注意事項：
一、 請依照題號順序作答，且必須列出計算過程，否則不予計分。
二、 本試題總共21題，各題配分標示於題號之後。

[Problem 1-3]

Assume that each of your calls to a popular radio station has a probability of 0.02 of connecting, that is, of not obtaining a busy signal. Assume that your calls are independent.

(1) What is the probability that your first call that connects is your tenth call? (4%)

(2) What is the probability that it requires more than five calls for you to connect? (4%)

(3) What is the mean number of calls needed to connect? (4%)

[Problem 4-6]

The thickness of a conductive coating in micrometers has a density function of $600x^{-2}$ for $100\,\mu\text{m} < x < 120\,\mu\text{m}$.

(4) Determine the mean of the coating thickness. (4%)

(5) Determine the mean and variance of the coating thickness. (4%)

(6) If the coating costs \$0.50 per micrometer of thickness on each part, what is the average cost of the coating per part? (4%)

[Problem 7-10]

From a poll of 800 television viewers, the following data have been accumulated as to their levels of education and their preference of television stations. We are interested in determining if the selection of a TV station is independent of the level of education.

	Educational Level		
	High School	Bachelor	Graduate
Public Broadcasting	50	150	80
Commercial Stations	150	250	120

(7) State the null and the alternative hypotheses. (3%)

(8) Calculate the expected frequency of high school students who are in favor of commercial stations. (4%)

(9) Compute the test statistic. (4%)

(10) Determine the p-value and perform the test at 95% confidence. (4%)

[Problem 11-13]

Allied Corporation is trying to determine whether to purchase Machine A or B. It has leased the two machines for a month. A random sample of 5 employees has been taken. These employees have gone through a training session on both machines. Below you are given information on their productivity rate on both machines.

	Productivity Rate	
Person	Machine A	Machine B
1	47	52
2	53	58
3	50	47
4	55	60
5	45	53

(11) State the null and alternative hypotheses for a two-tailed test. (3%)
(12) Compute the test statistic. (4%)
(13) Compute p-value and test the null hypothesis stated in Problem 11 at the 10% level. (4%)

[Problem 14]

The data consists of n selected pairs (X_i, Y_i) independently, where $i=1, 2, \ldots, n$. Let $M_i=X_i-Y_i$, the M_i's are assumed to be normally distributed with variance σ_p^2. Find the variance for $\hat{M}$ in terms of the correlation between X and Y. (5%)

[Problem 15]

A researcher would like to understand whether there are differences in prescription among A, B, and C types. He/she randomly takes a sample of 5 A types which have been experimenting for the past 5 years. Each of them is then matched with B and C types with the similar effects. The result by each in the last year is shown in the following table. How will you test the hypothesis that there is sufficient evidence at the 1% significance level to allow the researcher to conclude that there are differences in prescription among the holders of the three types of degrees? (Show the test value and the decision) (10%)

	A	B	C	
1	3.1	4.2	3.8	μ=3.7
2	6.2	6.1	6.5	μ=6.27
3	4.5	4.8	5.0	μ=4.77
4	4.4	4.5	5.0	μ=4.63
5	2.8	2.8	3.1	μ=2.9
	μ=4.2	μ=4.48	μ=4.68	Overall μ=4.45

[Problem 16-17]

Data on advertising expenditures ($1000s) and revenue ($1000s) for a restaurant are obtained as follows.

Advertising Expenditures	Revenue
1	19
2	32
4	44
6	40
10	52
14	53
20	54

(16) Let x equal advertising expenditures ($1000s) and y equal revenue ($1000s). Use the method of least squares to develop a straight line approximation of the relationship between the two variables. (5%)

(17) Test whether revenue and advertising expenditures are related at a 0.05 level of significance. Show the test value and the decision. (5%)

[Problem 18]

Consider the following data for a dependent variable y and two independent variables, x_1 and x_2.

x_1	x_2	y
30	12	94
47	10	108
25	17	112
51	16	178
40	5	94
51	19	175
74	7	170
36	12	117
59	13	142
76	16	211

(18) Using these data, develop an estimated regression equation relating y to x_1 and x_2. (5%) Estimate y if x_1=45 and x_2=15. (5%)

[Problem 19-21]

There are two students, A and B, who compare their examinatorial scores with 36 times. We use 1 to represent the compared result if the score of A is higher than that of B; otherwise, we use 0. The final compared result is sequentially listed as follows.

