# Problem 4

Exercise 1ab on page 346, but use this subset of data:

## a)

For this point estimate, $\bar{X}$ is used:

$$\hat{\mu} = \bar{X} = \frac{X_1 + ... + X_n}{n} = 113.7$$

The estimated standard error is the sample standard deviation divided by $\sqrt{n}$

$$\hat{\sigma}_{\bar{X}} = \frac{s}{\sqrt{n}} = 13.0$$

```
const IQ = [
   82,  96, 102, 103, 106, 107, 108, 108, 108, 109, 110, 110, 111,
  113, 113, 113, 115, 115, 118, 119, 121, 122, 127, 136, 140, 146,
]
const xBar = mean(IQ)
const stdErr = stdev(IQ) / Math.sqrt(IQ.length)
console.table([{ xBar, stdErr }])
```

## b)

The estimate of the value that separates the lowest 50% from the highest 50%, is the sample median.

$$\hat{m} = \tilde{X} = \frac{113 - 111}{2} = 112$$

The estimated standard error determined by bootstrapping method was 2.5

```
const boostrapSample = sample => {
  return sample.map(() => {
    const r = Math.floor(Math.random() * sample.length)
    return sample[r]
  })
}

const B = 200;
const bootstrapMedians = []
for (let i = 0; i < B; i++) {
  bootstrapMedians.push(median(boostrapSample(IQ)))
}
const SB = Math.sqrt((1/(B - 1) * variance(bootstrapMedians)))
console.log(SB)
```