MATH 140 FINAL EXAMINATION

CLOSED BOOK GRAPHING CALCULATORS ALLOWED

***** FORMULAS ARE ON THE LAST PAGE**

***** IMPORTANT: No cell phones or other communication devices may be turned on or in sight at any time during the exam. If your phone is seen during the exam, your exam will be collected and you will receive an F on the exam and quite possibly for the course as well.**

NAME _____

INSTRUCTOR _____

Problem Number	Possible Points	Score
PART I: #1-15	5 each, 75 total	
PART 2: #1-8	4 each, 32 total	
PART 3:	93 total:	
#1	13	
#2	8	
#3	8	
#4	8	
#5	13	
#6	10	
#7	7	
#8	16	
#9	10	
Total	**200**	

PART I: MULTIPLE CHOICE **Circle the letter of the best answer for each problem below:**

1. If a distribution is skewed to the right, then:

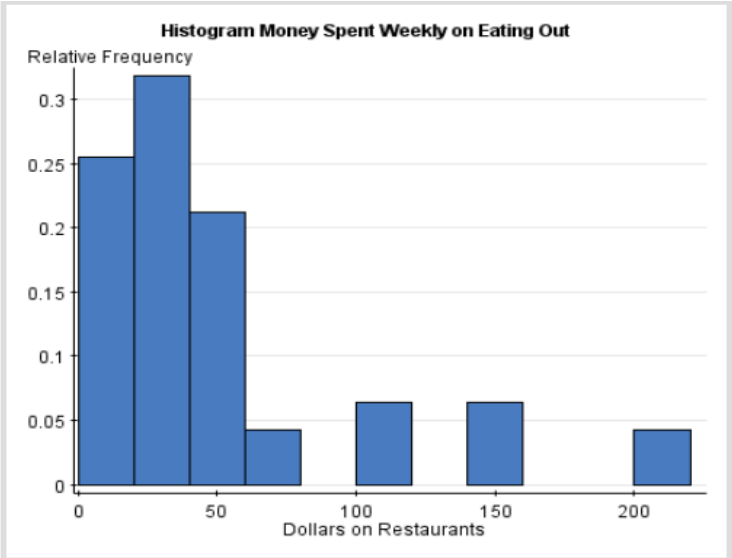
(a) the mean and median are approximately equal
(b) the mean is almost certainly greater than the median
(c) the mean is almost certainly less than the median
(d) the mean will be a better measure of the center of the distribution than the median

2. A sample of households in a certain community is selected at random from the telephone directory for a survey. 4% of the households in the community have no telephone, 10% have only cell phones, and another 28% have unlisted telephone numbers. It is certain that the sample will suffer from:

(a) undercoverage
(b) nonresponse
(c) false responses
(d) systematic bias

3. For the data shown in the graph below, which of the following would be the best measure of the typical amount of money spent weekly on eating out?

(a) Mean
(b) IQR
(c) Median
(d) Standard Deviation



4. Birth weights at a Los Angeles hospital are normally distributed with a mean of 3350 grams and a standard deviation of 480 grams. The hospital plans to set up special observation for the lightest 4% of the babies. What weight cutoff should be used to separate the lightest 4% of the babies from the others? (You'll need to do an appropriate calculation.)

(a) 2390 grams
(b) 2510 grams
(c) 4190 grams
(d) 2870 grams

5. The _____ variable is the variable whose value we suspect can be at least partly explained by the _____ variable.

(a) explanatory; response
(b) explanatory; lurking
(b) lurking; response
(d) response; explanatory

6. Researchers surveyed 1,000 randomly selected adults in the U.S. A strong positive correlation was found between income level and the number of recycling containers typically used in a month.

(a) This result indicates that earning more money influences people to recycle more than if they earn less money.

(b) This sample is too small to draw any conclusions about the relationship between income level and amount of recycling for adults in the U.S.

(c) We cannot conclude whether earning more money causes more recycling among U.S. adults because this information does not allow us to infer causation.

(d) This result confirms that recycling is one of the ways that people can gain extra income.

