MVR_Linear_Func_IS_UniNormal
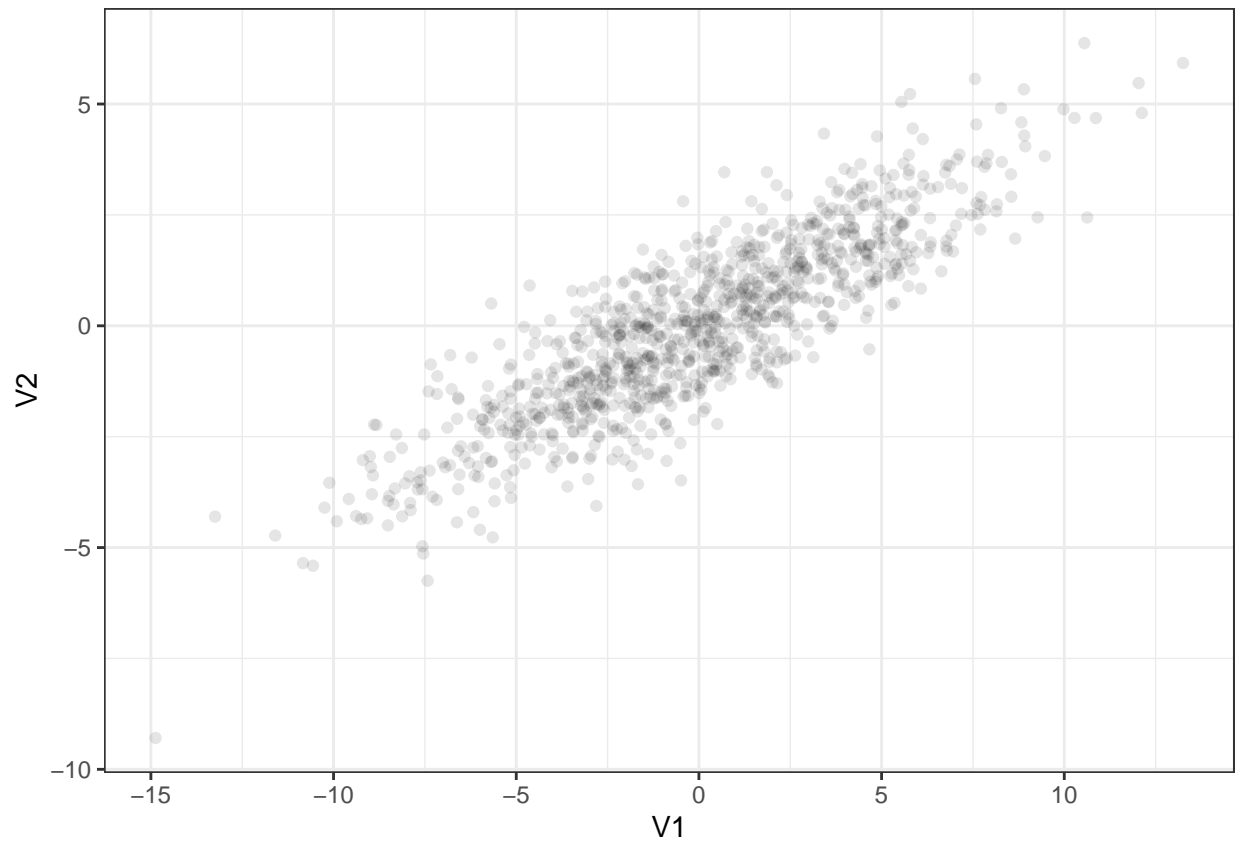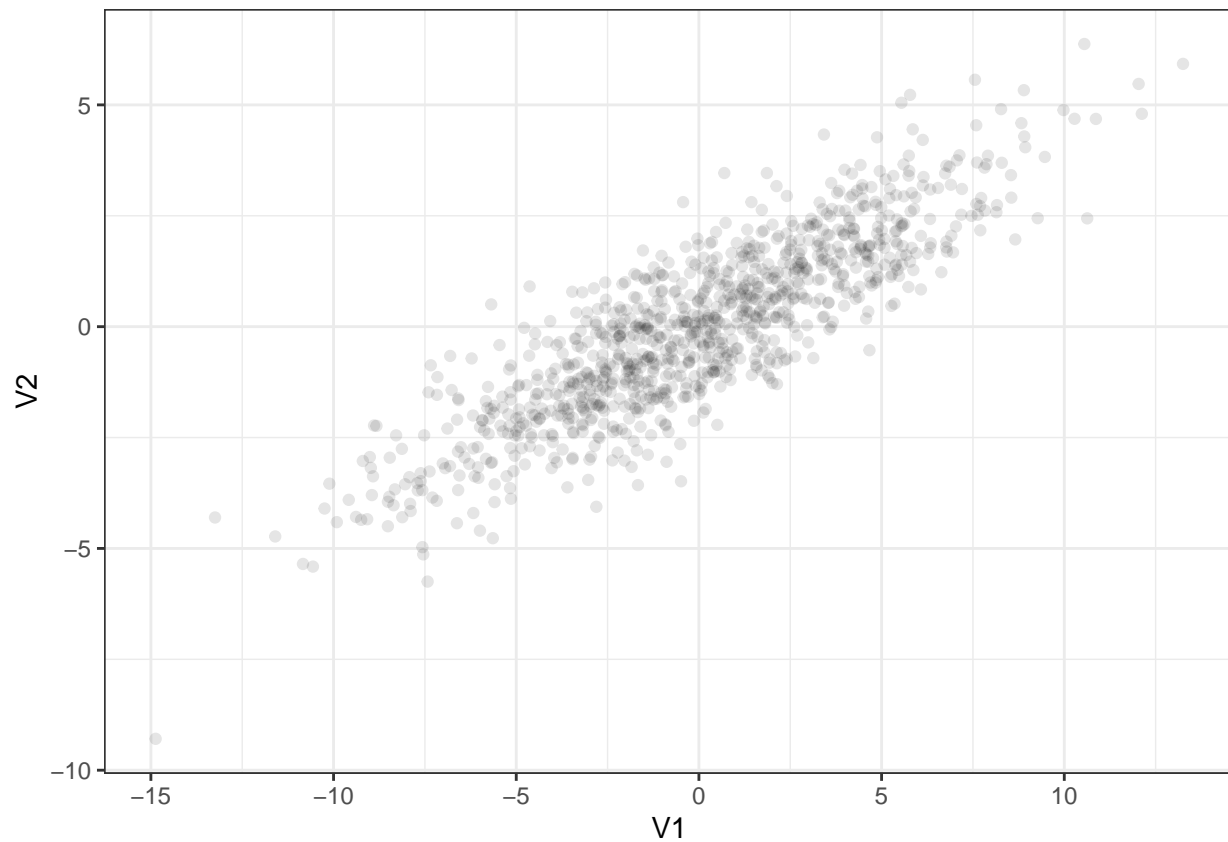
Sachith M Gunawardane

2023-05-27

```r
library(ggplot2)
library(mvtnorm)
library(MASS)
```

```r
#population
# population cov matrix
v <- matrix(c(16,7,7,4), nrow = 2, ncol = 2 , byrow = TRUE)
# True mean
mu <- c(0,0)
n <- 1000

d1 <- as.data.frame(rmvnorm(n, mean = mu, sigma = v))
