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Rousset, P., P. Trouvé, & S. Lawes (2016)

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in G. Ritschard & M. Studer (eds), Proceedings of the International Conference on Sequence Analysis and Related Methods, Lausanne, June 8-10, 2016, pp 591-606.

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Employment pathways forecasting

What are the future prospects for young people after three years of vocational experience? Over/under-performing

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This paper is an exposition of an analysis of employment entry pathways. Through a sequential analysis it selects individuals who emerged with different career pathways than might have been expected considering their working position 3 years after leaving school. It identifies young people who have developed a secure career pathway through their vocational experience. The Céreq survey *Génération* was carried out in 2011 recording the monthly "occupational calendar" over a 7 year period of 12,365 young people who left the French school system in 2004. Sequential analysis has become increasingly popular following the work of Abbott (Abbott, 1983). Its success derives from the adoption of an holistic approach which focuses on the entire career of an individual (Elzinga, Studer, 2015 ; Studer, Ritschard, 2015 ; Robette, Bry, 2012). Sequential analysis is now frequently applied to vocational pathway studies (Massoni and al., 2009 ; Grelet, 2002). The relationship between different career pathways in identifying the most successful students has already been used in a number of studies indicating a strong link between the vocational pathway and the qualification gained (Céreq, 2007). In our analysis we take the opposite perspective, that of identifying individuals who exceed expectations during the period 2007-2011 in relation to their potential, job security (high/low or increasing/decreasing level), as identified by their vocational situation at 2007. An open-ended contract or a fixed-term contract are two current employment contracts in common use that are perceived as having different potentials in relation to establishing secure employment pathways. Potential is defined in this paper as the statistical probable pathway.

The aim is to compare the career pathway achieved by an individual with the statistically probable pathway that is representative of the expected pathway. Our problem naturally relates to defining the probability, based on empirical expectations, of reaching each point B in the future, starting at point A. Transitional approaches or Markovian Models lie within this overall approach. In sequential analysis a first approach is to translate any individual pathway as a Markovian model in order to be able to compare the actual career pathway with the expected pathway. A Markovien model for any individual pathway is achieved through Drifting Markov Model DMM (Massoni & al, 2010). Such an approach requires sufficiently rich individual information and therefore very lengthy sequences. The matrices of dissimilarity, as for Optimal Matching (Halpin, 2010 ; Studer and Ritschard, 2014), only compare actual pathways. They can't define a distance between actual career pathways and probable career pathways. As an alternative approach, Euclidian metrics allow for the projection from the past to the future. Therefore for individuals defined by their affiliation to a group, the probable career pathway is the mean pathway of the group and the gap between the actual and probable pathways measures inertia. We therefore selected Euclidian metrics methods to use in our analysis. The chi-square distance, applied directly between sequences, allows for controlling frequencies effects and does not take into account the order of sequences (Robette, Thilbault, 2008). Therefore the status of employment taken at two different points in time often had the same

potential for establishing secure employment pathways but not the same *frequency*. The methodology *"emlt"* outlined in Rousset and Giret (2007) and Rousset et al (2012) relates to our present work as it established a Euclidian metric between career pathways through the transitions matrix at every step giving weighting to the short and long term. An inter-pathway matrix enables the measurement of the distance to the probable pathway. From the point of view of our study, the position of individuals reflects their potential for developing more secure employment pathways, that is the probability of maintaining or making the transition towards status of employment or unemployment.

In terms of practical application, the literature indicates broadly that entry to the labour market in France is strongly linked to qualification, measured three years after the end of education. (Céreq, 2007). Our results show however, that the probable career pathway after three years is more closely linked to a more secure pathway than an insecure pathway which suggests that beyond the achievement of a qualification individuals remain active agents in the development of their career pathways. A typology of individuals according to their achievement in terms of degree of job insecurity referring to employment status and the gap between probable pathways illustrates this point. This analysis will be developed fully in the paper as will the potential for the development of security of professional status. In the first instance, the paper will expand on the methodological analysis of career pathways. It will show, through comparison with other methodological approaches, the link with transitions and its pertinence to vocational pathways. The second part of the article will examine the prediction of pathways. The third part will illustrate the findings applied to the establishment of secure career pathways.

1 The survey

The CEREQ 'Generation 2004-7' survey (2011) involved 12,365 young people exiting the school system in 2004. Over a period of 7 years (88 months) a monthly calendar of each individual's position in the job market was produced according to five categories of employment or unemployment status : *open-ended contract*[1]*, fixed-term employment contract, qualification contract*[2]*, temporary work,* other subsidised employment contracts and respectively *unemployment, not actively seeking employment, training or return to study .*

2. Methodology

The *emlt* methodology employed is presented in detail and its application in sequential analysis is developed in Rousset and Giret (2007) and in Studer and Ritschard (2015). The reader can find the *seqemlt* function in Ritschard et al (2015).The following summary presents an overview of its principles. The methodology specifies in particular the metric for the Euclidean space of transitions and for those inferred for career pathways. For a more detailed technical description the reader is referred to articles by Rousset et al (2012) and to Joseph et al (2013) for an example of an application. This methodology proposes an alternative to methods such as Optimal Matching

