A MODIFIED WEIGHTED DISTRIBUTION - APPLICATION ON DIABETES MELLITUS AND PANCREATIC CANCER DATA

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Abstract

This research article attempts to establish and explore a case of two parameter Nwikpe distribution and termed it as Area Biased C2N distribution. As the characteristics of Hydrogen per Oxide(H_2O_2) is quite different from that of Water (H_2O) even though both are the different combinations of the same elements Oxygen & Hydrogen, the characteristics of initial distribution is also entirely different from that of the area biased modified distribution. The implemented new distribution has distinct structural characteristics, and its parameters are estimating using maximum likelihood estimation. Utilizing biomedical data, the new distribution's application has been examining to ascertain its superiority and utility. One lifetime data set shows the mean reduction in blood glucose (mg/dL) after three days of the first usage of the Metformin medicine from a random sample of 130 patients from a hospital at Chennai, TamilNadu with type 2 diabetes mellitus by testing the FBS-Fasting Blood Glucose. The another set of lifetime data shows the mean reduction in blood glucose (mg/dL) after each dosage of the FIASP insulin-medicine in alternate days of a pancreatic cancer patient, noted for 63 days randomly. Both data set is going to fit to the new distribution and analyze them, to determine the supremacy and usefulness.

Keywords: area biased distribution, length biased distribution, weighted distributions, reliability, estimate.

1. Introduction

When samples from both the parent distribution and newly derived distributions can be obtained, the concept of weighted distributions (WD) suggests a method to fit models to the unknown weight function. The WD plays a remarkable role in better understanding of the standard distributions and can extend distributions by adding flexibility, while dealing with the modeling of statistical data when classical distributions cannot imply observations with the same probabilities. The statistical explanation of WD & size biased distribution was made by Buckland and Cox [1] within the renewal theory framework. If only the length in units considers for the weight function, the WD becomes a length-biased distribution. Other environmental, econometric, and biomedical sampling problems, as well as a number of forestry applications, have brought up the length-biased and area-biased distributions. Numerous scholars created significant area-biased weighted probability models that have a significant impact on how data sets from diverse practical domains are processed. Bashir and Mahmood [2] presented multivariate area-biased Lindley distribution. The estimation of parameters of area biased Ailamujia distribution detailed by Rao and Pandey [3]. Kayid *et al.* [4] explained the length-biased Rayleigh distribution. Oluwafemi and Olalekan [5] investigated the exponentiated Weibull distribution biased by length and area. The weighted quasi-Xgamma distribution was analyzed by Hassan *et al.* [6] with applications in survival times. Elangovan *et al.* citeelanetal investigated the Samade distribution with length bias. Fazal [8] provided specifics on the Poisson exponential distribution with area bias. Chouia and colleagues [9] examined the size-biased Zeghdoudi distribution and its practical applications. Nwikpe and Essi [10] have proposed the two parameter Nwikpe distribution (TPND), a continuous lifetime distribution. Some of its statistical characteristics are discussed.

A Generalized Area-Biased Power Ishita Distribution with a biomedical data is studied and the Survival time in days of lung cancer patients after their second cycle of chemotherapy is analyzed and fitted with an area biased weighted distribution by Roshni *et al.* [11]. The relationship between Pancreatic cancer and Diabetes, is analyzed and detailed by Teresa *et al.* [12]. A meta-analysis of cohort studies based on Diabetes mellitus and risk of pancreatic cancer is studied by Qiwen Ben [13]. To describe, diabetes mellitus correlates with increased risk of pancreatic cancer, a population-based cohort study in Taiwan is conducted by Liao *et al.* [14].
Many biomedical data show non-symmetric nature. The data based on Blood sugar in some situations exhibit positive skewness. The normal fasting blood glucose/sugar (FBS) ranges between 70 mg/dL – 100 mg/dL (or 3.9 mmol/L – 5.6 mmol/L). If it is ranges 100 mg/dL – 125 mg/dL (or 5.6 mmol/L – 6.9 mmol/L) glycemia monitoring and lifestyle changes are required.

