Student Information

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Answer 1

Question says that population is normally distributed. Question also says that

$$n(sample\ size) = 17, \bar{X} = 7.8, s = 1.4, \sigma = 1.4$$

a)

For this question we will use Z-test(because we have standard deviation of the population) where we will assume it is unsuccesful and say:
$H_0: \mu = 7$
$H_A: \mu > 7$
We will test the null hypothesis against the one-sided right-tail alternative

1st step calculating Z:

$$Z = \frac{\bar{X} - 7}{\sigma/\sqrt{n}} = \frac{7.8 - 7}{1.4/\sqrt{17}} = 2.35606$$

2nd Step: Acceptence/Rejection:
since confidence level is %95 and its a right tail alternate we will check z_a(z_a is 1.645 $< - >$ 1-a=0.95 so a is 0.05). If Z<1.645 we will accept H_0 otherwise reject it.
since Z=2.35606$\geq$1.645 we will reject H_0

3rd Step:
Our test statistic Z = 2.35606 belongs to the rejectance region([1.645,∞)) therefore, we reject the null hypothesis. Above data provides evidence in favor of the alternative hypothesis that the call center is **successful**.

b)

if a customer gave 1 instead of 10 then we would have to calculate our new sample values(since we re using Z-test calculating $\bar{X}$ would be enough) first according to wrong data:
$\bar{X}$=7.8-9/17=7.27058823529

Now we need to use the above steps once again where we will assume it is unsuccesful and say:
$H_0: \mu = 7$
$H_A: \mu > 7$

We will test the null hypothesis against the one-sided right-tail alternative

1st step calculating Z:

$$Z = \frac{\bar{X} - 7}{\sigma/\sqrt{n}} = \frac{7.27058823529 - 7}{1.4/\sqrt{17}} = 0.796903$$

2nd Step: Acceptence/Rejection:
since Z=0.796903<1.645 we will accept H_0

3rd Step:
Our test statistic Z = 0.796903 does not belong to the rejectance region($[1.645,\infty)$) therefore, we would have accepted the null hypothesis and said that "Above data provides evidence in favor of the Null hypothesis that the call center is **unsuccessful**".

c)

once again we would need to calculate $\bar{X}$
$\bar{X}$=7.8-9/45=7.6
Now we can once again use above steps where we will assume it is unsuccesful and say:
$H_0: \ \mu = 7$
$H_A: \ \mu > 7$
We will test the same hypothesis as before

$$Z = \frac{\bar{X} - 7}{\sigma/\sqrt{n}} = \frac{7.6 - 7}{1.4/\sqrt{45}} = 2.87494$$

since Z=2.87494 is even higher(also higher then 1.645 which is what we should check) then result of part a we would reject H_0.

Mistake would only have an insignificant effect on the successfullness of the call center(In this case it doesn't have an important effect because the Z-test value of both situations are far away from the intersection of the regions). And this effect will become more and more insignificant as sample size rises.

d)

If the threshold for success was set to 8 since we Z would always be negative it could never be higher then z_a. So it would always be never be in the rejectance region. Null hypothesis would always be accepted.

And evidance would always show in favor of the Null Hypothesis that the call center is **unsuccessful**.

Answer 2

we will use Z-test(since n$\geq$30) where we will assume that new vaccine is not better then the old vaccine :
H$_0$: $\mu_1 = mu_2$
H$_A$: $\mu_1 > mu_2$
Since the question asks "can we state that the new vaccine really protects for a longer duration"

We will test the null hypothesis against the one-sided right-tail alternative because question wants us to check if 1st company's vaccine is better or not

Our data are right below(1st company is the new company second company is the older company)

$$n_1(sample\ size) = 55, \bar{X_1} = 6.2\ months, s_1 = 1.5$$

$$n_2(sample\ size) = 55, \bar{X_2} = 5.8\ months, s_2 = 1.1$$

1st step calculating Z:

$$Z = \frac{\bar{X_1} - \bar{X_2}}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{6.2 - 5.8}{\sqrt{\frac{1.5^2}{55} + \frac{1.1^2}{55}}} = 1.59479$$

2nd Step: Acceptence/Rejection:
since confidence level is 95%(5% level of significance) and its a right tail alternate we will check z$_a$(z$_a$ is 1.645 $<->$ 1-a=0.95 so a is 0.05). If Z<1.645 we will accept H$_0$ otherwise reject it.
since Z=1.59479<1.645 we will accept H$_0$

Note: We used s_1 and s_2 **3rd Step:**
Our test statistic Z = 1.59479 does not belong to the rejectance region([1.645,∞)) therefore, we accept the null hypothesis. Above data provides evidence in favor of the Null hypothesis that new vaccine is **not better then the old vaccine**.

Answer 3

1st party is red 2nd party is blue

$$n(sample\ size) = 400, p_1 = \bar{X_1} = 0.48, p_2 = \bar{X_2} = 0.37$$

a)

We can look at this question as 400 bernoulli trials and in this way we can find estimator of standard deviation estimator of p with it since it is unbiased and it has approximately normal distribution for large samples. It is(for q being (1-p)):

$$s(\bar{p}) = \sqrt{\bar{p} * \bar{q}/n}$$

so for Red party margin of error would be

$$z_{0.025}\sqrt{\bar{p} * \bar{q}/n} = 1.96\sqrt{0.48 * 0.52/400} = 0.0489608 \quad -> \quad \%4.89608$$

and for the blue party margin of error would be:

$$1.96\sqrt{0.37 * 0.63/400} = 0.0473148 \quad -> \quad \%4.73148$$

b)

as for the lead which was sampled %11 error of margin would be calculated by adding blue and read team's error of margins to each other because the most difference would be generated when Red and Blue party are on different sides of their margin of errors. So it is:
0.0489608+0.0473148=0.0962756 $<->$ %9.62756

c)

Red party's margin of error is higher because its estimated probability(from the sample) is closer to %50(which would create highest margin of error)

the margin of error calculation is dependent on 2 things confidence level(which is constant here) and standard error of the parameter(p).

standard error of p's estimator has 3 things: p,q(1-p) and n. n is same for both. So it is dependent on p*q which takes its highest value at p being 0.5.

d)

n would multiply itself by 4.5. which would make $s(\bar{p}) = \sqrt{\bar{p} * \bar{q}/n}$ 0.47140452079 times of itself which would make margin of error 0.47140452079 times of itself. So margin of error would be less then half of its former self.