MATH 2300 Final Exam --- Spring 2013 - A

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Provide an appropriate response.

1) A meteorologist constructs a graph showing the total precipitation in Phoenix, Arizona in each of the months of 1998. Does this involve descriptive statistics or inferential statistics? 1) _____

A) Descriptive B) Inferential

Answer the question.

2) 100,000 randomly selected adults were asked whether they drink at least 48 oz of water each day and only 45% said yes. Identify the sample and population. 2) _____

A) Sample: the 100,000 selected adults; population: the 45% of adults who drink at least 48 oz of water

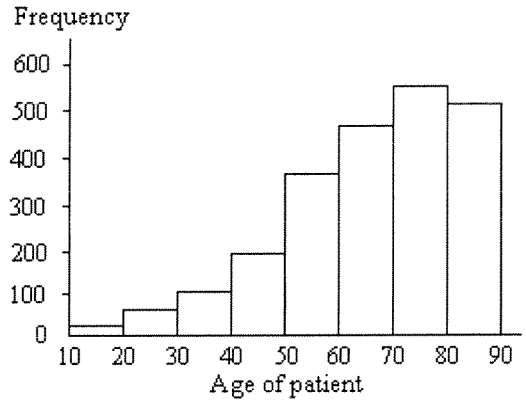
B) Sample: the 100,000 selected adults; population: all adults

C) Sample: the 45% of adults who drink at least 48 oz of water; population: all adults

D) Sample: all adults ; population: the 100,000 selected adults

A graphical display of a data set is given. Identify the overall shape of the distribution as (roughly) bell-shaped, triangular, uniform, reverse J-shaped, J-shaped, right skewed, left skewed, bimodal, or multimodal.

3) The ages of a group of patients being treated at one hospital for osteoporosis are summarized in the frequency histogram below. 3) _____



A) Right skewed B) Left skewed

C) Bell-shaped D) Reverse J-shaped

Classify the data as either qualitative or quantitative.

4) The following table shows the average weight of offensive linemen for each given football team. 4) _____

Team	Average weight (pounds)
Gators	303.52
Lakers	326.78
Eagles	290.61
Pioneers	321.96
Lions	297.35
Mustangs	302.49
Rams	345.88
Buffalos	329.24

What kind of data is provided by the information in the first column?

A) Qualitative B) Quantitative

Classify the data as either discrete or continuous.

5) The number of cars passing a busy intersection between 4:30 P.M. and 6:30 P.M. on a Monday is 2,200. 5) _____

A) Discrete B) Continuous

Provide an appropriate response.

6) The data in the following table show the results of a survey of college students asking which vacation destination they would choose given the eight choices shown. Determine the value that should be entered in the relative frequency column for Arizona. 6) _____

Destination	Frequency	Relative frequency
Florida	34	
Mexico	80	
Belize	18	
Puerto Rico	26	
Alaska	4	
California	20	
Colorado	12	
Arizona	6	

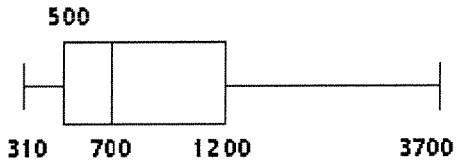
A) 0.06 B) 0.03 C) 0.003 D) 6

Construct and interpret a boxplot or a modified boxplot as specified.

7) The weekly salaries (in dollars) of 24 randomly selected employees of a company are shown below. Construct a boxplot for the data. 7) _____

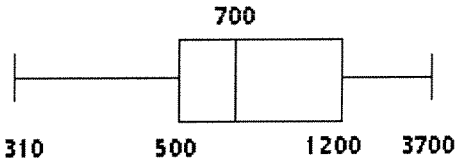
310	320	450	460	470	500	520	540
580	600	650	700	710	840	870	900
1000	1200	1250	1300	1400	1720	2500	3700

A)



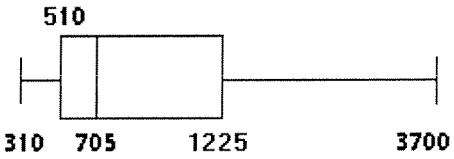
The data is highly right-skewed.

B)



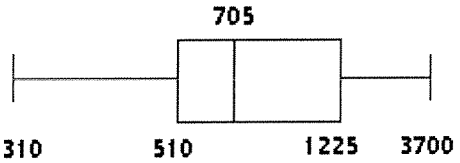
The data is fairly symmetrical.

C)



The data is highly right-skewed.

