# UNIVERSITI KUALA LUMPUR
## BUSINESS SCHOOL

## FINAL EXAMINATION
## MARCH 2025 SEMESTER

| | | |
|---|---|---|
| **COURSE CODE** | : | **EGB10103** |
| **COURSE NAME** | : | **ECONOMIC STATISTICS 1** |
| **PROGRAMME NAME** | : | **BACHELOR OF SCIENCE (HONOURS) IN ANALYTICAL ECONOMICS** |
| **DATE** | : | **30TH JUNE 2025** |
| **TIME** | : | **2.00 PM – 5.00 PM** |
| **DURATION** | : | **3 HOURS** |

## INSTRUCTIONS TO CANDIDATES

1. **Please CAREFULLY read the instructions given in the question paper.**
2. **This question paper has information printed on both sides of the paper.**
3. This question paper consists of **FIVE (5) Questions.**
4. Answer **ALL** questions.
5. Please write your answers on the answer booklet provided.
6. All questions must be answered in **English** (any other language is not allowed).
7. **This question paper must not be removed from the examination hall.**
8. Tables and formulas have been appended for your reference.

**THERE ARE FIVE (5) PAGES OF QUESTIONS, INCLUDING THIS PAGE.**

**(Total: 100 marks)**

**Question 1**

(a) A student hostel comprises 30% Semester 1 students, 20% Semester 2 students and 50% Semester 3 students. 2% of Semester 1 students, 4% of Semester 2 students and 5% of Semester 3 students have their own transport. One student is selected at random.

i. Construct a tree diagram to illustrate the above survey.

[4 marks]

ii. Determine the probability that a Semester 1 student is without transport.

[2 marks]

iii. Calculate the probability that a student is without transport.

[2 marks]

iv. Given that a student is without transport, calculate the probability that he/she is a Semester 2 student?

[2 marks]

(b) The probability that Ali wins a match is 0.8. If he plays 6 consecutive matches, determine the probability that he will win at least 5 matches.

[3 marks]

(c) The probability that Siti passes Mathematics is 2/3 and the probability that she passes English is 4/9. If the probability of passing both courses is 1/4, calculate the probability that Siti will pass at least one of these courses.

[3 marks]

(d) Suppose that a scheduled flight departs on time, the given probability P(D) = 0.83 and the probability that it arrives on time is P(A) = 0.82. Also, the probability that its departing and arriving on time is given by P (A∩D) = 0.78. Determine the probability that the aircraft arrives on time given that it departed on time.

[4 marks]

**Question 2**

(a) The probability that a certain kind of component will survive a given shock test is 3/4. Calculate the probability that exactly 2 of the next 4 components tested survive.

[4 marks]

(b) Each sample of water from river has 10% chance of contamination by heavy metal.

i. Determine the probability that in 18 independent samples taken from the same river, only 2 samples were contaminated.

[4 marks]

ii. Calculate the probability that in 18 independent samples taken from the same river, at least 4 samples were contaminated.

[4 marks]

iii. Calculate the probability that in 18 independent samples taken from the same river, at least 3 but less than 7 samples were contaminated.

[4 marks]

(c) A small voting district has 101 female voters and 95 male voters. A random sample of 10 voters is drawn. Determine the probability exactly 7 of the voters will be female.

[4 marks]

**Question 3**

(a) Calculate the probabilities for each, using the standard normal distribution.

i. $P(0 < z \leq 1)$

[2 marks]

ii. $P(z > 1.75)$

[1 mark]

iii. $P(-1.65 < z \leq 1.93)$

[2 marks]

(b) The mass of apple from A farm is normally distributed with mean 550g and variance $256g^2$. If 120 of apple have masses between 510g and 570g, determinme the total number of apple from the farm.

[4 marks]

(c) According to recent survey, 30% of households have company medical insurance that cover every family member. If a random sample of 200 households is selected, use the normal approximation to find the probability.

