Mathematica Labs | Denis Shubleka

Subject: Calculus

Topic: Differential Equations

Goal: Use *Mathematica* to solve differential equations.

Task 1

Consider the differential equation $\frac{dy}{dt} = ky$, where k is constant. By separation of variables, we know that the general solution is $y(t) = A\ e^{kt}$.

Mathematica solves differential equations such as $\frac{dy}{dt} = 0.2\,y$, using the DSolve command:

```
DSolve[{y'[t] == 0.2 y[t]}, y[t], t]
```

The result represents the set of solutions, a family of curves where each member is uniquely defined by the constant C[1]. Below we define some of these solutions, for C[1] values between -1 to 5 in increments of 0.5.

```
solutions = Table[y[t] /. %[[1]] /. C[1] → n, {n, -1, 5, 0.5}]
```

To obtain a plot of these thirteen solutions, enter and execute the following:

```
Plot[solutions, {t, 0, 20}]
```

Next, we use the DSolve command to solve an initial value problem, and then plot the solution curve. The differential equation is $\frac{dy}{dx} = x + y$ with initial condition (0,1).

```
initialvalue = {0, 1};
DSolve[{y'[x] == x + y[x], y[0] == 1}, y[x], x]
```

```
Plot[y[x] /. %, {x, -1, 3}, Epilog → {PointSize[0.02], Blue, Point[initialvalue]}]
```

Related Exercises/Notes:
