國立臺北大學 103 學年度碩士班一般入學考試試題

系（所）組別：財政學系

科　　目：統計學

☑可 ☐不可使用計算機

Part I (60%) 選擇題

1. The number of possible four-letter code words, selecting from the 26 letters in the alphabet? How many four-letter code words, where all four letters are different, are possible? (A) 4! (B) P_4^{26} (C) C_4^{26} (D) 22! (E) 26!.
2. A life insurance company issues standard, preferred and ultra-preferred policies. Of the company's policyholders of a certain age, 60% are standard with a probability of 0.01 dying in the next year, 30% preferred with a probability of 0.008 of dying in the next year, and 10% are ultra-preferred with a probability of 0.007 of dying in the next year. A policyholder of that age dies in the next year. What is the probability of dying being ultra-preferred? (A) 0.0007 (B) 0.01 (C) 0.0769 (D) 0.2637 (E) 0.6593.
3. A lot of 250 semiconductor chips is inspected by selecting five at random and without replacement. If at least one of the five is defective, the lot is rejected. Find the probability of rejecting the lot if in the 250, 5 are defective.

   (A) $C_5^{250}0.02^5 0.98^{245}$ (B) $1-C_0^5 0.02^0 0.98^5$ (C) $\frac{C_1^5 C_4^{245}}{C_5^{250}}$ (D) $1-\frac{C_0^5}{C_5^{250}}$ (E) $1-\frac{C_0^5 C_5^{245}}{C_5^{250}}$.
4. It is estimated that one out of 10 vouchers examined by the audit staff employed by a branch of the Department of Health and Human Services will contain an error. Define X be the number of vouchers in error out of 20 randomly selected vouchers. What is the expected number of error vouchers? (A) 0.947 (B) 1.8 (C) 2 (D) 10 (E) 20.
5. An average of one book per week are returned to a bookstore. Assume that the number of returned books is Poisson distributed. What is the probability that at least one book will be returned in a month? (A) 0.0183 (B) 0.0733 (C) 0.3679 (D) 0.6321 (E) 0.9817.
6. A bakery shop sells loaves of freshly made French bread. Any unsold loaves at the end of the day are either discarded or sold elsewhere at a loss. The demand X for this bread has followed a normal distribution with mean $\mu=35$ loaves and standard deviation $\sigma=8$ loaves. How many loaves should the bakery make each day so that they can meet the demand 95% of the time? (A) 22 (B) 25 (C) 46 (D) 49 (E) 51. 9.
7. Suppose we want to investigate the percentage of over-time labors in the blue-collar population. To do this, the investigator asks some of labors taken at random from this population. However, some labors might not understand what over-time means in Taiwan. In turn, sometimes a labor classifies as an over-time labor (O) as one not over-time (N) or they classify a non-overtime labor (N) as one that is overtime (O). Suppose these error rates are P[N|O]=0.08 and P[O|N]=0.05, respectively. Let us pretend that only two percent of all labors are overtime; that is P[O]=0.02 and P[N]=0.98. Select a labor at random. What is the probability that the investigator classifies the labor as overtime? (A) 0.020 (B) 0.018 (C) 0.049 (D) 0.067 (E) 0.273.
8. Suppose we want to investigate the percentage of over-time labors in the blue-collar population. To do this, the investigator asks some of labors taken at random from this population. However, some labors might not understand what over-time means in Taiwan. In turn, sometimes a labor classifies as an over-time labor (O) as one not over-time (N) or they classify a non-overtime labor (N) as one that is overtime (O). Suppose these error rates are P[N|O]=0.08 and P[O|N]=0.05, respectively. Let us pretend that only two percent of all labors are overtime; that is P[O]=0.02 and P[N]=0.98. Select a labor at random. Given the label is classified as overtime, what is the probability that the labor is not overtime? (A) 0.020 (B) 0.018 (C) 0.049 (D) 0.067 (E) 0.273.
9. Suppose we want to investigate the percentage of over-time labors in the blue-collar population. Let us pretend that only two percent of all labors are overtime; that is P[O]=0.02 and P[N]=0.98. To verify whether this assumption is true. A random sample of size 100 workers is sampled. Which of the following test is not designed to verify such a hypothesis?
   (A) A binomial test
   (B) A Chi-square test
   (C) One-way analysis of variance
   (D) One sample T test
   (E) One sample proportion Z test

10. Suppose we want to investigate whether there is a significant difference in the percentage of over-time between the white-collar and blue-collar populations. To do this, the investigator asks some of labors taken at random from these two populations. To do this, investigator randomly selects workers from these two populations. The workers are asked whether they are working overtime (O) and non-overtime (N). A random sample of size 50 workers from each population is sampled. The following table gives the sampling result:

Type	Status of workers	
	Overtime (O)	Non-overtime (N)
White		
Blue		

Which of the following test is designed to verify such a hypothesis?

