

Negative Binomial Distribution

Note Title

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Y = number of the trial on which the r^{th} success occurs.

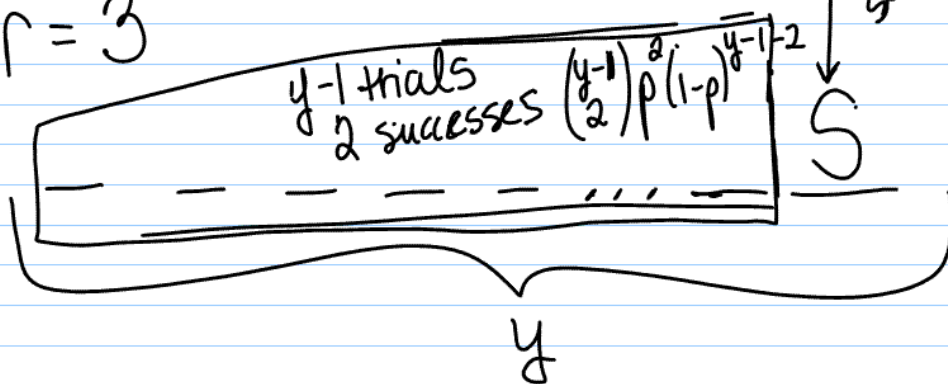
Geometric (Neg. Binom when $r=1$)

$$Y = r, r+1, \dots$$

parameters: p & r

$$P(Y=y) = \binom{y-1}{r-1} p^r (1-p)^{y-r}$$

$$r=3$$



$$P(Y=y) = \binom{y-1}{2} p^3 (1-p)^{y-1-2}$$

$$= \binom{y-1}{r-1} p^r (1-p)^{y-r} \quad y = r, r+1, r+2, \dots$$

Geometric

$$r=1 = p(1-p)^{y-1} \quad y=1, 2, \dots$$

$$\mu = E(Y) = \frac{r}{p} \quad \sigma^2 = V(Y) = \frac{r(1-p)}{p^2}$$

$$P(Y \leq 4) = \text{pnbin}(2:4, 2, 0.9)$$

↑
r

$$P(Y \geq 6) = 1 - P(Y \leq 5)$$

$$= 1 - \text{sum}(\text{dnbin}(2:5, 2, 0.9))$$

② $p = 0.2$

a) $r = 2$, $P(Y = 5) = \text{dnbin}(5, 2, 0.2)$
 $= 0.08192$

b) $r = 2$, $P(Y \leq 10) = \text{sum}(\text{dnbin}(2:10, 2, 0.2))$
 $= 0.6242$

c) $r = 3$, $E(Y) = \frac{3}{0.2} = 15$

$$V(Y) = \frac{3(0.8)}{(0.2)^2} = 60$$

③ (a) $p = 1/6$, $r = 2$

$$P(Y = 6) = \text{dnbin}(6, 2, 1/6)$$

(b) $r = 3$

$$P(Y \geq 11) = 1 - P(Y \leq 10)$$

$$1 - \text{sum}(\text{dnbin}(3:10, 3, 1/6))$$

$$(c) r=2 \quad E(Y) = \frac{2}{1/6} = 12$$