Máster universitari en Estadística i Investigació Operativa (MESIO)

Computación en Estadística y en Optimización

Test 1 con R (Grupo B)

Instrucciones:

- Bajar los ficheros `GrBTestR1.R` y `wine.csv` de ATENEA y guardarlos en un disco local o una memoria USB.
- Cambiar el nombre del script `GrBTestR1.R` a `GrBTestR1_`*`ApellidoNombre`*`.R`.
- Incluir en este script todas las instrucciones necesarias para resolver los ejercicios. Posibles comentarios (se valorarań) se pueden incluir detrás de una almohadilla (`#`).
- Entregar el script vía ATENEA o por correo electrónico a `amonleong@ub.edu` **antes** de las 15h.

Ejercicio 1 (4,5 puntos)

a) Cread el siguiente vector `a` de longitud 49. Contad el numḿero de elementos del vector para comprobar que es correcto:

```
a <- c(1:50)
a <- a[-2]
a
```

```
##  [1]  1  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
## [24] 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47
## [47] 48 49 50
```

```
#longitud del vector:
length(a)
```

```
## [1] 49
```

b) Utilizad el vector `a` para construir la matriz cuadrada `A` con los uĺtimos 25 elementos:

```
A <- matrix(a[(49-24):49], byrow = F, nr = 5)
A
```

```
##      [,1] [,2] [,3] [,4] [,5]
## [1,]   26   31   36   41   46
## [2,]   27   32   37   42   47
## [3,]   28   33   38   43   48
## [4,]   29   34   39   44   49
## [5,]   30   35   40   45   50
```

