# Lecture 2: Coordinate systems

Math 195 Section 91

Wednesday June 24, 2009

Goal: section 11.3 and 13.1 and 13.2.

What is a "coordinate system"? why are these important? the greatness of analytic geometry!

## 0.1 Polar coordinates

Examples of polar coordinates

$x = r\cos\theta, y = r\sin\theta$

converting back and forth. same point may have many names.

graphing polar equations $r = f(\theta)$. it helps to graph the function in cartesian coordinates first!

example: $r = 17$.

example: $r = 2\cos\theta$ and then rearrange to find that this is a circle

example: $r = 1 + \sin\theta$ cardioid

example: $r = \cos(2\theta)$ four-petaled rose

## 0.2 Calculus in polar coordinates

find slopes of tangent lines $dy/dx$. same trick as in parametric case.

## 0.3 Three dimensional systems

three coordinates!

draw some pictures

draw the $xz$, $xy$, and $yz$ planes.

draw all the points where an equation holds: $z = 3$, $y = 3$, $x = 3$, $x = y$, $x^2 + y^2 = 4$. $x^2 + y^2 + z^2 = 1$.

this reminds me about the distance formula!

equation of a sphere with center $(a, b, c)$ and radius $r$.

complete-the-square to transform complicated looking equations into the equation for a sphere.

doing calculus in this situation—it will be coming later.

## 0.4 Vectors

a "vector" means different things: a tuple of numbers, a direction with a magn itude, an arrow, a...

add vectors with triangles (and componentwise)

does it matter what order you add?

scale a vector by multiplying by a scalar (hence the name). do this algebraically and geometrically.

subtract vectors

say a bit about the "span" of vectors $(1, 0, 0)$ and $(0, 1, 0)$. What about the span of two other 3-vectors?