D)



The data is fairly symmetrical.

Find the sample standard deviation for the given data. Round your final answer to one more decimal place than that used for the observations.

8) Christine is currently taking college astronomy. The instructor often gives quizzes. On the past seven quizzes, Christine got the following scores. 8) _____

42 11 36 29 14 50 64

A) 36 B) 19 C) 8645.1 D) 10,814

Find the mean for the given sample data. Unless otherwise specified, round your answer to one more decimal place than that used for the observations.

9) Frank's Furniture employees earned $326.90, $262.82, $253.23, $254.01, $352.07, and $209.77 last week. Find the mean wage of the employees. Round your answer to the nearest cent. 9) _____

A) $319.76 B) $414.70 C) $331.76 D) $276.47

Determine the quartile or interquartile range as specified.

10) The weights (in pounds) of 17 randomly selected adults are given below. Find the interquartile range. 10) _____

144 165 187 143 119 132
127 156 179 159 180 202
114 146 151 168 173

A) 30 lb B) 37.5 lb C) 37 lb D) 38 lb

Use the regression equation to predict the y-value corresponding to the given x-value. Round your answer to the nearest tenth.

11) The regression equation relating attitude rating (x) and job performance rating (y) for ten randomly selected employees of a company is $\hat{y} = 11.7 + 1.02x$. Predict the job performance rating for an employee whose attitude rating is 77. 11) _____

A) 12.6 B) 80.1 C) 88.9 D) 90.2

Provide an appropriate response.

12) For the linear equation $y = 8 + 6x$, explain what the y-intercept and slope represent in terms of the graph of the equation. 12) _____

A) The y-intercept, $b_0 = 8$, gives the y-value at which the straight line $y = 8 + 6x$ intersects the y-axis. The slope, $b_1 = 6$, indicates that the x-value increases by 6 units for every increase in y of 1 unit.

B) The y-intercept, $b_0 = 8$, gives the y-value at which the straight line $y = 8 + 6x$ intersects the x-axis. The slope, $b_1 = 6$, indicates that the x-value increases by 6 units for every increase in y of 1 unit.

C) The y-intercept, $b_0 = 8$, gives the y-value at which the straight line $y = 8 + 6x$ intersects the y-axis. The slope, $b_1 = 6$, indicates that the y-value increases by 6 units for every increase in x of 1 unit.

D) The y-intercept, $b_0 = 6$, gives the y-value at which the straight line $y = 8 + 6x$ intersects the y-axis. The slope, $b_1 = 8$, indicates that the y-value increases by 8 units for every increase in x of 1 unit.

13) For the 14 teams in baseball's American league , the correlation with number of wins in the 2007 regular season is 0.51 for shutouts, 0.61 for hits made, -.70 for runs allowed and -0.56 for homeruns allowed. (mlb.mlb.com/stats/) Which variable has the strongest linear association with number of wins? 13) _____

A) homeruns allowed
B) hits made
C) shutouts
D) runs allowed

Compute the coefficient of determination. Round your answer to four decimal places.

14) A regression equation is obtained for a set of data points. It is found that the total sum of squares is 138.7, the regression sum of squares is 81.8, and the error sum of squares is 56.9. 14) _____

A) 0.4102 B) 0.5898 C) 1.6956 D) 0.6956

Find the indicated probability.

15) If you flip a coin three times, the possible outcomes are HHH HHT HTH HTT THH THT TTH TTT. What is the probability of getting at least one head? 15) _____

A) $\frac{7}{8}$ B) $\frac{1}{4}$ C) $\frac{1}{2}$ D) $\frac{3}{4}$

Find the indicated probability by using the special addition rule.

16) A percentage distribution is given below for the size of families in one U.S. city. 16) _____

Size	Percentage
2	49.2
3	24.2
4	12.1
5	9.6
6	2.9
7+	2.0

A family is selected at random. Find the probability that the size of the family is at most 3. Round approximations to three decimal places.

A) 0.266 B) 0.734 C) 0.492 D) 0.242

List the outcomes comprising the specified event.

17) Three board members for a nonprofit organization will be selected from a group of five people. The board members will be selected by drawing names from a hat. The names of the five possible board members are Allison, Betty, Charlie, Dave, and Emily. The possible outcomes can be represented as follows. 17) _____

ABC ABD ABE ACD ACE
ADE BCD BCE BDE CDE

Here, for example, ABC represents the outcome that Allison, Betty, and Charlie are selected to be on the board. List the outcomes that comprise the following event.