c) Obtened 3 matrices aleatorias (`A1`,`A2` y `A3`) con remplazamiento a partir de los elementos de la matriz `A` con dimensión 50x50. Comprobad que la dimensión de la matriz obtenida es realmente 50X50 y que el máximo y el mínimo (de A1,A2,A3) están dentro del máximo y el mínimo de los elementos de la matriz A.

```
A1 <- matrix(sample(A,size = 50*50,replace = T), byrow = F, nr = 50)
#representar la matriz A1, A2, A3,... muestras aleatorias de A
A1
```

```
##       [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10] [,11] [,12] [,13]
##  [1,]   45   34   26   30   40   27   45   49   35    38    49    48    47
##  [2,]   29   28   46   40   38   36   46   29   31    45    33    30    42
##  [3,]   34   49   41   31   37   46   34   26   44    42    39    47    49
##  [4,]   30   44   42   50   35   30   40   40   37    40    42    29    43
##  [5,]   27   35   42   38   42   47   28   49   39    39    31    50    37
##  [6,]   31   35   33   29   27   34   31   34   37    28    40    48    48
##  [7,]   40   28   29   38   34   43   42   39   37    32    39    42    40
##  [8,]   34   43   40   46   42   35   49   38   33    44    29    37    30
##  [9,]   38   44   27   34   45   48   50   46   37    43    44    36    43
## [10,]   27   44   37   28   49   45   37   42   44    44    27    38    48
## [11,]   50   27   34   33   39   48   50   31   40    30    39    46    45
## [12,]   39   40   43   41   49   47   35   26   47    46    42    30    30
## [13,]   38   43   38   47   42   40   29   46   27    28    45    36    44
## [14,]   39   46   46   35   31   44   48   48   42    44    35    29    36
## [15,]   36   27   35   36   43   40   41   41   45    39    38    29    35
## [16,]   49   47   26   28   50   44   41   27   31    50    47    46    45
## [17,]   37   26   46   49   42   41   32   31   36    34    26    48    49
## [18,]   40   39   38   36   50   31   26   41   27    45    32    29    29
## [19,]   44   30   27   28   31   33   40   47   50    29    30    43    45
## [20,]   32   47   29   36   34   38   50   28   33    29    28    32    29
## [21,]   42   28   50   28   44   48   43   37   38    43    30    36    44
## [22,]   35   32   30   36   40   27   50   42   50    42    45    42    40
## [23,]   28   42   27   44   42   48   32   45   27    39    42    31    34
## [24,]   44   37   34   50   47   35   38   42   41    35    48    34    30
## [25,]   40   42   46   39   44   40   44   44   49    46    26    37    34
## [26,]   40   41   34   34   33   39   42   29   45    48    49    49    28
## [27,]   45   30   37   30   36   46   50   34   47    35    42    49    38
## [28,]   31   49   45   26   32   30   29   37   47    29    29    49    33
## [29,]   44   40   46   32   50   29   38   39   49    38    45    35    42
## [30,]   38   46   45   49   41   31   44   36   28    41    35    28    42
```

```
## [31,]   48   35   28   41   47   27   34   35   35   28   33   39   36
## [32,]   38   36   46   34   41   40   35   32   29   38   33   43   44
## [33,]   49   35   32   31   49   27   27   47   50   31   43   49   27
## [34,]   32   31   42   30   33   32   42   27   44   42   29   43   45
## [35,]   45   41   30   45   49   32   40   40   41   35   28   35   44
## [36,]   35   40   49   35   39   38   37   47   26   41   34   38   31
## [37,]   43   27   28   44   41   50   42   30   35   41   50   30   37
## [38,]   30   47   41   33   37   38   26   28   35   48   43   41   48
## [39,]   41   48   47   34   26   32   46   42   46   43   44   39   40
## [40,]   42   45   28   38   26   31   47   30   27   36   27   39   50
## [41,]   36   26   28   28   38   35   43   44   46   29   27   31   34
## [42,]   27   32   41   32   29   49   47   28   29   45   43   50   41
## [43,]   42   41   41   35   33   37   45   30   40   39   40   42   42
## [44,]   31   34   49   45   40   49   50   31   30   44   34   26   49
## [45,]   30   47   48   41   41   50   40   38   45   33   46   28   26
## [46,]   48   49   44   26   37   50   41   30   47   35   32   28   26
## [47,]   39   42   46   46   29   37   30   40   42   32   29   45   28
## [48,]   26   33   43   44   31   32   28   29   32   27   26   45   35
## [49,]   49   37   45   33   49   46   50   34   50   39   29   34   34
## [50,]   26   37   40   27   36   39   31   39   34   49   33   46   41
##       [,14] [,15] [,16] [,17] [,18] [,19] [,20] [,21] [,22] [,23] [,24]
##  [1,]    41    50    44    47    37    39    26    41    37    40    26
##  [2,]    33    39    27    41    43    44    37    49    26    41    26
##  [3,]    47    35    39    30    27    48    46    42    44    46    46
##  [4,]    49    29    34    44    39    42    30    45    26    35    49
##  [5,]    42    41    38    49    45    30    48    48    34    28    34
##  [6,]    36    30    47    36    50    39    36    48    36    39    44
##  [7,]    29    43    48    43    33    42    44    46    38    35    44
##  [8,]    50    37    29    43    50    39    32    34    36    29    32
##  [9,]    43    36    50    28    30    40    45    32    49    39    38
## [10,]    38    47    50    29    34    26    31    39    41    40    29
## [11,]    49    37    46    41    32    41    27    27    32    48    42
## [12,]    38    46    30    30    35    33    30    49    31    50    27
## [13,]    49    41    42    31    43    42    29    35    40    28    44
## [14,]    36    26    34    28    34    28    32    28    37    37    45
## [15,]    31    48    31    44    46    48    28    27    42    43    42
## [16,]    47    28    47    50    40    38    31    26    28    36    40
## [17,]    31    34    42    38    40    38    44    27    41    42    39
```

```
## [18,]   35   41   36   48   36   36   47   37   37   28   44
## [19,]   45   36   28   32   31   30   47   36   33   34   29
## [20,]   30   35   44   27   34   48   47   33   39   32   30
## [21,]   26   41   42   30   29   26   27   46   34   30   35
## [22,]   38   32   46   39   48   44   30   27   32   32   37
## [23,]   44   27   48   42   42   30   36   36   35   32   38
## [24,]   46   34   48   28   50   28   42   44   32   33   34
## [25,]   32   43   27   42   39   39   36   47   40   50   34
## [26,]   27   26   29   35   36   50   44   34   33   27   34
## [27,]   33   28   36   45   29   33   40   40   40   32   35
## [28,]   37   47   35   49   31   34   34   44   34   36   46
## [29,]   36   38   47   40   27   34   41   26   47   37   33
## [30,]   28   44   47   45   32   44   43   37   34   46   33
## [31,]   47   45   29   46   43   46   49   40   31   42   44
## [32,]   36   31   46   26   38   36   47   45   41   30   46
## [33,]   33   44   37   36   39   48   50   33   29   32   49
## [34,]   28   46   45   36   30   39   37   43   30   49   34
## [35,]   37   30   27   41   48   47   38   27   48   45   38
## [36,]   43   41   33   46   42   46   31   42   29   39   48
## [37,]   47   26   30   45   50   47   48   48   36   45   46
## [38,]   44   45   47   40   33   32   35   47   31   49   39
## [39,]   38   47   42   39   47   45   32   30   38   35   39
## [40,]   31   42   38   39   50   37   48   37   35   48   34
## [41,]   28   44   34   34   47   45   41   46   48   30   32
## [42,]   30   27   49   47   40   26   38   40   26   33   41
## [43,]   47   50   36   33   49   50   38   36   45   43   34
## [44,]   26   29   38   39   38   28   43   35   32   31   37
## [45,]   50   29   46   49   34   47   46   39   37   35   26
## [46,]   35   46   29   28   30   45   45   40   41   41   36
## [47,]   41   39   41   48   50   34   33   38   44   49   37
## [48,]   43   32   47   41   48   50   36   47   40   35   32
## [49,]   30   45   26   27   42   28   32   36   45   46   31
## [50,]   36   27   27   41   48   26   45   40   27   45   29
##       [,25] [,26] [,27] [,28] [,29] [,30] [,31] [,32] [,33] [,34] [,35]
##  [1,]   47   50   48   30   48   44   38   39   30   43   43
##  [2,]   28   36   35   48   50   42   44   49   36   38   28
##  [3,]   41   33   33   26   27   38   30   49   36   40   28
##  [4,]   31   50   46   48   44   48   41   46   44   34   30
```

```
##  [5,]   44   43   38   37   39   49   44   48   31   28   44
##  [6,]   40   39   41   29   48   47   50   41   31   42   29
##  [7,]   40   30   36   36   50   27   42   42   32   45   34
##  [8,]   32   27   27   40   48   26   26   27   43   37   39
##  [9,]   31   32   35   45   32   30   36   47   36   46   26
## [10,]   50   34   35   46   36   33   31   47   35   27   27
## [11,]   28   39   28   47   38   42   48   38   46   41   47
## [12,]   47   37   27   50   40   44   50   38   27   47   39
## [13,]   35   27   44   38   38   40   42   44   38   41   29
## [14,]   32   40   29   48   29   30   35   27   29   39   37
## [15,]   34   43   40   50   29   41   40   42   26   26   44
## [16,]   44   31   36   34   27   34   47   49   32   33   40
## [17,]   49   34   45   36   47   42   43   40   42   36   38
## [18,]   43   38   31   42   49   39   37   44   46   39   38
## [19,]   28   28   39   37   45   37   39   50   32   33   47
## [20,]   29   48   43   38   37   47   36   29   49   46   38
## [21,]   28   47   42   33   35   47   47   45   44   36   45
## [22,]   43   47   40   33   47   49   30   47   48   41   36
## [23,]   41   34   29   31   41   31   30   46   48   30   34
## [24,]   46   31   30   40   30   42   41   50   33   36   39
## [25,]   34   32   50   29   31   44   42   29   42   42   42
## [26,]   35   38   37   26   32   49   34   26   37   28   41
## [27,]   49   35   36   39   45   36   30   35   39   50   31
## [28,]   33   29   26   31   50   45   36   44   46   26   46
## [29,]   28   27   30   34   39   31   38   38   40   36   34
## [30,]   33   45   28   26   49   40   30   48   34   36   35
## [31,]   29   45   46   46   39   31   43   36   30   39   41
## [32,]   31   43   34   45   27   46   28   39   44   27   31
## [33,]   40   32   50   26   36   26   50   43   28   45   33
## [34,]   31   31   49   43   37   46   47   35   44   45   41
## [35,]   43   34   30   50   48   27   43   50   46   36   33
## [36,]   41   47   45   39   50   49   39   40   37   29   30
## [37,]   46   38   31   28   32   43   34   46   27   37   36
## [38,]   36   49   36   39   50   39   31   27   31   36   39
## [39,]   31   41   48   31   38   42   36   37   46   31   36
## [40,]   29   41   34   33   28   28   28   32   39   43   33
## [41,]   35   43   44   33   28   29   34   50   47   35   40
## [42,]   33   46   45   47   40   35   45   49   40   30   29
```

```
## [43,]    46    27    31    47    34    42    40    41    38    38    26
## [44,]    29    28    36    31    44    29    30    40    48    34    48
## [45,]    30    40    48    28    37    39    43    39    43    31    50
## [46,]    39    49    40    49    41    44    38    28    32    36    29
## [47,]    29    27    42    47    29    47    43    33    28    47    33
## [48,]    32    43    34    44    48    35    34    33    27    50    40
## [49,]    47    41    37    37    31    28    36    34    28    35    34
## [50,]    31    28    27    37    47    49    28    39    29    46    29
##       [,36] [,37] [,38] [,39] [,40] [,41] [,42] [,43] [,44] [,45] [,46]
##  [1,]    34    39    35    40    38    45    49    42    42    40    46
##  [2,]    50    26    36    41    30    41    36    49    41    35    40
##  [3,]    30    29    48    26    49    32    34    26    38    40    31
##  [4,]    44    29    36    32    31    35    38    45    28    31    41
##  [5,]    31    46    32    28    39    37    37    28    40    42    34
##  [6,]    49    30    37    39    47    39    44    32    28    50    44
##  [7,]    35    48    49    50    36    38    49    42    30    44    35
##  [8,]    29    43    45    27    41    31    50    41    44    43    28
##  [9,]    34    47    33    34    46    28    34    46    38    45    28
## [10,]    26    37    30    26    28    47    50    39    43    29    41
## [11,]    27    48    38    27    39    30    31    46    38    33    43
## [12,]    31    28    26    34    39    32    34    36    47    48    39
## [13,]    42    32    34    50    49    39    40    26    32    50    39
## [14,]    38    42    50    46    27    42    48    31    29    28    48
## [15,]    32    32    32    44    33    43    45    38    33    38    47
## [16,]    33    33    38    35    46    38    48    45    44    48    32
## [17,]    49    38    27    42    46    28    39    41    31    29    28
## [18,]    48    44    45    37    36    41    44    32    32    34    48
## [19,]    48    40    43    44    39    42    34    39    33    44    30
## [20,]    26    39    40    31    38    49    35    28    50    45    27
## [21,]    48    32    28    40    27    46    37    45    41    38    27
## [22,]    27    50    32    35    40    45    41    46    42    36    30
## [23,]    40    32    27    41    30    37    28    43    49    47    43
## [24,]    38    39    37    34    29    49    47    32    32    31    32
## [25,]    50    26    26    33    43    38    40    35    48    48    33
## [26,]    29    36    39    40    40    42    42    46    38    44    40
## [27,]    37    38    43    35    46    28    31    34    41    44    38
## [28,]    36    39    41    34    45    35    47    48    33    27    31
## [29,]    29    32    28    34    35    41    36    43    37    30    34
```

```
## [30,]    50    40    41    48    31    29    29    50    47    28    47
## [31,]    36    35    47    33    45    40    31    42    33    33    42
## [32,]    42    48    32    31    30    35    29    49    41    34    26
## [33,]    35    42    31    50    29    27    35    43    40    31    36
## [34,]    40    35    33    45    31    50    37    49    40    34    47
## [35,]    47    34    39    44    42    47    46    30    38    39    26
## [36,]    27    39    50    49    45    48    26    47    26    38    45
## [37,]    27    34    40    47    45    38    26    42    42    44    31
## [38,]    45    38    33    28    34    47    26    43    33    36    50
## [39,]    50    27    48    29    33    31    28    28    30    46    48
## [40,]    39    32    43    39    47    38    40    30    29    43    35
## [41,]    43    37    40    36    32    39    31    43    31    39    42
## [42,]    35    29    43    37    36    38    29    50    47    26    46
## [43,]    45    28    38    31    27    40    48    36    49    46    38
## [44,]    45    48    29    49    45    36    40    48    37    43    31
## [45,]    33    27    37    33    47    45    45    44    31    49    34
## [46,]    49    30    48    39    46    45    29    27    26    31    30
## [47,]    29    28    47    38    48    42    35    34    50    33    31
## [48,]    45    37    42    32    42    27    46    33    28    33    39
## [49,]    44    48    32    26    31    42    49    26    26    46    31
## [50,]    28    50    50    39    26    34    38    45    26    46    36
##       [,47] [,48] [,49] [,50]
##  [1,]    27    31    35    34
##  [2,]    27    37    30    34
##  [3,]    46    46    29    35
##  [4,]    42    41    39    46
##  [5,]    36    31    46    33
##  [6,]    35    49    48    32
##  [7,]    46    28    41    46
##  [8,]    49    26    50    40
##  [9,]    27    41    31    46
## [10,]    34    36    27    32
## [11,]    48    36    38    30
## [12,]    36    40    37    44
## [13,]    34    35    37    29
## [14,]    46    38    28    34
## [15,]    50    32    39    37
## [16,]    46    37    50    29
```

```
## [17,]    41    40    28    40
## [18,]    50    49    36    48
## [19,]    26    39    32    26
## [20,]    33    45    28    44
## [21,]    38    32    40    31
## [22,]    43    43    37    43
## [23,]    35    41    47    49
## [24,]    35    42    32    47
## [25,]    30    44    37    26
## [26,]    26    31    26    45
## [27,]    31    31    43    33
## [28,]    28    49    40    40
## [29,]    41    26    32    37
## [30,]    28    31    44    32
## [31,]    43    31    49    49
## [32,]    50    28    47    44
## [33,]    42    34    39    27
## [34,]    45    30    49    49
## [35,]    39    33    27    49
## [36,]    28    39    31    39
## [37,]    41    26    33    40
## [38,]    44    37    37    27
## [39,]    44    39    47    41
## [40,]    40    34    48    28
## [41,]    41    41    43    31
## [42,]    44    50    40    47
## [43,]    47    32    27    26
## [44,]    28    29    31    29
## [45,]    35    28    42    46
## [46,]    43    28    29    36
## [47,]    33    36    41    40
## [48,]    46    32    43    35
## [49,]    32    38    28    48
## [50,]    34    46    30    46
```

