

考試科目	基礎數學	系所別	統計所	考試時間	2 月 5 日(五) 第一節
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Part I: multiple choice questions (4 points each)

- Which of the following statements are true?
 - f is differentiable at x_0 implies that f is continuous at x_0 .
 - $f(x) = x^4 + 3$ has an inflection point.
 - $\lim_{x \rightarrow \infty} (1 + 1/x)^x = 1$.
 - $\lim_{x \rightarrow \infty} x^{-1/2} \ln x = 0$.
 - None of the above.
- Let $f(x) = \ln(1+x)$. Which of the following statements are true?
 - The Taylor series about $x = 0$ is $x - x^2 + x^3 - x^4 + \dots$, for $|x| < 1$.
 - The Taylor series about $x = 0$ is $x - x^2/2 + x^3/3 - x^4/4 + \dots$, for $|x| < 1$.
 - $f'(x)$ is increasing in x for $x > -1$.
 - $f''(x)$ is increasing in x for $x > -1$.
 - None of the above.
- Consider $f(x) = 1/(1+x)$. Which of the following statements are true?
 - The Taylor series about $x = 0$ is $1 + x + x^2 + x^3 + \dots$, for $|x| < 1$.
 - The Taylor series about $x = 0$ is $1 - x + x^2 - x^3 + \dots$, for $|x| < 1$.
 - $\int_{-1}^1 f(x) dx = \infty$.
 - $\int_{-1}^{\infty} f(x) dx = \infty$.
 - None of the above.
- Which of the following statements are true?
 - $1/2 + 1/3 + \dots + 1/n < \ln n$
 - $1 + 1/2 + 1/3 + \dots + 1/n > \ln n$
 - $1 + 1/2 + 1/3 + 1/4 + \dots$ does not converge.
 - $1 + 1/2^{1.5} + 1/3^{1.5} + 1/4^{1.5} + \dots$ does not converge.
 - $1/2 - 1/3 + 1/4 - 1/5 + \dots + (-1)^n/n + \dots$ does not converge.
- Let $f(x_1, x_2, x_3) = x_1^2 + x_2^2 + x_3^2$ and $\mathbf{x} = (x_1, x_2, x_3)^T$, a 3×1 column vector. Which of the following statements are true?
 - The gradient of f with respect to \mathbf{x} is $(2x_1, 2x_2, 2x_3)^T$.
 - The Hessian of f with respect to \mathbf{x} is $(2, 2, 2)^T$.
 - The minimum value of f subject to $2x_1 + 2x_2 - x_3 = 7$ is 5.
 - The maximum value of f subject to $2x_1 + 2x_2 - x_3 = 7$ is 10.
 - None of the above.
- Let $f(x) = (\sin x)/x$. Which of the following statements are true?
 - $\lim_{x \rightarrow 0} f(x) = 0$.
 - $\lim_{x \rightarrow 0} f(x) = 1$.
 - $\lim_{x \rightarrow \frac{\pi}{2}} f(x) = 0$.
 - $\max_x f(x) = 1$.
 - None of the above.

備

註

- 作答於試題上者, 不予計分。
- 試題請隨卷繳交。

考試科目	基礎數學	系所別	統計所	考試時間	2 月 5 日(五) 第一節
------	------	-----	-----	------	----------------

