

8 October 1932.

Mr. W. Edwards Deming,
Bureau of Chemistry and Soils,
U.S. Dept. of Agriculture,
Washington,
U.S.A.

Dear Sir:

I am very glad you wrote to me, your letter of 24 September, though on considering it I think your question is not a simple one. On the point you raise I should say that efficient estimates are better than others as material out of which to build tests of significance. The fact is that "Student's" paper of 1908 really went behind and superseded the whole concept of "probable error", or "standard error" as an adequate description of the reliability of estimates in the theory of small samples. This cuts the ground from under your quasite "and its probable error σ is wanted". Your equation (2) is, I think, a valid and efficient estimate of the quartile deviation of the distribution of means of n observations about their true mean. However, if μ is the true mean, and we wish to test any theory about its value, the quantity

$$t = \frac{\bar{x} - \mu}{s \sqrt{n}}$$

possesses the two important properties (i) that it involves the unknown μ in conjunction only with known quantities, (ii) that its sampling distribution is independent of the unknowns μ and σ . Hence it provides an absolutely valid test of significance. Other tests might be constructed with these two properties, but if they involve statistics other than the efficient estimates \bar{x} and s they will be, I imagine, less efficient, less sensitive that is, for their purpose.

This may not be so much what you want as some notes of mine printed in Vol. I of the British Association's Mathematical Tables, (of which unfortunately I have no off-prints), where I develop the distribution required for the ~~real~~^{most} general "use" to which the two optimum statistics can in this case be put.

Yours sincerely,