TUTORIAL 03

ENVX1002

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R Commands for Binomial and Poisson

$X \sim Bin(np)$ and $X \sim Po(\lambda)$

Function	Binomial	Poisson
PDF $P(X = x)$	$dbinom(x, n, p)$	$dpois(x, \lambda)$
CDF $F(x) = P(X \leq x)$	$pbinom(x, n, p)$	$ppois(x, \lambda)$

Binomial distribution

1. Let's think about a situation that could be modelled by $X \sim Bin(n = 8, p = 0.7)$?
2. Use R to find the following **Binomial** probabilities for hybrid tomatoes:

The new Dixie Red hybrid tomato is claimed to have larger fruit, better disease package and higher yield potential compared to the current industry leader Florida 47 R hybrid tomato.

https://www.growingproduce.com/vegetables/seminis-introduces-dixie-red-fresh-tomato-variety/

Suppose we plant 8 seeds of Dixie Red and that each seed has a 70% success rate of germination.

- Let $X =$ The number of Dixie Red seeds that germinate. What is the distribution of X?
- Use R to find the exact probability distribution function and add in the table.

Number seeds x	0	1	2	3	4	5	6	7	8
Probability $P(X = x)$									

```r
x <- c(0,1,2,3,4,5,6,7,8) # creates x values. You can also use x <- 0:8
p <- dbinom(x,8,0.7) #calculated the probabilities at each x.
rbind(x,round(p,3)) # view the probabilities with x in top row and rounded p in bottom row
```

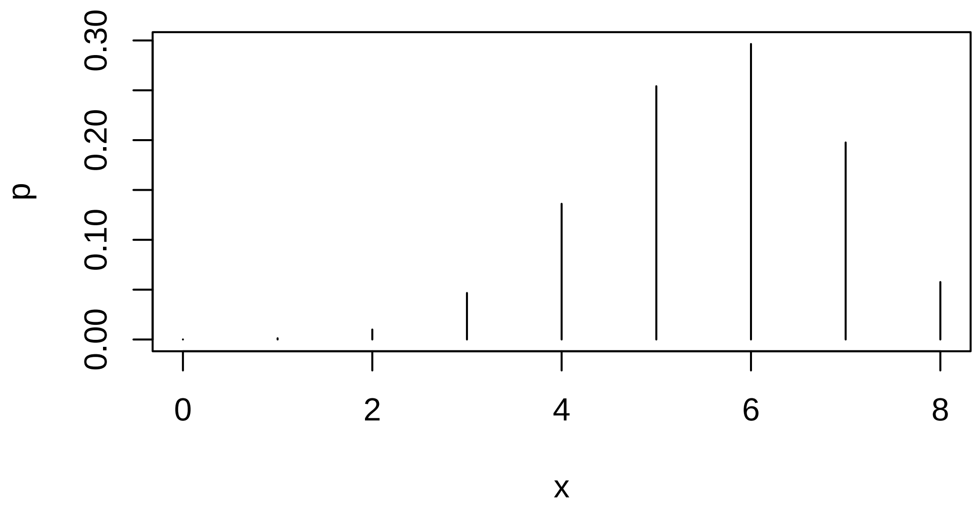
```
  [,1]  [,2] [,3]  [,4]  [,5]  [,6]  [,7]  [,8]  [,9]
x    0 1.000 2.00 3.000 4.000 5.000 6.000 7.000 8.000
     0 0.001 0.01 0.047 0.136 0.254 0.296 0.198 0.058
```

```r
sum(p) # Notice that all the probabilities sum to 1
```

```
[1] 1
```

- Use R to construct a histogram of the pdf. You can hit the code button to reveal the code to use.

```
plot(x,p,type="h") # type "h" draws lines to the points
```



Notice the Shape: The pdf is **left skewed**. This is because there is a high success rate *(p = 0.7)* so we expect more germination than no germination.

- What is the probability that 7 or more Dixie Red seeds germinate?

