procedure. Because the method is geared to diagnostic features such as cell walls and stomata, and not only to silica bodies, prickly hairs and asperities, young plant material is now amenable to treatment.

LITERATURE CITED


A Plea for Fewer but More-Significant Digits

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Highlight

Using data from this journal, the author shows how considerable savings can be made in space and in reading time by rounding tabulated data.

In a scientific world that is being deluged by more and more published information, a weary but interested reader makes a plea for fewer digits. We are deluged by more and more published work for the printer not to mention the reader! Still, an equivalent amount of comparative information is transmitted, but more concisely and more clearly. In the examples in Table 1, the original presentation of the data required 259 digits and decimals to be printed. By rounding, only 150 were required. This is a saving of 42% of the space and in reading time by rounding tabulated data.

Examples of Too Many Digits

I have excerpted data from several articles in the January issue of Volume 21 of the Journal of Range Management (Table 1) and arranged the data in paired columns. The left-hand column of each pair shows the way the data were represented in the journal article, and the right-handed column shows a suggested alternative method of presentation.

In rounding numbers in many instances not only is there a saving in the number of digits printed, but in some cases there also is a saving of having to set the decimal point in print. By rounding the data to fewer digits I believe the message still is transmitted, but more concisely and more clearly. In the examples in Table 1, the original presentation of the data required 259 digits and decimals to be printed. By rounding, only 150 were required. This is a saving of 42% of the space and in reading time by rounding tabulated data.

How Many Digits Are Justified?

How many significant digits do we have in our range research data? Certainly, the number of digits depends upon the technique and upon the design of the investigation. Some suggested guidelines are presented here as examples for a few commonly measured variables.

Botanical composition. It is absurd to represent visual estimates of botanical composition by four significant digits, to the nearest .01%! Yet this can be found in reports on range studies. In most instances percentage data can adequately be represented to the nearest 1%.

Herbage yield. Considering sampling errors and variability involved, yield data to the nearest 10 lb/acre often would be sufficient. Seldom is the sampling scheme sufficiently intensive to be able to precisely measure yield to the nearest 0.1 lb/acre as is reported in many articles.

Frequency data. Another factor affecting the number of significant digits is the number of samples taken. For example, if frequency data are based on 25 plots, then data are good to only the nearest 4%. Then in representing frequencies in that case, even if averaged over replicates, there is no justification in presenting data to the nearest 0.1%.

Precipitation. Meteorological data, especially precipitation, frequently are reported in range research articles. Considering the variability in rainfall patterns and considering the errors in measurement, it seems questionable that values to the nearest 0.01 inch/year are meaningful. Perhaps annual precipitation data to the nearest inch, and certainly to the nearest 0.1 inch would be sufficient for most purposes.

Chemical composition. Often labora-

TECHNICAL NOTES
Table 1. Comparison of reported and suggested data extracted from *Journal of Range Management*, Vol. 21 (1). In each set a description of the data is given followed by paired tabulations of the format published (left) vs. the suggested (right) and brief comments on sampling conditions.

<table>
<thead>
<tr>
<th>Page 1</th>
<th>Page 6</th>
<th>Page 10</th>
<th>Page 10</th>
<th>Page 22</th>
<th>Page 26</th>
</tr>
</thead>
<tbody>
<tr>
<td>Col. 1</td>
<td>Col. 1</td>
<td>Col. 1</td>
<td>Col. 4</td>
<td>Col. 5</td>
<td>Col. 7</td>
</tr>
<tr>
<td>% germination</td>
<td>% cover</td>
<td>%</td>
<td>%</td>
<td>density</td>
<td>% crude protein</td>
</tr>
<tr>
<td>76.75 77</td>
<td>91.0 91</td>
<td>35.0 35</td>
<td>65.4 ± 438.0</td>
<td>65 ± 438</td>
<td>15 ± 16</td>
</tr>
<tr>
<td>69.25 69</td>
<td>95.0 94</td>
<td>22.7 22</td>
<td>563.2 ± 96.3</td>
<td>563 ± 96</td>
<td>10 ± 11</td>
</tr>
<tr>
<td>50.25 50</td>
<td>95.0 95</td>
<td>30.0 30</td>
<td>627.3 ± 91.4</td>
<td>627 ± 91</td>
<td>7 ± 0.7</td>
</tr>
<tr>
<td>89.00 89</td>
<td>96.0 96</td>
<td>7.5 8</td>
<td>416.5 ± 52.6</td>
<td>416 ± 52</td>
<td>5 ± 0.6</td>
</tr>
<tr>
<td>18.50 18</td>
<td>97.0 97</td>
<td>2.5 2</td>
<td>222.2 ± 222.3</td>
<td>222 ± 222</td>
<td>5.67 ± 6</td>
</tr>
</tbody>
</table>

100 seeds/rep insufficient explanation of sampling scheme

**How Were the Data Collected and Analyzed?**

Another problem in presenting data is related to the vagaries of the sampling scheme. For example, for chemical composition data, these data obtained on duplicate samples, were the samples for various plots in the field composited before analyses, were the samples composited for various replicates in the field, were the samples composited for various animals? All too frequently these sampling and analysis conditions are not specified.

A plea is made for explicit statement of the sampling and measurement scheme. Range research methods are not highly standardized. It is not sufficient to say simply that some variable "was measured by the method of (some author)." That may mean you used his equipment or it might mean you used his specific sampling plan. It would be more specific to say the variable was measured by the method of (some author) using (some number of) plots, lines, points, and so forth.

Frequently authors indicated "the data were subjected to analysis of variance." This is insufficient information if there is a non-trivial design. To be meaningful it is necessary to state what factors were considered fixed effects, which were random effects, and what error terms were used.

The computer causes a problem in our modern literature. With many computers, as many as 11 significant digits may be carried routinely in the calculations and printed in the output. This may be true even though the input data had only two significant digits. Many researchers seem to feel that the computer can produce more significant digits than they had initially and that "Avoid presenting numerical data of greater precision than accuracy of the method justifies."