[1] Open-ended contract : permanent employment contract
[2] French Public policy for young people under 26 years old

(Abbott, 1983) and chi-square distance (Grelet, 2002) taking better account of transitions and of order and sequences. Beyond this it integrates two important points : that transitions develop over time and that transitions must be considered in one and several steps. In fact exchanges on Optimal Matching (Wu 2000) ; Halpin, (2010) reveal the difficulties of this method in taking account of transitions. As far as the chi-square distance is concerned, the co-concurrence which does not integrate the sequential order replaces the notion of transition. Harmonic analysis (Robette and Thibault, 2008) is designed to better adapt the approach through an interplay of windows where adherence to a window of time depends on sequential order. The methodology presented here goes further in defining the metric on the basis of transition rates at one and several steps by modulating the long and short term.

Definition and encoding of sequences

In the formal sense, the calendar of an individual *i* gives rise to the status category that he occupies at each *t moment.* The set *E* of available outcomes of status *e* is finite. The methodology is based on the transitions to one and several steps. These transitions are time dependent, for example transitions to work are always greater in the months following exit from the school system and lessens over time. In order to take account of this, the status categories are indexed over time, and are then called 'situations'. Subsequently, the term *situation s=e*, designates the position in status category *e* at instant *t.* Probable career pathways and transitions: the realm of probable career pathways

Let us consider a situation *s=e,* and the set Ω_s of an individual who have experienced this situation. For each instant *t'>t*, we can identify empirically the probability of transition of *s* towards the set of status categories *e'* from *t'* as the rate of individuals in Ω_s who have experienced the situation $s'=e'_{t'}$. We can then establish the probable career pathway of *s* as the vector of transition probabilities for each *t'* instant. Finally, we can identify the set of probable career pathways for the set of *s* situations. We call this set 'the realm of probable career pathways'. The realm of probable career pathways is defined by the matrix ($\Phi_s^{s'}$) which general term indicates the empirical probability to reach *s'* starting at *s.* Each line corresponds to a situation *s* and provides the probable career pathway from *s.*

- $\Phi_s^{s'} = 0$, if $t' < t$
- $\Phi_s^{s'} = \frac{\sum_{i=1}^{I} Y_i^s Y_i^{s'}}{\sum_{i=1}^{I} Y_i^s}$, where *Y* has the value of 1 if individual *i* has experienced situation *s,* otherwise 0

A metric for the field of probable career pathways

In the following we asses a situation and its own probable pathway that is also considered as its potential. The distance between two situations is defined as the one between two probable career pathways. A natural metric for defining the distance between two probable career pathways is the chi-square distance, such that the gap between two transitions does not depend on situational

frequency. The methodology enables us to balance time so as to give greater weight to correlations in the short-long term. When we need to balance the distance between transitional profiles of two situations by giving more weight in the short-term than in the long-term, we replace $\Phi_s^{s'}$ by its balanced value $\beta_s^{s'}\ \Phi_s^{s'}$ where $\beta_s^{s'}$ is a parameter that diminishes with time as in this study with $\beta_s^{s'} = \frac{1}{t'-t+1}$.

A metric for the space of sequences based on transitions

Instead of using directly this metric, Torgerson's method (Torgerson 1958, Benzécri 1973) enables us to use the traditional Euclidean quadratic distance applied to transformed coordinates of situations. These coordinates are given by the *seqenlt* function. At that time, all Euclidean methods applied to this coordinates are available, giving a powerful tool for sequence analysis. The *seqenlt* function enables us to obtain transformed coordinates for achieved career pathways by defining a sequence as the sum of successive situations. The probably career pathway coordinates are then obtained averaging real pathways. The main aim of this paper is to show how this method defines, with the same metric, both the distance between actual and probable trajectories. In this way the study of global performance (one individual compared to others) and relative performance (one individual's actual performance compared to his or her own expected performance) are based on the same criterion (the same metric).

Properties of the methodology

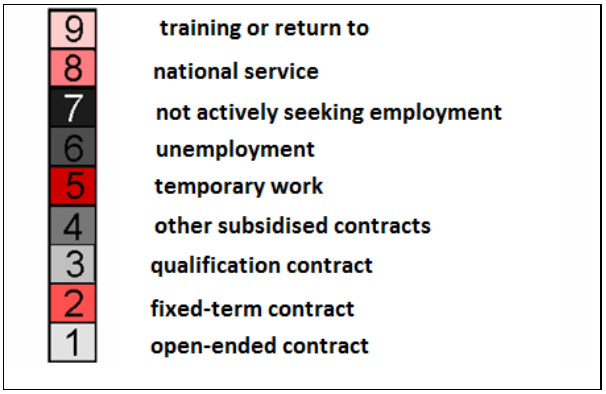
The fundamental property of this methodology is to draw on the transitions matrix in that the distance between the pathway trajectories is a Euclidean distance which is based on the space between transitions. It thus draws on the order of the data where others do not take it into account. In our application of this methodology to career pathways, the status of the individual is not what is written in his/her contract but his/her future potential, particularly in the short-term. The internal distance between probable pathways and the internal distance between achieved pathways as well as the distance between probable and achieved pathways is the same, and it is this which guarantees coherence of approach and results.

