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Use of Extrapolation Method to Estimate the Extreme Rainfall Probabilities

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Abstract: *Accurate estimation of rainfall is essential for various application such as agriculture, hydrology, urban planning and many more. Extrapolation is a statistical method for predicting future values based on existing data trends. This research paper comprises of trend line method which is a statistical technique used to analyse time series data and predict future trends. It examines the effectiveness of this method in comparison to other established methods. The study uses historical rainfall data from a particular location to demonstrate the application of trend line method to estimate the future rainfall.*

Key words: *rainfall, trend lines, extrapolation, trends.*

1. INTRODUCTION:

Rainfall estimation is a critical aspect of weather forecasting and water resource management. Accurate and timely estimation of rainfall can help in predicting flood conditions, drought conditions, and planning for water availability. However, rainfall measurement can be challenging, especially in remote areas or locations with limited rainfall measuring equipment. In such cases, extrapolation, a statistical technique that estimates values beyond the range of data points, can be used to estimate rainfall (Bowler et al.,2006). This paper will focus on the use of extrapolation to estimate rainfall, including its definition, types, advantages, disadvantages, and application in real-life scenarios. The paper aims to provide an overview of the extrapolation method and its usefulness in estimating rainfall, which can help meteorologists, hydrologists, and other professionals in making informed decisions related to water resource management and weather forecasting.

2. EXTRAPOLATION METHOD: -

Extrapolation is a statistical method used to predict future values or trends based on existing data. It involves estimating a value that lies outside the range of known data points by extending a trend or pattern observed in the data. Hettiarachchi et al. (2005) suggested that there are different methods of extrapolation, but the most common one is linear extrapolation, where a straight line is drawn between two points in a data set, and then the line is extended beyond the data range to predict future values. However, extrapolation can be risky because it assumes that the pattern or trend observed in the existing data will continue into the future (Cojocaru & Karlsson 2006). In reality, unforeseen events, changes in conditions, or random fluctuations can disrupt the pattern and make the prediction inaccurate. Therefore, it's essential to use caution when relying on extrapolation and to consider other factors that may influence the prediction (Wu et al., 1996).

3. TYPES OF EXTRAPOLATION METHODS: -

Scofield (1987) explained that there are different types of extrapolation methods including:

Linear Extrapolation: This method involves drawing a straight line between two points in a data set and then extending the line beyond the data range to predict future values.

Polynomial Extrapolation: This method involves fitting a polynomial equation to a data set and then using the

equation to predict future values.

Curve Fitting Extrapolation: This method involves fitting a curve to a data set and then using the curve to predict future values.

Time-Series Extrapolation: This method involves analyzing the historical trend of a time-series data set and using it to predict future values.

Neural Network Extrapolation: This method involves using a neural network algorithm to learn patterns in a data set and then using the learned patterns to predict future value

4. TRENDLINES METHOD: -

The trend lines method is a type of extrapolation method that involves fitting a line or curve to a data set to represent the trend or pattern observed in the data (Sokol et al., 2017). The trend lines can then be extended beyond the data range to predict future values. In Excel, the trend line method is commonly used to create a trend line for a data set. This involves selecting a chart that displays the data and then adding a trend line. Excel offers several options for the type of trend line, including linear, polynomial, exponential, logarithmic, and power trend lines (Berenguer et al., 2011)

To use trend lines method for estimating rainfall, follow these steps:

- Gather rainfall data: Collect rainfall data for a specific region for a minimum of 10 years. This data can be obtained from local weather stations or government agencies.
- Plot the data: Plot the rainfall data on a graph, with the years on the x-axis and the amount of rainfall on the y-axis.
- Draw a trend line: Draw a straight line through the data points on the graph. This line should represent the general direction of the rainfall trend over the years.
- Analyse the trend line: Look at the slope of the trend line to determine if the rainfall is increasing or decreasing over time. If the slope is positive, then the rainfall is increasing, while a negative slope indicates a decrease in rainfall.
- Estimate future rainfall: Based on the direction and rate of change of the trend line, estimate future rainfall for the region. However, it is important to note that this method is not always accurate and should be used in conjunction with other rainfall prediction models and techniques.

Overall, trend lines method can provide a simple and quick estimate of the rainfall trend for a specific region over a period of time. However, it is important to use other methods to verify the accuracy of the estimate before making any significant decisions based on the data.

