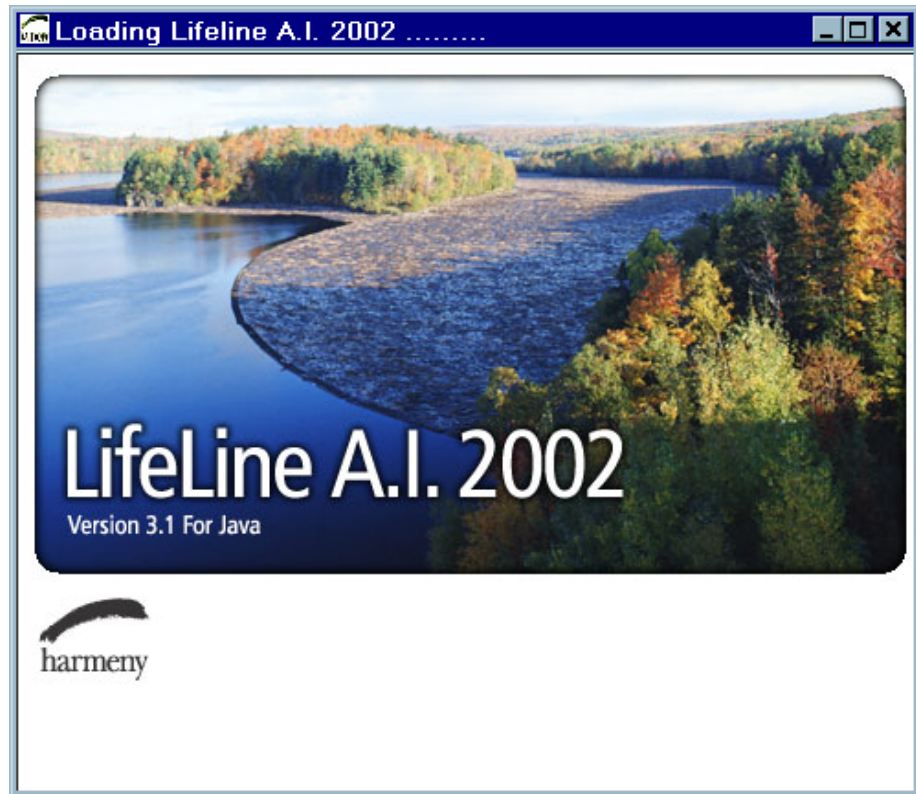


Making Better Decisions Every Day ...



Lifeline AI 2002 Tutorial  
Version 3.1 For Java



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# Introduction

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Welcome to LifeLine AI 2002.

Lifeline AI helps forestry companies make better decisions by making their data more useful. LifeLine AI is an inventory management system allowing users to integrate and summarize the information needed for ecosystem management and environmental certification. Lifeline AI helps consolidate inventory, explore land bases, develop indicators, define management scenarios and visualize results. With LifeLine AI you can take a complex information system and make it simpler, more stable and more flexible.

The LifeLine AI system allows you to ask questions of complex databases, without having to know a great deal about the "TECH" aspects of databases, so you can concentrate on the "FORESTRY" aspects of solving real world problems and making decisions on large land bases that have to take into account numerous constraints, and multiple land use perspectives.

*The "AI" in LifeLine has a double meaning.  
An "Adaptive Inventory", that can grow and  
change as your information needs change, as  
well as "Artificial Intelligence" the concepts and  
technology for logic based systems that inspired  
the development of LifeLine.*

# A Day in the Life of Joe Forester

Consider an overworked Forest Manager named Joe who is trying to get some information about an area within the company's forest estate. He goes to his friendly, neighbourhood Inventory Specialist, Yid Numeric.

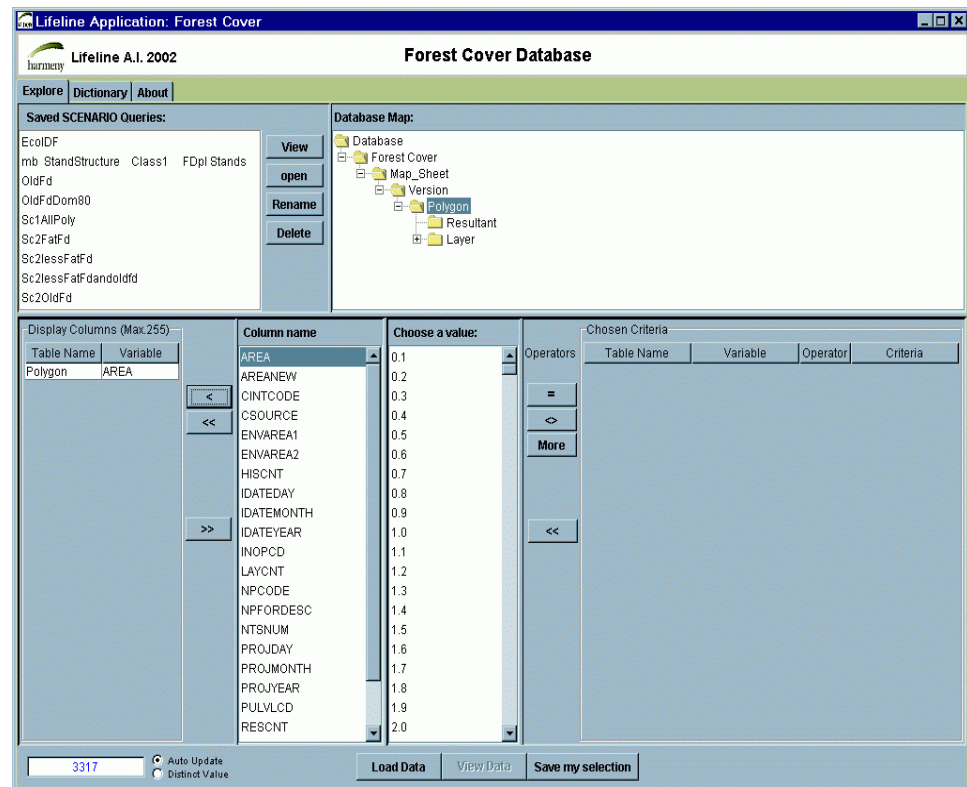
**Joe Forester:** How much area do we have in our forest estate? Will it take long to find out. I'd like a report by next week at the latest.

**Yid Numeric:** It won't take long at all, indeed, I'll show you how to do it yourself using LifeLine AI. You can do it in five minutes. We've loaded the Forest Cover from our entire estate into LifeLine AI. To ask LifeLine AI a question, you have to select the following things:

1. The variables you would like to see in the answer.
2. The constraints you want on the answer.

You want to know about Area, which is information in the Polygon level of our database. You want to know about ALL Polygons, so you don't need to select any constraints.

This is what your question looks like in LifeLine AI.



And here is your answer, a listing of all the areas for Forest Cover polygons within the forest estate. Note there are 3317 polygons within this forest estate.



The screenshot shows a 'Data Viewer' window with a title bar containing a small icon, the text 'Data Viewer', and standard window controls. Below the title bar, there is a header area with 'Name:' on the left, 'Record: 3317' in the center, and two buttons labeled 'Copy All' and 'Save' on the right. The main area of the window is a table with a single column titled 'AREA'. The table contains 3317 rows of numerical values. The visible values in the first 20 rows are: 0.4, 4.2, 9.4, 0.3, 5.4, 3.2, 24.7, 7.7, 0.6, 61.1, 40.7, 19.5, 7.9, 38.5, 21.6, 20.7, 2.9, 15.6, 5.8, 3, 8.6, 8.9, 2.9, 39.6, and 1.6. A vertical scrollbar is visible on the right side of the table area.