Comparison with other methods

In a general sense, the advantage of this method is that it brings together two status categories, not only if there are links between them but also if they have the same links in relation to other status categories and therefore they play the same role in the pathway. Rousset et al's article (2012) presents a comparative study of employment access drawing on data from *Génération* after 7 years**.** The comparison in this article aims at an examination of the absolute performance of an individual in relation to others and not the relative performance in relation to his/her own individual potential. The graph (Figure 1), a chronogram, provides juxtaposition to cumulative histograms giving monthly details of the relative share that each status category has at a particular point in time. It thus represents the development over time (the abscissa) of the contribution of each status category of

each cohort participant. This type of representation gives a good picture of the development over time of a group of individuals. On the other hand, it masks the number of individual transitions by presenting an image of systematic and regular development. Figures 2, 3 and 4 show these latter results concerning the difference between the methodology presented here, optimal matching and the chi-square distance. The results show a greater ability to draw out tendencies, for example to show employment loss or Open-ended contracts (CDIs[3]) loss. This is the only methodology that provides a category of lost CDI. We see that Optimal Matching gives a great deal of importance to frequencies extracted from CDIs, two categories are dedicated to accelerated access to CDIs. The chi-square distance gives much greater importance to rare situations (qualification contracts are more rare five years after end of study). These two methodologies each therefore reflect the effect of frequencies. For the first, the frequencies are more linked to coding than to actual reality: by separating CDIs and civil service posts or by aggregating temporary contracts with fixed-term contracts (CDD[4]), the frequencies would have been different. The adjustment of frequencies by chi-square is not necessarily adequate either in cases where public policy is evaluated in the sense that public policy aims to increase the number of beneficiaries. The comparison of trends based on transitions (only for these are frequencies adjusted) limits the effect of frequencies: thus if CDDs and temporary contracts have the same transitions to stable employment, their impact will be added. This is why, in this article, we developed a methodology based on transitions which additionally enables us to work with probable trajectories.

Key to figures 1, 2, 3 and 4



[3] CDI: Contrat de Durée Indéterminée
[4] CDD: Contrat à Durée déterminée

Figure 1 : Chronogram of employment status of young people over 7 years, immediately following full-time education

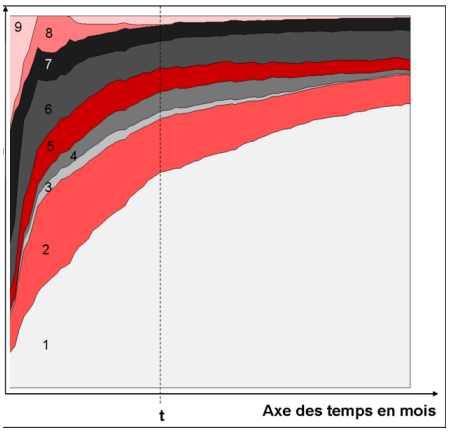


Figure 2: Typologie of career entry of young people after full-time education in 1998 over a 7 year period with the methodology presented here. Divided into 8 categories based on the seqemlt method (for key see key to figures 2, 3, 4).

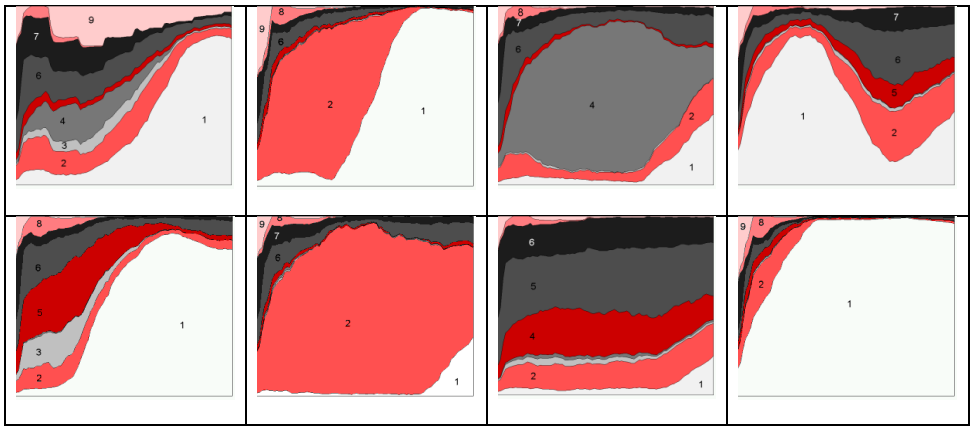


Figure 3 : Typology of career entry of young people after full-time education in 1998 over a 7 year period. Divided into 8 categories based on optimal matching (for key see key to figures 2, 3, 4).

