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Weak ties and the emergence of a migration field

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A well known paper, Mark Granovetter wrote about the « strength of weak ties », meaning by that the fact that unimportant relations are often the cause of important shifts in the course of everybody's life. Similarly, we will propose in this lecture that weak ties can generate strong spatial structures i. e. the reparttition of migrants inside a continent, a state or a city. Indeed, migrants originating from one place or from one country often cluster in some areas of the country of destination. In the most extreme case, we speak of a process of ghettoisation. Simultaneously, the natives dont accept to live amongst migrants and the migrants from their own part try to rebuilt their original community gathering people of the same origin. We illustrate this trend, first with data at the level of the European Union, then at the level of France and lastly, inside the Paris city.

In a second part, we try to explain these patterns using a microsimulation model based on successive migration waves and an opposition between active and passive migrants. The model will fit quite well the data but it depends on a lot of assumptions and parameters. Therefore a simpler model, the allocation model is presented in the third part. It procures the same good fit with the data. Moreover, it can be generalized to input-output matrices of internal migration and even to

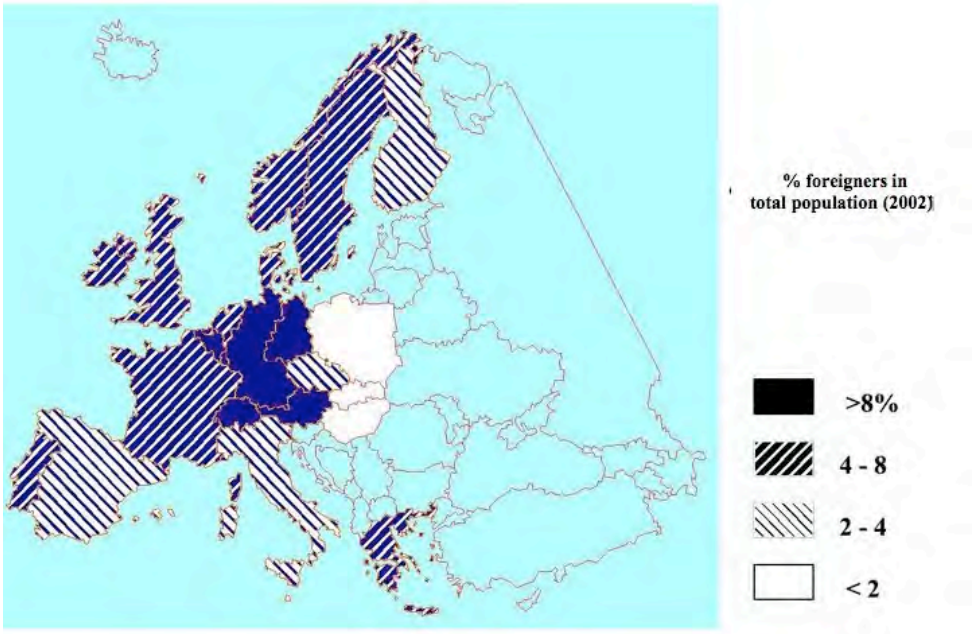
marriage market models.

I Clusters of migrants of the same origin

We compare, not the proportion of migrants of the same origin (national or regional) in the population of destination, but their proportion in the total number of migrants to throw light of the dominance of certain origins and groups.

A/European Union

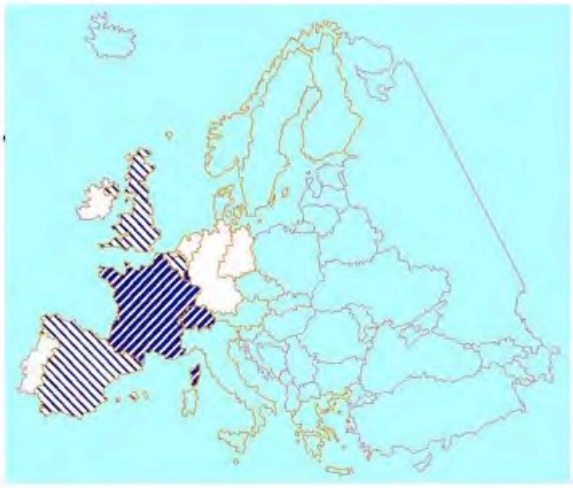
Six maps display the proportion of turks, portugueses, Balkan citizens (former Yougoslavia, Albania, Bulgaria), irakians and ukranian-moldovian-romanians. They are arranged two by two according to the time at the peak of their wave.



The first wave (turks, portugueses) looks very simple: France and Germany needed manpower. Turkey and Portugal had manpower in excess. The supply and demand mechanism acted in term of minimizing the distance : Turkey was closer to Germany, Portugal to France. The maps shows a second feature, although minor : portuguese are flooding from Frane into the neighboring states, and similarly, turks around Germany as if they were colonizing the surroundings of their first stronghold. The second set of maps compares Moroccans going to France and Spain and citizens from Balkan states aiming at Mitteleuropa. The geography explains less well their choices. Endly, the third set of maps shows the more recent migration flows in direction of states with no regard of spatial proximity : the migrants go were some places are free and not taken by the preceding flows

% Turks in the foreign population (2002)

26%
10-20
5-10
1- 5

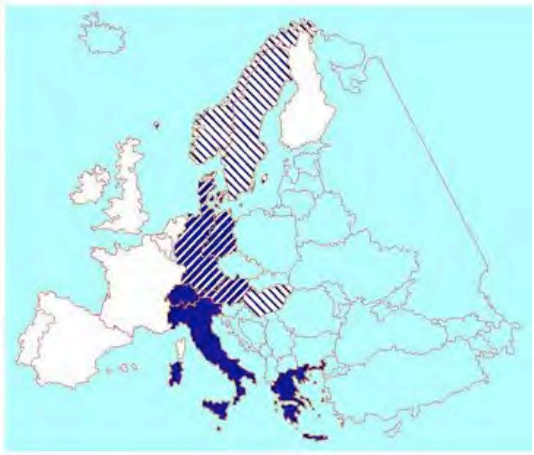


% Portugueses in the foreign population (2002)

36%
10-20
3- 10
1 - 3

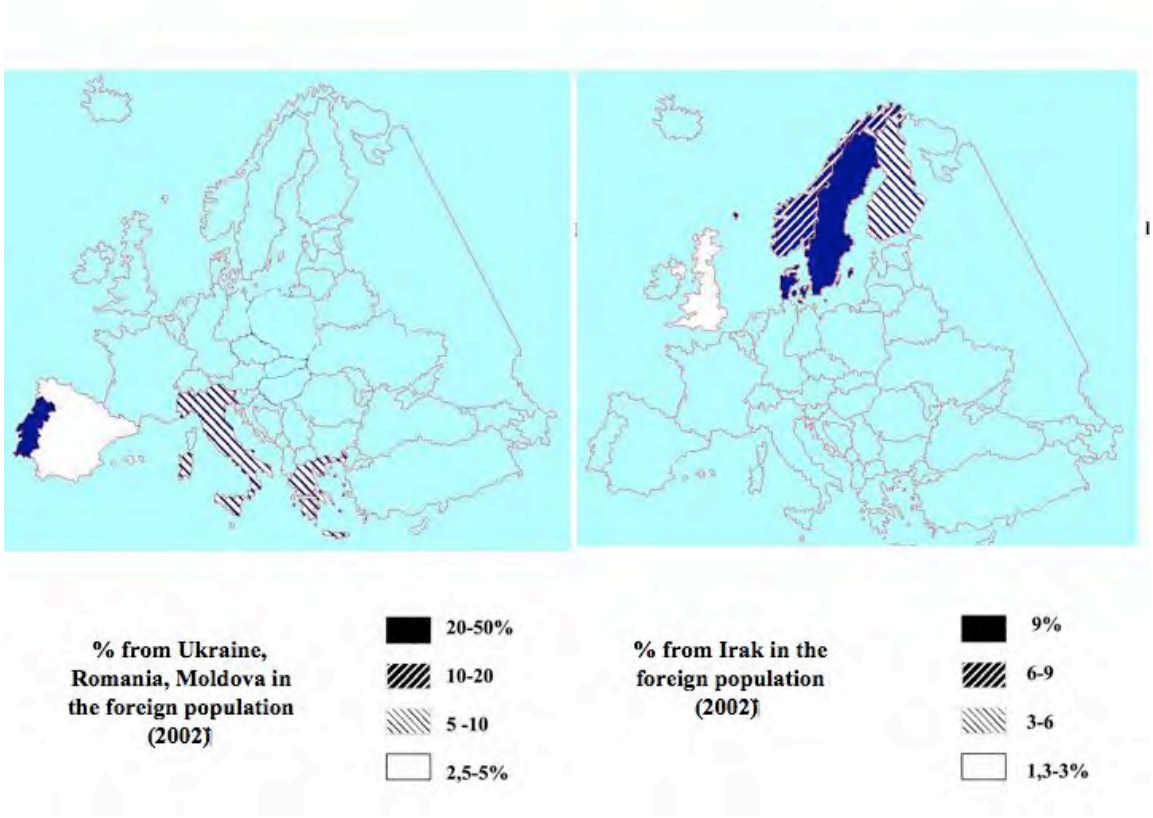
% Moroccans in the foreign population (2002)

21%
12-16
6-12
1 - 6



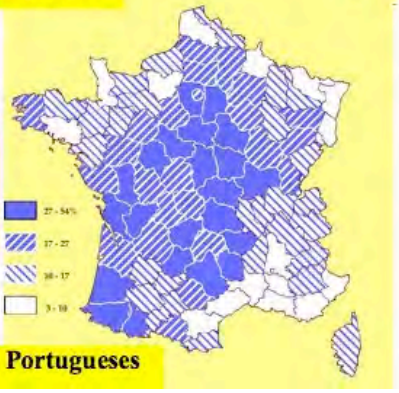
% citizens from Balkan states in the foreign population (2002)

> 20%
10 - 20
5 - 10
1 - 5

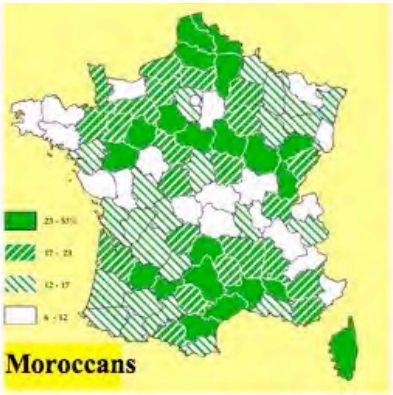


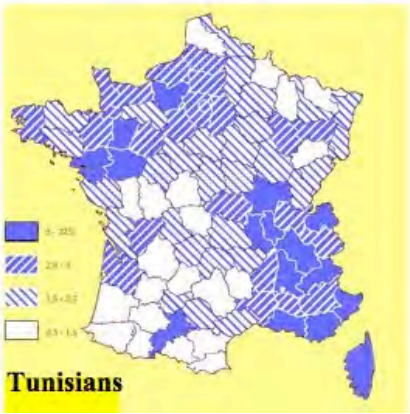
B/ France

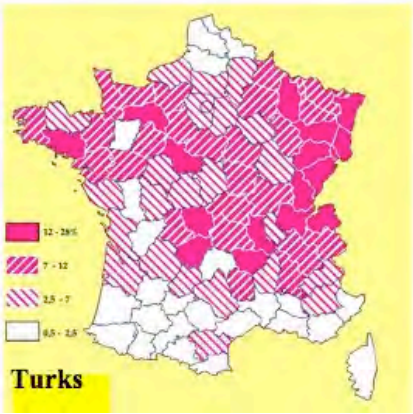
The maps show the proportion of the 7 most important foreign groups as proportion of the total number of foreigners in the french departments (in 1999, last census taken). One can make exactly the same remarks as in the preceding section : the first wave breaks in accordance with spatial proximities. This is less true of the second wave (the portugueses jump on the spaniards who occupy south France to settle down a bit futher north). The last wave with the turks occupy the remaining space, with no respect to geographical position of Turkey towards France.



