15.871 Recitation #4

Modeling Product Adoption & Diffusion

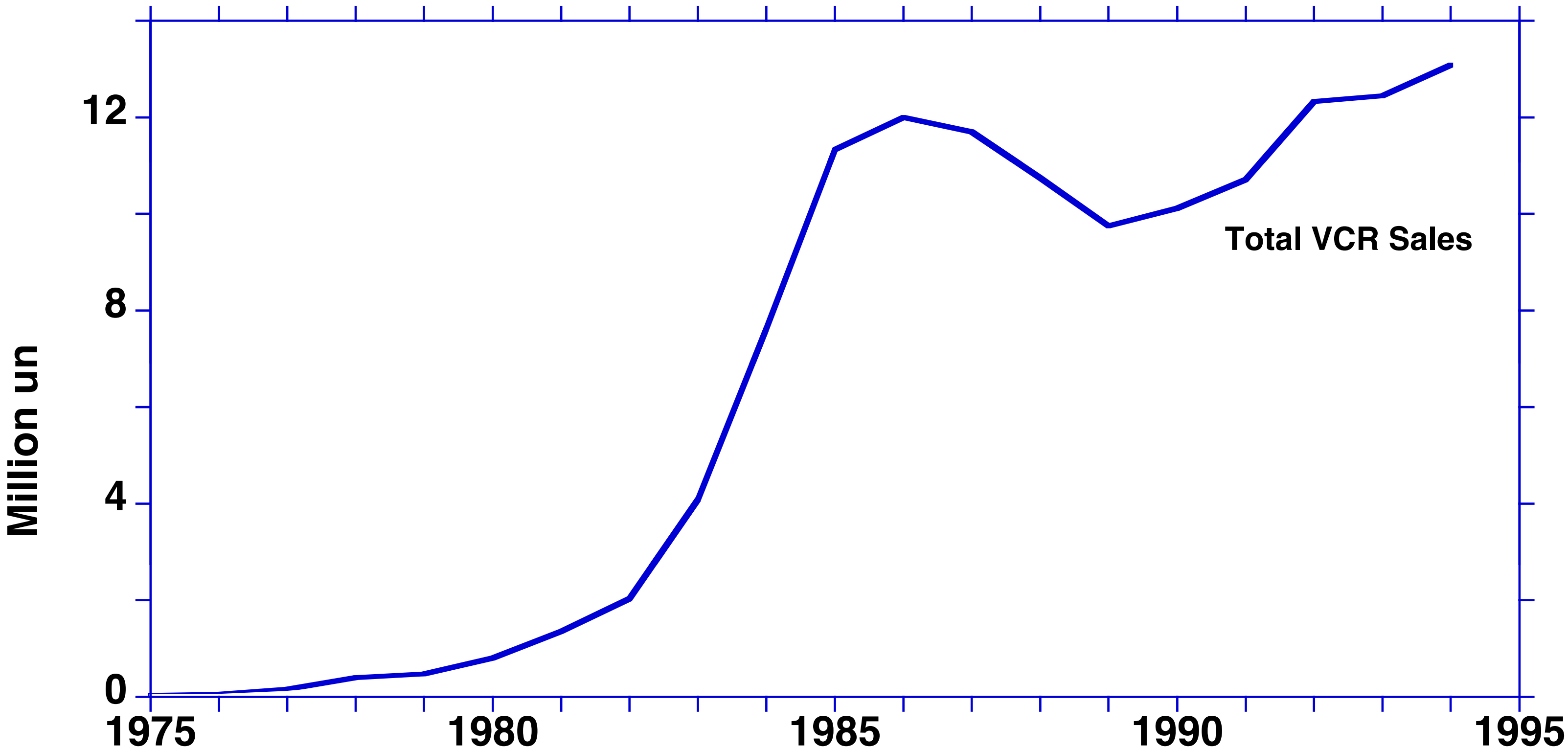
Fall 2013

MITSloan

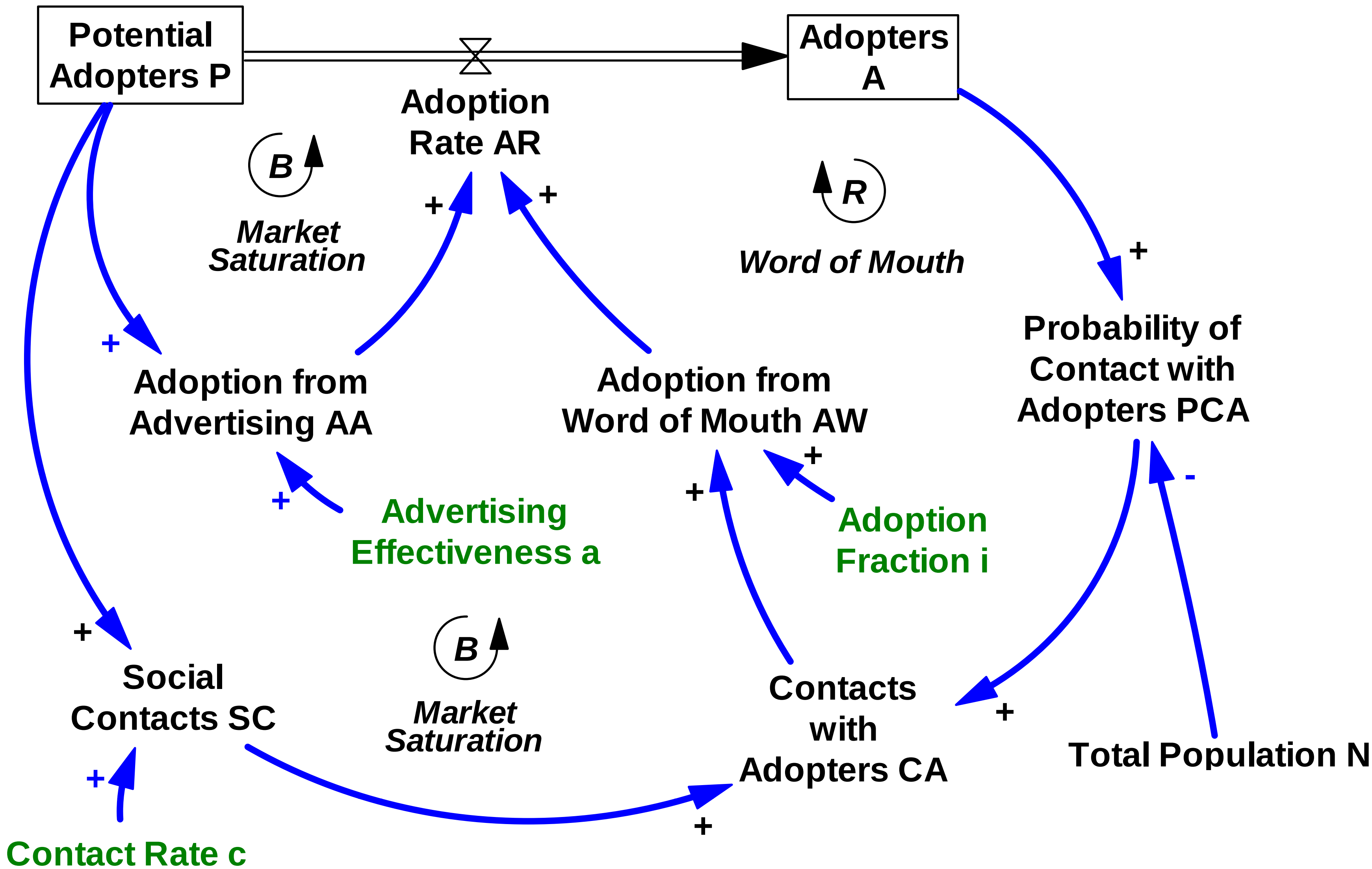
Agenda

- Adoption/Diffusion Models
  - Modified Bass Diffusion Model (starting Vensim model)
- Delays
  - Response of a Delay (Ch 11.1-11.2, more in H2)
- Stock Management
  - Beer Game Stock Management Example
- Learning Curve (Ch 10, BD pg 337-8)
- Partial Model Tests
- Robustness under Extreme Conditions

