A USER'S GUIDE TO THE DOUGLAS-FIR CALCULATOR

L. Knowles, M. Kimberley, L. Wichmann

Report No. 29 February 2003

DOUGLAS-FIR COOPERATIVE

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L. Knowles, M. Kimberley, L. Wichmann
Forest Research, Rotorua, NZ

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Introduction

The Douglas-fir calculator is a stand level (one-hectare) modeling system, which has been made by distilling the results from some 244 STANDPAK runs. These runs have been selected to cover a wide range of input values, allowing a 'response surface' to be fitted to the results. Where possible functions were selected for the STANDPAK runs that were appropriate for the whole country, rather than for one particular forest or region. The resulting relationships that predict the output values from the core input variables have been placed within the calculator, which runs under EXCEL.

The 34 variables that the user inputs into the calculator can be placed into five categories:
1. Land and livestock- 3 inputs
2. Financial- 7 inputs
3. Growth and quality - 6 inputs
4. Silviculture- 6 inputs
5. Log pricing- 12 inputs

The 46 output variables that the calculator produces can be placed under four categories:
1. Financial:- 6 outputs
2. Wood and stand quality:- 6 outputs
3. Stand level status:- establishment (1 output), thinning to waste (4 outputs), production thinning (4 outputs), and clear felling (3 outputs).
4. Volumes (by log grades):- production thinning (11 outputs) and clear felling (11 outputs).

The main advantages of the calculator are:
- the user interface is contained within a single application window
- the user can quickly test many different options through the built in sensitivity feature
- optimisation is readily achieved by using the 'solver' facility within EXCEL
- the ability to quickly and simply examine many different scenarios. This can be highly educational, and inevitably leads to a number of 'what if' type scenarios being examined
- default values for many of the input variables are contained in 'look-up' tables located on tabs at the base of the screen
- the simple, user-friendly design means the user is unlikely to make mistakes, or if mistakes are made, they can be easily noticed and rectified.

The user has to decide which of the following they are attempting to achieve

a) An evaluation of the most profitable silviculture, as shown by maximising Net Present Value (NPV) per hectare for a given discount rate.
b) Maximisation of NPV (i.e. the same as a), but conditioned by the need to meet certain constraints. These constraints could be financial, quality, or yield oriented, or some combination of all of these.
c) A comparison of land use, particularly where the current land use is livestock grazing, and the user wishes to compare that to Douglas-fir plantation forestry.

Each of these objectives places different requirements on the calculator. Not all of the input variables may be required to evaluate some options. For example, variables dealing with land and livestock are not usually required for silvicultural evaluations.

Getting started

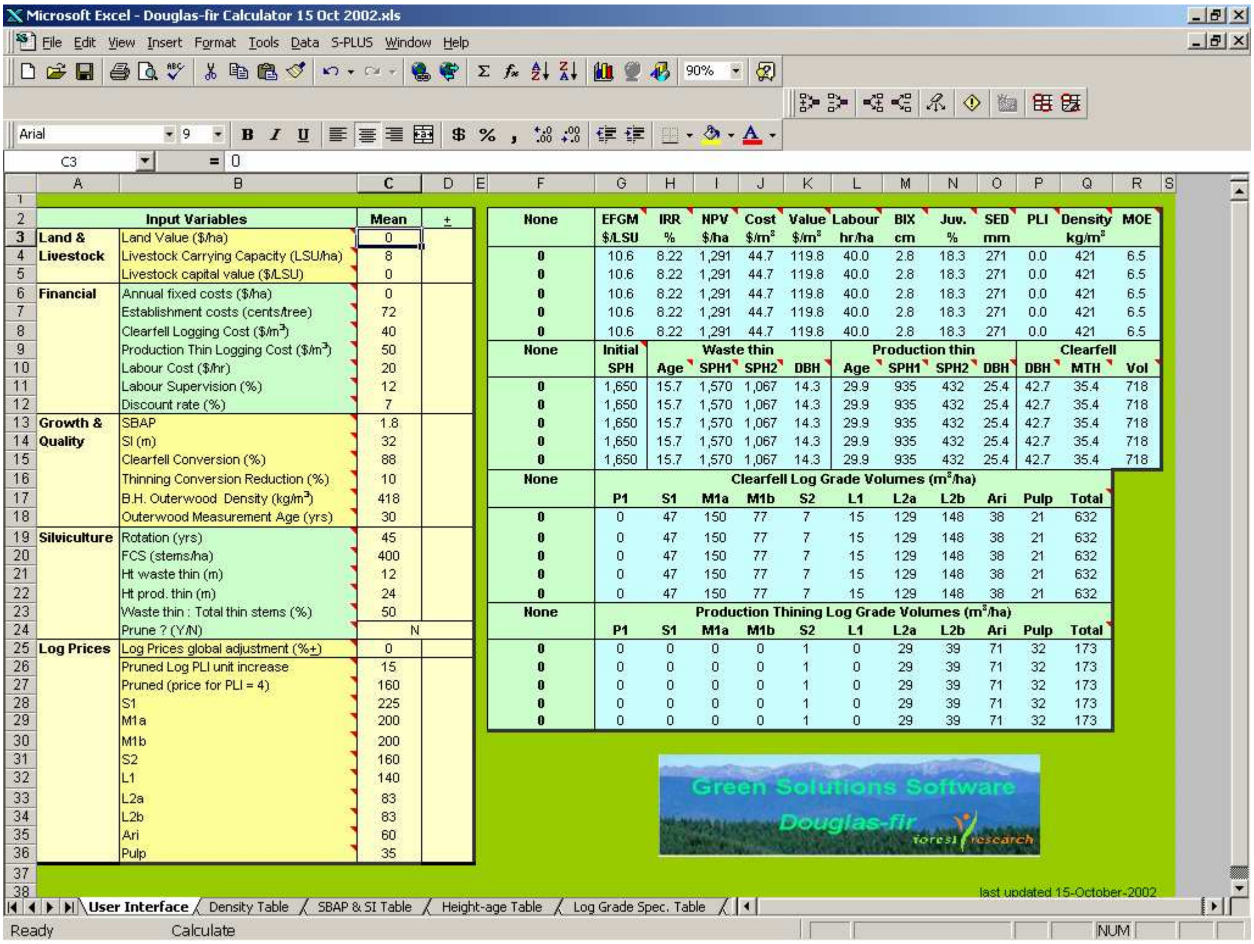
First, let's assume we wish to identify the silvicultural options for a particular site that yields the highest NPV.

