Gorilla Faceshape (Male vs. Female) Bayesian Procrusts:

Debashis Chatterjee

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Load the Landmark Data of Gorilla

```
#install.packages("githubinstall")
#require(githubinstall)
#githubinstall("BPviGM1")

#install.packages("devtools")
#require(devtools)
#install_github("debashischatterjee111/BPviGM1")
```

```
require(shapes)
```

```
## Loading required package: shapes
```

```
require(Morpho)
```

```
## Loading required package: Morpho
```

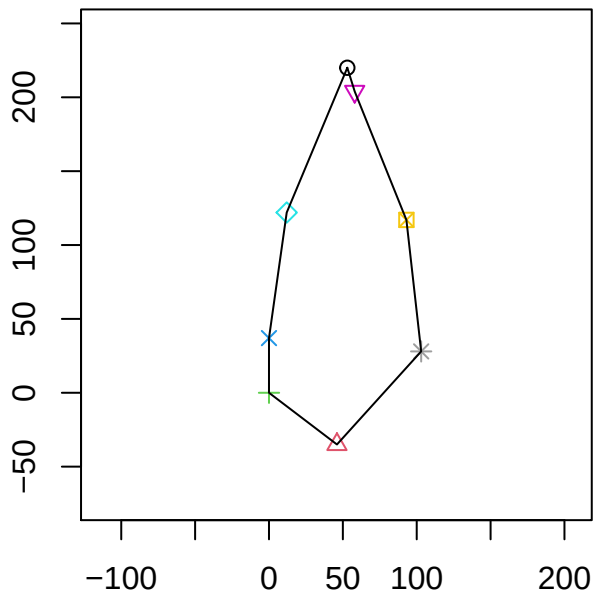
```
require(BPviGM1)
```

```
## Loading required package: BPviGM1
```

```
data(gorf.dat)
data(gorm.dat)
```

```
ogf=gf=gorf.dat
ogm=gm=gorm.dat
```

```
plotshapes(gm[,,1],joinline=c(1,6,7,8,2,3,4,5,1), col=1:8, symbol=1:8)
```




```
#polygon(gm[,1,1],gm[,2,1])
```

Check for proper dimension of 3D array

```
dim(ogm)
```

```
## [1]  8  2 29
```

Sort according to Landmark order

```
sortcoldat=function(dat,seq)
{dat[,,]=dat[seq,,]
  return(dat)
}
```

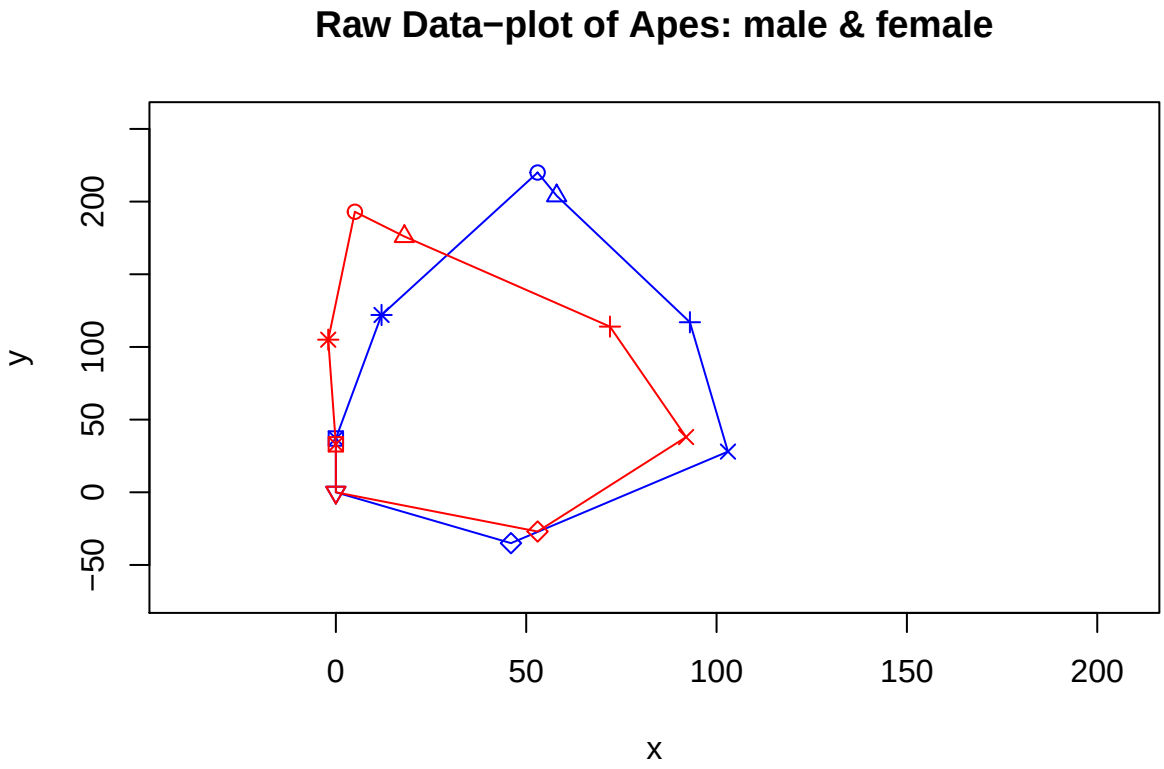
```
o.gf=ogf=sortcoldat(ogf,c(1,6,7,8,2,3,4,5))
o.gm=ogm=sortcoldat(ogm,c(1,6,7,8,2,3,4,5))
```

