Probabilistic Projection of Net International Migration Rates For All Countries

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Outline

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- Population projections and international migration

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- Probabilistic projections of net international migration needed for all countries
  - Should give calibrated intervals, e.g. 80% prediction intervals should contain the truth 80% of the time on average.

Stylized Facts About Net International Migration

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- Sums to zero across the globe for all sex-age groups
- Countries often cross over between being sending and receiving countries:
  - 46% of countries were either sending countries in 1950–55 and receiving countries in 2005–2010, or vice versa.

Trends in Migration: A Migration Paradox?

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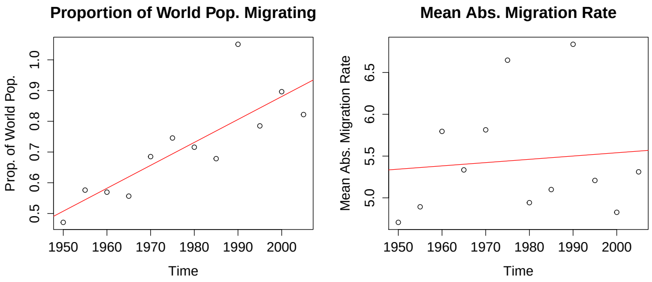

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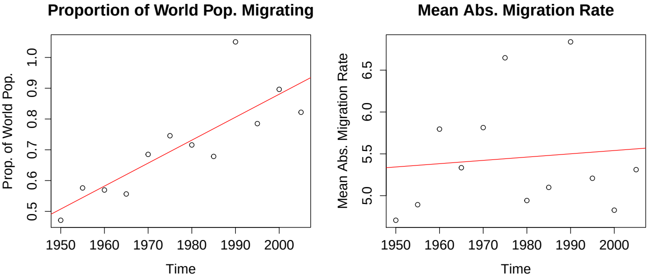

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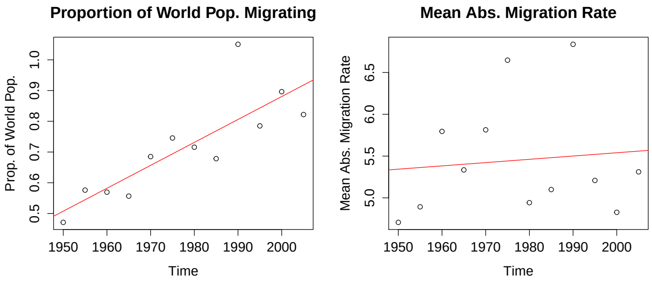

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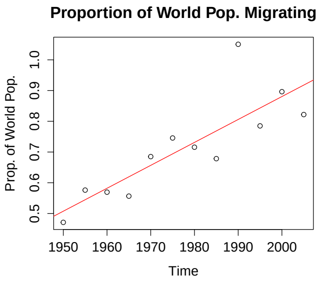

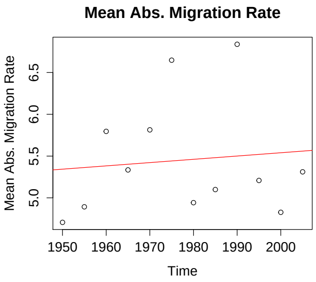

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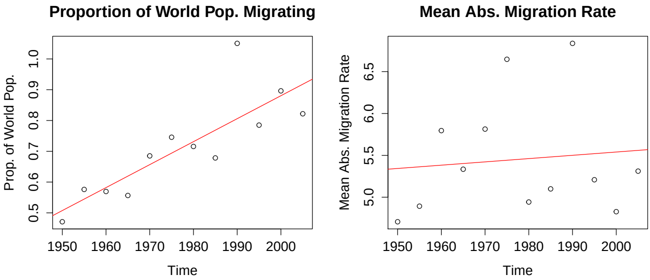

