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What do migration statistics users expect from statisticians?

Perspective from academics.

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UNECE-Eurostat Work Session on Migration Statistics,
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Evidence-Based Monitoring of International Migration Flows in Europe

Frans Willekens[1]

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Content

1. Challenge: users want high-quality migration statistics
   "The best possible population statistics using all available data sources" (ONS)
2. Strategy:
   - Focus on relocations and their measurement
   - Simulate relocations and measurement methods
3. Conclusion

Challenge 1 Obtain 'true' migration flows

- Infer true migration flows from the limited observations on the flows.
- Observations need to be:
  - **Valid**: measure what one is supposed to measure
  - **Accurate**: observed value is close to true value (implies absence of bias)
  - **Reliable**: repeated measurements lead to same results
  - **Comparable**: permit comparison (requires that consistent concepts and methods are used)

Challenge 2. Harmonization

= Adjustment of differences and inconsistencies among different measurements, methods and procedures to make them uniform or mutually compatible

-> comparable data

= Procedures to produce comparable statistics from data that are diverse and inconsistent

-> ***comparable statistics***

Strategy

1. **Focus on the process generating relocations**
2. **Focus on different ways of measuring relocations**

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Strategy: simulate the relocation process

- **Relocation = change of usual residence** (address or place of residence)
  - No temporal constraint
  - No spatial constraint
- **Relocation occurs in continuous time**
  -> continuous-time process
- **All migrations are relocations but not all relocations are migrations**
  - temporal and spatial conditions
- **Continuous observation of individuals and their location is not feasible**

Observation of relocation

- **Direct observation**
  - **At time of event**
    - Method: self-reporting -> registration
  - **At later date**
    - Method: interview (census, survey)
  - **Before the event**
    - Method: interview (relocation intention)
    - With/without adjustment (eg IPS: switchers)

Observation of relocation

- **Indirect observation: comparison of locations at two points in time**
  - Prospective: panel data
  - Retrospective: current place of residence and place of residence at prior date (census, survey)
    - Interval fixed length (eg 5 years prior to census)
    - Interval variable length (eg lifetime (place of birth))

Each method has strengths and weaknesses

- **Registration**
  - timely
  - self)reporting => underreporting (under-registration), overreporting (double count) and misreporting

  -> emigration flows < immigration flows
- **Census and sample survey**
  - coverage -> representativeness
  - underreporting/nonresponse (skip a question) -> undercount

Coverage and undercount

- **Population undercount**: *presence vs observation*
  - Persons may not be counted (undercount) or may be counted twice (overcount)
- **Event undercount**: *occurrence vs observation*
  - Events (immigrations and emigrations) in a given period are not counted (undercount) or may be counted twice (overcount)

Metadata (documentation of concepts and methods of observation)

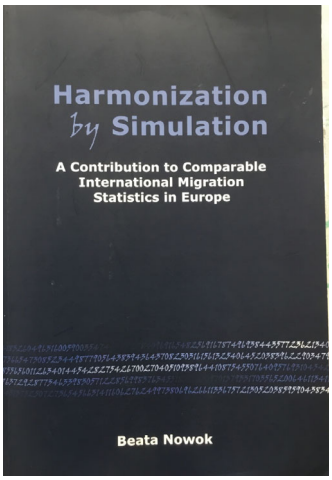
- **Producers of data (registration office; survey organisation; census bureau)**
- **Statistical offices**
- **Inventories**
  - THESIM
  - PROMINSTAT

Metadata should be complete and accurate.
and allow
- **interpretation of data**
- **quality assessment of data**
- **modelling of underlying relocation process**

Simulation

A method for the harmonization of statistics

Simulation of relocation process and its measurement



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A Probabilistic Framework for Harmonisation of Migration Statistics

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Integrated Modeling of European Migration

James Raymer , Arkadiusz Wiśniowski , Jonathan J. Forster , Peter W. F. Smith & Jakub Bijak

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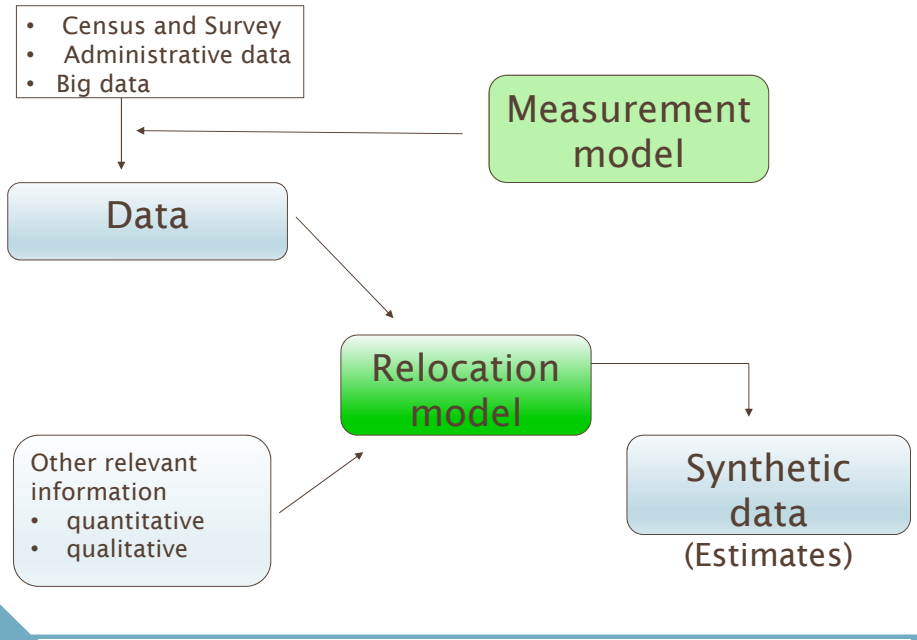
Simulation of relocation process and its measurement

