Math 1040 Final Exam Form A Introduction to Statistics Fall Semester 2012

Instructor ________________________ Name __________________________________

Time Limit = 120 minutes

Any calculator is okay. Necessary tables and formulas are attached to the back of the exam.
All problems are equally weighted.

Computers, cell phones or other devices that connect to the Internet or communicate with others are not allowed. Students may not bring notes, formulas, or tables into the exam.

This exam has two parts:
PART I: 10 multiple choice questions
PART II: 10 open ended questions

PART I Instructions: Questions 1 – 10 are multiple choice. Answer all TEN questions and circle the correct answer. It is not necessary to show work. No partial credit will be awarded on this portion of the exam.

1) From 9 names on a ballot, a committee of 3 will be elected to attend a political national convention. How many different committees are possible?

A) 252 B) 729 C) 504 D) 60,480 E) 84

2) Forty–seven math majors, 22 music majors and 31 history majors are randomly selected from 585 math majors, 279 music majors and 393 history majors at the state university. What sampling technique is used?

A) convenience
B) stratified
C) cluster
D) systematic
E) simple random

3) A doctor at a local hospital is interested in estimating the birth weight of infants. How large a sample must she select if she desires to be 90% confident that her estimate is within 2 ounces of the true mean? Assume that $\sigma = 4.9$ ounces and that birth weights are normally distributed.

A) 13 B) 15 C) 16 D) 17 E) 19

4) According to the law of large numbers, as more observations are added to the sample, the difference between the sample mean and the population mean

A) Remains about the same
B) Tends to become smaller
C) Is inversely affected by the data added
D) Tends to become larger

5) The length of time it takes college students to find a parking spot in the library parking lot follows a normal distribution with a mean of 6.5 minutes and a standard deviation of 1 minute. Find the probability that a randomly selected college student will take between 5.0 and 7.5 minutes to find a parking spot in the library lot.

A) 0.4938 B) 0.0919 C) 0.7745 D) 0.2255

6) A researcher wishes to construct a confidence interval for a population mean μ. If the sample size is 19, what conditions must be satisfied to compute the confidence interval?

A) The population standard deviation σ must be known.
B) It must be true that $n\hat{p}(1-\hat{p}) \geq 10$ and $n \leq 0.05N$.
C) The data must come from a population that is approximately normal with no outliers.
D) The confidence level cannot be greater than 90%.

7) Investing is a game of chance. Suppose there is a 36% chance that a risky stock investment will end up in a total loss of your investment. Because the rewards are so high, you decide to invest in five independent risky stocks. Find the probability that **at least one** of your five investments becomes a total loss.

A) 0.8926 B) 0.0604 C) 0.006 D) 0.302

8) If we do not reject the null hypothesis when the null hypothesis is in error, then we have made a

A) Type I error
B) Correct decision
C) Type II error
D) Type β error

9) What effect would increasing the sample size have on a confidence interval?

A) No change

B) Change the confidence level

C) Increase the width of the interval

D) Decrease the width of the interval

10) A seed company has a test plot in which it is testing the germination of a hybrid seed. They plant 50 rows of 40 seeds per row. After a two–week period, the researchers count how many seeds per row have sprouted. They noted that the least number of seeds to germinate was 33 and some rows had all 40 germinate. The germination data is given below in the table. The random variable X represents the number of seeds in a row that germinated and P(x) represents the probability of selecting a row with that number of seeds germinating. Determine the expected number of seeds per row that germinated.

x	33	34	35	36	37	38	39	40
$P(x)$	0.02	0.06	0.10	0.20	0.24	0.26	0.10	0.02

A) 1.51

B) 4.61

C) 36.50

D) 36.86

E) 37.00

PART II Instructions: Questions 11 – 20 are open response. Answer all TEN questions carefully and completely, for full credit you must show all appropriate work and clearly indicate your answers.

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11) The owner of a computer repair shop has determined that their daily revenue has mean \$7200 and standard deviation \$1200. The daily revenue totals for the next 30 days will be monitored. What is the probability that the mean daily revenue for the next 30 days will exceed \$7500? Round your answer to 4 decimal places.

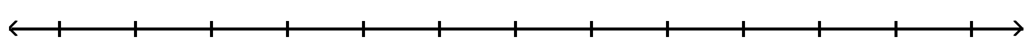
12) The costs in dollars of a random sample of 20 college textbooks are given in the stem–and–leaf plot below.

Stem	Leaves
2	7 8
3	6
4	0 2
5	3
6	7
7	1 6 9 9
8	2 4 4
9	0 3 5 7
10	5 7

Legend: 2|7 represents $27

i) Find the five number summary for this data set. Include the name or correct symbol for each of the numbers as well as its value.

ii) Draw a boxplot of this data set.



iii) Use complete sentences to briefly describe the shape of the distribution for this data.

13) Find the mean, median, and mode of the following statistic students' test scores. Round to the nearest tenth if necessary.