Let $X \sim B(200, 0.3)$

i. $P(X = 70)$

[2 marks]

ii. $P(52 < X < 59)$

[3 marks]

iii. $P(66 \leq X \leq 76)$

[3 marks]

iv. $P(48 < X \leq 61)$

[3 marks]

**Question 4**

For most recent year available, the mean annual cost to attend a private university in the United States was \$26,889. Assume the distribution of annual costs follows the normal probability distribution and the standard deviation is \$4,500. Calculate:

(a) The probability that a student will have to pay more than \$25,000 to attend a private university.

[5 marks]

(b) The probability that a student will have to pay no more than \$23,500 to attend the private university.

[5 marks]

(c) The probability that a student will pay more than \$30,000 to attend a private university.

[5 marks]

(d) The probability that a student will pay between \$20,000 and \$28,000 to attend the private university

[5 marks]

**Question 5**

(a) During peak hours, the arrival of customers at a fast-food restaurant is random with an average rate of 90 customers per hour. Calculate:

i. The probability that exactly two customers will arrive at the restaurant within a specified one-minute period during peak hours.

[4 marks]

ii. The probability that at least four customers will arrive within a specified two-minute period during peak hours.

[4 marks]

(b) In a production line, it is known that, on average, for every 500 items produced there will be one defective item. Determine the probability that a random sample of 5000 items will result in less than 8 defectives.

[4 marks]

(c) A monitor issues a warning signal when an action is needed as part of a production process. The interval, X hours, between successive signals follows an exponential distribution with parameter 0.08. Calculate the probability that the interval between the next two signals is:

i. Between 10 and 20 hours.

[4 marks]

ii. Less than two hours.

[2 marks]

iii. Longer than 50 hours.

[2 marks]

**END OF EXAMINATION PAPER**

# LIST OF FORMULAE FOR EGB 10103 ECONOMIC STATISTICS 1

## INTRODUCTION TO PROBABILITY

**Counting Rule for Combinations**

$$C_n^N = \binom{N}{n} = \frac{N!}{n!(N-n)!}$$

**Counting Rule for Permutations**

$$P_n^N = n!\binom{N}{n} = \frac{N!}{(N-n)!}$$

**Computing Probability Using the Complement**

$$P(A) = 1 - P(A^c)$$

**Addition Law**

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

**Conditional Probability**

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$
$$P(B \mid A) = \frac{P(A \cap B)}{P(A)}$$

**Multiplication Law**

$$P(A \cap B) = P(B)P(A \mid B)$$
$$P(A \cap B) = P(A)P(B \mid A)$$

## CONTINUOUS PROBABILITY DISTRIBUTION

**Uniform Probability Density Function**

$$f(x) = \begin{cases} \frac{1}{b-a} & \text{for } a \le x \le i \\ 0 & \text{elsewhere} \end{cases}$$

**Normal Probability Density Function**

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-(x-\mu)^2/2\sigma^2}$$

**Converting to the Standard Normal Random Variable**

$$z = \frac{x-\mu}{\sigma}$$

**Exponential Probability Density Function**

$$f(x) = \frac{1}{\mu} e^{-x/\mu} \qquad \text{for } x \ge 0$$

**Exponential Distribution: Cumulative Probabilities**

$$P(x \le x_0) = 1 - e^{-x_0/\mu}$$

## DISCRETE PROBABILITY DISTRIBUTION

**Binomial Probability Function**

$$f(x) = \binom{n}{x} p^x (1-p)^{(n-x)}$$

**Expected Value for the Binomial Distribution**

$$E(x) = \mu = np$$

**Variance for the Binomial Distribution**

$$Var(x) = \sigma^2 = np(1-p)$$

**Poisson Probability Function**

$$f(x) = \frac{\mu^x e^{-\mu}}{x!}$$

**Hypergeometric Probability Function**

$$f(x) = \frac{\binom{r}{x}\binom{N-r}{n-x}}{\binom{N}{n}}$$

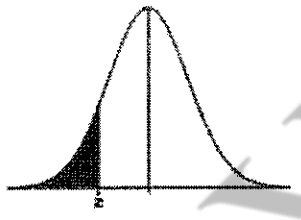
**Expected Value for the Hypergeometric Distribution**

$$E(x) = \mu = n\left(\frac{r}{N}\right)$$

**Variance for the Hypergeometric Distribution**

$$Var(x) = \sigma^2 = n\left(\frac{r}{N}\right)\left(1 - \frac{r}{N}\right)\left(\frac{N-n}{N-1}\right)$$

