

Modeling Contagiousness of Diarrhea Diseases: A Spatial Probit Model

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Abstract

Every year some two million death including some 1.7 million deaths among children under five years old are caused by diarrhea diseases. Identifying the diseases risk factors becomes crucial in designing an effective intervention for reducing the diseases occurrences. Accordingly, a researcher has to translate the diseases behavior in a mathematical model accurately to obtain good estimates. Nevertheless, we observed that none of the researchers has taken contagiousness into account in a diarrhea prevalence model. In this paper, we propose a spatial probit model to accommodate the contagiousness of diarrhea. Particularly, we propose a format of contiguous matrix used in the model. Although we cannot illustrate the proposed model fully, we apply the model to the data sample of children under five years old in a district in Indonesia. We find out that the occurrence of diarrhea in a child relates to the diarrhea occurrence of the other children in the same area.

Keywords: Bayesian, contagiousness, contiguous matrix, diarrhea, probit.

1. Introduction

Diarrhea is one of the important health problems in developing countries, especially among preschool children. Every year some two million death including some 1.7 million deaths among children under five years old are caused by diarrhea diseases [1]. In Indonesia, about 12 million diarrhea cases are reported every year [2] resulting in 35.5 thousand deaths [3]. To improve this condition, identification of diarrhea risk factors becomes crucial in designing effective public health interventions for reducing diarrhea occurrences. In order to access diarrhea risk factors, a researcher has to translate diarrhea behavior in a mathematical/statistical model hence he/she can measure the magnitude and test the significance of potential diarrhea risk factors.

Generally, a good model should describe the phenomena of interest as precisely as possible to obtain a good estimates of the parameters of interest. Nevertheless, in modeling diarrhea prevalence, we observe that researchers ignore one of the important natures of diarrhea that is contagiousness (e.g. [4], [5]). The contagiousness of diarrhea can be translated as the occurrence of diarrhea in one person can be caused by infectious substances originating from another person who suffers from diarrhea at first in a diarrhea capture area. Here, we infer that the diarrhea occurrence in one person depends on the diarrhea occurrence in other neighboring persons. Ignoring dependency among observation, we may obtain biased estimates and incorrect standard errors [6].

To account dependency among observations, Anselin [7] introduced the basic idea of spatial modeling. He translated dependency among observations in a weight or contiguity matrix and a lagged spatial dependency parameter. LeSage [8] mentioned six types of contiguity matrix, but none of them fit to describe the dependency in diarrhea occurrences. None of the matrices takes the occurrence time into account. In this paper, we propose a contiguity matrix which can be used not only in diarrhea but also other contagious diseases modeling. The proposed matrix is integrated in a spatial logit model. Nevertheless, due to data limitation, we could not apply the proposed contiguity matrix fully.

2. Diarrhea Pevalence in a Probit Model

Researchers often use probit model in modeling disease prevalence. By means of a probit model, one can predict the probability of diarrhea occurrence for a group of subject with a particular