

Differential Equations Modeling Worksheet

1. Newton's Law of Cooling

Suppose you have just poured a cup of freshly brewed coffee with temperature 95°C in a room where the temperature is 20°C . When do you think the coffee cools most quickly? What happens to the rate of cooling as time goes by? Explain.

Newton's Law of Cooling states that the rate of cooling of an object is proportional to the temperature difference between the object and its surroundings. Write a differential equation that expresses Newton's Law of Cooling for this particular situation. What is the initial condition? Solve the differential equation. If the coffee is 80°C 10 minutes after it's been poured, what is the temperature of the coffee 30 minutes later?

Do you think this differential equation is an appropriate model for cooling?

2. **Epidemiology** - a very simple model.

The number of people per day who become infected with a virus is proportional to the number of interactions between a sick person and a susceptible person.

The proportionality constant in epidemiology is called the infectious contact rate. Flu in a student population has an infectious contact rate of 0.005. Assume there are 873 students and only 1 has the flu. Write a differential equation to describe this situation. What is the initial condition? Solve the differential equation. How many days pass until 75% of the students have the flu?

In what ways is this model not accurate?