Resolución del sistema de ecuaciones

$$\begin{cases} P'(t) = \alpha_1 P(t) - \alpha_2 P(t) d(t) \\ d'(t) = -\beta_1 d(t) + \beta_2 P(t) d(t) \end{cases}$$

1) Igualamos a 0 (condiciones)

$$P'(t) = \alpha_1 P(t) - \alpha_2 P(t) d(t) = 0$$
$$d'(t) = -\beta_1 d(t) + \beta_2 P(t) d(t)$$

2) Despejar

$$\alpha_1 P(t) = \alpha_2 P(t) d(t) \qquad -\beta_1 d(t) = -\beta_2 P(t) d(t)$$
$$d(t) = \frac{\alpha_1 P(t)}{\alpha_2 P(t)} \qquad P(t) = \frac{-\beta_1 d(t)}{-\beta_2 d(t)}$$

$$\boxed{d(t) = \frac{\alpha_1}{\alpha_2}} \qquad \boxed{P(t) = \frac{-\beta_1}{-\beta_2}}$$

- Realizar Promedios

$$\bar{P} = \frac{\beta_1}{\beta_2} \qquad \bar{d} = \frac{\alpha_1}{\alpha_2}$$

$$\bar{P} = \frac{715.7}{21} = 34.08095$$

$$\bar{d} = \frac{423.5}{21} = 20.16667$$

2) Despeje y sustitución

$$\frac{715.7}{21} = \frac{\beta_1}{\beta_2} \qquad \frac{423.5}{21} = \frac{\alpha_1}{\alpha_2}$$

$$\beta_1 = \frac{715.7}{21}\beta_2 \qquad \alpha_1 = \frac{423.5}{21}\alpha_2$$

- Sustitución de datos en ecuaciones para encontrar constantes

$p(t) = p(0) \cdot e^{\alpha_1 t}$ (población depredador baja)

$d(t) = p(0) \cdot e^{-\beta_1 t}$ (población de presas bajas)

- Años 1909 = 25.4 1908 = 22 (conejos)
  1909 = 9.1 1908 = 8.3 (lince)

2) sustitución

$p(t) \Rightarrow 25.4 = 22\, e^{\frac{423.5}{21}\alpha_2}$ • aplico ln

$\ln\left|\frac{25.4}{22}\right| = \frac{423.5}{21}\alpha_2$

$\alpha_2 = \frac{6}{121}\ln\left|\frac{127}{110}\right| = 7.12595 \times 10^{-3} = \alpha_2$

- sustitución

$d(t) \Rightarrow 9.1 = 8.3\, e^{\frac{-715.7}{21}\beta_2}$

$\frac{9.1}{8.3} = e^{\frac{-715.7}{21}\beta_2}$ • aplico ln

$\ln\left|\frac{9.1}{8.3}\right| = \frac{-715.7}{21}\beta \Rightarrow \beta_2 = \frac{-21}{715.7}\ln\left|\frac{9.1}{8.3}\right|$

$\beta_2 = -2.70001 \times 10^{-3}$

Sustituir en EC.

$\alpha_1 = \frac{423.5}{21}\alpha_2 \Rightarrow \alpha_1 = \frac{423.5}{21}(7.12595 \times 10^{-3})$

$\beta_1 = \frac{715.7}{21}\beta_2 \Rightarrow \beta_1 = \frac{715.7}{21}(-2.70001 \times 10^{-3})$

## Resultados

$\alpha_1 = 0.14371$ $\quad$ $\beta_1 = -0.09201$

$\alpha_2 = 7.12595 \times 10^{-3}$ $\quad$ $\beta_2 = -2.70001 \times 10^{-3}$

- Ecuaciones (constantes sustituidas)

$p'(t) = 0.14371\, p(t) - 7.12595 \times 10^{-3}\, p(t)\, d(t)$

$d(t) = \frac{\alpha_1}{\alpha_2} = \frac{0.14371}{7.12595} = 20.16714$

$d'(t) = -\beta_1 d(t) + \beta_2 p(t)\, d(t)$

$d'(t) = 0.09201\, d(t) - 2.70001 \times 10^{-3}\, p(t)\, d(t)$

$p(t) = \frac{\beta_1}{\beta_2} = \frac{-0.09201}{-2.70001 \times 10^{-3}} = 34.07765$