68 73 82 82 82 86 87 90 91 97

mean = ____________________

median = ____________________

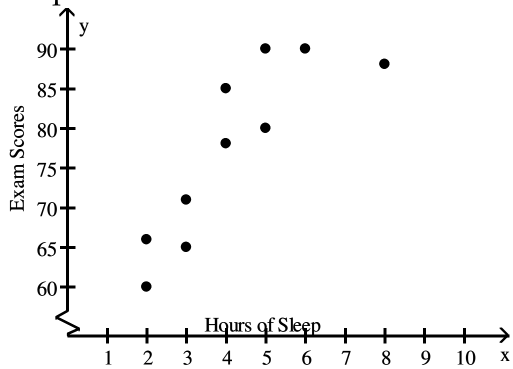
mode = ____________________

14) A physical fitness association is including the mile run in its secondary–school fitness test. The time for this event for boys in secondary school is known to have a normal distribution with a mean of 470 seconds and a standard deviation of 40 seconds. The fitness association wants to recognize the fastest 10% of the boys with certificates of recognition. What time would the boys need to beat in order to earn a certificate of recognition from the fitness association? Note that the fastest runners have the shortest times. Round to the nearest second.

15) The data below are the final exam scores of 10 randomly selected history students and the number of hours they slept the night before the exam.

Hours, x	3	5	2	8	2	4	4	5	6	3
Scores, y	65	80	60	88	66	78	85	90	90	71

The scatterplot for this data:



i) Based on the scatterplot, is it reasonable to suggest that there is a linear relationship between hours of sleep and exam scores? **Yes** or **No** (circle one)

ii) Find the correlation coefficient for the given data. Round to 4 decimal places.

iii) Determine if there is a significant linear correlation. Report the critical value and state your conclusion.

iv) Find the equation of the least–squares regression line for this data. Round values to 2 decimal places.

v) Use the regression equation to predict the exam score of a student who slept for 7 hours the night before the exam. Is the predicted exam score a good estimate? Briefly explain your answer.

16) A random sample of 20 college students is selected. Each student is asked how much time he or she spent on the Internet during the previous week. The following times (in hours) are recorded:

8	12	3	15	16	5	16	5	6	10
3	12	13	4	4	11	9	17	14	12

i) Create a frequency and relative frequency table for this data. Use 3 as the lower class limit of the first class, and use a class width of 4.

Class	Tally (optional)	Frequency	Relative Frequency

ii) Create a relative frequency histogram for the data. Be sure to label your axes.

17) When 440 junior college students were surveyed, 200 said they have a passport. Construct a 95% confidence interval for the proportion of junior college students that have a passport. Round to the nearest thousandth.

18) The National Association of Realtors estimates that 23% of all homes purchased in 2004 were considered investment properties. If a sample of 800 homes sold in 2004 is obtained what is the probability that at most 200 homes are going to be used as investment property? Round your answer to 4 decimal places.

19) In 2010, 36% of adults in a certain country were morbidly obese. A health practitioner suspects that the percent has changed since then. She obtains a random sample of 1042 adults and finds that 393 are morbidly obese. Is this sufficient evidence to support the practitioner's suspicion that the percent of morbidly obese adults has changed at the $\alpha = 0.10$ level of significance?

Are you using the Classical or P–Value approach? (circle one)

Null Hypothesis:

Alternative Hypothesis:

Test Statistic:

Critical Value(s) or P–Value (circle which of these you are using):

Conclusion about the Null Hypothesis:

Do the data support the health practitioner's suspicion? Answer with complete sentences.

20) A shipping firm suspects that the mean life of a certain brand of tire used by its trucks is less than 40,000 miles. To check the hypothesis, the firm randomly selects and tests 18 of these tires and finds that they have a mean lifetime of 39,300 miles with a standard deviation of 1200 miles. At $\alpha = 0.05$, test the shipping firm's hypothesis. Assume that the life of the tires is normally distributed with no outliers. Show a complete solution including all your steps.

Chapter 2 Organizing and Summarizing Data

- Relative frequency $= \dfrac{\text{frequency}}{\text{sum of all frequencies}}$
- Class midpoint: The sum of consecutive lower class limits divided by 2.

Chapter 3 Numerically Summarizing Data

- Population Mean: $\mu = \dfrac{\sum x_i}{N}$
- Sample Mean: $\bar{x} = \dfrac{\sum x_i}{n}$
- Range = Largest Data Value − Smallest Data Value
- Population Variance: $\sigma^2 = \dfrac{\sum (x_i - \mu)^2}{N} = \dfrac{\sum x_i^2 - \dfrac{(\sum x_i)^2}{N}}{N}$
- Sample Variance: $s^2 = \dfrac{\sum (x_i - \bar{x})^2}{n - 1} = \dfrac{\sum x_i^2 - \dfrac{(\sum x_i)^2}{n}}{n - 1}$
- Population Standard Deviation: $\sigma = \sqrt{\sigma^2}$
- Sample Standard Deviation: $s = \sqrt{s^2}$
- ***Empirical Rule:*** If the shape of the distribution is bell-shaped, then
  - Approximately 68% of the data lie within 1 standard deviation of the mean
  - Approximately 95% of the data lie within 2 standard deviations of the mean
  - Approximately 99.7% of the data lie within 3 standard deviations of the mean
- Population Mean from Grouped Data: $\mu = \dfrac{\sum x_i f_i}{\sum f_i}$
- Sample Mean from Grouped Data: $\bar{x} = \dfrac{\sum x_i f_i}{\sum f_i}$
- Weighted Mean: $\bar{x}_w = \dfrac{\sum w_i x_i}{\sum w_i}$
- Population Variance from Grouped Data:

$$\sigma^2 = \frac{\sum (x_i - \mu)^2 f_i}{\sum f_i} = \frac{\sum x_i^2 f_i - \dfrac{(\sum x_i f_i)^2}{\sum f_i}}{\sum f_i}$$

