

R Exercises

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1 Vectors

1.1 Exercises

1. Create the vectors: (For parts e., f. and g. look at the help for the function rep.)
 - a. (1,2,3,...,19,20)
 - b. (20,19,...,2,1)
 - c. (1,2,3,...,19,20,19,18,...,2,1)
 - d. (4,6,3) and assign it to the name tmp.
 - e. (4,6,3,4,6,3,...,4,6,3) where there are 10 occurrences of 4.
 - f. (4,6,3,4,6,3,...,4,6,3,4) where there are 11 occurrences of 4, 10 occurrences of 6 and 10 occurrences of 3.
 - g. (4,4,...,4,6,6,...,6,3,3,...,3) where there are 10 occurrences of 4, 20 occurrences of 6 and 30 occurrences of 3.
2. Create a vector of the values of $e^x \cos(x)$ at $x = 3, 3.1, 3.2, \dots, 6$.
3. Create the following vectors:
 - a. $(0.1^3 0.2^1, 0.1^6 0.2^4, \dots, 0.1^{36} 0.2^{34})$
 - b. $(2, \frac{2^2}{2}, \frac{2^3}{3}, \dots, \frac{2^{25}}{25})$
4. Calculate the following:
 - c. $\sum_{i=10}^{100} (i^3 + 4i^2)$
 - d. $\sum_{i=1}^{25} (\frac{2^i}{i} + \frac{3^i}{i^2})$
5. Use the function paste to create the following character vectors of length 30:
 - a. ("label 1", "label 2",, "label 30"). (Note that there is a single space between label and the number following.)
 - b. ("fn1", "fn2", ..., "fn30"). (In this case, there is no space between fn and the number following.)
6. Execute the following lines which create two vectors of random integers which are chosen with replacement from the integers 0, 1,..., 999. Both vectors have length 250.

```
set.seed(50)
xVec <- sample(0:999, 250, replace=T)
yVec <- sample(0:999, 250, replace=T)
```

Suppose $X = (x_1, x_2, \dots, x_n)$ denotes the vector xVec and $Y = (y_1, y_2, \dots, y_n)$ denotes the vector yVec .

- a. Create the vector $(y_2 - x_1, \dots, y_n - x_{n-1})$.

- b. Create the vector $(\frac{\sin(y_1)}{\cos(x_2)}, \frac{\sin(y_2)}{\cos(x_3)}, \dots, \frac{\sin(y_{n-1})}{\cos(x_n)})$
- c. Create the vector $(x_1 + 2x_2 - x_3, x_2 + 2x_3 - x_4, \dots, x_{n-2} + 2x_{n-1} - x_n)$.
- d. Calculate $\sum_{i=1}^{n-1} \frac{e^{-x_i+1}}{x_i+10}$
7. This question uses the vectors `xVec` and `yVec` created in the previous question and the functions `sort`, `order`, `mean`, `sqrt`, `sum` and `abs`.
- Pick out the values in `yVec` which are greater than 600.
 - What are the index positions in `yVec` of the values which are greater than 600?
 - What are the values in `xVec` which correspond to the values in `yVec` which are > 600 ? (By correspond, we mean at the same index positions.)
 - Create the vector $(|x_1 - \bar{x}|^{1/2}, |x_2 - \bar{x}|^{1/2}, \dots, |x_n - \bar{x}|^{1/2})$ where \bar{x} denotes the mean of the vector $X = (x_1, x_2, \dots, x_n)$.
 - How many values in `yVec` are within 200 of the maximum value of the terms in `yVec`?
 - How many numbers in `xVec` are divisible by 2? (Note that the modulo operator is denoted `%%`.)
 - Sort the numbers in the vector `xVec` in the order of increasing values in `yVec`.
 - Pick out the elements in `yVec` at index positions 1, 4, 7, 10, 13,
8. By using the function `cumprod` or otherwise, calculate $1 + \frac{2}{3} + (\frac{2}{3} \frac{4}{5}) + (\frac{2}{3} \frac{4}{5} \frac{6}{7}) + \dots + (\frac{2}{3} \frac{4}{5} \dots \frac{38}{39})$

