Applications Programming

Introduction to Excel Model Building

Population Model

- Math Formula:
  P[t] = P[0]*e^(r*t) = P[0] * EXP(r*t)
  or P[t] = P[t-1]*e^(r) = P[t-1] * EXP(r)

- Parameters:
  P[0] — Initial population
  r — Yearly growth rate

Excel Model Principles

- Put parameters in a separated area
- Data vs Information
    - Data, especially parameter data, must have accompanying explanation so that its information can be understood
- Raw data vs Processed data
- Avoid repetitive manual work and write ONE formula for all similar situations

Loan Model

- Math Formula:
  Assume that you borrowed N dollars with the yearly interest rate R, and decided to make monthly payment M. Then, your first month's balance would be N. And each month, the interest generated would be I = (balance*R/12); the amount to pay down the principal would be (M - I); and the new balance (balance for next month) would be (balance-(M-I)).

- Parameters:
  N — Capital borrowed
  R — Yearly interest rate
  M — Monthly payment

Moon Movement

- Our Earth revolves around the Sun and the Moon revolves around the Earth. We want to graph the orbit of the Moon with respect to the Sun.
- To simplify the problem, we have the following assumptions:
  - The orbit of the Earth around the Sun is a circle.
  - The orbit of the Moon around the Earth is also a circle.
  - Both orbits lie in the same plane.
  - The radius of the Earth orbit is one length unit.
  - A full orbit of the Earth takes one time unit (one year).

Moon Movement Formula

- Parameters:
  R — Radius of Earth’s orbit around the Sun
  r — Radius of Moon’s orbit around the Earth (r < R)
  m — the number of full orbits of the Moon in one full Earth orbit

- then at time t (as percentage of a full Earth orbit), the Earth's position relative to the Sun is:
  <xp, yp> = <R*cos(2*Pi*t), R*sin(2*Pi*t)>

- and the Moon's position relative to the Earth is:
  <xr, yr> = <r*cos(2*Pi*m*t), r*sin(2*Pi*m*t)>

- and the Moon's position relative to the Sun is:
  <xm, ym> = <R*cos(2*Pi*t) + r*cos(2*Pi*m*t),
  R*sin(2*Pi*t) + r*sin(2*Pi*m*t)>