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## ANALYSIS OF PERSISTENCY IN THE MONTHLY COIMBATORE RAINFALL

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## ABSTRACT

India is basically an agricultural country and the success or failure of the harvest and water scarcity in any year is always considered with the greatest concern. So, we predict that rainfall in the certain period. The Pearson correlation coefficient is computed to check the significance of persistency of Coimbatore monthly rainfall data from the year (1961 -1990). The Pearson correlation shows insignificant results so, a specific method chi-square ( $\chi^2$ ) test statistics is used in this paper for finding the persistency of Coimbatore rainfall.

## KEYWORDS

chi-square, pearson correlation coefficient, persistency, rainfall, significance.

## INTRODUCTION

Rainfall is most essential for our life. Rainfall is important for food production plan, water resource management and all activity plans in the nature. The occurrence of prolonged dry period or heavy rain at the critical stages of the crop growth and development may lead to significant reduce crop yield. India is an agricultural country and its economy is largely based upon crop productivity. Thus rainfall prediction becomes a significant factor in agricultural countries like India (Kannan et. al, 2010). When an area is subject to the influences of large-scale climatic phenomena, the local weather patterns show features of persistence- at times for several weeks. The persistence may influence consecutive months of weather patterns and rainfall yields recorded in those months. In such cases, statistical independence between monthly yields would not exist.

## PEARSON CORRELATION COEFFICIENT

Correlation is a measure of the strength of relationship between random variables. The Pearson correlation coefficient is used for this analysis and is defined as

$$r = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^n (X_i - \bar{X})^2} \sqrt{\sum_{i=1}^n (Y_i - \bar{Y})^2}} \quad (1)$$

Where X and Y are the observations of two variables and n is the number of observations.

Pearson correlation coefficient is a measure of the strength of the association between two variables. It ranges from -1 to +1. The other way of defining the correlation between two variables X and Y is:

$$r(X, Y) = \text{Covariance}(X, Y) / \{\text{Variance}(X) * \text{Variance}(Y)\}^{1/2} \quad (2)$$

r is called the Product Moment Correlation Coefficient or simply the Correlation Coefficient. It is a number that summarizes the direction and closeness of linear relations between two variables. The sign (+ or -) of the correlation defines the direction of the relationship. When the correlation is positive ( $r > 0$ ), it means that as the value of one variable increases, so does the other.

If a correlation is negative ( $r < 0$ ), it indicates that when one variable **increases**, the other variable **decreases**. This means there is an inverse relationship between the two variables. This coefficient, r, is a relative measure of the degree of persistence. However, this test implies that persistence, if it exists, is equally active throughout the recorded monthly rainfall sequence. In other words, it does not give pattern of persistence effects, but only evidence of its existence (Hoel, P.G; 1962). The Product Moment Correlation Coefficient computed for the monthly Coimbatore rainfall data gives no evidence of significant persistent effects. Since, the Product Moment Correlation Coefficient results insignificant, a more specific test is required to determine the persistence of Coimbatore rainfall.

## CHI SQUARE TEST

A method to test for persistence of this type would be to check whether the sign of the deviation of the monthly rainfall yield from its monthly mean is consistently followed by a similar deviation in the following month. This can be achieved by using a standard statistical test for independence in a 2 x 2 contingency table (Wetherill, 1967).

TABLE 1: DEVIATION OF MONTHLY RAINFALLS FROM THE MEAN

		Month (m + 1)		
		Below mean	Above mean	Total
Month (m)	Below mean	A	B	A+B
	Above mean	C	D	C+D
	Total	A+C	B+D	A+B+C+D

Table 1 represents the frequency of occurrence of monthly rainfall yields above and below the respective means of two consecutive months. A  $\chi^2$  test statistic  $\chi^2 = (AD-BC)^2 / (A+B+C+D) / (A+B)(A+C)(B+D)(C+D)$

is used as the criterion of acceptance or rejection of the null hypothesis of independence. The null hypothesis is rejected if

$$\chi^2 > \chi^2_{\alpha, d} \quad (3)$$

where  $\chi^2_{\alpha,d}$  is obtained from  $\chi^2$  tables corresponding to  $\alpha$ , the level of significance and d, the number of degrees of freedom. For a 2 x 2 contingency table the number of degrees of freedom d, is one.

## RESULTS

The 30 years of complete monthly rainfall records for Coimbatore were tested for persistence. The  $\chi^2$  test was applied to the consecutive pairs of months throughout the year. Calculations were performed using equation 3. The null hypothesis is rejected if  $\chi^2 > \chi^2_{\alpha,d} = 3.84$  for  $\alpha = 5\%$  and  $d=1$ . Results of the test statistic  $\chi^2$  are listed in table 2.

Table 2. Results of applying the test statistic  $\chi^2$  to Coimbatore rainfall records. Persistence is assumed if  $\chi^2 > \chi^2_{\alpha,d} = 3.84$ . The level of significance for  $\alpha = 5\%$  is given below.

Months	$\chi^2$
January – February	0.0680
February – March	0.7187
March – April	0.625
April – May	0.7408
May – June	0.0893
June – July	1.5311
July – August	0.0487
August – September	0.2715
September – October	0.6206
October – November	0.9184
November – December	1.1552
December – January	0.6394

## CONCLUSION

Thus, by Pearson correlation coefficient the persistence effect is found to be insignificant. The  $\chi^2$  test also shows insignificant persistence of rainfall between the pairs of months throughout the year. This test does not show satisfactory results at the level of significance for  $\alpha = 5\%$ . This persistence pattern is important in some hydrological studies, so some other method can be used to find the persistent effect.

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