

Assignment 1: Probability Assignment

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Question 1

If you repeatedly sample with replacement 2 numbers from a uniform distribution of whole numbers from 1 to 25, what is the expected value of the largest of the two numbers?

We can get a good estimate of what the expected value of the situation by doing a monte carlo simulation. By picking a sufficiently large sample size of 10,000,000, the estimate would be quite accurate. Running a simple simulation in python, we find that the expected value is 17.15. The code for the simulation is as seen in Code Snippet 1.

```
1 import numpy as np
2 SIZE = 10_000_000
3 samples = np.random.randint(1, 26, (SIZE, 2))
4 max_sample = np.max(samples, axis=1)
5 expected_value = np.mean(max_sample)
6 print(expected_value)
```

Code Snippet 1: Code for simulation

Question 2

If you repeatedly sample without replacement 2 numbers from a uniform distribution of whole numbers from 1 to 25, what is the expected value of the largest of the two numbers?

Doing a similar approach as in the previous question, we find that the expected value is 17.34. The code for the simulation is as seen in Code Snippet 2.

```
1 import numpy as np
2
3 nums_range = np.arange(1, 26)
4 num_trials = 10_000_000
5 samples_per_trial = 2
6
7 samples = np.array([
8     np.random.choice(nums_range, size=samples_per_trial, replace=False) for _ in range(num_trials)
9 ])
10
11 max_numbers = np.max(samples, axis=1)
12 expected_value = np.mean(max_numbers)
13
14 print(expected_value)
```

Code Snippet 2: Code for simulation