STAT 1222 — Spring 2014

Common Final Exam — May 1, 2014

Please print the following information:

Name: ______________________ Instructor: ______________________

Student ID #: ______________________ Section/Time: ______________________

THIS EXAM HAS TWO PARTS

PART I. Consists of 30 multiple choice questions worth a total of 60 points. Read all questions carefully. You may do calculations on the test paper. Mark the number of the opscan sheet corresponding to the test question number with a Number 2 pencil or a mechanical pencil with HB lead. Mark only one answer; otherwise the answer will be counted as incorrect. In case there is more than one answer, mark the best answer. Please make sure that your name appears on the opscan sheet in the spaces provided.

PART II. This part consists of 3 questions (40 points in total). You MUST show all work for each question in the space provided to receive full credit for that question. If you write your explanations in another part of the test, please indicate accordingly.

At the end of the examination, you MUST hand in this test booklet, your answer sheet and all scratch paper.

FOR DEPARTMENTAL USE ONLY:
PART II:

Questions	1	2	3
Maximum	12	14	14
Score			

Part I Part II Total

Part I

Use the following to answer Questions 1 - 2.

The times (in seconds) for a sample of seven sports cars to accelerate from 0 to 60 miles per hour are as follows:

3.8 4.0 4.8 4.7 4.8 5.1 4.8

1. Find the mean and the standard deviation of the sample, ($\bar{x}$, s).
   (a) (4.75,0.44)
   (b) (4.75,0.23)
   (c) (4.57,0.48)
   (d) (4.57,0.23)
   (e) (4.80,0.23)

2. How many standard deviations is 3.8 away from the mean of the sample?
   (a) -1.60
   (b) -1.96
   (c) -0.77
   (d) 0.77
   (e) 1.645

3. A random sample of 11 days were selected from last year's records maintained by the maternity ward in a local hospital, and the number of babies born on each of the days is given below:

   3 7 7 10 0 7 1 2 5 3 0

   Find the five-number summary (minimum, first quartile, second quartile, third quartile and maximum) of the data set.

(a) (0.5, 1.5, 3.5, 7.5, 9.5)

(b) (1, 1, 3, 7, 7)

(c) (0, 1, 7, 7, 10)

(d) (0, 1, 2, 7, 10)

(e) (0, 1, 3, 7, 10)

Use the following to answer Questions 4-5.

According to records in a large hospital, the birth weights of newborns have a symmetric and bell-shaped relative frequency distribution with mean 6.8 pounds and standard deviation 0.5 pounds.

4. Approximately what proportion of babies are born with birth weight under 6.3 pounds?

   (a) 50%

   (b) 2.5%

   (c) 95%

   (d) 68%

   (e) 16%

5. If a baby is born with a birth weight which has a z-score of 3, which of the following statements best describes the baby's birth weight?

   (a) This is a very heavy baby in comparison to other babies.

   (b) This is a very light baby in comparison to other babies.

   (c) This baby's weight is near the average weight of other babies.

   (d) This baby's weight is under average but not by a lot.

   (e) One cannot tell how heavy the baby is since only the z-score of the weight is given but not the actual weight.

Use the following to answer Questions 6-7.

Six months before an election for student body president in a university, the pool of candidates has reduced to five distinct possibilities:

- JJ (James Jordan - male)
- BB (Benjamin Berry - male)
- HH (Helen Hart - female)
- MM (Michael Moss - male)
- CC (Caroline Cai - female)

Suppose their respective probabilities of being elected into the office are provided below:

Gender	Male			Female	
Candidate	JJ	BB	MM	HH	CC
Probability	0.30	0.10	0.10	0.20	?

6. What is the probability that CC will be voted into the office?

   (a) 0.50

   (b) 0.10

   (c) 0.20

   (d) 0.05

   (e) 0.30

7. What is the probability that a female candidate will be voted into the office?

   (a) 0.05

   (b) 0.10

   (c) 0.20

   (d) 0.50

   (e) 0.30

8. On a particular Sunday morning in a local farmers market, 24 bags of potatoes were randomly selected and weighed. The weights of these 24 bags have a mean of 25 lb and standard deviation 0.5 lb, and the relative frequency distribution of the sample does not appear to be bell-shaped or symmetric. How many of these 24 bags weighed between 24 and 26 lb.?

