Rodriguez_Felipe_DSC530_7.2Exercise

January 29, 2023

[70]:
```
# Taken from book to download scripts
from os.path import basename, exists


def download(url):
    filename = basename(url)
    if not exists(filename):
        from urllib.request import urlretrieve

        local, _ = urlretrieve(url, filename)
        print("Downloaded " + local)
```

[71]:
```
download("https://github.com/AllenDowney/ThinkStats2/raw/master/code/nsfg.py")
download("https://github.com/AllenDowney/ThinkStats2/raw/master/code/first.py")
download("https://github.com/AllenDowney/ThinkStats2/raw/master/code/
 ↪thinkstats2.py")
download("https://github.com/AllenDowney/ThinkStats2/raw/master/code/thinkplot.
 ↪py")
download("https://github.com/AllenDowney/ThinkStats2/raw/master/code/estimation.
 ↪py")
download("https://github.com/AllenDowney/ThinkStats2/raw/master/code/
 ↪2002FemPreg.dct")
download("https://github.com/AllenDowney/ThinkStats2/raw/master/code/
 ↪2002FemPreg.dat.gz")
```

[72]:
```
# Imports scipts used
import nsfg
import pandas as pd
import thinkplot
import thinkstats2
import math
import random
import numpy as np
from estimation import RMSE, MeanError
import first
```

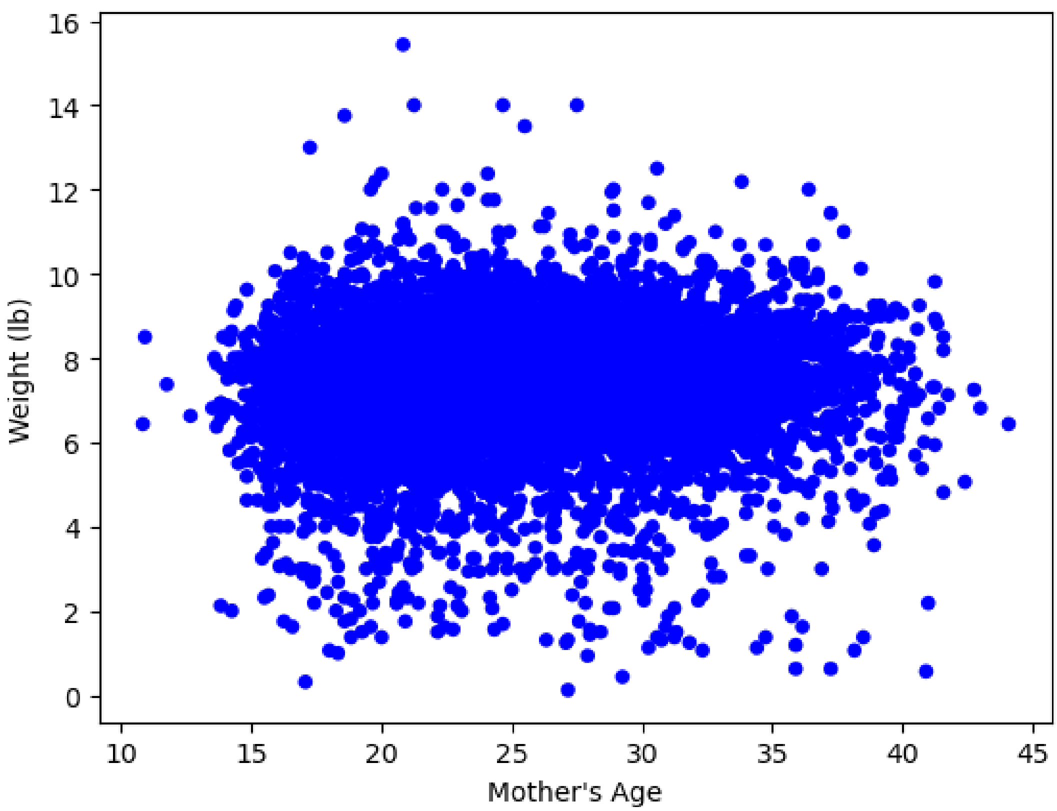
7-1 Using data from the NSFG, make a scatter plot of birth weight versus mother's age. Plot percentiles of birth weight versus mother's age. Compute Pearson's and Spearman's correlations. How would you characterize the relationship between these variables?

