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Financial scenario modelling: a guide for universities

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ABSTRACT

Universities face an uncertain funding environment and turbulent marketplace. Financial scenario modelling offers a potential mechanism to assist in navigating a way forward. Our previous paper on UK universities' practice found some variation in the sophistication of the approaches taken, but the overall impression was of a relatively simple approach, with spreadsheets generally viewed as having sufficient functionality to meet current strategic needs. This subsequent paper offers guidance on the construction of financial scenario models. It addresses the key variables that universities may wish to include, and it offers advice on how models might be formulated and evolve. The characteristics of differing approaches taken by universities in meeting their own scenario modelling requirements are explored by identifying three forms of model: basic, intermediate and advanced. The contribution of this paper is to enable universities, in the UK and beyond, to evaluate and improve their own financial scenario modelling practices.

KEYWORDS

Budget; finance; financial management; financial modelling; scenarios; key variables

Introduction

Operating in an environment that is 'marketised' through competition (Taylor, 2013) and yet subject to dirigiste, and unpredictable, government policies (Parker, 2012), it is increasingly challenging for universities to plan. In such a turbulent context, sound financial management is crucially important (Wellington, 2007). Annual budgets and short-term financial forecasts are key tools for the management of finance, control systems, strategic planning, communication, achievement of KPIs (key performance indicators) and regulatory compliance (Kenno et al., 2021). However, it is difficult, if not impossible, to produce accurate longer term financial forecasts in such an uncertain environment. Yet, in difficult circumstances, having a good financial understanding of the future becomes increasingly important.

One approach to addressing an uncertain future is scenario modelling (Wack, 1985a, 1985b), which is an established and widely used technique in large business organisations (Varum & Melo, 2010). Often misunderstood, scenario modelling is concerned not with forming a specific forecast but with helping managers to

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understand key business drivers and hence manage risk (Pierone, 2013). Scenario models offer multiple views of a future that is not predictable with any degree of confidence (CGMA, 2015), enabling managers to conduct sensitivity ('what if') analysis, whereby the implications of different sets of assumptions can be explored (Prowle & Morgan, 2005). For example, scenario models assisted UK institutions to evaluate and determine the effect of differing home undergraduate tuition fee rates following the Browne Review (Browne, 2010). Although much of the focus might be on contingency planning for mitigating downside risks (CGMA, 2013), Makridakis et al. (2009) recommend generating ideas and developing strategies that could neutralise sources of threats. Upside risk and how to respond if unexpectedly positive conditions or outcomes occur should also be considered.

Financial scenario modelling thus seems to be of potential value to universities. Indeed, the university funding bodies in the UK have required institutions to undertake it for some years (e.g., Higher Education Funding Council for England, 2011, 2016; Higher Education Funding Council for Wales, 2020; Office for Students, 2019; Scottish Funding Council, 2020) and it is recognised as an effective tool to regulate financial sustainability within higher education (OfS, 2023a). (The Higher Education Funding Council for England (HEFCE) distributed public money for teaching and research to universities and colleges in England before being replaced by the Office for Students (OfS) as the main regulator of higher education on 1 January 2018. Other UK higher education funding bodies include: Research England, the Scottish Funding Council (SFC), the Higher Education Funding Council for Wales (HEFCW), and the Department for the Economy, Northern Ireland (DfE)).

However, they do not prescribe the form that such modelling should take, and they have not published any detailed information on what universities currently do, perhaps because they have no integrated model to test scenarios themselves (National Audit Office, 2022). Instead, they merely suggest that universities comment on the modelling techniques employed, specifying key sensitivities. A university's governing body is expected to consider the impact of possible future changes in student recruitment and retention, and staff pay and pension pressures (HEFCE, 2016). HEFCE's replacement, the OfS (Office for Students), has more recently referred to the need for 'rigorous and independent' scenario and contingency planning (OfS, 2019, p. 20). To some extent, this parallels broader developments; the Financial Reporting Council suggests that, when assessing whether there is adequate support for the going concern assumption in preparing a set of accounts, auditors should consider:

> Whether and, if so, how management considered alternative assumptions by, for example, performing a sensitivity analysis, including 'pessimistic' and 'optimistic' scenarios, to determine the effect of changes in the assumptions on the data used in making the assessment (FRC, 2019, ISA (UK) 570 Going Concern, A8–7)

In a university context, this means ensuring that forecasts have been stress tested against a number of differing scenarios, with liquidity a key focus (Grant Thornton, 2021). The OfS emphasises the need for scenario planning in universities to 'navigate an uncertain environment and ensure financial viability and sustainability' (OfS, 2019, p. 4) so that it can understand what they 'have already done, or planned to do, to mitigate the risks of

uncertainty in your forecasts' (OfS, 2022, p.97). It is therefore sensible to align the period of the scenario modelling with the timeframe of the forecasts being prepared.

