

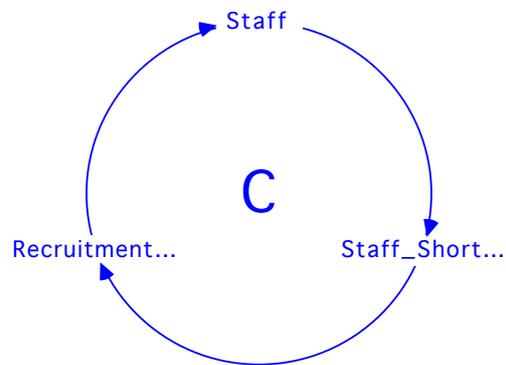
Exploring Models 2

Stella Guide 4

Drifting Goal Solution & Exercises



Loop 1: p1 (Intended Balance)



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The Problem

A firm recruits staff according to shortage of staff measured next to a fixed goal, or target. See Stella guide 3. However because staff leave they find they are permanently under recruiting. Advise them on a different recruitment policy.

Aim

In this lab you will learn how to solve a drifting goal problem and have the opportunity to explore two more drifting goal situations.

True Solution to Drifting Goal

Before going any further bring back the model of staff recruitment from Stella Guide 3

Solution

If the recruitment rate could be increased by an amount equal to the leaving rate then balance at the target level could be achieved. I.e.

$$\text{If recruitment rate} = \text{Staff shortage} / \text{recruit time} + \text{leaving per month} *$$

Thus the firm needs knowledge of the recruitment rate. However there is a **problem** fundamental to modelling:

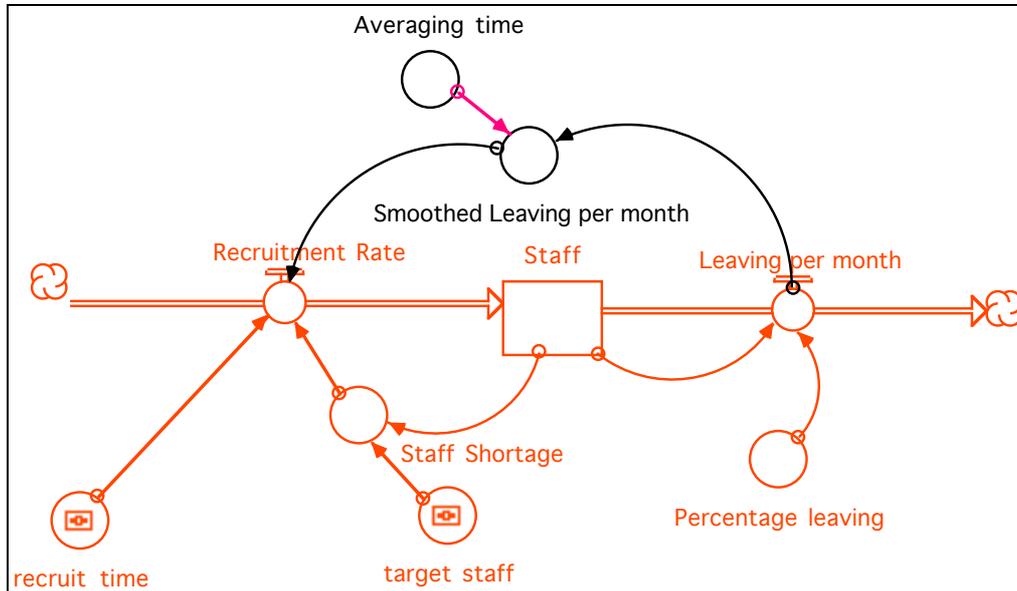
RATES ARE INSTANTANEOUS AND CANNOT BE MEASURED

Any converter, or flow, in Stella which is per unit time is such a rate and its value is in the limit as $dt \rightarrow 0$. Thus they cannot be measure in the real world.

Thus leaving rate cannot be measured by any method at an instant. Thus formula * cannot be used.

Instead all a firm can do is take an average of the leaving rate over a period of time. Stella has a number of functions for this. One is called SMTH3. It is third order smoothing - an average over a period of time.

