

## 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

### 3.1 | TODO Explicitly deriving

## 4 | Linear Approximations

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

### 4.1 | TODO Algebraically getting set accuracy bounds

## 5 | Differentials

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

$$-dx < dy < dx$$