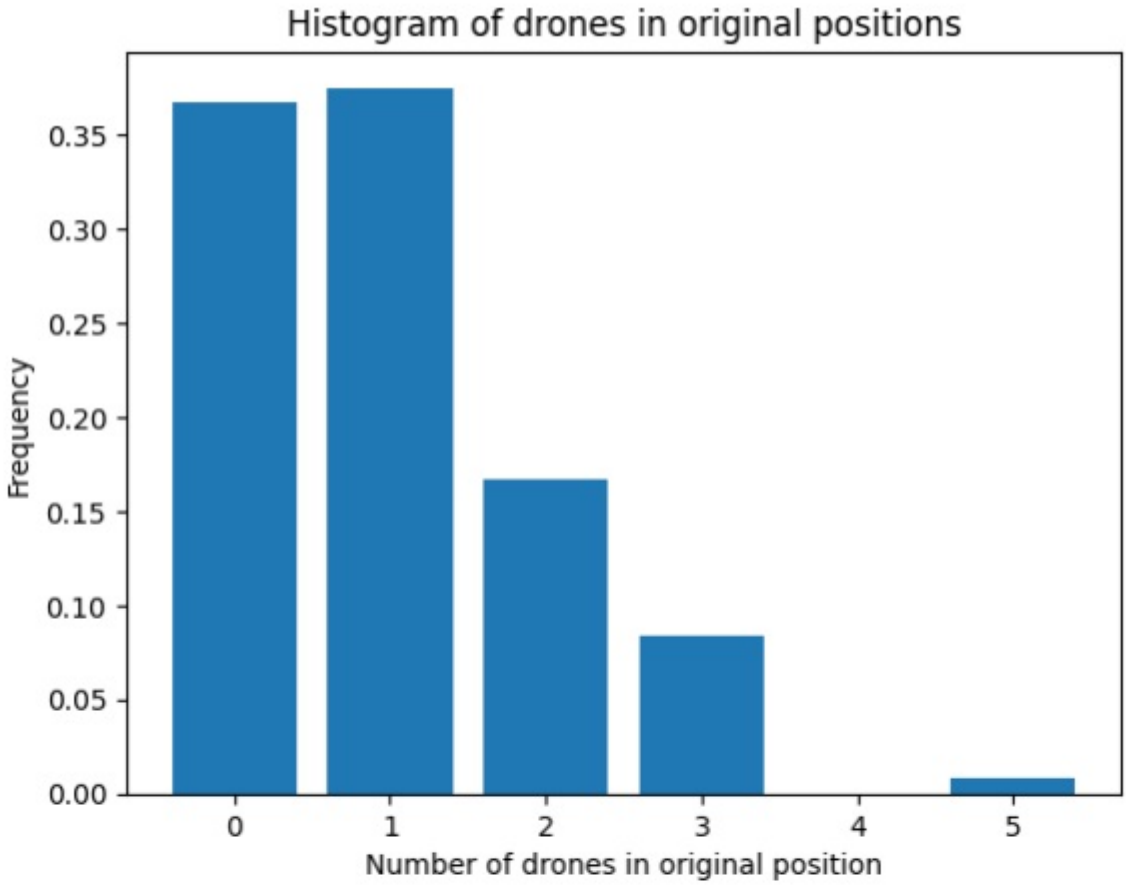
In [ ]:
```
'''
Suppose that there are five drones parked at five marked positions. All drones tak
What is the expected number of drones parking at their original position? How abou

Conduct both theoretical analysis and simulation to find out the expectation.

Submit your Matlab or Python code and results.

Hint: You are asked to find out the expectation only, not the distribution. Let Xi
j. Let X be the number of drones parking at their original position. Then X=X1+...
'''
```

Out[ ]:
```
'\nSuppose that there are five drones parked at five marked positions. All drones
take off at the same time, fly around and park at the marked positions randomly
(i.e., all parking arrangements are equally likely).\nWhat is the expected number
of drones parking at their original position? How about 10 drones with 10 positio
ns?\n\nConduct both theoretical analysis and simulation to find out the expectati
on.\n\nSubmit your Matlab or Python code and results.\n\nHint: You are asked to f
ind out the expectation only, not the distribution. Let Xi be a Bernoulli random
variable. Xi=1 represents drone i parks at its original position and Xi=0 otherwi
se. Drone i takes one of the five positions with equal probability. Xi and Xj are
not independent for i\nj. Let X be the number of drones parking at their original
position. Then X=X1+...+X5. Note here X is NOT binomial since X1...X5 are not ind
ependent.\n'
```

