

Mathematics In R

$\tau\rho$

Set Operations

→ Performs **set** union, intersection, difference, equality and membership on two vectors

General form :

`union(x, y)`

`intersect(x, y)`

`setdiff(x, y)`

`setequal(x, y)`

`is.element(el, set) or el %in% set`

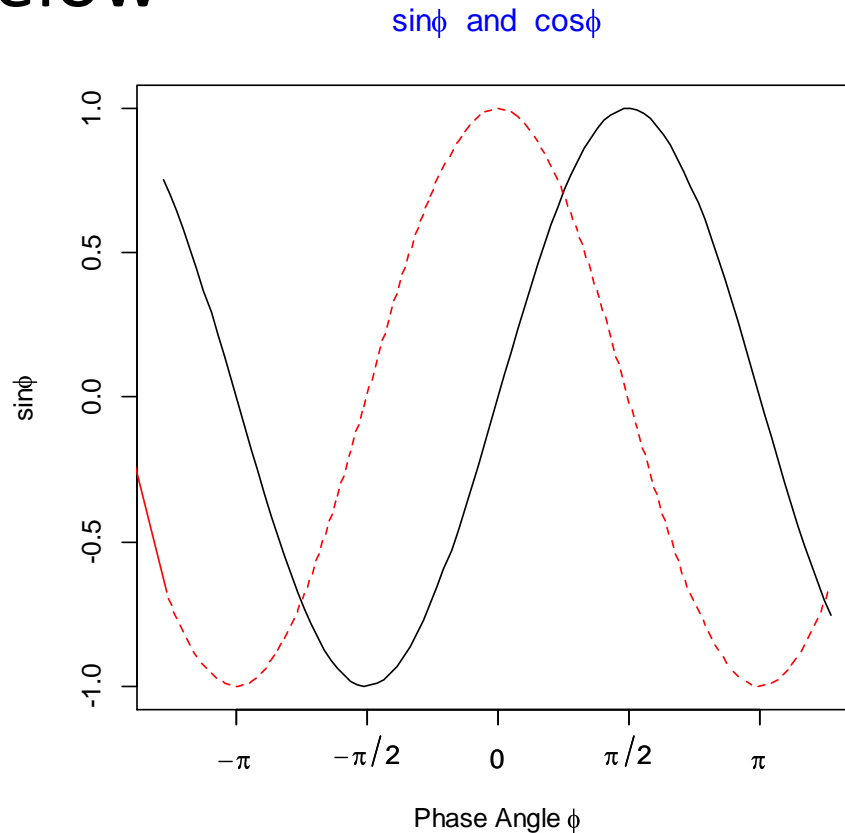
Example 1

Could you explain what are these programs do for?

- ```
x<-1:20;y<-19:22
setequal(union(x,y),c(setdiff(x,y),intersect(x,y),
setdiff(y,x)))
```
- ```
sstr<-c("c","ab","B","bba","c",NA,"@", "bla","a","Ba","%")
sstr[sstr %in% c(letters, LETTERS)]
```
- ```
"%w/o%" <- function(x, y) x[!x %in% y]
(1:10) %w/o% c(3,7,12)
```

# Example 2

Create  $\sin\phi$  and  $\cos\phi$  plot in one graph with the output below



# Answer 2

```
x <- seq(-4, 4, len = 101)
y <- cbind(sin(x), cos(x))
matplot(x,y,type = "l", xaxt = "n",
 main=expression(paste(plain(sin)*phi," and ",
 plain(cos)* phi)),
 ylab= expression("sin"*phi,"cos"*phi),
 xlab= expression(paste("PhaseAngle",phi)),
 col.main = "blue")
axis(1,at = c(-pi, -pi/2, 0, pi/2, pi),l
 abels = expression(-pi, -pi/2, 0, pi/2, pi))
```

# Calculus

- Derivatives

## General form

`D(expr, name)`

`deriv(expr, ...)`

`eval(expr)`

- Integral

## General form

`integrate(f, ...)`

# Example 3

Find the derivatives of these function below :

a.  $\frac{\delta \sin(x^2)}{\delta x}$

b.  $\frac{\delta \sin(\cos(x)y)}{\delta x}$  and  $\frac{\delta \sin(\cos(x)y)}{\delta y}$

# Answer 3

- `deriv((y~sin(x^2)), "x", func=TRUE)`
- `D(expression(sin(x^2)), "x")`
  
- `deriv((y~sin(cos(x)*y)), c("x", "y"), func=TRUE)`
- `D(expression(sin(cos(x)*y)), "x")`
- `D(expression(sin(cos(x)*y)), "y")`



# Example 4

Create a function for finding the  $k$  derivatives (order= $k$ ) from the function  $x^9$ !

# Answer 4

```
DD <- function(expr, name, order = 1) {
 if(order < 1) stop("'order' must be >= 1")
 if(order == 1) D(expr, name)
 else DD(D(expr, name), name, order - 1)
}
DD(expression(x^9), "x", 3)
```

# Example 5

Find the integral from these functions below :

- $\int_{-1.96}^{1.96} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}(x)^2} dx$

- $\int_0^{\infty} \frac{1}{(x+1)\sqrt{x}} dx$

# Answer 5

- `integrate(dnorm, -1.96, 1.96)`
- `integrand<-function(x) {1/((x+1)*sqrt(x)) }`  
`integrate(integrand, lower=0, upper=Inf)`

# Matrix Algebra

- General form

`t(...)`

`%*%, #`

`solve(...)`

`diag(...)`

`eigen(...)`

## Example 6

Let  $A = \begin{bmatrix} -1 & 1 & 0 \\ -1 & 2 & 1 \\ -1 & 0 & 2 \end{bmatrix}$ , using program in R, could you prove that all of column vectors of  $A$  are linear independent?

# Answer 6

- `solve(cbind(-1, c(1:2, 0)), 0:2), rep(0, 3))`
- `det(cbind(-1, c(1:2, 0)), 0:2)`
- `eigen(cbind(-1, c(1:2, 0)), 0:2)`

Thank you 😊