Keep the data in Pre-shape space

```
for(k in 1:dim(ogf)[3])
{
  o.gf[,,k] <- rotonto(ogf[,,1],ogf[,,k],scale=T)$yrot
```

```
}

for(k in 1:dim(ogm)[3])
{
  o.gm[,,k] <- rotonto(ogm[,,1],ogm[,,k],scale=T)$yrot
}
```

```
plot(c(min(o.gm[,1,])-30, 100+max(o.gm[,1,])), c(min(o.gm[,2,])-30, max(o.gm[,2,])+30), type = "n", mai
#plotshapes(gm[,,1],joinline=c(1,6,7,8,2,3,4,5,1), col=1:8, symbol=1:8)

polygon(o.gm[,1,1],o.gm[,2,1],density=0, col="skyblue", border="blue")
points(o.gm[,1,1],o.gm[,2,1], col="blue",pch=1:8)
polygon(o.gf[,1,1],o.gf[,2,1],density=0, col="pink", border="red")
points(o.gf[,1,1],o.gf[,2,1], col="red",pch=1:8)
```



Load the novel R package BPviGM1

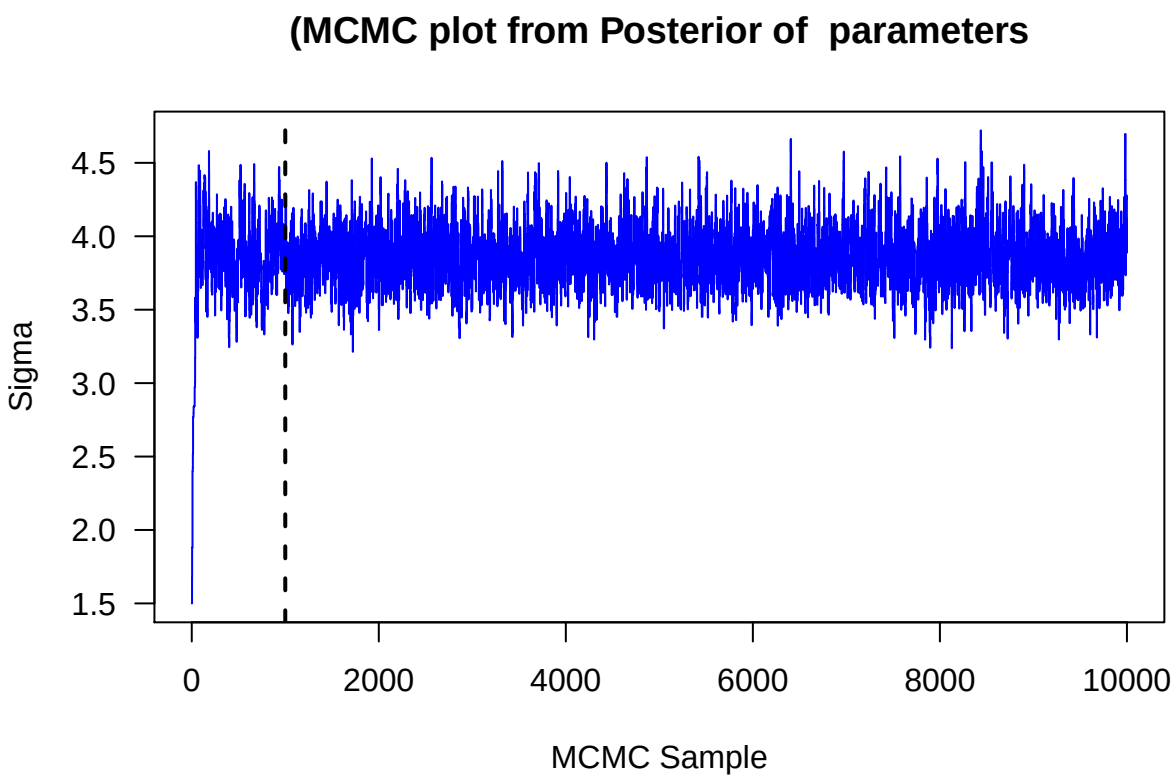
Start & Run MCMC for Gorilla Male upto 10 objects

```
require(BPviGM1)
apem10000.10=MCMCpostPsample2D(1.5,
rep(0.5,1),o.gm[,,1:10],10000)
```

```
##   |                                      |                                      |   0%current sample:[1] mcm
## : Done :[1] "***"
```

```
## [1] "Time taken:"
##    user  system elapsed
##  232.47    0.47  243.88
```

```
PPLOTpostvar2D(apem10000.10, 1000,colu="blue")
```