- Sample Variance from Grouped Data:

$$s^2 = \frac{\sum (x_i - \mu)^2 f_i}{\left(\sum f_i\right) - 1} = \frac{\sum x_i^2 f_i - \dfrac{(\sum x_i f_i)^2}{\sum f_i}}{\sum f_i - 1}$$

- Population z-score: $z = \dfrac{x - \mu}{\sigma}$
- Sample z-score: $z = \dfrac{x - \bar{x}}{s}$
- Interquartile Range: $\text{IQR} = Q_3 - Q_1$
- Lower and Upper Fences: Lower fence $= Q_1 - 1.5(\text{IQR})$; Upper fence $= Q_3 + 1.5(\text{IQR})$
- Five-Number Summary

  Minimum, Q_1, M, Q_3, Maximum

Chapter 4 Describing the Relation between Two Variables

- Correlation Coefficient: $r = \dfrac{\sum \left(\dfrac{x_i - \bar{x}}{s_x}\right)\left(\dfrac{y_i - \bar{y}}{s_y}\right)}{n - 1}$
- The equation of the least-squares regression line is $\hat{y} = b_1 x + b_0$, where $\hat{y}$ is the predicted value, $b_1 = r \cdot \dfrac{s_y}{s_x}$ is the slope, and $b_0 = \bar{y} - b_1 \bar{x}$ is the intercept.
- Residual = observed y − predicted $y = y - \hat{y}$
- $R^2 = r^2$ for the least-squares regression model $\hat{y} = b_1 x + b_0$
- The coefficient of determination, R^2, measures the proportion of total variation in the response variable that is explained by the least-squares regression line.

Chapter 5 Probability

- Empirical Probability

$$P(E) \approx \frac{\text{frequency of } E}{\text{number of trials of experiment}}$$

- Classical Probability

$$P(E) = \frac{\text{number of ways that } E \text{ can occur}}{\text{number of possible outcomes}} = \frac{N(E)}{N(S)}$$

- Addition Rule for Disjoint Events

$$P(E \text{ or } F) = P(E) + P(F)$$

- Addition Rule for n Disjoint Events

$$P(E \text{ or } F \text{ or } G \text{ or} \cdots) = P(E) + P(F) + P(G) + \cdots$$

- General Addition Rule

$$P(E \text{ or } F) = P(E) + P(F) - P(E \text{ and } F)$$

- Complement Rule

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

- Multiplication Rule for Independent Events

$$P(E \text{ and } F) = P(E) \cdot P(F)$$

- Multiplication Rule for n Independent Events

$$P(E \text{ and } F \text{ and } G \cdots) = P(E) \cdot P(F) \cdot P(G) \cdot \cdots$$

- Conditional Probability Rule

$$P(F|E) = \frac{P(E \text{ and } F)}{P(E)} = \frac{N(E \text{ and } F)}{N(E)}$$

- General Multiplication Rule

$$P(E \text{ and } F) = P(E) \cdot P(F|E)$$

- Factorial

$$n! = n \cdot (n-1) \cdot (n-2) \cdot \cdots \cdot 3 \cdot 2 \cdot 1$$

- Permutation of n objects taken r at a time: ${}_nP_r = \dfrac{n!}{(n-r)!}$

- Combination of n objects taken r at a time:

$${}_nC_r = \frac{n!}{r!(n-r)!}$$

- Permutations with Repetition:

$$\frac{n!}{n_1! \cdot n_2! \cdot \cdots \cdot n_k!}$$

Chapter 6 Discrete Probability Distributions

- Mean (Expected Value) of a Discrete Random Variable

$$\mu_X = \sum x \cdot P(x)$$

- Variance of a Discrete Random Variable

$$\sigma_X^2 = \sum (x-\mu)^2 \cdot P(x) = \sum x^2 P(x) - \mu_X^2$$

- Binomial Probability Distribution Function

$$P(x) = {}_nC_x p^x (1-p)^{n-x}$$

- Mean and Standard Deviation of a Binomial Random Variable

$$\mu_X = np \qquad \sigma_X = \sqrt{np(1-p)}$$

- Poisson Probability Distribution Function

$$P(x) = \frac{(\lambda t)^x}{x!} e^{-\lambda t} \qquad x = 0, 1, 2, \ldots$$

- Mean and Standard Deviation of a Poisson Random Variable

$$\mu_X = \lambda t \qquad \sigma_X = \sqrt{\lambda t}$$

Chapter 7 The Normal Distribution

- Standardizing a Normal Random Variable

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

- Finding the Score: $x = \mu + z\sigma$

Chapter 8 Sampling Distributions

- Mean and Standard Deviation of the Sampling Distribution of $\bar{x}$

$$\mu_{\bar{x}} = \mu \quad \text{and} \quad \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

- Sample Proportion: $\hat{p} = \dfrac{x}{n}$

- Mean and Standard Deviation of the Sampling Distribution of $\hat{p}$

$$\mu_{\hat{p}} = p \text{ and } \sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$$

Chapter 9 Estimating the Value of a Parameter Using Confidence Intervals

Confidence Intervals

- A $(1-\alpha) \cdot 100\%$ confidence interval about μ with σ known is $\bar{x} \pm z_{\alpha/2} \cdot \dfrac{\sigma}{\sqrt{n}}$.
- A $(1-\alpha) \cdot 100\%$ confidence interval about μ with σ unknown is $\bar{x} \pm t_{\alpha/2} \cdot \dfrac{s}{\sqrt{n}}$. *Note*: $t_{\alpha/2}$ is computed using $n-1$ degrees of freedom.
- A $(1-\alpha) \cdot 100\%$ confidence interval about p is $\hat{p} \pm z_{\alpha/2} \cdot \sqrt{\dfrac{\hat{p}(1-\hat{p})}{n}}$.
- A $(1-\alpha) \cdot 100\%$ confidence interval about σ^2 is $\dfrac{(n-1)s^2}{\chi^2_{\alpha/2}} < \sigma^2 < \dfrac{(n-1)s^2}{\chi^2_{1-\alpha/2}}$.

