請注意：在此考試中，應考者僅能使用不含統計或特殊數學功能之計算機，請監考人員在試前先行檢查應考者所攜帶之計算機，不合規定者請先代爲保管，待試後再歸還。

1. In the setup of a manufacturing process, a machine is either correctly or incorrectly adjusted. The probability of a correct adjustment is 0.90. When correctly adjusted, the machine operates with a 5% defective rate and 95% good rate. However, if it is incorrectly adjusted, a 75% defective rate and 25 % good rate occurs. (18%)
   a. After the machine starts a production run, what is the probability that a defect is observed when one product is tested?
   b. Suppose that a product selected by an inspector is found to be defective. What is the probability that the machine is incorrectly adjusted? What would you conclude from such a result?
   c. A second product is tested and found good before the conclusion in (b) is made. Given that the second product is good, compute the revised probability of an incorrect adjustment by using your revised probabilities from (b) as the most recent prior probabilities. What conclusion would you make now?

2. A major credit card company from a careful data analysis indicates that about 20% of all customers would pay their bills in full before any interest charges are incurred. Use the information to answer the followings: (18%)
   a. In a sample of 5 customers, estimate the probability that at least 2 customers pay their account charges before any interest charges are incurred.
   b. For a sample of 100 credit card holders,
      (1) By approximating the binominal to the normal, what is the probability that between 20 and 25 customers pay their account charges before any interest charges are incurred?
      (2) If among these 100 holders, 15 of them are found paying their bills in full before any interest charges are incurred. Under such a sampling result, discuss whether the company has to change its current assumption about the percentage of customers paying full bills before any interest charges are incurred. State clearly your hypothesis. Use α=0.05.

3. A toy company hires 4 production analysts to rate 3 groups of workers on their job performances. The ratings (see the table below) are then to be used by the company manager to determine whether or not there is any significant variation among the 4 analysts in the ratings. If no variation exists, then the manager needs not be concerned with which analyst is assigned to a particular group; but if the ratings do differ, the manager must consider this situation in the assigning. (20%)

	The 4 analysts' ratings				
Group of workers	A	B	C	D	Row mean
1	33	36	33	27	32.3
2	32	34	28	41	33.8
3	46	49	44	43	45.5
Column mean	37.0	39.7	35.0	37.0	Overall mean: 37.2

   a. Give answers to the blanks in the following ANOVA table. Write the answers in order and show explicitly how they are obtained. A test of the ANOVA model show that the R Square = 0.7917.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F-value	Critical value
Analysts' Rating	(1)	(5)	(9)	(12)	(14)
Worker group	(2)	(6)	(10)	(13)	(15)
Error	(3)	(7)	(11)		
Total	(4)	(8)			

   b. At α=0.05 level of significance, list your hypothesis and test to determine your conclusion.

(背面仍有題目,請繼續作答)

4. Tainan Ltd. Co. provided the following data as an example of selection among 20 male and 20 female applicants for 15 open positions: (10%)

Applicant	Selected	No selected	Total
Male	10	10	20
Female	5	15	20

Using the above data to show and discuss whether Tainan Co. has a selection bias in favor of males for the 15 open positions at a statistical significance level of α=0.10. State clearly your hypothesis.

5. The first year graduate students in NCKU were told that their future living costs would be less than $8,000 per month. To confirm this information, a sample of 64 first-year graduate students randomly selected from Engineering School was examined. The sample showed a mean expenditure of $8,600 and a standard deviation of $2,000 per month. (12%)

a. Do you agree with the claim that the living cost of a first-year graduate student would be less than NT$8,000? Use α=0.05. State clearly your hypothesis.

b. Construct a 95% confidence interval for the population mean. What hypothesis- testing conclusion would you draw based on this interval?

c. What happens to the width of the interval estimate as the confidence level is increased? Why does this seem reasonable? What should you do if you want to increase the precision of the interval while maintain the same confidence level? Do you think the sample chosen is good enough to represent the population?

6. Refer to problem 5. If now the test was conducted in terms of asking the students to answer the following question: (12%)

Your living cost is less than NT$8,000 per month? Yes ☐ No ☐

Similarly, a sample of 64 first-year graduate students was randomly selected from Engineering School. The sample showed a mean of 55% of the students in the test answered "Yes" for the above question.

a. Do you agree that there are over half of the first-year graduate students spend money less than NT$8,000 per month? Use α=0.05. State clearly your hypothesis.

b. Comparing to the data of problem 5. Explain whether it is possible to have a sample data that over 50% (for example, 55%) students indicate their monthly expenses are under $8,000, while their average expenditure per month is over $8,000 (for example, 8,600). Why?

c. Suppose the school is currently considering to raise the financial support for the graduate students to $8,000 and would like to know whether this amount of money is enough to cover most of the students' monthly expenses. Comparing the two methods conducted in problem 4 and problem 5, which would you suggest the school to use? State your reason.

