MANAGEMENT ACCOUNTING – DECISION MANAGEMENT

In the second of his two articles on risk and uncertainty, **Ian Janes** shows how two-way tables can be used to deal with multiple uncertain variables.

In my article in the previous issue, I analysed a situation where there was a range of possible outcomes from a course of action but where there was only one uncertain variable. Clearly, this is a fairly unrealistic scenario, since many decisions in practice will have two or more uncertain variables. But the techniques that I described can still be deployed where there are multiple uncertain variables – through the use of joint probabilities.

Let's consider an example that has featured several times in P2 papers: one with two uncertain events, giving rise to the use of the two-way data table. (We assume that these events are independent of each other, so that the value of one of the variables does not influence that of the other.) New Vale Sports and Social Club holds an annual awards dinner to celebrate the achievements of its rugby and cricket teams. In order to stage the event at its own premises, the club will incur fixed costs of £1,000, including the hire of a band and disco, extra bar staff, trophies for players and gifts for sponsors. Each person attending the dinner will pay £20, and the variable cost to the club of catering for each of them is £10. The number of attendees is uncertain, but based upon previous years it is expected to be as follows:

- A 20 per cent probability that 60 people will attend the dinner.
- A 50 per cent probability that 80 people will attend.
- A 30 per cent probability that 100 people will attend.

Raffle prizes are donated by the club members, but the amount that each attendee spends on raffle tickets is also subject to uncertainty as follows:

- A 30 per cent probability that there will be an average spend of £2 per head.
- A 60 per cent probability that there will be an average spend of £3 per head.
- A 10 per cent probability that there will be an average spend of £4 per head.

1 A template two-way table

	Uncertain event 1			
Uncertain event 2	**Possibility 1**	**Possibility 2**	**Possibility 3**	**And so on**
Possibility 1	x	x	x	x
Possibility 2	x	x	x	x
Possibility 3	x	x	x	x
And so on	x	x	x	x

2 Table showing profit for each combination of outcomes

Average raffle	Number of attendees		
spend per head	**60**	**80**	**100**
£2	-£280	-£40	£200
£3	-£220	£40	£300
£4	-£160	£120	£400

3 Table showing joint probability of each combination of outcomes

Average raffle spend per	Number of attendees (and probability)		
head (and probability)	**60 (0.2)**	**80 (0.5)**	**100 (0.3)**
£2 (0.3)	0.06	0.15	0.09
£3 (0.6)	0.12	0.30	0.18
£4 (0.1)	0.02	0.05	0.03

New Vale is a not-for-profit organisation, but it would like to return a surplus and, owing to ongoing financial pressures, will hold the event only if it can at least cover its costs. We could use the expected values method as follows to see whether it's worth holding the dinner or not.

The expected number of attendees is: (0.2 x 60) + (0.5 x 80) + (0.3 x 100) = 82.

The expected raffle income per head is: (0.3 x £2) + (0.6 x £3) + (0.1 x £4) = £2.80.

So the expected profit from the event is: (82 x £10) + (82 x £2.80) – £1,000 = £49.60.

This analysis seems to indicate that the event should go ahead, but it fails to take into account the fact that the dinner is held only once a year and the "averaging-out" process that arises from repeated events is not going to occur (except in the very long term, by which time key variables may well have altered). In such cases we need to consider the various outcomes that could actually occur, albeit by using a rather simplified three outcomes for each uncertain event. This is best done with a two-way data table.

Where there are several possibilities for two variables, the general form of the table is shown in figure 1. Table entries can show revenue, contribution, profit or even the joint probabilities of each combination of outcomes. Since there are three possibilities for the first uncertain event (the number of attendees) and three possibilities for the second event (their spending on the raffle), there are nine possible "profit" outcomes, as can be seen in figure 2.

Now we calculate the joint probability of each of the nine outcomes. For example, if there's a 50 per cent chance that 80 people will attend the dinner and a 60 per cent chance that they will spend £3 per head on the raffle, then the combined probability that both outcomes will occur is: 0.5 x 0.6 = 0.3, or 30 per cent. The calculations can again be summarised in tabular form (*see figure 3*).

It's unlikely that the P2 examiner would ask you to calculate such figures without also requiring you to interpret them. In doing so, don't be afraid to state the obvious. In fact, some relatively straightforward marks can be obtained by doing just that.

So, if we combine the values summarised in figures 2 and 3, we can see that there's a 35 per cent chance that the event will make a loss (ie, 0.06 + 0.12 + 0.02 + 0.15 = 0.35). The organisers may consider this to be too much of a risk.

Using similar logic, there's a 65 per cent chance that the event will make a profit (ie, 0.30 + 0.05 + 0.09 + 0.18 + 0.03 = 0.65). We can also confirm that the expected profit found earlier is not an actual outcome that will be obtained on any one occasion and is, of course, an average value. In fact, there is a range of possible results from a loss of £280 (if only 60 people attend and spend an average of £2 each on the raffle) to a profit of £400 (if 100 people attend and spend an average of £4 each on the raffle).

Lastly, the probabilities can also be used to demonstrate that the distribution of possible values is skewed, because the probability that the profit will be above the average (expected) value of £49.60 is 35 per cent (ie, 0.05 + 0.09 + 0.18 + 0.03), while the probability that it will be below that is 65 per cent (ie, 0.06 + 0.12 + 0.02 + 0.15 + 0.30).

Of course, the use of only three discrete values (or point estimates) for each of the unknown variables, and of their associated probabilities, is a simplification and can only be an approximation of the risk and uncertainty in these estimates. For example, any number of people may well attend the dinner within the capacity of the venue. Nonetheless, the point estimates and their probabilities can be a reasonably good approximation of what is known as a continuous probability distribution, especially if there are enough of them.

Decision-makers in organisations can use the type of information shown in this example to evaluate their decisions in more detail. Rather than simply calculating a single value, which is unlikely to be one that can actually occur, a two-way data table can show the range of values that could occur and the likelihood of each result.

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P2 further reading

J Avis, L Burke and C Wilks, *Management Accounting – Decision Management CIMA Official Learning System* (2009 edition), CIMA Publishing, 2008.

C Drury, *Management and Cost Accounting*, International Thomson Business Press, 2000.

C Horngren, A Bhimani, G Foster and S Datar, *Management and Cost Accounting*, Financial Times/ Prentice Hall, 2002.