

LETTERS TO THE EDITOR

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DISTRIBUTION OF FISHER'S g_1 FOR SAMPLES OF THREE FROM A CONTINUOUS RECTANGULAR DISTRIBUTION

AN easy method to find out the distribution of Fisher's g_1 for samples of three from continuous populations appears possible from the following considerations.

Let x_1, x_2, x_3 be the sequence in which the three individuals are observed and let

$$\tau_i = \frac{x_i - \bar{x}}{s} \text{ where } \bar{x} = \frac{1}{3} \sum_{i=1}^3 x_i$$

$$\text{and } s^2 = \frac{1}{3} \sum_{i=1}^3 (x_i - \bar{x})^2. \quad (1)$$

It is easy to see that if the τ_i 's are arranged in ascending order of absolute magnitude forming the sequence $\tau'_1, \tau'_2, \tau'_3$

then $0 \leq |\tau'_1| \leq \frac{1}{\sqrt{2}}; \frac{1}{\sqrt{2}} \leq |\tau'_2| \leq \sqrt{\frac{3}{2}};$

$$\sqrt{\frac{3}{2}} \leq |\tau'_3| \leq \sqrt{3}. \quad (2)$$

Also since

$$\sum_{i=1}^3 \tau_i = 0; \sum_{i=1}^3 (\tau_i')^2 = 3$$

$$\text{and } \sum_{i=1}^3 (\tau_i')^3 = \sqrt{\frac{3}{2}} g_1 \quad (3)$$

we find that

$$g_1 = \sqrt{6} \tau_i' (\tau_i'^2 - \frac{3}{2}) \quad (4)$$

and the distribution of g_1 can be determined once the distribution of τ_i' is known.

From the principles outlined elsewhere,¹³ the distribution of τ_i' follows from the distribution of τ_i .

Also

$$\tau_i = \frac{\sqrt{2} \theta}{\sqrt{3 + \theta^2}} \quad (5)$$

where

$$\theta = \frac{x_i - \bar{x}'}{s'} \quad (6)$$

x' and s' are respectively the mean and the standard deviation of the two observations left after excluding x_i . Hence if the probability distribution of θ is determined that of g_1 will follow immediately. This method is applied below to get the distribution of g_1 for samples of three from a continuous rectangular distribution. The notation used above has been kept up all through this note.

RECTANGULAR DISTRIBUTION

Let

$$p(x_i) = \begin{cases} 1 & \text{for } 0 \leq x_i \leq 1 \\ 0 & \text{elsewhere} \end{cases} \quad (7)$$

So

$$p(x_i, \bar{x}', s') = \begin{cases} 4 & \text{for } 0 \leq x_i \leq 1 \\ & 0 \leq s' \leq \frac{1}{2}; s' \leq x' \leq 1-s' \end{cases} \quad (8)$$

Also

$$p(\theta, \bar{x}', s') = \begin{cases} 4s' & \text{for } -1 \leq \theta \leq 1; 0 \leq s' \leq \frac{1}{2}; s' \leq x' \leq 1-s' \\ & \text{for } 1 \leq \theta \leq \infty; 0 \leq s' \leq \frac{1}{1+\theta}; \\ & s' \leq \bar{x}' \leq 1-\theta s' \end{cases} \quad (9)$$

$$\text{for } -\infty \leq \theta \leq -1; 0 \leq s' \leq \frac{1}{1-\theta}; -\theta s' \leq \bar{x}' \leq 1-s'$$

$$\therefore p(\theta) = \begin{cases} \frac{1}{3} & \text{for } -1 \leq \theta \leq 1 \\ = \frac{1}{3} \cdot \frac{1}{(1+\theta)^2} & \text{for } 1 \leq \theta \leq \infty \\ = \frac{1}{3} \cdot \frac{1}{(1-\theta)^2} & \text{for } -\infty \leq \theta \leq -1 \end{cases} \quad (10)$$

Since

$$g_1 = \frac{\sqrt{3} \theta (\theta^2 - 9)}{(3 + \theta^2)^{3/2}} \quad (11)$$

it follows that

$$p(g_1) = \frac{(3 + \theta^2)^{5/2}}{27 \sqrt{12} (1 - \theta^2)} \text{ for } -1 \leq \theta \leq 1 \quad (12)$$