國立清華大學 103 學年度碩士班考試入學試題

系所班組別：計量財務金融學系　甲組、乙組

考試科目（代碼）：統計學 (4503) (4603)

請將計算過程寫在試題紙上，只將最後的答案寫在答案卷上. 請依題目順序做答.

1 (30% 每題 5 分).

假設股價 $S_t, t=0,1,2$ 的走勢只有往上以及往下兩種走勢:

$$S_t = \begin{cases} u \times S_{t-1}, \text{ upward; with probability } p, \\ d \times S_{t-1}, \text{ downard; with probability } 1-p, \end{cases} \quad \text{for all } t=1,2,$$

其中 u 與 d 分別是已知的上漲與下跌比例，且當 $t=0$ 時，S_0 為已知。

假設有一衍生性商品，它的報酬 (payoff) 為 $\max(S_2-K,0)$，其中 K 為已知的執行價格 (exercise price)。又假設折現利率為 0。

(1) 請計算 S_2 的機率密度函數。

(2) 請計算衍生性商品的平均報酬。

(3) 若已知第 1 期 ($t=1$) 股價走勢 S_1 往上，請計算在這情況之下衍生性商品的平均報酬，並將它計為 A_u。

(4) 若已知第 1 期 ($t=1$) 股價走勢 S_1 往下，請計算在這情況之下衍生性商品的平均報酬，並將它計為 A_d。

(5) 依據 A_u 與 A_d 的結果以及他們發生的機率，再計算 A_u 與 A_d 在 $t=0$ 的平均報酬。

(6) 比較 (2) 以及 (5) 的結果，兩者是否相同? 為什麼? 請依據統計理論說明。

請將計算過程寫在試題紙上，只將最後的答案寫在答案卷上. 請依題目順序做答.

2 (10% 每題 5 分).

The probability generating function (PGF) $\phi(s)$ of a random variable X taking finitely or countably many non-negative integer values n with probabilities p_n is defined as

$$\phi(s) = \mathrm{E}(s^X);$$

it is usually considered for $-1 \le s \le 1$ to guarantee convergence. An important fact is that the PGF determines the distribution of random variable X uniquely. Also,

$$\mathrm{E}(X) = \frac{d}{ds}\phi(s),$$

evaluated at $s = 1$;

$$\mathrm{E}[X(X-1)] = \frac{d^2}{ds^2}\phi(s),$$

evaluated at $s = 1$.

Now, a coin shows heads with probability $p > 0$ and tails with probability $1 - p$. Let Y_i be the number of tosses need to obtain i heads.

(1) Find the PGF for $Y_i, i = 1$.

(2) Compute its mean and variance.

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3 (10% 每題 5 分).

Let $Y \sim N(\mu, \sigma^2)$. Suppose that the marginal utility function is of the form:

$$Z = \exp(\delta Y + \theta),$$

where δ, θ are constant. The distribution of Z can be used to prove the Black-Scholes formula.

(1) Calculate the PDF of the marginal utility function.

(2) Calculate the mean of the marginal utility function.

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4 (5% 每題 5 分).

Let X, Y be independent random variables with values in $[0,\infty)$ and the same probability density functions (PDF): $2e^{-x^2}/\sqrt{\pi}$ and $2e^{-y^2}/\sqrt{\pi}$. Let $U = X^2 + Y^2$, $V = Y/X$. Compute the joint PDF $f_{U,V}$.

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5 (25% 每題 5 分).

Suppose that $X_1, X_2, \cdots, X_n$ is a sample of i.i.d. random variables $X_i \sim N(\mu, 1)$. Consider the following two estimators for μ:

$$Y = \frac{X_1 + X_2 + X_{n-1} + X_n}{4} \quad \text{and} \quad \bar{X} = \frac{X_1 + \cdots + X_n}{n}.$$

(1) Are Y and $\bar{X}$ unbiased? Are Y and $\bar{X}$ consistent?

Now we want to test the null hypothesis: $\mu = 3$.

(2) What is the test statistic if we use Y as an estimator? What is the distribution of the test statistic?

(3) What is the test statistic if we use $\bar{X}$ as an estimator? What is the distribution of the test statistic?

(4) Which test statistic will you select? Why?

