HW 1 - Bootstrap with Simulated Data

2023-09-11

Set parameters

```
theta <- 12
N <- 30
NumSamples <- 250
set.seed(123)
```

Simulate data

```
SimUni <- data.frame(x = replicate(N, theta * runif(1)))
```

Make boostrap examples

```
set.seed(1)
BootSS <- replicate(NumSamples, sample(SimUni$x, replace = TRUE))
```

Calculate summary statistics for each bootstrap sample

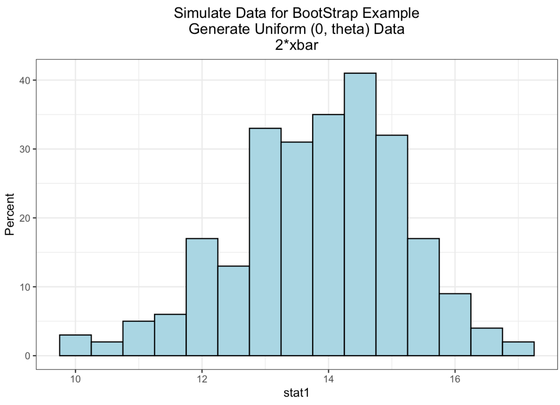
```
Bootdist <- data.frame(
  replicate = 1:NumSamples,
  mean_x = apply(BootSS, 2, mean),
  max_x = apply(BootSS, 2, max),
  min_x = apply(BootSS, 2, min)
)
```

Calculate additional statistics

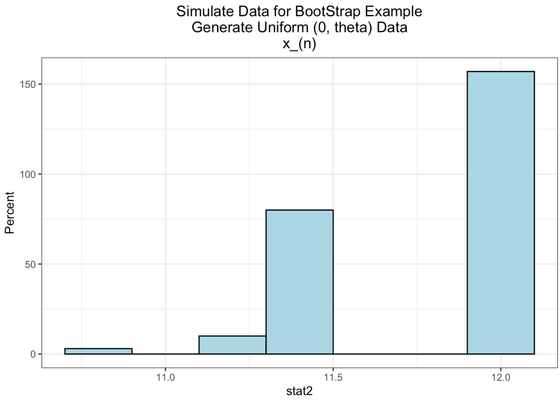
```
OutStatsUni <- Bootdist %>%
  mutate(stat1 = 2 * mean_x,
         stat2 = max_x,
         stat3 = min_x + max_x)
```

Plots

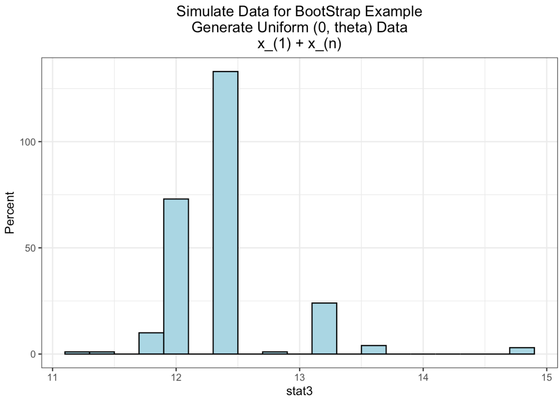
```
ggplot(OutStatsUni, aes(x = stat1)) +
  geom_histogram(binwidth = .5, fill = "lightblue", color = "black") +
  labs(title = "Simulate Data for BootStrap Example\nGenerate Uniform (0, theta) Data\n2*xbar") +
  ylab("Percent") +
  theme_bw() +
  theme(plot.title = element_text(hjust = 0.5))
```




```
ggplot(OutStatsUni, aes(x = stat2)) +
  geom_histogram(binwidth = .2, fill = "lightblue", color = "black") +
  labs(title = "Simulate Data for BootStrap Example\nGenerate Uniform (0, theta) Data\nx_(n)") +
  ylab("Percent") +
  theme_bw() +
  theme(plot.title = element_text(hjust = 0.5))
```




```
ggplot(OutStatsUni, aes(x = stat3)) +
  geom_histogram(binwidth = .2, fill = "lightblue", color = "black") +
  labs(title = "Simulate Data for BootStrap Example\nGenerate Uniform (0, theta) Data\nx_(1) + x_(n)") +
  ylab("Percent") +
  theme_bw() +
  theme(plot.title = element_text(hjust = 0.5))
```



Summary statistics

```
Outstats2 <- OutStatsUni %>%
  summarise(mean_stat1 = mean(stat1),
            mean_stat2 = mean(stat2),
            mean_stat3 = mean(stat3),
            sd_stat1 = sd(stat1),
            sd_stat2 = sd(stat2),
            sd_stat3 = sd(stat3),
            min_stat1 = min(stat1),
            min_stat2 = min(stat2),
            min_stat3 = min(stat3),
            max_stat1 = max(stat1),
            max_stat2 = max(stat2),
            max_stat3 = max(stat3))

print(Outstats2)
```

```
##   mean_stat1 mean_stat2 mean_stat3 sd_stat1 sd_stat2 sd_stat3 min_stat1
## 1   13.83129   11.74591   12.40139 1.325286 0.255102 0.486328  9.800639
##   min_stat2 min_stat3 max_stat1 max_stat2 max_stat3
## 1  10.70903  11.21374  17.10002  11.93124  14.88429
```