Assignment - 6

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Problem - 1

A soft drink machine is regulated so that the amount of drink it dispenses follows a normal distribution with a known standard deviation of the drinks dispensed of 20 milliliters.

A random sample of 30 drinks from the machine had an average volume of 373 milliliters. Determine a 95% confidence interval for the average amount of all drinks dispensed by this machine.

Given Data:

Sample mean = **373 milliliters**
Population standard deviation = **20 milliliters**
Sample size = **30**
95% confidence level Z-value = **1.96**

Using the formula for the confidence interval:

$$\text{Confidence interval} = \bar{X} \pm Z \cdot \left(\frac{\sigma}{\sqrt{n}}\right)$$

Substituting the values:

$$\text{Confidence interval} = 373 \pm 1.96 \cdot \left(\frac{20}{\sqrt{30}}\right)$$

$$\text{Confidence interval} = 373 \pm 7.33 = (365.67, 380.33) \text{ milliliters}$$

Therefore, we can be 95% confident that the average amount of all drinks dispensed by the machine is between `365.67 ml` and `380.33 ml`.

Problem - 2

A Human Resources Manager is interested in finding the average compensation for financial analysts. Through market research she obtained compensation information for a sample of 57 financial planners.

Summary statistics for the sample data is as follows:
mean = $52,746 and standard deviation = $9,528

Calculate a 95% confidence interval for the mean compensation for the population of financial analysts under study

Given Data:

Sample mean = **$52,746**
Population standard deviation = **$9,528**
Sample size = **57**
95% confidence level Z-value = **1.96**

Using the formula for the confidence interval:

$$\text{Confidence interval} = \bar{X} \pm Z \cdot \left(\frac{\sigma}{\sqrt{n}}\right)$$

Substituting the values:

$$\text{Confidence interval} = 52746 \pm 1.96 \cdot \left(\frac{9528}{\sqrt{57}}\right)$$

$$\text{Confidence interval} = (\$50272.45172, \$55219.54828)$$

Therefore, we can be 95% confident that the average compensation for the population of financial analysts under study is between `$50,272.45` and `$55,219.54`.

Problem - 3

An Excel printout of the descriptive measures of daily checking account balances (in dollars) of customers of First Daisy Bank is shown below. Develop a 95% confidence interval estimate for the mean of the population of the checking balances.

Account Balance Information	
Mean	4828.29
Median	5115.25
Mode	4976.50
Sample Standard Deviation	1143.57
Sample Variance	1307763.49
Kurtosis	8.63
Skewness	-3.06
Range	4968.50
Minimum	600.00
Maximum	5568.50
Sum	173818.50
Count	36.00

To find the 95% confidence interval estimate for the mean of the population of the checking balances, we can use the formula:

$$\text{Confidence interval} = \bar{X} \pm \text{Critical Value} \cdot \left(\frac{s}{\sqrt{n}}\right)$$

where:

- $\bar{X}$ is the sample mean (**4828.29** in this case),
- Critical Value is assuming t-distributiuon **2.03**.
- s is the sample standard deviation (**1143.57** in this case),
- n is the sample size (**36** in this case).

Now, substitute the values into the formula:

$$\text{Confidence interval} = 4828.29 \pm 2.03 \cdot \left(\frac{1143.57}{\sqrt{36}}\right)$$

$$\text{Confidence interval} = (\$4441.38215, \$5215.19785)$$

Therefore, we can be 95% confident that the mean of the population of checking balances is between `4441.38215` and `5215.19785` dollars.

Problem - 4

A random sample of 200 consoles were examined for a scratch defect. Of the 200 samples, 22 were found to have the defect. Find a 95% confidence interval for the population proportion of consoles with this scratch defect.

To find the 95% confidence interval for the population proportion of consoles with the scratch defect, we can use the formula:

$$\text{Confidence interval} = \hat{p} \pm Z \cdot \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

Where:

- $\hat{p}$ is the sample proportion (in this case, $\frac{22}{200}$ or 0.11).

  22200
- Z is the Z-value for the 95% confidence level, which is 1.96.
- n is the sample size (200 in this case).

Substitute the values in the above equation:

$$\text{Confidence interval} = 0.11 \pm 1.96 \cdot \sqrt{\frac{0.11 \times 0.89}{200}}$$

$$\text{Confidence interval} = (0.066635692, 0.1533643088)$$

Therefore, we can be 95% confident that the population proportion of consoles with this scratch defect is between `0.06` and `0.15`.

