Assignment 1

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Two dice D_1 and D_2 are rolled and let S be the sum $S = D_1 + D_2$.

```
# Exercise 1 and 2 data setup:
die1 <- c(1:6)
die2 <- c(1:6)
rolls <- expand.grid(die1, die2)
R <- data.frame(rolls, rowSums(rolls))
colnames(R) <- c("D_1", "D_2", "S")
totalDifferentRolls <- dim(R)[1]
```

```
answer1 <- sum(R$D_1 < 4 | R$S > 9) / totalDifferentRolls
answer1
```

1. Find $\Pr(D_1 < 4 \cup S > 9)$ [10 marks]

```
## [1] 0.6666667
```

```
answer2 <- sum(R$D_1 < 4 & R$S == 8) / sum(R$S == 8)
answer2
```

2. Find $\Pr(D_1 < 4 \mid S = 8)$ [10 marks]

```
## [1] 0.4
```

```
#Data cleanup exercise 1 and 2:
rm(list = ls())
```

Suppose $X \sim Binomial(n = 10, p = 0.3)$.

```
#data setup exercise 3 and 4
n <- 10
p <- 0.3
```

```r
xSmallerEqualSix <- c(0:6)
xBetweenTwoAndEight <- c(3:7)
intersection <- intersect(xSmallerEqualSix, xBetweenTwoAndEight)
answer3 <- sum(dbinom(intersection,n,p))
answer3
```

3. Find $\Pr(X \leq 6 \cap 2 < X < 8)$. **[10 marks]**

```
## [1] 0.6066251
```

4. Find $\Pr(X < 4 \mid X \leq 6)$. **[10 marks]**

$$\Pr(X < 4 \ \cap X \leq 6) -> Pr(X < 4)$$

```r
#Pr(X<4 And X<= 6) / Pr(X<=6) -> Pr(X<4) / Pr(X<=6)
probSmallerThanFour <- pbinom(3, n, p)
probSmallerEqualSix <- pbinom(6, n, p)
answer4 <- probSmallerThanFour / probSmallerEqualSix
answer4
```

```
## [1] 0.6565651
```

```r
#Data cleanup exercise 3 and 4:
rm(list = ls())
```

Suppose $X \sim Poisson(\lambda = 5)$.

```r
#data setup exercise 5 and 6
lambda <- 5
```

```r
# insert code
xBetweenThreeAndSevenInclusive <- c(4:7)
answer5 <- sum(dpois(xBetweenThreeAndSevenInclusive, lambda))
answer5
```

5. Find $\Pr(3 < X \leq 7)$. **[10 marks]**

```
## [1] 0.6016024
```

6. Find $\Pr(X < 3 \cup X \geq 7)$. **[10 marks]**

$$Pr(X < 3 \cap X \geq 7) = 0$$

```r
# insert code
probSmallerThanThree <- ppois(2,lambda)
probBiggerOrEqualSeven <- ppois(6, lambda, lower.tail = FALSE)
probOfIntersection <- 0
answer6 <- probSmallerThanThree + probBiggerOrEqualSeven - probOfIntersection
answer6
```

```
## [1] 0.3624686
```

```r
#Data cleanup exercise 5 and 6:
rm(list = ls())
```

Create a function [40 marks]

Suppose $X \sim Poisson(\lambda)$. Create a function which plots the pmf and cdf for the interval $[x_1 - 5, x_1 + 5]$ and calculate the $p(x_1)$ and $F(x_1)$ for a given value of x_1.

