Experimentos No Determinísticos

1. Ejercicios de Experimentos No Determinísticos

1.1. Simulaciones

En está práctica de simulaciones se utiliza principalmente las siguientes funciones:

- **set.seed**, para fijar una semilla y contar siempre con el mismo resultado
- **sample**, en este caso se utiliza para generar una muestra de números aleatorios
- **size**, determina el tamaño de la muestra
- **replace**, True si queremos que exista reemplazamiento, caso contrario False
- **table**, que crea una tabla de frecuencias
- **freq**, muestra una tabal de frecuencias completa
- **plot**, o hist para graficar
- **cbind**, para unir dos vectores en columnas
- **pnorm**, permite calcular la función de distribución acumulada de la distribución normal

Nota: Previamente se deben tener cargadas las librerias que permiten llamar a las funciones.

1.1.1 Lanzamiento de moneda 1285 veces

```
set.seed(1234)
resul1 <- sample(c("cara", "sello"),
                 size = 1285, replace=T)
print(resul1)
```

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##    [1] "sello" "sello" "sello" "sello" "cara"  "sello" "cara"  "cara"  "cara"
##   [10] "sello" "sello" "sello" "sello" "cara"  "sello" "sello" "sello" "cara"
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```
freq1 <- table(resul1)
freq1
```

```
## resul1
##  cara sello
##   655   630
```

```
plot(freq1,main="Gráfico 1: Histograma del experimento lanzamiento de una moneda")
```

```r
resul2 <- ifelse(resul1=="cara",0,1)
resul2
```

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##    [1] 1 1 1 1 0 1 0 0 0 1 1 1 1 0 1 1 1 0 1 1 1 1 1 1 1 1 0 1 1 1 0 1 0 0 0 1 0
##   [38] 1 1 0 1 0 1 1 1 0 0 0 0 1 1 1 1 1 0 1 0 0 1 0 1 1 0 1 0 0 1 0 0 1 1 0 0 0
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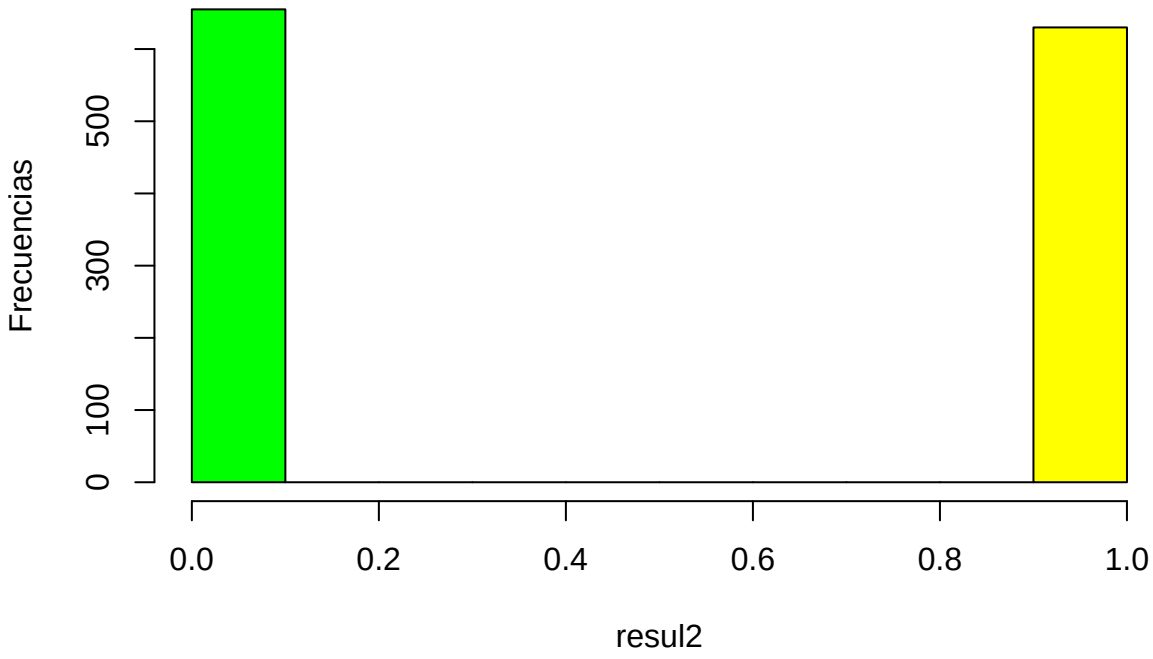
##  [593] 1 0 1 1 0 1 0 1 1 1 1 1 1 1 1 1 1 0 0 0 1 0 0 0 1 0 0 1 0 1 0 0 0 0 0 0 0
##  [630] 1 1 0 0 0 0 0 0 1 1 1 0 1 0 0 0 1 1 0 1 1 1 0 0 0 1 1 1 1 0 0 0 1 1 0 1 1 1
##  [667] 0 1 0 1 1 1 1 0 0 0 0 0 0 0 0 1 1 0 0 1 1 0 1 1 0 0 0 1 0 1 0 1 1 1 1 1 0 1
##  [704] 1 0 0 1 1 0 1 0 1 1 0 0 0 1 0 0 0 0 0 0 1 1 1 0 0 1 0 1 0 0 0 0 0 0 0 1 0 0 1
##  [741] 0 0 1 0 1 0 1 0 1 0 0 0 0 1 1 0 0 0 1 1 1 0 0 0 1 1 1 0 0 1 0 0 0 1 0 1 0
##  [778] 1 1 0 0 0 0 0 0 0 0 0 1 0 1 1 0 1 0 0 0 0 0 0 1 1 1 0 1 1 0 0 1 0 1 1 0 0 1 1
##  [815] 1 1 1 1 0 0 0 0 1 0 0 0 0 1 1 1 0 0 1 1 0 1 1 1 1 0 0 0 0 0 0 1 0 1 0 1 0 1
##  [852] 1 1 0 0 1 0 1 0 0 1 1 0 1 0 1 1 1 1 0 1 0 0 1 1 1 0 1 1 0 1 0 0 0 0 0 0 1 0
##  [889] 0 0 1 1 0 0 1 1 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 1 0 0 0 1 1 0 0 1 1 1 0 1 0
##  [926] 1 1 0 1 1 0 1 1 0 0 1 0 1 0 0 1 0 0 1 1 1 1 0 1 1 0 1 1 1 1 0 0 0 0 0 0 1 1
##  [963] 0 1 0 0 1 1 1 0 0 1 1 1 0 1 0 1 1 0 1 0 1 1 0 0 0 1 0 0 0 0 0 1 1 1 0 0 0
## [1000] 1 1 0 1 0 1 1 0 0 1 1 1 1 0 0 0 0 1 0 1 0 0 1 0 1 1 1 1 0 0 0 0 1 0 1 0 0
## [1037] 1 0 0 1 0 1 0 0 1 0 0 1 0 1 0 1 1 1 0 0 1 0 0 1 1 0 1 0 1 1 0 0 0 1 1 0 0
## [1074] 0 0 1 0 1 0 0 0 1 1 1 0 0 0 0 1 1 1 0 0 1 1 0 0 0 1 0 1 1 0 1 0 0 0 0 0 0
## [1111] 1 0 0 0 0 1 1 0 0 0 1 0 0 1 0 1 0 0 1 0 1 1 0 0 1 1 1 1 1 1 1 0 0 0 0 0 1
## [1148] 1 0 1 1 0 1 0 0 0 1 1 1 1 1 1 0 0 0 0 1 0 1 0 1 1 0 1 0 1 1 1 0 1 1 0 0 0
## [1185] 1 0 1 1 1 1 1 1 0 1 0 0 1 1 1 0 0 1 1 1 1 0 0 1 1 1 0 0 1 1 1 0 1 1 0 0 1 1
## [1222] 0 0 0 1 0 1 0 0 1 0 1 0 1 1 0 1 1 0 1 0 0 0 1 1 1 1 1 1 0 1 0 1 1 0 0 0 0
## [1259] 0 1 0 1 1 1 0 0 1 1 0 1 1 0 1 0 1 0 0 1 1 1 0 1 1 1 1
```