(a) At most 16

(b) At most 17

(c) At least 18

(d) At least 19

(e) At least 20

Use the following to answer Questions 9-10.
An industrial psychologist administered a personality inventory test for passive-aggressive traits to a sample of employees of a large firm. Each individual was given a score from 1 to 5, where 1 was extremely passive and 5 extremely aggressive. A score of 3 indicated neither trait. The results are shown below.

x	1	2	3	4	5
$P(x)$	.16	.22	.28	.20	.14

9. Find the mean score of this distribution.

(a) 3

(b) 2.94

(c) 2.24

(d) 2.01

(e) 1.6

10. The standard deviation of this distribution is about

(a) 1.27

(b) 1.62

(c) 1.89

(d) 1.37

(e) 1.76

11. $P(0.16 < z < 2.18)$ is approximately

(a) 0.49

(b) 0.55

(c) 0.48

(d) 0.42

(e) 0.04

12. A survey indicates that people use their cellular phones an average of 1.5 years before buying a new one. The standard deviation is 0.25 year. A cellular phone user is selected at random. Find the probability that the user will use their current phone for less than 1 year before buying a new one. Assume that x, denoting the random variable of interest, is normally distributed.

(a) 0.9772

(b) 0.0183

(c) 0.0228

(d) 0.5

(e) 0.9817

Use the following to answer Questions 13-14.

The mean height of women in the United States (ages 20-29) is $\mu = 64.1$ inches and the standard deviation is $\sigma = 2.71$ inches. A random sample of 60 women in this age group is selected. Let $\bar{X}$ be the average of the 60 heights.

13. What is the approximate probability distribution of $\bar{X}$?

(a) A normal distribution with mean $\mu = 60$ and standard deviation $\sigma = 2.71$.

(b) A t-distribution and with mean $\mu = 64.1$ and standard deviation $\sigma = 2.71$.

(c) A normal distribution with mean $\mu = 64.1$ and standard deviation $\sigma = 0.3499$.

(d) A normal distribution with mean $\mu = 64.1$ and standard deviation $\sigma = 2.71$.

(e) A t-distribution and with mean $\mu = 64.1$ and standard deviation $\sigma = 0.3499$.

14. What is the approximate probability that the mean height ($\bar{X}$) is greater than 65 inches?

(a) 0.0051

(b) 0.0510

(c) 0.1515

(d) 0.3707

(e) 0.0371

Use the following to answer Questions 15-16.

A random sample of elementary school children in New York State is to be selected to estimate the proportion p who had received a medical examination during the past year. A random sample of 200 elementary school children indicated that 18 of them had received a medical examination in the past year.

15. Find point estimate for p and also construct a 95% confidence interval for p.

(a) 0.09, (0.04 , 0.14)

(b) 0.9, (0.01, 0.17)

(c) 200, (0.01, 0.17)

(d) 200, (0.05 ,0.13)

(e) 0.09, (0.05 ,0.13)

16. Find the minimum sample size needed to estimate the population proportion p with 99% confidence. The estimate must be accurate to within .02 of p.

(a) $n = 1701$

(b) $n = 4145$

(c) $n = 1358$

(d) $n = 2936$

(e) $n = 2401$

Use the following to answer Questions 17-20.

Is the probability of a newborn being a boy the same as that of being a girl? To answer this question, we let p be the probability of a newborn being a boy and $q = 1 - p$ be the probability of a newborn being a girl.

17. Suppose you would like to test the claim that "there is an even chance for a boy and a girl". The appropriate hypothesis to be tested is

    (a) $H_0 : \hat{p} = 0.48$ vs. $H_a : \hat{p} \neq 0.48$

    (b) $H_0 : p \geq 0$ vs. $H_a : p < 0$

    (c) $H_0 : p \leq 0$ vs. $H_a : p > 0$

    (d) $H_0 : p = 0.5$ vs. $H_a : p \neq 0.5$

    (e) $H_0 : p = 0$ vs. $H_a : p \neq 0$

18. Suppose you randomly selected 400 recently issued birth certificates and observed 192 boys. Based on the sample, what is the value of your standard test statistic?

    (a) -0.800

    (b) -1.000

    (c) -1.280

    (d) -1.645

    (e) -1.960

19. What is the p-value of the test?

    (a) 0.2119

    (b) 0.1587

    (c) 0.1000

    (d) 0.3174

    (e) 0.4238

20. At $\alpha = 0.20$, do you have sufficient evidence in your sample to suggest that the proportions of boys and girls at birth are different? Find the best answer below.