- Try:



- Where the following should be set by doubling clicking the converters/flows
 - Averaging_time = 3
 - Smoothed_Leaving_per_month = SMTH3(Leaving_per_month,Averaging_time)
Choose SMTH3 from the function list.
 - Recruitment_Rate = Staff_Shortage/recruit_time + Smoothed_Leaving_per_month

Thus the leaving rate is averaged over a recent 3 month period.

Simulation

Back to the interface layer. Set up slider for the *Averaging Time* and run.

You should find the target is achieved.

Question: What affect does changing the *Averaging Time* have - especially if the leaving rate is averaged over a longer period?

Third order smoothing will be explained in a later guides.

Other solutions

- 1 Rather than third order smoothing try first order smoothing

$$\text{Smoothed_Leaving_per_month} = \text{SMTH1}(\text{Leaving_per_month}, \text{Averaging_time})$$

In this case the average gives less weight to later values.

- 2 Rather than look back, look forward and forecast the number leaving per month:

$$\text{Smoothed_Leaving_per_month} = \text{FORCST}(\text{Leaving_per_month}, \text{Averaging_time}, 0)$$

This does a simple trend extrapolation into the future over the required time.

What Has Been Achieved?

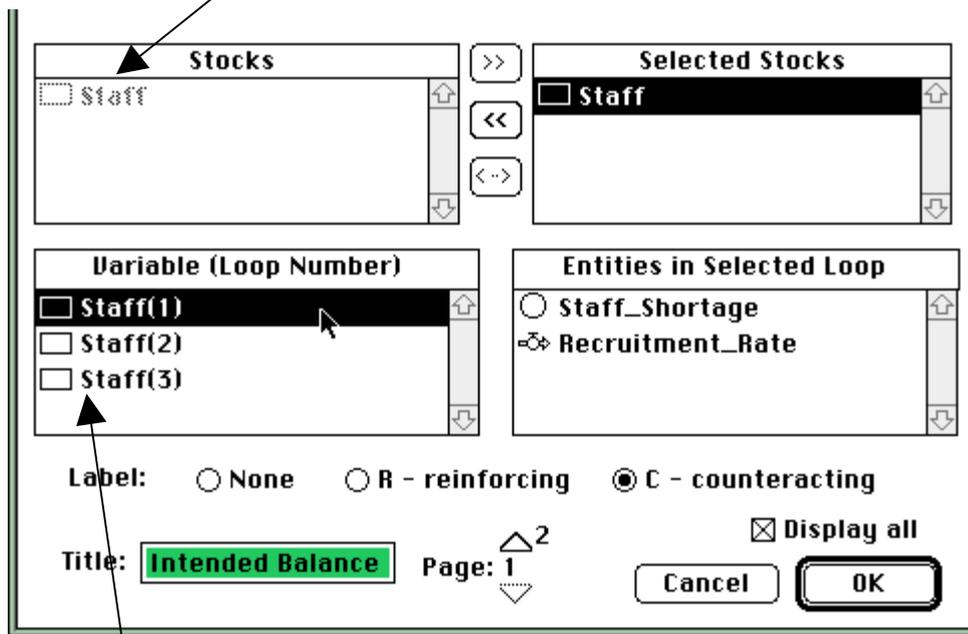
In the last exercise the problem of the drifting goal was solved by making a **policy decision**. That is the firm should change its recruitment policy by adding in a number per month based on an average number leaving in the last few months. This way their targets will be met.

Feedback Loops in Stella

You can get Stella to extract the feedback (causal) loops of a model. On interface (top) layer click the icon



You will be given a list of stock variables through whom you loops are centred. There is only one in this case.

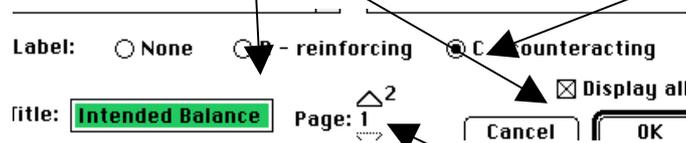


Select staff.

There now appears a list of loops (3 in this case). Select one of these to get the loop.

You will need to check the “display all” box so that each element in the loop is shown

You will need to decided whether it is reinforcing (R) or balancing (called counteracting, C, in Stella).



You can have more than one loop on the same pad by use page.