Table 1. The annual rainfall for the month of July for 9 years

YEAR	ANNUAL RAINFALL
1901	241.4
1902	284.9
1903	293.2
1904	260.3
1905	253
1906	286.5
1907	225.4
1908	320.5
1909	302.3

5. RESULTS AND DISCUSSIONS: -

The data in Table 1 is taken from Indian metrologicall station, Pune.
(http://www.indiaenvironmentportal.org.in/media/iep/infographics/Rainfall%20i n%20India/112%20years%20of%20rainfall.html)

Table 1 accounts for the annual rainfall for the month of July for 9 years. On this data, trend line method of forecasting is applied and figure 1 is obtained.

Figure 1 includes graph in which horizontal-axis represents years and vertical-axis represents annual rainfall. Blue curve represents variation of annual rainfall with years varying from 1901 to 1909. whereas yellow, orange and grey represents upper confidence bound, forecast and lower confidence bound respectively from 1910 to 1915.

Table 2 represents the forecasting data obtained using trend line method from year 1910 to 1915. the lower confidence bound, upper confidence bound and forecast for years 1910, 1911, 1912, 1913, 1914, 1915 are 218.77, 248.86, 267.10, 225.39, 255.49, 273.73 and 300.94, 331.03,
349.27, 308.25, 338.35, 356.59 and 259.85, 289.94, 308.18, 266.82, 296.91, 315.15

respectively.

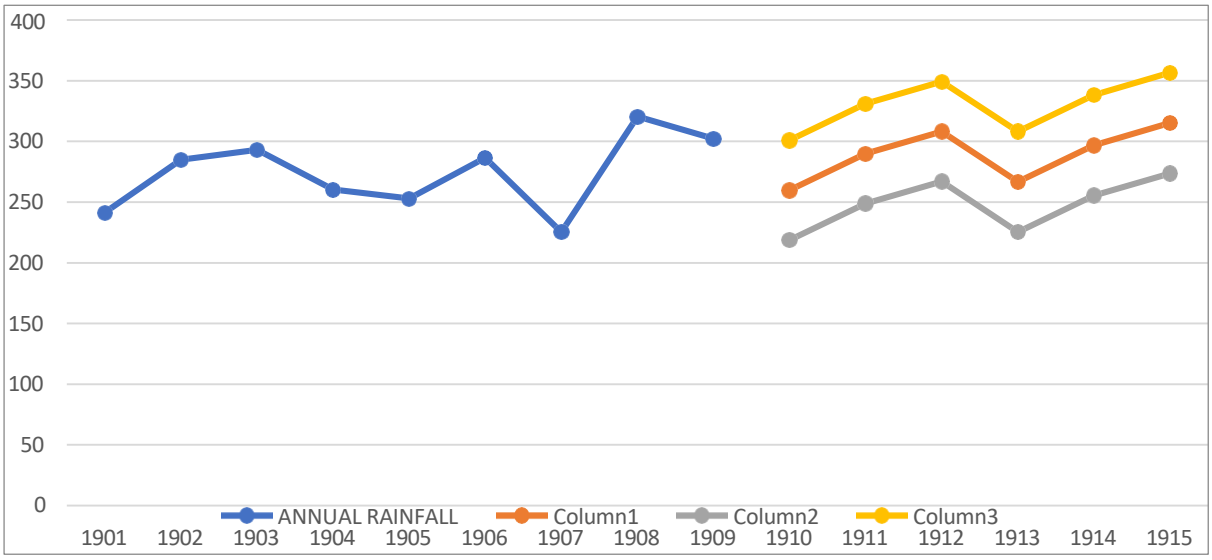

Figure 1. Variation of annual rainfall with years

Table 2. The forecasting data obtained using from year 1910 to 1915

Year	Annual Rainfall	Forecast	Lower confidence bound	Upper confidence bound
1901	241.4			
1902	284.9			
1903	293.2			
1904	260.3			
1905	253			
1906	286.5			
1907	225.4			
1908	320.5			
1909	302.3			
1910		259.8525878	218.77	300.94
1911		289.9455763	248.86	331.03
1912		308.1883009	267.10	349.27
1913		266.8242471	225.39	308.25
1914		296.9172357	255.49	338.35
1915		315.1599603	273.73	356.59

6. CONCLUSION: -

It is important to exercise caution when using extrapolation and to consider other methods of forecasting, such as simulation or scenario analysis, to account for uncertainty and variability in the data. By using a combination of methods, analysts can gain a more comprehensive understanding of the potential future outcomes and make more informed decisions

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