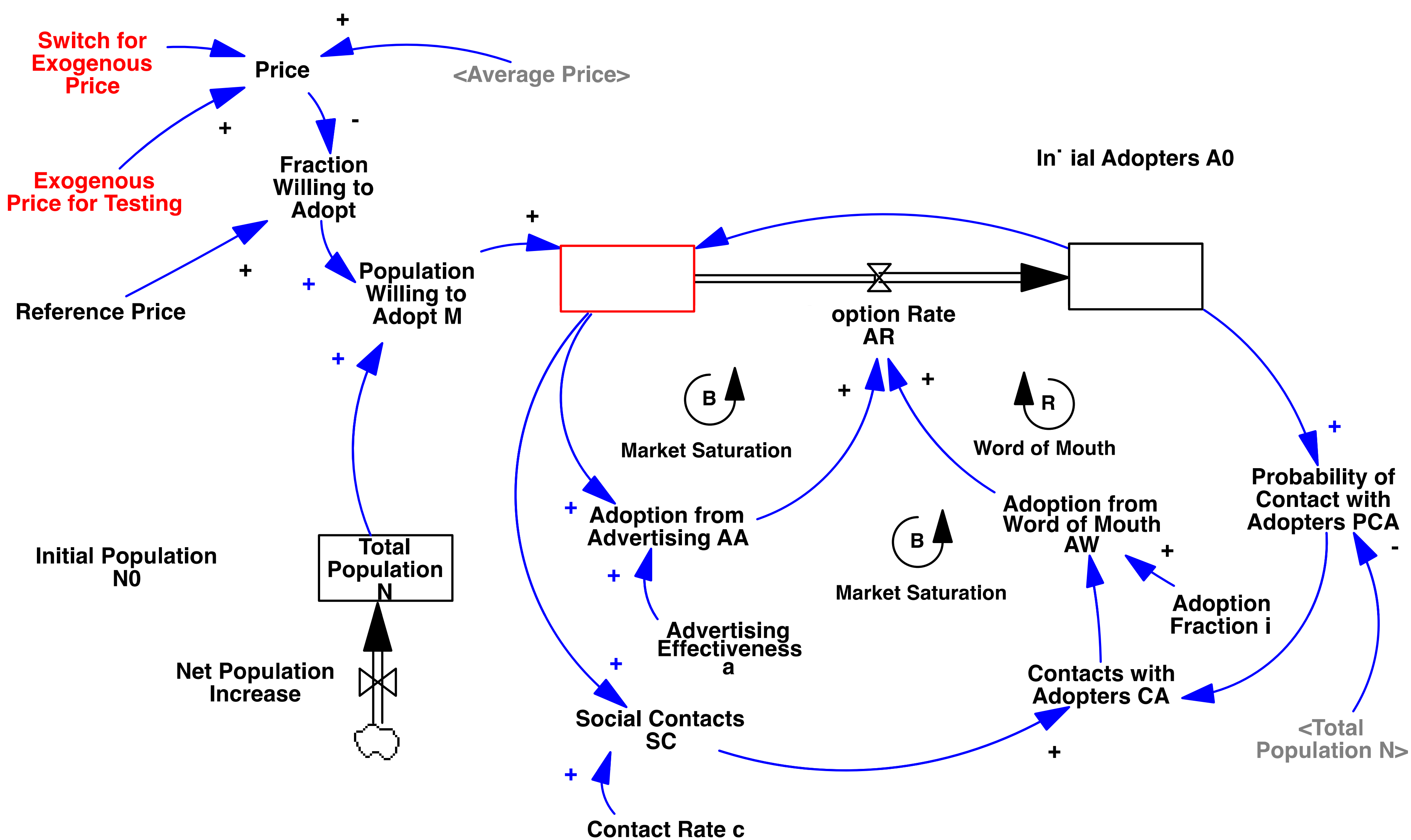
Historical Data: Upload vdf VCR Sales, US