(a) Yes, since the p-value is less than $\alpha = 0.20$.

(b) No, since the p-value is greater than $\alpha = 0.20$.

(c) Yes, since the p-value is greater than $\alpha = 0.20$.

(d) No, since the p-value is less than $\alpha = 0.20$

(e) Yes, because $\hat{p} = 0.48$ is less than $p_0 = 0.50$.

21. Suppose a marine biologist wishes to estimate the mean length of fully-grown great white sharks (μ) in an area off the Bermuda coast. Due to the difficulty in capturing great white sharks, he is only able to measure three of them. Their respective lengths are: 24, 20, and 22 feet. Assuming the lengths of great white sharks in the study area are normally distributed, a 95% confidence interval for the mean length of great white sharks in the study area is closest to:

(a) (20.01, 23.90)

(b) (19.74, 24.26)

(c) (18.63, 25.37)

(d) (17.03, 26.97)

(e) (18.33, 25.67)

22. Professor Jackson runs an after-school tutoring program which currently enrolls 182 students. The program offers tutoring help in Mathematics and English. Among these 182 students enrolled, 82 need help in both Mathematics and English, 46 need help in Mathematics but not in English, and 38 need help in English but not in Mathematics. The grouping may be better illustrated by the following table:

	Need Help in Math (M)	Do Not Need Help in Math (M')
Need Help in English (E)	82	38
Do Not Need Help in English (E')	46	16

A student is randomly selected from the program. Let

$$M = \{\text{the selected student needs help in Math}\}$$
$$E = \{\text{the selected student needs help in English}\}$$

Consider the following statements:

I. Events M and E are mutually exclusive.

II. $P(M \text{ and } E) = 0.4505$

III. $P(M \text{ or } E) = 0.4505$

IV. $P(E) = 0.2088$

V. $P(M') = 0.2967$

Which of the above statements are true?

(a) I and V only.

(b) I and II only.

(c) I, II, and III only.

(d) II and V only.

(e) III and V only.

Use the following to answer Questions 23-24.

A paint manufacturer uses a machine to fill 1-gallon cans with paint. The exact amount of paint in each 1-gallon can is however subject to random fluctuation. As a part of the quality control process, it is often of interest to estimate the average amount of paint (μ) in the cans while the machine is in operation. Assume the population standard deviation is $\sigma = 0.85$ ounces.

23. The manufacturer wants to estimate the mean volume of paint the machine is putting in the cans to within a margin of error of 0.25 ounces by a 90% confidence interval. How large should the minimum sample size be?

(a) 87

(b) 64

(c) 90

(d) 32

(e) 16

24. If the manufacturer wishes to construct a 90% confidence interval with a margin of error smaller than 0.25, which of the following is true about the required minimum sample size n the manufacturer needs to take.

(a) n is less than the answer to Problem 23.

(b) n is greater than the answer to Problem 23.

(c) n is equal to the answer to Problem 23.

(d) $n = 45$

(e) $n = 90$

25. In testing a null hypothesis H_0 versus an alternative hypothesis H_a, a Type I error is referring to which of the following?

(a) The null hypothesis is rejected when it is true.

(b) The null hypothesis is not rejected when it is true.

(c) The alternative hypothesis is accepted when it is true.

(d) The alternative hypothesis is not accepted when it is true.

(e) The null hypothesis is rejected regardless whether it is true or false.

26. Suppose we want to test the hypothesis of $H_0 : \mu \geq 1$ versus $H_a : \mu < 1$, and a random sample of $n = 49$ gives mean $\bar{x} = -1$ and standard deviation $s = 6.4516$. What is the p-value of the test?

(a) p-value=0.005

(b) p-value=0.010

(c) p-value=0.015

(d) p-value=0.020

(e) p-value=0.025

Use the following to answer Questions 27-28.

A credit card watchdog group claims that there is a difference in the mean credit card debts of households in New York and Texas. The results of a random survey of 250 households from each state are shown below.

