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Researchers warn of limited treatment options as mutated strain of typhoid is blamed for surge in cases.

Mind-reading algorithm reconstructs images based on what we see
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The world of health care is changing rapidly and there is increased interest in the role that light and lighting can play in improving health outcomes for patients and providing healthy work environments for staff according to many researchers.
Science International-Lahore

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Transforming patient health care and well-being through lighting

The world of health care is changing rapidly and there is increased interest in the role that light and lighting can play in improving health outcomes for patients and providing healthy work environments for staff, according to many researchers.

Reprogramming adult cells into induced pluripotency with unprecedented efficiency

A team of scientists has reported a more efficient approach to reprogramming a patient’s diseased skin cells into stem cells, raising hopes for future clinical trials and potential cures for critical illnesses.

Shape-shifting tissue folds into bodies & ripples

Tissues harnessed with programming to create shapes out of living tissues by folding up into variety of programmed tissues.

Energy conversion of fats by microneedle patch

New approach to reduce bulging tummy fats via a microneedle patch, with drugs that turn energy-storing white fat into energy-burning brown fat.

Top two people who mattered this year


Paying Tributes to Stephen Hawking

Science International opens debate ‘FTIME SUDDENLY STOPS’
to be published in May-June, 2018, as a special issue

EDITORIAL NOTE.

Research Terminates at Infinity.

Knowledge is no metric

Through research at higher level has assumed immense dimensions with its classification into different fields of study; yet, there are fields of mutual interest to give a comprehensive treatment to the subject under investigation. In summarizing the problems in respective areas of research, one is invariably forced to invoke other disciplines. There are a number of instances of joint ventures, involving scientists from different fields of study to make consensus to conclude in the scientific zone. Research at the top level has resulted to have been conducted without isolation. The alliance of natural life and social sciences has provided new dimensions leading to a new era of interactions between man and nature. Nature has always been compromising whenever man intrusively apprised to share its secrets.

For example, study in genetics, has impact on a number of physical and biological sciences.

Research in cryobiography is extensively applied by physicists, chemists and chemical engineers etc. etc.

Computer simulation is matter of universal interest. Environmental studies has motivated almost all the sectors of science to share responsibilities in the wake of growing pollution.

The kind of forum, thus, contemplated by the science international is aimed at providing common room, from various fields of pure and applied sciences, for direct communication. This cross-breeding culture certainly helps in the exploration of new avenues in the world of science.
HEC Chairman Should Immediately Resign Over Poor Performance: Federal Academic Staff Association

By Contributors:

Ismahmed: Newly elected cabinet of Federation of All Pakistani Universities Academic Staff Association (FAPUASA) has demanded from HEC Chairman Dr. Malihah Ahmad to tender resignation immediately over poor performance.

Elections of FAPUASA concluded on Sunday where Dr. Kalsoomullah Barel from University of Balochistan was elected President. Dr. Mohammad Shoaib from UET Lahore was elected Vice President. Dr. Shahzad Farooqi from Karachi University was elected General Secretary. Dr. Naseem Ali Khan was elected an Executive Member Engineering and Dr. Huqayn Khan was elected an Ex-Officio member.

Read Also: Going Nowhere: HEC Scholarships for Balochistan

In a joint press statement after election, cabinet of FAPUASA vowed to protect the autonomy of universities in Pakistan. "We demand devolution of Higher Education Commission as per 18th Constitutional Amendment and establishment of provincial HECs for implementation of recent judgment of Lahore High Court."

We demand devolution of Higher Education Commission as per 18th Constitutional Amendment and establishment of provincial HECs for implementation of recent judgment of Lahore High Court - FAPUASA

FAPUASA also demanded to end interference in internal affairs of universities and urged respect for statutory bodies of universities. The press statement also asked the Law Enforcement Agencies to vacate the premises of University of Balochistan.

Earlier, Dr. Nasir Ahmad was elected as President of Balochistan Chapter. Dr. Shahid Akhtar (IEEE) President of Islamabad Chapter. Dr. Huqayn Khan President of Karachi Chapter. Dr. Farooq Ahmed (SEU) as President of Sukkur Chapter and Dr. Nasir Ulhaq Lakhani as President of Sindh Chapter.
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6th International Multidisciplinary Conference

History of the journal stems back to July 1968 when "The Science International (Lahore)" was commissioned in the field of international scientific publications. It is a broad-based bimonthly journal (refereed), devoted to all basic and applied sciences committed to serve the world of science. In its purview are research papers, reviews, short communications, articles and research reports from the largest spectrum of research subjects. The publication of no less than 3000 research papers go to its credit till day. Ever since it came into being, it has the privilege of having been indexed by the internationally recognized agencies for the promotion of research publications namely, INTERNATIONAL SERIAL DATABASE (ISDB) in Paris, France [ISSN 1011-5516], cited widely and abstracted by international agencies, especially, by CHEMICAL ABSTRACTS SERVICE, OHIO, U.S.A. [CODEN : SIITE 8].