[73]:
```
# Creates Data
live, firsts, others = first.MakeFrames()
live = live.dropna(subset=['agepreg', 'totalwgt_lb'])
```

[74]:
```
# Creates Total Weight
birth_weight = live.totalwgt_lb
```

[75]:
```
# Creates Ages Pregnant
age_preg = live.agepreg
```

[76]:
```
# Creates Scatter Plot
thinkplot.Scatter(age_preg, birth_weight, alpha=1)
thinkplot.Config(xlabel="Mother's Age",
                 ylabel='Weight (lb)',
                 legend=False)
```



[77]:
```
# Displays Pearson's and Spearman's Correlation
print("Pearson's Correlation", thinkstats2.Corr(age_preg, birth_weight))
```

```
print("Spearman's Correlation", thinkstats2.SpearmanCorr(age_preg,␣
 ↪birth_weight))
```

```
Pearson's Correlation 0.06883397035410911
Spearman's Correlation 0.09461004109658226
```

The scatter plot shows a week correlation between age and weight since it is non linear. Both Pearson and Spearman correlation are low and support the weak correlation in the scatter plot.

8-1 In this chapter we used $\bar{x}$ and median to estimate µ, and found that $\bar{x}$ yields lower MSE. Also, we used S^2 and S_{n-1}^2 to estimate , and found that S^2 is biased and S_{n-1}^2 unbiased. Run similar experiments to see if $\bar{x}$ and median are biased estimates of µ. Also check whether S^2 or S_{n-1}^2 yields a lower MSE.

[78]:
```
# Mean Error Function
def Mean_Error(n=7, m=100000):
    mu = 0
    sigma = 1

    # Creates mean and median lists
    means = []
    medians = []
    # Calculation of Mean Error
    for _ in range(m):
        xs = [random.gauss(mu, sigma) for i in range(n)]
        xbar = np.mean(xs)
        median = np.median(xs)
        # Adds values to list
        means.append(xbar)
        medians.append(median)

    # Displays Results
    print('MSE Results')
    print('mean error xbar', MeanError(means, mu))
    print('mean error median', MeanError(medians, mu))
```

[79]:
```
# Bias Function
def Bias(n=7, m=100000):
    mu = 0
    sigma = 1

    estimates1 = []
    estimates2 = []
    for _ in range(m):
        xs = [random.gauss(mu, sigma) for i in range(n)]
        biased = np.var(xs)
        unbiased = np.var(xs, ddof=1)
        estimates1.append(biased)
```

```
        estimates2.append(unbiased)

    print('Biased vs Unbiased Results')
    print('RMSE biased', RMSE(estimates1, sigma**2))
    print('RMSE unbiased', RMSE(estimates2, sigma**2))
```

[80]:
```
def main():
    Mean_Error()
    Bias()

if __name__ == '__main__':
    main()
```

```
MSE Results
mean error xbar 0.0003920250241303121
mean error median 0.0007809353008293616
Biased vs Unbiased Results
RMSE biased 0.5140058974128343
RMSE unbiased 0.5764352241123035
```

8-2 Suppose you draw a sample with size n=10 from an exponential distribution with =2. Simulate this experiment 1000 times and plot the sampling distribution of the estimate L. Compute the standard error of the estimate and the 90% confidence interval.

Repeat the experiment with a few different values of `n` and make a plot of standard error versus `n`.

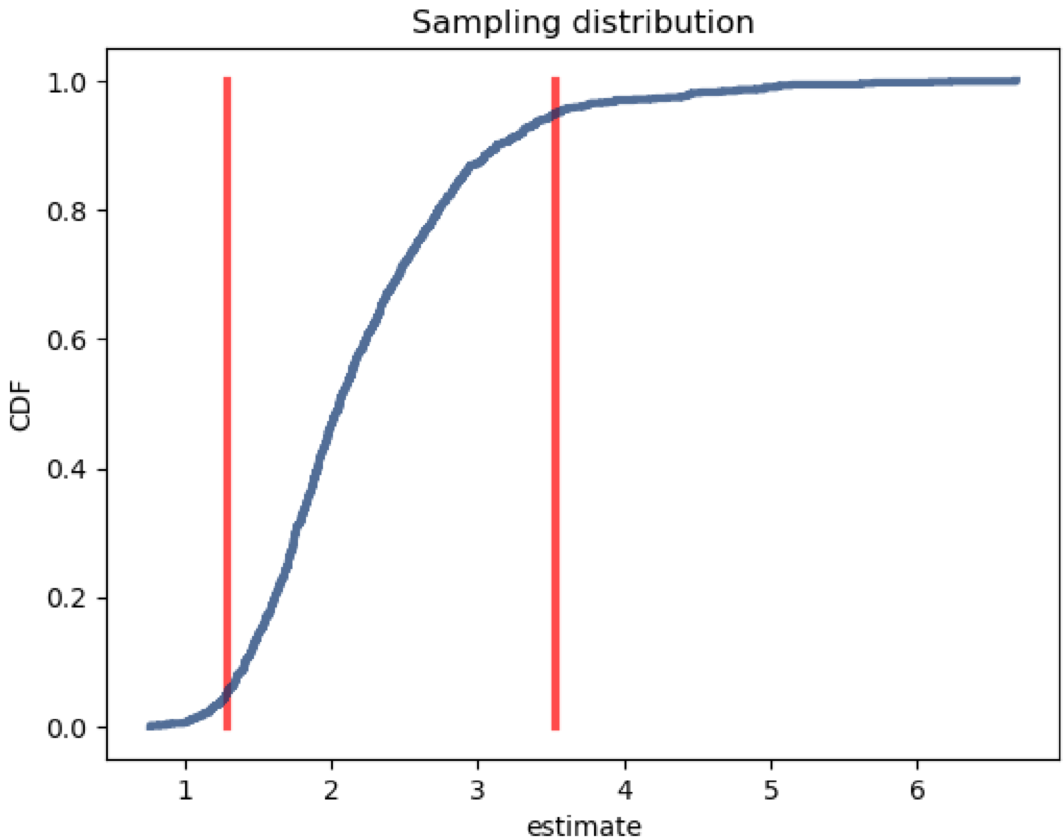
[81]:
```
# Calculates RMSE grabbed from book
def RMSE(estimates, actual):
    # Calculation
    e2 = [(estimate-actual)**2 for estimate in estimates]
    mse = np.mean(e2)
    return np.sqrt(mse)
```

