Stochastic gradient decent

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```
library(readr)
```

```
## Warning: package 'readr' was built under R version 3.4.1
```

```
data <- read_csv("~/GitHub/SDS385-course-work/Excercise 2/stochastic gradient decent/wdbc.csv",col_name
```

```
## Parsed with column specification:
## cols(
##   .default = col_double(),
##   X1 = col_integer(),
##   X2 = col_character()
## )
```

```
## See spec(...) for full column specifications.
```

```
source('~/GitHub/SDS385-course-work/Excercise 2/stochastic gradient decent/gradient decent functions.R'
```

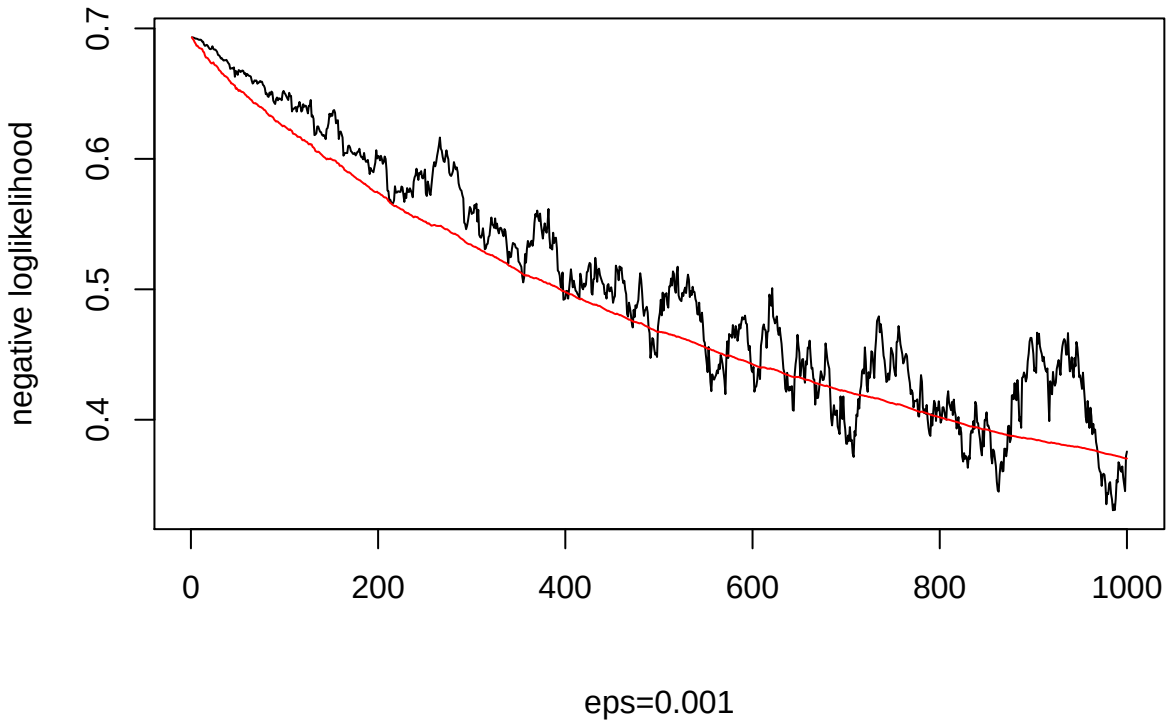
```
X=as.matrix(data[3:12])
X=scale(X)
X=cbind(X,1)
y=as.vector(matrix(nrow=nrow(data),ncol=1))
for(i in 1:nrow(data)){
  if(data[i,2]=="M")y[i]=1
  else y[i]=0
}
beta0=as.vector(matrix(0,nrow=11))