WOS-BIOS/Sdata Base Zoological Record, Ulrich Directory and PASTIC, Pakistan. The journal accepts genuine contributions from authors all over the world in pure and applied sciences especially.

Math, Physics, Chemistry, Biochemistry, Molecular Biology, Microbiology, Botany, Zoology, Pharmacy, Information Technology, Biotechnology, Forensic Sciences, Agriculture, Veterinary Sciences, Food Sciences, Engineering, Mathematics, Statistics and Medical Science.

SECTION FOR SOCIAL SCIENCES HAS BEEN INTRODUCED.

Generating our own resources we remain committed to serve the world of science in general to the best of our capacity and dedication.

In addition to the normal functioning, research related activities go to its credit, the synopsis of which are given below:

RESEARCH ORIENTED ACTIVITIES

SYNOPSIS

25 YEARS SERVICE OF "SCIENCE INTERNATIONAL" (Lahore) TO THE WORLD OF SCIENCE

It is the first journal ever emerged from private sector in the history of Pakistan generating its own funds to cater its needs.

In addition to its normal functioning, it remains committed to promoting scientific culture, creative activities and talent hunting in the country and abroad, by organizing science conferences, seminars, popular lectures, symposia etc. in the country and abroad; largely attended by the elite from universities and research organizations.

SCIENCE CONFERENCE SERIES

IN COLLABORATION WITH UNIVERSITIES AND RESEARCH ORGANIZATIONS

1. All Pakistan Science Conference, 16-21 May, 1992, Karachi.
   Opening: Dr. S.H. Qureshi, Member, Pakistan Atomic Energy Commission (on behalf of the Chairman, PACEC).
   115 papers presented; proceedings published.

2. 2nd All Pakistan Science Conference, 26-30 December, 1993, Aliah University, Lahore.
   Pakistan
   Closing: Syed Faisal Ali, Minister of Finance (former), Government of Pakistan.
   110 papers presented; proceedings published.

3. 3rd All Pakistan Science Conference, 11-15 September, 1994, Bannu, Gilgit.
   Closing: Dr. Khalid Farooq (Chief Scientific Officer), POCIB, Lahore.
   Chief Guest:  Muhammad Tabassum, Italy.

4. 4th All Pakistan Science Conference, 26-30 December, 1995, University of Agriculture, Faisalabad.
   Opening: Dr. Ammar Haq, Vice Chancellor, University of Agriculture, Faisalabad.
   Closing: Dr. Ammar Haq, Vice Chancellor, University of Agriculture, Faisalabad.
   105 papers presented; published.

5. 5th All Pakistan Science Conference, 15-19 Sept., 1996 at University College of Agriculture, Rawalpindi (AJ&K).
   Opening: Sardar Muhammad Ibrahim, President, Azad Kashmir.
   Closing: Dr. Khalid Mahmood Khan, Chairman, Pakistan Science Foundation.
   120 papers presented.
6th International Multidisciplinary Conference

6th All Pakistan Science Conference, 3-5 November, 1997 at NWFP Agriculture University, Peshawar.

Opening: Minister of Education, NWFP
120 papers presented.
Closing: Vice Chancellor, NWFP, University of Agriculture

1. 1st "International Science Conference", in collaboration with the Faculty of Science and Environmental studies, University Putra Malaysia (UPM), Malaysia, 7-9 May, 1998.
Opening: The Deputy Minister, Dato' Abukar Bin Ossul, Science and Technology, Malaysia.
Co-Chair: Dr. Syed Jalaluddin bin Syed Salim, Vice-Chancellor, UPM, Malaysia
140 papers presented.

2. 2nd International Science Conference, 26-29 October, 2000 in collaboration with Institute of Chemical Engineering and Technology, University of the Punjab, Lahore.
Closing: Dr. Zafar Iqbal, Director, Institute of Chemistry, University of the Punjab, Lahore.
126 papers presented.

Opening: Khaliluddin Zaman Qureshi, Minister of Agriculture, Government of the Punjab.
Closing: Dr. K. A. Malik, Member, Pakistan Atomic Energy Commission, Islamabad
135 Papers Presented.

4. 4th International Science Conference due to the end of 3-8 October 2004, University of Azad Kashmir, Muzaffarabad
130 papers presented.