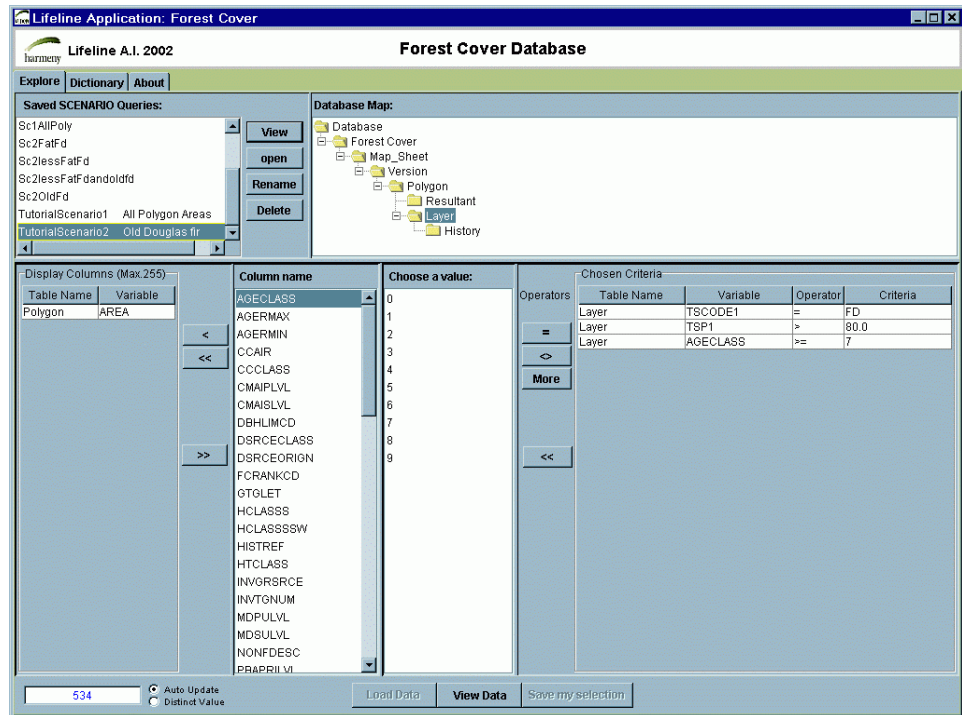
AREA
0.4
4.2
9.4
0.3
5.4
3.2
24.7
7.7
0.6
61.1
40.7
19.5
7.9
38.5
21.6
20.7
2.9
15.6
5.8
3
8.6
8.9
2.9
39.6
1.6

# A Harder Question

**Joe Forester:** Well that was quick! But how about a harder question. I'd like to know how much of the forest is classified as "Old" Douglas-fir.

**Yid Numeric:** Well, let's see. Douglas-fir stands can be characterized as being greater than or equal to 80 % Douglas-fir. Old stands can be characterized as anything over 140 years old, or in other words, greater than or equal to age class 7. So, go to the LifeLine Tree. Again Select "Areas" as the variable you are interested in from the Polygon level. But now you are also interested in some constraints. Go to the Layer level of the LifeLine Tree. Your first constraint is by Leading Tree Species (TSCODE1) as Douglas Fir. Your second constraint is by Percent Cover (TSP1) as greater than 80 %. Your third constraint is by Age Class (AGECLASS) as greater than or equal to 7.

This is what your question looks like in LifeLine AI.



And here is the resulting listing of areas for polygons that meet your criteria. Notice that only 534 polygons meet this definition of "Old Douglas fir"

Data Viewer	
Name: TutorialScenario2 Old Douglas fir	
Record: 534	
<input type="button" value="Copy All"/> <input type="button" value="Save"/>	
AREA	
1.5	
2.6	
45.7	
8.2	
8.5	
24.7	
71.9	
0.5	
0.4	
19.5	
2.7	
3.4	
38.5	
0.7	
9.2	
10.7	
2.9	
7.7	
1.6	
38.7	
5.9	
24.8	
13.3	
28	
26.4	

**Joe Forester:** Wow, that was pretty easy. But you were moving a bit quick. Could you take me through how you did that step by step?

# LifeLine Step by Step

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**Yid Numeric:** Okay, lets take it step-by-step. But this time you drive.

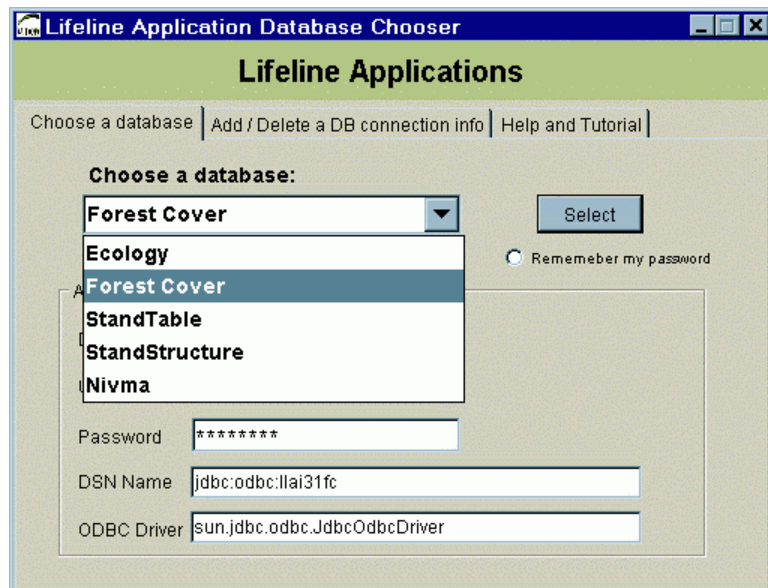
**Joe Forester:** Sure. But I'd really appreciate some backseat driving my first time on the road or "down the tree" as it were.

**Yid Numeric:**

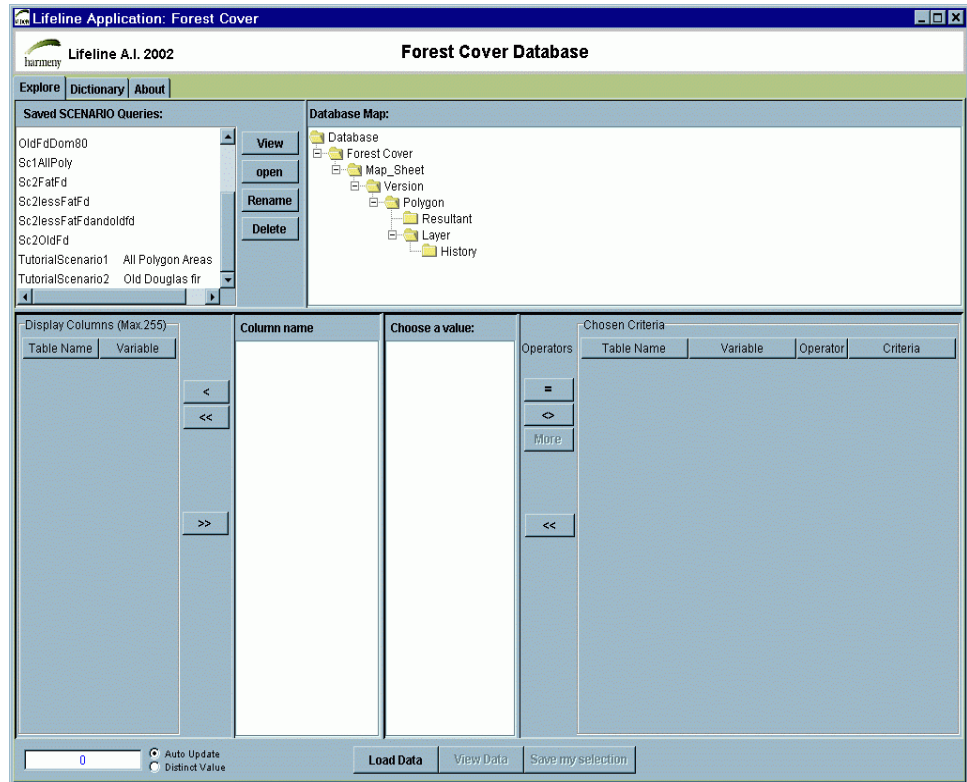
*Step 1.* Start LifeLine. Select the "Choose a database" tab.

Then select a database. In our case it will be the Forest Cover database.

Single click the "Select" Button.



Pressing the "Select Button" will open the main application's "Explore" window. Most of your work will be in this window.



Before we take any drastic action, let's get a bit familiar with this window. Notice it corresponds to the "Explore" tab, and there are two other tabs: "Dictionary" and "About". We will cover them later.

The top half of the Explore window is divided into two areas. The left half is dominated by a "Saved SCENARIO Queries" area. The right half is dominated by a "Database Map" area.

The bottom half of the Explore window is divided into four areas.

