tinytex::install_tinytex()

```
############################################ Exercicio 02/11

######## Vikson Andrade 10733900, Guilherme Bergamim 8124076

# Devido ao item h preferimos criar amostras para os parametros, de modo
que fosse possivel executar
# o codigo diversas vezes e obter direrentes resultados

require(tinytex)

## Loading required package: tinytex

require(coda)

## Loading required package: coda

require(rmarkdown)

## Loading required package: rmarkdown

rm(list=ls(all=TRUE))
#### Declaracoes

v <- c(1,0,0.5,2,3,1,0.2,0.9,4,1,0,5)   # Amostra para y definida de
forma completamente arbitraria
y <- sample(v,4)                        # Escolha aleatória de um valor
para os y
start <- c(1)                           # Definido de forma completamente
arbitraria
a <- c(1000,900,700,850)                # Amostra para M definida de
forma completamente arbitraria
M <- sample(a,1)                        # Escolha aleatória de um valor
para M
n <- M
burn_in <- 150                          # Definido de forma completamente
arbitraria
thin <- 6                               # Definido de forma completamente
arbitraria
taxa=0

y

## [1] 1.0 0.2 4.0 3.0

n

## [1] 850
```

```r
#### Distribuicao conjunta (x|y)

p=function(x,y){

  p=(2+x)^y[1]*(1-x)^(y[2]+y[3])*x^y[4]

  return(p)

}

##### Método de Metropolis-Hastings para gerar uma amostra aleatória de uma distribuicao,
##### usando a teoria das Cadeias de Markov para convergir a distribuicao estacionária (Contexto Bayesiano)

# M = Numero de repeticoes do processo e tamanho da amostra
# Start = Vetor inicial (theta0)
# p = distribuicao a posteriori sem parametro

#### Burn in -> Número de estados que descartamos até atingirmos o ponto onde
#### atingimos a distribuicao estacionaria e a partir dele, temos amostras dependentes

#### Thin -> o número de transições necessárias para a cadeia ir de um estado de equilibrio para outro

# Selecionando um theta em especifico para criar graficos e estipular intervalos

theta=matrix(NA,nrow=n) # Vetor de parametros de quantidades desconhecidas e de n componentes

theta=start

for(i in 2:M) {

  x = runif(1)

