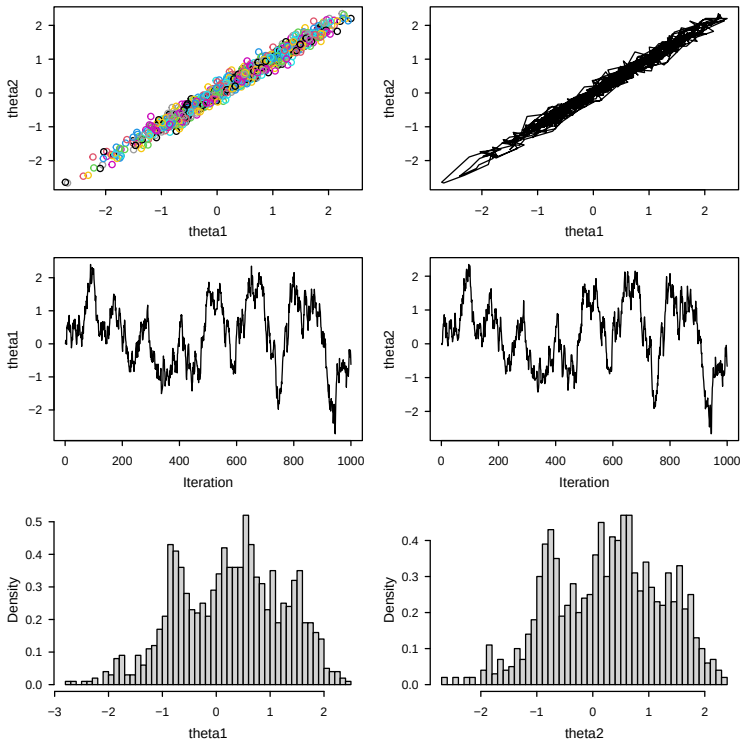
November 24, 2022

The results below are generated from an R script.

```
### Formative Assignment 3 - Gibbs Sampling Implementation
# gibbs_example: Code from Example 2.3.1
# gibbs_a: Q2a(ii) Gibbs sampler
# gibbs_b: Q2b(ii) Gibbs sampler

gibbs_example=function(N,rho)
{
  mat=matrix(ncol=2,nrow=N)
  th1=0
  th2=0
  mat[1, ]=c(th1,th2)
  for (i in 2:N)
  {
    th1=rnorm(1,rho*th2,sqrt(1-rho^2))
    th2=rnorm(1,rho*th1,sqrt(1-rho^2))
    mat[i, ]=c(th1,th2)
  }
  return(mat)
}

gibbs_a=function(N,rho)
{
  mat=matrix(ncol=2,nrow=N)
  phi1=0
  phi2=0
  mat[1, ]=c(phi1,phi2)
  for (i in 2:N)
  {
    phi1=rnorm(1,0,sqrt(1+rho))
    phi2=rnorm(1,0,sqrt(1-rho))
    mat[i, ]=c(phi1,phi2)
  }
  return(mat)
}

gibbs_b=function(N,rho)
{
  mat=matrix(ncol=2,nrow=N)
  phi1=0
  phi2=0
  mat[1, ]=c(phi1,phi2)
  for (i in 2:N)
  {
```

```
    phi1=rnorm(1,0,sqrt(1+rho))
    phi2=rnorm(1,0,sqrt(1-rho))
    # now obtain th1 and th2 from phi1 and phi2
    # using change of variable transformation
    th1 = (1/2)*sqrt(2)*(phi1+phi2)
    th2 = (1/2)*sqrt(2)*(phi1-phi2)
    mat[i, ]=c(th1,th2)
  }
  return(mat)
}


# modify this line to produce different plots
# for comparison (eg. out = gibbs_a(1000, .99))
out=gibbs_example(1000,.99)

par(mfrow=c(3,2))
plot(out,col=1:1000,xlab="theta1",ylab="theta2")
plot(out,type="l",xlab="theta1",ylab="theta2")
plot(ts(out[,1]),xlab="Iteration",ylab="theta1")
plot(ts(out[,2]),xlab="Iteration",ylab="theta2")
hist(out[,1],40,freq=FALSE,main="",xlab="theta1")
hist(out[,2],40,freq=FALSE,main="",xlab="theta2")
```



The R session information (including the OS info, R version and all packages used):

```
sessionInfo()

## R version 4.2.2 (2022-10-31 ucrt)
## Platform: x86_64-w64-mingw32/x64 (64-bit)
```

```
## Running under: Windows 10 x64 (build 19045)
##
## Matrix products: default
##
## locale:
## [1] LC_COLLATE=English_United Kingdom.utf8  LC_CTYPE=English_United Kingdom.utf8
## [3] LC_MONETARY=English_United Kingdom.utf8 LC_NUMERIC=C
## [5] LC_TIME=English_United Kingdom.utf8
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## loaded via a namespace (and not attached):
##  [1] compiler_4.2.2  magrittr_2.0.3  tools_4.2.2     tinytex_0.42    stringi_1.7.8
##  [6] highr_0.9       grid_4.2.2      knitr_1.41      stringr_1.4.1   xfun_0.35
## [11] evaluate_0.17   lattice_0.20-45
```

```
Sys.time()
```

```
## [1] "2022-11-24 21:53:51 GMT"
```