7. A recent study found that consuming more fast food, candy and soda was not correlated with higher body mass index (BMI). fortune.com/2015/11/06/fastfood-obesity/ This indicates that:

(a) People with higher BMIs tend to consume more fast food than people with lower BMIs
(b) People with higher BMIs tend to consume less fast food than people with lower BMIs
(c) The more fast food a person tends to consume, the higher their BMI tends to be
(d) The more fast food a person tends to consume, the lower their BMI tends to be
(e) None of the above

8. Suppose 100 tests of significance are performed, each one using a significance level of 5%. If in fact the null hypothesis is true for every one of them, then the number of these tests that will reject the null hypothesis will probably be about:

(a) 0
(b) 1
(c) 5
(d) 95

9. A test of significance was conducted by researchers and showed no statistically significant difference in the average level of a certain enzyme between the fish that were exposed to a certain herbicide and those that were not. Therefore:

(a) the average enzyme level in the fish exposed to the herbicide was the same as for the fish not exposed to the herbicide.

(b) the sample size may have been too small to detect a statistically significant difference.

(c) the researchers must not be interpreting the results correctly; there should be a significant difference.

(d) the herbicide does not affect the average enzyme level in fish.

10. The table below is based on records of accidents compiled by a State Highway Safety and Motor Vehicles Office. The Office wants to decide if people are less likely to have a fatal accident if they are wearing a seatbelt. Which of the following comparisons is most appropriate for supporting this conclusion?

Safety Equipment in Use	Injury		ROW TOTAL
	Nonfatal	Fatal	
Seat Belt	412,368	510	412,878
No Seat Belt	162,527	1,601	164,128
COLUMN TOTAL	574,895	2,111	577,006

(a) Compare the ratios 510/412,878 and 1,601/164,128
(b) Compare the ratios 510/577,006 and 1,601/577,006
(c) Compare the numbers 510 and 1,601
(d) Compare the ratios 510/2,111 and 1601/2,111

11. If you want to estimate the percentage of American adults who want to see the new Star Wars movie, why would it be better to have a larger random sample than a smaller one?

(a) The estimate from a larger sample probably will be closer to the proportion of all American adults who want to see the new Star Wars movie than an estimate from a smaller sample.
(b) Small samples tend to be biased, while large samples tend to be unbiased.
(c) There is less chance that your estimate will be biased by people who answer the wrong way.
(d) The standard error is larger with a larger sample.

12. In a survey conducted this October by The Roper Center, 8% of a random sample of 1166 pet owners planned to dress up a pet for Halloween. A 95% confidence interval based on this survey has a margin of error of 1.6%. Therefore we can be 95% confident that _____ _____ is in the confidence interval.

(a) the percentage of pets that were dressed up for Halloween
(b) the percentage of all pet owners who planned to dress up a pet for Halloween
(c) the percentage of all Americans who planned to dress up a pet for Halloween
(d) the percentage of the 1166 pet owners who planned to dress up a pet for Halloween

Questions 13-15 refer to the following situation: Several years ago, the mean height of all women 20 years of age or older was 63.7 inches. Suppose that a random sample of 45 women who are 20 years of age or older today results in a mean height of 64.2 inches.

13. The appropriate null and alternative hypotheses to test if women are taller today are:

(a) $Ho: \mu = 63.7$ versus $H_1: \mu \neq 63.7$
(b) $Ho: \mu = 64.2$ versus $H_1: \mu > 64.2$
(c) $Ho: \mu = 63.7$ versus $H_1: \mu > 63.7$
(d) $Ho: \mu = 63.7$ versus $H_1: \mu < 63.7$

14. The *p*-value for the test came out to be 0.11. This means:

(a) There is a 0.11 probability of obtaining a sample mean height of 64.2 inches or taller from a population whose mean height is 63.7 inches.
(b) There is a 0.11 probability of obtaining a sample mean height of exactly 64.2 inches from a population whose mean height is 63.7 inches.
(c) There is a 0.11 probability of obtaining a sample mean height of 63.7 inches or taller from a population whose mean height is 64.2 inches.
(d) There is a 0.11 probability of obtaining a sample mean height of 64.2 inches or shorter from a population whose mean height is 63.7 inches.