trainX=X[1:250,]
trainy=y[1:250]
testX=X[251:569,]
testy=y[251:569]
```

```
ite=1000
alpha=0.05
```

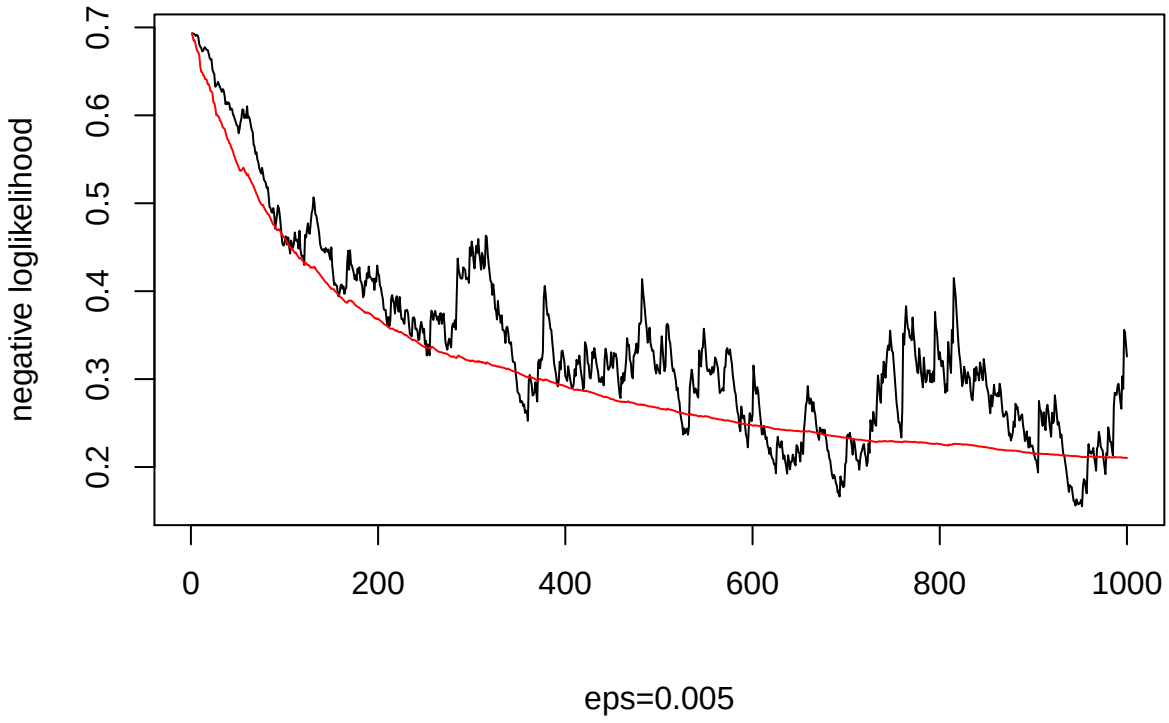
we use moving average with exponential decay to compute "averagenegloglikelihood": averageX(t)=X(t)*alpha+averageX(t-1)*(1-alpha)

black line is the moving average of loglikelihood computed using exponential decay:averageX(t)=X(t)*alpha+averageX(t-1)*(1-alpha), red