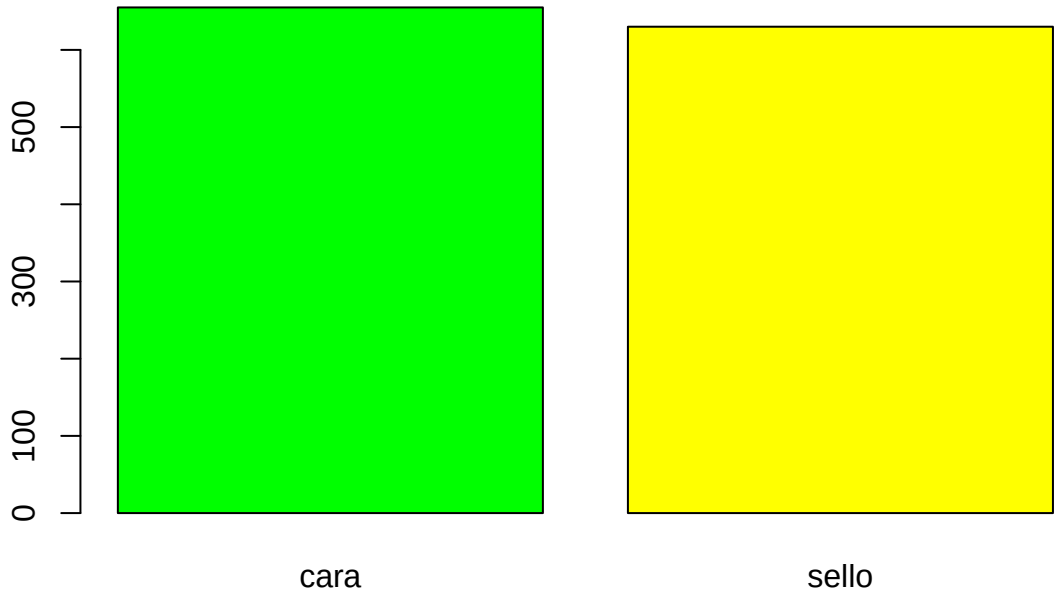
```r
hist(resul2,main="Gráfico 2: Histograma del experimento lanzamiento de una moneda",
     ylab="Frecuencias",
     col=c("green","yellow"))
```