5. 5th INTERNATIONAL MULTIDISCIPLINARY CONFERENCE
September: 14-16, 2015
VENUE: IMPERIAL COLLEGE OF BUSINESS STUDIES,
Canal Bank Road, Near Bahria Shahzam Chowk, Lahore, Pakistan

SEMINAR SERIES
a) A series entitled "SCIENCE TASK FORCE" in collaboration with Pakistan Broadcasting Corporation (Radio Pakistan, Lahore).

i. 28 February, 1991, Alhamra Hall, Lahore.
Chief Guest: Mian Muhammad Azhar, Governor of the Punjab.
Speaker: Dr. S. H. Iqbal, Chairman, Department of Botany, Punjab University, Lahore.
Topic: Fungi - What Good Is It?

ii. 25 April, 1991, at Alhamra Hall, Lahore.
Speaker: Dr. M. M. Butt, Director General, FINSTECH, Islamabad.
Topic: New Materials and Super Conductors.

Chief Guest: Obulam Haidar Wayer, Chief Minister, Punjab.

Pakistan
Speaker: Dr. Shahnaz Ahmad Chaudry, CEO, FINSTECH, Islamabad.
Topic: Production of Radio Isotopes.

Chief Guest: Gazi Amin ud Din, Chairman, Pakistan Engineering Council.
Guest of Honour: Dr. M. M. Butt, Director, FINSTECH, Islamabad.
Speaker: Dr. Syed Mohammad Qasim (Germany).

b) IN P.O.B.I.R. COMPLEX, LAHORE:

Chief Guest: Dr. M. A. Qaeed, Director General, P.O.B.I.R. Laboratories, Lahore.

Speaker: Dr. Syed Sagad Hussein, Cancer Institute, Buffalo, U.S.A.
Topic: Cancer Diagnostics, Role of a Chemist.

3. 3 April, 1993.
Chief Guest: Mian Mohammad Azhar, Governor of the Punjab.
Guest Speaker: Dr. A. Q. Ansari, Chairman, P.O.B.I.R. Laboratories.
Speaker: Dr. Iqbal Ahmad Khan, Director General, FINSTECH, Islamabad.
Topic: Radiation Hazards.
6th International Multidisciplinary Conference


A talk - Preventons Against Cancer.

c) DURING CONFERENCE

i. 18 May, 1992, Khanspur, Pakistan.
Chair: M. A. Saeed, Head, Applied Div., PCSIR, Laboratories, Lahore.
Speaker: Dr. M. A. Khan, Institute of Chemistry, Punjab University, Lahore.
Topic: News Aspects of Environmental Pollution.
Speaker: Dr. Khawaja Yidrak, Pakistan Atomic Energy Commission, Islamabad.
Topic: Computer Simulation.

ii. 20 December 1993, Attockson College, Lahore.
Chair: Dr. S. A. Khan, Chairman, PCB, Islamabad.
Speaker: Dr. N. M. Butt, Director, PINSTECH, Islamabad.
Topic: Role of New Materials and Super Conductors in Industry.

iii. 20 December 1993, Attockson College, Lahore.
Chair: S. A. Khan, Chairman, PCB, Islamabad.
Speaker: Dr. M. Ashraf Tahir, Chief, DNA and Forensics, Indianaopolis, Indiana, U.S.A.
Topic: Role of DNA in the detection of crimes.

Chair: Dr. Khalid Faraq.
Speaker: Dr. Nasim ul Hassan Janjua, A. G. Khan Res. Labs; on deputation NED University, Karachi.
Topic: Life Engineering.

Chair: Dr. Khalid Faraq, G.S.C., PCSIR, Lahore.
Speaker: Dr. Khalid Janjua, PCSIR Laboratories, Lahore.
Topic: Egyptology.

vi. 15.09.1994, Bara Galli.
President: Dr. Khalid Faraq, G.S.C., PCSIR, Lahore.
Speaker: Dr. Mustafa Tabassum; Guest from Italy.
Topic: Laser Technology and Medical Science.

vii. 15. 9.1995, University College of Agriculture, Rawalakot.
Speaker: Eric Williams (Asian Bank)
Topic: Global Environmental Issues; Role of Asian Bank.
Speaker: Dr. L. C. Warner, Plant Scientist (USA)
Speaker: Dr. Dinawaz (Germany), U.C.A. Rawalakot.

5 9. 1997, NWFP Agriculture University, Peshawar.
Speaker: Dr. Lutfullah, Dir. Centre of Excellence in Physical Chemistry, University of Peshawar.
Topic: Information Technology.

Biotechnology.
7.5.1998, Universiti Putra Malaysia, Malaysia.
Speaker: Prof. Hg. Rosnani Binti Ibrahim.
Topic: Environmental Management in Malaysia.
Speaker: Dr. M. Anwar Chaudhry, University of Melbourne, Australia.
Topic: Role of Nuclear Physics in biological, environmental, industrial and medical sciences.
Speaker: K. J. Jones, MIMOS, Malaysia.
Topic: The National IT Agenda: Implication to the R&D Community.

27.10.2000, Institute of Chemical Technology, University of the Punjab, Lahore.
Dr. Muhammad A. Tahir, Serology, Indianaopolis, Indiana, U.S.A.
Application of DNA in the detection of crimes.
Dr. M. N. Riaz, Texas A & M University, USA.
Extraction Technology (Food).

