



A commuting generation model requiring only aggregated data

Maxime Lenormand, Guillaume Deffuant, Sylvie Huet

► To cite this version:

Maxime Lenormand, Guillaume Deffuant, Sylvie Huet. A commuting generation model requiring only aggregated data. 7th European Social Simulation Association Conference, Sep 2011, Montpellier, France. pp.16. hal-02596121

HAL Id: hal-02596121

<https://hal.inrae.fr/hal-02596121>

Submitted on 6 Jul 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

A commuting generation model requiring only aggregated data

Maxime Lenormand, Sylvie Huet & Floriana Gargiulo

Laboratory of Engineering for Complex Systems
Cemagref of Clermont-Ferrand

ESSA 2011
September 20th 2011



Prototypical Policy Impacts on Multifunctional Activities in rural municipalities

A collaborative project under the
EU Seventh Framework Programme



This publication has been funded under the PRIMA (Prototypical policy impacts on multifunctional activities in rural municipalities) collaborative project, EU 7th Framework Programme (ENV 2007-1), contract no. 212345.

Motivation



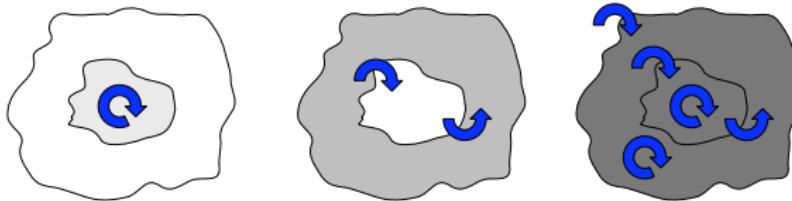
- Studies on traffic and planning infrastructures
(Ortùzar and Willumsen, 2011)
- Diffusion of epidemics
(Balcan et al., 2009)
- Large demographic simulations
(Huet and Deffuant, 2011)

Problem description

INPUT: Total out and in-commuters (dark grey line and column)

OUTPUT: Origin-destination region table (light grey table)

Residence \ Work	M_1	...	M_j	...	M_n	M_{n+1}	...	M_m	Total
M_1	0	...	R_{1j}	...	R_{1n}	R_{1n+1}	...	R_{1m}	O_1
...
M_i	R_{i1}	...	R_{ij}	...	R_{iN}	R_{in+1}	...	R_{im}	O_i
...
M_n	R_{n1}	...	R_{nj}	...	0	R_{nn+1}	...	R_{nm}	O_n
Outside	x	...	x	...	x				
Total	I_1	...	I_j	...	I_n	I_{n+1}	...	I_m	



Summary



- 1 Commuting generation model
- 2 Exponential law versus power law
- 3 β estimation for universal calibration

Commuting generation model

Input of the model

- $D = (d_{ij})_{\substack{1 \leq i \leq n \\ 1 \leq j \leq m}}$ the Euclidean distance matrix between the municipalities both in the same region and in the outside.
- $(I_j)_{1 \leq j \leq m}$ the number of in-commuters of the municipality j of the region and outside of it.
- $(O_i)_{1 \leq i \leq n}$ the number of out-commuters of the municipality i of the region only.



Commuting generation model

Algorithm description

For each remaining commuter who has not already found its place of work (while $O_i > 0 \forall 1 \leq i \leq n$), do:

- Select a living municipality i at random among the municipalities where at least one out-commuter remains (such as $O_i \neq 0$)
- Select the working destination j randomly following the probability distribution given by:

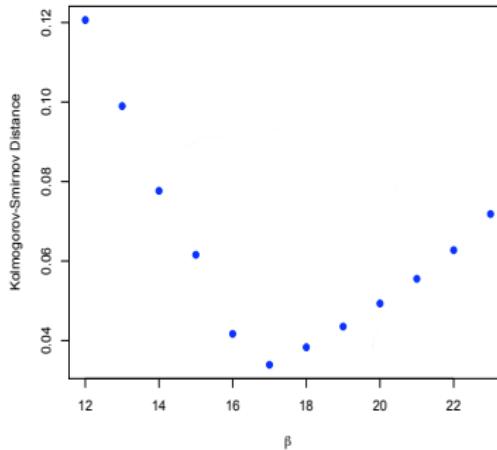
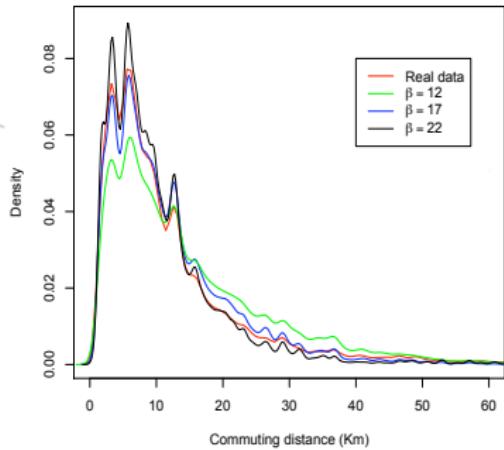
$$P_{i \rightarrow j} = \frac{l_j f(d_{ij}, \beta)}{\sum_{k=1}^m l_k f(d_{ik}, \beta)}, \quad \beta > 0.$$

