

The Binomial Distribution and STDs

As reported on NBC Nightly News, May 14, 1998, 1 out of every 5 US adults between the ages of 15 to 55 years old is infected with an STD. **Present (2014) statistics shown 40% infection from 18 - 30 years of age.** What might this mean to you as a future college student? Consider the example below (using the Binomial Probability Distribution) relating the probability of STD infection for any sex act with drawing colored marbles from an urn.

Consider a college dorm with 1000 male and 1000 females housing 40% infected students (red marbles) and 60% uninfected students (white marbles). Develop a function which predicts the probability of acquiring an STD for a sexually active student in the college dorm described above.

Assumptions:

- 1) You can't predetermine infected partners with any certainty
- 2) You might have sex with a previous partner
- 3) Sex with an infected partner has a 100% chance of infection

This problem is analogous with drawing out from an urn x number of red marbles in n number of trials with replacement... a binomial experiment!

The random variable x is defined as having sex with an infected partner (drawing out a red marble or more than one red marble) and therefore becoming infected. ***You theorize an "acceptable risk of infection" during your college years might be obtained by having sex only once per month. Assuming your freshman year last 12 months, determine the probability of infection by the end of the year.***

of white marbles in the urn: $w := 600$

of red marbles in the urn: $r := 400$

of trials (with replacement): $n := 12$

Each trial is independent of the others.

Thus, the probability (p) of drawing a red marble is:

$$p := \frac{r}{w + r} \quad p = 0.4$$

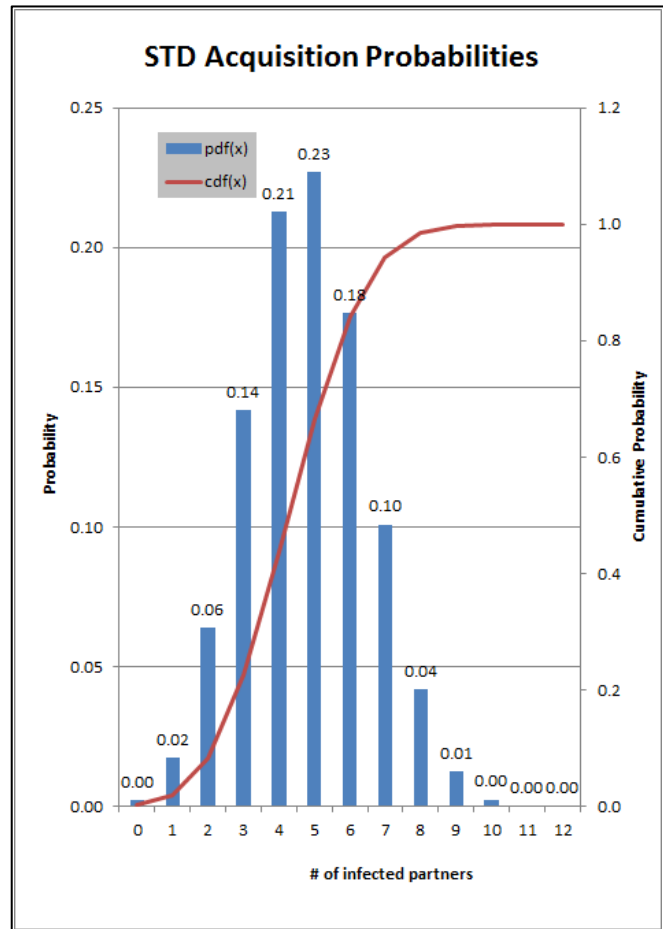
The probability (q) of drawing a white marble is:

$$q := 1 - p \quad q = 0.6$$

PDF for the discrete binomial probability distribution is: $f(x) := \left[\frac{n!}{x!(n-x)!} \right] \cdot q^{n-x} \cdot p^x$

where: $\frac{n!}{x!(n-x)!}$ is the number of possible combinations or: nC_r

n =	12	Binomial
p =	0.4	
x	pdf(x)	cdf(x)
0	0.002	0.002
1	0.017	0.020
2	0.064	0.083
3	0.142	0.225
4	0.213	0.438
5	0.227	0.665
6	0.177	0.842
7	0.101	0.943
8	0.042	0.985
9	0.012	0.997
10	0.002	1.000
11	0.000	1.000
12	0.0000	1.0000
total =	1.0000	



This graph shows a nearly 100% probability that you will encounter an infected partner by your 12th month (and therefore become infected yourself)!

Assuming you follow your promiscuous plan, you are virtually guaranteed to be infected before the end of your freshman year!