



ZIMBABWE EZEKIEL GUTI UNIVERSITY

FACULTY OF HERITAGE, HUMANITIES AND SOCIETAL ADVANCEMENT

EXAMINATION PAPER

COURSE CODE : BSSW223
COURSE TITLE : SOCIAL RESEARCH METHODS 2
SPECIAL REQUIREMENTS : Formulae Sheets
Statistical Tables
Graph Paper
DURATION : 3 Hours
LEVEL : 2.2
DATE : 11 APR 2025

INSTRUCTIONS TO CANDIDATES:

1. No cell phones are allowed in the examination venue.
2. Section A is compulsory and answer any THREE (3) questions from Section B.
3. The number of marks for each question or part question is shown in brackets ()
4. Use of non-programmable calculators is allowed.
5. Show all your workings in order to gain full marks.
6. Begin each answer on a new page.
7. **DO NOT OPEN THIS PAPER UNTIL THE INVIGILATOR INSTRUCTS YOU.**

SECTION A (ANSWER ALL QUESTIONS FROM THIS SECTION)

QUESTION ONE

- a) Social workers are interested in understanding the speed of vehicles passing through a community area in Muzarabani. The speed of cars recorded at a speed trap by a detector between 10:00am and 13:00pm on Thursday morning was summarized in the table below:

Speed in Km/h	Frequency
35 - < 45	33
45 - < 55	40
55 - < 65	30
65 - < 75	20

- Construct cumulated frequency curve (less than ogive) for these data **[5 marks]**
- Compute the mean, mode, median, and coefficient of variation **[14 marks]**
- Write a brief report commenting on the statistics computed in (i) and (ii) above. Be sure to include the skewness of the speed, the variability of the speeds, as well as the reliability of the measures of central location. **[6 marks]**

SECTION B (ANSWER ANY THREE QUESTIONS FROM THIS SECTION)

QUESTION TWO

- a) A University mathematics Lecturer decides to test the effect of using an education computer package, consisting of geometric designs and illustrations, to teach geometry. Since the package is expensive, the lecturer wishes to determine whether using the package will result in an improvement in the students' understanding of the topic. The lecturer randomly assigns pupils to two groups; a control group receiving standard lessons and an experimental group using new package. The students are selected in pairs of equal mathematical ability with one from each pair assigned at random to the control group and the other to the experimental group. On completion

of the topic the students are given a test to measure their understanding. The results, percentage marks, are shown in the table below:

Pair	1	2	3	4	5	6	7	8	9	10
Control	72	82	93	65	76	89	81	58	95	91
Experiment	75	79	84	71	82	91	85	68	90	92

Assuming percentage marks to be normally distributed, investigate the claim that the educational computer package produces an improvement in pupil' understanding of geometry. Use 5% level of significance. **[19 marks]**

b) A social work organization is interested in evaluating the satisfaction of clients with the services provided by a community support program. Approximately 900 clients use the program annually. The program director wants to determine clients' satisfaction with the services. She developed a questionnaire that yields a satisfaction score between 10 and 50 for participant responses. A random sample of 35 of the 900 clients is asked to complete a satisfaction survey. The satisfaction scores for the 35 participants are averaged to produce a mean satisfaction score.

- i. What is the population for this study? **[1 mark]**
- ii. What is the sample for this study? **[1 mark]**
- iii. What is test-statistic for this study? **[2 marks]**
- iv. What would be a parameter for this study? **[2 marks]**

QUESTION THREE

a) A local politician is concerned that a program for the homeless in her city is discriminating against blacks and other minorities. The data below were taken from a random sample of black and white homeless people.

Received services	Race		Totals
	Black	White	
Yes	6	7	13
No	4	9	13
Totals	10	16	26

Is there a statistically significant relationship between race and whether or not the person has received services from the program? **[20 marks]**

- b) A social work organization requested a breakdown of travel expenses for social workers to attend various professional conferences. It was found that 31% of the travel expenses was spent for transportation costs, 25% was spent for lodging, 17% was spent for food, and 20% was spent for conference registration fees; the remainder was spent for miscellaneous costs. Graph the data using the appropriate chart. [5 marks]

QUESTION FOUR

- a) The following are the number of hours which a random sample of ten students studied for an examination and the grades the students received.