However, in the absence of guidance on scenario planning and sensitivity analysis, some of the modelling being undertaken might fall short of its potential or even be inappropriate. For example, HEFCE indicated that grant cuts of 20% of income during 2009 were unlikely to arise, yet one unnamed vice-chancellor admitted to modelling cuts on this scale (Newman, 2009).

Moreover, our previous empirical study (Cropper & Cowton, 2021) found that, although many institutions felt that their scenario planning or sensitivity analysis satisfied their own requirements and those of reporting to their funding council, they were uncertain whether they were in fact adopting the right approach, particularly given the lack of sector guidance. We found that a range of practices exist in the sector, but there is little sharing of ideas on the models used and therefore little opportunity for a given institution to gain insights into alternative approaches. Drawing on general guidance (e.g., CGMA, 2015), our previous empirical research findings (Cropper & Cowton, 2021) and our own professional experience, the aim of this paper is to offer such guidance for universities.

A flowchart of the stages involved in financial modelling has been created to structure the paper. The process of implementing scenario analysis in practice will be more

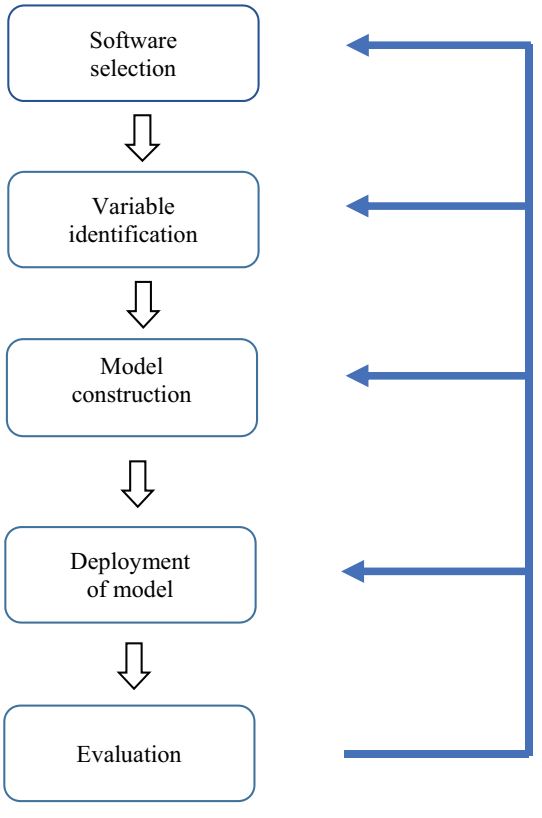

Figure 1. Financial scenario modelling stages. Source: authors, for this paper.

complicated, involving iterations and returns to previous stages, but the model in Figure 1 provides an overview of the key elements involved in developing financial scenario models.

The remainder of the paper is structured by addressing each of the stages in Figure 1 in a separate section, followed by the Conclusion.

Software selection

Various specialist software packages offer financial scenario modelling functionality. These include IBM Cognos, Axiom, Quantrix, Budgeting Solutions and Oracle BI. However, such software tends to come with implementation and maintenance costs – sometimes a very significant expense in terms of upfront purchase, on-going licence fees and consultancy. Furthermore, all such software requires specialist training. Alternatively, providers of finance systems (e.g., Oracle, Unit4) often incorporate the capability to undertake scenario analysis using embedded software models. However, such specialist modelling software also requires training.

It is perhaps not surprising, therefore, that the most commonly used software for financial scenario modelling in UK universities is Excel (Cropper & Cowton, 2021). Excel is ubiquitous and very familiar to finance staff. It is also easy to use and, even though it is not as powerful as specialist software, it apparently possesses sufficient functionality to meet the perceived needs of universities. Widespread familiarity with Excel also makes it easier for those who have not built the model to understand it. Therefore, our discussion will generally assume that Excel is being used, although many of the points that we make will also be relevant to modelling with other tools.

