ITU
CIVIL ENGINEERING FACULTY HYDRAULICS DIVISION
HYDROLOGY

EXAMPLES –2 ANALYSIS OF PRECIPITATION

YEAR	1	2	3	4	5	6	7	8	9	10
1951	52	76	80	57	61	72	102	103	114	107
1952	43	58	62	47	45	60	80	91	92	92
1953	52	66	72	55	53	65	89	89	96	100
1954	73	94	99	78	77	100	137	159	139	152
1955	37	55	55	41	41	49	72	95	76	82
1956	42	54	51	48	47	56	70	101	78	80
1957	51	63	69	59	55	64	96	134	112	108
1958	52	65	67	59	53	61	86	105	94	89
1959	46	60	66	52	51	58	87	117	99	100
1960	52	74	79	58	55	71	96	135	108	110
1961	51	68	70	56	56	68	106	125	108	110
1962	53	73	71	56	55	72	103	131	112	109
1963	47	66	63	55	55	65	99	120	102	103
1964	43	61	60	48	44	62	87	110	94	93
1965	50	65	64	59	56	65	87	108	98	96
1966	55	75	79	60	55	78	106	138	118	113
1967	60	80	84	69	65	83	120	166	131	132
1968	52	64	64	58	56	65	88	118	109	100

ANALYSIS OF PRECIPITATION

Q1. The following table presents the annual precipitation depths between 1951-68 measured from 10 precipitation gauges located over a river basin. The homogeneity of data from Gauge 8 is suspicious.

a. Check the homogeneity of the gauge using *double mass curve method*. At which year does the change of the gauge location correspond?

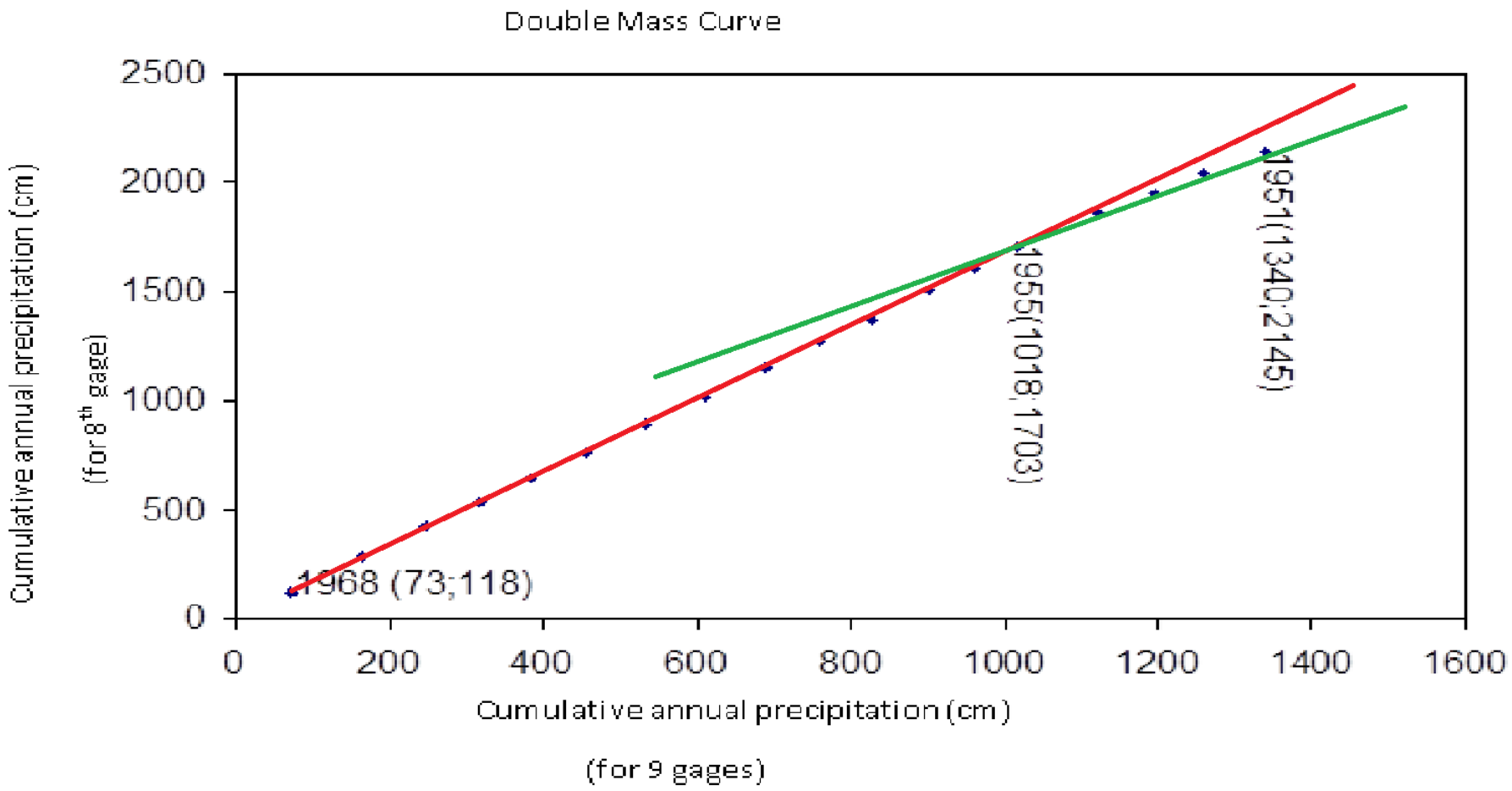
b. Homogenise the readings of gauge 8 before this year.

