國立雲林科技大學 102 學年度 系所：運籌所
碩士班暨碩士在職專班招生考試試題 科目：統計學(2)

1. (a) (5%) Describe what are **random variables**?
(b) (5%) Describe what are **sampling distributions**?

2. 10% residents of a city had H1N1 influenza. There is a 0.90 probability that a H1N1 patient will have a positive reaction to a medical test. However, there is also a 0.05 probability that a healthy person will show a positive reaction to the test. Answer the following questions.
(a) (4%) Use a **probability tree** to describe the problem. Describe each probability in the tree by an appropriate notation.
(b) (6%) If a randomly selected resident from the city takes the test and shows positive reaction, what is the probability that the resident **actually does not** have H1N1 influenza?

3. Given the joint density function

$$f(x,y) = c\,(x+2y), 0 \le x \le 1, 0 \le y \le 1,$$
$$= 0, \text{ elsewhere}$$

(a) (4%) Evaluate the constant c such that $f(x,y)$ is a valid joint density function.
(b) (6%) Evaluate $P(Y < 1/2)$.

4. (10%) Suppose that random variable X has the following p.d.f.:

$$f(x) = x, \quad 0 < x < 1$$
$$= 2 - x, \quad 1 \le x < 2$$
$$= 0, \quad \text{elsewhere}$$

Evaluate the **expected value** of $60X^2 + 39X$.

5. (10%) A machine in a manufacturing shop breaks down according to a Poisson process with an average 1.5 breakdowns per **month**. What is the probability that it will take **longer than** 1.5 months from now until the next breakdown?

6. (10%) A physical education director claims by taking a special vitamin, a weight lifter can increase his strength. Eight athletes are selected and given a test of strength, using the standard bench press. After two weeks of regular training, supplemented with the vitamin, they are tested again. Test the effectiveness of the vitamin regimen at α=0.05. Each value in these data represents the maximum number of pounds the athlete can bench-press. Assume that the variable is approximately normally distributed.

Athlete	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Before	210	230	182	205	262	253	219	216
After	219	236	179	204	270	250	222	216

7. A psychologist wants to determine if there is a linear relationship between the number of hours a person goes without sleep and the number of mistakes he/she makes on a simple test. The following data is recorded.

Hours without Sleep, x	Number of Mistakes, y
32	6
38	8
48	13
24	5
46	7
35	6
30	5
34	8
42	12

(a) (12%) Find a regression line relating x to y.

(b) (3%) Predict the number of mistakes when hours without sleep are 48 hours.

Question 8 to 12 are multiple choice questions, please select the correct answer.

8. (5%) A college believes that 28% of applicants to that school have parents who have remarried. How large a sample is needed to estimate the true proportion of students who have parents who have remarried to within 5 percentage points with 95% confidence?

(A) 104 (B) 220 (C) 310 (D) 465 (E) 566

9. (5%) If the probability of a type II error in a hypothesis test is 0.30, and $\alpha = 0.01$, then the power of this test is

(A) 0.01 (B) 0.30 (C) 0.4 (D) 0.70 (E) 0.99

10. (5%) Suppose that you carry out a statistical test and find that the test statistic is $z = 1.20$ (Assume that the sample size is at least 30.) If the test is right-tailed, then the p-value is:

(A) -0.0124 (B) 0.0062 (C) 0.1151 (D) 0.9876 (E) 0.1212

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11. (5%) A certain brand of electric bulbs has an average life of 300 hours with a standard deviation of 25. A random sample of 100 bulbs is tested. What is the probability that the sample mean will be less than 295 hours?

(A) 0.0228 (B) 0.0548 (C) 0.1096 (D) 0.0793 (E) 0.4452

12. (5%) When the sample size increases, everything else remaining the same, the width of a confidence interval for a population parameter will:

(A) Increase

(B) Decrease

(C) Remain unchanged

(D) Sometimes increase and sometimes decrease

(E) Impossible to tell

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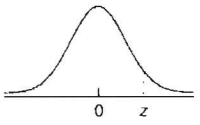
TABLE II (cont.)
Areas under the standard normal curve



	Second decimal place in z									
z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.7	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.8	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.9	1.0000†									

† For $z \geq 3.90$, the areas are 1.0000 to four decimal places.

