

Negative Binomial distribution : basics

We consider a sequence of indep. Bernoulli trials with constant probability of success π . Y denotes the total number of failures before the r th success.

$$Y \sim \text{NBin}(r, \pi)$$

$$\text{PMF } p_{r,\pi}(y) = \binom{y+r-1}{r-1} \pi^r (1-\pi)^y \mathbb{1}_{\mathbb{R}^+}(x)$$

Example : Suppose the probability that a person has blood type B is 0.12. We conduct a study concerning people who have blood type B and patients are sampled independently until we reach 10 who have blood type B. What is the probability that at most 30 patients have to have their blood type determined?

$$P(Y \leq 20) = \sum_{j=0}^{20} \binom{j+9}{9} 0.12^{10} 0.88^j$$

$$\approx \underline{0.0019} \quad (\approx 0.2\%)$$

In R : `pnbinom(20, 10, 0.12)`

Reference : Introduction to Mathematical Statistics; Hogg, Tanaka, Craig; 2019