

A Very Basic Introduction to R

This document will guide you through the most elementary operations in R, showing the commands and their accompanying output. Try all of the commands and verify the output. Then complete the set of exercises at the end of the document.

Arithmetic

```
> 37 + 26
```

```
[1] 63
```

```
> 53 - 38
```

```
[1] 15
```

```
> 111111*111111
```

```
[1] 12345654321
```

```
> 12321/111
```

```
[1] 111
```

```
> 1111^2
```

```
[1] 1234321
```

```
> sqrt(12345678987654321)
```

```
[1] 111111111
```

Modular Arithmetic:

37 mod 5

```
> 37%%5
```

```
[1] 2
```

```
> 37%%5 # quotient without remainder
```

```
[1] 7
```

Absolute Value:

$$|-37|$$

```
> abs(-37)
```

```
[1] 37
```

Functions

Exponential e^x :

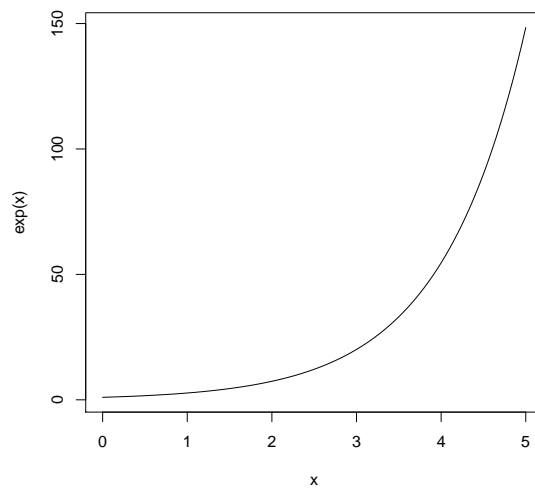
```
> exp(1)
```

```
[1] 2.718282
```

```
> exp(2.5)
```

```
[1] 12.18249
```

```
> curve(exp(x), from=0, to=5)
```



Natural Logarithm $\ln(x)$ or $\log_e(x)$:

```
> log(1)
```

```
[1] 0
```

```
> log(exp(1))
```

```
[1] 1
```

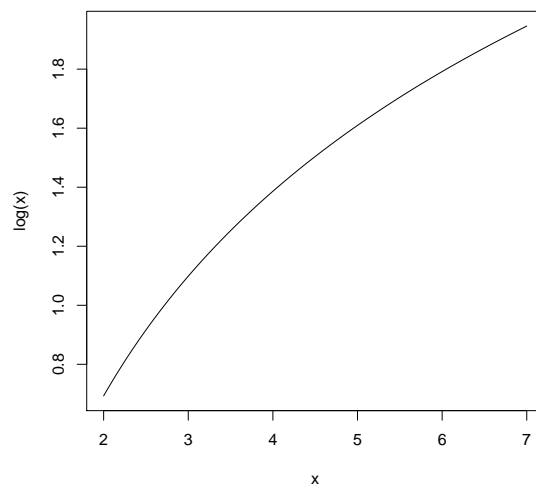
```
> log(exp(2.5))
```

```
[1] 2.5
```

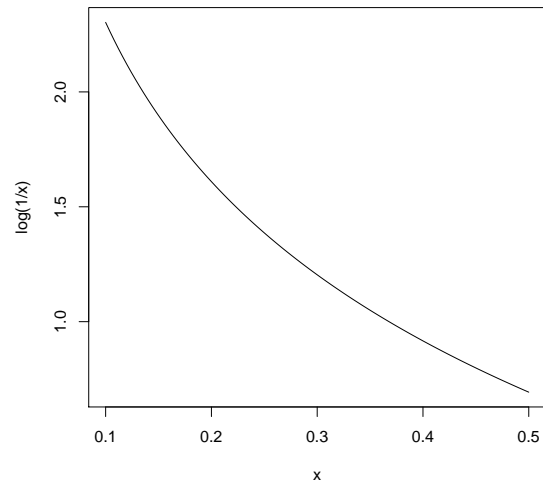
```
> log(0)
```

```
[1] -Inf
```

```
> curve(log(x), from=2, to=7)
```



```
> curve(log(1/x), from=0.1, to=0.5)
```



