Some challenges in projecting demographic change

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Basic Methods

- National level: cohort-component rules
- Subnational: wide variety now including
  - Econometric methods
  - Gravity models
  - Simple extrapolations
  - Mixed methods – Hybrid cohort-component with daysemetric mapping
    - Choice of method is usually scale-dependent!

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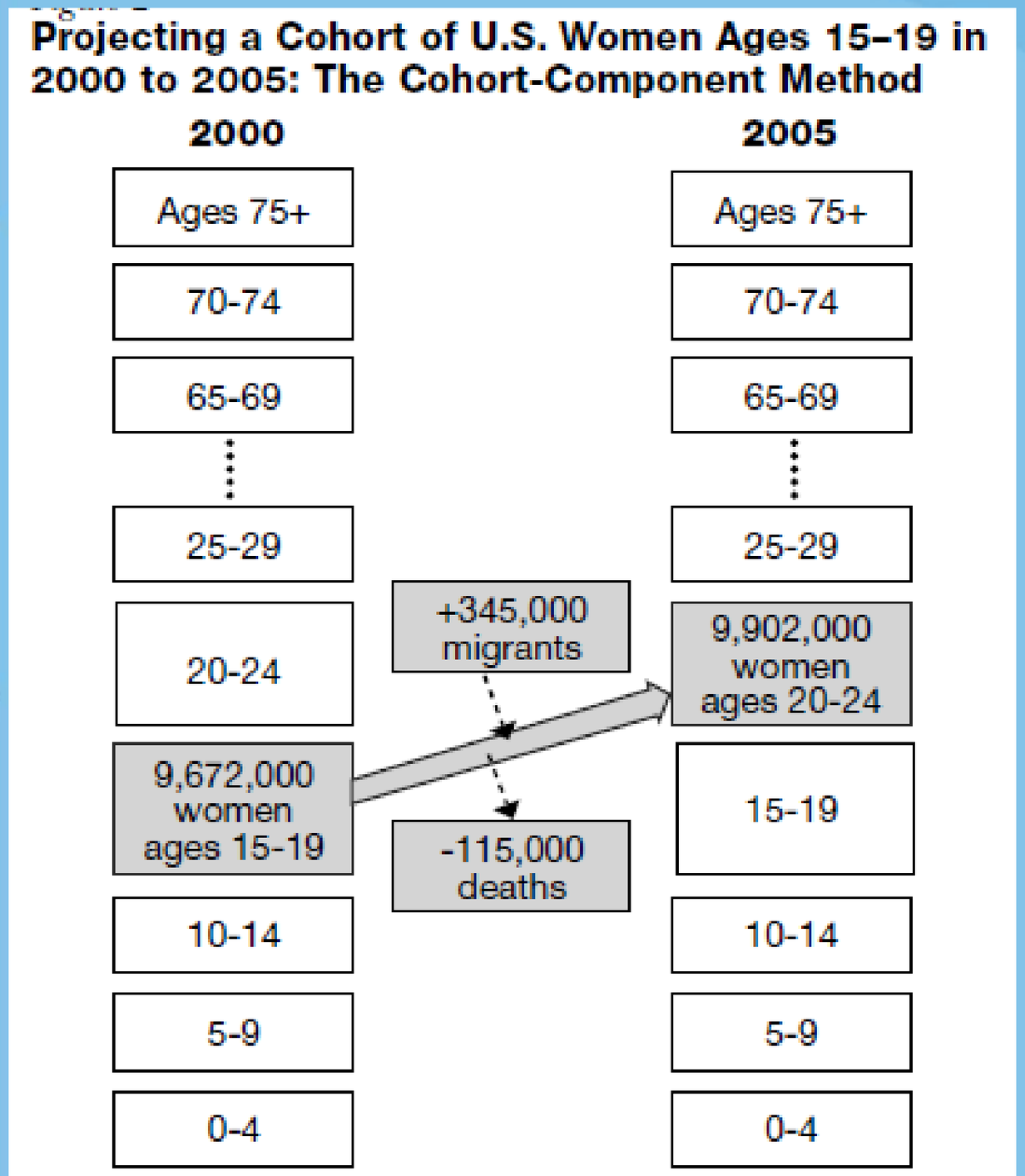
Cohort component



- Data requirements do not seem so arduous
  - Age-structure
  - Birth
  - Deaths
  - Net Migrants
- Migration is the troublesome variable here.
  - Decadal in-migration is captured pretty well at the county-level, but out migration is not.
  - Even if captured, migration behavior is less patterned than age, births and deaths

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Econometric models

- Gravity Models
  - Calculate the potential suitable or desirability of each location.

$$v_i = a_i l_i \sum_{j=1}^{m} P_j^{\alpha} e^{-\beta d_{ij}}$$

  - Such models usually account for population counts, and geographic suitability
    - But do not formally account for demographic behaviors – births, deaths or migration – or socioeconomic conditions.
    - But they could.