7. Let $F(x) = \int_0^x |(\sin t)/t| dt$. Which of the following statements are true?
- $\lim_{x \rightarrow 0} F(x) = 0$.
 - $\lim_{x \rightarrow 0} F(x) = 1$.
 - $\lim_{x \rightarrow \infty} F(x) < \pi$.
 - $\lim_{x \rightarrow \infty} F(x) > \pi$.
 - None of the above.
8. Let A be an $m \times n$ matrix. Which of the following statements are true?
- $\text{nullity}(A) + \text{rank}(A) = n$.
 - $\text{rank}(A) = \text{rank}(A^T)$.
 - If $m = 7$ and $n = 5$, then $\text{rank}(A)$ is at most 5.
 - Suppose that $m = n$. Then, " A is singular" \Leftrightarrow " A has rank n ".
 - None of the above.
9. Let A be an $n \times n$ matrix whose (i, j) component is a_{ij} . The trace of A is defined as $\text{tr}A = \sum_{i=1}^n a_{ii}$. Let B and C be $n \times n$ matrices. Which of the following statements are true?
- $\text{tr}(AB) = \text{tr}(BA)$.
 - $\text{tr}(ABC) = \text{tr}(CBA)$.
 - $\text{tr}(A^T B) = \text{tr}(AB^T)$.
 - $\text{tr}(A + B) = (\text{tr}B)(\text{tr}A)$.
 - None of the above.
10. Let A be an $n \times n$ matrix whose (i, j) component is a_{ij} . Let f be a real-valued function defined on A . Let $\nabla_A f(A)$ be the gradient of $f(A)$ with respect to A : $\nabla_A f(A)$ is defined as an $n \times n$ matrix whose (i, j) entry is $\partial f / \partial a_{ij}$. Let B and C be $n \times n$ matrices. Which of the following statements are true?
- If $f(A) = \text{tr}(AB)$, then $\nabla_A f(A) = B$.
 - If $f(A) = \text{tr}(AB)$, then $\nabla_A f(A) = B^T$.
 - If $f(A) = \text{tr}(AA^T C)$, then $\nabla_A f(A) = CA + C^T A^T$.
 - If $f(A) = \text{tr}(AA^T C)$, then $\nabla_A f(A) = CA + CA^T$.
 - None of the above.
11. Which of the following statements are true?
- $A_{n \times n}$ is singular if and only if $Ax = b$ has infinitely many solutions for every $n \times 1$ vector b .
 - Every matrix transformation is a linear transformation.
 - If A is a nonsingular upper triangular matrix, then the adjoint matrix is lower triangular.
 - The dimension of the zero space $\{0\}$ is 0.
 - None of the above.
12. Let A be a 2×2 matrix defined as $A = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$. Which of the following statements are true?
- The characteristic function is $f_A(\lambda) = \lambda^2 - 1$.
 - The eigenvalues are $\pm\sqrt{-1} = \pm i$.
 - The eigenvectors are $(1, i)$ and $(1, -i)$.
 - The eigenvectors are $(-1, i)$ and $(-1, -i)$.
 - None of the above.

備

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- 作答於試題上者，不予計分。
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考試科目	基礎數學	系所別	統計所	考試時間	2月5日(五)第一節
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13. Which of the following are projection matrices?

(a) $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$

(b) $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$

(c) $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

(d) $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$

(e) None of the above.

14. Find the matrix for the reflection of R^2 through the $x = y$ line.

(a) $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$

(b) $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$

(c) $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

(d) $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$

(e) None of the above.

15. Let A be an $n \times n$ matrix. Which of the following statements are true?

(a) A symmetric matrix A is positive definite if and only if all the eigenvalues of A are positive.

(b) A is nonsingular if and only if $\det A \neq 0$.

(c) A is singular if and only if 0 is an eigenvalue of A .

(d) $\det A = \lambda_1 + \lambda_2 + \cdots + \lambda_n$, where λ_i 's are eigenvalues of A .

(e) None of the above.

Part II: short answer questions

1. (10 points) Find the limit.

$$\lim_{x \rightarrow \infty} \frac{x^{-1/2} - (x+1)^{-1/2}}{x^{-1}}$$

2. (10 points) Evaluate the integral.

$$\int_0^{\infty} 2 \left(\frac{x}{5}\right)^2 e^{-\left(\frac{x}{5}\right)^2} dx.$$

3. (20 points) Suppose that $u_0 = 1$, $u_1 = 1$, and $u_n = 2u_{n-1} + 3u_{n-2}$.

(a) Find eigenvalues of the matrix $A = \begin{pmatrix} 2 & 3 \\ 1 & 0 \end{pmatrix}$.

(b) Find the value of u_{100} .

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	數理統計學	系所別	統計學系	考試時間	2 月 5 日(五) 第二節
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1. (35pt) 此大題請直接填寫答案，不需要提供過程說明

a. (5pt) Let X be one observation from a $N(0, \theta)$ distribution. Find the sufficient statistic for θ .

b. (5pt) Let X_1, X_2, \dots, X_n be i.i.d. from the density $f(x; \theta) = \frac{1}{\pi} \frac{1}{1 + (x-\theta)^2}$. Find the sufficient statistic for θ .

c. (5pt) Let X be one observation from the density

$$f(x; \theta) = \left(\frac{\theta}{2}\right)^{|x|} (1 - \theta)^{1 - |x|}, x = -1, 0, 1; 0 \leq \theta \leq 1.$$