The 34 input variables are located within column C, under the five categories- land and livestock, financial, growth and quality, silviculture, and log pricing.

The sensitivity feature is located within column D. This feature can only operate against one input variable at a time. More details on this feature are covered below.

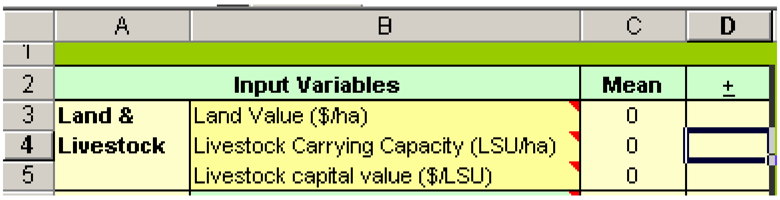
- ***It is important to remember that the user only enters information into the cells in columns C and D. No other part of the screen requires user input.***

- ***Holding down the Ctrl key and pressing the R key at the same time restores the input sheet to the default values. This is an easy way to restore the screen if values are entered into other areas by mistake, or for some other reason the input sheet degenerates.***



Land and livestock

The first three input cells - **C3**, **C4 and C5**- can be set to zero as they involve land and livestock, and are not usually required for silvicultural evaluations. They will be common to all silvicultural options except those comparing understorey grazing. Such agroforestry comparisons are available in the radiata pine calculator, but not in the Douglas-fir calculator.



Costs and financial

Cell **C6** deals with annual fixed (overhead) costs, which are also common to all silvicultural evaluations. For this reason this cell can be set initially to zero.

Cell **C7** requires the cost, in cents, of establishing a Douglas-fir seedling, excluding labour. This covers the cost of nursery plants including transport to the site, ground preparation (ripping, mounding), herbicide, and fertiliser. A typical value will be around about 70 cents, but the range could be much higher or lower than this.

Cells **C8** and **C9** are concerned with the cost of clearfell and production thinning harvesting (in $\$/m^3$) respectively. If the price point of the log grades shown in cells C27-C36 is gross returns at the mill door, then these costs need to include harvesting, loading, road cartage, unloading, and commission. If the price point is 'on skid', they should only include the harvesting cost, and possibly commission. If the price point is stumpage, you will need to set cells C8 and C9 to zero. The problem with this option is that it does not allow for any differentiation in cost of harvesting between clear felling, and production thinning. For this reason, price points 'on skid' or at 'mill door' are preferred.

Cell **C10** is where the cost of silviculture labour, in $/hr, is entered. This is the labour used for tree establishment, releasing, thinning to waste, and pruning (i.e. silviculture). It is not the labour involved in production thinning, clearfelling, roading, or other forest management activities.