% of Spaniards, Italians and Portugueses in the foreign population in France (1999)

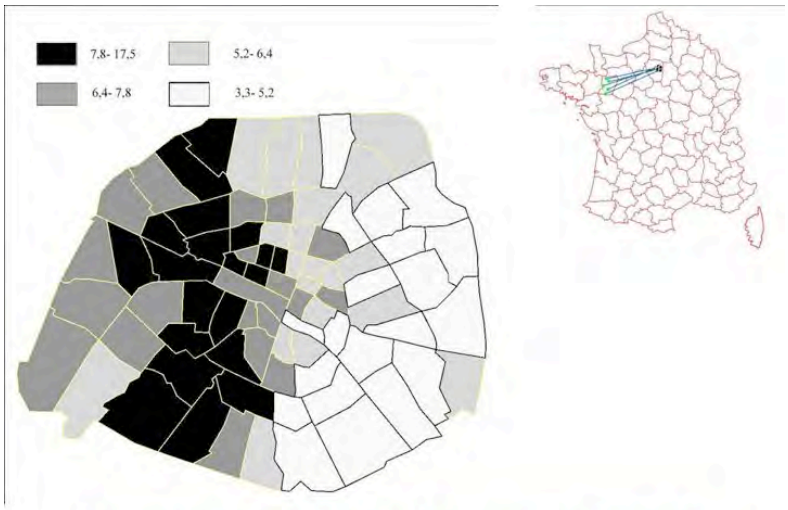




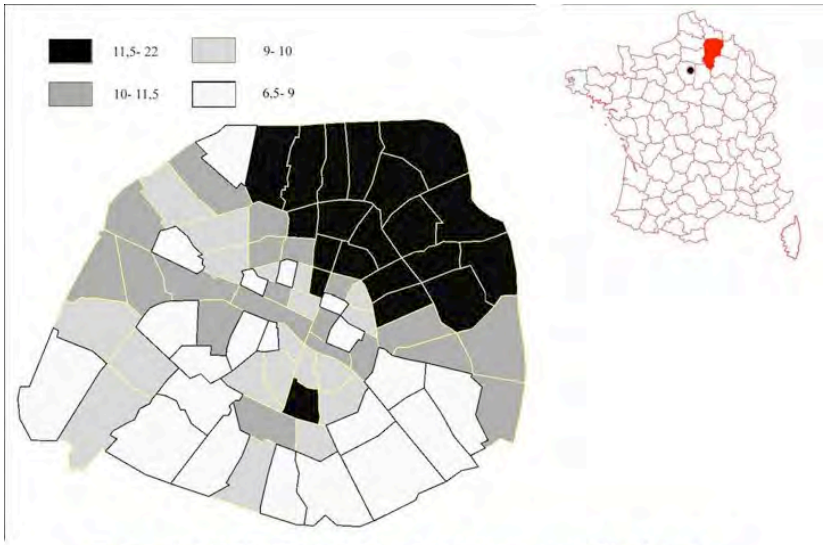


C/ Countrymen (« provinciaux ») in Paris

The 1911 census provides an axcellent table crossing the department of birth (87 units) and the district (neighborhood) of residence (80) of all the inhabitants of Paris. In the same way as above, we computed the proportion of the migrants of a given departement in the total of the migrants for each district. The result is somewhat astounding. In the two first examples (Mayenne and Aisne) migrants settle down in the districts located in the exact direction of their origin as if a straight line was drawn, as if they followed it and took roots just when entering Paris. This behaviour can be explained by so called « intervening opportunities » as Samuel Stouffer called them in his paper of 1940 (see the formula below).



Proportion (0/00) of people born in Mayenne amongst the migrants in each district of Paris in 1911



Proportion (0/00) of people born in Aisne amongst the migrants in each district of Paris in 1911

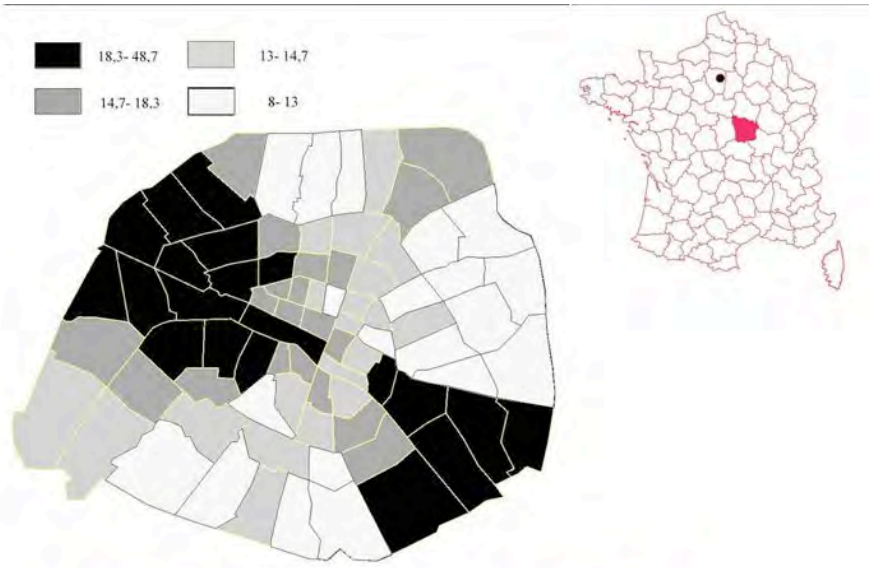
But, the third example (Nièvre) does no more follow the pattern of proximity or follows it for one half only and the last case (Alpes Maritimes, not far from here) is following the opposite pattern. How to give a rational account of this diversity of behaviour

Stouffer : intervening opportunities

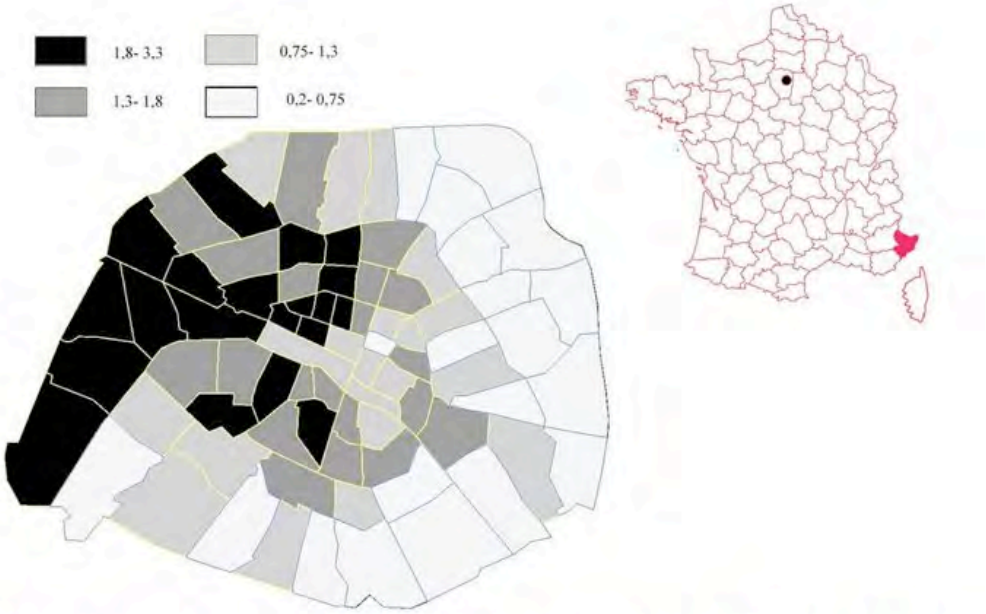
$$M_{i,j} = kI_iE_j / O_{i,j}$$

$M_{i,j}$: migrants from i to j
I_i : outmigrants from i
E_j : opportunities in j
$O_{i,j}$: intervening opportunities between i and j

Proportion (0/00) of people born in Nièvre amongst the migrants in each district of Paris in 1911

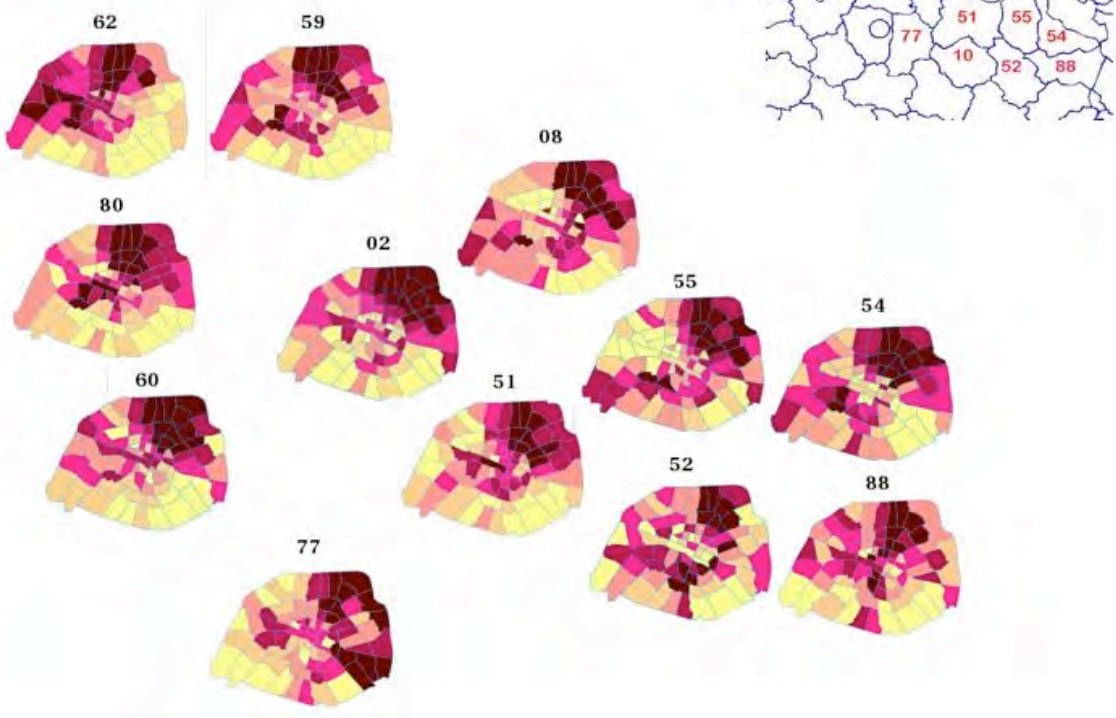


Proportion (0/00) of people born in Nièvre amongst the migrants in each district of Paris in 1911



Proportion (0/00) of people born in Alpes maritimes amongst the migrants in each district of Paris in 1911

The three next three figures group together departments exhibiting the same pattern. They belong to the same broad regions. In fact, as we will see a bit later, these regions correspond to railways stations inside Paris. The migrants dont arrive in the great city by foot but by railway and their first steps in Paris are not on the border of the city but around the railway station corresponding to their origin, gare du nord, de l'est, Montparnasse, de Lyon, etc. Let us built a simple model which produces qualitatively the same patterns as those displayed by the in-migrants to Paris.


