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Research Paper

Regional vector stationary time series

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ABSTRACT : Rainfall of a region can be treated as a vector time series. In this article, we have treated rainfall of Marathwada of Maharastra state as a vector $\bar{r} = (X_1, X_2, \ldots X_5)$, where, $X_1 =$ rainfall at Aurangabad, $X_2 =$ rainfall at Parbhani, $X_3 =$ rainfall at Osmanabad, $X_4 =$ rainfall at Beed and $X_5 =$ rainfall at Nanded. Thus, we get a vector time series, $\overline{T} = (r_{ij})$, i = 1, 2 , …….n years, j = 1,2….5 districts(districts having five rainfall stations). This opens up very interesting questions. How are the properties of T related to component time series? A preliminary discussion of properties of vector time series and possible testing methodology for stationary property precedes the actual application to regional rainfall data.

KEY WORDS : Time series, Vector time series, Regression analysis, Auto covariance, Auto-correlation

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Vector time series can occur naturally in real life. For example, if we consider the rainfall over a region, where rainfall is recorded over a cluster of recording stations, we get a vector rainfall time series. To what extent the properties of component time series determine the properties of the regional vector time series is worth looking into.

In what follows are first discussed in relation to, few properties of vector time series and then tried to compute the same for the regional annual rainfall record of Marathwada by using data from 1971 to 2002 .

Basic concepts :

Basic definitions and few properties of vector stationary time series are given in this section.

Definition 1: A random vector:

A random vector, $\overline{X} = (X_1, X_2, \ldots X_K)$ is a single valued function whose domain is Ω, whose range is in Euclidean n-space R^n and which is B-measurable, *i.e.* for every subset R C R^n $\{\omega \varepsilon \Omega \mid X_1(\omega) \ldots X_K(\omega) \varepsilon R\} \varepsilon B$. A random vector will also be called an K- dimensional random variable or a vector random variable.

If $X_1, X_2 \ldots X_K$ are k random variables and $\overline{X} = (X_1, X_2, \ldots X_K)$ is a random vector , [15].

Definition 2 : A vector time series :

Let (Ω, C, P) be a probability space ; with Ω sample space; $C = \sigma(\Omega)$. Let T be an index set and N = {1,2... k}. A real valued vector time series is a real valued function $X_{it}(\omega)$, i = 1,2…k defined on $N \times T \times \Omega$ such that for each fixed $t \varepsilon T$, $i \varepsilon N$, $X_{it}(\omega)$ is a random variable on (Ω, C, P).

A vector time series can be considered as a collection $\{X_{it} : t \varepsilon T\}$, i =1,2 ... k of random variables [11].

Definition 3 : Stationary vector time series:

A process whose probability structure does not change with time is called stationary. Broadly speaking a vector time series is said to be stationary, if there is no systematic change in mean *i.e.* no trend. There is no systematic change in variance.

Let $\overline{X} = (x_1, x_2, \ldots x_n)$ be realizations of random variables $(X_1, X_2, \ldots X_K)$.

Definition 4 : Strictly stationary vector time series :

A vector time series is called strictly stationary, if their