國立政治大學 109 學年度 碩士暨碩士在職專班 招生考試試題

考試科目	個體經濟學	系所別	經濟學系	考試時間	2月7日（五） 第二節

1.(十分)下列哪些函數不可能是追求支出極小化之下個別消費者的支出函數(E)？並說明原因。其中 P_X 和 P_Y 為商品的價格，M 為所得，U 為效用水準。

a. $E = P_X P_Y U$

b. $E = P_X P_Y M$

c. $E = \frac{P_X^2}{P_Y} U$

d. $E = \frac{P_X^2}{P_Y} M$

e. $E = \sqrt{\frac{P_X P_Y}{U}}$

f. $E = \sqrt{\frac{P_X P_Y}{M}}$

2.(四十分，每小題十分) 請使用文字、圖形以及數學解釋說明下列敘述為『真』、『偽』、或是『不確定』。

a. 當消費者的偏好滿足嚴格凸性的假設時，其無異曲線必定是負斜率。

b. 補償變量(compensating variation)等於均等變量(equivalent variation)的充份必要條件為替代效果等於所得效果。

c. 如果生產函數具有遞增規模報酬(increasing returns to scale)的特性時，邊際成本有可能是負數。

d. 成本函數對要素價格的一階偏微分，一定是正數。

3. [20 points] (Labor Supply) Steve maximizes his utility over leisure (N) and consumption (C) given the following utility function:

$$U(C, N) = \ln C + \ln N,$$

subject to the following constraints:

$$H = 1 - N \text{ and}$$

$$C = wH + Y^*,$$

where H is the hours of work per day (divided by 24 hours), w is the wage rate, and Y^* is his unearned income.

a. [5 points] Discuss the effects of an increase in Y^* on labor supply and consumption.

b. [5 points] Discuss the effects of an increase in w on labor supply and consumption.

c. [5 points] Suppose the government imposes a tax rate, τ, on his **wage income**, discuss the effect of an increase in τ on his labor supply and consumption.

d. [5 points] Suppose the government also imposes a tax rate, θ, on his **consumption**, discuss the effect of an increase in θ on his labor supply and consumption.

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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4. [15 points] (Labor Demand) Sam wanted to open a caramel apple business and knows that the going price for caramel apples is $5. After studying the production process, he determined that the productivity of workers was given by the following table (blank columns are included for your convenience). Please be sure the logic for your answers is clear.

Workers	Total apples/hour		
0	0		
1	6		
2	11		
3	15		
4	18		
5	20		

a. [5 points] Assume that Sam is operating in a perfectly competitive labor market and the going wage for caramel apple work is **$13/hour**. How many workers should Sam hire for his business? Why?

b. [10 points] Now assume that Sam is operating in a labor market where he faces an upward-sloping labor supply curve. The labor supply schedule is provided below (with blank columns for your convenience).

Suppose Sam is a **non-discriminating monopsonist**, how many workers should Sam hire for his business? What wage should he pay? Why?

Workers	Wage		
0			
1	10		
2	11		
3	12		
4	13		
5	14		

5. [15 points] (Minimum Wage) Use graphical analysis to explain why it is possible that placing a minimum wage on a **monopsonist** could increase employment.

考試科目	總體經濟學	系所別	經濟學系	考試時間	2月7日(五)第三節

I. Multiple Choice (2 point each)

1. Michelle grows apples and catches fish. Last year she harvested 1500 apples and 600 fish. She values one fish as having a worth of three apples. She gave James 300 apples and 100 fish for helping her to harvest apples and catch fish, all of which were consumed by James. Michelle set aside 200 fish to help with next year's harvest. In terms of fish, consumption would equal
   (A) 700 fish. (B) 900 fish. (C) 1100 fish. (D) 2700 fish.

2. What is the unemployment rate if there are 180 million people employed, 6 million people unemployed, and 14 million not in the labor force?
   (A) 3.00% (B) 3.23% (C) 3.33% (D) 3.65%

3. In forecasting consumer spending using surveys of consumer confidence, research suggests that
   (A) the forecasts are not improved when using consumer confidence measures.
   (B) the forecasts are improved when using consumer confidence measures.
   (C) the forecasts are improved when using consumer confidence measures for forecasts made during recessions, but not expansions.
   (D) the forecasts are not improved when using consumer confidence measures for forecasts made during expansions, but not recessions.

4. An increase in the price of capital goods will
   (A) increase the expected future marginal product of capital.
   (B) reduce the expected future marginal product of capital.
   (C) increase the interest cost and the depreciation cost of capital.
   (D) increase the interest cost but not affect the depreciation cost of capital.

