DISTRIBUTION OF THE RATIO OF SAMPLE RANGE TO SAMPLE STANDARD DEVIATION FOR NORMAL AND COMBINATIONS OF NORMAL DISTRIBUTIONS

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1. Introduction. The distribution of sample ranges in terms of the standard deviation of the sampled population for homogeneous populations has been dealt with in some detail by mathematical methods for the normal parent and by empirical sampling methods for non-normal parents. These results are presented in summary in Tables XXII, XXIII, and XXIV of [1]. Bliss [2] suggests that the range in different sized samples from a normal parent at various levels of significance, in terms of the standard deviation computed with varying degrees of freedom, would be a valuable table. It is not clear whether he means that the standard deviation is to be estimated from the same sample as the range or from a second independent sample, as is done by Newman [3], Pearson and Hartley [4], and Hartley [5].

In natural hybridization of distinct types of plants and subsequent back crossing with parental types distinctly bimodal populations may develop. Heiser [6] has described such a situation for sunflowers. Similar situations may occur in natural and artificial crossing of peaches and apricots as shown by the work of Hesse [7] of this station. In studying such genetical material it often would be helpful to know the expected distributions of the sample ranges in terms of the sample standard deviations estimated from the same sample for certain typical nonhomogenous populations. Applications to such data will be published elsewhere.

Since the mathematical situation for the distributions of the sample range (R) in terms of the sample standard deviation (s) appears somewhat complex, empirical sampling methods were resorted to for obtaining the distributions for a normal parent (N), a symmetrical distinctly bimodal nonhomogeneous parent (A), and a weakly bimodal but strongly skewed parent (B). Populations A and B are pictured in charts A (p. 341) and B (p. 348) of [8].
Population N is approximately represented by

$$(N) \qquad \frac{1296}{5\sqrt{2\pi}} \text{ exp. } - \tfrac{1}{2} \frac{(X - 15.5)^2}{25},$$

population A by

$$(A) \qquad \frac{648}{5\sqrt{2\pi}} \left(\text{exp. } - \tfrac{1}{2} \frac{(X - 15.5)^2}{25} + \text{exp. } - \tfrac{1}{2} \frac{(X - 32.5)^2}{25} \right),$$

and population B by

$$(B) \qquad \frac{972}{5\sqrt{2\pi}} \left(\text{exp. } - \tfrac{1}{2} \frac{(X - 15.5)^2}{25} + \tfrac{1}{3} \text{ exp. } - \tfrac{1}{2} \frac{(X - 31.5)^2}{25} \right).$$