Bayesian estimation of transition probabilities in multi-state models: study of hospitalization of severe influenza cases

Lesly Acosta[1], *Carmen Armero*[2]

[1]lesly.acosta@upc.edu, Department of Statistics and Operations Research, Universitat Politècnica de Catalunya, Barcelona-TECH

[2] Departament d'Estadística i Investigació Operativa, Universitat de València, Spain.

Multi-state models are survival models that study the transit of individuals in a target population between different states over time. In medical contexts, states often represent different situations of illness and/or health. Outcomes of interest in these models are times between transitions and trajectories through the states of the process. Our work focuses on the second issue raised.

Transition probabilities between states are conditional probabilities generated by binomial or multinomial sampling models. The Bayesian approach is adopted to estimate the posterior distribution for these conditional probabilities using conjugate Beta-Binomial and Dirichlet-Multinomial models. In addition, we account for the posterior distribution of the unconditional probabilities associated to the different absorbing states of the model by means of simulation tools.

Data for the analysis were collected from a retrospective cohort study of 1306 hospitalized laboratory confirmed influenza (SHLCI) patients registered by the 14 hospitals included in the Influenza Surveillance System of Catalonia (PIDIRAC) from 1 October 2017 to 22 May 2018. All patients were initially attended by a physician at admission registration, and then were redirected to either Ward 1 or to ICU. Patients on ward 1 could be sent to ICU, discharged home, derived to a long-term care facility or die. Patients in ICU can die or, if they improve, be sent to a second ward of the hospital, from where they can die, be discharged home or be sent to a long term facility center.

The results of the combined use of the Bayesian approach within a multi-state model framework are advantageous. The posterior distributions obtained would contain all relevant information over the transition probabilities of interest, and thus would also allow to gain a better insight of the clinical evolution of the influenza disease. Overall, they may be a useful tool in the effective management of Influenza hospitalized patients during peak influenza epidemic activity.

Keywords: Conditional probabilities; Confirmed influenza hospitalization; Survival analysis.