1. **Problem:**
   Let each trial have a chance of success $p = 0.71$. If 218 trials occur, what is the probability of getting at least 149 but at most 164 successes?

   In other words, let $X \sim \text{Bin}(n = 218,\ p = 0.71)$ and find $P(149 \leq X \leq 164)$.

   Use a normal approximation along with the continuity correction.

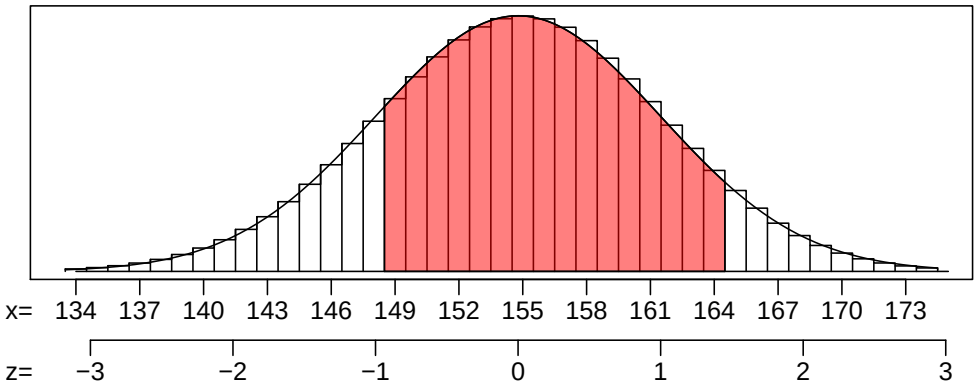
Solution: Find the mean.

$$\mu = np = (218)(0.71) = 154.78$$

Find the standard deviation.

$$\sigma = \sqrt{np(1-p)} = \sqrt{(218)(0.71)(1-0.71)} = 6.6997$$

Make a sketch, specifically try to picture whether you need to add or subtract 0.5 for the continuity correction.



Find the z scores.

$$z_1 = \frac{148.5 - 154.78}{6.6997} = -0.94$$

$$z_2 = \frac{164.5 - 154.78}{6.6997} = 1.45$$

Find the percentiles (from z-table).

$$\ell_1 = 0.1736$$

$$\ell_2 = 0.9265$$

Calculate the probability.

$$P(149 \leq X \leq 164) = 0.9265 - 0.1736 = 0.7529$$

2. **Problem:**
   Let each trial have a chance of success $p = 0.12$. If 93 trials occur, what is the probability of getting more than 10 but less than 17 successes?

   In other words, let $X \sim \text{Bin}(n = 93, p = 0.12)$ and find $P(10 < X < 17)$.

   Use a normal approximation along with the continuity correction.

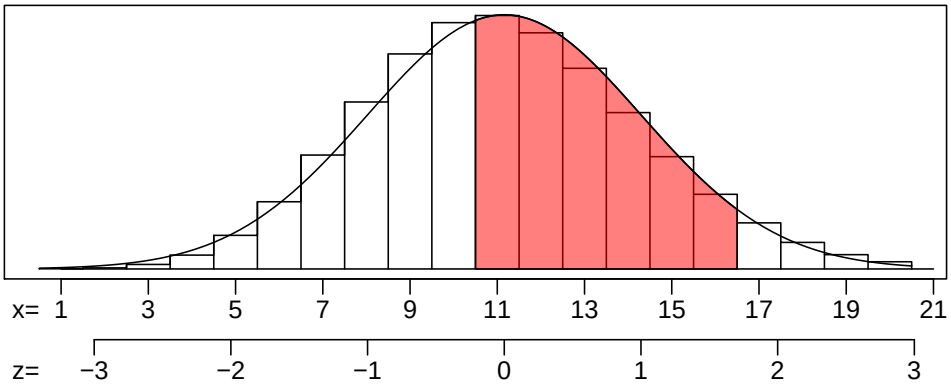
Solution: Find the mean.

$$\mu = np = (93)(0.12) = 11.16$$

Find the standard deviation.

$$\sigma = \sqrt{np(1-p)} = \sqrt{(93)(0.12)(1-0.12)} = 3.1338$$

Make a sketch, specifically try to picture whether you need to add or subtract 0.5 for the continuity correction.



Find the z scores.

$$z_1 = \frac{10.5 - 11.16}{3.1338} = -0.21$$

$$z_2 = \frac{16.5 - 11.16}{3.1338} = 1.7$$

Find the percentiles (from z-table).

$$\ell_1 = 0.4168$$

$$\ell_2 = 0.9554$$

Calculate the probability.

$$P(10 < X < 17) = 0.9554 - 0.4168 = 0.538$$

3. **Problem:**
   Let each trial have a chance of success $p = 0.7$. If 94 trials occur, what is the probability of getting more than 59 but at most 71 successes?