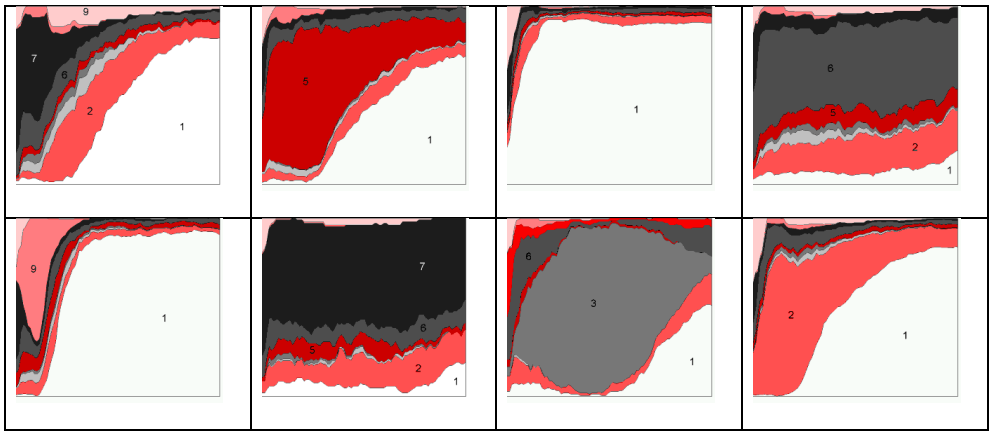
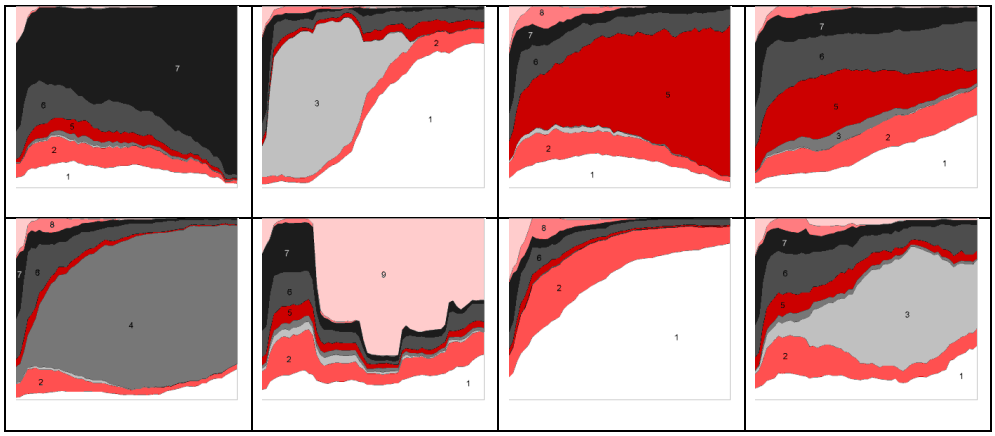


Figure 4 : Typologie of career entry of young people after full-time education in 1998 over a 7 year period. Divided into 8 categories based on harmonic analysis (for key see key to figures 2, 3, 4).



3. The Forecast

The aim of the forecast is to define the probable future career pathway of individuals based on knowledge of their present and past. Section 2 outlines the properties of this research methodology. It assimilates the position of each individual, at each *t* moment, with a potential for near and distant future. This potential is defined by the number of transitions as a whole. Furthermore, the distance between the achieved career pathway and the probable pathway is measured by a metric of associated space deduced from the transitions metric. The pathways are defined in Euclidian space. In this way, the mean of a group of individuals' pathway indicates the probable pathway of individuals in that group.

Definition:

Considering the referring position at t_0, the probable future pathway of a group is defined as the expectation or the mean of pathways over the period $\{t_0, \ldots, T\}$.

Properties:

The constitution of a group may be the total number of individuals in the same situation at t_0, referred to as prediction in relation to the present moment t_0. In this first case, the probable pathway for the group of individuals in status *e* at moment t_0 is specifically defined by the transitions $\Phi_s^{s'}$ in section 2, where *s* is the situation in status *e* at moment t_0 and *t'* each of the situations for $t>t_0$. This case is illustrated as follows. The distance between pathways is therefore exactly what enables us to define the distance between an actual pathway and a probably pathway. Remembering that this property guarantees the coherence of analysis for both actual and probably pathways.