Cell **C11** is where you enter the average supervision (as a percentage) involved in the operations contributing to cell C10. Normally this would be a value of between 10 and 20.

Cell **C12** is where the discount rate is entered. You need to set this to the discount rate that your organisation uses for discounted cash flow analysis. It should be used in conjunction with cells I4-I8, which show the net present value (NPV) per hectare. The NPV is the surplus or deficit, expressed as a lump sum per hectare at the start of the rotation, which applies at the discount rate entered in cell C12. If positive, this surplus could have been spent on land, so that is one reason why the land value in cell C3 can be set to zero.

6	**Financial**	Annual fixed costs ($/ha)	0	
7		Establishment costs (cents/tree)	72	
8		Clearfell Logging Cost ($\$/m^3$)	40	
9		Production Thin Logging Cost ($\$/m^3$)	50	
10		Labour Cost ($/hr)	20	
11		Labour Supervision (%)	12	
12		Discount rate (%)	7	

Growth and quality

Cells **C13** and **C14** describe the productive potential of the site. Cell C13 is the site basal area potential, or SBAP. This, together with site index (MTH at 40 yrs) which is required in cell C14, have been calculated for some 1600 sample plots of Douglas-fir, and summarised in a look-up table for forests, and regions throughout New Zealand. This look-up table is located on a tab at the base of the screen.

Cell C14 is more straightforward than cell C13, in that most foresters already have a reasonable idea of the site index they expect to achieve on certain sites. A table linking mean top height at any age to site index is also shown on a tab at the base of the screen.

13	**Growth &**	SBAP	1.8	
14	**Quality**	SI (m)	32	
15		Clearfell Conversion (%)	88	
16		Thinning Conversion Reduction (%)	10	
17		B.H. Outerwood Density (kg/m^3)	418	
18		Outerwood Measurement Age (yrs)	30	

Cell **C15** is the percentage of the total standing volume at clearfelling that is recovered as merchantable wood. It is usually obtained from MARVL inventories. The default value of 88% and the range of 85% to 91% have been derived from the evaluation of several hundred MARVL inventories of Douglas-fir stands in the Central North Island.

Cell **C16** is the reduction of the value that is entered in cell C19 that applies to production thinning. If a value of say 88 is entered in cell C15, and 12 in cell C16, then a recovery of 76% will apply to the production thinning. Remember that if the stand does not receive a thinning to waste at some stage prior to a production thinning, then the recovery of merchantable logs removed in the production thinning, and their quality, may be reduced. A MARVL inventory prior to the production thinning should illustrate this, and provide an appropriate reduction factor to enter in cell C16.

If you have measured the breast height outerwood density at time of inventory, then enter it in cell **C17**. Also enter the age of the stand at time of inventory in cell **C18**. This allows the wood density at final harvest to be modified depending upon the inventory age, and the rotation age. If you have not done any measurement, and need a default value, there is a look-up table at the base of the screen. The values in cells C17 and C18 only affect the predicted wood density (cells Q4-Q8) and Modulus of Elasticity (cells R4-R8). This is a measure of the stiffness of the sawn timber recovered from the logs produced. Wood density is not used in the log grade specifications in this version of the calculator, but could be incorporated in future.

Silviculture

Cell **C19** requires you to enter the rotation age (in years), and **C20** requires the final crop stocking at harvest. Note that this is the actual number of trees per hectare that will be alive at time of harvest- not the nominal stocking based on what the stand was thinned to, perhaps many years before.

19	**Silviculture**	Rotation (yrs)	45	
20		FCS (stems/ha)	400	
21		Ht waste thin (m)	12	
22		Ht prod. thin (m)	24	
23		Waste thin : Total thin stems (%)	50	
24		Prune ? (Y/N)	N	

Cell **C21** is the stand mean top height, in metres, at time of thinning to waste. The age of the stand, and mean DBH of the waste thinnings, are shown in cells H11-H15 and K11-K15 respectively. The stocking of live trees available immediately before the waste thinning is shown in cells I11-I15. The stocking remaining immediately after the waste thinning, necessary to meet the requirements of a following production thinning (if scheduled), and the final crop stocking, are shown in cells J11-J15. Only one thinning to waste can be scheduled. If you do not wish to thin to waste, then simply leave this cell blank.

Cell **C22** is the stand mean top height (in metres), for production thinning. The age of the stand, and mean DBH of the production thinnings, are shown in cells L11-L15 and O11-O15 respectively. . The stocking of live trees available immediately before the production thinning is shown in cells M11-M15. The stocking remaining immediately after the production thinning, necessary to meet the required final crop stocking (cell C20), is shown in cells N11-N15. Only one production thinning can be scheduled. If you do not wish to production thin, then simply leave this cell blank. In this case, do not enter a zero. Similarly, to make a cell empty press delete rather than entering zero.