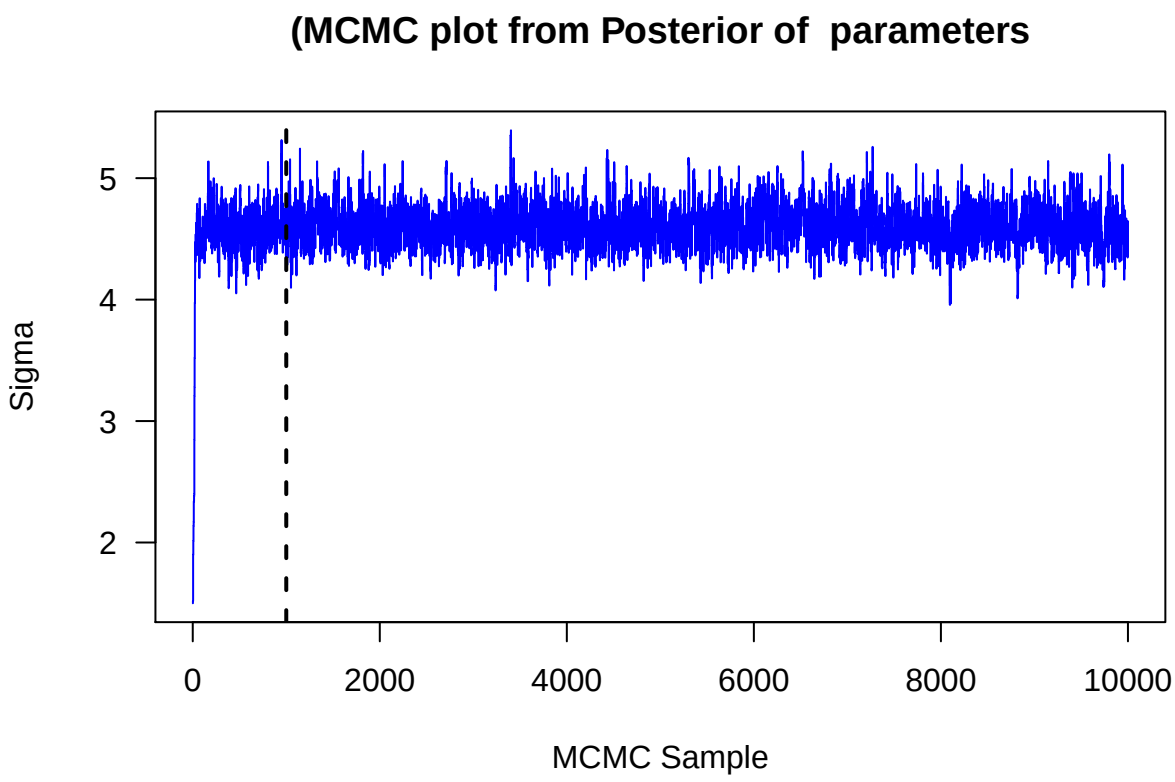


Start & Run MCMC for Gorilla Male upto 20 objects

```
apem10000.20=MCMCpostPsample2D(1.5,
rep(0.5,1),o.gm[,,1:20],10000)
```

```
##   |                                      |                              |   0%current sample:[1] mcm
## : Done :[1] "***"
## [1] "Time taken:"
##    user  system elapsed
##  449.72    0.89  469.03
```

```
PPLOTpostvar2D(apem10000.20, 1000,colu="blue")
```

