Investigation of Heterogeneity Measure using various Nonlinear approaches by deriving characteristics through SWAT model
Shiyamalagowri G, Ganapathy G.P
Centre for Disaster Mitigation and Management, Vellore Institute of Technology (VIT), Vellore-632014, India. Email: shiyamalagowri1947@gmail.com

Introduction
Flooding ranks as the most devastating natural disaster causing high economic loss and large number of fatalities. The main objective of frequency analysis of hydrologic data is to relate the magnitude of extreme events to their frequency of occurrence through the use of probability distributions. Globally many linear clustering techniques are employed to categorize the watershed which are ineffective when dealing with noise and outliers. The present study overcomes this by proposing a relatively new Non-Linear Clustering Algorithm based on Hierarchical estimation of Densities (NLCAHD) for the Cauvery basin, where the Homogeneity test (H) is enforced to identify the group of stations with same populations.

Study Area
• Daily discharge data
• 1971-2017 (CWC)
• 28 gauging stations
• Average annual rainfall -1250 mm
• Mean annual discharge -21.36 BCM
• Drainage area
• Elevation
• Baseflow index
• Mean annual precipitation
• Annual maximum streamflow

Heterogeneity Test
A homogeneity test (H) is conducted to measure the degree of uniformity among all the gauging stations belonging to a cluster.
• H<1 = purely homogeneous
• 1≤ H < 2 = possibly heterogeneous
• H>2 = absolutely heterogeneous

Methodology
DATA SOURCE
Basin Characteristics
- Extracted from SWAT Model
Physiographic
Geographical
Meteorological
Channel
Annual Maximum Stream flows

METHODS
Assign vectors to every station
Apply Clustering Algorithm
Apply Homogeneity Test
Regions are Homogeneous ?
No
Yes
Adjust the regions to become homogeneous
Calculation of Quantities for various Return Periods

RESULTS
Formation of Clusters
Generate Optimum Regions
Derive L-Moments
Probability Distributions
Parameter Estimates

Results and Conclusion
The approach automatically classifies the region into 6 homogeneous clusters, where the number of clusters were neither known nor mentioned a prior, whereas in the case of other clustering algorithms like K-means and C-means the number of clusters should be initialized before the partitioning of datasets takes place. The algorithm measures the density over the stations based on the kernel distance of 0.4, which serves as the radius of the neighborhood in order to form the clusters.

Fig.1 Cauvery Basin map with locations of gauging stations
Fig.2 The structural outline of the methodology involved in the analysis of the study
Fig.3 Cauvery Basin – Classification of 6 Clusters
Fig.4 Comparison of NLCAHD with K means and C means
Fig.5 L-moment ratio diagrams for the 6 clusters

References