Rose Curves Challenge Problem (Bonus)

Let's clear the global computing environment:

```
rm( list = ls() )
```

Challenge Problem: Rose Curves (Bonus)

This is a challenge problem, which means that it's something for you to try if you're interested. It's not required, and it's not part of Problem Set 4.

In a previous challenge problem, we saw how to construct the Lemniscate of Bernoulli by using vectorized methods.

The idea was to construct a vector of parameter values using the `seq()` function, and then use vectorized operations on this vector to obtain vectors of x- and y-coordinates.

The curve could then be plotted using the `lines()` function.

In this problem, we'll explore another such parametric curve, called a *rose* curve.

Part (a): Creating a plotting display

Construct a completely blank plotting region, with the x-axis ranging from -1 to 1 and the y-axis also ranging from -1 to 1.

Also, make the plotting display square.

Finally, draw in horizontal reference lines $y = 0$ and $x = 0$; notice that these reference lines will now bisect the plotting region.

For this part, just construct this plotting region; we'll use this as the foundation for our other graphs.

Solution

Part (b): Drawing a rose curve

Now we'll draw a rose curve.

The parametric equation for the x-coordinate of a rose curve is:

$$x(\theta) \;=\; \cos(k\theta) \cdot \cos(\theta)$$

This only works if k is a rational number i.e. it has to be a ratio of two whole numbers.

In this part, we'll graph the equation where $k = 3$.

- First, use the `seq()` function to construct a sequence of 1,000 values for θ from 0 to π.

- Next, compute a vector of x-coordinates using the formula:

$$x(\theta) \;=\; \cos(3\theta) \cdot \cos(\theta)$$

- Similarly, compute a vector of y-coordinates using the formula:

$$x(\theta) \;=\; \cos(3\theta) \cdot \sin(\theta)$$

Copy the code you developed in part (a), and then draw the curve using the `lines()` function

Solution

Part (c): Drawing a rose curve

Now we'll draw another rose curve.

In this part, we'll graph the equation where $k = 4/3$.

The parametric equation for the x-coordinate is:

$$x(\theta) \;=\; \cos\left(\frac{4}{3} \cdot \theta\right) \cdot \cos(\theta)$$

The parametric equation for the y-coordinate is:

$$x(\theta) \;=\; \cos\left(\frac{4}{3} \cdot \theta\right) \cdot \sin(\theta)$$

For this curve, the parameter values should range from 0 to 6π.

You're welcome and encouraged to copy your code from part (b) and modify it.

If you wrote your code in part (b) well, you should be able to do this problem with very little effort.

Solution

Part (d): Drawing a rose curve

Now we'll draw another rose curve.

In this part, we'll graph the equation where $k = 3/7$.

The parametric equation for the x-coordinate is:

$$x(\theta) \;=\; \cos\left(\frac{3}{7} \cdot \theta\right) \cdot \cos(\theta)$$

The parametric equation for the y-coordinate is:

$$x(\theta) \;=\; \cos\left(\frac{3}{7} \cdot \theta\right) \cdot \sin(\theta)$$

For this curve, the parameter values should range from 0 to 7π.

You're welcome and encouraged to copy your code from part (b) and modify it.

If you wrote your code in part (b) well, you should be able to do this problem with very little effort.

Solution