※ 考生請注意：本試題 ☑可 □不可 使用計算機

1. (15%) A large manufacturing plant has 400 incandescent light bulbs illuminating the manufacturing floor. The rate at which the bulbs fail follows some distribution with a mean of two bulbs every five thousand hours.
   a. (5%) Give a proper distribution model for the problem.
   b. (5%) Calculate the mean number of bulbs fails in an eight-hour shift.
   c. (5%) Calculate the probability that no bulbs fail in an eight-hour shift.

2. (15%) Suppose the probability function of a random variable X is
$$f(x) = \begin{cases} cx & x = 2,4,6 \\ 0 & elsewhere \end{cases}$$
   a. (5%) Find mean and variance of X.
   b. (5%) Find $P(|X - \mu| \le 1.8\sigma)$.
   c. (5%) List the Chebyshev inequality and compare the results.

3. (10%) The local area network (LAN) for the computing system of a certain company is temporarily shutdown for repairs. Previous shutdowns have been due to hardware failure, software failure, or power failure. Engineers have determined that the probabilities of hardware, software and, power problems are 0.01, 0.02, 0.03, respectively.　And the shutdown rate of hardware, software and, power problems are 70%, 10%, and 50%, respectively.
   a. (5%) What is the probability that the current shutdown of the LAN is due to hardware failure?
   b. (5%) What is the probability that none of the hardware, software and, power problems happens?

4. (20%) The table below is a probability distribution of random variable X.
   a. (5%) Find the range, mean and standard variation of this distribution.
   b. (5%) Find the sampling distribution of the sample mean for a sample of size =2 from this distribution.
   c. (5%) Calculate the mean and standard deviation of the sample mean.
   d. (5%) State the Central Limit Theorem.

x	0	1	6
P(x)	.5	.2	.3

5. (20%) A randomized complete block design (RCBD) was used to compare the three mean responses for three treatments. Observations x_{ij} i=1,2,3, and j=1,2.

	Block	
Treatment	1	2
A	3.4	5.6
B	4.6	6.4
C	1.0	3.0

(背面仍有題目,請繼續作答)

系所組別： 製造資訊與系統研究所乙組

考試科目： 機率與統計　　　　　　　　　　　　　　　考試日期：0307，節次：3

※ 考生請注意：本試題 ☑可 □不可 使用計算機

    a. (5%) Write out the effects model for the RCBD and describe how to arrange the order of the treatment for the design.

    b. (10%) Calculate the ANOVA table.

    c. (5%) Do the data provide the sufficient evidence to indicate that the treatment means differ? Use alpha=0.05.

6. (20%) Consider the yield (y) of certain product that might be predicted by temperature (x1) and pressure (x2). Based on the following computer output and graphs to answer the following questions.

    a. (5%) Use the model

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \varepsilon$$

    to fit the data. Is this model useful for predicting Yield? Justify your answer.

    b. (5%) Use the complete second order model to fit the data

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1^2 + \beta_4 x_2^2 + \beta_5 x_1 x_2 + \varepsilon$$

    Compare these two models. Which one is better? Explain all reasons you can think of.

    c. (5%) When the temperature increases 10 degrees, what is the amount of yield that will change in these two models?

    d. (5%) What assumptions are needed in the model for the P-values in the table to be trusted?

```
The regression equation is
y = - 1.57 + 0.0257 x1 + 0.0336 x2

Predictor      Coef        StDev         T         P
Constant    -1.5705       0.4937      -3.18     0.003
x1          0.025732      0.004024     6.40     0.000
x2          0.033615      0.004928     6.82     0.000

S = 0.4023     R-Sq = 68.1%     R-Sq(adj) = 66.4%

Analysis of Variance
Source        DF        SS          MS        F        P
Regression     2     12.7859      6.3930    39.51    0.000
Error         37      5.9876      0.1618
Total         39     18.7735

Source        DF      Seq SS
x1             1      5.2549
x2             1      7.5311
```
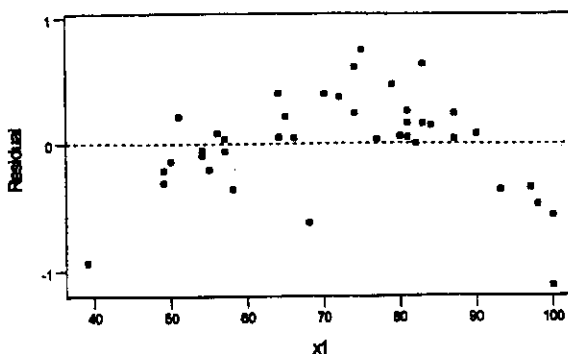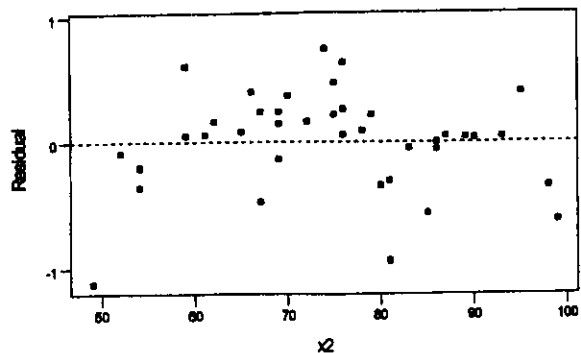