Sample Size

- To estimate the population mean with a margin of error E at a $(1-\alpha) \cdot 100\%$ level of confidence: $n = \left(\dfrac{z_{\alpha/2} \cdot \sigma}{E}\right)^2$ rounded up to the next integer.
- To estimate the population proportion with a margin of error E at a $(1-\alpha) \cdot 100\%$ level of confidence:
  $n = \hat{p}(1-\hat{p})\left(\dfrac{z_{\alpha/2}}{E}\right)^2$ rounded up to the next integer, where $\hat{p}$ is a prior estimate of the population proportion, or $n = 0.25\left(\dfrac{z_{\alpha/2}}{E}\right)^2$ rounded up to the next integer when no prior estimate of p is available.

CHAPTER 10 Testing Claims Regarding a Parameter

Test Statistics

- $z_0 = \dfrac{\bar{x} - \mu_0}{\sigma / \sqrt{n}}$ single mean, σ known
- $t_0 = \dfrac{\bar{x} - \mu_0}{s / \sqrt{n}}$ single mean, σ unknown
- $z_0 = \dfrac{\hat{p} - p_0}{\sqrt{\dfrac{p_0(1 - p_0)}{n}}}$
- $\chi_0^2 = \dfrac{(n - 1)s^2}{\sigma_0^2}$

CHAPTER 11 Inferences on Two Samples

- Test Statistic for Matched-Pairs data

$$t_0 = \frac{\bar{d} - \mu_d}{s_d / \sqrt{n}}$$

where $\bar{d}$ is the mean and s_d is the standard deviation of the differenced data.

- Confidence Interval for Matched-Pairs data:

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

Note: $t_{\alpha/2}$ is found using $n - 1$ degrees of freedom.

- Test Statistic Comparing Two Means (Independent Sampling):

$$t_0 = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}}$$

- Confidence Interval for the Difference of Two Means (Independent Samples):

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

Note: $t_{\alpha/2}$ is found using the smaller of $n_1 - 1$ or $n_2 - 1$ degrees of freedom.

- Test Statistic Comparing Two Population Proportions

$$z_0 = \frac{\hat{p}_1 - \hat{p}_2 - (p_1 - p_2)}{\sqrt{\hat{p}(1 - \hat{p})}\sqrt{\dfrac{1}{n_1} + \dfrac{1}{n_2}}} \quad \text{where } \hat{p} = \frac{x_1 + x_2}{n_1 + n_2}.$$

- Confidence Interval for the Difference of Two Proportions

$$(\hat{p}_1 - \hat{p}_2) \pm z_{\alpha/2}\sqrt{\frac{\hat{p}_1(1 - \hat{p}_1)}{n_1} + \frac{\hat{p}_2(1 - \hat{p}_2)}{n_2}}$$

- Test Statistic for Comparing Two Population Standard Deviations

$$F_0 = \frac{s_1^2}{s_2^2}$$

- Finding a Critical F for the Left Tail

$$F_{1-\alpha, n_1-1, n_2-1} = \frac{1}{F_{\alpha, n_2-1, n_1-1}}$$

CHAPTER 12 Inference on Categorical Data

- Expected Counts (when testing for goodness of fit)

$$E_i = \mu_i = np_i \quad \text{for} \quad i = 1, 2, \ldots, k$$

- Expected Frequencies (when testing for independence or homogeneity of proportions)

$$\text{Expected frequency} = \frac{(\text{row total})(\text{column total})}{\text{table total}}$$

- Chi-Square Test Statistic

$$\chi_0^2 = \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}} = \sum \frac{(O_i - E_i)^2}{E_i}$$

$i = 1, 2, \ldots, k$

All $E_i \geq 1$ and no more than 20% less than 5.

CHAPTER 13 Comparing Three or More Means

- Test Statistic for One-Way ANOVA

$$F = \frac{\text{Mean square due to treatment}}{\text{Mean square due to error}} = \frac{\text{MST}}{\text{MSE}}$$

where

$$\text{MST} = \frac{n_1(\bar{x}_1 - \bar{x})^2 + n_2(\bar{x}_2 - \bar{x})^2 + \cdots + n_k(\bar{x}_k - \bar{x})^2}{k - 1}$$

$$\text{MSE} = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2 + \cdots + (n_k - 1)s_k^2}{n - k}$$

- Test Statistic for Tukey's Test after One-Way ANOVA

$$q = \frac{(\bar{x}_2 - \bar{x}_1) - (\mu_2 - \mu_1)}{\sqrt{\dfrac{s^2}{2} \cdot \left(\dfrac{1}{n_1} + \dfrac{1}{n_2}\right)}} = \frac{\bar{x}_2 - \bar{x}_1}{\sqrt{\dfrac{s^2}{2} \cdot \left(\dfrac{1}{n_1} + \dfrac{1}{n_2}\right)}}$$

