Lab03

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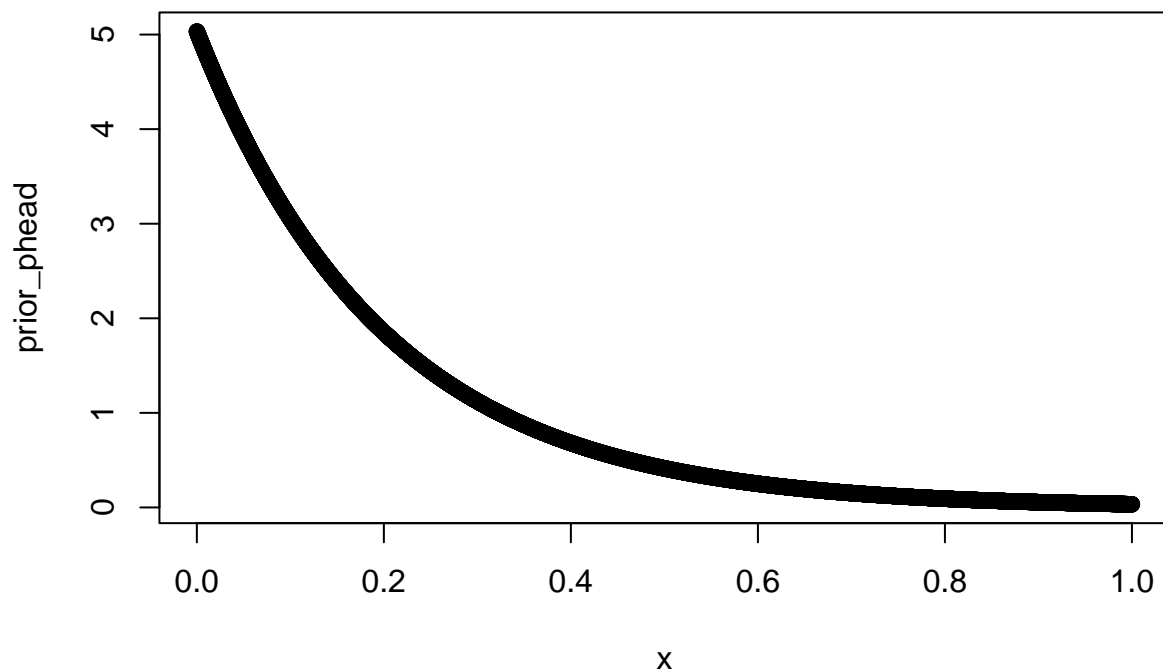
Part-1A

```r
rm(list = ls())
x = seq(0,1, 0.0001)

prior_phead = vector()

for (i in 1:length(x)) {
  if (x[i]>=0 && x[i]<=1){
    prior_phead[i] = dexp(x[i], rate = 5)/0.9932621
  }
  else{
    prior_phead[i] = 0
  }
}

plot(x, prior_phead)
```

Problem-1B: Metropolis

```r
#-------------------------------------------------------------------------
#                    The Metropolis algorithm
#-------------------------------------------------------------------------
rm(list = ls())
piOld = 0.5

nIter = 1000
postDistMetro = vector(length = nIter)

for (i in 1:nIter) {

  pOld = (dexp(piOld, rate=5)/0.9932621) * dbinom(14,24, piOld)

  piNew = piOld + rnorm(1,0,sd=0.01)

  if (piNew > 1) {piNew=1}
  else if (piNew <0) {piNew=0}

  pNew = (dexp(piNew, rate=5)/0.9932621) * dbinom(14,24, piNew)

  ratio = pNew/pOld

  if (ratio >1 || ratio >= runif(1)){
```

```r
    piOld = piNew
  }

  postDistMetro[i] = piOld
}

myHist = hist(postDistMetro, breaks =200, plot=FALSE)
plot(myHist$mids, myHist$counts/nIter, col='darkblue')
dexpsum = sum(dexp(myHist$mids, rate=5)/0.9932621)
lines(myHist$mids, (dexp(myHist$mids, rate=5)/0.9932621)/dexpsum, col='blue')

#--------------------------------------------------------------------
#                 Compare Metropolis with prior beta(40,40)
#--------------------------------------------------------------------

piOld = 0.5

nIter = 1000
postDistMetro = vector(length = nIter)

for (i in 1:nIter) {

  pOld = dbeta(piOld, 40, 40) * dbinom(14,24, piOld)