15. Using α = .10 as the level of significance, a proper conclusion for this hypothesis test is:

(a) Reject the null hypothesis. There is sufficient evidence to conclude that the mean height of women 20 years of age or older is greater today.

(b) Reject the null hypothesis. There is not sufficient evidence to conclude that the mean height of women 20 years of age or older is greater today.

(c) Do not reject the null hypothesis. There is sufficient evidence to conclude that the mean height of women 20 years of age or older is greater today.

(d) Do not reject the null hypothesis. There is not sufficient evidence to conclude that the mean height of women 20 years of age or older is greater today.

PART II: TRUE OR FALSE Circle the correct response for each question below:

1. **True or False** The correlation coefficient *r* can never be less than –1.

2. **True or False** Randomization in assigning the experimental units to treatments in experiments tends to balance the comparison groups with respect to lurking variables.

3. **True or False** When a simple random sample of size *n* is drawn from a population, each member of the population has an equal chance of being selected in the sample.

4. **True or False** When both a 90% confidence interval and a 95% confidence interval are computed from the same data, the 95% confidence interval will be narrower.

5. **True or False** A 95% confidence interval for μ = population mean IQ is (99, 113). Therefore a test of H_0: μ = 100 against $H_a : \mu \neq 100$ at α = 5% would fail to reject the null hypothesis.

6. **True or False** A test of significance answers the following question, "Is the observed effect due to bias?"

7. **True or False** The power of a test is the probability of rejecting H_0 when it is false.

8. **True or False** The smaller the *p*-value, the more evidence there is against the null hypothesis.

PART III: PROBLEMS **Show work for each problem completely and clearly:**

1. Here is a stemplot of the test scores of 22 students:

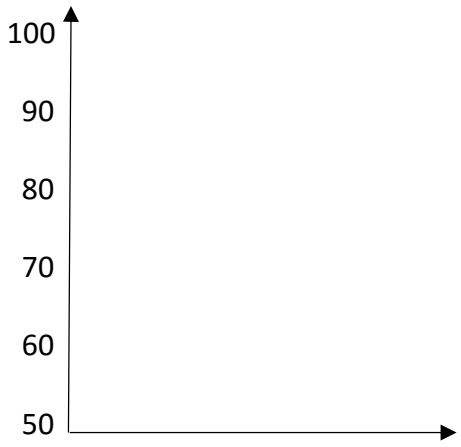
5	19
6	0778
7	00112578
8	12566
9	148

(a) Find the five-number summary. Enter it into the second row of the table below. Use the top row to indicate what feature of the data each of the five numbers is. One entry has been made for you.

Minimum				

(b) Give the interquartile range (IQR) for the data:

(c) Draw a boxplot for the final-exam scores:



2. What can statistics teachers do to alleviate anxiety in their students? To explore this question, anxiety in two statistics classes was compared. In one class, the instructor lectured in a formal manner, including dressing formally. In the other, the instructor dressed informally, was more personal, used humor, and called on students by their first names. Anxiety was measured using a questionnaire. Higher scores indicate a greater level of anxiety. The mean anxiety score for students in the formal lecture class was **25.40;** in the informal class the mean was **20.41.** Indicate whether each boldface number is a parameter (P) or a statistic (S).

3. An experiment is to be performed to compare the effectiveness of two advertisements (Ad 1 and Ad 2) for the same product. 18 subjects have been chosen to participate in this experiment; subjects will be scored based on whether they have a favorable or an unfavorable reaction to the advertisement. Use a diagram to outline a completely randomized design in which each type of ad will be seen by half of the subjects. Make sure to label your diagram completely.

4. A student scored 60 on a mathematics test that has a mean of 54 and a standard deviation of 3. She scored 80 on a history test with a mean of 75 and a standard deviation of 2. On which test did she perform better relative to the distribution of scores for the test? Justify your answer with calculations.