  A = p(x,y)/p(theta[i-1],y)

  prob=min(1,A)

  u=runif(1)

  if(u < prob) {

    theta[i]=x
```

```
    taxa=taxa+1

  }

  else theta[i]=theta[i-1]

}

taxa=taxa/M

taxa

## [1] 0.5305882

theta

##   [1] 1.00000000 0.07226096 0.32314138 0.32314138 0.24565008
0.23474266
##   [7] 0.23474266 0.24448174 0.68522615 0.55506215 0.55506215
0.55506215
##  [13] 0.46746646 0.43726956 0.43726956 0.46321669 0.45230178
0.45230178
##  [19] 0.35159670 0.35159670 0.56576365 0.43059355 0.52931108
0.45323131
##  [25] 0.55849432 0.55849432 0.30177378 0.18278889 0.18789334
0.82534571
##  [31] 0.64653962 0.34221584 0.34221584 0.25644555 0.25644555
0.56935628
##  [37] 0.56935628 0.33178207 0.33178207 0.33178207 0.49244912
0.49244912
##  [43] 0.51156287 0.51156287 0.51156287 0.51156287 0.51156287
0.51156287
##  [49] 0.45775929 0.45775929 0.45775929 0.45775929 0.45775929
0.45775929
##  [55] 0.45775929 0.36840639 0.36840639 0.36840639 0.36840639
0.36840639
##  [61] 0.36840639 0.53325444 0.53325444 0.50728788 0.50728788
0.30468525
##  [67] 0.30468525 0.30468525 0.30468525 0.34577844 0.70662223
0.70662223
##  [73] 0.41287744 0.41287744 0.65686729 0.65686729 0.55068752
0.18372440
##  [79] 0.81919540 0.81919540 0.10348723 0.22793314 0.71069915
0.71069915
##  [85] 0.47451858 0.47451858 0.42837475 0.49169184 0.49169184
0.49169184
##  [91] 0.67610681 0.10055483 0.75554173 0.20533714 0.42892199
0.23889879
##  [97] 0.36409656 0.54208160 0.40467462 0.38386510 0.84445539
```

```
0.62767652
## [103] 0.26475291 0.68385871 0.31566756 0.70104863 0.59408821
0.59408821
## [109] 0.59408821 0.59408821 0.27683069 0.64800358 0.64800358
0.64800358
## [115] 0.55385455 0.55385455 0.55385455 0.24865823 0.42166855
0.42166855
## [121] 0.42166855 0.42166855 0.36041778 0.36041778 0.53961922
0.25753585
## [127] 0.76195441 0.76195441 0.13608296 0.13608296 0.61951972
0.37507200
## [133] 0.57016492 0.57016492 0.57016492 0.57016492 0.57016492
0.57016492
## [139] 0.68574564 0.21219389 0.21219389 0.64846621 0.70923829
0.34250161
## [145] 0.34250161 0.34250161 0.34250161 0.70846625 0.20894597
0.20894597
## [151] 0.61639308 0.62102733 0.26524640 0.25029009 0.24934176
0.21278664