Variable identification

The starting point is to identify the key variables to be used to construct the financial model that will produce the projections over the chosen time period. Often referred to as the model 'drivers', variables that are material are the core components of the model. The relationships between them need to be understood (Morrison & Mecca, 1988; Ryan, 2008; Schoemaker, 1991), and any non-financial variables needs to be converted into, or associated with, a monetary value so that, when it is flexed, the appropriate adjustment is made to the financial scenario model. It may also be necessary to identify a 'base year', so that the adjustments can be applied on a cumulative basis from this point onwards.

Different types of institution have different strategic emphases, KPIs and financial characteristics (Williams, 2012). However, several key variables seem to be applicable to all universities, even though they vary in their income diversification (Eastwood, 2008; Garland, 2020) and cost structures (Hogan, 2011). Each will be discussed in turn.

Student income

On the revenue side, the variable likely to be given the highest priority is student income, which is the largest source of funding in most institutions' accounts (OfS, 2023b). Given the importance of student income, it would usually be expected to break down the total figure into different streams, such as level (undergraduate, postgraduate), domicile

(home, international) and mode of study (full-time, part-time, sandwich, distance learning). In all cases where the amounts are material, it makes sense to model both the physical numbers involved (student numbers) and the respective fees and any other associated income (e.g., the various elements of OfS supplementary funding that support high-cost courses).

Given that teaching income is such a major funding stream for virtually all institutions (Taylor, 2013), a sub-model, or set of sub-models, focused on its various components and drivers might be useful. Student recruitment tends to vary over time, as can retention, so both should be reflected in the model, especially where courses (such as typical undergraduate degrees) extend over multiple academic years that will lie within the time horizon covered by the financial scenario model. Furthermore, adequate consideration will need to be given to new and strategic funding (such as apprenticeships in the UK), which may not follow the more traditional teaching funding model.

The importance of a particular income stream is likely to affect how much detail it is broken down into and whether it warrants a sub-model. For example, international students have come to provide a significant source of income for many universities, including those in the UK, and their recruitment has had a marked influence on the business models adopted by universities (Guthrie et al., 2021). However, their numbers can fluctuate because of competitive pressures and both domestic and international political shifts, influenced by differing strategies in each country (UUK International, 2021). Any forecasts are therefore subject to considerable uncertainty, and it will make sense, if a university is heavily reliant on international student income, to model it in some detail in scenario models, paying attention to the principal 'markets' from which they come.

Another example of differential modelling is retention. Different retention rates might be included in the model, to reflect differences according to subject areas or student characteristics. On the other hand, for some universities it might be sufficient just to include an overall average.

Research funding

As a further example of modelling income streams in different degrees of detail, a research-intensive university might wish to model possible gains or losses in research income by type of funder, whereas an institution with relatively little research activity might be content to undertake sensitivity analysis at the level of total research income only.

Other revenue

Finally, other examples of sources of income that are likely to vary significantly by institution, and so feature differently in their models (if at all), include philanthropic fund-raising, franchise operations, catering and accommodation, conferences, enterprise activities and other third stream funding.

Staffing costs

On the cost side, staffing will be a central focus. In all cases where the amounts are material – which they are likely to be, given that staff costs are the largest cost in most institutions' accounts (OfS, 2023a) – it makes sense to model both the physical numbers involved (staff headcount, perhaps classified into different categories or areas) and the respective salary levels and oncosts, including employer pension contributions. Even with the shift towards defined contribution or 'money purchase' pensions provision, the continued existence of defined benefit pension obligations means that pension contributions can swing significantly, depending on pension fund valuations, especially when they are judged to be in significant deficit.

The pensions example is a reminder that it is not just the size of a figure that should affect the way it is modelled and the degree of attention that is paid to it.

Other operating expenditure

Other operating expenses (non-pay) cover a multitude of items, from travel and subsistence to computing equipment, and may or may not have a matching funding stream. Some larger items of equipment may even be capitalised and replaced by a multi-year depreciation charge, which is a non-cash item.

Inflation

Scenario analysis involves multi-year projections, so how inflation is to be treated should also be considered. This has always been the case because, even when the inflation rate is low, the cumulative effect over several years can be significant; but in recent times, annual inflation has increased to levels not seen in most developed economies since the 1980s, so it has become especially important.