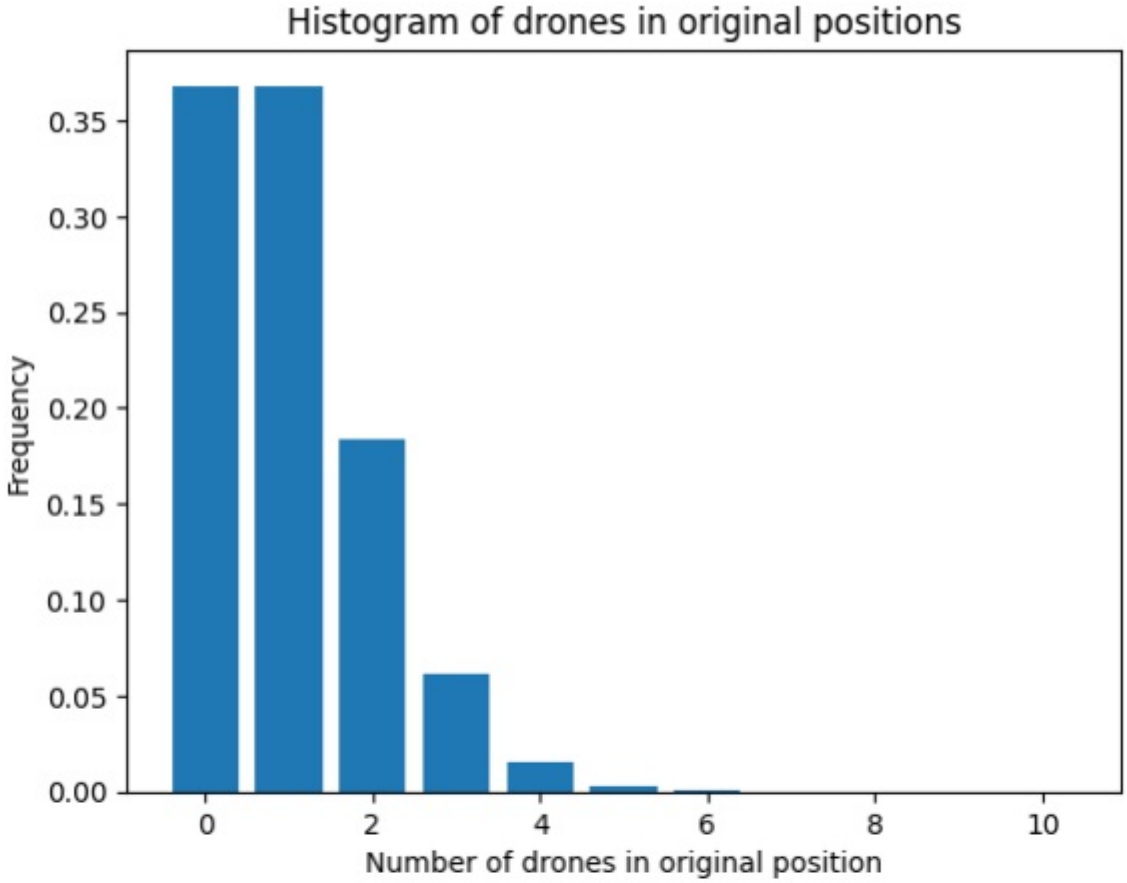
In [ ]:
```
import numpy as np
import matplotlib.pyplot as plt
import random
def simulate_drones(num_drones, num_simulations):
    counts = []
    for _ in range(num_simulations):
        positions = list(range(num_drones))
        random.shuffle(positions)
        count = sum(i == pos for i, pos in enumerate(positions))
        counts.append(count)
    return counts

n_drones_5 = 5
n_drones_10 = 10
n_simulations = 1000000

expected_5 = 1.0*sum(simulate_drones(n_drones_5, n_simulations))/ n_simulations
expected_10 = 1.0*sum(simulate_drones(n_drones_10, n_simulations))/ n_simulations

print(f"Expected number of drones in original position for 5 drones: {expected_5}"
print(f"Expected number of drones in original position for 10 drones: {expected_10
```

```
Expected number of drones in original position for 5 drones: 1.000582
Expected number of drones in original position for 10 drones: 1.000455
```

In [ ]:
```
num_drones = 5
#num_simulations = 1000000
counts = simulate_drones(num_drones, num_simulations)

plt.hist(counts, bins=range(num_drones + 2), align='left', rwidth=0.8, density=Tru
plt.xlabel('Number of drones in original position')
plt.ylabel('Frequency')
plt.title('Histogram of drones in original positions')
plt.show()
```



In [ ]:
```
num_drones = 10
#num_simulations = 1000000
counts = simulate_drones(num_drones, num_simulations)

plt.hist(counts, bins=range(num_drones + 2), align='left', rwidth=0.8, density=Tru
plt.xlabel('Number of drones in original position')
plt.ylabel('Frequency')
plt.title('Histogram of drones in original positions')
plt.show()
```


Histogram of drones in original positions
Frequency
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
2
4
6
8
10
Number of drones in original position