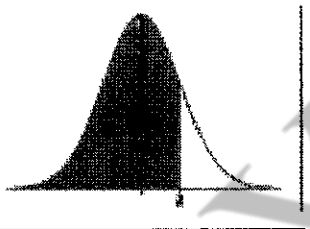
## Standard Normal Cumulative Probability Table




**Cumulative probabilities for NEGATIVE z-values are shown in the following table:**

| z | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| -3.4 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0002 |
| -3.3 | 0.0005 | 0.0005 | 0.0005 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0003 |
| -3.2 | 0.0007 | 0.0007 | 0.0006 | 0.0006 | 0.0006 | 0.0006 | 0.0006 | 0.0005 | 0.0005 | 0.0005 |
| -3.1 | 0.0010 | 0.0009 | 0.0009 | 0.0009 | 0.0008 | 0.0008 | 0.0008 | 0.0008 | 0.0007 | 0.0007 |
| -3.0 | 0.0013 | 0.0013 | 0.0013 | 0.0012 | 0.0012 | 0.0011 | 0.0011 | 0.0011 | 0.0010 | 0.0010 |
| -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 | 0.2389 | 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 | 0.2483 | 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 |

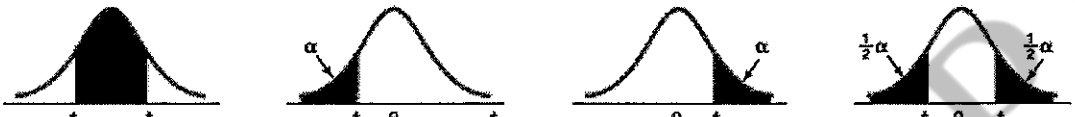
## Standard Normal Cumulative Probability Table



**Cumulative probabilities for POSITIVE z-values are shown in the following table:**

| 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 | 0.7517 | 0.7549 |
| 0.7 | 0.7580 | 0.7611 | 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 | 0.9987 | 0.9987 | 0.9987 | 0.9988 | 0.9988 | 0.9989 | 0.9989 | 0.9989 | 0.9990 | 0.9990 |
| 3.1 | 0.9990 | 0.9991 | 0.9991 | 0.9991 | 0.9992 | 0.9992 | 0.9992 | 0.9992 | 0.9993 | 0.9993 |
| 3.2 | 0.9993 | 0.9993 | 0.9994 | 0.9994 | 0.9994 | 0.9994 | 0.9994 | 0.9995 | 0.9995 | 0.9995 |
| 3.3 | 0.9995 | 0.9995 | 0.9995 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9997 |
| 3.4 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9998 |

