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Hypergeometric probability Distribution

It is closely related to the binomial distribution

The two probability distributions differ in two key ways.

- In hypergeometric distribution, the trials are not independent
- the probability of sucess changes from trial to trial.

Hypergeometric probability function:

It is used to compute the probability that is a random selection of n elements, selected without replacement, we obtain x elements labeled success and n-x elements labeled failure.

$$f(x) = \frac{\binom{r}{x}\binom{N-r}{n-x}}{\binom{N}{n}}$$

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(10) Given $N = 10$ and $r = 3$

Compute value of n and x.

(a) $n = 4$, $x = 1$

$$f(x) = \frac{\binom{r}{x}\binom{N-r}{n-x}}{\binom{N}{n}}$$

$$f(1) = \frac{\binom{3}{1}\binom{10-3}{4-1}}{\binom{10}{4}} = \frac{\left(\frac{3!}{1!\,2!}\right)\left(\frac{7!}{3!\,4!}\right)}{\left(\frac{10!}{4!\,6!}\right)}$$

$$f(1) = 0.50//$$

(b) $n = 2$, $x = 2$

$$f(2) = \frac{\binom{3}{2}\binom{7}{0}}{\binom{10}{2}}$$

$$f(2) = 0.067//$$

(c) $n = 2$, $x = 0$

$$f(0) = \frac{\binom{3}{0}\binom{7}{2}}{\binom{10}{2}}$$

$$f(0) = 0.4667//$$

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(d) $n=4$, $x=2$

$$f(2) = \frac{\left(\frac{3}{2}\right)\left(\frac{7}{2}\right)}{\left(\frac{10}{4}\right)}$$

$$f(2) = 0.30//$$

(e) $n=4$, $x=4$

Given x is greater than 4 so,

$$f(4) = 0$$

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(49) Given $N = 10$ Football → 7
$n = 3$ Basketball → 3

(a)

$N = 10 \quad n = 3$
$x = 2 \quad r = 7$

$$f(x) = \frac{\binom{r}{x}\binom{N-r}{n-x}}{\binom{N}{n}}$$

$$f(2) = \frac{\binom{7}{2}\binom{3}{1}}{\binom{10}{3}}$$

$$f(2) = 0.5250 //$$

(b) $$f(2) = \frac{\binom{7}{2}\binom{3}{1}}{\binom{10}{3}} = 0.5250$$

$$f(3) = \frac{\binom{7}{3}\binom{3}{0}}{\binom{10}{3}} = 0.2917$$

$+ \Rightarrow 0.8167 //$

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(5a) Given $N = 60$, $n = 10$

(a) $N = 60$, $n = 10$
$x = 0$, $r = 20$

$$f(0) = \frac{\binom{20}{0}\binom{40}{10}}{\binom{60}{10}}$$

$$f(0) = 0.0112 //$$

(b) $N = 60$, $n = 10$
$x = 1$, $r = 20$

$$f(1) = \frac{\binom{20}{0}\binom{40}{9}}{\binom{60}{10}}$$

$$f(1) = 0.0725 //$$

(c) for two or more employee
let's exclude them from the total Probability i.e. 1

$$f(x) = 1 - f(0) - f(1)$$
$$= 1 - 0.0112 - 0.0725$$
$$= 0.9163 //$$

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(d) for texas : $N = 60$ $n = 10$
$x = 9$ $r = 40$

$$f(9) = \frac{\binom{40}{9}\binom{20}{1}}{\binom{60}{10}}$$

$$f(9) = 0.0725 //$$