CITY UNIVERSITY OF HONG KONG

Department of Management Sciences

Module code & title	:	GE2262 Business Statistics
Session	:	Examination (Semester B, 2021-2022)
Time allowed	:	9:30–11:50 am (2 hours for the examination, 20 minutes for file submission)

This paper has *EIGHT* pages (including this cover page, and three pages of Formulae and statistical tables).

Instructions to students:

1. This paper consists of FOUR questions.
2. Answer ALL questions.
3. For each question, show sufficient working.
4. Display all non-integer numeric values to 3 decimal places unless specified.
5. Formulae and statistical tables are provided at the end of this paper.
6. Write your answers on paper, take photo for each page of your answer script, combine them together to one pdf file and upload the pdf file to CANVAS before May 5, 11:50 am. Please name your file using your student ID and course code (eg 5*******_GE2262.pdf) and remember to write your SID on the answer script.

This is an open-book examination. Students can refer to the teaching materials of this course provided in CANVAS during the examination.

Materials, aids and instruments permitted to be used during examination:
Only university approved calculator is permitted. Computer software such as Excel is not permitted.

Materials other than those stated above are not permitted. Candidates will be subject to disciplinary action if any unauthorized materials or aids are found on them.

Academic honesty pledge

"I pledge that the answers in this test/examination are my own and that I will not seek or obtain an unfair advantage in producing these answers. Specifically,

- I will not plagiarize (copy without citation) from any source;
- I will not communicate or attempt to communicate with any other person during the test/examination; neither will I give or attempt to give assistance to another student taking the test/examination; and
- I will use only approved devices (e.g., calculators) and/or approved device models.
- I understand that any act of academic dishonesty can lead to disciplinary action."

Please reaffirm the honesty pledge by writing "I pledge to follow the Rules on Academic Honesty and understand that violations may lead to severe penalties" onto the first test/examination answer sheet.

<u>Question 1</u> (25 marks)

(a) Suppose that the return on investments for 15 companies in a certain industry for a certain year is arranged in ascending order as follows:

-24.6	-2.6	2.4	3.8	5.6
6.7	7.5	8.2	8.6	8.8
9.0	9.2	9.7	10.0	14.5

Draw a box-and-whisker plot of these data. Are the data skewed? If so, how? (3.5 marks)

(b) An Australian firm has an investment opportunity in Hong Kong. The initial outlay is HK$5,000,000. The firm constructs the following probability distribution for the gross return:

Gross return (in million HK$)	-20	-10	0	10	20
Probability	0.05	0.10	?	0.50	0.20

Find the expected value and standard deviation of the net return in Australian dollars, assuming an exchange rate of HK$5 to one AUS$. (Hint: net return = gross return – initial outlay) (7 marks)

(c) In the long run, 70% of the customers in an investment firm are satisfied with the service provided by the firm. 65% of the customers are male and 85% of the male customers are satisfied with the service.

(i) Suppose a randomly selected customer is a female, what is the probability that the customer is not satisfied with the service? (**Note: you have to use 4 decimal places in this calculation**) (5 marks)

Suppose each customer is independent and the probability of a customer being satisfied with the firm service is 0.7.

(ii) If nine customers are randomly selected, what is the probability that at least eight of them are satisfied with the service? (3 marks)

(iii) If 90 customers are randomly selected, what is the approximate probability that at least 60 of them are satisfied with the service? Justify whether your approximation method is appropriate. (6.5 marks)

Question 2 (25 marks)

A consultant has introduced an improvement process to a reception office. He claims that the receptionist should not do more than 10 minutes of paperwork in each hour. A check is made on 40 random hours of operation. The sample mean and sample standard deviation of the time spent on paperwork are found to be 9.0 and 3.0 minutes respectively.

(a) Calculate a 90% confidence interval for the population mean time spent on paperwork. Do you need any assumption(s) for the calculation? Explain briefly. (4 marks)

(b) Assume the population standard deviation of paperwork time is 3.1 minutes.

(i) How large a sample is needed to obtain a 90% confidence interval with the width of 1 minute? (2 marks)

(ii) Test the consultant's claim using both critical value and p-value approaches at 5% level of significance. (8 marks)

(iii) Describe Type II error in the context of this problem. Suppose the true population mean paperwork time is 11 minutes. Find the probability of making a Type II error. (7 marks)

(iv) Suppose the true population mean and standard deviation of paperwork time is 11 minutes and 3.1 minutes, respectively. If a sample of 40 hours is randomly selected, what is the probability that the sample mean is in between 10 minutes and 12 minutes? (4 marks)

<u>Question 3</u> (25 marks)

A market research company took a random sample of 30 consumers and asked the consumers to indicate their preference among three brands of mobile phones (A, B, and C). The table below shows the preference of these 30 consumers.

