

Estimation of latent ageing profiles from heterogeneous population

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Subject of the project: It has long been recognized that the demographics of developed societies such as France are undergoing a fundamental change, with people living longer lives, and as a consequence experiencing a longer period of frailty in old age. This has immediate implications for economy and labour force dynamics, as well as the social welfare system (Tinker, 2002). Increasing efforts are being made to improve our understanding of this new phenomenon. For this purpose, many countries have organized a large scale national survey related to ageing over the years, offering a complex and comprehensive view of the representative samples of the population. Our aim is to utilize the national longitudinal survey data to improve our understanding of the ageing process on a finer scale and to aid both individual and policy-level decision making. In particular, as the population, by definition, is a mixture of very heterogeneous entities, it is vital to characterise the varying experiences of ageing in order to understand the needs of individuals and to quantify the impacts of any future policy changes.

The fundamental characteristics of such types of data are dependent and irregularly sampled (trajectory) data over time, which cannot be easily transformed into the standard framework of independent tabular-like samples. Longitudinal data analysis is a fundamental tool to understand changes over time, especially, in the context of studying the ageing process (Daskalopoulou et al. 2016). Earlier works have focused on creating an indicator such as frailty index or healthy ageing index and identify the factors that are associated with the indicators, based on relatively simple modelling assumptions. Although it is a convenient summary, ageing is a complex process that affects not only the physical and mental but also the emotional well-being of individuals, and these aspects are closely linked. In addition, the effect of time cannot be simply treated as an instance of the survey (waves), as often been done. Our idea is that time should reflect the individual evolution related to age.

The primary objectives of this project are to develop advanced and flexible statistical modelling techniques to quantify the heterogeneity of the ageing profiles of the population. In particular, we would like to distinguish the chronological age from the latent biological/physiological age that derives the current state of the individual in terms of the measurable markers over time. For example, we imagine that there is a latent non-linear time transformation that each individual experiences over the years.

Propensity to develop certain types of ailments observed among the ageing population is most likely to be associated with genetic variation. Understanding the variation of the genetic profiles would enhance our understanding and characterisation of the complex ageing process. Although the genetic data is not often directly available from national survey data, it would be nevertheless possible to study the link between the characteristics observed in the population and those available on the publicly available genetic database such as UK biobank. The second objectives is to utilize the genetic database to develop an alternative method to study and quantify the effect of the chronological age and the latent biological/physiological age.

Profiles of the candidate: The candidate is expected to have a good knowledge in advanced mathematical and statistical modelling and methods, with competence in computing and programming using R, python or matlab. Familiarity with longitudinal data analysis, functional data analysis, graphical models or machine learning would be appreciated. A good command of English in both oral and written communication is required.

References

- [1] Daskalopoulou, C., Stubbs, B., Kralj, C., Koukounari, A., Prince, M., and Prina, A.M. (2016) Physical activity and healthy ageing: A systematic review and meta-analysis of longitudinal cohort studies. *Ageing Research Reviews* 38, 6-17,
- [2] Tinker, A. (2002). The social implications of an ageing population. Introduction. *Mechanisms of Ageing and Development*, 123(7), 729–735.