## [157] 0.51200451 0.51200451 0.51200451 0.51200451 0.51200451
0.36753000
## [163] 0.36753000 0.36753000 0.35683600 0.58181418 0.31730554
0.31730554
## [169] 0.51592595 0.51592595 0.51592595 0.35075850 0.46910291
0.46910291
## [175] 0.46910291 0.39704851 0.39704851 0.39704851 0.45022794
0.35292838
## [181] 0.55915448 0.29595269 0.42437687 0.62339604 0.62339604
0.22370534
## [187] 0.29626179 0.29304478 0.43807037 0.43807037 0.43807037
0.43807037
## [193] 0.35284284 0.35284284 0.35284284 0.55700597 0.46437974
0.54970178
## [199] 0.54970178 0.54970178 0.40850111 0.20008510 0.20008510
0.55747356
## [205] 0.47171361 0.47171361 0.47171361 0.37226785 0.55878757
0.55878757
## [211] 0.66234960 0.66234960 0.35787042 0.35787042 0.60311719
0.60311719
## [217] 0.52824759 0.51737536 0.51737536 0.51737536 0.51737536
0.56399704
## [223] 0.37198348 0.31857054 0.47726864 0.47726864 0.47726864
0.47726864
## [229] 0.47726864 0.45867072 0.45867072 0.33082023 0.56230219
0.54666003
## [235] 0.55250687 0.33867589 0.30228074 0.46881340 0.46881340
0.32773941
## [241] 0.20981593 0.20981593 0.20981593 0.20981593 0.20981593
0.50317528
## [247] 0.50317528 0.50317528 0.62439749 0.54313404 0.31384984
```

```
0.46879590
## [253] 0.46879590 0.20311393 0.61184358 0.70466882 0.70466882
0.38513668
## [259] 0.18139477 0.31196120 0.35819011 0.35819011 0.31557656
0.42515667
## [265] 0.42515667 0.55460970 0.55460970 0.15668520 0.15668520
0.25476783
## [271] 0.31952055 0.31952055 0.31952055 0.31952055 0.19860599
0.19860599
## [277] 0.12130968 0.67175755 0.67175755 0.65779347 0.65779347
0.65779347
## [283] 0.65779347 0.52510424 0.56871239 0.56871239 0.56871239
0.36019330
## [289] 0.36019330 0.36019330 0.36019330 0.36019330 0.14367266
0.38121997
## [295] 0.38121997 0.38121997 0.46062410 0.34901149 0.34901149
0.33481175
## [301] 0.48600252 0.48600252 0.43222203 0.28980168 0.28980168
0.58977252
## [307] 0.58977252 0.21319024 0.21319024 0.21319024 0.21319024
0.49357579
## [313] 0.49357579 0.65918790 0.56753480 0.56753480 0.24279343
0.24279343
## [319] 0.24279343 0.48777078 0.48777078 0.48777078 0.34585830
0.34585830