Table I

Random Numbers

Row Number	01–05	06–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50
01	89392	23212	74483	36590	25956	36544	68518	40805	09980	00467
02	61458	17639	96252	95649	73727	33912	72896	66218	52341	97141
03	11452	74197	81962	48443	90360	26480	73231	37740	26628	44690
04	27575	04429	31308	02241	01698	19191	18948	78871	36030	23980
05	36829	59109	88976	46845	28329	47460	88944	08264	00843	84592
06	81902	93458	42161	26099	09419	89073	82849	09160	61845	40906
07	59761	55212	33360	68751	86737	79743	85262	31887	37879	17525
08	46827	25906	64708	20307	78423	15910	86548	08763	47050	18513
09	24040	66449	32353	83668	13874	86741	81312	54185	78824	00718
10	98144	96372	50277	15571	82261	66628	31457	00377	63423	55141
11	14228	17930	30118	00438	49666	65189	62869	31304	17117	71489
12	55366	51057	90065	14791	62426	02957	85518	28822	30588	32798
13	96101	30646	35526	90389	73634	79304	96635	06626	94683	16696
14	38152	55474	30153	26525	83647	31988	82182	98377	33802	80471
15	85007	18416	24661	95581	45868	15662	28906	36392	07617	50248
16	85544	15890	80011	18160	33468	84106	40603	01315	74664	20553
17	10446	20699	98370	17684	16932	80449	92654	02084	19985	59321
18	67237	45509	17638	65115	29757	80705	82686	48565	72612	61760
19	23026	89817	05403	82209	30573	47501	00135	33955	50250	72592
20	67411	58542	18678	46491	13219	84084	27783	34508	55158	78742

Table II

Critical Values for Correlation Coefficient

n		*n*		*n*		*n*	
3	0.997	10	0.632	17	0.482	24	0.404
4	0.950	11	0.602	18	0.468	25	0.396
5	0.878	12	0.576	19	0.456	26	0.388
6	0.811	13	0.553	20	0.444	27	0.381
7	0.754	14	0.532	21	0.433	28	0.374
8	0.707	15	0.514	22	0.423	29	0.367
9	0.666	16	0.497	23	0.413	30	0.361

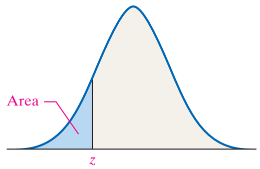


Table V

Standard Normal Distribution

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
−3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
−3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
−3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
−3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
−2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
−2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
−2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
−2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
−2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
−2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
−2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
−2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
−2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
−2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
−1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
−1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
−1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
−1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
−1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
−1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
−1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
−1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
−1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
−1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
−0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
−0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
−0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
−0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
−0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
−0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
−0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
−0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
−0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
−0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
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

Confidence Interval Critical Values, $z_{\alpha/2}$

Level of Confidence	Critical Value, $z_{\alpha/2}$
0.90 or 90%	1.645
0.95 or 95%	1.96
0.98 or 98%	2.33
0.99 or 99%	2.575

Hypothesis Testing Critical Values

Level of Significance, α	Left Tailed	Right Tailed	Two-Tailed
0.10	−1.28	1.28	±1.645
0.05	−1.645	1.645	±1.96
0.01	−2.33	2.33	±2.575

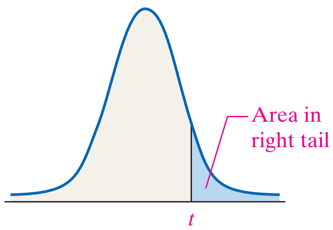


Table VI

t-Distribution

Area in Right Tail

df	0.25	0.20	0.15	0.10	0.05	0.025	0.02	0.01	0.005	0.0025	0.001	0.0005
1	1.000	1.376	1.963	3.078	6.314	12.706	15.894	31.821	63.657	127.321	318.309	636.619
2	0.816	1.061	1.386	1.886	2.920	4.303	4.849	6.965	9.925	14.089	22.327	31.599
3	0.765	0.978	1.250	1.638	2.353	3.182	3.482	4.541	5.841	7.453	10.215	12.924
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	3.610	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
31	0.682	0.853	1.054	1.309	1.696	2.040	2.144	2.453	2.744	3.022	3.375	3.633
32	0.682	0.853	1.054	1.309	1.694	2.037	2.141	2.449	2.738	3.015	3.365	3.622
33	0.682	0.853	1.053	1.308	1.692	2.035	2.138	2.445	2.733	3.008	3.356	3.611
34	0.682	0.852	1.052	1.307	1.691	2.032	2.136	2.441	2.728	3.002	3.348	3.601
35	0.682	0.852	1.052	1.306	1.690	2.030	2.133	2.438	2.724	2.996	3.340	3.591
36	0.681	0.852	1.052	1.306	1.688	2.028	2.131	2.434	2.719	2.990	3.333	3.582
37	0.681	0.851	1.051	1.305	1.687	2.026	2.129	2.431	2.715	2.985	3.326	3.574
38	0.681	0.851	1.051	1.304	1.686	2.024	2.127	2.429	2.712	2.980	3.319	3.566
39	0.681	0.851	1.050	1.304	1.685	2.023	2.125	2.426	2.708	2.976	3.313	3.558
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
70	0.678	0.847	1.044	1.294	1.667	1.994	2.093	2.381	2.648	2.899	3.211	3.435
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
90	0.677	0.846	1.042	1.291	1.662	1.987	2.084	2.368	2.632	2.878	3.183	3.402
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	0.842	1.036	1.282	1.645	1.960	2.054	2.326	2.576	2.807	3.090	3.291

Math 1040 Final Exam Form A Introduction to Statistics Fall Semester 2012

Instructor ________________________ Name __________________________________

Time Limit = 120 minutes SOLUTIONS

Any calculator is okay. Necessary tables and formulas are attached to the back of the exam.
All problems are equally weighted.

