Date / /

Bayesian Computing

Name :- Preksha A. Patel
Sapid :- 60004210126
Branch :- Computer Engineering
Div :- C2

Experiment no. 8

Aim :- To implement a model for analysis of the stanford Heart transplant data.

Theory :-
In Bayesian Computing, the Pareto model, Laplace fit & metropolis, random walk are concepts that relate to statistical modeling, inference and sampling.

Pareto Model :
The Pareto distribution, also known as 80/20 rule, is often used in Bayesian computing to model phenomena where a small number of factors contribute to the majority of the observed effects. It is characterized by a power-low probability distribution, indicating that a few variables have a high impact, while many others have a minimal effect. In Bayesian modeling, Pareto distribution might be used as a prior to capture the idea that a small subset of parameters is crucial in explaining the observed data. It is particularly useful when dealing with sparse ~~or~~ as heavy - tailed distributions where conditional models may not be appropriate.

Laplace fit :
Laplace approximation is a technique used in Bayesian Computing to approximate a probability distribution with a simpler, max tractable distribution, often a Gaussian (normal) distribution. It is based on the idea of fitting a Gaussian distribution to the posterior distribution of the mode (peak), providing a convenient way to approximate the uncertainty around the mode.

Page No.
Date

Metropolis Random Walk :-

This is a MCMC method used in Bayesian computing for Sampling from complex probability distributions. In Metropolis Random walk, a chain of samples is generated where each sample is obtained by making a random move from previous sample and the move is accepted or rejected based on a certain criteria.

Conclusion :-

In this experiment, we applied Bayesian methods to the stanford heart transplant data using Pareto distribution model. The LearnBayes library in R was utilized for this purpose. The model paramaters were estimated and posterior distributions were plotted.

SAP ID.: 60004210126 Name: Preksha Ashok Patel

Batch: C2-1

Subject: Bayesian Computing Laboratory Semester: VII

Experiment No. 9

Aim:

Implement a model for Analysis of the Stanford Heart Transplant Data.

Code:

Importing libraries:

```
Library(LearnBayes)
```

Using a Pareto model for analyzing Stanford Heart Transplant data:

Laplace fit:

```
start <- c(0, 3, -1) laplacefit <-

laplace(transplantpost,

                  start, stanfordheart)
laplacefit
```

Random walk metropolis:

```
proposal <- list(var=laplacefit$var, scale=2)

s <- rwmetrop(transplantpost,

           proposal,              start,

10000, stanfordheart) s$accept



par(mfrow=c(2,2))
```

```
tau <- exp(s$par[,1]) plot(density(tau),
main="TAU") lambda <- exp(s$par[,2])
plot(density(lambda),
main="LAMBDA") p <- exp(s$par[,3])
plot(density(p), main="P")

apply(exp(s$par), 2, quantile, c(.05, .5, .95))

par(mfrow=c(1,
1)) t <- seq(1, 240)
p5 <- 0*t p50 <- 0
* t p95 <- 0 * t for
(j in 1:240){
  S <- (lambda / (lambda + t[j])) ^
p    q <- quantile(S, c(.05, .5, .95))
p5[j] <- q[1]    p50[j] <- q[2]
p95[j] <- q[3]
}
```

Estimating a patient's survival curve:

```
plot(t, p50, type="l",
    ylim=c(0,1),
```

```
    ylab="Prob(Survival)",
    xlab="time")
lines(t, p5, lty=2)
lines(t, p95, lty=2)
```

Output:

Using a Pareto model for analyzing Stanford Heart Transplant data:

Laplace fit:

```
$mode
[1] -0.09210954  3.38385249 -0.72334008

$var
             [,1]         [,2]        [,3]
[1,]  0.172788525 -0.009282308 -0.04995160
[2,] -0.009282308  0.214737054  0.09301323
[3,] -0.049951602  0.093013230  0.06891796

$int
[1] -376.2504

$converge
[1] TRUE
```

Random walk metropolis:

```
[1] 0.193
```

```
         [,1]     [,2]      [,3]
5%  0.4923842 12.81158 0.3063081
50% 0.9672965 28.82477 0.4648687
95% 2.0249481 63.96780 0.7425854
```

Estimating a patient's survival curve: