Lab F Human Population - Logistic Models

$$\frac{\Delta y}{\Delta t} = r \cdot y \cdot \left(1 - \frac{y}{L}\right)$$

Where do r, L Come from?

Population Data

How do we get r, L from Pop Data? Linear Regression

① P 313 $\Delta t = 1$

$$\frac{\Delta y}{\Delta y} = r - r \cdot \frac{y}{L}$$

② Div by y

③ Distribute r

$$\frac{\Delta y}{y} = -\left(\frac{r}{L}\right) \cdot y + r$$

$$\frac{\Delta y}{y} = m \cdot y + b$$

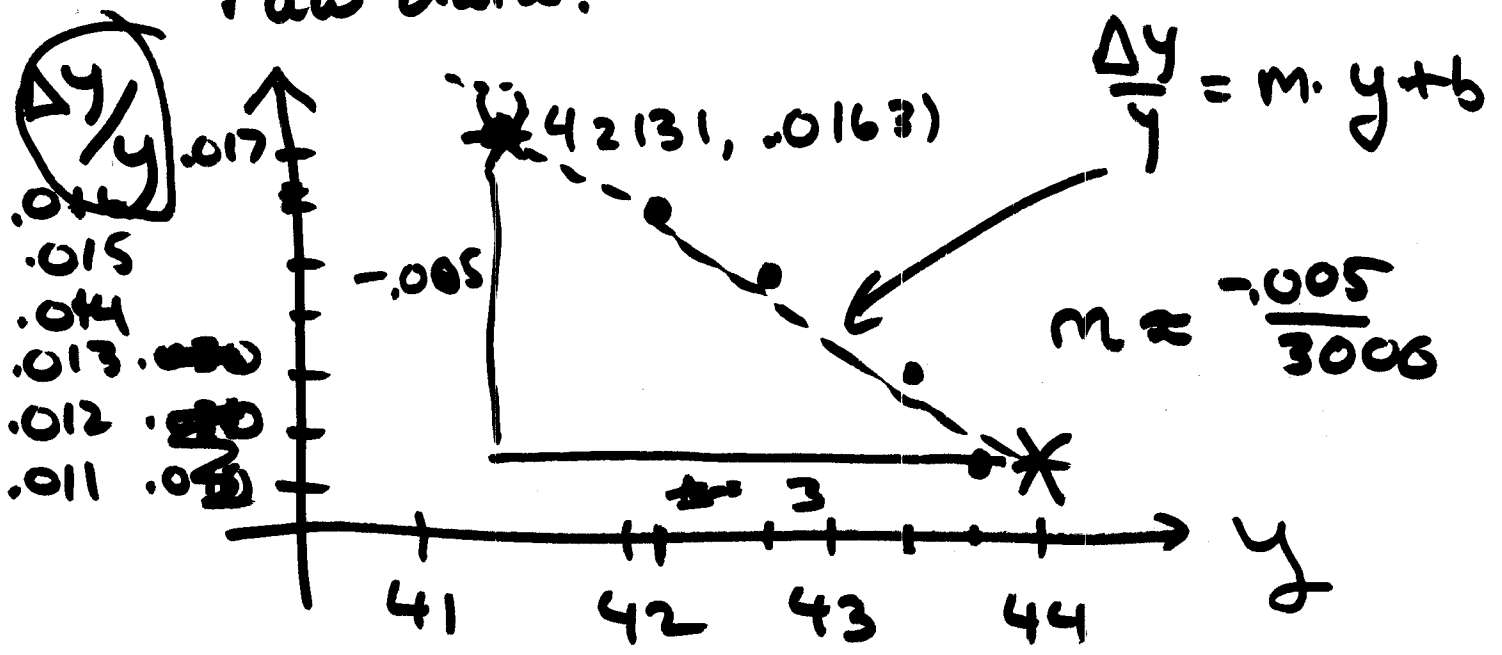
Knowing m, b we can find r, L

$r = b$ $\quad -\frac{r}{L} = m \quad L = \frac{-r}{m}$

$L = \frac{-b}{m}$

Yr	Pop	% change $\Delta y/y$
97	41,456	
98	42131	$(42131-41456)/41456 = .0163 = 1.63\%$
99	42754	1.48%
00	43309	1.30%
01	43,792	1.12%

raw data.



Excel : ③

$m = -3.088\,E\text{-}06$ ← 6 d. places to left

↑ scientific notation.

