Project Outline

MATH 3820
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- Topic: Heat Loss -- **Newton's law of Cooling**.
  It states that the rate of heat loss of a body is proportional to the difference in temperatures between the body and its surroundings.

$$\frac{dT(t)}{dt} = -k\left(T - T_{env}\right)$$

  - $\frac{dT}{dt}$ = the rate of heat loss of a body
  - T = the temperature of a body
  - T_{env} = the temperature of environment
  - k = a positive constant
  - The above equation is linear first-order ordinary differential equation and will be solved using "Separable different equation".

- "Newton's law of cooling" is easily applied to lots of real-life problems. For example, a pizza deliverer is supposed to deliver the "hot" pizza to the customer. Here "Newton's law of Cooling" can give the pizza deliverer an estimated time for a pizza to cool down. So it is a useful tool to estimate the time of the heat loss. In my opinion, "Newton's law of Cooling" is worth being discussed because heat loss happens all the time in our life and somehow we would like to know how long an object takes to cool down.

- I will carry out an experiment on a glass of hot water in a room. I will use a thermometer to measure the temperature of the hot water and the room for a period of time. Finally, I will use these data to do the "Curve-Fitting" to fit them into a kind of function (i.e. linear, exponential, and etc.) and then analyze the results.

- Do some real-life examples.
  - Estimate the time for a delivery driver to deliver the pizza to the customer before it cools down.

$$\frac{dT(t)}{dt} = -k\left[T(t) - A(t)\right],\ T(t_0) = T_0$$

    - The above equation is a linear first order ODE with an initial condition.
    - Solve it by "Integrating Factor"
    - Here A(t) = the temperature in the car at time t (assuming the car is operating air condition or heating).

- Estimate the time of death for a dead body.
  - Using the equation at the top

- Control the temperature inside a building.

$$\frac{dT(t)}{dt} = k\left[A(t) - T(t)\right] + U(t) + V(t)$$

  - $U(t)$ = the rate of change in temperature due to people, light and machines inside a building at time t
  - $V(t)$ = the rate of change in temperature due to the air conditioner or heater inside a building at time t

  - People always want to keep the indoor temperature to maintain at a comfortable degree. Here "Newton's law of Cooling" will be used to analyze whether or not it is always possible to do that.

- The software "Maple" and "Matlab" will be used to solve some equations and plot some graphs and then analyze the relationship among those variables in the equations.

- I am still reading some books about this topic. So more things may be added to my project.