## [325] 0.34585830 0.39572534 0.39572534 0.39572534 0.66920199
0.17468110
## [331] 0.17468110 0.52594832 0.38576997 0.58862112 0.52851935
0.34662525
## [337] 0.34662525 0.34662525 0.34662525 0.34662525 0.34662525
0.28816942
## [343] 0.28816942 0.70971595 0.20855548 0.21640745 0.38547320
0.26259433
## [349] 0.56009711 0.56785983 0.65260880 0.65260880 0.65260880
0.65260880
## [355] 0.71989794 0.71989794 0.71989794 0.23985367 0.79080822
0.79080822
## [361] 0.79080822 0.40072174 0.40072174 0.53171981 0.15966926
0.53686288
## [367] 0.67214514 0.25241293 0.61911148 0.51481907 0.64610342
0.14350952
## [373] 0.68229515 0.50949641 0.55552450 0.51530365 0.33371712
0.18814529
## [379] 0.57685082 0.57685082 0.56806122 0.56806122 0.72338298
0.68710418
## [385] 0.42655016 0.42655016 0.42655016 0.42655016 0.42655016
0.42655016
## [391] 0.42655016 0.42655016 0.25642133 0.25642133 0.47228011
0.57614149
## [397] 0.40492243 0.40492243 0.40492243 0.40492243 0.40492243
```

```
0.40492243
## [403] 0.40492243 0.40492243 0.40492243 0.52521460 0.52521460
0.52521460
## [409] 0.52521460 0.28308215 0.32725470 0.32725470 0.32725470
0.32725470
## [415] 0.32725470 0.36932154 0.36932154 0.62269620 0.62269620
0.41588251
## [421] 0.41588251 0.25600061 0.56860432 0.37848127 0.67817458
0.25447985
## [427] 0.25447985 0.25447985 0.38185023 0.50849690 0.50849690
0.43526625
## [433] 0.43526625 0.43526625 0.43526625 0.43526625 0.43526625
0.43526625
## [439] 0.51014973 0.51014973 0.51014973 0.66844305 0.61198696
0.61198696
## [445] 0.61198696 0.61198696 0.61198696 0.61198696 0.61198696
0.61198696
## [451] 0.70632558 0.60524702 0.26925178 0.25237599 0.52600266
0.68975580
## [457] 0.37759274 0.60826859 0.60826859 0.66207716 0.66207716
0.66313074
## [463] 0.66313074 0.28991382 0.28696491 0.59083557 0.59083557
0.56696958
## [469] 0.42740437 0.47115531 0.47115531 0.47115531 0.40433327
0.40433327
## [475] 0.40433327 0.49607246 0.49607246 0.49607246 0.34800071
0.60064051
## [481] 0.60064051 0.60064051 0.63132885 0.79527046 0.46238435
0.46238435
## [487] 0.46238435 0.46238435 0.46238435 0.83071991 0.15870706
0.73109890
## [493] 0.19963615 0.69745612 0.50282446 0.50282446 0.50282446
0.20387645