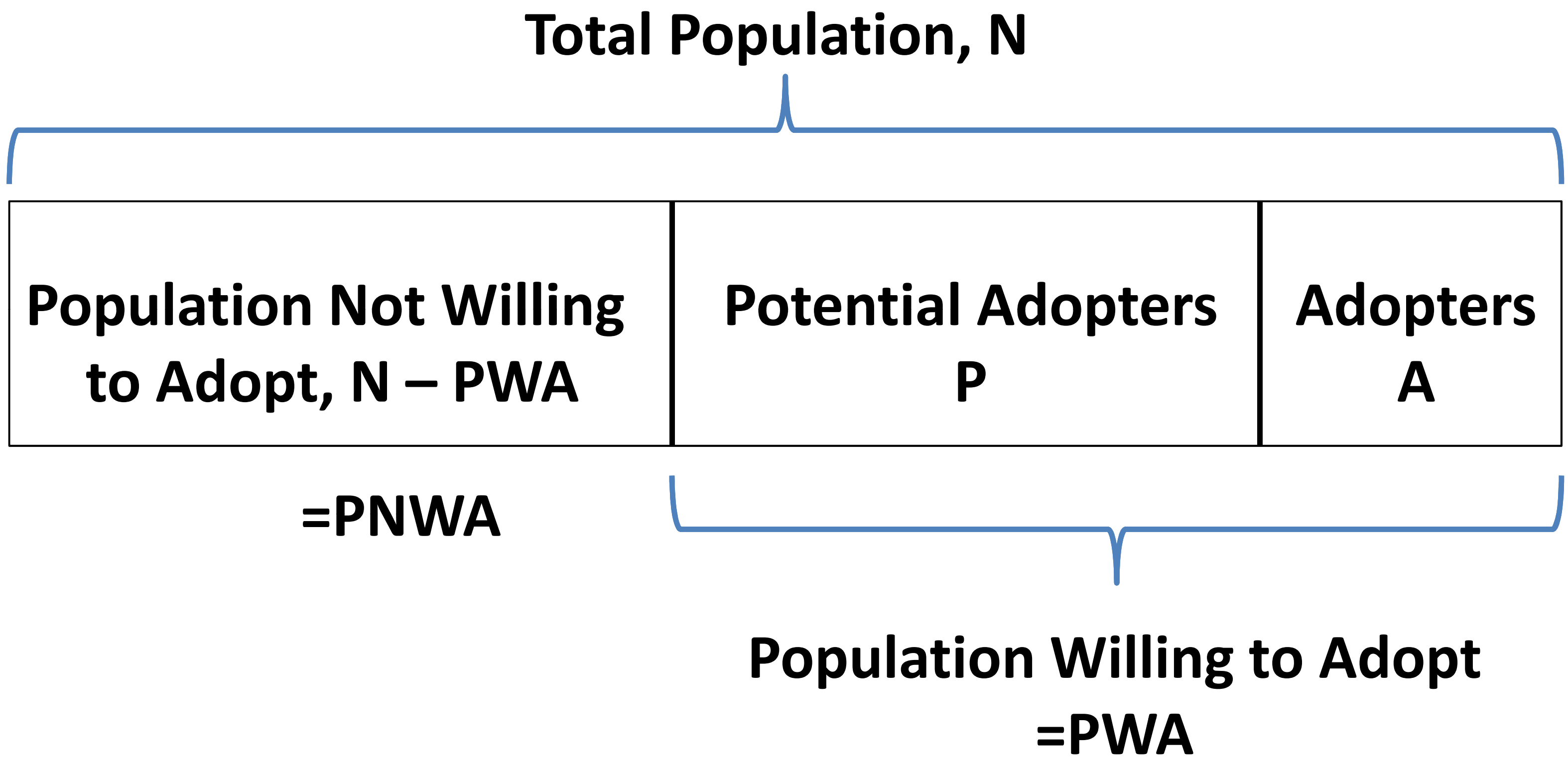


Bass Diffusion Model



Modified Bass Diffusion Model



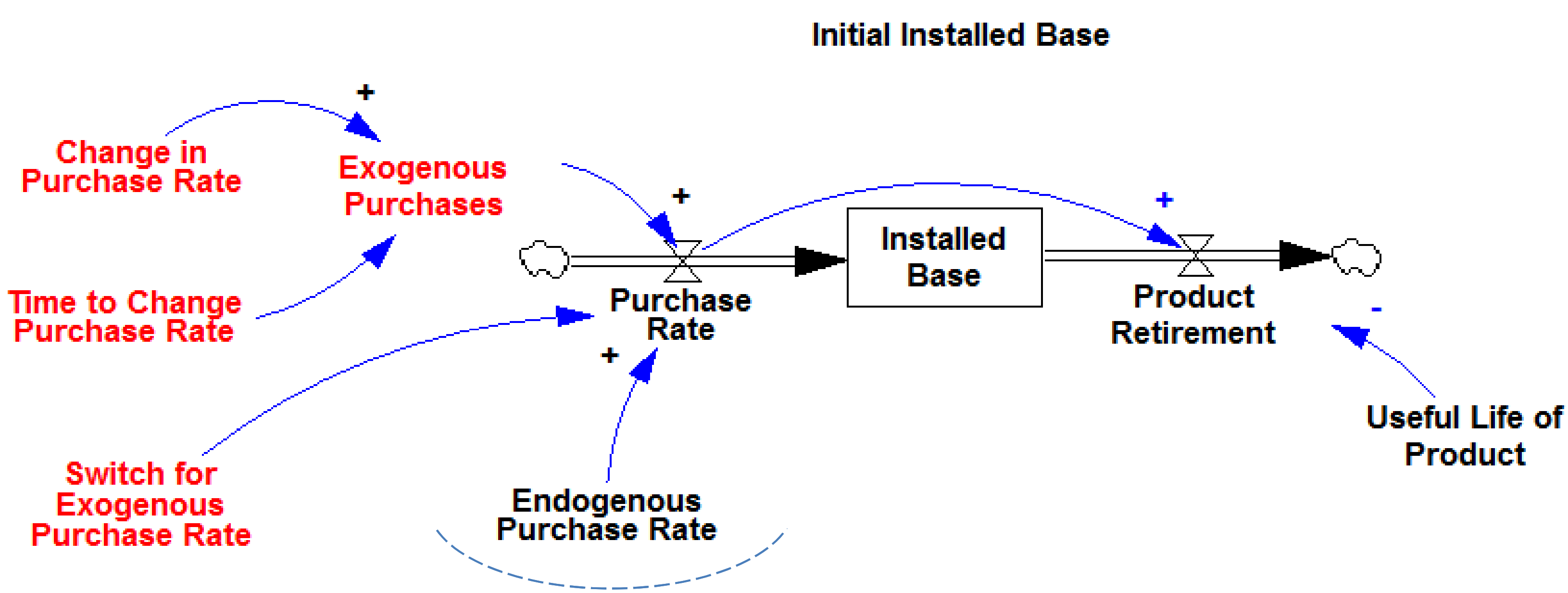


N = INTEGRAL(Net Population Increase, N_0)

Adopters = INTEGRAL(Adoption Rate, Initial Adopters)

Potential Adopters = MAX(0, Population Willing to Adopt – Adopters)

Stock Management Structure

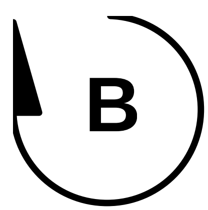


PART A INTERACTIVE : BEER GAME STOCK MANAGEMENT EXAMPLE

Draw the causal loop diagram (CLD) and write the equation for the “order rate” according to assumptions that will be presented.