5. The following table lists the ages of the wife and husband for eight married couples:

Couple	1	2	3	4	5	6	7	8
age of wife	21	25	31	39	41	43	50	61
age of husband	65	27	28	39	42	39	53	66

The mean age of the wives is 38.9 years, and the mean age of the husbands is 44.9 years. The standard deviation for the wives' ages is 13.1 years, and the standard deviation for the husbands' ages is 15.1 years. The correlation between the two variables is 0.394.

(a) Using the age of the husband as the explanatory variable and the age of the wife as the response variable, find the slope of the regression line.

(b) Interpret the slope of the regression line.

(c) Still using the age of the husband as the explanatory variable and the age of the wife as the response variable, find the equation of the least-squares regression line.

(d) Use the regression line to predict the age of the wife of a man who is 44 years old.

6. A professor of a statistics course surveyed her students to see how many of them were getting at least 8 hours of sleep per night. Only two of her 30 students were getting at least 8 hours of sleep per night.

(a) Treating the professor's class as a random sample of all students at the instructor's university, find a 95% confidence interval for the proportion of the entire student body that is getting at least 8 hours of sleep per night. Use the *plus four* confidence interval.

(b) Write a clear and grammatical sentence that interprets the confidence interval.

7. Do people who get angry easily tend to have a higher incidence of heart disease? The data below come from a study in which the subjects took the Spielberger Trait Anger Scale test, which measures how prone a person is to sudden anger. They were also assessed to see whether they had coronary heart disease (CHD).

	Low Anger	Moderate Anger	High Anger
CHD	53	110	27
No CHD	3057	4621	606

(a) What proportion of the people without CHD were classified as having moderate anger?

(b) What proportion of the people that were classified as having high anger had CHD?

8. A 2012 Gallup poll asked a random sample of 120 American adults whether they thought the news media exaggerate the seriousness of global warming. The proportion who responded "No" was 59.2%. Is this good evidence that majority (more than half) of American adults do not believe the news media exaggerate the seriousness of the global warming?

(a) Set up appropriate null and alternative hypotheses to answer the above question.

(b) Calculate the value of the test statistic.

(c) Determine the *p*-value of the test.

(d) Is the data significant at the 5% level ($\alpha = 0.05$)? Explain why or why not.

(e) State your conclusion in the context of the question above.

9. 75 healthy men were randomly assigned to one on the two groups: about half were given alcohol to drink (0.85 grams of per kilogram of body weight); the rest drank a placebo. Participants were then given 30 minutes to read up to 36 pages of a book. Every three to four minutes participants were prompted to indicate whether they were "zoning out" (losing concentration on what they were reading). The number of times participants indicated they were "zoning out" was recorded for each subject. The following table summarizes data on the number of episodes of zoning out.

Group	*n*	Mean number of times "zoning out"	Standard deviation
Alcohol	40	2.24	0.40
Placebo	35	1.44	0.24

(a) Give the number of degrees of freedom for the conservative (non-software) option for using a two-sample *t* procedure:

(b) Assume that the conditions for inference are satisfied and determine a 90% confidence interval for the difference in population means when alcohol is administered versus when it is not, using the degrees of freedom from your answer to part (a).

Table entry for z is the area under the standard Normal curve to the left of z.

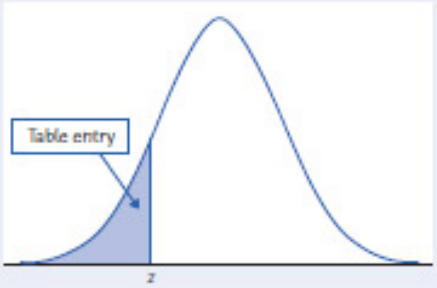


TABLE A STANDARD NORMAL CUMULATIVE PROPORTIONS

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
−3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
−3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
−3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
−3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
−2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
−2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
−2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
−2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
−2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
−2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
−2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
−2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
−2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
−2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
−1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
−1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
−1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
−1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
−1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
−1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
−1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
−1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
−1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
−1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
−0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
−0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
−0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
−0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
−0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
−0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
−0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
−0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
−0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
−0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641

Table entry for z is the area under the standard Normal curve to the left of z.

