Letters to the Editor

THE ESTIMATION OF CATCHMENT RAINFALL USING POLYNOMIAL METHOD

The usual techniques of estimating areal rainfall such as polygon, isohyetal method is valued considerable degree of subjectivity. Moreover, due to preparation of charts and diagrams, these techniques may not provide rapid results required for catchment modelling.

The polynomial technique depends on the presumption that point rainfall can be expressed as a polynomial function of its location vector. This is obviously valid considering the spatial variation of point rainfall.

Consider that the rainfall \( r \) at point \( (x, y) \) is expressed as a second degree polynomial of \( x \) and \( y \).

\[
r = a_1 x + a_2 x^2 + a_3 xy + a_4 y + a_5 y^2 + a_6
\]

(1)

consider a rectangular area \( O (0, 0), A (a, 0), B(a, b) \) and \( C (0, b) \), which represents the catchment satisfactorily.

Let,

\[
P_1 = \int_0^a \int_0^b x \, dx \, dy
\]

\[
P_2 = \int_0^a \int_0^b x^2 \, dx \, dy
\]

\[
P_3 = \int_0^a \int_0^b xy \, dx \, dy
\]

\[
P_4 = \int_0^a \int_0^b y \, dx \, dy
\]

\[
P_5 = \int_0^a \int_0^b y^2 \, dx \, dy
\]

\[
P_6 = \int_0^b \int_0^a \, dx \, dy
\]

The volume of rainfall over the area will be

\[
V = a_1 P_1 + a_2 P_2 + \ldots + a_6 P_6 \text{ in matrix notations}
\]

\[
V = P.A
\]

(2)

where, \( A = (a_1, a_2, \ldots, a_6) \) and \( P = (P_1, P_2, \ldots, P_6) \).

The rainfall at \( n \) points gives a system of \( n \) equations of the form (1) which may be expressed as

\[
R = FA
\]

(3)

Figs. (a-c). Isohyetal patterns of rainstorm (a) 29 July 1965 — A case of light rainfall, (b) 15 July 1965 — A case of moderate rainfall and (c) 15 July 1965 — A case of heavy rainfall

(539)
where, $R = (r_1, r_2, \ldots, r_n)$.

$F = \begin{bmatrix}
  f_{11} & f_{12} & \cdots & f_{1n} \\
  f_{21} & f_{22} & \cdots & f_{2n} \\
  \vdots & \vdots & \ddots & \vdots \\
  f_{m1} & f_{m2} & \cdots & f_{mn}
\end{bmatrix}$

From (3), $F'FA = F'R$, : $A = (F'F)^{-1} F'R$

From (2), $V = P(F'F)^{-1} F'R$

The actual weights can be obtained by dividing the proportional values by their sum. In that case we get the mean catchment rainfall.

$\bar{R} = W.R \quad (4)$

Tapi catchment (area 62272 km² between Lat. 20°5' - 22°10' and 73°45' - 75°15' Long.), having 14 stations (shown in Figs. 1(a-c) considered for the computations.

$F$ is a $14 \times 6$ matrix whose rows are obtained by substituting the values of co-ordinates in respect of origin of the rectangle for all 14 stations in

$F = (x, x^2, xy, y^2, y, 1) \ldots \ldots \ldots 14 \times 6$

From the weight matrix $WT = P (F'F)^{-1} F'$, we can obtain the actual weights for all stations. Three rainfall events along with the rectangles and isohyetes are shown in Fig. 1(a) (Light rainfall with mean of the order of 10 mm), Fig. 1(b) (medium rainfall with mean of the order 25 mm), Fig. 1(c) (heavy rainfall with mean of the order of 40 mm). The polynomial method was applied to each case separately. The computations of areal mean rainfall for these 3 events have been made by (i) Areal mean method (ii), Isohyetal method (iii) Polynomial method. The results are provided in the following Table

<table>
<thead>
<tr>
<th></th>
<th>Light rainfall event</th>
<th>Medium rainfall event</th>
<th>Heavy rainfall event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polynomial method</td>
<td>12.72</td>
<td>29.95</td>
<td>40.8</td>
</tr>
<tr>
<td>Arithmetic mean method</td>
<td>12.67</td>
<td>27.34</td>
<td>36.77</td>
</tr>
<tr>
<td>Isohyetal method</td>
<td>13.6</td>
<td>34.6</td>
<td>38.7</td>
</tr>
</tbody>
</table>

with the help of the computer, this method provides quick estimate of weights allotted to each station to be used for objective estimation of areal rainfall. These weights are the function of their location and net work density of the catchment. However, if used on operational basis, periodical verification of the results would be desirable by comparison with known standard methods.

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Reference


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661.993 : 628.51

A NOTE ON CARBON MONOXIDE AND NOISE LEVELS AT COCHIN

Industrialization and the subsequent urbanization have resulted in widespread damages to property and day to day living, notwithstanding its vital importance and basic purpose with which it has been initiated. The impact of urbanization is, sometimes, more severe than that of industrialization, particularly with regard to vehicular traffic. The vehicles (automobiles) not only emit the obnoxious gases such as carbon monoxide (CO) but also cause lot of noise, especially, when the horns are used. Some studies have been carried out for the measurement of CO and its effect on nearby shopkeepers and the traffic policeman and reported by NIOH (Annual report 1974). Vittal Murthy et al. (1979) have measured the CO levels at busy corners in Visakhapatnam. Yennavar et al. (1970) have reported the CO levels at Calcutta.

In the present note, the CO concentrations and the noise levels have been measured at selected traffic junctions at Cochin. Their variation with time has been studied. Some remedies have also been suggested.

2. The concentrations of CO were measured by means of CO detector, sensitive to concentrations of 3 ppm and above. This instrument is based on the colourimetric principle and is simple to use. It consists of an aspirator bulb for sucking the air. The detector tube containing the indicating gel should be inserted into the instrument so that the sucked in air would pass through the tube. If CO is present, the colour of the gel changes and the concentration can be read from a precalibrated colour code.

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