## [499] 0.32736158 0.51520909 0.43509129 0.43509129 0.57356095
0.57356095
## [505] 0.57356095 0.50511942 0.50511942 0.50995689 0.29187023
0.19195925
## [511] 0.56882836 0.56882836 0.55534734 0.55534734 0.50901527
0.50901527
## [517] 0.57623154 0.57623154 0.59662651 0.47097437 0.47097437
0.47097437
## [523] 0.47097437 0.48434021 0.48434021 0.55989638 0.52863236
0.52863236
## [529] 0.52863236 0.52863236 0.39634158 0.39634158 0.39634158
0.39634158
## [535] 0.39634158 0.53159448 0.51454891 0.51454891 0.65317847
0.62350311
## [541] 0.62350311 0.62350311 0.71224937 0.71224937 0.53653271
0.59055642
## [547] 0.59055642 0.63115793 0.59073355 0.34019251 0.34019251
```

```
0.34019251
## [553] 0.16203723 0.16203723 0.42590409 0.43401666 0.46860719
0.14558663
## [559] 0.33256404 0.41331491 0.41331491 0.48402883 0.48402883
0.32116372
## [565] 0.32116372 0.32116372 0.32116372 0.67710839 0.43645495
0.43645495
## [571] 0.67457968 0.67457968 0.67457968 0.45853681 0.59792122
0.59792122
## [577] 0.51249047 0.51249047 0.29142759 0.31908691 0.31908691
0.31908691
## [583] 0.31908691 0.31908691 0.44482554 0.44482554 0.44482554
0.44482554
## [589] 0.33027696 0.33027696 0.33027696 0.33027696 0.33027696
0.62964502
## [595] 0.33226991 0.33226991 0.20073766 0.70960744 0.60267009
0.60267009
## [601] 0.60267009 0.20743416 0.20743416 0.28177821 0.28177821
0.28177821
## [607] 0.63767927 0.63767927 0.71344794 0.71344794 0.47411033
0.47411033
## [613] 0.47411033 0.19756830 0.67507351 0.63597940 0.63597940
0.63597940
## [619] 0.14172916 0.32455498 0.72952928 0.72952928 0.40081951
0.40081951
## [625] 0.40081951 0.38685268 0.47531684 0.47531684 0.47531684
0.47531684
## [631] 0.47531684 0.40969001 0.40969001 0.23971315 0.23971315
0.74788907
## [637] 0.52723801 0.54523241 0.54523241 0.54523241 0.20665534
0.61809947
## [643] 0.61809947 0.61809947 0.61809947 0.26886389 0.26886389
0.26886389
## [649] 0.26886389 0.61189821 0.15619265 0.15619265 0.79626486
0.14025528
## [655] 0.14025528 0.68605366 0.48527091 0.48527091 0.38850959
0.57908189
## [661] 0.33852548 0.33852548 0.36671981 0.55137513 0.55137513
0.57548928