Gráfico 2: Histograma del experimento lanzamiento de una moneda




```
library("descr")
freq2 <- freq(resul1,
              main = "Gráfico 3: Frecuencias del experimento lanzamiento de una moneda",
              col=c("green","yellow"))
```

Gráfico 3: Frecuencias del experimento lanzamiento de una moned




```
freq2
```

```
## resul1
##       Frequency Percent
## cara        655   50.97
## sello       630   49.03
## Total      1285  100.00
```

```
tab <- freq2
dim(tab)
```

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

```
fx <- tab[,2]/100
fx
```

```
##      cara     sello     Total
## 0.5097276 0.4902724 1.0000000
```

```
tab <- cbind(tab,fx)
print(tab)
```

```
##       Frequency   Percent        fx
## cara        655  50.97276 0.5097276
## sello       630  49.02724 0.4902724
## Total      1285 100.00000 1.0000000
```

1.1.2 Lanzamiento de un dado 1100 veces

```
dado <- c(1,2,3,4,5,6)
simuld <- NULL
nd <- 1100
simuld <- sample(dado, nd, replace = TRUE)
simuld
```

```
##    [1] 6 2 1 5 6 2 2 1 6 6 3 5 3 2 4 2 3 5 6 4 6 2 1 3 4 1 5 5 6 1 6 4 2 3 4 4 5
##   [38] 3 2 4 2 2 3 2 1 6 5 2 4 5 1 3 4 1 6 3 2 2 2 2 4 3 5 5 4 5 6 3 4 2 2 1 6 1
##   [75] 4 6 1 2 4 6 4 5 1 5 6 1 5 1 4 1 3 3 5 4 1 3 3 6 4 2 1 1 5 3 5 6 4 5 4 4 6
##  [112] 5 3 3 4 2 2 4 3 3 4 5 6 3 5 3 1 1 4 6 1 3 4 1 5 5 3 4 4 6 5 4 2 3 2 3 5 2
##  [149] 3 6 6 5 1 3 6 3 5 4 2 5 5 3 3 6 6 5 1 2 3 2 6 1 5 5 4 3 6 3 4 6 4 2 5 4 3
##  [186] 6 3 1 2 6 5 6 1 1 6 4 5 4 5 1 2 3 1 3 5 1 1 2 3 1 1 5 2 6 3 5 2 6 4 3 6 1
##  [223] 5 6 5 4 1 5 6 4 1 4 6 1 2 6 4 6 6 2 3 6 3 3 6 6 6 5 2 3 3 1 5 3 2 5 3 6 4
##  [260] 5 4 6 4 4 3 1 6 3 2 4 2 5 6 6 4 4 4 4 4 3 3 4 4 6 3 3 5 6 1 6 5 1 1 4 4 5
##  [297] 3 3 5 4 1 5 4 6 6 5 3 1 1 2 1 5 1 6 2 1 1 3 3 2 5 3 6 4 3 6 6 6 4 3 5 1 1
##  [334] 2 1 1 3 2 2 3 5 6 3 6 5 5 2 3 1 2 1 5 4 6 4 4 3 2 6 4 5 6 2 2 5 3 3 2 4 4
##  [371] 4 4 5 3 1 5 1 3 4 3 1 1 5 4 3 2 6 5 2 3 5 5 2 1 5 6 4 1 4 2 1 6 2 3 5 6 6
##  [408] 3 5 1 5 4 4 5 2 5 4 6 3 2 4 6 2 1 5 5 4 4 6 3 4 2 6 2 1 3 4 2 4 3 5 4 6 3
##  [445] 6 2 4 6 3 2 3 6 2 1 3 2 6 2 4 6 4 1 2 2 4 5 2 4 3 5 6 6 2 6 5 1 3 3 6 5 2
##  [482] 6 4 5 3 5 1 4 2 5 1 4 5 2 6 2 3 5 3 2 5 2 3 2 3 2 6 1 4 4 1 6 4 2 1 4 1 4
##  [519] 4 6 1 2 1 6 6 4 6 5 4 2 4 3 3 3 5 5 5 5 2 4 3 4 1 5 3 1 2 5 5 4 3 5 4 1 2
##  [556] 5 3 4 1 1 1 4 5 5 6 5 5 6 5 3 2 2 5 5 2 3 3 6 5 5 5 6 6 4 2 1 4 6 2 5 1 5
##  [593] 3 1 1 5 5 4 3 4 5 5 2 6 5 1 1 4 2 5 1 4 3 5 6 6 1 6 4 2 2 4 4 2 6 4 2 1 3
##  [630] 1 1 5 5 4 1 3 6 3 4 2 2 4 6 4 5 6 1 4 4 5 5 3 2 5 4 6 5 4 5 6 1 4 5 3 5 4
##  [667] 4 5 6 6 2 4 2 3 6 4 5 2 6 5 5 3 1 2 2 1 4 5 2 6 2 3 4 1 2 2 4 3 3 3 2 5 1
##  [704] 2 3 6 2 4 6 6 5 4 2 1 5 1 2 4 4 3 6 2 1 5 2 6 1 2 5 2 4 1 2 5 3 5 3 1 5 4
##  [741] 3 5 6 6 5 6 6 2 2 3 5 5 5 4 3 1 5 1 2 4 3 2 6 1 6 3 5 6 6 6 5 2 1 3 5 4 1
##  [778] 4 3 2 3 5 2 3 2 6 6 6 5 4 4 3 2 1 5 2 3 6 6 6 2 1 5 1 6 6 2 1 1 5 3 5 1 5
##  [815] 1 6 2 3 6 1 4 1 4 6 4 4 4 1 4 1 3 6 5 6 4 5 6 4 2 6 3 6 3 4 4 2 2 2 5 4 4
##  [852] 5 5 1 5 3 1 3 1 6 5 3 1 5 6 6 2 6 3 4 6 1 6 3 4 6 2 5 5 3 4 5 4 1 2 6 2 3
##  [889] 6 5 1 5 2 6 3 6 1 1 3 4 6 2 1 3 3 3 3 3 2 4 6 6 5 2 5 3 4 6 4 2 5 5 5 3 3
##  [926] 3 6 3 4 3 4 6 6 3 6 6 1 6 3 2 3 6 1 4 1 4 6 3 1 3 2 4 5 3 2 2 4 1 2 1 3 1
##  [963] 2 2 5 3 1 4 5 4 2 4 5 3 1 6 2 5 6 6 4 2 6 6 3 5 1 1 5 3 1 1 5 4 1 6 1 4 1
## [1000] 6 6 4 2 1 5 6 3 2 2 6 1 5 6 1 3 3 4 4 1 6 1 4 4 5 6 6 1 5 3 1 2 2 1 3 1 6
## [1037] 6 5 2 4 1 2 1 4 3 4 1 4 5 6 2 1 2 3 2 2 2 5 6 5 3 5 5 6 1 2 6 3 4 3 5 3 3
## [1074] 2 5 5 6 5 2 4 1 5 6 1 1 3 3 1 5 5 2 1 4 2 1 1 4 1 3 2
```

