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Research Article

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On the Generalization of Arithmetic Distribution and its Properties as Applied to Estimations in Plant Breeding

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Abstract Literatures on distributions and plant breeding were examined.
We introduce Arithmetic Distribution that establishes the estimator of combine effect of desirable traits in the breeding hybridization mechanism in plant. The estimator (the expectation of arithmetic distribution) shall estimate the relative acceptability that breeder(s) is/are intending to achieve by combining the desirable traits in a specified species of crop and measure the acceptance ratio of crop with a desirable trait to the one which combines about two or more desirable traits.
The discrepancies in acceptability in the selected species of crop can be estimated using either the variance or standard deviation of Arithmetic Distribution.
In view of the above, an Arithmetic Distribution is presented by (1) and some of its characteristics are shown by equations (3) and (4).

Keywords Arithmetic Distribution, Plant Breeding

Introduction

Some Literatures on Distribution

McCulloch [1] traced the history of generalized linear models, current work was reviewed and some predictions were made.

A generalization of the log-logistic distribution is defined and its moments are determined. It is pointed out that the t-approximation for the F-distribution can be used to evaluate the cumulative distribution function of the generalized log-logistic distribution. Finally, some relationships between the generalized log-logistic and other distributions are established [2].

Olapade [3] derived a probability density function that generalizes the Burr XII distribution. The cumulative distribution function and the nth moment of the generalized distribution are obtained while the distributions of some order statistics of the distribution are established. A theorem that relates the new distribution to another statistical distribution is established.

Kantam, Ramakrishna, Ravikumar [4] developed a generalization of the Half Logistic Distribution through exponentiation ofits survival function and named the Type II Generalized Half Logistic Distribution (GHLD). The distributional characteristics are presented and estimation of its parameters using maximum likelihood and modified maximum likelihood methods is studied with comparisons. Discrimination between Type II GHLD and exponential distribution in pairs is conducted via likelihood ratio criterion.

A combination of Gaussian and Bingham distributions is used to develop a linear filter that accurately estimates the distribution of the pose parameters, in their true space. The approach was first implementation to use a Bingham distribution for 6 DoF pose estimation. Experiments assert that this approach is robust to initial estimation errors as well as sensor noise. Compared to state of the art methods, this approach takes less iteration

to converge onto the correct pose estimate. The efficacy of the formulation was illustrated with a number of simulated examples on standard datasets as well as real-world experiments [5].
Al-Kadim [6] proved some theorems that characterize the logistic distribution with possible application of the characterization theorem were included.

Some Literatures on Plant Breeding

Wilhelm Johannsen in 1903, using common beans, Wilhelm Johannsen developed the Pure-Line Theory, confirming selection techniques could produce uniform cultivars, or true breeding. He also coined the terms "genotype" and "phenotype."
In 1925, Charlie Gunn and Tom Roberts establish the first hybrid corn-breeding program. By 1933, they were developing hybrids that were getting 35-percent yield boost. Their research would eventually transform agriculture and the world economy.
Norman Borlaug's groundbreaking research on wheat improvements helped to combat world hunger. He is credited with saving more than a billion lives through his introduction of high-yielding, disease-resistant wheat varieties into developing countries like Mexico, Pakistan and India. In 1970, Borlaug was awarded the Nobel Peace Prize for his contribution to world peace through increasing the food supply. In 1986, he created the World Food Prize to recognize leaders in food innovation and to promote further research
James D. Watson and Francis Crick, in 1953, the duo discovered the structure of DNA – the double helix – which helped explain how hereditary information is coded and replicated. This discovery was one of the most significant of the 20th century, and has helped advance molecular biology to this day.
2013 World Food PrizeMonsanto's, Dr. Robert Fraley, along with Marc Van Montagu of Belgium and Mary-Dell Chilton of the United States, received the 2013 World Food Prize for their independent breakthrough achievements in founding, developing and applying modern agricultural biotechnology [7].
Also, Vil'a, Weber and D'Antonio [8] reviewed the ecological factors and mechanisms that promote such hybridization events and their negative consequences on biological diversity.

Arithmetic Distribution

$$P_X(x) = \begin{cases} \frac{2x}{n(n+1)}, x \in N^* \\ 0, \ Otherwise \end{cases} \tag{1}$$

where:
$N = \{1, 2, 3, \ldots\}$;
$N^* = \{1, 2, 3, \ldots, n\}$; and
$P_X(x)$is the probability mass function of Arithmetic Distribution.

