

```
library(ggplot2)

## Warning: le package 'ggplot2' a été compilé avec la version R 4.1.3

num_Trials <- 10^7
```

**fix the seed to have reproductive results**

```
set.seed(2022)
```

**sample x from a uniform distribution**

```
x <- runif(num_Trials, min = -pi/2, max = pi/2)
```

**sample y from a uniform distribution**

```
y_min <- -pi
y_max <- 1
y <- runif(num_Trials, min = y_min, max = y_max)
```

idea : number of points inside / total points = area inside / total area

Determine which points are inside:

create a vector of TRUE and FALSE values

for a point to be inside, conditions to be satisfied:

- 1)  $y > -2*x - \pi$
- 2)  $y > 2*x - \pi$
- 3)  $y < -\sin(2*x)$  when  $x \geq \pi/2$  and  $< 0$
- 4)  $y < \sin(2*x)$  when  $x \geq 0$  and  $\leq \pi/2$

```
is_inside <- (y > - 2*x - pi) &
              (y > 2*x - pi) &
              (((y < -sin(2*x)) & x < 0 ) | 
               ((y < sin(2*x)) & x >= 0 ) )
```

compute number of points inside / total points

```
ratio_inside <- sum(is_inside) / num_Trials
ratio_inside
```

```
## [1] 0.5330881
```

compute total area

```
total_area_rect <- pi * (y_max - y_min)
total_area_rect
```

```
## [1] 13.0112
```

compute area inside

```
area_inside <- total_area_rect * ratio_inside  
area_inside # solution : area inside -----> #####
```

```
## [1] 6.936114
```

plot

```
df <- data.frame(x=x, y=y, is_inside=is_inside)  
  
ggplot(df, aes(x, y)) +  
  geom_point(aes(color=is_inside)) +  
  theme_bw()
```

