注意：本試卷共有六頁，統計分配表檢附於後。您不可使用英文翻譯機或字典。請考生答題前，
務必閱讀每大項的注意事項說明！

第一部份：單選題（每題3分，共60分）
（1） 請將答案寫在<u>答案卷第一頁</u>『選擇題作答區』對應題號的空格內（第1～20格）。
（2） 若您覺得有多個答案，請選出最適的答案。
（3） 每格答對得3分，答錯或未作答得0分。
（4） 答題不要求任何計算過程，只依答案格內的答案對錯給分。

PART I. Multiple Choice Questions: Choose the correct or the <u>best</u> answer (3 points each)

1. Let P[·] be a probability set function. Given $P[A \cup B] = 0.7$ and $P[A \cup B^c] = 0.9$ where B^c is complement of B, determine P[A].
A) 0.2　B) 0.4　C) 0.6　D) 0.8　E) 1.6

2. If a distribution is skewed to the left, then this distribution has
A) a mean smaller than the mode.　B) positive skewness coefficient.
C) a median smaller than the mean.　D) Answers <u>B</u> and <u>C</u>.
E) None of the above is correct.

3. The phenomenon that stock returns are typically higher in January than most other months, often referred as the January effect, is an example of
A) trend component.　B) seasonal component.
C) cyclical component.　D) irregular component.
E) Answers <u>B</u> and <u>C</u>.

4. Which of the following statements is valid?
A) The arithmetic mean is smaller or equal to the geometric mean.
B) The geometric mean is frequently used to calculate average stock rates of return.
C) The arithmetic mean is less sensitive to extreme values than the geometric mean.
D) The geometric mean cannot be calculated for data containing either zero or negative values.
E) Answer <u>B</u> and <u>D</u>.

5. Which of the following statement about the Central Limit Theorem is *in*correct?
A) The application of the Central Limit Theorem does not require that we know the distribution of the population.
B) The Central Limit Theorem allows us to use sample statistics to make inferences about population parameters.
C) The Central Limit Theorem tells us that as population size grows, its distribution approaches normal.
D) The Central Limit Theorem tells us that as the sample size increases, the sampling distribution of the mean approaches normal, regardless of the population distribution.
E) All of the above are correct.

6. At a private university with 20,000 students, admission administrators find that enrollment for the current year consists of 63% in-state students and 37% out-of-state students. If a random sample of 1,000 students is taken, what is the probability that the percentage of out-of-state students is between 35% and 41%?
A) 0.8098　B) 0.9912　C) 0.9049　D) 0.9005　E) 0.9956

7. A print manufacturer wants to determine the average drying time of a new interior wall paint. If for 12 test areas of equal size he obtained a mean drying time of 66.3 minutes and a standard deviation of 8.4 minutes, construct a 95% confidence interval for the true mean μ. The upper confidence limit is
A) 70.65 B) 71.64 C) 71.05 D) 60.96 E) 61.55

8. (Refer to 7) Explain what the phrase "95% confident" means.
A) 95% of the similarly constructed intervals would contain the value of the sample mean.
B) 95 % of the sample means from similar samples fall within the interval.
C) In repeated sampling, 95% of the intervals constructed would contain μ.
D) 95% of the population values will fall within the interval.
E) The probability is (1 – 95%) that the random interval includes the unknown fixed point μ.

9. In the test of a certain hypothesis, the *p*-value corresponding to the test statistic is 0.0316. At which of the following significance level can the null hypothesis be rejected.
A) 0.01 B) 0.05 C) 0.10 D) B and C E) Depending on one-sided or two-sided tests.

10. A sample size of 25 is taken from a normally distributed population. The sample standard deviation is 7. Which of the following is true? (σ denotes the standard deviation of the population)
   i. The null hypothesis (H_0:$\sigma \le 5.6$) can be rejected at $\alpha = 0.05$
   ii. The null hypothesis (H_0:$\sigma \le 5.6$) cannot be rejected at $\alpha = 0.05$
   iii. The null hypothesis (H_0:$\sigma \ge 5.6$) can be rejected at $\alpha = 0.05$
   iv. The null hypothesis (H_0:$\sigma \ge 5.6$) cannot be rejected at $\alpha = 0.05$
A) i and iii B) ii and iv C) i and iv D) ii and iii E) None of the above is correct.

11. Which of the following can cause OLS estimators to be biased?
A) Including an irrelevant or unnecessary variable in a model.
B) Omitting a relevant variable in a model.
C) Two dependent variables are highly correlated (with sample correlation coefficient of 0.95) to each other.
D) Heteroskedasticity.
E) All of the above.