## [667] 0.57548928 0.16947337 0.16947337 0.16947337 0.50459881
0.39886236
## [673] 0.46798149 0.46798149 0.46798149 0.46798149 0.46798149
0.46798149
## [679] 0.33559314 0.33559314 0.33559314 0.33559314 0.33559314
0.33559314
## [685] 0.33559314 0.24744798 0.24744798 0.24744798 0.60548973
0.45997408
## [691] 0.40605274 0.40605274 0.40605274 0.25607672 0.35334271
0.35334271
## [697] 0.35334271 0.27395018 0.27395018 0.27395018 0.27395018
```

```
0.27395018
## [703] 0.29087915 0.29087915 0.29087915 0.19528660 0.48508689
0.30844837
## [709] 0.30844837 0.30844837 0.30844837 0.30844837 0.35920949
0.35920949
## [715] 0.35920949 0.43946940 0.54845303 0.54845303 0.54845303
0.54845303
## [721] 0.68630661 0.42329036 0.40886086 0.38067460 0.49935075
0.49935075
## [727] 0.63855268 0.35504594 0.45728090 0.45728090 0.45728090
0.45728090
## [733] 0.45728090 0.34570691 0.34570691 0.34570691 0.59915623
0.59915623
## [739] 0.59915623 0.61209378 0.66958087 0.56110828 0.56110828
0.56110828
## [745] 0.56110828 0.49556590 0.49556590 0.20155131 0.20155131
0.20155131
## [751] 0.42711751 0.42711751 0.26971223 0.37310747 0.37310747
0.41364035
## [757] 0.41364035 0.46638170 0.35616215 0.73882900 0.41915737
0.41915737
## [763] 0.36875076 0.27013462 0.41199056 0.41199056 0.36802821
0.36802821
## [769] 0.36802821 0.36802821 0.36802821 0.75964322 0.75964322
0.65591268
## [775] 0.54702730 0.54702730 0.54702730 0.54702730 0.50320362
0.50320362
## [781] 0.50320362 0.43029851 0.43029851 0.43029851 0.43029851
0.46277619
## [787] 0.74247033 0.63996068 0.25328674 0.61648578 0.18981934
0.37421009
## [793] 0.37421009 0.37421009 0.37421009 0.37421009 0.44353860
0.34649406
## [799] 0.07695401 0.07695401 0.85754364 0.19510606 0.42484527
0.42484527
## [805] 0.49141039 0.52324242 0.17475897 0.17475897 0.17475897
0.25257527
## [811] 0.40424292 0.60029145 0.51283519 0.51283519 0.51283519
0.48729631
## [817] 0.13686869 0.75242010 0.57725113 0.57725113 0.20992018
0.46161818
## [823] 0.46161818 0.46161818 0.42047604 0.38324561 0.56358937
0.56358937
## [829] 0.55745265 0.54129221 0.22853817 0.52751144 0.62516580
0.53510846
## [835] 0.53510846 0.53510846 0.49435215 0.37242428 0.37242428
0.18674872