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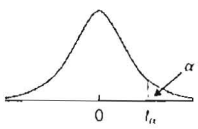
TABLE IV
Values of t_α



df	$t_{0.10}$	$t_{0.05}$	$t_{0.025}$	$t_{0.01}$	$t_{0.005}$	df
1	3.078	6.314	12.706	31.821	63.657	1
2	1.886	2.920	4.303	6.965	9.925	2
3	1.638	2.353	3.182	4.541	5.841	3
4	1.533	2.132	2.776	3.747	4.604	4
5	1.476	2.015	2.571	3.365	4.032	5
6	1.440	1.943	2.447	3.143	3.707	6
7	1.415	1.895	2.365	2.998	3.499	7
8	1.397	1.860	2.306	2.896	3.355	8
9	1.383	1.833	2.262	2.821	3.250	9
10	1.372	1.812	2.228	2.764	3.169	10
11	1.363	1.796	2.201	2.718	3.106	11
12	1.356	1.782	2.179	2.681	3.055	12
13	1.350	1.771	2.160	2.650	3.012	13
14	1.345	1.761	2.145	2.624	2.977	14
15	1.341	1.753	2.131	2.602	2.947	15
16	1.337	1.746	2.120	2.583	2.921	16
17	1.333	1.740	2.110	2.567	2.898	17
18	1.330	1.734	2.101	2.552	2.878	18
19	1.328	1.729	2.093	2.539	2.861	19
20	1.325	1.725	2.086	2.528	2.845	20
21	1.323	1.721	2.080	2.518	2.831	21
22	1.321	1.717	2.074	2.508	2.819	22
23	1.319	1.714	2.069	2.500	2.807	23
24	1.318	1.711	2.064	2.492	2.797	24
25	1.316	1.708	2.060	2.485	2.787	25
26	1.315	1.706	2.056	2.479	2.779	26
27	1.314	1.703	2.052	2.473	2.771	27
28	1.313	1.701	2.048	2.467	2.763	28
29	1.311	1.699	2.045	2.462	2.756	29
30	1.310	1.697	2.042	2.457	2.750	30
31	1.309	1.696	2.040	2.453	2.744	31
32	1.309	1.694	2.037	2.449	2.738	32
33	1.308	1.692	2.035	2.445	2.733	33
34	1.307	1.691	2.032	2.441	2.728	34
35	1.306	1.690	2.030	2.438	2.724	35
36	1.306	1.688	2.028	2.434	2.719	36
37	1.305	1.687	2.026	2.431	2.715	37
38	1.304	1.686	2.024	2.429	2.712	38
39	1.304	1.685	2.023	2.426	2.708	39
40	1.303	1.684	2.021	2.423	2.704	40
41	1.303	1.683	2.020	2.421	2.701	41
42	1.302	1.682	2.018	2.418	2.698	42
43	1.302	1.681	2.017	2.416	2.695	43
44	1.301	1.680	2.015	2.414	2.692	44
45	1.301	1.679	2.014	2.412	2.690	45
46	1.300	1.679	2.013	2.410	2.687	46
47	1.300	1.678	2.012	2.408	2.685	47
48	1.299	1.677	2.011	2.407	2.682	48
49	1.299	1.677	2.010	2.405	2.680	49

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本份試卷共有 **8** 大題問答及計算題，請依照題序做答，未提供說明者不計分。

1. *(5 points)* Please draw a graph and use a few words to illustrate why (competitive) market equilibrium is good in terms of social welfare.

2. *(10 points)* Please use a graph and a few words to analyze the impact of the following event on the market equilibrium.
a. The impact of a continuously increasing number of college or university on the labor market of college graduated students.
b. The impact of an increase on sugar price on the rice market, assuming that sugarcane and rice are substitute in production.