   In other words, let $X \sim \text{Bin}(n = 94, p = 0.7)$ and find $P(59 < X \leq 71)$.

   Use a normal approximation along with the continuity correction.

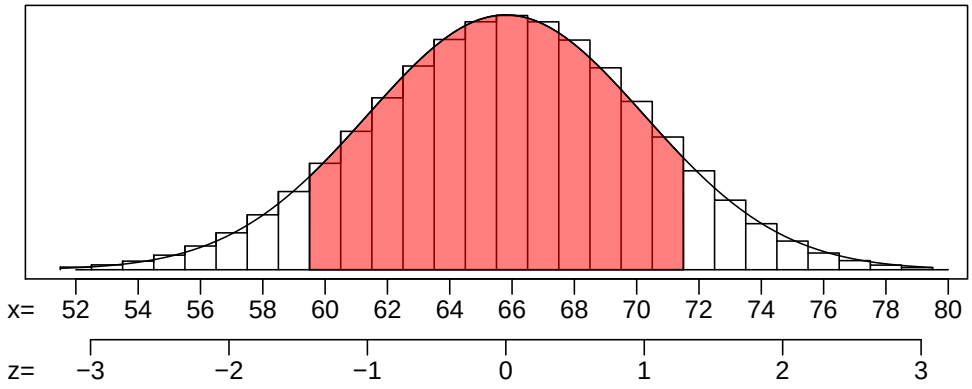
Solution: Find the mean.

$$\mu = np = (94)(0.7) = 65.8$$

Find the standard deviation.

$$\sigma = \sqrt{np(1-p)} = \sqrt{(94)(0.7)(1-0.7)} = 4.443$$

Make a sketch, specifically try to picture whether you need to add or subtract 0.5 for the continuity correction.



Find the z scores.

$$z_1 = \frac{59.5 - 65.8}{4.443} = -1.42$$

$$z_2 = \frac{71.5 - 65.8}{4.443} = 1.28$$

Find the percentiles (from z-table).

$$\ell_1 = 0.0778$$

$$\ell_2 = 0.8997$$

Calculate the probability.

$$P(59 < X \leq 71) = 0.8997 - 0.0778 = 0.822$$

4. **Problem:**
   Let each trial have a chance of success $p = 0.87$. If 128 trials occur, what is the probability of getting at least 114 but less than 120 successes?

   In other words, let $X \sim \text{Bin}(n = 128,\ p = 0.87)$ and find $P(114 \leq X < 120)$.

   Use a normal approximation along with the continuity correction.

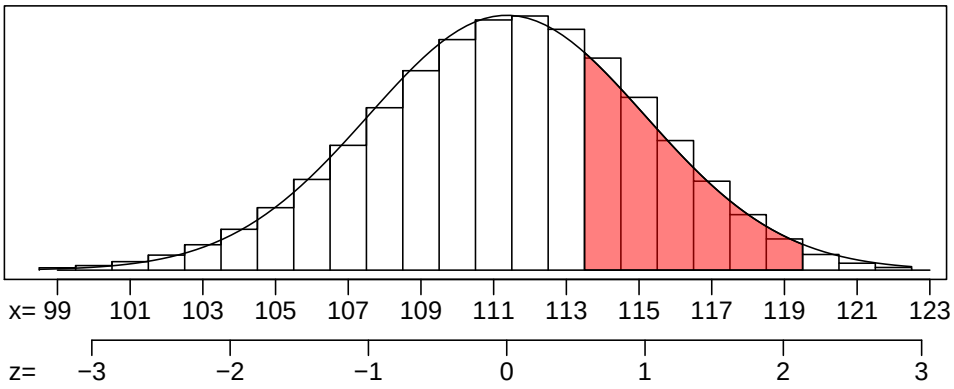
Solution: Find the mean.

$$\mu = np = (128)(0.87) = 111.36$$

Find the standard deviation.

$$\sigma = \sqrt{np(1-p)} = \sqrt{(128)(0.87)(1-0.87)} = 3.8048$$

Make a sketch, specifically try to picture whether you need to add or subtract 0.5 for the continuity correction.



Find the z scores.

$$z_1 = \frac{113.5 - 111.36}{3.8048} = 0.56$$

$$z_2 = \frac{119.5 - 111.36}{3.8048} = 2.14$$

Find the percentiles (from z-table).

$$\ell_1 = 0.7123$$

$$\ell_2 = 0.9838$$

Calculate the probability.

$$P(114 \leq X < 120) = 0.9838 - 0.7123 = 0.272$$

5. **Problem:**
   Let each trial have a chance of success $p = 0.92$. If 140 trials occur, what is the probability of getting more than 131 but less than 136 successes?

