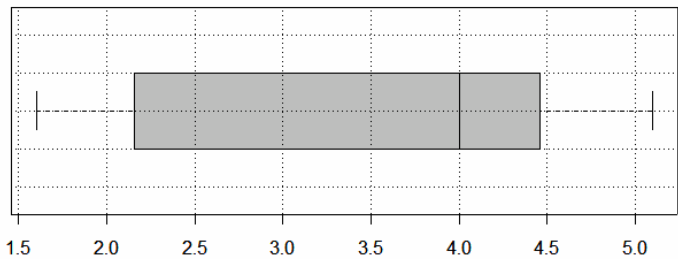
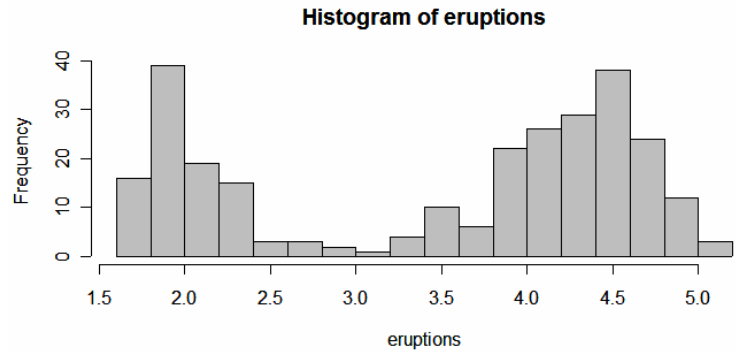


Quiz #1 (50 minutes) Name _____

- Open book and open note. Use a simple calculator if necessary. Show your work. Each subproblem is 3 point each.

1. Here is the distribution of the duration of 272 eruptions (in minutes) at Old Faithful.

- What's the median duration? Where's the mode(s)? (The mean duration is 3.49 minutes, by the way)
- What's the range of the distribution?
- What's the IQR of the distribution?
- How many outliers are there in the distribution?
- (6 pt) If you observe an eruption with duration 10 minutes, would you count it as an outlier in the boxplot? Explain.
- How would you describe the eruption duration distribution?



2. A smoke detector system uses two devices, A and B. If smoke is present, the probability that it will be detected by device A is .95; by device B, .90. Assume the two devices work independently.

- Find the probability that the smoke will be detected by both A and B.
- Find the probability that the smoke will be detected by either device A or B or both devices.

2. You want to inspect whether a coin is weighted and probability of head is larger than 50%. You toss it 100 times to check it out.

- Let Y be the number of heads appearing in 100 tosses. It has binomial distribution. What are the values of the parameters n and π assuming the coin was fair?
- Approximate the distribution in a) by normal distribution, again assuming the coin was fair. Specify the mean and standard deviation.
- At the end of the experiment, you have observed 55 heads. Were the true head probability be 50%, what would be the chance that the observed number of heads is greater than or equal to 55? Is it very likely, somewhat likely, or unlikely? Use the approximate distribution you gave in c).
- (6 pt) Consider a similar experiment but assume you tossed 1,000 times instead of 100 and observed 600 heads. Repeat b and c for this new experiment.

Quiz #1 Solutions

1. (All answers are approximate since no numerical clues are provided)

a. median is 4.0. Two modes are at near 1.9 and 4.5

b. the range is $\sim 5.1 - 1.6 = 3.5$

c. the IQR is $\sim 4.4 - 2.2 = 2.2$

d. No outliers

e. Right inner fence is $Q3 + 1.5 \cdot IQR = 4.4 + 1.5 \cdot 2.2 = 4.4 + 3.3 = 7.7$. 10 is larger than this so it will show as an outlier in the boxplot.

f. It's bimodal

2.

a. $P(A \text{ and } B) = 0.95 \cdot 0.90 = 0.855$

b. $P(A \text{ or } B) = 0.95 + 0.90 - 0.855 = 0.995$

2.

a. $n = 100$ and $\pi = 0.5$

b. $\mu = n\pi = 50$ and $\sigma = \sqrt{100 \cdot 0.5 \cdot 0.5} = 5$

c. $P(Y > 55) \sim P(Z > (55 - 50)/5) = 1 - \text{pnorm}(1) = 0.159$. It is somewhat likely.

d. $\mu = n\pi = 500$ and $\sigma = \sqrt{1000 \cdot 0.5 \cdot 0.5} = 15.8$.

$P(Y > 550) \sim P(Z > (550 - 500)/15.8) = 1 - \text{pnorm}(3.165) \sim 0$. It is very unlikely.

R-codes used for the plots:

```
attach(faithful)
```

```
par(mfrow=c(2,1))
```

```
hist(eruptions, nclass=20, col='gray')
```

```
boxplot(eruptions, horizontal=TRUE, col='gray')
```

```
grid(col='black')
```