A diagnosis of diabetic is made if the FBS is 126mg/dL(7mmol/L) or higher on 2 separate tests. When a person has low FBS concentration (hypoglycemia) which is less than 70 mg/dL (3.9 mmol/L), they may experience palpitations, blurred vision dizziness, sweating and other symptoms which require to be closely watched. Hyperglycemia -the increased FBS concentration - is a sign of a raised risk of diabetes. FBS may be within normal range if a person does not diabetic or if they are taking effective treatment with medication that lowers blood sugar in diabetics. Mean FBS is used as a stand-in for diabetes treatment and for encouraging healthy eating & lifestyle choices at the national level.

Metformin (Fortamet, Glumetza, others) is usually prescribed first for type 2 diabetes. Liver Produces less glucose and sensitivity to insulin increases, making the body use insulin effectively. One can use any medication that content Metformin, such as the 500mg Glyciphage SR tablet. It controls the blood sugar levels. It is for the treatment of type 2 diabetes mellitus, a disorder in which diet and exercise alone are insufficient to control blood sugar level, causing them to rise above normal. It belongs to a class of medicines called biguanides. It works by reducing the glucose production in the liver, raising the body's sensitivity to insulin and delaying the absorption of sugar from the intestines.

Pancreas produces Insulin, that enables our body to utilize glucose for energy. High blood sugar- Hyperglycemias - results from insufficient insulin production or usage, results diabetes. Insulin is to control blood sugar in people with condition in which the body does not make insulin (type 1 diabetes) and therefore cannot control the amount of sugar in the blood or in people with condition in which the blood sugar is too high (type 2 diabetes) because for whom body does not produce or use. If the fasting plasma glucose is greater than 250 mg/dL or the HbA1c is greater than 10% then Insulin therapy usually needed. The Hyperinsulinemia rapid rise linked with type 2 diabetes and obesity, predicts a rise in pancreatic cancer frequency. Insulin effects at different stages of pancreatic cancer progression are unclear.

FIASP is a fast-acting insulin. It is a type of insulin that's spontaneously released into our bloodstream. It is a solution in a vial, PenFill cartridge or FlexTouch pen. It is the same as the insulin NovoRapid, with the addition of two ingredients, to increase the speed at which FIASP is absorbed into the blood are niacinamide (Vitamin B3) and the amino acid L-arginine. Insulin in

FIASP helps glucose enter cells from the blood and acts in the same method as the body's own insulin. This reduces the symptoms and complications of diabetes, and controls the level of blood glucose.

2. Methods

I. Area Biased C2N Distribution (ABC2ND)

The probability density function '(PDF) of TPND is,

$$f(x;\theta,\alpha) = \frac{\theta^3}{(\theta^5+2\alpha+6)}(\theta x^3+\alpha x^2+\theta^3)e^{-\theta x}; \quad 0<x<\infty, 0<\alpha,\theta<\infty, \tag{1}$$

and the Cumulative density function '(CDF) of TPND is,

$$F(x;\theta,\alpha) = \left(1-\left(1+\frac{\theta^3x^3+(\alpha+3)(\theta^2x^2+2\theta x)}{(\theta^5+2\alpha+6)}\right)e^{-\theta x}\right); 0<x<\infty, 0<\alpha,\theta<\infty. \tag{2}$$

Let $'X'$ be a negative random variable and has pdf $f(x)$ and $w(x)$ be a non-negative weight function, then the pdf of a weighted random variable X_w is,

$$f_w(x) = \frac{w(x)f(x)}{E(w(x))}, x>0 \text{ where } E(w(x)) = \int w(x)f(x)dx < \infty.$$

