

CHAPTER 1 : INTRODUCTION

The need to understand the value of Uncertainty Information

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1.1 THE NEED FOR UNCERTAINTY INFORMATION

Key Messages:

- There are good theoretical reasons why Uncertainty Information should be of value in decision-making.
- However, estimates of uncertainty are arbitrarily utilised in practice.
- Organisations appear to avoid explicit consideration of uncertainty.

“The big current issue for economists is when the US economy will pick up steam. Interviewed recently for Entrepreneur.com, Jan Hatzius, senior economist with the Goldman Sachs group, concluded that the risk for 2003 is on the side of renewed recession, for which his group sees a probability of 30-40 per cent over the next 12 months. A forecast like this has the advantage of giving a probability estimate, which is rare to see in forecasts published in the media.” (Noble, 2002)

There is a growing complexity in the business world, with an increasing requirement to make decisions under uncertainty. However, communicating uncertainty in forecasts is not only rare in the media, indications of uncertainty are also rare in the key data required for business decisions. There seems to be an arbitrary utilisation of Uncertainty Information (UI) in business. For example, uncertainty is taken into account in finance through the use of Beta values (Sharpe, 1964), and is fundamental to Monte Carlo simulation (Metropolis & Ulam, 1949). However, UI is rarely used in management and accounting (Chen & Summers, 1977; Nakano, 1976).

This arbitrary utilisation of UI in practice is interesting, given that there are good theoretical reasons why UI should be of value in decision-making under uncertainty. From Expected Value theory (Bernoulli, 1738) to the two-stage model of decision-making under uncertainty suggested by Tversky & Fox (1995)

and based on Cumulative Prospect Theory (Kahneman & Tversky (1992), the ability to assess uncertainty is central to theories of decision-making under uncertainty. However, when making decisions under uncertainty people exhibit systematic biases and a limited processing capacity (for example, Das & Teng, 1999; Goodwin & Wright, 1994; Hogarth, 1975; Tversky & Kahneman, 1974). As a result, information about the level of uncertainty that a decision-maker is operating under should improve decisions by providing valuable information and reducing the processing load placed on the decision-maker¹.

Several authors have argued that people's inability to make effective decisions under uncertainty creates a strong need for a means of communicating an indication of uncertainty (for example, Armstrong, 1986; Kydd, 1989; Makridakis, 1988; Mohn & Reid, 1977; Remus & Simkin, 1987). The explicit representation of UI, such as in the form of a confidence interval², is one way to provide a better indication of uncertainty.

Despite strong theoretical support for the use of UI in decision-making, in practice UI has been arbitrarily utilised. In some disciplines it's used extensively, while in others it has been practically ignored.

¹ See Chen & Summers (1977) for a mathematical proof using Information Theory of how information is increased when probabilistic information replaces single-valued information in accounting.

² Confidence Intervals are an expression of uncertainty. They indicate the likelihood that the true value of a particular variable will be contained within the given interval. They are also referred to as prediction intervals or interval forecasts. Uncertainty Information can also be presented in the form of a probability density forecast.

Abt, Borja, Menke & Pezier (1979) advocate the use of probabilistic forecasts for indicating the future sales of new pharmaceutical products. Citing the production planning experiences of various pharmaceutical companies, the authors emphasise that some of the most valuable benefits coming from probabilistic forecasts relate to improved communication between departments (such as production and marketing) and better preparation for various production scenarios. This improved communication and decision-making occurs because managers realise that what will happen in reality comes from a probability distribution, rather than relying on a point estimate that is unlikely to be perfectly accurate.

Accounting information, such as the value of a capital asset, is generally reported as an exact figure. For example, when accountants produce forecasts of expected returns for various asset classes in an asset allocation decision “little or no use is made of the prediction interval in the decision-making process” (Blair, 2002, p. 325). However, there are often uncertainties around figures reported by companies. Many organisations and individuals make important investment and strategic decisions based on the accounting information reported by companies on a regular basis. There is strong evidence that the users of financial statements anchor on the contents of these statements, and that this anchoring influences their judgments and decisions (Kennedy, Mitchell & Sefcik, 1998). The accuracy of these statements, and any level of associated uncertainty, is of vital importance to these decision-makers. As a result, some authors have argued that accounting information should be reported in a probabilistic manner (for example, Chen & Summers, 1977; Hawkins, 1974; Nakano, 1976).

Academic and professional accounting bodies have both called for the disclosure of probabilistic financial information (AAA, 1966; AICPA, 1973, 1994; ICAEW, 2002a, 2002b). For instance, there have already been requests for the explicit identification of uncertainties underlying the disclosure of assets and liabilities by using probabilities to supplement best estimates (IASB, 1998).

In spite of strong theoretical arguments in favour of reporting the uncertainty associated with probabilistic accounting data and forecasts, little has changed. Armstrong (1986) reviewed the forecasting literature and pointed out it could not be argued that managers did not understand uncertainty, since even the general public understands estimates of uncertainty in weather forecasting (Murphy et al., 1980). Armstrong (1986) also agreed with March & Simon (1963) that uncertainty might not accompany forecasts, because organisations do not like to discuss uncertainty. Rush & Page (1979) found evidence of a trend towards this aversion to communicating uncertainty. In a study of metals forecasts, they found 22 percent of published forecasts from 1910 to 1939 provided indications of uncertainty. This figure dropped to only 8 percent during 1939 to 1964.

