

# Separable Equations Worksheet

Accompanies Section 1.2 in ODEP

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## 1 First-order separable differential equations

In this workshop, you will see how to solve (remember the technical meaning of this word) separable first-order differential equations, that is, equations of the form

$$M(x) + N(y) \frac{dy}{dx} = 0.$$

### Activity 1.1.

- (a) Divide both sides by  $y^2$  to put the equation in standard form.
- (b) Integrate each side with respect to the evident variable. (This is justified by appeal to  $u$ -substitution:  $dy = y' dx$ .)
- (c) You should now have an equation that is free of derivatives, but with a constant of integration. Plug in the initial values to find the value of this constant.
- (d) If possible, solve your equation for  $y$ .
- (e) Substitute your function and its derivative into (??) to make sure your solution is correct.

### Activity 1.2.

- (a) Solve the initial value problem

$$1 + ye^{-x}y' = 0, \quad y(0) = 1. \tag{1.1}$$

### Activity 1.3.

- (a) Find solutions to the differential equation

$$y' = \frac{3x^2 + 4x + 2}{2(y - 1)}. \tag{1.2}$$

### Activity 1.4.

- (a)  $y' = \frac{x^2}{y}$
- (b)  $y' + y^2 \sin x = 0$
- (c)  $y' = \frac{x^2}{y + yx^3}$

### Activity 1.5.

- (a) For what values of  $y_0$  does the solution have a vertical asymptote at  $t = 6$  and a  $t$ -interval of existence  $-\infty < t < 6$ ?