(ii)、(iii)推得的均衡條件求解均衡工資率 w ，資本租金率 r ，廠商利潤 π ，總勞動投入 L ，以及總產出 Y 。

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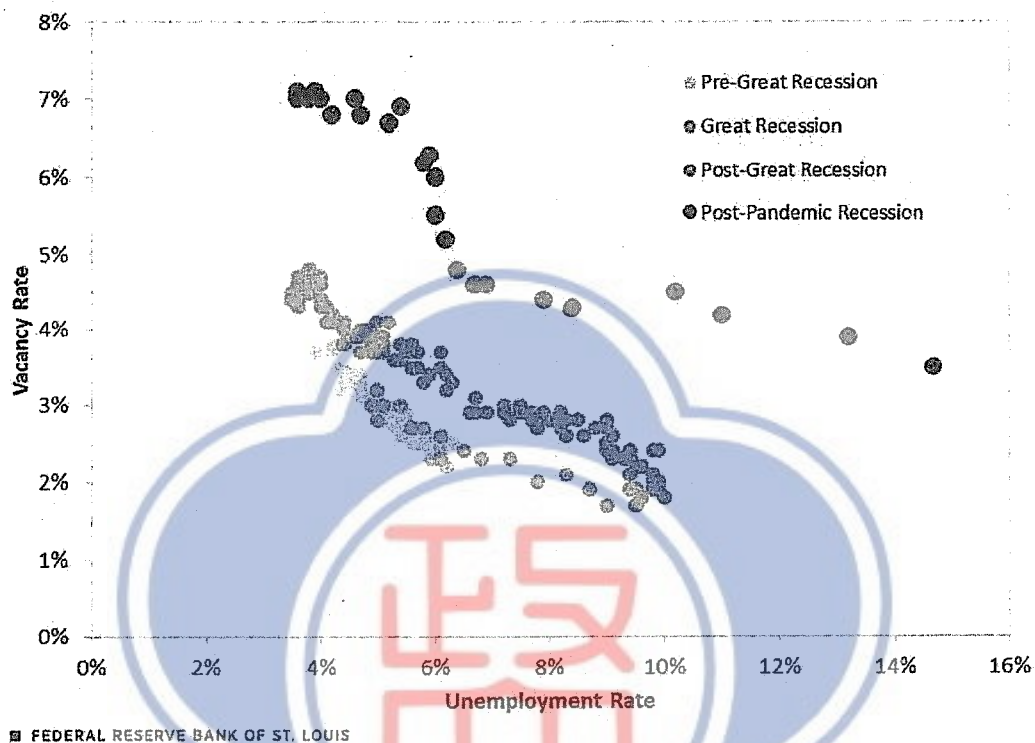


Figure 1: The Beveridge curve during different periods (Source: BLS and St. Louis Fed)

Q2. 失業率與景氣循環 (合計 20 分)

(i) (5分) 請敘述貝佛里奇曲線 (Beveridge Curve) 的斜率和截距所代表的經濟意涵。

(ii) (5分) 請解釋大蕭條之後 (Post-Great Recession) 以及新冠肺炎疫情之後 (Post-Pandemic Recession)

貝佛里奇曲線外移的現象所造成的原因。(參照 Figure 1)

(iii) (10分) 請問你是否能以傳統的「實質景氣循環理論」的觀點解釋貝佛里奇曲線上點的移動與整條曲線移動的現象？請說明原因。

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Q3. Solow Growth Model (合計 30 分)

A closed economy is characterized by the following production function:

$$Y_t = K_t^\alpha (A_t N_t)^{1-\alpha}, \alpha \in (0,1),$$

where Y_t is aggregate output, A_t refers to technology, K_t is total capital and N_t is total workers (subscript t referring to discrete time period). The economy's saving rate is s and the depreciation rate of capital is δ . Also, the number of workers grow at a rate n (that is,

$$\frac{N_{t+1}}{N_t} = 1 + n) \text{ and the technology growth rate is } g \text{ (that is, } \frac{A_{t+1}}{A_t} = 1 + g).$$

Answer the following questions: [You are required to write down the whole procedure of your derivation.]

- (i) Suppose that $g = 0$ and $A_t = A_0$. Derive the values of capital and output per worker (in terms of $A_0, s, n, \delta, \alpha$), respectively, under the steady state equilibrium. (10 分) What is the saving rate that can maximize steady state consumption per worker (in terms of A_0, n, δ, α) under the steady state equilibrium? (10 分)
- (ii) Suppose that $g > 0$. Derive the growth rates of capital output per worker and total output Y , respectively, under the steady state equilibrium. (10 分) [Hint: Since both g and n are small, you can ignore the term of $g \cdot n (\approx 0)$.]

