Geometric Distribution

Again, assume a series of Bernoulli trials (independent trials with constant prob. p of success), let the r.v. X denote the number of trials until the first success. Then X is a geometric random variable with parameter $0<p<1$ and

$$f(x) = (1-p)^{x-1} \cdot p \quad , \quad x = 1, 2, \ldots$$

Ex In flipping a coin experiment, what is the prob. of observing first Head in the third trial?

$$P(X=3) = (1-p)^2 \cdot p \qquad \text{observing head} \to \text{success} //$$

$$= \left(1-\frac{1}{2}\right)^2 \cdot \frac{1}{2}$$

$$= \left(\frac{1}{2}\right)^2 \cdot \frac{1}{2} = \frac{1}{2^3} = \frac{1}{8}$$

$\underline{T} \; \underline{T} \; \underline{H}$

$\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{8}$

Example 3-20, 3-21 → Discuss

Negative Binomial Distribution

In a series of Bernoulli trials (independent trials with constant probability p of a success), let the random variable X denote the number of trials until r successes occur. Then X is a negatif binomial r.v. with parameters $0<p<1$ and $r = 1, 2, 3, \ldots$ and $f(x) = \binom{x-1}{r-1} (1-p)^{x-r} \cdot p^r \quad x = r, r+1, \ldots$

Ex: In flipping a coin experiment, what is the prob. of observing two Heads in the third trial? $r=2$ $x=3$

H T H $\quad P(X=x) = \binom{x-1}{2-1}(1-p)^{x-2}p^2 \quad x=2,3,\ldots$

T H H $\quad P(X=3) = \binom{3-1}{2-1}(1-p)^1 p^2 \quad x=3$

$$P(X=3) = \binom{2}{1}\frac{1}{2}\cdot\left(\frac{1}{2}\right)^2$$

$$= 2\cdot\frac{1}{2^3} = 2/8 = 1/4$$

Ex-3-24, Ex 3-25 → Discuss

Hypergeometric Distribution

A set of N objects contains
K objects classified as successes
$N-K$ objects classified as failures

A sample of size n objects is selected randomly (without replacement) from the N objects, where $K \le N$ and $n \le N$.

Let the r.v. X denote the number of successes in the sample. Then X is a hypergeometric r.v. and

$$f(x) = \frac{\binom{K}{x}\binom{N-K}{n-x}}{\binom{N}{n}}, \quad x = \max(0, n+K-N) \text{ to } \min(K, n)$$

Ex 3-26, Ex 3-27 → Discuss