1.2 Answers

- 1:20
 - 20:1
 - `c(1:20,19:1)`
 - `tmp <- c(4,6,3)`. Note: it is good style to use `<-` for assignment and to leave a space on both sides of the assignment operator `<-`.
 - `rep(tmp,10)`
 - `rep(tmp,length.out=31)` or `c(rep(tmp,10),4)`
 - `rep(tmp,times=c(10,20,30))`
- `tmp <- seq(3,6,by=0.1); exp(tmp) * cos(tmp)`
- `(0.1^seq(3,36,by=3))*(0.2^seq(1,34,by=3))`
 - `(2^(1:25))/(1:25)`
- `tmp <- 10:100; sum(tmp^3 + 4 * tmp^2)`
 - `tmp <- 1:25; sum((2^tmp) / tmp + (3^tmp) / tmp^2)`
- `paste("label", 1:30)`, or `paste("label", 1:30, sep=" ")`. Note: there is a space in `sep=" "`.
 - `paste("fn", 1:30, sep="")`, Note: there is no space in `sep=""`.
- `yVec[-1] - xVec[-length(xVec)]`
 - `sin(yVec[-length(yVec)]) / cos(xVec[-1])`
 - `xVec[-c(249,250)] + 2*xVec[-c(1,250)] - xVec[-c(1,2)]`, or, for an answer which works whatever the length of `xVec`,
`xVecLen <- length(xVec); xVec[-c(xVecLen-1,xVecLen)] + 2*xVec[-c(1,xVecLen)] - xVec[-c(1,2)]`
 - `sum(exp(-xVec[-1])/(xVec[-length(xVec)]+10))`
- `yVec[yVec>600]`
 - `(1:length(yVec))[yVec>600]` or `which(yVec>600)`
 - `xVec[yVec>600]`
 - `sqrt(abs(xVec-mean(xVec)))`
 - `sum(yVec>max(yVec)-200)`
 - `sum(xVec%%2==0)`
 - `xVec[order(yVec)]`
 - `yVec[seq(1, 250, by=3)]`, or `yVec[c(T,F,F)]`
- `1+sum(cumprod(seq(2,38,b=2)/seq(3,39,b=2)))`

2 Functions

2.1 Exercises

1. 丟3 顆公平的骰子，其和為dice.sum，`dice.sum <- sum(sample(1:6, 3, replace = TRUE))`，試寫一 R 函式，印出總和dice.sum 並做如下判別: 如果和大於13 點，則印出「Good!!」，反之印出「Try Again」。

2. 設 $a_n = \frac{n+3}{n+8}$, $b_n = \frac{2n^2+3}{2n^2+8n}$, $c_n = \frac{\sqrt{(n)}}{2+\sqrt{(n)}}$, 依定義可得 $\lim_{n \rightarrow \infty} a_n = \lim_{n \rightarrow \infty} b_n = \lim_{n \rightarrow \infty} c_n = 1$, 請列出下表。

n	an	bn	cn
1	0.4444444	0.5000000	0.3333333
10	0.7222222	0.7250000	0.6125741
20	0.8214286	0.8364583	0.6909830
30	0.8684211	0.8838235	0.7325211
40	0.8958333	0.9099432	0.7597469
50	0.9137931	0.9264815	0.7795188
60	0.9264706	0.9378906	0.7947869
70	0.9358974	0.9462355	0.8070727
80	0.9431818	0.9526042	0.8172560
90	0.9489796	0.9576241	0.8258876
100	0.9537037	0.9616827	0.8333333
10000	0.9995004	0.9996002	0.9803922

3. 有一函數為

$$f(x) = |x^2 + x|, \text{ if } x < 0; \sin(x), \text{ if } 0 \leq x < 3; \text{ and } 3e^x \text{ if } x \geq 3.$$

計算並列出下列表格:

n	fx
-5	20.0000000
-4	12.0000000
-3	6.0000000
-2	2.0000000
-1	0.0000000
0	0.0000000
1	0.8414710
2	0.9092974
3	60.2566108

n	fx
4	163.7944501
5	445.2394773

2.2 Answers

- ```
a.f <- function (){
 dice.sum <- sum(sample(1:6, 3, replace = TRUE))
 cat("The dice you rolled is:", dice.sum, "")
 ifelse(dice.sum > 13, "good!", "Try Again!")
}
```
- ```
an <- function (n){
  (n + 3) / (n + 8)
}
bn <- function (n){
  (2 * n^2 + 3) / (2 * n^2 + 8 * n)
}
cn <- function (n){
  sqrt(n) / (2 + sqrt(n))
}
n <- c(1, seq(10,100, by=10), 10000)
knitr::kable(cbind(n, an(n=n), bn(n=n), cn(n=n)), col.names = c('n', 'an', 'bn',
'cn'))
```
- ```
fx <- function(x){
 ifelse(x<0, abs(x^2 + x), ifelse(x<3, sin(x), 3 * exp(x)))
}
x<- -5:5
knitr::kable(cbind(x, fx(x=x)), col.names = c("n", "fx"))
```