3. *(15 points)* Please draw a graph and use a few words to illustrate the social inefficiency (deadweight loss) for each of the following cases:
a. Monopoly
b. Externality cost
c. Price limit

4. *(10 points)* What actions can government take to improve the social welfare in each of the following cases?
a. Monopoly
b. Externality costs

5. *(10 points)* Please make examples to explain the following concepts:
a. Adverse selection
b. Moral hazard

6. If an individual should subtract the present value of future tax obligations due to the government deficit from his or her disposable income, this situation suggests that, in aggregate analysis, the government deficit should be subtracted from disposable income. That is, instead of $C = a+b(Y-T)$, we should use:

$$C = a+b((Y-T-(G-T)), \text{ or}$$
$$= a+b(Y-G)$$

where C is consumption, Y is output, T is tax, G is government spending, and a and b are constant parameters.

a. *(5 points)* Using this consumption function and the further relations:

$$I = I$$

G = G

T = T

Y = C + I + G

where I is investment.

Write the equilibrium equation determining Y as a function of a, I, G, and T.

b. *(15 points)* If b equals 0.5, what are the numerical values of the multipliers for I, G, and T, respectively?

7. Assume that a country's production function is $Y = K^{(0.5)} \times L^{(0.5)}$, and there is no population growth or technological change.

a. *(5 points)* What is the per-worker production function $y = f(k)$?

b. *(5 points)* Assume that the country possesses 40,000 units of capital and 10,000 units of labor. What is Y?

c. *(5 points)* Assume that 10 percent of capital depreciates each year. What gross saving rate is necessary to make the given capital-labor ratio the steady-state capital-labor ratio?

d. *(5 points)* If the saving rate equals the steady-state level, what is consumption per worker?

8. Suppose that the interest rate has no effect on investment. Assume that the economy starts at the natural level of output. Suppose there is a shock to the unemployment benefit (due to an increase in the unemployment benefit in the economy), so that the aggregate demand (AD) curve shifts up.

a. *(5 points)* What is the short-run effect on output and the price level?

b. *(5 points)* What happens to output and the price level over time?

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(填空題, 每題 6.25 分)

1. State their domains of *i). f(x)g(x)* and *ii).* $f(x)/g(x)$, where $f(x)=\sqrt{3-x}$ *and* $g(x)=\sqrt{x^2-1}$
2. Find $(f \circ g \circ h)$ where $f(x)= 2x-1$, $g(x)=x^2$, $h(x)=1-x$. Express the equation in the simplest form. *[Formula: (f ∘ g)(x)=f(g(x))]*
3. Evaluate $lim_{h\to 0}\frac{\sqrt{h^2+9}-3}{h^2}$ *[Hint :Please apply* $\frac{\sqrt{h^2+9}+3}{\sqrt{h^2+9}+3}$ *]*
4. Find *i).* the first derivative and *ii).* the second derivatives of the function $y=\frac{4x}{\sqrt{x+1}}$
5. Find the maximum distance between a point on the ellipse $x^2+\frac{y^2}{4}=1$ and the point $(1, 0)$. *[Hint: Square of distance* $= (x-1)^2+(y-0)^2$*]*
6. Find f if $f'(x)=x\sqrt{x}$ and $f(1)=2$
7. Differentiate the function $y = (e^x+e^{-x}) / (e^x-e^{-x})$ *[Hint:* $\frac{d}{dx}(e^u) = e^u\frac{du}{dx}$*]*
8. Find the derivative of the function $f(x)= (\sqrt{x})^x$ *[Hint: Logarithmic Differentiation]*
9. Find the sum of the series $\sum_{n=1}^{\infty}\frac{1}{n(n+3)}$
10. Find the radius of convergence and interval of convergence of the series $\sum_{n=0}^{\infty}\frac{2^n(x-3)^n}{\sqrt{n+3}}$
11. Find $\int_0^{1/2}\frac{xe^{2x}}{(1+2x)^2}dx$
12. Find $\int(\cos x+\sin x)^2\cos 2x dx$
13. Find $\int_2^{\infty}\frac{dx}{x\ln x}$
14. If $x^2y'-y=2x^3e^{-1/x}$, find $y(x)$.
15. Find $\iint_R(x+y)e^{x^2-y^2}dA$, where R is the rectangle enclosed by the line $x-y=0$, $x-y=2$, $x+y=0$, and $x+y=3$.
16. Find the points on the sphere $x^2+y^2+z^2=1$ where the tangent plane is parallel to the plane $2x+y-3z=2$.