First step to a weather forecast — look out the window

Not much chance of rain in Canberra today, by the looks of it.

The Bureau of Meteorology does well forecasting tomorrow's weather. It predicts wind, pressure, and cloud cover especially well, because these aspects are parts of large-scale activities that progress systematically across the country.

Rain, however, is much harder to predict because it is so variable from place to place — even between one suburb and another.

Since the occurrence of rain is such a chancy business, many people have adopted their own approach to deciding whether to take an umbrella or not. Instead of listening to the Bureau's forecast, they take a look out the window to see whether it looks like rain.

This simple scheme works remarkably well. Indeed, it works so well that the Bureau of Meteorology has begun to use a system with this as its starting point. In Canberra, the A.C.T. Regional Office of the Bureau is now running a trial where a forecast for the chance of rain in the next 12-hour period is based on the existing weather.

Of course, the scheme doesn't just rely on the good weather sense of a long-resident Canberran. Rather, it is based on statistics and probabilities.

The theory is the same as that used already for forecasts of rain, fog, frost, and thunderstorms in the United States, Canada, Germany, and some other countries. The value of the approach was recognized by Dr Alan Miller of the CSIRO Division of Mathematics and Statistics and, with Dr Lance Leslie of the Bureau of Meteorology Research Centre, he drew up a rain-forecasting scheme for a number of Australian capital cities.

Called a Markov-chain model, the statistical model simply looks at all the occasions when the weather is the same as now, and establishes the degree of probability that rain will fall in the next few hours.

The most important factors needed for the model to work are an assessment of the amount of cloud (none, some, or overcast), and whether or not it is presently raining. Another major determinant is the prevalence of cloud and rain 3 hours ago.

With this information to hand, and a table of probabilities, the forecaster can rapidly assess the chance of rain in the immediate future. Indeed, anybody could do it. You don't even need a computer!

The Regional Director of the Canberra Office, Mr Ian Mason, considers that the Markov-chain model can provide rain forecasts for up to 12 hours ahead that are as accurate (at least) as those provided by the traditional method, which uses weather maps, numerical models, and satellite pictures. Both approaches will be used in arriving at the actual issued forecast.

For the Canberra trial, the accuracy of the technique has

Putting numbers on the chance of rain

If it's not raining at 9 a.m. in Canberra in August, then it's extremely likely that a fine day is ahead (the odds of rain in the next 9 hours are more than 45:1 against) if:

- the sky is clear
- 3 hours ago the sky was clear
- the barometer shows 960 mb
- it's risen by 3 mb in the last 3 hours
- the humidity is 65%
- the east–west component of the wind is less than 5 knots

If it's not raining at 9 a.m. in Canberra in August, then there's a 57% probability of rain in the next 6 hours if:

- the sky is overcast
- 3 hours ago it was raining
- the barometer shows 940 mb
- it's fallen by 3 mb in the last 3 hours
- the humidity is 85%
- the east–west component of the wind is 10 knots

The Markov-chain model of probabilities allows future weather states to be accurately predicted using present weather observations and those of 3 hours previously.

been improved a little further by including a number of other relevant factors. These are: the atmospheric pressure at the time, and whether it has risen or fallen in the previous 3 hours; the humidity; and the strength and direction of the wind.

Mr Mason sought out Dr Miller, and the technique, after reading the paper on Markov-chain forecasting by Dr Miller and Dr Leslie in an American meteorological journal. The method is first being tried out in day-to-day operations in Canberra, tying in well with another innovation being assessed there — the issuing, with the forecast, of a figure for the probability of rain.

The Canberra Office will use a microcomputer to calculate the probability of rain over the next 3–12 hours. From the operational viewpoint, the great advantage of the method is its speed. Observations can be made at 9 a.m., and the forecast issued at 9:01.

The disadvantage of the Markov-chain forecast is that it applies only at one location. But its simplicity means that every location could make use of its own table of probabilities, based on past weather records, and issue its own forecast. You could even do it for your own backyard!

Andrew Bell

Short-term single-station forecasting of precipitation. A.J. Miller and L.M. Leslie. *Monthly Weather Review*, 1984, **112**, 1198–205.

Short-term single-station probability of precipitation forecasting using linear and logistic models. A.J. Miller and L.M. Leslie. *Beitrage Physik Atmosphare (Contributions to Atmospheric Physics)*, 1985, **58** (in press).

Did they misread the signs?