ggplot(d1, aes(V1, V2)) +geom_point(alpha = 0.1) + theme_bw()
```

```
d2 <- as.data.frame(rmvnorm(n, mean = mu, sigma = v))
ggplot(d1, aes(V1, V2)) +geom_point(alpha = 0.1) + theme_bw()
```
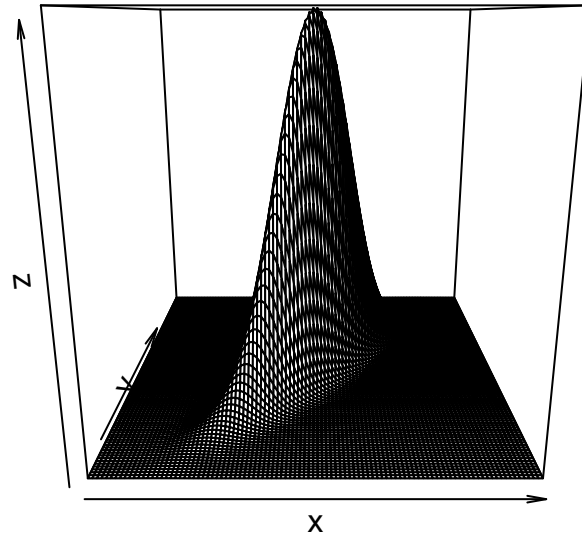

3D Plot

```
x <-  seq(-20, 20, length =100)
y <- seq(-8,8, length = 100)

calc.z <- function(x,y,mu,sigma)
{
  z <- matrix(ncol = length(y), nrow = length(x))
  for (i in 1:length(x))
  {
    for (j in 1:length(y)){