## B.5 Student's *t* Distribution




Confidence interval | Left-tailed test | Right-tailed test | Two-tailed test

| | Confidence Intervals, *c* | | | | | |
|---|---|---|---|---|---|---|
| | 80% | 90% | 95% | 98% | 99% | 99.9% |
| | Level of Significance for One-Tailed Test, α | | | | | |
| *df* | 0.10 | 0.05 | 0.025 | 0.01 | 0.005 | 0.0005 |
| | Level of Significance for Two-Tailed Test, α | | | | | |
| | 0.20 | 0.10 | 0.05 | 0.02 | 0.01 | 0.001 |
| 1 | 3.078 | 6.314 | 12.706 | 31.821 | 63.657 | 636.619 |
| 2 | 1.886 | 2.920 | 4.303 | 6.965 | 9.925 | 31.599 |
| 3 | 1.638 | 2.353 | 3.182 | 4.541 | 5.841 | 12.924 |
| 4 | 1.533 | 2.132 | 2.776 | 3.747 | 4.604 | 8.610 |
| 5 | 1.476 | 2.015 | 2.571 | 3.365 | 4.032 | 6.869 |
| 6 | 1.440 | 1.943 | 2.447 | 3.143 | 3.707 | 5.959 |
| 7 | 1.415 | 1.895 | 2.365 | 2.998 | 3.499 | 5.408 |
| 8 | 1.397 | 1.860 | 2.306 | 2.896 | 3.355 | 5.041 |
| 9 | 1.383 | 1.833 | 2.262 | 2.821 | 3.250 | 4.781 |
| 10 | 1.372 | 1.812 | 2.228 | 2.764 | 3.169 | 4.587 |
| 11 | 1.363 | 1.796 | 2.201 | 2.718 | 3.106 | 4.437 |
| 12 | 1.356 | 1.782 | 2.179 | 2.681 | 3.055 | 4.318 |
| 13 | 1.350 | 1.771 | 2.160 | 2.650 | 3.012 | 4.221 |
| 14 | 1.345 | 1.761 | 2.145 | 2.624 | 2.977 | 4.140 |
| 15 | 1.341 | 1.753 | 2.131 | 2.602 | 2.947 | 4.073 |
| 16 | 1.337 | 1.746 | 2.120 | 2.583 | 2.921 | 4.015 |
| 17 | 1.333 | 1.740 | 2.110 | 2.567 | 2.898 | 3.965 |
| 18 | 1.330 | 1.734 | 2.101 | 2.552 | 2.878 | 3.922 |
| 19 | 1.328 | 1.729 | 2.093 | 2.539 | 2.861 | 3.883 |
| 20 | 1.325 | 1.725 | 2.086 | 2.528 | 2.845 | 3.850 |
| 21 | 1.323 | 1.721 | 2.080 | 2.518 | 2.831 | 3.819 |
| 22 | 1.321 | 1.717 | 2.074 | 2.508 | 2.819 | 3.792 |
| 23 | 1.319 | 1.714 | 2.069 | 2.500 | 2.807 | 3.768 |
| 24 | 1.318 | 1.711 | 2.064 | 2.492 | 2.797 | 3.745 |
| 25 | 1.316 | 1.708 | 2.060 | 2.485 | 2.787 | 3.725 |
| 26 | 1.315 | 1.706 | 2.056 | 2.479 | 2.779 | 3.707 |
| 27 | 1.314 | 1.703 | 2.052 | 2.473 | 2.771 | 3.690 |
| 28 | 1.313 | 1.701 | 2.048 | 2.467 | 2.763 | 3.674 |
| 29 | 1.311 | 1.699 | 2.045 | 2.462 | 2.756 | 3.659 |
| 30 | 1.310 | 1.697 | 2.042 | 2.457 | 2.750 | 3.646 |
| 31 | 1.309 | 1.696 | 2.040 | 2.453 | 2.744 | 3.633 |
| 32 | 1.309 | 1.694 | 2.037 | 2.449 | 2.738 | 3.622 |
| 33 | 1.308 | 1.692 | 2.035 | 2.445 | 2.733 | 3.611 |
| 34 | 1.307 | 1.691 | 2.032 | 2.441 | 2.728 | 3.601 |
| 35 | 1.306 | 1.690 | 2.030 | 2.438 | 2.724 | 3.591 |