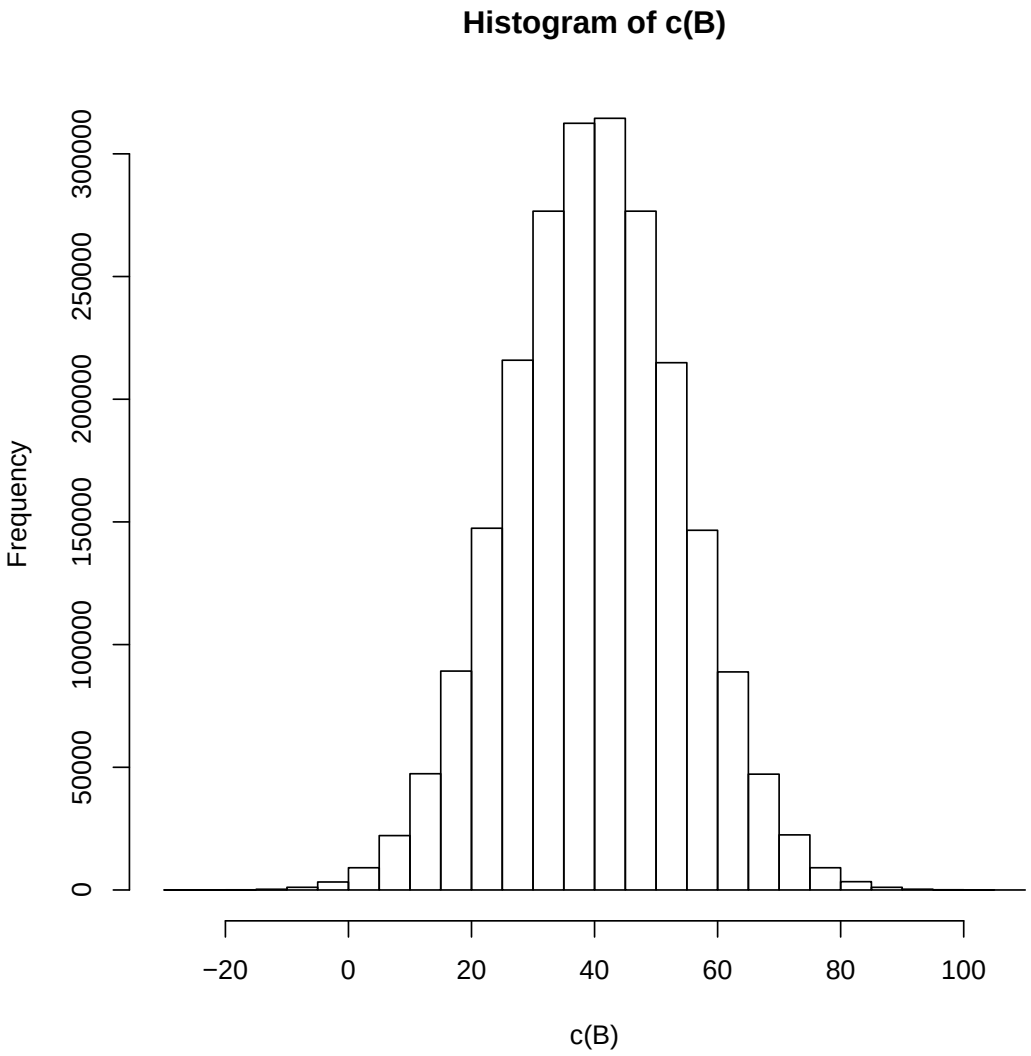
```
#comprobad la dimension de A1, A2, A3
dim(A1)
```

```
## [1] 50 50
```

```
#Haced un summary() de los elementos de A1
summary(c(A1))

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   26.00   32.00   38.00   38.01   44.00   50.00

#Haced un summary() de A y observad que m?nimo y m?ximo estan dentro del mismo rango.
summary(c(A))

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##      26      32      38      38      44      50
```

d) Cread una matriz (`B`) de dimensión 1500×1500 con valores aleatorios de una distribución Normal con media $\mu = 40$, $\sigma = 14$. Representad el historgrama del vector generado para comprobar que es realmente normal.

```
B <- matrix(rnorm((1500*1500),mean = 40, sd = 14), byrow = F, nr = 1500)
hist(c(B))
```



e) Cread un vector `b` con números pares de longitud 48, consecutivos, y tomados de 4 en 4, como por ejemplo:

```
b <- seq(from = 2,to = (48*4+1),by = 4) #(48-1)*3
b

##  [1]   2   6  10  14  18  22  26  30  34  38  42  46  50  54  58  62  66
## [18]  70  74  78  82  86  90  94  98 102 106 110 114 118 122 126 130 134
## [35] 138 142 146 150 154 158 162 166 170 174 178 182 186 190
```