If both cells C21 and C22 are left blank, you are now specifying no thinning (i.e. millennium regime). The initial stocking will be automatically adjusted in output cells G11-G15 to achieve the final crop stocking you have specified in cell C20, taking the rotation age in cell C19 into account. Remember that without thinning, the recovery of merchantable logs removed in the clear felling (as shown in cell C15) may need to be reduced. The quality of such logs may also be misrepresented in the various output log grade volumes (cells G18-G22, to Q18-Q22)

Cell **C23** contains the percentage of waste thinning stems to production thinning stems, and is only used where both a waste thinning and a production thinning are present in the same regime. A value of 50 entered in cell C23 means that fifty percent of the trees that are thinned are removed in the thinning to waste, and the other 50 percent are removed in the production thinning. An emphasis on waste thinning could see a ratio of up to 75 being used, and an emphasis on production thinning would see a ratio as low as 25 being used. Values greater than 75, or less than 25, should not be used. If 100% waste thinning is desired, simply leave cell C22 blank. Similarly, if 100% production thinning is planned, leave cell C21 blank. If either of cells C21 or C22 is left blank, then any value entered in cell C23 will not operate.

Cell **C24** is a simple switch, which turns pruning on (y) or off (n). Pruning is assumed to be always in two lifts to a height of 5.3m, yielding a sawlog 5.1 m in length, with a diameter-over-pruned-stubs (DOS) for both pruning lifts of around 17 cm. With pruning turned on, cells G18-G22 will show the volume in the pruned logs, and cells P4-P8 will show the mean predicted pruned log index (PLI) for these pruned logs. Note that any volume in logs with a PLI less than 4.0 is automatically transferred to log grade S2. The labour content of the pruning operations will appear in the total silvicultural labour displayed in cells L4-L8, based on the Forest Service South Island work study standards. Moderate hindrance and easy terrain are assumed.

Log pricing

Cell **C25** is used to affect a global change in the log prices entered in cells C27-C36. Cell **C26** sets the unit increase in the price of pruned logs. Normally each log grade would be re-priced individually in cells **C27-C36**, so cell C25 may be seldom used. Users need to be alert when using this cell, as anomalous results may occur if it is used in conjunction with cells D27-D36. Two forms of log price variation used at the same time can result in a puzzling tangle.

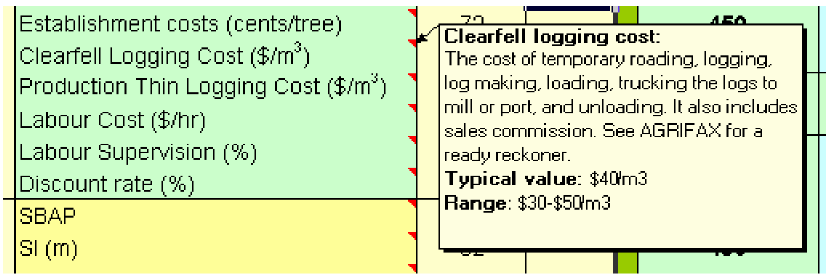
25	Log Prices	Log Prices global adjustment (%+)	0	
26		Pruned Log PLI unit increase	15	
27		Pruned (price for PLI = 4)	160	
28		S1	225	
29		M1a	200	
30		M1b	200	
31		S2	160	
32		L1	140	
33		L2a	83	
34		L2b	83	
35		Ari	60	
36		Pulp	35	

The price for pruned logs is set in the following way. The base price for a pruned log is always derived from whatever value is entered in cell C27, assuming a minimum PLI of 4.0. The default value is set as the same as the S2 grade, but the user can over ride this. The volume of any pruned logs of PLI less than 4.0 (which can be considered unpruned) will be automatically transferred into the S2 category, and displayed in cells K18-K22. The effect of increasing the PLI above 4 on the value of pruned logs is determined by whatever value is entered in cell **C26**, which is the increase in price of a pruned log, for each one additional unit of PLI above 4.0. If a pruned stand has a mean PLI of say 7.4 (as displayed in cells P4-P8) and the value entered in cell C26 is 15, then the pruned logs will be valued at the base price in cell C27, plus (7.4-4.0)*15. I.e. 160+(3.4*15)=$211/m^3. The value of pruned logs (with a PLI greater than 4.0) is therefore automatically set from the values entered in cells C26 and C27.

