**S12**

**Using Normal Distribution to Approximate Binomial and Hypergeometric Distributions**

**Binomial Distribution**

* As the number of trials increases, the binomial distribution takes on the characteristics of a normal distribution.
* IF the values of **np** and **nq** are both greater than 5, you can approximate the binomial distribution using a normal distribution.

$$σ=\sqrt{npq}$$

$$μ=np$$

**Hypergeometric Distribution**

* If the sample size is small compared to the population size, a hypergeometric distribution takes on the characteristics of a normal distribution.
* If the sample size is less than one-tenth of the population size, $np<\frac{1}{10}NP$, you can approximate the hypergeometric distribution using a normal distribution.

$$σ=\sqrt{npq\left(\frac{NP-n}{NP-1}\right)}$$

$$μ=np$$

* Note, you must use a continuity correction when approximating a discrete distribution with a normal distribution.
* Continuity correction is a correction applied when using normal approximation to correct for the difference between a discrete and continuous distribution.

Example: A fair coin is tossed 6 times. Construct a probability distribution table and a histogram for the number of tails in the 6 tosses:

Recall: Probability for a binomial distribution is: P(X) = nCxpxq(n-x)

|  |  |  |
| --- | --- | --- |
| xi | Number of Tails | Probability |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Show the continuity correction for $P(X=2)$

Example 2:

The probability of rolling a six on a weighted die is 0.25. The die is rolled 25 times.

1. Is it reasonable to approximate this distribution with a normal distribution? Justify your answer.
2. Determine the mean and standard deviation of the normal approximation.
3. Determine the probability that the die will show a 6 fewer than 8 times.

Example 3:

Allison has a drawer full of unmatched socks. The drawer contains 30 blue socks, 30 green socs, and 30 yellow socks. She pulls seven socks form the drawer and records the number of blue socks in the sample.

1. Is it reasonable to approximate this distribution with a normal distribution? Justify your answer.
2. Determine the mean and standard deviation of the normal approximation.
3. What is the probability that 3, 4, or 5 socks are blue?