

It seems Dr Bigsby has made the error of assuming the change in a product is the product of the changes in its factors. As a piece of historical trivia, I note that according to Professor Bell ("Men of Mathematics", chapter 7), Gottfried Leibniz (1646-1716), the discoverer with Isaac Newton (1642-1727) of the Calculus, at first made the same mistake when trying to find the product rule for derivatives.

Garry Herrington

## Dr Bigsby responds

The formula is a definition of NPV and is meant only to illustrate the point that changes to NPV will arise from changes to any or all of prices, volumes per area and area over time. My apologies if I have misled anyone as to how the changes would actually have to be calculated. With any luck, Leibniz will read this as well and not feel compelled to have to return and pull me up for it also.

Hugh Bigsby



# RegRAM-I – A flexible, forest harvest scheduling and industrial processing, global optimisation model

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## ABSTRACT

*This paper describes a Regional Resource Allocation Model, known as RegRAM-I, that has been used by Tasman Forestry Ltd, since 1991 as the company's major resources planning tool. RegRAM-I allows the user to interactively describe the objects to be modelled, (forests, processes, external suppliers, markets), transport costs between various locations, and how time is to be treated, on separate independent spreadsheets. The system uses both optimisation and simulation techniques, and can generate: individual stand models, single time period resource allocation models, single forest 'on-truck' models, multiple forest 'delivered to mill gate' models, multi-location integrated forestry and processing models – all without the need for separate mathematical formulations.*

## COMPANY BACKGROUND

Tasman Forestry Limited is the forest growing and harvesting subsidiary of New Zealand's largest company, Fletcher Challenge Ltd, and is the sole log supplier to the wood processing companies in the Group:

- Tasman Pulp and Paper Ltd,
- Tasman Lumber Ltd,
- and Fletcher Wood Panels.

In New Zealand the Group's current annual production is:

- 342,000 tonnes of newsprint,
- 153,000 tonnes of kraft pulp,
- 190 million board ft of sawn timber,
- 402 million sq ft of wood panels,
- 800,000 m<sup>3</sup> of log exports.

The company has two major areas of operation in New Zealand: the Central North Island where it owns 165,000 ha of forest, and Nelson/Marlborough, where it jointly owns 60,000 ha of forest.

The Central North Island is by far the most complex region, with all the Group's processing plants situated there, including: newsprint and kraft pulp mills at Kawerau, sawmills at Kawerau, Putaruru, Rainbow Mountain and Taupo, and particle board and

medium density fibre board plants at Taupo.

The company also supplies logs to other companies and small sawmills throughout the region, as well as substantial volumes of log exports via Mt Maunganui.

The company logs its own forests, state-owned forests, and minor woodlots, throughout the region. Wood residues such as sawmill chip, for its pulp and paper and wood panels' plants, come from both its own and external processing plants.

## THE PROBLEM TO BE SOLVED

The pattern of log allocation between the forests and processing plants in a region varies over time, because the availability of logs from each forest varies. Since cartage costs can be a significant part of the delivered value, it is impossible to decide the best time to harvest a crop without knowing where the logs will be sold. However, where logs will be sold depends upon the log availability from all other forests. Thus even for a pure forest owner, harvesting decisions need to be made in conjunction with log allocation decisions.

For an integrated forest owning and processing group, the situation is even more complex. For example, the more wood residues that are produced, the fewer pulp logs that will be required by the pulp plants. Thus the volume of logs to be delivered to the pulp mills cannot be determined until you know the volume of sawlogs going to the sawmills and how much chip will be produced as a result.

Since a substantial proportion of the costs at existing processing plants can be regarded as fixed, the marginal value of logs to existing processing plants can be very high. Marginal values will also vary from one grade of log to another. Moreover, the differing log grades can incur different processing costs, and consume different amounts of plant capacity.

These considerations were persuasive enough to suggest that the work done on an earlier single-period resource allocation model, LOGRAM (McGuigan 1984), should be carried forward into a new multi-period version RegRAM-I, that would include harvest scheduling as well as resource allocation. This paper describes the new model and some of our experiences to date.

## DESIGN OBJECTIVES

Fletcher Challenge is an exceedingly dynamic company. The only thing that is permanent is change. Thus any system developed had to be highly flexible. There was no point in developing a system

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