5.8 (3 points; one for each)

**5.8.** **(a)** The distribution of $\bar{x}$ is approximately Normal. (The distribution of observed values—that is, the population distribution—is unaffected by the sample size.) **(b)** $\bar{x}$ is within $\mu \pm 2\sigma/\sqrt{n}$ about 95% of the time. **(c)** The (distribution of the) sample mean $\bar{x}$ is approximately Normal. ($\mu$ is not random; it is just a number, albeit typically an unknown one.)

5.10 (3 points; one for each)

**5.10.** **(a)** $\sigma_{\bar{x}} = \sigma/\sqrt{200} \doteq 0.08132$. **(b)** With $n = 200$, $\bar{x}$ will be within $\pm 0.16$ (about 10 minutes) of $\mu = 7.02$ hours. **(c)** $P(\bar{x} \le 6.9) = P\left(Z \le \frac{6.9 - 7.02}{0.08132}\right) \doteq P(Z \le -1.48) \doteq 0.0694$.

5.11 (3 points; one for each)

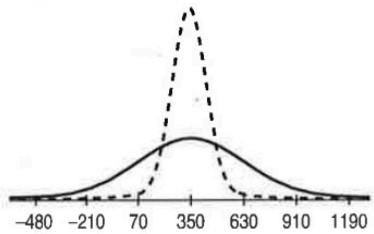
**5.11.** **(a)** With $n = 200$, the 95% probability range was about $\pm 10$ minutes, so need a larger sample size. (Specifically, to halve the range, we need to roughly quadruple the sample size.) **(b)** We need $2\sigma_{\bar{x}} = \frac{5}{60}$, so $\sigma_{\bar{x}} \doteq 0.04167$. **(c)** With $\sigma = 1.15$, we have $\sqrt{n} = \frac{1.15}{0.04167} = 27.6$, so $n = 761.76$—use 762 students.

5.12 (2 points; one for each)

**5.12.** **(a)** The standard deviation is $\sigma/\sqrt{10} = 280/\sqrt{10} \doteq 88.5438$ seconds. **(b)** In order to have $\sigma/\sqrt{n} = 15$ seconds, we need $\sqrt{n} = \frac{280}{15}$, so $n \doteq 348.4$—use $n = 349$.

5.14 (2 points; one for each)

**5.14.** **(a)** For this exercise, bear in mind that the actual distribution for a single song length is definitely *not* Normal; in particular, a Normal distribution with mean 350 seconds and standard deviation 280 seconds extends well below 0 seconds. The Normal curve for $\bar{x}$ should be taller by a factor of $\sqrt{10}$ and skinnier by a factor of $1/\sqrt{10}$ (although that technical detail will likely be lost on most students). **(b)** Using a $N(350, 280)$ distribution, $1 - P(331 < X < 369) \doteq 1 - P(-0.07 < Z < 0.07) \doteq 0.9442$. **(c)** Using a $N(350, 88.5438)$ distribution, $1 - P(331 < X < 369) \doteq 1 - P(-0.21 < Z < 0.21) \doteq 0.8336$.




5.19 (2 points; one for each)

**5.19.** **(a)** $\mu_{\bar{x}} = 0.5$ and $\sigma_{\bar{x}} = \sigma/\sqrt{50} = 0.7/\sqrt{50} \doteq 0.09899$. **(b)** Because this distribution is only approximately Normal, it would be quite reasonable to use the 68–95–99.7 rule to give a rough estimate: 0.6 is about one standard deviation above the mean, so the probability should be about 0.16 (half of the 32% that falls outside $\pm 1$ standard deviation). Alternatively, $P(\bar{x} > 0.6) \doteq P\left(Z > \frac{0.6 - 0.5}{0.09899}\right) = P(Z > 1.01) = 0.1562$.

5.21(2 points; one for each)

**5.21.** Let $X$ be Sheila's measured glucose level. **(a)** $P(X > 140) = P(Z > 1.5) = 0.0668$. **(b)** If $\bar{x}$ is the mean of three measurements (assumed to be independent), then $\bar{x}$ has a $N(125, 10/\sqrt{3})$ or $N(125 \text{ mg/dl}, 5.7735 \text{ mg/dl})$ distribution, and $P(\bar{x} > 140) = P(Z > 2.60) = 0.0047$.

5.22 (4 points; one for each)

**5.22.** **(a)** $\mu_X = (\$500)(0.001) = \$0.50$ and $\sigma_X = \sqrt{249.75} \doteq \$15.8035$. **(b)** In the long run, Joe makes about 50 cents for each \$1 ticket. **(c)** If $\bar{x}$ is Joe's average payoff over a year, then $\mu_{\bar{x}} = \mu = \$0.50$ and $\sigma_{\bar{x}} = \sigma_X/\sqrt{104} \doteq \$1.5497$. The central limit theorem says that $\bar{x}$ is approximately Normally distributed (with this mean and standard deviation). **(d)** Using this Normal approximation, $P(\bar{x} > \$1) \doteq P(Z > 0.32) = 0.3745$ (software: 0.3735).

5.23 (1 point)

**5.23.** The mean of three measurements has a $N(125 \text{ mg/dl}, 5.7735 \text{ mg/dl})$ distribution, and $P(Z > 1.645) = 0.05$ if $Z$ is $N(0, 1)$, so $L = 125 + 1.645 \cdot 5.7735 \doteq 134.5$ mg/dl.