Q4. IS-LM model in an open economy (合計 20 分)

Country A (the domestic country) is an open economy with flexible exchange rates. The IS and LM curves of Country A are given by

$$IS: Y = C(Y - T) + I(Y, i) + G + NX(Y, Y^*, E);$$

$$LM: i = \bar{i},$$

where

Y : Output; C : Consumption; I : Investment; i : The nominal interest rate;

G : Government spending; T : Taxes; NX : Net Export; Y^* : Foreign output

E : The nominal exchange rate (a unit of domestic currency can exchange E units of foreign currency)

Note that the nominal interest rate i ($=\bar{i}$) is controlled by the central bank of Country A and Marshall-Lerner condition holds. Moreover, the following relation (the interest rate parity) always holds under perfect capital mobility:

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$$E = \frac{1+i}{1+i^*} \bar{E}^e,$$

where i^* is the nominal interest rate of the foreign country and $\bar{E}^e$ is the expected future nominal exchanged rate. Assume that the exchange rate E is equal to E_0 originally. Answer the following questions:

- (i) Draw diagrams to show the effects of an increase in foreign output Y^* on Country A's output, investment, NX , and the exchange rate E , keeping all other things fixed. (6 分)
- (ii) Draw diagrams to show the effects of an increase in the foreign interest rate i^* on Country A's output, investment, NX , and the exchange rate E , keeping all other things fixed. (6 分)
- (iii) Country A announces that it will always keep its exchange rate at E_0 . Draw diagrams to show the effects of an increase in the foreign interest rate i^* on Country A's output, interest rate, investment, and NX , keeping all other things fixed. (8 分)

備

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1. (25%) There are four restaurants in the Northtown area. The numbers of burgers sold at the respective restaurants for each of the last 6 weeks are shown below. At the .05 significance level, what is the value of the test statistic and is there a difference in the mean number sold among the four restaurants when the factor of week is considered?

Week	Restaurant			
	Metro	Interstate	University	River
1	124	160	320	190
2	234	220	340	230
3	430	290	290	240
4	105	245	310	170
5	240	205	280	180
6	310	260	270	205

2. (25%) For many years, TV executives used the guideline that 30% of the audience were watching each of the traditional big three prime-time networks and 10% were watching cable stations on a weekday night. A random sample of 500 viewers in the Tampa-St. Petersburg, Florida, area last Monday night showed that 165 homes were tuned in to the ABC affiliate, 140 to the CBS affiliate, and 125 to the NBC affiliate, with the remainder viewing a cable station. What is the value of the test statistic? At the .05 significance level, can we conclude that the guideline is still reasonable? What is the value of the test statistic?
3. (20%) An investigation of the effectiveness of a training program to improve customer relationships included a pre-training and a post-training customer survey. To compare the differences, they computed (post-training survey score - pre-training survey score). Seven customers were randomly selected and completed both surveys. The results are shown below. For a 0.05 significance level, what is the value of the test statistic and the decision regarding the hypothesis that the training was effective in improving customer relationships?

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The information of question 3.

Customer	Pre-training Survey	Post-training Survey
A	6	8
B	5	5
C	10	10
D	7	10
E	6	8
F	5	6
G	2	8

4. (30%) Suppose that the sales manager of a large automotive parts distributor wants to estimate the total annual sales for each of the company's regions. Five factors appear to be related to regional sales: the number of retail outlets in the region, the number of automobiles in the region registered as of April 1, the total personal income recorded in the first quarter of the year, the average age of the automobiles (years), and the number of sales supervisors in the region. The data for each region were gathered for last year. For example, see the following table. In region 1 there were 1,739 retail outlets stocking the company's automotive parts, there were 9,270,000 registered automobiles in the region as of April 1, and so on. The region's sales for that year were \$37,702,000.

(1)(10%) The output for all five variables is shown below. What percent of the variation is explained by the regression equations?

(2)(20%) Some result is shown below. Conduct a global test of hypothesis to determine whether any of the regression coefficients are not zero. State null and alternate hypotheses. Identify and compute the test statistic, and formulate a decision rule. Use the .05 significance level.

