

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.

$$n_1 \text{ (sample size of day shift)} = 200$$

$$p_1 \text{ (proportion of selected parts met specifications)} = \frac{188}{200}$$

$$n_2 \text{ (sample size of night shift)} = 200$$

$$p_2 \text{ (proportion of selected parts met specifications)} = \frac{180}{200}$$

p_d : difference in proportions of parts produced within specifications by two shifts

2-Proportion Z Interval will be used.

(C-Level is 96)

*Conditions $\Rightarrow n_1 p_1 = 188$, $n_1(1-p_1) = 22$, $n_2 p_2 = 180$, $n_2(1-p_2) = 20 > 10$
Random sample (given), we can assume day shift and night shift are independent.

$$\text{Left} = -0.01557 \quad \text{Right} = 0.095565$$

$$(-0.01557, 0.095565)$$

- (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.

$$H_0: p_d = 0$$

$$H_a: p_d \neq 0$$

Since 0 is in the 96 percent confidence interval, we have not enough evidence to reject H_0 . Therefore, the difference in the proportions of parts produced within specifications by the two shifts is not significantly different from 0.

GO ON TO THE NEXT PAGE.

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.

$$0.04 \pm 0.56$$

$$= -0.0156 \text{ to } 0.096 \quad \text{Confidence level } 96\%$$

Confidence interval for $p_1 - p_2$, where p_1 is the proportion for the day shift, and p_2 the night shift.

- (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.

Since the confidence interval contains 0, which indicates there is no difference, the two proportions are not significantly different at $\alpha = 0.04$. Based on the confidence interval, there is not enough evidence to suggest that there is a statistically significant difference between the proportions of the products within specifications for two different shifts.

GO ON TO THE NEXT PAGE.

AP[®] STATISTICS
2006 SCORING COMMENTARY (Form B)

Question 2

Sample: 2A

Score: 4

This essay identifies and computes a 96 percent confidence interval for the difference in two population proportions, uses the confidence interval to test the null hypothesis that the proportions are equal, and reaches appropriate conclusions. A correct formula for the confidence interval is provided and correct numerical substitutions into the formula are made. The assumption of independent samples is checked. The quantity

$\sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_1(1-p_1)}{n_1}}$ may not provide an appropriate standard error if the samples are not independent. The essay also shows that the sample sizes are large enough to accurately use the 98th percentile of the standard normal distribution in constructing the 96 percent confidence interval. The essay provides a good interpretation of the confidence interval with respect to estimating the difference in the proportions of parts that meet specifications for the two shifts. Part (b) clearly indicates that there is not sufficient evidence to support the manager's belief that the proportions are different, because the 96 percent confidence interval for the difference in the proportions contains zero. Although this essay lacks a direct connection to a significance level in part (b), and it switches to a 95 percent confidence level, it was scored as essentially correct.

Sample: 2B

Score: 3

In part (a) the essay clearly identifies the two proportions and corresponding sample sizes. A two-sample Z confidence is specified, and the lower and upper limits are correctly evaluated. Further, the essay presents the assumption that the day shift and night shift results are independent, and it explicitly checks for sufficiently large sample sizes. However, it fails to provide any interpretation of the confidence interval in part (a). The appropriate null and alternative hypotheses are stated in part (b), and an appropriate conclusion is reached by noting that the confidence interval includes zero. This essay also would have been stronger if it had made a connection between the 96 percent level of confidence and the $\alpha = 0.04$ level of significance.

Sample: 2C

Score: 2

This essay provides a good response to part (b) that uses the result that the confidence interval contains zeros to conclude that at the $\alpha = 0.04$ level of significance there is not enough evidence to conclude there is a difference between proportions of parts that meet specifications for the two shifts. In part (a) a correct 96 percent confidence interval is provided, but the essay does not identify the procedure for constructing the confidence, either by formula or in words; it does not address the assumptions of independent samples and large sample sizes; and it does not provide any interpretation of the confidence interval.