[82]:
```
# Used from Estimation.py
def SimulateSample(lam=2, n=10, m=1000):
    # lam: parameter of an exponential distribution
    # n: sample size
    # m: number of iterations

    # Establishes Plots for percentiles, used later
    def VertLine(x, y=1):
        thinkplot.Plot([x, x], [0, y], color='red', linewidth=3)

    # Creates Estimates list
    estimates = []
    # Calculation
    for j in range(m):
        xs = np.random.exponential(1/lam, n)
```

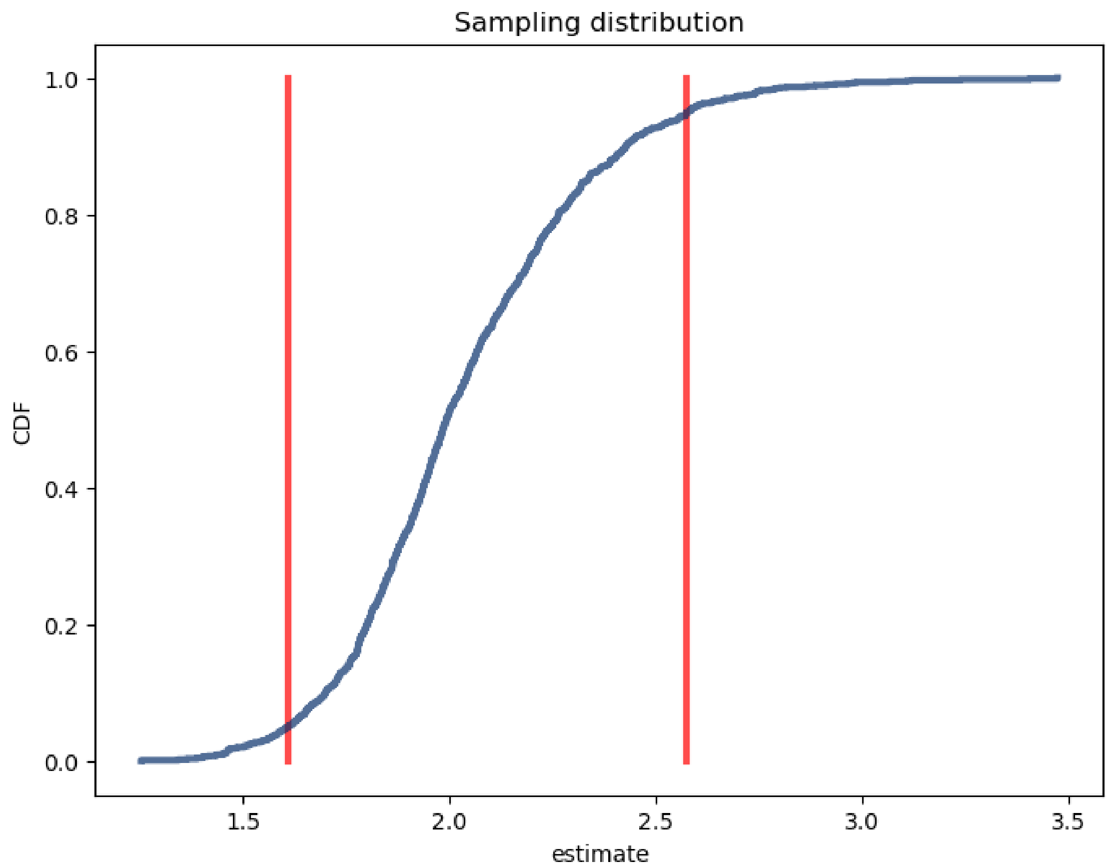
```python
        lamhat = 1/np.mean(xs)
        # Adds calculation to list
        estimates.append(lamhat)

    # Calculate Standard Error base on estimate list and exponential parameter
    standard_error = RMSE(estimates, lam)
    print('standard error', standard_error)

    # Creates estimates cdf
    cdf = thinkstats2.Cdf(estimates)

    # Creates confidence interval based on 90%
    confidence_interval = cdf.Percentile(5), cdf.Percentile(95)
    print('confidence interval', confidence_interval)

    # Plots lines for 5th and 95th Percentile
    VertLine(confidence_interval[0])
    VertLine(confidence_interval[1])

    # Plots the CDF
    thinkplot.Cdf(cdf)
    thinkplot.Show(root='estimation2',
                   xlabel='estimate',
                   ylabel='CDF',
                   title='Sampling distribution')

    return standard_error
```

