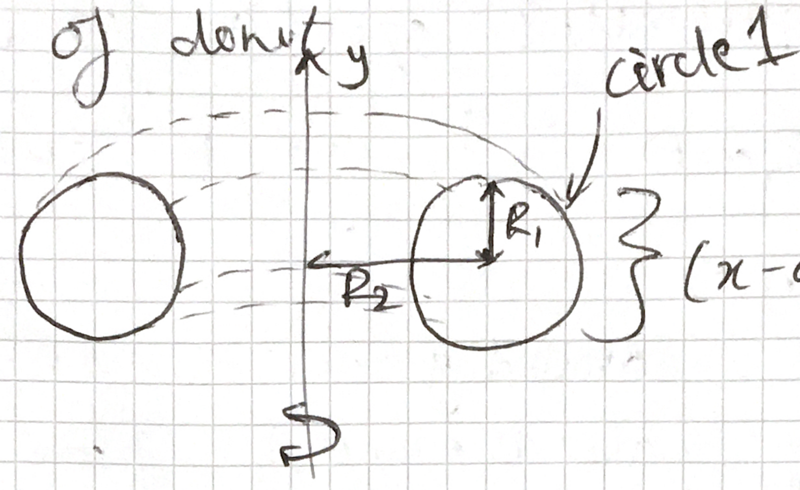
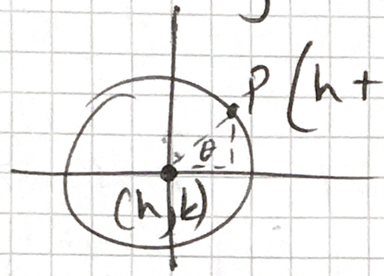
formation of donut



$$(x-a)^2+(y-b)^2=r^2$$

converting equation of circle to parametric:



$P(h+r\cos\theta,\ k+r\sin\theta)$

so $x = h + r\cos\theta$

$y = k + r\sin\theta$

OR

using $(x-a)^2 + (y-b)^2 = r^2$

&

$\sin^2\theta + \cos^2\theta = 1$

$\times r^2 \qquad \times r^2$

$r^2\sin^2\theta + r^2\cos^2\theta = r^2$

$\sqrt{r^2 \times \sin^2\theta = (x-a)^2}$ $\qquad$ $\sqrt{r^2\cos^2\theta = (y-b)^2}$

$r \times \sin\theta = x - a$ $\qquad$ $r\cos\theta = y - b$

$x = r\sin\theta + a$ $\qquad$ $y = r\cos\theta + b$

* x or y can have either cos or sin - doesn't matter as long as sin/cos isn't repeated in both x & y.

Now the parametric equation for Circle 1 is:

$$x = R_2 + R_1 \cos\theta \quad \& \quad y = R_1 \sin\theta$$

Rotation Matrices:

around x axis:

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\phi & -\sin\phi \\ 0 & \sin\phi & \cos\phi \end{bmatrix}$$

around y axis:

$$\begin{bmatrix} \cos\phi & 0 & \sin\phi \\ 0 & 1 & 0 \\ -\sin\phi & 0 & \cos\phi \end{bmatrix}$$

around z axis:

$$\begin{bmatrix} \cos\phi & -\sin\phi & 0 \\ \sin\phi & \cos\phi & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

So to rotate Circle 1 around y axis:

$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} \cos\phi & 0 & \sin\phi \\ 0 & 1 & 0 \\ -\sin\phi & 0 & \cos\phi \end{bmatrix} \begin{bmatrix} R_2 + R_1\cos\theta \\ R_1 \sin\theta \\ 0 \end{bmatrix} = \begin{bmatrix} (R_2 + R_1\cos\theta)\cos\phi \\ R_1\sin\theta \\ -(R_2 + R_1\cos\theta)\sin\phi \end{bmatrix}$$

* where ϕ and θ are from 0 to 2π radians & plot point for every value of ϕ and θ.