(5) We observe 8 observations which are shown in the following table:

x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8
2	4	5	6	-4	-16	3	3

Based on this data set, what is the conclusion (reject or accept the null hypothesis: $\mu = 3$) if we use the test statistic in (2). Why?

Based on this data set, what is the conclusion (reject or accept the null hypothesis: $\mu = 3$) if we use the test statistic in (3). Why?

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6 (20% 每題 5 分).

Answer the following questions with "True" or "False" and explain your answer very briefly.

(1) Given the model $Y_t = X_t\beta + \varepsilon_t$, suppose that ε_t is not normally distributed. It is still possible to compute the maximum likelihood estimator (MLE).

(2) Given the model $Y_t = X_t\beta + \varepsilon_t$, the MLE of β is always equivalent to the ordinary least squares (OLS) estimator of β.

(3) Given an estimated regression model, if the *F*-test for all the coefficients (except the constant term) equal to zero is significant at the level α, then all the individual *t*-ratios must also be significant at the same level.

(4) In a linear model where ε_t are i.i.d. $N(0,\sigma^2)$. Then the OLS residual $\hat{\varepsilon}_t$ is also distributed as $N(0,\sigma^2)$.

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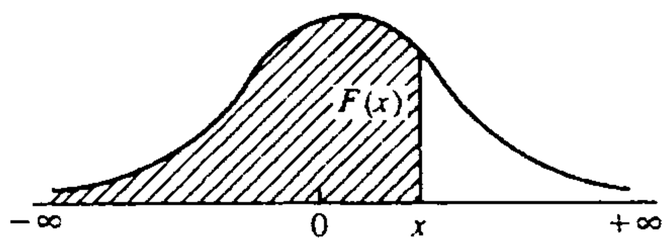
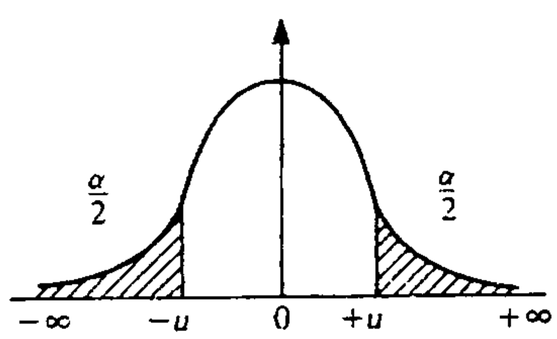
Table 1
Cumulative Distribution Function of the Standard Normal Distribution



$$F(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} \mathrm{e}^{-u^2/2} \mathrm{d}u$$