One simple method is to be clear that the financial model is expressed in 'real terms', that is, without taking inflation into account. Given that scenario analysis is not a forecasting exercise, this might be sufficient to enable management to explore key business drivers. However, for any but the simplest models, it is probably best to include inflation in the model as a variable that can itself be explored for its possible impact, especially when there might be different inflation rates for certain key elements of income or expenditure, if they are not expected to follow the general rate of inflation.

Given their importance, it is particularly useful to consider how student fees or staff costs might increase. Some proportion of student fees is likely to affected by government policy. Regarding staff costs, at least three factors are important beyond just general inflationary pressures: the increase in actual salary levels, which over the long term has tended to be higher than general price inflation; rising pension contributions, as well as other on-costs (such as bonuses, allowances, national insurance contributions, market supplements, honorariums, etc, where applicable); and incremental drift in salaries, which can become particularly significant if staff turnover or the recruitment of new (generally cheaper) employees fall, perhaps because a university, or the sector as a whole, are encountering difficulties.

Items to omit

Some items could sensibly be omitted from scenario models as they offer little of value in understanding movements in income and expenditure under different assumptions although they may still be referred to. These might typically include: in the case of UK institutions, Financial Reporting Standard 102 actuarial pension adjustments which identify the projected annual cost of servicing future pension liabilities; transfers to reserves, committed but not yet expended costs; and non-recurrent expenditure on self-financing sites. Each is either a non-cash item or covers spend that has little or no impact on the surplus or deficit of an institution. The latter may arise in the case of research income streams with a matching expenditure, and thus changes in income result in compensating movements in spending.

Given that the aim of financial modelling and sensitivity analysis is to help institutions cope with an uncertain future, the volatility and uncertainty associated with variables are at least as important as size. Indeed, there is little need for a scenario model where variables are easily predictable, as the outcome requires less exploration. Such uncertainty can have many sources. In a university setting, Prowle and Morgan (2005) emphasise the need for models to be sufficiently flexible to consider changes in government policy, inflation, tuition fees, third stream income and international recruitment as significant areas.

Model construction

When constructing a financial model, the relationships between some of the variables should be modelled using formulae, and there should be links to any more detailed sub-models for important variables, the outputs of which are pulled through to the main model. Practices will tend to reflect the importance of the key variables identified. Thus, sub-models for staff costs and student fee income may be common, and connections made between income and staffing costs. Students and staffing could also be linked through a formula for staff-student ratios; significantly increasing (reducing) student numbers tends to result in an increased (reduced) need for teaching staff. Bursaries/scholarships as a proportion of student numbers might be beneficial too. Such linkages between variables imply that models have some degree of sophistication in terms of making associations between movements in income and expenditure. Another important task is to distinguish between fixed and variable cost behaviour, because a reduction in the volume of activity will not always result in a reduction in costs.

It may be necessary to undertake several iterations of the model building process before the appropriate strategic focus becomes apparent, but it is worth keeping in mind the advice on good practice in Excel (such as ICAEW, 2014) to keep the approach simple, flexible and logical, using understandable formulae and automating as much as possible.

End users of models produced in Excel should be provided with outputs that are easy to understand, at an appropriate level of detail, incorporating adequate notes together with visual aids such as colour coding and graphs. Models should be tested and have sense-checks built-in. Furthermore, common definitions of key drivers such as 'Full Time Equivalent (FTE)' students and staff, etc. should be agreed at the outset.

Deployment of model

Data for variables might be entered manually into an Excel model, drawn from relevant databases. Universities generally have sophisticated finance, staff and student record systems that permit the extraction of data at a detailed level for key variables such as tuition fee income and staff costs.

However, determining which details are most relevant can be challenging (Hoffelder, 2013). An appropriate level of sophistication or complexity has to be determined. Disaggregated figures do not necessarily produce better forecasts than aggregated data (Bavnea & Lakonishok, 1980). Simpler models are also easier for finance staff to maintain, and they reduce the likelihood of errors creeping in. Too much complexity can also make a model difficult to understand and use. A CFO Research Services (2011) study of financial planning suggests that the amount of data should be minimised so that managers and planners can focus on key drivers, resulting in:

- the avoidance of a false perception of accuracy, because too many complex calculations can lead university planners and managers to the conclusion that the model is accurate simply because it is complex;
- focusing on the most important activities that have the greatest potential effect on the university; and
- allowing the finance team to undertake scenario analysis and perform 'what-if' analysis on a timely basis.