Computers, cell phones or other devices that connect to the Internet or communicate with others are not allowed. Students may not bring notes, formulas, or tables into the exam.

This exam has two parts:
PART I: 10 multiple choice questions
PART II: 10 open ended questions

PART I Instructions: Questions 1 – 10 are multiple choice. Answer all TEN questions and circle the correct answer. It is not necessary to show work. No partial credit will be awarded on this portion of the exam.

1) From 9 names on a ballot, a committee of 3 will be elected to attend a political national convention. How many different committees are possible?
A) 252 B) 729 C) 504 D) 60,480 E) 84

2) Forty–seven math majors, 22 music majors and 31 history majors are randomly selected from 585 math majors, 279 music majors and 393 history majors at the state university. What sampling technique is used?
A) convenience
B) stratified
C) cluster
D) systematic
E) simple random

3) A doctor at a local hospital is interested in estimating the birth weight of infants. How large a sample must she select if she desires to be 90% confident that her estimate is within 2 ounces of the true mean? Assume that $\sigma = 4.9$ ounces and that birth weights are normally distributed.
A) 13 B) 15 C) 16 D) 17 E) 19

4) According to the law of large numbers, as more observations are added to the sample, the difference between the sample mean and the population mean

A) Remains about the same
B) Tends to become smaller
C) Is inversely affected by the data added
D) Tends to become larger

5) The length of time it takes college students to find a parking spot in the library parking lot follows a normal distribution with a mean of 6.5 minutes and a standard deviation of 1 minute. Find the probability that a randomly selected college student will take between 5.0 and 7.5 minutes to find a parking spot in the library lot.

A) 0.4938 B) 0.0919 C) 0.7745 D) 0.2255

6) A researcher wishes to construct a confidence interval for a population mean μ. If the sample size is 19, what conditions must be satisfied to compute the confidence interval?

A) The population standard deviation σ must be known.
B) It must be true that $n\hat{p}(1-\hat{p}) \geq 10$ and $n \leq 0.05N$.
C) The data must come from a population that is approximately normal with no outliers.
D) The confidence level cannot be greater than 90%.

7) Investing is a game of chance. Suppose there is a 36% chance that a risky stock investment will end up in a total loss of your investment. Because the rewards are so high, you decide to invest in five independent risky stocks. Find the probability that **at least one** of your five investments becomes a total loss. Round to the nearest ten–thousandth when necessary.

A) 0.8926 B) 0.0604 C) 0.006 D) 0.302

8) If we do not reject the null hypothesis when the null hypothesis is in error, then we have made a

A) Type I error
B) Correct decision
C) Type II error
D) Type β error

9) What effect would increasing the sample size have on a confidence interval?
A) No change
B) Change the confidence level
C) Increase the width of the interval
(D) Decrease the width of the interval

10) A seed company has a test plot in which it is testing the germination of a hybrid seed. They plant 50 rows of 40 seeds per row. After a two–week period, the researchers count how many seeds per row have sprouted. They noted that the least number of seeds to germinate was 33 and some rows had all 40 germinate. The germination data is given below in the table. The random variable X represents the number of seeds in a row that germinated and $P(x)$ represents the probability of selecting a row with that number of seeds germinating. Determine the expected number of seeds per row that germinated.

x	33	34	35	36	37	38	39	40
$P(x)$	0.02	0.06	0.10	0.20	0.24	0.26	0.10	0.02

A) 1.51 B) 4.61 C) 36.50 (D) 36.86 E) 37.00

PART II Instructions: Questions 11 – 20 are open response. Answer all TEN questions carefully and completely, for full credit you must show all appropriate work and clearly indicate your answers.

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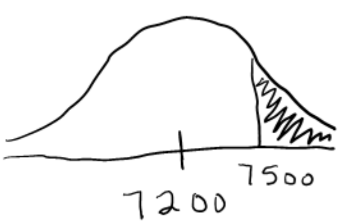
11) The owner of a computer repair shop has determined that their daily revenue has mean $7200 and standard deviation $1200. The daily revenue totals for the next 30 days will be monitored. What is the probability that the mean daily revenue for the next 30 days will exceed $7500? Round your answer to 4 decimal places.



$\mu = 7200$

$\sigma = 1200$

$n = 30$

$$Z = \frac{\bar{x} - \mu_{\bar{x}}}{\sigma_{\bar{x}}} = \frac{7500 - 7200}{\frac{1200}{\sqrt{30}}} \approx 1.37$$

$$P(\bar{x} > 7500) = P(z > 1.37)$$

$$= 1 - 0.9147$$

$$= \boxed{0.0853}$$

12) The costs in dollars of a random sample of 20 college textbooks are given in the stem–and–leaf plot below.