New York	**Texas**
$\overline{x}_1 = \$4446.25$	$\overline{x}_2 = \$4567.24$
$s_1 = \$1045.70$	$s_2 = \$1361.95$
$n_1 = 250$	$n_2 = 250$

27. Set up the null and alternative hypotheses to check the watchdog group's claim.

(a) $H_0 : \mu_1 \geq \mu_2$ vs. $H_a : \mu_1 < \mu_2$

(b) $H_0 : \overline{x}_1 = \overline{x}_2$ vs. $H_a : \overline{x}_1 \neq \overline{x}_2$

(c) $H_0 : \mu_1 \leq \mu_2$ vs. $H_a : \mu_1 > \mu_2$

(d) $H_0 : \mu_1 = \mu_2$ vs. $H_a : \mu_1 \neq \mu_2$

(e) $H_0 : \overline{x}_1 \geq \overline{x}_2$ vs. $H_a : \overline{x}_1 < \overline{x}_2$

28. Find the standardized test statistic.

(a) 1.69

(b) 1.01

(c) -1.11

(d) -1.59

(e) -1.96

Use the following to answer Questions 29-30.

The number of hours spent online during a weekend and the score on the test on the following Monday for each of the 12 students are given below:

Hours spent online (x)	0	1	2	3	3	5	5	5	6	7	7	10
Test Scores (y)	96	85	82	74	95	68	76	84	58	65	75	50

29. Suppose the regression line for the above (Hours online and Scores on test) data is:

$$\hat{y} = -4.07x + 93.97.$$

What would you predict to be the test score for a student who spent 9 hours online during the weekend prior?

(a) 89

(b) 84

(c) 63

(d) 57

(e) 74

30. In the equation of the regression line, $\hat{y} = -4.07x + 93.97$, if x increases by one unit, then

(a) y increases by about 4.07 units

(b) y decreases by about 4.07 units

(c) y decreases by about 93.97 units

(d) y increases by about 93.97 units

(e) the response of y can not be predicted.

End of Multiple Choice Questions

Part II

1. The mayor of a large city claims that the average net worth of families living in this city is at least \$300,000. A random sample of 100 families selected from this city produced a mean net worth of \$288,000 with a standard deviation of \$80,000. Using the 5% significance level, can you conclude that the mayor's claim is false?.

   (a) State the null and alternative hypotheses. (2 pts.)

   (b) Calculate the standardized test statistic. (3 pts.)

   (c) Find the critical value(s), and determine the rejection and nonrejection regions for this statistic. (3 pts.)

   (d) Find the P-value. (2 pts.)

   (e) Make your decision and interpret it in the context of the problem. (2 pts.)

2. A company wants to determine whether its consumer product ratings (0-10) have changed from last year to this year. The table shows the company's product ratings from the same eight consumers for last year and this year. At $\alpha = 0.05$, is there enough evidence to conclude that the product ratings have changed?

Consumer	1	2	3	4	5	6	7	8
Rating(Last year)	5	7	2	3	9	10	8	7
Rating(This year)	5	9	4	6	9	9	9	8

Define the difference $d =$ Rating last year $-$ Rating this year. Assume that the distributioin of difference of ratings is approximately normal.

(a) Find the sample mean and standard deviation of the differences. (2 pts.)

(b) State the null and alternative hypotheses to test whether the ratings have changed. (3 pts.)

(c) Find the value of the standardized test statistic. (3 pts.)

(d) Determine the critical value(s) and the rejection regions. (3 pts.)

(e) Make a decision and interpret it. (3 pts.)

3. A sample of ten commuters were asked for the distance and the time(in minutes) required commuting to their jobs on a given day. The data is shown in the table.

Distance x	1	3	5	5	7	7	8	10	10	12
Time y	5	10	15	20	15	25	20	25	35	35

From the data one obtains:

$$\sum xy = 1670,\ \sum x^2 = 566,\ \sum y^2 = 5075,\ \sum x = 68,\ \sum y = 205$$

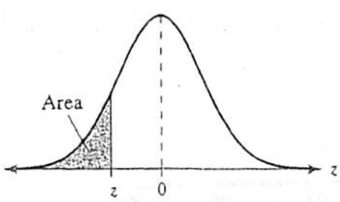
(a) Calculate the correlation coefficient r between x and y. (3 pts.)

(b) Test the significance of the correlation coefficient using $\alpha = 0.05$ (5 pts.)

(c) Find the estimated regression line relating y to x. (4 pts.)

(d) Predict the commuting time to work for a person living 9 miles from her job. (2 pts.)