| | Confidence Intervals, *c* | | | | | |
|---|---|---|---|---|---|---|
| | 80% | 90% | 95% | 98% | 99% | 99.9% |
| | Level of Significance for One-Tailed Test, α | | | | | |
| *df* | 0.10 | 0.05 | 0.025 | 0.01 | 0.005 | 0.0005 |
| | Level of Significance for Two-Tailed Test, α | | | | | |
| | 0.20 | 0.10 | 0.05 | 0.02 | 0.01 | 0.001 |
| 36 | 1.306 | 1.688 | 2.028 | 2.434 | 2.719 | 3.582 |
| 37 | 1.305 | 1.687 | 2.026 | 2.431 | 2.715 | 3.574 |
| 38 | 1.304 | 1.686 | 2.024 | 2.429 | 2.712 | 3.566 |
| 39 | 1.304 | 1.685 | 2.023 | 2.426 | 2.708 | 3.558 |
| 40 | 1.303 | 1.684 | 2.021 | 2.423 | 2.704 | 3.551 |
| 41 | 1.303 | 1.683 | 2.020 | 2.421 | 2.701 | 3.544 |
| 42 | 1.302 | 1.682 | 2.018 | 2.418 | 2.698 | 3.538 |
| 43 | 1.302 | 1.681 | 2.017 | 2.416 | 2.695 | 3.532 |
| 44 | 1.301 | 1.680 | 2.015 | 2.414 | 2.692 | 3.526 |
| 45 | 1.301 | 1.679 | 2.014 | 2.412 | 2.690 | 3.520 |
| 46 | 1.300 | 1.679 | 2.013 | 2.410 | 2.687 | 3.515 |
| 47 | 1.300 | 1.678 | 2.012 | 2.408 | 2.685 | 3.510 |
| 48 | 1.299 | 1.677 | 2.011 | 2.407 | 2.682 | 3.505 |
| 49 | 1.299 | 1.677 | 2.010 | 2.405 | 2.680 | 3.500 |
| 50 | 1.299 | 1.676 | 2.009 | 2.403 | 2.678 | 3.496 |
| 51 | 1.298 | 1.675 | 2.008 | 2.402 | 2.676 | 3.492 |
| 52 | 1.298 | 1.675 | 2.007 | 2.400 | 2.674 | 3.488 |
| 53 | 1.298 | 1.674 | 2.006 | 2.399 | 2.672 | 3.484 |
| 54 | 1.297 | 1.674 | 2.005 | 2.397 | 2.670 | 3.480 |
| 55 | 1.297 | 1.673 | 2.004 | 2.396 | 2.668 | 3.476 |
| 56 | 1.297 | 1.673 | 2.003 | 2.395 | 2.667 | 3.473 |
| 57 | 1.297 | 1.672 | 2.002 | 2.394 | 2.665 | 3.470 |
| 58 | 1.296 | 1.672 | 2.002 | 2.392 | 2.663 | 3.466 |
| 59 | 1.296 | 1.671 | 2.001 | 2.391 | 2.662 | 3.463 |
| 60 | 1.296 | 1.671 | 2.000 | 2.390 | 2.660 | 3.460 |
| 61 | 1.296 | 1.670 | 2.000 | 2.389 | 2.659 | 3.457 |
| 62 | 1.295 | 1.670 | 1.999 | 2.388 | 2.657 | 3.454 |
| 63 | 1.295 | 1.669 | 1.998 | 2.387 | 2.656 | 3.452 |
| 64 | 1.295 | 1.669 | 1.998 | 2.386 | 2.655 | 3.449 |
| 65 | 1.295 | 1.669 | 1.997 | 2.385 | 2.654 | 3.447 |
| 66 | 1.295 | 1.668 | 1.997 | 2.384 | 2.652 | 3.444 |
| 67 | 1.294 | 1.668 | 1.996 | 2.383 | 2.651 | 3.442 |
| 68 | 1.294 | 1.668 | 1.995 | 2.382 | 2.650 | 3.439 |
| 69 | 1.294 | 1.667 | 1.995 | 2.382 | 2.649 | 3.437 |
| 70 | 1.294 | 1.667 | 1.994 | 2.381 | 2.648 | 3.435 |

