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Research article

A Chen Type Generated Family of Distributions

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Abstract

Inspired by [1] and [2] we introduce a new Chen type generated family of distributions and show a sub-model of this broad class of statistical distributions is a good fit to real-life data. Our hope is that readers will consider investigating some properties and applications of this new class of distributions.

Contents

The New Family Illustrated

We begin with the following

Definition 2.1.1: Let T be a random variable with $PDF\ g(t)$ and $CDF\ G(t)$, and let X be a random variable with $CDF\ F(x)$,the new Chen generated family of distributions ("$C_T - X$" for short) is defined by the following integral for its CDF

$$\int_0^{-\log(1-F(x))} \frac{\lambda\beta}{1-e^{-\lambda(1-e)}} g(t)G(t)^{\beta-1} e^{G(t)^{\beta}} e^{\lambda(1-e^{G(t)^{\beta}})} dt$$

Where $\lambda, \beta > 0$

From the above we have the following

Proposition 2.1.2: The CDF of $C_T - X$ is given by

$$\frac{1-e^{\lambda(1-e^{G(-\log(1-F(x)))^{\beta}})}}{1-e^{-\lambda(1-e)}}$$

where the random variable T has $CDF\ G$, the random variable X has $CDF\ F(x)$, and $\lambda, \beta > 0$, and $x \in Supp(F)$

For illustrative purposes, let us assume $T \sim Exponential(f)$, and $X \sim Normal(c,d)$, then from the Proposition immediately above we have the following **Theorem 2.1.3**: The CDF of Chen Exponential-Normal is given by

$$\frac{1-\exp\left(\lambda\left(1-e^{\left(1-\left(1-\frac{1}{2}erfc\left(\frac{c-x}{\sqrt{2}d}\right)\right)^{f}\right)^{\beta}}\right)\right)}{1-e^{(1-e)\lambda}}$$

where $erfc(.)$ gives the complementary error function, $d,f,\lambda,\beta>0$, and $x,c \in \mathbb{R}$.

Obviously, the PDF can be obtained upon differentiating the CDF above. We write $W \sim CEN(\lambda,\beta,c,d,f)$, if W is a Chen Exponential-Normal random variable. The Chen Exponential Normal distribution is a good fit to real life data as shown below [Figure 1].

Acknowledgement

None.

Conflict of Interest

No conflict of interest.

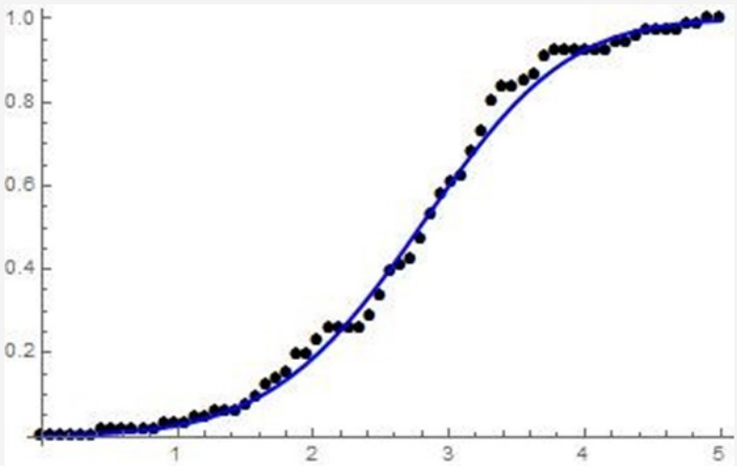

Figure 1: The CDF of CEN (0.343747,2.1242,4.14304,1.80964,5.49146) fitted to the empirical distribution of Table 2[3]

References

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