5. Suppose output is $25 billion, government purchases are $9 billion, desired consumption is $12 billion, and desired investment is $6 billion. Net foreign lending would be equal to
   (A) -$4 billion. (B) -$2 billion. (C) $2 billion. (D) $4 billion.

6. According to the Solow model, an increase in the capital-labor ratio will
   (A) always reduce steady-state consumption per worker.
   (B) always increase steady-state consumption per worker.
   (C) reduce steady-state consumption per worker if the capital—labor ratio is below the Golden rule capital stock.
   (D) increase steady-state consumption per worker if the capital—labor ratio is below the Golden rule capital stock.

7. If real income rises 4%, prices rise 1%, and nominal money demand rises 4%, what is the income elasticity of real money demand?
   (A) 3/4 (B) 4/5 (C) 1 (D) 5/3

8. If the asset market is to remain in equilibrium, then if the money supply increases, output is unchanged, the price level is unchanged, and the expected inflation rate is unchanged, then
   (A) the real interest rate must rise. (B) the real interest rate must decline.
   (C) the nominal interest rate must rise. (D) the inflation rate must rise.

9. The Conference Board Leading Economic Index (LEI) for US includes 10 data series that are used to forecast economic activity about _____ in advance.

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(A) one month (B) six to nine months (C) one to two years (D) five to ten years

10. Which of the following is *true*?
(A) Employment is procyclical and unemployment is coincident with the business cycle.
(B) Industries that are extremely sensitive to the business cycle are the capital goods and nondurable goods sectors.
(C) Nominal interest rates are procyclical and leads the business cycle.
(D) Research on the effects of recessions on the real level of GDP shows that recessions cause both temporary and permanent declines in real GDP, but most of the decline is temporary.

11. Which of the following is *true*?
(A) Based on the sticky-price model, the short-run aggregate supply curve will be steeper, the greater the proportion of firms with flexible prices.
(B) According to the sticky-wage model, an unexpected increase in the price level raises the real wage, increases the quantity of labor hired, and increases the quantity of output produced.
(C) The imperfect-information model bases the difference in the short-run and long-run aggregate supply curve on procyclical real wages.
(D) The sticky-wage model predicts that the real wage is procyclical and data indicate that the real wage in the United States is countercyclical.

12. Which of the following is *true*?
(A) A speculative attack on a currency occurs when a central bank adopts a currency board to back the domestic currency with a foreign currency.
(B) If short-run equilibrium in the Mundell-Fleming model is represented by a graph with Y along the horizontal axis and the exchange rate along the vertical axis, then the LM^* curve is vertical because the exchange rate does not enter into the LM^* equation.
(C) Assuming there is perfect capital mobility, compared to a *large* open economy, a *small* open economy is one in which the exchange rate is floating.
(D) If the exchange rate of currency A is fixed to a unit of currency B, then a potential problem for the central bank in charge of currency A is running out of currency A.

13. Which of the following is *true*?
(A) In the Keynesian model in the long run, a decrease in the money supply will cause no change in the real interest rate and a decrease in the price level.
(B) In the Keynesian model in the long run, an increase in taxes causes the price level to fall and the real interest rate to rise.
(C) Keynesians explain the procyclical behavior of average labor productivity by introducing the concept of menu costs.
(D) In the efficiency wage model with the efficiency wage above the market-clearing wage, when employment is at its full-employment level there is an excess demand for labor.

14. Which of the following is *false*?
(A) Other things being equal, an increase in the effective tax rate on capital would cause the IS curve to shift down and to the left.
(B) The Federal Reserve has increased the money supply to avoid a recession. For a given price level, you would expect the LM curve to shift down and to the right as the real money supply rises.

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(C) Other things being equal, the *IS-LM* model predicts that a temporary beneficial supply shock increases output, national saving, and investment, but not the real interest rate.
(D) An increase in taxes (when Ricardian equivalence doesn't hold) causes the real interest rate to fall and the price level to rise in general equilibrium.

15. Which of the following is *false*?
(A) A temporary adverse productivity shock would decrease the level of employment.
(B) An adverse supply shock would directly decrease labor productivity by changing the amount of output that can be produced with any given amount of capital and labor. It would also indirectly increase average labor productivity through changes in the level of employment.
(C) One important reason why the Solow residual may be strongly procyclical even if the actual technology used in production doesn't change is that employment is procyclical.
(D) Prescott's calibrated RBC model was able to match the data in terms of the correlation between many key macroeconomic variables and GNP; that is, in terms of how closely they moved with GNP over the business cycle.