*(In order to check whether there is a change in the position or the measurement method of a precipitation gage and if it is done, the **double mass curve** method is used to homogenize the old records.)*

ANALYSIS OF PRECIPITATION

Year	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P8	Σ P8	P_{mean} (other 9 gages)	ΣP_{ort} (other 9 gages)
1968	52	64	64	58	56	65	88	118	109	100	118	118	73	73
1967	60	80	84	69	65	83	120	166	131	132	166	284	92	165
1966	55	75	79	60	55	78	106	138	118	113	138	422	82	247
1965	50	65	64	59	56	65	87	108	98	96	108	530	71	318
1964	43	61	60	48	44	62	87	110	94	93	110	640	66	384
1963	47	66	63	55	55	65	99	120	102	103	120	760	73	456
1962	53	73	71	56	55	72	103	131	112	109	131	891	78	535
1961	51	68	70	56	56	68	106	125	108	110	125	1016	77	612
1960	52	74	79	58	55	71	96	135	108	110	135	1151	78	690
1959	46	60	66	52	51	58	87	117	99	100	117	1268	69	758
1958	52	65	67	59	53	61	86	105	94	89	105	1373	70	828
1957	51	63	69	59	55	64	96	134	112	108	134	1507	75	903
1956	42	54	51	48	47	56	70	101	78	80	101	1608	58	962
1955	37	55	55	41	41	49	72	95	76	82	95	1703	56	1018
1954	73	94	99	78	77	100	137	159	139	152	159	1862	105	1124
1953	52	66	72	55	53	65	89	89	96	100	89	1951	72	1196
1952	43	58	62	47	45	60	80	91	92	92	91	2042	64	1260
1951	52	76	80	57	61	72	102	103	114	107	103	2145	80	1340

ANALYSIS OF PRECIPITATION



ANALYSIS OF PRECIPITATION

As seen in the Fig. the annual precipitation data of 8th gage is homogeneous between 1955 and 1968 years. To homogenize the data before 1955;

$$k = \frac{tg\alpha_2}{tg\alpha_1} = \frac{\left(\frac{1703-118}{1018-73}\right)}{\left(\frac{2145-1703}{1340-1018}\right)} = 1.23$$

	Observed data in P8	Homogenized data for 8th gage
Year	(8th gage)	k. P8 (cm)
1954	159	196
1953	89	109
1952	91	112
1951	103	127

ANALYSIS OF PRECIPITATION

Calculation of the Regional Mean Precipitations

- Arithmetical mean method

Calculates mean precipitation using the arithmetic mean of all the point

- Thissen method

Calculates station weights based on the relative areas of each measurement station in the Thiessen polygon network. The individual weights are multiplied by the station observation and the values are summed to obtain the areal average precipitation

- Isohyet method

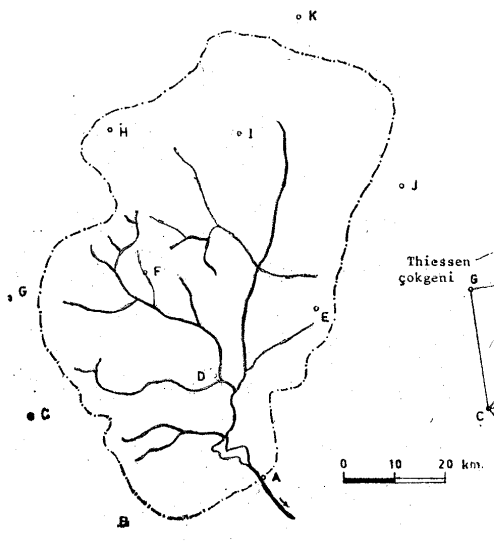
Involves drawing estimated lines of equal rainfall over an area based on point measurements. The magnitude and extent of the resultant rainfall areas of coverage are then considered versus the area in question in order to estimate the areal precipitation value.