- Spatio-temporal regression models
  - Calculate population growth rates of local area and nearby neighbors,

$$G = \left[\frac{P_{90} - P_{80}}{10} + \frac{P_{90} - P_{70}}{20} + \frac{P_{90} - P_{60}}{30} \right] / 3$$

  - Place growth rate into a regression with other co-variates, including land-use, housing and local services.
    - Growth is measured, but demographic components are not.
    - Local-area forecasting only
    - Usually cannot forecast far into the future with this method.

Urban vs. Rural

- Different methods for different strata
  - Methods are optimized on national urban fractions, or small area rural distributions.
- City growth (in population and area) much less well understood than urban fractions (of counties or states).
  - A spatial lens helps to think about horizontal and vertical growth in *and between* cities.
  - Many possibilities: Coupling spatial and population data for cities requires choices.

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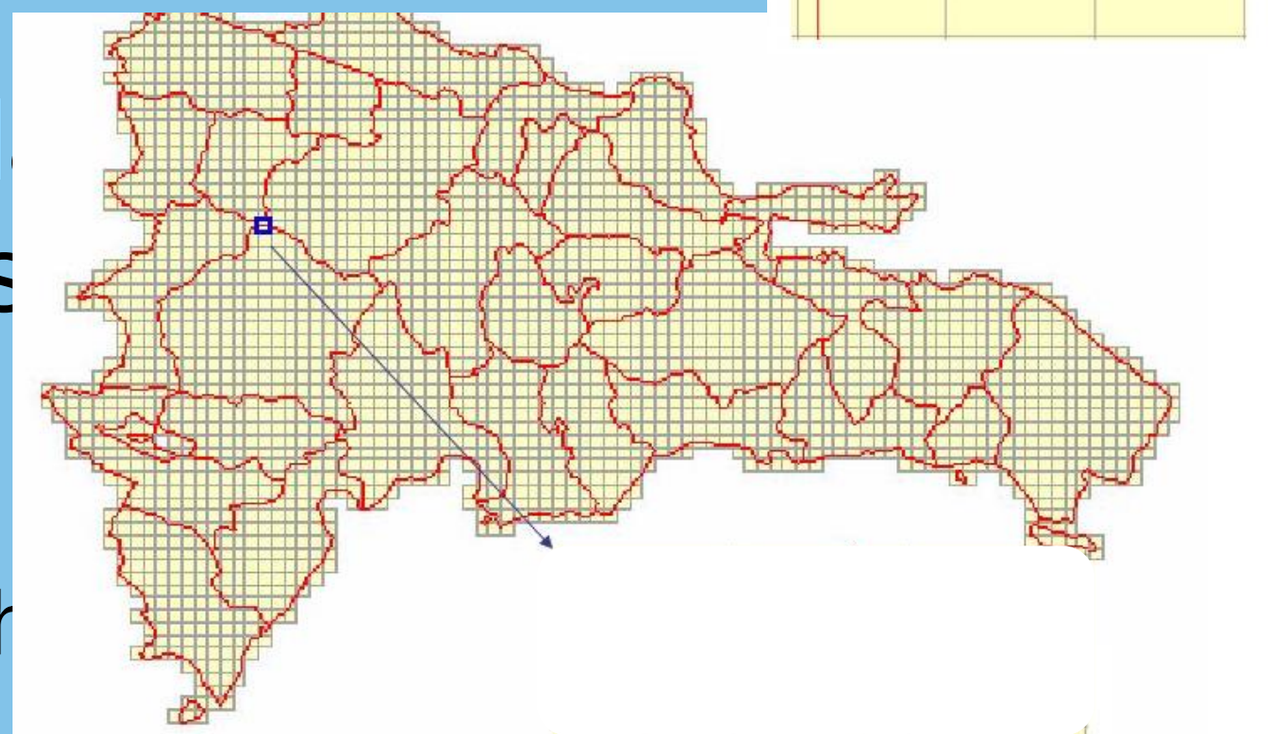
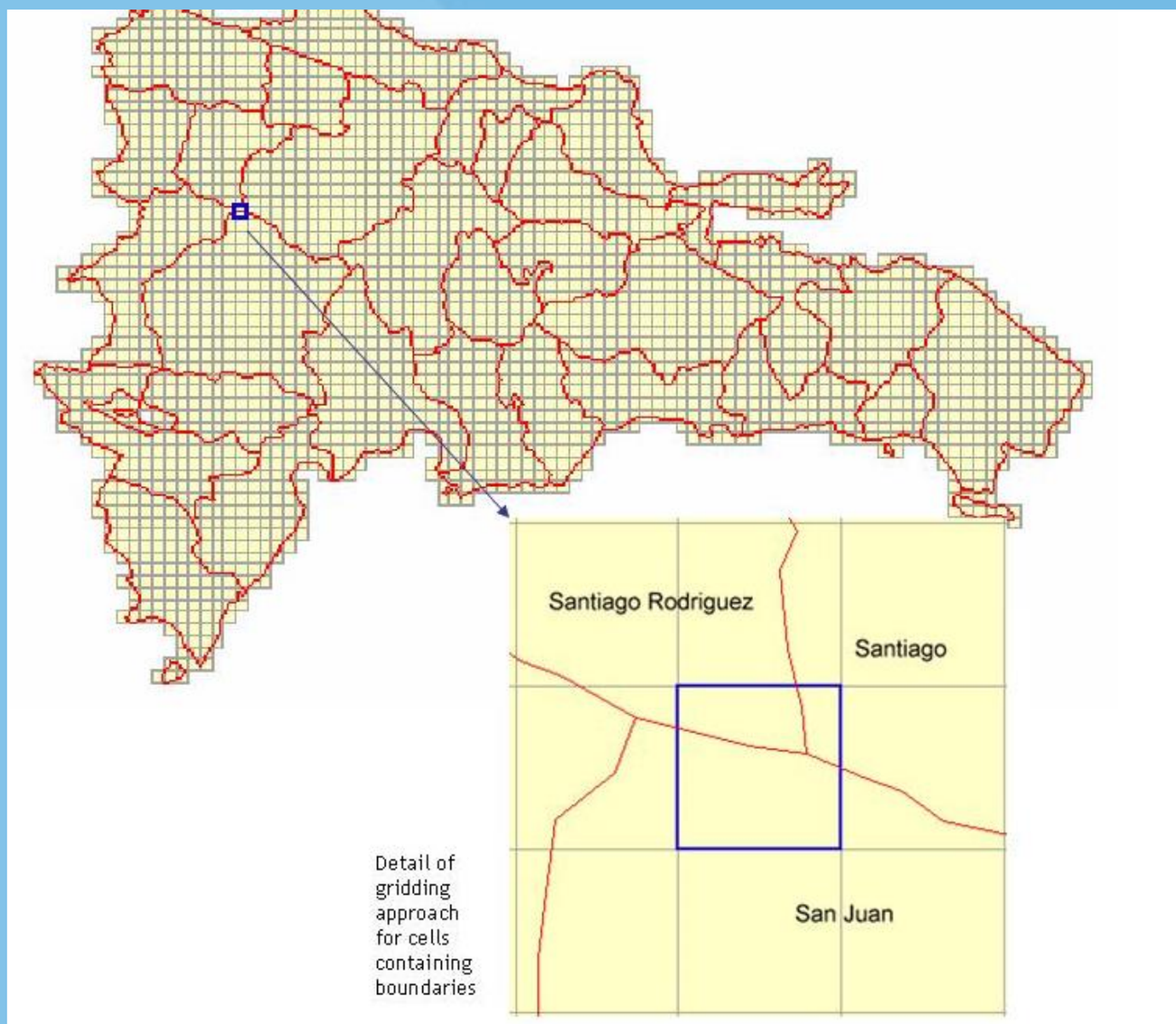
Data Formats