Please note that your CLD and equation for the “order rate” should be “dimensionally consistent”.

order rate= ?



PART A INTERACTIVE :
MAPPING OF A SIMPLE STOCK-MANAGEMENT STRUCTURE

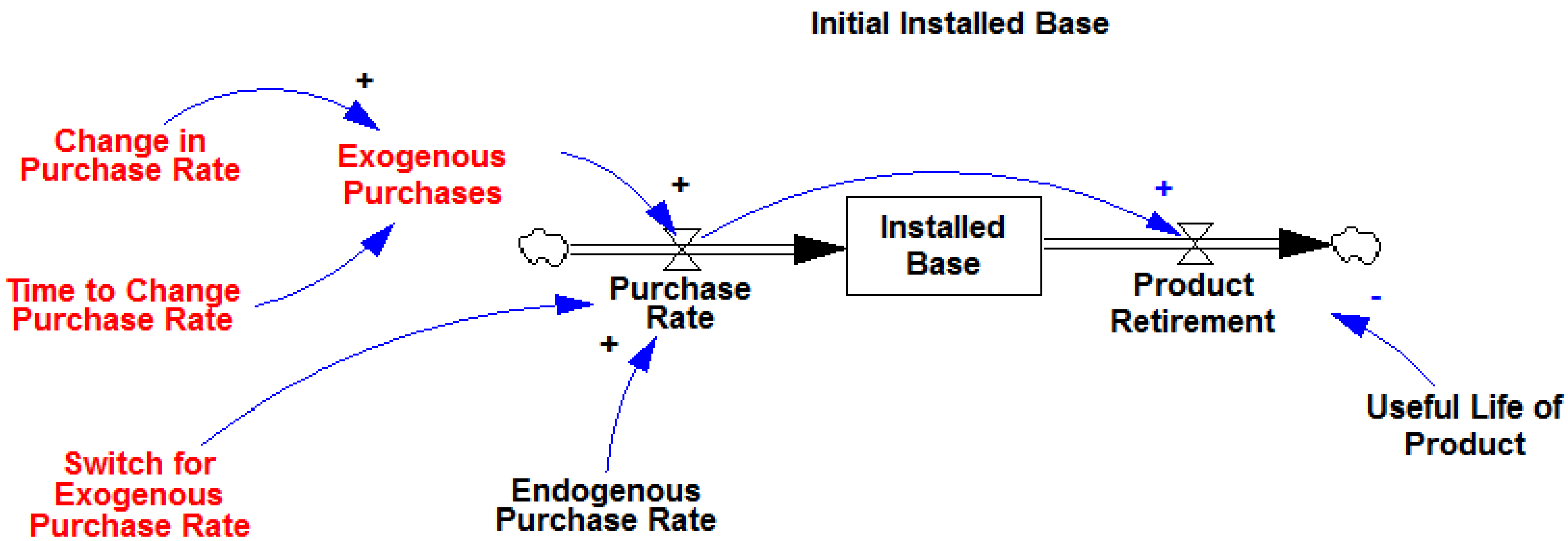
Draw the causal loop diagram (CLD) and write the equation for the “orders” according to the assumptions below. Please note that your CLD and equation for the “orders” should be “dimensionally consistent”.

ASSUMPTIONS:

- No delays in deliveries
- No returns
- Shipments are exogenous
- Firm adjusts orders to bring inventory in line with “desired inventory”
- Seeks to close any inventory gaps over a 2-week period.

- HINT: What should go into the “orders” variable?

