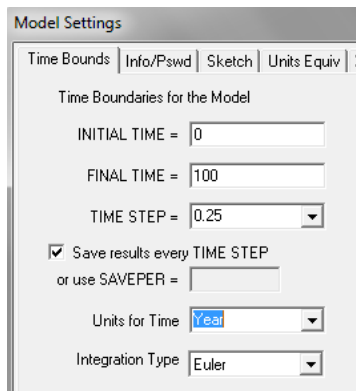


## Exercise 3 - Customer Base

*Imagine you are the customer service manager of a firm that manufactures a durable product. You are interested in modeling the behavior of the customer base for your product, in order to understand future customer service requirements better.*

### Part A.

1. Start Vensim.
2. Create a new model using the New Model toolbar button or the File>New menu command. Don't forget to save your work as you go.
3. Simulate the model for 100 years, using a time step and save period of 0.25 year:



4. Draw a customer base structure, using the stock, flow, and auxiliary tools:



. If you make a mistake, you can delete variables or links




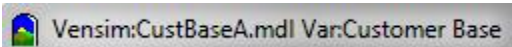




using the Delete tool . Incorporate the following assumptions:

- Your customer base is increased by new adoptions, and decreased by customers dropping out. Initially, you have no customers.
- Following product launch in year 10, 1000 customers per year adopt your product. (You can use the Vensim STEP function to simulate this behavior: STEP(1000,10) returns 0 until year 10, and then returns 1000 after that time).
- Each year, a tenth of your customers drop out of the customer base. This yields an average residence time for customers in the base of 10 years (why?).

5. Once you have sketched your model's structure, define equations for each variable by clicking with the equation tool, . Be sure to enter units of measure for each variable: . What kind of feedback loop(s) are in your model?

6. When you are finished, check that your units balance using Units Check on the Model menu (be sure to set the units for time to "years" first).
7. Before you run or look at any output graphs, take a moment to sketch the behavior you expect for the customer base:



8. Simulate the model .
9. Make Customer Base the workbench variable by double-clicking it with the hand or lock tool  . You should see the variable name appear in the window title bar:  

10. Use the graph  or strip graph  tools to explore the model output. What does the behavior of the customer base look like? Were your expectations correct? Why or why not?
11. Simulate the model again, using different product lifetimes. Use the toolbar to give each run a unique name  

12. Use the table tool  to answer the following questions:

- How is the final customer base related to the product lifetime?
- How long does it take for the customer base to reach 1/2 its final value?
- How long does it take for the customer base to reach 2/3 its final value?
- How long does it take for the customer base to reach 95% of its final value?

**Part B.**

*So far, your firm's sales (new customer adoptions) have been constant. In reality, the adoption rate increases as your growing customer base leads to more word of mouth sales. You would like to modify your model structure to reflect this fact.*

13. Save your model under a new name.

14. Modify your model with the following assumptions:

- The total customer adoption rate is no longer a step or constant; instead it is the sum of word of mouth adoptions and promotional adoptions.
- Promotional adoptions occur when your company seeds the market with free products. You seed the market with a one-time giveaway of products to 1000 customers at product launch in year 10. (See the notes at the end of the exercise for a way to use the Vensim PULSE function to represent this).
- Word of mouth adoptions occur when your customers contact other people and convince them to buy your product.
- Each of your customers contacts about 10 other potential customers per year.
- Only about 1% of your customers' contacts are fruitful, leading to a sale.

15. Sketch the model structure and define equations. What kind of feedback loop(s) do the new features add to your model?

16. Check that your units balance (Model>Units Check menu, be sure to set the units for time to "years" first).

17. Take a moment to sketch the behavior you expect for the customer base:



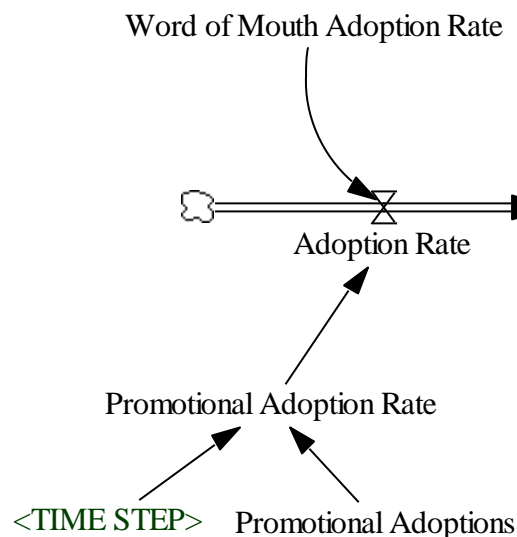
18. Simulate the model .

19. Use the graph or strip graph tools to explore the model output. What does the behavior of the customer base look like? Were your expectations correct? Why or why not?
20. Simulate the model again, assuming that customer contacts are only half as fruitful - 0.5% of contacts result in a sale. What happens to the behavior?
21. Simulate the model with more fruitful contacts - try 1.5% and 2% of contacts resulting in a sale. What happens to the behavior? How can you explain the change in behavior (vs. #18) in terms of feedback loop structure?
22. Working with the model runs from #19, use the table tool to answer the following questions:
  - After year 10, what is the annual net growth rate of the customer base?
  - How long does it take for the customer base to double?
  - How long does it take for the customer base to quadruple?
  - How is the doubling time related to the net growth rate, contact fruitfulness, and other parameters?
23. Conduct a simulation experiment to compare the effect of doubling contact fruitfulness to doubling the initial pulse of promotional adoptions. Which change has a greater impact on the customer base? If you were trying to maximize the customer base, what parameters offer the most leverage?
24. What's wrong with this model?

## Using the PULSE Function for Instantaneous Flows

The goal of the promotional adoptions process in your model is to get 1000 customers into your customer base stock in a single event - "instantaneously". You want this to work no matter what TIME STEP you choose for the simulation, as you may want to change your TIME STEP to ensure that it stays "small enough" to ensure accurate results.

If your TIME STEP is 0.25 year, this means that you will need the flow (rate) of promotional adoptions to be 4000 customers/year:  $4000 \text{ customers/year} * 0.25 \text{ year} = 1000 \text{ customers}$ . If you were to later change your TIME STEP to .01 year, you would need a rate of 100,000 customers/year. You can create a Promotional Adoption Rate that automatically adjusts to changes in the TIME STEP with a structure like the following:



```

Adoption Rate=
    Promotional Adoption Rate+Word of Mouth Adoption Rate
    Units: customers/Year
Promotional Adoption Rate=
    Promotional Adoptions/TIME STEP*PULSE(10,TIME STEP)
    Units: customers/Year
Promotional Adoptions=
    1000
    Units: customers
  
```

PULSE is a built-in Vensim function that acts as a switch to identify the starting time (year 10) and duration (one TIME STEP) of the promotional adoptions. Promotional\_Adoptions/TIME\_STEP identifies how fast the promotional adoption rate must be - the smaller the time step, the faster the flow.