An investigation the effects of generalized skew coefficient (Third moment) on instantaneous annual maximum discharges.

(Case study: Dez basin in south western of Iran)

1. Nasser, Tahmasebi, Assistant professor in university of Lorestan, Faculty of Agricultural
Email: n_tahmasebi@yahoo.com
2. Mohammad, Mahdavi, professor in university of Tehran, Faculty of Natural Resources.
3. Forood, sharifi, Assistant professor in soil conservation and watershed Management Research Institute.
4. Hamid. Pezeshk, Associate professor in university of Tehran, College of science
5. Sayed Mahmood Reza, Tabatabei, Member of scientific Board in Soil conservation and watershed Management Research Institute.

1.Abstract

One of the methods of reduce flood hazard is correct estimation discharge designing of water structures, because without computation of estimated discharge water structures is destroy by flood occurrence and increase flood hazard power. Use of data in gauging stations in the area is the best method for estimation discharge flood design. Also computation of generalized coefficient skew of measurement data decrease estimated error and water structures dimensions improve designing in the basin without gauging stations or with short data.The study is located in 47 degree and 39 minute to 50 degree and 21 minute in eastern length and 31 degree and 15 minute to 34 degree and 33 minute in northern latitude. We selected 24 gauging stations. Then, the test of outlier was conducted by using statistical parameters of peak flow in the hydrometric stations, and it was determined that there are no outlier points among data. So completing and lengthening for common statistical period performed. Then statistical distribution of aforementioned data was fitted. Using griding method, the centroid of high area of each hydrometric station was determined generalized skew coefficients of points then were computed using the unbiased skew coefficient , the weight coefficient of data and the distance of each hydrometric gauge from centroid of sub-basin. Spline (Smooth plate Line) method was applied to generalize the skew with the mean square error of %34. The results show that the range of percentage of differences between unbiased and generalized skew are from 58% to 137%. The observed data have been fitted well with the normal distribution. using this method results less differences between observed and estimated values of peak discharges as where generalized skew were used, the differences of peaks for return periods of 2, 100 and 1000 years, were %12, %77 and %180 respectively. It can be concluded that the fitness of selected probability distribution with the data is quite best using the generalized skew in estimation of peak discharge.

Keyword: Generalized coefficient, Hydrometric, station skew, Instantaneous maximum discharge, Dez basin.

2.Introduction

The analysis of peak flow is fund a mental to the design of drainage facilities . Errors in the estimates will result in a structure that is either undersized and causes more drainage problems or oversized and costs mor than necessary.
2. Flood frequency analysis is an essential of extreme floods (i.e.Greater than a 1000 year flood)
All regionalization methods implicitly or explicitly make assumptions about the regional distribution of annual floods. One of the most common regionalization methods utilizes normalized annual flood series, that is, flood series that have been standardized by one more at-site statistics.
Flood frequency curve for individual gaging station were developed following the guidelines described in Bulletin 17B, Interagency advisory committee on water data (1982). A log-pearson type three distribution function was used to fit annual peak discharges to log-probability curves (Giese and Franklin 1996).Bulletin 17Brecommends the use of generalized skew coefficients developed from detailed studies using pooled information from nearby long-term stations instead of generalized skew coefficients taken from the nationwide mapor plotting station skew coefficient on a map and drawing lines of equal values.(Williams-sether 1992)

Naghavi ,Babak and Fang Xin yu (1991) provided generalized skew map for Louisiana streams, Missssissippi,Arkansas and Texas with 200r more years of annual flood recorders and show that mean square error for Louisiana generalized skew map is 16 perecent Less than generalized skew map recommended by the u.s Water Resources Council.
Hodgkins and Martin (2003)
Estimated of peak flow are given for 222 gaging stations in Kentucky .In the development of the peak flow estimated at gaging stations, a new generalized skew coefficient was calculated for the state. This single statewide value of 0.011 (with a standard error of prediction of 0.520)
Is more appropriate for Kentuky than the national skew isoline map in Bulletin 17B of the Interagency Advisory Committee on Water Data.