Exercise - Tree Planting and Harvesting

1. A fruit farmer loses about 8% of his trees every year. So that he doesn't lose the amount of fruit he sells he replenishes them at 8% each year.
 - a) Construct in Stella a basic systems dynamics model of this idealised situation.
 - b) What are the feedback loops?
 - c) Examine the behaviour.
 - d) What effect does changing the initial number of fruit trees have?
 - e) The farmer decides to replenish at a rate of 10% so that he keeps having more fruit to sell. Investigate the outcome in Stella.

2. Instead the farmer decides to set a **goal** of 1000 fruit trees to grow although he currently only has 500. He decided to plant 30% of the difference between his current number of fruit trees and his target number each year thinking that it is best to plant many now and slow down when he is near his target number. He is still losing 8% each year.
 - a) Construct, in Stella, a basic systems dynamics model of this idealised situation.
 - b) What are the feedback loops?
 - c) Examine the behaviour. Is the target achieved, if not what target is achieved?
 - e) Suggest a strategy to the farmer to achieve his target, given he must order trees before he knows the year's losses. Try it out in Stella.

Debrief – Types of Causal Links

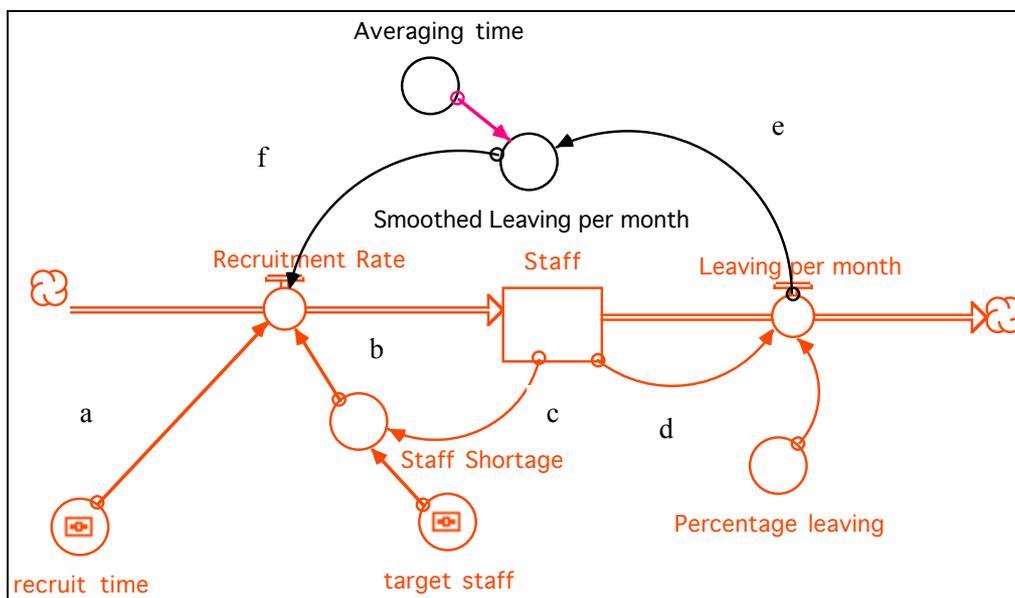
A causal link is statement of cause and effect. If there is a link from A to B it means A causes B. What is more subtle is that some links are different from others. Some can be removed or added because in the real world situation someone can control them, these can be called policy links. Others cannot be changed because they are natural cause and effects and outside human control. Let us call these model links.

Policy Link

A connector which someone in the real world has a choice about putting in or leaving out. They are under human control. They represent a policy of choice.

Model link

A connector which is outside of human control. It is part of the natural laws, physical, social or logical, that govern the system.



a

b

c

d

e

f

When a structural change is made to a model only POLICY links can be changed!

Debrief – Types of Parameters

A parameter is constant (or variable with time) whose value is determined outside the model (exogenous). They represent the boundary of the model.

Like causal links some are under human control and some are not. However the ones that are under human control will have limits to their control. This is called leverage. How much can you legitimately change each parameter?

Leverage of Parameters

Recruit time

Target Staff

Percentage leaving

As you see there was very little scope for solving the problem of missing the goal by changing parameter values. That is why a structural change was sought.