Mover-Stayer Models

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The Mover-Stayer (MS) model is an extension of the MARKOV CHAIN MODEL for dealing with a very specific type of unobserved heterogeneity in the population. The population is assumed to consist of two unobserved groups (latent classes): a stayer group containing persons with a zero probability of change, and a mover group following an ordinary Markov process. Early references to the MS model are Blumen, Kogan, and McCarthy (1955) and Goodman (1961). Depending on the application field, the model might be known under a different name. In the biomedical field, one may encounter the term long-term survivors, which refers to a group that has a zero probability of dying or experiencing another type of event of interest within the study period. In marketing research, one uses the term brand-loyal segments as opposed to brand-switching segments. There is also a strong connection with zero-inflated models for binomial or Poisson counts.

Suppose the categorical variable Y_t is measured at T occasions, where t denotes a particular occasion, $1 \leq t \leq T$, D is the number of levels of Y_t, and y_t a particular level of Y_t, $1 \leq y_t \leq D$. This could, for example, be a respondent's party preference measured at 6-month intervals. The vector notation $\mathbf{Y}$ and $\mathbf{y}$ is used to refer to a complete response pattern.

A good way to introduce the MS model is as a special case of the mixed Markov model. The latter is obtained by adding a discrete unobserved heterogeneity component to a standard Markov chain model. Let X denote a discrete latent variable with C levels. A particular latent class is enumerated by the index x, $x = 1, 2, ..., C$. The mixed Markov model has the form

$$P(\mathbf{Y} = \mathbf{y}) = \sum_{x=1}^{C} P(X = x)P(Y_1 = y_1|X = x) \prod_{t=2}^{T} P(Y_t = y_t|Y_{t-1} = y_{t-1}, X = x)$$

As can be seen, latent classes differ with respect to the initial state and the transition probabilities. A MS model is obtained if $C = 2$ and $P(Y_t = y_t|Y_{t-1} = y_t, X = C) = 1$ for each y_t. Note that $P(X = x)$ is the proportion of persons in the mover and stayer classes, and $P(Y_1 = y_1|X = x)$ is the initial distribution of these groups over the various states.

In order to identify the MS model, we need at least three occasions, but it is not necessary to assume the process to be stationary in the mover chain.

With three time points ($T = 3$) and two states ($D = 2$), a non-stationary MS model is a saturated model.

A restricted variant of the MS model is the Independence-Stayer model in which the movers are assumed to behave randomly; that is, $P(Y_t = y_t | Y_{t-1} = y_{t-1}, X = 1) = P(Y_t = y_t | X = 1)$. Another variant is obtained with absorbing states, such as, for example, first marriage and death. In such cases, everyone starts in the first state, $P(Y_1 = 1 | X = x) = 1$, and backward transitions are also impossible in the mover class, $P(Y_t = 2 | Y_{t-1} = 2, X = C) = 1$.

The formulation as a mixed Markov model suggests several types of extensions, such as the inclusion of more than one class of movers or a LATENT MARKOV MODEL variant that corrects for measurement error. Another possible extension is the inclusion of covariates, yielding a model that is similar to a zero-inflated model for counts.

Two programs that can be used to estimate the MS model and several of its extensions are PANMARK and LEM.

References

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