For various choices of weight function $w(x)$, if $w(x)=x^c$, the proposed distribution is mentioned as weighted distribution. Here, $c=2$, the weight function is taken as $w(x)=x^2$ to formulate the area biased version of TPND, and the pdf of the new distribution is obtained from,

$$f_a(x) = \frac{x^2 f(x)}{E(x^2)} \text{ where } E(x^2) = \frac{120+24\alpha+2\theta^5}{\theta^2(\theta^5+2\alpha+6)}, \text{ as,}$$

$$f_a(x) = \frac{x^2\theta^5}{(120+24\alpha+2\theta^5)}(\theta x^3+\alpha x^2+\theta^3)e^{-\theta x}, 0<x,\theta,\alpha<\infty$$

and the CDF of ABC2ND can be determined as,

$$F_a(x) = \int_0^x f_a(x)dx = \frac{1}{(120+24\alpha+2\theta^5)}\left(\theta^6\int_0^x x^5e^{-\theta x}dx + \alpha\theta^5\int_0^x x^4e^{-\theta x}dx + \theta^8\int_0^x x^2e^{-\theta x}dx\right).$$

Let $\theta x = t$, then $\theta dx = dt$, implies $dx = dt/\theta$. $x = \frac{t}{\theta}$ when $x \to x$, and $t \to \theta x$ and as $x \to \theta$, $t \to 0$ and by using usual Gamma Integral notations, the CDF of ABC2ND is,

$$F_a(x) = \frac{1}{(120+24\alpha+2\theta^5)}\left(\gamma(6,\theta x)+\alpha\gamma(5,\theta x)+\theta^5\gamma(3,\theta x)\right) \tag{3}$$

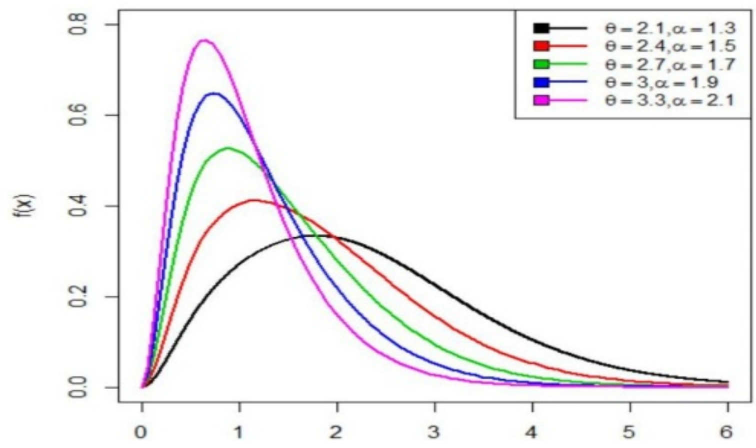

Figure 1: *PDF of ABC2ND*

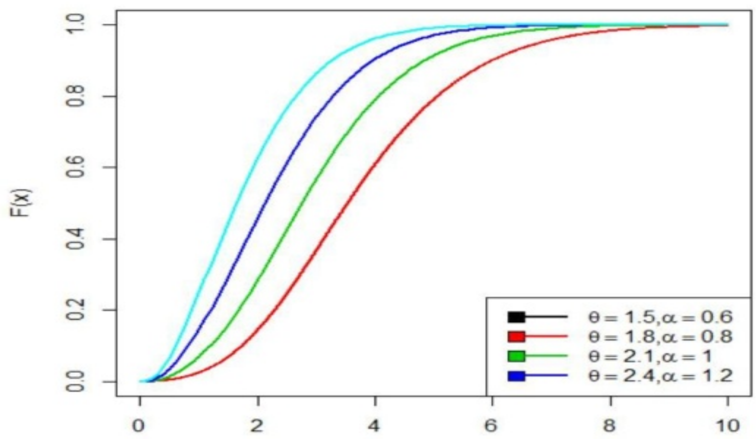

Figure 2: *CDF of ABC2ND*

The Nature of PDF and CDF of ABC2ND is clear from the Figure 1 and Figure 2. ABC2ND is non-symmetric. It is positively skewed. Hence it may show good fit for many real data set than any conventional distribution.