Hours Studied (X)	8	5	11	13	10	5	18	15	2	8
Grade (Y)	56	44	79	72	70	54	94	85	33	65

Calculate Spearman's rank correlation coefficient (r_s), and comment on the result. [15 marks]

- b) A social worker is tasked with selecting a sample of car drivers to participate in a study commissioned by the city council. If the parkade has a carrying capacity of 500 cars, describe how the social worker would select a random sample of 30 drivers using a suitable sampling method. [10 marks]

QUESTION FIVE

It seems logical that restaurant chains with more units (restaurants) would have greater sales. This assumption is mitigated, however, by several possibilities: some units may be more profitable than others, some units may be larger, some units may serve more meals, some units may serve more expensive meals, and so on. The data shown here were published by a reputable Research Unit in the country.

	Number of Units Chain (1000)	Sales (\$ billions)
McDonald's	12.4	17.1
Burger King	7.5	7.9
Taco Bell	6.8	4.8
Pizza Hut	8.7	4.7
Chicken Inn	4.6	4.6

KFC	5.1	4.0
Subway	11.2	2.9
Dairy Queen	5.1	2.7
Chicken Mart	2.9	2.7

- a. Plot the data and comment. **[5 marks]**
- b. Perform a simple regression analysis to predict a restaurant chain's sales by its number of units. **[8 marks]**
- c. Estimate restaurant chain's sales if number of units chain is 10 **[2 marks]**
- d. Compute the coefficient of determination and comment **[5 marks]**
- e. How strong is the relationship between the number of units and restaurant chain's sales? **[5 marks]**

THE END

STATISTICAL FORMULAS

MEASURES OF CENTRAL TENDENCY

Ungrouped data

$$\text{Population mean, } \mu = \frac{\sum x}{N}$$

$$\text{Sample mean, } \bar{x} = \frac{\sum x}{n}$$

$$\text{Median, } M_e = \frac{n+1}{2}$$

Grouped data

$$\text{Population mean, } \mu = \frac{\sum fx}{N}$$

$$\text{Sample mean, } \bar{x} = \frac{\sum fx}{n}$$

$$\text{Median, } M_e = L_m + \frac{(\frac{n}{2} - F)C}{f_m}$$

$$\text{Mode, } M_o = L_m + \frac{(d_1) c}{d_1 + d_2}$$

MEASURES OF DISPERSION

Ungrouped data

$$\text{Population average deviation, } AD = \frac{\sum |x - \mu|}{N}$$

$$\text{Sample average deviation, } AD = \frac{\sum |x - \bar{x}|}{n}$$

$$\text{Population variance} = \sigma^2 = \frac{1}{N} (\sum x^2 - \frac{1}{N} (\sum x)^2)$$

$$\text{Sample variance} = s^2 = \frac{1}{n-1} (\sum x^2 - \frac{1}{n} (\sum x)^2)$$

$$\text{Population standard deviation, } \sigma = \sqrt{\frac{1}{N} (\sum x^2 - \frac{1}{N} (\sum x)^2)}$$

$$\text{Sample standard deviation, } s = \sqrt{\frac{1}{n-1} (\sum x^2 - \frac{1}{n} (\sum x)^2)}$$

Grouped data

Range = maximum value – minimum value

$$\text{Percentile, } P_k = L_p + \frac{\left(\frac{kn}{100} - F\right)C}{fp}$$

$$\text{Decile, } D_x = L_d + \frac{\left(\frac{xn}{10} - F\right)C}{fd}$$

$$\text{Lower quartile, } Q_1 = L_q + \frac{\left(\frac{n}{4} - F\right)C}{fq}$$

$$\text{Upper quartile } Q_3 = L_q + \frac{\left(\frac{3n}{4} - F\right)C}{fq}$$

Interquartile range = $Q_3 - Q_1$

$$\text{Quartile deviation} = \frac{Q_3 - Q_1}{2}$$

$$\text{Population average deviation, AD} = \frac{\sum f|x - \mu|}{N}$$

$$\text{Sample average deviation, AD} = \frac{\sum f|x - \bar{x}|}{n}$$

$$\text{Population variance, } \sigma^2 = \frac{1}{N} (\sum fx^2 - \frac{1}{N} (\sum fx)^2)$$

$$\text{Sample variance} = s^2 = \frac{1}{n-1} (\sum fx^2 - \frac{1}{n} (\sum fx)^2)$$

$$\text{Population standard deviation, } \sigma = \sqrt{\frac{1}{N} (\sum fx^2 - \frac{1}{N} (\sum fx)^2)}$$