Find an unbiased estimate for θ .

d. (10pt) Let X_1, X_2, \dots, X_8 be a random sample from $\text{Uniform}(\mu - \sqrt{3}\sigma, \mu + \sqrt{3}\sigma)$, where μ and $\sigma > 0$ are the unknown parameters. Find the MLE of μ and σ based on the 8 observations:

$$X_1 = 2.88, X_2 = -4.04, X_3 = -3.26, X_4 = -3.57,$$

$$X_5 = -0.09, X_6 = 0.25, X_7 = -2.58, X_8 = 4.59.$$

e. (5pt) Let X be one observation from $\text{Uniform}(\theta, \theta + 1)$. For testing $H_0: \theta = 0$ vs. $H_1: \theta > 0$, find the power function for the decision rule that we reject H_0 if $X > 0.9$

f. (5pt) Let X_1, X_2, \dots, X_n be a random sample from $P(X = k) = \theta(1 - \theta)^{k-1}, k = 1, 2, \dots$. Find the MLE of θ .

2. (20pt) Let the distribution of X be $\text{Uniform}(0, 1)$. Conditional on $X = x$, let the distribution of Y be the normal distribution with mean x and variance x^2 .

a. (8pt) Find the distribution of Y .

b. (12pt) Are $\frac{Y}{X}$ and X independent? Prove or disprove it with your work.

3. (15pt) Let X_1, X_2, \dots, X_n be a random sample from the density $f(x; \theta) = \frac{1}{\theta} \exp\left(\frac{(1-\theta)}{\theta} \ln x\right), 0 < x < 1$.

Test $H_0: \theta \leq \theta_0$ vs. $H_1: \theta > \theta_0$. Find a uniformly most powerful size α test if such exists.

4. (30pt) Let X_1, X_2, \dots, X_n be a random sample from the density

考試科目	數理統計學	系所別	統計學系	考試時間	2 月 5 日(五) 第二節
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$$f(x; \theta) = \begin{cases} \frac{2x}{\theta}, & 0 < x \leq \theta \\ \frac{2(1-x)}{1-\theta}, & \theta < x \leq 1 \end{cases}, \text{ where } 0 \leq \theta \leq 1.$$

- (5pt) Find $E(X_1)$
- (4pt) Find the moment estimate of θ
- (7pt) Find the maximum likelihood estimate of θ for $n = 1$
- (7pt) For $n = 1$ find a complete sufficient statistic if such exists.
- (7pt) Find a UMVUE of θ for $n = 1$ if such exists



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考 試 科 目	統計方法	系 所 別	統計學系	考 試 時 間	2 月 5 日(五) 第四節
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Note: Use the level of significance 0.05 for the test of hypothesis if required.

1. (35%) Ten golf players hit each a drive with one of three driver designs, namely A, B, and C, in a randomly selected order, and the overall distance (in yard) was recorded. The following table shows the result by player.

Player	Design		
	A	B	C
1	306	323	320
2	279	313	289
3	293	318	314
4	277	288	282
5	281	286	287
6	272	312	283
7	297	326	332
8	271	306	284
9	279	325	294
10	323	319	289
* $\sum Y_i$	2878	3116	2974
** $\sum Y_i^2$	830820	972804	887336

*denotes the sum of observations

** denotes the sum of squared observations

Assume that overall distance follows a normal distribution. Answer the following questions.

- (a) Construct a 95% confidence interval for the mean driving distance using design A. (6%)
- (b) Test the equality of the population variances of driving distance between designs A and B. (7%)
- (c) Test the equality of the population means of driving distance between designs A and B. (10%)
- (d) If the total sum of squares is 10125.87, then test whether the mean driving distance is the same for all three designs. (12%)
2. (35%) We now consider a regression analysis for the same data in Question 1 by employing the overall distance as the response variable, and defining the following dummy variables as explanatory variables:

$$D_1 = \begin{cases} 1 & \text{if from Design B} \\ 0 & \text{otherwise} \end{cases}, \quad D_2 = \begin{cases} 1 & \text{if from Design C} \\ 0 & \text{otherwise} \end{cases}$$

考試科目	統計方法	系所別	統計學系	考試時間	2 月 5 日(五) 第(四)節
------	------	-----	------	------	------------------

We then obtain the following regression result.

	Standard error
<i>Constant</i>	5.185
D_1	7.333
D_2	7.333

Please answer the following questions.