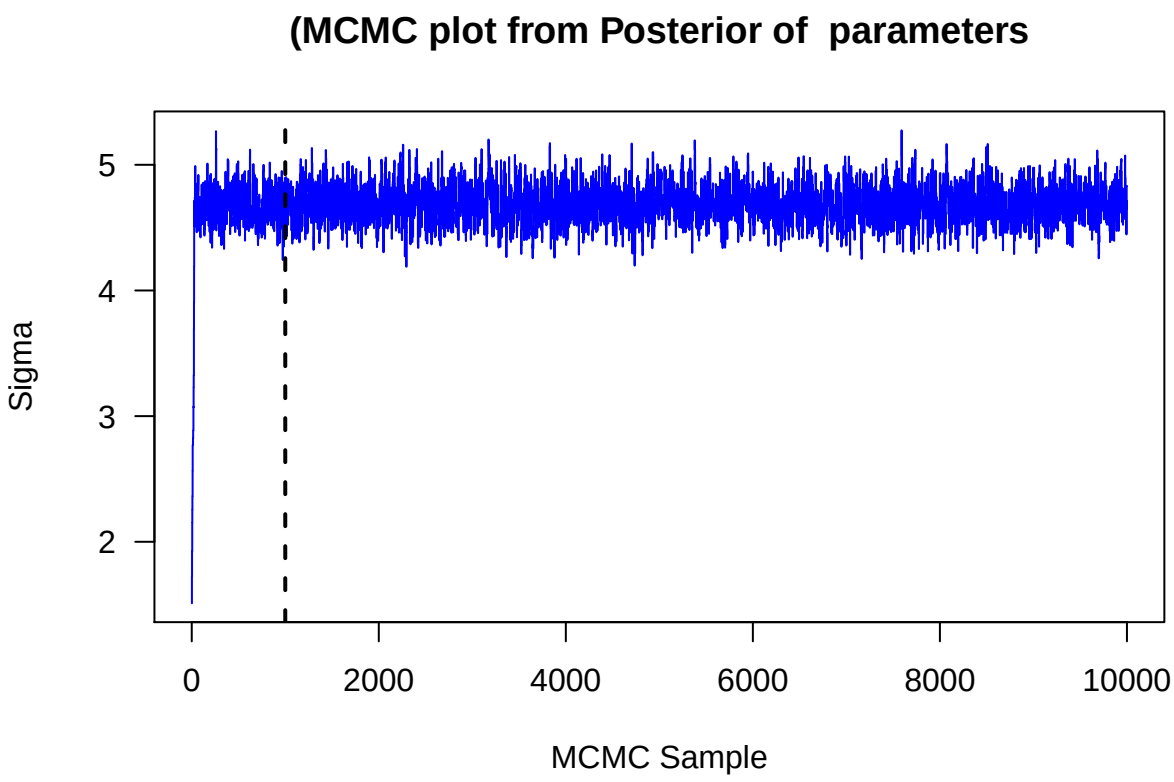


Start & Run MCMC for Gorilla Male upto 30 objects

```
apem10000.30=MCMCpostPsample2D(1.5,
rep(0.5,1),o.gm[,,],10000)
```

```
##   |                                      |                              |   0%current sample:[1] mcm
## : Done :[1] "***"
## [1] "Time taken:"
##    user  system elapsed
##  633.05    1.14  651.22
```

```
PPLOTpostvar2D(apem10000.30, 1000,colu="blue")
```

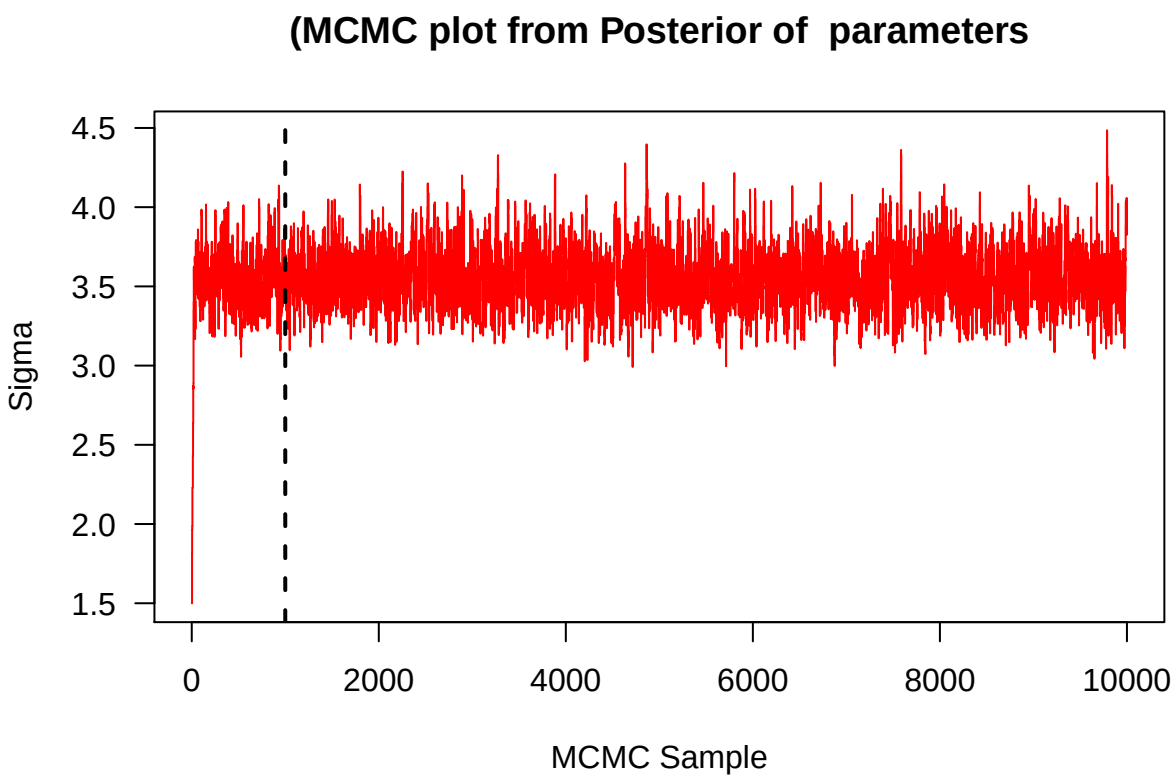


Start & Run MCMC for Gorilla Female upto 10 objects

```
apef10000.10=MCMCpostPsample2D(1.5,
rep(0.5,1),o.gf[,,1:10],10000)
```

```
##   |                                      |                              |   0%current sample:[1] mcm
## : Done :[1] "***"
## [1] "Time taken:"
##    user  system elapsed
##  221.22    0.44  228.61
```

```
PPLOTpostvar2D(apef10000.10, 1000,colu="red")
```

