Issues and Opinions

Logic Programming as a Paradigm for Financial Modeling: A Comment

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Introduction

The last decade has seen a rapid increase in financial modeling, along with research into ways to improve it. The most obvious spur to modeling has been the development of the spreadsheet, which is analogous to the traditional "analysis paper." The ideal for modeling systems is for them to be easily understood by the non-specialist.

It is in this context that Minch's (1989) paper, "Logic Programming as a Paradigm for Financial Modeling," should be assessed. Minch is strongly critical of existing systems. He finds six key limitations of spreadsheets and modeling systems: (1) they impose one-to-one relationships of formulas-to-values; (2) cell references are tightly coupled; (3) only non-symbolic, arithmetic opertions are possible; (4) no meta-level manipulation is possible; (5) they have restricted query capability; and (6) they lack explanations of deductive reasoning. He argues that logic programming is substantially superior to the existing systems because all previously existing limitations are overcome and the financial modeling goals are achieved.

While we do not disagree with his view that logic programming can lead to improved models, we do believe that Minch has failed to identify the problems with logic programming. He has ignored the nature of the model builder in his analysis, as well as the nature of much current model building.

We undertook a survey of more than 200 professional accounting offices in East Anglia, England, followed by a series of in-depth interviews with financial modelers within those firms. Given the experience, background, and work constraints of the financial modeler today, spreadsheets and modeling languages are seen by these individuals to provide a very satisfactory service at a low cost in time and money. The benefits to be gained from changing to an even more sophisticated approach (such as Prolog) are far outweighed by the enormous costs involved.

The Financial Modeler Today

In order to evaluate the validity of Minch's arguments, we must ask some pertinent questions: Who builds models? Why are they modeling at all? At what level are they modeling? The goals of financial modeling follow from the model builder's goals, and these will be largely influenced by the background of the modeler and his or her reasons for building a computerized financial model.

Our survey and interviews confirm that the overwhelming majority of modelers within the firms were not specialists in computers or model building but were qualified accountants. Aside from some short (usually no more than a few days) in-house training on computers or spreadsheets, these modelers were virtually all self-taught in model building. Their most frequent source of guidance was software manuals; not one had consulted a textbook about the process of model building.

The reason for the increase in computer-based modeling activity by accountants is fairly straightforward: cost-effectiveness. All modelers

also emphasized the time constraints under which they worked. Thus no time was ever spent learning any but the most familiar, basic facilities offered by the spreadsheet. Even graphics were largely ignored.

The lack of both experience and time meant that modelers frequently compressed several stages of the model building process together, often going straight from discussion with the client about the relevant variables and their interrelationships to inputting formulas into the spreadsheet. Seldom was any non-computer-based representation made of the structure of the model or the reasoning behind it. The most the clients could, and indeed did, expect was a list of assumptions made in the model; this was supplied primarily for professional indemnity against legal charges of negligence rather than as an integral part of the model-building process.

The natural result of this is that most of the financial models built are small, crude, superficial, simplistic, and issue-specific. When a new problem arose, a new model had to be built to solve it.

Analysis of Minch's Arguments

We can now consider Minch's six arguments against spreadsheets and modeling systems in the light of our survey findings.

His first limitation is that the existing paradigms impose one-to-one relationships of formulas-to-values. This is overcome by the logic programming paradigm, which provides multiple values, hypotheses, and even solutions. Our discussions with accountants indicated they believe that time is too short to do more than "quick and dirty" estimates of relationships, let alone generate several ways of defining a value. Different hypotheses can be incorporated by simply running the program several times with different parameters.

Similarly, the problem of only being able to use non-symbolic, arithmetic operations, Minch's third limitation, is of little relevance to accountant modelers: the survey indicated they never want to use any other kinds of operations. Indeed, a common response from our interviewees was that accountants only understand numbers and would be unhappy with any other representation of reality.

