

## **COPULA-BASED FRAMEWORK FOR MODELLING HETEROSCEDASTIC RELATIONSHIPS: AN ALTERNATIVE TO SIMPLE LINEAR REGRESSION**

**D.K. Hemachandra<sup>1\*</sup>, S.G.J. Senarathne<sup>1,2</sup> and M.B. Dehideniya<sup>1,2</sup>**

<sup>1</sup>*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.*

<sup>2</sup>*Department of Computer Science and Statistics, University of Peradeniya, Peradeniya, Sri Lanka.*

\*deepkaushi93@gmail.com

Traditional regression models rely on assumptions such as normally distributed residuals and constant variance, which are often violated in real-world applications. In particular, heteroscedasticity in residuals can significantly reduce model accuracy and reliability. This study addresses the above limitations by employing bivariate Archimedean copulas, which offer greater flexibility in capturing complex dependencies and handling non-normal data. A copula-based model is proposed as an alternative to simple linear regression for addressing heteroscedasticity and systematically evaluate its performance under diverse scenarios. A simulation study was conducted using known parameter values to generate synthetic data, considering different sample sizes (30, 50, and 100) and dependence levels (correlations of 0.55, 0.75, and 0.90) between explanatory and response variables. Parameters of the copula-based model were estimated via maximum likelihood estimation, while ordinary least squares were applied for simple linear regression. Model performance was compared in terms of predictive accuracy, using the Mean Absolute Prediction Error (MAPE). Results demonstrate that the copula-based models consistently achieve lower prediction errors across sample sizes and dependence levels. These findings indicate that copula-based approaches provide a more effective alternative to simple linear regression when classical assumptions are violated. Future research could extend this framework to structured model selection in multiple regression and multivariate contexts under heteroscedasticity.

*Financial assistance from Postgraduate Institute of Science, University of Peradeniya (Grant No. PGIS/2024/13) is acknowledged.*

**Keywords:** Archimedean copula, Maximum likelihood estimation, Mean absolute prediction error, Non-normal data, Ordinary least squares