Testing for the Assumptions of Probability Distribution

First Condition Using Mathematical Induction

$$P_X(x=1) = \frac{2}{n(n+1)}; \qquad 0 \le \frac{2}{n(n+1)} \le 1, \qquad for\, n \ge 1$$

$$P_X(x=2) = \frac{4}{n(n+1)}; \qquad 0 \le \frac{4}{n(n+1)} \le 1, \qquad for\, n \ge 1$$

$$P_X(x=k) = \frac{2k}{n(n+1)}; \qquad 0 \le \frac{2k}{n(n+1)} \le 1, \qquad for\, k \le n \ge 1$$

$$P_X(x=k+1) = \frac{2(k+1)}{n(n+1)}; \qquad 0 \le \frac{2(k+1)}{n(n+1)} \le 1, \qquad for\, k+1 \le n \ge 1$$

$$P_X(x=n) = \frac{2n}{n(n+1)}; \qquad 0 \le \frac{2n}{n(n+1)} \le 1, \quad for\, n \ge 1$$

Second condition

$$\sum_{x=1}^{n}\frac{2x}{n(n+1)} = \frac{2}{n(n+1)}\sum\nolimits_{x=1}^{n} x$$

$$= \frac{2}{n(n+1)} \times \frac{n}{2}(n+1)$$

$$= 1$$

$$\Rightarrow \quad \sum\nolimits_{x=1}^{n} P_X(x) = 1$$

The Characteristics of the Arithmetic Distribution

Expectation

$$E[X] = \sum_{x=1}^{n} x\, P_X(x)$$

$$= \sum\nolimits_{x=1}^{n} x\, \frac{2x}{n(n+1)}$$

$$= \frac{2}{n(n+1)} \sum\nolimits_{x=1}^{n} x^2$$

$$= \frac{2}{n(n+1)} \times \frac{n(n+1)(2n+1)}{6}$$

$$\Rightarrow E[X] = \frac{2n+1}{3} \qquad (2)$$

Variance

$V[X] = E[X^2] - (E[X])^2$

To start with

$$E[X^2] = \sum_{x=1}^{n} x^2 \frac{2x}{n(n+1)}$$

$$= \frac{2}{n(n+1)} \sum\nolimits_{x=1}^{n} x^3$$

$$= \frac{2}{n(n+1)} \times \frac{n^2(n+1)^2}{4}$$

$$= \frac{n(n+1)}{2} \qquad (3)$$

Therefore

$$V[X] = \frac{n(n+1)}{2} - \left(\frac{2n+1}{3}\right)^2$$

$$= \frac{9n(n+1) - 2(2n+1)^2}{18} \qquad (4)$$

Summary

It has been shown that the distribution subscribed to the assumptions below:

- $0 \le P_X(x) \le 1$; and
- $\sum_{x=1}^{n} P_X(x) = 1$;

Hence, the expectation and the variance of the distribution are

$E[X] = \frac{2n+1}{3}$ and $V[X] = \frac{9n(n+1)-2(2n+1)^2}{18}$ respectively.

References

[1]. C. E. McCulloch (1999): Generalized Linear Models. *Biometrics Unit Technical Report Series and was supported by NSF grant DMS-9625476.*

[2]. M. O. Ojo and A. K. Olapade (2003): On the Generalized Logistic and Log-Logistic Distributions. *Kragujevac J. Math*. 25: 65-73.

[3]. A. K. Olapade (2008): On a six-parameter generalized Burr XII distribution. *Ar Xiv:0806.1579v1[Math.ST]*

[4]. R. R. L. Kantam, V. Ramakrishna, M. S. Ravikumar (2014): Estimation and Testing in Type-II Generalized Half Logistic Distribution. *Journal of Modern Applied Statistical Methods* Vol. 13, No. 1, 267-277.

[5]. R. A. Srivatsan, M. Xu, N. Zevallos and H. Choset (2017): Bingham Distribution-Based Linear Filter for Online Pose Estimation. *Robotics Institute, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213*.

[6]. K. A. AL-Kadim (2018): On Characterization of the Logistic Distribution. *Department of Mathematics College of Education- IbnHayyan Babylon University*.

[7]. Monsanto and Vine Design® and DEKALB® (2014): History of Plant Breeding. *Monsanto*.

[8]. M. Vil`a, E. Weber1 and C. M. D'Antonio (2000): Conservation implications of invasion by plant hybridization**.** *Kluwer Academic Publishers. Printed in the Netherland, Biological Invasions* 2:207–217.