The values for the different log grades (as $/m^3) in cells C27-C36 can be set by the user, taking the log grade specifications shown on the 'log grade specifications' tab, and market prices, into account. Note that it is not possible to change the log grade specifications in the calculator, without have to reconstruct it again from the start. To test the effect of varying log grade specifications, the user needs to access STANDPAK.

Accessing the comments box

For each of the input cells, and most of the output cells as well, additional comments and guidance can be obtained by pausing the cursor over the small red triangle located in the top right corner of the cells in column C. The following illustrates the comments box produced by pausing the cursor over the triangle in the Clearfell Logging Cost cell (C8)



Using the sensitivity feature

Column D provides the opportunity to evaluate the effects of varying any of the values entered into column C, one at a time. The name of the variable that is chosen by entering a value into column D is displayed at the top of column F. Each value entered into column D is both added to, and subtracted from, the value entered in the adjacent cell in column C. These become the minimum and maximum values to be evaluated. Two intermediate values are also calculated. Together with the original value entered into column C, that results in five values being evaluated at one time. Being able to divide the total range by five ensures round numbers are displayed. As different values are entered into any particular D cell, the range of values for which sensitivity is tested will change in column F. The outputs for these five values are automatically displayed in the output columns (G to R) for each output variable. If more than one variable is entered into column D, then only the entry closest to the top of the column will be evaluated.

Entering a value of 100 in cell D20, means that the user is asking the calculator to evaluate final crop stockings of 400±100 i.e. final crop stockings of between 300 and 500 stems/ha

19	**Silviculture**	Rotation (yrs)	45	
20		FCS (stems/ha)	400	100
21		Ht waste thin (m)	12	

The particular variable chosen for sensitivity testing (Final crop stocking, or FCS for short in this case) will automatically be shown as the label in cells F2, F9, F18, and F23. The range of output values generated by these actions will be shown next to these labels on the output side of the screen.

The example for cells F4-F8 is shown below.

F
FCS
300
350
400
450
500

- ***Remember to first check the comments box before entering a range, to ensure you are working within the limits of the calculator.***
- ***The calculator can only evaluate one range at a time.***

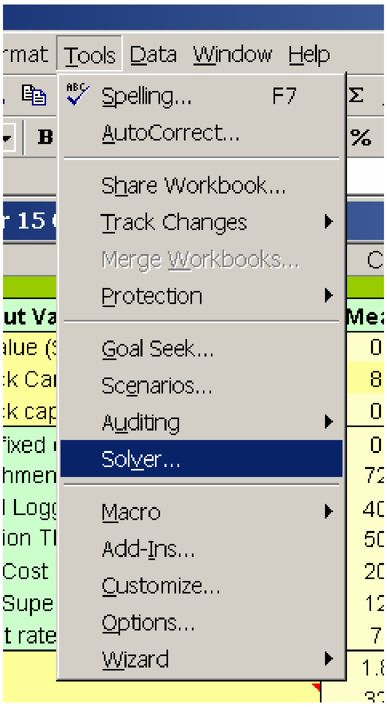
Maximising NPV

Excel has a ‘solver’ facility that can assist with evaluating silvicultural options that maximise NPV. To utilise this feature, go to ‘tools’ on the tool bar. If the solver is not on the tools menu, go to ‘add-ins…’ on the same menu, and then select the ‘solver add in’. Before running the solver:

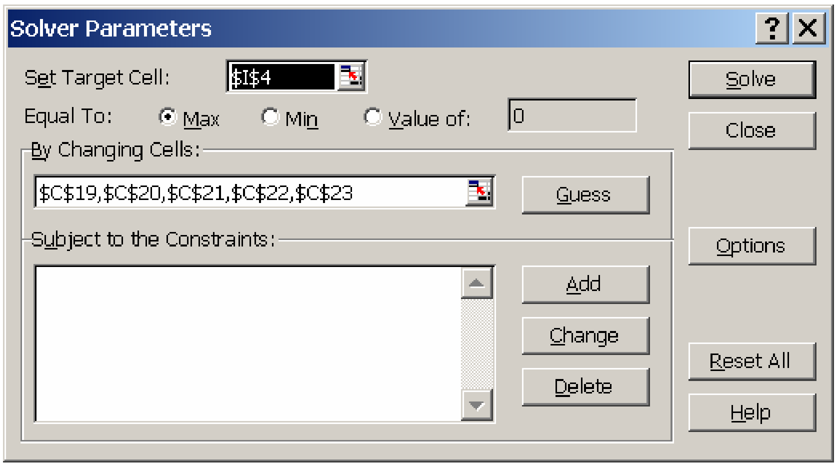
- ***Remember to first check the comments boxes to find the bounds for the input variables that the solver should work within.***