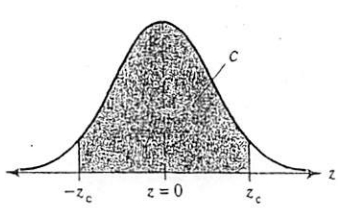
Standard Normal Distribution



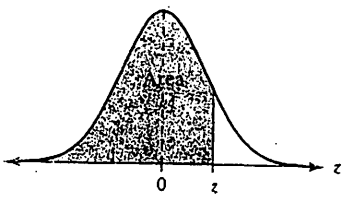
z	.09	.08	.07	.06	.05	.04	.03	.02	.01	.00
−3.4	.0002	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003
−3.3	.0003	.0004	.0004	.0004	.0004	.0004	.0004	.0005	.0005	.0005
−3.2	.0005	.0005	.0005	.0006	.0006	.0006	.0006	.0006	.0007	.0007
−3.1	.0007	.0007	.0008	.0008	.0008	.0008	.0009	.0009	.0009	.0010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

Critical Values

Level of Confidence c	z_c
0.80	1.28
0.90	1.645
0.95	1.96
0.99	2.575

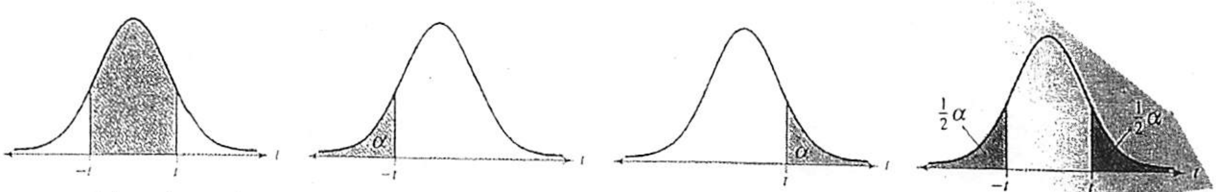


Standard Normal Distribution *(continued)*



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 5— *t*-Distribution



c-confidence interval | Left-tailed test | Right-tailed test | Two-tailed test

d.f.	Level of confidence, *c*	0.50	0.80	0.90	0.95	0.98	0.99
	One tail, α	0.25	0.10	0.05	0.025	0.01	0.005
	Two tails, α	0.50	0.20	0.10	0.05	0.02	0.01
1		1.000	3.078	6.314	12.706	31.821	63.657
2		.816	1.886	2.920	4.303	6.965	9.925
3		.765	1.638	2.353	3.182	4.541	5.841
4		.741	1.533	2.132	2.776	3.747	4.604
5		.727	1.476	2.015	2.571	3.365	4.032
6		.718	1.440	1.943	2.447	3.143	3.707
7		.711	1.415	1.895	2.365	2.998	3.499
8		.706	1.397	1.860	2.306	2.896	3.355
9		.703	1.383	1.833	2.262	2.821	3.250
10		.700	1.372	1.812	2.228	2.764	3.169
11		.697	1.363	1.796	2.201	2.718	3.106
12		.695	1.356	1.782	2.179	2.681	3.055
13		.694	1.350	1.771	2.160	2.650	3.012
14		.692	1.345	1.761	2.145	2.624	2.977
15		.691	1.341	1.753	2.131	2.602	2.947
16		.690	1.337	1.746	2.120	2.583	2.921
17		.689	1.333	1.740	2.110	2.567	2.898
18		.688	1.330	1.734	2.101	2.552	2.878
19		.688	1.328	1.729	2.093	2.539	2.861
20		.687	1.325	1.725	2.086	2.528	2.845
21		.686	1.323	1.721	2.080	2.518	2.831
22		.686	1.321	1.717	2.074	2.508	2.819
23		.685	1.319	1.714	2.069	2.500	2.807
24		.685	1.318	1.711	2.064	2.492	2.797
25		.684	1.316	1.708	2.060	2.485	2.787
26		.684	1.315	1.706	2.056	2.479	2.779
27		.684	1.314	1.703	2.052	2.473	2.771
28		.683	1.313	1.701	2.048	2.467	2.763
29		.683	1.311	1.699	2.045	2.462	2.756
∞		.674	1.282	1.645	1.960	2.326	2.576

Formulas

DESCRIPTIVE:

Sample Mean: $\bar{x} = \frac{\sum x}{n}$

Sample Standard Deviation: $s = \sqrt{\frac{\sum(x-\bar{x})^2}{n-1}} = \sqrt{\frac{n(\sum x^2)-(\sum x)^2}{n(n-1)}}$

