

本試卷共分兩大題。第一大題為單選題，考生應作答於答案卡。第二大題為計算說明題，考生應作答於答案卷上。請依照題號順序作答。

第一大題 單選題，每題六分，請作答於答案卡

1. A manager wants to know whether customers in Taiwan, on average, would spend more than \$2,000 per month on the service that is similar to what her company provides. The following information regarding the consumer behavior of 51 customers was provided by her marketing research team:

$N = 51$; Average of Monthly Consumption = \$2,400; Standard Deviation = 1,800; Stand Error = 252.05.

She is going to test examine the data by using a t-test (at the 0.1 level of significance). What is the power of the above test if the population mean of the monthly spending is \$1,900, assuming the population standard deviation is 1,800?

- A. 0.047
 - B. 0.021
 - C. 0.953
 - D. 0.091
 - E. 0.909
2. Following the question 1, what is the probability of causing the Type II error if the population mean of the monthly spending is \$2,200 using the 0.1 level of significance and assuming the population standard deviation is 1,800?
 - A. 0.803
 - B. 0.197
 - C. 0.527
 - D. 0.313
 - E. 0.687
 3. A car maker is interested in the average age of buyers who have successfully applied for their car loan. Assuming the sample is unbiased and the sample standard deviation of age of those consumers is 10 regardless of the sample size, how many consumers will need to be sampled if the company wants this estimate within $\pm 10\%$ and with 95% confidence?

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- A. 38,416
B. 27,060
C. 9,604
D. 6,765
E. 1,960
4. The XYZ corporation recognizes its employees with awards in three categories: best performance, helpfulness, and performance progress. Last year, the best performance award was awarded to 100 employees, the most helpful award was awarded to 240 employees, and the performance progress award was awarded to 120 employees. Among those award-winners, 40 people got both the best performance and the most helpful awards, 30 people simultaneously got the most helpful and the performance progress awards, and 10 people got both the best performance and the performance progress awards. 5 people among them got the three awards at the same time. How many people got at least one award in this company?
- A. 460
B. 395
C. 390
D. 385
E. 380
5. The government wants to estimate the average monthly salary of labors in the service industry. Analysts in the government randomly collected data from 100 workers and the 95% of confidence interval in this dataset was (\$24,873, \$67,709). Which of the following interpretations is correct?
- A. In the population of the service industry, 95% of employees have a monthly salary that falls in the interval from \$24,873 to \$67,709.
B. 95% of the sampled monthly salary fell between \$24,873 and \$67,709.
C. We are 95% confident that the average monthly salary of all workers in the service industry falls in the interval from \$24,873 to \$67,709.
D. We are 95% confident that the mean of the sampled monthly salary falls between \$24,873 and \$67,709.
E. None of the above.

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6. The XYZ company launched a survey and collected data regarding income information from two groups of consumers. They got 500 and 600 respondents, respectively. The standard deviations of these two groups of sampled data are 3,800 and 2,000, respectively. If the population variances are unknown and we do NOT assume $\sigma_1 = \sigma_2$, what is the estimate of standard error in this case (the test statistic $S_{\bar{x}_1 - \bar{x}_2}$)?

- A. 129.47
 B. 188.54
 C. 5.27
 D. 10.93
 E. 174.88

7. The following table shows the data regarding the sales information of two different products across five retailers. What is the 90% confidence interval of the difference between sales of product A and product B? (the critical t for $\alpha = 0.1$ when the degree of freedom = 5, is 2.015; the critical t for $\alpha = 0.1$ when the degree of freedom = 4, is 2.132)

Retailer	Sales of Product A	Sales of Product B
1	55	49
2	61	56
3	79	60
4	75	68
5	28	20

- A. (3.864, 14.136)
 B. (2.924, 15.076)
 C. (3.565, 14.435)
 D. (4.404, 13.596)
 E. (4.137, 13.863)
8. A bank wanted to know which options would be most important to small businesses. The bank hypothesized that the options that businesses found to be important would vary as annual sales of the businesses varied. The bank set up a cross-tabulation to investigate if any changes in importance were occurring between the groups of businesses. The following table lists the number of businesses that reported each of the options as most important. What is the chi-square value and how many degrees of freedom are there?

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Option	Annual Sales	
	< \$1M	\$1M to \$10M
Checking account	45	25
Mutual fund	30	70
Savings account	50	60

- A. $\chi^2 = 633.37$; degree of freedom = 5
- B. $\chi^2 = 633.37$; degree of freedom = 2
- C. $\chi^2 = 15.24$; degree of freedom = 2
- D. $\chi^2 = 15.24$; degree of freedom = 5
- E. $\chi^2 = 15.24$; degree of freedom = 4

第二大題 計算說明題，請作答於答案卷

1. (16%)