62
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80
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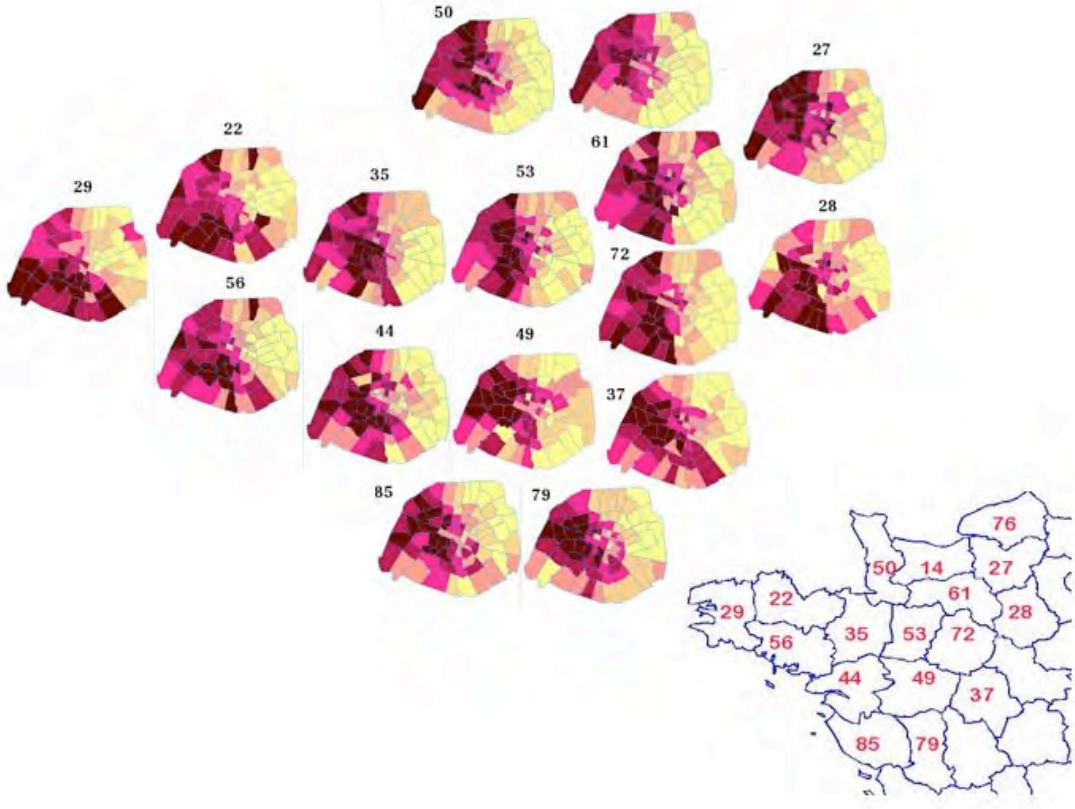
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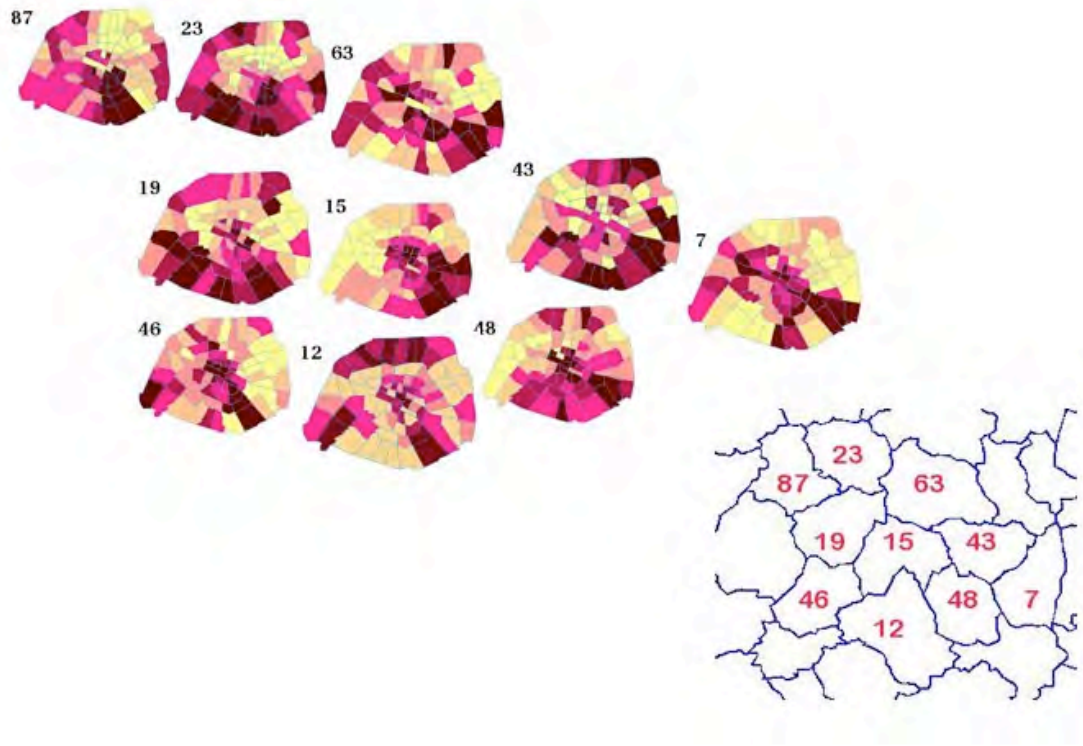
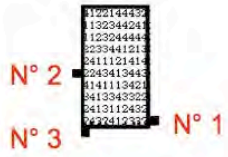


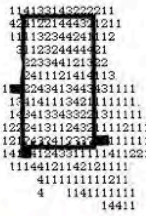
II First micro-simulation model

The idea of the model is taken from Hägerstrand seminal work « Migration and Area ». Hägerstrand had no computer in 1953 and made its microsimulation by hand using the old Tipett table of random numbers. Hâgerstrand first supposes there exist two types of migrants : active and passive. The active ones start from their location and look at random for an available space. The simulation of his quest is done by a random walk. The passive ones know a preceding migrant, join him immediately and find a place in his vicinity. Hägerstand studied the migrations from a given city to all the other places. Here the situation is different and we adapted the process he designed. We supposed four different regions of origin and a city with an old core where people coming of the four regions are scattered at random in equal number. At a certain time, railways arrived and three stations were built with lines connecting each one to one of the regions (thus one region, the 4^{th} , could not be reached by the railway). We supposed three migration waves each one originating from one different region. During each wave, the migratory flow was three times higher than customarily. Only the flow from the 4^{th} region stood constant through time. As Hägerstrand, we supposed that one on two migrants was active and the second passive (chosen at random during the monte-Carlo process).

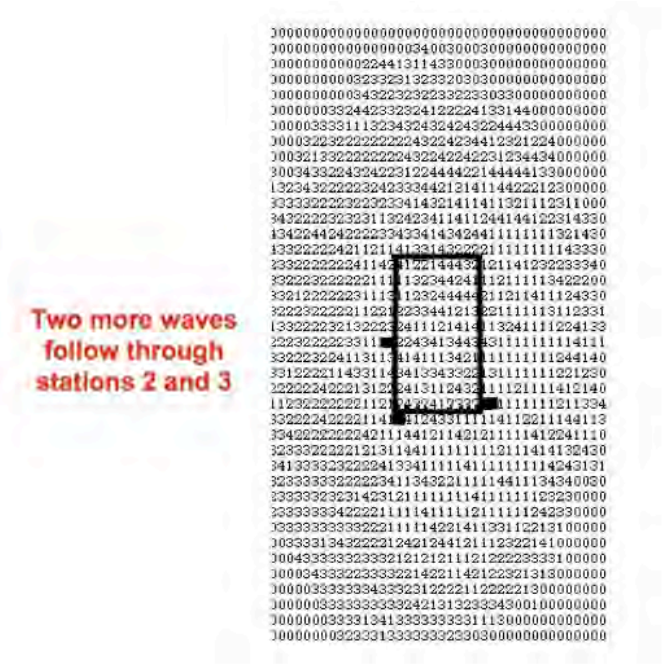
Town center
(each place is for one people and the number is for the region of origin of that people)



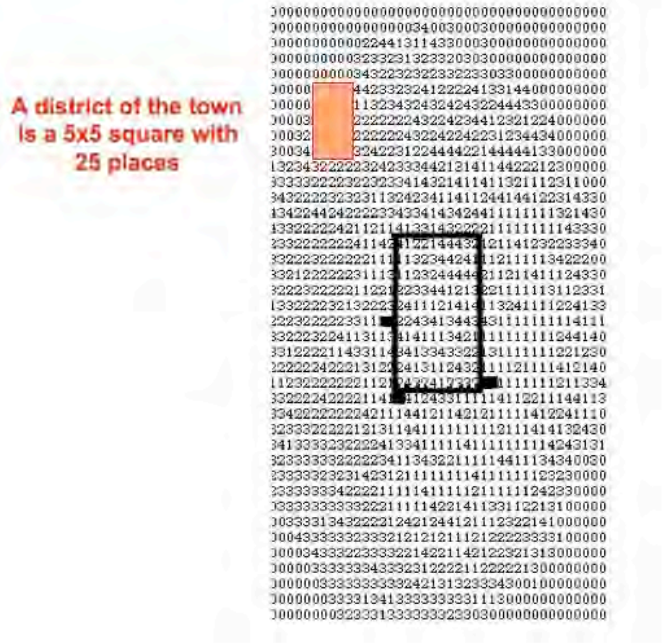
The railway stations

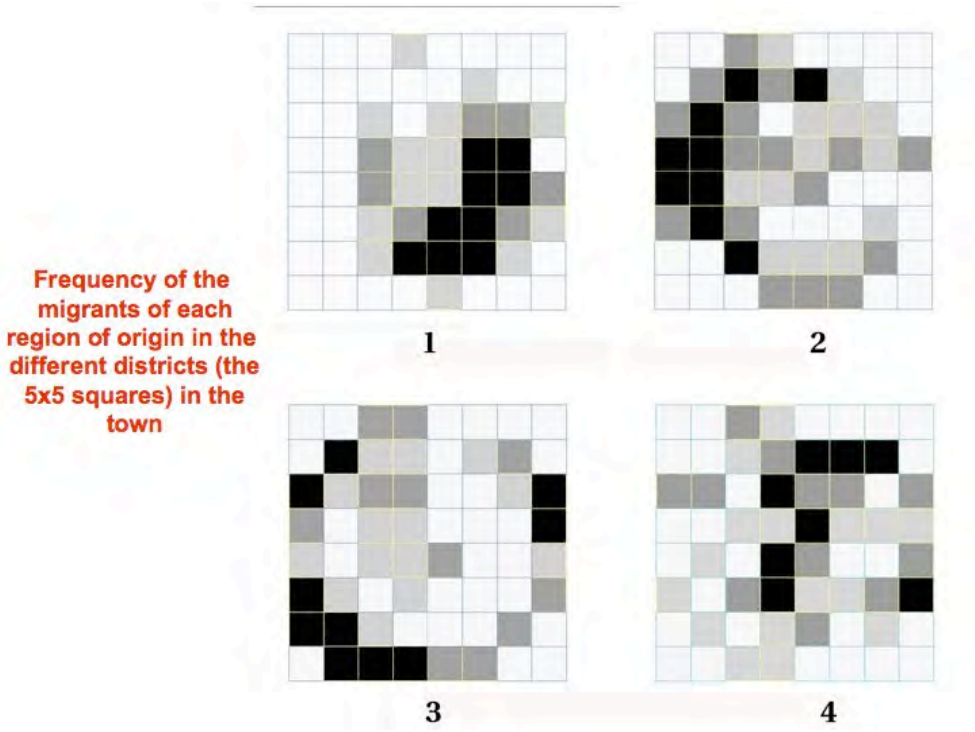


The first migration wave arrives at station N° 1 and people look for the nearest available place searching by random walk