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Annual Sales (\$millions) y	Number of Retail Outlets, X ₁	Number of Automobiles Registered (millions), X ₂	Personal Income (\$billions), X ₃	Average Age of Automobiles (years), X ₄	Number of Supervisors, X ₅
37.702	1,739	9.27	85.4	3.5	9.0
24.196	1,221	5.86	60.7	5.0	5.0
32.055	1,846	8.81	68.1	4.4	7.0
3.611	120	3.81	20.2	4.0	5.0
17.625	1,096	10.31	33.8	3.5	7.0
45.919	2,290	11.62	95.1	4.1	13.0
29.600	1,687	8.96	69.3	4.1	15.0
8.114	241	6.28	16.3	5.9	11.0
20.116	649	7.77	34.9	5.5	16.0
12.994	1,427	10.92	15.1	4.1	10.0

Predictor	Coef	SE Coef	T	P
Constant	-19.672	5.422	-3.63	0.022
Outlets	-0.0000629	0.002638	-0.24	0.823
Automobiles	1.7399	0.55530	3.15	0.035
Income	0.40994	0.04385	9.35	0.001
age	2.0357	0.8779	2.32	0.081
bosses	-0.0344	0.1880	-0.18	0.864

Analysis of Variance

Source	DF	SS	MS	F	P
Regression		1593.81			
Error		9.08			
Total					

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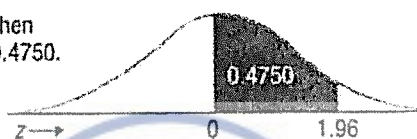
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B.3 Areas under the Normal Curve

Example:
If $z = 1.96$, then
 $P(0 \text{ to } z) = 0.4750$.



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

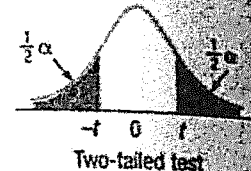
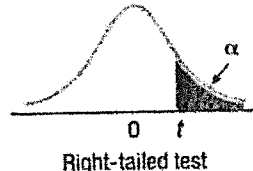
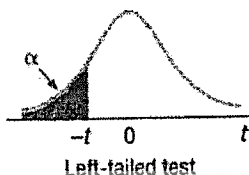
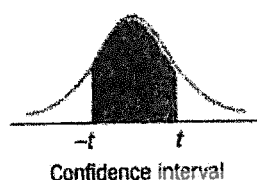
備

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	經濟學系	考 試 時 間	2 月 2 日(四) 第 4 節
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B.5 Student's *t* Distribution



Confidence Intervals, <i>c</i>						
<i>df</i>	80%	90%	95%	98%	99%	99.9%
	Level of Significance for One-Tailed Test, α					
	0.10	0.05	0.025	0.01	0.005	0.0005
	Level of Significance for Two-Tailed Test, α					
	0.20	0.10	0.05	0.02	0.01	0.001
1	3.078	6.314	12.706	31.821	63.657	636.619
2	1.886	2.920	4.303	6.965	9.925	31.599
3	1.638	2.353	3.182	4.541	5.841	12.924
4	1.533	2.132	2.776	3.747	4.604	8.610
5	1.476	2.015	2.571	3.365	4.032	6.869
6	1.440	1.943	2.447	3.143	3.707	5.959
7	1.415	1.895	2.365	2.998	3.499	5.408
8	1.397	1.860	2.306	2.896	3.355	5.041
9	1.383	1.833	2.262	2.821	3.250	4.781
10	1.372	1.812	2.228	2.764	3.169	4.587
11	1.363	1.796	2.201	2.718	3.106	4.437
12	1.356	1.782	2.179	2.681	3.055	4.318
13	1.350	1.771	2.160	2.650	3.012	4.221
14	1.345	1.761	2.145	2.624	2.977	4.140
15	1.341	1.753	2.131	2.602	2.947	4.073
16	1.337	1.746	2.120	2.583	2.921	4.015
17	1.333	1.740	2.110	2.567	2.898	3.965
18	1.330	1.734	2.101	2.552	2.878	3.922
19	1.328	1.729	2.093	2.539	2.861	3.883
20	1.325	1.725	2.086	2.528	2.845	3.850
21	1.323	1.721	2.080	2.518	2.831	3.819
22	1.321	1.717	2.074	2.508	2.819	3.792
23	1.319	1.714	2.069	2.500	2.807	3.768
24	1.318	1.711	2.064	2.492	2.797	3.745
25	1.316	1.708	2.060	2.485	2.787	3.725
26	1.315	1.706	2.056	2.479	2.779	3.707
27	1.314	1.703	2.052	2.473	2.771	3.690
28	1.313	1.701	2.048	2.467	2.763	3.674
29	1.311	1.699	2.045	2.462	2.756	3.659
30	1.310	1.697	2.042	2.457	2.750	3.646
31	1.309	1.696	2.040	2.453	2.744	3.633
32	1.309	1.694	2.037	2.449	2.738	3.622
33	1.308	1.692	2.035	2.445	2.733	3.611
34	1.307	1.691	2.032	2.441	2.728	3.601
35	1.306	1.690	2.030	2.438	2.724	3.591