A	B	A	A	C	A	B	A	A	C
C	A	C	A	A	C	A	B	B	B
B	A	C	A	A	A	B	C	B	B

(a) Explain whether you can use numerical measures of central tendency to describe the data. If yes, use the measure(s) to describe the data. (2 marks)

(b) Use one table and one graph to present the data. (4 marks)

(c) Construct a 90% confidence interval for the population proportion of consumers preferring brand A. Interpret the interval. Justify whether your method is appropriate. (5 marks)

(d) A follow up study is conducted to estimate the population proportion of consumers preferring brand A to within ±0.05 with 95% confidence. How many additional consumers should the market research company survey? (Hint: use sample proportion in the calculation) (2.5 marks)

(e) A manufacturer claimed that at least 60% of the consumers prefer brand A.

(i) Test the manufacturer's claim at the 0.05 level of significance by using both critical value and p-value approaches to hypothesis testing. (9 marks)

(ii) If the significance level used for the test in (i) changes from 0.05 to 0.10, is the conclusion different from (i)? Comment on the results. (2.5 marks)

Question 4 (25 marks)

A manager feels the demand for a product (denoted by D) may be related to the number of television advertisements placed during the previous month about the product (denoted by T). He has collected the following six observations

Demand for a product (D)	**Number of television Advertisements (T)**
3	3
6	?
7	?
5	?
10	?
8	5

and found that

$$\sum_{i=1}^{6} D_i = 39 \qquad \sum_{i=1}^{6} T_i = 33$$

$$\sum_{i=1}^{6} (D_i - \bar{D})(T_i - \bar{T}) = 17.5 \qquad \sum_{i=1}^{6} \left(T_i - \bar{T}\right)^2 = 17.5$$

(a) What is least-squares line? Obtain the least-squares line for these data and interpret the slope coefficient. (5 marks)

(b) What is your estimate for the product demand if there are six television advertisements about the product during the previous month? (1 mark)

(c) The recent product demand is 5 for having six television advertisements during the previous month. Explain why this is not the same as your estimate in (b). (2 marks)

(d) Compute SST. If SSE=12, compute SSR and the standard error of the estimate. (4.5 marks)

(e) Compute the sample coefficient of correlation and the sample coefficient of determination. Explain the meaning of these coefficients. (4.5 marks)

(f) Are the demand for the product and the number of television advertisements linearly related? Test at 0.05 level of significance using critical value approach. (8 marks)

GE2262 Business Statistics
Formula Sheet & Statistical Tables

<u>Formula Sheet</u>

1. $\mu = \frac{1}{N}\sum X_i$; $\sigma^2 = \frac{1}{N}\sum (X_i - \mu)^2$

$\overline{X} = \frac{1}{n}\sum X_i$; $s^2 = \frac{1}{n-1}\sum (X_i - \overline{X})^2$

2. $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$;

$P(A \text{ and } B) = P(A \mid B)P(B)$; $P(A \mid B) = \frac{P(A \text{ and } B)}{P(B)}$

3a. $\mu = E(X) = \sum X_i P(X_i)$; $\sigma^2 = Var(X) = \sum (X_i - \mu)^2 P(X_i)$

3b. If $X \sim Bin(n, p)$, then (a) $P(X = k) = \frac{n!}{k!(n-k)!} p^k (1-p)^{n-k}$

(b) $\mu = E(X) = np$; $Var(X) = np(1-p)$

3c. If $X \sim N(\mu, \sigma^2)$, then $Z = \frac{X - \mu}{\sigma} \sim N(0, 1^2)$

4. If $\overline{X} \sim N(\mu, (\frac{\sigma}{\sqrt{n}})^2)$, then $Z = \frac{\overline{X} - \mu}{\frac{\sigma}{\sqrt{n}}} \sim N(0, 1^2)$

5. $\overline{X} \pm z_{\alpha/2}\frac{\sigma}{\sqrt{n}}$; $\overline{X} \pm t_{\frac{\alpha}{2}, n-1}\frac{s}{\sqrt{n}}$; $E = z_{\alpha/2}\frac{\sigma}{\sqrt{n}}$

6. $Z = \frac{\overline{X} - \mu}{\frac{\sigma}{\sqrt{n}}}$; $t = \frac{\overline{X} - \mu}{\frac{s}{\sqrt{n}}}$

