Introduction

Estimation of design floods in ungauged catchments is frequently required in hydrological practice and is of great economic significance. Hydrologists consider artificial unit hydrograph as one of applicable methods to estimate peak discharge for watersheds for which hydro climatology data is not available.

In general, there are three methods for estimating peak discharges, including; Schneider, the Soil Conservation Service (SCS) and triangular methods. All three methods give the same results in regards to the confidence level. However, SCS method estimates flood hydrographs with less error than other methods.

The aim of this research is to suggest the best peak discharge estimation which has the most compatibility with natural hydrographs method. Moreover, natural and artificial methods and unit hydrograph will be compared with each other. In addition, the best estimation method will be proposed for calculation of coefficients of artificial method. Finally, the flood peak and design flood will be determined.

The study area

Kermanshah province with area of 24856km² is located in west of Iran which its average altitude is around 1200m above sea level. Gharahso catchment is located in longitudes 45° 22' to 47° and latitudes 34° and 34° 55'. Gharahso River is one of the most important tributary of Saymareh River. It collects water from Kermanshah and Kurdistan provinces and delivers it to Saymareh River.

Materials and methods using flood data in gauged stations

In general, recorded data have some limitations. However, most of methods require complete statistical data from under study catchment to estimate the peak discharge and to calculate more accurately runoffs. In observational method, to estimate flood in the study area, the recorded data in gauged stations are been used. Estimated maximum instantaneous discharges in selected stations based on different return periods are given in table 1.

Flood estimation using Kriging method

Kriging’s formula is a world widely used formula to determine maximum flood discharge for big and ungauged catchments. Kriging’s formula is as follows:
Q = 46CA

Where:
Q = peak flood discharge (ft³/s)
A = watershed area (mile)
C = coefficient of watershed which its amount depends on climatic and physiographic of under study watershed.

Table 1: Maximum estimated and observed instantaneous discharge in selected stations based on various return period (m³/s)

<table>
<thead>
<tr>
<th>Station</th>
<th>Return period(year)</th>
<th>Maximum observed instantaneous discharge (m³/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Pole kohne</td>
<td>1587</td>
<td>1083</td>
</tr>
<tr>
<td>Hojat abad</td>
<td>663</td>
<td>472</td>
</tr>
<tr>
<td>Khers abad</td>
<td>212</td>
<td>178</td>
</tr>
<tr>
<td>Doab merek</td>
<td>409</td>
<td>320</td>
</tr>
</tbody>
</table>

Estimating flood using Soil Conversation Service (SCS) method

Estimating rain water discharge using Curve Number (CN) is an internationally known method. Soil Conversation Service of untied states presented this method as SCS or dimensionless unit hydrograph in year 1957. Results showed that this model can be used in each urban area, natural and mixed watershed.

Required in formation fore estimation in this soft ware are:
- Physiographic of watershed.
- Permeability status of watershed
- Numerical amount of CN parameter.
- Selecting design pattern and continuity of raining flood’s trajectory in the river

Results and discussion

Results of Kriging Method

Peak flood in Gharahso River in Doab Ghazanchi station was estimated using Kriging method. Thus using this method and estimated peak flood (for different return periods) in Pole Kohne gauge station the coefficient of C was determined. Therefore, the estimated coefficient C was suggested for the study area and Pole Kohne station. The coefficient C for different return periods are given in table 2.

Table 2: Flood’s peak in Gharahso River in Doab Ghazanchi by Kriging method for different return period m³/s

<table>
<thead>
<tr>
<th>Place name</th>
<th>return period(year)</th>
<th>Area (Km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Pole kohne</td>
<td>1587</td>
<td>1083</td>
</tr>
<tr>
<td>Creager's C</td>
<td>11.0</td>
<td>7.5</td>
</tr>
<tr>
<td>Doab Ghazanchi</td>
<td>1530</td>
<td>1045</td>
</tr>
</tbody>
</table>
SCS method results
Considering the geographical characteristics of catchments and gauged stations in the study area, one representative rain gauge station was determined for each sub basin. Using maximum precipitation for different return periods, the volume of peak flood for 2 to 100 years return periods were estimated. However, the flood hydrograph for 100-year return period for Gharaso River in Doab Ghazanchi and Pole Kohne stations are shown in figures 1 and 2. As it is observed, the maximum volume of peak flood of Gharaso River in Doab Ghazanchi and Pole Kohne are estimated as $1479\text{m}^3$ and $1520\text{m}^3$.

Fig.1: 100-year return period for peak flow in Gharaso River, Doab Ghazanchi station

Fig.2: 100-years return period peak flow in Gharaso river, Pole Kohne station

Conclusion
For Doab Ghazanchi (ungauged station), Kriging method was used to estimate the peak flood. The peak flood was estimated to be $1530\text{m}^3/\text{s}$ for 100-year return period. Moreover, at the same station, the peak flood equaled to $1479\text{m}^3/\text{s}$ for 100-year return period, using SCS method. Consequently considering possible mistakes in recorded data and lack of determined and perfect hydrograph (useful for data collection) as well as weakness in observational methods in one hand and the accuracy of SCS method which considers different climatic, geological and Physiographic and precipitation specifications on the other hand led us to accept the results of SCS method as the design flood.

Key words
Peak flood flow; Flood; SCS method; HEC-HMS Software; Creager method; Observing method