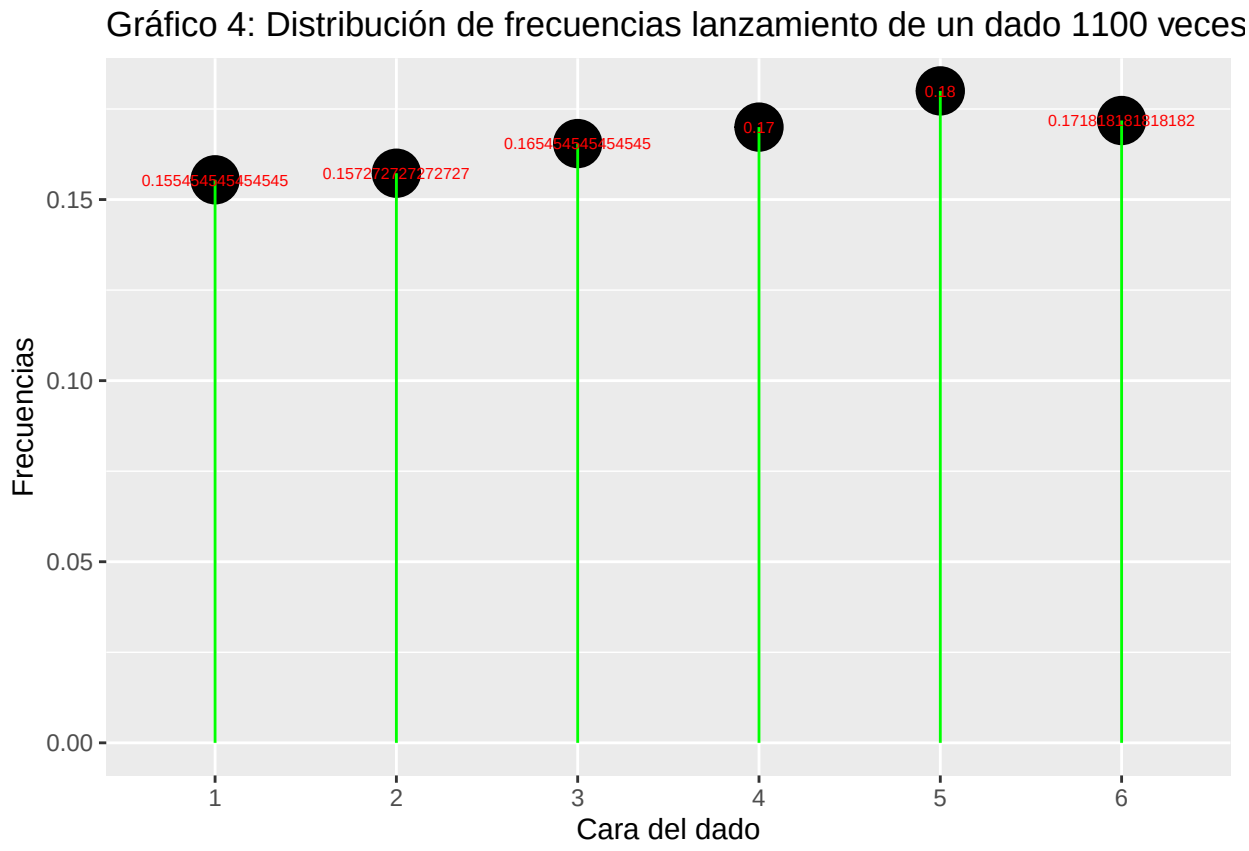
```
t2 <- table(simuld)
t2
```

```
## simuld
##   1   2   3   4   5   6
## 171 173 182 187 198 189
```

```
t2p <- prop.table(t2)
addmargins(t2p)
```

```
## simuld
##         1         2         3         4         5         6       Sum
## 0.1554545 0.1572727 0.1654545 0.1700000 0.1800000 0.1718182 1.0000000
```

