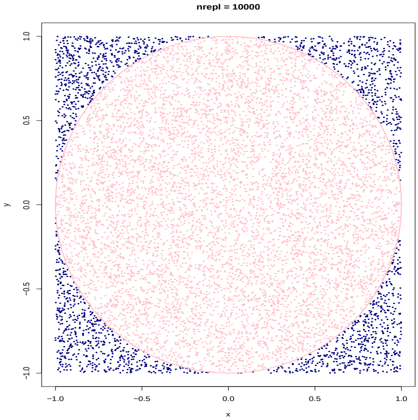
Un po' di conti con R

https://cran.r-project.org/

https://www.rstudio.com/

```
pi.greco=function(nrepl=10000){
+     xy=runif(nrepl*2, min=-1, max=1)
+     dim(xy)=c(nrepl,2)
+     inside=apply(xy^2,1,sum)<1
+     plot(xy, pch=20, cex=.5, col=c("navy","pink")
+          [inside+1],
+          xlab="x", ylab="y",
+          main=paste("nrepl =",nrepl))
+     a=seq(0,2*pi,length.out=100)
+     xy.circle=cbind(cos(a),sin(a))
+     lines(xy.circle,col="pink",lwd=2)
+     return( sum(inside)/nrepl *4)
+ }
```

```
> pi.greco()
[1] 3.1408
> pi.greco()
[1] 3.1556
> pi.greco()
[1] 3.1396
> pi.greco()
[1] 3.14
> pi.greco()
[1] 3.1288
> pi.greco()
[1] 3.1188
```



```
> pi.greco6 = function(nrepl=10000){
+     x=runif(nrepl, min=0, max=0.5)
+     dim(x) = c(nrepl,1)
+     somma= sum(1/sqrt(1 -x^2),1)
+     print(somma*3/nrepl)
+ }
```

```
> pi.greco6()
[1] 3.141353
> pi.greco6()
[1] 3.141853
> pi.greco6()
[1] 3.142525
> pi.greco6()
[1] 3.14333
```

```
> pi.greco6()
[1] 3.142465
> pi.greco6()
[1] 3.140517
> pi.greco6()
[1] 3.144073
> pi.greco6()
[1] 3.142422
```

```
> pi.greco6()
[1] 3.14008
> pi.greco6()
[1] 3.14226
> pi.greco6()
[1] 3.141166
> pi.greco6()
[1] 3.143552
```

Consideriamo la matrice stocastica P

	1	2	3	4	5
1	1	0	0	0	0
2	0.2	0.8	0	0	0
3	0	0	0.2	0.3	0.5
4	0	0	0	0.6	0.4
5	0	0.2	0.4	0.4	0

```
> library(foreign)
> library(xtable)
> Ide5=matrix(c(1,0,0,0,0,
+               0,1,0,0,0,
+               0,0,1,0,0,
+               0,0,0,1,0,
+               0,0,0,0,1), nrow=5, ncol = 5, byrow=TRUE)
> P=matrix(c(1,0,0,0,0,
+            .2,.8,0,0,0,
+            0,0,.2,.3,.5,
+            0,0,0,.6,.4,
+            0,.2,.4,.4,0), nrow=5, ncol = 5, byrow=TRUE)
> P2 <- P %*% P
> P3 <- P2 %*%P
> P4 <- P3 %*%P
> B <- Ide5 + P + P2 + P3 + P4
> B
```

```
        [,1]   [,2]   [,3]   [,4]   [,5]
[1,] 5.0000 0.0000 0.0000 0.0000 0.0000
[2,] 1.0214 1.4251 0.0000 0.0000 0.0000
[3,] 0.0548 0.2554 1.7216 1.5776 1.2536
[4,] 0.0464 0.2312 0.4288 3.0032 1.1744
[5,] 0.1620 0.4138 0.7456 1.4960 1.7776

> xtable(B, type = "latex", file = "B.tex")
```