3.Materials and methods

3.1. **LOCATION**

Watershed Dez located in the south West of IRAN (Figure 1)

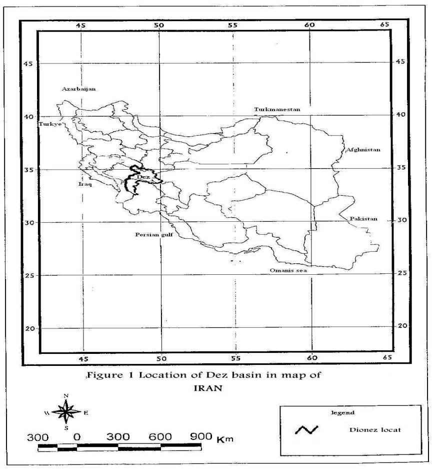

Figure 1 Location of Dez basin in map of IRAN

3.2.Characteristic of gaging stations

in this study selected 24 station that shown their characteristic in the table 1.

Table1 characteristics of gaging station in Dez basin

Elevation (m)	Latitude (ddmm)	Longitude (ddmm)	Area (km^2)	Station code	Station name	River name
1520	33-39	49-01	973	21-255	Do khaharan	Tireh
1980	33-55	48-36	65	21-257	Vanaee	Sarab sefid
2000	33-54	48-35	60	21-259	Vanaee	Gale rud
1490	33-47	48-48	1000	21-261	Rahim abad	Silakhor
1540	33-44	48-46	223	21-263	Boz azna	Absardeh
1600	33-42	48-58	120	21-265	Biatun	Biatun
1450	33-29	49-04	3400	21-267	Do rud	Tireh
1830	33-24	49-24	2010	21-271	Cham zaman	Azna
1930	33-19	49-26	35	21-273	Kamandan	Kamandan
1890	33-23	49-23	36	21-275	Dare takht	Dare takht
1800	33-29	49-22	2185	21-277	Dare takht	Mar bareh
1450	33-29	49-05	2655	21-279	Do rud	Mar bareh
1290	33-13	48-59	345	21-281	Cham chit	Ab sabzeh
1000	33-14	48-54	158	21-283	Sepid dasht	Vask
970	33-13	48-53	7174	21-285	Sepid dasht	Sezar
970	33-13	48-53	680	21-287	Sepid dasht	Zaz
770	33-08	48-38	336	21-289	Keshvar	Sorkhab
600	32-56	48-45	9410	21-291	Tang panj	Sezar
540	32-56	48-46	6432	21-293	Tang panj	Bakhtiari
480	32-49	48-46	16213	21-295	Tale zang	Dez
2000	33-08	49-41	438	21-400	Kazem abad	Kakolestan
2355	32-51	50-01	58254	21-402	Zard fahrami	Vehargan
2000	33-00	49-48	744	21-457	Cheshme langan	Cheshme langan
1850	33-04	49-39	414	21-968	Gholian (sekane)	Gholian

3.3. Determination of outlier

For determination of outlier used of bellow equation and there are no outlier

$$(1)\ X_{H,L} = \overline{X} \pm k_N S$$

There:
X_H= up outlier threshold ;
X_L= Down outlier threshold ;
Mean of data; $\overline{X}$ =
S= Standard deviation ;and
K_N= Frequency coefficient of outlier.

3.4. Skew Coefficient of Station

The station coefficient is computed as follows:

$$G_s = \frac{N}{(N-1)(N-2)S^3}\sum_{i=1}^{N}(X_i - \overline{X})^3 \qquad (2)$$

Where:
G_x=stations skew coefficient;
X_i=stations log-transformed annual peak discharge for yeari;
$\overline{x}$ = stations log-transformed mean of annual peak discharges;
S=stations log-transformed standard deviation of annual peak discharges;
N=station number of years of peak discharge record.
Many studies have shown that the stations skew coefficient is a biased estimator of the populations skew coefficient.
A bias –correction equation based on record length (years) is presented by Tasker and stedinger (1986) as:

$$C_b = (1 + \frac{6}{N}) \qquad (3)$$

Where:
C_b=stations bias-correction factor; And
N=stations number of year of peak-discharge record.
The station skew coefficient (G_s) for each of the 24 stations (sample) used in this study was multiplied by the bias-correction factor to obtain and unbiased value (Table 2)