[83]:
```python
def main():
    # Establishes different values for sample size
    for n in [10, 50, 100]:
        print('Sample size:', n)
        stderr = SimulateSample(n=n)


if __name__ == '__main__':
    main()
```

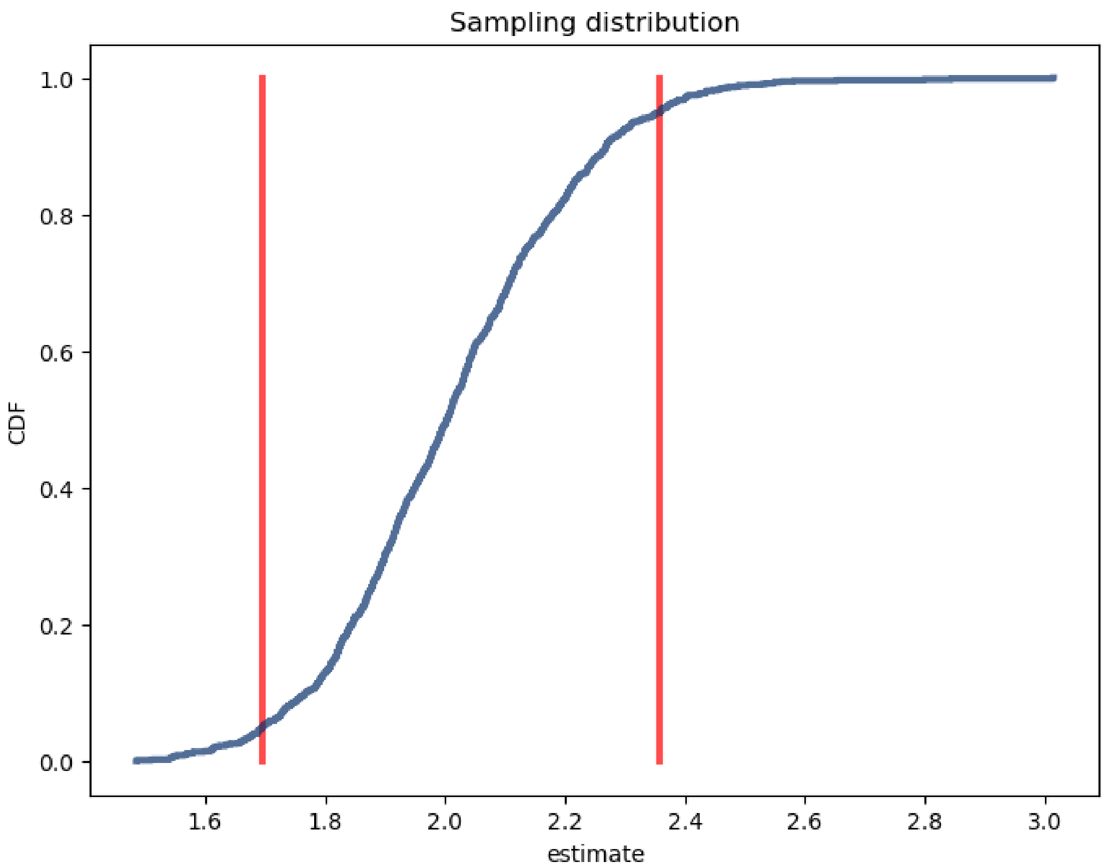
```
Sample size: 10
standard error 0.8026281306832422
confidence interval (1.2894786659794217, 3.534847307551774)
```




```
Sample size: 50
standard error 0.3013747624233301
confidence interval (1.6096525122515635, 2.575582712058378)
```




```
Sample size: 100
standard error 0.20038615457224068
confidence interval (1.6965719075499197, 2.3586207627256424)
```



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