A = event that Charlie is selected

A) CDE
B) ABC, ACD, ACE, BCD, BCE, CDE, BDE
C) ABC, ACD, ACE, BCD, CDE
D) ABC, ACD, ACE, BCD, BCE, CDE

Calculate the specified probability

18) Suppose that D is a random variable. Given that $P(D > 0.4) = 0.45$, find $P(D \leq 0.4)$. 18) _____

A) 0.55 B) 0 C) 0.45 D) 0.275

Find the indicated probability or percentage for the normally distributed variable.

19) The diameters of bolts produced by a certain machine are normally distributed with a mean of 0.30 inches and a standard deviation of 0.01 inches. What percentage of bolts will have a diameter greater than 0.32 inches? 19) _____

A) 97.72% B) 2.28% C) 47.72% D) 37.45%

20) The variable X is normally distributed.The mean is $\mu = 22.0$ and the standard deviation is $\sigma = 2.4$. Find $P(19.7 < X < 25.3)$. 20) _____

A) 0.7477 B) 0.3370 C) 1.0847 D) 0.4107

Find the specified percentile, quartile, or decile.

21) At one college, GPAs are normally distributed with a mean of 2.8 and a standard deviation of 0.5. Find the third quartile, Q_3. 21) _____

A) 3.175 B) 3.135 C) 2.465 D) 3.05

Identify the distribution of the sample mean. In particular, state whether the distribution of $\bar{x}$ is normal or approximately normal and give its mean and standard deviation.

22) The weights of people in a certain population are normally distributed with a mean of 157 lb and a standard deviation of 24 lb. Determine the sampling distribution of the *sample* mean $\bar{x}$ for samples of size 6. (State whether it is normal or approximately normal, and give mean and standard deviation.) 22) _____

A) Approximately normal, mean = 157 lb, standard deviation = 9.8 lb

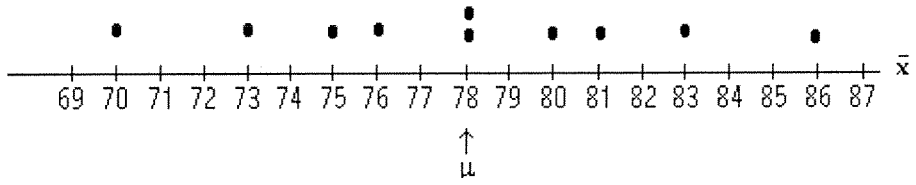
B) Normal, mean = 157 lb, standard deviation = 9.8 lb

C) Normal, mean = 157 lb, standard deviation = 24 lb

D) Approximately normal, mean = 157 lb, standard deviation = 4 lb

Find the requested probability.

23) The test scores of 5 students are under consideration. The following is the dotplot for the sampling distribution of the sample mean for samples of size 2. 23) _____



Find the probability, expressed as a percent, that the sample mean will be equal to the population mean.

A) 30% B) 5% C) 10% D) 20%

For samples of the specified size from the population described, find the mean and standard deviation of the sample mean $\bar{x}$.

24) The mean and the standard deviation of the sampled population are, respectively, 115.3 and 36.5. 24) _____

n = 81

A) $\mu_{\bar{x}} = 36.5$; $\sigma_{\bar{x}} = 4.1$

B) $\mu_{\bar{x}} = 4.1$; $\sigma_{\bar{x}} = 115.3$

C) $\mu_{\bar{x}} = 115.3$; $\sigma_{\bar{x}} = 4.1$

D) $\mu_{\bar{x}} = 280.6$; $\sigma_{\bar{x}} = 2.8$

Find the confidence interval specified.

25) A random sample of 131 full-grown lobsters had a mean weight of 15 ounces. Assume that $\sigma = 3.4$ ounces. Construct a 95% confidence interval for the population mean μ. 25) _____

A) 14.2 to 15.8 ounces

B) 14.4 to 15.6 ounces

C) 14.5 to 15.5 ounces

D) 14.3 to 15.7 ounces

Solve the problem.

26) Based on a sample of 40 randomly selected years, a 90% confidence interval for the mean annual precipitation in one city is from 42.7 inches to 45.3 inches. Find the margin of error. 26) _____

A) 2.6 inches

B) 0.34

C) 1.3 inches

D) There is not enough information to find the margin of error.

Find the confidence interval specified. Assume that the population is normally distributed.

