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UNVEILING THE POWER OF CAUCHY'S RESIDUE THEOREM FOR EVALUATING THE INTEGRATION OF DIFFERENT TYPES OF COMPLEX FUNCTIONS

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Abstract: Cauchy's residue theorem gives a relatively general form for a complex integral along a simple closed contour. With the help of Cauchy's residue theorem, an appropriate closed contour can be chosen to calculate some abnormal definite integrals that might be very complicated and difficult to solve by conventional methods. This study focuses on four distinct types of definite integrals: integrals involving sine and cosine functions, polynomial functions, exponential functions, and logarithmic functions. The contours chosen are a sector of a circle that involves one or several isolated singularities of the function. The residue at the isolated singularities of the function is then calculated. The value of the residues is substituted in the formula deducted from Cauchy's residue theorem. The integral along the simple closed contour can be expressed in two parts, one along the real axis and the other along the circle. This study demonstrates that Cauchy's Residue Theorem is superior to conventional real analysis methods for evaluating the integrals of different types of complex functions.

Keywords and Phrases: Residue, definite integral, improper integral, proper integral.

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