- ***Delete any values in column D***

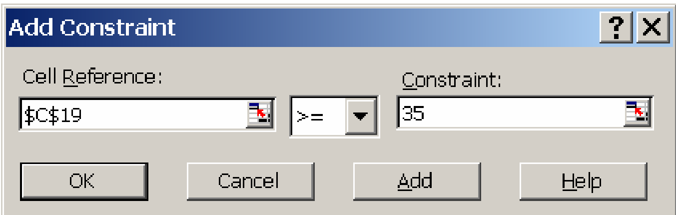
Now click with the mouse on ‘solver...’ on the tools menu, and then click with the mouse on cell I6 of the output sheet, which is the NPV cell. Then select the ‘max’ radio button immediately below it in the solver dialog box.



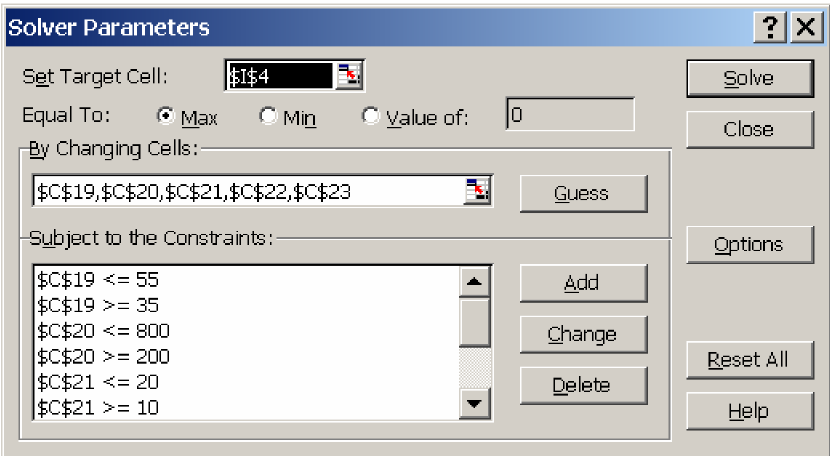
Now you need to set the ‘By changing cells…’ section. Click the mouse on the entry bar, and then click onto the silvicultural input values, beginning with cell C17. Add a comma, and then click on cell C18. Repeat this procedure until you have entered all the main silvicultural variables into the solver ‘By changing cells…’ box, down to cell C23.



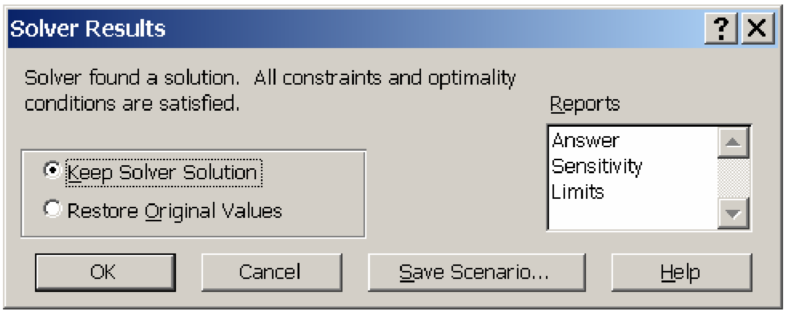
Now you need to place some bounds on these input variables, otherwise impractical solutions may be identified. Go to the ‘Subject to the Constraints:’ section, by selecting the ‘add’ feature. Then select each of the silvicultural variables previously selected, and then add the <= or the >= characters after them. For example, you will need to ‘add’ the rotation age to >= 35 and on the next line ‘add’ <= 55.



Repeat this procedure until all the bounds are entered.



Now click the ‘solve’ button in the top right corner of the box. The solver will attempt to maximise NPV, by changing the listed silvicultural input variables, within the bounds entered. The solver reports progress by messages displayed in the lower left screen. These will be ‘Setting up problem’, followed by ‘Trial solution 1’ and then ‘Trial solution 2’ etc, along with the improvements to the selected cell (I6) that it has been able to achieve. Eventually it will report that it has found a solution.



Click on the ‘OK’ button. The calculator will now display the input variables for the silvicultural options that maximise NPV. It is useful to round off these values as required, and then to test the sensitivity of the result by entering some variation into column D for each of the solved silvicultural variables, one by one.