27) A savings and loan association needs information concerning the checking account balances of its local customers. A random sample of 14 accounts was checked and yielded a mean balance of $664.14 and a standard deviation of $297.29. Find a 90% confidence interval for the true mean checking account balance for local customers. 27) _____

A) $523.43 to $804.85

B) $492.52 to $835.76

C) $493.71 to $834.57

D) $455.65 to $872.63

Find the requested value.

28) A long-distance phone company wishes to estimate the mean duration of long-distance calls originating in California. A random sample of 15 long-distance calls originating in California yields the following call durations, in minutes. 28) _____

2	3	2	4	2
14	10	18	24	28
1	19	12	2	37

Use the data to obtain a point estimate of the mean call duration for all long-distance calls originating in California.

A) 12.5 minutes B) 12.0 minutes C) 12.3 minutes D) 11.9 minutes

A sample mean, sample size, and population standard deviation are given. Use the one-mean z-test to perform the required hypothesis test at the given significance level. Use the critical -value approach.

29) $\bar{x} = 20$, n = 60, $\sigma = 1.5$, H_0: $\mu = 22$; H_a: $\mu \neq 22$, $\alpha = 0.05$ 29) _____

A) z = -10.33; critical values = ±1.645; reject H_0

B) z = -10.33; critical values = ±1.645; do not reject H_0

C) z = -10.33; critical values = ±1.96; reject H_0

D) z = -10.33; critical values = ±1.96; do not reject H_0

For the given hypothesis test, explain the meaning of a Type I error, a Type II error, or a correct decision as specified.

30) A manufacturer claims that the mean amount of juice in its 16 ounce bottles is 16.1 ounces. A consumer advocacy group wants to perform a hypothesis test to determine whether the mean amount is actually less than this. The hypotheses are: 30) _____

$H_0 : \mu = 16.1$ ounces

$H_a : \mu < 16.1$ ounces

where μ is the mean amount of juice in the manufacturer's 16 ounce bottles. Explain the meaning of a Type I error.

A) A Type I error would occur if, in fact, $\mu < 16.1$ ounces, but the results of the sampling lead to the conclusion that $\mu > 16.1$ ounces.

B) A Type I error would occur if, in fact, $\mu < 16.1$ ounces, but the results of the sampling fail to lead to that conclusion.

C) A Type I error would occur if, in fact, $\mu = 16.1$ ounces, but the results of the sampling do not lead to rejection of that fact.

D) A Type I error would occur if, in fact, $\mu = 16.1$ ounces, but the results of the sampling lead to the conclusion that $\mu < 16.1$ ounces.

Solve the problem.

31) A variable of two populations has a mean of 39 and a standard deviation of 11 for one of the populations and a mean of 32 and a standard deviation of 15 for the other population. For independent samples of sizes 4 and 20, respectively, find the mean of $\bar{x}_1 - \bar{x}_2$. 31) _____

A) 7 B) -7 C) 71 D) 8.2

Determine the null and alternative hypotheses for the proposed hypothesis test.

32) A researcher wants to perform a hypothesis test to determine whether the mean credit card debt for credit card holders aged 18-35 is greater than the mean credit card debt for credit card holders aged over 35. 32) _____

A) Let μ_1 denote the mean credit card debt for credit card holders aged 18-35 and let μ_2 denote the mean credit card debt for credit card holders over 35. The null and alternative hypotheses are $H_0: \mu_1 = \mu_2$ and $H_a: \mu_1 < \mu_2$.

B) Let μ_1 denote the mean credit card debt for credit card holders aged 18-35 and let μ_2 denote the mean credit card debt for credit card holders over 35. The null and alternative hypotheses are $H_0: \mu_1 > \mu_2$ and $H_a: \mu_1 < \mu_2$.

C) Let μ_1 denote the mean credit card debt for credit card holders aged 18-35 and let μ_2 denote the mean credit card debt for credit card holders over 35. The null and alternative hypotheses are $H_0: \mu_1 = \mu_2$ and $H_a: \mu_1 > \mu_2$.

D) Let $\bar{x}_1$ denote the mean credit card debt for credit card holders aged 18-35 and let $\bar{x}_2$ denote the mean credit card debt for credit card holders over 35. The null and alternative hypotheses are $H_0: \bar{x}_1 = \bar{x}_2$ and $H_a: \bar{x}_1 > \bar{x}_2$.

FREE RESPONSE

1. A fair six-sided die is rolled. The faces are numbered 1 through 6.

   (a) List all possible outcomes of the roll.

   (b) List the outcomes of the event

   $$A = \text{an even number is rolled}$$

   (c) List the outcomes of the event

   $$B = \text{the number rolled is at most 2}$$

   (d) List the outcomes of $(A \ \& \ B)$, if any.