Confidence Intervals, <i>c</i>						
<i>df</i>	80%	90%	95%	98%	99%	99.9%
	Level of Significance for One-Tailed Test, α					
	0.10	0.05	0.025	0.01	0.005	0.0005
	Level of Significance for Two-Tailed Test, α					
	0.20	0.10	0.05	0.02	0.01	0.001
36	1.306	1.688	2.028	2.434	2.719	3.582
37	1.305	1.687	2.026	2.431	2.715	3.574
38	1.304	1.686	2.024	2.429	2.712	3.566
39	1.304	1.685	2.023	2.426	2.708	3.558
40	1.303	1.684	2.021	2.423	2.704	3.551
41	1.303	1.683	2.020	2.421	2.701	3.544
42	1.302	1.682	2.018	2.418	2.698	3.538
43	1.302	1.681	2.017	2.416	2.695	3.532
44	1.301	1.680	2.015	2.414	2.692	3.526
45	1.301	1.679	2.014	2.412	2.690	3.520
46	1.300	1.679	2.013	2.410	2.687	3.515
47	1.300	1.678	2.012	2.408	2.685	3.510
48	1.299	1.677	2.011	2.407	2.682	3.505
49	1.299	1.677	2.010	2.405	2.680	3.500
50	1.299	1.676	2.009	2.403	2.678	3.496
51	1.298	1.675	2.008	2.402	2.676	3.492
52	1.298	1.675	2.007	2.400	2.674	3.488
53	1.298	1.674	2.006	2.399	2.672	3.484
54	1.297	1.674	2.005	2.397	2.670	3.480
55	1.297	1.673	2.004	2.396	2.668	3.476
56	1.297	1.673	2.003	2.395	2.667	3.473
57	1.297	1.672	2.002	2.394	2.665	3.470
58	1.296	1.672	2.002	2.392	2.663	3.466
59	1.296	1.671	2.001	2.391	2.662	3.463
60	1.296	1.671	2.000	2.390	2.660	3.460
61	1.296	1.670	2.000	2.389	2.659	3.457
62	1.295	1.670	1.999	2.388	2.657	3.454
63	1.295	1.669	1.998	2.387	2.656	3.452
64	1.295	1.669	1.998	2.386	2.655	3.449
65	1.295	1.669	1.997	2.385	2.654	3.447
66	1.295	1.668	1.997	2.384	2.652	3.444
67	1.294	1.668	1.996	2.383	2.651	3.442
68	1.294	1.668	1.995	2.382	2.650	3.439
69	1.294	1.667	1.995	2.382	2.649	3.437
70	1.294	1.667	1.994	2.381	2.648	3.435

(continued)

考 試 科 目	統計學	系 所 別	經濟學系	考 試 時 間	2 月 2 日(四) 第 4 節
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B.5 Student's *t* Distribution (concluded)

df	Confidence intervals, <i>c</i>					
	80%	90%	95%	98%	99%	99.9%
	Level of Significance for One-Tailed Test, α					
	0.10	0.05	0.025	0.01	0.005	0.0005
	Level of Significance for Two-Tailed Test, α					
	0.20	0.10	0.05	0.02	0.01	0.001
71	1.294	1.667	1.994	2.380	2.647	3.433
72	1.293	1.666	1.993	2.379	2.646	3.431
73	1.293	1.666	1.993	2.379	2.645	3.429
74	1.293	1.666	1.993	2.378	2.644	3.427
75	1.293	1.665	1.992	2.377	2.643	3.425
76	1.293	1.665	1.992	2.376	2.642	3.423
77	1.293	1.665	1.991	2.376	2.641	3.421
78	1.292	1.665	1.991	2.375	2.640	3.420
79	1.292	1.664	1.990	2.374	2.640	3.418
80	1.292	1.664	1.990	2.374	2.639	3.416
81	1.292	1.664	1.990	2.373	2.638	3.415
82	1.292	1.664	1.989	2.373	2.637	3.413
83	1.292	1.663	1.989	2.372	2.636	3.412
84	1.292	1.663	1.989	2.372	2.636	3.410
85	1.292	1.663	1.988	2.371	2.635	3.409
86	1.291	1.663	1.988	2.370	2.634	3.407
87	1.291	1.663	1.988	2.370	2.634	3.406
88	1.291	1.662	1.987	2.369	2.633	3.405