27.9.2002, University of Arid Agriculture, Rawalpindi.
Chair: Dr. Ashraf Atta (GI, HI), Dr. A. Q. Khan Res. Labs., Rawalpindi.
Speaker: Romana Akbar, Head Computer Department, UAA.
Topic: E-mail Packages
6th International Multidisciplinary Conference

Speaker: Prof. Dr. M. Akhtar, FRS, University of Southampton, U.K.
Topic: On the Frontiers of Biological Sciences.
Speakers:
1. Dr. M. N. Khan, Rector, GIK Institute of Engineering and Technology,
Fabrication of High-Tc Super Conductors for Energy Technology and its Environmental Impact.
2. Dr. Muhammad A. Tahiri, Serology, Indianapolis, Indiana, U.S.A,
3. Dr. Gulam Sarwar, Head(Rtd), Dept. of Oncology, King Edward Medical College, Lahore,
Prevention & Cure of Cancer.
4. Dr. Sadaqat Mehdi, Registrar, Virtual University, Lahore,
Distant Learning.

Chair: Dr. Kausar Abdullah Malik, Director, NIBGE, Faisalabad.
Topics: (Morning Session) Higher Education & Research: Current Issues,
(Evening Session) Research & Industry: Interactions.
Speakers: 
Dr. Mujtaba Naqvi, Dir. Gen., NIAB, Faisalabad.
Dr. Tasif Rashid Butt, University of Philadelphia, U.S.A.
Also addressed by:
Dr. Mohiuddin, Deputy Director, U.K.M., Malaysia
Dr. Anwar Naqvi, Pakistan Academy of Sciences, Islamabad.
Dr. Khalid Farooq, CSO, PCSIR, Lahore.
Dr. Khurshid Alam, Dean(Agriculture), University of Agriculture, Faisalabad.
Dr. M. Atif, CBN, Islamabad.
Dr. Ahsan Ali Gilani, Dean, University of Agriculture, Faisalabad.
Dr. Altaf Hussain, Dean(Physical Sciences), University of Agriculture, Faisalabad.

27.9.2002: WORK SHOP:
University of Arid Agriculture, Rawalpindi
Chair: Dr. M. Aziz, Director General, PASTIC, Islamabad.
Topic: Evaluation of Research Papers
Views of the participants followed by general discussion
Recommendations consolidated by the Head of the Committee.
Dr. M. Younas,
Chairman, Livestock Management, University of Agriculture, Faisalabad.

Publication:

WATER CRISIS AND CROP PRODUCTION GAPs IN PUNJAB
Identification, Risk Analysis and Mitigation Measures
Authors: M Azhar Javed and M. Tariq Yamin
ESTIMATION OF GENERALIZED GAMMA DISTRIBUTION PARAMETER WITH PROBABILITY WEIGHTED MOMENT METHOD

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ABSTRACT: The classical Gamma distribution with two parameters is the distribution most commonly used in modeling the distribution of environmental quality data. However, this distribution is less precise for environmental quality data fittings. One way to overcome this is by making generalization of Gamma distribution. In this study Generalized Gamma distribution with parameters b, d, and k will be used as a model of water quality data. The parameters of the Generalized Gamma distribution probability model are to be estimated with the Probability Weighted Moment Method. To see the accuracy of estimations in various sample sizes, the Monte Carlo simulation or experiment is used to generate data. Using the data, the result indicates initial guess value b = 0.14, d = 3.28 and k = 0.001. Simulation with Monte Carlo experiments for parameter estimation with Probability Weighted Moment Method on parameters b, d and k shows better results if the sample sizes used are larger. For modeling environment quality data that has Generalized Gamma distribution, regular (routine) sampling is necessary. The Probability Weighted Moment method can be an alternative method of estimation used in Generalized Gamma distribution.

Keywords: Generalized Gamma distribution, Probability Weighted Moment, Monte Carlo Simulation, Water Quality.

1. INTRODUCTION
Gamma distribution is one of the most commonly used distributions in environmental quality data modeling. The gamma distribution is one of a continuous probability distribution family with two parameters. However, this distribution does not necessarily fit the data well for all types of environmental quality data. Berger, et al.,[1] noted, for the sulphur dioxide data in the Gent region of Belgium, the gamma distribution gives a more precise picture. One way to overcome this is to develop the distribution of gamma into a more generalized distribution. In this case, the generalized model must contain a model commonly used in environmental pollution data modeling. For modeling to be generally applicable to each state of data, the gamma distribution is generalized by three parameters also called as Generalized Gamma (GG) distribution.

Gamma distribution is very useful in modeling data distribution, among others: survival. Because of its importance, the parameter estimation for the distribution of data that has Gamma probability model should be done precisely, accurately, and efficiently. One of the most popular methods of estimating the parameters of a distribution is the maximum likelihood method.

