※ 考生請注意：本試題 ☑可 □不可 使用計算機

1. (15%) Suppose a flaw was discovered in the Pentium chip installed in many new personal computers. The chip produced an incorrect result when dividing two numbers. Assume the probability of a divide error with the Pentium chip is, in fact, 1/10,000,000,000.
   a. (5%) Consider three successive divisions performed using the flawed chip. What is the probability that none of three results will be in error?
   b. (5%) Compute the probability of at least one error in the 20,000,000,000 divisions.
   c. (5%) What assumptions did you have to make in order to answer these questions using the probability model?

2. (15%) Contamination is a problem in the manufacture of optical storage discs (CDs). When the production process is in control, the average number of particles of contamination is 0.1 per centimeter squared of media surface. The area of disc under study is 100 squared centimeters.
   a. (5%) State the proper probability model for the describing the number of particles X. Write out the probability function and cumulative distribution function of X.
   b. (5%) Find out the probability that 2 particles occur in the area of disc under study.
   c. (5%) Calculate $E(X^2)$.

3. (10%) A fault-tolerant system that processes transactions for a financial services use three separate computers. If the operating computer fails, one of the two spares can be immediately switched online. After the second computer fails, the last computer can be immediately switched online. Assume the probability of failure during any transaction is 10^{-8}
   a. (5%) State the proper probability model for the number of transactions X before all three computers have failed. Write out the probability function and cumulative distribution function of X.
   b. (5%) Calculate E(X).

4. (20%) A manufacturer of automobile batteries claims that the distribution of the life of its battery has a mean of 54 months and a standard deviation of 6 months. But the population mean is 50 months and population standard deviation is 7 months. Suppose a consumer group decides to check the claim by purchasing a sample of 50 of these batteries. No knowledge of the shape of the distribution of the life.
   a. (5%) Try to describe the sampling distribution of the mean life of a sample of 50 batteries.
   b. (5%) What is the probability the consumer group's sample has a mean life of 52 or fewer months?
   c. (5%) What assumption and what theory do you need to obtain the above sampling distribution of the mean life?
   d. (5%) What can you say about the probability of a certain battery which has a life between 40 and 60 months?

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5. (20%) The diameter of a ball bearing was measured by 8 inspectors, each using two different kinds of calipers. The results were:

Inspector	Caliper 1	Caliper 2
1	0.265	.263
2	0.265	.263
3	0.267	.264
4	0.267	.266
5	0.265	.264
6	0.265	.265
7	0.267	.266
8	0.267	.268

Is there a significant difference between the means of the population of measurements from which the two samples were selected?

a. (2%) Give the null hypothesis and alternative hypothesis for testing.
b. (8%) Use p-value to give a statistical test at level of significance of 0.05.
c. (5%) What assumptions you need for the test in **b**.
d. (5%) Construct a 95 percent confidence interval of the difference in mean diameter measurements for the two types of calipers.

6. (20%) The response time in milliseconds was determined for three different types of circuits that could be used in an automatic valve shutoff mechanism. The engineers propose that a completely randomized experiment should be used to compare the three different circuit types.

Circuit Type				
1	9	12	10	8
2	20	21	23	17
3	6	5	8	16

a. (5%) Explain what is a completely randomized experiment. Take this problem as the example.
b. (5%) Why the engineer wants such kind of experiment?
c. (8%) Test the hypothesis that the three circuit types have the same response time. Use alpha=0.05. List the assumptions you made for the test.
d. (2%) Which type of circuit would you select if you wished to minimize he response time? State the reasons.

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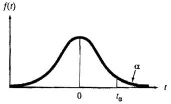
TABLE VI Critical Values of t



ν	$t_{.100}$	$t_{.050}$	$t_{.025}$	$t_{.010}$	$t_{.005}$	$t_{.001}$	$t_{.0005}$
1	3.078	6.314	12.706	31.821	63.657	318.31	636.62
2	1.886	2.920	4.303	6.965	9.925	22.326	31.598
3	1.638	2.353	3.182	4.541	5.841	10.213	12.924
4	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	1.319	1.714	2.069	2.500	2.807	3.485	3.767
24	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	1.296	1.671	2.000	2.390	2.660	3.232	3.460
120	1.289	1.658	1.980	2.358	2.617	3.160	3.373
∞	1.282	1.645	1.960	2.326	2.576	3.090	3.291

Source: This table is reproduced with the kind permission of the Trustees of Biometrika from E. S. Pearson and H. O. Hartley (eds.), *The Biometrika Tables for Statisticians*, Vol. 1, 3d ed., Biometrika, 1966.

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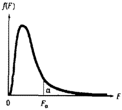
TABLE IX Percentage Points of the *F*-distribution, $\alpha = .05$



ν_2 \ ν_1	NUMERATOR DEGREES OF FREEDOM								
DENOMINATOR DEGREES OF FREEDOM	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	3.79	3.73	3.68
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80
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	2.77
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
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04
120	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88

Source. From M. Merrington and C. M. Thompson, "Tables of Percentage Points of the Inverted Beta (*F*)-Distribution," *Biometrika*, 1943, 33, 73–88. Reproduced by permission of the *Biometrika* Trustees.

(continued)