- Write a linear regression model with both D_1 and D_2 to fit these data, explain each of the terms, and state the assumptions necessary for the model. (8%)
 - Find the coefficient estimates of *constant*, D_1 , and D_2 . (6%)
 - Explain the meanings of the estimated coefficients for D_1 and D_2 . (6%)
 - Show the significances of the coefficient estimates for D_1 and D_2 . (8%)
 - What is the value of the adjusted R^2 ? (7%)
3. (20%) A salesperson makes four calls per day. A sample of 100 days gives the following frequencies (days) of sales volumes.

Number of sales	Days
0	30
1	32
2	25
3	10
4	3

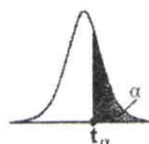
Assuming independent sales calls, the number of successful sales per day should follow a binomial distribution and the sales rate resulted from 30% of all sales calls. Use the goodness of fit test to determinant whether the assumption of a binomial probability distribution should be rejected.

4. (10%) One of the most common tests for the detection of prostate cancer is the prostate-specific antigen (PSA) test. Suppose there is a 0.23 probability that a male patient has prostate cancer before testing. The probability of a false-positive (tests that come back positive for cancer when no cancer is present) for the SPA test is 0.65, and the probability of a false-negative (no indication of cancer when cancer is actually present) is 0.18.

考試科目	統計方法	系所別	統計學系	考試時間	2 月 5 日(五) 第四節
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- (a) What is the probability that the male patient has prostate cancer if the PSA test comes back negative? (5%)
 (b) What is the probability that the male patient has prostate cancer if the PSA test comes back positive? (5%)

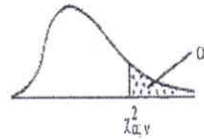
Percentage Points of the t Distribution; $t_{v, \alpha}$
 $P(T > t_{v, \alpha}) = \alpha$