7. If $\hat{p} \sim N(p, \frac{p(1-p)}{n})$, then $Z = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}} \sim N(0, 1^2)$;

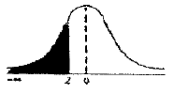
$\hat{p} \pm z_{\alpha/2}\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$; $E = z_{\alpha/2}\sqrt{\frac{p(1-p)}{n}}$

8. $S_{XY} = \frac{\sum_{i=1}^{n}(X_i - \overline{X})(Y_i - \overline{Y})}{n-1}$; $S_X = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \overline{X})^2}{n-1}}$; $S_Y = \sqrt{\frac{\sum_{i=1}^{n}(Y_i - \overline{Y})^2}{n-1}}$; $r_{xy} = \frac{S_{XY}}{S_X S_Y}$; $R^2 = 1 - \frac{SSE}{SST}$

For $Y = \beta_0 + \beta_1 X + \varepsilon$, $b_1 = \frac{\sum (X_i - \overline{X})(Y_i - \overline{Y})}{\sum (X_i - \overline{X})^2}$; $b_0 = \overline{Y} - b_1\overline{X}$ $b_1 \pm t_{\frac{\alpha}{2}, n-2} S_{b_1}$

The Cumulative Standardized Normal Distribution

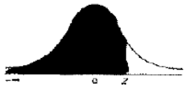
The Cumulative Standardized Normal Distribution
Entry represents area under the cumulative standardized normal distribution from $-\infty$ to Z



Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-6.0	0.000000001									
-5.5	0.000000019									
-5.0	0.000000287									
-4.5	0.000003398									
-4.0	0.000031671									
-3.9	0.00005	0.00005	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00003	0.00003
-3.8	0.00007	0.00007	0.00007	0.00006	0.00006	0.00006	0.00006	0.00005	0.00005	0.00005
-3.7	0.00011	0.00010	0.00010	0.00010	0.00009	0.00009	0.00008	0.00008	0.00008	0.00008
-3.6	0.00016	0.00015	0.00015	0.00014	0.00014	0.00013	0.00013	0.00012	0.00012	0.00011
-3.5	0.00023	0.00022	0.00022	0.00021	0.00020	0.00019	0.00019	0.00018	0.00017	0.00017
-3.4	0.00034	0.00032	0.00031	0.00030	0.00029	0.00028	0.00027	0.00026	0.00025	0.00024
-3.3	0.00048	0.00047	0.00045	0.00043	0.00042	0.00040	0.00039	0.00038	0.00036	0.00035
-3.2	0.00069	0.00066	0.00064	0.00062	0.00060	0.00058	0.00056	0.00054	0.00052	0.00050
-3.1	0.00097	0.00094	0.00090	0.00087	0.00084	0.00082	0.00079	0.00076	0.00074	0.00071
-3.0	0.00135	0.00131	0.00126	0.00122	0.00118	0.00114	0.00111	0.00107	0.00103	0.00100
-2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.7	0.2420	0.2388	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2482	0.2451
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

continued

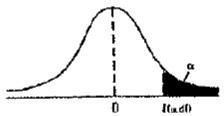
The Cumulative Standardized Normal Distribution (Continued)
Entry represents area under the cumulative standardized normal distribution from $-\infty$ to Z



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	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7518	0.7549
0.7	0.7580	0.7612	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.99865	0.99869	0.99874	0.99878	0.99882	0.99886	0.99889	0.99893	0.99897	0.99900
3.1	0.99903	0.99906	0.99910	0.99913	0.99916	0.99918	0.99921	0.99924	0.99926	0.99929
3.2	0.99931	0.99934	0.99936	0.99938	0.99940	0.99942	0.99944	0.99946	0.99948	0.99950
3.3	0.99952	0.99953	0.99955	0.99957	0.99958	0.99960	0.99961	0.99962	0.99964	0.99965
3.4	0.99966	0.99968	0.99969	0.99970	0.99971	0.99972	0.99973	0.99974	0.99975	0.99976
3.5	0.99977	0.99978	0.99978	0.99979	0.99980	0.99981	0.99981	0.99982	0.99983	0.99983
3.6	0.99984	0.99985	0.99985	0.99986	0.99986	0.99987	0.99987	0.99988	0.99988	0.99989
3.7	0.99989	0.99990	0.99990	0.99990	0.99991	0.99991	0.99992	0.99992	0.99992	0.99992
3.8	0.99993	0.99993	0.99993	0.99994	0.99994	0.99994	0.99994	0.99995	0.99995	0.99995
3.9	0.99995	0.99995	0.99996	0.99996	0.99996	0.99996	0.99996	0.99996	0.99997	0.99997
4.0	0.999968329									
4.5	0.999996602									
5.0	0.999999713									
5.5	0.999999981									
6.0	0.999999999									