Case study: Young Professional magazine

Young Professional magazine was developed for a target audience of recent college graduates who are in their first 10 years in a business/professional career. In its two years of publication, the magazine has been fairly successful. Now the publisher is interested in expanding the magazine's advertising base. Potential advertisers continually ask about the demographics and interests of subscribers to Young Professional. To collect this information, the magazine commissioned a survey to develop a profile of its subscribers. The survey results will be used to help the magazine choose articles of interest and provide advertisers with a profile of subscribers. As a new employee of the magazine, you have been asked to help analyze the survey results.

TABLE 8.6 Partial Survey Results for Young Professional Magazine

Age	Gender	Real estate purchases	Value of investments	Number of transactions	Broadband access	Household income	Children
38	female	no	12200	4	yes	75200	yes
30	male	no	12400	4	yes	70300	yes
41	female	no	26800	5	yes	48200	no
28	female	yes	19600	6	no	9300	no
31	female	yes	15100	5	no	73300	yes

Prepare a managerial report summarizing the results of the survey. In addition to statistical summaries, discuss how the magazine might use these results to attract advertisers. You might also comment on how the survey results could be used by the magazine's editors to identify topics that would be of interest to readers. Your report should address the following issues, but do not limit your analysis to just these areas.

(a) Descriptive Statistics for the quantitative variables follow:

Variable	Sample Size	Mean	Std Dev	Std Error	Minimum	Maximum	Skewness
Age	410	30.112	4.024	0.199	19.000	42.000	-0.03
Investments	410	28538	15811	781	0.000	133400	1.71
Transactions	410	5.973	3.101	0.153	0.000	21.000	1.21
Household Income	410	74460	34818	1720	16200	322500	2.01

(b) Descriptive Statistics for the qualitative variables follow:

Gender	Male: 229	Proportion male: .5585
Plan R.E. purchase Yes	Yes: 181	Proportion yes: 0.4415
Broadband access Yes	Yes: 256	Proportion yes: 0.6244
Have Children Yes	Yes: 219	Proportion yes: 0.5341

1. Develop 95% confidence intervals for the mean age and household income of subscribers. (2 points)

For Age:

$$\text{CI} = (\text{Mean} \pm (Z \times \text{Standard Error}))$$

For the mean age:
Mean = **30.112**
Standard Error = **0.199**
Sample Size = **410**

Using the Z-score for a 95% confidence level, which is 1.96, we can calculate the confidence interval for the mean age:

$$\text{CI for the mean age} = (30.112 \pm (1.96 \times 0.199))$$

$$\text{CI for the mean age} = (29.72196, 30.50204)$$

Therefore, the 95% confidence interval for the mean age of subscribers is (`29.722`, `30.502`).

For Household Income:

$$\text{CI} = (\text{Mean} \pm (Z \times \text{Standard Error}))$$

For the mean household income:
Mean = **$74,460**
Standard Error = **$1,720**
Sample Size = **410**

Using the Z-score for a 95% confidence level, which is 1.96, we can calculate the confidence interval for the mean age:

$$\text{CI for the mean age} = (74,460 \pm (1.96 \times 1,720))$$

$$\text{CI for the mean age} = (71088.8, 77831.2)$$

Therefore, the 95% confidence interval for the mean age of subscribers is (`71088.8`, `77831.2`).

2. Develop 95% confidence intervals for the proportion of subscribers who have broadband access at home and the proportion of subscribers who have children. (2 points)

To develop 95% confidence intervals for the proportion of subscribers who have broadband access at home and the proportion of subscribers who have children, we can use the formula:

$$CI = \left(\text{Proportion} \pm Z \times \sqrt{\frac{\text{Proportion} \times (1 - \text{Proportion})}{\text{Sample Size}}}\right)$$

For the proportion of subscribers who have broadband access at home:

Proportion=0.6244

Sample Size=410

Using the Z-score for a 95% confidence level, which is 1.96, we can calculate the confidence interval for the proportion of subscribers with broadband access:

$$\text{CI} = \left(0.6244 \pm 1.96 \times \sqrt{\frac{0.6244 \times (1 - 0.6244)}{410}}\right)$$

$$\text{CI} = (0.577523154, 0.671276846)$$

For the proportion of subscribers who have children:

Proportion=0.5341

Sample Size=410

Using the Z-score for a 95% confidence level, which is 1.96, we can calculate the confidence interval for the proportion of subscribers who have children:

$$\text{CI} = \left(0.5341 \pm 1.96 \times \sqrt{\frac{0.5341 \times (1 - 0.5341)}{410}}\right)$$

$$\text{CI for the mean age} = (0.485813938, 0.582386062)$$

Conclusion:

The 95% confidence interval for the proportion of subscribers who have broadband access at home is (`0.577523154` , `0.671276846`).
The 95% confidence interval for the proportion of subscribers who have children is (`0.485813938` , `0.582386062`).