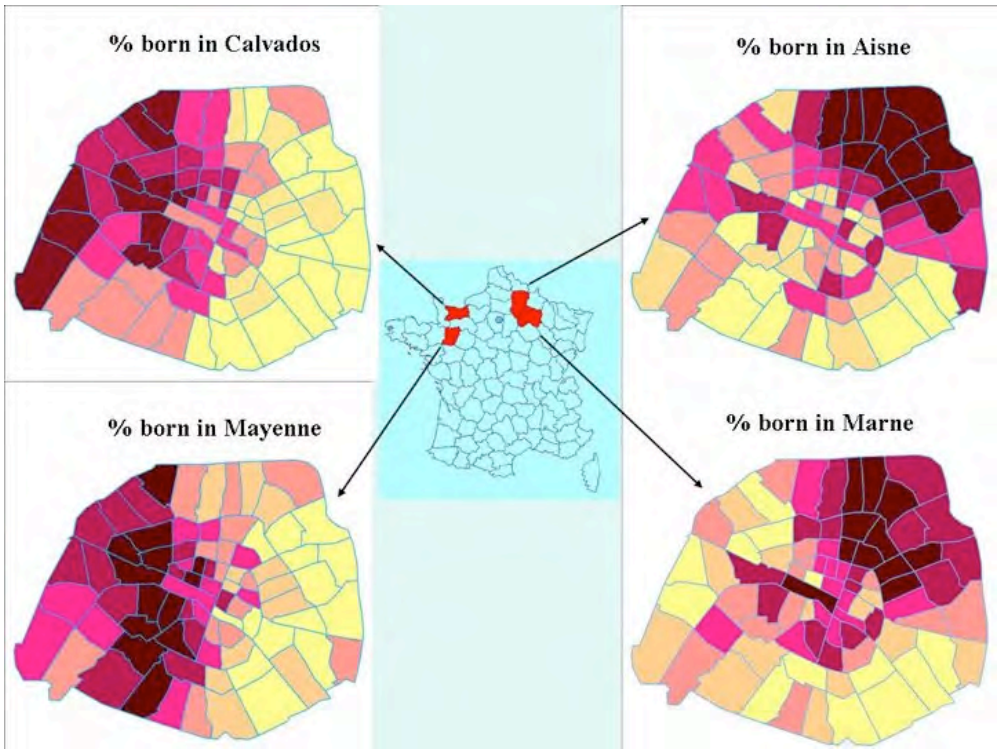


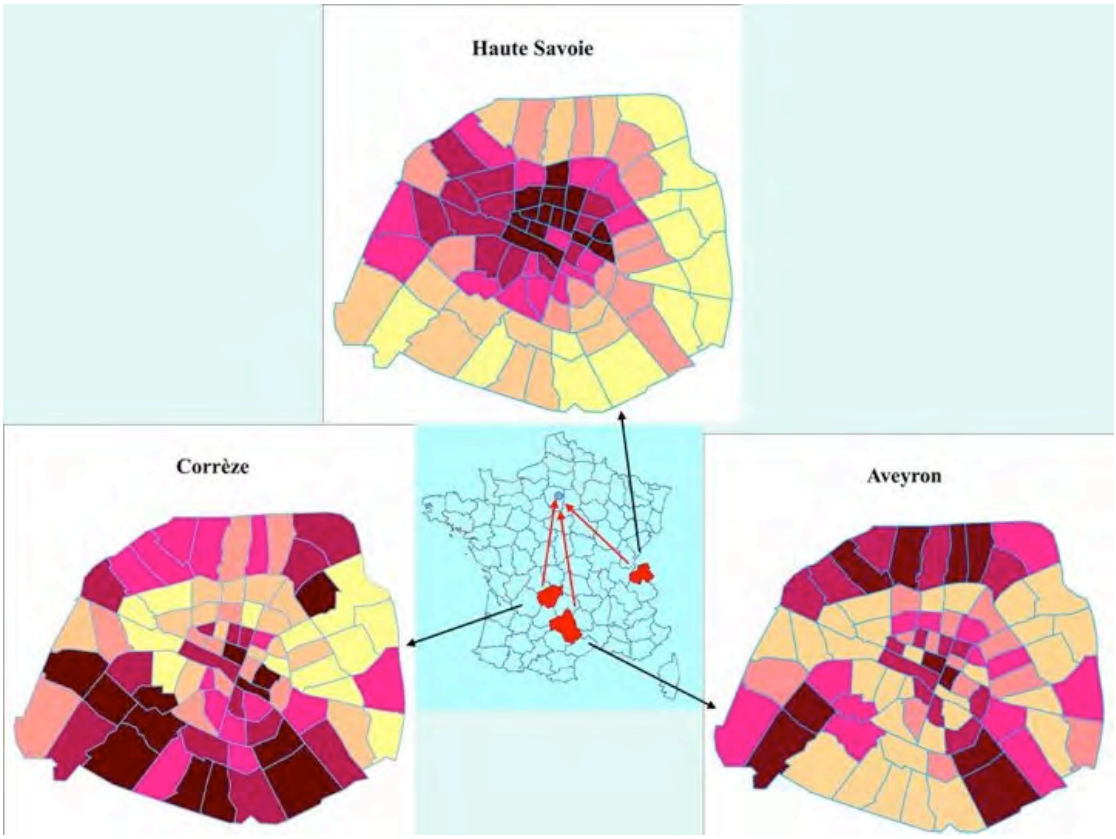
At the end, we divided the entire city in distrits of 5x5 elementary squares and we represented the proportion of migrants of each region in the same way as for the real districts of Paris. The patterns differ greatly from one region to the other irrespectively of the exact location of the railway station used.





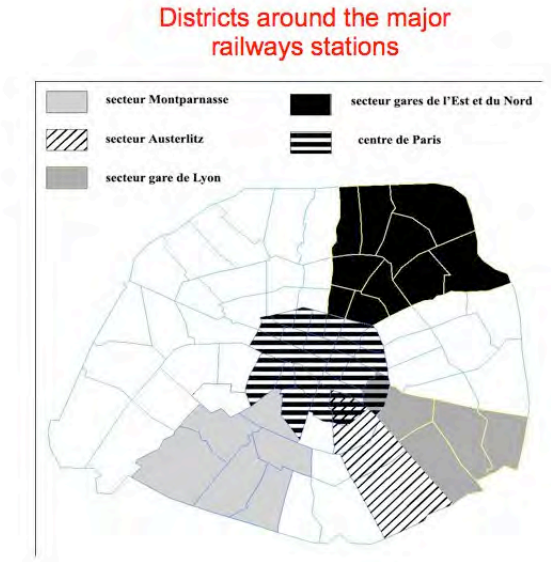
We can relate each of the four patterns to similar patterns of the french departments as is shown on the two next figures.

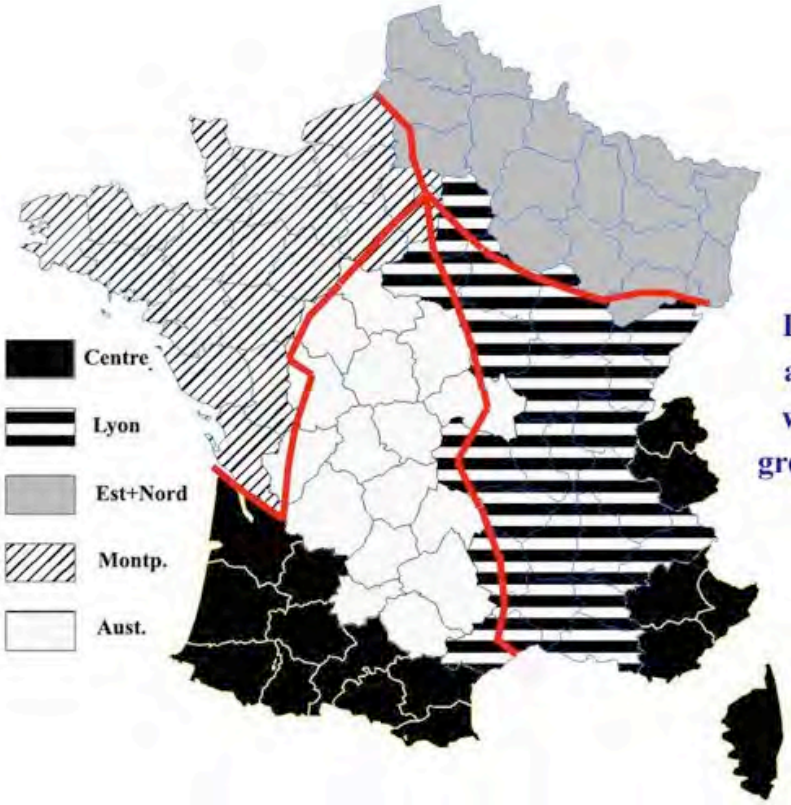




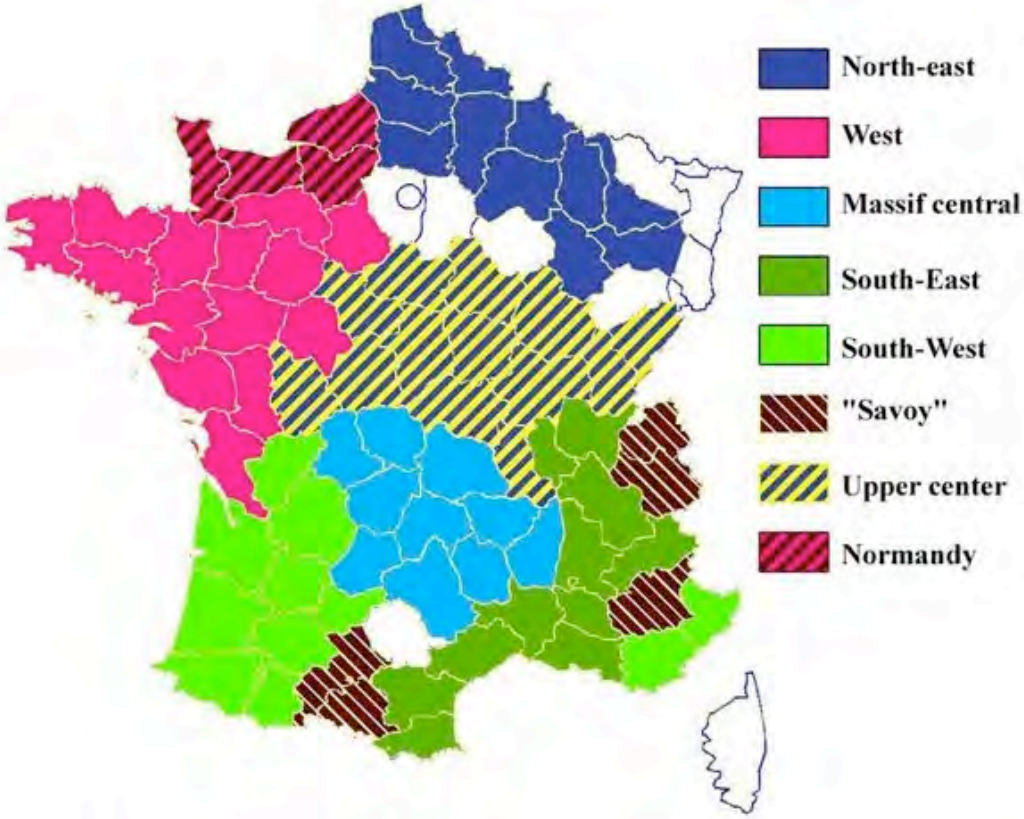
III A more realistic microsimulation

Coming back to Paris, we first verified that the highest percentages of migrants from a department were observed in the districts around the station linking Paris with it. For the most southern departements it did no more hold because the flows were very weak and the railway recently connected less in use and more expansive. Taking the railway network and other criteria of similarity (explained in chapter 13 of our book « Demography »), we gathered the departments in 8 homogeneous groups.