Stem	Leaves
2	7 8
3	6
4	0 2
5	3
6	7
7	1 6 9 9
8	2 4 4
9	0 3 5 7
10	5 7

$$Q_1 = \frac{42 + 53}{2}$$

$$Q_3 = \frac{90 + 93}{2}$$

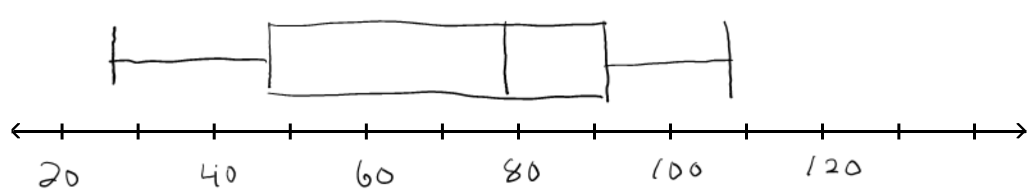
Legend: 2|7 represents $27

i) Find the five number summary for this data set. Include the name or correct symbol for each of the numbers as well as its value.

minimum = 27 $\quad Q_1 = 47.5 \quad$ median = 79

$Q_3 = 91.5 \quad$ maximum = 107

ii) Draw a boxplot for this data set.



iii) Use complete sentences to briefly describe the shape of the distribution for this data.

The data is skewed left.

13) Find the mean, median, and mode of the following statistic students' test scores. Round to the nearest tenth if necessary.

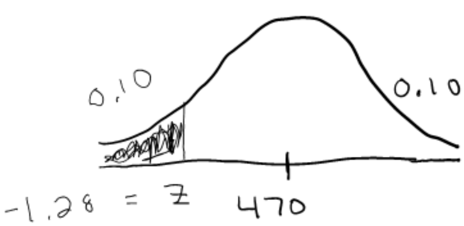
68 73 82 82 82 86 87 90 91 97

mean = 83.8

median = 84

mode = 82

14) A physical fitness association is including the mile run in its secondary–school fitness test. The time for this event for boys in secondary school is known to have a normal distribution with a mean of 470 seconds and a standard deviation of 40 seconds. The fitness association wants to recognize the fastest 10% of the boys with certificates of recognition. What time would the boys need to beat in order to earn a certificate of recognition from the fitness association? Round to the nearest second.



$\mu = 470$

$\sigma = 40$

$z\sigma + \mu = x$

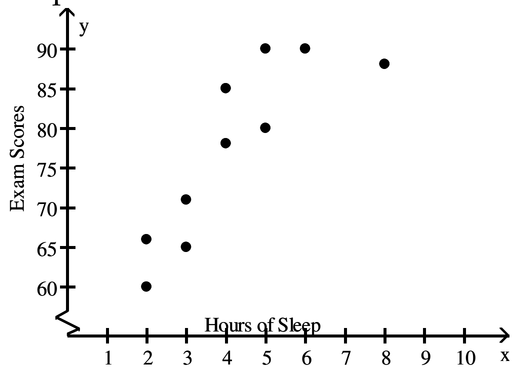
$-1.28(40) + 470$

419 seconds

15) The data below are the final exam scores of 10 randomly selected history students and the number of hours they slept the night before the exam.

Hours, x	3	5	2	8	2	4	4	5	6	3
Scores, y	65	80	60	88	66	78	85	90	90	71

The scatterplot for this data:



i) Based on the scatterplot, is it reasonable to suggest that there is a linear relationship between hours of sleep and exam scores? **Yes** or **No** (circle one)

ii) Find the correlation coefficient for the given data. Round to 4 decimal places.

$r = 0.8465$

iii) Determine if there is a significant linear correlation. Report the critical value and state your conclusion.

critical value = 0.632 $|r| > 0.632$

There is a significant linear correlation

iv) Find the equation of the least–squares regression line for this data. Round values to 2 decimal places.

$\hat{y} = 5.04x + 56.11$

v) Use the regression equation to predict the exam score of a student who slept for 7 hours the night before the exam. Is the predicted exam score a good estimate? Briefly explain your answer.

When $x = 7$ the predicted exam score is 91. The estimate is good because a significant correlation exists and because $x = 7$ is within the range of the collected data.

