Practical 4: Distributions

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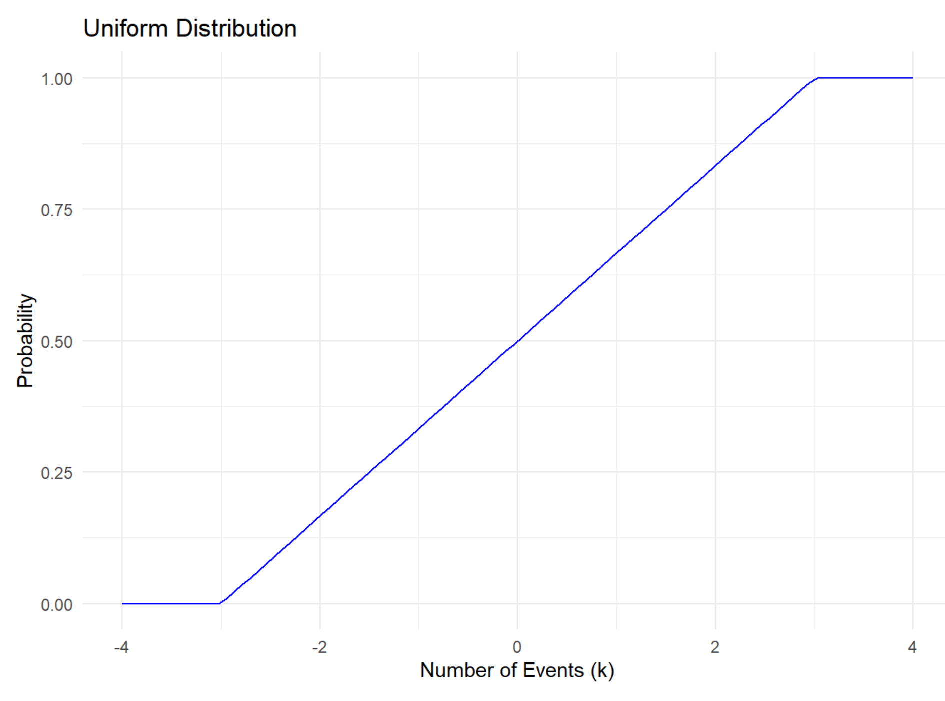
Uniform Distribution

```r
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 4.3.3
```

```r
# Function to plot Poisson distribution
plot_uni <- function(a,b,l) {
  # Generate a sequence of possible values for the number of events (k)
  k_values <- seq(-4,4,length=100)  # Use 3 times lambda to cover a broad range

  # Calculate the cdf of Poisson probability for each value of k
  uni_prob <- dunif(k_values, min=-3, max=3)

  # Create a data frame for plotting
 uni_data <- data.frame(k = k_values, Probability = uni_prob)

  # Plot the Poisson distribution
  ggplot(uni_data, aes(x = k, y = Probability)) +
    geom_line(color = "blue") +
   # geom_point(color = "red", size = 2) +
    labs(title = paste("Uniform Distribution"),
         x = "Number of Events (k)",
         y = "Probability") +
    theme_minimal()

#  plot(k_values,uni_prob, type = 'l')
}

plot_cdf_uni <- function(a,b,l) {
  # Generate a sequence of possible values for the number of events (k)
  k_values <- seq(a,b,length=l)  # Use 3 times lambda to cover a broad range

  # Calculate the cdf of Poisson probability for each value of k
  uni_prob <- punif(k_values, min=-3, max=3)

  # Create a data frame for plotting
  uni_data <- data.frame(k = k_values, Probability = uni_prob)

  # Plot the Poisson distribution
   ggplot(uni_data, aes(x = k, y = Probability)) +
    geom_line(color = "blue") +
    # geom_point(color = "red", size = 2) +
    labs(title = paste("Uniform Distribution"),
         x = "Number of Events (k)",
         y = "Probability") +
    theme_minimal()
}

plot_cdf_uni(-4,4,100)
```




```r
#probability of x=1 c
p_vlue<-dunif(1, min=-3, max=3)
print(p_vlue)
```