v	α													
	0.40	0.30	0.20	0.15	0.10	0.05	0.025	0.02	0.015	0.01	0.0075	0.005	0.0025	0.0005
1	0.325	0.727	1.376	1.963	3.078	6.314	12.706	15.895	21.205	31.821	42.434	63.657	127.322	636.590
2	0.289	0.617	1.061	1.386	1.886	2.920	4.303	4.849	5.643	6.965	8.073	9.925	14.089	31.598
3	0.277	0.584	0.978	1.250	1.638	2.353	3.182	3.482	3.896	4.541	5.047	5.841	7.453	12.924
4	0.271	0.569	0.941	1.190	1.533	2.132	2.776	2.999	3.298	3.747	4.088	4.604	5.598	8.610
5	0.267	0.559	0.920	1.156	1.476	2.015	2.571	2.757	3.003	3.365	3.634	4.032	4.773	6.869
6	0.265	0.553	0.906	1.134	1.440	1.943	2.447	2.612	2.829	3.143	3.372	3.707	4.317	5.959
7	0.263	0.549	0.896	1.119	1.415	1.895	2.365	2.517	2.715	2.998	3.203	3.499	4.029	5.408
8	0.262	0.546	0.889	1.108	1.397	1.860	2.306	2.449	2.634	2.896	3.085	3.355	3.833	5.041
9	0.261	0.543	0.883	1.100	1.383	1.833	2.262	2.398	2.574	2.821	2.998	3.250	3.690	4.781
10	0.260	0.542	0.879	1.093	1.372	1.812	2.228	2.359	2.527	2.764	2.932	3.169	3.581	4.587
11	0.260	0.540	0.876	1.088	1.363	1.796	2.201	2.328	2.491	2.718	2.879	3.106	3.497	4.437
12	0.259	0.539	0.873	1.083	1.356	1.782	2.179	2.303	2.461	2.681	2.836	3.055	3.428	4.318
13	0.259	0.538	0.870	1.079	1.350	1.771	2.160	2.282	2.436	2.650	2.801	3.012	3.372	4.221
14	0.258	0.537	0.868	1.076	1.345	1.761	2.145	2.264	2.415	2.624	2.771	2.977	3.326	4.140
15	0.258	0.536	0.866	1.074	1.341	1.753	2.131	2.249	2.397	2.602	2.746	2.947	3.286	4.073
16	0.258	0.535	0.865	1.071	1.337	1.746	2.120	2.235	2.382	2.583	2.724	2.921	3.252	4.015
17	0.257	0.534	0.863	1.069	1.333	1.740	2.110	2.224	2.368	2.567	2.706	2.898	3.222	3.965
18	0.257	0.534	0.862	1.067	1.330	1.734	2.101	2.214	2.356	2.552	2.689	2.878	3.197	3.922
19	0.257	0.533	0.861	1.066	1.328	1.729	2.093	2.205	2.346	2.539	2.674	2.861	3.174	3.883
20	0.257	0.533	0.860	1.064	1.325	1.725	2.086	2.197	2.336	2.528	2.661	2.845	3.153	3.850
21	0.257	0.532	0.859	1.063	1.323	1.721	2.080	2.189	2.328	2.518	2.649	2.831	3.135	3.819
22	0.256	0.532	0.858	1.061	1.321	1.717	2.074	2.183	2.320	2.508	2.639	2.819	3.119	3.792
23	0.256	0.532	0.858	1.060	1.319	1.714	2.069	2.177	2.313	2.500	2.629	2.807	3.104	3.768
24	0.256	0.531	0.857	1.059	1.318	1.711	2.064	2.172	2.307	2.492	2.620	2.797	3.091	3.745
25	0.256	0.531	0.856	1.058	1.316	1.708	2.060	2.167	2.301	2.485	2.612	2.787	3.078	3.725
26	0.256	0.531	0.856	1.058	1.315	1.706	2.056	2.162	2.296	2.479	2.605	2.779	3.067	3.707
27	0.256	0.531	0.855	1.057	1.314	1.703	2.052	2.158	2.291	2.473	2.598	2.771	3.057	3.690
28	0.256	0.530	0.855	1.056	1.313	1.701	2.048	2.154	2.286	2.467	2.592	2.763	3.047	3.674
29	0.256	0.530	0.854	1.055	1.311	1.699	2.045	2.150	2.282	2.462	2.586	2.756	3.038	3.659
30	0.256	0.530	0.854	1.055	1.310	1.697	2.042	2.147	2.278	2.457	2.581	2.750	3.030	3.646
40	0.255	0.529	0.851	1.050	1.303	1.684	2.021	2.123	2.250	2.423	2.542	2.704	2.971	3.551
60	0.254	0.527	0.848	1.045	1.296	1.671	2.000	2.099	2.223	2.390	2.504	2.660	2.915	3.460
120	0.254	0.526	0.845	1.041	1.289	1.658	1.980	2.076	2.196	2.358	2.468	2.617	2.860	3.373
∞	0.253	0.524	0.842	1.036	1.282	1.645	1.960	2.054	2.170	2.326	2.432	2.576	2.807	3.291

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Table of the Chi-square Distribution