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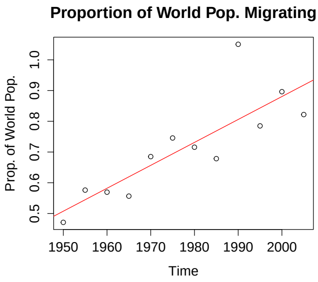

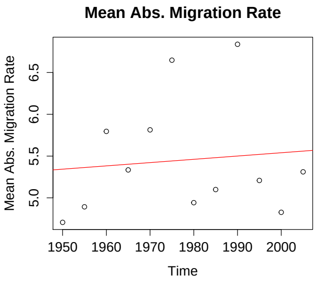

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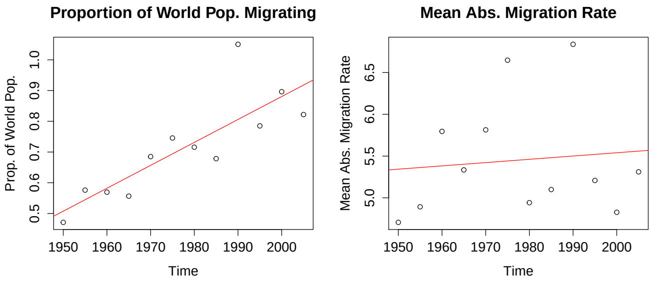

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  - Bigger increases in absolute migration rates in large countries.
  - Nonlinear changes in population and absolute migration

Bayesian Hierarchical Model for Net International Migration Rates

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- We model the net international migration rate, $r_{c,t}$, in country c and time period t by an AR(1) time series model as

$$(r_{c,t} - \mu_c) = \phi_c(r_{c,t-1} - \mu_c) + \varepsilon_{c,t}$$

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- Gives a sample of many possible future trajectories of migration in all countries and periods

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- Solution: Postprocess *each trajectory* for *each sex-age group* to ensure balance.

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Bayesian	3.2	4.8	5.1

- Bayesian method outperformed others at all 3 forecast horizons

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- Method reasonably well calibrated at all forecast horizons

Denmark

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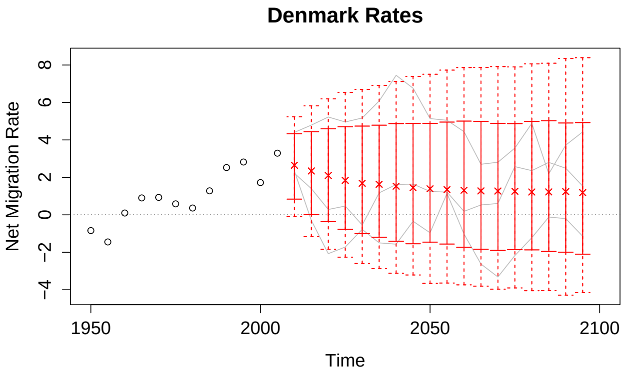
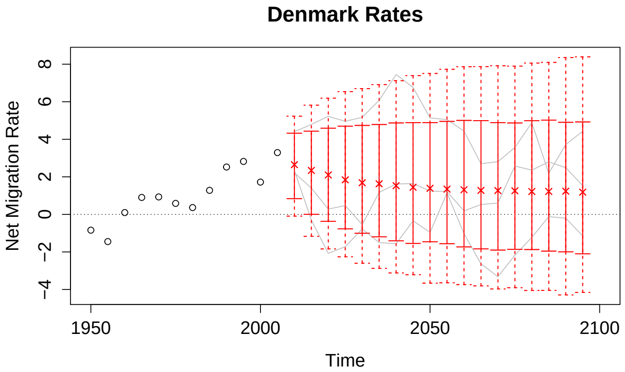