   (e) Draw a Venn diagram illustrating the relationship between A and B. Then shade the part representing $(A$ **or** $B)$.

2. Consider this set of three data points:

x	1	2	3
y	1	6	5

   (a) Compute S_{xx}, S_{xy}, S_{yy}.

   (b) Compute the least-squares estimates b_0 and b_1.

3. In one city, convicted burglars are sentenced to an average of 18.7 months in prison. A researcher wants to perform a hypothesis test to determine whether the mean sentence handed down by one particular judge for burglars differs from 18.7 months. She takes a random sample of 38 such cases from the court files of this judge and finds that $\overline{x} = 17$ months. Assume that the population standard deviation is 7.1 months. Test the hypothesis at the 5% significance level:

   (a) State the null and alternative hypotheses.

   (b) What is α?

   (c) Compute the value of the test statistic.

   (d) Determine the critical value(s).

   (e) State the conclusion of your test.

4. The networks for the top 20 television shows are shown in the following table.

CBS	ABC	CBS	ABC	ABC
Fox	CBS	CBS	Fox	CBS
ABC	CBS	CBS	CBS	Fox
Fox	Fox	CBS	Fox	ABC

   (a) Make a table of the frequency distribution.

   (b) Make a table of the relative-frequency distribution.

   (c) Construct a bar chart of the relative-frequency distribution. Remember to label the vertical axis (with numbers) and label each bar.

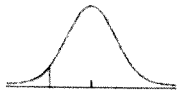


Table II Areas under the standard normal curve

Second decimal place in z										
0.09	*0.08*	*0.07*	*0.06*	*0.05*	*0.04*	*0.03*	*0.02*	*0.01*	*0.00*	z
									0.0000[†]	*−3.9*
0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	*−3.8*
0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	*−3.7*
0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	*−3.6*
0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	*−3.5*
0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	*−3.4*
0.0003	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005	*−3.3*
0.0005	0.0005	0.0005	0.0006	0.0006	0.0006	0.0006	0.0006	0.0007	0.0007	*−3.2*
0.0007	0.0007	0.0008	0.0008	0.0008	0.0008	0.0009	0.0009	0.0009	0.0010	*−3.1*
0.0010	0.0010	0.0011	0.0011	0.0011	0.0012	0.0012	0.0013	0.0013	0.0013	*−3.0*
0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0019	*−2.9*
0.0019	0.0020	0.0021	0.0021	0.0022	0.0023	0.0023	0.0024	0.0025	0.0026	*−2.8*
0.0026	0.0027	0.0028	0.0029	0.0030	0.0031	0.0032	0.0033	0.0034	0.0035	*−2.7*
0.0036	0.0037	0.0038	0.0039	0.0040	0.0041	0.0043	0.0044	0.0045	0.0047	*−2.6*
0.0048	0.0049	0.0051	0.0052	0.0054	0.0055	0.0057	0.0059	0.0060	0.0062	*−2.5*
0.0064	0.0066	0.0068	0.0069	0.0071	0.0073	0.0075	0.0078	0.0080	0.0082	*−2.4*
0.0084	0.0087	0.0089	0.0091	0.0094	0.0096	0.0099	0.0102	0.0104	0.0107	*−2.3*
0.0110	0.0113	0.0116	0.0119	0.0122	0.0125	0.0129	0.0132	0.0136	0.0139	*−2.2*
0.0143	0.0146	0.0150	0.0154	0.0158	0.0162	0.0166	0.0170	0.0174	0.0179	*−2.1*
0.0183	0.0188	0.0192	0.0197	0.0202	0.0207	0.0212	0.0217	0.0222	0.0228	*−2.0*
0.0233	0.0239	0.0244	0.0250	0.0256	0.0262	0.0268	0.0274	0.0281	0.0287	*−1.9*
0.0294	0.0301	0.0307	0.0314	0.0322	0.0329	0.0336	0.0344	0.0351	0.0359	*−1.8*
0.0367	0.0375	0.0384	0.0392	0.0401	0.0409	0.0418	0.0427	0.0436	0.0446	*−1.7*
0.0455	0.0465	0.0475	0.0485	0.0495	0.0505	0.0516	0.0526	0.0537	0.0548	*−1.6*
0.0559	0.0571	0.0582	0.0594	0.0606	0.0618	0.0630	0.0643	0.0655	0.0668	*−1.5*
0.0681	0.0694	0.0708	0.0721	0.0735	0.0749	0.0764	0.0778	0.0793	0.0808	*−1.4*
0.0823	0.0838	0.0853	0.0869	0.0885	0.0901	0.0918	0.0934	0.0951	0.0968	*−1.3*
0.0985	0.1003	0.1020	0.1038	0.1056	0.1075	0.1093	0.1112	0.1131	0.1151	*−1.2*
0.1170	0.1190	0.1210	0.1230	0.1251	0.1271	0.1292	0.1314	0.1335	0.1357	*−1.1*
0.1379	0.1401	0.1423	0.1446	0.1469	0.1492	0.1515	0.1539	0.1562	0.1587	*−1.0*
0.1611	0.1635	0.1660	0.1685	0.1711	0.1736	0.1762	0.1788	0.1814	0.1841	*−0.9*
0.1867	0.1894	0.1922	0.1949	0.1977	0.2005	0.2033	0.2061	0.2090	0.2119	*−0.8*
0.2148	0.2177	0.2206	0.2236	0.2266	0.2296	0.2327	0.2358	0.2389	0.2420	*−0.7*
0.2451	0.2483	0.2514	0.2546	0.2578	0.2611	0.2643	0.2676	0.2709	0.2743	*−0.6*
0.2776	0.2810	0.2843	0.2877	0.2912	0.2946	0.2981	0.3015	0.3050	0.3085	*−0.5*
0.3121	0.3156	0.3192	0.3228	0.3264	0.3300	0.3336	0.3372	0.3409	0.3446	*−0.4*
0.3483	0.3520	0.3557	0.3594	0.3632	0.3669	0.3707	0.3745	0.3783	0.3821	*−0.3*
0.3859	0.3897	0.3936	0.3974	0.4013	0.4052	0.4090	0.4129	0.4168	0.4207	*−0.2*
0.4247	0.4286	0.4325	0.4364	0.4404	0.4443	0.4483	0.4522	0.4562	0.4602	*−0.1*
0.4641	0.4681	0.4721	0.4761	0.4801	0.4840	0.4880	0.4920	0.4960	0.5000	*−0.0*