For Question 12-14, refer to the following table. The average weekly profits (in $1,000) of 5 restaurants are related to their seating capacities, and the average daily traffic (in thousands of cars) that passes their locations. Let profit be the dependent variable (y), and seating capacities (x_1) and traffic (x_2) be the independent variables. Assuming that the regression is linear with the coefficients estimated as:

Table 1 Estimation Results of the Regression

Independent variable	Coefficient	Standard error	*p*-value
Constant	–0.6267	1.4828	0.7137
x_1	0.0972	0.0054	0.0031
x_2	0.6618	0.0600	0.0081

12. What is the *t*-value of the *t* test for H_0: $\beta_1 \le 0.08$, where β_1 is the coefficient of x_1 ?
A) 3.19 B) 18 C) 7.12 D) 8.05 E) Insufficient information to answer.

13. What is the *p*-value of the *t* test for H_0: $\beta_2 \le 0$, where β_2 is the coefficient of x_2 ?
A) 0.0162 B) 0.0041 C) 0.0081 D) 0.0016 E) Insufficient information to answer.

14. Which of the following statement is correct?
    A) If we rescale the dependent variable y by changing the unit of measurement from \$1,000 to \$1, the coefficient of x_1 and x_2 become 97.2 and 661.8, respectively, but the constant will not change.
    B) If we rescale the independent variable x_1 by changing the unit of measurement from thousands of cars to cars, the coefficient of x_1 will become 97.2 but the coefficient of x_2 will not change.
    C) If we rescale the independent variable x_1 by changing the unit of measurement from thousands of cars to cars, the coefficient of x_1 and x_2 will become 9.72×10^{-5} and 6.618×10^{-4}, respectively.
    D) The value of R-squared may increase but not the adjusted R-squared.
    E) None of the above is correct.

15. If we regress quantity consumed against price per unit of a commodity, then the slope of this regression can be regarded as elasticity when we use
    A) Linear model with one <u>interaction</u> term in the right hand side of the regression relationship.
    B) Linear model with a <u>quadratic</u> term in the right hand side of the regression relationship.
    C) Log-linear model.
    D) Double log model.
    E) Linear-log model.

16. The coefficient of determination of a 3-dependent variable multiple regression is 0.8. If the number of observations is 20, then the F statistic for this regression is
    A) 25.6　B) 30.89　C) 27.9　D) 40.97　E) 21.33

17. If all the independent variables are uncorrelated, the variance inflationary factor for each explanatory factor will be equal to
    A) one　B) zero　C) ten　D) infinity　E) None of the above is correct.

18. An investment company's annual profit is normally distributed with mean 100 and variance 400. Let Z be normally distributed with mean 0 and variance 1 and let F(·) be the cumulative distribution function of Z. Determine the probability that the company's profit is at most 60, given that the profit in the year is positive.
    A) 1−F(2)　B) F(2)/F(5)　C) [1−F(2)]/F(5)
    D) [F(0.25)−F(0.1)]/F(0.25)　E) [F(5)−F(2)]/F(5)

19. Which of the following is the advantage of nonparametric tests over parametric tests?
    A) Nonparametric tests do not require us the make an assumption about a population's distribution.
    B) The efficiency of nonparametric tests is always higher than that of parametric tests.
    C) The power of nonparametric tests is greater than that of parametric tests.
    D) Answer <u>A</u> and <u>B</u>
    E) All of the above are correct.

20. In a sign test, the mean of the sampling distribution for performing the null hypothesis test is
    A) 1.0　B) 0.5　C) 0　D) 1/3　E) Depending on sample size.

第二部份：問答題（每題10分，共40分）

（1） 請將所有過程、步驟交代清楚；沒有說明過程者，不給分。

（2） 無法整除的數字，請保留至少2位小數點。

PART II. Essay Questions: Show detailed steps to get credits (10 points each)

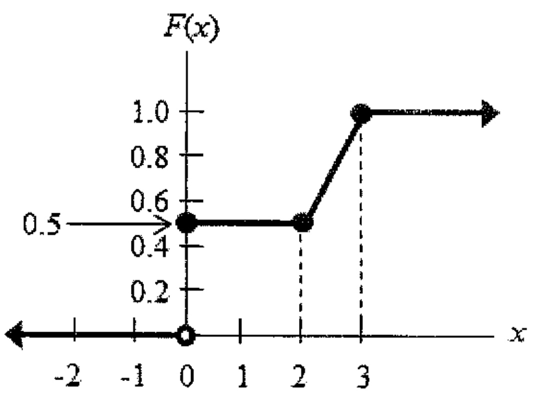
1. Let θ denote the probability that all patients given a new medication will recover from a certain disease. A manufacturer wants to test the null hypothesis $\theta = 0.9$ against the alternative hypothesis $\theta = 0.6$. His test statistic is X, the observed number of successes (recoveries) in 20 trials, and he will accept the null hypothesis if $x > 14$; otherwise, he will reject it. Find the probability of type I and type II errors, α and β.