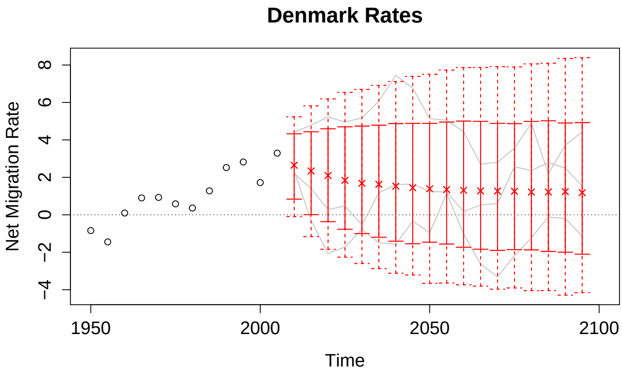
Denmark Rates
Net Migration Rate
−4
−2
0
2
4
6
8
1950
2000
2050
2100
Time

Denmark



- Crossed over from sending to receiving country

Denmark



- Crossed over from sending to receiving country
- Median projection: continuing (but declining) in-migration

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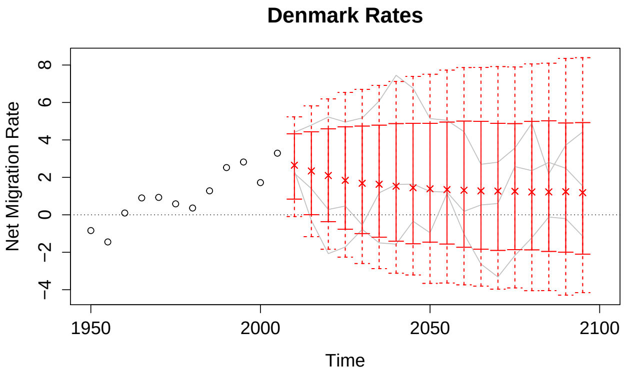

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- But nonnegligible probability of renewed out-migration

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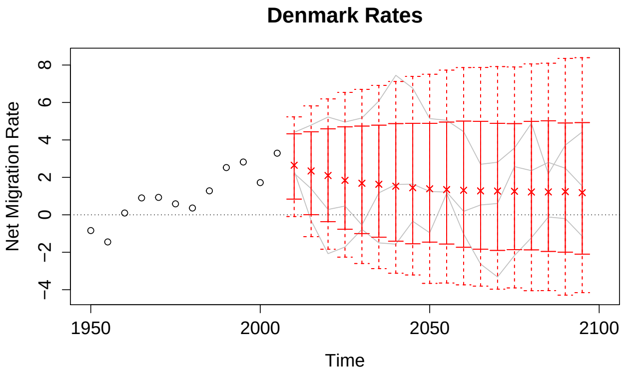
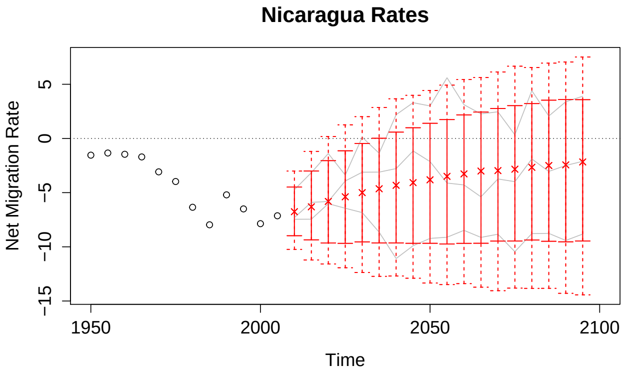


- Crossed over from sending to receiving country
- Median projection: continuing (but declining) in-migration
- But nonnegligible probability of renewed out-migration
  - and also of increased in-migration

