Confidence Intervals Two Sample Difference in Proportions Free Response

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Question 1

Qualification: AP Statistics

Areas: Confidence Intervals

Subtopics: Two Sample Z Interval For Difference in Proportions

Paper: Part-A / Series: 2006-Form-B / Difficulty: Medium / Question Number: 2

2. A large company has two shifts—a day shift and a night shift. Parts produced by the two shifts must meet the same specifications. The manager of the company believes that there is a difference in the proportions of parts produced within specifications by the two shifts. To investigate this belief, random samples of parts that were produced on each of these shifts were selected. For the day shift, 188 of its 200 selected parts met specifications. For the night shift, 180 of its 200 selected parts met specifications.

   (a) Use a 96 percent confidence interval to estimate the difference in the proportions of parts produced within specifications by the two shifts.

   (b) Based only on this confidence interval, do you think that the difference in the proportions of parts produced within specifications by the two shifts is significantly different from 0 ? Justify your answer.

Question 2

Qualification: AP Statistics

Areas: Experimental Design, Confidence Intervals

Subtopics: Double Blind , Relative Risk, Constructing a Confidence Interval , Interpreting a Confidence Interval, Two Sample Z Interval For Difference in Proportions

Paper: Part-B / Series: 2009-Form-B / Difficulty: Hard / Question Number: 6

6. Two treatments, A and B, showed promise for treating a potentially fatal disease. A randomized experiment was conducted to determine whether there is a significant difference in the survival rate between patients who receive treatment A and those who receive treatment B. Of 154 patients who received treatment A, 38 survived for at least 15 years, whereas 16 of the 164 patients who received treatment B survived at least 15 years.

(a) Treatment A can be administered only as a pill, and treatment B can be administered only as an injection. Can this randomized experiment be performed as a double-blind experiment? Why or why not?

(b) The conditions for inference have been met. Construct and interpret a 95 percent confidence interval for the difference between the proportion of the population who would survive at least 15 years if given treatment A and the proportion of the population who would survive at least 15 years if given treatment B.

In many of these types of studies, physicians are interested in the ratio of survival probabilities, $\frac{p_A}{p_B}$, where p_A represents the true 15-year survival rate for all patients who receive treatment A and p_B represents the true 15-year survival rate for all patients who receive treatment B. This ratio is usually referred to as the relative risk of the two treatments.

For example, a relative risk of 1 indicates the survival rates for patients receiving the two treatments are equal, whereas a relative risk of 1.5 indicates that the survival rate for patients receiving treatment A is 50 percent higher than the survival rate for patients receiving treatment B. An estimator of the relative risk is the ratio of estimated probabilities, $\frac{\hat{p}_A}{\hat{p}_B}$.

(c) Using the data from the randomized experiment described above, compute the estimate of the relative risk.

The sampling distribution of $\frac{\hat{p}_A}{\hat{p}_B}$ is skewed. However, when both sample sizes n_A and n_B are relatively large, the distribution of $\ln\left(\frac{\hat{p}_A}{\hat{p}_B}\right)$ — the natural logarithm of relative risk — is approximately normal with a mean of $\ln\left(\frac{p_A}{p_B}\right)$ and a standard deviation of $\sqrt{\frac{1-p_A}{n_A p_A}+\frac{1-p_B}{n_B p_B}}$, where p_A and p_B can be estimated by using $\hat{p}_A$ and $\hat{p}_B$.

When a 95 percent confidence interval for $\ln\left(\frac{p_A}{p_B}\right)$ is known, an approximate 95 percent confidence interval for $\frac{p_A}{p_B}$ — the relative risk of the two treatments — can be constructed by applying the inverse of the natural logarithm to the endpoints of the confidence interval for $\ln\left(\frac{p_A}{p_B}\right)$.

(d) The conditions for inference are met for the data in the experiment above, and a 95 percent confidence interval for $\ln\left(\frac{p_A}{p_B}\right)$ is (0.3868, 1.4690). Construct and interpret a 95 percent confidence interval for the relative risk, $\frac{p_A}{p_B}$, of the two treatments.

(e) What is an advantage of using the interval in part (d) over using the interval in part (b) ?

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