  piNew = piOld + rnorm(1,0,sd=0.01)

  if (piNew > 1) {piNew=1}
  else if (piNew <0) {piNew=0}

  pNew = dbeta(piNew, 40, 40) * dbinom(14,24, piNew)

  ratio = pNew/pOld

  if (ratio >1 || ratio >= runif(1)){
    piOld = piNew
  }

  postDistMetro[i] = piOld
}

myHist = hist(postDistMetro, breaks =200, plot=FALSE)
par(new=TRUE)
# plot(myHist$mids, myHist$counts/nIter, col='lightgreen')
dexpsum = sum(dbeta(myHist$mids, 40+14, 40+10))
lines(myHist$mids, dbeta(myHist$mids, 40+14, 40+10)/dexpsum, col='green')
```
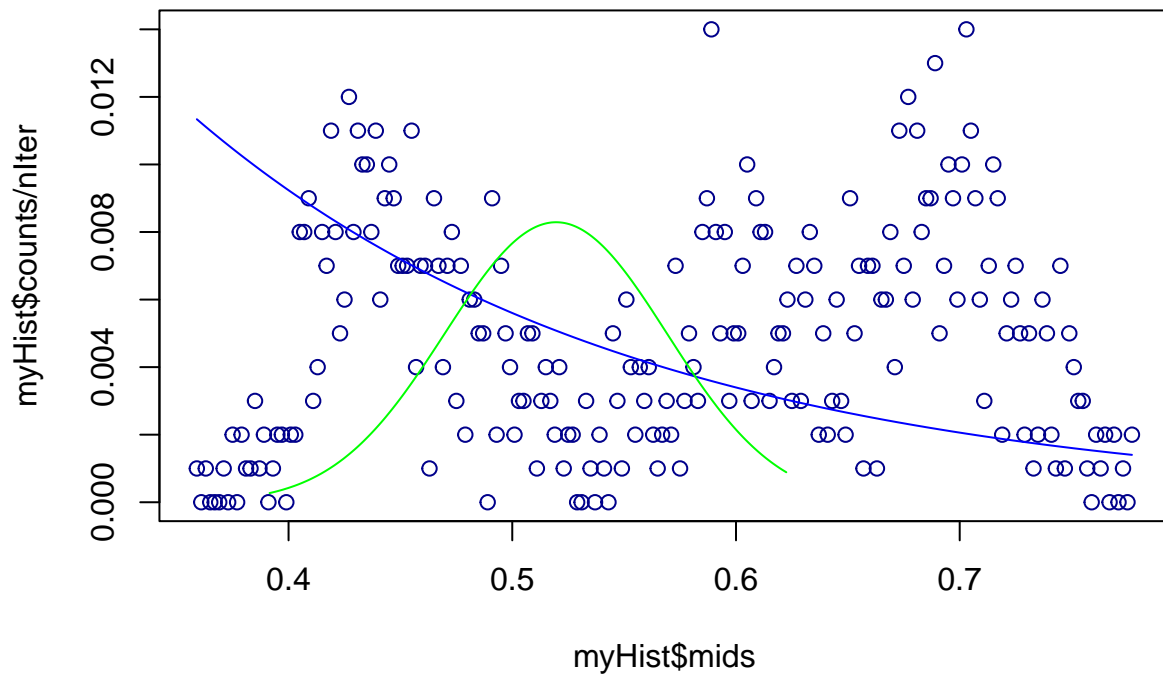
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Problem-1B: Grid

```
#----------------------------------------------------------------
#                    Grid approximation
#----------------------------------------------------------------
rm(list = ls())
numBreaks = 1000
postDistGrid = vector(length = numBreaks)
xVals = seq(0,1, 1/numBreaks)

i = 1
sum = 0
for (x in xVals) {

  postDistGrid[i] = (dexp(x, rate=5)/0.9932621) * dbinom(14, 24,x)
  sum = sum + postDistGrid[i]
  i = i+1

}

plot(postDistGrid / sum, col='darkorange')
lines((dexp(xVals, rate=5)/0.9932621)/sum(dexp(xVals, rate=5)/0.9932621), col='orange')

#----------------------------------------------------------------
#                    Compare Grid with prior beta(40,40)
```

```
#-----------------------------------------------------------------------

numBreaks = 1000
postDistGrid = vector(length = numBreaks)
xVals = seq(0,1, 1/numBreaks)

i = 1
sum = 0
for (x in xVals) {

  postDistGrid[i] = dbeta(x, 40, 40) * dbinom(14, 24,x)
  sum = sum + postDistGrid[i]
  i = i+1