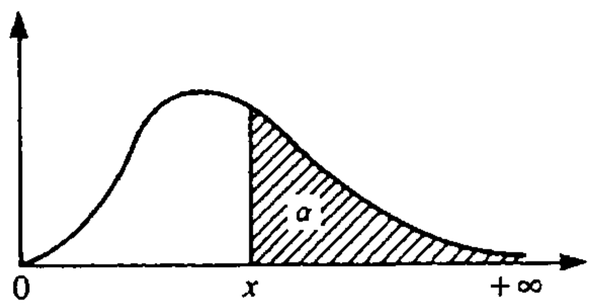
x	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.500 00	0.503 99	0.507 98	0.511 97	0.515 95	0.519 94	0.523 92	0.527 90	0.531 88	0.535 86
0.1	0.539 83	0.543 80	0.547 76	0.551 72	0.555 67	0.559 62	0.563 56	0.567 50	0.571 42	0.575 35
0.2	0.579 26	0.583 17	0.587 06	0.590 95	0.594 84	0.598 71	0.602 57	0.606 42	0.610 26	0.614 09
0.3	0.617 91	0.621 72	0.625 52	0.629 30	0.633 07	0.636 83	0.640 58	0.644 31	0.648 03	0.651 73
0.4	0.655 42	0.659 10	0.662 76	0.666 40	0.670 03	0.673 65	0.677 24	0.680 82	0.684 39	0.687 93
0.5	0.691 46	0.694 97	0.698 47	0.701 94	0.705 40	0.708 84	0.712 26	0.715 66	0.719 04	0.722 40
0.6	0.725 75	0.729 07	0.732 37	0.735 65	0.738 91	0.742 15	0.745 37	0.748 57	0.751 75	0.754 90
0.7	0.758 04	0.761 15	0.764 24	0.767 31	0.770 35	0.773 37	0.776 37	0.779 35	0.782 30	0.785 24
0.8	0.788 14	0.791 03	0.793 89	0.796 73	0.799 55	0.802 11	0.805 11	0.807 85	0.810 57	0.813 27
0.9	0.815 94	0.818 59	0.821 21	0.823 81	0.826 39	0.828 94	0.831 47	0.833 98	0.836 46	0.838 91
1.0	0.841 34	0.843 75	0.846 14	0.848 50	0.850 83	0.853 14	0.855 43	0.857 69	0.859 93	0.862 14
1.1	0.864 33	0.866 50	0.868 64	0.870 76	0.872 86	0.874 93	0.876 98	0.879 00	0.881 00	0.882 98
1.2	0.884 93	0.886 86	0.888 77	0.890 65	0.892 51	0.892 35	0.896 17	0.897 96	0.899 73	0.901 47
1.3	0.903 20	0.904 90	0.906 58	0.908 24	0.909 88	0.911 49	0.913 09	0.914 66	0.916 21	0.917 74
1.4	0.919 24	0.920 73	0.922 20	0.923 64	0.925 07	0.926 47	0.927 86	0 929 22	0.930 56	0.931 89
1.5	0.933 19	0.934 48	0.935 74	0.936 99	0.938 22	0.939 43	0.940 62	0.941 79	0.942 95	0.944 08
1.6	0.945 20	0.946 30	0.947 38	0.948 45	0.949 50	0.950 53	0.951 54	0.952 54	0.953 52	0.954 49
1.7	0.955 43	0.956 37	0.957 28	0.958 19	0.959 07	0.959 94	0 960 80	0.961 64	0.962 46	0.963 27
1.8	0.964 07	0.964 85	0.965 62	0.966 38	0.967 12	0.967 84	0.968 56	0.969 26	0.969 95	0.970 62
1.9	0.971 28	0.971 93	0.972 57	0.973 20	0.973 81	0.974 41	0.975 00	0.975 58	0.976 15	0.976 70
2.0	0.977 25	0.977 78	0.978 31	0.978 82	0.979 32	0.979 82	0.980 30	0.980 77	0.981 24	0.981 69
2.1	0.982 14	0.982 57	0.983 00	0.983 41	0.983 82	0.984 22	0.984 61	0.985 00	0.985 37	0.985 74
2.2	0.986 10	0.986 45	0.986 79	0.987 13	0.987 45	0.987 78	0.988 09	0.988 40	0.988 70	0.988 99
2.3	0.989 28	0.989 56	0.989 83	0.990 10	0.990 36	0.990 86	0.991 11	0.991 11	0.991 34	0.991 58
2.4	0.991 80	0.992 02	0.992 24	0.992 45	0.992 66	0.992 86	0.993 05	0.993 24	0.993 43	0.993 61
2.5	0.993 79	0.993 96	0.994 13	0.994 30	0.994 46	0.994 61	0.994 77	0.994 92	0.995 06	0.995 20
2.6	0.995 34	0.995 47	0.995 60	0.995 73	0.995 85	0.995 98	0.996 09	0.996 21	0.996 32	0.996 43
2.7	0.996 53	0.996 64	0.996 74	0.996 83	0.996 93	0.997 02	0.997 11	0.997 20	0.997 28	0.997 36
2.8	0.997 44	0.997 52	0.997 60	0.997 67	0.997 74	0.997 81	0.997 88	0.997 95	0.998 01	0.998 07
2.9	0.998 13	0.998 19	0.998 25	0.998 31	0.998 36	0.998 41	0.998 46	0.998 51	0.998 56	0.998 61

Table 2
Quantiles of the Standard Normal Distribution (u = value of Z such that $Pr(\mid Z \mid > u) = \alpha$)