      z[i,j] <- dmvnorm(c(x[i],y[j]), mean = mu , sigma = sigma)
    }
  }
   return(z)
}

z <- calc.z ( x,y, mu, v)
persp(x,y,z,theta=0)
```
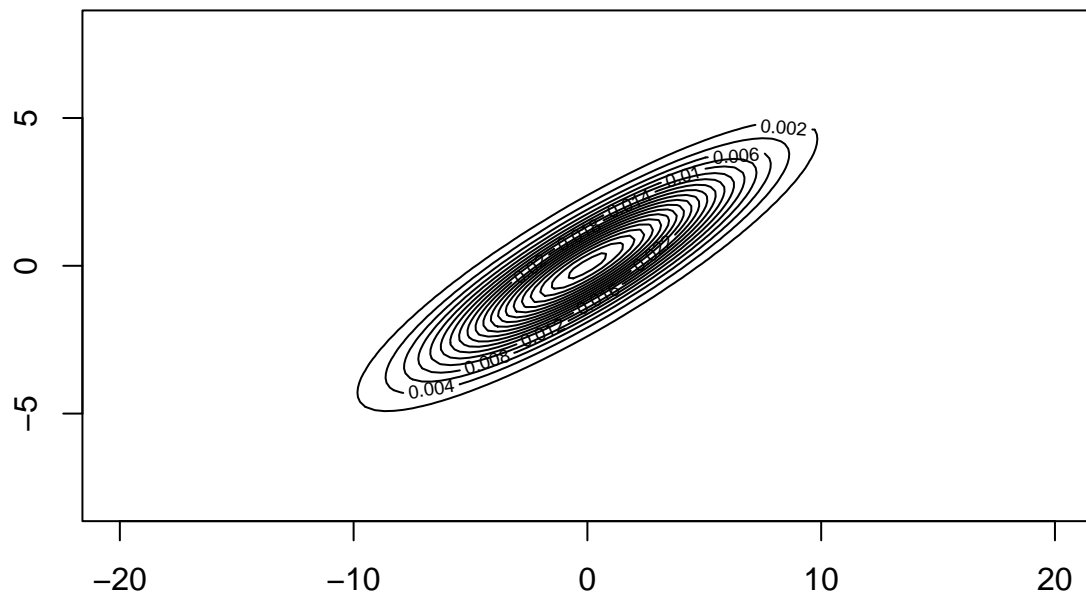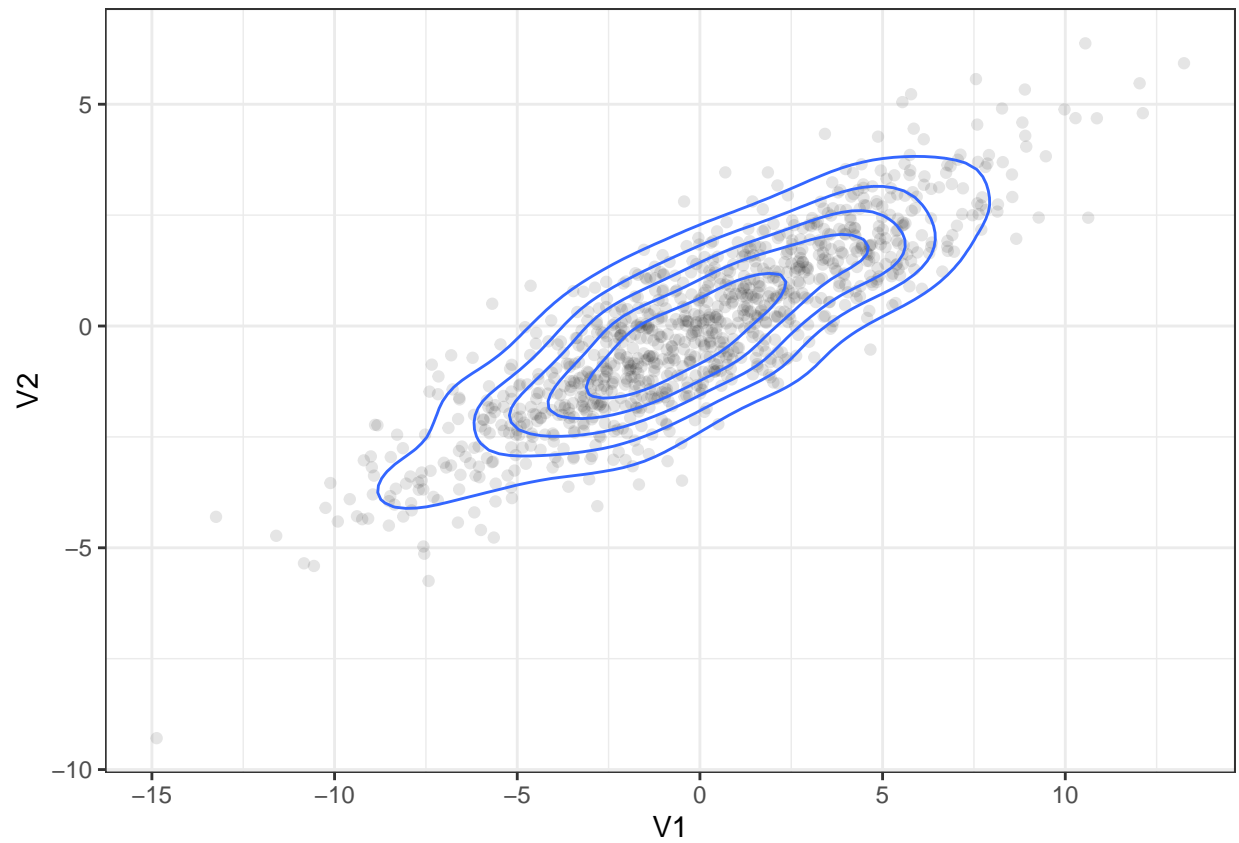
```
contour(x, y, z, nlevels= 20 )
```

```r
p1 <- ggplot(d1, aes(V1,V2))
p1 + geom_point(alpha = 0.1) + geom_density_2d()+theme_bw()
```
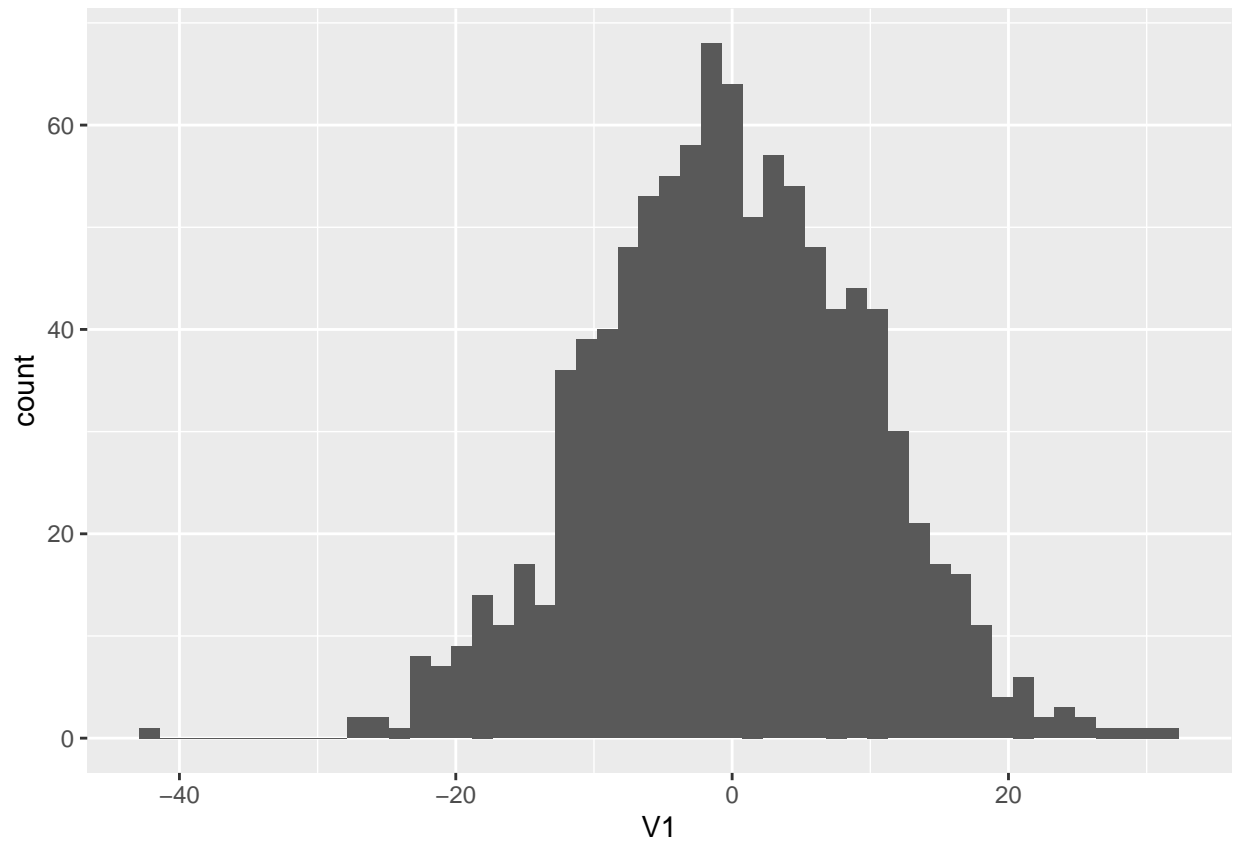