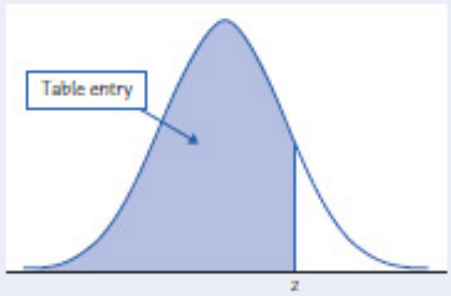


TABLE A STANDARD NORMAL CUMULATIVE PROPORTIONS (*CONTINUED*)

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998

Table entry for C is the critical value t^* required for confidence level C. To approximate one- and two-sided P-values, compare the value of the t statistic with the critical values of t^* that match the P-values given at the bottom of the table.

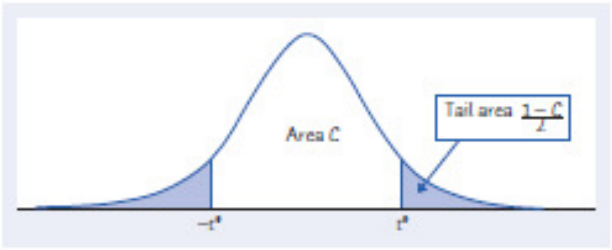


TABLE C *t* DISTRIBUTION CRITICAL VALUES

DEGREES OF FREEDOM	CONFIDENCE LEVEL *C*											
	50%	60%	70%	80%	90%	95%	96%	98%	99%	99.5%	99.8%	99.9%
1	1.000	1.376	1.963	3.078	6.314	12.71	15.89	31.82	63.66	127.3	318.3	636.6
2	0.816	1.061	1.386	1.886	2.920	4.303	4.849	6.965	9.925	14.09	22.33	31.60
3	0.765	0.978	1.250	1.638	2.353	3.182	3.482	4.541	5.841	7.453	10.21	12.92
4	0.741	0.941	1.190	1.533	2.132	2.776	2.999	3.747	4.604	5.598	7.173	8.610
5	0.727	0.920	1.156	1.476	2.015	2.571	2.757	3.365	4.032	4.773	5.893	6.869
6	0.718	0.906	1.134	1.440	1.943	2.447	2.612	3.143	3.707	4.317	5.208	5.959
7	0.711	0.896	1.119	1.415	1.895	2.365	2.517	2.998	3.499	4.029	4.785	5.408
8	0.706	0.889	1.108	1.397	1.860	2.306	2.449	2.896	3.355	3.833	4.501	5.041
9	0.703	0.883	1.100	1.383	1.833	2.262	2.398	2.821	3.250	3.690	4.297	4.781
10	0.700	0.879	1.093	1.372	1.812	2.228	2.359	2.764	3.169	3.581	4.144	4.587
11	0.697	0.876	1.088	1.363	1.796	2.201	2.328	2.718	3.106	3.497	4.025	4.437
12	0.695	0.873	1.083	1.356	1.782	2.179	2.303	2.681	3.055	3.428	3.930	4.318
13	0.694	0.870	1.079	1.350	1.771	2.160	2.282	2.650	3.012	3.372	3.852	4.221
14	0.692	0.868	1.076	1.345	1.761	2.145	2.264	2.624	2.977	3.326	3.787	4.140
15	0.691	0.866	1.074	1.341	1.753	2.131	2.249	2.602	2.947	3.286	3.733	4.073
16	0.690	0.865	1.071	1.337	1.746	2.120	2.235	2.583	2.921	3.252	3.686	4.015
17	0.689	0.863	1.069	1.333	1.740	2.110	2.224	2.567	2.898	3.222	3.646	3.965
18	0.688	0.862	1.067	1.330	1.734	2.101	2.214	2.552	2.878	3.197	3.611	3.922
19	0.688	0.861	1.066	1.328	1.729	2.093	2.205	2.539	2.861	3.174	3.579	3.883
20	0.687	0.860	1.064	1.325	1.725	2.086	2.197	2.528	2.845	3.153	3.552	3.850
21	0.686	0.859	1.063	1.323	1.721	2.080	2.189	2.518	2.831	3.135	3.527	3.819
22	0.686	0.858	1.061	1.321	1.717	2.074	2.183	2.508	2.819	3.119	3.505	3.792
23	0.685	0.858	1.060	1.319	1.714	2.069	2.177	2.500	2.807	3.104	3.485	3.768
24	0.685	0.857	1.059	1.318	1.711	2.064	2.172	2.492	2.797	3.091	3.467	3.745
