

USING GOLDSIM TO FORECAST ELECTRICITY DEMAND FROM IRON ORE MINES

This paper describes how GoldSim was used to forecast electricity demand from new iron ore mines in the Mid West region of Western Australia. An accurate forecast was required to estimate the size of new demand from greenfield iron ore mines and assist in demonstrating the need for a new 330 kV transmission line.

Background

Western Power owns the largest electricity network in Western Australia. As owner of the electricity network, it is Western Power's responsibility to ensure that the network has the capacity to accommodate growth in the demand for electricity. In recent years, however, much of the growth has occurred on the periphery of the network. This growth has in fact been derived from an increasing demand for raw materials from East Asia, in particular China.

Demand for Western Australia's raw materials has grown so rapidly that Western Australia's traditional mineral provinces such as the Pilbara are unable to keep pace. This has created an opportunity to exploit resources in other parts of Western Australia, albeit at lower grades of mineral resource.

The Mid West region has substantial magnetite iron ore resources. Unfortunately, there isn't much in the way of port, rail or electricity infrastructure. So in order to exploit the resources present in the Mid West, it is necessary to invest hundreds of millions of dollars in new infrastructure. Western Power's role is to extend the electricity grid such that there is sufficient capacity to accommodate the increased demand for electricity from several prospective iron ore mines.

A complicating factor is that these new iron ore mines were expected to contribute substantially to the new infrastructure. Naturally, they saw it differently; the main argument being that Western Power, as a state-owned enterprise, is an agent that should promote economic development by funding the infrastructure. Such matters are determined in accordance with the *Electricity Access Code 2004*. Compliance with the Access Code requires a benefit-cost analysis.

Justifying GoldSim

The Access Code requires that the cost analysis be conducted using discounted cash flow model. Traditionally, this is implemented in an Excel spreadsheet using what I regard as the traditional net present value (NPV) approach. That is, a deterministic model with standard low, middle and high scenarios. Given the volatility in commodities markets, however, I regarded the traditional NPV approach as insufficient for the task. In particular, there is a threat that the prospective mines could cease development if economic conditions deteriorated suddenly. Western Australia has experienced many mining collapses in the past.

This presented a problem as conducting modelling that is somewhat more sophisticated invariably makes the Excel spreadsheet so complex that it is very difficult to audit. It is also quite cumbersome to use.

GoldSim, by contrast, is substantially easier to understand and follow. Moreover, its functionality is substantially more sophisticated than available in Excel. A nice feature is its visual orientation making it substantially easier for auditors to vet the model. These considerations, however, are secondary to the main advantage of using GoldSim.

The Monte Carlo functionality allows the modelling to explicitly recognise uncertainty. This is a primary consideration for the incremental revenue model given that the timeframe of the investment is 50 years. Despite our expectation that the new iron ore mines will be able to keep

operating over that timeframe it soon became apparent that they would not agree to signing contracts for that period of time. So Western Power needed to demonstrate the robustness of the new demand to its funders.

Given that risk assessment invariably requires a series of judgements to be made, the incremental revenue model developed in GoldSim would allow financial analysts to work through those judgements in a systematic manner. Moreover, it would allow analysts to focus on the assumptions underlying model outcomes. Often, disagreements between negotiating parties revolve around differences in judgements about key assumptions. The GoldSim model allows an evaluation of which assumptions were the most critical, in turn facilitating a consensus view.

Real options analysis versus traditional NPV assessment

A special feature of Western Power's incremental revenue model is that it employed Real Options Analysis. Traditional NPV analysis by contrast, implicitly assumes that a prospective investment proposal will expire if not acted on immediately. This is often an unreasonable assumption. Many prospective mining development projects can and are deferred. Comparing many real-life projects with standard finance theory consistently shows that the standard theory is not a good predictor of real behaviour. Many investments do not proceed until sometime substantially after the NPV indicates a positive return on investment. This is because of the uncertainty associated with investments that require a substantial and irreversible upfront investment with an uncertain payoff received over many years.

This presented a significant problem to Western Power as any significant investment in the electricity grid that is poorly timed would be a costly embarrassment.

Given that Real Options Analysis explicitly recognises uncertainty of real-world projects, it was always much more likely that it would be a better predictor of real-world behaviour. Therefore, integrating Real Options Analysis into the incremental revenue model provides insight into the circumstances in which the mining projects is most likely to proceed immediately.

Real Options Analysis was integrated in the model in two ways. The first was to calculate the option value of waiting, which is defined as the difference between the expected NPV of a high scenario in the next period less the expected NPV if the project proceeds now given prevailing economic conditions. In effect, the option value of waiting is added to the capital expenditure estimate of the project. The decision rule is thus: if the expected NPV of proceeding now exceeds the sum of the capital expenditure and the option value of waiting, proceed now. Otherwise, wait until the next period and re-evaluate.

The option value of abandonment usually provides an estimate of the option to walk away from the project once it is committed. The higher the option value of abandonment the easier it is to commit to the project. This was calculated according to Nouvaes and Souza (2005)¹ using Margrabe's adaptation of the Black-Scholes option model.

Model structure

The integrated Monte Carlo features of GoldSim combined with its visual orientation met at the model structure itself could remain simple and intuitive. In essence, the core of the GoldSim is a simple financial spreadsheet. Taking this approach, all of the normal financial parameters such as operating expenditure, capital expenditure, revenue etc. could be retained.

¹ Novaes, Antonio G.N. and Joao Carlos Souza (2005). "[A Real Options Approach to a Classical Capacity Expansion Problem](#)", *Pesquisa Operacional*, v.25, n.2, p.159-181, Maio a Agosto de 2005, versão impressa ISSN 0101-7438 / versão online ISSN 1678-5142.

GoldSim model performance

The GoldSim model as described above performs well. The main outcome of the model results indicated that both iron ore mines are highly likely to proceed if the new 330 kV transmission line is constructed. Indeed, the GoldSim incremental revenue estimates formed a fundamental component of investment proposals to the Department of the Treasury (Western Australia) and the Economic Regulation Authority.

With some modification, the Department of the Treasury appeared to accept the model structure and results. The Economic Regulation Authority, however, adopted a much more conservative stance. Indeed, the Economic Regulation Authority paid relatively little attention to the GoldSim model and its results. In its place, they produced what they referred to as the discounted weighted average tariff model, employing a deterministic scenario.² The Economic Regulation Authority gave no consideration to sensitivity analysis and, to date, their judgements have not been seriously questioned.

Postscript

Following what was ultimately a successful approval process, construction of the new 330 kV transmission line is about to begin. A separate economic modelling project which quantified substantial market benefits assisted substantially in securing approval. However, at best the market benefits could only justify about half of the construction cost. The other half of the benefits needed to come from the incremental revenue estimate.

The GoldSim model has provided considerable degree of insight. Among those concerned with accountability within Western Power, the model has provided assistance in forming judgements about whether to proceed with the investment.

Overall, the use of GoldSim has demonstrated the power of using advanced economic modelling to inform investment decisions. On that basis, the GoldSim model must be judged a success. Indeed, GoldSim will be employed again to evaluate other investment options both in the Mid West and the Goldfields.

Contact details: Grant Coble-Neal

Email: grant.cobleneal@westernpower.com.au

Find me on Google+: +Grant Coble-Neal in the Google search field

² Economic Regulation Authority, [Final Determination on the New Facilities Investment Test Application for the Mid West Energy Project \(Southern Section\)](#).