$\alpha =$	0.995	0.99	0.98	0.975	0.95	0.90	0.80	0.20	0.10	0.05	0.025	0.02	0.01	0.005	0.001	$=\alpha$
V=1	0.000393	0.00137	0.00228	0.00393	0.0158	0.0642	1.642	2.706	3.841	5.024	5.412	6.635	7.879	10.827	V=1	
2	0.0100	0.0201	0.0404	0.0506	0.103	0.211	0.446	3.219	4.605	5.991	7.378	7.824	9.210	10.597	13.815	2
3	0.0717	0.115	0.185	0.216	0.352	0.584	1.005	4.642	6.251	7.815	9.348	9.837	11.345	12.838	16.268	3
4	0.207	0.297	0.429	0.484	0.711	1.064	1.649	5.989	7.779	9.488	11.143	11.668	13.277	14.860	18.465	4
5	0.412	0.554	0.752	0.831	1.145	1.610	2.343	7.289	9.236	11.070	12.832	13.388	15.086	16.750	20.517	5
6	0.676	0.872	1.134	1.237	1.635	2.204	3.070	8.558	10.645	12.592	14.449	15.033	16.812	18.548	22.457	6
7	0.989	1.239	1.564	1.690	2.167	2.833	3.822	9.803	12.017	14.067	16.013	16.622	18.475	20.278	24.322	7
8	1.344	1.646	2.032	2.180	2.733	3.490	4.594	11.030	13.362	15.507	17.535	18.168	20.090	21.955	26.125	8
9	1.735	2.088	2.532	2.700	3.325	4.168	5.380	12.242	14.684	16.919	19.023	19.679	21.666	23.589	27.877	9
10	2.156	2.558	3.059	3.247	3.940	4.865	6.179	13.442	15.987	18.307	20.483	21.161	23.209	25.188	29.588	10
11	2.603	3.053	3.609	3.816	4.575	5.578	6.989	14.631	17.275	19.675	21.920	22.618	24.725	26.757	31.264	11
12	3.074	3.571	4.178	4.404	5.226	6.304	7.807	15.812	18.549	21.026	23.337	24.054	26.217	28.300	32.909	12
13	3.565	4.107	4.765	5.009	5.892	7.042	8.634	16.985	19.812	22.362	24.736	25.472	27.688	29.819	34.528	13
14	4.075	4.660	5.368	5.629	6.571	7.790	9.467	18.151	21.064	23.685	26.119	26.873	29.141	31.319	36.123	14
15	4.601	5.229	5.985	6.262	7.261	8.547	10.307	19.311	22.307	24.996	27.488	28.259	30.578	32.801	37.697	15
16	5.142	5.812	6.614	6.908	7.962	9.312	11.152	20.465	23.542	26.296	28.845	29.633	32.000	34.267	39.252	16
17	5.697	6.408	7.255	7.564	8.672	10.085	12.002	21.615	24.769	27.587	30.191	30.995	33.409	35.718	40.790	17
18	6.265	7.015	7.906	8.231	9.390	10.865	12.857	22.760	25.989	28.869	31.526	32.346	34.805	37.156	42.312	18
19	6.844	7.633	8.367	8.707	10.117	11.651	13.716	23.900	27.204	30.144	32.852	33.687	36.191	38.582	43.820	19
20	7.434	8.260	9.237	9.591	10.851	12.443	14.578	25.038	28.412	31.410	34.170	35.020	37.566	39.997	45.315	20
21	8.034	8.897	9.915	10.283	11.591	13.240	15.445	26.171	29.615	32.671	35.479	36.343	38.932	41.401	46.797	21
22	8.643	9.542	10.600	10.982	12.338	14.041	16.314	27.301	30.813	33.924	36.781	37.659	40.289	42.796	48.268	22
23	9.260	10.196	11.293	11.688	13.091	14.848	17.187	28.429	32.007	35.172	38.076	38.968	41.638	44.181	49.728	23
24	9.886	10.856	11.992	12.401	13.848	15.659	18.062	29.553	33.196	36.415	39.364	40.270	42.980	45.558	51.179	24
25	10.520	11.524	12.697	13.120	14.611	16.473	18.940	30.675	34.382	37.652	40.646	41.566	44.314	46.928	52.620	25
26	11.160	12.198	13.409	13.844	15.379	17.292	19.820	31.795	35.563	38.885	41.923	42.856	45.642	48.290	54.052	26
27	11.808	12.879	14.125	14.573	16.151	18.114	20.703	32.912	36.741	40.113	43.194	44.140	46.963	49.645	55.476	27
28	12.461	13.565	14.847	15.308	16.928	18.939	21.588	34.027	37.916	41.337	44.461	45.419	48.278	50.993	56.893	28
29	13.121	14.256	15.574	16.047	17.708	19.768	22.475	35.139	39.087	42.557	45.722	46.693	49.588	52.336	58.302	29
30	13.787	14.953	16.306	16.791	18.493	20.599	23.364	36.250	40.256	43.773	46.979	47.962	50.892	53.672	59.703	30
40	20.706	22.164	23.838	24.433	26.509	29.051	32.345	47.269	51.805	55.759	59.342	60.436	63.691	66.766	73.402	40
50	27.991	29.707	31.664	32.357	34.764	37.689	41.449	58.164	63.167	67.505	71.420	72.613	76.154	79.490	86.661	50
60	35.535	37.485	39.699	40.482	43.188	46.459	50.641	68.972	74.397	79.082	83.298	84.580	88.379	91.952	99.607	60
70	43.275	45.442	47.893	48.758	51.739	55.329	59.898	79.715	85.527	90.531	95.023	96.368	100.425	104.215	112.317	70
80	51.171	53.539	56.213	57.153	60.391	64.278	69.207	90.405	96.578	101.880	106.629	108.069	112.329	116.321	124.839	80
90	59.196	61.754	64.634	65.646	69.126	73.291	78.558	101.034	107.565	113.145	118.136	119.648	124.116	128.299	137.208	90
100	67.327	70.065	73.142	74.222	77.929	82.358	87.945	111.667	118.498	124.342	129.561	131.142	135.807	140.170	149.449	100