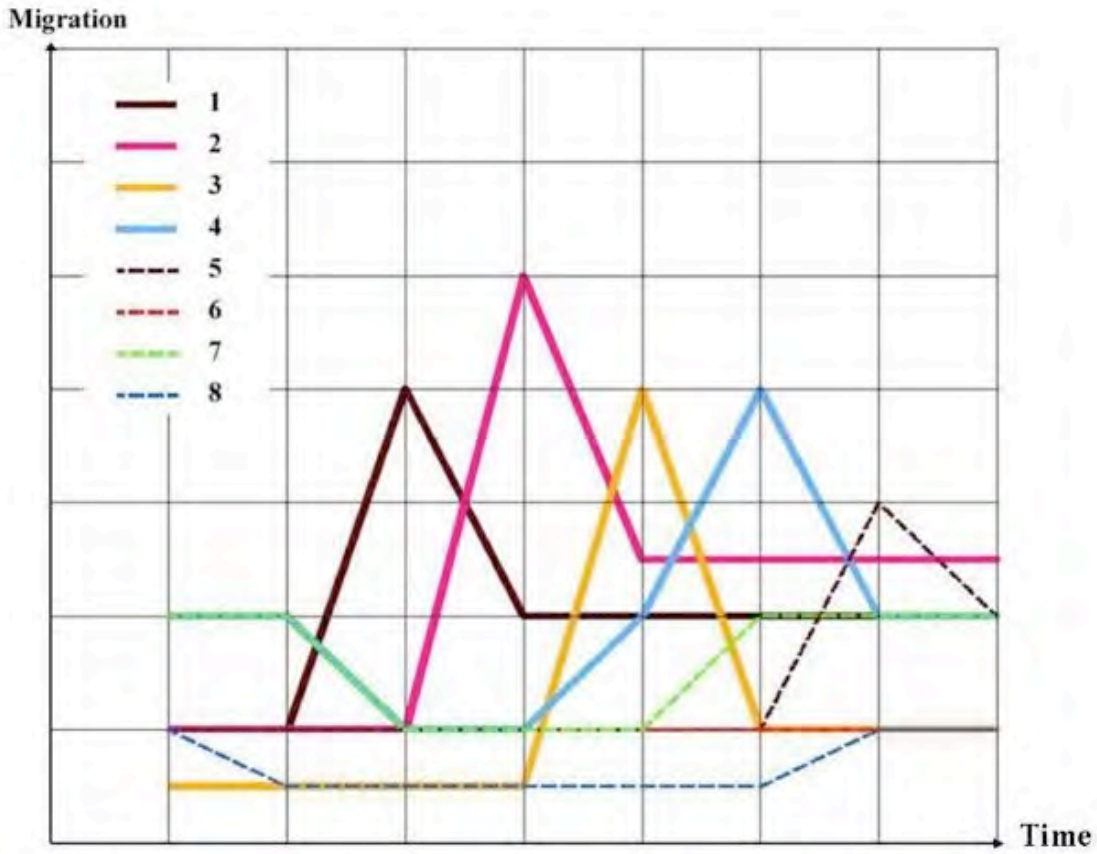


Departements classified according to the station whose sector attract the greatest proportion of their immigrants

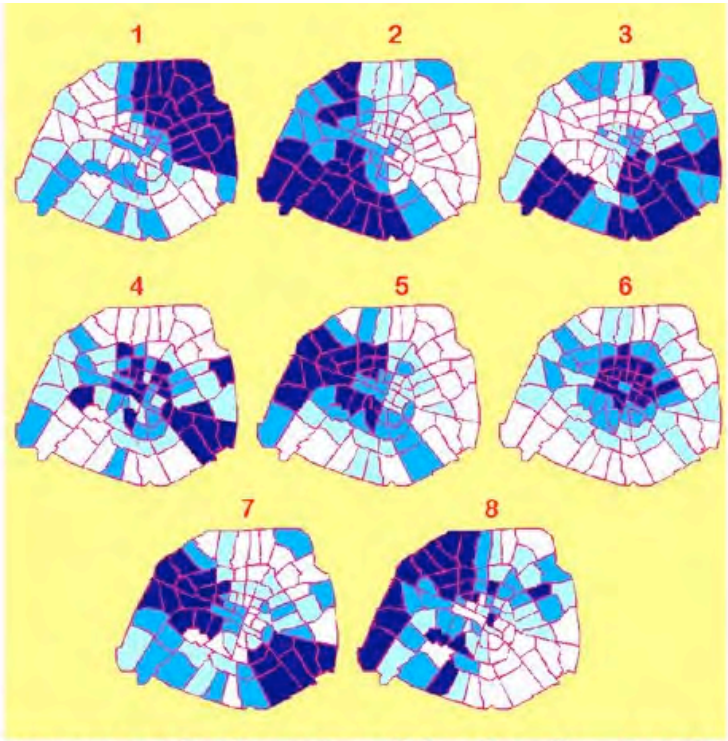


8 regions with homogeneous migration-profiles

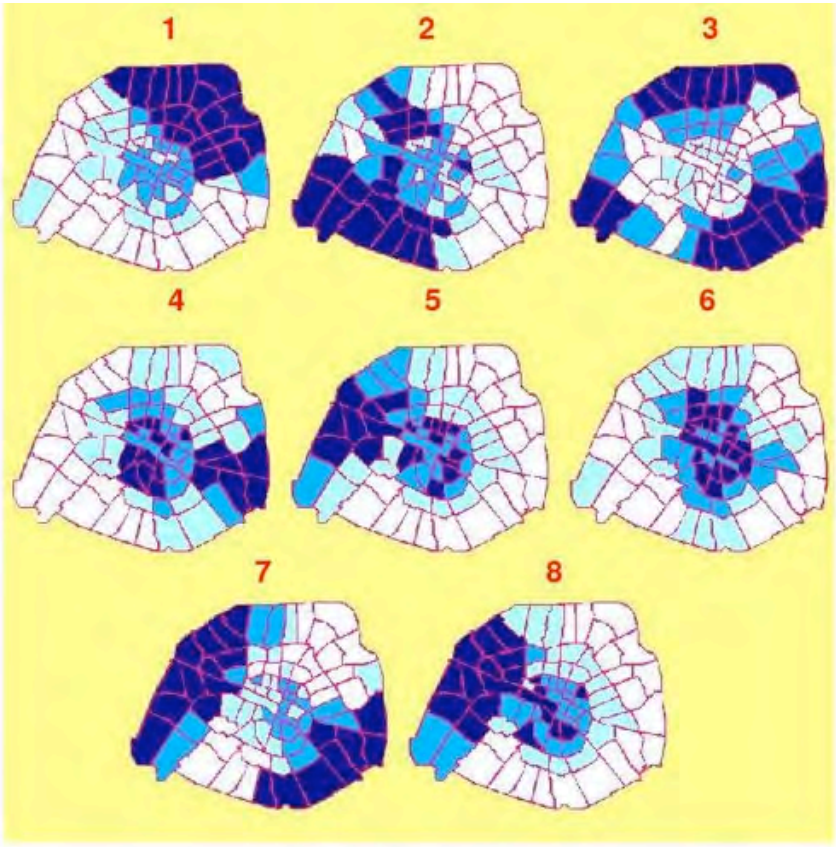
We repeated for them the preceding micro-simulation with an exception for the group coming from Massif Central were the proportion of active migrants rose to 75% instead of the usual 50%. We supposed a succession of migration waves illustrated on the next figure and in agreement with the known history of the migrations toward Paris. The results displayed in the next figure fit well the data.



Migration from each of the 8 regions through time (waves)



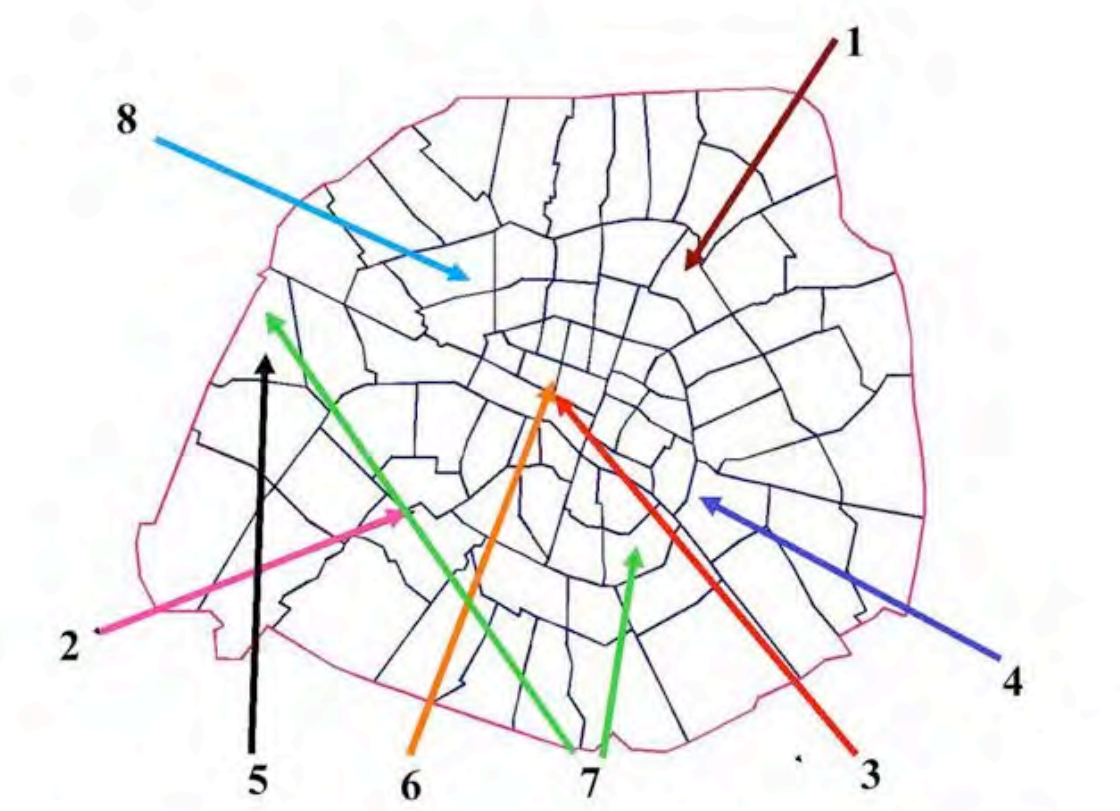
Frequency of migrants originating from each of the 8 regions in the 80 districts



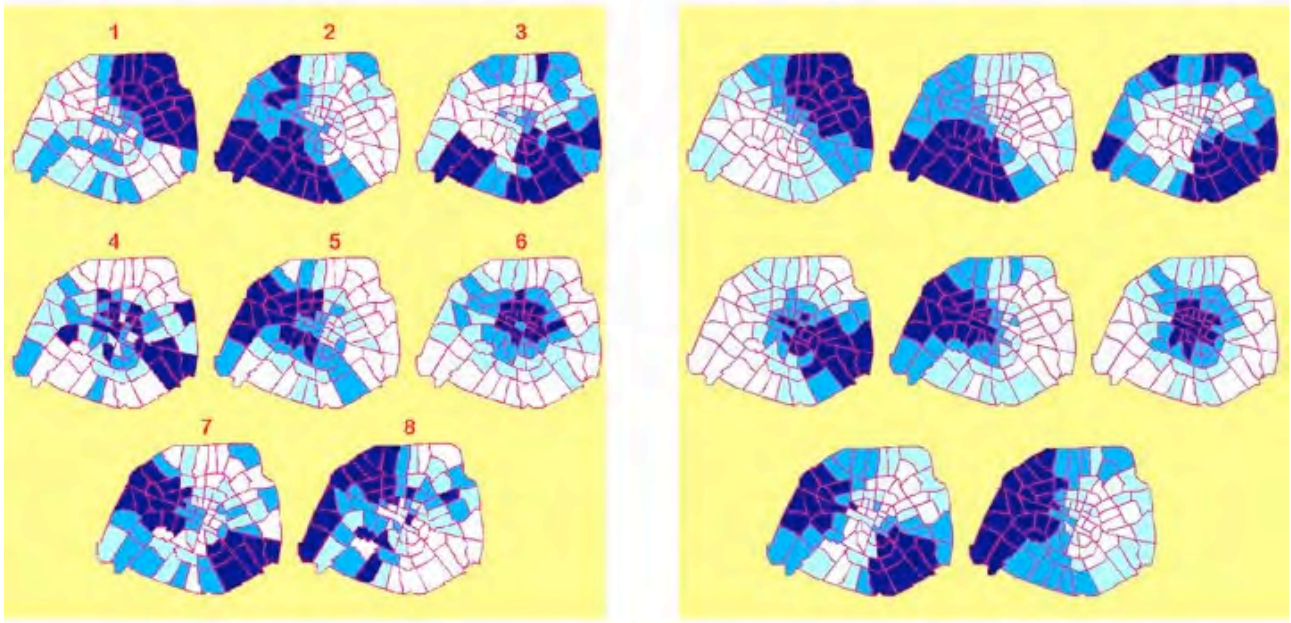
Simulation 1

At this stage, one objection is evident : with such a high number of assumptions and parameters it would be surprising not to get a good fit. To face the objection, we repeated the simulation with different parameters and timing and with different proportions of active migrants. At our surprise, the results did not vary at all. The core of the model was different. It was not the waves as supposed since the beginning of this paper that influenced the distribution of the migrants, but something deeper.