## [841] 0.85130365 0.40146056 0.27435543 0.27435543 0.27435543
0.22096346
## [847] 0.31161870 0.31161870 0.31161870 0.34781361
```

```r
amostra <- as.mcmc(theta)
amostra1 <- mcmc(theta)
summary(amostra1)
```

```
##
## Iterations = 1:850
## Thinning interval = 1
## Number of chains = 1
## Sample size per chain = 850
##
## 1. Empirical mean and standard deviation for each variable,
##    plus standard error of the mean:
##
##           Mean             SD       Naive SE Time-series SE
##       0.447684       0.153891       0.005278       0.006977
##
## 2. Quantiles for each variable:
##
##   2.5%    25%    50%    75%  97.5%
## 0.1620 0.3385 0.4573 0.5582 0.7371
```

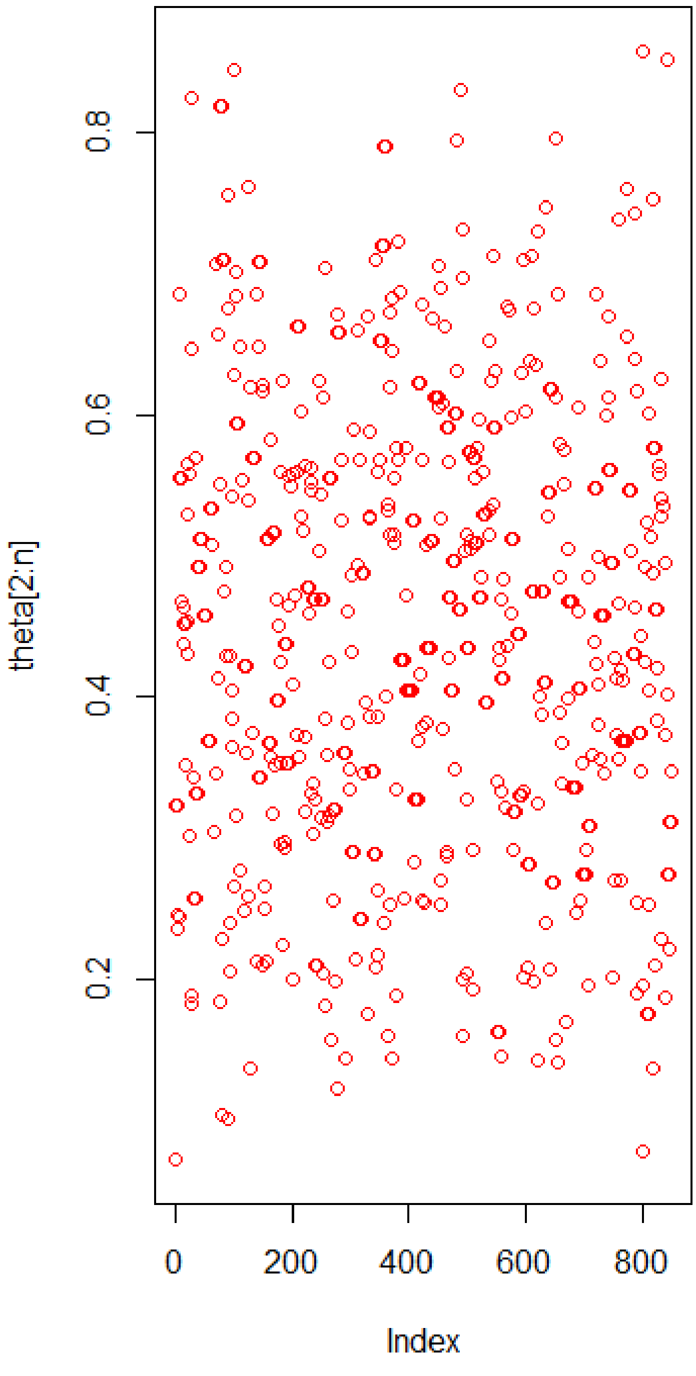
```r
HPDinterval(amostra,0.9)
```

```
##          lower     upper
## var1 0.1898193 0.6871042
## attr(,"Probability")
## [1] 0.9
```

```r
IC90 = quantile(theta,c(0.05,0.95))
IC90
```

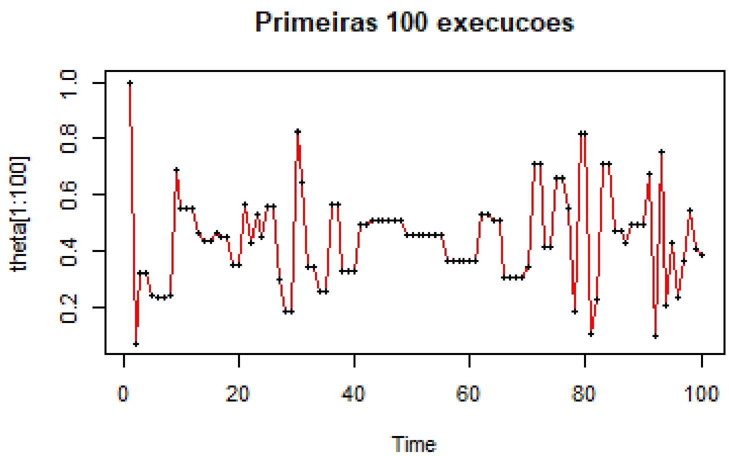
```
##        5%       95%
## 0.1986060 0.7046688
```

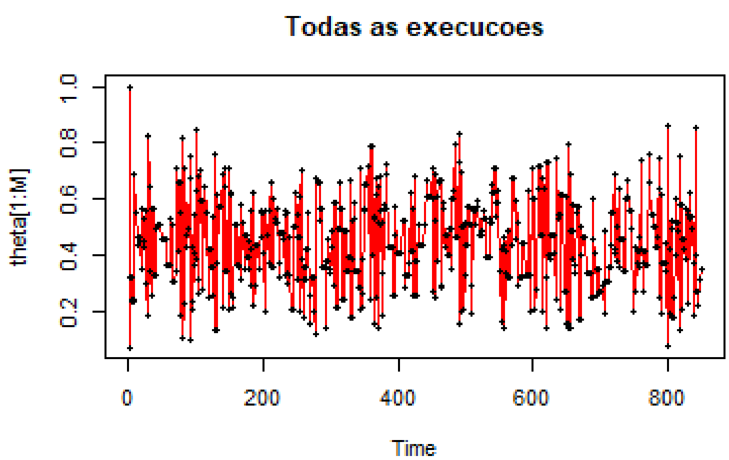
```r
#### Graficos

plot(theta[2:n],col="red")
```



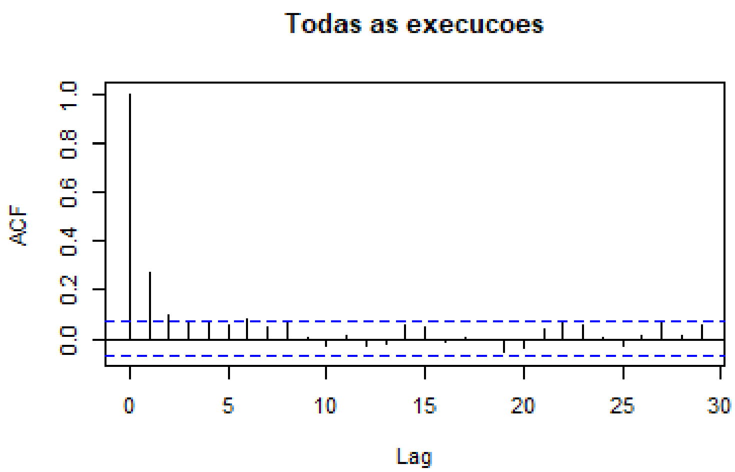

```
par(mfrow=c(3,1))
ts.plot(theta[1:100],main="Primeiras 100 execucoes",col="red")
points(1:100,theta[1:100],col="black",pch=19,cex=0.7)
ts.plot(theta[1:M],main="Todas as execucoes",col="red")
```

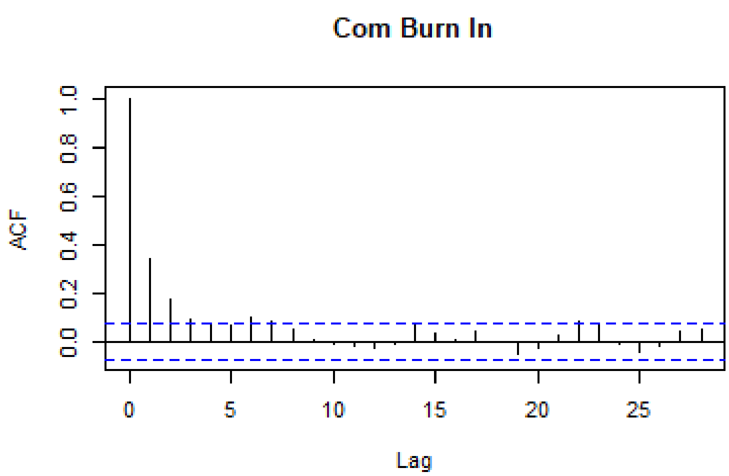
```r
points(1:M,theta[1:M],col="black",pch=19,cex=0.7)

par(mfrow=c(3,1))
```

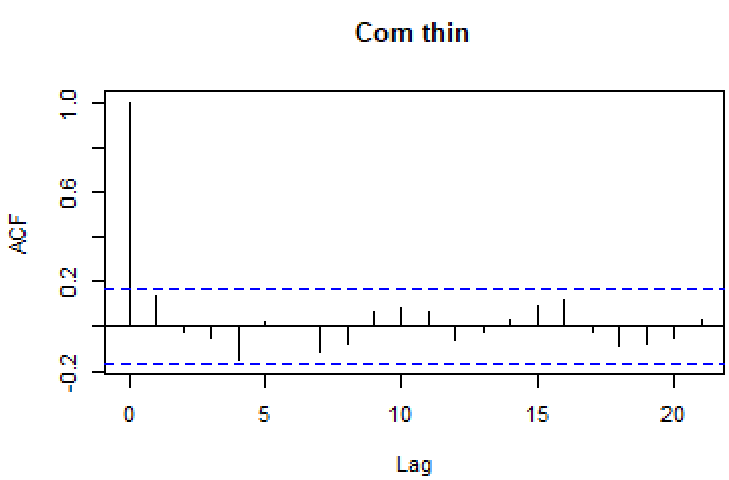




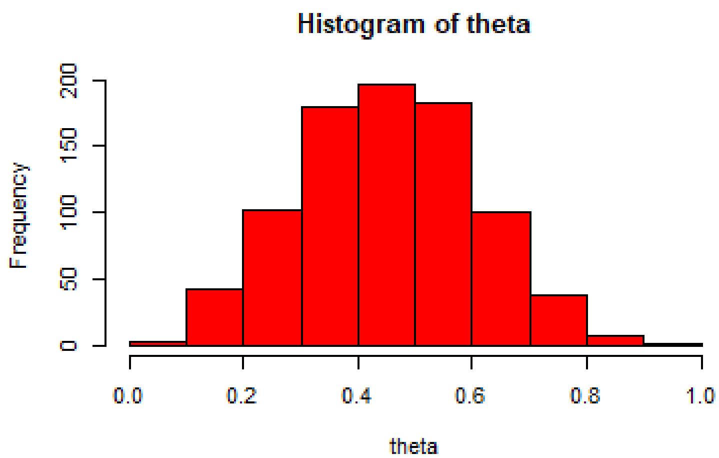
```r
acf(theta,main="Todas as execucoes")
acf(theta[burn_in:M],main="Com Burn In")
acf(theta[seq(1,M,thin)],main="Com thin")
```







```r
hist(theta,col = "red")

##### Perdas

# Considerando-se a funcao de perda quadratica o estimador bayesiano será
a média da distribuicao a posteriori, ou seja

mean(theta)

## [1] 0.4476841

# Considerando-se a funcao de perda modular o estimado rbayesiano sera a
mediana da distribuicao a posteriori, ou seja

median(theta)

## [1] 0.4572809
```



Histogram of theta
Frequency
0
50
100
150
200
0.0
0.2
0.4
0.6
0.8
1.0
theta