Inequality (Due to Chance) Simulator

First let's import our libraries. Most of this can be done in Numpy, but we'll use Matplotlib/Seaborn

```
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sb
```

We'll set up a few of the variables that can be tuned below.

```
# Tuning
initial_wealth = 50000 # The initial wealth of each individual
num_people = 100 # The number of people in our sample
max_exchange_perc = .05 # No exchange can be more than this amount of individual's overall wealtl
num_exchanges = 100000 # The number of exhanges (simulations) to run
```

The actual simulation happens in the code block below. The general logic is:

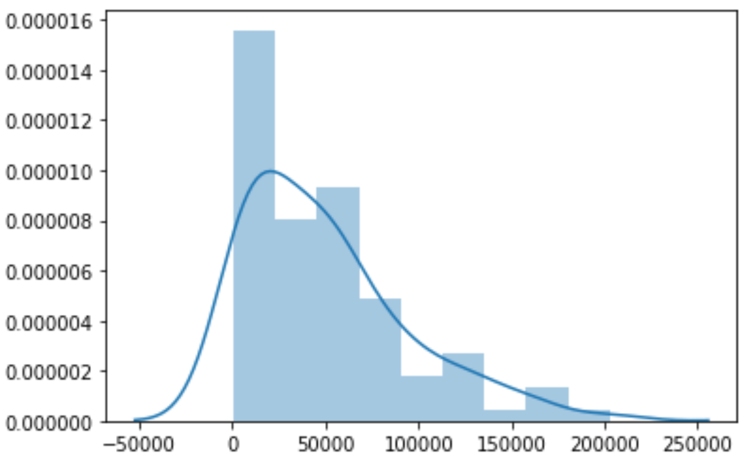
1. Create an array of length `num_people` representing our sample, each with an initial wealth value of `initi`
2. Simulate `num_exchanges` exchanges of wealth between randoom participant pairs from our sample giver
    - We randomly choose a pair at each iteration.
    - The maximum amount of wealth exchanged is no more than `max_exchange_perc` tim is, each exchange can only be a fraction of the lowest wealth amount in the pair.
    - The exchange value is randomly chosen (so long as it meets the consideration above).
    - We randomly choose who receives the exchanged amount and who loses the exchange

```
# Create our initial array with initial wealths
sim_array = np.full(num_people, initial_wealth, dtype=float)
# Create an array of our indices so we can draw from this randomly
poss_indices = np.arange(0,len(sim_array),1)

# Simulate the exchanges
for i in range(num_exchanges):

  # Randomly choose our pairs
  a, b = np.random.choice(poss_indices, size=2, replace=False)

  # Set the maximum exchange value to a fraction of the lowest wealth present
  ab_vals = max_exchange_perc * np.array([sim_array[a], sim_array[b]])
  max_exchange = np.min(ab_vals)

  # Randomly determines the wealth exchange amount noting the consideration above
  poss_exchanges = np.linspace(0, max_exchange, num=50) # 'num' is arbitrary and only affects the
  exchange_amount = np.random.choice(poss_exchanges, size=1)

  # Randomly choose who "wins" in the exchange and add/subtract the exchange amount accordingly
  who_loses = np.random.randint(1,2)
```

```
  if who_loses == 1:
    sim_array[a] = sim_array[a] - exchange_amount
    sim_array[b] = sim_array[b] + exchange_amount
  else:
    sim_array[a] = sim_array[a] + exchange_amount
    sim_array[b] = sim_array[b] - exchange_amount

# Round our output array for presentation
sim_array = np.round(sim_array, 2)
```

With the results in, let's do some visualization and metrics on our simulation.

```
# Plot a histogram of our distribution
sb.distplot(sim_array)
plt.show()
```




```
# Print some basic statistical metrics on the distribution
print("The maximum wealth is {}".format(sim_array.max()))
print("The minimum wealth is {}".format(sim_array.min()))
print("The average wealth is {}".format(np.round(sim_array.mean(),2)))
print("The median wealth is {}".format(np.median(sim_array)))
```

```
The maximum wealth is 202685.9
The minimum wealth is 615.64
The average wealth is 50000.0
The median wealth is 42373.835
```

Let's also look at how much wealth different quantiles own in the aggregate.

```
# Creating boolean masks of which array members belong in which quantil
top_1_perc = sim_array > np.quantile(sim_array,.99)
top_5_perc = sim_array > np.quantile(sim_array,.95)
top_25_perc = sim_array > np.quantile(sim_array,.75)
bottom_50_perc = sim_array < np.quantile(sim_array,.50)

# The total wealth from all individuals (to be used for percentages)
total_wealth = sim_array.sum()

# The aggregated wealth of individuals in each quantile (using the masks from above)
top_1_wealth = sim_array[top_1_perc].sum() / total_wealth * 100
top_5_wealth = sim_array[top_5_perc].sum() / total_wealth * 100
```

```
top_5_wealth = sim_array[top_5_perc].sum() / total_wealth * 100
top_25_wealth = sim_array[top_25_perc].sum() / total_wealth * 100
bottom_50_wealth = sim_array[bottom_50_perc].sum() / total_wealth * 100

# And finally plot a bar plot of those results
sb.barplot(x=["Top 1%", "Top 5%", "Top 25%", "Bottom 50%"],
           y=[top_1_wealth, top_5_wealth, top_25_wealth, bottom_50_wealth])
plt.show()
```