Linear Regression With Multiple Changepoints: An Application to Monthly Mean United States Temperature trends

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Abstract:

Changepoints (inhomogeneities) are present in many climatic time series. Changepoints are physically plausible whenever a station location is moved, a recording instrument is changed, a new method of data collection is employed, an observer changes, etc. In many climate settings, the time of the changepoint is known. A typical US station sees at least 4 changepoints over a century of operation. If the data indeed has a changepoint, then an ordinary regression model obviously leaves the data poorly explained. In a study of monthly mean temperature trends, we introduce a periodic simple linear regression model under multiple changepoints, which allows for a mean shift at each changepoint time and simultaneously estimates both trend and changepoint effects. As the number of stations with good quality data has now increased over previous studies, the spatial picture of climate change in the United States has become more complete and reliable. Overall, the results suggest more warming than previous studies. Finally, the large sample properties of the least squares trend estimate in a simple linear regression model with multiple changepoints are examined and its asymptotic normality is established under wide generality.