f) Extraed a partir de la matriz (`B`) una submatriz cuadrada a partir de las 48 primeras filas y 48 primeras columnas y nombradla como (`C`). Comprobad su dimensión y multiplicad todos los valores por 2 y renombradla como C.

```r
C<- B[1:48,1:48]
dim(C) #dimension de la matriz C
```

```
## [1] 48 48
```

```r
C<-2*C
round(C,1)
```

```
##        [,1]  [,2]  [,3]  [,4]  [,5]  [,6]  [,7]  [,8]  [,9] [,10] [,11]
##  [1,]  57.6  26.7  43.6  58.8 106.9  67.8 119.1 100.6 125.8  66.9  55.9
##  [2,]  63.1 102.4  82.0  97.6  78.0  28.8  87.4  70.6  86.2 112.5  71.5
##  [3,]  87.0  11.3  65.6  70.0 120.0  41.3  79.9  96.5  63.8  59.4  75.3
##  [4,]  72.7  53.0  40.8  15.4 127.9  57.9 137.0  26.0  44.0  98.0  40.5
##  [5,] 119.6  50.8  80.9  87.6  84.0 108.1 101.3  73.9  51.7  64.9 102.1
##  [6,]  25.8 114.1  82.6  96.5 108.0  56.8  90.2  94.6  81.6  84.0  86.6
##  [7,]  88.6  82.8 116.5  95.7  81.2  90.2 162.9  63.9  29.9  85.2  94.6
##  [8,] 111.1  65.6 100.6  80.5  69.6  75.4  94.3  83.1  40.7  77.1  64.9
##  [9,]  88.5  72.9  70.1  57.1  54.3  95.9 104.6  54.3  94.4  92.8 112.4
## [10,]  56.9  93.8  85.5  59.2  93.3 120.0 110.8  60.3  69.4  79.2  59.2
## [11,]  75.6 147.4  79.8  74.3  85.8  83.1  62.1 120.9  85.6  99.0 114.9
## [12,]  69.1 110.9  51.1  98.8  87.9 111.0  99.9  63.7  80.8  81.3  29.7
## [13,]  98.0  86.8  32.1  56.7  48.2 103.0  65.8  41.9  95.2 128.7  97.3
## [14,]  68.8 114.7 115.4  83.3 131.3  94.0  75.8  68.6  90.1  65.4  59.9
## [15,] 115.7 124.8  71.8  61.0  80.1   9.6 105.0  90.5  76.4  81.7  57.1
## [16,] 109.6  67.9  57.7  87.3  90.2  47.7  35.9 108.3  76.6 104.1 165.1
## [17,]  97.5  97.0  96.8  68.1  33.3  59.6 107.6 102.3  78.7  65.2 102.1
## [18,]  76.7  88.8 108.3 147.3 101.8  41.2  71.4  16.7  74.5 112.5 125.3
## [19,]  64.0  26.3  71.5  78.1 122.0  40.3  86.5  74.4  57.8  71.2  80.9
## [20,]  79.2  50.5 159.2 111.2 120.5  70.7  70.7  42.2  96.0  96.7 108.3
## [21,]  79.8  71.4  78.9  96.6  71.4  88.6  56.1  72.7 103.8 143.2  45.0
## [22,]  26.4  85.8  97.8  78.9  14.9 112.8 104.5  75.7 121.7  71.7 126.2
## [23,]  60.1  66.7  55.8  61.0  13.4  92.5  90.4  95.7 109.7  43.0 108.7
## [24,]  85.7  91.2 112.7  85.6  48.9 105.1  74.9  53.1  31.0  87.5 138.0
## [25,] 111.9  68.4 119.4  85.4  89.4  80.8  95.7  17.7  67.8  93.7  94.3
## [26,] 123.0  91.7  73.6  69.7  74.3  66.4  67.6  65.9 106.5 115.5  34.4
## [27,] 105.4  45.5 132.7  87.2 106.9  37.6  47.4  63.5  74.3 111.6  48.0
## [28,] 123.2  96.2  16.1 106.5  54.0 105.0  41.6  55.9  82.7  71.4  98.5
## [29,] 114.3  30.0 114.8  48.6  52.6  73.1  73.2  20.7  69.5 161.0 130.5
## [30,] 102.9  96.4  71.5  80.0  47.8  38.4  99.2  43.3  45.9  43.2  21.6
## [31,]  62.5  24.1 127.0  73.6  58.2 106.8 118.5 108.9  89.2  78.4 153.3
```

```
## [32,] 101.5  57.8 121.8  43.6  92.1  72.9  68.0  58.4  31.3  73.1  19.1
## [33,]  94.9 108.2  76.3  69.7  88.8 107.0  89.1  77.7 101.9  -2.0  94.8
## [34,]  58.4  89.2  68.6  48.1  63.0  72.1  65.1 112.9  82.0  74.9  68.9
## [35,]  97.1  41.1  93.8 141.2  80.1  52.3 121.8  84.5  89.5 116.2  17.6
## [36,]  80.4  67.4  96.7 104.7  79.8  69.5  62.7  55.1  75.9  65.6  69.7
## [37,]  92.4  96.7  77.7 113.0  69.6 117.1 110.2  40.1 109.6  49.5  44.2
## [38,] 113.3 106.4  80.0  36.6  64.1  99.5  56.6  74.3  89.8  84.0  95.9
## [39,]  59.8  60.6  88.3  59.1  80.1 135.9  66.4 110.0  99.6 111.2  82.3
## [40,]  73.9  85.5  89.1  72.7 110.6  77.4 107.2  87.1  38.3  88.0  72.5
## [41,]  33.8 130.6 108.4  46.3 149.2  65.6  47.2 109.4  91.0  89.4  82.6
## [42,]  31.6  77.0 133.5  75.9  63.9  73.8  56.8  84.8 126.0 126.5 113.0
## [43,]  30.3  86.0 131.8 131.0  83.2  93.7 129.8  99.7  78.7 103.1 103.8
## [44,]  80.0  64.7  51.3  88.0  70.1  52.4  68.9  87.8  90.4  84.9 124.9
## [45,]  74.3 112.7  66.9  57.1  83.7  95.8  68.9  59.5  85.9  94.6  65.0
## [46,]  81.2 115.7  83.6  62.0 114.1  71.2  95.3  46.7  93.4  91.0  44.3
## [47,]  87.5  62.5  22.9  60.7  78.1 111.7  91.9  67.0  71.1  76.0  63.6
## [48,] 121.9 118.2  58.7  73.8  82.6  70.0  68.6 104.5  84.7  81.8  56.6
##       [,12] [,13] [,14] [,15] [,16] [,17] [,18] [,19] [,20] [,21] [,22]
##  [1,] 119.9  45.8  65.2  99.6  88.8  26.4 107.8  91.1 108.7 106.6  73.4
##  [2,]  88.8  71.0  68.5  78.6 141.4  91.7  64.7  86.0  46.5  94.7  67.4
##  [3,] 114.8 100.0  72.2 125.7 118.0  53.6 100.4  80.0  62.7  68.0 109.5
##  [4,] 106.7  95.6  28.3  71.3  25.3 116.2  38.2  74.5  59.8  51.1  91.4
##  [5,]  68.6 116.3  41.6 122.8 113.2  77.1  96.5  85.8  78.1  89.4 137.9
##  [6,]  70.3  62.1  64.7  88.9  87.1  86.8  54.6  72.9  78.2  84.4  49.0
##  [7,]  80.3  61.2 106.6  93.1  77.2  17.2  88.2 112.6  55.0  64.5 105.8
##  [8,]  70.2  97.0 118.9  66.4  90.6  76.5  52.8 119.3 127.4  38.7  85.1
##  [9,] 135.5  52.8 109.8 112.4   9.2 127.6  78.7  32.9 106.9  45.4   8.9
## [10,]  81.4  97.0  90.2  45.4  68.0  77.7  30.8 105.9 128.0 117.9  17.0
## [11,]  14.4  97.0  85.2 115.2  91.8  94.6 105.2 124.5 100.3  64.0 123.7
## [12,]  93.8  76.7  63.5  84.5  15.4  74.8  88.6  81.4 108.4  63.9  80.0
## [13,] 105.9  84.9  62.1  81.5  95.7  98.8  60.8 110.5  97.3 100.5  59.0
## [14,]  92.0  83.4 117.7  52.4  86.3  30.4  83.5 114.3  55.7 106.8  84.9
## [15,]  93.8  92.9  86.0  47.1 114.6 123.1  47.1  84.5  87.8  51.7  92.6
## [16,]  45.9  67.9  84.6  55.7  60.1  77.8  73.1  83.7 105.3  45.3  58.0
## [17,]  70.8  89.9 129.4  78.4  58.7 103.7  38.2  81.0  93.9  65.0  55.7
## [18,]  57.5  55.1  86.8  64.6  53.6 118.5  68.8  68.1  53.5  87.9  31.1
## [19,] 119.5  59.8  69.0  58.6  92.6  68.5  26.2  92.1 103.8 118.5  87.0
## [20,]  80.9 140.5  59.6  37.7 122.8 155.3  53.0  74.9  68.9  90.2  67.2
```

```
## [21,]  92.5  86.7  51.6 105.1  62.3  58.0 139.0  52.3  33.8  64.0  62.7
## [22,]  43.0 112.3  54.3  61.3  24.9  72.4 135.5  87.7 120.5  59.5  67.5
## [23,]  20.4  74.2  81.6  64.0  96.3  20.3  89.6  95.1  58.6  46.0  63.4
## [24,]  99.5  61.5  62.0  70.0  86.6  33.6  89.8 104.6  99.5  86.8 122.0
## [25,]  51.3  74.7  33.7 145.4 102.7  89.0 120.3  50.6  78.4  91.9  98.0
## [26,]  69.2  83.2  86.1  67.8  76.6  55.9 129.2  83.9  85.9  56.2  98.2
## [27,]  91.0  62.2  57.9 130.9  90.8  84.5 113.2  70.5  86.0  -3.0  63.0
## [28,] 101.8 106.8 102.1  46.9  68.5  93.9 113.3 121.0  82.9 123.6 121.5
## [29,]  71.1  71.9 112.1  70.3  89.7  79.1  57.6  49.2  53.5  63.6  66.2
## [30,]  22.8 112.4 111.3  76.0 125.5 118.2 102.1 122.4  99.6 104.1  56.4
## [31,] 124.3  98.5  73.0  95.4  85.5  62.3  69.2  62.4  80.7  99.5  67.7
## [32,]  85.8 106.3  60.7  66.4 101.1  83.5  83.3  90.2 107.2  46.0  85.2
## [33,]  80.8  35.9  54.3  91.8  81.6 134.1  73.4  49.6  94.6 116.6  93.4
## [34,]  75.0  95.5  75.7  16.4  84.4  95.9 111.4  95.4  86.7  78.7  65.7
## [35,]  80.9  48.3 103.6  75.8 118.3  83.6  95.2  84.8  84.7  65.2  83.2
## [36,] 106.5  98.2  74.5 105.6  91.0 108.2  38.2  94.6  90.6  57.8  98.9
## [37,]  96.1  88.6 118.0 106.2  74.8 102.2  76.6  99.5 104.4  68.4  89.5
## [38,] 113.0  47.7 136.3  80.7 114.2  56.5  89.1  33.3  63.6  77.3  86.9
## [39,] 101.2  42.8  90.2  45.6 103.8  80.3  82.5  94.6  81.5  48.6  78.2
## [40,]  96.9 111.3 114.1 122.8  76.5  92.0  92.7 110.8  68.5  90.1  70.7
## [41,]  38.3 101.5  84.4  72.6  78.6  49.7  82.3  70.2  98.4  37.7 103.9
## [42,]  56.2  94.7 119.2  54.8  81.6  90.8  99.9  74.9  73.2  96.7  68.4
## [43,]  24.8 133.2 117.9  74.2  98.1 117.1  71.5  87.9  94.4 131.5  92.3
## [44,] 104.5 121.9  39.4  27.7  82.7  93.5  40.5  43.7  87.5  45.8  19.6
## [45,]  96.1  53.1 141.7 106.9 105.8  63.8 128.2 100.8  90.6  85.3 107.8
## [46,]  61.8  87.7  70.3 123.3  31.0  -4.8 122.5  52.7  62.7  85.1  81.8
## [47,]  68.9  89.4  68.9  53.8  86.2  47.9  48.7  68.3  89.1  44.6  35.3
## [48,]  90.6 115.3  62.8  48.8  83.3  56.1 123.3 100.4  45.6  71.0  96.9
##       [,23] [,24] [,25] [,26] [,27] [,28] [,29] [,30] [,31] [,32] [,33]
##  [1,]  58.7  26.5 103.9  59.1  81.6  -3.5 126.6  55.6  85.6  99.2  61.2
##  [2,] 132.2  79.3  72.0 108.0  97.2  77.5  72.8 112.8 123.2  98.2  97.7
##  [3,]  55.1 112.8  87.1 136.6  97.0  27.3  98.5  70.5  53.6 108.3  44.0
##  [4,]  74.8  70.2  93.7  41.9 103.6  64.3  58.8  60.4   9.9 138.8  84.9
##  [5,] 120.3  59.8  89.2  46.5  84.8  48.5  90.6  53.1  76.6 129.4  50.2
##  [6,]  63.9 133.1  93.2  54.4  96.0  69.0  89.9  84.0  72.5  57.5  68.3
##  [7,]  66.8  70.3  66.6 119.6  57.2  34.4  63.2  64.9  82.7  79.6  82.5
##  [8,]  93.2  72.8  96.8 113.3  21.9 111.2 126.4  96.1  94.4  83.8 106.3
##  [9,]  79.9  90.2 102.3 116.8  64.6  18.2  80.9  71.3  42.8 121.7  48.1
```

