Figure 3.8. MEASURING: Results of Paper Thickness Investigating

Tabulation of 96 measurements of paper thickness made by 24 students

student	..........thickness in mm			....	average	range	+	–
A	.0757	.0762	.0769	.0746	.0758	.0023	0	4
B	.0808	.0793	.0781	.0821	.0801	.0040	4	0
C	.0811	.0772	.0770	.0756	.0777	.0055	2	2
D	.0655	.0683	.0714	.0746	.0700	.0091	0	4
E	.0741	.0710	.0748	.0711	.0728	.0038	0	4
F	.0756	.0772	.0776	.0759	.0766	.0020	2	2
G	.0775	.0785	.0760	.0761	.0770	.0025	2	2
H	.0747	.0765	.0735	.0776	.0756	.0041	1	3
I	.0719	.0762	.0802	.0713	.0749	.0089	1	3
J	.0734	.0833	.0833	.0783	.0796	.0099	3	1
K	.0755	.0740	.0714	.0743	.0738	.0041	0	4
L	.0788	.0817	.0794	.0766	.0791	.0051	3	1
M	.0731	.0716	.0726	.0714	.0722	.0017	0	4
N	.0833	.0794	.0783	.0788	.0800	.0050	4	0
O	.0767	.0775	.0765	.0793	.0775	.0028	2	2
P	.0787	.0798	.0864	.0817	.0816	.0077	4	0
Q	.0784	.0799	.0789	.0802	.0794	.0018	4	0
R	.0784	.0820	.0796	.0818	.0804	.0036	4	0
S	.0830	.0796	.0778	.0767	.0793	.0063	3	1
T	.0741	.0680	.0733	.0723	.0719	.0061	0	4
U*	.0759	.0766	.0772	.0466	.0766	----	1	3
V	.0810	.0812	.0789	.0776	.0797	.0036	4	0
W	.0777	.0759	.0795	.0790	.0780	.0036	3	1
X	.0784	.0786	.0797	.0859	.0806	.0075	4	0

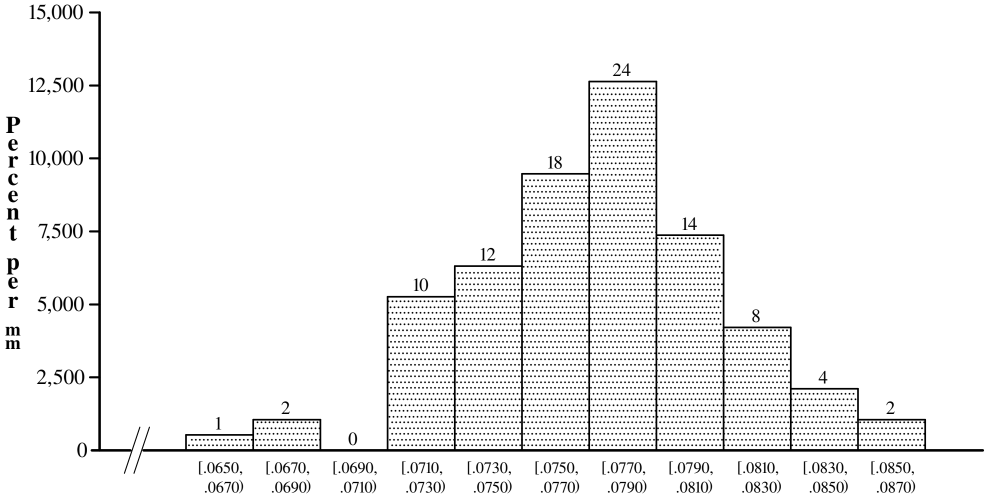
Total for 95 measurements = 7.3239 mm

Average for 95 measurements = .07709 mm

Average for 23 ranges = .00483 mm

*The fourth measurement made by student U (.0466) appears to be a mistake, as it is little more than half as large as the other measurements. This measurement is omitted from the collection and the total and average calculated from the remaining 95 measurements.

Histogram for 95 measurements of paper thickness made by 24 students



Thickness per sheet (mm)

(*continued overleaf*)

1 What is the *range* of the 95 observations and the *range* of the 24 averages?
- Do these two ranges illustrate a general property of averages? Explain briefly.
- Why is this property important?

2 For the range as a measure of *variation*:
- what are its advantage(s)?
- what are its *dis*advantage(s)?

3 The last two columns in the table overleaf on page 3.15 give, for the four observations made by each student, the number *above* and the number *below* the overall average of 0.07709 mm. Can you suggest a *simple* probability model for these data?
- Do the 24 pairs of numbers seem to agree or to disagree with what your model predicts?
- What conclusion(s) of importance to measuring processes do you draw from the agreement or disagreement with your model?

4 What are the *essential* characteristics of the *shape* of the histogram?

5 In the *absence* of the table of data, how could you use the *histogram* to find an approximate value for:
- the *average* of the 95 observations?
- the *median* of the 95 observations?
- the *range* of the 95 observations?

6 Comparing the table and the histogram given overleaf on page 3.15 as methods of *data presentation*:
- what are the strengths and weaknesses of the *table*?
- what are the strengths and weaknesses of the *histogram*?