Trigonometric Functions, e.g. $\sin(x)$

```
> sin(0)
```

```
[1] 0
```

```
> sin(pi/2)
```

```
[1] 1
```

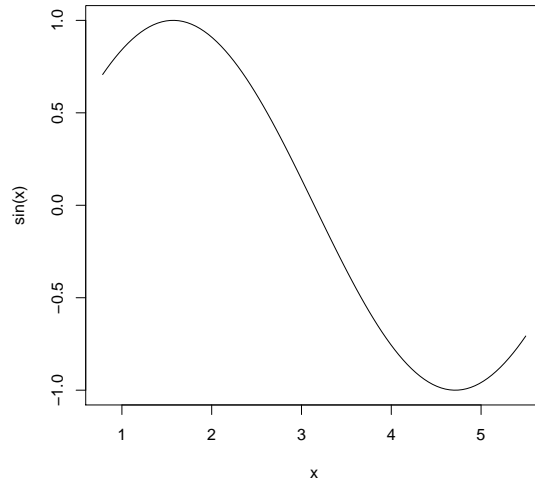
```
> cos(pi/2)
```

```
[1] 6.123234e-17
```

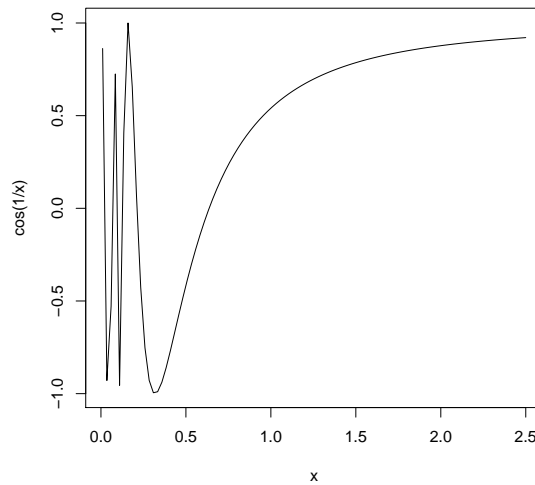
```
> sin(3.14)
```

```
[1] 0.001592653
```

```
> curve(sin(x), from=pi/4, to = 7*pi/4)
```



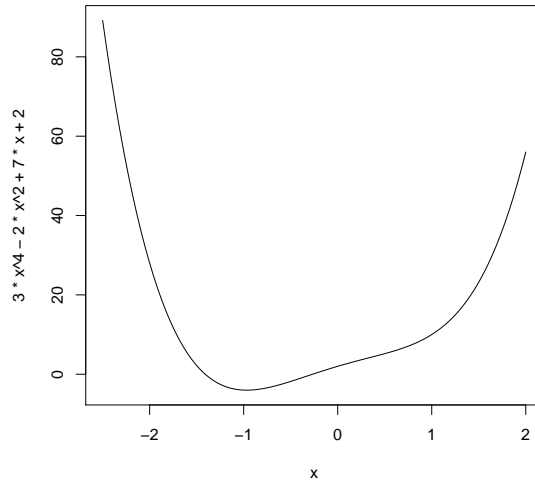
> `curve(cos(1/x), from = 0.01, to= 2.5)`



Polynomials

Graphing $p(x) = 3x^4 - 2x^2 + 7x + 2$ on the interval $[-2.5, 2]$.

