

DENSITY-FUNCTIONAL FLUCTUATION THEORY OF RESIDENTIAL DEMOGRAPHY

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ABSTRACT

Quantifying drivers of residential choice is crucial to understanding and addressing issues of inequality as well as forecasting human migration. In the United States, residential segregation by race/ethnicity is driven by manifold factors including racial biases, income inequality, and preferences to living in communities with shared cultures. Demographic studies commonly reduce segregation to a single index, but we show that indices are insufficient to understand important nuances. Instead, we apply a statistical physics-based method, Density-Functional Fluctuation Theory (DFFT), to measure the racial residential segregation in human populations in a functional form for the first time. This approach quantifies the probability of observing a neighborhood with a given composition in a manner independent of the overall composition of a larger region. Importantly, DFFT extracts these functions directly from data while making minimal assumptions about the nature of the segregation. Using block level racial/ethnic composition data from the 1990, 2000, and 2010 Censuses, I will present the county level multi-group racial segregation across the US through the lens of DFFT. We expect this method can be used to inform policies to reduce the well-documented negative effects of residential segregation in America.

Understanding population distributions is also essential to forecast how populations change as people become more mobile. Traditional demographic projections have yet to incorporate descriptions of segregation and thus cannot forecast population dynamics at scales finer than the county level. We use DFFT to forecast population changes from the county down to the block group scale, two orders of magnitude smaller than current demographic projections. To probabilistically forecast the composition of a block group, we start with the initial composition of the block group in 2000 and use our segregation functions to predict its composition in 2010. We expect that DFFT coupled with traditional demographic methods will provide detailed forecasts that better inform decisions made at levels from city planning to national policy.

Keywords: demography, segregation, density functional theory, emergent descriptions of complex systems