II. Reliability and Hazard functions

Reliability function: The reliability function of ABC2ND is,

$$R(x) = 1 - F_\alpha(x) = 1 - \frac{1}{(120 + 24\alpha + 2\theta^5)} \left(\gamma(6, \theta x) + \alpha\gamma(5, \theta x) + \theta^5\gamma(3, \theta x)\right).$$

Hazard function: The hazard function,

$$h(x) = \frac{f_a(x)}{(1 - F_a(x))} = \frac{x^2\theta^5 \left(\theta x^3 + \alpha x^2 + \theta^3\right) e^{-\theta x}}{(120 + 24\alpha + 2\theta^5) - (\gamma(6, \theta x) + \alpha\gamma(5, \theta x) + \theta^5\gamma(3, \theta x))}$$

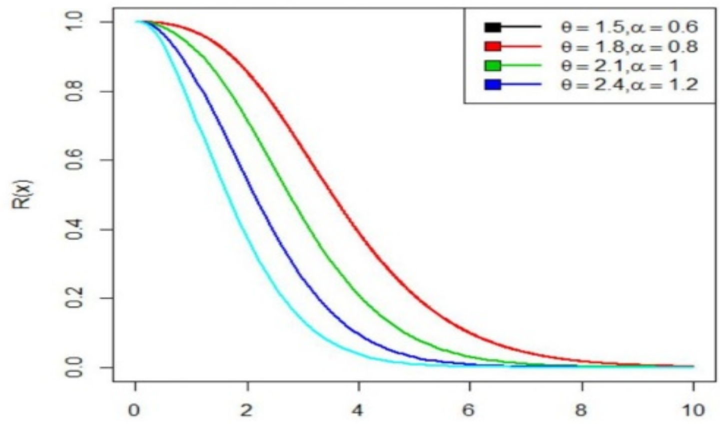

Figure 3: *Reliability function*

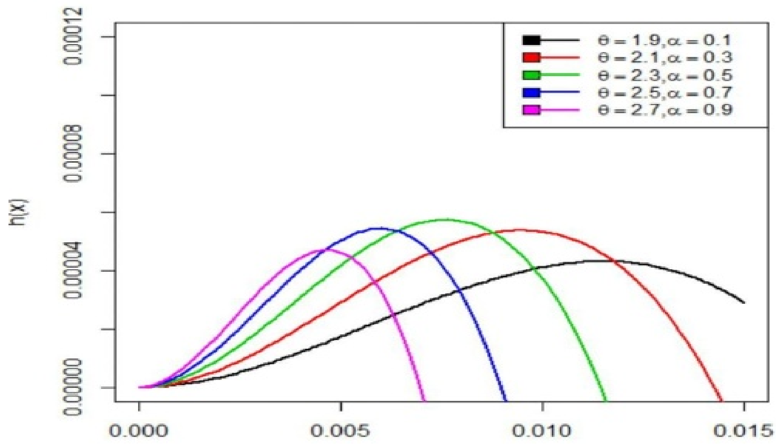

Figure 4: *Hazard function*

The Nature of Reliability Function and Hazard Function of ABC2ND is clear from the Figure 3 and Figure 4.

3. Results

I. Moments

Let X be a random variable following ABC2ND with parameters θ and α, then the r^{th} order moment $E(X^r)$ is,

$$E(X^r) = \mu_r' = \int_0^\infty x^r f_a(x)dx = \int_0^\infty x^r \frac{x^2\theta^5}{(120+24\alpha+2\theta^5)}(\theta x^3 + \alpha x^2 + \theta^3)e^{-\theta x}dx$$

$$= \frac{\theta^5}{(120+24\alpha+2\theta^5)}\left(\theta\int_0^\infty x^{(r+6)-1}e^{-\theta x}dx + \alpha\int_0^\infty x^{(r+5)-1}e^{-\theta x}dx + \theta^3\int_0^\infty x^{(r+3)-1}e^{-\theta x}dx\right). \quad (4)$$