$P(X \geq 7) = P(X = 7) + P(X = 8) = 1 - P(X < 7) = 1 - P(X \leq 6)$

$P(X \geq 7) = \frac{8!}{7!(8-7)!} 0.7^7 (1 - 0.7)^{8-7} + \frac{8!}{8!(8-8)!} 0.7^8 (1 - 0.7)^{8-8}$

```
dbinom(7,8,0.7)+dbinom(8,8,0.7)
```

```
[1] 0.2552983
```

```
## or

1-pbinom(6,8,0.7)
```

```
[1] 0.2552983
```

Poisson distribution

On a certain joy flight path, the number of dolphin pod sightings is 2.2 per hour. Using a Poisson model, calculate the probabilities of viewing 0 to 8 dolphin pods in the table below

- Use R to findnd the exact probability distribution function and all in the table.

Number dolphin pods x	0	1	2	3	4	5	6	7	8
Probability $P(X = x)$									

```
x <- c(0,1,2,3,4,5,6,7,8) # creates x values. You can also use x <- 0:8
p <- dpois(x,2.2) #calculated the probabilities at each x and round to 3 d.p.
rbind(x,round(p,3)) # view the probabilities with x in top row and p in bottom row
```

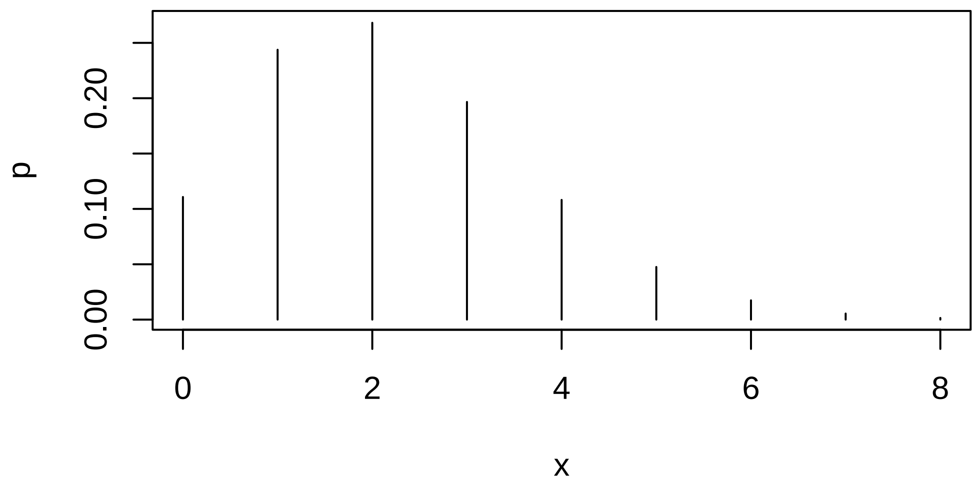
```
   [,1]  [,2]  [,3]  [,4]  [,5]  [,6]  [,7]  [,8]  [,9]
x 0.000 1.000 2.000 3.000 4.000 5.000 6.000 7.000 8.000
  0.111 0.244 0.268 0.197 0.108 0.048 0.017 0.005 0.002
```

```
sum(p) ## notice that all the probabilities don't sum to 1
```

```
[1] 0.9995305
```

- do a barplot of the probabilities

```
plot(x,p,type="h") # type "h" draws lines to the points
```



- What is the probability of seeing no dolphin pods.

$P(X = 0) = \frac{2.2^0 e^{-2.2}}{0!} = 0.1108$

so about 11% of the flights i.e. 1 in 10 flights you will see no dolphins

```
dpois(0,2.2)
```

```
[1] 0.1108032
```

- What is the probability of seeing more than 3 dolphin pods?

$P(X \geq 3) = 1 - P(X = 0) - P(X = 1) - P(X = 2) - P(X = 3)$

$P(X \geq 3) = 1 - \frac{2.2^0 e^{-2.2}}{0!} - \frac{2.2^1 e^{-2.2}}{1!} - \frac{2.2^2 e^{-2.2}}{2!} - \frac{2.2^3 e^{-2.2}}{3!} = 0.1806476$

```r
1-dpois(0,2.2)-dpois(1,2.2)-dpois(2,2.2)-dpois(3,2.2)
```

```
[1] 0.1806476
```

```r
1-ppois(3,2.2)
```

```
[1] 0.1806476
```