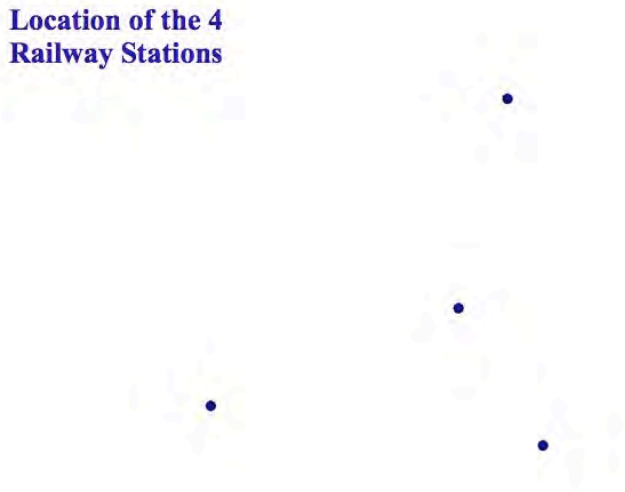
In fact the location of the stations proved crucial. The distinction active/passive was only important for the Massif Central group and the waves were superfluous. Going a step further, we changed radically the simulation procedure. We supposed a very simple behaviour : before its arrival in Paris, each migrant knew N possible places where to settle down. Each migrant was drawn at random, all regions put together and he landed at the place (amongst the N and still not occupied before by and other migrant) which was the closest to the railway station corresponding to his region. For the Massif Central Group we choosed a smaller number N. The results as displayed in the usual way are as good as in the preceding ultrasophisticated model. But they are obtained with fewer assumptions, fewer parameters, in a word, with greater parsimony.



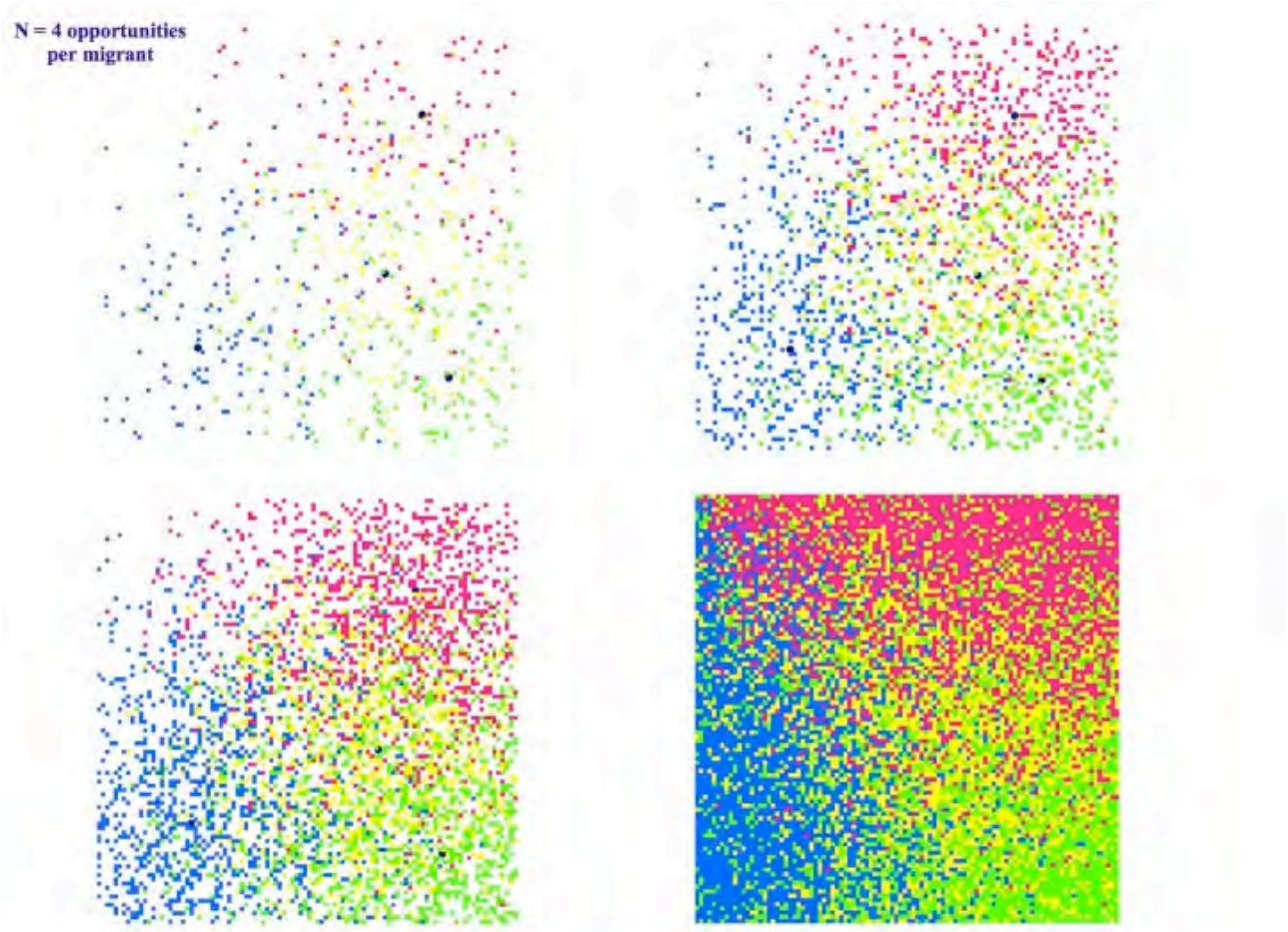
Points of arrival of the 8 regional migrations inside Paris



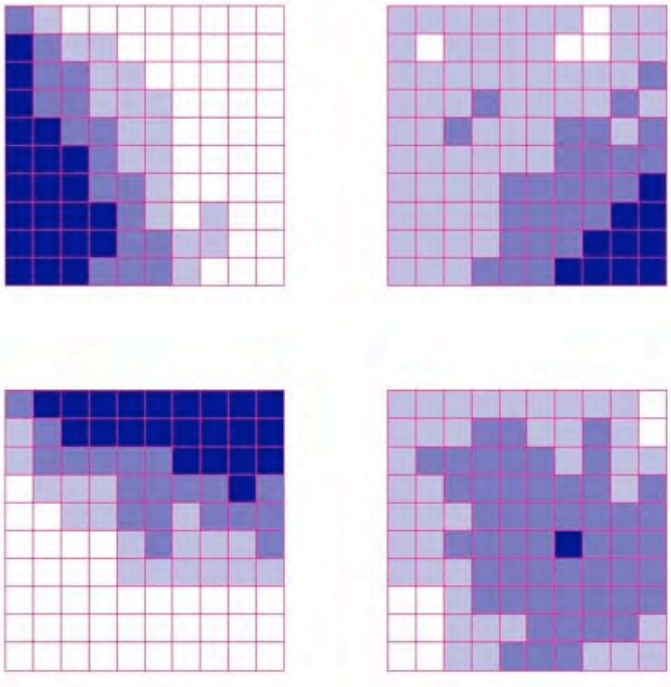
To illustrate this simple process, we apply it to the first simple model with the four regions and four railways stations.



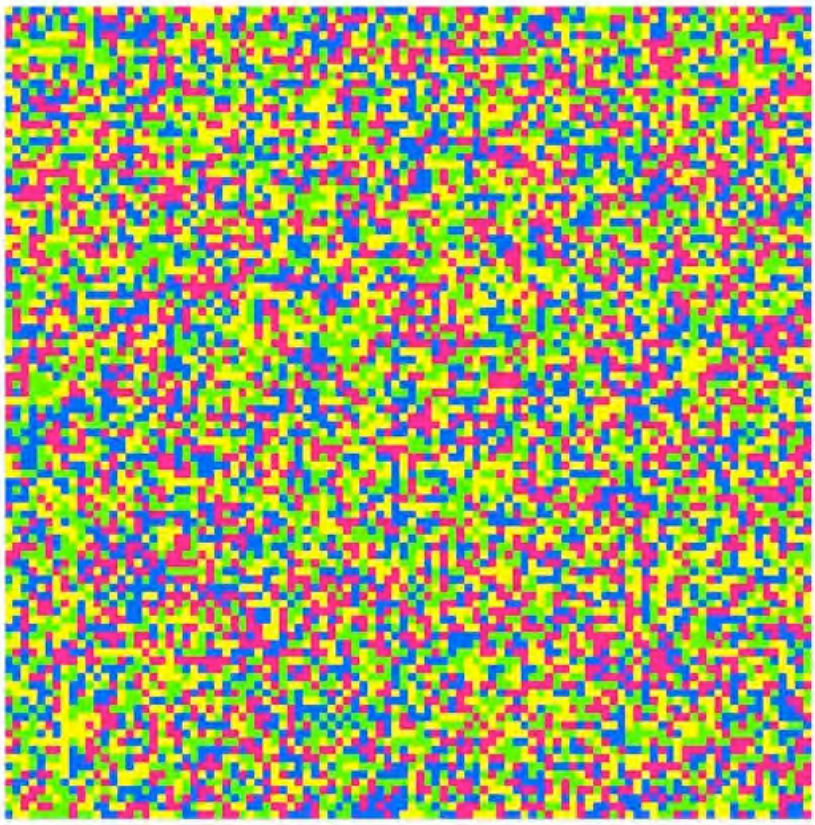
Successive steps in the filling of the space according to the allocation procedure (simple model with the four railway stations located as on the preceding map.



Frequency of migrants of each group in the districts (quartiles)