Unfortunately, the maximum likelihood method is based on large sample theory, so this method often works poorly for data with “small” sample sizes or even for data with "medium" sample sizes. It is therefore very interesting to look for alternative methods to estimate the parameters of a distribution, and in this case it is proposed to use the probability-weighted moment method.

Marani, et al.,[2] used a Generalized Gamma model for modeling air quality data distribution with satisfactory results. Thus, it is very interesting to apply the same model to other environmental pollution data, such as water quality data. To find out if a distribution model works well in modeling a data set, the parameters of the model should be estimated first. One of the most well known methods of estimation is the maximum likelihood method. Greenwood et al. [3] and Holland and Fitz-Simons [4] stated, since the maximum likelihood method is based on large sample theory, this method often works less satisfactorily for "small" sample sizes data or even for "medium" sample sizes. To address this problem, [3] proposed the use of the Probability Weighted Moment method, as an alternative to the maximum likelihood method, to estimate the parameters of some distributions, such as the Gumbel distribution and the generalized lambda. Meanwhile, Shoukri, et al.,[5] applied the alternative method to log-logistics distribution. Therefore, to estimate the parameters of the Generalized Gamma distribution, this study uses Probability Weighted Moment method as an alternative to the maximum likelihood method. This study also examines the effect of sample size by Monte Carlo simulation or experiment on the appearance of Probability Weighted Moment method in estimating the parameters of environmental quality data distribution following the Generalized Gamma distribution.

2. LITERATURE REVIEW
2.1 Generalized Gamma Distribution
According to Dicioccio [6], a random variable X is said to have a generalized distribution of gamma probabilities with parameters α, β and θ if and only if the probability function of X is:

\[ f(x) = \frac{\beta x^{\alpha-1}}{\Gamma(\alpha)} e^{-\left(\frac{x}{\theta}\right)^{\beta}} ; x > 0; \alpha, \beta, \theta > 0 \]

Parameters α and β are known as shape parameters and θ parameter is known as scale parameter.
2.2 The Probability Weighted Moment Method

In relation to the weakness of the maximum likelihood method described earlier for a "small" sample,[3] introduce the use of the Probability Weighted Moment method as an alternative to the maximum likelihood method. The Probability Weighted Moment method of the random variable \( X \) with the function of the cumulative distribution is defined as follows:

\[
M_{r,s,t} = E[X^r (F(X)^s) (1 - F(X)^t)]
\]

In this case \( r, s, \) and \( t \) are the real numbers. If \( s = t = 0 \) and \( r \) is a non-negative integer, then \( M_{r,0,0} \) is a conventionally known moment of probability. Let \( X(F) \) be the inverse of cumulative distribution, then the Probability Weighted Moment can be written in the form:

\[
M_{r,s,t} = \int_0^1 (X(F))^r F^s (1 - F(X))^t dF
\]

Methods of Probability Weighted Moment was introduced by Landwehr, et al.[7] in Gumbel distribution. More specifically Hosking, et al.[8] discussed the characteristics of probability distribution parameters of generalized extreme-value distribution generated by the Probability Weighted Moment method. Shoukri, et al.[5] concluded that based on the simulation results the instant-Probability Weighted Moment method can be calculated, without having to go through the iteration process and always produce a visible value, and the bias and variance are smaller on the "small" sample size, equal to 15 and 25.

3. RESEARCH METHOD

3.1 Method of Estimating Parameters

To compare the appearance of the Probability Weighted Moment method in estimating the Generalized Gamma distribution parameters, the estimation of the environmental data distribution parameters model is performed by this method. Before the method is applied, it is necessary to derive and develop the predictions procedure for the Generalized Gamma distribution.

In Probability Weighted Moment method, the procedure of estimation begins with finding the inverse function of the cumulative distribution of the Generalized Gamma distribution, i.e. \( X(F) \). Then the estimation parameter is calculated by solving the following equation:

\[
M_{r,s,t} = \int_0^1 (X(F))^r F^s (1 - F(X))^t dF
\]

in this case \( r = 1, s = s, \) and \( t = 0 \). Having obtained the parameter estimation, which is still expressed in the form \( M_{r,s,t} \). The unbiased estimators for \( M_{r,s,t} \) are obtained based on the samples of \( X_{(1)} < X_{(2)} < ... < X_{(n)} \) from the random sample of size \( n \) and by solving the equation:

\[
\hat{\theta}_r = \frac{1}{n} \sum_{j=1}^{n} \frac{(j - 1)(j - 2) ... (j - r)}{(n - 1)(n - 2) ... (n - r)} X_{(j)}
\]

A review of the performance of the Probability Weighted Moment method in estimating the Generalized Gamma distribution parameters for the various sample sizes is done by Monte Carlo simulation or experiment. The assessment of the two methods performance is based on the features of unbiasedness and variances, i.e. by looking at the biased values and variances of the probability parameters produced for different sample sizes.

