Statistics CH3

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3.1.0.1 Exercise

```
X = rpois(1e5, lambda = 2)
mean(X)
```

```
## [1] 2.00311
```

3.2.0.3 Exercise

```
set.seed(123)
x = rnorm(n=50,mean=10,sd=5)
x_bar = mean(x)
sigma_hat = var(x) ** 0.5
k = 10000
B = numeric(k)
for (i in 1:k){
  x_boot = rnorm(n=50,mean=x_bar,sd=sigma_hat)
  x_boot_bar = mean(x_boot)
  B[i] = x_boot_bar - x_bar
}
mean(B)
```

```
## [1] 0.0002678918
```

```
mean(B**2)
```

```
## [1] 0.4149513
```

```
var(B)
```

```
## [1] 0.4149927
```

```
sd(B)
```

```
## [1] 0.6441993
```

3.2.0.4 Exercise

```
set.seed(123)
x = rnorm(n=50,mean=10,sd=5)
x_bar = mean(x)
sigma_hat = var(x) ** 0.5
k = 10000
B = numeric(k)
for (i in 1:k){
  x_boot = rnorm(n=50,mean=x_bar,sd=sigma_hat)
  sigma_hat_boot = var(x_boot) ** 0.5
  B[i] = sigma_hat_boot - sigma_hat
}
mean(B)
```

```
## [1] -0.01757885
```

```
mean(B**2)
```

```
## [1] 0.2187664
```

```
var(B)
```

```
## [1] 0.2184793
```

```
sd(B)
```

```
## [1] 0.4674176
```

3.2.0.5 Exercise

```
set.seed(123)
X = rnorm(n=50,mean=10,sd=5)
X_bar = mean(X)
sigma_hat = sd(X)*(49/50) ** 0.5
coe_hat = sigma_hat/X_bar
k = 1e4
B = numeric(k)
for (i in 1:k) {
  X_boot = rnorm(n=50,mean=X_bar,sd=sigma_hat)
  coe_hat_boot = sd(X_boot)*(49/50) ** 0.5/mean(X_boot)
  B[i] = coe_hat_boot - coe_hat
}
mean(B)
```

```
## [1] -0.004466309
```

```
mean(B**2)
```

```
## [1] 0.002866235
```

```
var(B)
```

```
## [1] 0.002846572
```

```
sd(B)
```

```
## [1] 0.05335328
```

3.2.0.6 Exercise

```
# formula
size = 57
p_hat = 32/57
bias = 0
se = (p_hat*(1-p_hat)/size) ** 0.5
mse = p_hat*(1-p_hat)/size
# bootstrap
k = 1e4
B = numeric(k)
for (i in 1:k){
  X_boot = rbinom(1, size=size, prob=p_hat)
  p_hat_boot = X_boot/size
  B[i] = p_hat_boot - p_hat
}
c(bias, mean(B))
```

```
## [1]  0.0000000000 -0.0002701754
```

```
c(mse, mean(B**2))
```

```
## [1] 0.004319818 0.004236750
```

```
c(se**2, var(B))
```

```
## [1] 0.004319818 0.004237100
```

```
c(se, sd(B))
```

```
## [1] 0.06572532 0.06509301
```

3.2.0.7 Exercise

```r
set.seed(123)
x = rpois(20,2)
lambda_hat = mean(x)
p0 = exp(-1*lambda_hat)
k = 1e4
B = numeric(k)
for (i in 1:k) {
  x_boot = rpois(20,lambda_hat)
  lambda_boot = mean(x_boot)
  p0_boot = exp(-1*lambda_boot)
  B[i] = p0_boot - p0
}
mean(B)
```

```
## [1] 0.005749716
```

```r
mean(B**2)
```

```
## [1] 0.001215366
```

```r
sd(B)
```

```
## [1] 0.03438641
```