From left to right these are:

"Display Columns" area. Note the maximum columns to display is 255.

"Column Name" area. This is where one selects column's to display.

"Choose a Value" area. This is where one selects values from a column.

"Chosen Criteria". This is where selected values are displayed.

In summary the two left-hand columns focus on "What will be Displayed", while the two right-hand columns focus on "What Values will Constrain" the results displayed.

The "Saved SCENARIO Queries" area has a number of listed queries such

as "TutorialScenario 1 All Polygon Areas", "SC1AllPoly" etc. These are previously generated scenario queries. There are a few buttons beside this area. We'll cover this area in more detail a little later.

Okay, let's get you working with the upper right half of the display window, the "Database Map". This is the main navigation area in LifeLine's Explore window.

The "Database Map" area presents an Object Oriented model of your database.

In this case, the relevant objects are:

Forest Cover, Mapsheet, Version, Polygon, Resultant, Layer, History.

They are represented as a "Tree" which is a kind of graph. We will call this graph the "LifeLine Tree"

The folder icons beside each object name represent "nodes".

This is much like the standard "Windows Explorer" interface used to manage file systems. Note also that the way objects are placed in the graph represents the relationships between database objects. For example one Polygon has many Resultants that are associated with it.

A Polygon also has many Layers associated with it. Thus both Resultant and Layer are represented as nodes that are related directly to Polygon.

The relationship is represented by a dotted line. Note that Resultant and Polygon are not related to each other, since there is no dotted line that connects them. If several nodes can be reached by following dotted line connections, that is called a "path". So there could be a path through: Mapsheet/Version/Polygon/Resultant. But, there is no direct path from Resultant to Layer. I apologize if this is all mind numbingly obvious, Joe.

**Joe Forester:** No problem Yid. I think I've got it all down .....

Though I'm losing feeling in my left toe.

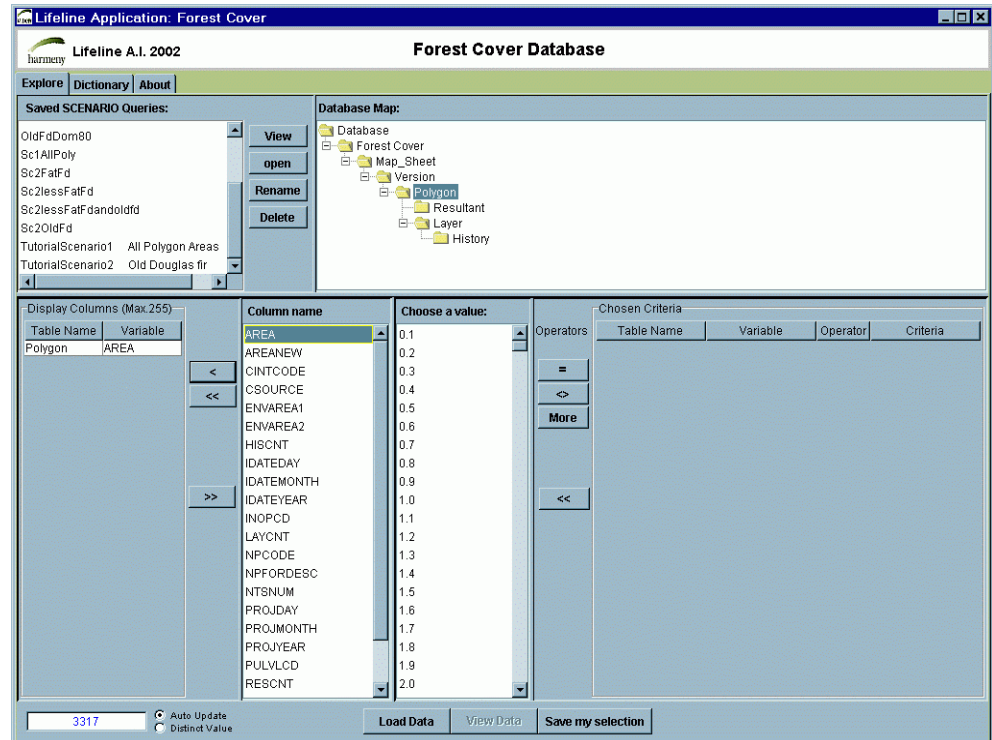
**Yid Numeric:** Err, where was I. Oh, Step 2.

*Step 2.* Choose your variables (in this case, variable).

Select the node in the LifeLine Tree you wish to get information from, by single clicking on the folder icons. In this case, single click on the Polygon folder and you will see a list of variables appear below "Column name".

From this list single click on "Area" and a list appears below "Choose a value:".

Single click on the "<" button to the right of the "Column name" area and an entry appears below "Display Columns (Max 255)". The entry indicates that the "Table Name" is "Polygon" and the Variable is "Area".



In this instance, we've chosen only a single variable "Area" from a single node "Polygon" but we could have selected variables from several nodes in exactly the same way.

Single clicking on the button "<<" allows you to select all display variables at a node.

Single clicking on the button ">>" allows you to de-select all display variables currently selected.

**Joe Forester:** So, what I've done is selected the variables I want to display from the Polygon object in the LifeLine model. I could choose more variables from more objects, in the same way. What about the "Chosen Criteria" area -- I haven't done anything there yet.

**Yid Numeric:** Which brings us to .....

*Step 3.* Select your constraints. For your question, all of your constraints come from the "Layer" node of the LifeLine Tree.

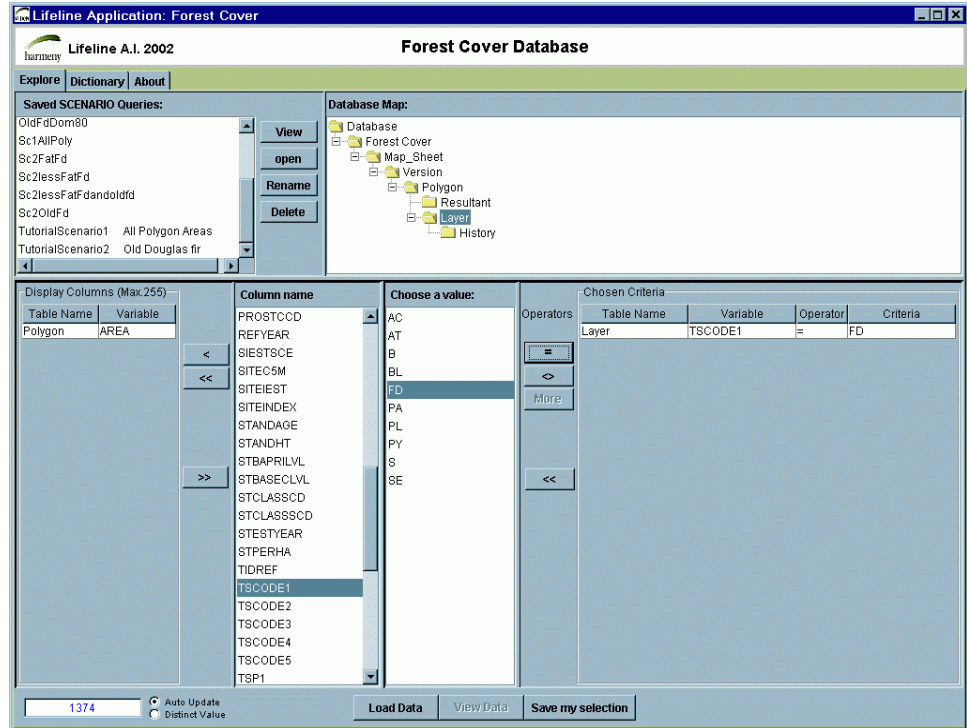
*Step 3a.* Single click on the Layer node.

Single click on the variable TSCODE1. TSCODE1 identifies the leading tree species.

In the "Choose a Value" area there appear a number of values.

Note that unlike for AREA, where the values were numbers, for TSCODE1 the values are text codes (so TSCODE1 is a categorical variable).

Single click on the code "FD". Then single click on the "=" button.  
 You have now constrained your answer to Polygons that have Douglas Fir in a Layer.



