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Three new methodologies for calculating the effective sample size when performing population adjustment

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The concept of population is fundamental in epidemiology and statistics, represented as the 'P' in PICOS statements and as a key attribute of an estimand. Direct sampling from the population of interest is not always feasible, leading to the use of weighting as a statistical method for making inferences when samples are unrepresentative of the population of interest. The effective sample size (ESS) estimates the sample size required for an unweighted sample to achieve the same precision as a weighted sample. ESS reflects the information retained after weighting and is easy to interpret. Traditional ESS calculations rely on strong assumptions, such as homoscedasticity of outcome data. We propose three new approaches to compute ESS that are valid for any data type and weighted analysis. The first method compares the variances of weighted and unweighted estimates by calculating variances in a valid way, regardless of data type or statistical model. The second method uses re-sampling to find the smallest unweighted sample size that produces variance at least as large as that of the weighted analysis. The third method uses existing closed-form variance expressions for unweighted estimates, applying scale factors to determine the necessary sample size for equivalent precision. We illustrate these methods with a numerical example involving a matching-adjusted indirect comparison analysis. Our findings highlight the importance of accurate ESS calculations for valid statistical inferences

in weighting techniques for population adjustment. This research aims to improve the conventional calculation and application of ESS for statistical inference.