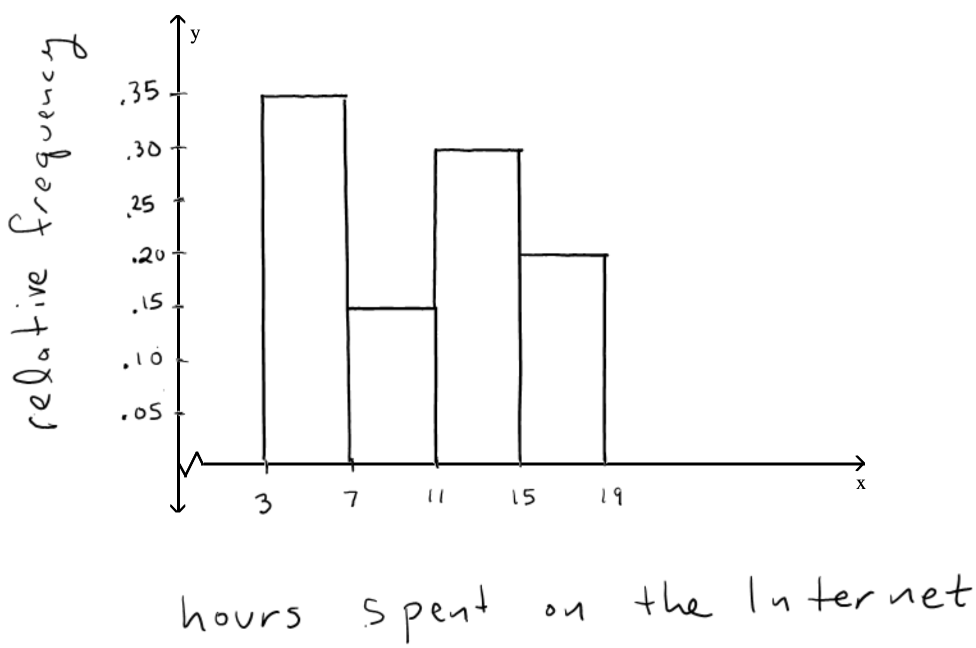
16) A random sample of 20 college students is selected. Each student is asked how much time he or she spent on the Internet during the previous week. The following times (in hours) are recorded:

8	12	3	15	16	5	16	5	6	10
3	12	13	4	4	11	9	17	14	12

i) Create a frequency and relative frequency table for this data. Use 3 as the lower class limit of the first class, and use a class width of 4.

Class	Tally (optional)	Frequency	Relative Frequency
3 - 6	𝍸 II	7	0.35
7 - 10	III	3	0.15
11 - 14	𝍸 I	6	0.3
15 - 18	IIII	4	0.2

ii) Create a relative frequency histogram for the data. Be sure to label your axes.



17) When 440 junior college students were surveyed, 200 said they have a passport. Construct a 95% confidence interval for the proportion of junior college students that have a passport. Round to the nearest thousandth.

$\hat{p} = \frac{200}{440}$

$n\hat{p}(1-\hat{p}) \approx 109 \geq 10$, $n \leq 0.05N$

conditions are met

$E = 1.96\sqrt{\frac{\hat{p}(1-\hat{p})}{440}} \approx 0.0465$

$$\boxed{0.408 < p < 0.501}$$

18) The National Association of Realtors estimates that 23% of all homes purchased in 2004 were considered investment properties. If a sample of 800 homes sold in 2004 is obtained what is the probability that at most 200 homes are going to be used as investment property? Round your answer to 4 decimal places.

$p = 0.23 \qquad \hat{p} = \frac{200}{800} = 0.25$

$z = \frac{\hat{p} - \mu_{\hat{p}}}{\sigma_{\hat{p}}} = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}} = \frac{0.25 - 0.23}{\sqrt{\frac{(0.23)(0.77)}{800}}} \approx 1.34$

$P(\hat{p} \leq 0.25) = P(z \leq 1.34) = \boxed{0.9099}$

19) In 2010, 36% of adults in a certain country were morbidly obese. A health practitioner suspects that the percent has changed since then. She obtains a random sample of 1042 adults and finds that 393 are morbidly obese. Is this sufficient evidence to support the practitioner's suspicion that the percent of morbidly obese adults has changed at the $\alpha = 0.1$ level of significance? Round $\hat{p}$ to five decimal places when calculating the test statistic.

Are you using the Classical or P–Value approach? (circle one)

$\hat{p} = \frac{393}{1042}$ $n = 1042$

$\alpha = 0.10$

Null Hypothesis:

$H_0: p = 0.36$

Alternative Hypothesis:

$H_1: p \neq 0.36$

Test Statistic:

$$z_0 = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} \approx 1.15$$

Critical Value(s) or P–Value (circle which of these you are using):

critical values $= \pm 1.645$ } P-value $= 0.2502$

Conclusion about the Null Hypothesis:

Fail to reject H_0

z_0 is not in the critical region } P-value $> \alpha$

Do the data support the health practitioner's suspicion? Answer with complete sentences.

There is not sufficient evidence to support the health practitioner's suspicion that the proportion of morbidly obese adults has changed since 2010.

20) A shipping firm suspects that the mean life of a certain brand of tire used by its trucks is less than 40,000 miles. To check the hypothesis, the firm randomly selects and tests 18 of these tires and finds that they have a mean lifetime of 39,300 miles with a standard deviation of 1200 miles. At $\alpha = 0.05$, test the shipping firm's hypothesis. Assume that the life of the tires is normally distributed with no outliers. Show a complete solution including all your steps.

$n = 18$

$s = 1200$

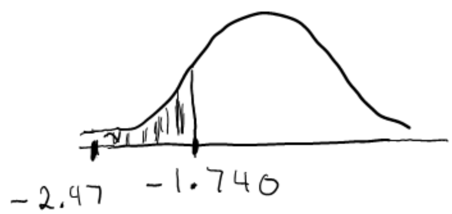
$\bar{x} = 39,300$

$\alpha = 0.05$

$H_0: \mu = 40,000$ $\quad H_1: \mu < 40,000$

Test statistic: $t_0 = \dfrac{\bar{x} - \mu_0}{\frac{s}{\sqrt{n}}} \approx -2.47$

critical value $t = -1.740$ or P-value < 0.02



t_0 is in the critical region, so reject H_0

P-value $< \alpha$ reject H_0

There is sufficient evidence to support the shipping firm's suspicion that the mean life of the tires is less than 40,000 miles.