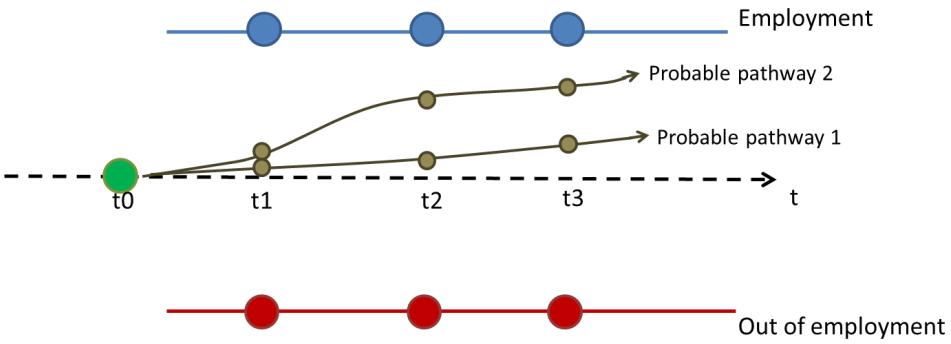
The choice of the group may also be composed of individuals who have identical time sequences $\{t_0', \ldots, t_0\}$, in which case individuals are described as having a common past, or else as individuals who are re-grouped in relation to a secondary variable. In the first case of re-grouping in relation to a time sequence { t0', …, t0}, a weighting may be used which gives more weight as t_0 gets closer in the same way as parameter β in section 2.

The mean future pathway, i.e. probable pathway, and the mean past pathway, when put together constitute a mean pathway for the whole period. This property, which gives greater coherence to the whole analysis and which broadly allows for interterpretations to be made, is not, for example, checked against the modal pathway: modal pathways over periods in the past and future do not necessarily constitute the modal pathway for the whole period.

4. Analysis of individuals who have over-performed

In our study, the forecast of a pathway enables us to identify individuals who have significantly over-performed in their expected pathway. The first result that we obtained through this method is to be able to measure the quadratic deviation between the achieved pathway and the probable pathway. In a group of individuals, the smaller the probability of deviation from the probable pathway, the lowerwill be the performance. In figure 5, employment signifies lower performance in the case of probable pathway 2 than in the case of probable pathway 1. This property is not verified either with the modal pathway which does not depend on the quadratic deviation.

Figure 5 : In case of probable pathway 2, the rate of individual in employment increase more in time than in case of probable pathway 1. Therefore, the performance of "being in employment" is smaller than in case of probable pathway1.



In the context of our application, we consider the position of 12,365 young people in the *Generation* study of 2004 in the labour market 3 years after the end of their studies according to a list of five employment and four unemployment status categories : *open-ended contract*[5]*, fixed-term employment contract, qualification contract*[6]*, temporary work, other subsidised employment contracts* and respectively *unemployment, not actively seeking employment, training or return to study.* We are seeking to find out if the employment pathway that they have achieved beyond this date corresponds to an expected pathway, an over-performing pathway, or an under-performing pathway. The expected pathway depends here on the position at a point 3 years after the end of schooling. Thus, an individual on a fixed-term contract after 3 years deviates from his/her expected pathway if the deviation D between the achieved pathway and the probably pathway is great. The level of the deviation subsequently considered is given by the variable D.

In order to know if the pathway is over or under performing, the distance between achieved pathways and the 8 patterns of pathways, namely open-ended contract, fixed-term contract, temporary contract, qualification contract, other subsidised employment contracts, unemployed, not actively seeking employment, return to study. The principle component of these 8 variables is the indicator Q, chosen to measure the quality of status. The analysis of correlations shows that the indicator Q contrasts open-ended contracts (correlation –0.4) with other less secure status categories (correlation between 0.4 and 0.5) and is thus an indicator of employment stability. Two classifications which emerge respectively from variables D and Q have been established. The intersection of typologies in Table 1 identifies the intersection of the two dimensions, D in lines and Q in columns.

It shows that, in most cases in the Table, there is a gap between the future trajectory achieved and the probable trajectory with the exception of young people who had already obtained an open-ended contract. This implies that after 3 years there is still substantial uncertainty around future trajectories and that young people's efforts to find employment immediately after the end of their

[5] Open-ended contract : permanent employment contract
[6] French Public politics for young people under 26 years old

schooling is of great importance to the trajectory. Only young people who obtained an open-ended contract during the first three years have a secure future and this corresponds to a low gap between the probable trajectory and high performance. These young people are in a group where absolute high performance can constitute relative performance in line with expectations. This observation justifies the identification of an intersection between relative and absolute performances. Thus in cases where the future is more or less determined, as for those with open-end contracts after three years, the level of the diploma or social features have been some of the main determining factors. For all the other cases, the gap between the probable and achieved pathway is medium or high and the security of the pathway has yet to be stabilised. Where qualifications or family characteristics have not sufficed, the efforts made by the young person or the initial working environment are the determining factors. In the rest of this article we will confine our analysis to that which pertains to employment status at the point 3 years after the end of schooling. Other factors, such as the characteristics of types of companies or discrimination will be the subject of further studies.