}

par(new=TRUE)
plot(postDistGrid / sum, col='darkred')
lines(dbeta(xVals, 40+14, 40+10)/sum(dbeta(xVals, 40+14, 40+10)), col='red')
```
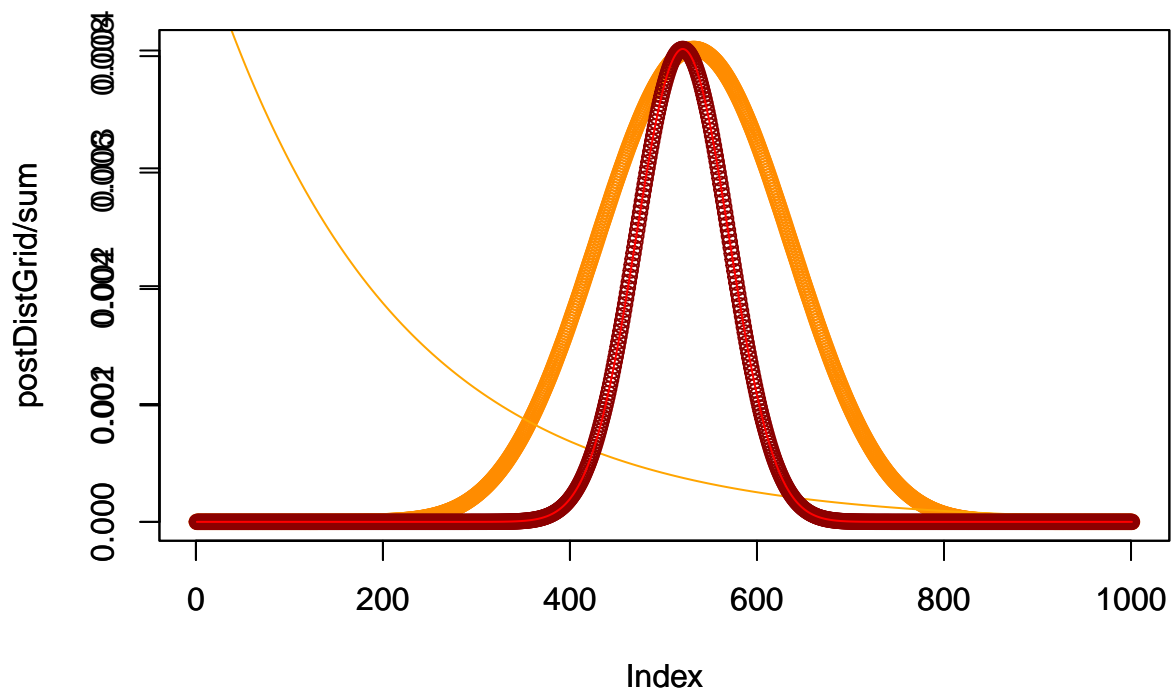

Problem 1C: Matropolis

```
#-----------------------------------------------------------------------
#                    The Metropolis algorithm
#-----------------------------------------------------------------------
```

```r
rm(list = ls())
piOld = 0.5

nIter = 100000
postDistMetro = vector(length = nIter)

for (i in 1:nIter) {

  pOld = (dexp(piOld, rate=5)/0.9932621) * dbinom(583,1000, piOld)

  piNew = piOld + rnorm(1,0,sd=0.0001)

  if (piNew > 1) {piNew=1}
  else if (piNew <0) {piNew=0}

  pNew = (dexp(piNew, rate=5)/0.9932621) * dbinom(583,1000, piNew)

  ratio = pNew/pOld

  if (ratio >1 || ratio >= runif(1)){
    piOld = piNew
  }

  postDistMetro[i] = piOld
}

myHist = hist(postDistMetro, breaks =200, plot=FALSE)
plot(myHist$mids, myHist$counts/nIter, col='darkblue')
dexpsum = sum(dexp(myHist$mids, rate=5)/0.9932621)
lines(myHist$mids, (dexp(myHist$mids, rate=5)/0.9932621)/dexpsum, col='blue')

#-------------------------------------------------------------------------
#                   Compare Metropolis with prior beta(40,40)
#-------------------------------------------------------------------------

piOld = 0.5

nIter = 100000
postDistMetro = vector(length = nIter)

for (i in 1:nIter) {

  pOld = dbeta(piOld, 40, 40) * dbinom(583,1000, piOld)

  piNew = piOld + rnorm(1,0,sd=0.0001)

  if (piNew > 1) {piNew=1}
  else if (piNew <0) {piNew=0}

  pNew = dbeta(piNew, 40, 40) * dbinom(583,1000, piNew)