25	0.684	0.856	1.058	1.316	1.708	2.060	2.167	2.485	2.787	3.078	3.450	3.725
26	0.684	0.856	1.058	1.315	1.706	2.056	2.162	2.479	2.779	3.067	3.435	3.707
27	0.684	0.855	1.057	1.314	1.703	2.052	2.158	2.473	2.771	3.057	3.421	3.690
28	0.683	0.855	1.056	1.313	1.701	2.048	2.154	2.467	2.763	3.047	3.408	3.674
29	0.683	0.854	1.055	1.311	1.699	2.045	2.150	2.462	2.756	3.038	3.396	3.659
30	0.683	0.854	1.055	1.310	1.697	2.042	2.147	2.457	2.750	3.030	3.385	3.646
40	0.681	0.851	1.050	1.303	1.684	2.021	2.123	2.423	2.704	2.971	3.307	3.551
50	0.679	0.849	1.047	1.299	1.676	2.009	2.109	2.403	2.678	2.937	3.261	3.496
60	0.679	0.848	1.045	1.296	1.671	2.000	2.099	2.390	2.660	2.915	3.232	3.460
80	0.678	0.846	1.043	1.292	1.664	1.990	2.088	2.374	2.639	2.887	3.195	3.416
100	0.677	0.845	1.042	1.290	1.660	1.984	2.081	2.364	2.626	2.871	3.174	3.390
1000	0.675	0.842	1.037	1.282	1.646	1.962	2.056	2.330	2.581	2.813	3.098	3.300
z^*	0.674	0.841	1.036	1.282	1.645	1.960	2.054	2.326	2.576	2.807	3.091	3.291
One-sided P	.25	.20	.15	.10	.05	.025	.02	.01	.005	.0025	.001	.0005
Two-sided P	.50	.40	.30	.20	.10	.05	.04	.02	.01	.005	.002	.001

FORMULAS

$z = \frac{x - \mu}{\sigma}$ $\qquad$ $\hat{y} = a + bx$, where $b = r\frac{s_y}{s_x}$ and $a = \bar{y} - b\bar{x}$

Standard error of $\hat{p}$ = $\sqrt{\hat{p}(1-\hat{p})/n}$ $\qquad$ $SE_{\bar{x}} = \frac{s}{\sqrt{n}}$

$m = z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$ $\qquad$ $n = \left(\frac{z^*}{m}\right)^2 p^*(1-p^*)$

$\hat{p} \pm z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$ where $\hat{p} = \frac{\text{number of successes in the sample}}{n}$

$\tilde{p} \pm z^* \sqrt{\frac{\tilde{p}(1-\tilde{p})}{n+4}}$ where $\tilde{p} = \frac{\text{number of successes in the sample} + 2}{n+4}$

$(\hat{p}_1 - \hat{p}_2) \pm z^*\text{SE}$ where SE = $\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$

$\bar{x} \pm t^* \frac{s}{\sqrt{n}}$

$\bar{x}_1 - \bar{x}_2 \pm t^* \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$

$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$ $\qquad$ $z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$

where $\hat{p} = \frac{\#\text{successes in both samples combined}}{\#\text{individuals in both samples combined}}$

$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$ $\qquad$ $t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$