$$y = k \cdot a^t$$

Growth

$DT = \frac{\log 2}{\log a}$

$a = 2^{\frac{1}{DT}}$

DT = "Doubling time"

a = growth factor

$a = 1 + r$

$r = a - 1$

r = growth rate

2 steps – the long way

Rule of 70 – approximate

Short cut to $r \leftrightarrow DT$

Write r as a number

$DT = \frac{70}{r}$ or $r = \frac{70}{DT}$

ex ~~If~~ at 4% $DT = \frac{70}{4} = 17.5$ yrs

Steps to graph in Excel

① Enter Data in Columns

② Click in Data

③ Insert (menu) Chart

④ XY Scatter

⑤ Enter Titles, X,Y axes

Info given a graph

		doubled to		
~5000	in 1940	10,000	in '75	-35 yrs
~6000	in 1950	12000	in '85	~35 yrs
~7000	1960	14	in '95	~35 yrs

with $DT = 35$ yrs, $r = \frac{70}{35} = 2(\%)$

Rough Exponential Model

$k = 5000$

$a = 1 + .02$

$y = 5000 \cdot 1.02^t$

$y =$ pop Ch. (K's)

$t =$ yrs @ 1940

Using Excel to find regression line, curve from plotted data

① Click on a data point.

② Chart Menu → Add Trendline

③ Type · Linear or Exponential

Options - Display Equation

- Display R^2

$$y = \underbrace{4922.9}_{k}\left(e^{0.0194}\right)^t$$

$$Q = e^{0.0194} = e\text{^}(0.0194)$$

$$= \exp(0.0194)$$

$$= 1.0195589$$

$$Q - 1 = r = 1.96\%$$

Two Models

rough/ready

$$y = 5000 \cdot 1.02^{t}$$

quick, reasonably accurate

regression

$$y = 4922.9 \cdot 1.0196^{t}$$

Used excel for many calculations but best possible exponential model - least RMSR.

9-16-05

Log Graphs in Excel (5)

(1) Data - Add column = Log(y)

t	y	Log(y)
.	.	.
.	.	.
.	.	.
.	.	.

(2) Graph of t - log(y)

- Click in data
- ~~Select~~ Chart
  Insert

- Delete y-series
- Added Titles Axes
  Log(y) on vertical axis

(3) Data modeled by
exponential ⟷ log(y)
graph is linear