> `curve(3*x^4 - 2*x^2 + 7*x + 2, from=-2.5, to=2)`



Sequences and Series

```
> 1:7
```

```
[1] 1 2 3 4 5 6 7
```

```
> 3:19
```

```
[1] 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
```

```
> seq(2, 7, 0.5)
```

```
[1] 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0
```

```
> seq(-4, 12, 2)
```

```
[1] -4 -2 0 2 4 6 8 10 12
```

```
> 1/seq(1,5)
```

```
[1] 1.0000000 0.5000000 0.3333333 0.2500000 0.2000000
```

```
> seq(1,5)^3
```

```
[1] 1 8 27 64 125
```

```

> rep(3, 7)
[1] 3 3 3 3 3 3 3
> rep(2:4, 3)
[1] 2 3 4 2 3 4 2 3 4
> rep(2:4, rep(3,3))
[1] 2 2 2 3 3 3 4 4 4
> rep(2:4, 1:3)
[1] 2 3 3 4 4 4
> sum(1:7)
[1] 28
> cumsum(1:7)
[1] 1 3 6 10 15 21 28

```

Linear Algebra

Vectors:

$$x = \begin{bmatrix} 3 \\ 5 \\ 6 \\ 7 \end{bmatrix}$$

```
> x <- c(3, 5, 6, 7)
```

$$y = \begin{bmatrix} 5 \\ 3 \\ 3 \\ 9 \end{bmatrix}$$

```
> y <- c(5, 3, 3, 9)
```

$x + y =$

```
> x + y
```

```
[1] 8 8 9 16
```

$x - y =$

```
> x - y
```

```
[1] -2 2 3 -2
```

Inner Products:

$x^T y =$

```
> x%*%y
```

```
      [,1]  
[1,] 111
```

Matrices:

$$A = \begin{bmatrix} 2 & 3 & 4 & 6 \\ 2 & 1 & 0 & 3 \\ 1 & 2 & 3 & 5 \\ 9 & 8 & 6 & 5 \end{bmatrix}$$

```
> A <- matrix(c(2, 2, 1, 9, 3, 1, 2, 8, 4, 0, 3, 6, 6, 3, 5, 5), nrow=4)  
> A
```

```
      [,1] [,2] [,3] [,4]  
[1,]    2    3    4    6  
[2,]    2    1    0    3  
[3,]    1    2    3    5  
[4,]    9    8    6    5
```


Solving Linear Systems:

$$Az = x, \quad z = ?$$

```
> z <- solve(A, x)
> z
```

```
[1] -43  79 -43   4
```

Scalar Multiplication:

$$3A =$$

```
> 3*A
```

```
      [,1] [,2] [,3] [,4]
[1,]    6    9   12   18
[2,]    6    3    0    9
[3,]    3    6    9   15
[4,]   27   24   18   15
```

Transposition:

$$A^T =$$

```
> t(A)
```

```
      [,1] [,2] [,3] [,4]
[1,]    2    2    1    9
[2,]    3    1    2    8
[3,]    4    0    3    6
[4,]    6    3    5    5
```

Exercises

1. Write down the R commands used to calculate the following:

(a) 17×247

(b) $-292 + 18$

(c) $|200 - 37 \times 14|$

(d) The remainder after dividing 47^3 by 18.

2. Write down the R commands which can be used to calculate the following:

(a) $\log(2.5\pi)$

(b) $e^{\sin(2)}$

3. Write down the R commands to draw the following graphs:

(a) $\sin(\log(x))$ on the interval $[.2, .8]$.

(b) e^{-x^2} on the interval $[-2, 1.75]$.

4. Write down the R commands to construct the following sequences:

(a) [1] 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35

(b) [1] -5 -2 1 4 7

(c) [1] 4 4 4 4 4 4 4

(d) [1] 2 5 8 2 5 8 2 5 8 2 5 8 2 5 8 2 5 8 2 5 8

(e) [1] 1 4 9 16 25 36 49 64 81 100

5. Calculate $\sum_{i=3}^{177} i^2$

6. Suppose

$$C = \begin{bmatrix} 2 & -3 & 3 \\ 0 & 1 & 0 \\ 1 & 4 & 9 \end{bmatrix}$$

Find the vector x which satisfies the equation $Cx = y$ when $y = [2 \ 3 \ 5]$.

What is $x^T y$? Finally, find the solution to $C^T x = y$.