is the negative loglikelihood per data point on the test data

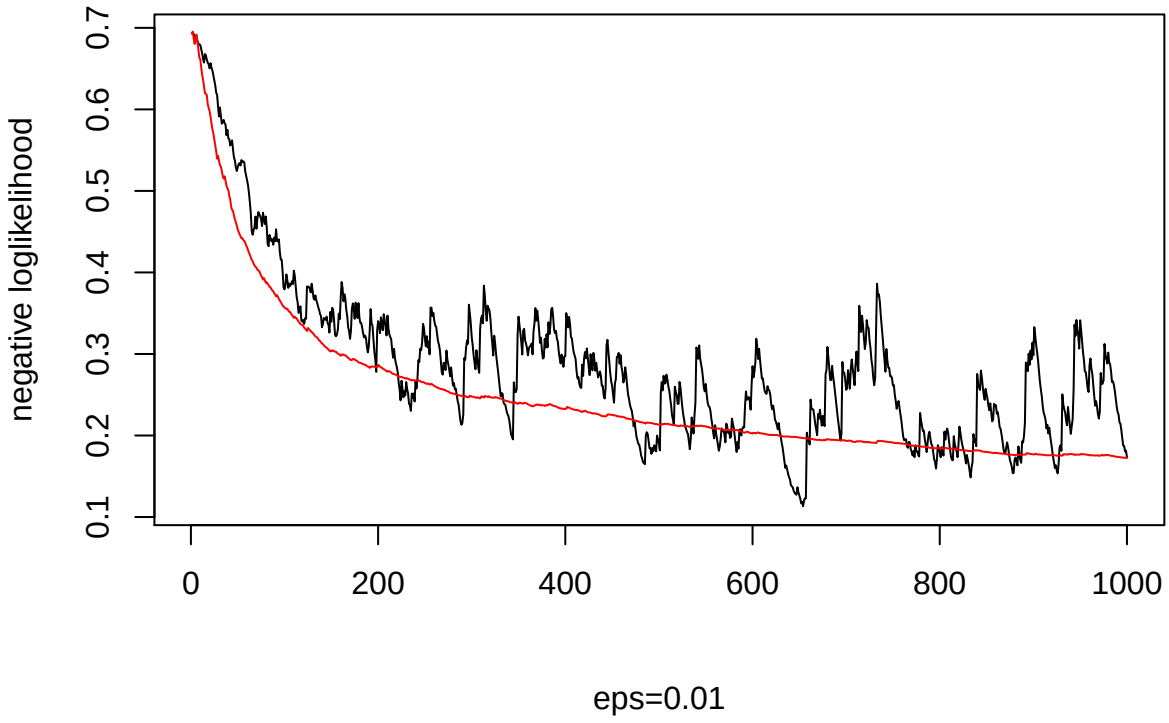
```
eps=0.001
result=stochasticgradientdecent(trainX,trainy,testX,testy,beta0,eps,ite,alpha)
plot(result$averagenegloglikelihood,type='l',xlab='',ylab='negative loglikelihood',sub='eps=0.001')
lines(result$testnegloglikelihoood,col='red')
```



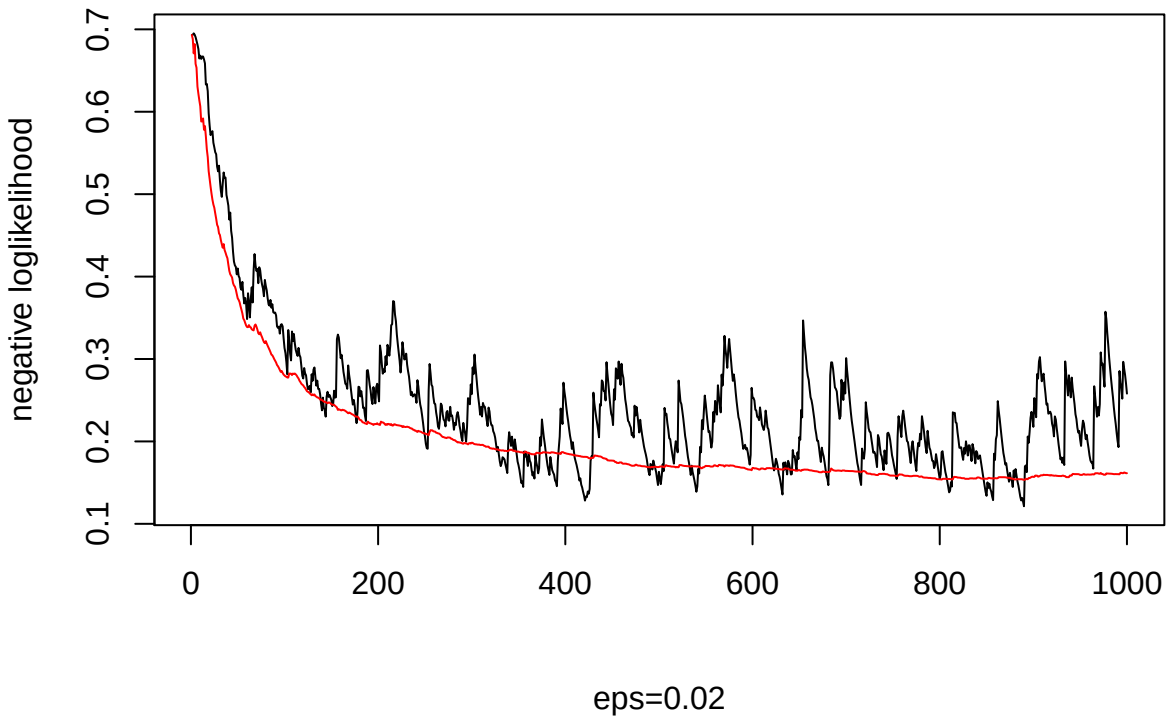