(A) A binomial test
(B) A Chi-square test
(C) One-way analysis of variance
(D) One sample *T* test
(E) One sample proportion *Z* test

11. Suppose an investigator would like to evaluate whether there is a significant difference in the work stress between the white-collar and blue-collar populations. A designed measurement with score ranged from 0 to 100 is used to measure the work stress. To do this, investigator randomly selects 50 workers from each population. The workers are asked to fill in the questions in the measurement and the result is compared. Which of the following test is not appropriate to evaluate whether two populations have a similar work stress?

(A) A Chi-square test
(B) One-way analysis of variance
(C) A simple linear regression
(D) Two independent sample *T* test
(E) A Wilcoxon test

12. Suppose the government realizes there is a serious working anxiety in the blue-collar population. They would like to launch an intervention program to release such a working anxiety. A designed measurement with score ranged from 0 to 100 is used to measure the work stress. To do this, investigator randomly selects 100 workers. Before and after participating the intervention program, the workers are asked to fill in the same questions in the measurement and the results from these two periods are compared. Which of the following test is the most appropriate test to evaluate such a concern?

(A) One-way analysis of variance
(B) A paired *T* test
(C) A simple linear regression
(D) A Wilcoxon test
(E) Two independent sample *T* test

13. Assume there exists an old measurement that can be used to evaluate the working anxiety. The result of this old measurement is a score ranged from 0-100. Suppose an investigator would like to develop another measurement that can also be used to evaluate the working anxiety. The result of this new measurement is also a score ranged from 0-100. What the following method can be used to evaluate the association between these two measurements?

(A) A Chi-square test
(B) One-way analysis of variance
(C) A simple linear regression
(D) Two independent sample *T* test
(E) A Wilcoxon test

14. The marketing agency for computer software of personal micro systems would like to estimate with 95% confidence that mean time that it takes for a beginner to learn to use a standard software package. Past data indicate that the learning time can be approximated by a normal distribution with a standard deviation of 20 minutes. How large a sample size should the marketing agency choose if the mean time to learn to use the software package is to be estimated within 8 minutes with 95% confidence? (A) 5 (B) 7 (C) 11 (D) 17 (E) 25.
15. Which of the following statement is incorrect about the inference in a simple linear regression $E[Y \mid X = x] = \beta_0 + \beta_1 x$, where Y is the variable of interest and X is the potential predictor?
    (A) The coefficient of determination can be directly determined by the correlation of coefficient between Y and X.
    (B) The larger the absolute correlation of coefficient between Y and X, the better the predictive power of the model.
    (C) The larger the coefficient of determination between Y and X, the better the predictive power of the model.
    (D) The larger the sum of the cross product between Y and X, the better the predictive power of the model.
    (E) The sign of β_1 is the same as the sign in the correlation of coefficient between Y and X.

Part II (40%) 簡答題

1. (25%) A manager in charge of a production process is interested in the amount of time Y, in minutes (Tasktime) that takes a production worker to perform a certain task relative to his or her score on an aptitude test (Aptitude) and relative to the person's on-the-job experience (Exper) in years. 40 workers are randomly chosen. The manager uses a multiple linear regression with Aptitude and Exper to predict Tasktime. Partial results are presented in the following ANOVA table:

Source	DF	SS	MS
Model	a	32411	e
Residual	b		f
Total	c	36699	

   A. (6%) State the basic assumption of the simple linear regression.
   B. (12%) Fill in the values a-f and determine whether Aptitude and Exper are statistically linear related to Tasktime. [Use the most appropriate table to find the critical values]
   C. (7%) Compute the coefficient of determination and interpret this value.