If we study the performance for each situation at a 3 year point, as pointed out above and examined in Table 2, the open-ended contract is the most secure. Eighty-four percent of young people achieve a very successful pathway with a small gap between the probably and actual pathway. The risk for young people with open-ended contracts is thus very low. Moreover, the gap between the probable and actual pathway would need to be very large for there to be significant under performance (2.5% of open-ended contracts). For employment with temporary status, fixed-term contracts are shown to have greater security potential than temporary work, as showed respectively in Tables 3 and 4 . In effect, fixed-term contract show a medium gap in the probable pathway allowing for high and medium performances (respectively 23% and 22% of fixed-term contracts), while it allows essentially for average performance for temporary work (4% and 23% average). In the same way, with fixed-term contracts high performance is obtained with a large or medium gap (respectively 18% and 23%) as opposed to a high gap for temporary work (4% medium and 18% high). Nevertheless, for temporary as for fixed-term contracts, under-performance constitutes a large gap which shows that young people have a greater tendency to make their pathway secure by their own efforts to find employment rather than to fall into insecurity. What is more, underperformance is generally a result of insecure employment pathways where there is a low incidence of unemployment. In respect of subsidised work, we find a more uncertain configuration where most pathways show a large gap with probably pathways (77% of young people in the line 'high gap'), which reveals a situation of greater uncertainty that young people find themselves in. Nevertheless, 18% are able to gain more secure employment by obtaining an Open-ended contract which is evidence of high performance. Average performance correlates with a reduction in job insecurity, through a belated Open-ended contract (17%) or for 22% a less insecure status (resumption of studies, temporary work). The 37% of under-performing pathways correspond to pathways where the incidence of unemployment is at approximately 50% on average. Young people who are unemployed at the 3 year point, are equally in a very uncertain position since their future trajectories represent a large gap with the probable pathway (80% of young people are in the 'high gap' line). Furthermore, the population is divided into two more or less equal parts: 46% achieve medium performance often with an Open-ended contract at the end of the period, while 54% experience a pathway where employment is often temporary and unemployment accounts for more than half of the period.

Key to tables 1to 6

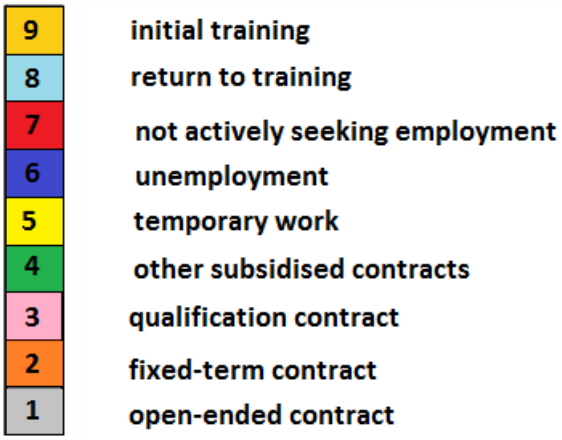


Table 1: Who is over/under-performing 3 years after living school? Chronogram of the cohort of school leavers in 2004 . Employment pathways in terms of contracts : 1- Open-ended, 2- Fixed-term, 3- Qualification, 4- Subsidised work, 5- Temping, 6- Unemployment, 7- Inactivity, 8- Training, 9- Studies

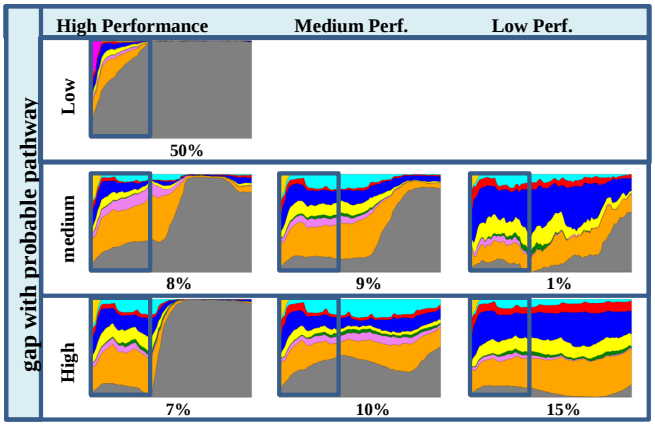


Table 2: Who is over/under-performing 3 years after living school when the situation at 3 years is a **Open-ended contract**? Chronogram of the cohort of school leavers in 2004 . Employment pathways in terms of contracts : 1- Open-ended, 2- Fixed-term, 3- Qualification, 4- Subsidised work, 5- Temping, 6- Unemployment, 7- Inactivity, 8- Training, 9- Studies

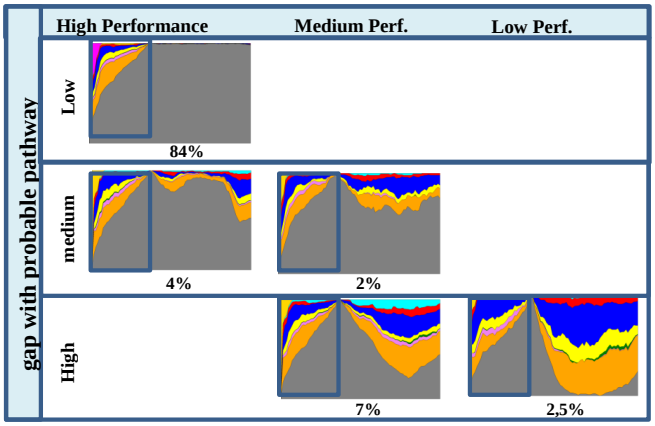


Table 3: Who is over/under-performing 3 years after living school when the situation at 3 years is a **Fixed-term contract**? Chronogram of the cohort of school leavers in 2004 . Employment pathways in terms of contracts : 1- Open-ended, 2- Fixed-term, 3- Qualification, 4- Subsidised work, 5- Temping, 6- Unemployment, 7- Inactivity, 8- Training, 9- Studies