111001110000110011101011010011011101

(19) At α=0.05, is there enough evidence to claim that the learning performance of A is higher than that of B? Show the test value and the decision. (5%)

(20) At α=0.05, is there enough evidence to claim that that the order of win/losing is random? Show the test value and the decision. (5%)

(21) At α=0.05, if we want to show that the learning performance of A is certainly higher than that of B, how many wins of A could come to this conclusion? (5%)

Appendix: Distribution Tables

Table 1: The Standard Normal Distribution

z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995

Table 2: t Distribution Critical Value Table

	Area in upper tail							
Degrees of Freedom	**0.3**	**0.2**	**0.1**	**0.05**	**0.025**	**0.01**	**0.005**	**0.001**
1	0.727	1.376	3.078	6.314	12.706	31.821	63.657	318.309
2	0.617	1.061	1.886	2.920	4.303	6.965	9.925	22.327
3	0.584	0.978	1.638	2.353	3.182	4.541	5.841	10.215
4	0.569	0.941	1.533	2.132	2.776	3.747	4.604	7.173
5	0.559	0.920	1.476	2.015	2.571	3.365	4.032	5.893
6	0.553	0.906	1.440	1.943	2.447	3.143	3.707	5.208
7	0.549	0.896	1.415	1.895	2.365	2.998	3.499	4.785
8	0.546	0.889	1.397	1.860	2.306	2.896	3.355	4.501
9	0.543	0.883	1.383	1.833	2.262	2.821	3.250	4.297
10	0.542	0.879	1.372	1.812	2.228	2.764	3.169	4.144
11	0.540	0.876	1.363	1.796	2.201	2.718	3.106	4.025
12	0.539	0.873	1.356	1.782	2.179	2.681	3.055	3.930
13	0.538	0.870	1.350	1.771	2.160	2.650	3.012	3.852
14	0.537	0.868	1.345	1.761	2.145	2.624	2.977	3.787
15	0.536	0.866	1.341	1.753	2.131	2.602	2.947	3.733
16	0.535	0.865	1.337	1.746	2.120	2.583	2.921	3.686
17	0.534	0.863	1.333	1.740	2.110	2.567	2.898	3.646
18	0.534	0.862	1.330	1.734	2.101	2.552	2.878	3.610
19	0.533	0.861	1.328	1.729	2.093	2.539	2.861	3.579
20	0.533	0.860	1.325	1.725	2.086	2.528	2.845	3.552
21	0.532	0.859	1.323	1.721	2.080	2.518	2.831	3.527
22	0.532	0.858	1.321	1.717	2.074	2.508	2.819	3.505
23	0.532	0.858	1.319	1.714	2.069	2.500	2.807	3.485
24	0.531	0.857	1.318	1.711	2.064	2.492	2.797	3.467
25	0.531	0.856	1.316	1.708	2.060	2.485	2.787	3.450
26	0.531	0.856	1.315	1.706	2.056	2.479	2.779	3.435
27	0.531	0.855	1.314	1.703	2.052	2.473	2.771	3.421
28	0.530	0.855	1.313	1.701	2.048	2.467	2.763	3.408
29	0.530	0.854	1.311	1.699	2.045	2.462	2.756	3.396
30	0.530	0.854	1.310	1.697	2.042	2.457	2.750	3.385
40	0.529	0.851	1.303	1.684	2.021	2.423	2.704	3.307
50	0.528	0.849	1.299	1.676	2.009	2.403	2.678	3.261
60	0.527	0.848	1.296	1.671	2.000	2.390	2.660	3.232
70	0.527	0.847	1.294	1.667	1.994	2.381	2.648	3.211
80	0.526	0.846	1.292	1.664	1.990	2.374	2.639	3.195
90	0.526	0.846	1.291	1.662	1.987	2.368	2.632	3.183
100	0.526	0.845	1.290	1.660	1.984	2.364	2.626	3.174
120	0.526	0.845	1.289	1.658	1.980	2.358	2.617	3.160
∞	0.524	0.842	1.282	1.645	1.960	2.326	2.576	3.092