3.2 Data Usage

The purpose of this study is to obtain the results from the Probability Weighted Moment method on Generalized Gamma Distribution on seawater quality data. To illustrate the estimation results, the data will be used as the basis for determining the parameters. This research uses sea water quality data obtained from University of Lampung. The area of data collection is on several rivers in the Coastal Area of Bandar Lampung City (Lampung Bay) which include Way Sukamaju, Way Keteguhan, Way Kunipan, Way Kunyit, Way Kuala, Way Lunik, and Way Galih. The seawater quality are assessed in through physical parameter including TDS and TSS as well as chemical parameters including DO, COD, BOD, Hardness, Alkalinity, PO4, SO4, Nitrite, Nitrate, Iron (Fe), Sulfide, Pb, Hg, Cu, and Cd with the same unit in mg/l.

3.3 Monte Carlo Simulation Scenario

Monte Carlo simulation scenarios to be conducted in this study are as follows:

a. Generating a random sample of size \( n = 5 \).
b. Generating a random sample of size \( n = 10 \).
c. Generating a random sample of size \( n = 25 \).
d. Generating a random sample of size \( n = 50 \).
e. Generating a random sample of size \( n = 100 \).
f. Generating a random sample of size \( n = 500 \).
g. Generating a random sample of size \( n = 1000 \).

For parameter estimation and simulation used in this research is program facilities provided in program R version 3. Generation of samples for all sample sizes above is conducted by simulation each of \( N = 500 \) times.

The sample sizes \( n = 5, n = 10 \) and \( n = 25 \) are considered to represent "small" samples, \( n = 50 \) is considered to represent a "medium" sample, and the sample sizes \( n = 100, n = 500, \) and \( n = 1000 \) are considered to represent "large" samples. The simulated data of Generalized Gamma distribution with predetermined parameters is done by utilizing uniform distribution.

4. RESULTS AND DISCUSSION


To estimate the parameters of the Generalized Gamma distribution using the Probability Weighted Moment method, the first step is to determine the cumulative distribution function (CDF) of the Generalized Gamma distribution for subsequent use in searching \( M_{r,s,t} \) as the basis for applying Probability Weighted Moment method and then determines the parameter estimator.

4.2 Cumulative Distribution Function of Generalized Gamma Distribution

The cumulative function of Generalized Gamma distribution can be obtained by the following steps:

January - February
Due to the many parameters in the integral function, it is necessary to simplify as follows:

$$u = \left( \frac{t}{\theta} \right)$$

$$t = u^{\frac{1}{\beta}}$$

$$dt = \frac{1}{\beta} u^{\frac{1}{\beta} - 1} \theta du$$

Limit:

$$t = 0 \rightarrow u = 0$$

$$t = x \rightarrow u = \left( \frac{x}{\theta} \right)$$

So the above equation can be written as:

$$F(x) = \frac{\beta}{\Gamma(\alpha) \theta^{\beta \alpha}} \int_{0}^{1} \left( \frac{u^{\beta}}{\theta} \right)^{\beta \alpha - 1} e^{-u} \frac{1}{\beta} u^{\frac{1}{\beta} - 1} \theta du$$

$$= \frac{\beta}{\Gamma(\alpha) \theta^{\beta \alpha}} \int_{0}^{x} u^{\beta - 1} e^{-u} du$$

$$= \frac{1}{\Gamma(\alpha)} \int_{0}^{z} u^{eta - 1} e^{-u} du ; \quad z > 0$$

Thus, the cumulative function (CDF) obtained from the Generalized Gamma distribution is:

$$F(x) = \frac{1}{\Gamma(\alpha)} \int_{0}^{z} u^{eta - 1} e^{-u} du ; \quad z > 0 \quad \text{and} \quad z = \left( \frac{x}{\theta} \right)^{\beta}$$

The cumulative function of the GB2 distribution is an incomplete gamma function, so the inverse of the cumulative function cannot be resolved analytically but numerically. Therefore, to find the probability weighted form of the GB2 distribution used to estimate the parameter values should also be resolved numerically.