$$\text{Sample standard deviation, } s = \sqrt{\frac{1}{n-1} (\sum fx^2 - \frac{1}{n} (\sum fx)^2)}$$

$$\text{Population coefficient of variation, CV} = \frac{\sigma}{\mu} \times 100\%$$

$$\text{Sample coefficient of variation, CV} = \frac{s}{\bar{x}} \times 100\%$$

SHAPE OF FREQUENCY DISTRIBUTIONS

$$\text{Population skewness, } Sk = \frac{3(\mu - \text{median})}{\sigma} \text{ or } \frac{(\mu - \text{mode})}{\sigma}$$

$$\text{Sample skewness, } Sk = \frac{3(\bar{x} - \text{median})}{s} \text{ or } \frac{(\bar{x} - \text{mode})}{s}$$

$$\text{Population kurtosis} = \frac{\sum f(X-\mu)^4}{\sigma^4}$$

$$\text{Sample kurtosis} = \frac{\sum f(X-\bar{x})^4}{s^4}$$

BASIC PROBABILITY CONCEPTS

i. **Classical Method of Assigning Probabilities:** $P(E) = \frac{ne}{N}$

ii. **Probability by Relative Frequency of Occurrence**

$$\frac{\text{Number of Times an Event Occurred}}{\text{Total Number of Opportunities for the Event to Occur}}$$

iii. **Complementary rule:** $P(A') = 1 - P(A)$

iv. **Addition rule**

a) If X, Y are non-mutually exclusive, $P(X \cup Y) = P(X) + P(Y) - P(X \cap Y)$

b) If X, Y are mutually exclusive, $P(X \cup Y) = P(X) + P(Y)$

v. **Multiplication rule**

a) If X, Y are dependent (conditional probability),
 $P(X \cap Y) = P(X) \cdot P(Y|X) = P(Y) \cdot P(X|Y)$

b) If X, Y are independent, $P(X \cap Y) = P(X) \cdot P(Y)$

vi. **Law of Conditional Probability,** $P(X | Y) = \frac{P(X \cap Y)}{P(Y)} = \frac{P(X) \cdot P(Y | X)}{P(Y)}$

PROBABILITY DISTRIBUTION

Probability distribution	Mean	Variance
Binomial distribution $P(x) = \frac{n!}{x!(n-x)!} p^x (q)^{n-x}$	np	npq
Poisson distribution $P(x) = \frac{\lambda^x e^{-\lambda}}{x!}$	λ	λ
Standard normal distribution $Z = \frac{x - \mu}{\sigma}$	0	1

CONFIDENCE INTERVALS

Mean of a single normal population

- i. If sample size is small (i.e., $n < 30$) and σ^2 Unknown

$$\bar{x} - t_{\alpha/2} (n - 1) \frac{s}{\sqrt{n}} \leq \mu \leq \bar{x} + t_{\alpha/2} (n - 1) \frac{s}{\sqrt{n}} \text{ or simply } \bar{x} \pm t_{\alpha/2} (n - 1) \frac{s}{\sqrt{n}}$$

- ii. If sample size is large and σ^2 unknown

$$\bar{x} - z_{\alpha/2} \frac{s}{\sqrt{n}} \leq \mu \leq \bar{x} + z_{\alpha/2} \frac{s}{\sqrt{n}} \text{ or simply, } \bar{x} \pm z_{\alpha/2} \frac{s}{\sqrt{n}}$$

- iii. If variance, σ^2 is known

$$\bar{x} - z_{\alpha/2} \frac{\sigma}{\sqrt{n}} \leq \mu \leq \bar{x} + z_{\alpha/2} \frac{\sigma}{\sqrt{n}} \text{ or simply, } \bar{x} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$$

TESTING OF HYPOTHESIS (ONE SAMPLE CASE)

Tests on the mean of a single population

- i. If when σ^2 is unknown and sample size is small ($n < 30$), then the t Statistic is such that,

$$t = \frac{\bar{x} - \mu_x}{\frac{s}{\sqrt{n}}}$$

- ii. If when σ^2 is known and sample size is large, then the z statistic is such that:

$$z = \frac{\bar{x} - \mu_x}{\frac{\sigma_x}{\sqrt{n}}} = Z = \frac{\bar{x} - \mu_x}{\frac{\sigma}{\sqrt{n}}}$$