Response of a Delay

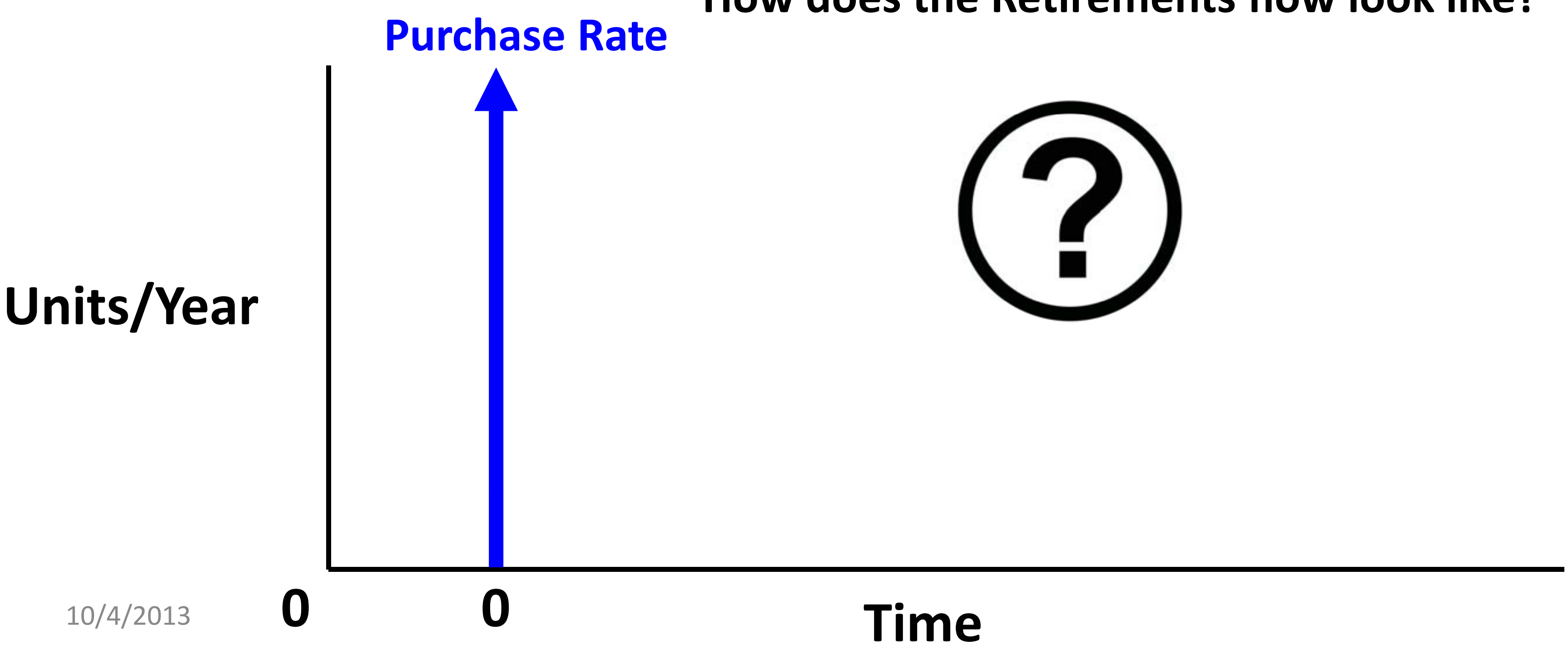


Product Retirement= DELAY N(Purchase Rate, Useful Life of Product, 0, 6)