- Update the number of in-commuters of j : $l_j = l_j - 1$
- Update the number of out-commuters of i : $O_i = O_i - 1$

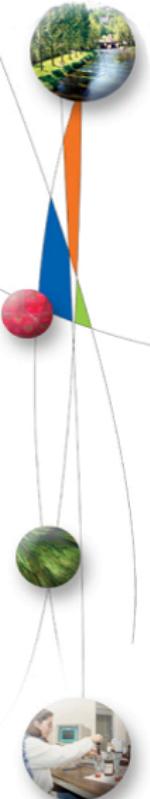
$$f(d_{ij}, \beta) = d_{ij}^{-\beta} \text{ or } e^{-\beta \frac{d_{ij}}{\bar{d}}} \quad 1 \leq i \leq n \text{ and } 1 \leq j \leq m$$

\bar{d} is the average distance between the municipalities of the region

Commuting generation model Calibration

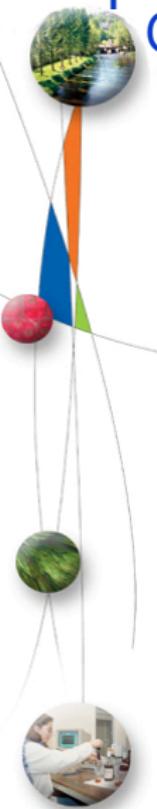


Summary



- 1 Commuting generation model
- 2 Exponential law versus power law
- 3 β estimation for universal calibration

Exponential law versus power law Comparison indicators

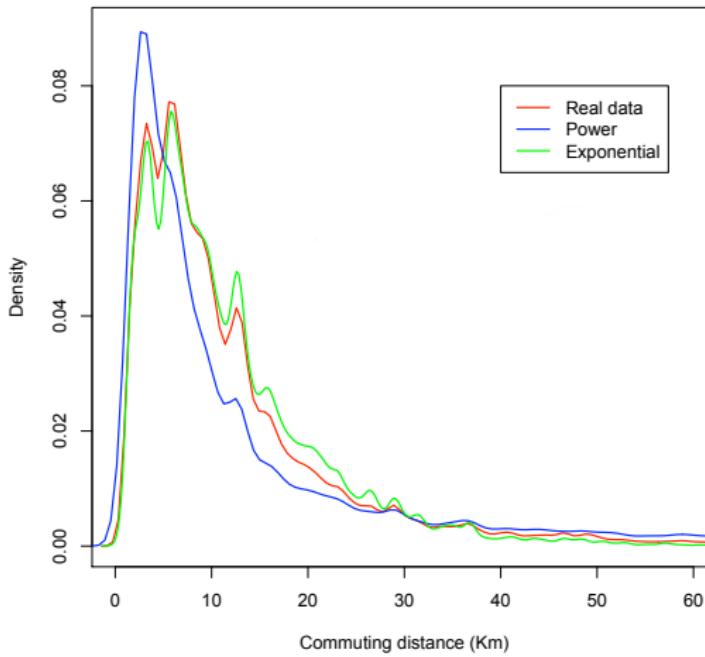
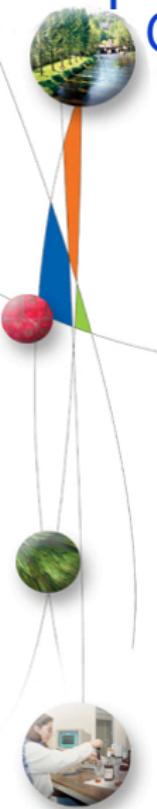