2. Suppose that N and S are jointly distributed as indicated in the following table.

N \ S	0	1	2	3 or more
0	0.04	0.06	0.10	0.04
1	0.10	0.18	0.08	0.03
2	0.12	0.06	0.05	0.02
3 or more	0.05	0.04	0.02	0.01

Let E(·) and Var(·) denote the expected value and variance, respectively, of the random variable. Calculate $E(N \mid N + S = 2)$ and $Var(N \mid N + S = 2)$.

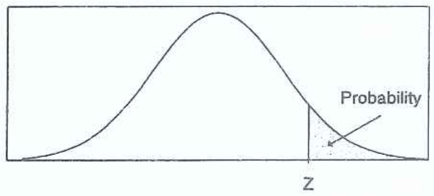
3. The figure below shows the cumulative distribution function of a random variable, X. Find its density function and calculate $E(X)$.



4. In 1982 Bob's mother scored at the 93rd percentile in the math SAT exam. In 1982 the mean score was 503 and the variance of the scores was 9604. In 2008 Bob took the math SAT and got the same numerical score as his mother has received 26 years before. In 2008 the mean score was 521 and the variance of the scores was 10,201. Math SAT scores are normally distributed. Calculate the <u>percentile</u> for Bob's score.

A: Normal probabilities

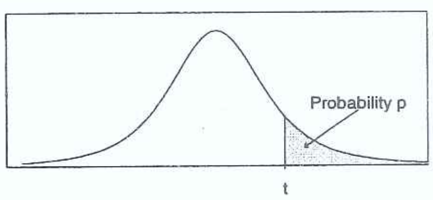
Table entry is the probability in the right-hand tail of a standard normal distribution (mean 0 and standard deviation 1). For negative values of z, probabilities are found by symmetry.



	Second decimal place of z									
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	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
3.5	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002

B: Critical values for t statistic

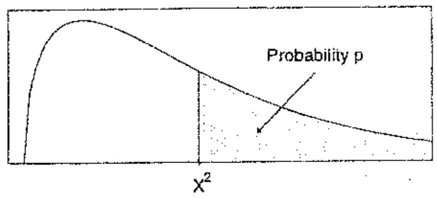
Table entry is the point t with the probability p lying above it. The first column gives the degrees of freedom. Use symmetry for negative t values.



	Tail probability p				
df	0.1	0.05	0.025	0.01	0.005
1	3.08	6.31	12.71	31.82	63.66
2	1.89	2.92	4.30	6.96	9.92
3	1.64	2.35	3.18	4.54	5.84
4	1.53	2.13	2.78	3.75	4.60
5	1.48	2.02	2.57	3.36	4.03
6	1.44	1.94	2.45	3.14	3.71
7	1.41	1.89	2.36	3.00	3.50
8	1.40	1.86	2.31	2.90	3.36
9	1.38	1.83	2.26	2.82	3.25
10	1.37	1.81	2.23	2.76	3.17
11	1.36	1.80	2.20	2.72	3.11
12	1.36	1.78	2.18	2.68	3.05
13	1.35	1.77	2.16	2.65	3.01
14	1.34	1.76	2.14	2.62	2.98
15	1.34	1.75	2.13	2.60	2.95
16	1.34	1.75	2.12	2.58	2.92
17	1.33	1.74	2.11	2.57	2.90
18	1.33	1.73	2.10	2.55	2.88
19	1.33	1.73	2.09	2.54	2.86
20	1.33	1.72	2.09	2.53	2.85
21	1.32	1.72	2.08	2.52	2.83
22	1.32	1.72	2.07	2.51	2.82
23	1.32	1.71	2.07	2.50	2.81
24	1.32	1.71	2.06	2.49	2.80
25	1.32	1.71	2.06	2.49	2.79
30	1.31	1.70	2.04	2.46	2.75
40	1.30	1.68	2.02	2.42	2.70
50	1.30	1.68	2.01	2.40	2.68
60	1.30	1.67	2.00	2.39	2.66
70	1.29	1.67	1.99	2.38	2.65
80	1.29	1.66	1.99	2.37	2.64
90	1.29	1.66	1.99	2.37	2.63
100	1.29	1.66	1.98	2.36	2.63
∞	1.28	1.64	1.96	2.33	2.58

C: Critical values for χ^2 statistic

Table entry is the point X^2 with the probability p lying above it. The first column gives the degrees of freedom.