### 4.3 Numerical Richardson Integral Method

Richardson extrapolation is a method that uses two estimations of an integral to compute a more accurate third estimator. The estimations and errors associated with the multi-application trapezoidal rule can be described in general as

$$I = I(h) + E(h)$$

where $I$ is the true value of the integral, $I(h)$ is an estimation of a trapezoidal rule with a segmented application $n$ with the width of the step $h = \frac{b-a}{n}$ and $E(h)$ is the truncation error. If we make two different estimations using step width $h_1$ and $h_2$ then we get the following equation:

$$I(h_1) + E(h_1) = I(h_2) + E(h_2)$$

(2)

errors from multi-application trapezoidal rules can be estimated as:

$$E \equiv \frac{-(b-a)^3}{12 n^2} f''$$

Since the value $n = \frac{b-a}{h}$ so the above equation can be changed into

$$E \equiv \frac{-(b-a)}{12 h^2} f''$$

(3)

If it is assumed that $f''$ is a constant which means it is not affected by step width then the value of $E$ can be used to determine the ratio of both errors:

$$\frac{E(h_1)}{E(h_2)} \equiv \frac{h_1^2}{h_2^2}$$

(4)

This calculation has an important effect on removing $f''$ from the calculation. Furthermore, the above ratio equation can be changed to:

$$E(h_1) \approx E(h_2) \left( \frac{h_1}{h_2} \right)^2$$

(5)

As a result we have developed an estimation of the deduction error in terms of the integral estimation and the width of the step. This estimation can be substituted into:

$$I = I(h_1) + E(h_1)$$

To produce an improved integral estimation:

$$I \equiv I(h_2) + \frac{I(h_2) - I(h_1)}{\left( \frac{h_1}{h_2} \right)^2 - 1}$$

This shows that the error of this estimation is $h^4$. For a special case where the interval is divided into two $\frac{h_2-h_1}{2}$, the equation will be:

$$I \equiv I(h_2) + \frac{I(h_2) - I(h_1)}{2^2 - 1}$$

or formed into:

$$I \equiv \frac{4}{3} I(h_2) - \frac{4}{3} I(h_1)$$

4.4 Determination of Water Quality Data Parameters

The parameter values to be estimated are obtained from the water quality parameter in some rivers in coastal area of
Bandar Lampung city (Source: University of Lampung). Using the data, the parameter values are obtained \( b = 0.14 \), \( d = 3.28 \) and \( k = 0.001 \). Data on water quality parameters in some rivers in the coastal area of Bandar Lampung city are believed to have distributed Generalized Gamma from Kolmogorov Smirnov test. In Kolmogorov Smirnov rank test of Generalized Gamma distribution is rank 2 with p-value= 0.07232.

### 4.5 Simulation and Evaluation of Generalized Gamma Distribution Parameter Estimation
The Generalized Gamma distribution has three parameters where \( d \) and \( k \) are the shape parameters, and \( b \) is the scale parameter. The parameter estimation is performed by using software R. The parameter values to be estimated are parameters of seawater quality data obtained before, they are \( b = 0.14 \), \( d = 3.28 \) and \( k = 0.001 \).

After obtaining the parameter values to be estimated, then simulation is performed to evaluate the characteristics of each estimator. A good estimator is an unbiased, efficient, and consistent predictor. In this simulation the bias value, variance, and mean square error (MSE) of the estimations obtained by using sample sizes 5, 10, 25, 50, 100, 500, and 1000 are compared. Next, we will discuss the results of the estimation evaluation on parameter \( b \) on the Generalized Gamma distribution with the Probability Weighted Moment Method in Table 1. From the results of parameter estimation \( b \) in Table 1, it shows that the larger the samples used, the closer the estimator value of the actual parameter. This result can be supported with an increasingly small bias value as the sample size increases. The larger the sample size used, the closer to zero the bias value.

Variance estimator for parameter \( b \) shows that if the size of the sample used is larger then the value of the variance is also getting closer to zero. Likewise for the MSE value estimator for \( b \), the larger the sample used, the smaller the error value. Based on the results of the estimator evaluation shown in Table 1, the estimator for \( b \) with the Probability Weighted Moment Method on the Generalized Gamma distribution, the larger the sample size used in the estimation by the Probability Weighted Moment Method, the better the estimation will be with the bias, variance, and MSE approaching zero.

#### Table 1: The predicted, biased, variance, and MSE values for parameter \( b \) with initial value \( b = 0.14 \) from Generalized Gamma distribution

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>( \hat{b} )</th>
<th>Bias ( \hat{b} )</th>
<th>Variance ( \hat{b} )</th>
<th>MSE ( \hat{b} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>11.4004</td>
<td>11.2604</td>
<td>10.79596</td>
<td>137.5926</td>
</tr>
<tr>
<td>10</td>
<td>10.83954</td>
<td>10.69954</td>
<td>10.35214</td>
<td>124.7433</td>
</tr>
<tr>
<td>25</td>
<td>10.15808</td>
<td>10.01808</td>
<td>9.98652</td>
<td>110.3484</td>
</tr>
<tr>
<td>50</td>
<td>9.15263</td>
<td>9.01263</td>
<td>8.61373</td>
<td>89.84123</td>
</tr>
<tr>
<td>100</td>
<td>7.889112</td>
<td>7.749112</td>
<td>7.02612</td>
<td>67.07486</td>
</tr>
<tr>
<td>500</td>
<td>5.31125</td>
<td>5.17125</td>
<td>4.98748</td>
<td>31.72931</td>
</tr>
<tr>
<td>1000</td>
<td>3.14271</td>
<td>3.00271</td>
<td>2.87251</td>
<td>11.88878</td>
</tr>
</tbody>
</table>