```
eps=0.005
result=stochasticgradientdecent(trainX,trainy,testX,testy,beta0,eps,ite,alpha)
plot(result$averagenegloglikelihood,type='l',xlab='',ylab='negative loglikelihood',sub='eps=0.005')
lines(result$testnegloglikelihoood,col='red')
```




```
eps=0.01
result=stochasticgradientdecent(trainX,trainy,testX,testy,beta0,eps,ite,alpha)
plot(result$averagenegloglikelihood,type='l',xlab='',ylab='negative loglikelihood',sub='eps=0.01')
lines(result$testnegloglikelihoood,col='red')
```



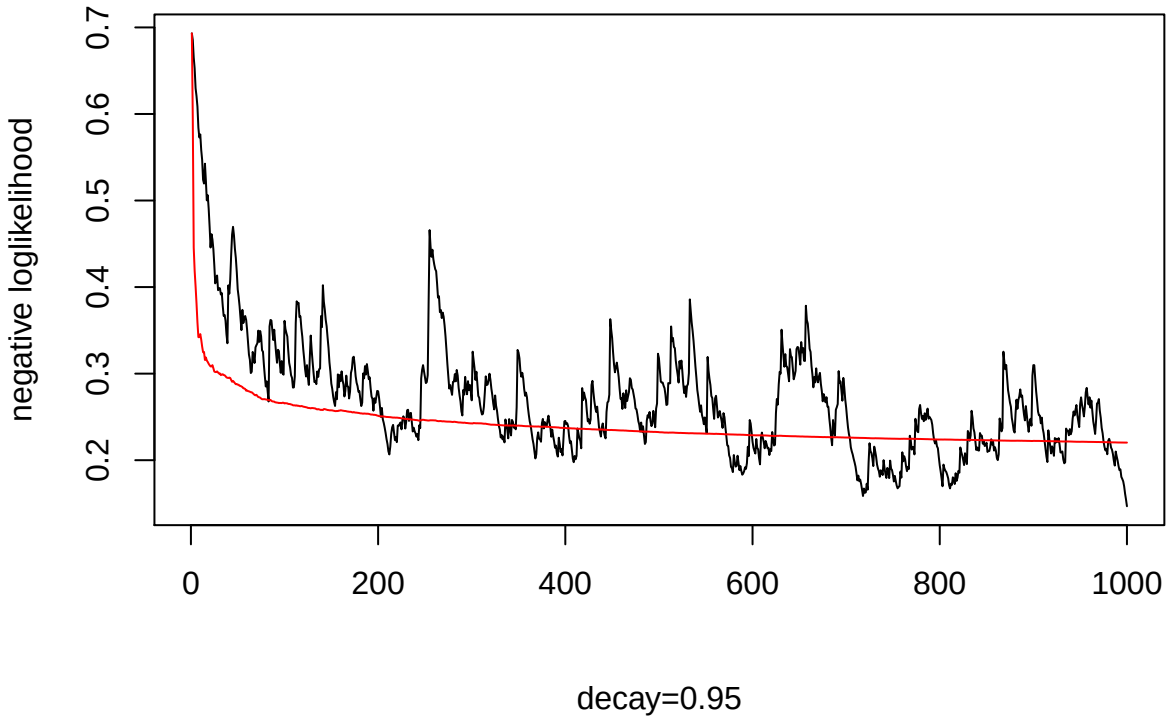

```
eps=0.02
result=stochasticgradientdecent(trainX,trainy,testX,testy,beta0,eps,ite,alpha)
plot(result$averagenegloglikelihood,type='l',xlab='',ylab='negative loglikelihood',sub='eps=0.02')
lines(result$testnegloglikelihoood,col='red')
```



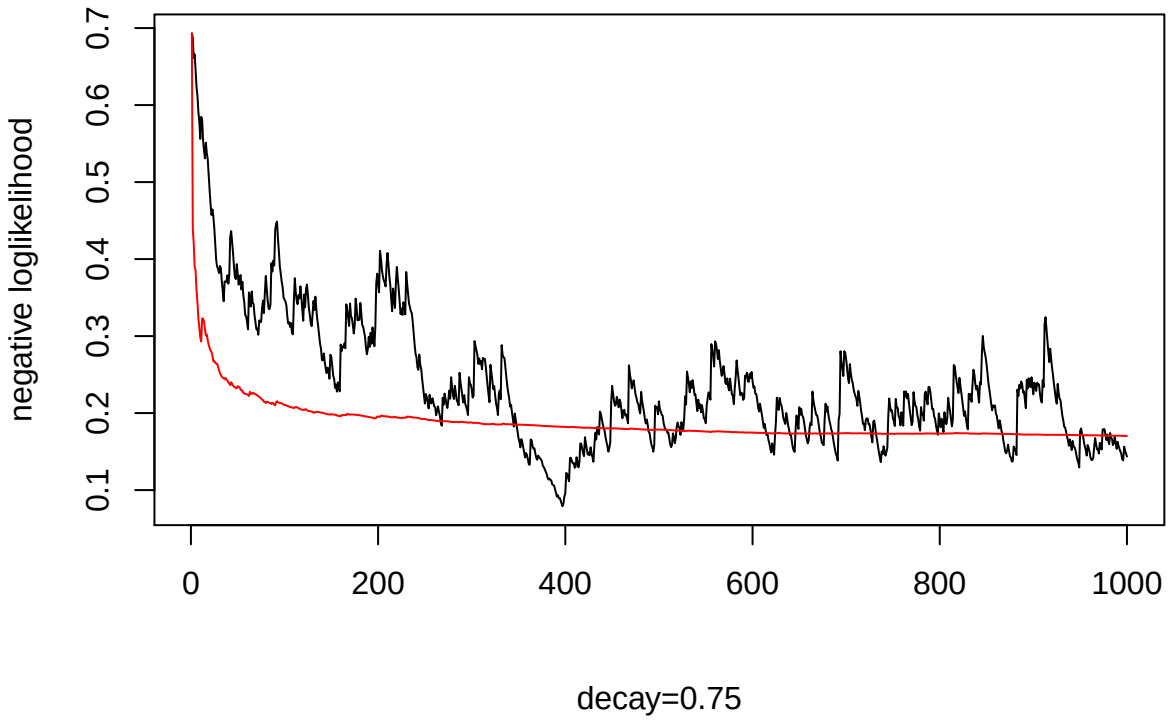
varying steps, we use the Robbins-Monro rule where (step size at t)=C/(t+t0)^decay