```
## [10,]  43.9  98.3  38.0 107.2  36.5  82.4  96.8  57.5  81.0  35.7  57.6
## [11,]  85.7  90.7  68.3  81.9  47.7  85.7  53.6 104.6  81.7 105.9 112.6
## [12,]  80.6  39.8  71.8 109.7 104.7  85.2  96.8  73.7 146.6  19.0  77.2
## [13,]  38.8  74.9  38.7 108.2 107.4  88.5  66.5  86.3  41.9  77.9  89.1
## [14,]  50.4  55.8  94.5  81.5  64.6  88.9  45.1  54.4  41.2  30.0  75.5
## [15,]  53.6  93.5  80.5 106.9 120.1  51.3  70.5  78.6  74.2  87.9  50.7
## [16,]  76.1  86.7  49.7  57.2 118.8  40.2 106.4  94.6 107.1  42.7 122.1
## [17,]  70.3  21.1  85.9  63.8  88.6  74.6 116.0  57.0  41.6  96.3  81.4
## [18,]  81.9  85.9  47.6  40.8  91.5  65.8  74.7  79.4 111.6  45.1 -19.6
## [19,] 118.4 135.4  62.7 141.1 101.7 105.5  79.2 133.1  58.8  22.8  68.8
## [20,]  50.8  29.5  97.4  18.8 112.1  85.3  43.9  74.3  54.6 115.1 102.9
## [21,]  85.0  69.1  84.5 114.5 113.2  88.4  82.9  83.3 103.3 106.5 124.4
## [22,]  94.2  80.0  45.5  75.0  35.7  40.7  92.7  46.0  58.5  64.6 101.9
## [23,]  78.7  21.3 119.2  68.3  27.0 148.7 109.1  65.6  99.4  44.4  68.8
## [24,] 112.8 102.9  60.4  72.5  92.7  88.1  96.1  39.2  87.8 167.0 121.5
## [25,]  91.9  45.2  52.5  62.3  54.9 109.0  67.2  84.8 130.4  93.2  43.4
## [26,]  93.7  29.1  61.5 132.1  66.1  43.7  73.0  80.1 140.2  75.2  40.2
## [27,]  75.0  76.2  61.9  58.3  58.8  54.9  46.7  79.8 101.4  50.5  83.3
## [28,] 103.5 110.7  55.8  69.6  77.6  84.7  72.6 104.3  35.5 121.1  89.7
## [29,]  53.8 131.3  48.1 125.1  68.3  87.7  11.6 102.2 108.5  50.6  90.0
## [30,]  98.0  89.4  45.7  69.8  56.8  98.3  83.7  64.3 135.8  88.0  94.2
## [31,] 112.2  57.0  70.0  81.0  58.2  92.8  92.6  45.7  88.5 123.0 108.5
## [32,]  60.4  46.2 109.1  26.5  91.5 116.3  64.9  84.8  97.6 106.4 125.3
## [33,]  58.0  50.4 123.5  70.5 115.0  65.6 100.8  61.3  83.7  78.2 109.9
## [34,]  62.5  60.9 124.6  72.7 112.4  44.7  85.8  99.4  90.9  85.2 129.1
## [35,] 105.7  75.6  73.5 106.7  79.3  42.6  91.0  85.3  60.6  39.3  89.5
## [36,]  94.5  96.7  89.8  69.3  52.6  81.7  47.9  54.9  68.6 117.5  18.4
## [37,]  36.2 102.1  88.5 127.6 130.7 107.7  60.1  94.1  46.5 104.9   5.4
## [38,] 103.1 140.9  99.7  59.7  64.3 120.9 123.9  70.0  55.9 106.9  75.9
## [39,] 109.6  57.7  48.7  74.1  78.0  68.9  64.9 111.3 134.3 108.9  53.4
## [40,]  19.7 116.8  11.1  52.5  58.6 102.0  62.1  86.8  50.4  91.7 110.1
## [41,] 102.5  70.1  61.0  80.0  63.7  96.9  71.0  71.5 112.1  90.3  98.0
## [42,] 110.7  31.6 107.5  92.1  96.8  48.3  88.0  98.9  74.8  99.8  75.6
## [43,] 112.7 106.3 101.3  65.2  60.4 114.7 124.5  22.7  72.4 102.3 151.0
## [44,] 103.2  51.2 102.3  54.3 112.9  77.6 105.6 123.0  81.1 125.4  67.7
## [45,]  65.9  27.8 110.8  37.1  69.8 101.6  31.0  85.6  99.3  89.7 107.7
## [46,]  67.4  75.0 142.9 131.0 101.7  68.9  75.6  77.3  97.8 157.6 117.5
## [47,] 112.9  49.5 124.9 106.1  13.7 121.7  68.5  74.5  67.4 124.1  84.0
```

```
## [48,]  36.5 128.0  39.3  85.1 113.7  51.3  61.4  79.6 114.3  88.5  65.0
##       [,34] [,35] [,36] [,37] [,38] [,39] [,40] [,41] [,42] [,43] [,44]
##  [1,] 101.1  95.3  42.7  89.5 111.9  76.2  53.7 109.2  46.7 110.8  87.0
##  [2,] 105.4 103.0  81.7  68.0  92.3  90.7  76.2 122.2 108.2  72.9  77.0
##  [3,]  99.3  51.3  61.9  77.2  84.9  95.2  77.0 102.0  78.5  63.1 102.7
##  [4,]  12.0 107.8  23.9  87.2  66.4  57.5  21.4 100.4 107.7 128.7  19.2
##  [5,] 114.1  43.1  78.9 106.9  96.4  95.1  74.8  73.2  80.1  59.3 113.6
##  [6,] 105.1  60.4  90.9  92.8  72.8  62.2 106.8  68.5  73.8 105.4  33.3
##  [7,] 116.5  94.7 119.5 116.1  38.4  87.7  79.5  56.1  72.9 135.3  59.3
##  [8,]  48.1  65.4  74.7  69.0  63.2 136.1  90.2  94.7  56.9  83.8 192.6
##  [9,]  46.8 122.2 113.0  62.0  74.7  88.0  67.2  99.5  91.5 102.4 123.2
## [10,]  70.9  73.7  44.0  82.7  51.6  94.2  91.2 114.9  63.7  99.8  76.3
## [11,]  99.9 112.7  53.2  74.5  92.0 127.1  68.2 117.7  69.1  90.3  98.0
## [12,]  21.7  94.4  61.0  63.4 126.4  94.2 132.9 114.7  88.1 105.6  82.1
## [13,]  62.2 108.4  71.3  70.9  85.8  16.1 108.7  86.7  92.5  98.2  87.3
## [14,]  35.1 119.4  84.4 105.5 109.9  77.8  82.3  78.7  84.7  33.9  94.8
## [15,] 143.7  52.5  52.9  98.4  46.5  71.8  93.0 103.5  67.4  88.9  51.2
## [16,]  55.0  83.2  78.3  63.2  59.3  95.2  33.1  76.3 115.1  72.5  96.2
## [17,]  76.7  35.6  81.6 110.8  63.6  51.9  85.6  65.5 131.1  80.7  76.7
## [18,]  74.4  68.7  99.2  69.4  88.0  23.4  79.4  91.5  49.5  79.3  80.7
## [19,]  91.5  71.1  60.4  98.4  92.9  50.7  60.9 112.7  11.2  56.7  89.7
## [20,] 107.6 115.0  70.2  93.4  91.0  90.3  73.8 111.7  71.1 116.6 100.0
## [21,] 120.0 103.6  84.0  77.8  29.3  82.3  80.5  66.3  94.9  98.0  72.7
## [22,]  42.7  62.3 146.8 129.7  86.5  87.1  92.3  50.2  88.7  42.7  37.6
## [23,]  81.3  92.2 115.7 103.1  52.6 116.6 115.6  74.1  66.6  69.2  63.6
## [24,] 103.3  94.7 111.9  42.8  56.0  64.4  45.2 116.8 125.0  95.0 112.7
## [25,]  82.9  52.9  85.5  35.3  59.6  84.0  59.9  93.1  77.7 120.9  80.7
## [26,]  60.2 107.1  77.9  49.1  41.8  52.9  47.6 109.8 121.4  94.2 106.9
## [27,]  54.4  89.4  71.5  72.2  93.6  51.4  80.5 119.3  95.0  62.2  86.6
## [28,] 125.9  30.7 106.5  68.0  62.6  66.0  96.4  76.4  75.7  64.0 116.5
## [29,]  87.7  70.4 119.4  82.1  77.0 105.0 100.5  98.8  83.5  22.5  23.2
## [30,]  83.9  72.4  80.5  45.6  21.0 110.4  71.8  71.7  97.9  69.6 117.0
## [31,]  79.1  77.4  55.4  96.4  -1.1 110.0 114.8  52.8  77.7 116.2  71.4
## [32,]  65.3  92.7  54.1  92.8  35.2 115.7  80.7  30.1  58.6  74.0  34.7
## [33,]  30.7 139.0  78.4  78.9  84.8 113.3 154.1 128.8  86.1  72.9  95.1
## [34,]  34.7  77.8  70.1 106.7  30.2  78.2  73.9 118.1  80.5 101.5  59.3
## [35,]  30.5  93.7  98.9 101.3  63.3  59.7 108.7  65.6  89.9  75.9  65.4
## [36,]  86.7  63.0  95.1  70.2 113.9  66.2  97.1  81.9  37.3  59.9 136.2
```

```
## [37,]  91.0  32.0  98.7  80.5  95.9  50.6  58.4  74.5  74.3  77.3  55.4
## [38,]  57.2  23.6  41.3 103.6 109.4 132.9 149.9  22.0  67.9  68.1 105.5
## [39,]  94.8  54.6  57.3  69.1 162.0 136.5 114.8  46.2 125.4  57.8  29.4
## [40,]  94.6  62.2 142.4  58.6  99.5  99.8  20.6  75.0  88.7  82.6  58.5
## [41,]  43.5  28.9  81.4  50.3 111.6 128.7  73.0  57.7 110.4 107.0  79.6
## [42,]  58.4 105.1  87.7  68.0 132.1  69.4 126.6 117.4 124.4  61.5  89.3
## [43,] 119.3  64.7  96.6  95.8  95.4 127.2  94.1  44.0  75.5  99.5  79.9
## [44,] 111.4  80.7  77.2  79.4  22.0  72.2  93.2 125.3  65.1  78.8  86.2
## [45,] 113.5  29.5  66.3  72.8  83.5  22.5  50.0  54.7 118.8 141.8  16.7
## [46,] 142.2  96.9  93.0  99.7  89.1  66.9 112.9 111.2  31.6 118.4 126.4
## [47,]  43.1  29.4  45.4  91.4 132.0  78.9  90.4  87.0 100.8 104.6  40.9
## [48,] 126.2  80.4  72.4  58.2  73.8 129.5  82.6 105.6  76.0  22.4  96.3
##       [,45] [,46] [,47] [,48]
##  [1,]  79.4  99.1 114.3  85.8
##  [2,]  68.7  29.7 -12.5  81.9
##  [3,] 121.0  69.5  98.1  90.4
##  [4,] 107.1  66.7 101.4 103.9
##  [5,] 120.4  98.4  74.0  66.0
##  [6,]  81.6  71.1 124.4  42.6
##  [7,]  52.4  67.6  34.9  91.1
##  [8,]  97.0  60.0  31.3 124.1
##  [9,]  83.3  48.0  72.2  76.8
## [10,]  93.4  78.9  94.1  83.7
## [11,]  59.7  75.0  93.2  83.8
## [12,] 112.4  64.0  90.0  72.4
## [13,]  41.1  64.9 115.8  89.9
## [14,]  87.2  47.1  59.6  37.0
## [15,]  67.1  64.7  97.4  71.3
## [16,]  13.0  66.8  95.5 111.9
## [17,]  72.0  94.0 115.1  53.0
## [18,] 134.2  96.7  53.4  74.5
## [19,] 123.5  72.5 105.1  36.7
## [20,]  48.5  47.7  77.5  70.3
## [21,] 115.4 109.5  49.4  60.7
## [22,]  95.9   7.0  86.3  76.9
## [23,]  45.0 130.6  66.7  47.8
## [24,]  99.4   8.7  90.2  80.1
## [25,]  96.5  80.6  61.8  62.6
```

```
## [26,]  48.7 127.9   9.9 105.2
## [27,]  23.0  90.1  56.7  56.1
## [28,] 129.7  78.0  74.0  67.8
## [29,]  74.8  72.9 102.3  86.7
## [30,] 106.1  57.4  95.4  83.9
## [31,]  40.4 106.1  68.5  47.8
## [32,] 105.6  64.4  87.4  73.6
## [33,]  85.1 100.8  85.4 104.5
## [34,]  92.7  46.0  50.7  46.6
## [35,]  51.1  44.9 124.2  52.2
## [36,]  74.2  63.0  86.7  52.2
## [37,]  89.5  72.9  87.5  34.8
## [38,]  92.2  78.1 132.3  79.9
## [39,]  80.4  83.0  91.7  72.3
## [40,]  69.5  54.0 103.2  65.4
## [41,]  87.5  92.0  48.3  84.9
## [42,]  74.9  38.6  86.7  70.0
## [43,] 109.3  47.3  62.3 113.8
## [44,]  55.4 119.6  58.0  82.6
## [45,]  92.5  73.7  69.5  83.2
## [46,]  49.0  61.3 106.5 106.6
## [47,] 148.1  57.6  46.0  67.7
## [48,] 128.0 111.3  75.7 141.0
```