**Joe Forester:** So -- let me guess. You said the "=" button allows me to select that a "Chosen Criteria" is equal to FD (Douglas fir). So, I will only see Polygons that have Douglas fir as a leading species. You've got three other "Operator" buttons. I would guess that the "<>" button means "not equal to" and if I'd single-clicked on it instead, I would be asking for the AREA of all Polygons that DO NOT have Douglas Fir as a leading species. And I guess that the "<<" button functions similar to the ">>" button that was next to the ">>" button de-selected chosen "Display Columns". So the "<<" button de-selects currently "Chosen Criteria".  
 But what does the blanked out "More" button do?

**Yid Numeric:** Well, your guesses are right on, Joe.  
 As to the "More" button. Notice that when you had selected "AREA" as a display variable, the button was visible. "AREA" has numerical values. When you selected "TSCODE1", the leading tree species, the "More" button is blanked out. That is because the values of "TSCODE1" are text codes. For text codes, you can select individual code values which you want to use

as constraints. For numerical or integer values, you can instead choose a range of values that you wish to use as constraints. This is what the "More" button is for.

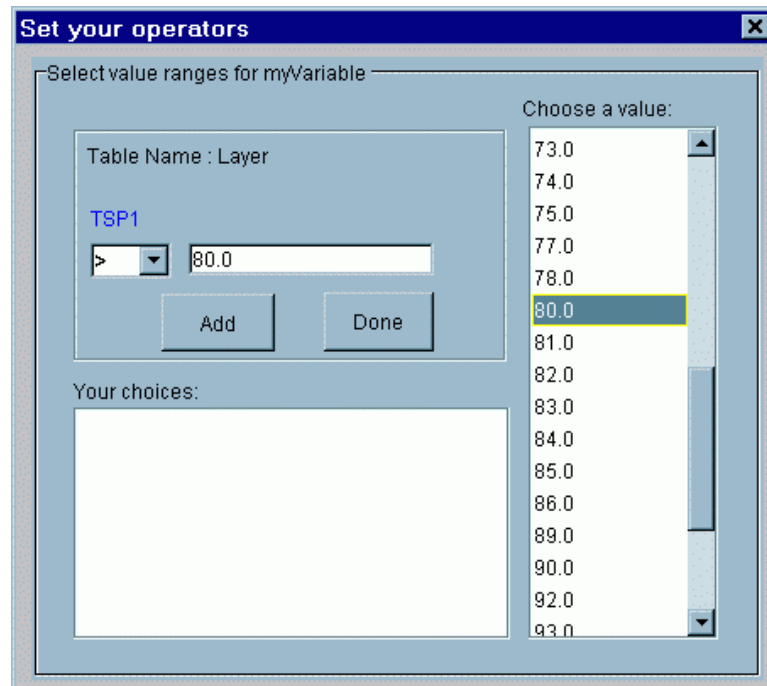
*Step 3b.* So far, we've said we want a listing of all AREA for Polygons with FD as the leading species (TSCODE1 = FD). Now let us add an extra constraint and say that the cover of Douglas fir has to be greater than or equal to 80% as a leading species. For this we need to use the column "TSP1" whose values are numerical and represent percent cover.

From the Layer node, select single click on "TSP1" then click on the "More" button. This opens up the "Set your operators" window.

Choose the operator ">" which means "greater than".

Select from the "Choose a value" list to the right the value "80" by single clicking on it (which also highlights it).

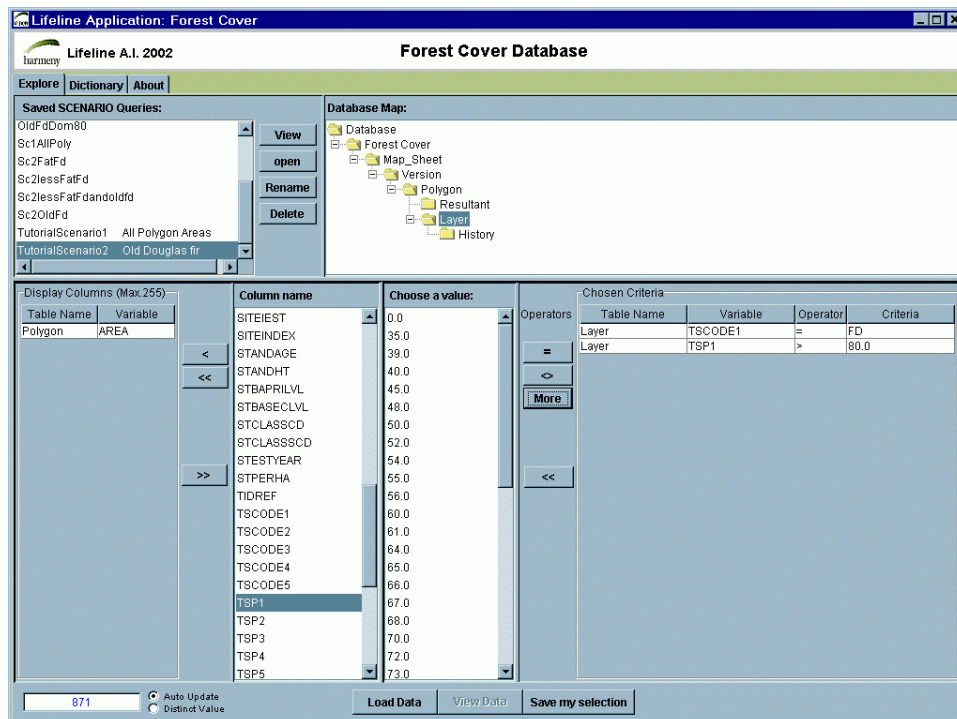
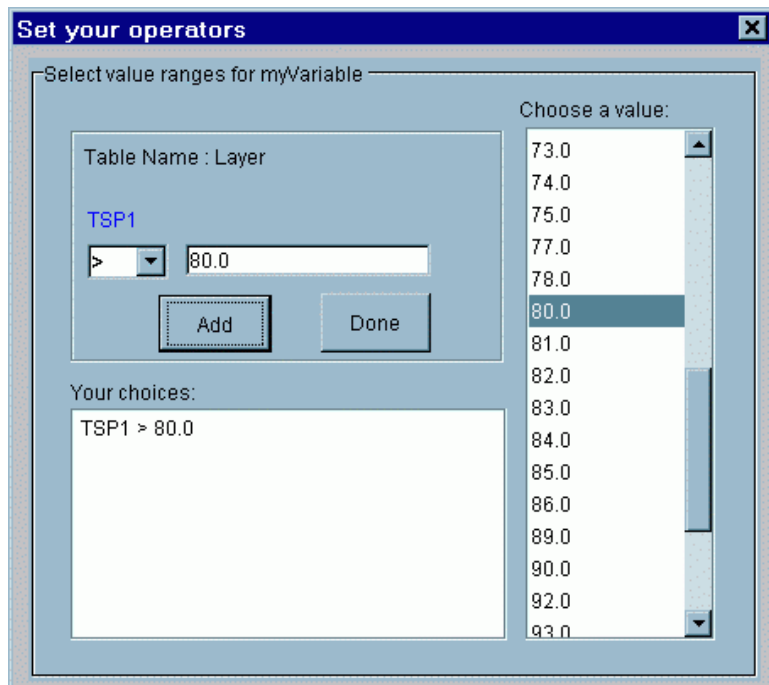
The value "80" now appears in the box beside your operator.



Then single click the "Add" button which adds your selection under "Your choices".

Finally, click the "Done" button which returns you to the Explore window.

You will see in the Explore window that your selections have been added to "Chosen Criteria".