某間小學的校長正在評估是否要在學童用完營養午餐之後，推動一項簡易伸展操的運動計畫，以提升小朋友們的健康與免疫力，並減少保健室的醫療費用。為了獲得更多的資訊，他先選了幾個班級，試行該運動計畫。根據過去經驗，這位校長知道在冬天爆發感冒與流感事件的可能性很高，後續的醫療費用相當可觀。因此，他決定採用配對設計，記錄施行計畫前 12 個月的醫療費用與施行計畫後 12 個月的醫療費用。「之前」與「之後」的費用 (以新台幣 1,000 元為單位) 以月對月的方式做比較，列出如下。

月份	一	二	三	四	五	六	七	八	九	十	十一	十二
之前	68	44	30	58	35	33	52	69	23	69	48	30
之後	59	42	20	62	25	30	56	62	25	75	40	26

- (1) 這些資料是否顯示此運動計畫可減少醫療費用？(使用 $\alpha = 0.05$)。
- (2) 以 95% 的信心估計因此運動計畫而節省的平均醫療費用。

2. (16%)

一個隨機化區集實驗 (random block design) 產生下列統計量：

處理的個數 (number of treatments) : $k = 5$

區集的個數 (number of blocks) : $b = 12$

處理的平方和 (sum of squares for treatments) : $SSTr = 1500$

區集的平方和 (sum of squares for blocks) : $SSB = 1000$

總變異 (total variation) : $SST = 3500$

- (1) 請問處理平均數是否相等。(使用 $\alpha = 0.05$)。
- (2) 請問區集平均數是否相等。(使用 $\alpha = 0.05$)。

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3. (20%)

某電商想測試四組不同版型與配色設計 (A、B、C、D) 對於某商品的銷售影響。考量到不同時段以及不同促銷活動對於潛在顧客的影響，決定以下列方式進行測試，並列出測試一週之後的單週銷售量，單位為一千份。

- (1) 請問這是什麼樣的實驗設計？
- (2) 請在 0.05 的顯著水準下，進行檢定。

	打折	抽獎	點數加倍累計	第二件五折
時段一	A 48	B 38	C 42	D 53
時段二	B 39	C 43	D 50	A 54
時段三	C 42	D 50	A 47	B 44
時段四	D 46	A 48	B 46	C 52

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附錄一 Standard Normal Cumulative Probability Table

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

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附錄二 t-distribution

df. \ α	0.1	0.05	0.025	0.01	df. \ α	0.1	0.05	0.025	0.01
1	3.078	6.314	12.706	31.821	35	1.306	1.690	2.030	2.438
2	1.886	2.920	4.303	6.965	40	1.303	1.684	2.021	2.423
3	1.638	2.353	3.182	4.541	45	1.301	1.679	2.014	2.412
4	1.533	2.132	2.776	3.747	50	1.299	1.676	2.009	2.403
5	1.476	2.015	2.571	3.365	55	1.297	1.673	2.004	2.396
6	1.440	1.943	2.447	3.143	60	1.296	1.671	2.000	2.390
7	1.415	1.895	2.365	2.998	65	1.295	1.669	1.997	2.385
8	1.397	1.860	2.306	2.896	70	1.294	1.667	1.994	2.381
9	1.383	1.833	2.262	2.821	75	1.293	1.665	1.992	2.377
10	1.372	1.812	2.228	2.764	80	1.292	1.664	1.990	2.374
11	1.363	1.796	2.201	2.718					
12	1.356	1.782	2.179	2.681					
13	1.350	1.771	2.160	2.650					
14	1.345	1.761	2.145	2.624					
15	1.341	1.753	2.131	2.602					
16	1.337	1.746	2.120	2.583					
17	1.333	1.740	2.110	2.567					
18	1.330	1.734	2.101	2.552					
19	1.328	1.729	2.093	2.539					
20	1.325	1.725	2.086	2.528					
21	1.323	1.721	2.080	2.518					
22	1.321	1.717	2.074	2.508					
23	1.319	1.714	2.069	2.500					
24	1.318	1.711	2.064	2.492					
25	1.316	1.708	2.060	2.485					
26	1.315	1.706	2.056	2.479					
27	1.314	1.703	2.052	2.473					
28	1.313	1.701	2.048	2.467					
29	1.311	1.699	2.045	2.462					
30	1.310	1.697	2.042	2.457					

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The F Distribution $\alpha = 0.05$

df1:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
df2:															
1	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54	241.88	242.98	243.91	244.69	245.36	245.95
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.40	19.41	19.42	19.42	19.43
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.76	8.74	8.73	8.71	8.70
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.94	5.91	5.89	5.87	5.86
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.70	4.68	4.66	4.64	4.62
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.03	4.00	3.98	3.96	3.94
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.60	3.57	3.55	3.53	3.51
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.31	3.28	3.26	3.24	3.22
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.10	3.07	3.05	3.03	3.01
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.94	2.91	2.89	2.86	2.85
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.82	2.79	2.76	2.74	2.72
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.72	2.69	2.66	2.64	2.62
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.63	2.60	2.58	2.55	2.53
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.57	2.53	2.51	2.48	2.46
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.51	2.48	2.45	2.42	2.40

試題隨卷繳回