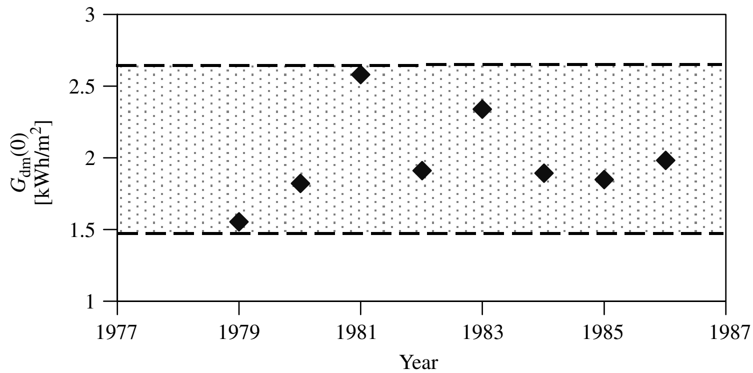

Figure 20.10 January means of the global horizontal irradiation $G_{dm}(0)$ in Madrid, for the years 1979 to 1986, in kWh/m^2

average value, much larger than the accuracy of the original data! Then, our questioner's retort would probably be, "How 'high' is the probability and how 'large' is the range?".

Basic statistical theory [17] gives proper answers to this question. For example, if we desire a 99% probability (the *confidence coefficient*) we must keep a $\pm 3\sigma$ range (the *confidence interval*) around the average value, in which σ is the *standard deviation* of the past observed values. In our example, $\sigma = 0.31$ kWh/m^2, so that $\pm 3\sigma$ represents $\pm 47\%$ of the average value. Still larger than the previously considered range, noted by the band of Figure 20.10! In order to keep on intervals of practical use, a $\pm 2\sigma$ interval is often employed. The corresponding confidence interval is 95%. In our example, $\pm 2\sigma$ represents $\pm 31\%$. Using the 2σ confidence level, the correct way to state the daily global irradiation prediction for the next January would be to say

$$1.37 \text{ kWh/m}^2 \leq G_{dm}(0) \leq 2.61 \text{ kWh/m}^2$$

or

$$G_{dm}(0) = 1.99 \text{ kWh/m}^2 \pm 31\%$$

Probably, surprised by such large uncertainty ($\pm 31\%$ seems badly matched and inconsistent with the "high accuracy" image generally associated with modern computational technology), our questioner would retort, "How can this uncertainty be reduced?" In fact, the only way is by enlarging the number of years of the future for which the prediction applies. That is, to give an estimate not for the next January, but for the average value of the following Januarys. Then, it can be shown that the confidence interval becomes reduced by a factor of $1/\sqrt{N}$, N being the number of future years for which the prediction is extended. Coming back to our example, and considering a future length of 10 years, the correct prediction would be

$$1.79 \text{ kWh/m}^2 \leq G_{dm}(0) \leq 2.19 \text{ kWh/m}^2$$

or

$$G_{dm}(0) = 1.99 \text{ kWh/m}^2 \pm 10\%$$