By Simplifying the equation (4), we obtain

$$E(X^r) = \mu'_r = \frac{\Gamma(r+6) + \alpha\Gamma(r+5) + \theta^8\Gamma(r+3)}{\theta^r(120+24\alpha+2\theta^5)}. \tag{5}$$

Letting $r = 1, 2, 3$ and 4 in equation (5), we get the first four moments of ABC2ND as,

$$\mu'_1 = \frac{720+120\alpha+6\theta^8}{\theta(120+24\alpha+2\theta^5)}, \mu'_2 = \frac{5040+720\alpha+24\theta^8}{\theta^2(120+24\alpha+2\theta^5)}$$
$$\mu'_3 = \frac{40320+5040\alpha+120\theta^8}{\theta^3(120+24\alpha+2\theta^5)}, \mu'_4 = \frac{362880+40320\alpha+720\theta^8}{\theta^4(120+24\alpha+2\theta^5)}.$$

II. MGF and CF of ABC2ND Let a random variable X follows ABC2ND with parameters θ and α, then the MGF is,

$$M_X(t) = E(e^{tx}) = \int_0^\infty e^{tx} f_a(x)dx.$$

Using Taylor's series, we obtain

$$M_X(t) = E(e^{tx}) = \int_0^\infty \left(1 + tx + \frac{(tx)^2}{2!} + \cdots\right) f_a(x)dx = \int_0^\infty \sum_{j=0}^\infty \frac{t^j}{j!} x^j f_a(x)dx$$

$$= \sum_{j=0}^\infty \frac{t^j}{j!}\mu'_j M_x(t) = E(e^{tx}) = \sum_{j=0}^\infty \frac{t^j}{j!}\left(\frac{\Gamma(j+6)+\alpha\Gamma(j+5)+\theta^8\Gamma(j+3)}{\theta^j(120+24\alpha+2\theta^5)}\right)$$

$$M_x(t) = E(e^{tx}) = \frac{1}{(120+24\alpha+2\theta^5)} \sum_{j=0}^\infty \frac{t^j}{j!\theta^j}(\Gamma(j+6)+\alpha\Gamma(j+5)+\theta^8\Gamma(j+3)).$$

Similarly, the CF of ABC2ND is,

$$\phi_x(t) = \frac{1}{(120+24\alpha+2\theta^5)} \sum_{j=0}^\infty \frac{it^j}{j!\theta^j}(\Gamma(j+6)+\alpha\Gamma(j+5)+\theta^8\Gamma(j+3)).$$

III. Maximum Likelihood Estimation (MLE) and Fisher's Information Matrix (FIM) of ABC2ND The MLE of the parameters of ABC2ND are estimated. Let $X_1, X_2, \ldots X_n$ be n random sample from the ABC2ND, then the likelihood function

$$L(x) = \prod_{i=1}^n f_a(x) L(x) = \frac{\theta^{5n}}{(120+24\alpha+2\theta^5)^n} \prod_{i=1}^n \left(x_i^2(\theta x_i^3 + \alpha x_i^2 + \theta^3)e^{-\theta x_i}\right). \tag{6}$$

Taking log and differentiating with respect to θ and α, we get two Normal equations.

$$\frac{\partial \log L}{\partial \theta} = \frac{5n}{\theta} - n\left(\frac{10\theta^4}{(120+24\alpha+2\theta^5)}\right) + \sum_{i=1}^n \left(\frac{(x_i^3+3\theta^2)}{(\theta x_i^3+\alpha x_i^2+\theta^3)}\right) - \sum_{i=1}^n x_i = 0$$

$$\frac{\partial \log L}{\partial \alpha} = -n\left(\frac{24}{(120+24\alpha+2\theta^5)}\right) + \sum_{i=1}^n \left(\frac{x_i^2}{(\theta x_i^3+\alpha x_i^2+\theta^3)}\right) = 0.$$

Getting an algebraic solution is complicated here, hence apply some numerical methods like Newton-Raphson approach to estimate the parameters of the distribution through R software. In order to determine the confidence interval (CI), apply the asymptotic normality results. We know