Relevant scenarios need to be defined based on a range of operating environments and possible disturbances. By agreeing a baseline scenario drawn from a current strategy, KPIs, operational plans and budgets it is possible to then introduce triggers which result in alternative scenarios. The key risks and uncertainties facing universities are often set out in their operating and financial review within the annual published financial statements. Recent challenges include the COVID-19 pandemic, global inflationary pressures, reliance on international student recruitment, sustainability of pension schemes, investment in facilities and environmental policies – and, specifically in the UK, Brexit.

When attempting to model possible student recruitment scenarios, basic trends need consideration, including demographic and social trends such as the number of 18 years-olds likely to attend university, graduate employment opportunities, competition in the marketplace, etc. Checking for consistency and plausibility is important. For example, forecasting unrestricted overseas student growth when there are government restrictions on immigration visas, does not seem logical.

As institutions are primarily interested in a limited number of outputs, the key variables can be minimised. These outputs concentrate on assessing the impact of changes to total income, total expenditure, surplus or deficit and, perhaps unsurprisingly, the cash position.

As found in our earlier empirical study (Cropper & Cowton, 2021), models can vary in their degree of sophistication. Supplementing our own practical experience with insights drawn from conducting that research, as well as from conversations with other practitioners, Table 1 summarises three broad approaches to financial scenario modelling,

Table 1. Characteristics of financial scenario modelling approaches.

Characteristic	Basic	Intermediate	Advanced
Variable analysis	Single variable sensitivity analysis	Multi-variable based sensitivity analysis	Multi-variable based sensitivity analysis with inter-connecting themes
Lead variables	Teaching income	Teaching income and staff costs	Teaching income, staff costs and non-pay items
Separate table of key variable assumptions	No	Yes	Yes
Financial period (years)	3–4	4–5	4–7
Revenue and capital items?	Revenue only	Revenue and capital cost converted to depreciation	Revenue and capital
Mitigating actions identified	Narrative explanation	Narrative explanation	Narrative explanation and values for specific approaches
Changes to individual key variables	Constant and/or a basic trend of percentage changes	Movements based on non-linear changes	Sophisticated movements based on non-linear changes
Revenue, capital and/or cash statements	Key headings of income and expenditure	I&E statements and changes to cash balances	I&E statements, balance sheets and cash flows
Presentation of results	Basic tabular structure	Detailed tabular structure with colour coding	Detailed tabular structure and some use of charts

Source: Authors, for this paper.

distinguished according to the key elements that we have been discussing. The 'basic', 'intermediate' and 'advanced' approaches might not be completely exemplified in practice, but they provide an indication of the differences that are likely to be observed and the possible stages of development that might take place.

It is worth exploring differences in the characteristics of these approaches to assist institutions in selecting an approach that works well for their particular circumstances. Basic approaches will focus on a few key income and expenditure streams and generally assess the increase/decrease in income/expenditure as a result of varying assumptions for revenue headings only, such as the effect of changes in home undergraduate and overseas postgraduate student recruitment. The intention is to provide an understandable model at the expense of incorporating more sophisticated linkages which can be found in intermediate models that add a degree of complexity, with a wider range of key variables. Such models usually contain a separate table of key variables and changes are fed through to monetary values in the relevant heading of income and expenditure. Some of these variables may relate to a single year only, such as one-off staff payments on restructuring or to address cost-of-living increases (Mitchell, 2022).

Unlike basic models, the intermediate approach results in revised income and expenditure accounts, but with some important alterations such as separating out the non-cash actuarial pension cost adjustment, identifying target savings in order to achieve a certain level of surplus, or the introduction of key ratios of staff costs to income, or wherever emphasis is thought necessary.