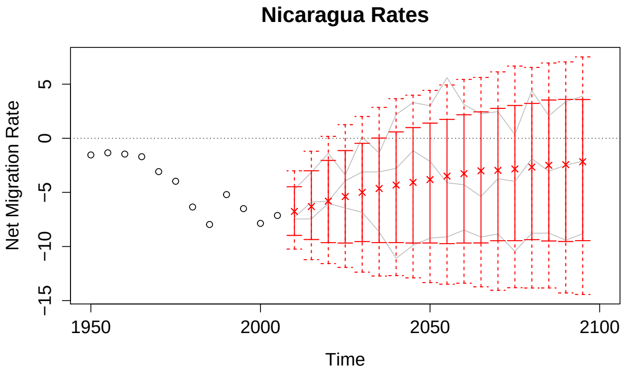
Nicaragua

Nicaragua



Nicaragua Rates
Net Migration Rate
5
0
−5
−10
−15
1950
2000
2050
2100
Time

Nicaragua



- Classic sending country with high out-migration

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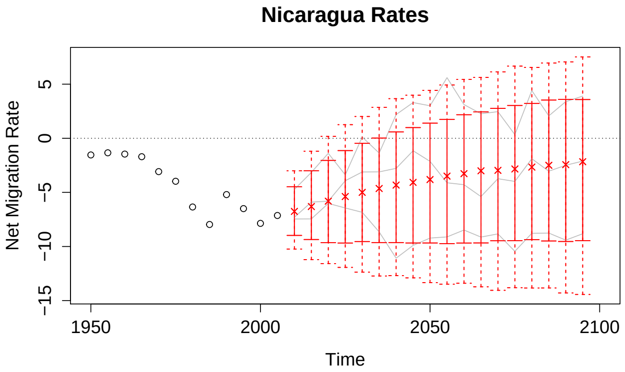

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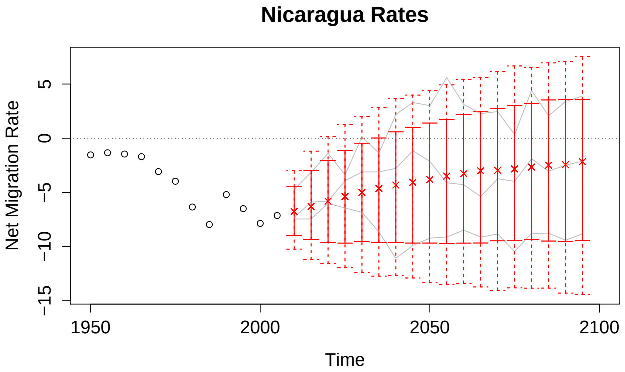
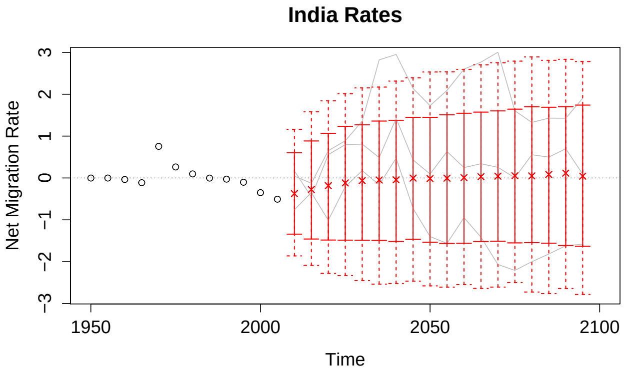


- Classic sending country with high out-migration
- Median projection is for this to continue, but at a reduced rate
- Continued high out-migration, and becoming a receiving country by 2100, also (less likely) possibilities

India

India


India Rates
Net Migration Rate
3
2
1
0
−1
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1950
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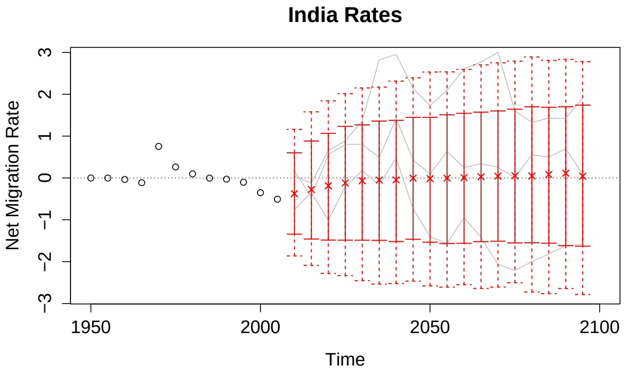
India