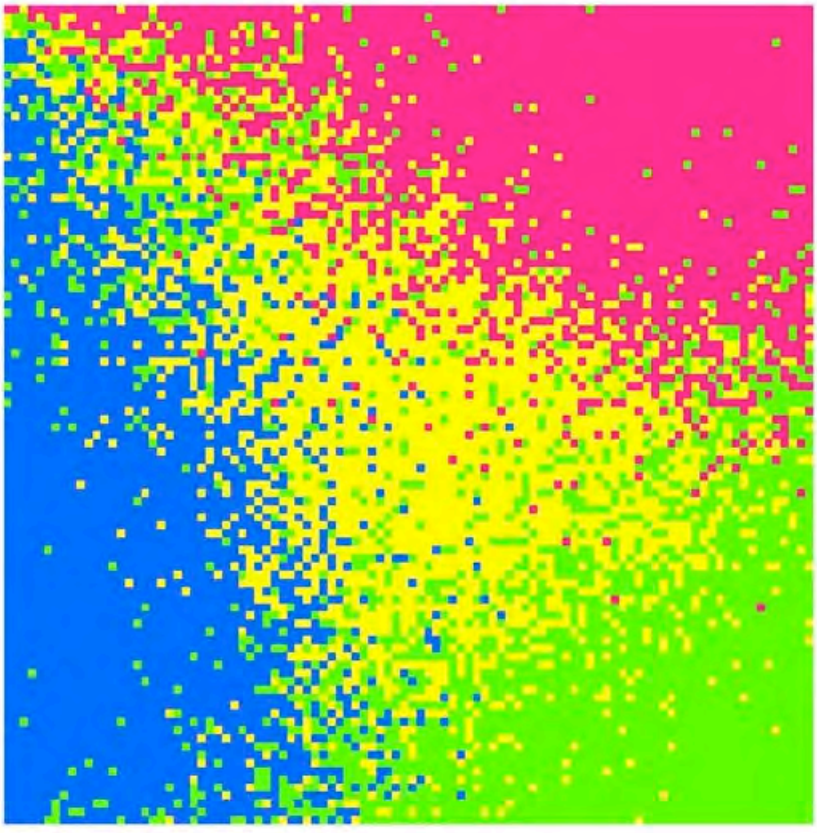


n=1



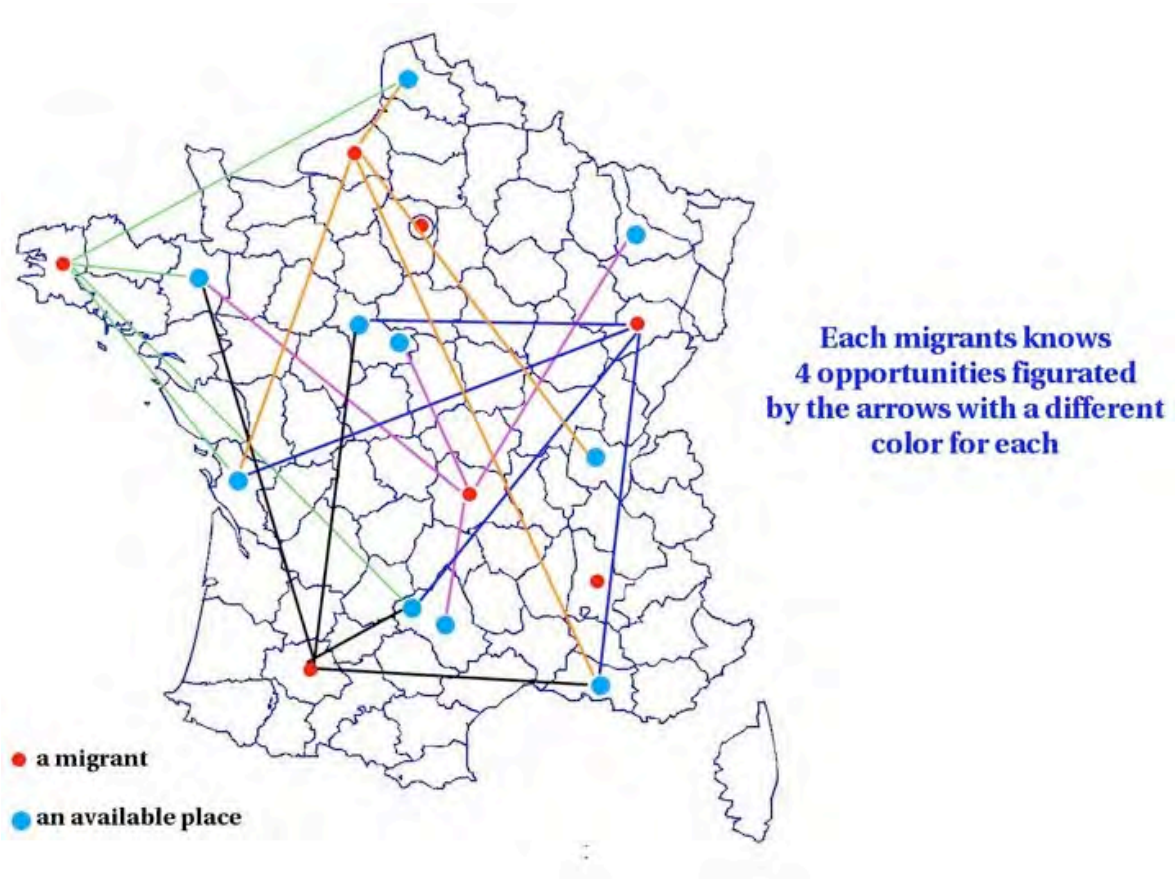
IV

n=10



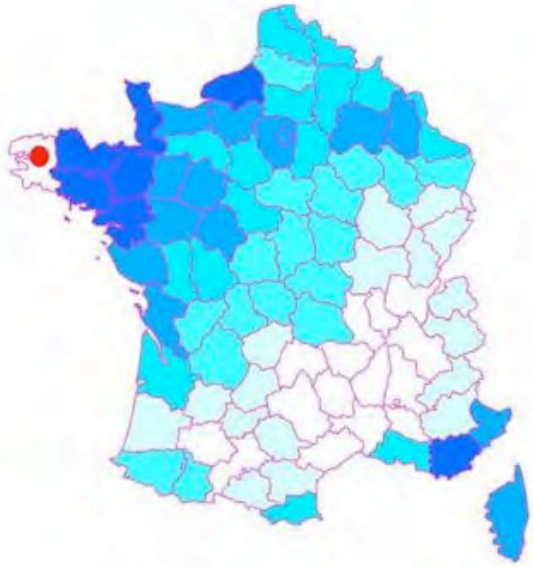
Internal migrations in France

The last model can be applied to internal migration matrices very simply. We suppose as before that each migrants has N possible places where to settle down all around France. These places are chosen at random at the beginning of the simulation process irrespective of the location nof the migrant. Each migrant is drawn at random and he goes to the closest available place 'not occupied by an other before him) from his point of departure. It is as the region of origin and the corresponding railway station of the preceding simulation were confounded. Taking N = 15, the results are in an astoninghly agreement with the data as you can see for outmigration, inmigration and even net migration.



Out-migrations

Observed



Simulated

> 4%
2 - 4%
1 - 2%
0,5 - 1%
0,2-0,5%
< 0,2%

Out-migrations

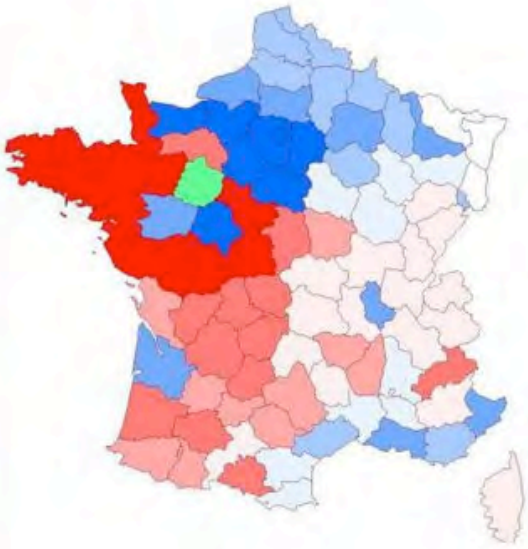
Observed

Simulated

> 4%
2 - 4%
1 - 2%
0,5 - 1%
0,2-0,5%
< 0,2%

Observed

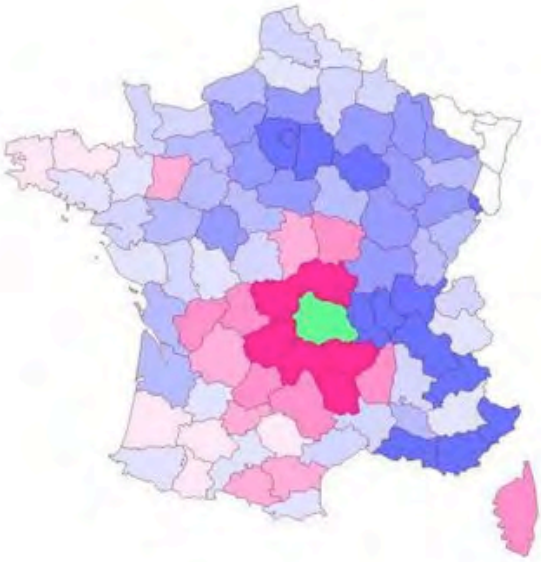
Simulated

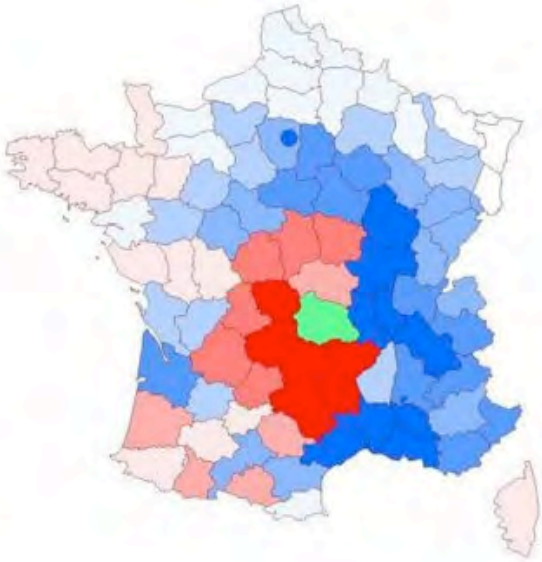


> 1%
0,5 - 1%
0,5% - 0%
0 - -0,5%
-0,5% - -1%
< -1%

Observed

Simulated





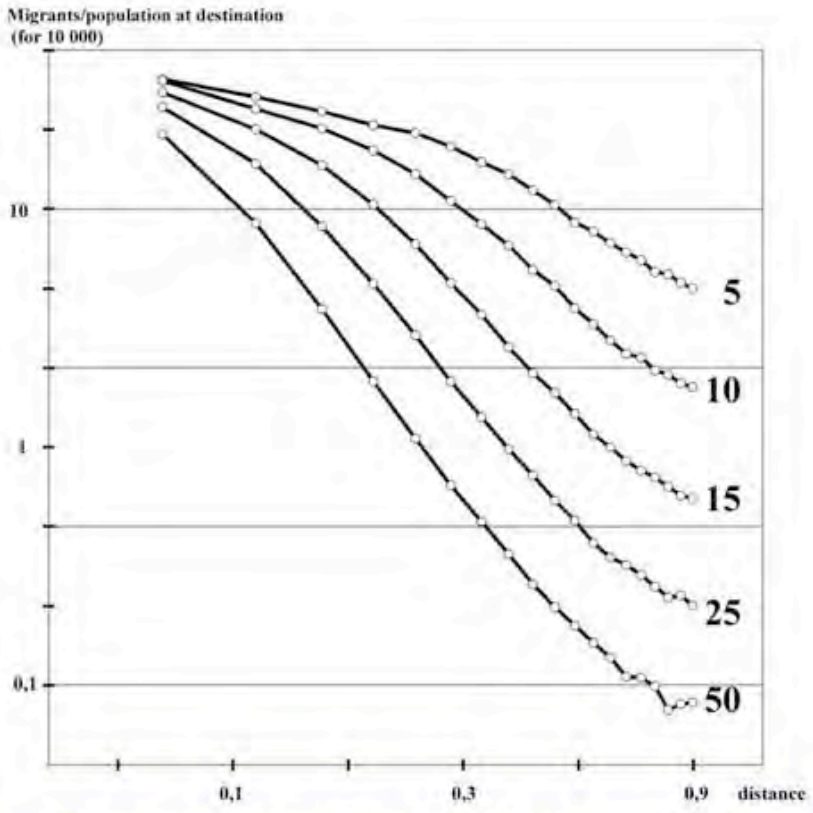
> 1%
0,5 - 1%
0,5% - 0%
0 - -0,5%
-0,5% - -1%
< -1%

What is more, is that the distribution of the flows according to the distance for each department follow a gravity law, i.e. a linear relation between the logarithm of the distance and the proportion of migrants at that distance or a power law. The exponent of the law (i.e. the slope of the line) vary with N, a fact of observation. Of course, the gravity law prevails also in the real data as shown on the figures for some departments.

