Center of Population Computation

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Per US Census Bureau, the center of population is the point whose latitude ($\bar{\phi}$) and longitude ($\bar{\lambda}$) that satisfy the equations:

$$\bar{\phi} = \frac{\sum w_i \phi_i}{\sum w_i} \quad \bar{\lambda} = \frac{\sum w_i \lambda_i \cos(\phi_i \frac{\pi}{180})}{\sum w_i \cos(\phi_i (\frac{\pi}{180}))}$$

where ϕ_i, λ_i, and w_i are the latitude, longitude, and populuation attached to the basic small units of area used in the computation.

Is it fine just to compute

$$\bar{\phi} = \frac{\sum w_i \phi_i}{\sum w_i} \quad \bar{\lambda} = \frac{\sum w_i \lambda_i}{\sum w_i}$$

Let ϕ_i, λ_i, w_i, be the latitude, longitude, and *weighted* population in each 1-km grid cell, compute

$$\bar{\phi} = \frac{\sum w_i \phi_i}{\sum w_i} \quad \bar{\lambda} = \frac{\sum w_i \lambda_i}{\sum w_i}$$

as population center points for that particular ADM2.

In particular, each w_i is computed as

$$w_i = \gamma_i \cdot \text{population}$$

where γ_i is the percentage of coverage of the ADM2 in that grid cell