α	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	∞	2.5758	2.3263	2.1701	2.0537	1.9600	1.8808	1.8119	1.7507	1.6954
0.1	1.6449	1.5982	1.5548	1.5141	1.4758	1.4395	1.4051	1.3722	1.3408	1.3106
0.2	1.2816	1.2536	1.2566	1.2004	1.1750	1.1503	1.1264	1.1031	1.0803	1.0581
0.3	1.0364	1.0152	0.9945	0.9741	0.9542	0.9346	0.9154	0.8965	0.8779	0.8596
0.4	0.8416	0.8239	0.7892	0.8064	0.7722	0.7554	0.7388	0.7255	0.7063	0.6903
0.5	0.6745	0.6588	0.6433	0.6280	0.6128	0.5978	0.5828	0.5681	0.5534	0.5388
0.6	0.5244	0.5101	0.4959	0.4817	0.4677	0.4538	0.4399	0.4261	0.4125	0.3989
0.7	0.3853	0.3719	0.3585	0.3451	0.3319	0.3186	0.3000	0.2924	0.2793	0.2663
0.8	0.2533	0.2404	0.2275	0.2147	0.2019	0.1819	0.1764	0.1637	0.1510	0.1383
0.9	0.1257	0.1130	0.1004	0.0878	0.0753	0.0627	0.0502	0.0376	0.0251	0.0125

Table 3
Quantiles of the Chi-Square Distribution with ν Degrees of Freedom
(x = value of χ^2 such that $Pr(\chi^2 > x) = \alpha$)



ν \ α	0.990	0.975	0.950	0.900	0.100	0.050	0.025	0.010	0.001
1	0.000 2	0.001 0	0.003 9	0.015 8	2.71	3.84	5.02	6.63	10.83
2	0.02	0.05	0.10	0.21	4.61	5.99	7.38	9.21	13.82
3	0.12	0.22	0.35	0.58	6.25	7.81	9.35	11.34	16.27
4	0.30	0.48	0.71	1.06	7.78	9.94	11.14	13.28	18.47
5	0.55	0.83	1.15	1.61	9.24	11.07	12.83	15.09	20.52
6	0.87	1.24	1.64	2.20	10.64	12.59	14.45	16.81	22.46
7	1.24	1.69	2.17	2.83	12.02	14.07	16.01	18.47	24.32
8	1.65	2.18	2.73	3.49	13.36	15.51	17.53	20.09	26.13
9	2.09	2.70	3.33	4.17	14.68	16.92	19.02	21.67	27.88
10	2.56	3.25	3.94	4.87	15.99	18.31	20.48	23.21	29.59
11	3.05	3.82	4.57	5.58	17.27	19.67	21.92	24.72	31.26
12	3.57	4.40	5.23	6.30	18.55	21.03	23.34	26.22	32.91
13	4.11	5.01	5.89	7.04	19.81	22.36	24.74	27.69	34.53
14	4.66	5.63	6.57	7.79	21.06	23.68	26.12	29.14	36.12
15	5 .23	6.26	7.26	8.55	22.31	25.00	27.49	30.58	37.70
16	5.81	6.91	7.96	9.31	23.54	26.30	28.84	32.00	39.25
17	6.41	7.56	8.67	10.08	24.77	27.59	30.19	33.41	40.79
18	7.01	8.23	9.39	10.86	25.99	28.87	31.53	34.80	42.31
19	7.63	8.91	10.12	11.65	27.20	30.14	32.85	36.19	43.82
20	8.26	9.59	10.85	12.44	28.41	31.41	34.17	37.57	45.32
21	8.90	10.28	11.59	13.24	29.61	32.67	35.48	38.93	46.80
22	9.54	10.98	12.34	14.04	30.81	33.92	36.78	40.29	48.27
23	10.20	11.69	13.09	14.85	32.01	35.17	38.08	41.64	49.73
24	10.86	12.40	13.85	15.66	33.20	36.41	39.37	42.98	51.18
25	11.52	13.12	14.61	16.47	34.38	37.65	40.65	44.31	52.62
26	12.20	13.84	15.38	17.29	35.56	38.88	41.92	45.64	54.05
27	12.88	14.57	16.15	18.11	36.74	40.11	43.19	46.96	55.48
28	13.57	15.31	16.93	18.94	37.92	41.34	44.46	48.28	56.89
29	14.26	16.05	17.71	19.77	39.09	42.56	45.72	49.59	58.30
30	14.95	16.79	18.49	20.60	40.26	43.77	46.98	50.89	59.70

when $\nu > 30$. then $\sqrt{2\chi^2} - \sqrt{2\nu - 1}$ is approximately $N(0,1)$.

