An Active Fairness Algorithm for Estimating Socioeconomic Status From Household Surveys and Satellite Images

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Limited socioeconomic data in developing countries has led to increased reliance on predictive models for socioeconomic estimation, but their proclivity to produce unequal error rates for different subpopulations introduces bias and potentially excludes individuals from monetary aid. Therefore, this study sought to investigate the efficacy of Active Fairness with a confidence threshold in achieving both statistical and individual notions of fairness in a predictive socioeconomic model and expanded the current framework to include non-tabular features from satellite imagery. The tabular features were obtained from the household section in the Nigerian Demographic and Health Survey (DHS) (n=40,127) and a Convolutional Neural Network (CNN) was used to obtain non-tabular features from images (n=1,441). For each case, feature values were actively acquired until a confidence threshold was met. We empirically tested values for threshold to investigate its efficacy in an active learning framework. When tabular and non-tabular features were classified, accuracy increased 9.64% compared to tabular features alone, and the difference between urban and rural subgroup accuracies decreased 63.3%. Overall accuracy equality was achieved at an upper threshold or 0.95 and a lower threshold of 0.05. To consider the implications of these results, a cost function was derived to estimate costs and tradeoffs in this framework. These findings offer insights on a novel method which can provide a fair and cost-effective socioeconomic estimation in nations with limited socioeconomic data, which can eventually be utilized to allocate humanitarian aid.

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