- ① The commuting distance distribution

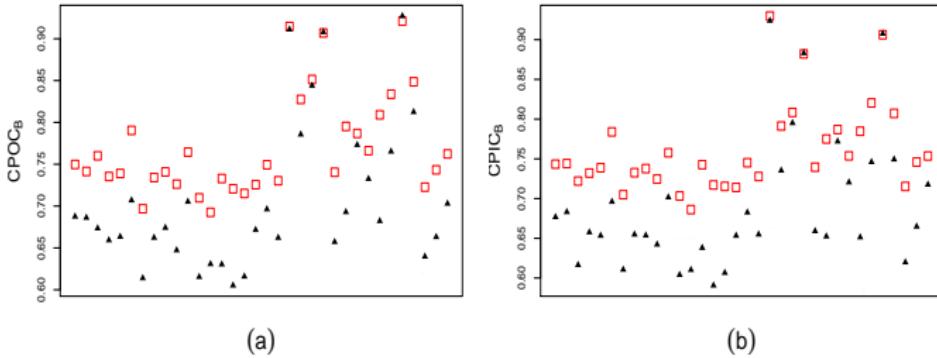
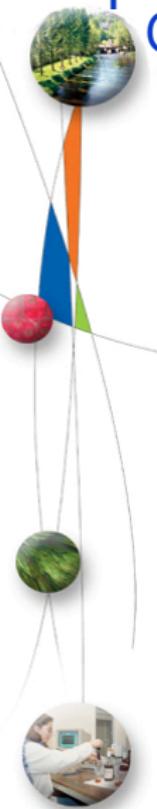
- ② $CPC_{n \times m}(S, R) = \frac{2NCC_{n \times m}(S, R)}{NC_{n \times m}(R) + NC_{n \times m}(S)}$

- $NCC_{n \times m}(S, R) = \sum_{i=1}^n \sum_{j=1}^m \left(S_{ij} \mathbb{1}_{(R_{ij} - S_{ij}) \geq 0} + R_{ij} \mathbb{1}_{(R_{ij} - S_{ij}) < 0} \right)$
- $NC_{n \times m}(R) = \sum_{i=1}^n \sum_{j=1}^m R_{ij}$

Exponential law versus power law Commuting distance distribution

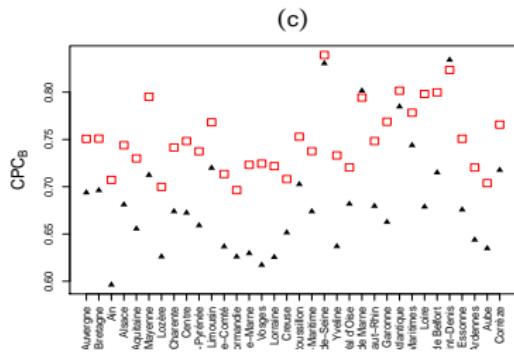


Exponential law versus power law Common part of commuters



(a)

(b)

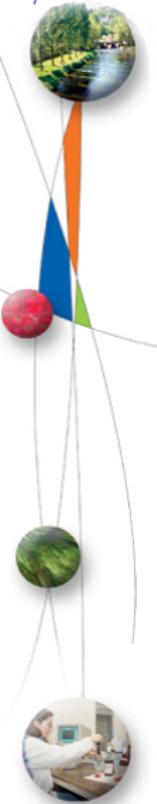


Summary

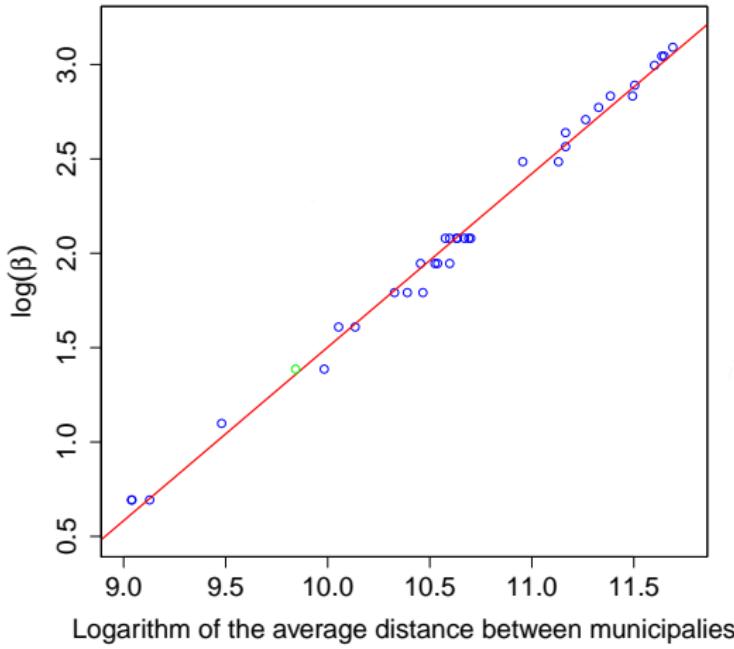


- 1 Commuting generation model
- 2 Exponential law versus power law
- 3 β estimation for universal calibration