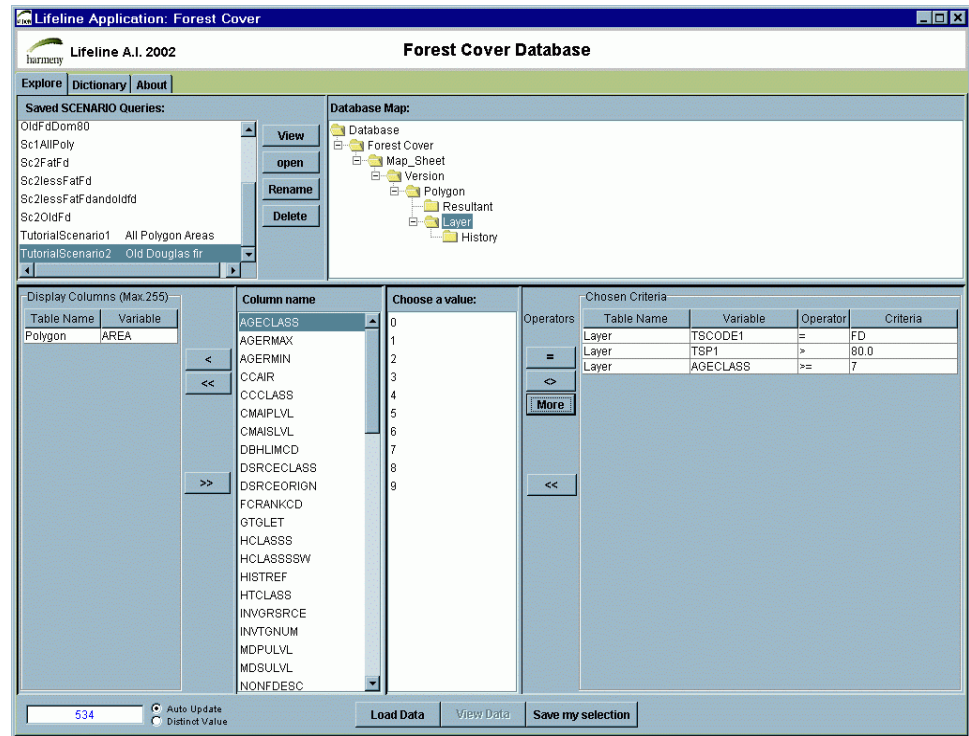
Joe Forester: Okay Yid, let me fill in the rest. I use the same procedure to select AGECLASS

which has integer values.

I use the "More" button to select which values of AGECLASS I want. I want ">=" 7.

I click the "Add" button, and the "Done" button and I am done.

I've now re-created the same scenario you did.



**Yid Numeric:** Yup, exactly. I should mention that for a numeric variable the operators you can choose from the "Set your operators" window are:

">" which means "greater than"

">=" which means "greater than or equal to"

"<" which means "less than"

"<=" which means "less than or equal to" and

"<>" which means "not equal to".

You are not restricted to making a single selection. Indeed you can make several selections, clicking the "Add" button after each selection, and finally clicking the "Done" button. This allows one to make fairly sophisticated continuous and discontinuous range based queries on numerical data. The "<>" allows one to even build up exclusions. All of this can be useful in building a range of classes. But I'll let you try that out and explore those options on your own. We're just one step away from home.

Step 4. Load your data by single clicking the "Load Data" button in the Explore window. Once data is loaded the "View Data" button is visible.

View your data by single clicking the "View Data" button.

The "Data Viewer" window now appears with your results which you can either copy to another program by pressing the "Copy All" button or save as a comma separated values text file (CSV format) by pressing the "Save" button. You can try those options out, they work similar to "Copy" and "Save" in other applications on your computer.



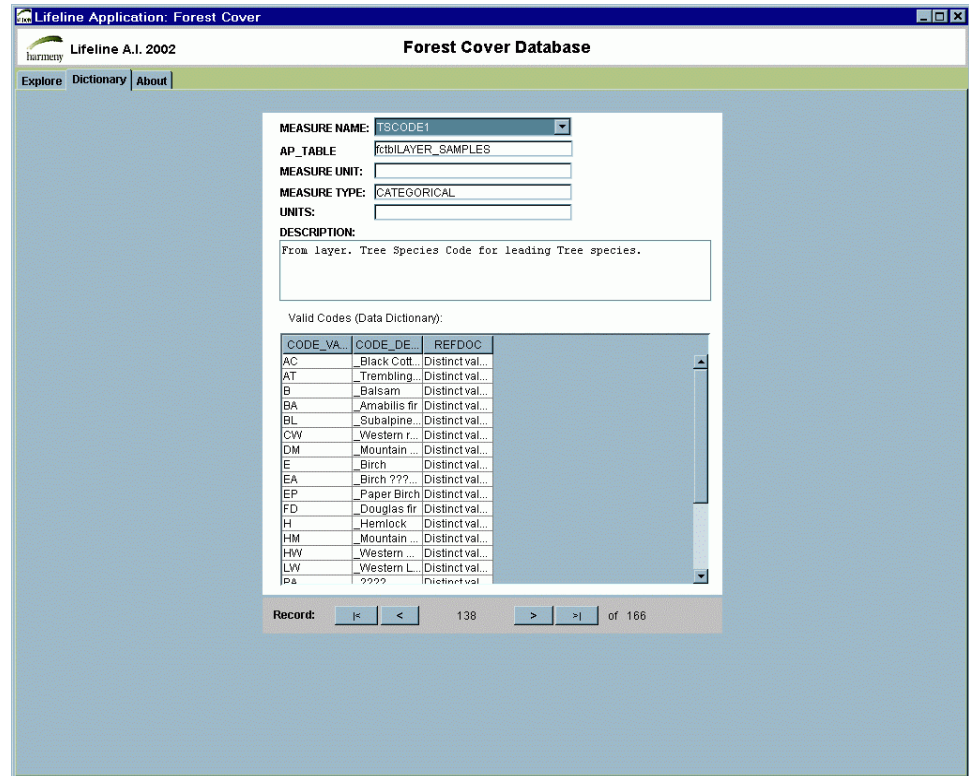
The screenshot shows a window titled "Data Viewer" with a blue header. Below the header, there are fields for "Name:" and "Record: 534", along with "Copy All" and "Save" buttons. The main area contains a table with a column labeled "AREA" and a list of numerical values. A vertical scrollbar is visible on the right side of the table.

AREA
1.5
2.6
45.7
8.2
8.5
24.7
71.9
0.5
0.4
19.5
2.7
3.4
38.5
0.7
9.2
10.7
2.9
7.7
1.6
38.7
5.9
24.8
13.3
28
26.4

**Joe Forester:** Uh right -- TSCODE1, FD, TSP1 .... hmm hope I can remember all these variable acronyms -- hey I see a " Dictionary" tab right beside the "Explore" tab. What is it for?

**Yid Numeric:** For those of us without total recall. Try it out.

**Joe Forester:** Oh, it's a dictionary of the variable names and code definitions for the database.



**Yid Numeric:** Yes -- a field expert working with the LifeLine Administrator can fill in the definitions for the data-dictionary -- it's a way of capturing additional expert knowledge in the system. You can also enter jokes, though that voids the warranty. Play around with the buttons, and you will see how to navigate the Dictionary. The "About" tab doesn't do anything analytical, it simply credits the LifeLine design team, and tells you where to send compliments and complaints, as warranted.

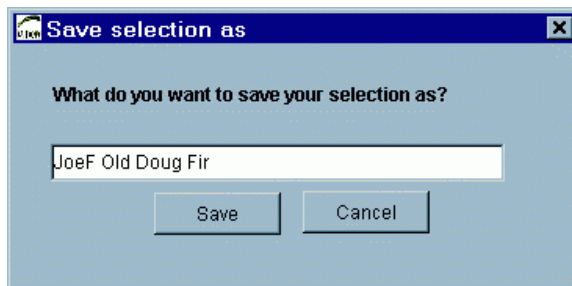
**Joe Forseter:** I'm done. That was easy. But I have a few more questions.

