1. **Send money.**

All of the histograms are centered around $p = 0.05$. As n gets larger, the shape of the histograms get more unimodal and symmetric, approaching a Normal model, while the variability in the sample proportions decreases.

6. **M&M's.**

a) The histogram of the proportions of green candies in the bags would probably be skewed slightly to the right, for the simple reason that the proportion of green M&M's could never fall below 0 on the left, but has the potential to be higher on the right.

b) The Normal model cannot be used to approximate the histogram, since the expected number of green M&M's is $np = 50(0.10) = 5$, which is less than 10. The Success/Failure condition is not met.

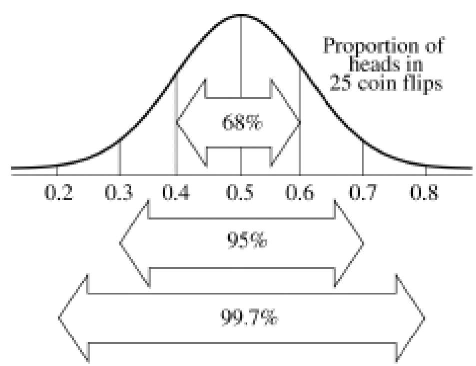
c) The histogram should be centered around the expected proportion of green M&M's, at about 0.10.

d) The proportion should have standard deviation $\sqrt{\frac{pq}{n}} = \sqrt{\frac{(0.1)(0.9)}{50}} \approx 0.042$.

7. **More coins.**

a) $\mu_{\hat{p}} = p = 0.5$ and $\sigma(\hat{p}) = \sqrt{\frac{pq}{n}} = \sqrt{\frac{(0.5)(0.5)}{25}} = 0.1$

About 68% of the sample proportions are expected to be between 0.4 and 0.6, about 95% are expected to be between 0.3 and 0.7, and about 99.7% are expected to be between 0.2 and 0.8.

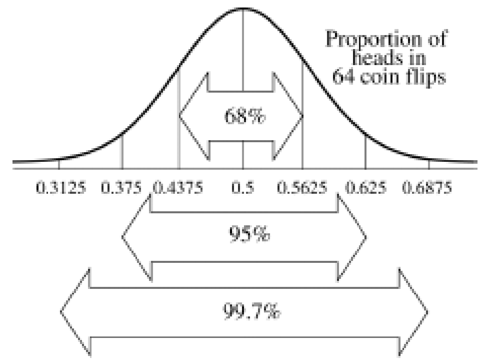


b) First of all, coin flips are independent of one another. There is no need to check the 10% Condition. Second, $np = nq = 12.5$, so both are greater than 10. The Success/Failure condition is met, so the sampling distribution model is $N(0.5, 0.1)$.

c) $\mu_{\hat{p}} = p = 0.5$ and $\sigma(\hat{p}) = \sqrt{\frac{pq}{n}} = \sqrt{\frac{(0.5)(0.5)}{64}} = 0.0625$

About 68% of the sample proportions are expected to be between 0.4375 and 0.5625, about 95% are expected to be between 0.375 and 0.625, and about 99.7% are expected to be between 0.3125 and 0.6875.

Coin flips are independent of one another, and $np = nq = 32$, so both are greater than 10. The Success/Failure condition is met, so the sampling distribution model is $N(0.5, 0.0625)$.



d) As the number of tosses increases, the sampling distribution model will still be Normal and centered at 0.5, but the standard deviation will decrease. The sampling distribution model will be less spread out.

25. Nonsmokers.

Randomization condition: We will assume that the 120 customers (to fill the restaurant to capacity) are representative of all customers.

10% condition: 120 customers represent less than 10% of all potential customers.

Success/Failure condition: $np = 72$ and $nq = 48$ are both greater than 10.