2. (15%) The driver of a diesel-powered automobile decided to test the quality of three types of diesel fuel sold in the area based on mpg. The following data (in mpg) and also the summary statistics were obtained:

Brand	MPG	Total	Sample mean	Sample variance
A	38.7, 39.2, 40.1, 38.9	156.9	39.23	0.38
B	41.9, 42.3, 41.3	125.5	41.83	0.25
C	40.8, 41.2, 39.5, 38.9,40.3	200.7	40.1	0.88

   Fill in the values of a-g and make inference about whether there exists a statistical significant difference in the quality of three types of diesel fuel. [Note: Use the most appropriate statistical tables to find the critical values.]

Source	DF	SS	MS
Model	a	d	f
Residual	b	e	g
Total	c	16.97	

Table 1: Area under the standard normal curve

	$P[Z<z]$									
z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.10	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.20	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.30	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.40	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.50	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.60	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.70	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.80	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.90	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.00	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.10	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.20	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.30	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.40	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.50	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.60	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.70	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.80	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.90	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.00	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.10	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.20	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.30	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.40	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.50	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.60	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.70	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.80	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.90	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.00	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

Table 2: Value of t_α for t distribution where $P[T > t_\alpha] = \alpha$

df	$t_{0.10}$	$t_{0.05}$	$t_{0.025}$	$t_{0.01}$	$t_{0.005}$
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787

Table 3: Percentage points of the F distribution at $\alpha = 0.01$

	Number of degrees of freedom for numerator (Df1)										
Df2	1	2	3	4	6	8	10	12	15	20	24
2	98.50	99.00	99.17	99.25	99.33	99.37	99.40	99.42	99.43	99.45	99.46
3	34.12	30.82	29.46	28.71	27.91	27.49	27.23	27.05	26.87	26.69	26.60
4	21.20	18.00	16.69	15.98	15.21	14.80	14.55	14.37	14.20	14.02	13.93
5	16.26	13.27	12.06	11.39	10.67	10.29	10.05	9.89	9.72	9.55	9.47
6	13.75	10.92	9.78	9.15	8.47	8.10	7.87	7.72	7.56	7.40	7.31
7	12.25	9.55	8.45	7.85	7.19	6.84	6.62	6.47	6.31	6.16	6.07
8	11.26	8.65	7.59	7.01	6.37	6.03	5.81	5.67	5.52	5.36	5.28
9	10.56	8.02	6.99	6.42	5.80	5.47	5.26	5.11	4.96	4.81	4.73
10	10.04	7.56	6.55	5.99	5.39	5.06	4.85	4.71	4.56	4.41	4.33
11	9.65	7.21	6.22	5.67	5.07	4.74	4.54	4.40	4.25	4.10	4.02
12	9.33	6.93	5.95	5.41	4.82	4.50	4.30	4.16	4.01	3.86	3.78
13	9.07	6.70	5.74	5.21	4.62	4.30	4.10	3.96	3.82	3.66	3.59
14	8.86	6.51	5.56	5.04	4.46	4.14	3.94	3.80	3.66	3.51	3.43
15	8.68	6.36	5.42	4.89	4.32	4.00	3.80	3.67	3.52	3.37	3.29
16	8.53	6.23	5.29	4.77	4.20	3.89	3.69	3.55	3.41	3.26	3.18
17	8.40	6.11	5.18	4.67	4.10	3.79	3.59	3.46	3.31	3.16	3.08
18	8.29	6.01	5.09	4.58	4.01	3.71	3.51	3.37	3.23	3.08	3.00
19	8.18	5.93	5.01	4.50	3.94	3.63	3.43	3.30	3.15	3.00	2.92
20	8.10	5.85	4.94	4.43	3.87	3.56	3.37	3.23	3.09	2.94	2.86
21	8.02	5.78	4.87	4.37	3.81	3.51	3.31	3.17	3.03	2.88	2.80
22	7.95	5.72	4.82	4.31	3.76	3.45	3.26	3.12	2.98	2.83	2.75
23	7.88	5.66	4.76	4.26	3.71	3.41	3.21	3.07	2.93	2.78	2.70
24	7.82	5.61	4.72	4.22	3.67	3.36	3.17	3.03	2.89	2.74	2.66
25	7.77	5.57	4.68	4.18	3.63	3.32	3.13	2.99	2.85	2.70	2.62
26	7.72	5.53	4.64	4.14	3.59	3.29	3.09	2.96	2.81	2.66	2.58
27	7.68	5.49	4.60	4.11	3.56	3.26	3.06	2.93	2.78	2.63	2.55
28	7.64	5.45	4.57	4.07	3.53	3.23	3.03	2.90	2.75	2.60	2.52
29	7.60	5.42	4.54	4.04	3.50	3.20	3.00	2.87	2.73	2.57	2.49
30	7.56	5.39	4.51	4.02	3.47	3.17	2.98	2.84	2.70	2.55	2.47
40	7.31	5.18	4.31	3.83	3.29	2.99	2.80	2.66	2.52	2.37	2.29
60	7.08	4.98	4.13	3.65	3.12	2.82	2.63	2.50	2.35	2.20	2.12