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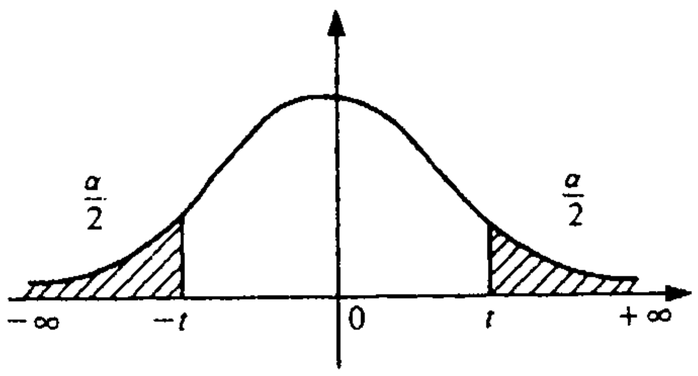
　　*請在【答案卷、卡】作答

Table 4
Quantiles of the Student Distribution with ν Degrees of Freedom
(t = value of T such that $Pr(|\ T\ | > t) = \alpha$)



α / ν	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.001
1	0.158	0.325	0.510	0.727	1.000	1.376	1.963	3.078	6.314	12.706	31.821	63.657	636.619
2	0.142	0.289	0.445	0.617	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	31.598
3	0.137	0.277	0.424	0.584	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	12.929
4	0.134	0.271	0.414	0.569	0.741	0.941	1.190	1.533	2.132	2.776	3.747	1.604	8.610
5	0.132	0.267	0.408	0.559	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	6.869
6	0.131	0.265	0.404	0.553	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.959
7	0.130	0.263	0.402	0.549	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	5.408
8	0.130	0.262	0.399	0.546	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	5.041
9	0.129	0.261	0.398	0.543	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.781
10	0.129	0.260	0.397	0.542	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.587
11	0.129	0.260	0.396	0.540	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.437
12	0.128	0.259	0.395	0.539	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	4.318
13	0.128	0.259	0.394	0.538	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	4.221
14	0.128	0.258	0.393	0.537	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	4.140
15	0.128	0.258	0.393	0.536	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	4.073
16	0.128	0.258	0.392	0.535	0.690	0.865	1.071	1.377	1.746	2.120	2.583	2.921	4.015
17	0.128	0.257	0.392	0.534	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.965
18	0.127	0.257	0.392	0.534	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.922
19	0.127	0.257	0.391	0.533	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.883
20	0.127	0.257	0.391	0.533	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.850
21	0.127	0.257	0.391	0.532	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.819
22	0.127	0.256	0.390	0.532	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.792
23	0.127	0.256	0.390	0.532	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.767
24	0.127	0.256	0.390	0.531	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.745
25	0.127	0.256	0.390	0.531	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.725
26	0.127	0.256	0.390	0.531	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.707
27	0.127	0.256	0.389	0.531	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.690
28	0.127	0.256	0.389	0.530	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.674
29	0.127	0.256	0.389	0.530	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.659
30	0.127	0.256	0.389	0.530	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.656
40	0.127	0.255	0.388	0.529	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.551
80	0.126	0.254	0.387	0.527	0.679	0.848	1.046	1.296	1.671	2.000	2.390	2.660	3.460
120	0.126	0.254	0.386	0.526	0.677	0.845	1.041	1.289	1.658	1.980	2.358	2.617	3.373
∞	0.126	0.253	0.385	0.524	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.291

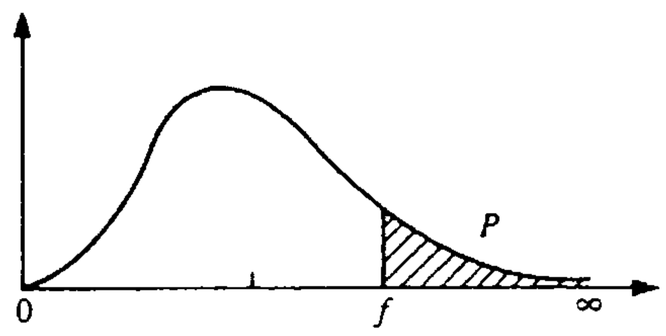
國立清華大學 103 學年度碩士班考試入學試題

系所班組別：計量財務金融學系　甲組、乙組

考試科目（代碼）：統計學 (4503) (4603)