- Vector: Administrative boundary and census enumerator data. The unit of policy.
  - In GIS terms: Point or polygon
  - Irregular in shape
  - Identified by FIPS code or name
- Raster: land cover/l
  geographic features
  - Regular grid
  - Identified by geograph



Data Formats

- Vector vs. Grid: assume reasonable permeability between formats!
- Choices must be made when converting between formats, and may introduce some error
  - But with transparency, errors may be evaluated by end-users



Micro data vs. Census Aggregates

- Census aggregates are freely available, down to the census block
  - Limited attributes (age, sex, race) at the block-level. Tracts level has fuller data, historically. Recent changes with new ACS data.
- Census micro-data available as samples of the full record for coarser geographies
  - Full Individual-level data available via census enclaves; even then, geographic detail (better) but still limited.

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What inputs do we need?

- Climate scenarios and impacts, such as coastal flooding, may make us rethink how we want to package census data
  - What would the ingredients of a coastal population forecast look like?
    - Census aggregates: counties? Tracts? Blocks?
    - Census micro-data reassembled?

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Time vs. Space

- Projections usually trade one for the other
  - Long-term population forecast are done at the global or national-level
  - Small-area projections are typically done for only a decade. Large counties and cities only forecast 30 years max.

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Uncertainity?

- Drilling down in space
- Forecasting out in time
  - Tendency to use “medium” forecast
- Subnational or spatially-explicit projections will need to capture both kinds of uncertainty

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