

**Problem 1:** Run the following code,

```
t = seq(from = 0, to = 2*pi, length.out = 200)
x = cos(t) + runif(200, min = -.1, max = .1)
y = sin(t) + runif(200, min = -.1, max = .1)
A = rbind(c(1,-1),c(1,-2))
B = matrix(NA, nrow = 200, ncol = 2)
for(i in 1:200){
  B[i,] = A%%c(x[i],y[i])
}
plot(B)
```

This will produce 200 points whose “*signal*” is an ellipse but there is random “*noise*” which causes small random fluctuations. This ellipse can be described by the equation,

$$Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$$

We can assume that  $A = 1$  by dividing out by the  $A$  coefficient. Use *least-squares* to determine the coefficients. If you did this correctly then you should get (after rounding a few digits) that the ellipse is given by,

$$x^2 - 1.2xy + 0.4y^2 = 0.2$$

You can solve for  $y$  and then plot the curve.