- iii. If when σ^2 is unknown and sample size is large, then the t statistic is approximately a standard normal random variable such that: $z = \frac{\bar{x} - \mu_x}{\frac{s}{\sqrt{n}}}$

Hypothesis to be tested	Distribution	Reject H_0 if
$H_0: \mu = \mu_0$ $H_1: \mu \neq \mu_0$	Z -distribution	$Z > Z_{\alpha/2}$ $Z < - Z_{\alpha/2}$
	T - distribution	$T > T_{\alpha/2} (n - 1)$ $T < - t_{\alpha/2}(n-1)$
$H_0: \mu \leq \mu_0$ $H_1: \mu > \mu_0$	Z-distribution	$Z > Z_{\alpha}$
	T-distribution	$T > t_{\alpha} (n-1)$
$H_0: \mu \geq \mu_0$ $H_1: \mu < \mu_0$	Z-distribution	$Z < - Z_{\alpha}$
	T-distribution	$T < - t_{\alpha} (n-1)$

TESTING OF HYPOTHESIS (TWO SAMPLE CASE)

Comparing Two Population Means when samples are from independent populations

Use if sample sizes > 30 or if σ_1 and σ_2 are known: $z = \frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{\frac{\delta_1^2}{n_1} + \frac{\delta_2^2}{n_2}}}$

Use if sample sizes > 30 or if σ_1 and σ_2 are unknown: $z = \frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$

Comparing Population Means with Unknown Population Standard Deviations (the Pooled t -test)

Small sample test of means ($n < 30$)

The required assumptions are: (1) Both populations must follow the normal distribution. (2) The populations must have equal standard deviations and (3) The samples are from independent populations.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{S_p^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}} \text{ where } S_p^2 = S_p^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}$$

Degrees of freedom (df) : $n_1 + n_2 - 2$

Two-Sample Tests of Hypothesis: Dependent Samples

Use the following test when the samples are dependent:

$$t = \frac{\bar{d}}{s_d / \sqrt{n}}$$

Degrees of freedom (df): $n - 1$

CHI-SQUARE TEST

$$\chi^2_{\text{calc}} = \sum \frac{(f_o - f_e)^2}{f_e}$$

Degrees of freedom (df) = (number of rows - 1) × (number of columns - 1)

SIMPLE REGRESSION AND CORRELATION

Fitted Trend Line: $Y = a + bX$

$$b = \frac{n \sum XY - \sum X \sum Y}{n \sum X^2 - (\sum X)^2}$$

$$a = \bar{Y} - b \bar{X}$$

$$\text{Correlation coefficient, } r = \sqrt{R^2} = \frac{n \sum XY - \sum X \sum Y}{\sqrt{[n \sum X^2 - (\sum X)^2][n \sum Y^2 - (\sum Y)^2]}}$$

$$\text{Coefficient of determination, } R^2 = \left(\frac{n \sum XY - \sum X \sum Y}{\sqrt{[n \sum X^2 - (\sum X)^2][n \sum Y^2 - (\sum Y)^2]}} \right)^2$$

BUSINESS CALCULATIONS

Quadratic formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Differentiation

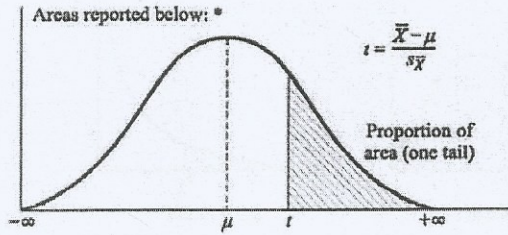
- i. if $f(x) = x^n$ then $f'(x) = nx^{n-1}$; if $y = x^n$ then, $\frac{dy}{dx} = nx^{n-1}$
- ii. Rule 1: The constant rule. If $h(x) = cf(x)$ then $h'(x) = cf'(x)$ for any constant c .
- iii. Rule 2: The sum rule. If $h(x) = f(x) + g(x)$ then $h'(x) = f'(x) + g'(x)$
- iv. Rule 3: The difference rule. If $h(x) = f(x) - g(x)$ then $h'(x) = f'(x) - g'(x)$
- v. Rule 4: The chain rule. If y is a function of u , which is itself a function of x , then

$$\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$$

- vi. Rule 5: The product rule. If $y = uv$ then $\frac{dy}{dx} = u \frac{dv}{dx} + v \frac{du}{dx}$
- vii. Rule 6: The quotient rule. If $y = \frac{u}{v}$ then $\frac{dy}{dx} = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$
- viii. Implicit differentiation: $\frac{dy}{dx} = -\frac{f_x}{f_y}$