ANALYSIS OF PRECIPITATION

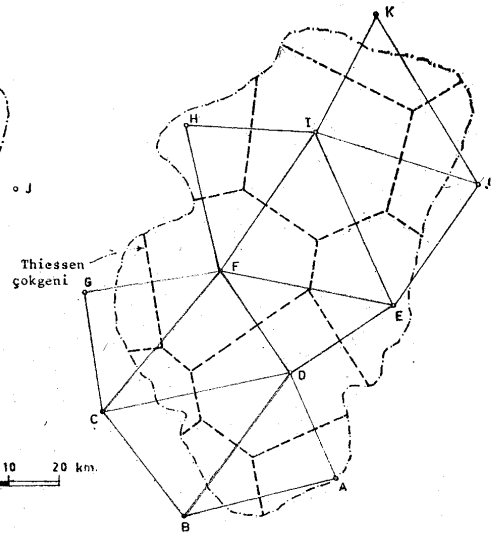
2. The precipitation values measured during a storm in the basin given below is listed.

a) Calculate the mean precipitation values in the area with arithmetical mean method, Thissen method and isohyet method (the interval of isohyets will be 5 mm).

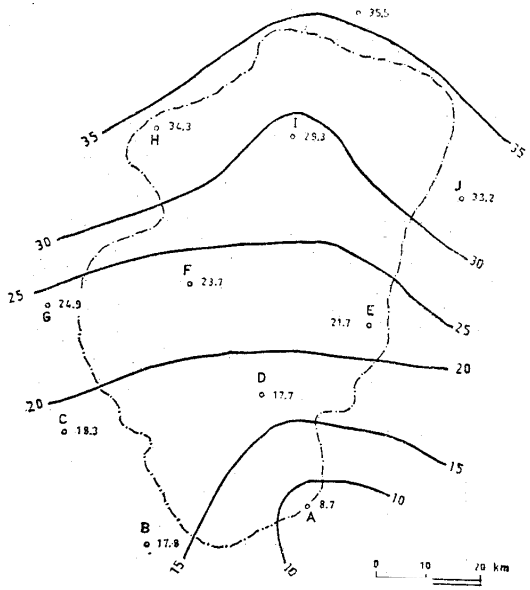
b) Determine the local distribution of precipitation in this basin for this storm and draw the "precipitation-area" curve



Hydrologic basin



Thissen Polygon



Isohyets

Gage	Precipitation P_i(mm)	Thissen Polygon Area A_i (km^2)
A	8.7	233.10
B	17.8	644.91
C	18.3	481.74
D	17.7	186.48
E	21.7	85.47
F	23.7	828.80
G	24.9	160.58
H	34.3	297.85
I	29.3	903.91
J	33.2	297.85
K	35.5	248.64

ANALYSIS OF PRECIPITATION

Gage	Precipitation P_i(mm)	Thissen Polygon Area A_i (km^2)	P_iA_i
A	8.7	233.10	2027.97
B	17.8	644.91	11479.40
C	18.3	481.74	8815.84
D	17.7	186.48	3300.70
E	21.7	85.47	1854.70
F	23.7	828.80	19642.56
G	24.9	160.58	3998.44
H	34.3	297.85	10216.26
I	29.3	903.91	26484.56
J	33.2	297.85	9888.62
K	35.5	248.64	8826.72
Total		4369.33	106535.77

a) *ARITHMETICAL MEAN METHOD:*

$$P_{mean} = \frac{\sum_{i=1}^{N} P_i}{N} = \frac{P_A + P_D + P_E + P_F + P_H + P_I}{6} = \frac{135{,}4}{6} = 22.6mm.$$

THISSEN METHOD:

$$P_{mean} = \frac{\sum_{i=1}^{N} P_i A_i}{\sum_{i=1}^{N} A_i} = \frac{106535.77}{4369.33} = 24.4mm.$$