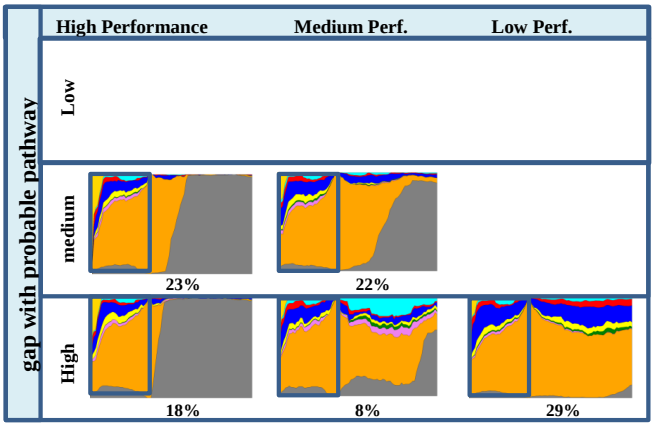


Table 4: Who is over/under-performing 3 years after living school when the situation at 3 years is a **Temporary work**? Chronogram of the cohort of school leavers in 2004 . Employment pathways in terms of contracts : 1- Open-ended, 2- Fixed-term, 3- Qualification, 4- Subsidised work, 5- Temping, 6- Unemployment, 7- Inactivity, 8- Training, 9- Studies

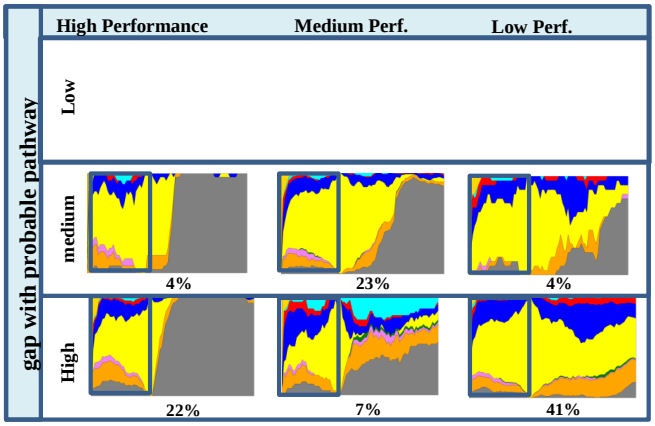


Table 5: Who is over/under-performing 3 years after living school when the situation at 3 years is **Subsidised work**? Chronogram of the cohort of school leavers in 2004 . Employment pathways in terms of contracts : 1- Open-ended, 2- Fixed-term, 3- Qualification, 4- Subsidised work, 5- Temping, 6- Unemployment, 7- Inactivity, 8- Training, 9- Studies

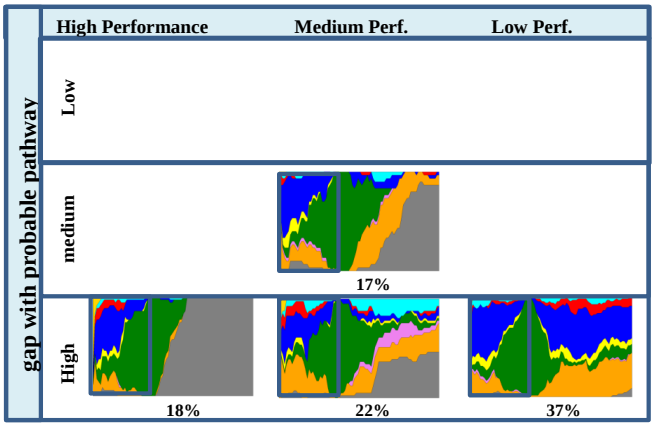
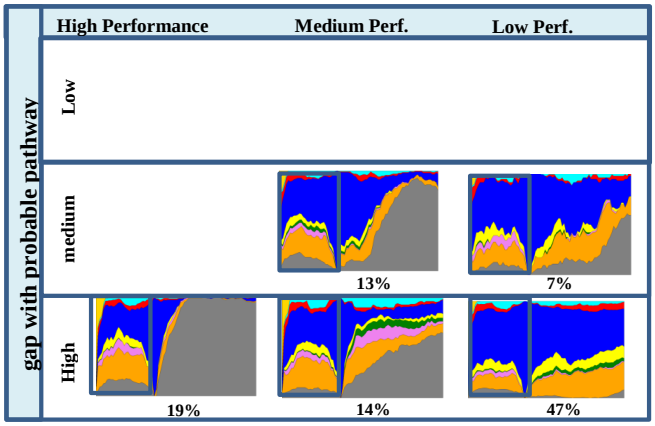


