Q4

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Traditional formula

a $n = 37$ = Sample (random)
$X = 24$ = no helmets showing damage.

$$p = \frac{24}{37} = \frac{X}{n} = 0.649$$

Traditional confidence interval with 90%

$$p\left(-z_{\frac{\alpha}{2}} < \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n} + \frac{z^2_{\alpha/2}}{4n^2}}} \right.$$

$$1 + \frac{z^2_{\frac{\alpha}{2}}}{n}$$

$$p\left[-z_{\frac{\alpha}{2}} < \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}} < z_{\frac{\alpha}{2}}\right] = 100(1-\alpha)\%$$

$$p = \frac{\hat{p} + \frac{z^2_{\alpha/2}}{2n} + z_{\frac{\alpha}{2}}\sqrt{\frac{\hat{p}(1-\hat{p})}{n} + \frac{z^2_{\frac{\alpha}{2}}}{4n^2}}}{1 + \frac{z^2_{\frac{\alpha}{2}}}{n}}$$

$$\hat{p} \pm z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}\hat{q}}{n}}$$

$$0.649 \pm (1.645)\sqrt{\frac{0.649 \times 0.351}{37}}$$

$$0.649 \pm 0.129$$

$$(0.52, 0.778)$$

(b) $$n = \frac{4 z_{\frac{\alpha}{2}}^2 \hat{p}\hat{q}}{\omega^2} = \frac{4 \cdot (1.645)^2 (0.649)(0.351)}{(0.1)^2}$$

$$= 246.6 \approx 247$$