g) Sumad el vector `b` a la tercera fila de la matriz (`C`) y nombrad el resultado como matriz (`C1`). Comprobad el resultado obtenido.

```
C1<- C
C1[3,]<-b+C1[3,]
C[3,] #fila 3 de C
```

```
##  [1]  86.98293  11.27542  65.63470  70.01239 120.04978  41.25038  79.91661
##  [8]  96.45039  63.82955  59.39985  75.27537 114.80007 100.03452  72.16908
## [15] 125.73345 117.98186  53.58911 100.37728  80.03172  62.66760  67.95972
## [22] 109.47126  55.08861 112.78295  87.06582 136.56129  96.98928  27.28313
## [29]  98.51129  70.45044  53.57062 108.30664  43.97312  99.27580  51.34197
## [36]  61.89019  77.18216  84.89923  95.24776  76.95747 102.02872  78.47257
## [43]  63.06032 102.70925 121.03926  69.52568  98.07359  90.40779
```

```
C1[3,] #fila 3 de C + b
```

```
##  [1]  88.98293  17.27542  75.63470  84.01239 138.04978  63.25038 105.91661
```

```
##  [8] 126.45039  97.82955  97.39985 117.27537 160.80007 150.03452 126.16908
## [15] 183.73345 179.98186 119.58911 170.37728 154.03172 140.66760 149.95972
## [22] 195.47126 145.08861 206.78295 185.06582 238.56129 202.98928 137.28313
## [29] 212.51129 188.45044 175.57062 234.30664 173.97312 233.27580 189.34197
## [36] 203.89019 223.18216 234.89923 249.24776 234.95747 264.02872 244.47257
## [43] 233.06032 276.70925 299.03926 251.52568 284.07359 280.40779
```