Linear function is Univariate Normal

```r
a <-  c(1,3)
u <- t(t(a)%*%t(d1))

ggplot(as.data.frame(u), aes(x=V1))+geom_histogram(bins=50)
```
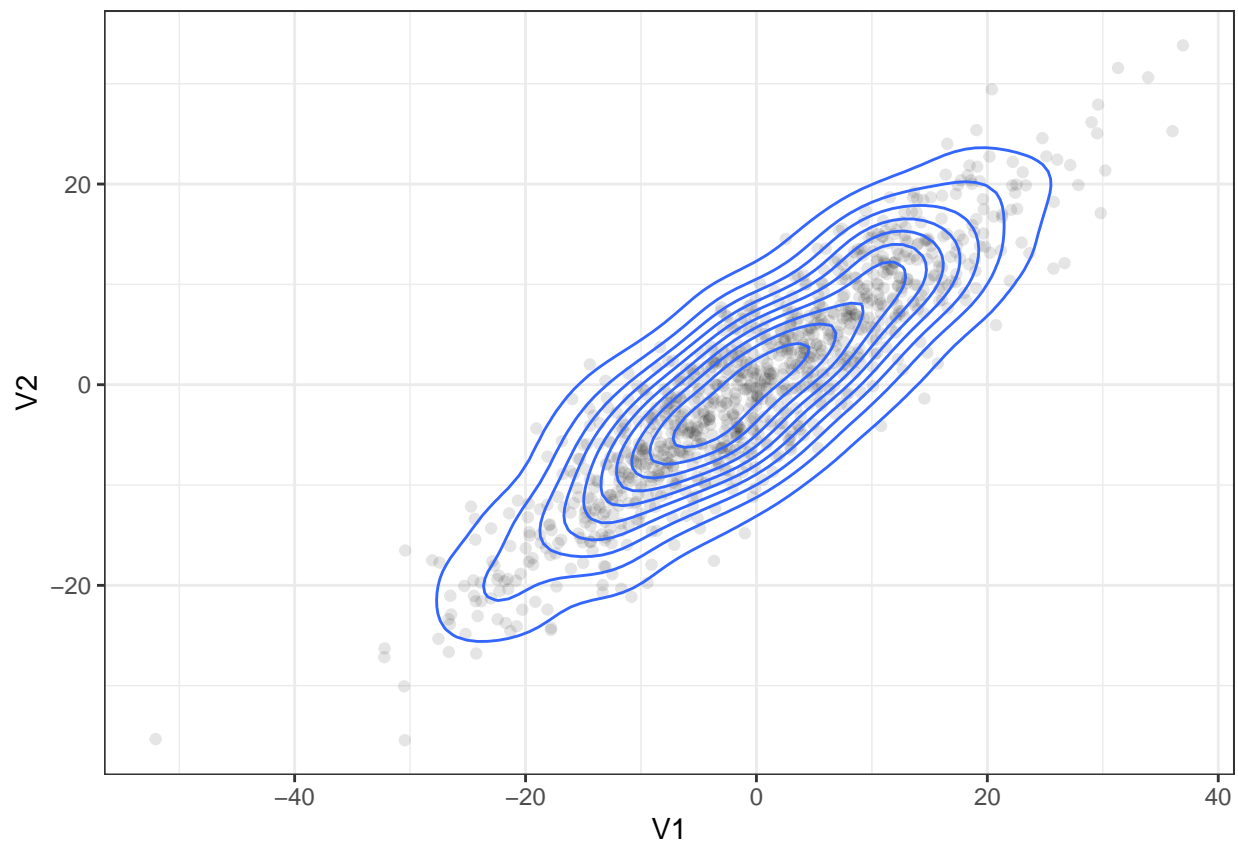
```r
shapiro.test(u) # test for normality
```

```
## 
##  Shapiro-Wilk normality test
## 
## data:  u
## W = 0.99828, p-value = 0.4226
```

```r
A <- matrix(c(1,3,4,-1),nrow = 2)
v = as.data.frame(t((A)%*%t(d1)))

p2 <- ggplot(v, aes(V1,V2))
p2+geom_point(alpha=0.1)+geom_density_2d()+theme_bw()
```

```
library(MVN)
```

```
## Warning: package 'MVN' was built under R version 4.2.3
```

```
mvn(v)
```

```
## $multivariateNormality
##            Test       HZ   p value MVN
## 1 Henze-Zirkler 0.6816138 0.6198835 YES
##
## $univariateNormality
##               Test Variable Statistic   p value Normality
## 1 Anderson-Darling      V1     0.2210    0.8321      YES
## 2 Anderson-Darling      V2     0.1978    0.8872      YES
##
## $Descriptives
##       n        Mean  Std.Dev     Median       Min      Max      25th     75th
## V1 1000 -0.18857916 11.67990 -0.4465298 -52.03884 36.94826 -8.009514 8.002431
## V2 1000 -0.09449085 10.57277 -0.1345433 -35.43086 33.82636 -7.027079 7.083335
##          Skew      Kurtosis
## V1 -0.04685324 0.1723476838
## V2 -0.04090332 0.0002339134
```