Critical Values of t

Critical Values of t
For a particular number of degrees of freedom, entry represents the critical value of t corresponding to a specified upper-tail area (α)



Degrees of Freedom	Upper-Tail Areas 0.25	0.10	0.05	0.025	0.01	0.005
1	1.0000	3.0777	6.3138	12.7062	31.8207	63.6574
2	0.8165	1.8856	2.9200	4.3027	6.9646	9.9248
3	0.7649	1.6377	2.3534	3.1824	4.5407	5.8409
4	0.7407	1.5332	2.1318	2.7764	3.7469	4.6041
5	0.7267	1.4759	2.0150	2.5706	3.3649	4.0322
6	0.7176	1.4398	1.9432	2.4469	3.1427	3.7074
7	0.7111	1.4149	1.8946	2.3646	2.9980	3.4995
8	0.7064	1.3968	1.8595	2.3060	2.8965	3.3554
9	0.7027	1.3830	1.8331	2.2622	2.8214	3.2498
10	0.6998	1.3722	1.8125	2.2281	2.7638	3.1693
11	0.6974	1.3634	1.7959	2.2010	2.7181	3.1058
12	0.6955	1.3562	1.7823	2.1788	2.6810	3.0545
13	0.6938	1.3502	1.7709	2.1604	2.6503	3.0123
14	0.6924	1.3450	1.7613	2.1448	2.6245	2.9768
15	0.6912	1.3406	1.7531	2.1315	2.6025	2.9467
16	0.6901	1.3368	1.7459	2.1199	2.5835	2.9208
17	0.6892	1.3334	1.7396	2.1098	2.5669	2.8982
18	0.6884	1.3304	1.7341	2.1009	2.5524	2.8784
19	0.6876	1.3277	1.7291	2.0930	2.5395	2.8609
20	0.6870	1.3253	1.7247	2.0860	2.5280	2.8453
21	0.6864	1.3232	1.7207	2.0796	2.5177	2.8314
22	0.6858	1.3212	1.7171	2.0739	2.5083	2.8188
23	0.6853	1.3195	1.7139	2.0687	2.4999	2.8073
24	0.6848	1.3178	1.7109	2.0639	2.4922	2.7969
25	0.6844	1.3163	1.7081	2.0595	2.4851	2.7874
26	0.6840	1.3150	1.7056	2.0555	2.4786	2.7787
27	0.6837	1.3137	1.7033	2.0518	2.4727	2.7707
28	0.6834	1.3125	1.7011	2.0484	2.4671	2.7633
29	0.6830	1.3114	1.6991	2.0452	2.4620	2.7564
30	0.6828	1.3104	1.6973	2.0423	2.4573	2.7500
31	0.6825	1.3095	1.6955	2.0395	2.4528	2.7440
32	0.6822	1.3086	1.6939	2.0369	2.4487	2.7385
33	0.6820	1.3077	1.6924	2.0345	2.4448	2.7333
34	0.6818	1.3070	1.6909	2.0322	2.4411	2.7284
35	0.6816	1.3062	1.6896	2.0301	2.4377	2.7238
36	0.6814	1.3055	1.6883	2.0281	2.4345	2.7195
37	0.6812	1.3049	1.6871	2.0262	2.4314	2.7154
38	0.6810	1.3042	1.6860	2.0244	2.4286	2.7116
39	0.6808	1.3036	1.6849	2.0227	2.4258	2.7079
40	0.6807	1.3031	1.6839	2.0211	2.4233	2.7045
41	0.6805	1.3025	1.6829	2.0195	2.4208	2.7012
42	0.6804	1.3020	1.6820	2.0181	2.4185	2.6981
43	0.6802	1.3016	1.6811	2.0167	2.4163	2.6951
44	0.6801	1.3011	1.6802	2.0154	2.4141	2.6923
45	0.6800	1.3006	1.6794	2.0141	2.4121	2.6896
46	0.6799	1.3002	1.6787	2.0129	2.4102	2.6870
47	0.6797	1.2998	1.6779	2.0117	2.4083	2.6846
48	0.6796	1.2994	1.6772	2.0106	2.4066	2.6822

