### 1 | Implicit Differentiation

The usual process:

- 1. Differentiate everything with respect to x
- 2. Apply the chain rule to functions left in the mix: since  $(f(g(x)))' = g'(x)f'(g(x)), \frac{d}{dx}y^2 = \frac{dy}{dx}y^2$ .
- 3. Apply algebra to get  $\frac{dy}{dx}$  on one side.
- 4. OPTIONAL(?): Convert back to explicit form by plugging in value of y.

#### 1.1 | Common Problems and their Respective Approaches

#### 1.1.1 | Find the equation of the tangent/normal at (A,B)

Remember that L(a) = f(a) + f'(a)(x-a), and that'll give you tangent. Normal line is just perpendicular of tangent, so  $\frac{-1}{L(a)}$ .

### 1.1.2 | Find location of curve where tangent is *vertical*

Simply find what values of x and y make the tangent go to infinity. System of equations with the derivative and the original implicit equation itself. You can make this faster with fractions by only using denom/numerator.

### 1.1.3 | Find location of curve where tangent is *horizontal*

Same as above but solve for what makes tangent go to zero.

#### 1.2 | Misc Tips

### 1.2.1 | Pay attention to the original equations!

They're very useful in algebra!

### 2 | Derivatives of Inverse Functions

Formula for this is  $(f^{-1}(x))' = \frac{1}{f'(f^{-1}(x))}$ .

# 3 | Derivatives of Inv. Trig Functions

Remember the derivs

Taproot • 2021-2022 Page 1

### 3.1 | TODO Explicitly deriving

# 4 | Linear Approximations

 $L(a)=f(a)+f^{\prime}(a)(x-a)$  Plug in for appropriate a, and manually check for over/underestimation if problem asks.

### 4.1 | TODO Algebraically getting set accuracy bounds

# 5 | Differentials

$$dy = f'(x)dx$$
$$-dx < dy < dx$$

Taproot • 2021-2022 Page 2