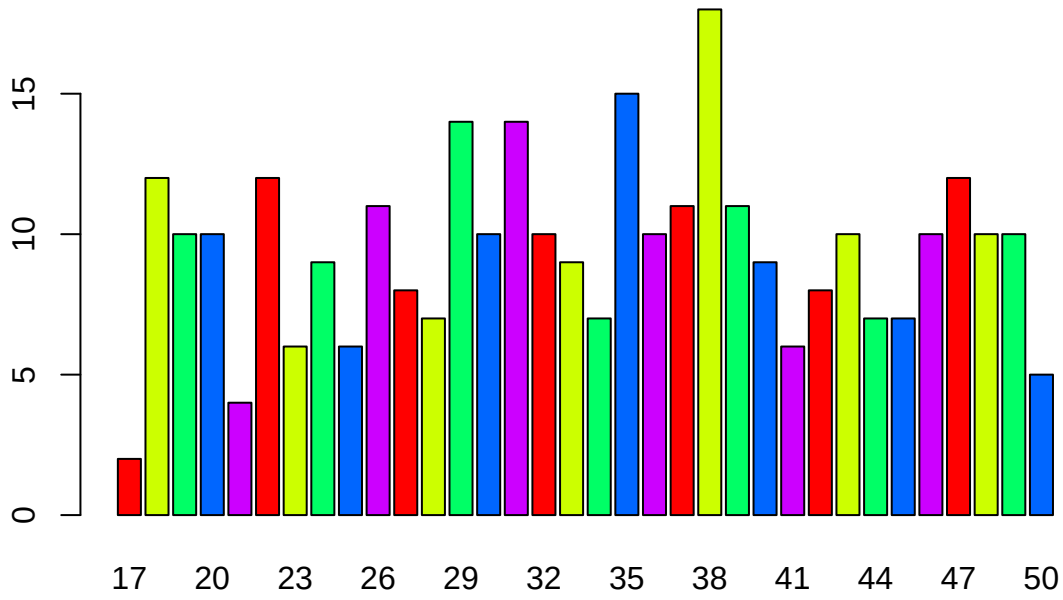
```
### Ahora realizaremos un gráfico de la distribución de las frecuencias relativas utilizando la librerí

library (ggplot2)
t2p <- as.data.frame(t2p)
ggplot(t2p, aes(x=simuld, y=Freq, label=Freq)) +
  geom_point(stat='identity', fill="green", size=8)  +
  geom_segment(aes(x = simuld,
                   xend = simuld,
                   y = 0,
                   yend = Freq),
               color = "green") +
  geom_text(color="red", size=2) +
  labs(title="Gráfico 4: Distribución de frecuencias lanzamiento de un dado 1100 veces",
       x = "Cara del dado",y = "Frecuencias")
```



1.1.3 Selección de los estudiantes con edades en el rango de 17 A 50 años

```
set.seed(1234)
ed_u <- sample(17:50, size=320,replace=T)
freq4 <-freq(ed_u,plot=T, col=rainbow(5), main="Gráfico 5: Distribución de Frecuencias edades")
```

Gráfico 5: Distribución de Frecuencias edades




```
tab <- freq4
fx <- tab[,2]/100
tb <- cbind(tab,fx)

colnames(tb) <- c("Frecuencia","%","fx")
print(tb)
```

```
##       Frecuencia       %       fx
## 17             2  0.6250 0.006250
## 18            12  3.7500 0.037500
## 19            10  3.1250 0.031250
## 20            10  3.1250 0.031250
## 21             4  1.2500 0.012500
## 22            12  3.7500 0.037500
## 23             6  1.8750 0.018750
## 24             9  2.8125 0.028125
## 25             6  1.8750 0.018750
## 26            11  3.4375 0.034375
## 27             8  2.5000 0.025000
## 28             7  2.1875 0.021875
## 29            14  4.3750 0.043750
## 30            10  3.1250 0.031250
## 31            14  4.3750 0.043750
## 32            10  3.1250 0.031250
## 33             9  2.8125 0.028125
## 34             7  2.1875 0.021875
```