考 試 科 目	統計方法	系 所 別	統計學系	考 試 時 間	2 月 5 日(五) 第 四 節
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F - Distribution ($\alpha = 0.05$ in the Right Tail)

df ₂	df ₁	Numerator Degrees of Freedom								
		1	2	3	4	5	6	7	8	9
1		161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54
2		18.513	19.000	19.164	19.247	19.296	19.330	19.353	19.371	19.385
3		10.128	9.5521	9.2766	9.1172	9.0135	8.9406	8.8867	8.8452	8.8123
4		7.7086	9.9443	6.5914	6.3882	6.2561	6.1631	6.0942	6.0410	6.9988
5		6.6079	5.7861	5.4095	5.1922	5.0503	4.9503	4.8759	4.8183	4.7725
6		5.9874	5.1433	4.7571	4.5337	4.3874	4.2839	4.2067	4.1468	4.0990
7		5.5914	4.7374	4.3468	4.1203	3.9715	3.8660	3.7870	3.7257	3.6767
8		5.3177	4.4590	4.0662	3.8379	3.6875	3.5806	3.5005	3.4381	3.3881
9		5.1174	4.2565	3.8625	3.6331	3.4817	3.3738	3.2927	3.2296	3.1789
10		4.9646	4.1028	3.7083	3.4780	3.3258	3.2172	3.1355	3.0717	3.0204
11		4.8443	3.9823	3.5874	3.3567	3.2039	3.0946	3.0123	2.9480	2.8962
12		4.7472	3.8853	3.4903	3.2592	3.1059	2.9961	2.9134	2.8486	2.7964
13		4.6672	3.8056	3.4105	3.1791	3.0254	2.9153	2.8321	2.7669	2.7144
14		4.6001	3.7389	3.3439	3.1122	2.9582	2.8477	2.7642	2.6987	2.6458
15		4.5431	3.6823	3.2874	3.0556	2.9013	2.7905	2.7066	2.6408	2.5876
16		4.4940	3.6337	3.2389	3.0069	2.8524	2.7413	2.6572	2.5911	2.5377
17		4.4513	3.5915	3.1968	2.9647	2.8100	2.6987	2.6143	2.5480	2.4943
18		4.4139	3.5546	3.1599	2.9277	2.7729	2.6613	2.5767	2.5102	2.4563
19		4.3807	3.5219	3.1274	2.8951	2.7401	2.6283	2.5435	2.4768	2.4227
20		4.3512	3.4928	3.0984	2.8661	2.7109	2.5990	2.5140	2.4471	2.3928
21		4.3248	3.4668	3.0725	2.8401	2.6848	2.5727	2.4876	2.4205	2.3660
22		4.3009	3.4434	3.0491	2.8167	2.6613	2.5491	2.4638	2.3965	2.3419
23		4.2793	3.4221	3.0280	2.7955	2.6400	2.5277	2.4422	2.3748	2.3201
24		4.2597	3.4028	3.0088	2.7763	2.6207	2.5082	2.4226	2.3551	2.3002
25		4.2417	3.3852	2.9912	2.7587	2.6030	2.4904	2.4047	2.3371	2.2821
26		4.2252	3.3690	2.9752	2.7426	2.5868	2.4741	2.3883	2.3205	2.2655
27		4.2100	3.3541	2.9604	2.7278	2.5719	2.4591	2.3732	2.3053	2.2501
28		4.1960	3.3404	2.9467	2.7141	2.5581	2.4453	2.3593	2.2913	2.2360
29		4.1830	3.3277	2.9340	2.7014	2.5454	2.4324	2.3463	2.2783	2.2229
30		4.1709	3.3158	2.9223	2.6896	2.5336	2.4205	2.3343	2.2662	2.2107
40		4.0847	3.2317	2.8387	2.6060	2.4495	2.3359	2.2490	2.1802	2.1240
60		4.0012	3.1504	2.7581	2.5252	2.3683	2.2541	2.1665	2.0970	2.0401
120		3.9201	3.0718	2.6802	2.4472	2.2899	2.1750	2.0868	2.0164	1.9588
∞		3.8415	2.9957	2.6049	2.3719	2.2141	2.0986	2.0096	1.9384	1.8799

