Measuring Variability:
1. Simply by looking at ranges we can determine that Group 3 has the largest amount of variability (Range = 33) while Group 2 has the smallest amount of variability (Range = 6). You could also calculate sample standard deviations to show the same thing.

\[ V(Y) = \sigma_Y^2 = \frac{\sum(Y_i - \bar{Y})^2}{n-1} = \frac{\sum Y^2 - (\sum Y)^2}{n-1} = 9.5 \]

\[ \text{Cov}(X,Y) = \frac{\sum(X_i - \bar{X})(Y_i - \bar{Y})}{n-1} = \frac{\sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n-1} = 8.5 \]

\[ r = \frac{\text{Cov}(X,Y)}{(S_X)(S_Y)} = 0.872 \]

Note: In all cases, if the limiting instructions on the summation are omitted, sum over all \( i \)

Normal Probability Distribution:
1. \( a = 0.31 \)
2. \( a = -1.96 \)
3. 0.05
4. \( 0.4641 - 0.3413 = 0.1228 \)
5. Interquartile Range = \( Q_3 - Q_1 \), or the middle 50% of the values, with 25% on either side of the mean due to the symmetry of the Normal distribution. The corresponding Z-score is \( \approx 0.675 \). The Z-score tells us that the defining x values are 0.675 standard deviations above and below the mean.

Values are \( 100 \pm (0.675)(5) \Rightarrow 96.625 \text{ and } 103.375 \)

6. \( 2(.5000 - .4332) = 0.1336 \)
7. \( P(-5 \leq X - \mu \leq 5) = P(-1 \leq Z \leq 1) = .6826 \)

If the standard deviation decreases, the probability will increase. Consider the effect the smaller standard deviation has on the spread of the distribution, and therefore on Z-score.
8. a. \( P(X < 0) = P(Z < -2) = .5000 - .4772 = .0228 \)

b. \( P(X < 0) = P(Z < -1) = .5000 - .3413 = .1587 \) Notice how increasing the variability increases the chance of losing money. Higher variance in return means higher risk associated with the investment.

9. a. \( P(X < 115) = 0.90 \) The corresponding Z-score is 1.282.

\[
1.282 = \frac{115 - 100}{\sigma} \quad \Rightarrow \quad \sigma = 11.7
\]

b. \( P(X > x) = 0.05 \) The corresponding Z-score is 1.645. Therefore, the value \( x \) must be 1.645 standard deviations above the mean.

\[
x = \mu + (1.645)(\sigma) = 100 + (1.645)(11.7) = 119.25 \Rightarrow 120
\]

10. a. \( P(X > 72,000) = P(Z > 1.25) = .5000 - .3944 = .1056 \)

b. \( E[\text{Loss}] = (\$5,000)(.1056) + (\$0)(1 - .1056) \) Since the expected loss is higher than the $200 cost of the extra employees, hire the additional employees.

Sampling Distributions:
1. a. \( P(X > 80) = P(Z > 0.60) = .5000 - .2257 = .2743 \) Notice that this part of the problem is about the original population variable \( X \) and its distribution, not a sampling distribution. The question is about the responses for one weekend.

b. \( P(\bar{X} > 80) = P(Z > 1.90) = .5000 - .4713 = .0287 \) This part of the problem is about the sampling distribution of \( \bar{X} \). The question is about the average response over 10 weekends. Did you remember to use \( \sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}} \)?

2. a. \( P(-0.01 \leq \bar{X} - \mu \leq 0.01) = P(-1.11 \leq Z \leq 1.11) = 2(.3665) = .7330 \)

b. To have probability = 0.95, we need \( P(-1.96 \leq Z \leq 1.96) \)

\[
1.96 = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}} = \frac{0.01}{0.07/\sqrt{n}} \quad \Rightarrow \quad n = 188.2384 \Rightarrow n = 189
\]

3. \( P(\hat{p} < 0.10) = P(Z_{\hat{p}} = \frac{\hat{p} - p}{\sqrt{p(1-p)/n}} < -1.64) = .5000 - .4495 = .0505 \) You should have verified that using the Normal approximation to the Binomial was a reasonable thing to do: \( np \) and \( n(1-p) \) need to be at least 5.