Residuals Versus x1
(response is y)

Residuals Versus x2
(response is y)

※ 考生請注意：本試題 ☑可　□不可 使用計算機

```
The regression equation is
y = - 9.92 + 0.167 x1 + 0.138 x2 - 0.00111 x1sq -0.000843 x2sq +0.000241 x1x2

Predictor        Coef        StDev          T        P
Constant       -9.917        1.354       -7.32    0.000
x1            0.16681      0.02124        7.85    0.000
x2            0.13760      0.02673        5.15    0.000
x1sq        -0.0011082    0.0001173      -9.45    0.000
x2sq        -0.0008433    0.0001594      -5.29    0.000
x1x2         0.0002411    0.0001440       1.67    0.103

S = 0.1871    R-Sq = 93.7%    R-Sq(adj) = 92.7%

Analysis of Variance

Source        DF         SS         MS        F        P
Regression     5     17.5827     3.5165    100.41    0.000
Error         34      1.1908     0.0350
Total         39     18.7735

Source        DF      Seq SS
x1             1      5.2549
x2             1      7.5311
x1sq           1      3.6434
x2sq           1      1.0552
x1x2           1      0.0982
```
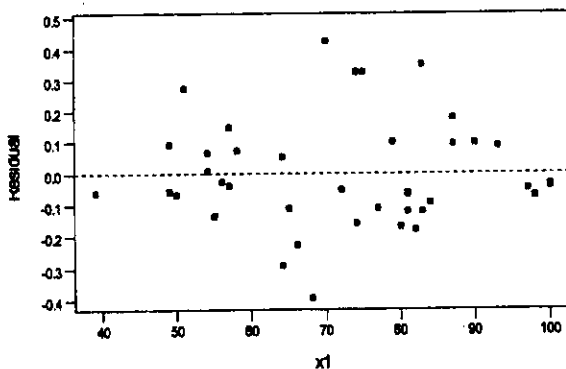
Residuals Versus x1
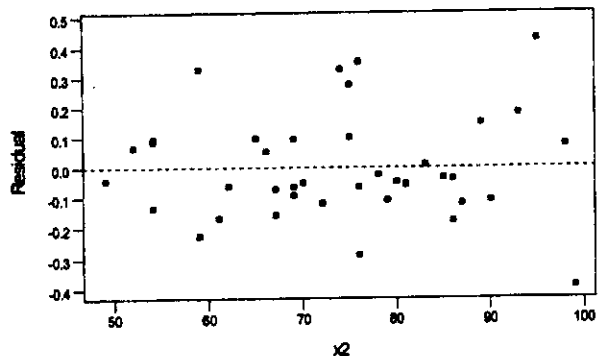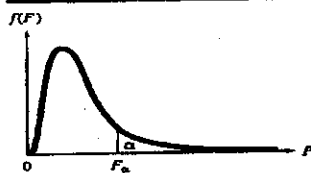(response is y)

Residuals Versus x2
(response is y)

TABLE IX   Percentage Points of the F-distribution, $\alpha = .05$

$f(F)$

NUMERATOR DEGREES OF FREEDOM

ν_2 \ ν_1	1	2	3	4	5	6	7	8	9
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10
7	5.59	4.74	4.35	4.12	3.97	3.87	3.50	3.44	3.39
8	5.32	4.46	4.07	3.84	3.69	3.58	3.29	3.23	3.18
9	5.12	4.26	3.86	3.63	3.48	3.37	3.14	3.07	3.02
10	4.96	4.10	3.71	3.48	3.33	3.22	3.01	2.95	2.90
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.85	2.80
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.77	2.71
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21

（背面仍有題目,請繼續作答）

1152　　Appendix B　Tables

TABLE IV　Normal Curve Areas
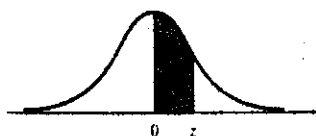
z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
.4	.1554	.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	.2517	.2549
.7	.2580	.2611	.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
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.49903	.49906	.49910	.49913	.49916	.49918	.49921	.49924	.49926	.48829
3.2	.49931	.49934	.49936	.49938	.49940	.49942	.49944	.49946	.49948	.49950
3.3	.49952	.49953	.49955	.49957	.49958	.49960	.49961	.49962	.49964	.49965
3.4	.49966	.49968	.49969	.49970	.49971	.49972	.49973	.49974	.49975	.49976
3.5	.49977	.49978	.49978	.49979	.49980	.49981	.49981	.49982	.49983	.49983
3.6	.49984	.49985	.49985	.49986	.49986	.49987	.49987	.49988	.49988	.49989
3.7	.49989	.49990	.49990	.49990	.49991	.49991	.49992	.49992	.49992	.49992
3.8	.49993	.49993	.49993	.49994	.49994	.49994	.49994	.49995	.49995	.49995
3.9	.49995	.49995	.49996	.49996	.49996	.49996	.49996	.49996	.49997	.49997

Source: Abridged from Table I of A. Hald, *Statistical Tables and Formulas* (New York: Wiley), 1952. Reproduced by permission of A. Hald.