[†] For $z \leq -3.90$, the areas are 0.0000 to four decimal places.

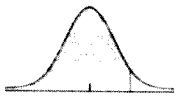


Table II (cont.) Areas under the standard normal curve

	Second decimal place in 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	0.7517	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
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.7	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.8	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.9	1.0000[†]									

[†] For $z \geq 3.90$, the areas are 1.0000 to four decimal places.

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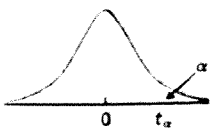
TABLE IV
Values of t_α



NOTE: *See the version of Table IV in Appendix A for additional values of* t_α.

df	$t_{0.10}$	$t_{0.05}$	$t_{0.025}$	$t_{0.01}$	$t_{0.005}$	df
1	3.078	6.314	12.706	31.821	63.657	1
2	1.886	2.920	4.303	6.965	9.925	2
3	1.638	2.353	3.182	4.541	5.841	3
4	1.533	2.132	2.776	3.747	4.604	4
5	1.476	2.015	2.571	3.365	4.032	5
6	1.440	1.943	2.447	3.143	3.707	6
7	1.415	1.895	2.365	2.998	3.499	7
8	1.397	1.860	2.306	2.896	3.355	8
9	1.383	1.833	2.262	2.821	3.250	9
10	1.372	1.812	2.228	2.764	3.169	10
11	1.363	1.796	2.201	2.718	3.106	11
12	1.356	1.782	2.179	2.681	3.055	12
13	1.350	1.771	2.160	2.650	3.012	13
14	1.345	1.761	2.145	2.624	2.977	14
15	1.341	1.753	2.131	2.602	2.947	15
16	1.337	1.746	2.120	2.583	2.921	16
17	1.333	1.740	2.110	2.567	2.898	17
18	1.330	1.734	2.101	2.552	2.878	18
19	1.328	1.729	2.093	2.539	2.861	19
20	1.325	1.725	2.086	2.528	2.845	20
21	1.323	1.721	2.080	2.518	2.831	21
22	1.321	1.717	2.074	2.508	2.819	22
23	1.319	1.714	2.069	2.500	2.807	23
24	1.318	1.711	2.064	2.492	2.797	24
25	1.316	1.708	2.060	2.485	2.787	25
26	1.315	1.706	2.056	2.479	2.779	26
27	1.314	1.703	2.052	2.473	2.771	27
28	1.313	1.701	2.048	2.467	2.763	28
29	1.311	1.699	2.045	2.462	2.756	29
30	1.310	1.697	2.042	2.457	2.750	30
35	1.306	1.690	2.030	2.438	2.724	35
40	1.303	1.684	2.021	2.423	2.704	40
50	1.299	1.676	2.009	2.403	2.678	50
60	1.296	1.671	2.000	2.390	2.660	60
70	1.294	1.667	1.994	2.381	2.648	70
80	1.292	1.664	1.990	2.374	2.639	80
90	1.291	1.662	1.987	2.369	2.632	90
100	1.290	1.660	1.984	2.364	2.626	100
1000	1.282	1.646	1.962	2.330	2.581	1000
2000	1.282	1.646	1.961	2.328	2.578	2000
	1.282	1.645	1.960	2.326	2.576	
	$z_{0.10}$	$z_{0.05}$	$z_{0.025}$	$z_{0.01}$	$z_{0.005}$	