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Table 4: Percentage points of the F distribution at $\alpha = 0.05$

	Df1										
Df2	1	2	3	4	6	8	10	12	15	20	24
2	18.51	19.00	19.16	19.25	19.33	19.37	19.40	19.41	19.43	19.45	19.45
3	10.13	9.55	9.28	9.12	8.94	8.85	8.79	8.74	8.70	8.66	8.64
4	7.71	6.94	6.59	6.39	6.16	6.04	5.96	5.91	5.86	5.80	5.77
5	6.61	5.79	5.41	5.19	4.95	4.82	4.74	4.68	4.62	4.56	4.53
6	5.99	5.14	4.76	4.53	4.28	4.15	4.06	4.00	3.94	3.87	3.84
7	5.59	4.74	4.35	4.12	3.87	3.73	3.64	3.57	3.51	3.44	3.41
8	5.32	4.46	4.07	3.84	3.58	3.44	3.35	3.28	3.22	3.15	3.12
9	5.12	4.26	3.86	3.63	3.37	3.23	3.14	3.07	3.01	2.94	2.90
10	4.96	4.10	3.71	3.48	3.22	3.07	2.98	2.91	2.85	2.77	2.74
11	4.84	3.98	3.59	3.36	3.09	2.95	2.85	2.79	2.72	2.65	2.61
12	4.75	3.89	3.49	3.26	3.00	2.85	2.75	2.69	2.62	2.54	2.51
13	4.67	3.81	3.41	3.18	2.92	2.77	2.67	2.60	2.53	2.46	2.42
14	4.60	3.74	3.34	3.11	2.85	2.70	2.60	2.53	2.46	2.39	2.35
15	4.54	3.68	3.29	3.06	2.79	2.64	2.54	2.48	2.40	2.33	2.29
16	4.49	3.63	3.24	3.01	2.74	2.59	2.49	2.42	2.35	2.28	2.24
17	4.45	3.59	3.20	2.96	2.70	2.55	2.45	2.38	2.31	2.23	2.19
18	4.41	3.55	3.16	2.93	2.66	2.51	2.41	2.34	2.27	2.19	2.15
19	4.38	3.52	3.13	2.90	2.63	2.48	2.38	2.31	2.23	2.16	2.11
20	4.35	3.49	3.10	2.87	2.60	2.45	2.35	2.28	2.20	2.12	2.08
21	4.32	3.47	3.07	2.84	2.57	2.42	2.32	2.25	2.18	2.10	2.05
22	4.30	3.44	3.05	2.82	2.55	2.40	2.30	2.23	2.15	2.07	2.03
23	4.28	3.42	3.03	2.80	2.53	2.37	2.27	2.20	2.13	2.05	2.01
24	4.26	3.40	3.01	2.78	2.51	2.36	2.25	2.18	2.11	2.03	1.98
25	4.24	3.39	2.99	2.76	2.49	2.34	2.24	2.16	2.09	2.01	1.96
26	4.23	3.37	2.98	2.74	2.47	2.32	2.22	2.15	2.07	1.99	1.95
27	4.21	3.35	2.96	2.73	2.46	2.31	2.20	2.13	2.06	1.97	1.93
28	4.20	3.34	2.95	2.71	2.45	2.29	2.19	2.12	2.04	1.96	1.91
29	4.18	3.33	2.93	2.70	2.43	2.28	2.18	2.10	2.03	1.94	1.90
30	4.17	3.32	2.92	2.69	2.42	2.27	2.16	2.09	2.01	1.93	1.89
40	4.08	3.23	2.84	2.61	2.34	2.18	2.08	2.00	1.92	1.84	1.79
60	4.00	3.15	2.76	2.53	2.25	2.10	1.99	1.92	1.84	1.75	1.70