h) Extraed a partir de la matriz (`B`) una submatriz cuadrada con las 5 primeras filas y 5 primeras columnas (redondead a 2 decimales) y nombradla como matriz (`D`).Obtened la matriz traspuesta y la inversa de `D`. Comprobad que el producto de D y de su inversa es la matriz identidad, como en el siguiente ejemplo:

```
D<- round(B[1:5,1:5],2)
print("Matriz D")
```

```
## [1] "Matriz D"
```

```
D
```

```
##       [,1]  [,2]  [,3]  [,4]  [,5]
## [1,] 28.81 13.34 21.82 29.40 53.44
## [2,] 31.54 51.21 41.01 48.82 38.99
## [3,] 43.49  5.64 32.82 35.01 60.02
## [4,] 36.37 26.52 20.42  7.70 63.96
## [5,] 59.81 25.39 40.44 43.79 41.98
```

```
print("Matriz traspuesta de D")
```

```
## [1] "Matriz traspuesta de D"
```

```
t(D)
```

```
##       [,1]  [,2]  [,3]  [,4]  [,5]
## [1,] 28.81 31.54 43.49 36.37 59.81
## [2,] 13.34 51.21  5.64 26.52 25.39
## [3,] 21.82 41.01 32.82 20.42 40.44
## [4,] 29.40 48.82 35.01  7.70 43.79
## [5,] 53.44 38.99 60.02 63.96 41.98
```

```
solve(D)
```

```
##             [,1]         [,2]         [,3]         [,4]        [,5]
## [1,]  0.02904433 -0.028911464 -0.045802429  0.004461420  0.04856690
```

```
## [2,]  0.02047855  0.007632861 -0.043225098  0.012125661  0.01016756
## [3,] -0.17230913  0.049524448  0.144963946  0.015964936 -0.05823277
## [4,]  0.08910237 -0.009317168 -0.049779740 -0.034725784  0.01930650
## [5,]  0.01927816 -0.001414330  0.003678927  0.007153692 -0.01556549
```

```
round(D%*%solve(D),2)
```

```
##      [,1] [,2] [,3] [,4] [,5]
## [1,]    1    0    0    0    0
## [2,]    0    1    0    0    0
## [3,]    0    0    1    0    0
## [4,]    0    0    0    1    0
## [5,]    0    0    0    0    1
```

