**Notes Pollution in a small loch**

This unit looks at the use of spreadsheets to generate a sequence of values for a recurrence relation. The sequence terms will represent the amounts of pollution in a small loch as the weeks pass by. A dot plot is then formed showing the sequence's terms plotted against the week number. This plot will show clearly how the amount of pollution in the loch changes with time. The idea of the unit is to show how dot plots may help students to visualize the idea of a sequence tending to a limit. It also gives them the insight of seeing that a linear recurrence relation does not depend on the initial amount of pollution in the loch.

 Problem:- The initial quantity of pollution in a loch is 80 tons. With treatment the Council remove 15% during the week while a nearby factory is allowed to discharge 6 tons into the loch at the end of the week. Set up a recurrence relation and use a spreadsheet to generate the sequence of values obtained from the recurrence relation. Create dot plots to show the sequence terms. Consider the limit of this sequence for two other initial values of pollution namely (i) 10 tons (ii) 200 tons , to see if the limit is independent of the initial value.



Students start with a new TI-Nspire document.

**ctrl**

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|  Press + page and select  |  |

Enter 'week' in box A and 'value1' in box B

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| Click in the box just below "week" and press | **menu** | and select,  |

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| We now wish to enter details for the week numbers 1, 2, . . . This is done as shown opposite  |  |

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| Click in the box just below "value1" and press | **menu** | and again select,  |

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| Now enter details for the recurrence relation.  |  |

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Set up dot plot with 'week' on horizontal axis and 'value1' on vertical.

You now have a dot plot showing you how the pollution changes as the weeks pass by. You should see the values getting closer and closer to a limiting value. Would we get the same limit if the initial amount of pollution in the loch was different?

Return to the spreadsheet and add ‘value2’ into box C.

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| Click in the box just below "value2" and press | **menu** | and again select,  |
| Now enter details for the recurrence relation with the changed initial value of 10 tons..  |  |

On the dot plot select the vertical axis, right click on the mouse and choose

1: Add Y variable and choose ‘value 2’.

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| The dot plot for both starting values should now be shown. Your diagram should look like that shown opposite. It should be clear to you that both sequences are tending to the same limit. |  |

The same recurrence relation with an initial pollution of say 200 tons emphasises the result even more that the limit is independent of the initial amount of pollution in the loch.

On the spreadsheet add ‘value3’ into box D.

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| Click in the box just below "value3" and press | **menu** | and again select,  |
| Now enter details of the recurrence relation with the changed initial value of 200 tons..  |  |

On the box plot select the vertical axis, right click on the mouse and choose

1: Add Y variable and choose ‘value 3’

You should now have all 3 variables selected.

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| The box plot for all three different starting values should now be shown. Your diagram should look like that shown opposite. It should be clear to you that all sequences are tending to the same limit and that this limit is independent of the initial amount of pollution in the loch. |  |

You may wish to alter the WINDOW settings for the diagram to get best picture for the sequences calculated. In this example press

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| **menu** |  |  |

and select

