Bayesian Statistics

Test Review

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Math 423 Review

Fisher Information

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

Cramer-Rao Enequality Theorem

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

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

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

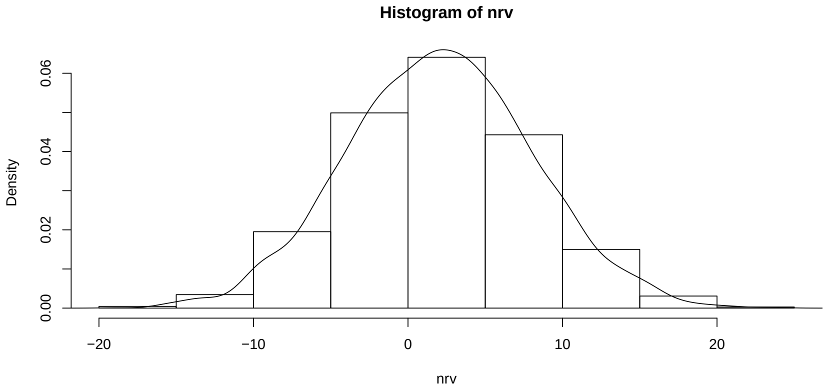
Bootstrapping in R

```
# 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%
61.59	76.1

Histogram Plot

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



Priors & Posteriors

2nd Section Slides