Ejercicio 2 (5,5 puntos)

a) Leed el fichero wine.csv de manera correcta. Este fichero contiene una serie de análisis químicos a tres tipos de vinos, con las caracterásticas químicas que los caracterizan. Importad correctamente el fichero a un dataframe con el nombre `wine`. Describid qué variables contiene y comprobad de alguna manera que la importación es correcta.

```
library(readr)
 wine <- read_csv("wine.csv", col_types = cols(Alcohol = col_double()),  skip = 1)
names(wine) #descripcion de las variables
```

```
##  [1] "Wine"                 "Alcohol"              "Malic.acid"
##  [4] "Ash"                  "Acl"                  "Mg"
##  [7] "Phenols"              "Flavanoids"           "Nonflavanoid.phenols"
## [10] "Proanth"              "Color.int"            "Hue"
## [13] "OD"                   "Proline"
```

```
attributes(wine) #atributos y descripcion de variables
```

```
## $names
##  [1] "Wine"                 "Alcohol"              "Malic.acid"
##  [4] "Ash"                  "Acl"                  "Mg"
##  [7] "Phenols"              "Flavanoids"           "Nonflavanoid.phenols"
## [10] "Proanth"              "Color.int"            "Hue"
## [13] "OD"                   "Proline"
##
## $class
## [1] "spec_tbl_df" "tbl_df"      "tbl"         "data.frame"
##
## $row.names
##   [1]   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17
##  [18]  18  19  20  21  22  23  24  25  26  27  28  29  30  31  32  33  34
##  [35]  35  36  37  38  39  40  41  42  43  44  45  46  47  48  49  50  51
##  [52]  52  53  54  55  56  57  58  59  60  61  62  63  64  65  66  67  68
##  [69]  69  70  71  72  73  74  75  76  77  78  79  80  81  82  83  84  85
##  [86]  86  87  88  89  90  91  92  93  94  95  96  97  98  99 100 101 102
## [103] 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119
## [120] 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136
## [137] 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153
## [154] 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170
## [171] 171 172 173 174 175 176 177 178
##
```

```
## $problems
## # A tibble: 1 x 5
##     row col     expected actual file
##   <int> <chr>   <chr>    <chr>  <chr>
## 1     2 Alcohol a double nn     'wine.csv'
##
## $spec
## cols(
##   Wine = col_double(),
##   Alcohol = col_double(),
##   Malic.acid = col_double(),
##   Ash = col_double(),
##   Acl = col_double(),
##   Mg = col_double(),
##   Phenols = col_double(),
##   Flavanoids = col_double(),
##   Nonflavanoid.phenols = col_double(),
##   Proanth = col_double(),
##   Color.int = col_double(),
##   Hue = col_double(),
##   OD = col_double(),
##   Proline = col_double()
## )
```

```
summary(wine)
```

```
##       Wine          Alcohol        Malic.acid         Ash
##  Min.   :1.000   Min.   :11.03   Min.   :0.740   Min.   :1.360
##  1st Qu.:1.000   1st Qu.:12.36   1st Qu.:1.603   1st Qu.:2.210
##  Median :2.000   Median :13.05   Median :1.865   Median :2.360
##  Mean   :1.944   Mean   :13.00   Mean   :2.336   Mean   :2.367
##  3rd Qu.:3.000   3rd Qu.:13.68   3rd Qu.:3.083   3rd Qu.:2.558
##  Max.   :3.000   Max.   :14.83   Max.   :5.800   Max.   :3.230
##  NA's   :1       NA's   :1
##       Acl              Mg            Phenols        Flavanoids
##  Min.   :10.60   Min.   : 70.00   Min.   :0.980   Min.   :0.340
##  1st Qu.:17.20   1st Qu.: 88.00   1st Qu.:1.742   1st Qu.:1.205
##  Median :19.50   Median : 98.00   Median :2.355   Median :2.135
##  Mean   :19.52   Mean   : 99.74   Mean   :2.295   Mean   :2.029
```

```
##  3rd Qu.:21.50   3rd Qu.:107.00   3rd Qu.:2.800   3rd Qu.:2.875
##  Max.   :30.00   Max.   :162.00   Max.   :3.880   Max.   :5.080
##  NA's   :1
##  Nonflavanoid.phenols    Proanth        Color.int           Hue
##  Min.   :0.1300       Min.   :0.410   Min.   : 1.280   Min.   :0.4800
##  1st Qu.:0.2700       1st Qu.:1.250   1st Qu.: 3.220   1st Qu.:0.7825
##  Median :0.3400       Median :1.555   Median : 4.690   Median :0.9650
##  Mean   :0.3623       Mean   :1.591   Mean   : 5.058   Mean   :0.9574
##  3rd Qu.:0.4400       3rd Qu.:1.950   3rd Qu.: 6.200   3rd Qu.:1.1200
##  Max.   :0.6600       Max.   :3.580   Max.   :13.000   Max.   :1.7100
##  NA's   :1
##        OD           Proline
##  Min.   :1.270   Min.   : 278.0
##  1st Qu.:1.938   1st Qu.: 500.5
##  Median :2.780   Median : 673.5
##  Mean   :2.612   Mean   : 746.9
##  3rd Qu.:3.170   3rd Qu.: 985.0
##  Max.   :4.000   Max.   :1680.0
##
```

b) Contad el número de valores missing (NA) total y por columna. Indicad en qué fila y columna se encuentran los valores missing (NA). Eliminad estos valores NA, renombrado el nuevo dataframe sin NA como `wine.sinNA`; comprobad que no queda ningún valor NA. A partir de ahora trabajad siempre con `wine.sinNA` sin NA (evitará errores).

```
#numero de missings total en wine
sum(is.na(wine))

## [1] 4

#numero de missings por variable/columna en wine
colSums(is.na(wine))

##                  Wine               Alcohol           Malic.acid
##                     1                     1                     0
##                   Ash                   Acl                    Mg
##                     0                     1                     0
##              Phenols           Flavanoids Nonflavanoid.phenols
##                     0                     0                     1
##              Proanth            Color.int                   Hue
##                     0                     0                     0
```

```
##                   OD              Proline
##                    0                    0

# localizacion de los missings
which(is.na(wine), arr.ind = T)

##      row col
## [1,]  14   1
## [2,]   2   2
## [3,]  39   5
## [4,]  25   9

#salvar los valores sin missings
wine.sinNA<-na.omit(wine)
sum(is.na(wine.sinNA)) #comprobacion de que no hay missings

## [1] 0
```

c) Utilizando el dataframe `wine.sinNA`. Indicad la cantidad de tipos de vino que aparecen analizadas: frecuencia y porcentaje por tipo de vino (variable Wine).

```
#nÃºmero de tipos de vino
table(wine.sinNA$Wine)

##
##  1  2  3
## 55 71 48

#porcentaje
round(100*table(wine.sinNA$Wine)/dim(wine.sinNA)[1],1)

##
##    1    2    3
## 31.6 40.8 27.6
```

d) Calculad el valor medio y la desviación estandart de la cantidad de alcohol por tipo de vino. Opcionalmente, puede listarse conjuntamente en una soła linea como lo que se muestra a continuacioń para cada tipo de vino, como en el ejemplo que aparece a continuacioń.

```
#media
#class(wine.sinNA£Wine)
#clase 1
m1<-mean(subset(wine.sinNA, Wine == 1)$Alcohol)
```

```
sd1<-sd(subset(wine.sinNA, Wine == 1)$Alcohol)
m2<-mean(subset(wine.sinNA, Wine == 2)$Alcohol)
sd2<-sd(subset(wine.sinNA, Wine == 2)$Alcohol)
m3<-mean(subset(wine.sinNA, Wine == 3)$Alcohol)
sd3<-sd(subset(wine.sinNA, Wine == 3)$Alcohol)
paste("Vino tipo 1: ", "Media alcohol=", round(m1,2), " ,sd alcohol=", round(sd1,2), se

## [1] "Vino tipo 1: Media alcohol=13.75 ,sd alcohol=0.44"

paste("Vino tipo 2: ", "Media alcohol=", round(m2,2), " ,sd alcohol=", round(sd2,2), se

## [1] "Vino tipo 2: Media alcohol=12.28 ,sd alcohol=0.54"

paste("Vino tipo 3: ", "Media alcohol=", round(m3,2), " ,sd alcohol=", round(sd3,2), se

## [1] "Vino tipo 3: Media alcohol=13.15 ,sd alcohol=0.53"
```

e) Utilizando el *data frame* `wine.sinNA`, indicad qué vino tiene maś contenido en cenizas (Ash) y listar todos sus valores, asićomo su tipo (1,2,3).

```
print(wine.sinNA[which(wine.sinNA$Ash == max(wine.sinNA$Ash)), ])

## # A tibble: 1 x 14
##    Wine Alcohol Malic.acid   Ash   Acl    Mg Phenols Flavanoids
##   <dbl>   <dbl>      <dbl> <dbl> <dbl> <dbl>   <dbl>      <dbl>
## 1     2    11.6       2.05  3.23  28.5   119    3.18       5.08
## # ... with 6 more variables: Nonflavanoid.phenols <dbl>, Proanth <dbl>,
## #   Color.int <dbl>, Hue <dbl>, OD <dbl>, Proline <dbl>
```