β estimation for universal calibration

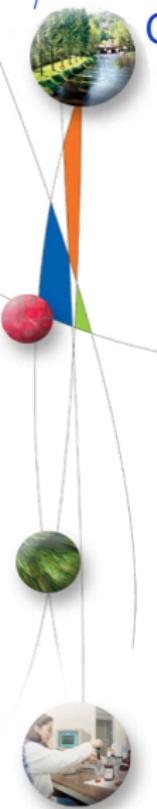


$$\beta = e^{-7.69} d^{0.92}$$



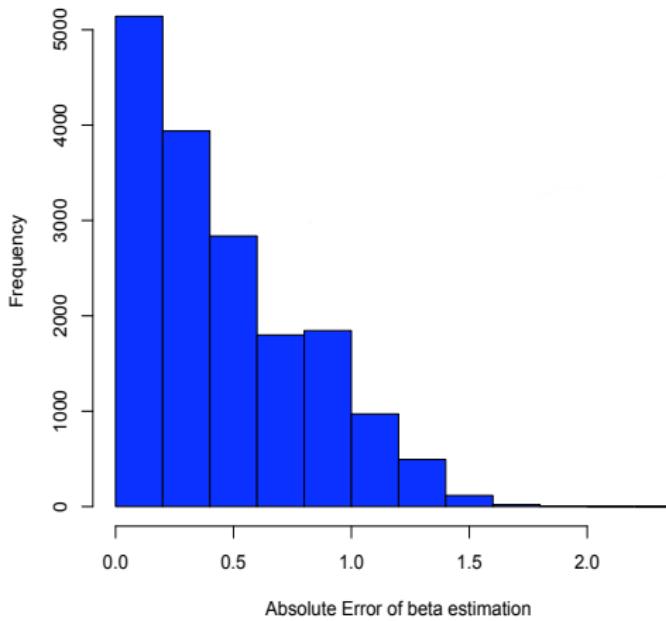
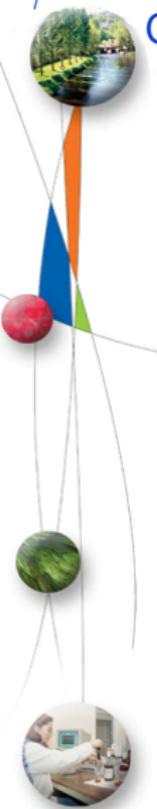
β estimation for universal calibration

Cross validation

- 
- We draw at random $\frac{2}{3}$ of the 34 observations to build the model.
 - We predict the remaining third with this model.
 - We compute the absolute error between prevision and observation.
- ⇒ The process is repeated 1,000 times.

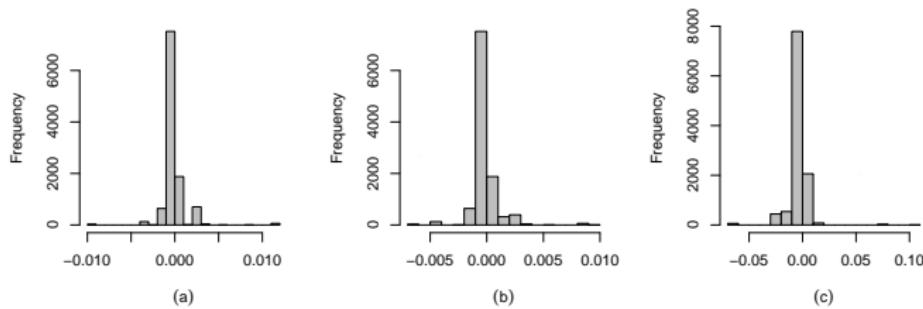
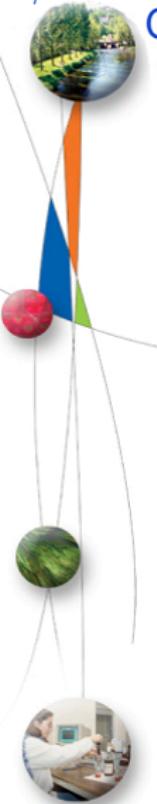
β estimation for universal calibration

Cross validation



β estimation for universal calibration

Cross validation



Conclusion and perspective

Conclusion

- Generation model managing with the lack of data
- Universally calibrated
- Tested on 35 case studies

Perspective

- Tested on more case studies
- Include the zero distance (Commuters and non-commuters)