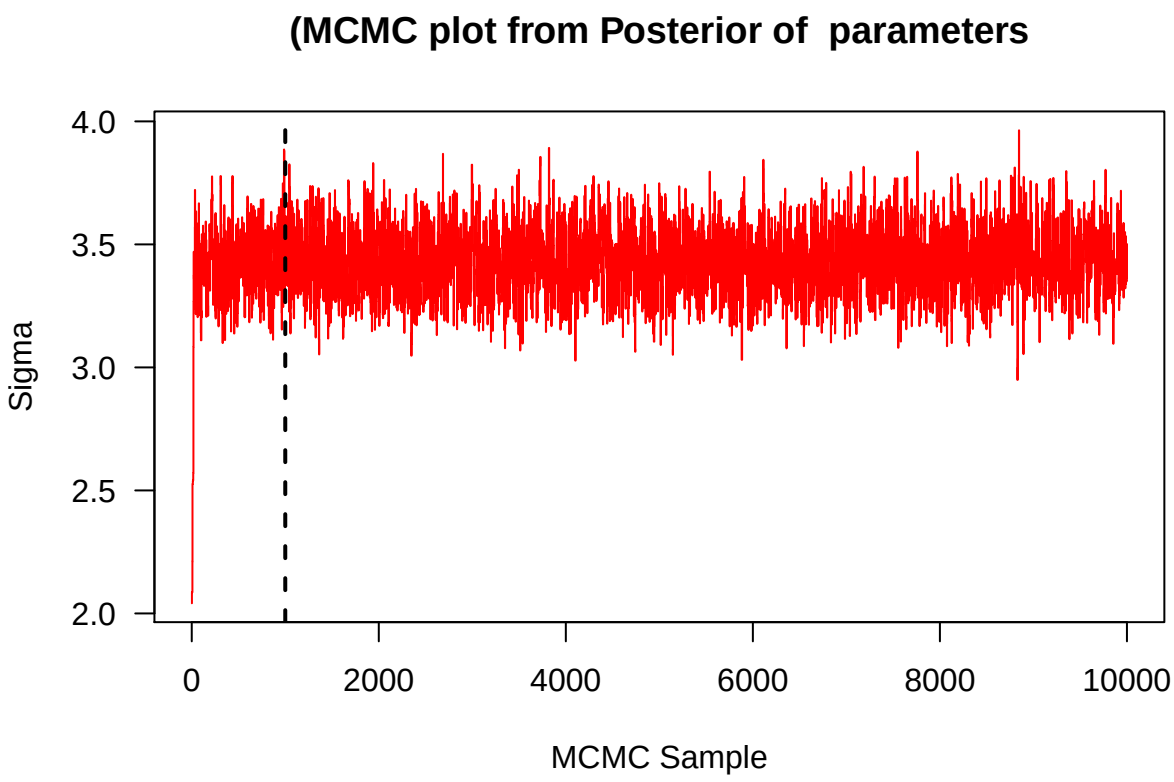


Start & Run MCMC for Gorilla Female upto 20 objects

```
apef10000.20=MCMCpostPsample2D(1.5,
rep(0.5,1),o.gf[,,1:20],10000)
```

```
##   |                                      |                              |   0%current sample:[1] mcm
## : Done :[1] "***"
## [1] "Time taken:"
##    user  system elapsed
##  447.34    1.00  465.04
```

```
PPLOTpostvar2D(apef10000.20, 1000,colu="red")
```