- Input: x_1 and λ;
- Output: $p(x_1)$ and $F(x_1)$
- Extra feature: stop the function if λ is negative and print a warning message. [**40 marks**]

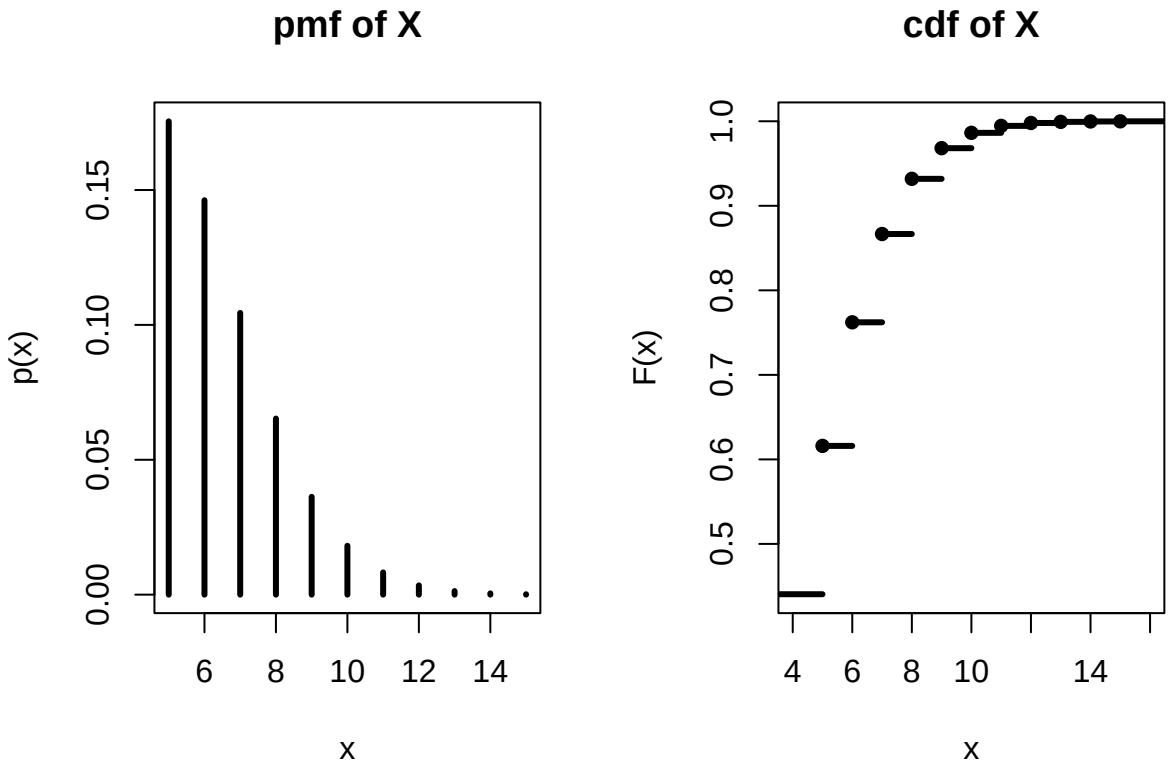
```r
poisson <- function(x1, lambda, plot = FALSE) {
  if (lambda <= 0) stop('lambda must be a positive number!')
  p_x <- dpois(x1, lambda)
  F_x <- ppois(x1, lambda)
  if (plot == TRUE) {
    par(mfrow = c(1, 2))
    INTERVAL_SIZE <- 5
    L <- x1 - INTERVAL_SIZE
    U <- x1 + INTERVAL_SIZE
    x <- c(L : U)
    pmf <- dpois(x, lambda)
    plot(x, pmf, lwd = 3, type = 'h', main = 'pmf of X', ylab = 'p(x)')

    cdf <- stepfun(x, c(ppois(L - 1, lambda), ppois(x, lambda)))
    plot.stepfun(cdf,
                 verticals = FALSE,
                 do.points = TRUE,
                 pch = 16, lwd = 3,
                 main = 'cdf of X',
                 ylab = 'F(x)')
  }
  list(p_x = p_x,
       F_x = F_x)
}
#poisson(10, 0) #This should throw an error
poisson(10, 5) #Only returns p_x and F_x
```

```
## $p_x
## [1] 0.01813279
```

```
##
## $F_x
## [1] 0.9863047
```

```
poisson(10, 5, TRUE) #Prints plot and returns p_x and F_x
```




```
## $p_x
## [1] 0.01813279
##
## $F_x
## [1] 0.9863047
```