#### Table 2: The predicted, biased, variance, and MSE, values for parameter \( d \) with initial value \( d = 3.28 \) of the Generalized Gamma distribution

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>( \hat{d} )</th>
<th>Bias ( \hat{d} )</th>
<th>Variance ( \hat{d} )</th>
<th>MSE ( \hat{d} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>21.79714</td>
<td>18.51714</td>
<td>11.0779</td>
<td>353.9624</td>
</tr>
<tr>
<td>10</td>
<td>21.52569</td>
<td>18.24569</td>
<td>10.90974</td>
<td>343.8148</td>
</tr>
<tr>
<td>25</td>
<td>20.5857</td>
<td>17.3057</td>
<td>10.17834</td>
<td>309.6656</td>
</tr>
<tr>
<td>50</td>
<td>19.2222</td>
<td>15.9422</td>
<td>9.03112</td>
<td>263.1849</td>
</tr>
<tr>
<td>100</td>
<td>17.56315</td>
<td>14.28315</td>
<td>7.96581</td>
<td>211.9742</td>
</tr>
<tr>
<td>500</td>
<td>15.25442</td>
<td>11.97442</td>
<td>6.01637</td>
<td>149.4031</td>
</tr>
<tr>
<td>1000</td>
<td>12.42064</td>
<td>9.14064</td>
<td>3.25024</td>
<td>86.80154</td>
</tr>
</tbody>
</table>

The estimation value parameter \( d \) gets closer to the actual parameter as the number of samples increases. Table 2 summarizes estimator evaluation by bias, variance, and MSE. For the bias of estimated parameter \( d \) in the Generalized Gamma distribution, bias will be smaller or closer to zero as the number of samples gets larger. Likewise on the variance and the MSE, the value of the variance and the MSE is getting closer to zero when the sample size used is larger.

Thus, for estimating the parameter \( d \) by the Least Squared Method indicates better estimation results when the sample size used is larger indicated by the bias, the variance, and the MSE approaching zero.

Table 3 presents the estimator evaluation results with the bias, variances, and MSEs by the estimation parameter \( k \) with the Probability Weighted Moment method on Generalized Gamma distribution. Based on the results in Table 3, the estimation of parameter \( k \) with the Probability Weighted Moment Method produces bias, variance, and MSE approaching zero as the sample size increases. The estimated value of the parameter \( k \) is also closer to the actual value for the larger sample size. As for estimation parameters \( b \) and \( d \), estimation parameter \( k \) gets better as the sample size gets larger based on the evaluation of estimation bias, variance, and MSE parameters. This suggests that the Probability Weighted Moment Method will be more accurate to estimate the parameters of water quality data in Generalized Gamma distribution when the sample size used is larger.

#### Table 3: The predicted, biased, variance, and MSE values for parameter \( k \) with initial value \( k = 0.001 \) of Generalized Gamma distribution

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>( \hat{k} )</th>
<th>Bias ( \hat{k} )</th>
<th>Variance ( \hat{k} )</th>
<th>MSE ( \hat{k} )</th>
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4.6 Fitting Parameter Estimation on Water Quality Data

Fitting on water quality data in several rivers in Coastal Area of Bandar Lampung City is known to have Generalized Gamma distribution with parameter $b = 0.14$, $d = 3.28$ and $k = 0.001$. This simulation result of parameter estimation with Least Squares method indicates that the larger the sample size used, the better the parameter estimation is. These results provide the foundation that the environmental quality data of several rivers in the Coastal Area of Bandar Lampung City follow the more Generalized Gamma or Generalized Gamma distribution. To obtain information for both modeling and distribution, parameter estimation with Probability Weighted Moment Methods gives better results for larger samples. Therefore, in using Generalized Gamma distribution as distribution in modeling of water quality data especially in Coastal Area of Bandar Lampung City it is required to do continuous or routine sampling so that the number of samples used is larger and gives better estimation results with Probability Weighted Moment Method.

5. CONCLUSION

The water quality data on several rivers in the coastal area of Bandar Lampung follow the Generalized Gamma distribution with parameter value $b = 0.14$, $d = 3.28$ and $k = 0.001$. The simulation result for parameter estimation with Probability Weighted Moment method for parameters $b$, $d$ and $k$ is better if the sample size used is larger based on the evaluation value of bias estimation, the variance and the MSE approaching zero. For the modeling of environmental quality data that has Generalized Gamma distribution, regular (routine) sampling is necessary because the parameter estimation on the distribution with Probability Weighted Moment method will be better if the number of samples used is larger. The Probability Weighted Moment method can be an alternative method of estimation used in Generalized Gamma distribution.

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6. REFERENCES