$= -.0000030888$

$b = +1.466\,E\text{-}01$ 1 d. place to left

$= +0.1466$

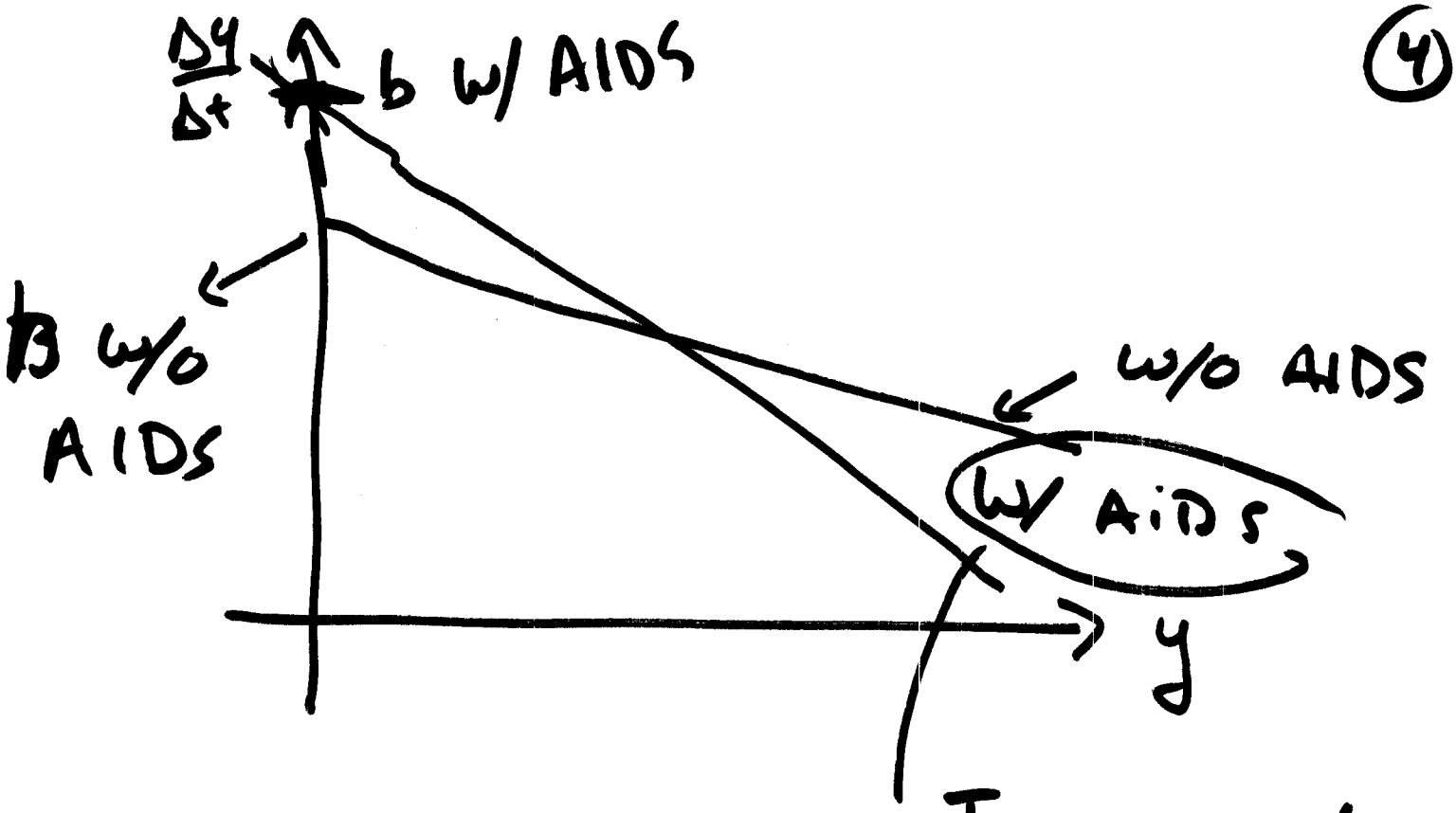
$r = b = -.1466 = -14.66\%$

$L = -\frac{b}{m} = +\frac{1.466\,E\text{-}01}{+3.088\,E\text{-}06}$

$= E(-1-(-6))$

$= .4746\ E\ 5$ ← 5 d. places to right

$= 47{,}460.$



The early growth rate of 14.66% is artificially high!

Increased the decrease in % growth rate

Raw data

t	y	Pop

Logistic Model

$$\frac{\Delta y}{\Delta t} = .1466\, y\left(1 - \frac{y}{47460}\right)$$

So the early exponential growth rate was about 14.66% & the carrying capacity of S.A. appears to be 47,460,000

Using Logistic Model to make predictions:

$\frac{\Delta y}{\Delta t}$ = change in y

$$= r y \cdot (1 - y/L)$$

Let $\Delta t = 1$

Change in $y = r y (1 - y/L)$

New y − old y = "

new y = old y + $r y (1 - y/L)$