ANALYSIS OF PRECIPITATION

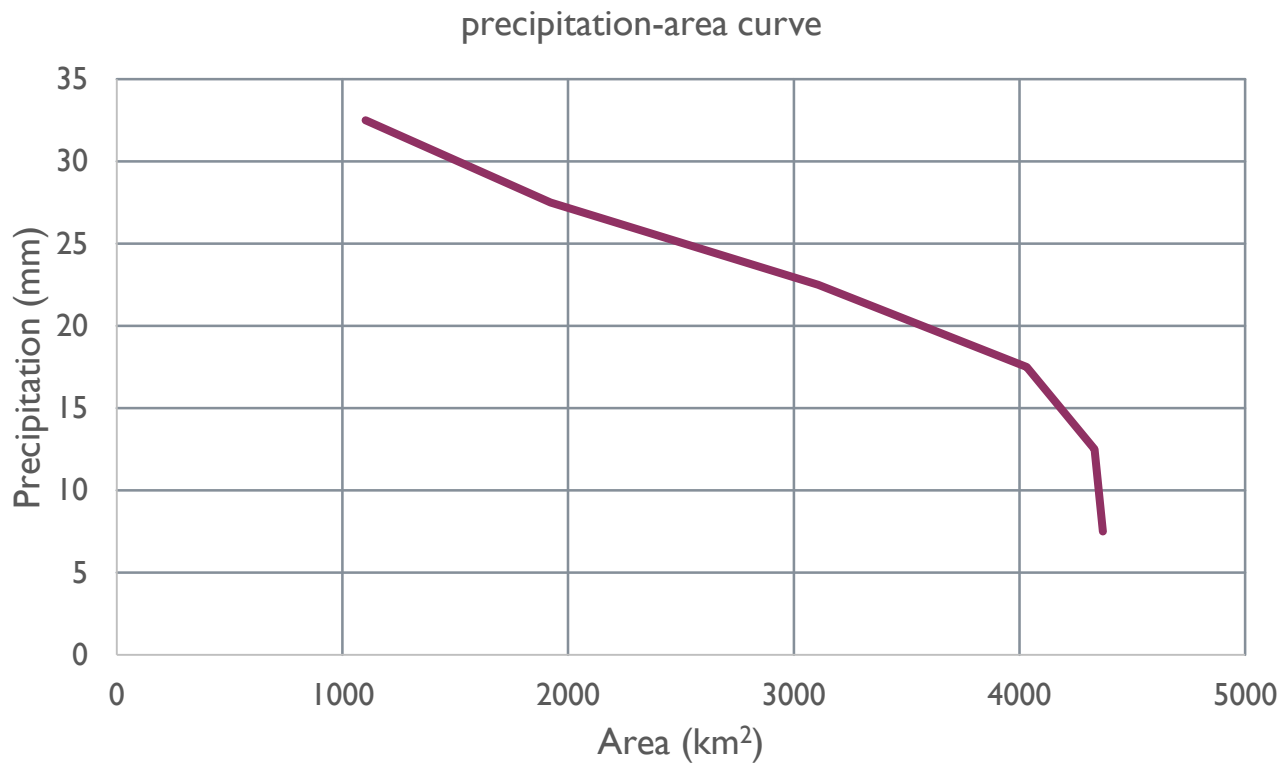
ISOHYETH METHOD

Isohyeths	P_i (mm)	A_i (km^2)	P_iA_i	$A=\Sigma A_i$ (km^2)	ΣP_iA_i	P_{mean} (mm)
35-30	32.5	1103.34	35858.55	1103.34	35858.55	32.5
30-25	27.5	818.44	22507.10	1921.78	58365.65	30.4
25-20	22.5	1186.22	26689.95	3108.00	85055.60	27.4
20-15	17.5	924.63	16181.03	4032.63	101236.63	25.1
15-10	12.5	300.44	3755.50	4333.07	104992.13	24.2
<10	7.5	36.26	271.95	4369.33	105264.08	24.1
TOTAL		4369.33	105264.08			

$$P_{mean} = \frac{\sum_{i=1}^{N} P_i A_i}{\sum_{i=1}^{N} A_i} = \frac{105264.08}{4369.33} = 24.1mm.$$

ANALYSIS OF PRECIPITATION

b) Determine the local distribution of precipitation in this basin for this storm and draw the “precipitation-area” curve



P_i (mm)	$A=\Sigma A_i$ (km^2)
32.5	1103.34
27.5	1921.78
22.5	3108.00
17.5	4032.63
12.5	4333.07
7.5	4369.33