**15. Loans.**

**a)** $\mu_{\hat{p}} = p = 7\%$

$$\sigma(\hat{p}) = \sqrt{\frac{pq}{n}} = \sqrt{\frac{(0.07)(0.93)}{200}} \approx 1.8\%$$

**b) Randomization condition:** Assume that the 200 people are a representative sample of all loan recipients.

**10% condition:** A sample of this size is less than 10% of all loan recipients.

**Success/Failure condition:** $np = 14$ and $nq = 186$ are both greater than 10.

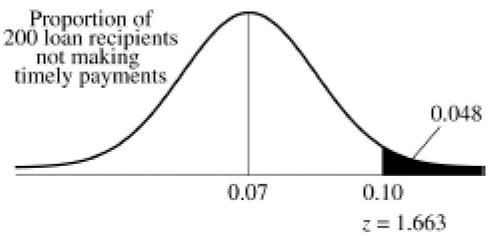
Therefore, the sampling distribution model for the proportion of 200 loan recipients who will not make payments on time is $N(0.07, 0.018)$.

**c)** According to the Normal model, the probability that over 10% of these clients will not make timely payments is approximately 0.048.

$$z = \frac{\hat{p} - \mu_{\hat{p}}}{\sqrt{\frac{pq}{n}}}$$

$$z = \frac{0.10 - 0.07}{\sqrt{\frac{(0.07)(0.93)}{200}}}$$

$$z \approx 1.663$$




**16. Contacts.**

**a) Randomization condition:** 100 students are selected at random.

**10% condition:** 100 is less than 10% of all of the students at the university, provided the university has more than 1000 students.

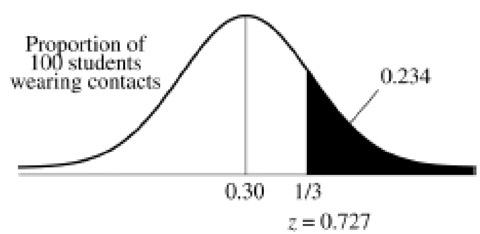
**Success/Failure condition:** $np = 30$ and $nq = 70$ are both greater than 10.

Therefore, the sampling distribution model for $\hat{p}$ is Normal, with:

$\mu_{\hat{p}} = p = 0.30$

$$\sigma(\hat{p}) = \sqrt{\frac{pq}{n}} = \sqrt{\frac{(0.30)(0.70)}{100}} \approx 0.046$$

**b)** According to the Normal model, the probability that more than one-third of the students in this sample wear contacts is approximately 0.234.




$$z = \frac{\hat{p} - \mu_{\hat{p}}}{\sqrt{\frac{pq}{n}}}$$

$$z = \frac{\frac{1}{3} - 0.30}{\sqrt{\frac{(0.30)(0.70)}{100}}}$$

$$z \approx 0.727$$

**19. Back to school, again.**

Provided that the students at this college are typical, the sampling distribution model for the retention rate, $\hat{p}$, is Normal with $\mu_{\hat{p}} = p = 0.74$ and standard deviation

$$\sigma(\hat{p}) = \sqrt{\frac{pq}{n}} = \sqrt{\frac{(0.74)(0.26)}{603}} \approx 0.018$$

This college has a right to brag about their retention rate. $522/603 = 86.6\%$ is over 7 standard deviations above the expected rate of 74%.

**21. Polling.**

**Randomization condition:** We must assume that the 400 voters were polled randomly.

**10% condition:** 400 voters polled represent less than 10% of potential voters.

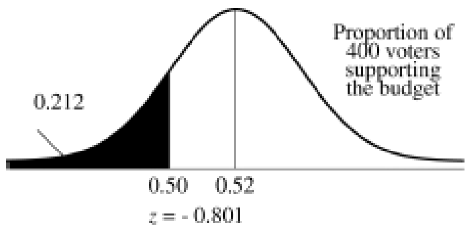
**Success/Failure condition:** $np = 208$ and $nq = 192$ are both greater than 10.

Therefore, the sampling distribution model for $\hat{p}$ is Normal, with:

$$\mu_{\hat{p}} = p = 0.52$$

$$\sigma(\hat{p}) = \sqrt{\frac{pq}{n}} = \sqrt{\frac{(0.52)(0.48)}{400}} \approx 0.025$$

According to the Normal model, the probability that the newspaper's sample will lead them to predict defeat (that is, predict budget support below 50%) is approximately 0.212.




$$z = \frac{\hat{p} - \mu_{\hat{p}}}{\sqrt{\frac{pq}{n}}}$$

$$z = \frac{0.50 - 0.52}{\sqrt{\frac{(0.52)(0.48)}{400}}}$$

$$z \approx -0.801$$

**23. Apples.**

**Randomization condition:** A random sample of 150 apples is taken from each truck.

**10% condition:** 150 is less than 10% of all apples.

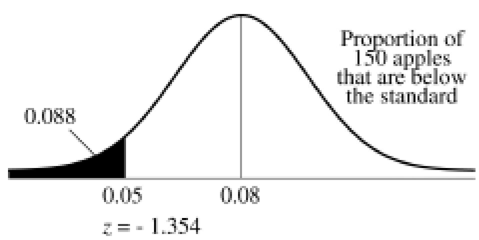
**Success/Failure Condition:** $np = 12$ and $nq = 138$ are both greater than 10.

Therefore, the sampling distribution model for $\hat{p}$ is Normal, with:

$$\mu_{\hat{p}} = p = 0.08$$

$$\sigma(\hat{p}) = \sqrt{\frac{pq}{n}} = \sqrt{\frac{(0.08)(0.92)}{150}} \approx 0.0222$$

According to the Normal model, the probability that less than 5% of the apples in the sample are unsatisfactory is approximately 0.088.




$$z = \frac{\hat{p} - \mu_{\hat{p}}}{\sqrt{\frac{pq}{n}}}$$

$$z = \frac{0.05 - 0.08}{\sqrt{\frac{(0.08)(0.92)}{150}}}$$

$$z \approx -1.354$$

**24. Genetic Defect.**

**Randomization condition:** We will assume that the 732 newborns are representative of all newborns.

**10% condition:** These 732 newborns certainly represent less than 10% of all newborns.

**Success/Failure condition:** $np = 29.28$ and $nq = 702.72$ are both greater than 10.

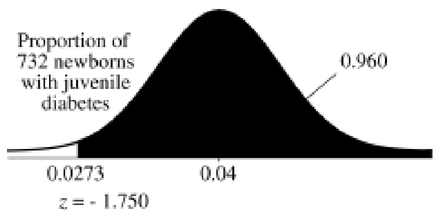
Therefore, the sampling distribution model for $\hat{p}$ is Normal, with:

$$\mu_{\hat{p}} = p = 0.04$$

$$\sigma(\hat{p}) = \sqrt{\frac{pq}{n}} = \sqrt{\frac{(0.04)(0.96)}{732}} \approx 0.0072$$

In order to get the 20 newborns for the study, the researchers hope to find at least $\hat{p} = \frac{20}{732} \approx 0.0273$ as the proportion of newborns in the sample with juvenile diabetes.

According to the Normal model, the probability that the researchers find at least 20 newborns with juvenile diabetes is approximately 0.960.




$$z = \frac{\hat{p} - \mu_{\hat{p}}}{\sqrt{\frac{pq}{n}}}$$

$$z = \frac{20/732 - 0.04}{\sqrt{\frac{(0.04)(0.96)}{732}}}$$

$$z \approx -1.750$$