spreadsheets (in Excel it is under the category of line graph). The data and graph are shown in Figure 3, which illustrates the bounds or limits of how much each objective function coefficient can be increased or decreased while the others are held constant and the LP problem would have the same solution values for the decision variables.

The small bar in between the ends of each range in the graph is the current value. The data (A13..D14) is arranged by columns with each row representing a coefficient. The four columns are the label, the low value, the high value (or these last two reversed) and the original (or close) value. This type of graph is normally used for stock market activity, but yields a useful picture of the relative sizes of the ranges. The lower limit is set to 0.0 but could be any appropriate value (like $0.500). Care must be taken if the upper or lower increase for a coefficient is infinite—you must set an appropriate bound. I usually set limits either on the graph scaling or on the spreadsheet using the MAX or MIN function. For this case, there are finite limits to the ranges.

The second data ranges that can be graphed are the resources. Resource constraints are usually supplies, materials that might be added or taken away. Including constraints that are ratio or material balance usually does not yield any insight. For this example, the data and HLC graph are shown in Figure 4.

Bananas have the widest allowable upper range not being a binding constraint (also indicated by the marginal value of $0.00). The narrowest range is the Hot Fudge resource, but of course each resource is measured in different units.

A way to be able to compare these "apples & oranges" is to measure the increase and decrease in terms of percentage. The data can be expressed in terms of percentage, with a low of 0% and an arbitrary high of 300% as shown in Figure 5.

Using percentages helps to compare the range increases and decreases in common terms, both visually and numerically.

Resource Ranges

	Low	High	Current
Ice Cream	83.3%	112.5%	100.0%
Bananas	94.3%	300.0%	100.0%
Hot Fudge	88.9%	104.4%	100.0%

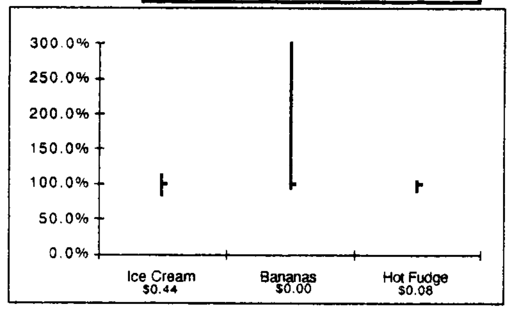

Figure 4: Resource range graphs.

Resource Ranges

	Low	High	Current
Ice Cream	40.00	54.00	48.00
Bananas	18.86	60.00	20.00
Hot Fudge	32.00	37.60	36.00

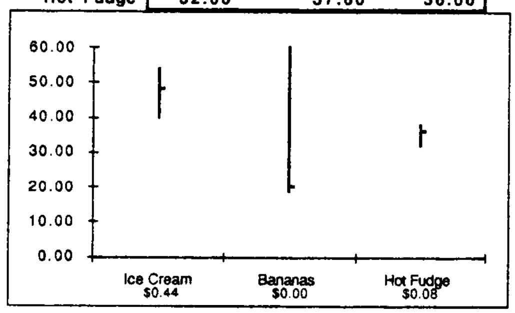

Figure 5: Resource range graph by percentage.

Conclusion

I have presented three ways of graphing some of the postoptimal information found in standard LP problems that is not limited to just two-variable problems using the High-Low-Close type graph. Next time we will look at single resource graphs and the opportunity to solve Bob's problem as an integer programming problem using a two-way data table. ■