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MAT 222
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Excel Lab 1: Ch.5 & 6

"When life gives you lemons, steal your grandma's jewelry and go clubbin'."
–Jean-Ralphio, Parks and Recreation

Suppose a group of Facebook™(FB) executives are considering charging a monthly subscription cost to use FB advertisement free. The executives believe that they average FB user will pay $\$5.00$/month (or more) for an ads-free version of FB. They hire an advertising and marketing company to investigate how much a typical FB user would pay per month for this version of FB. The data the agency collected is found in 'Facebook Costs'. From previous studies, the agency knows that the standard deviation in price that people will pay per month for ads-free social media websites is $\$5.35$ (see A6). Based on the data provided by the agency, answer the following questions.

Problem 1: Complete the **'Yearly Cost ($)'** column (cells B9–B62). Be sure to provide a print off.

Problem 2: If the advertising and marketing company had asked, "How much would you pay per year for an ads-free version of Facebook™?", would the participants' response be the same as you found in Problem 1? Explain.

The participants' response would most likely not be the same. This change of unit measurement would most likely change the responses. For example when asked, an individual may be willing to pay $5/month for a website when asked but not $60/year, even though these are the same yearly costs.

Problem 3: Complete the following:

Number of People Surveyed: 54

Average Surveyed Monthly Cost: $\$7.44$

Sample Standard Deviation of Surveyed Monthly Cost: $\$5.89$

Problem 4: What type of distribution does the average monthly cost the advertising and marketing company found come from? Justify your answer. What is the standard deviation of this distribution? Do you know the mean of this distribution?

Since n is sufficiently large (notice $n = 54$), the Central Limit Theorem applies (assuming they took a simple random sample). Therefore, the distribution of samples is approximately normal with mean μ (which we do not know, we only have a sample mean $\overline{x} = \$7.44$) and standard deviation $\sigma/\sqrt{n} = \$5.35/\sqrt{54} = \$0.73$, i.e. $N(\mu, \$0.73)$.

Problem 5: Use Excel to calculate a 97% confidence interval for the mean, μ, the average amount that people would be willing to pay for an ad-free version of Facebook™.

Lower Amount: $\$5.86$

Higher Amount: $\$9.02$

Problem 6: Give a verbal statement of the answer for the previous problem, including the confidence level. What do you need to be sure your statement is true?

We are 97% certain that the true average amount that a person would pay monthly for an ad-free version of Facebook™is between $\$5.86$ and $\$9.02$.

For this statement to be true, we needed the CLT. Therefore, we must have n large enough (it should be in this case) and a SRS (which we cannot be sure of here).

Problem 7: Perform an appropriate hypothesis (using $\alpha = 0.01$) test to determine if Facebook™ 'should' implement a monthly ad-free version, given that they want to charge $5.00/month. Be sure to state the H_0, H_a, z-statistic, and p-value, and give the conclusion in words.

$$\begin{cases} H_0 : \mu = 5 \\ H_a : \mu \geq 5 \end{cases}$$

$$z = \frac{7.44 - 5}{5.35/\sqrt{54}} = 3.36 \rightsquigarrow 0.999607$$

$$P(z \geq 3.36) = 1 - P(z \leq 3.36) = 1 - 0.999607 = 0.000393$$

Therefore, $p = 0.000393$. Since $p < \alpha = 0.01$, we reject the null hypothesis that $\mu = \$5.00$ in favor of the alternative hypothesis that $\mu \geq \$5.00$. This means people will be, on average, willing to pay at least $\$5.00$*/month for the site. They 'should' offer the alternative.*

Problem 8: Suppose the executives wanted to know if the average amount that people would be willing to pay was at 'the next pay level' of $10.00/month for the service. What is the power, using $\alpha = 0.01$ and $H_0 : \mu = 5$, of this test to be able to detect if this is the case? [You do not need to use Excel for this if you so choose.]

You reject at a z-statistic corresponding to 0.99, i.e. $z = 2.32$. The group mean corresponding to this is $\overline{x}$ so that $2.32 = z = \frac{\overline{x}-5}{5.35/\sqrt{54}}$, i.e. $\overline{x} = \$6.69$. If the true mean is $\mu = \$10$, the probability of seeing a group with mean $\overline{x}$ (or greater) is then calculated by: $z = \frac{6.69-10}{5.35/\sqrt{54}} = -4.54 \rightsquigarrow 0.00000279435$ so that the p-value is $1 - 0.00000279435 = 0.999997$. Therefore, the power is 99.9997%! Not surprising since the true mean is 'far' from the null hypothesis mean.