**Answer on Question #55862 – Math – Statistics and Probability**

A multichannel microwave link is to provide telephone communication to a remote community having 12 subscribers, each of whom uses the link 20% of the time during pick hours. How many channels are needed to make the link available during pick hours to:

**(a)** Eighty percent of the subscribers all of the time?

**(b)** All of the subscribers 80% of the time?

**(c)** All of the subscribers 95% of the time?

**Solution**

$$P(busy) = \frac{20}{100} = 0.2, \qquad P(not\ busy) = 1 - 0.2 = 0.8.$$

**(a)**

$$N = 12 \cdot \frac{80\%}{100\%} = 9.6\ round\ up\ to\ 10.$$

**(b)** We work with the binomial distribution with $p = 0.2\ and\ n = 12$.

Consider

$$P(X \le N) = binomialcdf(N; 12; 0.2) = \sum_{k=0}^{N} \frac{12!}{k!\,(12-k)!} 0.2^k (1 - 0.2)^{12-k} > 0.8.$$

In Excel it is given by

$$= BINOMDIST(N; 12; 0{,}2;\ TRUE)$$

where N can take on any value from the list {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}.

We calculate all these values and put them into the table:

| $N$ | $P(X \le N)$ |
|---|---|
| 0 | 0.068719 |
| 1 | 0.274878 |
| 2 | 0.558346 |
| 3 | 0.794569 |
| 4 | 0.927445 |
| 5 | 0.980595 |
| 6 | 0.996097 |
| 7 | 0.999419 |
| 8 | 0.999938 |
| 9 | 0.999995 |
| 10 | 1.000000 |
| 11 | 1.000000 |
| 12 | 1.000000 |

Therefore, at N = 4 links from 12 users will be satisfied 92.7% of the time. At this level, 4 channels would be sufficient to guarantee access more than 80% of the time to all subscribers.

**(c)**

$$P(X \le N) = binomialcdf(N; 12; 0.2) = \sum_{k=0}^{N} \frac{12!}{k!\,(12-k)!} 0.2^k (1-0.2)^{12-k} > 0.95.$$

From above, at N = 5 links users will be satisfied 98.1% of the time. At this level, 5 channels would be sufficient to guarantee access 95% of the time to all subscribers.