   In other words, let $X \sim \text{Bin}(n = 140,\ p = 0.92)$ and find $P(131 < X < 136)$.

   Use a normal approximation along with the continuity correction.

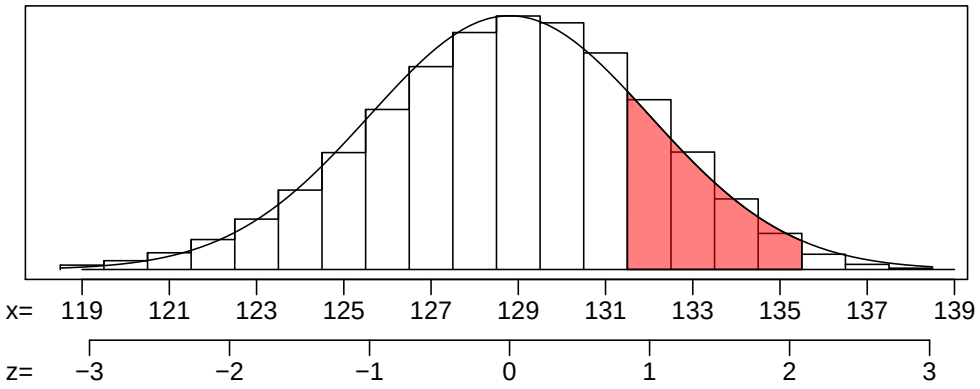
Solution: Find the mean.

$$\mu = np = (140)(0.92) = 128.8$$

Find the standard deviation.

$$\sigma = \sqrt{np(1-p)} = \sqrt{(140)(0.92)(1-0.92)} = 3.21$$

Make a sketch, specifically try to picture whether you need to add or subtract 0.5 for the continuity correction.



Find the z scores.

$$z_1 = \frac{131.5 - 128.8}{3.21} = 0.84$$

$$z_2 = \frac{135.5 - 128.8}{3.21} = 2.09$$

Find the percentiles (from z-table).

$$\ell_1 = 0.7995$$

$$\ell_2 = 0.9817$$

Calculate the probability.

$$P(131 < X < 136) = 0.9817 - 0.7995 = 0.182$$

6. **Problem:**
   Let each trial have a chance of success $p = 0.95$. If 232 trials occur, what is the probability of getting more than 221 but at most 228 successes?

   In other words, let $X \sim \text{Bin}(n = 232,\ p = 0.95)$ and find $P(221 < X \leq 228)$.

   Use a normal approximation along with the continuity correction.

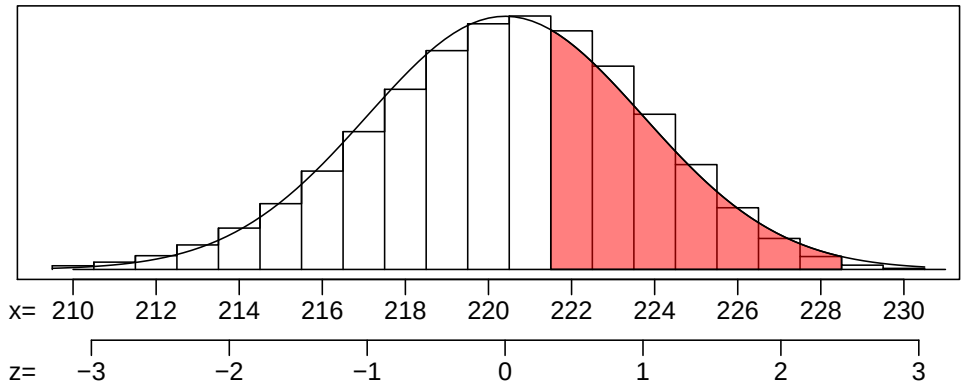
Solution: Find the mean.

$$\mu = np = (232)(0.95) = 220.4$$

Find the standard deviation.

$$\sigma = \sqrt{np(1-p)} = \sqrt{(232)(0.95)(1-0.95)} = 3.3196$$

Make a sketch, specifically try to picture whether you need to add or subtract 0.5 for the continuity correction.



Find the z scores.

$$z_1 = \frac{221.5 - 220.4}{3.3196} = 0.33$$

$$z_2 = \frac{228.5 - 220.4}{3.3196} = 2.44$$

Find the percentiles (from z-table).

$$\ell_1 = 0.6293$$

$$\ell_2 = 0.9927$$

Calculate the probability.

$$P(221 < X \leq 228) = 0.9927 - 0.6293 = 0.364$$

7. **Problem:**
   Let each trial have a chance of success $p = 0.33$. If 123 trials occur, what is the probability of getting at least 40 but at most 52 successes?