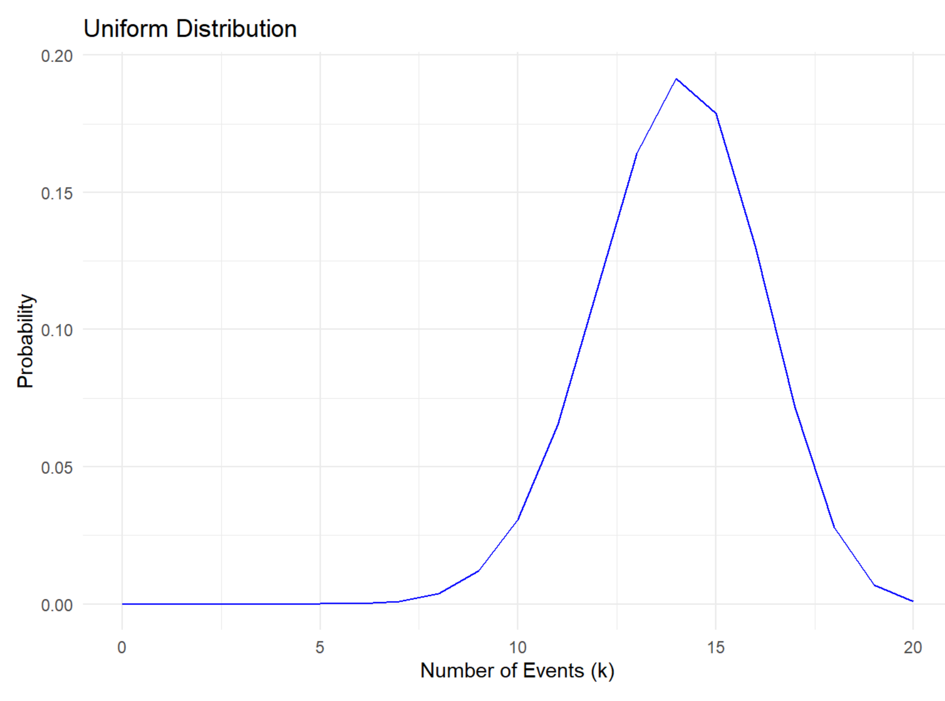
```
## [1] 0.1666667
```

```r
#probability of x<=1 cumulative
p_vlue<-punif(1, min=-3, max=3)
print(p_vlue)
```

