Computation of average rainfall over a Basin:-

In order to Compute the average rainfall over a basin or Catchment area, the rainfall is measured at a number of rain-gauge stations Suitably located in the area.

Number of rain gauge stations depend upon the area and distribution of rainfall.

If the basin or Catchment area Contains more than one rain guage station, the Computation of average rainfall may be done by the following Methods:

(1) Arithmetic Average Method.
(2) Thiessen Polygon Method.
(3) Isohytel Method.

(1) Arithmetic Average Method:-

* Simplest Method of estimating average rainfall.
* Average rainfall is Calculated by arithmetic average of recorded rainfall at various stations.
* If $P_1, P_2, P_3 \ldots\ldots P_n$ are the rainfall values measured at n number of gauge stations

$$P_{av} = \frac{P_1 + P_2 + P_3 \ldots\ldots P_n}{n} = \frac{\sum_{i=1}^{n} P_i}{n}$$

* This Method is Suitable when the rainfall is uniform.

Problem:- Using Arithmetic Average Method, find average rainfall over a Catchment - The rain gauge data is 12.6, 18.8, 14.8, 10.4 and 16.2mm

Solution:-

$$P_{av} = \frac{P_1 + P_2 + P_3 ----- P_n}{n}$$

$$P_{av} = \frac{12.6 + 18.8 + 14.8 + 10.4 + 16.2}{5}$$

$$P_{av} = \frac{72.8}{5}$$

$$\boxed{P_{av} = 14.56\text{mm}}$$

(2) Thiessen Polygon Method:-

Rainfall recorded at each station is given a weightage based on the area closed to the station -

Consider a catchment area with say, 3 raingauge Stations - Let there be 3 stations outside the Catchment, but in its neighborhood -

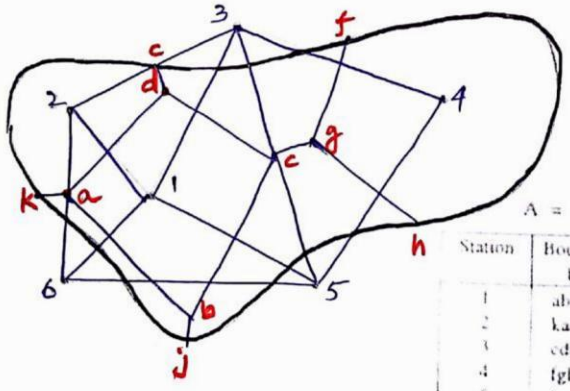
The catchment area is drawn to scale and the position of these 6 stations are plotted on it - These 6 stations are joined as to get a network of triangles -

Perpendicular bisectors are drawn to each of the sides of these triangles - These bisectors form a polygon around each station -

If the boundary of the catchment cuts the bisectors then the boundry is taken as the outer limit of the polygon.
These bounding polygons are called Thiessen Polygons. The area of these polygons is measured with a plainimeter.

Let Suppose if there are n stations with rainfall values $P_1, P_2, P_3 ---- P_n$ and $A_1, A_2, A_3 ---- A_n$ are the areas of respective Thiessen polygons, the average rainfall ove the catchment P is computed as:

$$P = \frac{P_1A_1 + P_2A_2 + P_3A_3 ----- P_nA_n}{A_1 + A_2 + A_3 ------ A_n} = \sum_{i=1}^{n} \frac{P_i A_i}{A}$$



A = total catchment area

Station	Bounded by	Area	Weightage
1	abcd	A_1	A_1/A
2	kade	A_2	A_2/A
3	cdegf	A_3	A_3/A
4	fgh	A_4	A_4/A
5	hgeby	A_5	A_5/A
6	jbak	A_6	A_6/A

Figure: Thiessen Polygon

Problem:-

Using thiesen polygon Method, find average rainfall over a catchment. The data is

Rain guage station	A	B	C	D	E
Polygon Area (km^2)	40	45	38	30	43
Precipitation (mm)	30.8	33.4	34.6	32.6	24.6

Solution:-

Rain gauge Station	Polygon Area (km^2) "A"	Precipitation P (mm)	A x P (km^2. mm)
A	40	30.8	1232
B	45	33.4	1503
C	38	34.6	1314.8
D	30	32.6	978
E	43	24.6	1057.8
Sum	193		6085.6

$$P_{av} = \frac{\Sigma (A \times P)}{\Sigma A} = \frac{6085.6}{193}$$

$$\boxed{P_{av} = 31.53 \text{ mm}}$$ Ans.

(3) Isohytel Method

Isohyet – It is a line joing points of equal rainfall magnitude.

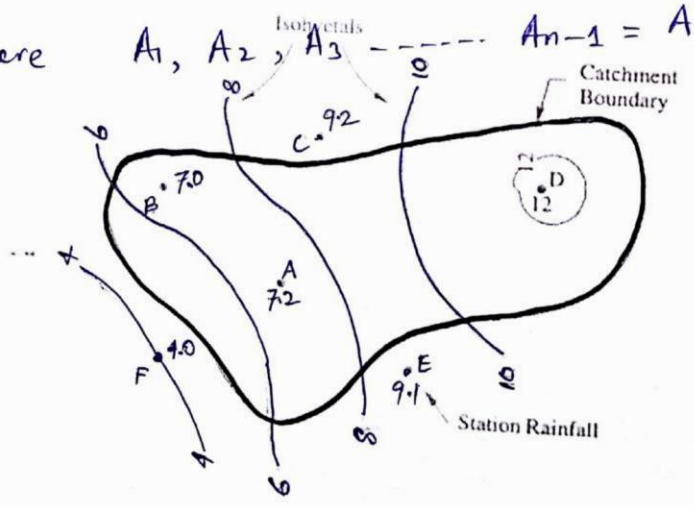
An isohyetal map is the map showing Countours of equal rainfall presents a more accurate picture of the rainfall distribution.

The area between adjacent isohyets is measured using a planimeter.

If the rainfall values Corresponding to the isohyets are $P_1, P_2, P_3 ----- P_n$ and $A_1, A_2, A_3 ------ A_{n-1}$ are the Corresponding inter isohyetal areas, the average rainfall over the Catchment is Computed as.

$$P = \frac{A_1\left(\frac{P_1+P_2}{2}\right) + A_2\left(\frac{P_2+P_3}{2}\right) ------ A_{n-1}\left(\frac{P_{n-1}+P_n}{2}\right)}{A_1+A_2+A_3 ------ A_{n-1}}$$

where $A_1, A_2, A_3 ------ A_{n-1} = A$.



Problem:- Using Isohyetal Method, find average rainfall over a catchment. The data is

Isohyetes (cm)	12		13		14		15	16	17
Area b/w Isohyetes (km²)		22		80		110	89	70	
Average precipitation (cm)		12.5		13.5		14.5	15.5	16.5	

Isohytes (cm)	Area b/w Isohyetes (km^2)	Average precipitation $(P_1+P_2)/2$	Product $A \times \frac{P_1+P_2}{2}$
12			
	22	12.5	275
13			
	80	13.5	1080
14			
	110	14.5	1595
15			
	89	15.5	1379.5
16			
	70	16.5	1155
17			
Sum	371		5484.6

$$P = \frac{\sum A \times \frac{P_1+P_2}{2}}{\sum A} = \frac{5484.6}{371}$$

$$\boxed{P = 14.78\text{cm}}$$