**Yid Numeric:** I live to serve. Specially for the guy who signs my purchase orders. Fire Away.

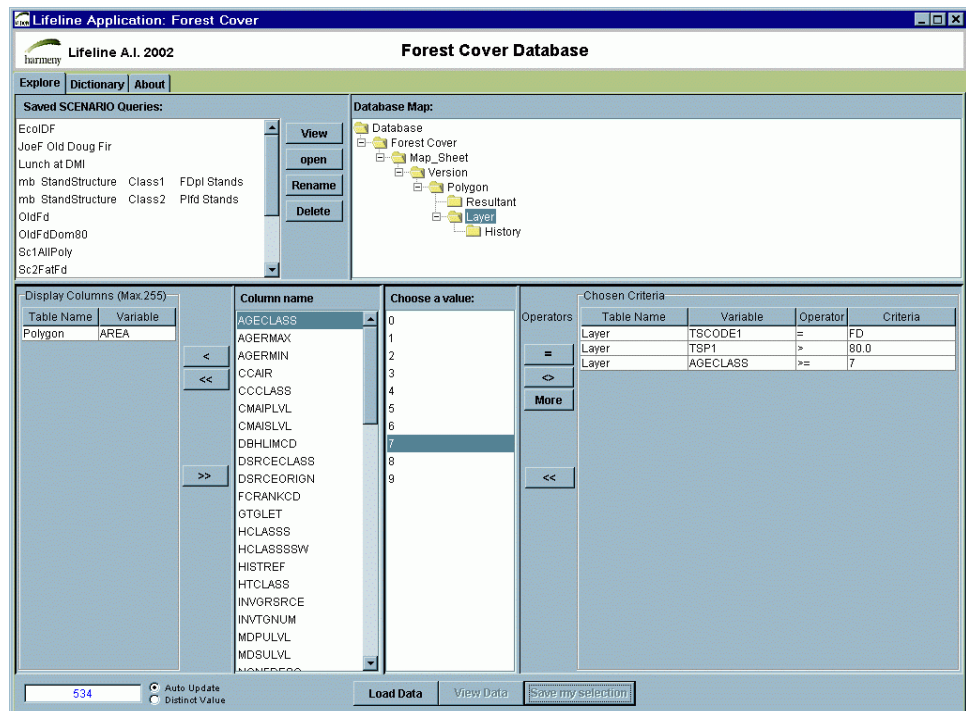
# LifeLine Scenarios

**Joe Forester:** Well, the question I asked you is basically only one scenario I've thought of. I've got several others that I want to check out. But I don't want to have to start from scratch each time. Can I save these scenarios.

**Yid Numeric:** Sure -- just press the "Save" button in the Explore window. This calls up the "Save selection as" dialog window. Give your Scenario a unique name. Let's call the one you just ran, "JoeF Old Doug Fir".



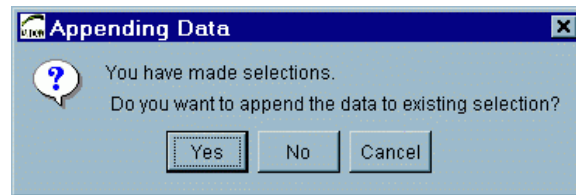
You'll see it's been added to a list right below "Saved SCENARIO Queries".



Notice that there are several buttons to the right of the "Saved SCENARIO Queries" area:

The "View" button allows you to view the Scenario's Display and Criteria selections, i.e. the data variables you will see, and the criteria that will constrain what you see.

The "Open" button opens a Scenario. It gives you two options -- either to replace a previous Scenario, or to combine your selection with a previous Scenario.



If you choose the "Yes" button, your current set of Display and Criteria selections will be added to with those from the Scenario you are opening.

If you choose the "No" button, your current set of Display and Criteria selections are replaced by the Scenario you are opening.

If you choose the "Cancel" button, you have opted to think a wee bit more before taking drastic action.

**Joe Forester:** You are a conservative kind of guy, aren't you Yid?

**Yid Numeric:** I refuse to incriminate myself. Returning to my de-railed train of thought. Combining existing Scenario's is a way of asking increasingly complex questions, building classification systems, or comparing perspectives.

The "Rename" button allows you to change the name of your Scenario.

This is useful if you've been building a number of Scenario's rapidly and feel a need to impose some order on the creative chaos by using a rational set of naming conventions.

Finally the "Delete" button allows you to remove Scenarios no longer of interest to you.

Try all these options out until you get the hang of them, and then send me a note on what you've been able to do with building Scenario systems. I should mention that LifeLine implements a form of "poor man's client server" so that several people can enter a database and build Scenario's at the same time without stepping on each other's cyber toes. This allows Joe to compare his perspective with, say, Mishtu.

**Joe Forester:** Hmm, and once I've got a scenario worked out can I export it to other applications. I'd like to set up some scenarios for realistic situations in our forest estate -- then turn it over to the planning guys and modelers to do their thing.

**Yid Numeric:** No Problem. At the top of the Data Viewer, click on the "Copy" button, and paste the scenario results into your favorite spreadsheet program, and numeric away on it. Or click on "Save" and put the results in a text file.

**Joe Forester:** Hey let me try that. I'll re-run the first scenario for ALL Polygons in our forest area, paste it into the excellent spreadsheet program and sum their areas. The answer is. 62480 ha.  
Now I'll run the second scenario, "JoeF Old Doug Fir" and paste it in. I'll sum their areas. The answer is. 12260 ha.  
That means, about 20 % of my landbase is "Old Doug Fir". That's enough to meet our targets.

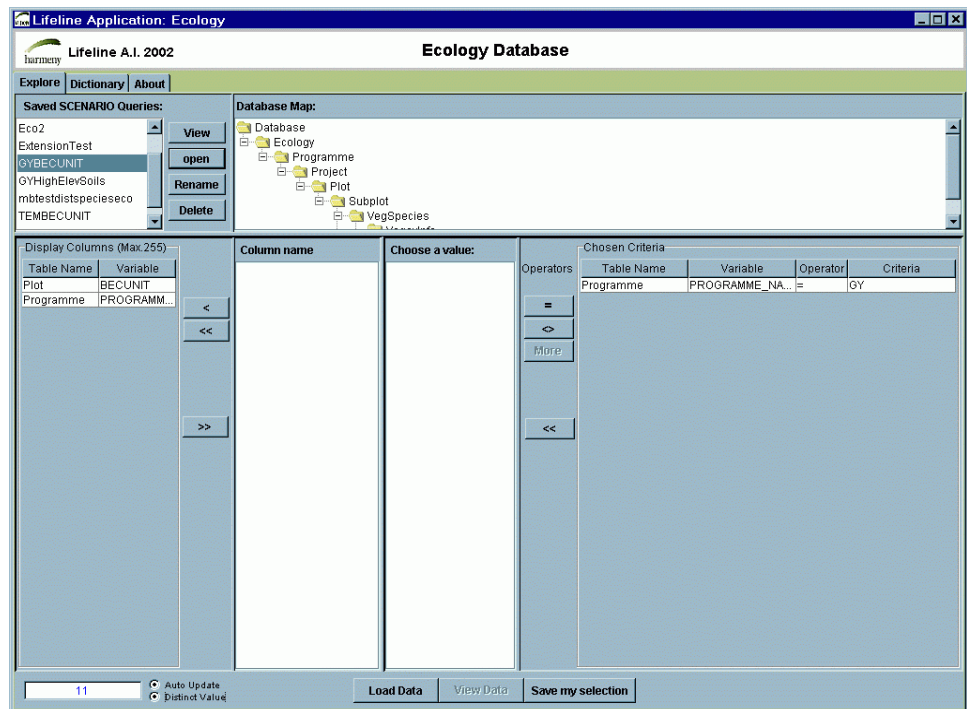
**Yid Numeric:** Pretty impressive. Good thing I'm not worried about job security.

# One Good Management Scenario, Deserves Another

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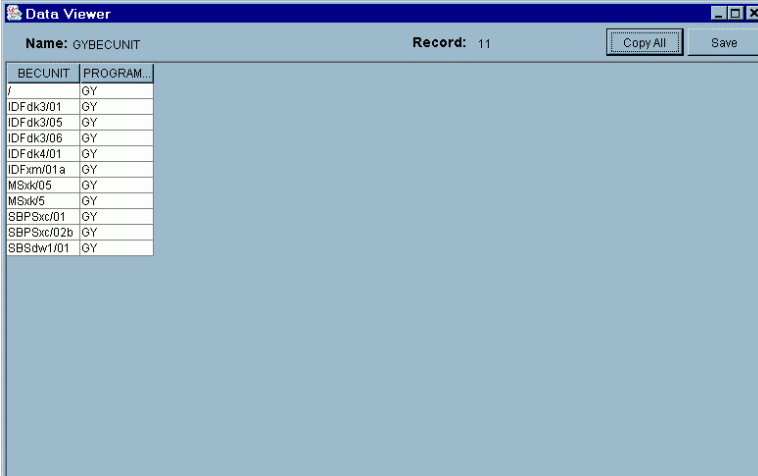
**Joe Forester:** Hmm. But maybe we should use a different definition of "Old", using structural features instead of age. Maybe we'll get a different number. I think I'll discuss this with the ecologists. How much space does this program take up. I'd like to get together with a couple of ecologists, and look at some other ways of defining "Old Doug Fir" using our forest cover data. Hey do you have the ecology data from our land base in LifeLine also? The ecologists have been asking about it. What about the special stand structure trials we're using to develop new yield curves.