3.5. Generalized and weighting of skew coefficient

In this study generalized skew coefficients are estimated from mapping . The estimating technique referred to above assume that the skew coefficient for each station have equal accuracy. Many investigation developed have equation to estimate the variance of stations skew coefficient (V_s) to vary with record Length (N) and corrected for bias and defined as:

$$V_a = \frac{6N(N-1)[1+(6/N)]^2}{(N-2)(N+1)(N+3)} \qquad (4)$$

A stations skew coefficient is weighted in verse proportion to the estimated stations variance (v_s); (Lumia and Bavesky 2000) there for, The weight given for each stations skew coefficient is;

$$W = \frac{1}{V_s} \qquad (5)$$

Where :

W= is the weight given to the stations unbiased skew coefficient and V_s is as defined previously.

The variance of gaging station skew coefficient and weight given to the station unbiased skew coefficient calculated for each of the 24 stations (table 2)

Table 2 Skew coefficient and weighted coefficient of peak flow data in Dez basin

W	G_s	Station code	Station name	River name
2.560	–0.018	21–255	Do khaharan	Tireh
1.516	–0.345	21–257	Vanaee	Sarab sefid
2.256	0.122	21–259	Vanaee	Gale rud
2.256	–0.343	21–261	Rahim abad	Silakhor
1.516	0. 260	21–263	Boz azna	Absardeh
1.232	0.657	21–265	Biatun	Biatun
4.128	0. 314	21–267	Do rud	Tireh
2.715	–0.262	21–271	Cham zaman	Azna
2.256	0.263	21–273	Kamandan	Kamandan
2.256	0.273	21–275	Dare takht	Dare takht
3.338	0.004	21–277	Dare takht	Mar bareh
1.956	0.750	21–279	Do rud	Mar bareh
4.128	–0.03	21–281	Cham chit	Ab sabzeh
4.128	–0.164	21–285	Sepid dasht	Sezar
3.025	0.075	21–287	Sepid dasht	Zaz
2.408	0.433	21–289	Keshvar	Sorkhab
2.715	0.299	21–291	Tang panj	Sezar
3.338	0.681	21–293	Tang panj	Bakhtiari
4.447	–0.853	21–295	Tale zang	Dez
1.808	–0.351	21–400	Kazem abad	Kakolestan
1.661	–0.411	21–402	Zard fahrami	Vehargan
1.661	0.96	21–457	Cheshme langan	Cheshme langan
1.808	0.535	21–968	Gholian (sekane)	Gholian

4.**Conclusion**

4.1. Map of skew coefficient

For mapping of skew coefficients Dez watershed with an equally spaced grid was plotted along with station skew coefficients for each study site of gaging station and geographic information systems (GIS) software was used to compute and unbiased skew coefficient for each node of the grid. The skew coefficient for each calculated from the following equations; (Lumia and Bavesky 2000)

$$(6)\; Z_i = \frac{\sum_{i=1}^{n} G_{sj}(w_j)(1/d_j)}{\sum_{i=1}^{n}(w_j)(1/d_j)}$$

Where :

Z_i= estimated skew coefficient at grid node;

G_{sj}= unbiased skew coefficient of station j;

n= number of stations selected to estimated Z_i;

d_j= distance from the grid node to centroid of drainage basin whose records define G_{sj}

W_j= weight given to G_s at station j.

By using equations 2 and 3 bias and skew coefficient for selected stations were computed than unbiased skew coefficient was computed for each grid node by the weighting procedure of equation 6 and Isoline skew coefficient were fitted through the grid node coefficients by an automated geographic information systems (GIS) technique. In Figure 2 generalized unbiased skew coefficient map is given.

