AN ANALYSIS OF A BIVARIATE TIME SERIES IN WHICH THE COMPONENTS ARE SAMPLED AT DIFFERENT INSTANTS

À la recherche du temps perdu

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It is desired to express the relationship between the components of a bivariate time series. What is unusual is that the components are observed at different times and that the observation times are irregularly distributed. The problem of different sampling times is dealt with by interpolating the values of the dependent series to the times of the independent. This is followed by nonparametric regression to estimate the relationship. The research is motivated by data collected at a station along the Solimões River in central Brazil and also at a second station along a branch of the Solimões. Of interest to geographers is the possible change in the proportion of the Solimões waters entering the branch. This is because an increased flow of Solimões water into the branch might lead to the branch's widening and becoming the main stream. This could have substantial environmental effects.

1. Introduction

Constance van Eeden has worked in many areas of statistics. Perhaps the problem that she has studied that is closest to the work of this paper is that of density estimation via kernels, e.g., van Eeden (1985). Her work on that problem, like on many others, has been via very careful analysis.

The genesis of our work is that H. O'R. Sternberg, Professor of Geography at Berkeley, visited with a problem and a data set. In statistical terms the problem concerned the development of an instantaneous relationship between the components of a bivariate time series. The difficulty was that the components were sampled at different instants. Further the spacings of the time points were irregular. The series were river flow rates measured at two places of a river system in Central Brazil.

According to Brazilian usage, the name Amazonas is applied to the Amazon river below the mouth of the Rio Negro. Upstream from the city of Manaus the main stem is known as the Solimões. Characteristically, the waters of the Solimões-Amazonas deposit, fork and come together, embracing islands approximately lenticular in shape. Strung along the river for many hundreds of kilometers, these islands split the stream bed into a master channel and one or more side channels, called *paranás*. One such channel exists just upstream from the mouth of the Rio Negro, where the Solimões (Amazon) sends off a branch, the Paraná do Careiro, that rejoins the trunk stream