Chapter 5 - Binomial Distribution

Probability distributions

A probability distribution describes the probability of any outcome in the sample space. The probability distribution of a discrete random variable can be described using the probability mass function, a table or a diagram.

When all the probabilities are the same, the distribution is known as discrete uniform distribution. For example, the score when a fair dice is rolled.

You can define a random variable 'X' to represent the number of successful trials. You can model X with a binomial distribution B(n, p) if:

- There are a fixed number of trials (n)
- There are two possible outcomes (success and failure)
- There is a fixed chance of success (p)
- The trials are independent of each other (one doesn't affect the other)

The binomial distribution is calculated by multiplying the probability of success raised to the power of the number of successes and the probability of failure raised to the power of the difference between the number of successes and the number of trials.

$$P_x = \binom{n}{x} p^x q^{n-x}$$

n= number of values - also called the index
p= probability of success - also called the parameter
q= probability of failure

You can use the binomial probability distribution function on the calculator to calculate the binomial probabilities.

$n = 7$ *shots*
$p = 0.82$
$k = 4$ *free throws*

$$P(X=k) = \binom{n}{k} p^k (1-p)^{n-k}$$

$$P(X=4) = \binom{7}{4} 0.82^4 (1-0.82)^{7-4}$$

$$P(X=4) = \left(\frac{7!}{4!(7-4)!}\right) 0.82^4 (0.18)^3$$

$$P(X=4) = (35) 0.82^4 (0.18)^3 = 0.0923$$

To find the mean of binomial distribution E(X) = n x p = np

To fid variance it is VAR(X) = n x p x q = npq

Cumulative probabilities

P(X ≤ *x*) gives the sum of all individual probabilities for values up to and including *x*.

P(X < *x*) gives the sum of all individual probabilities for values not greater than *x*.

P(X ≥ *x*) gives the sum of all individual probabilities for *x* and values greater than *x*.

P(X > *x*) gives the sum of all individual probabilities for values greater than *x*.

You can use the binomial cumulative probability function in the calculator to find cumulative probabilities for
X ~ B(n, p)