

Hypergeomtric Distribution

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1 Hypergeometric Distribution

- Based on
- Examples
- Assumptions

"Probability with R: An Introduction with Computer Science Applications"

Jane Horgan

https://en.wikipedia.org/wiki/Hypergeometric_distribution

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Example (1)

The classical application of the hypergeometric distribution is sampling without replacement.

Think of an urn with two types of marbles, red ones and green ones. Define drawing a green marble as a success and drawing a red marble as a failure (analogous to the binomial distribution).

- the variable N describes the number of all marbles in the urn (see contingency table below)
- K describes the number of green marbles
- then, $N - K$ corresponds to the number of red marbles.
- In this example, X is the random variable whose outcome is k , the number of green marbles actually drawn in the experiment

Example (2)

- the variable N describes the number of all marbles in the urn (see contingency table below)
- K describes the number of green marbles
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- In this example, X is the random variable whose outcome is k , the number of green marbles actually drawn in the experiment

| | drawn | not drawn | total |
|---------------|---------|-----------------|---------|
| green marbles | k | $K - k$ | K |
| red marbles | $n - k$ | $N - k - n - K$ | $N - K$ |
| total | n | $N - n$ | N |

Example (3)

- assume (for example) that there are 5 green and 45 red marbles in the urn.
- Standing next to the urn, you close your eyes and draw 10 marbles without replacement.
- What is the probability that exactly 4 of the 10 are green?
- Note that although we are looking at success/failure, the data are not accurately modeled by the binomial distribution,
- because the probability of success on each trial is not the same, as the size of the remaining population changes as we remove each marble.

| | drawn | not drawn | total |
|---------------|-------------|----------------------|--------------|
| green marbles | $k = 4$ | $K - k = 1$ | $K = 5$ |
| red marbles | $n - k = 6$ | $N + k - n - K = 39$ | $N - K = 45$ |
| total | $n = 10$ | $N - n = 40$ | $N = 50$ |

Assumptions

- The result of each draw (the elements of the population being sampled) can be classified into one of two mutually exclusive categories (e.g. Pass/Fail or Employed/Unemployed).
- The probability of a success changes on each draw, as each draw decreases the population (sampling without replacement from a finite population).