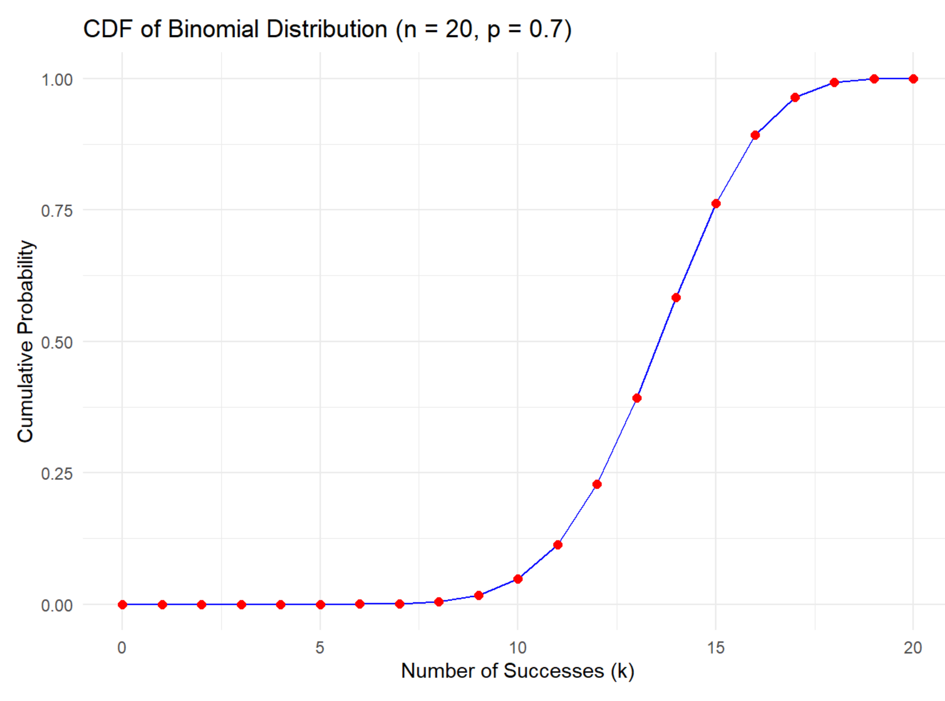
```
## [1] 0.6666667
```

Binomial Distribution

```r
library(ggplot2)

# Parameters
n <- 20
p <- 0.7

# Generate a sequence of possible values for the number of successes (k)
k_values <- 0:n
# Calculate the  probabilities for each k
p_values<-dbinom(k_values, size = n, prob = p)
#Creating d dataframe
p_data= data.frame(k = k_values, Probability = p_values)
#Plotting the probabilities
ggplot(p_data, aes(x = k, y = Probability)) +
  geom_line(color = "blue") +
  #geom_point(color = "red", size = 2) +
  labs(title = paste("Uniform Distribution"),
       x = "Number of Events (k)",
       y = "Probability") +
  theme_minimal()
```




```r
# Calculate the cumulative probabilities for each k
cdf_values <- pbinom(k_values, size = n, prob = p)

# Create a data frame for plotting
cdf_data <- data.frame(k = k_values, CDF = cdf_values)

# Plot the CDF of the Binomial distribution
ggplot(cdf_data, aes(x = k, y = CDF)) +
  geom_line(color = "blue") +
  geom_point(color = "red", size = 2) +
  labs(title = "CDF of Binomial Distribution (n = 20, p = 0.7)",
       x = "Number of Successes (k)",
       y = "Cumulative Probability") +
  theme_minimal()
```




```r
#probability of x=10 cumulative
p_vlue<-dbinom(10, size =20, prob = p)
print(p_vlue)
```

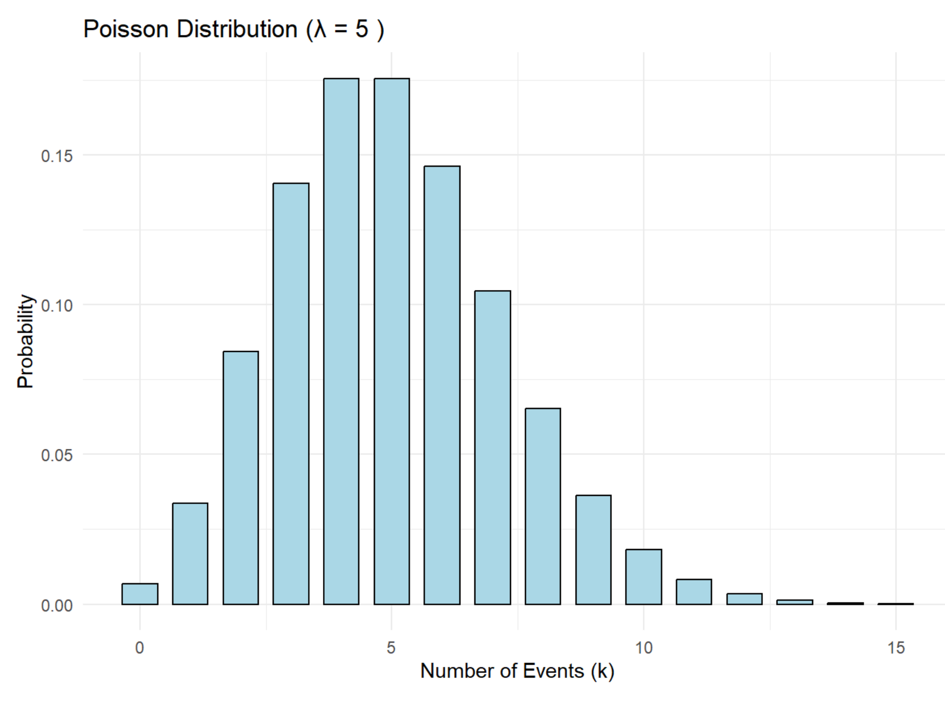
```
## [1] 0.03081708
```

```r
#probability of x<=10 cumulative
p_vlue<-pbinom(10, size =20, prob = p)
print(p_vlue)
```

```
## [1] 0.0479619
```