Several recent corporate failures (for example, Enron, Worldcom), and the questioning of internal and external auditing judgments may see interest in probabilistic accounting information increase. The advent of powerful, up to date, integrated accounting computer information systems (commonly referred to as Enterprise Resource Planning, or ERP, systems) also makes the preparation of UI almost as easy as preparing point estimates. ERP systems

facilitate the production of UI by containing significant amounts of historical data, which can be manipulated and used in calculations such as forecasts.

To summarise, despite strong theoretical reasons why UI should be of value in decision-making, there seems to be sporadic utilisation of UI in practice. It is worth considering whether there is practical benefit in providing UI, and that is the topic of the next section.

1.2 THE UNCLEAR VALUE OF UNCERTAINTY INFORMATION

Key Messages:

- Although there is a strong theoretical argument for providing decision-makers with UI, it's not clear that its provision improves, or indeed changes, decisions.
- Research into UI has focussed on the production of UI rather than its utility.
- There are only a small number of studies investigating the utility of UI, and their findings are inconclusive.

In the previous section it was demonstrated that there is a strong theoretical argument for the value of UI in decision-making, but it is often not used in practice. However, if UI is provided to decision-makers is it clear that their decision-making is improved? Only a small number of studies have investigated the practical value of UI, and their results are not conclusive.

Research into UI can be roughly divided into four areas: (i) the production of subjective UI; (ii) the production of objective UI; (iii) the extent that UI is used; and (iv) the utility of UI when it is used. While the production of UI has attracted significant research, the utilisation of UI has not.

Research into UI has focussed on the production of subjective estimates of probability, and assessing whether people are calibrated in their judgments. This has resulted in a large body of work (for example, Keren, 1991; Lichtenstein, Fischhoff & Phillips, 1982; Yates, 1990) and a relatively mature area of study.

A significant amount of research has investigated the production of objective UI. However, this is still seen as an area for future advancement, particularly in forecasting. Some time ago Armstrong (1986) identified uncertainty as an area of forecasting with good future research prospects. In outlining areas for improvement for the field of forecasting Makridakis (1991) stated, “if the field is to become useful and relevant it must be capable of assessing uncertainty in a credible, competent and realistic manner” (Makridakis, 1991, p. 124). Clements (2003) echoed these thoughts more recently.

While there has been considerable research into the production of UI, some researchers have started to look at UI from the users perspective. The fact that the practical value of UI has not been conclusively demonstrated makes it important to consider how UI is utilised by decision-makers. A group of researchers have investigated how UI is produced with the eventual ‘consumer’ of the information taken into account (Keren, 1991; O’Connor, Remus & Griggs, 2001; Yaniv & Foster, 1995, 1997; Yates, 1982; Yates et al., 1996), and particularly how they deal with resolution and calibration. However, this falls short of looking at how UI is actually utilised by decision-makers.

Studies into the use of UI, such as Rush & Page (1979), are rare (Armstrong, 1986). The study by Rush & Page (1979) looked at whether UI was used by long-term metals forecasters to communicate the level of uncertainty in metals forecasts between 1910 and 1964, but did not examine whether the UI was valuable. Given that UI is under-utilised in practice, it would appear that understanding whether UI provides decision-making value is of far more

importance than investigating how UI should be produced, or whether it is reported. However, those studies that have investigated the utility of UI have provided mixed results (for example, Foong, 1992, 2003; Johnson, 1982; Keys, 1978; Oliver, 1972). Some studies didn't find UI to influence decision-making at all, while others found it impacted decision-making only under certain circumstances. Consequently, although there are strong theoretical arguments for providing UI to decision-makers, it's not clear that UI is of value.

1.3 BUILDING THE CASE FOR UNCERTAINTY INFORMATION

Key Messages:

- This thesis seeks to better understand if and when UI is beneficial, in order to help make the case for providing UI to decision-makers and forecasters.

Although UI is not widely used in practice, and studies have not conclusively indicated its empirical value, its uncontested theoretical decision-making value and the obvious problems people have in dealing with uncertainty make it an area worthy of further study. This thesis seeks to better understand under what conditions UI has utility. Specifically, this study will seek to define a contingent model of UI utility, and test part of the model.

The objective is for the model to be the basis for an ongoing stream of research into the utility of UI, and ultimately determine under what circumstances UI is of value to decision-makers. With this knowledge, it will then be easier to establish whether UI should be used more in practice, and if so, how.

The remainder of this thesis is presented in the following chapters:

- Chapter 2 reviews all theoretical and empirical literature relevant to the utility of UI. Based on this review, a model of contingent effects summarising the contingent utility of UI is developed, which will help guide further investigation into the value of UI.
- Chapters 3, 4 and 5 each describe an experiment that investigates UI utility. The contingent model of UI utility developed in the literature review guides the design for each experiment.

- Chapter 6 summarises the main findings and conclusions of this study, together with a discussion of the implications of the findings. The chapter concludes with a note on the limitations of this study, and directions for future research.