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# lab3.R                                script file for lab3 calculations
#
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#

# first install the mvtnorm package
options(digits=4)
library(mvtnorm)

#
# bivariate normal distribution
#

mu.x = 0.05
sig.x = 0.10
mu.y = 0.025
sig.y = 0.05

# simulate from bivariate normal with rho = 0.9
rho.xy = 0.9
sig.xy = rho.xy*sig.x*sig.y
Sigma.xy = matrix(c(sig.x^2, sig.xy, sig.xy, sig.y^2), 2, 2, byrow=TRUE)

# use the rmvnorm() function to simulate from bivariate normal
?rmvnorm
n = 100
set.seed(123)
xy.vals = rmvnorm(n, mean=c(mu.x, mu.y), sigma=Sigma.xy)
head(xy.vals)

# scatterplot
plot(xy.vals[,1], xy.vals[,2], pch=16, cex=2, col="blue",
     xlab="x", ylab="y")
title("Bivariate normal: rho=0.9")
abline(h=mu.y, v=mu.x)
segments(x0=0, y0=min(xy.vals[,2]), x1=0, y1=0, col="red")
segments(x0=min(xy.vals[,1]), y0=0, x1=0, y1=0, col="red")

# compute area under bivariate standard normal distribution
# Finc P( -00 < X < 0 and -00 < Y < 0)
?pmvnorm
pmvnorm(lower=c(-Inf, -Inf), upper=c(0, 0), mean=c(mu.x, mu.y), sigma=Sigma.xy)
```