continued

Degrees of Freedom	Upper-Tail Areas 0.25	0.10	0.05	0.025	0.01	0.005
49	0.6795	1.2991	1.6766	2.0096	2.4049	2.6800
50	0.6794	1.2987	1.6759	2.0086	2.4033	2.6778
51	0.6793	1.2984	1.6753	2.0076	2.4017	2.6757
52	0.6792	1.2980	1.6747	2.0066	2.4002	2.6737
53	0.6791	1.2977	1.6741	2.0057	2.3988	2.6718
54	0.6791	1.2974	1.6736	2.0049	2.3974	2.6700
55	0.6790	1.2971	1.6730	2.0040	2.3961	2.6682
56	0.6789	1.2969	1.6725	2.0032	2.3948	2.6665
57	0.6788	1.2966	1.6720	2.0025	2.3936	2.6649
58	0.6787	1.2963	1.6716	2.0017	2.3924	2.6633
59	0.6787	1.2961	1.6711	2.0010	2.3912	2.6618
60	0.6786	1.2958	1.6706	2.0003	2.3901	2.6603
61	0.6785	1.2956	1.6702	1.9996	2.3890	2.6589
62	0.6785	1.2954	1.6698	1.9990	2.3880	2.6575
63	0.6784	1.2951	1.6694	1.9983	2.3870	2.6561
64	0.6783	1.2949	1.6690	1.9977	2.3860	2.6549
65	0.6783	1.2947	1.6686	1.9971	2.3851	2.6536
66	0.6782	1.2945	1.6683	1.9966	2.3842	2.6524
67	0.6782	1.2943	1.6679	1.9960	2.3833	2.6512
68	0.6781	1.2941	1.6676	1.9955	2.3824	2.6501
69	0.6781	1.2939	1.6673	1.9949	2.2816	2.6490
70	0.6780	1.2938	1.6669	1.9944	2.3808	2.6479
71	0.6780	1.2936	1.6666	1.9939	2.3800	2.6469
72	0.6779	1.2934	1.6663	1.9935	2.3793	2.6459
73	0.6779	1.2933	1.6660	1.9930	2.3785	2.6449
74	0.6778	1.2931	1.6657	1.9925	2.3778	2.6439
75	0.6778	1.2929	1.6654	1.9921	2.3771	2.6430
76	0.6777	1.2928	1.6652	1.9917	2.3764	2.6421
77	0.6777	1.2926	1.6649	1.9913	2.3758	2.6412
78	0.6776	1.2925	1.6646	1.9908	2.3751	2.6403
79	0.6776	1.2924	1.6644	1.9905	2.3745	2.6395
80	0.6776	1.2922	1.6641	1.9901	2.3739	2.6387
81	0.6775	1.2921	1.6639	1.9897	2.3733	2.6379
82	0.6775	1.2920	1.6636	1.9893	2.3727	2.6371
83	0.6775	1.2918	1.6634	1.9890	2.3721	2.6364
84	0.6774	1.2917	1.6632	1.9886	2.3716	2.6356
85	0.6774	1.2916	1.6630	1.9883	2.3710	2.6349
86	0.6774	1.2915	1.6628	1.9879	2.3705	2.6342
87	0.6773	1.2914	1.6626	1.9876	2.3700	2.6335
88	0.6773	1.2912	1.6624	1.9873	2.3695	2.6329
89	0.6773	1.2911	1.6622	1.9870	2.3690	2.6322
90	0.6772	1.2910	1.6620	1.9867	2.3685	2.6316
91	0.6772	1.2909	1.6618	1.9864	2.3680	2.6309
92	0.6772	1.2908	1.6616	1.9861	2.3676	2.6303
93	0.6771	1.2907	1.6614	1.9858	2.3671	2.6297
94	0.6771	1.2906	1.6612	1.9855	2.3667	2.6291
95	0.6771	1.2905	1.6611	1.9853	2.3662	2.6286
96	0.6771	1.2904	1.6609	1.9850	2.3658	2.6280
97	0.6770	1.2903	1.6607	1.9847	2.3654	2.6275
98	0.6770	1.2902	1.6606	1.9845	2.3650	2.6269
99	0.6770	1.2902	1.6604	1.9842	2.3646	2.6264
100	0.6770	1.2901	1.6602	1.9840	2.3642	2.6259
110	0.6767	1.2893	1.6588	1.9818	2.3607	2.6213
120	0.6765	1.2886	1.6577	1.9799	2.3578	2.6174
∞	0.6745	1.2816	1.6449	1.9600	2.3263	2.5758

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