Statistics 211
In-Class Assessments
Topic: Chapter 5
Date: Oct. 11, 2016

1. Consider a Binomial experiment, with n independent Bernoulli trials each with probability p of success.

   (a) Suppose we wish to test the null hypothesis $H_0 : p = p_0$ vs. the two-sided alternative $H_a : p \neq p_0$. We will test at *significance level* α (what we have also called inference with $(1 - \alpha) \times 100\%$ *confidence*).

      i. Suppose H_0 is true. If we use significance level $\alpha = 0.05$, what is the probability we will commit a Type I error due to a p-value less than 0.05?
      answer: 0.05

      ii. Suppose H_0 is true. If we use significance level $\alpha = 0.01$, what is the probability we will commit a Type I error due to a p-value less than 0.01?
      answer: 0.01

      iii. For a given alternative value $p_1 \neq p_0$, the *power* of a test (e.g., a bootstrap-based test) is the probability of rejecting H_0 due to a p-value less than α. Consider two possible alternative values p_1 and p_2 such that $p_0 < p_1 < p_2$. Which of the following would you expect to be true?

         A. Power to detect p_1 = power to detect $p_2 = \alpha$

         B. Power to detect p_1 < power to detect p_2

         C. Power to detect p_1 > power to detect p_2

         answer: b

2. Consider a random sample $x_1, x_2, \ldots, x_n$ from a population with median θ. Suppose we wish to test the null hypothesis $H_0 : \theta = 0$ vs. the one-sided alternative $H_a : \theta > 0$. Which of the following shows how to use the bootstrap to compute a p-value? In each, let `x` be the `R` variable containing our n observations.

   (a) Code:

```
med_obs <- median(x)
x_0 <- x - median(x)
med_b <- numeric(B)
for(b in 1:B) {
  med_b[b] <- median(sample(x, replace = TRUE))
}
p_val <- sum(med_b > med_obs) / B
```

   (b) Code:

```
med_obs <- median(x)
x_0 <- x - median(x)
```

```
med_b <- numeric(B)
for(b in 1:B) {
  med_b[b] <- mean(sample(x_0, replace = FALSE))
}
p_val <- sum(med_b > med_obs) / B
```

(c) Code:

```
med_obs <- median(x)
x_0 <- x - median(x)
med_b <- numeric(B)
for(b in 1:B) {
  med_b[b] <- mean(sample(x, replace = TRUE))
}
p_val <- sum(med_b > med_obs) / B
```

(d) Code:

```
med_obs <- median(x)
x_0 <- x - median(x)
med_b <- numeric(B)
for(b in 1:B) {
  med_b[b] <- median(sample(x_0, replace = TRUE))
}
p_val <- sum(med_b > med_obs) / B
```

answer: d