**Yid Numeric:** The ecology database is in, so the eco guys can "veg complex" and "soil horizon" to their hearts content. The stand structure trials should be loaded by next week. The LifeLine AI program has a small footprint. It can access databases through the network. I can have you set up in a half an hour. Here's what the Object Model for the ecology database looks like. The ecologists have already been playing around in LifeLine as you can see from the Scenarios.



**Joe Forester:** Hmm looks like some created a Scenario "GYBECUNIT", which has the Biogeoclimatic Ecosystem units constrained to those coming from the Growth and Yield program. Looks also like there's another Scenario called "TEMBECUNIT" which would probably be the same thing constrained to come from the Terrestrial Ecosystem Mapping program. Methinks someone is building a classification system. But at the bottom left hand corner I see the sample size is 11. That seems too low -- we've definitely got more than 11 ecology plots in our GY program. What's going on??? And who built these Scenarios???

Yid Numeric: Well, notice that to the right of the 11 are two radio buttons. The "Auto Update" button you've been using all along. When it's on, it automatically calculates the sample size value you see as you make selections. The "Distinct Value" button is why you get an 11. Selecting "Distinct Value" does not show you the results for all plots, but the results for every unique combination of your display variables.



BECUNIT	PROGRAM...
/	GY
IDFdk3/01	GY
IDFdk3/05	GY
IDFdk3/06	GY
IDFdk4/01	GY
IDFxm0/01a	GY
MSxk05	GY
MSxk05	GY
SBPSxcj01	GY
SBPSxcj02b	GY
SBSdw1/01	GY

In this case, it looks like there are 11 unique ecosystems represented in the GY ecology plots. We could combine the GYBECUNIT and TEMBECUNIT Scenarios to identify what unique ecosystems were represented across both programs. So, essentially using the "Distinct Value" option allows you to generate labeling systems. As to who built these Scenario's -- I think you're going to need to set some Scenario naming conventions or guidelines.

**Joe Forester:** Neat. I need to report to the Board of Directors this afternoon on the current state of the forest and whether or not we are meeting

our targets for Biodiversity. I want to run some more scenarios before then. How about getting the stand structure trials loaded into LifeLine AI this week, rather than next week. Also get in our long term stand monitoring program data. We've got a meeting with the research group next week, and I want to do some checking around on my own before then. You know Yid -- I don't think you should worry about job security. With greater access to our data, we'll keep you hopping getting more of our vital databases into the LifeLine system, so us non-tech types can directly explore the old fashioned way, by imagining real world scenarios, and then looking for ourselves.

**Yid Numeric:** What, me worry?

**Joe Forester:** Great. Oh, by the way, write up some Scenario Naming Conventions this afternoon, and have them on my desk for tomorrow morning. I'll review them, then you'll send a memo to all technical staff. If you get a chance, can you re-name all existing Scenario's in all LifeLine applications to the Scenario Naming Convention standards you set up. Better yet -- get the original Scenario Authors to do it. If anyone complains, send 'em my way. Thanks.

Gotta run! I think I double-booked meetings and I'm supposed to be somewhere else right now.

**Yid Numeric:** <Silence> <Sigh> <Double Sigh>

# Management by Information

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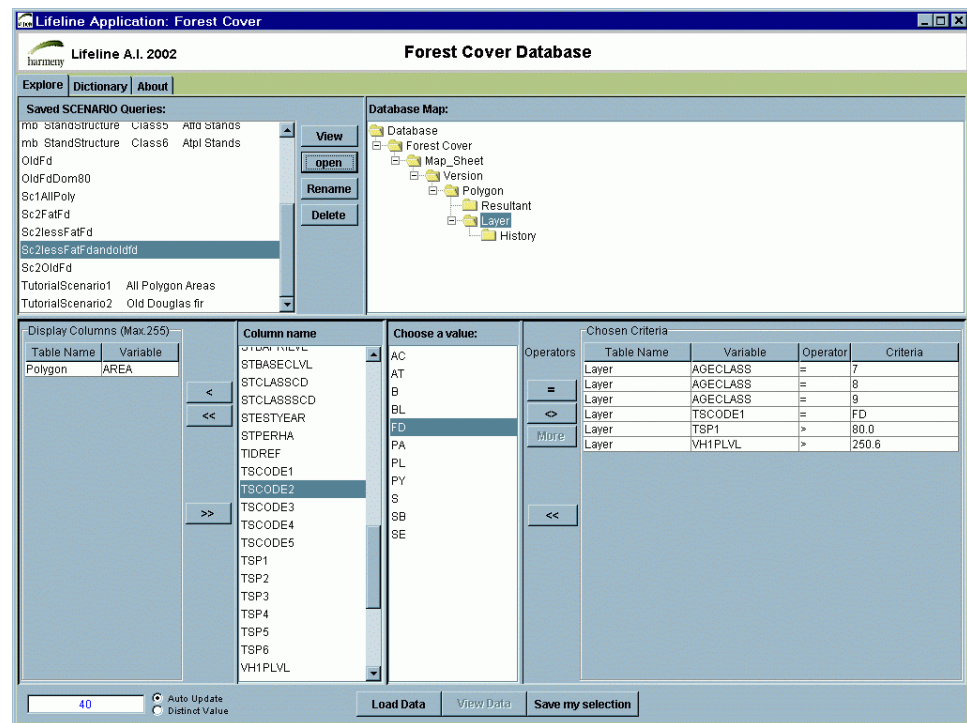
One week later.

**Yid Numeric:** Hi Joe. What's up. More LifeLine questions.

**Joe Forester:** Nope. Actually I've been playing around with LifeLine and wanted to show you some of what I've been doing. Just want to throw some ideas out, and get a bit of feedback, before I go further.

**Yid Numeric:** What's Up.

**Joe Forester:** I've been setting up some Scenario's in LifeLine. I'm trying to get a handle on how we can relate biodiversity issues into a management perspective. For example, I've been looking at Old Growth Definitions.



The Scenario "SC2lessFatandoldfd" is the product of combining two alternate definitions of old growth. The Scenario "Sc2OldFd" was the first definition we

worked on together in terms of Age Class  $\geq 7$ . "SC2lessFatFd" is a Scenario where rather than using Age Class as my criteria for old growth, I used a certain volume for the leading species (VH1PLVL = 250.6).

**Yid Numeric:** Hmm, you never read the Scenario Naming Conventions Memo, did you. What about the Scenario "Sc2FatFd"?

**Joe Forester:** Oh -- that's my original volume based Scenario for defining old growth. In it I had the primary utilization volume for the leading species set to about 300 (VH1PLVL ~ 300), but I found it too restrictive, so I lowered the volume required. As you can see, 40 polygons are members of the combined scenario - that is they meet BOTH my age class and volume based definitions.

**Yid Numeric:** So if I understand you. You created two different definitions of "Old Douglas Fir" based on different constraints. You then combined your definitions, to see how much they overlapped. In this case, 40 Polygons fall into both definitions. Remind me to give you a lesson in Venn Diagrams sometime. Now, not really knowing these forestry variables too well, I read from the "Chosen Criteria" that the constraints you set are:

```
"SELECT AgeClass IS 7 OR AgeClass IS 8 OR AgeClass IS 9  
AND TSCODE1 IS FD  
AND TSP1 IS 80  
AND VH1PLVL IS 250.6"
```