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

$$\mu_{\hat{p}} = p = 0.60$$

$$\sigma(\hat{p}) = \sqrt{\frac{pq}{n}} = \sqrt{\frac{(0.60)(0.40)}{120}} \approx 0.0447$$

Answers may vary. We will use 3 standard deviations above the expected proportion of customers who demand nonsmoking seats to be "very sure".

$$\mu_{\hat{p}} + 3\left(\sqrt{\frac{pq}{n}}\right) \approx 0.60 + 3(0.0447) \approx 0.734$$

Since 120(0.734) = 88.08, the restaurant needs at least 89 seats in the nonsmoking section.

31. Waist size revisited.

a)

n	Observed mean	Theoretical mean	Observed st. dev.	Theoretical standard deviation
2	36.314	36.33	2.855	$4.019/\sqrt{2} \approx 2.842$
5	36.314	36.33	1.805	$4.019/\sqrt{5} \approx 1.797$
10	36.341	36.33	1.276	$4.019/\sqrt{10} \approx 1.271$
20	36.339	36.33	0.895	$4.019/\sqrt{20} \approx 0.897$

b) The observed values are all very close to the theoretical values.

c) For samples as small as 5, the sampling distribution of sample means is unimodal and symmetric. The Normal model would be appropriate.

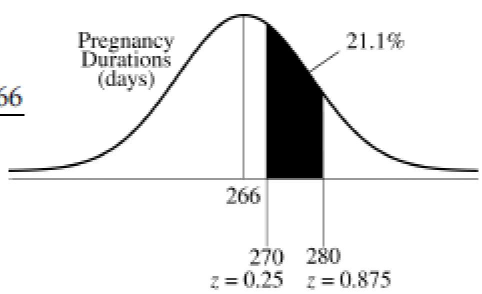
d) The distribution of the original data is nearly unimodal and symmetric, so it doesn't take a very large sample size for the distribution of sample means to be approximately Normal.

averages and will be more likely to be both safest and least safe.

37. Pregnancy.

a)

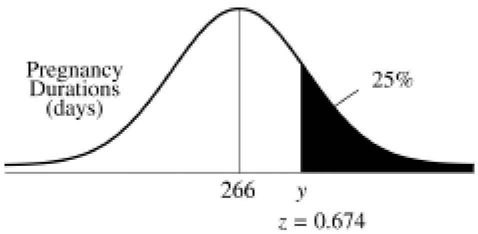
$$z = \frac{y-\mu}{\sigma}$$
$$z = \frac{270-266}{16}$$
$$z = 0.25$$



$$z = \frac{y-\mu}{\sigma}$$
$$z = \frac{280-266}{16}$$
$$z = 0.875$$

According to the Normal model, approximately 21.1% of all pregnancies are expected to last between 270 and 280 days.

b)



$$z = \frac{y - \mu}{\sigma}$$

$$0.674 = \frac{y - 266}{16}$$

$$y \approx 276.8 \text{ days}$$

According to the Normal model, the longest 25% of pregnancies are expected to last approximately 276.8 days or more.

c) **Randomization condition:** Assume that the 60 women the doctor is treating can be considered a representative sample of all pregnant women.

Independence assumption: It is reasonable to think that the durations of the patients' pregnancies are mutually independent.

10% condition: The 60 women that the doctor is treating certainly represent less than 10% of the population of all women.

Large Enough Sample condition: The sample of 60 women is large enough. In this case, any sample would be large enough, since the distribution of pregnancies is Normal.

The mean duration of the pregnancies was $\mu = 266$ days, with standard deviation $\sigma = 16$ days. Since the distribution of pregnancy durations is Normal, we can model the sampling distribution of the mean pregnancy duration with a Normal model, with

Large Enough Sample condition: The sample of 60 women is large enough. In this case, any sample would be large enough, since the distribution of pregnancies is Normal.

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$\mu_{\bar{y}} = 266$ days and standard deviation $\sigma(\bar{y}) = \frac{16}{\sqrt{60}} \approx 2.07$ days.

d) According to the Normal model, the probability that the mean pregnancy duration is less than 260 days is 0.002.