Public Abstract

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Title: Bayesian Semiparametric Spatial and Joint Spatial Temporal Smoothing

Over the past decades a great deal of effort has been expended in the collection and compilation of high quality data on cancer incidence and mortality in the United States. Most of this work is done by governmental agencies such as the National Cancer Institute's Surveillance Epidemiology and End Results (SEER) program and The Centers for Disease Control and Prevention's (CDC) National Program of Cancer Registries (NPCR) who jointly prepare the annual U.S. Cancer Statistics (USCS) report on cancer mortality and incidence in the nation. Other reports are prepared by the North American Association of Central Cancer Registries (NAACCR) and by state and regional registries, such as the Missouri Cancer Registry, the Oregon State Cancer Registry \cite{Oregon} and the Iowa Cancer Registry, and Greater Bay Area Cancer Registry . These data have largely been used in the creation and disbursement of descriptive statistics concerning the state of cancer in the U.S. The information available through these statistics present limited information concerning spatial or temporal trends in the course of cancer in the U.S. Recently, there have been more efforts made to investigate these trends in cancer incidence and mortality. For public health policy makers, there are two important initial questions about any disease, and cancer specifically, that need to be answered. First, how has the course of the disease changed over time; have incidence or mortality rates increased or decreased? Secondly, are there specific regions where the disease is more or less prevalent than others, and has this changed over time? These are important questions that provide feedback both to assess the effectiveness of public health policy and to provide guidance as to the best allocation of limited resources in preventing the spread of disease. Smoothing is the practice of modeling data in order to eliminate random variation from the observed data and provide estimates of the underlying process. Model are developed here beginning with an additive model that incorporates spatio-temporal smoothing of the observed data and provide estimates of the underlying process. Models are developed here beginning with an additive model that incorporate spatio-temporal smoothing of the observed number of deaths in each county in Missouri due to female breast cancer from 1969 through 2001. These data are stratified into eleven three year time periods, and into four ten year age-group periods, $40-49$, $50-59$, $60-69$ and $70+$ years of age. The next model developed uses an intrinsic auto regressive (IAR) prior to smooth the temporal trends in the data and a conditional auto-regressive (CAR) prior for the spatial effects. These two are combined in a single joint prior for spatio-temporal effects. The third model is a fully smoothed spatio-temporal model, using the IAR prior for the temporal trends and a spatial prior based on the thin-plate spline solution. At each step in the process the models proposed show improvement over the previous ones proposed by comparison using two different methods of model selection. These results open the door for further exploration including an alternate parameterization of the prior for the thin-plate spline smoothing parameter and for the joint modeling of both breast and cervical cancer mortality rates.