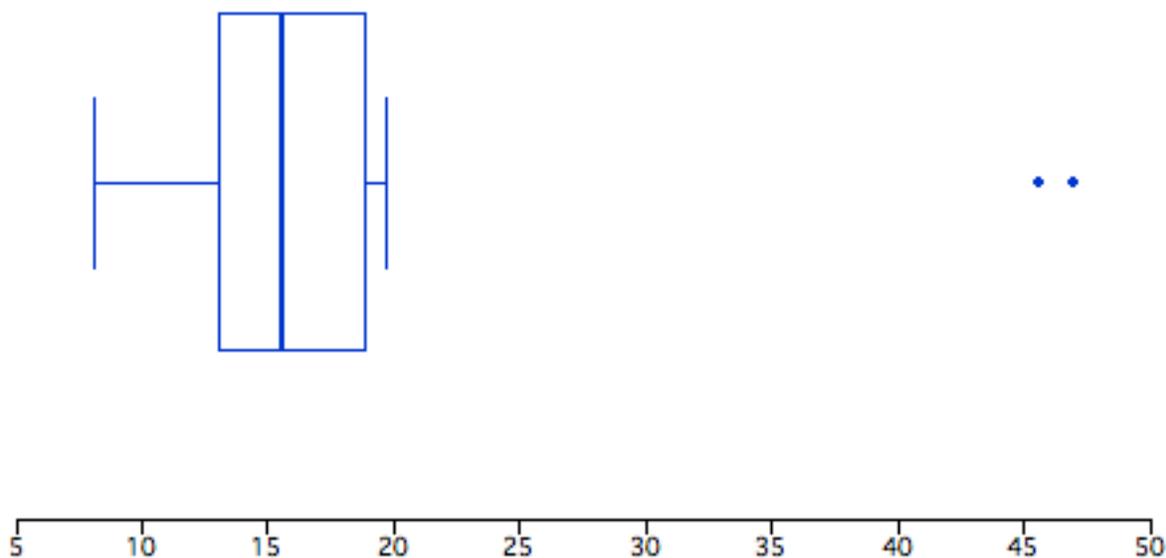


Midterm Answers

1. There is clearly reverse causation here.
2. The minimum is 8.1, the first quartile is 13.0, the median is 15.4, the third quartile is 18.85, the maximum is 46.9. There are two outliers, at 45.6 and 46.9



3. This is an example of the fallacious law of averages.
4. Using the binomial distribution:
 
$$P[6,013 \leq X \leq 6,021] = \sum_{X=6,023}^{6,021} \binom{8,023}{X} 0.75^X 0.25^{8,023-X} = 0.0923$$
5.
  - a. Average after-tax income is the same because each system raises the same amount of revenue.
  - b. The standard deviation of after-tax income is higher with (b) because it simply shifts the income distribution, while (a) compresses it.
6. The SOI is the Z value multiplied by 10. A SOI reading of -22.8 corresponds to a z value of -2.28, which has a probability of 0.0113.

7. This is like the birthday paradox. First determine the probability of no matches. The first person can have any sign. The second must have one of the remaining 11 signs, the third person one of the remaining 10 signs, and the fourth person one of the remaining nine signs. The probability of at least one match is equal to one minus the probability of no matches:

$$1 - 1 \frac{11}{12} \frac{10}{12} \frac{9}{12} = 0.427$$

8. The probability that the first digit is the same in all three months is  $P1 = 0.4^3 + 0.3^3 + 0.2^3 + 0.1^3$ . The probability that the last two digits match three times is  $P2 = (1/100)^2$ . The probability that all three digits match is  $P1 * P2$ .

9. It doesn't matter which X-Ray is done first, so let's assume the positive result comes back first. Based on this result, the revised probability is

$$P[M \text{ if } +] = \frac{P[M]P[+ \text{ if } M]}{P[M]P[+ \text{ if } M] + P[B]P[+ \text{ if } B]} = \frac{0.01(0.8)}{0.01(0.8) + 0.99(0.1)} = \frac{8}{107} = 0.075$$

Using this new probability, we can revise our probability in light of the negative test result:

$$P[M \text{ if } + -] = \frac{P[M]P[- \text{ if } M]}{P[M]P[- \text{ if } M] + P[B]P[- \text{ if } B]} = \frac{(8/107)(0.2)}{(8/107)(0.2) + (99/107)(0.9)} = \frac{16}{907} = 0.01764$$

Alternatively, we can directly calculate the revised probability in light of a positive and then negative test result:

$$P[M \text{ if } + -] = \frac{P[M]P[+ - \text{ if } M]}{P[M]P[+ - \text{ if } M] + P[B]P[+ - \text{ if } B]} = \frac{(0.01)(0.8)(0.2)}{(0.01)(0.8)(0.2) + (0.99)(0.1)(0.9)} = \frac{16}{907} = 0.01764$$

10. This study has survivor bias because it ignored funds that existed in 1970, but are no longer around. In fact, 40 percent of the 1970 funds had disappeared by 1990. When the performance of these disappearing funds is taken into account, mutual funds did worse than the overall market.