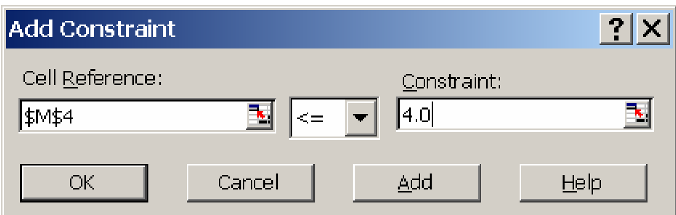
Although the solver has found the optimum solution, you may find that for some of the silvicultural input variables, there is a plateau of NPV rather than a ridge around where this occurs. In other words, for some variables it doesn’t matter very much what value is selected. For others, the values may be very sensitive. It is useful to be able to rank all the silvicultural variables in order of sensitivity.

Adding financial, quality or yield constraints.

It is possible to add certain constraints within which the solver must work. An example of such a problem could be:

“find the maximum NPV, by changing the silvicultural variables, subject to a branch index (BIX) of 4cm or less”.

To set up this additional constraint within the solver, add the cell M4 to the constraints by clicking on it with the mouse, and set the constraint as shown below.



Click on the OK button to get the solver to solve the problem, taking the additional constraint into account. The user may be interested to see how much the NPV reduces due to this additional constraint, or series of constraints. Other quality constraints, which can be considered, include setting a maximum percentage of juvenile wood (cell N4), or a target MoE (cell R4). Financial constraints include achieving a maximum value per cubic metre of wood (cell K4), or a maximum equivalent farming gross margin (cell G4). For the latter to be calculated, you must enter a positive number in cell C4. To remove constraints, first activate the relevant cell by clicking on it with the mouse.

Evaluating Land Use Comparisons

The calculator has a 'built–in' facility for evaluating a comparison of Douglas-fir with livestock. To do this, you will need to have entered positive values into cells C4 and C5. The output cells G4-G8 show the equivalent farming gross margin (EFGM) that the trees are generating, dependent on all the other input values. The EFGM is particularly dependent on the livestock carrying capacity of the land (cell C4) and the discount rate (cell C12). The user can enter a range for any of these key cells, one at a time, in column D, to show the effects such variation will have on the EFGM. The effect of varying the discount rate is shown below. The solver facility can also be used to maximise the EFGM, dependent on silvicultural or other input variables.

	A	B	C	D	E	F	G
1							
2		Input Variables	Mean	±		Discount rate	EFGM
3	Land &	Land Value ($/ha)					$/LSU
4	Livestock	Livestock Carrying Capacity (LSU/ha)	5			4	86.6
5		Livestock capital value ($/LSU)	65			5	59.7
6	Financial	Annual fixed costs ($/ha)	0			6	38.2
7		Establishment costs (cents/tree)	72			7	21.1
8		Clearfell Logging Cost ($/m^3)	40			8	7.5
9		Production Thin Logging Cost ($/m^3)	50			Discount rate	Initial
10		Labour Cost ($/hr)	20				SPH
11		Labour Supervision (%)	12			4	1,650
12		Discount rate (%)	6	2		5	1,650

Are the results correct?

It must be remembered that the calculator is only a tool, and an approximate one at that. Before applying any of the results, especially for large scale investments, users are strongly urged to run the same situations through a series of STANDPAK runs to check they are getting similar results, and drawing similar conclusions. The current version of the calculator (January, 2003) is based on the March 2002 version of the Douglas-fir models and functions in STANDPAK. These have since been updated, so the calculator may give slightly different results to STANDPAK. It is intended to update the calculator to more closely represent the latest version of STANDPAK. It is also intended to link log grade values to MoE in future upgrades of the calculator.

Some frequently asked questions

Question. Do I always have to use an initial stocking of 1650 stems/ha in the calculator?
Answer: In general, yes. The only exception is where you specify a final crop stocking, with no thinning. In this case, the calculator automatically calculates the initial stocking required to produce the final crop stocking, taking rotation age into account. An illustration of this is shown in the example below. A final crop stocking of 500, with a range of ±300, is entered. The values for heights at thinning to waste and production thinning are left blank. That means that no thinning is carried out.

19	**Silviculture**	Rotation (yrs)	45	
20		FCS (stems/ha)	500	300
21		Ht waste thin (m)		
22		Ht prod. thin (m)		
23		Waste thin : Total thin stems (%)		

The values showing in cells G11-G15 are the initial stockings required to produce these final crop stockings, on a 45 year rotation, without thinning.

As an additional option, STANDPAK can be used to evaluate a range of initial stocking.

