

## Sampling from a Biased Population

In this tutorial we will go over some code that recreates the visualizations in the Interactive Sampling Distribution Demo. This demo looks at a hypothetical problem that illustrates what happens when we sample from a biased population and not the entire population we are interested in. This tutorial assumes that you have seen that demo, for context, and understand the statistics behind the graphs.

```
In [4]: # Import the packages that we will be using for the tutorial
import numpy as np # for sampling for the distributions
import matplotlib.pyplot as plt # for basic plotting
import seaborn as sns; sns.set() # for plotting of the histograms

# Recreate the simulations from the video
mean_uofm = 155
sd_uofm = 5
mean_gym = 185
sd_gym = 5
gymperc = .3
totalPopSize = 40000

# Create the two subgroups
uofm_students = np.random.normal(mean_uofm, sd_uofm, int(totalPopSize * (1 - gymperc)))
students_at_gym = np.random.normal(mean_gym, sd_gym, int(totalPopSize * (gymperc)))

# Create the population from the subgroups
population = np.append(uofm_students, students_at_gym)

# Set up the figure for plotting
plt.figure(figsize=(10,12))

# Plot the UofM students only
plt.subplot(3,1,1)
sns.distplot(uofm_students)
plt.title("UofM Students Only")
plt.xlim([140,200])

# Plot the Gym Goers only
plt.subplot(3,1,2)
sns.distplot(students_at_gym)
plt.title("Gym Goers Only")
plt.xlim([140,200])

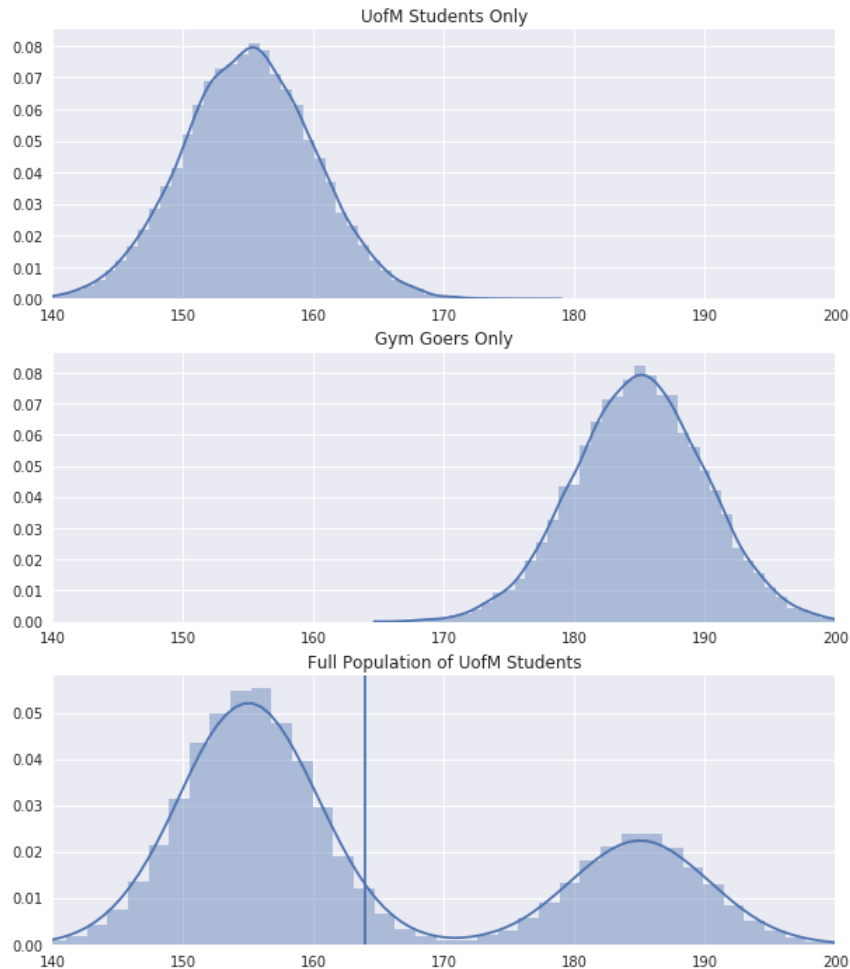
# Plot both groups together
plt.subplot(3,1,3)
sns.distplot(population)
plt.title("Full Population of UofM Students")
plt.axvline(x = np.mean(population))
plt.xlim([140,200])

plt.show()
```

```

/opt/conda/envs/python2/lib/python2.7/site-packages/matplotlib/axes/_axes.py:6571: UserWarni
ng: The 'normed' kwarg is deprecated, and has been replaced by the 'density' kwarg.
  warnings.warn("The 'normed' kwarg is deprecated, and has been "
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  warnings.warn("The 'normed' kwarg is deprecated, and has been "