Table 3: F Distribution Critical Value Table (α value=0.05)

Denominator degrees of freedom (ddf) / Numerator degrees of freedom (ndf)

ddf \ ndf	1	2	3	4	5	6	7	8	9	10	12	15	20	40	60	120	1000
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9	243.9	246.0	248.0	251.1	252.2	253.3	254.2
2	18.513	19.000	19.164	19.247	19.296	19.330	19.353	19.371	19.385	19.396	19.413	19.429	19.446	19.471	19.479	19.487	19.495
3	10.128	9.552	9.277	9.117	9.013	8.941	8.887	8.845	8.812	8.786	8.745	8.703	8.660	8.594	8.572	8.549	8.529
4	7.709	6.944	6.591	6.388	6.256	6.163	6.094	6.041	5.999	5.964	5.912	5.858	5.803	5.717	5.688	5.658	5.632
5	6.608	5.786	5.409	5.192	5.050	4.950	4.876	4.818	4.772	4.735	4.678	4.619	4.558	4.464	4.431	4.398	4.369
6	5.987	5.143	4.757	4.534	4.387	4.284	4.207	4.147	4.099	4.060	4.000	3.938	3.874	3.774	3.740	3.705	3.675
7	5.591	4.737	4.347	4.120	3.972	3.866	3.787	3.726	3.677	3.637	3.575	3.511	3.445	3.340	3.304	3.267	3.234
8	5.318	4.459	4.066	3.838	3.687	3.581	3.500	3.438	3.388	3.347	3.284	3.218	3.150	3.043	3.005	2.967	2.932
9	5.117	4.256	3.863	3.633	3.482	3.374	3.293	3.230	3.179	3.137	3.073	3.006	2.936	2.826	2.787	2.748	2.712
10	4.965	4.103	3.708	3.478	3.326	3.217	3.135	3.072	3.020	2.978	2.913	2.845	2.774	2.661	2.621	2.580	2.543
11	4.844	3.982	3.587	3.357	3.204	3.095	3.012	2.948	2.896	2.854	2.788	2.719	2.646	2.531	2.490	2.448	2.410
12	4.747	3.885	3.490	3.259	3.106	2.996	2.913	2.849	2.796	2.753	2.687	2.617	2.544	2.426	2.384	2.341	2.302
13	4.667	3.806	3.411	3.179	3.025	2.915	2.832	2.767	2.714	2.671	2.604	2.533	2.459	2.339	2.297	2.252	2.212
14	4.600	3.739	3.344	3.112	2.958	2.848	2.764	2.699	2.646	2.602	2.534	2.463	2.388	2.266	2.223	2.178	2.136
15	4.543	3.682	3.287	3.056	2.901	2.790	2.707	2.641	2.588	2.544	2.475	2.403	2.328	2.204	2.160	2.114	2.072
16	4.494	3.634	3.239	3.007	2.852	2.741	2.657	2.591	2.538	2.494	2.425	2.352	2.276	2.151	2.106	2.059	2.016
17	4.451	3.592	3.197	2.965	2.810	2.699	2.614	2.548	2.494	2.450	2.381	2.308	2.230	2.104	2.058	2.011	1.967
18	4.414	3.555	3.160	2.928	2.773	2.661	2.577	2.510	2.456	2.412	2.342	2.269	2.191	2.063	2.017	1.968	1.923
19	4.381	3.522	3.127	2.895	2.740	2.628	2.544	2.477	2.423	2.378	2.308	2.234	2.155	2.026	1.980	1.930	1.884
20	4.351	3.493	3.098	2.866	2.711	2.599	2.514	2.447	2.393	2.348	2.278	2.203	2.124	1.994	1.946	1.896	1.850
21	4.325	3.467	3.072	2.840	2.685	2.573	2.488	2.420	2.366	2.321	2.250	2.176	2.096	1.965	1.916	1.866	1.818
22	4.301	3.443	3.049	2.817	2.661	2.549	2.464	2.397	2.342	2.297	2.226	2.151	2.071	1.938	1.889	1.838	1.790
23	4.279	3.422	3.028	2.796	2.640	2.528	2.442	2.375	2.320	2.275	2.204	2.128	2.048	1.914	1.865	1.813	1.764
24	4.260	3.403	3.009	2.776	2.621	2.508	2.423	2.355	2.300	2.255	2.183	2.108	2.027	1.892	1.842	1.790	1.740
25	4.242	3.385	2.991	2.759	2.603	2.490	2.405	2.337	2.282	2.236	2.165	2.089	2.007	1.872	1.822	1.768	1.718
26	4.225	3.369	2.975	2.743	2.587	2.474	2.388	2.321	2.265	2.220	2.148	2.072	1.990	1.853	1.803	1.749	1.698
27	4.210	3.354	2.960	2.728	2.572	2.459	2.373	2.305	2.250	2.204	2.132	2.056	1.974	1.836	1.785	1.731	1.679
28	4.196	3.340	2.947	2.714	2.558	2.445	2.359	2.291	2.236	2.190	2.118	2.041	1.959	1.820	1.769	1.714	1.662
29	4.183	3.328	2.934	2.701	2.545	2.432	2.346	2.278	2.223	2.177	2.104	2.027	1.945	1.806	1.754	1.698	1.645
30	4.171	3.316	2.922	2.690	2.534	2.421	2.334	2.266	2.211	2.165	2.092	2.015	1.932	1.792	1.740	1.683	1.630