APPENDIX 5

Student's *t* Distribution



Proportions of Area for the *t* Distributions

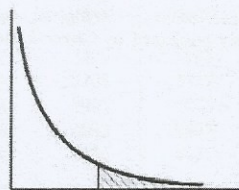
df	0.10	0.05	0.025	0.01	0.005	df	0.10	0.05	0.025	0.01	0.005
1	3.078	6.314	12.706	31.821	63.657	18	1.330	1.734	2.101	2.552	2.878
2	1.886	2.920	4.303	6.965	9.925	19	1.328	1.729	2.093	2.539	2.861
3	1.638	2.353	3.182	4.541	5.841	20	1.325	1.725	2.086	2.528	2.845
4	1.533	2.132	2.776	3.747	4.604	21	1.323	1.721	2.080	2.518	2.831
5	1.476	2.015	2.571	3.365	4.032	22	1.321	1.717	2.074	2.508	2.819
6	1.440	1.943	2.447	3.143	3.707	23	1.319	1.714	2.069	2.500	2.807
7	1.415	1.895	2.365	2.998	3.499	24	1.318	1.711	2.064	2.492	2.797
8	1.397	1.860	2.306	2.896	3.355	25	1.316	1.708	2.060	2.485	2.787
9	1.383	1.833	2.262	2.821	3.250	26	1.315	1.706	2.056	2.479	2.779
10	1.372	1.812	2.228	2.764	3.169	27	1.314	1.703	2.052	2.473	2.771
11	1.363	1.796	2.201	2.718	3.106	28	1.313	1.701	2.048	2.467	2.763
12	1.356	1.782	2.179	2.681	3.055	29	1.311	1.699	2.045	2.462	2.756
13	1.350	1.771	2.160	2.650	3.012	30	1.310	1.697	2.042	2.457	2.750
14	1.345	1.761	2.145	2.624	2.977	40	1.303	1.684	2.021	2.423	2.704
15	1.341	1.753	2.131	2.602	2.947	60	1.296	1.671	2.000	2.390	2.660
16	1.337	1.746	2.120	2.583	2.921	120	1.289	1.658	1.980	2.358	2.617
17	1.333	1.740	2.110	2.567	2.898	∞	1.282	1.645	1.960	2.326	2.576

*Example: For the shaded area to represent 0.05 of the total area of 1.0, value of *t* with 10 degrees of freedom is 1.812
 Source: From Table III of Fisher and Yates, *Statistical Tables for Biological, Agricultural and Medical Research*, 6th ed., 1974, published by Longman Group Ltd., London (previously published by Oliver & Boyd, Edinburgh), by permission of the authors and publishers.

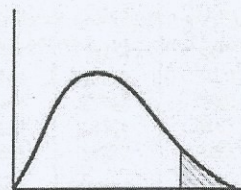
APPENDIX 6

Chi-Square Distribution

Areas reported below: *



For $df = 1, 2$



For $df \geq 3$

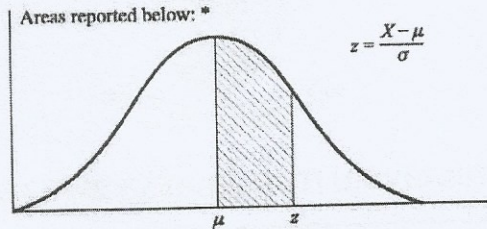
Proportions of Area for the χ^2 Distributions