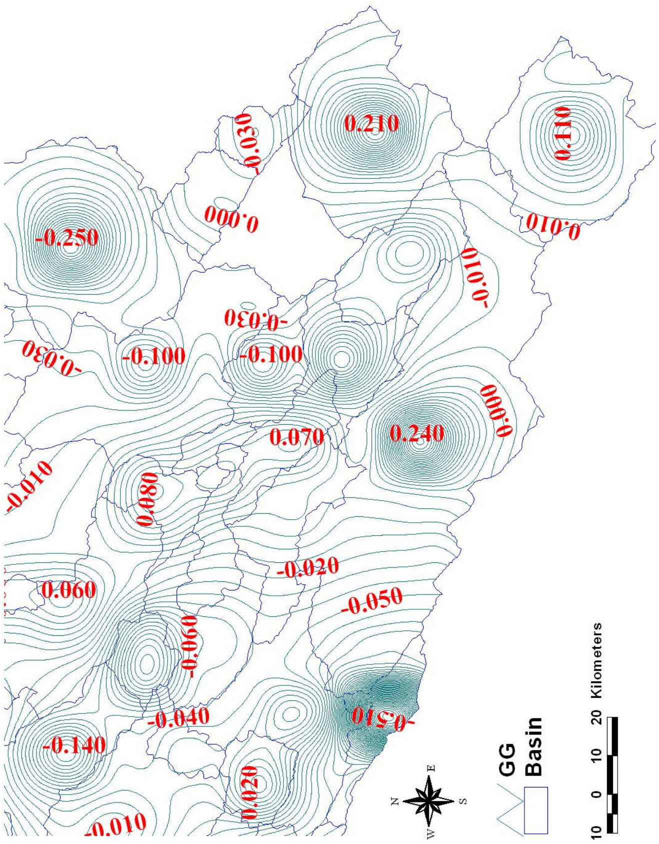

Figure 2 The map of skew of Dez basin and its nearby

4.2. Determination of best calculation method of generalized skew coefficient .

In this study generalized skew coefficient calculated by use of Isoline skew on the map . For evaluation of generalized skew coefficient accuracy compared mean square errors of four contour map to evaluate other methods to identify which one would provide the most accurate generalized skew coefficient . The methods evaluated were :

(1) Calculation of unbiased skew coefficient for each of grid node by TPSS, (2) The arithmetic unweighted means of the unbiased skew coefficient for each of grid node by TPSS, (3) calculation of inverse distance weight and unbiased skew coefficient for each of grid node, and (4) calculation of unbiased skew coefficient and inverse distance weight for each of grid node. Mean square errors (MSE) for each of the four methods of predicting generalized skew coefficients were computed for all regions and are based on observed and predicted skew coefficients at gaging stations.Generally, smallest (MSE) resulted from the first method (34%). The results are included in table 3 , which shows generalized skew coefficient for each of the methods.

Table3 calculation methods of generalized skew of peak flow in Dez basin

G_G by IDW or mean	G_G by IDW	G_G by TPSS or mean	G_G by TPSS [1]	G_s	N	Station code
-0.016	0.036	0.002	0.051	-0.018	22	21-255
-0.001	0.013	-0.005	0.005	-0.345	15	21-257
0.001	-0.009	-0.008	-0.005	0.122	20	21-259
0.010	0.014	0.009	-0.009	-0.343	20	21-261
0.016	-0.021	0.025	-0.019	0.260	15	21-263
-0.013	0.037	0.003	0.056	0.657	13	21-265
-0.015	-0.017	-0.016	-0.009	0.314	32	21-267
-0.058	0.039	-0.080	0.048	-0.262	23	21-271
-0.043	0.053	-0.061	0.063	0.263	20	21-273
-0.033	0.051	-0.034	0.053	0.273	20	21-275
0.040	0.056	-0.060	0.063	0.004	27	21-277
-0.016	-0.015	-0.017	-0.009	0.750	18	21-279
0.002	-0.059	0.015	-0.064	-0.030	32	21-281
-0.007	-0.050	0.001	-0.052	-0.164	32	21-285
-0.004	-0.047	-0.001	-0.049	0.075	25	21-287
-0.019	-0.037	-0.025	-0.019	0.433	21	21-289
0.016	-0.316	0.022	-0.388	0.299	23	21-291
0.007	-0.192	0.011	-0.260	0.681	27	21-293
0.007	-0.191	0.016	-0.340	-0.853	34	21-295
-0.002	-0.060	0.002	-0.064	-0.351	17	21-400
0.002	-0.075	0.010	-0.085	-0.411	16	21-402
-0.009	-0.018	0.001	-0.019	-0.960	16	21-457
0.021	-0.135	0.028	-0.143	0.535	17	21-968