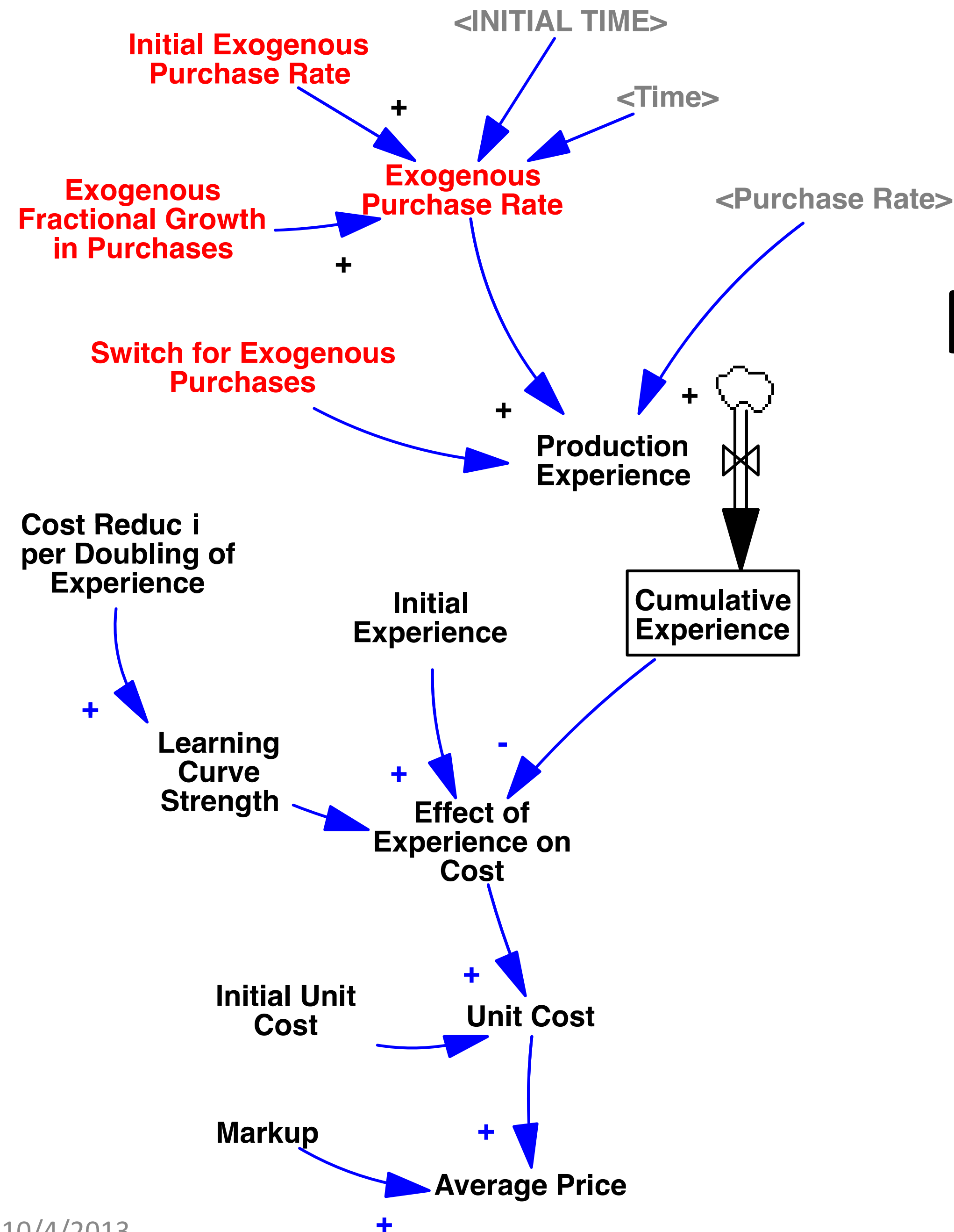
PART B INTERACTIVE : PULSE RESPONSE OF A DELAY

Please sketch your best estimate of “retirements” after a pulse of purchases:

How does the Retirements flow look like?



Price & Learning Curve



Ch 10, BD pg 337-8

Basic Learning Curve Formulation

$$c_t = f(E_t)$$

$$c_t = c_0 \left(\frac{E_t}{E_0} \right)^{\lambda}$$

$$(1 - f)c_0 = c_0 (2E_0 / E_0)^{\lambda}$$

or

$$\lambda = \ln(1 - f) / \ln(2) = \log_2 (1 - f)$$

- c_0, E_0 = initial unit costs and cumulative experience

$$E_t = \int_0^t e_s ds$$

- λ = learning curve strength
- Example: For a learning curve with *f=0.3,* λ*=0.5146*
- *f= 0.3 implies a 3*0% cost reduction for every doubling of cumulative experience ($\lambda \approx 0.51$)