df	Proportion of Area										
	0.995	0.990	0.975	0.950	0.900	0.500	0.100	0.050	0.025	0.010	0.005
1	0.00004	0.00016	0.00098	0.00393	0.0158	0.455	2.71	3.84	5.02	6.63	7.88
2	0.0100	0.0201	0.0506	0.103	0.211	1.386	4.61	5.99	7.38	9.21	10.60
3	0.072	0.115	0.216	0.352	0.584	2.366	6.25	7.81	9.35	11.34	12.84
4	0.207	0.297	0.484	0.711	1.064	3.357	7.78	9.49	11.14	13.28	14.86
5	0.412	0.554	0.831	1.145	1.61	4.251	9.24	11.07	12.83	15.09	16.75
6	0.676	0.872	1.24	1.64	2.20	5.35	10.64	12.59	14.45	16.81	18.55
7	0.989	1.24	1.69	2.17	2.83	6.35	12.02	14.07	16.01	18.48	20.28
8	1.34	1.65	2.18	2.73	3.49	7.34	13.36	15.51	17.53	20.09	21.96
9	1.73	2.09	2.70	3.33	4.17	8.34	14.68	16.92	19.02	21.67	23.59
10	2.16	2.56	3.25	3.94	4.87	9.34	15.99	18.31	20.48	23.21	25.19
11	2.60	3.05	3.82	4.57	5.58	10.34	17.28	19.68	21.92	24.73	26.76
12	3.07	3.57	4.40	5.23	6.30	11.34	18.55	21.03	23.34	26.22	28.30
13	3.57	4.11	5.01	5.89	7.04	12.34	19.81	22.36	24.74	27.69	29.82
14	4.07	4.66	5.63	6.57	7.79	13.34	21.06	23.68	26.12	29.14	31.32
15	4.60	5.23	6.26	7.26	8.55	14.34	22.31	25.00	27.49	30.58	32.80
16	5.14	5.81	6.91	7.96	9.31	15.34	23.54	26.30	28.85	32.00	34.27
17	5.70	6.41	7.56	8.67	10.09	16.34	24.77	27.59	30.19	33.41	35.72
18	6.26	7.01	8.23	9.39	10.86	17.34	25.99	28.87	31.53	34.81	37.16
19	6.84	7.63	8.91	10.12	11.65	18.34	27.20	30.14	32.85	36.19	38.58
20	7.43	8.26	9.59	10.85	12.44	19.34	28.41	31.41	34.17	37.57	40.00

df	Proportion of Area										
	0.995	0.990	0.975	0.950	0.900	0.500	0.100	0.050	0.025	0.010	0.005
21	8.03	8.90	10.28	11.59	13.24	20.34	29.62	32.67	35.48	38.93	41.40
22	8.64	9.54	10.98	12.34	14.04	21.34	30.81	33.92	36.78	40.29	42.80
23	9.26	10.20	11.69	13.09	14.85	22.34	32.01	35.17	38.08	41.64	44.18
24	9.89	10.86	12.40	13.85	15.66	23.34	33.20	36.42	39.36	42.98	45.56
25	10.52	11.52	13.12	14.61	16.47	24.34	34.38	37.65	40.65	44.31	46.93
26	11.16	12.20	13.84	15.38	17.29	25.34	35.56	38.89	41.92	45.64	48.29
27	11.81	12.83	14.57	16.15	18.11	26.34	36.74	40.11	43.19	46.96	49.64
28	12.46	13.56	15.31	16.93	18.94	27.34	37.92	41.34	44.46	48.28	50.99
29	13.12	14.26	16.05	17.71	19.77	28.34	39.09	42.56	45.72	49.59	52.34
30	13.79	14.95	16.79	18.49	20.60	29.34	40.26	43.77	46.98	50.89	53.67
40	20.71	22.16	24.43	26.51	29.05	39.34	51.81	55.76	59.34	63.69	66.77
50	27.99	29.71	32.36	34.76	37.69	49.33	63.17	67.50	71.42	76.15	79.49
60	35.53	37.43	40.48	43.19	46.46	59.33	74.40	79.08	83.30	88.38	91.95
70	43.28	45.44	48.76	51.74	55.33	69.33	85.53	90.53	95.02	100.4	104.2
80	51.17	53.54	51.17	60.39	64.28	79.33	98.58	101.9	106.6	112.3	116.3
90	59.20	61.75	65.65	69.13	73.29	89.33	107.6	113.1	118.1	124.1	128.3
100	67.33	70.06	74.22	77.93	82.36	99.33	118.5	124.3	129.6	135.8	140.2

*Example: For the shaded area to represent 0.05 of the total area of 1.0 under the density function, the value of x^2 is 18.31 when $df = 10$.

Source: From Table IV of Fisher and Yates, *Statistical Tables for Biological, Agricultural and Medical Research*, 6th ed., 1974, published by Longman Group Ltd., London (previously published by Oliver & Boyd, Edinburgh), by permission of the authors and publishers.



Proportions of Area for the Standard Normal Distribution

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4014
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4983	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987									
3.5	.4997									
4.0	.4999									

*Example: For z = 1.96, shaded area is 0.4750 out of the total area of 1.0000.

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