Letters to the Editor

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STUDY OF 5-DAY RAINFALL OF KOLABA DISTRICT IN RELATION TO RAINFALL OF BOMBAY

Jagannathan and Ramamurti (1961) evolved an objective technique for forecasting 5-day rainfall over Bombay during the monsoon season. The aim was to predict the class (S, N or A, each of which has a climatological probability of one-third) in which the rainfall of Bombay during the successive pentads of the southwest monsoon season will fall. The prediction parameters, their influence on the pentad rainfall and the efficiency of the technique were determined statistically. Sajnani (1962) working on similar lines evolved the necessary techniques for forecasting pentad rainfall of the monsoon season over Calcutta.

With a view to utilise the above techniques for forecasting pentad rainfalls over wider areas, a study was undertaken to estimate the representativeness of the single station pentad rainfall to the synchronous rainfalls over different areas surrounding the 'pilot station'. Once such regression factors connecting the pentad rainfall of the 'target area' to the pentad rainfall of the 'pilot station', and their reliance are established the forecasting of the total rainfall over the area during the period and indication of the 'confidence interval', which are very vital for planning agricultural operations, can be achieved by simple arithmetical procedure. The study made in respect of Kolaba District rainfall in relation to the rainfall at Bombay is reported here.

Utilising the daily rainfall recorded at all the raingauge stations in Kolaba district*, the mean rainfall of the district during the different pentads of the monsoon season was calculated. These amounts were correlated with the rainfall at Bombay for the same pentad. The entire monsoon season comprising of the pentads 31 to 54 was divided into 4 periods roughly corresponding to the four monsoon months.

Month	Pentads	Period
June	31—36	31 May to 29 Jun
July	37—42	30 Jun to 29 Jul
August	43—48	30 Jul to 28 Aug
September	49—54	29 Aug to 27 Sep

The relationship was determined in respect of each of the periods.

Table 1 shows the two way frequency distribution of pentad rainfall of June. As this suggests a linear relationship, regression equations† connecting the pentad rainfall of Kolaba district y and rainfall of the same pentad at Bombay x were evolved in the usual manner by using the method of least squares

$$y = ax + b \qquad (1)$$

The standard error of estimate was calculated by using the formula

$$S_{xy} = \sqrt{\Sigma(y-y')^2/n-2}$$

where y' is the value calculated from equation (1) and n the number of pairs correlated. The regression equations, multiple C.Cs., and the standard error of estimate are given below.

Month	Regression equation	Multiple C.C.	Standard error
Jun	$y=0\cdot99\,x+0\cdot54$	0·88	1·83
Jul	$y=0\cdot72\,x+4\cdot83$	0·68	2·08
Aug	$y=0\cdot98\,x+2\cdot70$	0·88	1·44
Sep	$y=1\cdot30\,x+0\cdot80$	0·88	1·42

*The stations utilised are (1) Alibag, (2) Panvel, (3) Uran, (4) Karjat, (5) Matheran, (6) Pen, (7) Roha, (8) Mangaon, (9) Mahad, (10) Shriwardhan, (11) Murud, (12) Sudhagad, (13) Mhasla, (14) Poladpur and (15) Khalapur

†For this purpose the actual rainfalls at Bombay and over Kolaba were utilised

TABLE 1

Frequency distribution of pentad rainfall of June

Kolaba district rainfall	Bombay rainfall (inches)											
	$<\frac{1}{2}$	0·50 to 0·99	1·00 to 1·99	2·00 to 2·99	3·00 to 3·99	4·00 to 4·99	5·00 to 5·99	6·00 to 6·99	7·00 to 7·99	8·00 to 8·99	9·00 to 9·99	10·00 and more	Total
$<\frac{1}{2}$ inch	18		1										19
0·50—0·99	2			1									3
1·00—1·99		2	1	1	1	1				1			7
2·00—2·99		1	3	2	1		1						8
3·00—3·99				2		1		1					4
4·00—4·99			1				1						2
5·00—5·99				1	1			1					3
6·00—6·99					1	1							2
7·00—7·99					1							1	2
8·00—8·99												2	2
9·00—9·99													
10·00 and more								1	2	1		4	8
Total	20	3	6	7	5	3	2	3	2	2		7	60