5.25 (1 point)

**5.25.** If $W$ is total weight, and $\bar{x} = W/25$, then:

$$P(W > 5200) = P(\bar{x} > 208) \doteq P\left(Z > \frac{208-190}{5/\sqrt{25}}\right) = P(Z > 2.57) = 0.0051$$

Ch5.2

5.41 (3 points; one for each)

(a) Separate flips are independent (coins have no "memory").

(b) Separate flips are independent (coins have no "memory").

(c) $\hat{p}$ can vary from one set of observed data to another; it is not a parameter.

5.42 (3 points; one for each)

**5.42. (a)** $X$ is a *count;* $\hat{p}$ is a proportion. **(b)** The given formula is the *standard deviation* for a binomial *proportion*. The variance for a binomial count is $np(1-p)$. **(c)** The rule of thumb in the text is that $np$ and $n(1-p)$ should both be at least 10. If $p$ is close to 0 (or close to 1), $n = 1000$ might not satisfy this rule of thumb. (See also the solution to Exercise 5.22.)

5.44 (3 points; one for each)

**5.44. (a)** This is not binomial; $X$ is not a count of successes. **(b)** A $B(20, p)$ distribution seems reasonable, where $p$ (unknown) is the probability of a defective pair. **(c)** This should be (at least approximately) the $B(n, p)$ distribution, where $n$ is the number of students in our sample, and $p$ is the probability that a randomly-chosen student eats at least five servings of fruits and vegetables.

5.46 (2 points; one for each)

**5.46. (a)** The $B(20, 0.3)$ distribution (at least approximately). **(b)** $P(X \geq 8) = 0.2277$.

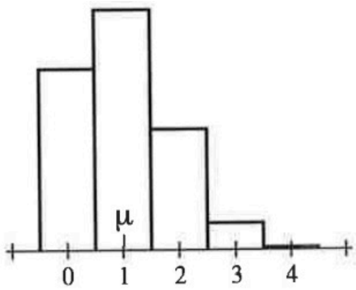
5.48 (2 points; one for each)

**5.48.** $X$, the number who listen to streamed music daily, has the $B(20, 0.25)$ distribution. **(a)** $\mu_X = np = 5$, and $\mu_{\hat{p}} = 0.25$. **(b)** With $n = 200$, $\mu_X = 50$ and $\mu_{\hat{p}} = 0.25$. With $n = 2000$, $\mu_X = 500$ and $\mu_{\hat{p}} = 0.25$. $\mu_X$ increases with $n$, while $\mu_{\hat{p}}$ does not depend on $n$.

5.53 (3 points; one for each)

**5.53. (a)** $n = 4$ and $p = 1/4 = 0.25$. **(b)** The distribution is below; the histogram is on the right. **(c)** $\mu = np = 1$.

| $x$ | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $P(X = x)$ | .3164 | .4219 | .2109 | .0469 | .0039 |




5.58 (4 points; one for each)

**5.58. (a)** $\hat{p} = \frac{294}{400} = 0.735$. **(b)** With $p = 0.8$, $\sigma_{\hat{p}} = \sqrt{(0.8)(0.2)/400} = 0.02$. **(c)** Still assuming that $p = 0.8$, we would expect that about 95% of the time, $\hat{p}$ should fall between 0.76 and 0.84. **(d)** It appears that these students prefer this type of course less than the national average. (The observed value of $\hat{p}$ is quite a bit lower than we would expect from a $N(0.8, 0.2)$ distribution, which suggests that it came from a distribution with a lower mean.)

5.62 (4 points; one for each)

**5.62. (a)** $\mu = (1200)(0.75) = 900$ and $\sigma = \sqrt{225} = 15$ students. **(b)** $P(X \geq 800) \doteq P(Z \geq -6.67) = 1$ (essentially). **(c)** $P(X \geq 951) \doteq P(Z \geq 3.4) = 0.0003$. **(d)** With $n = 1300$, $P(X \geq 951) \doteq P(Z \geq -1.54) = 0.9382$. Other answers are shown in the table on the right.

| | | *Continuity correction* | |
|---|---|---|---|
| Table Normal | Software Normal | Table Normal | Software Normal |
| 0.9382 | 0.9379 | 0.9418 | 0.9417 |

5.68 (3 points; one for each)

**5.68. (a)** $P(\text{first } \boxdot \text{ appears on toss } 2) = \left(\frac{5}{6}\right)\left(\frac{1}{6}\right) = \frac{5}{36}$.

**(b)** $P(\text{first } \boxdot \text{ appears on toss } 3) = \left(\frac{5}{6}\right)\left(\frac{5}{6}\right)\left(\frac{1}{6}\right) = \frac{25}{216}$.

**(c)** $P(\text{first } \boxdot \text{ appears on toss } 4) = \left(\frac{5}{6}\right)^3\left(\frac{1}{6}\right)$.

$P(\text{first } \boxdot \text{ appears on toss } 5) = \left(\frac{5}{6}\right)^4\left(\frac{1}{6}\right)$.

5.69 (1 point)

**5.69.** $Y$ has possible values $1, 2, 3, \ldots$. $P(\text{first } \boxdot \text{ appears on toss } k) = \left(\frac{5}{6}\right)^{k-1}\left(\frac{1}{6}\right)$.