- **Step 1. Describe the relocation process**
  - Relocation process is stochastic process -> stochastic process model -> **Relocation model**
- **Step 2.**
  - **Relate the parameters of the relocation model to observable quantities**
    - Account for different duration thresholds
  - **Account for uncertainties due to issues of coverage, undercount, and accuracy**

  -> **Measurement model**



Adapted from Raymer, J., Wiśniowski, A., Forster, J.J., Smith, P.W.F., and Bijak, J. (2013). Integrated modeling of European migration. *Journal of the American Statistical Association*, 108(503):801-819

The relocation process

- Stochastic process {N(t), t ≥ 0}, with N(t) the number of relocations in interval (0, t) is a counting process
- Simplest counting process: Poisson process
- **One parameter: relocation rate**

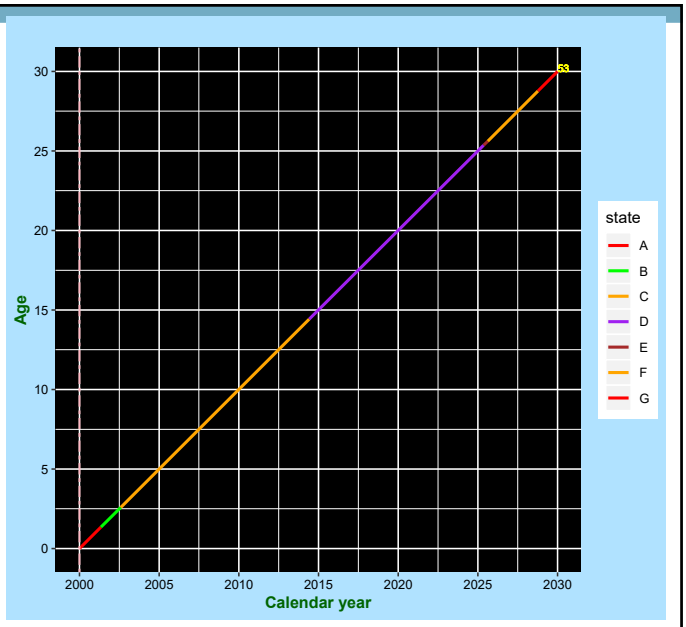
$$\Pr\{N(t) = n|\lambda\} = \frac{\lambda^n}{n!} exp[-\lambda]$$

E(N) = λ
var(N) = λ

λ = μt

- **Parameter μ may vary by migrant category and contextual variables**
- **Unobserved heterogeneity: mover-stayer model**
- **Direction of migration: Origin - destination**

Rate of relocation: 0.2



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Duration-of-stay criteria

Criterion	Percentage	Mig_rate
stay=0	100.00	0.200
stay=0.5	90.18	0.180
stay=1	81.43	0.162
stay=2	66.36	0.131
stay=5	35.95	0.069
stay=10	12.88	0.021

Percentage: number of relocations measured as percentage of total number of relocations

Proportion of relocations measured and relocation rate

Criterion	r_obs	r_exp	rates_obs	rates_exp
stay=0	1.0000	1.0000	0.200	0.200
stay=0.5	0.8994	0.9048	0.180	0.181
stay=1	0.8096	0.8187	0.162	0.164
stay=2	0.6552	0.6703	0.131	0.134
stay=5	0.3435	0.3678	0.069	0.074
stay=10	0.1070	0.1353	0.021	0.027

Indirect estimation of relocation: location at different points in time

		Residence					
Year	-	A	B	C	D	E	Total
0	0	10000	0	0	0	0	10000
15	0	517	1541	2172	2207	3563	10000
20	0	185	779	1426	1933	5677	10000
50	0	1	3	15	101	9880	10000

Residence	t1	t2
A	517	185
B	1541	779
C	2172	1426
D	2207	1933
E	1690	1924
F	1016	1534
G	525	1080
H	222	621
I	71	298
J	27	135
K	7	59
L	3	16
M	1	8
N	1	1
O	0	1
Sum	10000	10000