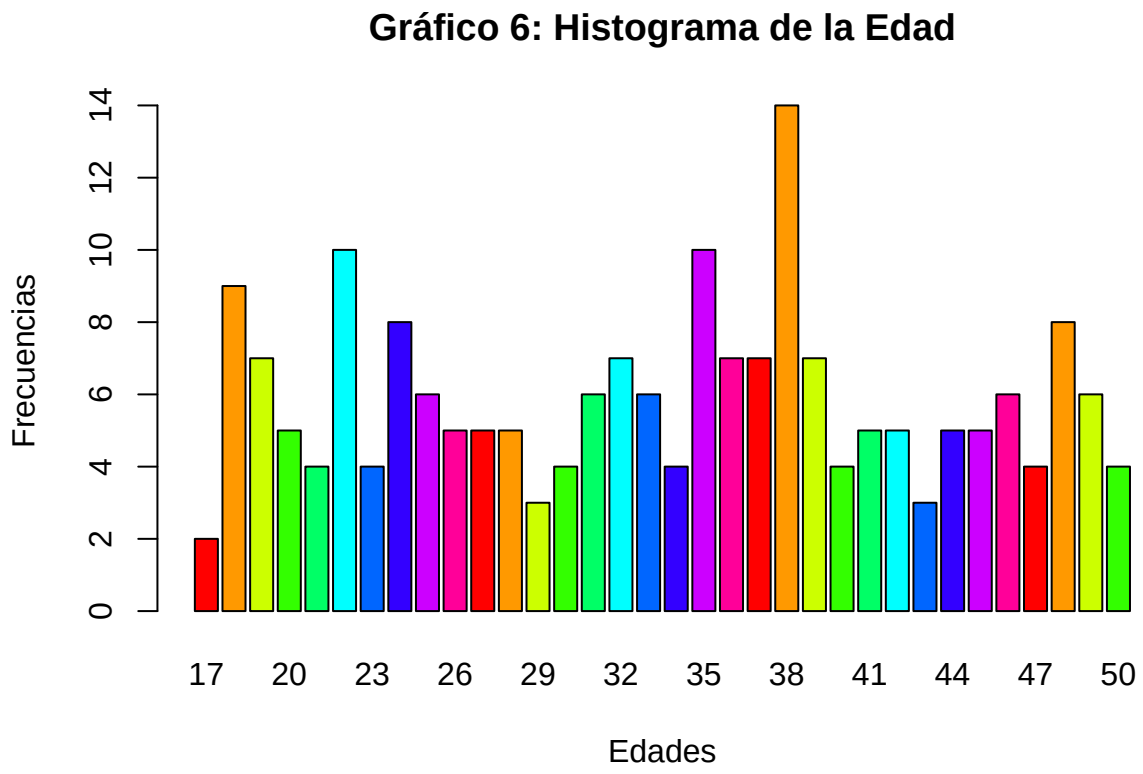
```
## 35            15   4.6875 0.046875
## 36            10   3.1250 0.031250
## 37            11   3.4375 0.034375
## 38            18   5.6250 0.056250
## 39            11   3.4375 0.034375
## 40             9   2.8125 0.028125
## 41             6   1.8750 0.018750
## 42             8   2.5000 0.025000
## 43            10   3.1250 0.031250
## 44             7   2.1875 0.021875
## 45             7   2.1875 0.021875
## 46            10   3.1250 0.031250
## 47            12   3.7500 0.037500
## 48            10   3.1250 0.031250
## 49            10   3.1250 0.031250
## 50             5   1.5625 0.015625
## Total        320 100.0000 1.000000
```

2. Gráficas de las funciones de probabilidad y de las distribuciones de la función de variables aleatorias

2.1. Simulaciones

2.1.1 Variables aletorias discretas

```
rm(list=ls())
set.seed(1234)
edad <- sample (17:50, 200, replace=T)
freq5 <- freq(edad,plot=F)
plot(freq5, main="Gráfico 6: Histograma de la Edad",
     xlab="Edades",
     ylab="Frecuencias",
     col=rainbow(10))
```