16. Which of the following is *false*?
(A) Advocates of passive policy argue that because monetary and fiscal policy lags are long and variable these policies should not be used to offset shocks.
(B) If people's expectations of inflation are formed rationally rather than based on adaptive expectations and if policymakers make a credible policy move to reduce inflation, then the costs of reducing inflation will be much lower than traditional estimates of the sacrifice ratio.
(C) Policy is conducted by rule if policymakers announce in advance how policy will respond to various situations and commit themselves to following through on this announcement.
(D) An argument in favor of allowing discretionary macroeconomic policy is that policymakers may make erratic shifts in policy in response to changing political situations.

17. Which of the following is *false*?
(A) The relationship between short-run aggregate supply curves and Phillips curves is that there is exactly one Phillips curve corresponding to each short-run aggregate supply curve.
(B) Based on the Phillips curve, unexpected movements in inflation are related to unemployment and based on the short-run aggregate supply curve, unexpected movements in the price level are related to output.
(C) Inflation inertia is represented in the aggregate supply and aggregate demand model by continuing upward shifts in the long-run aggregate supply curve.
(D) According to the natural-rate hypothesis, fluctuations in aggregate demand affect output in only in the short run.

18. The reason that the income response to a fiscal expansion is generally less in the *IS-LM* model than it is in the Keynesian-cross model is that the Keynesian-cross model assumes that:
(A) investment is not affected by the interest rate whereas in the *IS-LM* model fiscal expansion lowers the interest rate and crowds out investment.
(B) investment is not affected by the interest rate whereas in the *IS-LM* model fiscal expansion raises the interest rate and crowds out investment.
(C) investment is autonomous whereas in the *IS-LM* model fiscal expansion encourages higher investment, which raises the interest rate.
(D) the interest rate is fixed whereas in the *IS-LM* model it is allowed to vary.

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19. In the classical model, a temporary decrease in government spending would cause a decrease in
(A) output, employment, the real interest rate, and the price level.
(B) output, employment, real wages, and the price level.
(C) output, the real interest rate, real wages, and the price level.
(D) employment, the real interest rate, real wages, and the price level.

20. The Fed's forward guidance in late 2012 through mid-2015 was framed in terms of keeping interest rates low
(A) until the next Presidential election.
(B) at least until a particular date in the future.
(C) for an extended period.
(D) based on outcomes for the unemployment rate and inflation rate.

II. Analytical Questions (60 points in total)

1. (10 points) In the Keynesian model, suppose the Fed sets a target for the real interest rate. Describe how the real interest rate changes in a Keynesian model if a decrease in the effective tax rate on capital causes he movement of the IS curve and the Fed changes its policy to keep output unchanged.

2. 金融海嘯期間，商品市場需求減少，信用市場違約風險增加，銀行資產減計也不時衝擊經濟。請用總體經濟模型分析並回答下列問題：
(1)、信用市場違約和銀行資產減計加重了商品市場需求干擾的經濟效果。(15分)
(2)、引進信貸市場的IS-LM模型，流動性陷阱下的貨幣政策是否有效？(10分)

3. 底下是一個總和需求-總和供給的動態模型：
總和需求：$Y_t = \bar{Y}_t - \alpha(r_t - \rho) + \varepsilon_t$
Fisher方程式：$r_t = i_t - E_t\pi_{t+1}$
Phillips曲線：$\pi_t = E_{t-1}\pi_t + \varphi(Y_t - \bar{Y}_t) + v_t$
貨幣政策法則：$i_t = \pi_t + \rho + \theta_\pi(\pi_t - \pi_t^*) + \theta_Y(Y_t - \bar{Y}_t)$
其中，Y_t是總和產出；$\bar{Y}_t$是自然產出水準；r_t是實質利率；ε_t和v_t分別是需求面和供給面的隨機干擾；α、ρ、和φ是大於零的參數；$E_t\pi_{t+1}$代表著在t期對$t+1$期通貨膨脹的預期。進一步地，通貨膨脹的預期形式是：$E_{t-1}\pi_t = \pi_{t-1}$。請利用上述模型回答下列問題：
(1)、計算出該經濟體系的短期均衡與長期均衡。(10分)
(2)、令$\bar{Y}_t = 100$、$\pi_t^* = 2$、$\alpha = 1$、$\rho = 2$、$\varphi = 0.25$、$\theta_\pi = \theta_Y = 0.5$。假設供給面的隨機干擾$v_t$出現一次性增加、增加幅度是1%，之後回復至0的衝擊，則總和產出Y_t、通貨膨脹π_t、實質利率r_t在衝擊發生後的六個期間裡，它們的衝擊反應函數(impulse response functions)是如何變動？請繪圖呈現衝擊反應函數並說明理由。(15分)

考試科目	統計學	系所別	經濟系	考試時間	2 月 7 日(五) 第 四 節

1. (20%) The owners of the Happy Mall wished to study customer shopping habits. From earlier studies, the owners were under the impression that a typical shopper spends 0.75 hour at all the mall, with a standard deviation of 0.10 hour. Recently the mall owners added some specially restaurants designed to keep shoppers in the mall longer. The consulting firm, Brunner and Swanson Marketing Enterprises, was hired to evaluate the effects of the restaurants. A sample of 45 shoppers by Brunner and Swanson revealed that the mean time spent in the mall had increased to 0.80 hour. Suppose the mean shopping time actually increased from 0.75 hour to 0.79 hours. What is the probability of making a Type II error?