ν	$\alpha = .995$	$\alpha = .99$	$\alpha = .975$	$\alpha = .95$	$\alpha = .05$	$\alpha = .025$	$\alpha = .01$	$\alpha = .005$	ν
1	.0000393	.000157	.000982	.00393	3.841	5.024	6.635	7.879	1
2	.0100	.0201	.0506	.103	5.991	7.378	9.210	10.597	2
3	.0717	.115	.216	.352	7.815	9.348	11.345	12.838	3
4	.207	.297	.484	.711	9.488	11.143	13.277	14.860	4
5	.412	.554	.831	1.145	11.070	12.832	15.086	16.750	5
6	.676	.872	1.237	1.635	12.592	14.449	16.812	18.548	6
7	.989	1.239	1.690	2.167	14.067	16.013	18.475	20.278	7
8	1.344	1.646	2.180	2.733	15.507	17.535	20.090	21.955	8
9	1.735	2.088	2.700	3.325	16.919	19.023	21.666	23.589	9
10	2.156	2.558	3.247	3.940	18.307	20.483	23.209	25.188	10
11	2.603	3.053	3.816	4.575	19.675	21.920	24.725	26.757	11
12	3.074	3.571	4.404	5.226	21.026	23.337	26.217	28.300	12
13	3.565	4.107	5.009	5.892	22.362	24.736	27.688	29.819	13
14	4.075	4.660	5.629	6.571	23.685	26.119	29.141	31.319	14
15	4.601	5.229	6.262	7.261	24.996	27.488	30.578	32.801	15
16	5.142	5.812	6.908	7.962	26.296	28.845	32.000	34.267	16
17	5.697	6.408	7.564	8.672	27.587	30.191	33.409	35.718	17
18	6.265	7.015	8.231	9.390	28.869	31.526	34.805	37.156	18
19	6.844	7.633	8.907	10.117	30.144	32.852	36.191	38.582	19
20	7.434	8.260	9.591	10.851	31.410	34.170	37.566	39.997	20
21	8.034	8.897	10.283	11.591	32.671	35.479	38.932	41.401	21
22	8.643	9.542	10.982	12.338	33.924	36.781	40.289	42.796	22
23	9.260	10.196	11.689	13.091	35.172	38.076	41.638	44.181	23
24	9.886	10.856	12.401	13.848	36.415	39.364	42.980	45.558	24
25	10.520	11.524	13.120	14.611	37.652	40.646	44.314	46.928	25
26	11.160	12.198	13.844	15.379	38.885	41.923	45.642	48.290	26
27	11.808	12.879	14.573	16.151	40.113	43.194	46.963	49.645	27
28	12.461	13.565	15.308	16.928	41.337	44.461	48.278	50.993	28
29	13.121	14.256	16.047	17.708	42.557	45.722	49.588	52.336	29
30	13.787	14.953	16.791	18.493	43.773	46.979	50.892	53.672	30

D: Probabilities for Binomial distribution

		θ									
n	x	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50
20	0	.3585	.1216	.0388	.0115	.0032	.0008	.0002	.0000	.0000	.0000
	1	.3774	.2702	.1368	.0576	.0211	.0068	.0020	.0005	.0001	.0000
	2	.1887	.2852	.2293	.1369	.0669	.0278	.0100	.0031	.0008	.0002
	3	.0596	.1901	.2428	.2054	.1339	.0716	.0323	.0123	.0040	.0011
	4	.0133	.0898	.1821	.2182	.1897	.1304	.0738	.0350	.0139	.0046
	5	.0022	.0319	.1028	.1746	.2023	.1789	.1272	.0746	.0365	.0148
	6	.0003	.0089	.0454	.1091	.1686	.1916	.1712	.1244	.0746	.0370
	7	.0000	.0020	.0160	.0545	.1124	.1643	.1844	.1659	.1221	.0739
	8	.0000	.0004	.0046	.0222	.0609	.1144	.1614	.1797	.1623	.1201
	9	.0000	.0001	.0011	.0074	.0271	.0654	.1158	.1597	.1771	.1602
	10	.0000	.0000	.0002	.0020	.0099	.0308	.0686	.1171	.1593	.1762
	11	.0000	.0000	.0000	.0005	.0030	.0120	.0336	.0710	.1185	.1602
	12	.0000	.0000	.0000	.0001	.0008	.0039	.0136	.0355	.0727	.1201
	13	.0000	.0000	.0000	.0000	.0002	.0010	.0045	.0146	.0366	.0739
	14	.0000	.0000	.0000	.0000	.0000	.0002	.0012	.0049	.0150	.0370
	15	.0000	.0000	.0000	.0000	.0000	.0000	.0003	.0013	.0049	.0148
	16	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	.0013	.0046
	17	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	.0011
	18	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
	19	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
	20	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000