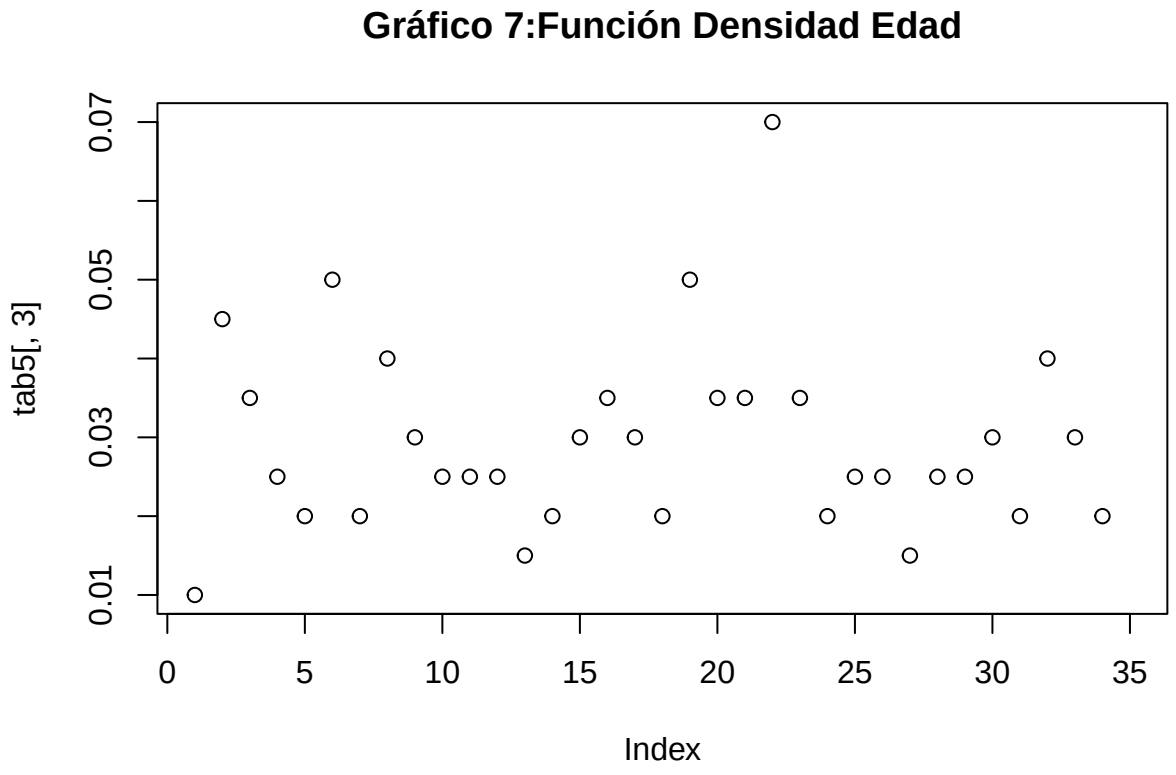



```
tab5 <- freq5
fx <- tab5[,2]/100
Fx <- cumsum(fx)
tab5 <- cbind(tab5,fx,Fx)
tab5
```

```
##       Frequency Percent    fx    Fx
## 17            2     1.0 0.010 0.010
## 18            9     4.5 0.045 0.055
## 19            7     3.5 0.035 0.090
## 20            5     2.5 0.025 0.115
## 21            4     2.0 0.020 0.135
## 22           10     5.0 0.050 0.185
## 23            4     2.0 0.020 0.205
## 24            8     4.0 0.040 0.245
## 25            6     3.0 0.030 0.275
## 26            5     2.5 0.025 0.300
## 27            5     2.5 0.025 0.325
## 28            5     2.5 0.025 0.350
## 29            3     1.5 0.015 0.365
## 30            4     2.0 0.020 0.385
## 31            6     3.0 0.030 0.415
## 32            7     3.5 0.035 0.450
## 33            6     3.0 0.030 0.480
## 34            4     2.0 0.020 0.500
## 35           10     5.0 0.050 0.550
```

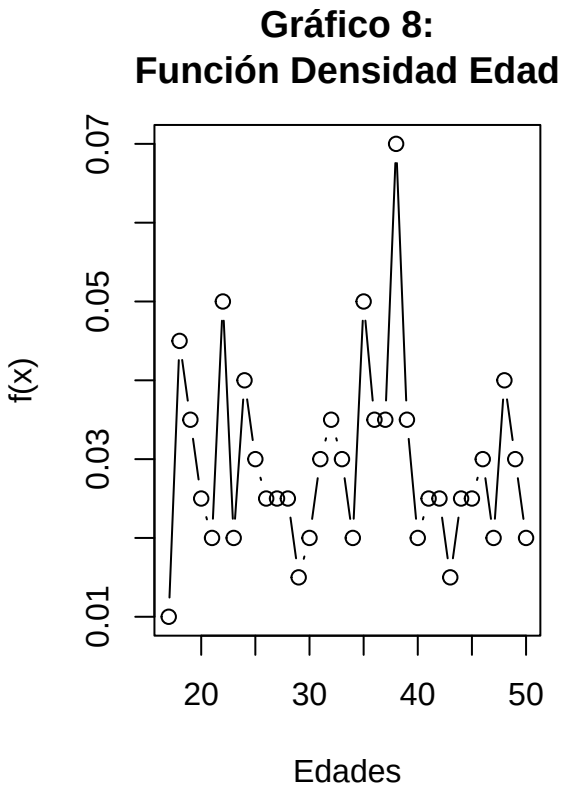
```
## 36            7     3.5 0.035 0.585
## 37            7     3.5 0.035 0.620
## 38           14     7.0 0.070 0.690
## 39            7     3.5 0.035 0.725
## 40            4     2.0 0.020 0.745
## 41            5     2.5 0.025 0.770
## 42            5     2.5 0.025 0.795
## 43            3     1.5 0.015 0.810
## 44            5     2.5 0.025 0.835
## 45            5     2.5 0.025 0.860
## 46            6     3.0 0.030 0.890
## 47            4     2.0 0.020 0.910
## 48            8     4.0 0.040 0.950
## 49            6     3.0 0.030 0.980
## 50            4     2.0 0.020 1.000
## Total       200   100.0 1.000 2.000
```

