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negative hypergeometric random variable

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Entry type	Definition
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Synonym	negative hypergeometric distribution

X is a **negative hypergeometric random variable** with parameters W, B, b if

$$f_X(x) = \frac{\binom{x+b-1}{x} \binom{W+B-b-x}{W-x}}{\binom{W+B}{W}}, \quad x = \{0, 1, \dots, W\}$$

Parameters:

- ★ $W \in \{1, 2, \dots\}$
- ★ $B \in \{1, 2, \dots\}$
- ★ $b \in \{1, 2, \dots, B\}$

Syntax:

$$X \sim \text{NegHypergeo}(W, B, b)$$

Notes:

1. X represents the number of “special” items (from the W special items) present before the b th object from a population with B items.
2. The expected value of X is noted as $E[X] = \frac{Wb}{B+1}$
3. The variance of X is noted as $Var[X] = \frac{Wb(B-b+1)(W+B+1)}{(B+2)(B+1)^2}$

Approximation techniques:

If $\binom{x}{2} \ll W$ and $\binom{b}{2} \ll B$ then X can be approximated as a **negative binomial random variable** with parameters $r = b$ and $p = \frac{W}{W+B}$. This approximation simplifies the distribution by looking at a system with replacement for large values of W and B .