Gravity models

$$M_{i,j} = kP_iP_j/(d_{i,j})^a$$

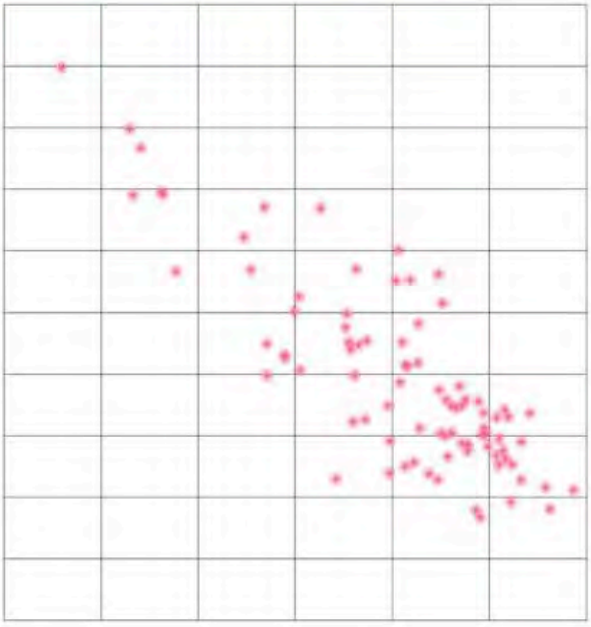
$M_{i,j}$:migrants from i to j
P_i : population in i
$d_{i,j}$: distance between i and j
k and a : constants



Migrations according to distance (log-log)
For various numbers of opportunities by migrant

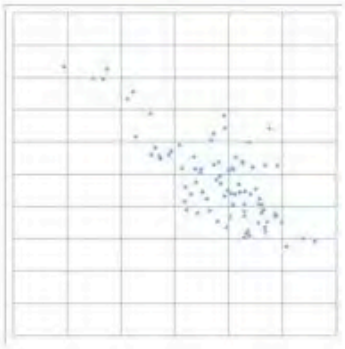
log(outmigrations/populations)

Département de l'Ain

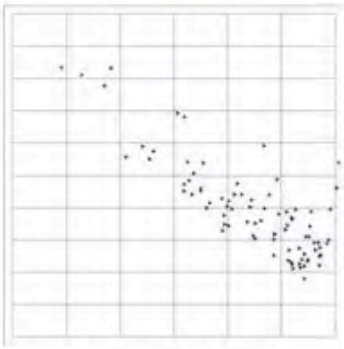


log(distances)

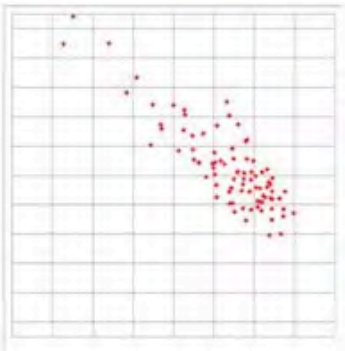
Allier



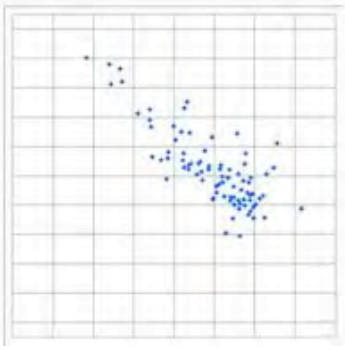
Calvados



Doubs

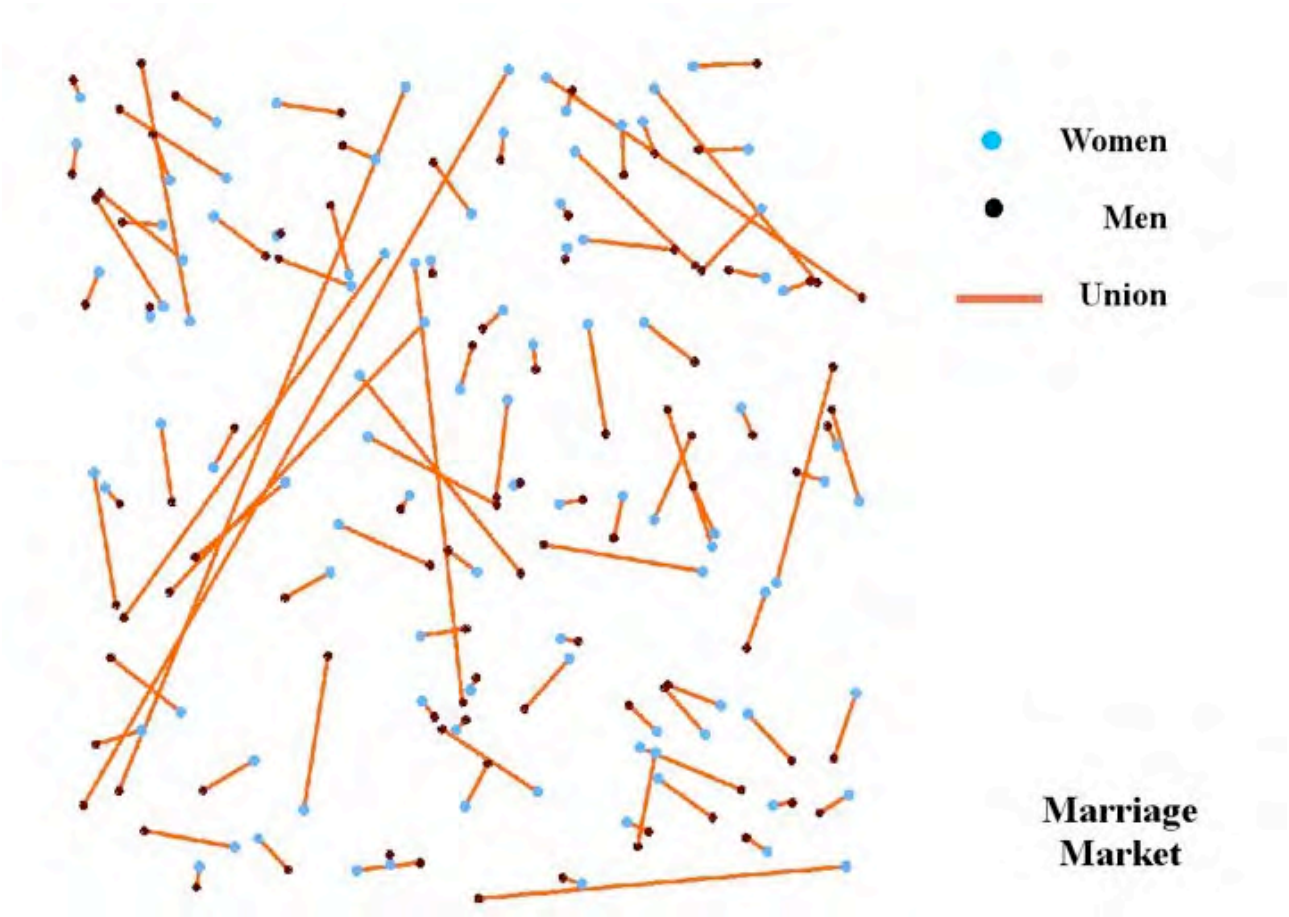


Indre et Loire

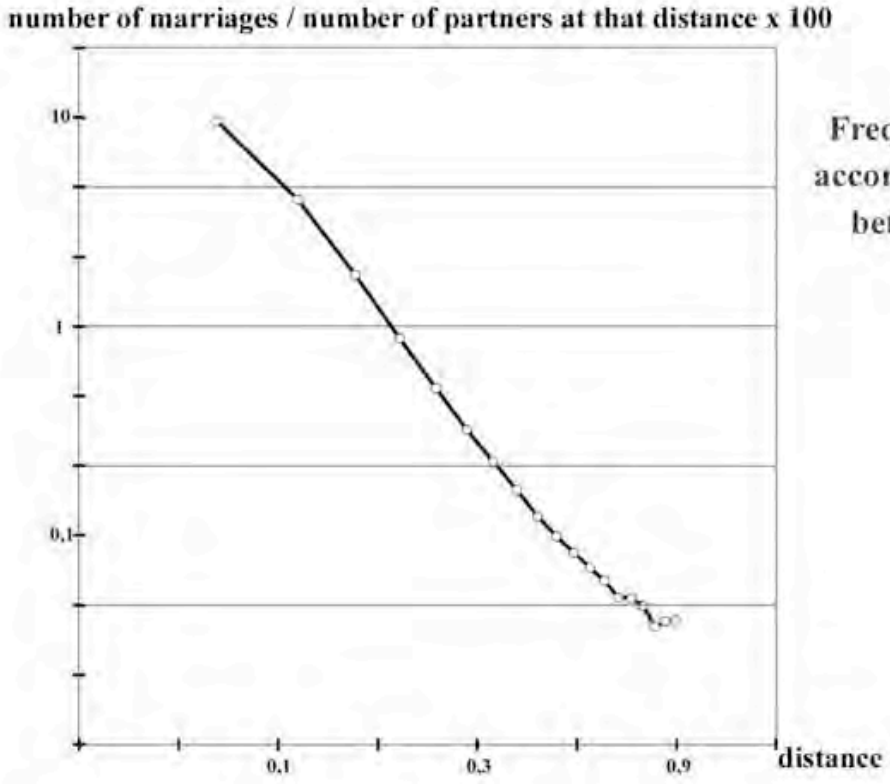


V Marriage market

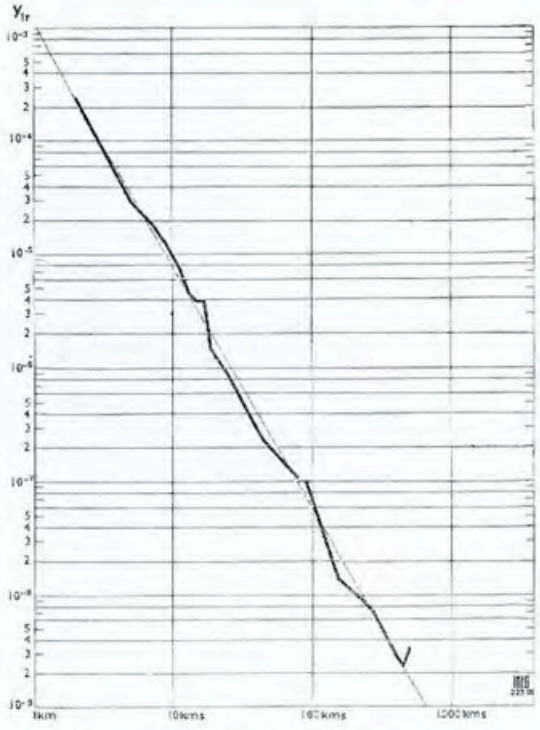
The same process can be applied at the study of the marriage market. If one replaces the point of departure by a man and the point of destination by a woman. If onesupposes that each man and woman is represented by a point in a certain space describing its age, social position, beauty, wealth, may be intelligence, the marriage process becomes the following : each man or woman is drawn at random and married to the closes available (not married) partner of the opposite sex. The results of such a process shows that most marriages occur between nearest people but that a minority of 25% approximately is less well fitted and much less for the worst 5%. In these case, celibacy can be an alternative.



What is behind this model is the so called squeeze. It can be reintroduced using the same device as in the last migration model : assuming that each man and woman cannot marry each man and woman but only a certain number N. In this case, the two models are the same, but as a result, some definite celibacy exists as in the real world. Moreover, because the models are the same, the gravity law holds also . It is also well documented as this example from a paper by Jean Sutter. A number of such examples were gathered between 1930 and 1970 under the heading of « residential propinquity » and they were used in population genetics in the dsicussion on « isolats ».



Frequency of marriage according to the distance between the spouses (log-log)



Graphique n° 39. — *Migrations matrimoniales du Loir-et-Cher. Période 1919-1925.*

Marriage migrations in the Loir et Cher (1919-25) The y axis figures the log of total number of mariages at the distance x divided by the total number of possible marriages at that distance (Sutter, 1974)

VI Some conclusions

The title was about weak ties. It meant that people of the same origin cluster and concentrate in certain area of the country or city of destination not because they have a strong feeling of community but for for unimportant reasons or causes that accumulate. Of course, dispersion will take place in the course of time, but it will be also quite lengthy as other models of diffusion can demonstrate.

The fact that weak ties create strong structures bear a name. It is emergence as developped for example in the recent book of Laughlin. Small unstructured and aleatory cause can build regular structures at the upper level. In the present case, the choice of the nearest place amongst N after random draw suffices to create strong spatial structures. There is no need to suppose important attractions for economic or cultural causes between the concerned people.

Some bibliographic orientations

Robert Laughlin's book (*A different universe : Reinventing physics from the bottom*, New-York, Basic Books 2005) is a good introduction to the challenge of emergence. Migration and marriage models are discussed in two of my books : *Essais de géométrie sociale*, Paris, Odile Jacob, 2000, and *La démographie*, Paris, Odile Jacob, 2005 (to appear in english at Princeton University Press in 2008) which contains a bibliography on these two topics, including gravity laws, Stouffer's works on migration, Hägerstrand masterpieces (*Migration and Area* of course) and papers on residential propinquity.