2. (30%) The following output was obtained from a multiple regression analysis.

Analysis of Variance		
Source	DF	SS
Regression	*	100
Residual Error	20	*
Total	25	140
Predictor	Coefficient	SE Coefficient
Constant	3.00	1.50
x_1	4.00	3.00
x_2	3.00	0.20
x_3	0.20	0.05
x_4	-2.50	1.00
x_5	3.00	4.00

(1) (15%) Conduct a global test of hypothesis to determine whether any of the regression coefficients are significant. State null and alternate hypotheses. Identify the test statistic, and formulate a decision rule. Use the 0.05 significance level.

(2) (15%) Test the regression coefficients individually. Would you consider omitting any variable(s)? If so, which one(s)? Use the 0.05 significance level.

3. (20%) Shank's Inc., a nationwide advertising firm, wants to know whether the size of an advertisement and the color of the advertisement make a difference in the response of magazine readers. A random sample of readers is shown ads of four different colors and three different sizes. Each reader is asked to give the particular combination of size and color a rating between 1 and 10. Assume that the ratings follow the normal distribution. The rating for each combination is shown in the following table (for example, the rating for small red ad is 2).

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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	Color of Ad			
Size of Ad	Red	Blue	Orange	Green
Small	2	3	3	8
Medium	3	5	6	7
Large	6	7	8	8

Is there a difference in the effectiveness of an advertisement by color and by size? Use the 0.05 level of significance.

4. (15%) The production manager of MPS Audio Systems Inc. is concerned about the idle time of workers. In particular, he would like to know if there is a difference in the idle minutes for workers on the day shift and the evening shift. The information below is the number of idle minutes yesterday for the five day-shift workers and the six evening-shift workers. Use the 0.05 significance level.

Day Shift	Evening Shift
92	96
103	114
116	80
81	82
89	88
	91

5. (15%) An investigation of the effectiveness of an antibacterial soap in reducing operating room contamination resulted in the accompanying table. The new soap was tested in a sample of eight operating rooms in the greater Seattle area during the last year. The following table reports the contamination levels before and after the use of the soap for each operating room.

	Operating Room							
	A	B	C	D	E	F	G	H
Before	6.6	6.5	9.0	10.3	11.2	8.1	6.3	11.6
After	6.8	2.4	7.4	8.5	8.1	6.1	3.4	2.0

At the 0.05 significance level, can we conclude the contamination measurements are lower after use of the new soap?

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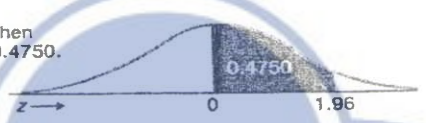
B.3 Areas under the Normal Curve

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

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B.5 Student's *t* Distribution

	Confidence Intervals, *c*					
	80%	90%	95%	98%	99%	99.9%
	Level of Significance for One-Tailed Test, α					
df	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
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 7 日(五) 第 四 節

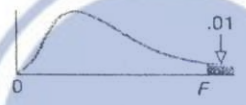
B.5 Student's *t* Distribution (*concluded*)

	Confidence Intervals, *c*					
	80%	90%	95%	98%	99%	99.9%
	Level of Significance for One-Tailed Test, α					
df	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

	Confidence Intervals, *c*					
	80%	90%	95%	98%	99%	99.9%
	Level of Significance for One-Tailed Test, α					
df	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

考試科目	統計學	系所別	經濟學系	考試時間	2 月 7 日(五) 第 四 節

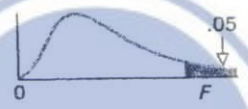
B.6B Critical Values of the *F* Distribution ($\alpha = .01$)



Degrees of Freedom for the Denominator	Degrees of Freedom for the Numerator															
	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40
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

考試科目	統計學	系所別	經濟學系	考試時間	2 月 7 日(五) 第 四 節

B.6A Critical Values of the *F* Distribution ($\alpha = .05$)



Degrees of Freedom for the Denominator	Degrees of Freedom for the Numerator: 1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40
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	4.26	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

考試科目	統計學	系所別	經濟學系	考試時間	2 月 7 日(五) 第 四 節

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