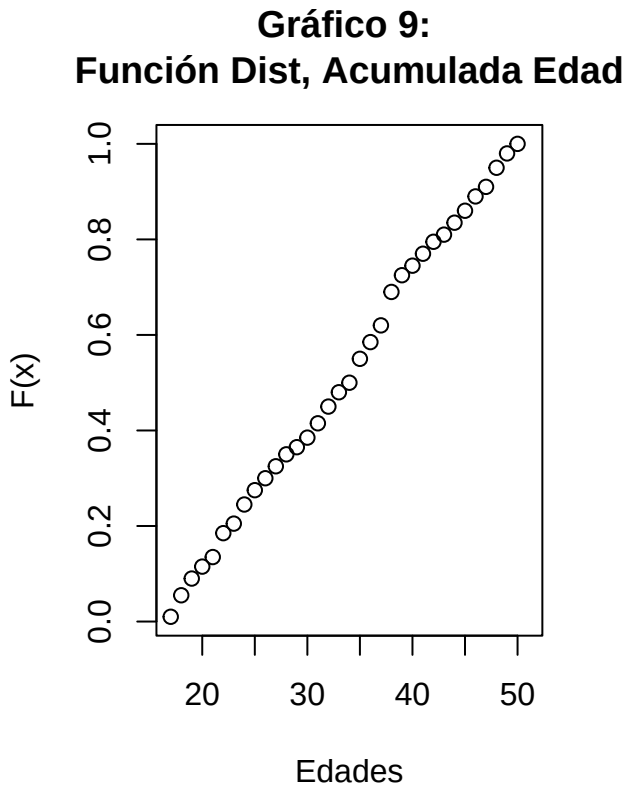
```
n <- length(tab5[,1])
tab5[n,3:4] <- NA
edad1 <- seq(17,51)
## Gráfico
plot(tab5[,3],  main="Gráfico 7:Función Densidad Edad")
```




```
par(mfrow=c(1,2))
plot(edad1,tab5[,3], type = "b", main="Gráfico 8:\nFunción Densidad Edad",
```

```
     xlab="Edades",
     ylab="f(x)",
     xlim=c(17,50))

plot(edad1,tab5[,4], type = "b", main="Gráfico 9: \nFunción Dist, Acumulada Edad",
     xlab="Edades",
     ylab="F(x)")
```





2.1.1 Variables aletorias continuas

```
par(mfrow=c(1,2))
z <- seq(-5,5,0.5)
fz <-(1/sqrt(2*pi))*exp(-(z^2/2))
Fz <- pnorm(z,0,1)
plot(z,fz,main="Gráfico  10: \nDist. normal estandarizada - fz",
     type="l",
     xlab="Valores Z",
     ylab="f(z)")

abline(v=0,col="red",lty=3)

plot(z,Fz,main="Gráfico 11: \nDist. normal estandarizada - Fz",
     type="l",
```

```
     xlab="Valores Z",
     ylab="F(z)")
```

Gráfico 10:
Dist. normal estandarizada − fz

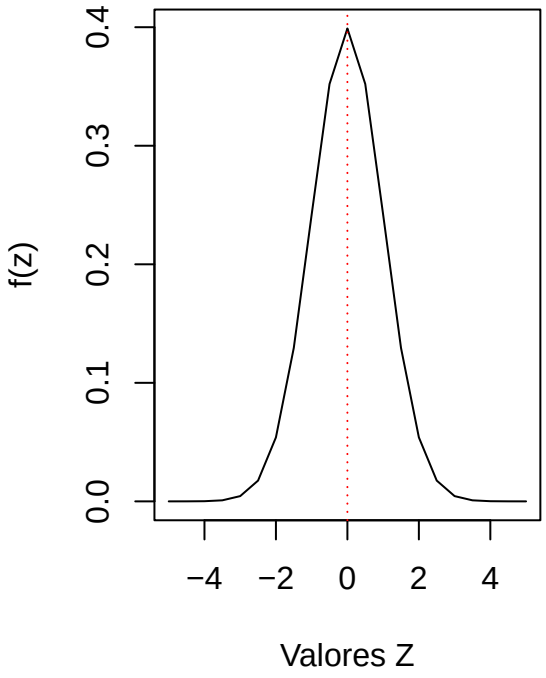


Gráfico 11:
Dist. normal estandarizada − Fz