Lab 3: Exploring Discrete Probability Distributions

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Bernoulli and Binomial Distributions

Functions `dbinom`,`pbinom`,`qbinom`,`rbino`

Binomial

Taken from Open Intro Exercise 4.17:

Data collected by the Substance Abuse and Mental Health Services Administration (SAMSHA) suggests that 69.7% of 18-20 year olds consumed alcoholic beverages in any given year. A random sample of 10 people age 18-20 was taken.

Write text below:

1. What distribution does the number of 18-20 that consumed alcohol follow?

Binomial distribution.

2. What is the expected value of this distribution?

```
n1 <- 10
p1 <- 0.697

n1*p1
```

```
## [1] 6.97
```

6.97.

3. What is the variance of this distribution?

```
n1*p1*(1-p1)
```

```
## [1] 2.11191
```

The variance is 2.11.

Write code below:

4. What is the probability that exactly 5 out of 10 18-20 year olds have consumed an alcoholic beverage?

```
dbinom(x=5,size=10,prob=0.697)
```

```
## [1] 0.1058711
```

The probability is 0.11.

5. What is the probability that at most 3 out of 10 randomly sampled 18-20 year olds have consumed alcoholic beverages?

```
pbinom(q=3,size=10,prob = 0.697)
```

```
## [1] 0.01123721
```

The probability is 0.01.

6. What is the probability that at least 6 out of 10 randomly sampled 18-20 year olds have consumed alcoholic beverages?

```
1-pbinom(q=5, size=10, prob=0.697)
```

```
## [1] 0.844538
```

The probability is 0.84

7. What is the median of this distribution?

```
qbinom(p=0.5, size=10, prob=0.697)
```

```
## [1] 7
```

The median is 7.

You can also randomly generate samples using a binomial distribution.

```
rbinom(n=100,size = 20,prob = 0.5)
```

```
##   [1] 13 15  7  5 10  9 11 10 12  9  9 13 12 10 10 10 10 11  5  8 10  9  9
##  [24] 10 14  9  8 12  9  9 12  9 11  7 11  9 10 10 10  9  8 11 10 12 10 12
##  [47] 10  8 10  5 10 12 10 11  8 12  8  6  6 12 12 12  9 10  9 10 12  6  9
##  [70] 10 13 10 12 11 14 14 11  9 11  9  7  9 12 14 14 10 15 10 10  8  9 10
##  [93]  8 11 12 14 12  8 12  8
```

Geometric Distribution

Functions `dgeom()`,`pgeom()`,`qgeom()`,`rgeom()`

In R, these functions model differently than the book. This looks at the number of failures until the first success.

The probability of a defective lightbulb at a certain factor is 0.30. Write text here:

8. What is distribution would the number of bulbs until the first defective is found follow?

Geometric

9. What is the expected number of lightbulbs that are checked before finding a defective bulb?

```
1/0.3
```

```
## [1] 3.333333
```

The expected number is 3.33.

10. What is the probability that the tenth lightbulb is the first defective bulb?

```
dgeom(x=9, prob = 0.3)
```

```
## [1] 0.01210608
```

11. What is the probability that the first defective bulb is found after the first 3 bulbs are checked?

```
1-pgeom(q=2,prob=0.3)
```

```
## [1] 0.343
```

12. Again we can draw a random sample:

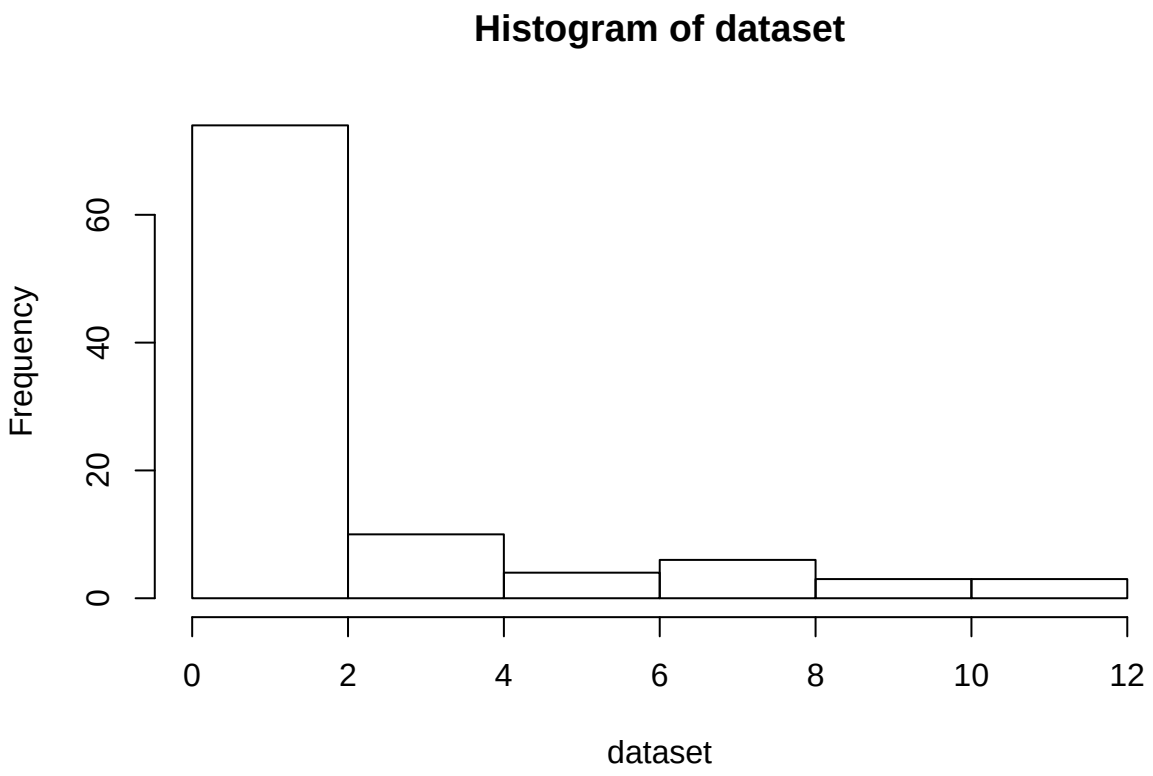
```
dataset <- rgeom(100,0.3)
dataset
```

```
##   [1]  1  1  2  1  3  1  0  1  5  2 11 10 11  1  3  1  1  2  0  1  1  2  1
##  [24]  0  1  1  7  0  0  0  0  0  2  0  1  1  0  0  0  1  0  5  2  4  1  0
##  [47]  3  6  0  2  0  0  0  0  8  4  8  1  9  0  1  0  0  1  0  0  0  0  4
##  [70] 10  0 12  2  0  0  0  7  0  7  0  3  1  5  0  2  0  1  1  1  4  2  2
##  [93]  1  3  1  0  3  8  2  1
```

```
mean(dataset)
```

```
## [1] 2.14
```

```
hist(dataset)
```


Histogram of dataset
Frequency
0
20
40
60
0
2
4
6
8
10
12
dataset