   In other words, let $X \sim \text{Bin}(n = 123,\ p = 0.33)$ and find $P(40 \leq X \leq 52)$.

   Use a normal approximation along with the continuity correction.

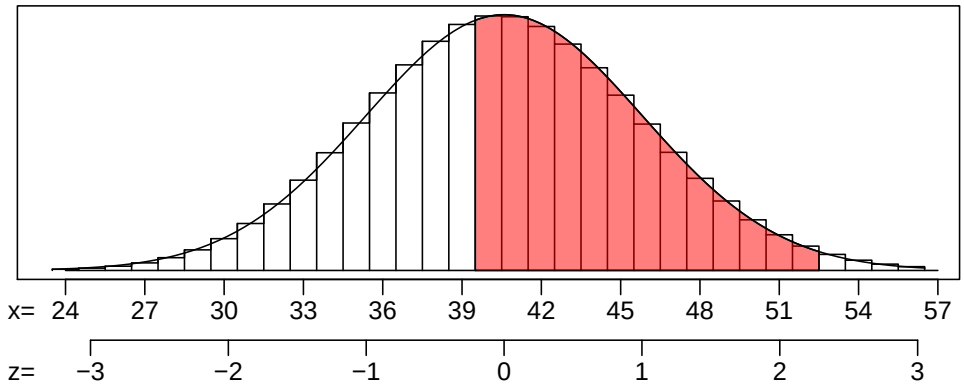
Solution: Find the mean.

$$\mu = np = (123)(0.33) = 40.59$$

Find the standard deviation.

$$\sigma = \sqrt{np(1-p)} = \sqrt{(123)(0.33)(1-0.33)} = 5.2149$$

Make a sketch, specifically try to picture whether you need to add or subtract 0.5 for the continuity correction.



Find the z scores.

$$z_1 = \frac{39.5 - 40.59}{5.2149} = -0.21$$

$$z_2 = \frac{52.5 - 40.59}{5.2149} = 2.28$$

Find the percentiles (from z-table).

$$\ell_1 = 0.4168$$

$$\ell_2 = 0.9887$$

Calculate the probability.

$$P(40 \leq X \leq 52) = 0.9887 - 0.4168 = 0.5719$$

8. **Problem:**
   Let each trial have a chance of success $p = 0.84$. If 206 trials occur, what is the probability of getting at least 170 but less than 183 successes?

   In other words, let $X \sim \text{Bin}(n = 206,\ p = 0.84)$ and find $P(170 \leq X < 183)$.

   Use a normal approximation along with the continuity correction.

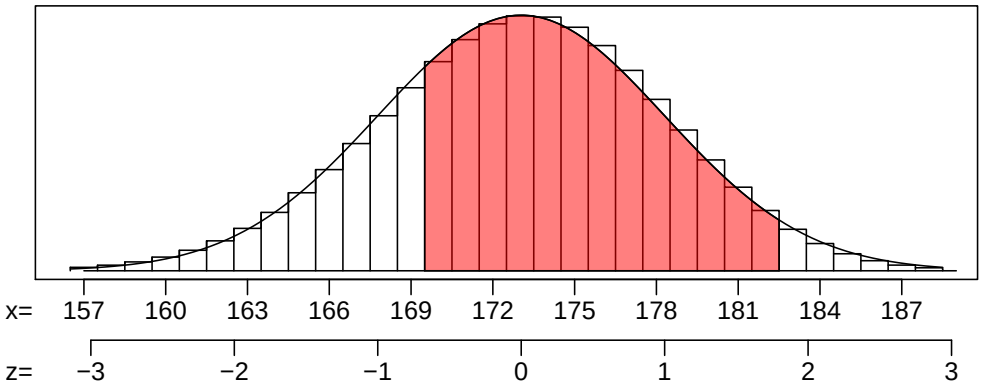
Solution: Find the mean.

$$\mu = np = (206)(0.84) = 173.04$$

Find the standard deviation.

$$\sigma = \sqrt{np(1-p)} = \sqrt{(206)(0.84)(1-0.84)} = 5.2618$$

Make a sketch, specifically try to picture whether you need to add or subtract 0.5 for the continuity correction.



Find the z scores.

$$z_1 = \frac{169.5 - 173.04}{5.2618} = -0.67$$

$$z_2 = \frac{182.5 - 173.04}{5.2618} = 1.8$$

Find the percentiles (from z-table).

$$\ell_1 = 0.2514$$

$$\ell_2 = 0.9641$$

Calculate the probability.

$$P(170 \leq X < 183) = 0.9641 - 0.2514 = 0.713$$