```
t0=1
C=0.5
```

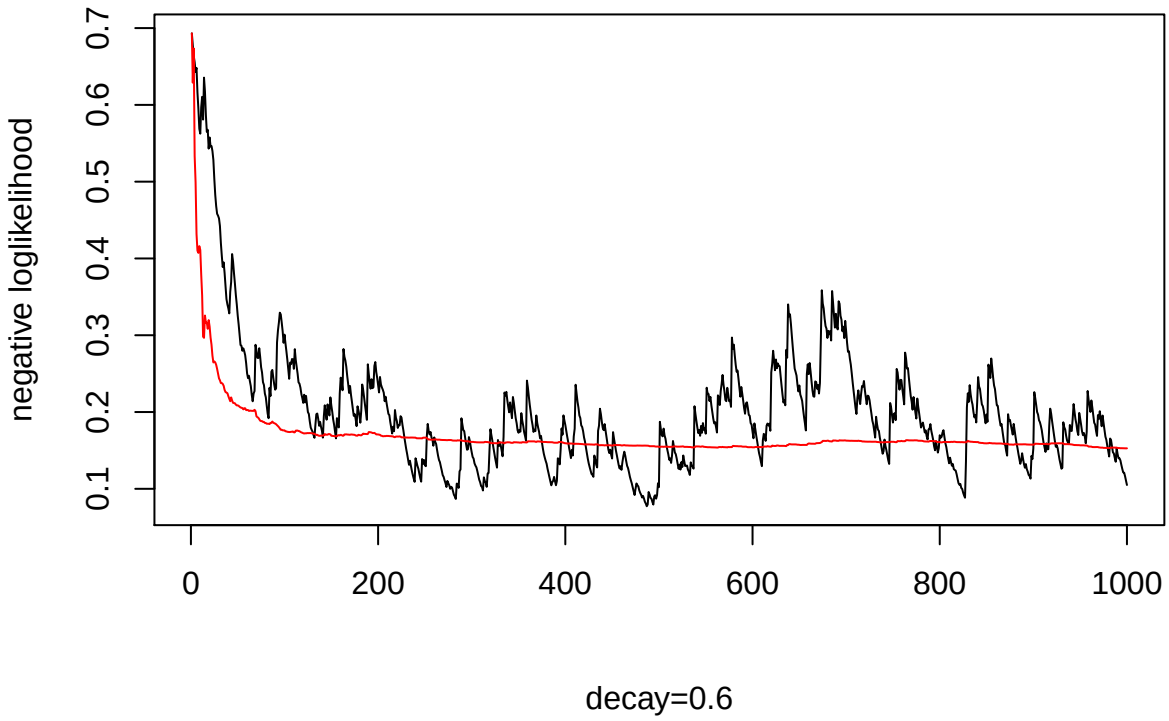
```
decay=0.95
result=varyingstepsgradientdecent(trainX,trainy,testX,testy,beta0,ite,alpha,decay,t0,C)
plot(result$averagenegloglikelihood,type='l',ylab='negative loglikelihood',xlab='',sub='decay=0.95')
lines(result$testnegloglikelihoood,col='red')
```




```
decay=0.75
result=varyingstepsgradientdecent(trainX,trainy,testX,testy,beta0,ite,alpha,decay,t0,C)
plot(result$averagenegloglikelihood,type='l',ylab='negative loglikelihood',xlab='',sub='decay=0.75')
lines(result$testnegloglikelihoood,col='red')
```




```
decay=0.6
result=varyingstepsgradientdecent(trainX,trainy,testX,testy,beta0,ite,alpha,decay,t0,C)
plot(result$averagenegloglikelihood,type='l',ylab='negative loglikelihood',xlab='',sub='decay=0.6')
lines(result$testnegloglikelihoood,col='red')
```


negative loglikelihood
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
200
400
600
800
1000
decay=0.6