

- Physical phenomenon : Case 1: Fall of free body

高中物理實驗: pivoting machine, paper

Case 2: Population dynamics:

人口爆炸!

Case 3: Cooling :

- Mathematical model :

Case 1: Fall of free body

$$m\ddot{r}(t) = -GMm/r^2$$

If r is near the surface of the earth, we have

$$r(t) = R + h(t)$$

where R is the radius of the earth and h is elevation. Therefore, we have

$$\ddot{h}(t) = -GM/(R + h(t))^2$$

Since $h \ll R$, we can reformulate the above equation to

$$\ddot{h}(t) = \frac{-GM}{R^2} \frac{R^2}{r^2} = -g \frac{R^2}{(R + h)^2} = -g$$

Case 2: Population dynamics:

$$\dot{y}(t) = \alpha y(t), y(0) = y_0$$

Method of solution:

- (1). Grossman
- (2). Successive iteration method(mathematica plot)
- (3). Series solution

Case 3: Newton's law of cooling:

$$\dot{y}(t) = \alpha y(t), y(0) = y_0$$

$\alpha > 0$?

$\alpha = 0$?

$\alpha < 0$?