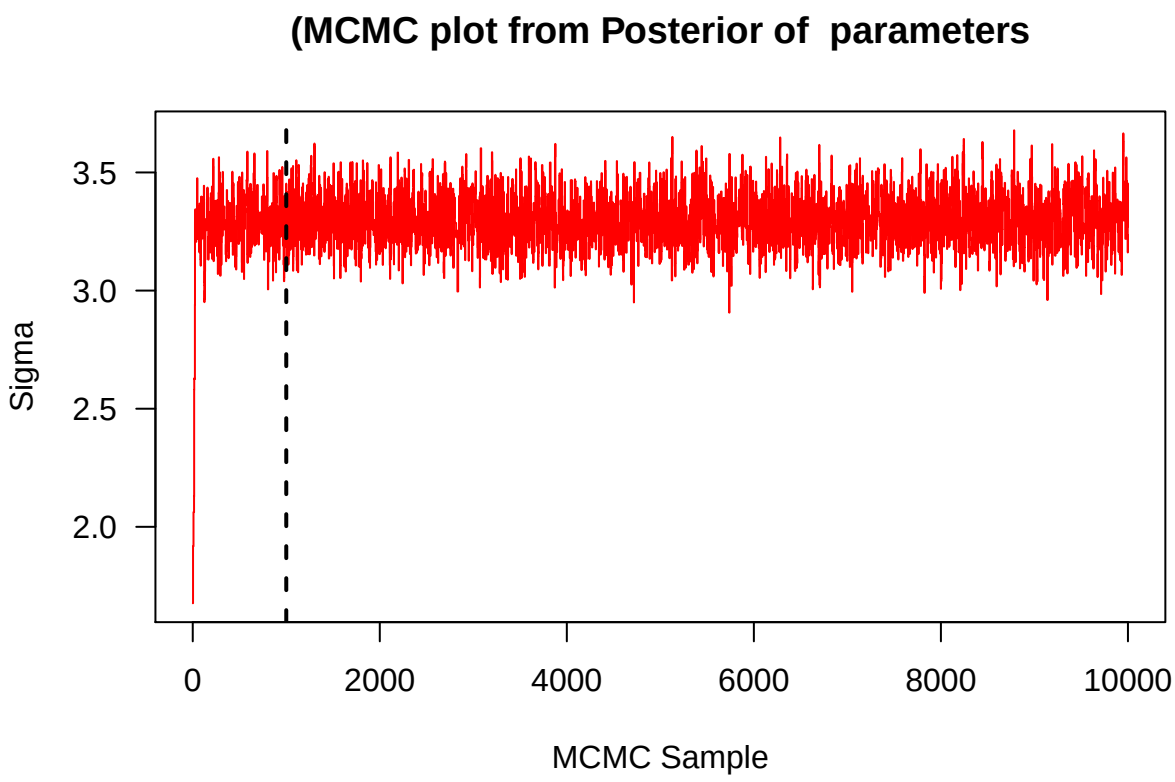


Start & Run MCMC for Gorilla Female upto 30 objects

```
apef10000.30=MCMCpostPsample2D(1.5,
rep(0.5,1),o.gf,10000)
```

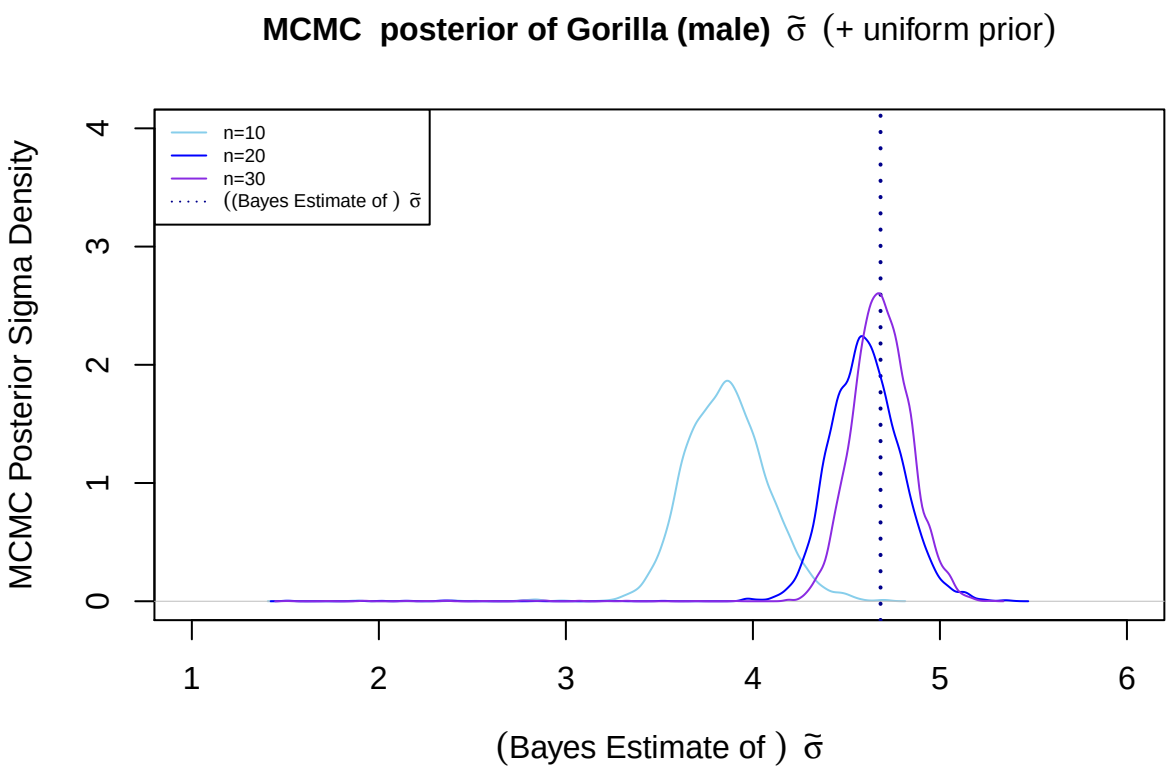
```
##   |                                      |                              |   0%current sample:[1] mcm
## : Done :[1] "***"
## [1] "Time taken:"
##    user  system elapsed
##  651.87    1.19  663.73
```

```
PPLOTpostvar2D(apef10000.30, 1000,colu="red")
```