3. Would Young Professional be a good advertising outlet for online brokers? Justify your conclusion with statistical data. (2 points)

To determine whether Young Professional would be a good advertising outlet for online brokers, we can analyze the data related to the subscribers, specifically focusing on the variables that might be relevant to online brokers. These variables could include real estate purchases, value of investments, and the number of transactions. Additionally, the survey provides information on broadband access, which is crucial for online activities, and household income, which is indicative of the purchasing power of the subscribers.

Given the data:

- The proportion of subscribers with broadband access is 0.6244.
- The mean value of investments is $28,538, with a maximum of $133,400.
- The mean number of transactions is 5.973, with a maximum of 21.
- The mean household income is $74,460, with a maximum of $322,500.

These statistics suggest that the subscribers of Young Professional have a relatively high value of investments, a reasonable number of transactions, and a substantial household income, indicating their potential capacity for financial activities such as online trading. Moreover, the significant proportion of subscribers with broadband access further supports the likelihood that they are active online users.

Therefore, based on the statistical data, Young Professional could be a good advertising outlet for online brokers, as the subscribers appear to have the financial capacity and technological access that aligns with the target audience of online brokers.

4. Would this magazine be a good place to advertise for companies selling educational software and computer games for young children? (2 points)

To assess whether the magazine would be a good place to advertise for companies selling educational software and computer games for young children, we can examine the data related to the subscribers, particularly the variables that might indicate their relevance to educational software and computer games for young children. These variables could include the presence of children in the household and the demographics of the subscribers, such as age and gender.

Considering the survey data:

- The proportion of subscribers with children is 0.5341.
- The mean age of subscribers is 30.112, with a minimum of 19 and a maximum of 42.
- The survey indicates both male and female subscribers.

Based on this data, the magazine appears to have a significant proportion of subscribers who have children. Additionally, the relatively young mean age of the subscribers, along with the presence of children, suggests that there could be a potential market for educational software and computer games for young children.

Furthermore, the magazine's focus on young professionals who are in the early stages of their careers implies that many of the subscribers may be starting families or have young children, making it a potentially suitable platform to advertise educational software and computer games for this demographic.

Therefore, considering the presence of children among the subscribers and the relatively young age group, Young Professional magazine could indeed be a good place to advertise for companies selling educational software and computer games targeted at young children.

5. Comment on the types of articles you believe would be of interest to readers of Young Professional. (2 points)

Based on the survey results and the profile of subscribers to Young Professional magazine, several types of articles may be of significant interest to the readers:

1. **Career Development Guidance:** Given that the magazine targets recent college graduates and young professionals, articles offering insights into career advancement, networking strategies, and skill development relevant to various industries would

likely be highly valued.

2. **Financial Planning and Investment Advice:** Since the subscribers exhibit a notable mean household income and value of investments, articles focusing on financial planning, investment strategies, and tips for wealth management could be of great interest to help them make informed financial decisions.
3. **Technology and Innovation Updates:** Considering the prevalence of broadband access among subscribers and the tech-focused career goals of the target audience, articles highlighting the latest technological trends, innovations, and their implications for various sectors could attract readers' attention.
4. **Work-Life Balance and Wellness:** Recognizing the demanding nature of professional careers, articles emphasizing strategies for maintaining a healthy work-life balance, managing stress, and promoting overall well-being may resonate well with the readers.
5. **Education and Skill Enhancement**: Given the demographic's pursuit of continuous growth and development, articles discussing opportunities for further education, certification programs, and skill enhancement in the data science and tech fields could be particularly relevant and beneficial.

By addressing these themes and providing content that aligns with the career aspirations, financial pursuits, technological interests, and overall well-being of the readers, the magazine can effectively engage its audience and cater to their professional and personal development needs.