

Bayesian Statistics

Test Review

Craig Johnson

February 12, 2018

Math 423 Review

Fisher Information

$$I(\theta) = \text{Var} \left(\frac{d}{d\theta} \log f(x; \theta) \right) = -E \left[\frac{d^2}{d\theta^2} \log f(x; \theta) \right]$$

Cramer-Rao Enequality Theorem

If X_1, \dots, X_n is a random sample from a distribution where the support of $f(x; \theta)$ does not depend on θ , then for any unbiased estimator $\hat{\theta}$:

$$\text{Var}(\hat{\theta}) \geq \frac{1}{I(\theta)}$$

Sampling Methods

- ▶ Bootstrapping
 - ▶ Assume sample is the population
 - ▶ Randomly draw from the data (with replacement) n number of times
- ▶ Jack Knife
 - ▶ Leave out one data point and sample
 - ▶ Repeat

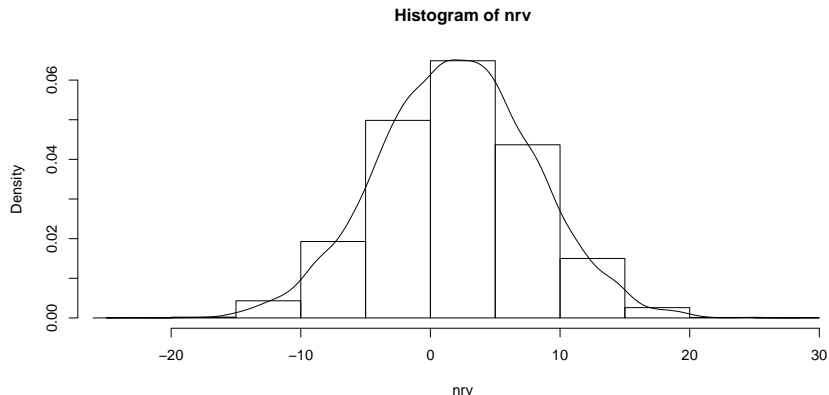
Bootstrapping in R

```
# Observed data
obs <- c(88.0, 76.7, 63.3, 68.4, 60.3, 57.7, 62.9)
n <- length(obs)
# Number of bootstrap resamples to collect
nBoot <- 20000
# Initialize vector of sample means
xbar <- rep(0, nBoot)
# Calculate the bootstrap means
for(i in 1:nBoot) {x = sample(obs, n, replace = T); xbar[i]}
# Find the 2.5th and 97.5th percentiles
pander::pander(quantile(xbar,c(0.025, 0.975)))
```

2.5%	97.5%
61.51	76.04

Histogram Plot

```
nrvc <- rnorm(5000, 2, 6)
d <- density(nrvc)
hist(nrvc, probability = TRUE)
lines(d$x, d$y)
```



Priors & Posteriors

2nd Section Slides