Formulas

Notation

n = sample size	Q_j = jth quartile	σ = population stdev	p = population proportion
$\bar{x}$ = sample mean	N = population size	d = paired difference	O = observed frequency
s = sample stdev	μ = population mean	$\hat{p}$ = sample proportion	E = expected frequency

Chapter 3 Descriptive Measures

- Sample mean: $\bar{x} = \dfrac{\Sigma x_i}{n}$
- Range: Range = Max − Min
- Sample standard deviation:

$$s = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n-1}} \quad \text{or} \quad s = \sqrt{\frac{\Sigma x_i^2 - (\Sigma x_i)^2/n}{n-1}}$$

- Interquartile range: IQR = $Q_3 - Q_1$
- Lower limit = $Q_1 - 1.5 \cdot \text{IQR}$, Upper limit = $Q_3 + 1.5 \cdot \text{IQR}$
- Population mean (mean of a variable): $\mu = \dfrac{\Sigma x_i}{N}$
- Population standard deviation (standard deviation of a variable):

$$\sigma = \sqrt{\frac{\Sigma(x_i - \mu)^2}{N}} \quad \text{or} \quad \sigma = \sqrt{\frac{\Sigma x_i^2}{N} - \mu^2}$$

- Standardized variable: $z = \dfrac{x - \mu}{\sigma}$

Chapter 4 Descriptive Methods in Regression and Correlation

- S_{xx}, S_{xy}, and S_{yy}:

$$S_{xx} = \Sigma(x_i - \bar{x})^2 = \Sigma x_i^2 - (\Sigma x_i)^2/n$$
$$S_{xy} = \Sigma(x_i - \bar{x})(y_i - \bar{y}) = \Sigma x_i y_i - (\Sigma x_i)(\Sigma y_i)/n$$
$$S_{yy} = \Sigma(y_i - \bar{y})^2 = \Sigma y_i^2 - (\Sigma y_i)^2/n$$

- Regression equation: $\hat{y} = b_0 + b_1 x$, where

$$b_1 = \frac{S_{xy}}{S_{xx}} \quad \text{and} \quad b_0 = \frac{1}{n}(\Sigma y_i - b_1 \Sigma x_i) = \bar{y} - b_1 \bar{x}$$

- Total sum of squares: $SST = \Sigma(y_i - \bar{y})^2 = S_{yy}$
- Regression sum of squares: $SSR = \Sigma(\hat{y}_i - \bar{y})^2 = S_{xy}^2/S_{xx}$
- Error sum of squares: $SSE = \Sigma(y_i - \hat{y}_i)^2 = S_{yy} - S_{xy}^2/S_{xx}$
- Regression identity: $SST = SSR + SSE$
- Coefficient of determination: $r^2 = \dfrac{SSR}{SST}$
- Linear correlation coefficient:

$$r = \frac{\frac{1}{n-1}\Sigma(x_i - \bar{x})(y_i - \bar{y})}{s_x s_y} \quad \text{or} \quad r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}}$$

Chapter 5 Probability and Random Variables

- Probability for equally likely outcomes:

$$P(E) = \frac{f}{N}$$

where f denotes the number of ways event E can occur and N denotes the total number of outcomes possible.