There is no doubt that the tight coupling of cell references, Minch's second point, does cause problems when model modifications are made, particularly by a "sloppy" programmer. The ripple effect of a simple change may have unnoticed consequences, and it does make auditability of the model a problem. However, learning a completely new programming language is a drastic solution, and an unlikely one if accountants will not even utilize the full potential of spreadsheets.

The related problem of storage space for all possible ad hoc query results would also, Minch states, be overcome by logic programming. However, this is really not a real concern with traditional methods given the small size of the models.

Minch suggests that a major advantage of logic programming is its provision of meta-level manipulation, thus overcoming the fourth limitation of traditional paradigms. While this does seem a very useful feature, Minch admits that it is the least-often used in logic programming. Our survey indicates that the questions available with this paradigm (e.g., What is the longest chain of relationships between input and output variables? What variables depend on both X and Y?) are neither currently considered nor thought worth considering.

It certainly would be thought that Minch's fifth limitation—restricted query capability—would be a severe drawback to efficient and effective model building. Questions such as "What is the sales amount for period 3?" and "What is the gross margin for periods 1 through 5?" are common among model users; indeed, they may be the main reason for building the model in the first place. However, these are not difficult questions to answer simply by looking at the spreadsheet output in the relevant columns or rows. The second advantage for logic programming claimed in this respect is also somewhat hollow. The ability to distinguish between what-if and goal-seeking queries—invertibility—is an elegant sophistication, but it is easily, if more crudely, accomplished within traditional systems.

The most important advantage of logic programming appears to be the enhanced validation given by the explanations of deductive reasoning. A distressing result of our survey was that there was little evidence of systematic model validation, although there were some verification procedures.

Strangely, the clients of our respondents do not seem to worry about all this: there was certainly no evidence of complaints. The reasons for this are probably twofold. First, they were generally involved in the early discussion about the structure of the model, the variables included, and their interrelationships; thus, they might be satisfied with the model from the start. Second, they may use other methods of validation. One way is for the client to "validate" the modeler him or herself and, having done so, accept any models produced. Another is simply to look at the results and see if they look reasonable—the "black box" approach. Certainly, this was the most common method of validation stated by the modelers: "We eyeball the output!" None of the respondents used any statistical analysis, and few even ran trial data other than that used to build the model.

It is therefore clear that Minch's sixth limitation is not seen as a practical problem. Although traditional systems effectively ignore the process involved, so do many model builders and users. Spreadsheets give little explanation of the reasoning behind the model, but the clients do not seem to want it.

Conclusion

It is quite true that spreadsheets have limitations in terms of systematic model building. But are these disadvantages so very important? The models built on spreadsheets by accountants are small; thus, model audit and query are comparatively simple. More facilities to assist model specification, construction, and use are available within spreadsheet packages than are currently used. For the task at hand, they are not seen as relevant. Logic programming would fail the same test. The problem is not the adequacy of the modeling tool but the modelers' failure to appreciate the nature of an adequate model building process.

It is important not to lose sight of the very great advantages that spreadsheets have, especially the ease with which they are understood and used by non-programmers. Minch admits that their popularity is due to their natural analogy with paper worksheets. This point cannot be overemphasized.

Accountants have a strong affinity with the analysis paper and can transfer their acquired accounting skills more or less directly on to the spreadsheet with little training. This, combined with the inexpensiveness of both the hardware and software required, means that the accountant need only make a small investment of both time and money in improving his or her technological image.

The value of models lies in the learning process involved in model building and in the use that is made of them within the framework of the problem-solving activities of managers. We need to educate the users and builders into greater awareness of the model building process first and then improve spreadsheets to help users build better models rather than expect users to reinvest in a new system.

We must not lose sight of the ends of model building and become too concerned with a model-building tool for its own sake.

Reference

Minch, R.P. "Logic Programming as a Paradigm for Financial Modeling," *MIS Quarterly* (13:1), March 1989, pp. 65–84.