Modeling Yeast Growth

Kurt Bryan and SIMIODE

Notebook to support Exercise 3.4.8, modeling yeast population growth.

```
> restart;
  with(plots) :
```

The data, in time/population pairs.

```
> data := [[0, 9.6], [1, 18.3], [2, 29], [3, 47.2], [4, 71.1], [5, 119.1], [6, 174.6], [7, 257.3], [8,
      350.7], [9, 441], [10, 513.3], [11, 559.7], [12, 594.8], [13, 629.4], [14, 640.8], [15,
      651.1], [16, 655.9], [17, 659.6]] :
```

Number of data points is

```
> N := nops(data)
```

A plot

```
> plt1 := pointplot(data, color = red, symbol = solidcircle, symbolsize = 20, labels
       = ["time (hours)", "Population (millions)"], labeldirections = [horizontal, vertical]) :
  pp := display(plt1);
```

Given that u(0) = 9.6, the solution to the logistic equation with intrinsic growth rate "r" and carrying capacity "K" is

$$> \ u(t) := \frac{K}{\left(1 + \exp(-r \cdot t) \cdot \left(\frac{K}{9.6} - 1\right)\right)}$$

A least-squares function can be formed as

$$> \ SS := add\left((u(data[j][1]) - data[j][2])^2, j = 1..N \right)$$

Now adjust r and K to minimize this.