$\hat{\gamma} = (\hat{\theta}, \hat{\alpha})$ represents the MLE of the $\gamma = (\theta, \alpha)$. We write, $\sqrt{n}(\hat{\gamma} - \gamma) \to N_2(0, I^{-1}(\gamma))$, where $I^{-1}(\gamma)$ is FIM.
i.e.,

$$I(\gamma) = -\frac{1}{n} \begin{pmatrix} E\left(\frac{\partial^2 \log L}{\partial \theta^2}\right) & E\left(\frac{\partial^2 \log L}{\partial \theta \partial \alpha}\right) \\ E\left(\frac{\partial^2 \log L}{\partial \alpha \partial \theta}\right) & E\left(\frac{\partial^2 \log L}{\partial \alpha^2}\right) \end{pmatrix}$$

$$E\left(\frac{\partial^2 \log L}{\partial \theta^2}\right) = -\frac{5n}{\theta^2} - n\left(\frac{(120 + 24\alpha + 2\theta^5)(40\theta^3) - (10\theta^4)^2}{(120 + 24\alpha + 2\theta^5)^2}\right)$$
$$+ \sum_{i=1}^{n} \left(\frac{(\theta x_i^3 + \alpha x_i^2 + \theta^3)(6\theta) - (x_i^3 + 3\theta^2)^2}{(\theta x_i^3 + \alpha x_i^2 + \theta^3)^2}\right)$$

$$E\left(\frac{\partial^2 \log L}{\partial \alpha^2}\right) = n\left(\frac{576}{(120 + 24\alpha + 2\theta^5)^2}\right) - \sum_{i=1}^{n} \left(\frac{E(x_i^2)^2}{(\theta x_i^3 + \alpha x_i^2 + \theta^3)^2}\right)$$

$$E\left(\frac{\partial^2 \log L}{\partial \theta \partial \alpha}\right) = n\left(\frac{(10\theta^4)(24)}{(120 + 24\alpha + 2\theta^5)^2}\right) - \sum_{i=1}^{n} \left(\frac{(x_i^3 + 3\theta^2)(x_i^2)}{(\theta x_i^3 + \alpha x_i^2 + \theta^3)^2}\right).$$

By $I^{-1}(\gamma)$ we estimate γ and utilized to attain an asymptotic CI for θ & α.

4. Discussion

I. Simulation Analysis
The simulated data from the pdf of ABC2ND is analyzed. The descriptive statistics for the same is noted here at Table 1.

Table 1: *The descriptive statistics of simulated data: ABC2ND, $\alpha = 3.9$, $\theta = 1.95$*

Mean	17.1	Range	40.5
Standard Error	0.497	Minimum	1.4
Median	8.45	Maximum	41.9
Mode	3.2	Sum	85500
Standard Deviation	12.46	Count	5000
Kurtosis	-0.73	Largest& Smallest	1.4 & 41.9
Pearson's Skewness*	1.12	Confidence Level (95.0%)	0.9769

Karl Pearson's Skewness = (Mean-Mode)/SD. The value of this coefficient will be zero for a symmetrical distribution. If mean >mode, the coefficient of skewness is positive else negative. For considerably skewed destitution this coefficient is lies between -1 and 1. If it is greater than 1 its highly positive skewed. Generally, if the distribution of data is skewed to the left, then mean <median <mode. If the distribution of data is skewed to the right, then mode <median <mean. Here from Figure 1 & Table 1, both cases imply the distribution is highly positive skewed.

II. Application
Hereby applying and analyzing a real data set for fitting ABC2ND in order to determine whether the ABC2ND shows a better fit than TPN, Nwikpe, Komal and Lindley distributions.

