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wxMaxima notebook to plot:

- normal distribution (univariate)
- bivariate normal distribution
- conditional distribution

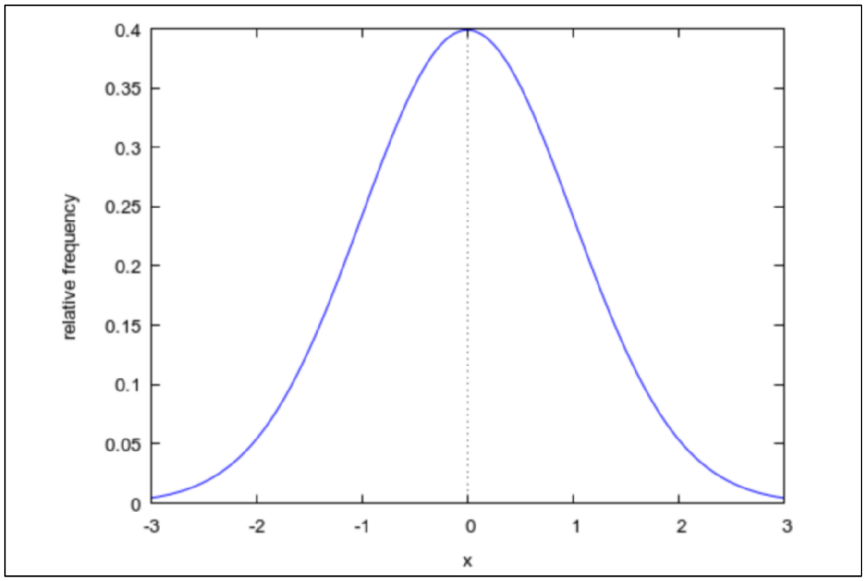
normal distribution (univariate):

(%i6)
```
f(x,mu,sigma) := (1/ sqrt(2 · %pi · sigma^2) ) · exp( (1/−2) · ( (((x − mu)/sigma)^2) )) $
print("the normal distribution: ","f(x,",mu,",",sigma^2,")"," = ",f(x,mu,sigma))$
print("")$
print("the standard normal: ",mu," = 0, ",sigma," = 1")$
wxplot2d( f(x,0,1), [x,−3,3],
   [xlabel,"x"], [ylabel,"relative frequency"])$
print("")$
```

the normal distribution: $f(x,\ \mu\ ,\ \sigma^2\ )\ =\ \frac{\%e^{-\frac{(x-\mu)^2}{2\,\sigma^2}}}{\sqrt{2}\,\sqrt{\pi}\,\left|\sigma\right|}$

the standard normal: $\mu\ = 0,\ \ \sigma\ = 1$

(%t5)



bivariate normal distribution

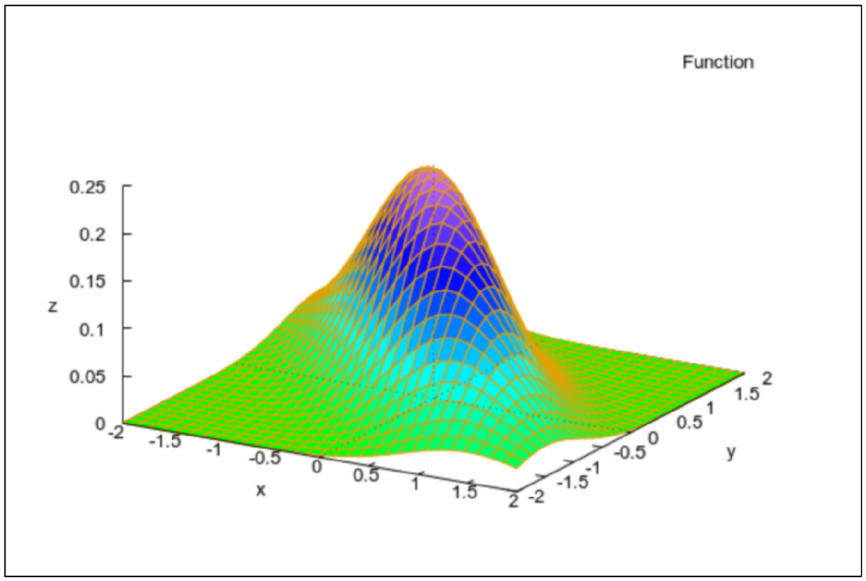
mean(x) = 0, mean(y) = 0,
sd(x) = 1, sd(y) = 1,
rho = -0.75

```
(%i15) g(x,y,mx,my,sx,sy,rho) := (1/ ( 2 · %pi · sx · sy · (( 1 − (rho)^2 )^(1/2)) )) ·
    exp( (1/(−2·(1−rho^2))) ·
      ( (((x − mx)/sx)^2) − 2·rho·((x−my)/sx)·((y−my)/sy) + (((y − my)/sy)^2) ) ) $
print("")$
print("the bivariate normal distribution: ")$
print("g(x,y,mx,my,sx,sy,rho)"," = ",g(x,y,mx,my,sx,sy,rho))$
print("")$
wxplot3d( g(x,y,0,0,1,1,−0.75) , [x,−2,2],[y,−2,2])$
 plot3d( g(x,y,0,0,1,1,−0.75) , [x,−2,2],[y,−2,2])$
print("The long \"ridge\" represents the correlation between X and Y.")$
print("")$
```

the bivariate normal distribution:

$$g(x,y,mx,my,sx,sy,rho) = \frac{\%e^{-\frac{\frac{(y-my)^2}{sy^2}-\frac{2\,\rho\,(x-my)\,(y-my)}{sx\,sy}+\frac{(x-mx)^2}{sx^2}}{2\,(1-\rho^2)}}}{2\,\pi\sqrt{1-\rho^2}\,sx\,sy}$$

(%t12)



The long "ridge" represents the correlation between X and Y.

Message from maxima's stderr stream: qt5ct: using qt5ct plugin

The conditional distribution is a cross-section of the bivariate distribution.

It's the distribution of Y, conditional upon a given value of X

```
/· take the cross section at: x = 0 ·/
h(y,mx,my,sx,sy,rho) := ''( g(0,y,mx,my,sx,sy,rho) ) $

print("")$
print("the conditional distribution: ")$
print("h(y,mx,my,sx,sy,rho)"," = ",h(y,mx,my,sx,sy,rho))$
print("")$
wxplot2d( h(y,0,0,1,1,−0.75), [y,−2,2],
  [xlabel,"y"], [ylabel,"relative frequency"])$
print("")$
```

The conditional distribution looks very similar to the univariate, but it is

not the same. The area beneath the conditional distribution is LESS than one.

```
print("")$
print("the area under the normal distrib is: ",
  ''(float(integrate(f(x,0,1), x, −99, 99))) )$
print("the area under this cross section is: ",
  float(integrate(h(y,0,0,1,1,−0.75), y, −99, 99) ))$
print("")$
```