Table 6: Who is over/under-performing 3 years after living school when the situation at 3 years is **Unemployment**? Chronogram of the cohort of school leavers in 2004 . Employment pathways in terms of contracts : 1- Open-ended, 2- Fixed-term, 3- Qualification, 4- Subsidised work, 5- Temping, 6- Unemployment, 7- Inactivity, 8- Training, 9- Studies



Conclusion

A comparison of the pathway achieved by an individual with the probable pathway enables the potential that an individual achieves in his/her pathway to be taken into account. The method used in this article enables both an examination of the absolute performance of an individual in relation to others and also the relative performance in relation to his/her own individual potential. The essential contribution of this article is to explain how our method takes into account the potential of an individual and can draw simultaneously on the two criteria that are the absolute performance and gap with probable pathway. This contribution is derived directly from the method and the metric presented in the methodology section.

In terms of application, we have been able to classify young people entering the labour market in relation to their ability to improve their situation by capitalising on their activity in employment. The methodology, significantly, enabled us to distinguish performance in absolute terms, due to qualifications and social categories (as mentioned in several studies), and also to relative performance linked to young peoples' proactive approach to job seeking.. In this article we have highlighted the difference in potential between different employment status groups. Moreover, the methodology we employed offers numerous possibilities of further exploration beyond status categories. We intend to use it to analyse the impact of companies on the provision of secure jobs; in particular to verify if large companies, companies belonging to networks or family-owned companies have the same perspectives. The methodology should enable us to identify cases where a company is able to affect the potential of an individual, from a company that recruits young people who already show good potential. In the same way, through an analysis of perceived discrimination, it could enable us to resolve the traditional problem of distinguishing outcomes resulting from the negative impact of discrimination from outcomes that result from a personal feeling of failure.

References

- Abbott, A. (1983) Sequences of social events: concepts and methods for the analysis of order in social processes. Hist. Meth., 16, 129–147.

- Benzecri J.P., 1973, L'Analyse des Données : TIIB n°2 : représentation Euclidienne d'un Ensemble fini de masses et de distances, Paris, Dunod, p. 65-95.

- Céreq – Centre d'études et de recherches sur les qualifications, 2007. *Quand la carrière commence… Les sept premières années de vie active de la Génération 98,* Marseille.

- Elzinga, C. H. and Studer, M. (2015) Spell sequences, state proximities and distance metrics. Sociol. Meth. Res.,44, 3–47.

- Grelet, Y. (2002) Des typologies de parcours: méthodes et usages. Notes de Travail Génération 92. Céreq, Paris.

- Joseph O., Lemière S., Lizé L., Rousset P., (2013), The Feeling of Dis-crimination and Job-Market Entry in France, Brussels Economic Review , Editions du DULBEA, 2013, 56 , pp.5-42

- Halpin, B. (2010) Optimal matching analysis and life-course data: the importance of duration. Sociol. Meth. Res.,38, 365–388.

- Massoni, Olteanu, Rousset (2009) Career-Path Analysis Using Optimal Matching and Self-Organizing Maps, Advances in self Organizing maps, Lecture Notes in computer science, vol 5629, 2009, Springer Berlin / Heidelberg.

- Massoni, Olteanu, Rousset. Career-path analysis using drifting Markov models (DMM) and self-organizing maps. MASHS, 2010, Lille, France. 2010.

- Robette,N. and Bry, X. (2012) Harpoon or bait?: a comparison of various metrics in fishing for sequence patterns.Bull. Sociol. Methodol., 116, 5–24.

- Robette N., Thilbault, N., (2008), « Analyse harmonique qualitative ou méthode d'appariement optimal? Une analyse exploratoire de trajectoires profes-sionnelles », Population, 63(4), 621-646.

- Rousset P., Giret J.F., (2007), « Classifying qualitative time series with SOM: the typology of career paths in France », in Sandoval F., Prieto A., Cabes-tani J., Grana M. (ed.), Computation and Ambiant Intelligent, Iwann 2007 proceeding, Lecture Note in Computer Science, Berlin, Springer, p. 757-764

- Rousset, P., Giret, J.-F. and Grelet, Y. (2012) Typologies de parcours et dynamique longitudinale. Bull. Sociol. Methodol., 114, 5–34.

- Studer, M. and Ritschard, G. (2014) A comparative review of sequence dissimilarity measures.Working Paper 33. Swiss National Center of Competence in Research LIVES, Geneva.

- Studer, M. and G. Ritschard (2015), What matters in differences between life trajectories: A comparative review of sequence dissimilarity measures,Journal of the Royal Statistical Society, Series A. (Early View, Open Access), doi: 10.1111/rssa.12125.

- Ritschard, G., M. Studer, R. Buergin (2015), Package `TraMineRextras', CRAN

- Torgerson W.S., (1958), Theory and methods of scaling, Wiley, New-York.

- WU L., (2000), Some comments on "Sequence analysis and optimal matching methods in sociology, review and prospect", Sociological methods and research, vol. 29(1), p.41-64