Math 183 HW9, Name: _______________________________, PID: ______________

4.20 Age at first marriage, Part II. Exercise 4.16 presents the results of a 2006 - 2010 survey showing that the average age of women at first marriage is 23.44. Suppose a social scientist believes that this value has increased in 2012, but she would also be interested if she found a decrease. Below is how she set up her hypotheses. Indicate any errors you see.

$$H_0 : \bar{x} = 23.44 \text{ } years \text{ } old$$
$$H_A : \bar{x} > 23.44 \text{ } years \text{ } old$$

4.22 Thanksgiving spending, Part II. Exercise 4.14 provides a 95% confidence interval for the average spending by American adults during the six-day period after Thanksgiving 2009: (\$80.31, \$89.11).

(a) A local news anchor claims that the average spending during this period in 2009 was \$100. What do you think of her claim?

(b) Would the news anchor's claim be considered reasonable based on a 90% confidence interval? Why or why not? (Do not actually calculate the interval.)

Math 183 HW9, Name: Chandler Blaid Burgess **, PID:** A98029[illegible]77

[illegible] Exercise [illegible] presents the results of a 2006 - 2010 survey showing that the average age of women at first marriage is 23.44. Suppose a social scientist believes that this value has increased in 2012, but she would also be interested if she found a decrease. Below is how she set up her hypotheses. Indicate any errors you see.

$$H_0: \bar{x} = 23.44 \text{ years old}$$
$$H_A: \bar{x} > 23.44 \text{ years old}$$

1) Since her Hypothesis rest on population averages, she should be using μ in place of $\bar{x}$ to represent the average

2) If she is interested in any deviation from 23.44 she should be searching for $\mu \neq 23.44$ as this is a two-sided problem.

[illegible] Exercise [illegible] provides a 95% confidence interval for the average spending by American adults during the six-day period after Thanksgiving 2009: ($80.31, $89.11).

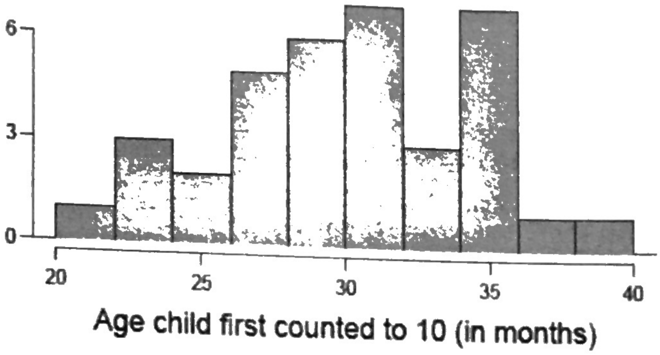
(a) A local news anchor claims that the average spending during this period in 2009 was $100. What do you think of her claim?

(b) Would the news anchor's claim be considered reasonable based on a 90% confidence interval? Why or why not? (Do not actually calculate the interval.)

a) Her claim is false w/ 95% confidence, as $100 does not fall within the 95% confidence interval.

b) No, because a less % confidence interval would be smaller/ closer toward the estimated value, thus she would be further from the estimated interval.

4.24 Gifted children, Part I. Researchers investigating characteristics of gifted children collected data from schools in a large city on a random sample of thirty-six children who were identified as gifted children soon after they reached the age of four. The following histogram shows the distribution of the ages (in months) at which these children first counted to 10 successfully. Also provided are some sample statistics.



n	36
min	21
mean	30.69
sd	4.31
max	39

(a) Are conditions for inference satisfied?

(b) Suppose you read online that children first count to 10 successfully when they are 32 months old, on average. Perform a hypothesis test to evaluate if these data provide convincing evidence that the average age at which gifted children fist count to 10 successfully is less than the general average of 32 months. Use a significance level of 0.10.

(c) Interpret the p-value in context of the hypothesis test and the data.

(d) Calculate a 90% confidence interval for the average age at which gifted children first count to 10 successfully.

(e) Do your results from the hypothesis test and the confidence interval agree? Explain.

a) Yes, Graph is $\approx$ Symmetric, sample is random and of good size.

b) $H_0 = \mu = 32$ months $\quad z = \frac{30.69-32}{4.31/6} = -1.82$

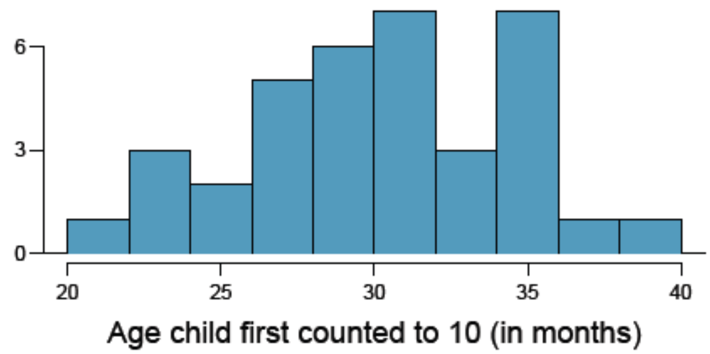
$H_A = \mu < 32$ months

$P = 0.034$

c) There is evidence, allowing us to infer that gifted children can count to 10 earlier.

d)