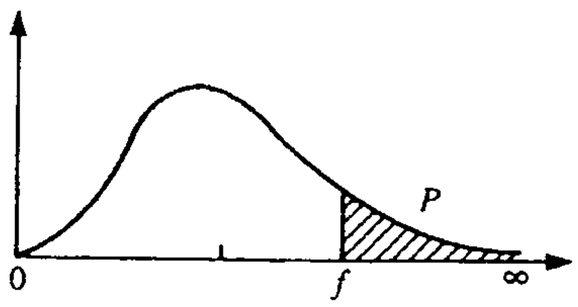
　　*請在【答案卷、卡】作答

Table 5
Quantiles of the Fisher–Snedecor Distribution with ν_1 and ν_2 Degrees of Freedom
(f = value of F such that $Pr(F > f) = \alpha$)



	$\nu_1 = 1$		$\nu_1 = 2$		$\nu_1 = 3$		$\nu_1 = 4$		$\nu_1 = 5$	
ν_2	$P = 0.05$	$P = 0.01$	$P = 0.05$	$P = 0.01$	$P = 0.05$	$P = 0.01$	$P = 0.05$	$P = 0.01$	$P = 0.05$	$P = 0.01$
1	161.4	4052	199.5	4999	215.7	5403	224.6	5625	230.2	5764
2	18.51	98.49	19.00	99.00	19.16	99.17	19.25	99.25	19.30	99.30
3	10.13	34.12	9.55	30.81	9.28	29.46	9.12	28.71	9.01	28.24
4	7.71	21.20	6.94	18.00	6.59	16.69	6.39	15.98	6.26	15.52
5	6.61	16.26	5.79	13.27	5.41	12.06	5.19	11.39	5.05	10.97
6	5.99	13.74	5.14	10.91	4.76	9 78	4.53	9.15	4.39	8.75
7	5.59	12.15	4.74	9.55	4.35	8.45	4.12	7.85	3.97	7.45
8	5.32	11.26	4.46	8.65	4.07	7.59	3.84	7.01	3.69	6.63
9	5.12	10.56	4.26	8.02	3.86	6.99	3.63	6.42	3.48	6.06
10	4.96	10.04	4.10	7.56	3.71	6.55	3.48	5.99	3.33	5.64
11	4.84	9.65	3.98	7.20	3 59	6.22	3.36	5.67	3.20	5.32
12	4.75	9.33	3.88	6.93	3.49	5.95	3.26	5.41	3.11	5.06
13	4.67	9.07	3.80	6.70	3.41	5.74	3.18	5.20	3.02	4.86
14	4.60	8.86	3.74	6.51	3.34	5.56	3.11	5.03	2.96	4.69
15	4.54	8.86	3.68	6.36	3.29	5.42	3.06	4.89	2.90	4.56
16	4.49	8.53	3.63	6.23	3.24	5.29	3.01	4.77	2.85	4.44
17	4.45	8.40	3.59	6.11	3.20	5.18	2.96	4.67	2.81	4.43
18	4.41	8.28	3.55	6.01	3.16	5.09	2.93	4.58	2.77	4.25
19	4.38	8.18	3.52	5.93	3.13	5.01	2.90	4.50	2.74	4.17
20	4.35	8.10	3.49	5.85	3.10	4.94	2.87	4.43	2.71	4.10
21	4.32	8.02	3.47	5.78	3.07	4.87	2.84	4.37	2.68	4.04
22	4.30	7.94	3.44	5.72	3.05	4.82	2.82	4.31	2.66	3.99
23	4.28	7.88	3.42	5.66	3.03	4.76	2.80	4.26	2.64	3.94
24	4.26	7.82	3.40	5.61	3.01	4.72	2.78	4.22	2.62	3.90
25	4.24	7.77	3.38	5.57	2.09	4.68	2.76	4.18	2.60	3.86
26	4.22	7.72	3.37	5.53	2.98	4.64	2.74	4.14	2.59	3.82
27	4.21	7.68	3.35	5.49	2.96	4.60	2.73	4.11	2.57	3.70
28	4.20	7.64	3.34	5.45	2.95	1 57	2.71	4.07	2.56	3.75
29	4.18	7.60	3.33	5.42	2.93	4.54	2.70	1.04	2.54	3.73
30	4.17	7.56	3.32	5.39	2.92	1.51	2.69	4.02	2.53	3.70
40	4.08	7.31	3.23	5.18	2.84	4.31	2.61	3.83	2.45	3.51
60	4.00	7.08	3.15	4.98	2.76	4.13	2.52	3.65	2.37	3.34
120	3.92	6.85	3.07	4.79	2.68	3.95	2.45	3.48	2.29	3.17
∞	3.84	6.64	2 99	4.60	2.60	3.78	2.37	3 32	2.21	3.02