TABLE 2

Percentage frequencies of Subnormal, Normal and Abnormal rainfall in Kolaba district corresponding to Subnormal, Normal and Abnormal rainfall at Bombay

		Kolaba district rainfall															
		June				July				August				September			
		S	*N*	*A*	Total	*S*	*N*	*A*	Total	*S*	*N*	*A*	Total	*S*	*N*	*A*	Total
Bombay rainfall	*S*	79	21	0	100	88	12	0	100	77	23	0	100	76	24	0	100
	N	20	60	20	100	26	54	20	100	48	48	4	100	25	75	0	100
	A	8	27	65	100	7	35	58	100	0	27	73	100	0	13	87	100
		Coefficient of contingency = 0·63				Coefficient of contingency = 0·62				Coefficient of contingency = 0·64				Coefficient of contingency = 0·71			

The *S*, *N* and *A* (Subnormal, Normal and Abnormal) values of Bombay and Kolaba district are related as indicated in Tables 2 and 3.

It is seen that the number of occasions when rainfall in the "target area" (Kolaba district) was of the same class (*S*, *N*, *A*) as rainfall of the "pilot station" (Bombay) is 66 to 68 per cent in June to August and 79 per cent in September. The number of occasions when rainfall in the target area differed from rainfall of the pilot station by one class is 12 to 21 per cent, when the target area received more rain; and 19 to 37 per cent, when it received less rain than the pilot station. There were 7 to 8 per cent occasions in June and July when rainfall in the target area was two classes lower

TABLE 3

Percentage number of occasions when rainfall of Kolaba district was in the same or different class from Bombay rainfall

Percentage number of occasions when rainfall of Kolaba district was	June	July	August	September
1. In the *same* class (*S*,*N*,*A*) as Bombay rainfall	68	66	66	79
*2. One class *higher* than Bombay rainfall (*i.e.*, Kolaba rainfall was *N* when Bombay rainfall was *S*, and *A* when Bombay rainfall was *N*)	21	16	13	12
*3. Two classes *higher* than Bombay rainfall (*i.e.*, Kolaba rainfall was *A* when Bombay rainfall was *S*)	0	0	0	0
†4. One class *lower* than Bombay rainfall (*i.e.*, Kolaba rainfall was *S* when Bombay rainfall was *N*, and *N* when Bombay rainfall was *A*)	24	31	37	19
†5. Two classes *lower* than Bombay rainfall (*i.e.*, Kolaba rainfall was *S* when Bombay rainfall was *A*)	8	7	0	0

*Kolaba district received more rain than Bombay †Kolaba district received less rain than Bombay

than rainfall of the pilot station. From this it would appear that Bombay rainfall has a slight tendency to over-estimate the district (Kolaba) rainfall. The above results indicate a fairly good relationship between 5-day rainfall amounts of Bombay and Kolaba district. A further measure of the degree of association between the two rainfalls is provided by the "Coefficients of Contingency" (given at the bottom of Table 2) calculated from the contingency tables of district rainfall (A) *versus* Bombay rainfall (B) using Pearson's formula given by Yule and Kendall—

$$C=\sqrt{(G-N)/G}$$

G being the summation

$$\Sigma[N\,(Am\,Bn)^2/(Am)\,(Bn)]$$

where Am is the total of the m^{th} column, Bn the total of n^{th} row, $AmBn$ is the frequency in the cell corresponding to m^{th} column and n^{th} row and N is the total number of observations. The value of C is of the order of 0·6 for June to August and 0·7 for September.

The practical utility of this study lies in the fact that the technique for forecasting five-day rainfall of Bombay developed by Jagannathan and Ramamurti can be utilized for predicting the class (*S*, *N*, *A*) of rainfall in Kolaba district with a fairly good accuracy of about 70 per cent.

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REFERENCES

Jagannathan, P. and Ramamurti, K. M. 1961 Contingency technique applied to Medium Range Forecasting of Rainfall during the Monsoon Season in India.

Sajnani, P. P. 1962 A statistical technique for Medium Range Forecasting of Rainfall over Calcutta during the Southwest Monsoon Season.

Yule, G. U. and Kendall, M. G. 1953 *An Introduction to the Theory of Statistics*, p. 53.