Data 1: The real data set at (Table 2), shows the mean reduction in blood glucose (mg/dL) after three days of the first usage of the Metformin medicine from a random sample of 130 patients

Table 2: *The mean reduction in blood glucose (mg/dL) by Metformin.*

5.5	6.1	8.7	13.9	7.8	9.5	7.1	6.1	8.2	4.7	5.1	14.3	7.1
5.2	14.4	7.5	12.7	7.8	6.2	7.1	6.1	8	6.1	5.3	6.1	7.9
6.1	7.3	14.8	9.1	14.3	8.3	9.6	7.1	7.8	5.6	6.1	7.7	14.8
4.9	8.5	6.3	11.5	7.7	8.9	7.1	6.1	8	6.1	12.3	7.8	9.1
5	14.2	6.7	11.9	7.8	9	7.1	6.1	8	6.1	13.1	7.8	9.3
6.1	7.9	4.8	10.3	7.6	8.6	9.9	11.2	8	5.9	9.9	7.6	8.5
6.1	8.1	4.9	10.7	7.6	8.7	10	11.3	8	6	7.1	6.1	8
4.8	8.3	5.9	11.1	7.6	8.8	7.1	11.4	8	6.1	7.1	6.1	8
5.4	6.1	8.3	13.5	7.8	9.4	7.1	6.1	8.1	4.6	9.8	7.1	7.9
6.1	7.5	14.8	9.5	14.7	8.4	9.7	7.1	7.8	5.7	5.8	6.1	4.5

from a hospital at Chennai, TamilNadu with type 2 diabetes mellitus by testing the FBS-Fasting Blood Glucose (Method: Hexokinase).

Here from Table 3. We get, the Mean >Median >Mode & Skewness = 0.8904 shows the data is positively skewed. Hence the data is non-symmetric. Thereby we are trying to analyze the goodness of fit of ABC2ND.

Table 3: *The descriptive statistics of the data at Table 2.* $(n = 130)$

Mean	8.1354	Minimum	4.5
Standard Error	0.2225	Maximum	14.8
Median	7.8	Sum	1057.6
Mode	6.1	Skewness	0.8904
SD	2.2910	Smallest & Largest	4.5 & 14.8
Kurtosis	0.7749	Confidence Level (95.0%)	0.4401

Data 2: The mean reduction in blood glucose (mg/dL) is noted Table 4, after each dosage of the FIASP insulin - medicine in alternate days of a pancreatic cancer patient is noted for 63 days randomly.

Table 4: *The mean reduction in blood glucose (mg/dL) FIASP insulin.*

3.2	3.3	3.6	7.8	3.2	7.5	8.2	11.8	7.1
7.7	16.2	14.4	16.5	3.8	3.2	8.5	15	3.2
14.5	16.3	7.1	16.6	3.2	3.1	8.6	15.1	3.2
7.1	3.2	7.2	16.7	14.8	3.5	8.7	15.2	3.2
4.3	3.3	7.3	3.2	3.4	3.2	7.4	15.3	14.7
16.8	3.2	3.7	16.3	7.1	7.6	8.3	3.2	4.4
16.9	16.1	3.9	16.4	3.2	3.2	8.4	14.9	14.6

Table 5: *The descriptive statistics of the data at Table 4.* $(n = 63)$

Mean	8.6	Minimum	3.1
Standard Error	0.663456	Maximum	16.9
Median	7.4	Sum	541.8
Mode	3.2	Smallest & Largest	3.1 & 16.9
S D	5.26	Skewness	1.038
Kurtosis	-1.46265	Confidence Level (95.0%)	1.3262

Here the Mean >Median >Mode & Skewness = 1.038 shows a high positive skewness. Hence the data is non-symmetric. Thereby we are trying to check the goodness of fit of ABC2ND.To the estimation of unknown parameters, and to determine the model comparison criterions, software R is applied.