*(continued)*

| | Confidence Intervals, $c$ | | | | | |
|---|---|---|---|---|---|---|
| | 80% | 90% | 95% | 98% | 99% | 99.9% |
| | Level of Significance for One-Tailed Test, $\alpha$ | | | | | |
| *df* | 0.10 | 0.05 | 0.025 | 0.01 | 0.005 | 0.0005 |
| | Level of Significance for Two-Tailed Test, $\alpha$ | | | | | |
| | 0.20 | 0.10 | 0.05 | 0.02 | 0.01 | 0.001 |
| 71 | 1.294 | 1.667 | 1.994 | 2.380 | 2.647 | 3.433 |
| 72 | 1.293 | 1.666 | 1.993 | 2.379 | 2.646 | 3.431 |
| 73 | 1.293 | 1.666 | 1.993 | 2.379 | 2.645 | 3.429 |
| 74 | 1.293 | 1.666 | 1.993 | 2.378 | 2.644 | 3.427 |
| 75 | 1.293 | 1.665 | 1.992 | 2.377 | 2.643 | 3.425 |
| 76 | 1.293 | 1.665 | 1.992 | 2.376 | 2.642 | 3.423 |
| 77 | 1.293 | 1.665 | 1.991 | 2.376 | 2.641 | 3.421 |
| 78 | 1.292 | 1.665 | 1.991 | 2.375 | 2.640 | 3.420 |
| 79 | 1.292 | 1.664 | 1.990 | 2.374 | 2.640 | 3.418 |
| 80 | 1.292 | 1.664 | 1.990 | 2.374 | 2.639 | 3.416 |
| 81 | 1.292 | 1.664 | 1.990 | 2.373 | 2.638 | 3.415 |
| 82 | 1.292 | 1.664 | 1.989 | 2.373 | 2.637 | 3.413 |
| 83 | 1.292 | 1.663 | 1.989 | 2.372 | 2.636 | 3.412 |
| 84 | 1.292 | 1.663 | 1.989 | 2.372 | 2.636 | 3.410 |
| 85 | 1.292 | 1.663 | 1.988 | 2.371 | 2.635 | 3.409 |
| 86 | 1.291 | 1.663 | 1.988 | 2.370 | 2.634 | 3.407 |
| 87 | 1.291 | 1.663 | 1.988 | 2.370 | 2.634 | 3.406 |
| 88 | 1.291 | 1.662 | 1.987 | 2.369 | 2.633 | 3.405 |

| | Confidence Intervals, $c$ | | | | | |
|---|---|---|---|---|---|---|
| | 80% | 90% | 95% | 98% | 99% | 99.9% |
| | Level of Significance for One-Tailed Test, $\alpha$ | | | | | |
| *df* | 0.10 | 0.05 | 0.025 | 0.01 | 0.005 | 0.0005 |
| | Level of Significance for Two-Tailed Test, $\alpha$ | | | | | |
| | 0.20 | 0.10 | 0.05 | 0.02 | 0.01 | 0.001 |
| 89 | 1.291 | 1.662 | 1.987 | 2.369 | 2.632 | 3.403 |
| 90 | 1.291 | 1.662 | 1.987 | 2.368 | 2.632 | 3.402 |
| 91 | 1.291 | 1.662 | 1.986 | 2.368 | 2.631 | 3.401 |
| 92 | 1.291 | 1.662 | 1.986 | 2.368 | 2.630 | 3.399 |
| 93 | 1.291 | 1.661 | 1.986 | 2.367 | 2.630 | 3.398 |
| 94 | 1.291 | 1.661 | 1.986 | 2.367 | 2.629 | 3.397 |
| 95 | 1.291 | 1.661 | 1.985 | 2.366 | 2.629 | 3.396 |
| 96 | 1.290 | 1.661 | 1.985 | 2.366 | 2.628 | 3.395 |
| 97 | 1.290 | 1.661 | 1.985 | 2.365 | 2.627 | 3.394 |
| 98 | 1.290 | 1.661 | 1.984 | 2.365 | 2.627 | 3.393 |
| 99 | 1.290 | 1.660 | 1.984 | 2.365 | 2.626 | 3.392 |
| 100 | 1.290 | 1.660 | 1.984 | 2.364 | 2.626 | 3.390 |
| 120 | 1.289 | 1.658 | 1.980 | 2.358 | 2.617 | 3.373 |
| 140 | 1.288 | 1.656 | 1.977 | 2.353 | 2.611 | 3.361 |
| 160 | 1.287 | 1.654 | 1.975 | 2.350 | 2.607 | 3.352 |
| 180 | 1.286 | 1.653 | 1.973 | 2.347 | 2.603 | 3.345 |
| 200 | 1.286 | 1.653 | 1.972 | 2.345 | 2.601 | 3.340 |
| ∞ | 1.282 | 1.645 | 1.960 | 2.326 | 2.576 | 3.291 |