- Special addition rule:

$$P(A \text{ or } B \text{ or } C \text{ or } \cdots) = P(A) + P(B) + P(C) + \cdots$$

(A, B, C, ... mutually exclusive)

- Complementation rule: $P(E) = 1 - P(\text{not } E)$
- General addition rule: $P(A \text{ or } B) = P(A) + P(B) - P(A \,\&\, B)$
- Mean of a discrete random variable X: $\mu = \Sigma x P(X = x)$
- Standard deviation of a discrete random variable X:

$$\sigma = \sqrt{\Sigma(x-\mu)^2 P(X=x)} \quad \text{or} \quad \sigma = \sqrt{\Sigma x^2 P(X=x) - \mu^2}$$

- Factorial: $k! = k(k-1)\cdots 2 \cdot 1$
- Binomial coefficient: $\dbinom{n}{x} = \dfrac{n!}{x!(n-x)!}$
- Binomial probability formula:

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

where n denotes the number of trials and p denotes the success probability.

- Mean of a binomial random variable: $\mu = np$
- Standard deviation of a binomial random variable:

$$\sigma = \sqrt{np(1-p)}$$

Chapter 6 The Normal Distribution

- z-score for an x-value: $z = \dfrac{x - \mu}{\sigma}$
- x-value for a z-score: $x = \mu + z \cdot \sigma$

Chapter 7 The Sampling Distribution of the Sample Mean

- Mean of the variable $\bar{x}$: $\mu_{\bar{x}} = \mu$
- Standard deviation of the variable $\bar{x}$: $\sigma_{\bar{x}} = \sigma/\sqrt{n}$

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Chapter 8 Confidence Intervals for One Population Mean

- Standardized version of the variable $\bar{x}$:

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$$

- z-interval for μ (σ known, normal population or large sample):

$$\bar{x} \pm z_{\alpha/2} \cdot \frac{\sigma}{\sqrt{n}}$$

- Margin of error for the estimate of μ: $E = z_{\alpha/2} \cdot \frac{\sigma}{\sqrt{n}}$

- Sample size for estimating μ:

$$n = \left(\frac{z_{\alpha/2} \cdot \sigma}{E}\right)^2$$

rounded up to the nearest whole number.

- Studentized version of the variable $\bar{x}$:

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

- t-interval for μ (σ unknown, normal population or large sample):

$$\bar{x} \pm t_{\alpha/2} \cdot \frac{s}{\sqrt{n}}$$

with df $= n - 1$.

Chapter 9 Hypothesis Tests for One Population Mean

- z-test statistic for H_0: $\mu = \mu_0$ (σ known, normal population or large sample):

$$z = \frac{\bar{x} - \mu_0}{\sigma/\sqrt{n}}$$

- t-test statistic for H_0: $\mu = \mu_0$ (σ unknown, normal population or large sample):

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

with df $= n - 1$.

Chapter 10 Inferences for Two Population Means

- Pooled sample standard deviation:

$$s_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

- Pooled t-test statistic for H_0: $\mu_1 = \mu_2$ (independent samples, normal populations or large samples, and equal population standard deviations):

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s_p\sqrt{(1/n_1) + (1/n_2)}}$$

with df $= n_1 + n_2 - 2$.

- Pooled t-interval for $\mu_1 - \mu_2$ (independent samples, normal populations or large samples, and equal population standard deviations):

$$(\bar{x}_1 - \bar{x}_2) \pm t_{\alpha/2} \cdot s_p\sqrt{(1/n_1) + (1/n_2)}$$

with df $= n_1 + n_2 - 2$.

- Degrees of freedom for nonpooled t-procedures:

$$\Delta = \frac{[(s_1^2/n_1) + (s_2^2/n_2)]^2}{\frac{(s_1^2/n_1)^2}{n_1 - 1} + \frac{(s_2^2/n_2)^2}{n_2 - 1}}$$

rounded down to the nearest integer.

- Nonpooled t-test statistic for H_0: $\mu_1 = \mu_2$ (independent samples, and normal populations or large samples):

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{(s_1^2/n_1) + (s_2^2/n_2)}}$$

with df $= \Delta$.

- Nonpooled t-interval for $\mu_1 - \mu_2$ (independent samples, and normal populations or large samples):

$$(\bar{x}_1 - \bar{x}_2) \pm t_{\alpha/2} \cdot \sqrt{(s_1^2/n_1) + (s_2^2/n_2)}$$

with df $= \Delta$.

- Paired t-test statistic for H_0: $\mu_1 = \mu_2$ (paired sample, and normal differences or large sample):

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

with df $= n - 1$.

- Paired t-interval for $\mu_1 - \mu_2$ (paired sample, and normal differences or large sample):

$$\bar{d} \pm t_{\alpha/2} \cdot \frac{s_d}{\sqrt{n}}$$

with df $= n - 1$.