Environmental Conservation: Calculation of Irregular Surface Area Utilizing the Monte Carlo Method and the Law of Large Numbers

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Irregular surface area, such as lake area, is hard to calculate using definite integrals and is traditionally calculated by using graph paper with small squares. Utilizing the Monte Carlo method and the Law of Large Numbers, a program was created to more efficiently calculate lake area. First, the lake was separated from its surroundings through the use of image segmentation. Then, random pixel selection and confirmation were used repeatedly to determine whether the random pixels were part of the lake or the surroundings. Using the lake to image area ratio, the image's physical area was multiplied to determine the lake's area. Comparisons with known area using definite integrals as well as with published lake area yielded extremely close results, with the possible difference being due to differences in interpretation of lake boundaries. Furthermore, calculation times were compared with calculation times when using every image pixels, and the relationship between the time ratio and the number of pixels used for random selection was determined using least squares regression analysis, allowing for the determination of approximate random pixel count "turning point," at which the random pixel selection method calculation time begins to become less than every single pixel method calculation time. The findings can be used to more efficiently calculate irregular surface area and can help in areas of accurate conservation monitoring.

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