- Large country with very low migration rates ($<$ 1 per 1,000)

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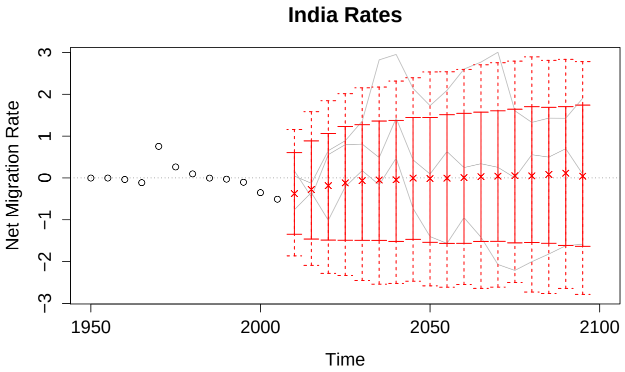

- Large country with very low migration rates (< 1 per 1,000)
- Median projection continues near zero

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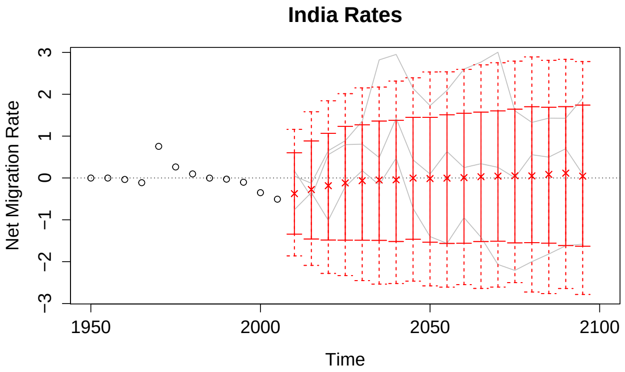

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- Median projection continues near zero
- But *absolute* migration rates projected to increase, closer to the world average (across countries) of 5 per 1,000.

Rwanda

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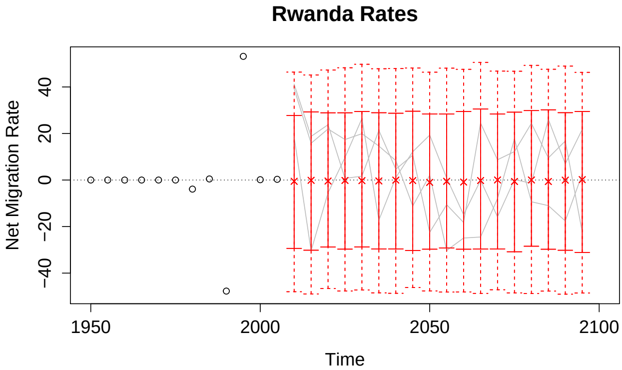
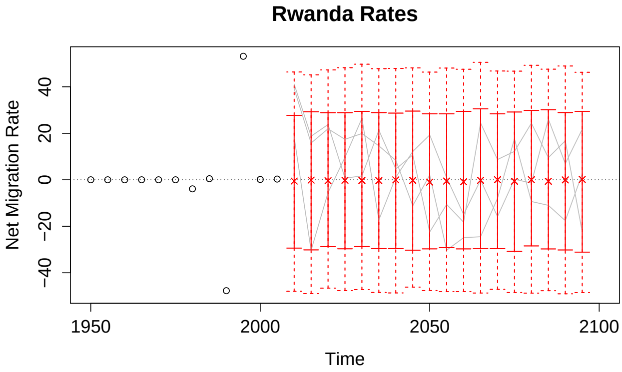