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	統計方法	系 所 別	統計學系	考 試 時 間	二 月 五 日 (五) 第 四 節
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F - Distribution ($\alpha = 0.025$ in the Right Tail)

df ₂ \ df ₁	Numerator Degrees of Freedom								
	1	2	3	4	5	6	7	8	9
1	647.79	799.50	864.16	899.58	921.85	937.11	948.22	956.66	963.28
2	38.506	39.000	39.165	39.248	39.298	39.331	39.335	39.373	39.387
3	17.443	16.044	15.439	15.101	14.885	14.735	14.624	14.540	14.473
4	12.218	10.649	9.9792	9.6045	9.3645	9.1973	9.0741	8.9796	8.9047
5	10.007	8.4336	7.7636	7.3879	7.1464	6.9777	6.8531	6.7572	6.6811
6	8.8131	7.2599	6.5988	6.2272	5.9876	5.8198	5.6955	5.5996	5.5234
7	8.0727	6.5415	5.8898	5.5226	5.2852	5.1186	4.9949	4.8993	4.8232
8	7.5709	6.0595	5.4160	5.0526	4.8173	4.6517	4.5286	4.4333	4.3572
9	7.2093	5.7147	5.0781	4.7181	4.4844	4.3197	4.1970	4.1020	4.0260
10	6.9367	5.4564	4.8256	4.4683	4.2361	4.0721	3.9498	3.8549	3.7790
11	6.7241	5.2559	4.6300	4.2751	4.0440	3.8807	3.7586	3.6638	3.5879
12	6.5538	5.0959	4.4742	4.1212	3.8911	3.7283	3.6065	3.5118	3.4358
13	6.4143	4.9653	4.3472	3.9959	3.7667	3.6043	3.4827	3.3880	3.3120
14	6.2979	4.8567	4.2417	3.8919	3.6634	3.5014	3.3799	3.2853	3.2093
15	6.1995	4.7650	4.1528	3.8043	3.5764	3.4147	3.2934	3.1987	3.1227
16	6.1151	4.6867	4.0768	3.7294	3.5021	3.3406	3.2194	3.1248	3.0488
17	6.0420	4.6189	4.0112	3.6648	3.4379	3.2767	3.1556	3.0610	2.9849
18	5.9781	4.5597	3.9539	3.6083	3.3820	3.2209	3.0999	3.0053	2.9291
19	5.9216	4.5075	3.9034	3.5587	3.3327	3.1718	3.0509	2.9563	2.8801
20	5.8715	4.4613	3.8587	3.5147	3.2891	3.1283	3.0074	2.9128	2.8365
21	5.8266	4.4199	3.8188	3.4754	3.2501	3.0895	2.9686	2.8740	2.7977
22	5.7863	4.3828	3.7829	3.4401	3.2151	3.0546	2.9338	2.8392	2.7628
23	5.7498	4.3492	3.7505	3.4083	3.1835	3.0232	2.9023	2.8077	2.7313
24	5.7166	4.3187	3.7211	3.3794	3.1548	2.9946	2.8738	2.7791	2.7027
25	5.6864	4.2909	3.6943	3.3530	3.1287	2.9685	2.8478	2.7531	2.6766
26	5.6586	4.2655	3.6697	3.3289	3.1048	2.9447	2.8240	2.7293	2.6528
27	5.6331	4.2421	3.6472	3.3067	3.0828	2.9228	2.8021	2.7074	2.6309
28	5.6096	4.2205	3.6264	3.2863	3.0626	2.9027	2.7820	2.6872	2.6106
29	5.5878	4.2006	3.6072	3.2674	3.0438	2.8840	2.7633	2.6686	2.5919
30	5.5675	4.1821	3.5894	3.2499	3.0265	2.8667	2.7460	2.6513	2.5746
40	5.4239	4.0510	3.4633	3.1261	2.9037	2.7444	2.6238	2.5289	2.4519
60	5.2856	3.9253	3.3425	3.0077	2.7863	2.6274	2.5068	2.4117	2.3344
120	5.1523	3.8046	3.2269	2.8943	2.6740	2.5154	2.3948	2.2994	2.2217
∞	5.0239	3.6889	3.1161	2.7858	2.5665	2.4082	2.2875	2.1918	2.1136

備

註

- 一、作答於試題上者，不予計分。
- 二、試題請隨卷繳交。