Binomial Distribution

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1 Bernoulli trials

```
# Simulate Bernoulli trials using `rbinom()`
# rbinom(n, size, prob)
# n: number of observations
# size: number of trials in each observation
# prob: probability of success on each trial
# returns 1 for success, 0 for failure

# Example: 10 observations of flipping a fair coin once
rbinom(n = 10, size = 1, prob = 0.5)
```

```
##  [1] 0 1 0 0 0 0 1 0 1 1
```

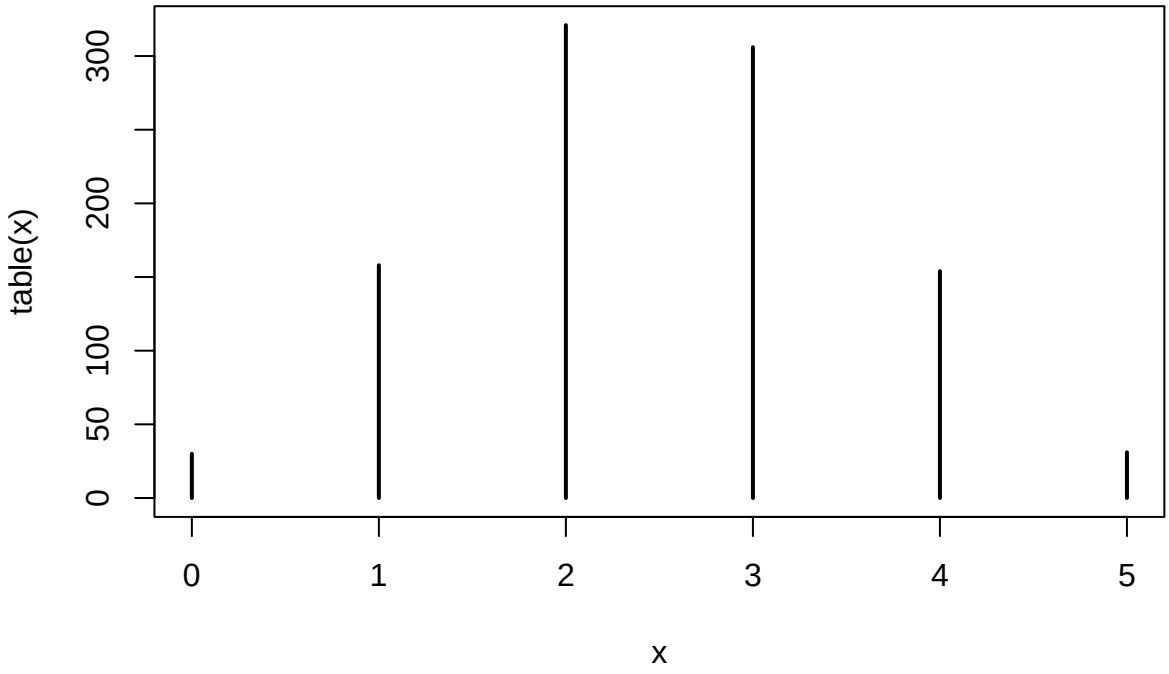
```
# Example: 10 observations of flipping a fair coin five times
# Mathematically written as: Bin(5, 0.5)
rbinom(n = 10, size = 5, prob = 0.5)
```

```
##  [1] 3 3 2 3 1 2 3 3 3 2
```

```r
# Tabulating the results
x <- rbinom(n = 1000, size = 5, prob = 0.5)
table(x)
```

```
## x
##   0   1   2   3   4   5
##  30 158 321 306 154  31
```

```r
# Plotting the results
plot(table(x))
```



2 Binomial Distribution Math

$$P(X = r) = \binom{n}{i} \cdot p^r \cdot (1-p)^{n-r}$$

```r
# This formula is carried out using `dbinom()`
# x: number of successes
# size: number of trials
```

```r
# prob: probability of success on each trial

# Example P(X = 2) for n=5 trials with p=0.3
dbinom(x = 2, size = 5, prob = 0.3)
```

```
## [1] 0.3087
```

3 Cummulative Distribution

$$P(X \leq r) = \sum_{i=0}^{r} \binom{n}{i} \cdot p^i \cdot (1-p)^{n-i}$$

```r
# This formula is carried out using `pbinom()`
# q: number of successes
# size: number of trials
# prob: probability of success on each trial
# lower.tail: if TRUE (default) -> P(X <= r), if FALSE -> P(X > r)

# Example P(X <= 2) for n=5 trials with p=0.3
pbinom(q = 2, size = 5, prob = 0.3)
```

```
## [1] 0.83692
```

4 Mean and Standard Deviation

```r
# Mean
# Method 1 (np)
5 * 0.3
```

```
## [1] 1.5
```

```r
# Method 2 (simulate over a million observations)
mean(rbinom(n = 1e6, size = 5, prob = 0.3))
```

```
## [1] 1.500193
```

```r
# Standard deviation
# Method 1 (sqrt(n * p * (1-p)))
sqrt(5 * 0.3 * 0.7)
```

```
## [1] 1.024695
```

```
# Method 2 (simulate over a million observations)
sd(rbinom(n = 1e6, size = 5, prob = 0.3))
```

```
## [1] 1.024615
```