Solutions -

Modified

2003 AP® STATISTICS FREE-RESPONSE QUESTIONS (Form B)

3. A study was conducted to determine if taking vitamin C reduces the occurrence of the flu. The study was conducted using 808 student volunteers who did not take a flu shot. The subjects were randomly assigned to one of two groups: a treatment group who received 1,000 milligrams of vitamin C daily or a control group who received a placebo flavored to taste like the vitamin C treatment. All participants were monitored to ensure that they adhered to their assigned treatment on a daily basis throughout the period of the study. At the end of the flu season, each subject's medical record was reviewed by a physician to determine whether he or she had contracted the flu during the period of the study. The physician did not know which treatment each subject received. The results of the study are shown in the table below.

	Flu	No Flu	Total
Placebo	331	74	405
Vitamin C	302	101	403
Total	633	175	808

a) Is this study an experiment or an observational study? Explain your answer.
b) If a student volunteer is selected at random from those students in the study, what is the probability that they contracted the flu?
c) Given that a student took Vitamin C, what is the probability that they contracted the flu?
d) Based upon your answers in part b & c, are "contracting the flu" and "taking Vitamin C" independent of each other? Explain.
e) A health expert believes that Vitamin C reduces the occurrence of the flu in the population of students who would volunteer for such a study. State the name of the significance test and the null and alternative hypothesis that the health expert could have used to assess his claim.
f) Assume that the conditions for running this test are met, the test resulted in a p value= 0.0096. Based upon the p value, what conclusion should the health expert make? Explain.

a) Is this study an experiment or an observational study? Explain your answer.

This is an experiment since the health experts imposed treatments of vitamin C and a placebo and subjects were randomly assigned to either group.

b) If a student volunteer is selected at random from those students in the study, what is the probability that they contracted the flu?

$P(\text{flu}) = \frac{633}{808} = 0.783$

The probability of getting the flu is 0.783.

c) Given that a student took Vitamin C, what is the probability that they contracted the flu?

$$P(\text{flu} \mid \text{Vitamin C}) = \frac{P(\text{flu and vitamin C})}{P(\text{flu})}$$

NO 'Bold answers'.

$$= \frac{(302/808)}{0.783} = \frac{302}{403} = 0.749$$

Probability of getting the flu, given an individual took vitamin C is 0.749.

d) Based upon your answers in part b & c, are "contracting the flu" and "taking Vitamin C" independent of each other? Explain.

$P(\text{flu} \mid \text{Vitamin C}) = 0.749$

$P(\text{flu}) = 0.783$.

We can see that an individual who takes vitamin C has a lower chance of contracting the flu (0.749) than any individual. Therefore these two events are dependent.

e) A health expert believes that Vitamin C reduces the occurrence of the flu in the population of students who would volunteer for such a study. State the name of the significance test and the null and alternative hypothesis that the health expert could have used to assess his claim.

- Procedure used would be a two-sample z-test for a difference of proportion.

$H_0: P_{\text{Placebo}} - P_{\text{vitamin c}} = 0$

$H_a: P_{\text{placebo}} - P_{\text{vitamin C}} > 0$

NEED to interpret in words.

where P_{placebo} is proportion of people in placebo group who contracted the and

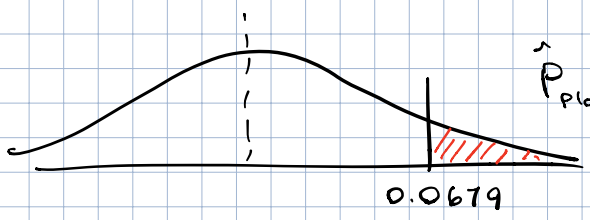
$P_{\text{vitamin C}}$ is the proportion of people in the vitamin C group who contracted the flu.

f) Assume that the conditions for running this test are met, the test resulted in a p value= 0.0096. Based upon the p value, what conclusion should the health expert make? Explain.

- Based on the small p-value of $0.0096 < 0.05 = \alpha$

we would reject the null hypothesis that the proportion of people who contract the flu changes based on whether or not they take vitamin C.

- 0.96% of future samples would yield a difference in proportions of 0.0679 or higher.
- we do have sufficient evidence to suggest the proportion of people who contract the flu is lower in individuals who take vitamin C.



$$\hat{p}_{placebo} - \hat{p}_{vitamin\ c} = \left(\frac{331}{405}\right) - \left(\frac{302}{403}\right)$$

$$= 0.0679.$$

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