df	Confidence intervals, <i>c</i>					
	80%	90%	95%	98%	99%	99.9%
	Level of Significance for One-Tailed Test, α					
	0.10	0.05	0.025	0.01	0.005	0.0005
	Level of Significance for Two-Tailed Test, α					
	0.20	0.10	0.05	0.02	0.01	0.001
89	1.291	1.662	1.987	2.369	2.632	3.403
90	1.291	1.662	1.987	2.368	2.632	3.402
91	1.291	1.662	1.986	2.368	2.631	3.401
92	1.291	1.662	1.986	2.368	2.630	3.399
93	1.291	1.661	1.986	2.367	2.630	3.398
94	1.291	1.661	1.986	2.367	2.629	3.397
95	1.291	1.661	1.985	2.366	2.629	3.396
96	1.290	1.661	1.985	2.366	2.628	3.395
97	1.290	1.661	1.985	2.365	2.627	3.394
98	1.290	1.661	1.984	2.365	2.627	3.393
99	1.290	1.660	1.984	2.365	2.626	3.392
100	1.290	1.660	1.984	2.364	2.626	3.390
120	1.289	1.658	1.980	2.358	2.617	3.373
140	1.288	1.656	1.977	2.353	2.611	3.361
160	1.287	1.654	1.975	2.350	2.607	3.352
180	1.286	1.653	1.973	2.347	2.603	3.345
200	1.286	1.653	1.972	2.345	2.601	3.340
∞	1.282	1.645	1.960	2.326	2.576	3.291

備

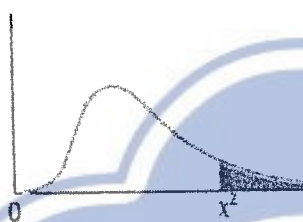
註

- 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	經濟學系	考 試 時 間	2 月 2 日(四) 第 4 節
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B.7 Critical Values of Chi-Square

This table contains the values of χ^2 that correspond to a specific right-tail area and specific number of degrees of freedom.

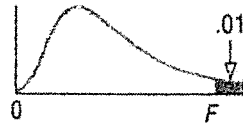


Example: With 17 df and a .02 area in the upper tail, $\chi^2 = 30.995$

Degrees of Freedom, df	Right-Tail Area			
	0.10	0.05	0.02	0.01
1	2.706	3.841	5.412	6.635
2	4.605	5.991	7.824	9.210
3	6.251	7.815	9.837	11.345
4	7.779	9.488	11.668	13.277
5	9.236	11.070	13.388	15.086
6	10.645	12.592	15.033	16.812
7	12.017	14.067	16.622	18.475
8	13.362	15.507	18.168	20.090
9	14.684	16.919	19.679	21.666
10	15.987	18.307	21.161	23.209
11	17.275	19.675	22.618	24.725
12	18.549	21.026	24.054	26.217
13	19.812	22.362	25.472	27.688
14	21.064	23.685	26.873	29.141
15	22.307	24.996	28.259	30.578
16	23.542	26.296	29.633	32.000
17	24.769	27.587	30.995	33.409
18	25.989	28.869	32.346	34.805
19	27.204	30.144	33.687	36.191
20	28.412	31.410	35.020	37.566
21	29.615	32.671	36.343	38.932
22	30.813	33.924	37.659	40.289
23	32.007	35.172	38.968	41.638
24	33.196	36.415	40.270	42.980
25	34.382	37.652	41.566	44.314
26	35.563	38.885	42.856	45.642
27	36.741	40.113	44.140	46.963
28	37.916	41.337	45.419	48.278
29	39.087	42.557	46.693	49.588
30	40.256	43.773	47.962	50.892

考 試 科 目	統計學	系 所 別	經濟學系	考 試 時 間	2 月 2 日(四) 第 4 節
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B.6B Critical Values of the F Distribution ($\alpha = .01$)