Although intermediate models are capable of handling the effect of multiple changes to key variables, more sophisticated linkages between changes to income and required changes to expenditure are more characteristic of an advanced approach. For example, staff-student ratios by course or program area could be used, as well as assumed average

non-pay expenditure to income. Rather than produce an output of simplified income and expenditure accounts, advanced models make good use of the main financial statements within the financial forecasting template supplied by the relevant funding body and modify them to prepare scenario models. A key variables sheet might include FTE numbers for home and overseas students, broken-down by cohort for each financial year and adjusted for differing retention rates, thereby allowing the figures to be modelled at a more granular level. Pay expenditure could vary by staff numbers with alterations made to the percentage for pay inflation, pension and other on-costs. These figures may be linked to separate staffing sub-models to arrive at a monetary value for the changes made. Aspects of non-pay could also be varied as required, including: monetary values for changes in annual expenditure; inflation percentages; dramatic changes to energy costs; and alterations to capital expenditure and the related depreciation. Some advanced approaches might also explicitly refer to possible mitigating actions, such as the use of contingencies, the easing of required entry qualifications (or longer term initiatives) to boost student recruitment, the slowing down of capital expenditure or the implementation of a cost reduction program.

Advanced models take a more granular approach, but the intention of all the model types is not to achieve precision, but to provide an analysis that is 'roughly right' in order to increase understanding of an institution's position and to encourage discussion of the significant areas of risk. When addressing risk, Schoemaker and van der Heijden (1992) warn against over-simplifying matters by undertaking best/worst case analysis. Despite this, it is a practice that remains popular with universities because of the seemingly logical structured approach (McKenzie, 2016), even though there is a human tendency to favour the intermediate scenario. In very uncertain environments, perhaps filtered by experience of the Covid pandemic, however, pessimistic approaches perhaps find favour.

Evaluation

Irrespective of the approach taken, scenario modelling within an institution should be regularly evaluated, because models are developed by learning from experience. The possibility of amending any of the stages that we have outlined is indicated by the feedback loop in Figure 1. Modelling should be assessed both from a technical perspective (likely to be the preserve of the finance staff who created it) and according to fitness for purpose, which will be judged by how well it supports users' decision-making (and whether it meets any funding or regulatory body requirements).

For example, Pierone (2013) emphasises the technical importance of evaluating the interplay between key drivers and suggests reviewing the financial outcome (which may include 'back testing' to compare the forecast results with the actuals) and even abandoning connections between variables when it becomes apparent that the logic has broken down.

Pierone (2013) also recommends gathering feedback from stakeholders. Indeed, users such as governing bodies and senior management might be expected to provide challenge anyway, leading to useful feedback. Over time, familiarity with the model presented and greater understanding of the tool are likely to result in an increased focus on key risks, the importance of which may fluctuate as changes in the sector and the individual institution are experienced, with consequent adjustments to both the model and its use. Most of

these changes could probably be accommodated using the existing software if this is Excel, but as scenario models evolve, institutions might decide to deploy specialist software to meet more demanding requirements.

Conclusion

Sound financial management is essential for universities to maximise their potential. Scenario analysis of a financial model gives finance staff, senior managers and governing bodies the means to explore the financial implications of possible future states of the world, helping them to develop an awareness of key issues and establish contingency plans. This article has provided practical guidance on financial scenario modelling, organised around a series of stages: software selection; variable identification; model construction; deployment of model; and evaluation.

The key points from each section can be summarised in a reference table for those charged with implementing and developing a financial scenario model Table 2.

Having provided some practical guidance to complement the insights from our earlier survey of financial scenario modelling in UK universities, we hope that future authors will be able to build on our efforts. Two types of development would be particularly welcome. First, detailed case studies of the construction and use of models by individual universities should prove enlightening. Second, given our limited focus, it would be helpful if future work could examine the situation in other countries. The UK is not the only country in which universities face financial challenges.

Table 2. Summary of key points for developing and maintaining financial scenario models.

Software selection
Review software packages offering financial scenario modelling
Employ commonly used Excel if appropriate
Variable identification
Include student income (domestic and international)
Approximate student recruitment and retention
Show research income in sufficient detail
Incorporate third stream and other income sources
Provide for staff costs (including pension contributions)
Separately identify material operating expenses (non-pay)
Allow for inflation
Model construction
Use formulae to link and model variables
Link to sub-models for more granular detail
Distinguish between fixed and variable costs
Undertake several iterations
Deployment of model
Collect available data from other systems
Use an appropriate level of sophistication
Agree a baseline scenario
Introduce triggers for alternative scenarios
Check for consistency and plausibility
Minimise outputs and key variables
Determine the required depth of the model
Evaluation
Develop by learning from experience
Ensure models are technically correct and fit for purpose
Evaluate the interplay between key drivers
Gather feedback from stakeholders to further refine models
Consider deploying specialist software as models develop

Disclosure statement

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