**Joe Forester:** Gee, Yid, you make it sound like you are reading a programming language.

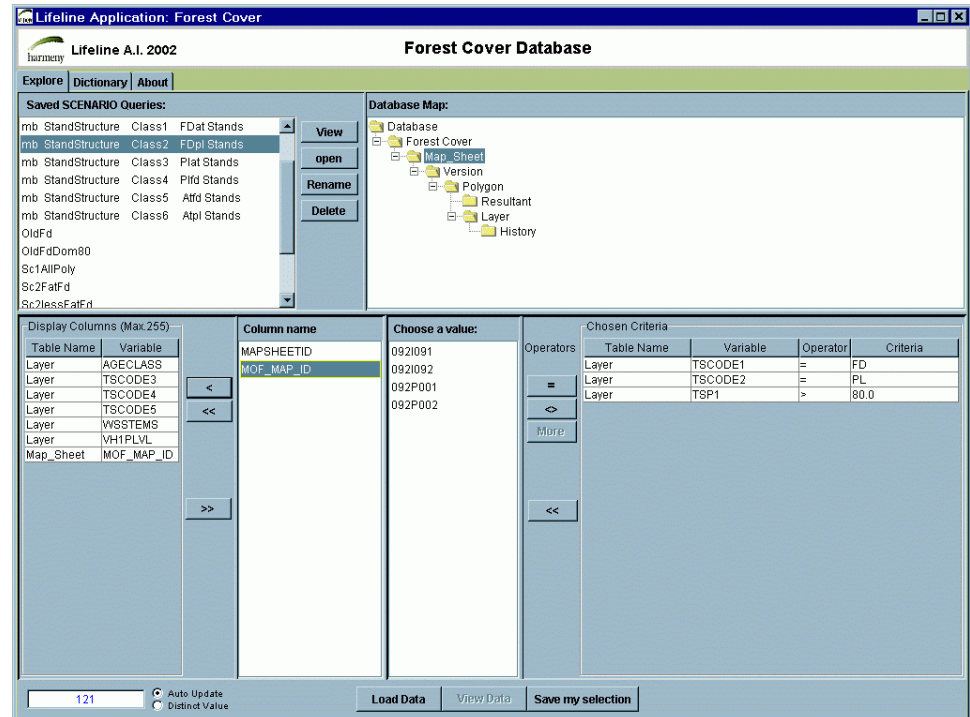
**Yid Numeric:** Indeed. But a programming language based on a Forest Cover database vocabulary of the world. Where are you going with all this.

**Joe Forester:** Well my basic idea is to take the same simple idea, but carry it out in more detail, and build up a system of Management Definitions based on our actual Forest Cover data. In particular, there are three kinds of definitions I'm interested in as a forest manager: Targets, Standards, Thresholds.

For me a Target is the results I want. The management goal.  
Standards represent a range of acceptable results.  
Thresholds are built around indicator variables. They represent a value or combination of values at which I have to take action.  
So my plan is to build a set of LifeLine Scenarios around those three concepts  
-- Targets, Standards, Thresholds --

That's something I'm going to tackle myself. I always thought it would be too technical to go through all of our Forest Cover data in this way, but now it's do-able. Targets, Standards, Thresholds can all be looked at as different kinds of constraints on criteria variables.

But I've got another set of Scenario's I've been working on with Mishtu and Ian that I'd also like to show you, Yid.



**Yid Numeric:** So, I'm looking at a Scenario named "mb StandStructure Class2 Fdpl Stands" whose constraints seem to be based on the leading species (TSCODE1, TSCODE2). It also looks like there are six classes, probably representing different species compositions. It also looks like, at least someone, read my Scenario Naming Conventions memo.

**Joe Forester:** So what we are doing here, is building a system of non-overlapping stand structure classes. We're starting with simple Scenario's first, to get a feel for the data, then we'll begin to create more complex and realistic classifications. But before we got too far I wanted to check with you if you've got any suggestions.

**Yid Numeric:** Well, not really even knowing what "Stand Structure"

means, I'll restrict my comments to some design principles.

Design Principle One: Build Complex Systems from Simple Blocks.

You, Ian and Mishtu seem to be starting to build your classes in terms of

Both Species composition (TSC1, TSC2) and in terms of Percent Cover.

This suggests, that the system could be built from simpler building blocks than the six classes you have designed so far. You could build a set of definitions for the 1st leading species only. A second set of definitions for the 2nd leading species only. Then you could combine those class definitions, to give you a more general classification system.

Design Principle Two: Explicitly test your logical assumptions.

For example, you are interested in building mutually exclusive Stand Structure classes. This means that any pair of Classes (let us call them A and B) will satisfy the following Overlap Rule:

"Sample Size for (A OR B) = Sample Size (A) and Sample Size (B)".

If your sample sizes for any pair of classes don't match the Overlap rule, you have an error in your class definitions.

**Joe Forester:** Okay Yid -- I follow you on the first rule.

I see, how we can always test the second rule in LifeLine by looking at sample sizes. But where the heck did you get this rule from. I mean it makes intuitive sense, but .....

**Yid Numeric:** Elementary my dear Watson. I've simply restated one of the axioms of inductive logic or probability. The general form of the rule is for probabilities ("Pr") and stated:

$$\text{Pr}(A \text{ OR } B) = \text{Pr}(A) + \text{Pr}(B) - \text{Pr}(A \& B).$$

Or in English,

"the probability of a set of events A or a set of events B is equal to the probability of the set of events A and the set of events B minus the probability of events A and B occurring together".

By this definition, a set of mutually exclusive (or non-overlapping) classes has no overlap, that is  $\text{Pr}(A \& B) = 0$ , and so  $\text{Pr}(A \text{ Or } B) = \text{Pr}(A) + \text{Pr}(B)$ .

**Joe Forester:** Gee Yid. That's getting a little abstract. But if I'm following you, you're basically saying the following.

1. A database contains events. These are the individual units of data.
2. Building a classification system from a database is like doing inductive logic.

3. There are rules of inductive logic that you can use to test your classifications.
4. The various Scenarios we are building in LifeLine can be considered logical statements --- which I guess would mean, they are either true or false for some portion of the data.

I guess, following from the above, my idea of building a management system from Target, Standard and Threshold Scenarios is also a kind of exercise in logic. We're not interested in just a single Scenario -- but a set of Scenarios that represent a particular perspective. For example, our Stand Structure Classification.

**Yid Numeric:** Exactly. Databases are not just big storage cabinets. They are logic systems. LifeLine's Scenario building capabilities focuses on the Logic, and logical analysis. But when you're building a Scenario, you need only focus on your particular management problem -- the logic is under the hood so to speak. The Dictionary for a forestry database creates a language in which we can make statements about forestry which we can test against the data. If we were working for a finance company -- rather than loading Forest Cover data, Plot data, etcetera into LifeLine, we would be loading Portfolio profiles, stock market information. And for a medical database we would be entering patient records, disease profiles. So -- the "vocabulary" changes as you move from one field to another, but the underlying logic doesn't.

**Joe Forester:** So, what do you think is happening here? What are we doing in the process of building up a set of Scenarios, often from different perspectives, and then combining these existing Scenarios to create new Scenarios?

**Yid Numeric:** Well -- essentially, as you create Scenario's you are adding your knowledge to the system. Knowledge does not reside in the raw data itself. It resides in the questions an intelligent human being asks of the data. The more you create custom Scenarios, the less the LifeLine system functions as a database access tool, and the more it becomes a reflection of the understanding of individuals -- their different viewpoints define Scenarios. By creating Scenarios you are structuring your perspective; constantly having expectations of what you will find, and rapidly testing those expectations.

The questions you can ask of a database -- the combinations you can seek in any large system are virtually unlimited. The questions you do choose to ask -- represent your perspective. Essentially your Scenarios become a data based model of "what's out there" viewed from multiple perspectives.

And I think the role of forest management, is to try and understand a problem from multiple perspectives and then to find the solution that best balances different perspectives. Are we managing for biodiversity? Are we managing for maximum fibre production? How do we balance Joe's definition of

"Old Douglas Fir" with legislative requirements to maintain a certain area in "Old Douglas Fir" with the ecologists telling us that a particular definition of "Old Douglas Fir" is critical wild-life habitat ?

**Joe Forester:** That's an interesting answer Yid. You surprise me. I never knew you had an interest in forest management.

**Yid Numeric:** Well, I like complex puzzles. And forest management is ...

**Joe Forester:** You know -- I was thinking, this LifeLine software is a tool. But what's really valuable to me, is the perspective behind the tool. The idea that a database is a set of questions you can ask about the world. The hardest thing to pass onto the next generation of manager is a feel for the right kinds of questions. Forestry is so complex. There are no absolute answers. Only deeper and deeper questions. The only limitation on questions that can be asked, seems to be one's imagination, and the limits of the data available.

Speaking of which .....

**Yid Numeric:** ..... you have another system you want me to load into LifeLine.

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The End (for now)  
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By  
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