$$B = \sum_{k=0}^{4} P^k$$

	1	2	3	4	5
1	5.00	0	0	0	0
2	1.64	3.36	0	0	0
3	0.06	0.38	1.72	1.58	1.25
4	0.05	0.34	0.43	3.00	1.17
5	0.22	0.76	0.75	1.50	1.78

$$C_1 = \{1\}, \quad T = \{2, 3, 4, 5\},$$

P matrice stocastica 8×8

	1	2	3	4	5	6	7	8
1	0.6	0.4	0	0	0	0	0	0
2	0	0	0.8	0.2	0	0	0	0
3	0	0.5	0.5	0	0	0	0	0
4	0	0	0	0.6	0.4	0	0	0
5	0	0	0.2	0.4	0	0.4	0	0
6	1	0	0	0	0	0	0	0
7	0	0	0	1	0	0	0	0
8	0	0	0	0	0	0	1	0

$$B = \sum_{k=0}^{7} P^k$$

	1	2	3	4	5	6	7	8
1	2.53	1.97	2.40	0.79	0.25	0.07	0	0
2	0.18	2.57	3.46	1.23	0.42	0.14	0	0
3	0.08	2.10	4.60	0.86	0.27	0.08	0	0
4	0.90	0.64	0.96	3.64	1.36	0.50	0	0
5	1.26	1.14	1.72	1.68	1.59	0.61	0	0
6	2.47	1.72	1.97	0.62	0.18	1.05	0	0
7	0.73	0.45	0.69	3.41	1.26	0.46	1.00	0
8	0.55	0.28	0.46	3.15	1.15	0.40	1.00	1.00

$$C_1 = \{1, 2, 3, 4, 5, 6\} \quad T = \{7, 8\}$$

P matrice stocastica 8×8

	1	2	3	4	5	6	7	8
1	0.6	0.4	0	0	0	0	0	0
2	0	0	0.80	0.20	0	0	0	0
3	0	0.5	0.5	0	0	0	0	0
4	0	0	0	1	0	0	0	0
5	0	0	0.2	0.4	0	0.4	0	0
6	1	0	0	0	0	0	0	0
7	0	0	0	1	0	0	0	0
8	0	0	0	0	0	0	1	0

$$B = \sum_{k=0}^{7} P^k$$

	1	2	3	4	5	6	7	8
1	2.46	1.94	2.33	1.27	0	0	0	0
2	0	2.47	3.29	2.24	0	0	0	0
3	0	2.06	4.52	1.42	0	0	0	0
4	0	0	0	8.00	0	0	0	0
5	0.95	0.95	1.43	3.27	1.00	0.40	0	0
6	2.43	1.71	1.93	0.93	0	1.00	0	0
7	0	0	0	7.00	0	0	1.00	0
8	0	0	0	6.00	0	0	1.00	1.00

Individuare le classi chiuse minimali e gli stati transienti.

P

	1	2	3	4	5	6	7	8
1	0.6	0.4	0	0	0	0	0	0
2	0	0	0.8	0.2	0	0	0	0
3	0	1	0	0	0	0	0	0
4	0	0	0	1	0	0	0	0
5	0	0	0.2	0.4	0	0.4	0	0
6	1	0	0	0	0	0	0	0
7	0	0	0	1	0	0	0	0
8	0	0	0	0	0	0	1	0

$$B = \sum_{k=0}^{7} P^k$$

	1	2	3	4	5	6	7	8
1	2.46	2.42	1.65	1.48	0	0	0	0
2	0	2.95	2.36	2.69	0	0	0	0
3	0	2.95	2.95	2.10	0	0	0	0
4	0	0	0	8.00	0	0	0	0
5	0.95	1.21	1.03	3.40	1.00	0.40	0	0
6	2.43	2.06	1.44	1.07	0	1.00	0	0
7	0	0	0	7.00	0	0	1.00	0
8	0	0	0	6.00	0	0	1.00	1.00

Individuare le classi chiuse minimali e gli stati transienti.