4.3.Estimation of peak flow by using generalized skew

By using this method results less differences between observed and estimated values of peak discharges as where generalized skew were used, the differences of peaks for return periods of 2, 100 and 1000 years, were %12, %77 and %180 respectively. It can be concluded that the fitness of selected probability distribution with the data is quite best using the generalized skew in estimation of peak discharge (Table 4).

Table 4 Peak flow (m^3/s) by using unbiased skew coefficient for recurrence interval, in year

1000	500	200	100	50	25	20	10	5	2	Q_t / S.code
975.05	804.50	611.35	487.22	380.06	288.20	261.62	187.58	125.25	57.7	21-255
33.49	30.98	27.60	25	22.36	19.65	18.76	15.92	12.93	8.40	21-257
45.56	40.54	34.37	30.04	25.96	22.12	20.92	17.32	13.83	9.09	21-259
543.58	443.47	333.67	265.17	207.35	158.71	144.79	106.26	73.95	38.35	21-263
2721.12	1577.50	749.36	417.14	226.35	118.71	95.55	46.84	21.07	5.52	21-265
126.03	102.26	76.35	60.31	46.85	35.61	32.41	23.60	16.27	8.30	21-273
63.81	52.86	40.64	32.88	26.20	20.48	18.81	14.16	10.15	5.56	21-275
338.37	302.29	257.30	225.17	194.56	165.30	156.14	128.31	101.07	63.85	21-281
1129.45	984.27	809.94	690.32	580.35	479.16	448.29	357.14	271.92	162.83	21-287
1560.07	1296.38	1001.84	816.12	656	520.64	481.04	369.60	273.10	160.82	21-289
361.45	320.56	268.42	230.53	194.04	159.01	148.04	114.97	83.30	42.78	21-400
390.55	359.64	318.07	286.03	253.41	220.09	209.17	174.53	138.16	84.80	21-402
1005.13	808.93	600.21	473.77	369.46	283.54	259.25	192.76	137.69	77.29	21-968

Reference

1. Giese.G.Land M.A.Franklin,1996,Magntude and frequency of floods in the Suwannee river water management District , Florida. U.S. Geological survey water-resources investigation report 96-ul76

2. Hodgkins, C.A. and Martin, C.R. 2003, Estimating the magnitude of peak for streams in Kentucky for selected recurrence intervals. U.S. Geological survey. Water-Resources investigations, report 03-u180.

3. Interagency advisory committee on water data, 1,82, Guidelines for determining flood flow frequency, Bulletin 17B of the hydrology subcommittee, Office of water data Coordination,u.s. Geological survey, Reston,Va,183P

4. Lumia, Richard and Yvonne H. Baevsky 2000, Development of a contour map showing generalized skew coefficients of Annual peak discharge of Rural Unregulated streams in New York, Excluding Long Island. U. S. Geological Survey. Water resources investigations report 00-4022

5. Mann.Michael P, Jule Rizzardo and Richard satkowski, 200u, Evaluation of methods used for estimating selected stream flow statistics and flood frequency and magnitude for small basins in north coastal California u.s. Geological survey , u.s. Department of the ninterior. Scientific investigations report 2004-506 &

6. Naghavi. B. and Yu.F.X. 1991, Generalized skew Coefficients of annual floods for Louisiana streams. Water-Resources Bulletin American Water-Resources Associations. Vol, 27, No. 2. PP: 209-216.

7. Tasker, G.Dand J.R.stedinger , 1, 86.Regional skew with weighted Ls regression . Journal of water resources planning and management 112(2):225-237

8. Williams-sether , Tara, 1992, Techniques for estimating peak-flow frequency Relations for north DaKoTa streams, u.s. Geological survey, water resources investigations report 92-uo2o.