  ratio = pNew/pOld
```
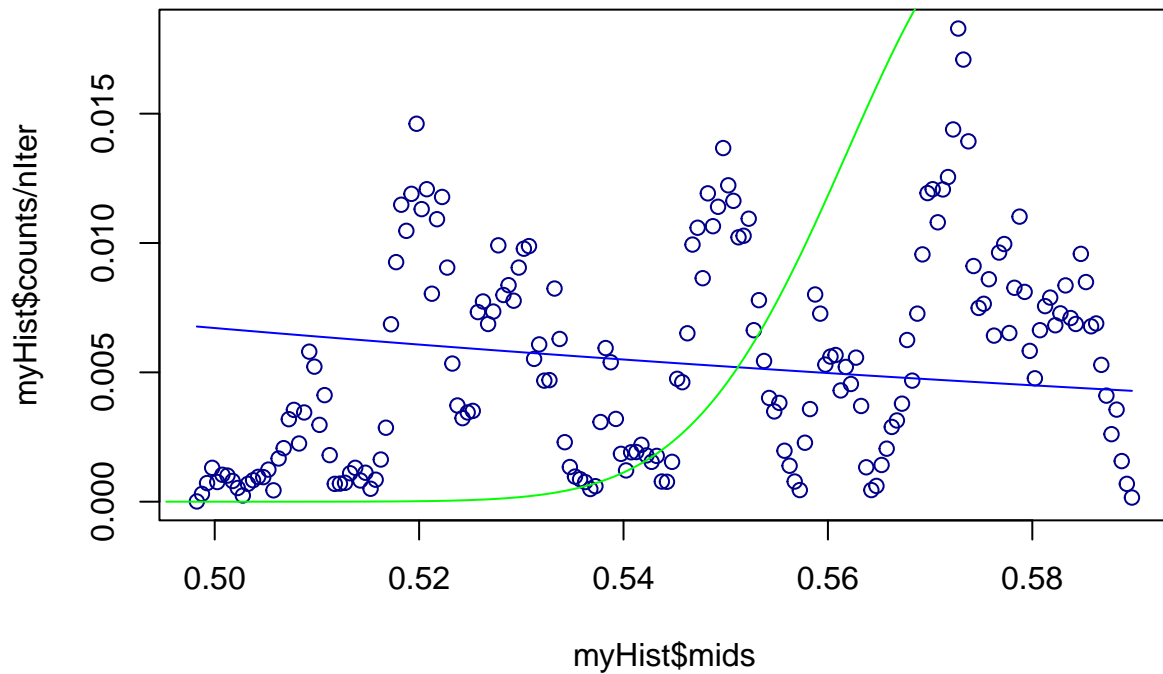
```
  if (ratio >1 || ratio >= runif(1)){
    piOld = piNew
  }

  postDistMetro[i] = piOld
}

myHist = hist(postDistMetro, breaks =200, plot=FALSE)
par(new=TRUE)
# plot(myHist$mids, myHist$counts/nIter, col='lightgreen')
dexpsum = sum(dbeta(myHist$mids, 40+583, 40+417))
lines(myHist$mids, dbeta(myHist$mids, 40+583, 40+417)/dexpsum, col='green')
```


Problem 1C: Grid

```
#------------------------------------------------------------------------
#                       Grid approximation
#------------------------------------------------------------------------
rm(list = ls())
numBreaks = 100000
postDistGrid = vector(length = numBreaks)
xVals = seq(0,1, 1/numBreaks)

i = 1
sum = 0
```

```r
for (x in xVals) {

  postDistGrid[i] = (dexp(x, rate=5)/0.9932621) * dbinom(583, 1000,x)
  sum = sum + postDistGrid[i]
  i = i+1

}

plot(postDistGrid / sum, col='darkorange')
lines((dexp(xVals, rate=5)/0.9932621)/sum(dexp(xVals, rate=5)/0.9932621), col='orange')

#------------------------------------------------------------------------
#                    Compare Grid with prior beta(40,40)
#------------------------------------------------------------------------

numBreaks = 100000
postDistGrid = vector(length = numBreaks)
xVals = seq(0,1, 1/numBreaks)

i = 1
sum = 0
for (x in xVals) {

  postDistGrid[i] = dbeta(x, 40, 40) * dbinom(583, 1000,x)
  sum = sum + postDistGrid[i]
  i = i+1

}

par(new=TRUE)
plot(postDistGrid / sum, col='darkred')
lines(dbeta(xVals, 40+583, 40+417)/sum(dbeta(xVals, 40+583, 40+417)), col='red')
```