PROBABILITY:

P(A or B) = P(A) + P(B) – P(A and B)

STANDARD SCORE or z-SCORE: $z = \frac{value-mean}{standard\ deviation} = \frac{x-\mu}{\sigma}$

DISCRETE RANDOM VARIABLE:

$$\mu = \sum xP(x) \qquad \sigma^2 = \sum (x-\mu)^2 P(x)$$

Standard Deviation: $\sigma = \sqrt{\sigma^2}$

CENTRAL LIMIT THEOREM:

$$\mu_{\bar{x}} = \mu \qquad \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} \qquad z = \frac{\bar{x}-\mu}{\sigma_{\bar{x}}}$$

INFERENCE ABOUT POPULATION MEAN (μ):

CONDITIONS	c- Confidence Interval	TEST STATISTIC
σ known or $n \geq 30$	$\bar{x} - z_c\frac{\sigma}{\sqrt{n}} < \mu < \bar{x} + z_c\frac{\sigma}{\sqrt{n}}$	$z = \frac{\bar{x}-\mu}{\sigma/\sqrt{n}}$
σ unknown or $n < 30$	$\bar{x} - t_c\frac{s}{\sqrt{n}} < \mu < \bar{x} + t_c\frac{s}{\sqrt{n}}$ with $d.f. = (n-1)$	$t = \frac{\bar{x}-\mu}{s/\sqrt{n}}$ with $d.f. = (n-1)$

INFERENCE ABOUT POPULATION PROPORTION (p):

c- Confidence Interval	TEST STATISTIC
$\hat{p} - z_c\sqrt{\frac{\hat{p}\hat{q}}{n}} < p < \hat{p} + z_c\sqrt{\frac{\hat{p}\hat{q}}{n}}$	$z = \frac{\hat{p}-p}{\sqrt{pq/n}}$

MIMIMUM SAMPLE SIZE:

to estimate population mean μ: $n = \left(\frac{z_c \sigma}{E}\right)^2$

to estimate population proportion p: $n = \hat{p}\hat{q}\left(\frac{z_c}{E}\right)^2$

where E is the maximum error in estimation.

INFERENCE ABOUT TWO POPULATION MEANS:

CONDITIONS	TEST STATISTIC
Independent samples, $n_1 \geq 30, n_2 \geq 30$	$z = \frac{(\overline{x_1} - \overline{x_2}) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$
Independent samples, normal populations $n_1 \text{ or } n_2 < 30;\ \sigma_1^2, \sigma_2^2 \text{ not equal}$	$t = \frac{(\overline{x_1} - \overline{x_2}) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$ with d.f. = smaller of $(n_1 - 1)$ and $(n_2 - 1)$
Independent samples, normal populations $n_1 \text{ or } n_2 < 30;\ \sigma_1^2, \sigma_2^2 \text{ equal}$	$t = \frac{(\overline{x_1} - \overline{x_2}) - (\mu_1 - \mu_2)}{\sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$ with d.f. = $n_1 + n_2 - 2$
Dependent samples, normal populations	$t = \frac{\bar{d} - \mu_d}{s_d/\sqrt{n}}$

CORRELATION AND REGRESSION:

Correlation Coefficient: $r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{n\sum x^2 - (\sum x)^2}\sqrt{n\sum y^2 - (\sum y)^2}}$

t-test for Correlation Coefficient: $t = \frac{r}{\sqrt{\frac{1-r^2}{n-2}}}$ with $d.f. = n - 2$

Equation of a Regression Line: $\hat{y} = mx + b$

$m = \frac{n\sum xy - (\sum x)(\sum y)}{n\sum x^2 - (\sum x)^2}$ $\qquad b = \bar{y} - m\bar{x}$

Standard Error of Estimate: $s_e = \sqrt{\frac{\sum(y_i - \hat{y}_i)^2}{n-2}} = \sqrt{\frac{\sum y^2 - b\sum y - m\sum xy}{n-2}}$

c-Prediction Interval for y when $x = x_0$:

$$\hat{y} - t_c s_e\sqrt{1 + \frac{1}{n} + \frac{n(x_0 - \bar{x})^2}{n\sum x^2 - (\sum x)^2}} < y < \hat{y} + t_c s_e\sqrt{1 + \frac{1}{n} + \frac{n(x_0 - \bar{x})^2}{n\sum x^2 - (\sum x)^2}}$$