Stat 230 - Probability **Fall 2016**

Lecture 16 and 17: October 19 - 21, 2016

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16.1 Negative Binomial Distribution

- The experiment consists of a sequence of independent trials
- Each trial in either a success or failure
- The probability of success p is constant from trial to trial
- The experiment continues until a total of k successes have been observed

16.1.1 Differences

In a binomial distribution we have n trials, but don't know the number of success that we will obtain.

In a negative binomial distribution, we know the number of successes, k, but we don't know the number of trials that we need to obtain k successes

16.1.2 Formula

$$f(x) = P(X = x) = \binom{x+k-1}{x} p^k (1-p)^x, x = 0, 1, 2....$$

Note : x is the total number of failure before the kth success

16.2 Geometric Random Variable

Suppose that independent trials, each having probability p, of being success, are performed util a success occurs. If we let X equal the number of failures obtained before the first success then

$$f(x) - P(X = x) = p(1-p)^x$$

16.3 Poisson Distribution

$$f(x) = P(X = x) = \frac{e^{-\mu}\mu^x}{x!}$$

Where :

- X = number of events of some type
- μ = expected (average) number of events
- e = base of natural logarithm

16.3.1 Poisson Process

Another use of the poisson probability distribution arises in situations where events occur at certain points in time or in space.

For some positive λ the following assumptions hold

1. Independence : The number of occurrences in non-overlapping intervals are independent
2. Individuality : for sufficiently short time periods of length δt; the probability that 2 or more events occurring in the interval is equal to zero
3. Uniformity : events occur at a uniform or homogeneous rate λ over time.

16.3.1.1 Interpretation of μ and λ

- λ : is the rate of occurrence parameter for the events. It represents the average rate of occurrences of events per unit of time
- $\lambda t = \mu$: represents the average number of occurrences in units of time