Number of persons, by location at t1 and t2

Transitions at t2 and t2-5

Residence at t1	Residence at t2									
	A	B	C	D	E	F	G	H	I	J
A	185	203	77	44	5	3	0	0	0	0
B	0	576	558	289	97	15	5	1	0	0
C	0	0	791	796	398	153	31	3	0	0
D	0	0	0	804	788	410	157	41	6	1
E	0	0	0	0	636	595	324	103	24	8
F	0	0	0	0	0	358	384	194	59	18
G	0	0	0	0	0	0	179	200	93	36
H	0	0	0	0	0	0	0	79	90	35
I	0	0	0	0	0	0	0	0	26	28
J	0	0	0	0	0	0	0	0	0	9

Transition probabilities during period (t1,t2)

Res at t1	Residence at t2								
	A	B	C	D	E	F	G	H	I
A	0.36	0.39	0.15	0.09	0.01	0.01	0.00	0.00	0.00
B	0.00	0.37	0.36	0.19	0.06	0.01	0.00	0.00	0.00
C	0.00	0.00	0.36	0.37	0.18	0.07	0.01	0.00	0.00
D	0.00	0.00	0.00	0.36	0.36	0.19	0.07	0.02	0.00
E	0.00	0.00	0.00	0.00	0.38	0.35	0.19	0.06	0.01
F	0.00	0.00	0.00	0.00	0.00	0.35	0.38	0.19	0.06
G	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.38	0.18
H	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.41
I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37

≠ probability of moving from i to j during period (t1,t2)
Multiple moves during period possible

Transitions during period (t1,t2)

- **Underlying process: Poisson process with relocation rate 0.2**
- **Residence at t1 is A**
- **Residence at t2 (t1+5): depends on number of relocations**
- **Distribution: theoretical vs sample**

	A	B	C	D	E	F
Poisson	0.368	0.368	0.184	0.061	0.015	0.003
Simulation	0.371	0.360	0.188	0.063	0.015	0.003

Add country of birth

- Migrations by origin, destination AND country of birth
- Abel (2018) "Estimation of global bilateral migration flows by gender between 1960 and 2015" International Migration Review, https://doi.org/10.1111/imre.12327

- **Assumption: underlying Poisson process**
- **Abel uses log-linear models, which are Poisson regression models**

Bilateral stock data:

		Place of residence (t)				
		A	B	C	D	Sum
Birthplace	A	100	10	10	0	120
	B	20	55	25	10	110
	C	10	40	140	65	255
	D	20	25	20	200	265
	Sum	150	130	195	275	750

		Place of residence (t + 1)				
		A	B	C	D	Sum
Birthplace	A	70	30	10	10	120
	B	25	60	10	15	110
	C	10	55	140	50	255
	D	40	45	0	180	265
	Sum	145	190	160	255	750

Estimates of origin–destination–place of birth flow tables:

Birthplace = A

		Destination				
		A	B	C	D	Sum
Origin	A	*70*	20	0	10	**100**
	B	0	*10*	0	0	**10**
	C	0	0	*10*	0	**10**
	D	0	0	0	*0*	**0**
	Sum	**70**	**30**	**10**	**10**	**120**

Birthplace = B

		Destination				
		A	B	C	D	Sum
Origin	A	*20*	0	0	0	**20**
	B	0	*55*	0	0	**55**
	C	5	5	*10*	5	**25**
	D	0	0	0	*10*	**10**
	Sum	**25**	**60**	**10**	**15**	**110**

Conclusions

- **Large diversity in how migration is measured -> statistics not comparable**
- **Each method of observation is a different way of looking at the same underlying process: the relocation process**
- **The relocation process is a stochastic process, eg Poisson process**
- **The stochastic process generates individual relocation/migration histories (*statistical individuals)***

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Conclusions

- **Simulated relocation histories**
  - = allows the estimation of all migrations, including circular migration
  - = tool to make migration data comparable across observation plans: *Harmonization by simulation*
- **The approach requires data and metadata**
  - Meta data: documentation of migration concepts used, methods of data collection and quality assessment

thank you

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NIDI is an institute of the Royal Netherlands Academy of Arts and Sciences KNAW and is affiliated to the University of Groningen

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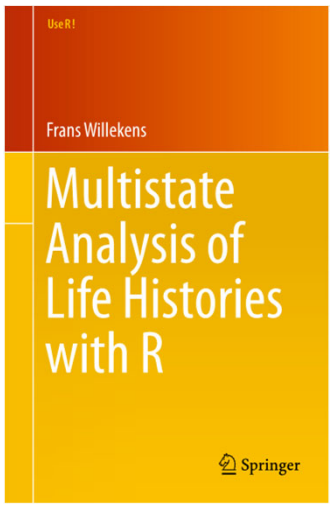

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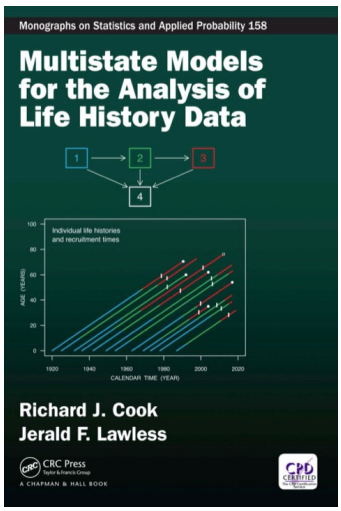

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