

**22S:166**  
**Homework 5**

Due Wed. Oct. 15

### 1 Bootstrap

1. A data frame called `aircondit` comes with the `boot` package. Access it, and also read its description in the “help” for the `boot` package.

```
hours
3
5
7
18
43
85
91
98
100
130
230
487
```

Carry out a *parametric* bootstrap analysis concerning the log of the sample mean as an estimator of the log of the population mean. Assume that the population distribution of failure times of airconditioning equipment is exponential.

- (a) Estimate the standard error of the log sample mean.
  - (b) Estimate the bias, and produce an “unbiased” estimate.
  - (c) Produce confidence intervals for the log population mean by the percentile method and the BCa method.
2. The bootstrap is not foolproof. To see this, consider analysis of a binomial model with “n” trials. You observe 0 successes. Discuss what would happen if you were to use the standard, non-parametric bootstrap in constructing a 95% C.I. for the binomial parameter  $p$ .

### 2 Jackknife

Carry out a reanalysis of the airconditioning data using the jackknife to estimate the standard error, and bias. To produce a confidence interval, take your original estimate, plus or minus twice your estimated standard error. Since the jackknife is a nonparametric procedure, your results can't be directly compared with those from the parametric bootstrap.

### 3 Rootfinding

The function

$$x^3 + 4x^2 - 10$$

has a real root in  $[0,3]$ .

1. Use the built-in R function called `uniroot` to locate this root.
2. Write a function to carry out the bisection algorithm as we discussed in class. Use it to find the root of the function.