7. An organization is planning a dinner and conference. The cost is $4,000 for renting the site plus $100 per plate for the dinner. The group wishes to set $150 as the registration fee. The organization has 1200 members and the program chairman assesses the probability of a percentage p (that is p% of the 1200 members) attending the conference as (10%)

P	10%	15%	20%	25%	30%	35%
Estimated probability of p	0.12	0.18	0.30	0.22	0.15	0.03

a. Find the decision whether or not to run the conference.

b. Suppose that a sample of 10 members is phoned and 1 decides to come. How do you adjust the prior decision you obtained in (a)? Describe clearly what assumption you make for such an adjustment.

Standard Normal Distribution:

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936

χ^2 - distribution:

degrees freedom	Area in Upper Tail									
	.995	.99	.975	.95	.90	.10	.05	.025	.01	.005
1	$392,704 \times 10^{-10}$	$157,088 \times 10^{-9}$	$982,069 \times 10^{-9}$	$393,214 \times 10^{-8}$	.0157908	2.70554	3.84146	5.02389	6.63490	7.87944
2	.0100251	.0201007	.0506356	.102587	.210720	4.60517	5.99147	7.37776	9.21034	10.5966
3	.0717212	.114832	.215795	.351846	.584375	6.25139	7.81473	9.34840	11.3449	12.8381
4	.206990	.297110	.484419	.710721	1.063623	7.77944	9.48773	11.1433	13.2767	14.8602
5	.411740	.554300	.831211	1.145476	1.61031	9.23635	11.0705	12.8325	15.0863	16.7496
6	.675727	.872085	1.237347	1.63539	2.20413	10.6446	12.5916	14.4494	16.8119	18.5476
7	.989265	1.239043	1.68987	2.16735	2.83311	12.0170	14.0671	16.0128	18.4753	20.2777
8	1.344419	1.646482	2.17973	2.73264	3.48954	13.3616	15.5073	17.5346	20.0902	21.9550
9	1.734926	2.087912	2.70039	3.32511	4.16816	14.6837	16.9190	19.0228	21.6660	23.5893
10	2.15585	2.55821	3.24697	3.94030	4.86518	15.9871	18.3070	20.4831	23.2093	25.1882
11	2.60321	3.05347	3.81575	4.57481	5.57779	17.2750	19.6751	21.9200	24.7250	26.7569
12	3.07382	3.57056	4.40379	5.22603	6.30380	18.5494	21.0261	23.3367	26.2170	28.2995
13	3.56503	4.10691	5.00874	5.89186	7.04150	19.8119	22.3621	24.7356	27.6883	29.8194
14	4.07468	4.66043	5.62872	6.57063	7.78953	21.0642	23.6848	26.1190	29.1413	31.3193
15	4.60094	5.22935	6.26214	7.26094	8.54675	22.3072	24.9958	27.4884	30.5779	32.8013
16	5.14224	5.81221	6.90766	7.96164	9.31223	23.5418	26.2962	28.8454	31.9999	34.2672
17	5.69724	6.40776	7.56418	8.67176	10.0852	24.7690	27.5871	30.1910	33.4087	35.7185
18	6.26481	7.01491	8.23075	9.39046	10.8649	25.9894	28.8693	31.5264	34.8053	37.1564
19	6.84398	7.63273	8.90655	10.1170	11.6509	27.2036	30.1435	32.8523	36.1908	38.5822

F - distribution

Denominator degree of freedom	Numerator Degrees of Freedom (Nominator)																		
	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	254.3
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.50
3	10.13	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	8.57	8.55	8.53
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	5.69	5.66	5.63
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	4.43	4.40	4.36
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	3.74	3.70	3.67
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	3.30	3.27	3.23
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	3.01	2.97	2.93
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	2.79	2.75	2.71
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	2.62	2.58	2.54
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	2.49	2.45	2.40
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	2.38	2.34	2.30
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	2.30	2.25	2.21
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	2.22	2.18	2.13
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	2.16	2.11	2.07
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	2.11	2.06	2.01
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	2.06	2.01	1.96
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	2.02	1.97	1.92
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	1.98	1.93	1.88