



北京航空航天大学

— 经济管理学院 —

BEIHANG UNIVERSITY  
SCHOOL OF ECONOMICS AND MANAGEMENT

# Generalized Linear Models

Lecture 7.0: Bootstrap



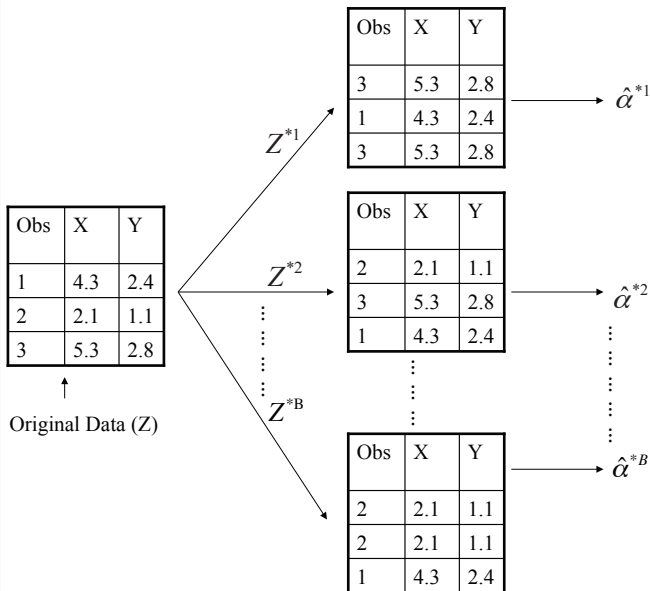
## Pull yourself up by your bootstraps



# What is the bootstrap?

- The bootstrap is a flexible statistical tool to **quantify the uncertainty** associated with a *given estimator*.
- We **mimic the process of obtaining new data sets** of the same size, so that we can estimate the variability of our estimate.
  - 1 Repeatedly sample observations **from the original data set with replacement** (nonparametric)
  - 2 Repeatedly sample observations **from an estimated model** (parametric).

# Illustration of the nonparametric bootstrap



## Bootstrap of sample median

- 1 Draw a random sample of data with replacement.
- 2 Calculate sample median of sample.

Repeat many times. Find percentiles of sample medians.

# Bootstrap of sample median



# Bootstrap of sample median



# Bootstrap of sample median

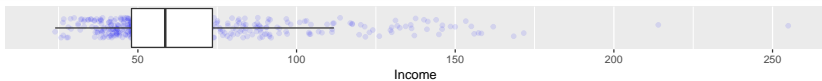




# Bootstrap of sample median



# Bootstrap of sample median



## Nonparametric bootstrap of sample median

- Percentiles of bootstrapped medians provide a confidence interval for the true median.

```
median(y)
```

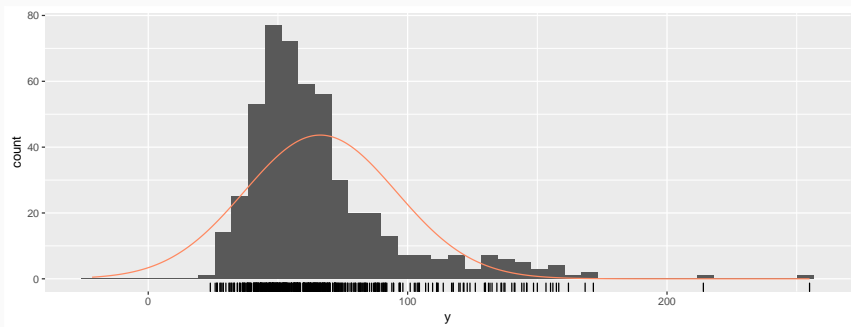
```
## [1] 58.62
```

```
bmedians <- numeric(100)
for(i in seq_along(bmedians))
  bmedians[i] <- median(sample(y, replace=TRUE))
quantile(bmedians, prob=c(0.025, 0.975))
```

```
##      2.5%    97.5%
## 57.3600 61.2687
```

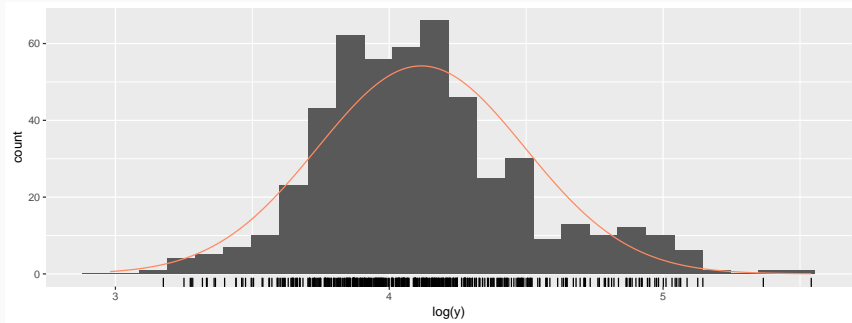
# Parametric bootstrap of sample median

- Assume a parametric model/distribution for data, and re-sample from the model.



# Parametric bootstrap of sample median

- Assume a parametric model/distribution for data, and re-sample from the model.
- Take log of data.



## Parametric bootstrap of sample median

- Take log of data.

```
logy <- log(y)
mu <- mean(logy)
sigma <- sd(logy)
n <- length(y)
for(i in seq_along(bmedians))
  bmedians[i] <- exp(median(rnorm(n, mu, sigma)))
quantile(bmedians, prob=c(0.025, 0.975))
```

```
##      2.5%      97.5%
## 59.01597 64.17273
```