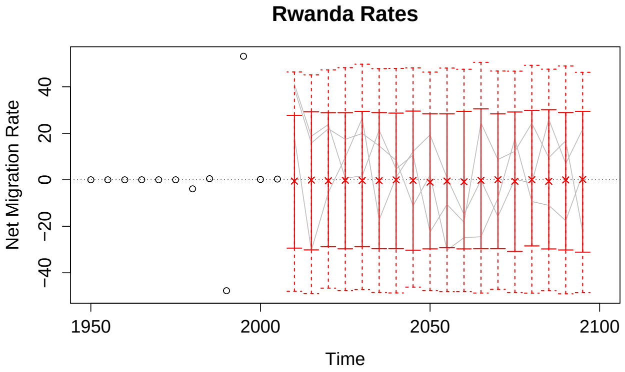
Rwanda Rates
Net Migration Rate
40
20
0
−20
−40
1950
2000
2050
2100
Time

Rwanda



- Dominated by large spikes in 1990s

Rwanda



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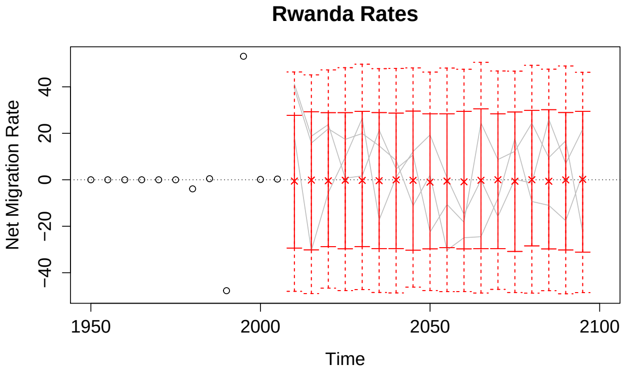

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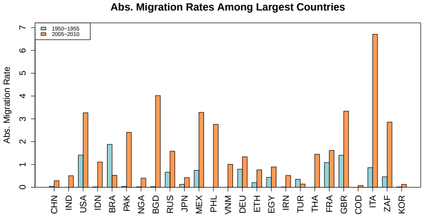

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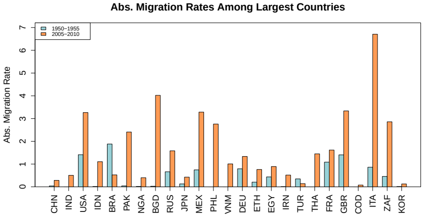

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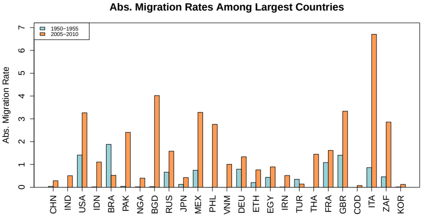

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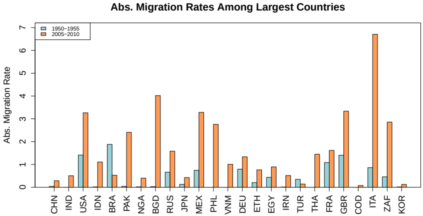

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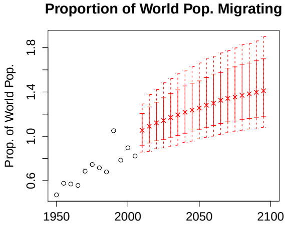

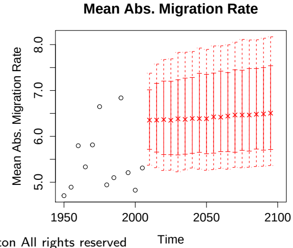

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- Probabilistic population projection references at www.stat.washington.edu/raftery/Research/soc.html

Supplementary Slide: Ensuring Balance

- Problem: Net migration counts sum to zero across the globe for all periods and sex-age groups
- But trajectories from the BHM do not do so
- Solution: Postprocess *each trajectory* for *each sex-age group* to ensure balance:
    1. For the k-th simulated parameter vector, project net migration rates for all countries one time period into the future.
    2. Convert net migration rate projections into counts.
    3. Break down migration counts by age and sex via model migration schedules
    4. Redistribute overflow migrants to all countries, in proportion to their projected populations.
    5. Continue projecting trajectories one time step at a time into the future, repeating steps 1-4.