		Degrees of Freedom for the Numerator															
		1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40
Degrees of Freedom for the Denominator	1	4052	5000	5403	5625	5764	5859	5928	5981	6022	6056	6106	6157	6209	6235	6261	6287
	2	98.5	99.0	99.2	99.2	99.3	99.3	99.4	99.4	99.4	99.4	99.4	99.4	99.4	99.5	99.5	99.5
	3	34.1	30.8	29.5	28.7	28.2	27.9	27.7	27.5	27.3	27.2	27.1	26.9	26.7	26.6	26.5	26.4
	4	21.2	18.0	16.7	16.0	15.5	15.2	15.0	14.8	14.7	14.5	14.4	14.2	14.0	13.9	13.8	13.7
	5	16.3	13.3	12.1	11.4	11.0	10.7	10.5	10.3	10.2	10.1	9.89	9.72	9.55	9.47	9.38	9.29
	6	13.7	10.9	9.78	9.15	8.75	8.47	8.26	8.10	7.98	7.87	7.72	7.56	7.40	7.31	7.23	7.14
	7	12.2	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72	6.62	6.47	6.31	6.16	6.07	5.99	5.91
	8	11.3	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91	5.81	5.67	5.52	5.36	5.28	5.20	5.12
	9	10.6	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35	5.26	5.11	4.96	4.81	4.73	4.65	4.57
	10	10.0	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94	4.85	4.71	4.56	4.41	4.33	4.25	4.17
	11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63	4.54	4.40	4.25	4.10	4.02	3.94	3.86
	12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39	4.30	4.16	4.01	3.86	3.78	3.70	3.62
	13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19	4.10	3.96	3.82	3.66	3.59	3.51	3.43
	14	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14	4.03	3.94	3.80	3.66	3.51	3.43	3.35	3.27
	15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89	3.80	3.67	3.52	3.37	3.29	3.21	3.13
	16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78	3.69	3.55	3.41	3.26	3.18	3.10	3.02
	17	8.40	6.11	5.18	4.67	4.34	4.10	3.93	3.79	3.68	3.59	3.46	3.31	3.16	3.08	3.00	2.92
	18	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60	3.51	3.37	3.23	3.08	3.00	2.92	2.84
	19	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52	3.43	3.30	3.15	3.00	2.92	2.84	2.76
	20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46	3.37	3.23	3.09	2.94	2.86	2.78	2.69
	21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40	3.31	3.17	3.03	2.88	2.80	2.72	2.64
	22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35	3.26	3.12	2.98	2.83	2.75	2.67	2.58
	23	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.41	3.30	3.21	3.07	2.93	2.78	2.70	2.62	2.54
	24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26	3.17	3.03	2.89	2.74	2.66	2.58	2.49
	25	7.77	5.57	4.68	4.18	3.85	3.63	3.46	3.32	3.22	3.13	2.99	2.85	2.70	2.62	2.54	2.45
	30	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07	2.98	2.84	2.70	2.55	2.47	2.39	2.30
	40	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.89	2.80	2.66	2.52	2.37	2.29	2.20	2.11
	60	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72	2.63	2.50	2.35	2.20	2.12	2.03	1.94
	120	6.85	4.79	3.95	3.48	3.17	2.96	2.79	2.66	2.56	2.47	2.34	2.19	2.03	1.95	1.86	1.76
	∞	6.63	4.61	3.78	3.32	3.02	2.80	2.64	2.51	2.41	2.32	2.18	2.04	1.88	1.79	1.70	1.59

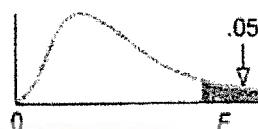
備

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	經濟學系	考 試 時 間	2 月 2 日(四) 第 4 節
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B.6A Critical Values of the F Distribution ($\alpha = .05$)



		Degrees of Freedom for the Numerator															
		1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40
Degrees of Freedom for the Denominator	1	161	200	216	225	230	234	237	239	241	242	244	246	248	249	250	251
	2	18.5	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.5	19.5	19.5
	3	10.1	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59
	4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72
	5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46
	6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77
	7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34
	8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04
	9	5.12	4.25	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83
	10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66
	11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53
	12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43
	13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34
	14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27
	15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20
	16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15
	17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.19	2.15	2.10
	18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06
	19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03
	20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99
	21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96
	22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94
	23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91
	24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89
	25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87
	30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79
	40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69
	60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59
	120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50
	∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.52	1.46	1.39

備

註

- 三、作答於試題上者，不予計分。
- 四、試題請隨卷繳交。