

Lesson 9

Read 3.1,3.2 and 3.3

Derivatives calculations

The tangent line problem

$f(x)$	$f'(x)$	textbook section
c constant	0	3.1
x^n , any real number n	nx^{n-1}	3.1
e^x	e^x	3.1
$\sin x$	$\cos x$	3.3
$\cos x$	$-\sin x$	3.3
$\tan x$	$\sec^2 x$	3.3
$\cot x$	$-\csc^2 x$	3.3
$\sec x$	$\sec x \tan x$	3.3
$\csc x$	$-\csc x \cot x$	3.3

Calculate the derivative of

▶ $f(x) = x^2$

▶ $f(x) = x^{\sqrt{2}}$

▶ $f(x) = x^e$

▶ $f(x) = \pi^e$

▶ $f(x) = \sqrt{x}$

▶ $f(x) = \frac{1}{x^2}$

Derivation rules

- ▶ $(f + g)' = f' + g'$
- ▶ $(f - g)' = f' - g'$
- ▶ $(fg)' = f'g + fg'$
- ▶ $\left(\frac{f}{g}\right)' = \frac{f'g - fg'}{(g')^2}$

The derivative of $\tan x$

$$(\tan x)' =$$

Calculate
 $(3 \sin x)'$

$$\left(\frac{3}{\sin x}\right)'$$

$$\left(\frac{e^x}{x^2}\right)'$$

Calculate
 $(e^{\sqrt{2}x})'$

$$\frac{d}{dr} \left(\frac{r}{ar+k} \right)$$

$$(x(x-1))'$$

Calculate $(|x|)'$

Find the second derivative of $f(x) = 3x^2$, $g(x) = e^x$,
 $h(x) = \sqrt{x} - 1$

The tangent line problem

The equation to the tangent line to the curve $y = f(x)$ through a point $P = (x_0, f(x_0))$ on the curve is

$$y = f(x_0) + f'(x_0)(x - x_0)$$

The tangent line problem

To find the equation to the tangent line to the curve $y = f(x)$ through a point $P = (x_0, y_0)$ NOT on the curve:

- ▶ Call $Q = (x, y) = (x, f(x))$ the unknown point of tangency on the curve.
- ▶ Write the equation of the slope of the tangent m in two different ways, set them equal, and solve for x

$$m = f'(x) = \frac{f(x) - f(x_0)}{x - x_0}$$

- ▶ If $x = x_1$ is the solution you found, then the tangent line is $y = f(x_1) + f'(x_1)(x - x_1)$

Find the equation of the tangent line to the curve $y = x^2$

- ▶ going through $P = (2, 4)$
- ▶ going through $Q = (2, 2)$
- ▶ parallel to the line $y = 3x + 1$