4.24 Gifted children, Part I. Researchers investigating characteristics of gifted children collected data from schools in a large city on a random sample of thirty-six children who were identified as gifted children soon after they reached the age of four. The following histogram shows the distribution of the ages (in months) at which these children first counted to 10 successfully. Also provided are some sample statistics.[43]



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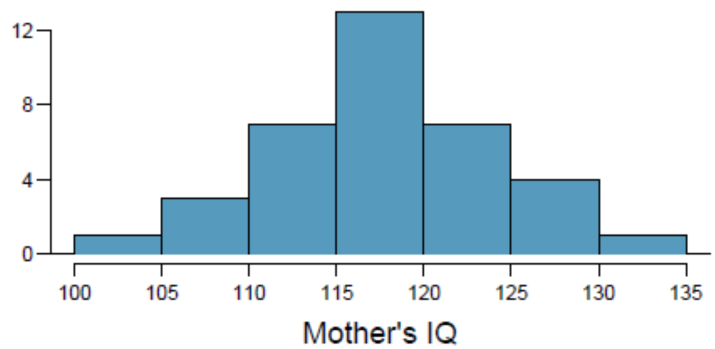
(c) Interpret the p-value in context of the hypothesis test and the data.

(d) Calculate a 90% confidence interval for the average age at which gifted children first count to 10 successfully.

(e) Do your results from the hypothesis test and the confidence interval agree? Explain.

4.26 Gifted children, Part II. Exercise 4.24 describes a study on gifted children. In this study, along with variables on the children, the researchers also collected data on the mother's and father's IQ of the 36 randomly sampled gifted children. The histogram below shows the distribution of mother's IQ. Also provided are some sample statistics.



n	36
min	101
mean	118.2
sd	6.5
max	131

(a) Perform a hypothesis test to evaluate if these data provide convincing evidence that the average IQ of mothers of gifted children is different than the average IQ for the population at large, which is 100. Use a significance level of 0.10.

(b) Calculate a 90% confidence interval for the average IQ of mothers of gifted children.

(c) Do your results from the hypothesis test and the confidence interval agree? Explain.

4.28 Working backwards, two-sided. You are given the following hypotheses:

$$H_0 : \mu = 30$$
$$H_A : \mu \neq 30$$

We know that the sample standard deviation is 10 and the sample size is 70. For what sample mean would the p-value be equal to 0.05? Assume that all conditions necessary for inference are satisfied.

4.31 Which is higher? In each part below, there is a value of interest and two scenarios (I and II). For each part, report if the value of interest is larger under scenario I, scenario II, or whether the value is equal under the scenarios.

(a) The standard error of $\bar{x}$ when $s = 120$ and (I) n = 25 or (II) n = 125.

(b) The margin of error of a confidence interval when the confidence level is (I) 90% or (II) 80%.

(c) The p-value for a Z-statistic of 2.5 when (I) n = 500 or (II) n = 1000.

(d) The probability of making a Type 2 Error when the alternative hypothesis is true and the significance level is (I) 0.05 or (II) 0.10.

Provide reasons for your claims.

R Questions

Consider the following game played with an **unfair coin** (heads probability = 0.6): You start at 0. Each heads flip moves you forward one unit. Each tails moves you back one unit. The game ends when you reach either -32 or +63. What is the expected number of flips it takes before this game ends?

R1. Write a simulation that will play the game until completion and count how many flips it takes. Then, play the game until completion a total of 1000 times and average these flip totals to get an approximation of the answer to the above question. [code, average]

```
# Counter for the number of trials
n <- 0

# Number of trials to average across
numOfTrials <- 10000

# Integer to calculate average
toAvg <- 0

# Probability set of the unfair coin (6/10)
sampSet <- c("h", "h", "h", "t", "t")

# Loop to perform 10,000 trials
while(n < numOfTrials) {
 # Number of Units moved
 points <- 0

 # Number of flips
 totFlips <- 0

 # Single game
 while(points <= 63 && points >= -32) {
  # A single flip of the coin
  flip <- sample(sampSet, 1, replace = FALSE)

  # Move one unit if it is heads, _ move back one unit
  if (flip == "h") {
   points <- points + 1
  } else {
   points <- points - 1
  }
  totFlips = totFlips + 1
 }

 # Sum up the number of flips for each trial
 toAvg <- toAvg + totFlips

 # Move onto the next trial
 n <- n + 1
}

# Average the number of flips for each trial
toAvg <- toAvg / numOfTrials

print(toAvg)
```

[1] 319.853

R2. Let's play the same game but with a **fair coin**. Change a small part of your code from R1 so the coin is fair. What average do you get now? Why did the simulation take longer to run? [new average, reason simulation is longer]

```
sampSet <- c("h", "h", "h", "h", "h", "t", "t", "t", "t", "t")
```

This simulation took longer to run, because the odds of flipping a heads and the odds of flipping a tail were even (Fair coin). Thus, to flip 63 more heads, or 32 more tails in a particular set, requires many flips to allot these strange occurrences.

[1] 2108.968

R3. [Optional Bonus (very hard!)] Assuming a **fair** coin, use probability theory to calculate the expected value of the number of flips required to end this game. Hint: This will not be modelled by anything we have seen; you will have to do something novel. You can check your answer is correct by comparing with R2 (you may want to run 10,000 trials). Your answer should be a "cute" number. [derivation of expected value, answer]