UNIVERSITI TEKNOLOGI MARA

COMPARATIVE STUDY OF TRAPEZOIDAL RULE (TR), CIRCULAR-BASED MODIFIED TRAPEZOIDAL RULE (CMTR), AND TRIANGULAR-BASED MODIFIED TRAPEZOIDAL RULE (TMTR) FOR OVERESTIMATED CURVATURE

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ABSTRACT

Numerical integration is widely used to estimate definite integrals when exact analytical solutions are difficult or impossible to obtain. The Trapezoidal Rule (TR) is one of the most commonly used numerical integration methods because of its simplicity. However, it tends to produce overestimation for functions with high curvature due to its straight-line approximation, resulting in reduced accuracy. Therefore, this study compares the performance of the classical TR with two modified methods of TR, namely the Circular-based Modified Trapezoidal Rule (CMTR) and the Triangular-based Modified Trapezoidal Rule (TMTR), for functions with overestimated curvature. Ten selected test functions consisting of rational, polynomial, exponential, trigonometri, and algebraic functions were used in the analysis. Maple software was employed to compute the exact values, numerical approximations, percentage relative errors, and CPU time, while Microsoft Excel was used to calculate the performance profile values and *SigmaPlot* was used to generate the performance profile graphs. The results showed that both CMTR and TMTR reduced the overestimation produced by the classical TR and achieved lower percentage of relative errors while maintaining comparable computational efficiency. The performance profile analysis indicated that TMTR achieved the best performance in terms of accuracy, while TR recorded the shortest CPU time across the selected test functions. In conclusion, TMTR was more accurate for functions with overestimated curvature, whereas TR was more computationally efficient.