Poisson's Distribution

```r
library(ggplot2)

# Function to plot Poisson distribution
plot_poisson <- function(lambda) {
  # Generate a sequence of possible values for the number of events (k)
  k_values <- 0:(lambda * 3)  # Use 3 times lambda to cover a broad range

  # Calculate the Poisson probability for each value of k
  poisson_prob <- dpois(k_values, lambda)

  # Create a data frame for plotting
  poisson_data <- data.frame(k = k_values, Probability = poisson_prob)

  # Plot the Poisson distribution
  ggplot(poisson_data, aes(x = k, y = Probability)) +
    geom_bar(stat = "identity", fill = "lightblue", color = "black", width = 0.7) +
    labs(title = paste("Poisson Distribution (λ =", lambda, ")"),
         x = "Number of Events (k)",
         y = "Probability") +
    theme_minimal()
}

# Function to plot Poisson distribution
plot_cdfpoisson <- function(lambda) {
  # Generate a sequence of possible values for the number of events (k)
  k_values <- 0:(lambda * 3)  # Use 3 times lambda to cover a broad range

  # Calculate the cdf of Poisson probability for each value of k
  poisson_prob <- ppois(k_values, lambda)

  # Create a data frame for plotting
  poisson_data <- data.frame(k = k_values, Probability = poisson_prob)

  # Plot the Poisson distribution
  ggplot(poisson_data, aes(x = k, y = Probability)) +
    geom_line(color = "blue") +
    geom_point(color = "red", size = 2) +
    labs(title = paste("CDF Poisson Distribution (λ =", lambda, ")"),
         x = "Number of Events (k)",
         y = "Probability") +
    theme_minimal()
}

# Plot for lambda = 2
plot_poisson(5)
```




```r
#plot_cdfpoisson(2)
# Plot for lambda = 5
#plot_cdfpoisson(5)

# Plot for lambda = 10
#plot_poisson(10)
#probability of 5 when lamada is 3
dpois(5, 3)
```

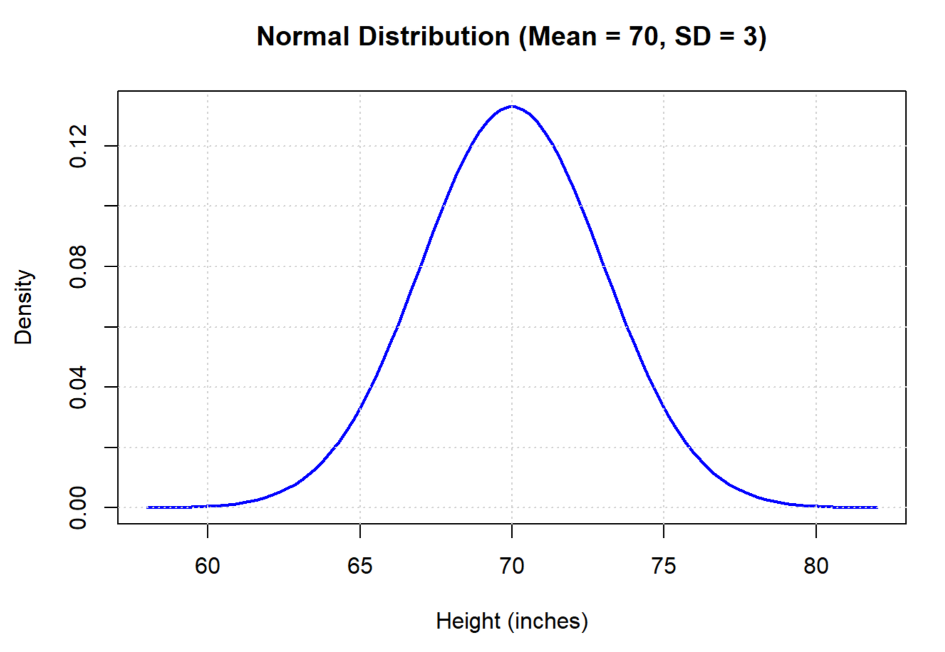
```
## [1] 0.1008188
```

```r
#CDF of 5 when lamada is 3
ppois(5, 3)
```

```
## [1] 0.9160821
```

Normal Distribution

```r
library(ggplot2)

# Define mean and standard deviation
mu <- 70   # Mean
sigma <- 3 # Standard deviation

# Generate a sequence of values (for x-axis)
x <- seq(mu - 4*sigma, mu + 4*sigma, length = 100)

# Calculate the corresponding PDF values
y <- dnorm(x, mean = mu, sd = sigma)

# Plot the PDF
plot(x, y, type = "l", lwd = 2, col = "blue",
     xlab = "Height (inches)", ylab = "Density",
     main = "Normal Distribution (Mean = 70, SD = 3)")

# Add a grid for better visualization
grid()
```




```r
# Calculate P(68 <= X <= 72)
p <- pnorm(72, mean = mu, sd = sigma) - pnorm(68, mean = mu, sd = sigma)
print(p) # Output will be approximately 0.4972
```

```
## [1] 0.4950149
```

```r
# Calculate the PDF value at X = 68
pdf_value <- dnorm(68, mean = mu, sd = sigma)
print(pdf_value) # Output will be approximately 0.188
```

```
## [1] 0.1064827
```