Question: Please explain the thinning ratio cell in more detail
Answer: Set the calculator so that heights are entered for both waste thinning (cell C21) and production thinning (cell C22). Set the thinning ratio cell (cell C23) to 50. Set the range for cell C23 to 25, in cell D23. Your screen should look like this:

20		FCS (stems/ha)	500	
21		Ht waste thin (m)	12	
22		Ht prod. thin (m)	26	
23		Waste thin : Total thin stems (%)	50	25

You are instructing the calculator to carry out a waste thinning, and a production thinning, in the same regime. Because you have also specified a final crop stocking- in this case, 500 stems/ha- the calculator needs to know what emphasis to give to these two thinning operations, in achieving this final crop stocking. By entering a value of 25 in Cell D23, we are evaluating the maximum range suggested- of 50 ±25, i.e. 25 to 75.

The output sheet illustrates the consequences. With a waste thinned to total thinned stems ratio of 25, very few trees (25% to be exact) are removed in the thinning to waste, and a lot (75%) are removed in the production thinning. The reverse applies when the ratio is set at 75. In this case, 75% of the total thinned stems are waste thinned, and only 25% are removed in the production thinning.

Waste thin ratio	Initial	Waste thin				Production thin			
	SPH	Age	SPH1	SPH2	DBH	Age	SPH1	SPH2	DBH
25	1,650	15.7	1,570	1,381	14.3	32.3	1,109	544	26.7
37.5	1,650	15.7	1,570	1,269	14.3	32.3	1,044	544	26.3
50	1,650	15.7	1,570	1,148	14.3	32.3	966	544	26.2
62.5	1,650	15.7	1,570	1,019	14.3	32.3	874	544	26.3
75	1,650	15.7	1,570	884	14.3	32.3	772	544	26.7

Question: Why don't I get the same equivalent farming gross margin (EFGM) using the calculator, as was shown in Farm Forestry- The Green Solution, Newsletter no 1?
Answer: The values for EFGM in the table in the Green Solution newsletter were calculated so that the discount rate was equal to the IRR, at the point where the livestock and the farm forestry options were identical. I.e. where the farming gross margin was equivalent. We now realise that you shouldn't use such a variable discount rate, so the EFGM is now calculated using the discount rate nominated in cell C12. Discount rate has a large impact on the EFGM, so the two methods are bound to give different results.

Question: Where do I enter the stocking before and after a thinning to waste, or a production thinning?
Answer: You don't, as these stockings are not needed.

Lets assume your regime has a single thinning, either to waste or for production. You will have an entry in either cell C21 (Ht waste thin) or an entry in cell C22 (Ht Production thin). One of these cells will be blank.

All regimes start with the same planted stocking- 1650 stems/ha. In cell C20 you have entered the final crop stocking. This is the actual number of trees to be felled, not the nominal stocking. So we know the number of trees planted, and the number of trees felled. We also know the mean top height of the stand when thinned (cell C22 **or** cell C23). There is no further information required.

The calculator estimates the stocking required to be left following the thinning, based on mortality trends, taking the time to clear felling, and the final crop stocking, into account. This stocking is displayed under the heading SPH2 in cells J11-J15 for a waste thinning, and cells N11-N15 for a production thinning. The live stocking prior to the thinning is shown under the heading SPH1 in cells I 11-I15 for a waste thinning, and cells M11-M15 for a production thinning. The calculator estimates the stockings before and after the thinning for you- you do not need to enter them.

Multiple thinning gets more complicated. See the question regarding the waste thinning : total thinning stems ratio (cell C23) above, which addresses the issue of how the calculator handles multiple thinning.

Question: How do I estimate the role of seed source in the growth, yield, and profitability of Douglas-fir?
Answer: The calculator is ideal for illustrating such issues.

Lets assume we measure a series of replicated mature seed source trials throughout New Zealand, and find that the mean SBAP and site index for our standard New Zealand landrace seed source (ex Washington State, USA) is 1.73 and 31m respectively. The same trials show that the best seed sources come from coastal California, close to San Francisco. These have an average SBAP of 2.3, and a site index of 34m.

Using the default settings (Ctrl+R), we then change cells C13 and C14 to represent these two sets of data, and quickly see what effect it has on growth, yield by log grades, and NPV. We can also use the solver to fine-tune a regime which suits these new seed sources, using a target branch size for example as a constraint. It is quite possible that these more vigorous seed sources may require a higher stocking, or a delayed thinning, to meet branch size expectations. In future, when the full range of wood properties such as timber stiffness (MoE) are installed in the calculator, the user will be able to readily put economic weights on the yield/wood quality aspects of particular seed sources, in the same manner as we have illustrated above. The present version of the calculator does display timber MoE, however these values are not linked to log value, and the returns achieved.

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