curved lines on either side of the linear regression.

The equation of the two curved lines is given by $Y \pm 2 \sqrt{\text{Var } Y}$ where Y is the predicted latency (from the regression equation) at a given height x and $\text{Var } Y$ is dependent on the x value.

$$\text{Var } Y = \text{MSR} \left[1 + \frac{1}{n} + \frac{(x - \bar{x})^2}{\sum(x - \bar{x})^2} \right]$$

with n as the sample size, x the given height and $\bar{x}$ the mean of the heights. MSR is the mean square deviation from regression and is given by

$$\text{MSR} = \frac{\sum(y - \bar{y})^2 - \frac{[\sum(x - \bar{x})(y - \bar{y})]^2}{\sum(x - \bar{x})^2}}{n - 2}$$

where y is the observed latency.

For 20 normal control subjects we obtained a regression equation F wave latency (ms) = 0.13 height (cm) + 6.1. The correlation coefficient for this relationship was $r = 0.601$ ($t = 3.187$, $DF = 18$, $p < 0.01$). The regression equation we obtained was similar to that of Lachman *et al.*¹ The regression line and 95% confidence limits are illustrated in the figure.

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Reference

- ¹ Lachman T, Shahani BT, Young RR. Late responses as aids to diagnosis in peripheral neuropathy. *J Neurol Neurosurg Psychiatry* 1980;43:156-62.

Wierzicka, Shahani and Young reply:

As Hutchinson and Daly have pointed out, 95% confidence limits are generally represented as curved lines which reflect the growing uncertainty in any prediction made as x recedes from the centre of gravity ($\bar{x}$, $\bar{y}$) of the regression line. However, when n approaches infinity (that is, the number of observations is large), the 95% limits shrink to a strip of widths 1.96 SE ($\text{SE} = \text{standard error of the estimate}$).¹ Indeed, if one takes the formula for computing 95% confidence limits, $Y \pm 2 \sqrt{\text{Var } Y}$ used by Hutchinson

Fig Relationship of the F wave latency of the median nerve (ms) to height (cm) of normal subjects. The broken lines represent the 95% confidence limits.

and Daly and lets n approach infinity, one obtains:

$$a = \left[1 + \frac{1}{n} + \frac{(x - \bar{x})^2}{\sum(x - \bar{x})^2} \right] \rightarrow 1$$

$$\sqrt{\text{MSR}} \approx S_y \sqrt{1 - r^2} = \text{SE}$$

$$\sqrt{\text{Var } Y} = \sqrt{\text{MSR} \cdot [a]} = \text{SE}$$

where: r = correlation coefficient
 S_y = standard deviation of y

Thus the confidence limits shown in our figure which reflect $n = 124$ observations are an excellent approximation to the true confidence limits. The curved limits shown by Hutchinson and Daly are, of course, exact and differ somewhat from straight lines because they are computed from a smaller number of observations ($n = 20$).

In summary, as the number of observations upon which such a diagram is based increase, the 95% confidence limits become less curved and more nearly linear. After all is said and done, do Hutchinson and Daly suggest a "significant" number of those who attend nerve conduction laboratories are poorly served if these lines are not a little

curved? The routine use of late responses has certainly improved the utility of electrophysiological studies in individual patients with various neuropathies and the use of diagrams relating latency to height are clearly an improvement over earlier and more inexact techniques which attempted to measure conduction velocity. Nevertheless, these responses represent only one aspect, albeit a particularly precise and quantitative one, of the patient's overall evaluation and we believe it would be unwise to attempt to be artificially more precise about the boundary between normal and abnormal values than is warranted by the biological complexity of the system.

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Reference

- ¹ Sachs L. *Applied Statistics, A Handbook of Techniques*. Berlin: Springer Verlag, 1984.