Winter 2023 Final Exam
Problem 16

Problem 16

We collect data on the play times of 100 games of *Chutes and Ladders* (sometimes known as *Snakes and Ladders*) and want to use this data to perform a hypothesis test.

Problem 16.1

Which of the following pairs of hypotheses can we test using this data?

Option 1: **Null Hypothesis:** In a random sample of Chutes and Ladders games, the average play time is 30 minutes. **Alternative Hypothesis:** In a random sample of Chutes and Ladders games, the average play time is not 30 minutes.

Option 2: **Null Hypothesis:** In a random sample of Chutes and Ladders games, the average play time is not 30 minutes. **Alternative Hypothesis:** In a random sample of Chutes and Ladders games, the average play time is 30 minutes

Option 3: **Null Hypothesis:** A game of Chutes and Ladders takes, on average, 30 minutes to play. **Alternative Hypothesis:** A game of Chutes and Ladders does not take, on average, 30 minutes to play.

Option 4: **Null Hypothesis:** A game of Chutes and Ladders does not take, on average, 30 minutes to play. **Alternative Hypothesis:** A game of Chutes and Ladders takes, on average, 30 minutes to play.

- ○ Option 1
- ○ Option 2
- ○ Option 3
- ○ Option 4

Problem 16.2

We use our collected data to construct a 95% CLT-based confidence interval for the average play time of a game of *Chutes and Ladders*. This 95% confidence interval is [26.47, 28.47]. For the 100 games for which we collected data, what is the mean and standard deviation of the play times?

Problem 16.3

Does the CLT say that the distribution of play times of the 100 games is roughly normal?

- Yes
- No

Problem 16.4

Of the two hypotheses you selected in part (a), which one is better supported by the data?

- Null Hypothesis
- Alternative Hypothesis

Fall 2022 Final Exam
Problem 6

Problem 6

In this question, we'll explore the relationship between the ages and incomes of credit card applicants.

Problem 6.1

The credit card company that owns the data in apps, BruinCard, has decided not to give us access to the entire `apps` DataFrame, but instead just a sample of `apps` called `small apps`. We'll start by using the information in `small_apps` to compute the regression line that predicts the age of an applicant given their income.

For an applicant with an income that is $\frac{8}{3}$ standard deviations above the mean income, we predict their age to be $\frac{4}{5}$ standard deviations above the mean age. What is the correlation coefficient, r, between incomes and ages in `small_apps`? Give your answer as a **fully simplified fraction**.

Problem 6.2

Now, we want to predict the income of an applicant given their age. We will again use the information in `small_apps` to find the regression line. The regression line predicts that an applicant whose age is $\frac{4}{5}$ standard deviations above the mean age has an income that is s standard deviations above the mean income. What is the value of s? Give your answer as a **fully simplified fraction**.

Problem 6.3

BruinCard has now taken away our access to both `apps` and `small_apps`, and has instead given us access to an even smaller sample of `apps` called `mini_apps`. In `mini_apps`, we know the following information: - All incomes and ages are positive numbers. - There is a positive linear association between incomes and ages.

We use the data in `mini_apps` to find the regression line that will allow us to predict the income of an applicant given their age. Just to test the limits of this regression line, we use it to predict the income of an applicant who is **-2 years old**, even though it doesn't make sense for a person to have a negative age.

Let I be the regression line's prediction of this applicant's income. Which of the following inequalities are guaranteed to be satisfied? Select all that apply.

- ☐ $I < 0$
- ☐ $I < \text{mean income}$
- ☐ $|I - \text{mean income}| \leq |\text{mean age} + 2|$
- ☐ $\dfrac{|I - \text{mean income}|}{\text{standard deviation of incomes}} \leq \dfrac{|\text{mean age} + 2|}{\text{standard deviation of ages}}$
- ☐ None of the above.

Problem 6.4

Yet again, BruinCard, the company that gave us access to `apps`, `small_apps`, and `mini_apps`, has revoked our access to those three DataFrames and instead has given us `micro_apps`, an even smaller sample of `apps`.

Using `micro_apps`, we are again interested in finding the regression line that will allow us to predict the income of an applicant given their age. We are given the following information:

- The correlation coefficient, r, between ages and incomes is $-\frac{1}{3}$ (note the negative sign).
- The mean income is $\frac{7}{2}$ (remember, incomes are measured in tens of thousands of dollars).
- The mean age is 33.
- The regression line predicts that a 24 year old applicant has an income of $\frac{31}{2}$.

Suppose the standard deviation of incomes in `micro_apps` is an integer multiple of the standard deviation of ages in `micro_apps`. That is,

$$\text{standard deviation of income} = k \cdot \text{standard deviation of age}.$$

What is the value of k? Give your answer as an **integer**.

Spring 2022 Final Exam
Problem 16

Problem 16

The HAUGA bedroom furniture set includes two items, a bed frame and a bedside table. Suppose the amount of time it takes someone to assemble the bed frame is a random quantity drawn from the probability distribution below.

Time to assemble bed frame	Probability
10 minutes	0.1
20 minutes	0.4
30 minutes	0.5

Similarly, the time it takes someone to assemble the bedside table is a random quantity, independent of the time it takes them to assemble the bed frame, drawn from the probability distribution below.

Time to assemble bedside table	Probability
30 minutes	0.3
40 minutes	0.4
50 minutes	0.3

Problem 16.1

What is the probability that Stella assembles the bed frame in 10 minutes if we know it took her less than 30 minutes to assemble? Give your answer as a decimal between 0 and 1.

Problem 16

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Time to assemble bed frame	Probability
10 minutes	0.1
20 minutes	0.4
30 minutes	0.5

Similarly, the time it takes someone to assemble the bedside table is a random quantity, independent of the time it takes them to assemble the bed frame, drawn from the probability distribution below.

Time to assemble bedside table	Probability
30 minutes	0.3
40 minutes	0.4
50 minutes	0.3

Problem 16.2

What is the probability that Ryland assembles the bedside table in 40 minutes if we know that it took him 30 minutes to assemble the bed frame? Give your answer as a decimal between 0 and 1

Problem 16

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Time to assemble bed frame	Probability
10 minutes	0.1
20 minutes	0.4
30 minutes	0.5

Similarly, the time it takes someone to assemble the bedside table is a random quantity, independent of the time it takes them to assemble the bed frame, drawn from the probability distribution below.

Time to assemble bedside table	Probability
30 minutes	0.3
40 minutes	0.4
50 minutes	0.3

Problem 16.3

What is the probability that Jin assembles the complete HAUGA set in at most 60 minutes? Give your answer as a decimal between 0 and 1.