Table 4: Chi-square Distribution Critical Value Table

Area in upper tail

Degrees of Freedom	0995	0.99	0.975	0.95	0.9	0.8	0.2	0.1	0.05	0.025	0.01	0.005
1	0.000	0.000	0.001	0.004	0.016	0.064	1.642	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	0.446	3.219	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	1.005	4.642	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	1.649	5.989	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	2.343	7.289	9.236	11.07	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	3.070	8.558	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	3.822	9.803	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	4.594	11.030	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	5.380	12.242	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	6.179	13.442	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	6.989	14.631	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	7.807	15.812	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	8.634	16.985	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	9.467	18.151	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	10.307	19.311	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	11.152	20.465	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	12.002	21.615	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	12.857	22.760	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	13.716	23.900	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	14.578	25.038	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	15.445	26.171	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	16.314	27.301	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	17.187	28.429	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	18.062	29.553	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	18.940	30.675	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	19.820	31.795	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	20.703	32.912	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	21.588	34.027	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	22.475	35.139	39.087	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	23.364	36.250	40.256	43.773	46.979	50.892	53.672
31	14.458	15.655	17.539	19.281	21.434	24.255	37.359	41.422	44.985	48.232	52.191	55.003
32	15.134	16.362	18.291	20.072	22.271	25.148	38.466	42.585	46.194	49.480	53.486	56.328
33	15.815	17.074	19.047	20.867	23.110	26.042	39.572	43.745	47.400	50.725	54.776	57.648
34	16.501	17.789	19.806	21.664	23.952	26.938	40.676	44.903	48.602	51.966	56.061	58.964
35	17.192	18.509	20.569	22.465	24.797	27.836	41.778	46.059	49.802	53.203	57.342	60.275
40	20.707	22.164	24.433	26.509	29.051	32.345	47.269	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	41.449	58.164	63.167	67.505	71.420	76.154	79.490
60	35.534	37.485	40.482	43.188	46.459	50.641	68.972	74.397	79.082	83.298	88.379	91.952
70	43.275	45.442	48.758	51.739	55.329	59.898	79.715	85.527	90.531	95.023	100.425	104.215
80	51.172	53.540	57.153	60.391	64.278	69.207	90.405	96.578	101.879	106.629	112.329	116.321
90	59.196	61.754	65.647	69.126	73.291	78.558	101.054	107.565	113.145	118.136	124.116	128.299
100	67.328	70.065	74.222	77.929	82.358	87.945	111.667	118.498	124.342	129.561	135.807	140.169
110	75.550	78.458	82.867	86.792	91.471	97.362	122.250	129.385	135.480	140.917	147.414	151.948
120	83.852	86.923	91.573	95.705	100.624	106.806	132.806	140.233	146.567	152.211	158.950	163.648