Table 5 Continued



	$\nu_1 = 6$		$\nu_1 = 8$		$\nu_1 = 12$		$\nu_1 = 24$		$\nu_1 = \infty$	
ν_2	$P = 0.05$	$P = 0.01$	$P = 0.05$	$P = 0.01$	$P = 0.05$	$P = 0.01$	$P = 0.05$	$P = 0.01$	$P = 0.05$	$P = 0.01$
1	234.0	5 859	238.9	5 981	243.9	6 106	249.0	6 234	254.3	6 366
2	19 33	99.33	19.37	99.36	19.41	99.42	19.45	99.46	19.50	99.50
3	8.94	27.91	8.84	27.49	8.74	27.05	8.64	26.60	8.53	26.12
4	6.61	15.21	6.04	14.80	5.91	14.37	5.77	13.93	5.63	13.46
5	4.95	10.67	4.82	10.27	1.68	9.89	4.53	9.47	4.36	9.02
6	4.28	8.47	4.15	8.10	4.00	7.72	3.84	7.31	3.67	6.88
7	3.87	7.19	3.73	6.84	3.57	6.47	3.41	6.07	3.23	5.65
8	3.58	6.37	3.44	6.03	3.28	5.67	3.12	5.28	2.93	4.86
9	3.37	5.80	3.23	5.47	3.07	5.11	2.90	4.73	2.71	4.31
10	3.22	5.39	3.07	5.06	2.91	4.71	2.74	4.33	2.54	3.91
11	3.09	5.07	2.95	4.74	2.79	4.40	2.61	4.02	2.40	3.60
12	3.00	4.82	2.85	4.50	2 69	4.16	2.50	3.78	2.30	3.36
13	2.92	4.62	2.77	4.30	2.60	3.96	2.42	3.59	2.21	3.16
14	2.85	4.46	2.70	4.14	2.53	3.80	2.35	3.43	2.13	3.00
15	2.79	4.32	2.64	4.00	2.48	3.67	2.29	3.29	2.07	2.87
16	2.74	4.20	2 59	3.89	2.42	3.55	2.21	3.18	2.01	2.75
17	2.70	4.10	2.55	3.79	2.35	3.45	2.19	3.08	1.96	2.65
18	2.66	4.01	2.51	3.71	2.34	3.37	2.15	3.00	1.92	2.57
19	2.63	3.94	2.48	3.63	2.31	3.30	2.11	2.92	1.88	2.49
20	2.60	3.87	2.45	3.56	2.28	3.23	2.68	2.86	1.84	2.42
21	2.57	3.81	2.42	3.51	2.25	3.17	2.05	2.80	1.81	2.36
22	2.55	3.76	2.40	3.45	2.23	3.12	2.03	2.75	1.78	2.31
23	2.53	3.71	2.38	3.41	2.20	3.07	2.00	2.70	1.76	2.26
24	2.51	3 67	2.36	3.36	2.18	1.03	1.98	2.66	1.73	2.21
25	2.49	3.63	2.34	3.32	2.16	2.99	1.96	2.62	1.71	2.17
26	2.47	3.59	2.32	3.29	2.15	2.96	1 95	2.58	1.69	2.13
27	2.46	3.56	2.30	3.26	2.13	2.93	1.93	2.55	1.67	2.10
28	2.44	3.53	2.29	3.23	2.12	2.90	1.91	2.52	1.65	2.06
29	2.43	3.50	2.28	3.20	2.10	2.87	1.90	2.49	1.64	2 03
30	2.42	3.47	2.27	3.17	2.09	2.84	1.89	2.47	1.62	2.01
40	2.34	3.29	2.18	2.99	2.00	2.66	1.79	2.29	1.51	1.80
60	2.25	3.12	2.10	2.82	1.92	2.50	1.70	2.12	1.39	1.60
120	2.17	2.96	2.01	2.66	1.83	2.34	1.61	1.95	1.25	1.38
∞	2.09	2.80	1.94	2.51	1.75	2.18	1.52	1.79	1.09	1.00