

Práctica I - Caminata Aleatoria Simple

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Introducción al Análisis de Datos con R

1 Práctica I: Caminata aleatoria Simple

[]:

$$S_n = S_{n-1} + X_n, \quad n \geq 1$$

Por ejemplo, la posición al efectuar el movimiento 1 es:

$$S_1 = S_0 + X_1 = 0 + 1 = 1$$

Por ejemplo, la posición al efectuar el movimiento 2 es:

$$S_2 = S_1 + X_2 = 1 + (-1) = 0$$

```
[7]: # function to simulate random walk
simple.random.walk <- function(n.steps, n.sim, prob.r=0.5){

  n <- n.steps
  a <- prob.r

  x.left = -1
  x.right = 1

  Sn_mat <- matrix(0,ncol=n+1,nrow=n.sim)

  for(i in 1:n.sim){
    for(j in 2:(n+1)){
      step <- sample(c(x.left,x.right),1,prob=c(1-a,a),replace=F)
      Sn_mat[i,j] <- Sn_mat[i,j-1] + step
    }
  }

  # data frame
  result_df <- data.frame('sim'=sapply(1:n.sim, function(i)
    paste('sim',i,sep='')),
```

```

      'Sn'=Sn_mat)

  return(result_df)
}

```

1.1 Simulation:

```

[9]: library("tidyverse")
      library("ggplot2")
      library("plotly")
      options(repr.plot.width=16, repr.plot.height=8)

```

```

[10]: ##### Example:
      n.steps <- 10000 # number of steps
      n.sim <- 1000    # number of trayectiries
      a <- 0.5         # probability to right 0 <= a <=1

```

```

[12]: # simulación
      df <- simple.random.walk(n.steps,n.sim,prob.r=a)
      ## Base para gráfico de trayectorias
      df_rw <- df %>%
        gather(key='t',value='valor',-sim) %>%
        mutate(t = as.numeric(substring(t,4,10))) %>%
        arrange(sim)

      moments_rw <- data.frame('t'=c(1:n.steps),'a'=a) %>%
        mutate('mean'=t*(a-(1-a)),
               'sd_sup'=mean + 2*sqrt(4*t*a*(1-a)),
               'sd_inf'=mean - 2*sqrt(4*t*a*(1-a)))

```

```

[14]: p1 <- ggplot(df_rw,aes(x=t,y=valor,color=sim)) +
      geom_line() +
      geom_line(moments_rw, mapping=aes(x=t,y=mean),col='red',size=0.7) +
      geom_line(moments_rw, mapping=aes(x=t,y=sd_sup),col='blue',size=0.7,linetype_
↳ "dashed") +
      geom_line(moments_rw, mapping=aes(x=t,y=sd_inf),col='blue',size=0.7,linetype_
↳ "dashed") +
      scale_colour_grey(start = 0.2,end = 0.6) +
      theme(legend.position="none") +
      ggtitle(paste(n.sim," trayectorias del camino aleatorio simple.",sep=''))
      p1

```

```
[16]: ## Distribución al tiempo t
t.selected <- 1000

df_dist <- df_rw %>% filter(t==t.selected)

p2 <- ggplot(df_dist,aes(valor)) +
  geom_histogram(bins=20, fill='red', col="white") +
  ggtitle(paste("Distribución al tiempo t = ",t.selected,sep=""))
p2
```

[22]: *## Caminata simple en dos dimensiones*

```
randomWalk2d_plot <- function(base, n.steps){  
  df <- base  
  
  df_2d <- df %>%  
    gather(key='t',value='valor',-sim) %>%  
    filter(sim == 'sim1' | sim=='sim2') %>%  
    spread(sim,valor) %>%  
    mutate(t = as.numeric(substring(t,4,10))) %>%  
    arrange(t) %>%  
    filter(t <= n.steps)  
  
  b2 <- ggplot(df_2d,aes(x=sim1,y=sim2))+  
    geom_point(color="blue") +  
    geom_point(df_2d%>%filter(t == 1),mapping=aes(x=sim1,y=sim2),color="green",  
↪size=3) +  
    geom_point(df_2d%>%filter(t ==  
↪max(t)),mapping=aes(x=sim1,y=sim2),color="red", size=3) +  
    geom_path()  
  b2  
  return(b2)  
}
```

[42]: options(repr.plot.width=14, repr.plot.height=10)
p3 <- randomWalk2d_plot(df, n.steps)
p3

```
[38]: randomWalk3d_plot <- function(base, n.steps){

  df <- base
  df_2d <- df %>%
    gather(key='t',value='valor',-sim) %>%
    filter(sim == 'sim1' | sim=='sim2' | sim == 'sim3') %>%
    spread(sim,valor) %>%
    mutate(t = as.numeric(substring(t,4,10))) %>%
    arrange(t) %>%
    filter(t <= n.steps)
  b3 <- plot_ly(x=df_2d$sim1, y=df_2d$sim2, z=df_2d$sim3, type="scatter3d",
    ↪mode="lines")

  return(b3)
}
```

```
[41]: p4 <- randomWalk3d_plot(base=df, n.steps)
p4
```

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