Hospital readmission rates of acute ischemic stroke in California

Chapters covered

This covers chapters 3 and 7.

Motivation

According to the Nationwide Readmissions Database of the Healthcare Cost and Utilization Project between 2010 and 2015, the 30-day hospital readmission rate for acute ischemic stroke patients on a national level is 12.4% (Bambhroliya et al. 2018). A researcher wants to test whether the proportion of 30-day hospital readmissions for a California hospital with an "as expected" hospital quality rating differs from the national 30-day readmission proportion.

Data

CSV Data file: *readmin.csv*

The data file contains ischemic stroke 30-day hospital readmission incidence data for a random sample of patients in a California hospital with an "as expected" quality rating obtained from a set of hospital records for 2014-2015. The 30-day readmission data from a sample of 50 patients was recorded.

Read in the dataset, which we'll call *readmin*.

```
readmin <- read.csv("readmin.csv")
head(readmin) # Shows the first six rows of the data set
```

```
##   ReadmissionStatus
## 1                 0
## 2                 0
## 3                 0
## 4                 0
## 5                 0
## 6                 0
```

The variable *ReadmissionStatus* is a binary variable which is equal to 1 if the patient was readmitted to the hospital within 30 days of discharge and equal to 0 if the patient was not readmitted to the hospital within 30 days of discharge.

Questions of interest

Two questions of interest are:

1. Is the proportion of stroke patients readmitted within 30-days of discharge from CA hospital different from the nationwide proportion?
2. What is the 95% confidence interval for the proportion of acute ischemic stroke patients readmitted within 30 days of discharge?

Instructions

Make sure to install the following packages using the install.packages() function, then load the corresponding libraries.

```r
library(binom)
```

Exploring the Data

Let's begin by looking at the variable of interest, readmission.

```r
# Table of Readmission Status
table(readmin$ReadmissionStatus)
```

```
##
##  0  1
## 44  6
```

There are 6 people who are readmitted to the hospital within 30 days and 44 people who are not readmitted.

Data Analysis

Determine the proportion of individuals readmitted in the sample.

```r
# Proportion table of Readmission Status
prop.table(table(readmin$ReadmissionStatus))
```

```
##
##    0    1
## 0.88 0.12
```

12% (or $p = \frac{6}{50} = 0.12$) of the sample was readmitted within 30 days.

The Binomial test

Write the null and alternative hypotheses for this statistical test, comparing the proportion of readmission in our study, to the population proportion of 0.124.

H_0 : The proportion of readmission in the population is 0.124

H_A : The proportion of readmission in the population is not 0.124

Run a two-sided binomial test to see if the sample proportion differs significantly from the population proportion.

```r
# Binomial test of readmission status
binom.test(x = 6, n = 50, p = 0.124,
           alternative = "two.sided")
```

```
##
##  Exact binomial test
##
## data:  6 and 50
## number of successes = 6, number of trials = 50, p-value = 1
## alternative hypothesis: true probability of success is not equal to 0.124
## 95 percent confidence interval:
##  0.04533532 0.24310132
## sample estimates:
## probability of success
##                   0.12
```

We fail to reject the null hypothesis that the population proportion differs significantly from 0.124 ($P = 0.9316$).

Agresti-Coull 95% Confidence Interval for the proportion

Next, calculate the 95% CI for the proportion of stroke patients who were readmitted within 30 days of discharge using the Agresti-Coull method.

```
# 95% CI for binomial test
binom.confint(6, n = 50, method = "ac")
```

```
##          method x  n mean      lower     upper
## 1 agresti-coull 6 50 0.12 0.05249712 0.2417271
```

The true proportion of patients readmitted within 30 days is between 0.0525 and 0.2417 95% of the time that it is calculated from new data.

Conclusions

Based on these results, we find no evidence that the population proportion is significantly different from 0.124. The 95% CI interval ($0.0525 < p < 0.2417$) indicates medium level of precision, given that it covers nearly 20% of possible proportions.

References

Bambhroliya AB, Donnelly JP, Thomas EJ, et al., "Estimates and Temporal Trend for US Nationwide 30-Day Hospital Readmission Among Patients With Ischemic and Hemorrhagic Stroke.", *JAMA Netw Open*, 1[2018]:e181190 https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2696869