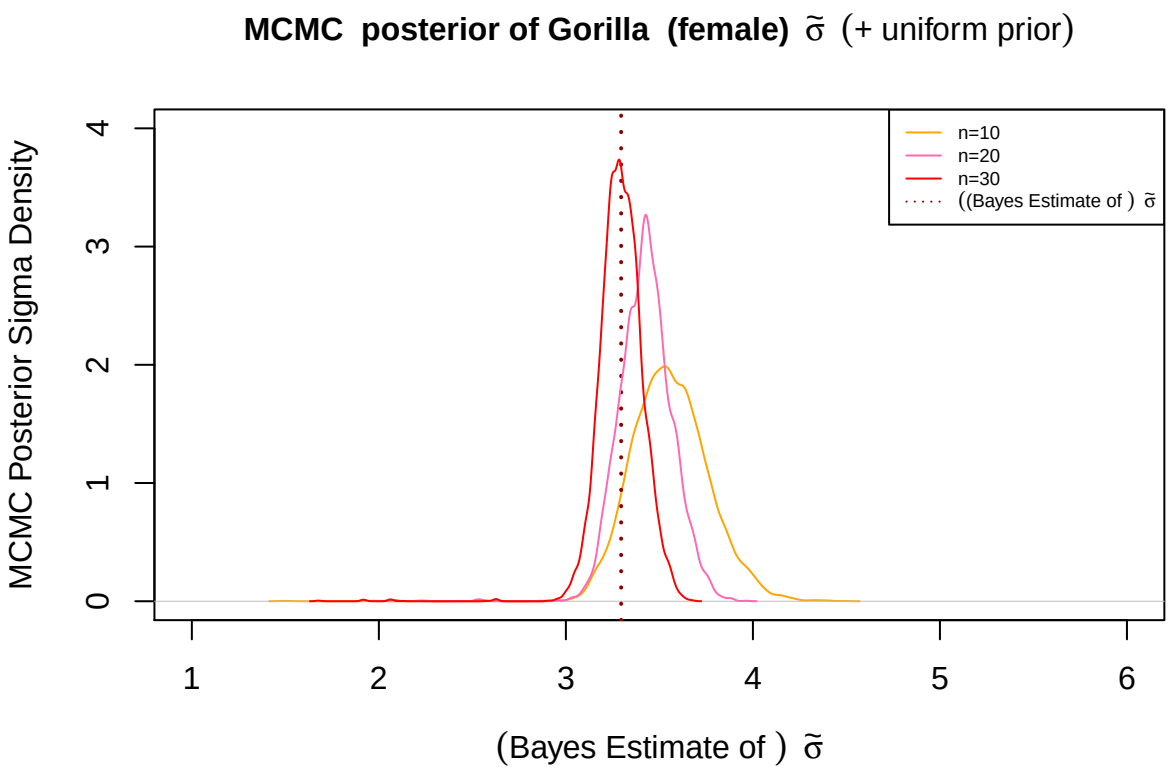
Plot for Posterior Convergence of Gorilla Male

```
#plot(density(ress_10[1001:10000,2]), xlim=c(0,8),ylim=c(0,5),col="red",ylab="density (with vague prior
plot(density(apem10000.10), xlim=c(1,6),ylim=c(0,4),col="skyblue", xlab=expression(("Bayes Estimate of
#abline(v=theta, col="black",lwd=2, lty=1)
abline(v=mean(apem10000.30), col="darkblue",lwd=2, lty=3)
#lines(density(apem10000.20), ylim=c(0,12),col="blue")
lines(density(apem10000.20), ylim=c(0,12),col="blue")
lines(density(apem10000.30), ylim=c(0,12),col="blueviolet")

legend("topleft",cex=0.6, c("n=10","n=20","n=30", expression(("(Bayes Estimate of ")~~tilde(sigma))), l
```