Table 6: *MLE, S.E, $-2\log L$, AIC, BIC and AICC of fitted distributions (data from Table 2)*

Dbn	MLE	S.E	$-2\log L$	AIC	BIC	AICC	K-S	P
ABC2N	$\hat{\alpha}$ = 3.7725 $\hat{\theta}$= 1.83	$\hat{\alpha}$ = 1.5712 $\hat{\theta}$ = 0.0001	174.31	178.3	182.5	178.7	0.029	0.7981
TPN	$\hat{\alpha}$ = 6.14 $\hat{\theta}$ = 9.70	$\hat{\alpha}$ = 1.667 $\hat{\theta}$ = 7.10	202.91	206.9	211.2	211.1	0.032	0.7777
Nwikpe	$\hat{\theta}$ = 1.29	$\hat{\theta}$ = 0.087	201.33	203.3	205.4	203.3	0.039	0.6780
Lindley	$\hat{\theta}$ = 0.57	$\hat{\theta}$ = 0.039	249.72	251.7	253.8	251.7	0.173	0.0459
Komal	$\hat{\theta}$ = 0.51	$\hat{\theta}$ = 0.037	254.87	256.9	259.0	256.9	0.197	0.0450

Table 7: *MLE, S.E, $-2\log L$, AIC, BIC, AICC (Data from Table 4)*

Dbn	MLE	S.E	$-2\log L$	AIC	BIC	AICC	K-S	p
ABC2N	$\hat{\alpha}$ = 3.5778 $\hat{\theta}$ = 1.63	$\hat{\alpha}$ = 1.357 $\hat{\theta}$ = 0.0001	167.31	171.3	175.5	171.5	0.03	0.8101
TPN	$\hat{\alpha}$ = 6.47 $\hat{\theta}$ = 9.80	$\hat{\alpha}$ = 1.67 $\hat{\theta}$ = 7.13	195.91	199.9	204.1	200.1	0.03	0.7810
Nwikpe	$\hat{\theta}$ = 1.79	$\hat{\theta}$ = 0.09	194.33	196.3	198.4	196.3	0.04	0.7670
Komal	$\hat{\theta}$ = 0.51	$\hat{\theta}$ = 0.04	247.87	249.8	252.0	249.9	0.15	0.0590
Lindley	$\hat{\theta}$ = 0.54	$\hat{\theta}$ = 0.04	242.72	244.7	246.8	244.7	0.12	0.0660

To compare the performance of ABC2ND over TPN, Nwikpe, Komal and Lindley distributions, we consider criterions – AIC (Akaike Information Criterion, BIC (Bayesian Information Criterion), AICC (Akaike Information Criterion Corrected) and $-2\log L$.The distribution is better if with the lesser criterion values of $-2\log L$, AIC, BIC and AICC. Here, AIC = $2k$ ı$2\log L$, BIC = $k\log n$, and AICC=AIC+$\frac{2k(k+1)}{n-k-1}$. Here, n = the sample size, k = the number of parameters and ı$2\log L$ = the maximized value of log-likelihood function. (Here K-S is Kolmogorov-Smirnov, p is p-value at level of significance α = 5%). The ABC2ND has smaller BIC, AICC, AIC, and $-2\log L$ values than the TPN, Nwikpe, Komal, and Lindley distributions, according to the results shown above in Tables 4 and 5. Implies that the ABC2ND shows a better fit over the other distributions for such skewed biomedical data.

5. Conclusion

Hereby explored and studied a new distribution named as Area Biased C2N Distribution. The developed new distribution is introduced by applying the area biased method to its initial distribution. Some of its statistical characteristics like moments, shape and behaviour of PDF and CDF, reliability function, hazard rate, MGF and CF are described. The parameters of the distribution are estimated. Two different applications of the new distribution have been presented to demonstrate its significance at biomedical data. The Data set 1 is the mean reduction in blood glucose (mg/dL) after three days of the first usage of the Metformin medicine from a random sample of 130 patients from a hospital at Chennai, TamilNadu with type 2 diabetes mellitus by testing the FBS-Fasting Blood Glucose. And the data set 2 is the mean reduction in blood glucose (mg/dL) is noted after each dosage of the FIASP insulin - medicine in alternate days of a pancreatic cancer. It is concluded for both cases that the result developed for ABC2ND provides a quite satisfactory fit over TPN, Nwikpe, Komal and Lindley distributions.

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