Exercise 3 - Monte Carlo Simulation of areas

Yannik Gaebel

2022-10-30

```
set.seed(12208157)
```

Task 1.1

```
# Calculate Monte Carlo Integral
b <- 6
X <- runif(100000, min=1, max=b)
cat(paste("Monte Carlo Integral:",mean(exp(-X^3)*(b-1))),"\n")
```

```
## Monte Carlo Integral: 0.0871443539183068
```

```
# Calculate Numerical Integral
cat(paste("Numerical Integral: "))
```

```
## Numerical Integral:
```

```
integrate(f = function(x){exp(-x^3)},lower = 1,upper = b)
```

```
## 0.08546833 with absolute error < 3.2e-07
```

Off by 0.002

Task 1.2

What would be a good density for the simulation in that case?

Answer:

exponential distribution

We change the formula in the following way so that the exponential distribution can be used

```
X <- rexp(100000)
cat(paste("Monte Carlo Integral:",mean(exp(-(X+1)^3)/dexp(X))),"\n")
```

```
## Monte Carlo Integral: 0.0858487251043112
```

```r
# Calculate Numerical Integral
cat(paste("Numerical Integral: "))
```

```
## Numerical Integral:
```

```r
integrate(f = function(x){exp(-x^3)},1,Inf)
```

```
## 0.08546833 with absolute error < 6.2e-06
```

Off by 0.0003

Task 1.3

Do you have an explanation why Monte Carlo integration agrees in 2. with integrate but not so much in 1.?

Answer:

No idea!!

Task 2.1

Task 2.2

Task 2.3

Task 2.4