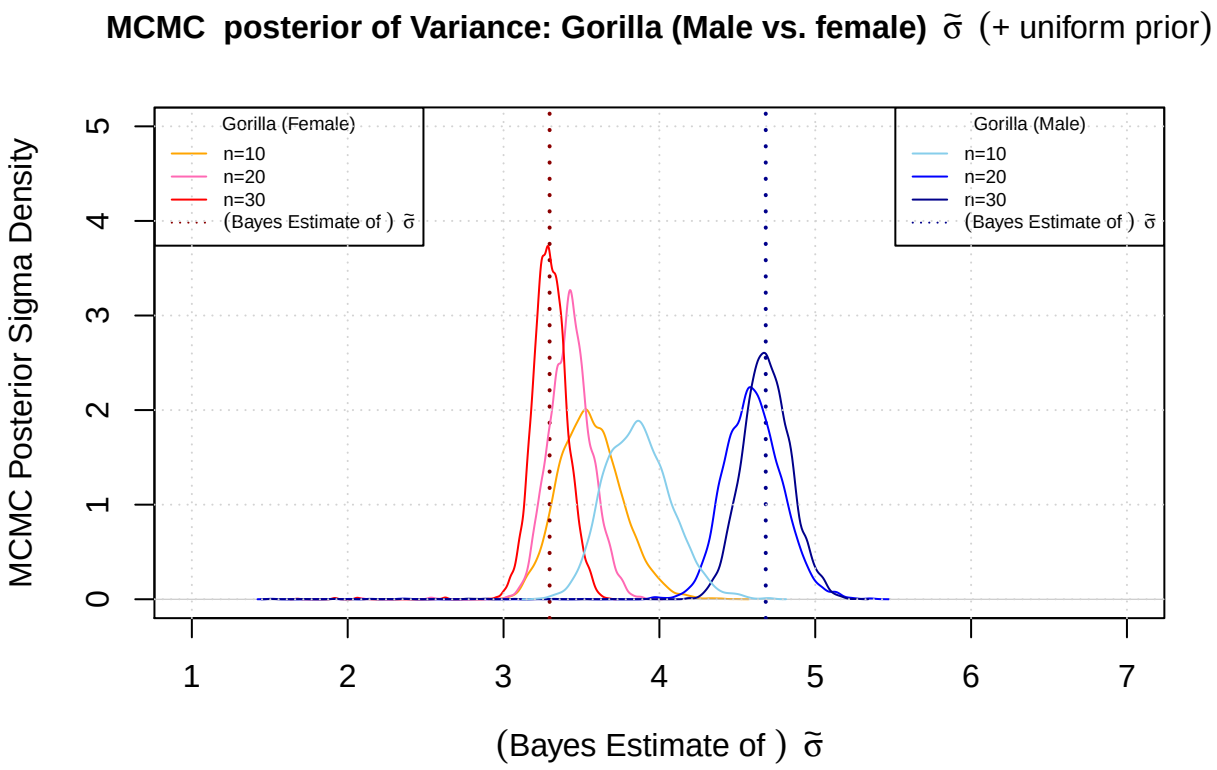
Plot for Posterior Convergence of Gorilla Female

```
#plot(density(ress_10[1001:10000,2]), xlim=c(0,8),ylim=c(0,5),col="red",ylab="density (with vague prior
plot(density(apef10000.10), xlim=c(1,6),ylim=c(0,4),col="orange", xlab=expression(("Bayes Estimate of "
#abline(v=theta, col="black",lwd=2, lty=1)
abline(v=mean(apef10000.30), col="red4",lwd=2, lty=3)
#lines(density(apem10000.20), ylim=c(0,12),col="blue")
lines(density(apef10000.20), ylim=c(0,12),col="hotpink")
lines(density(apef10000.30), ylim=c(0,12),col="red")

legend("topright",cex=0.6, c("n=10","n=20","n=30", expression(("(Bayes Estimate of ")~~tilde(sigma))), l
```



Combined-Plot for Shape-Variance Comparison Plot of Gorilla Female vs. Male

```
#COMBINED PLOT

#plot(density(ress_10[1001:10000,2]), xlim=c(0,8),ylim=c(0,5),col="red",ylab="density (with vague prior
plot(density(apef10000.10[1000:10000]), xlim=c(1,7),ylim=c(0,5),col="orange", xlab=expression(("Bayes Es
#abline(v=theta, col="black",lwd=2, lty=1)
abline(v=mean(apef10000.30), col="red4",lwd=2, lty=3)
#lines(density(apem10000.20), ylim=c(0,12),col="blue")
lines(density(apef10000.20), ylim=c(0,12),col="hotpink")
lines(density(apef10000.30), ylim=c(0,12),col="red")

legend("topleft",cex=0.6,title="Gorilla (Female)", c("n=10","n=20","n=30", expression(("Bayes Estimate
abline(v=mean(apem10000.30), col="darkblue",lwd=2, lty=3)
#lines(density(apem10000.20), ylim=c(0,12),col="blue")
lines(density(apem10000.20), ylim=c(0,12),col="blue")
lines(density(apem10000.30), ylim=c(0,12),col="blue4")
lines(density(apem10000.10[1000:10000]), ylim=c(0,12),col="skyblue");
legend("topright",cex=0.6,title="Gorilla (Male)", c("n=10","n=20","n=30", expression(("Bayes Estimate o
grid()
```



Conclusion

It is being observed from posterior Face-shape variance density comparison-plot that there are Bayesian evidence for more face-shape variability in Gorilla male than the same for Gorilla Female.