```



## What Happens if We Sample from the Entire Population?

We will sample randomly from all students at the University of Michigan.

```

In [2]: # Simulation parameters
numberSamps = 5000
sampSize = 50

# Get the sampling distribution of the mean from only the gym
mean_distribution = np.empty(numberSamps)
for i in xrange(numberSamps):
    random_students = np.random.choice(population, sampSize)
    mean_distribution[i] = np.mean(random_students)

# Plot the population and the biased sampling distribution
plt.figure(figsize = (10,8))

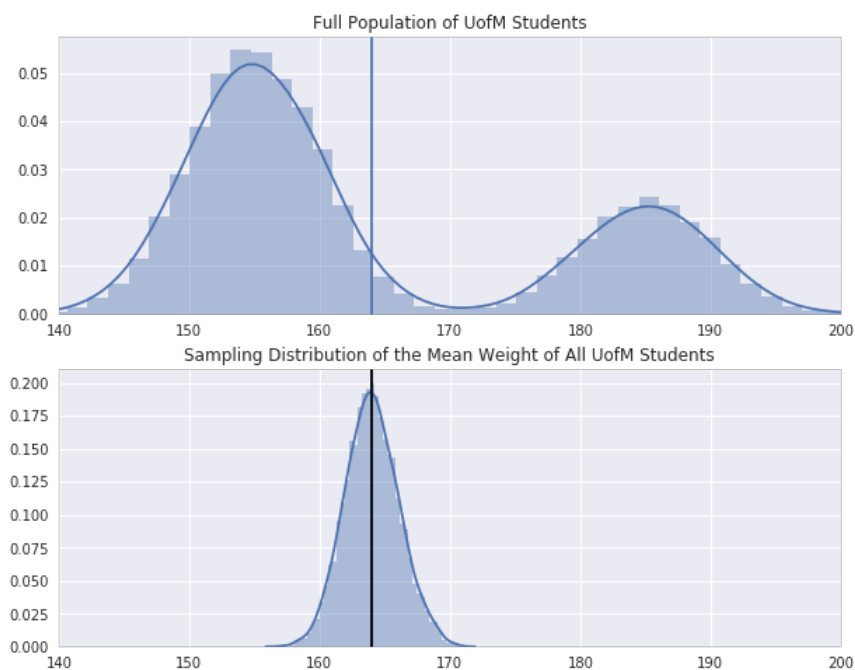
# Plotting the population again
plt.subplot(2,1,1)
sns.distplot(population)
plt.title("Full Population of UofM Students")
plt.axvline(x = np.mean(population))
plt.xlim([140,200])

# Plotting the sampling distribution
plt.subplot(2,1,2)
sns.distplot(mean_distribution)
plt.title("Sampling Distribution of the Mean Weight of All UofM Students")
plt.axvline(x = np.mean(population))
plt.axvline(x = np.mean(mean_distribution), color = "black")
plt.xlim([140,200])

plt.show()

```

/opt/conda/envs/python2/lib/python2.7/site-packages/matplotlib/axes/\_axes.py:6571: UserWarning: The 'normed' kwarg is deprecated, and has been replaced by the 'density' kwarg.  
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 warnings.warn("The 'normed' kwarg is deprecated, and has been ")



## What Happens if We take a Non-Representative Sample?

What happens if I only go to the gym to get the weight of individuals, and I don't sample randomly from all students at the University of Michigan?

```

In [3]: # Simulation parameters
numberSamps = 5000
sampSize = 3

# Get the sampling distribution of the mean from only the gym
mean_distribution = np.empty(numberSamps)
for i in xrange(numberSamps):
    random_students = np.random.choice(students_at_gym, sampSize)
    mean_distribution[i] = np.mean(random_students)

# Plot the population and the biased sampling distribution
plt.figure(figsize = (10,8))

# Plotting the population again
plt.subplot(2,1,1)
sns.distplot(population)
plt.title("Full Population of UofM Students")
plt.axvline(x = np.mean(population))
plt.xlim([140,200])

# Plotting the sampling distribution
plt.subplot(2,1,2)
sns.distplot(mean_distribution)
plt.title("Sampling Distribution of the Mean Weight of Gym Goers")
plt.axvline(x = np.mean(population))
plt.axvline(x = np.mean(students_at_gym), color = "black")
plt.xlim([140,200])

plt.show()

```

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