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FORECASTING OF MONSOON RAIN IN THE YEAR 2026 IN JHARKHAND

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Abstract— **Jharkhand frequently faces drought like situation quite often. Therefore, it requires careful planning before planting of crops. The planting of crops involves sufficient capital for the poor farmers who borrow money either from the banks or from private money lenders at much higher rates. Since the amount is heavy for the farmers, the crop failure can lead to farmer's suicide. Therefore, information about the future rain is very important. The earlier the information is available the better it will be for planning. This research is being carried out with this point in mind. In this research the data is collected over 32 years and based on these - three methods are used for prediction. The predicted value is the average of the three method results. The methods are: (1) the Fast Fourier Transform (FFT) method, (2) the Time Series method, and (3) the Root Mean Square (RMS) method using linear regression analysis,and the Artificial Neural Network (ANN) method.**

Index Terms— **Monsoon rain prediction, annual rainfall, rainfall frequency spectrum, El Nino and La Nina influence on rainfall, drought and famine, crop failure.**

I. INTRODUCTION AND OBJECTIVE OF RESEARCH

Fig. 1 shows the map of Jharkhand. It is a rocky area and storing water is difficult. Being rocky, drilling is difficult. This place suffers from lack of rain quite often. Many efforts have been made in the past for making arrangements for irrigation. Digging canals is difficult and costly. So is making reservoirs for storing water. Due to these factors and deficient rain - quite often the crop failures happen [1-6].

The crop failure results in decreased purchasing power for the farmers who are dependent on monsoon rains. In India, about 68% of the agriculture land is dependent on monsoon rain for irrigation. The lack of rain causes slowing down of the economy of India [7].

It becomes problematic when a country's water reserve becomes below 1,000 cubic meters per person per year; the country then faces water shortage [8]. About 700 million people in 43 countries were living below the 1,700 cubic meters per person threshold. Water stress has increased in regions such as China, India, and Sub-Saharan Africa, which has the largest population of the world.
The global warming effects are being felt throughout the world. For example, the state of California in United States of America (USA) went through a six-year drought period. As a result of this, the hydroelectric power stations had to be stopped many times. The lack of rain not only affects agriculture, but it also affects city supply, and hydropower has been discussed in [9]. The deficient rain conditions change the lifestyle of various places. One problem with Jharkhand is that it doesn't have enough reservoirs for storage of water.

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These days one finds the level of reservoirs to be low and affecting agriculture as well as generation of hydropower [10,11]. Not only Jharkhand but also many other areas of India are suffering from water shortages [12-31]. Many researchers have found this problem to be quite troublesome, and their research work can be seen in [32-39]. In this respect rainfall data by Indian Meteorological Department (IMD) can be seen in [40].

The present study has been undertaken to help farmers plan for the crop planting and purchasing of seeds etc. The help comes from forecasting well in advance about 7 months - about the rainfall in the next monsoon. This would also help planning for the hydropower generation as well as the municipalities who must supply water to the cities.

II. METHODOLOGY

Rainfall forecasting in this study is carried out using four methods: (1) the Time Series method, (2) the Fast Fourier Transform (FFT) method, (3) the Artificial Neural Network (ANN) method, and (4) the Root Mean Square (RMS) method. Further details about these methods can be found in references [31-35]. In the RMS method, the error between the data points and the regression line is minimized. In the Time Series method, each of the monsoon months—June, July, August, and September—is treated as a separate season. The regression line is chosen such that the overall error, considering all four months simultaneously, is minimized.

In the ANN method, the input vector initially consists of rainfall data for 32 years, starting from the year 1878. The corresponding output vector contains the rainfall data for the 33rd year from 1878. Based on Eq. (1), the elements of the weight matrix are obtained by numerical optimization.

In the ANN formulation, one has a relationship of the form

$$\{O\}=[W]\{I\} \qquad (1)$$

Where $\{O\}$ and $\{I\}$ are the output and input vectors of sizes $m\times1$ and $n\times1$, respectively, and $[W]$ is the weight matrix of size $m\times n$.
Subsequently, the input vector is shifted forward by one year, and the corresponding output vector is also updated. Thus, the starting year for the input vector becomes 1879, with the next 31 years forming the remaining elements, while the output vector now represents the 34th year from 1878. This procedure is repeated until the output vector

corresponds to the year 2025. In this manner, the weight matrix [W] is obtained.

In the FFT method, the Fourier coefficients are computed using a fast algorithm. These coefficients are then used to construct the Fourier series for the 32-year record, and a trend line is fitted. Using this trend, the function value at the 33rd point is evaluated as the value of the first point plus 32 times the slope of the trend curve.

Computational Method (Linear-Programming Neural Network Method) Is A Hybrid Computational Approach Developed To Combine The Learning Capability Of Neural Networks With The Optimization Precision Of Linear Programming (Lp). It Was First Introduced By Sharan And Balasubramanian And Sharan (1996) In The Journal Of Dynamic Systems, Measurement, And Control (Asme Transactions) As A New Paradigm For Solving Engineering Problems That Involve Complex, Nonlinear, And Constrained Data Relationships.

III. RESULTS AND DISCUSSIONS

Fig. 2 shows the results of calculations using the Time Series method, the Fast Fourier Transform method (FFT), the Root Mean Square (RMS) method, the Artificial Neural Network (ANN) and the actual rainfall record for the month of June. The details about these methods can be seen in [41-43]. In this figure one can see that the actual rainfall varies quite rapidly from year to year whereas the calculated values for the other methods do not show that kind of variation. In the Table 1 one can see the summary of results. Here, one can see that the FFT method gives the highest value and the RMS method - the lowest. The predicted value is the average of these three methods. One can compare the predicted value with the average of past 32 years. It shows that the predicted value is less than the 32-year average value.

Fig 2 shows various output puts computed by different methods. It shows that the actual rain values differ each year very rapidly. In Fig. 3, the Time Series method and the RMS method both show a similar declining trend. The actual rainfall curve shows rapid changes from year to year. The FFT method results also vary but not to the same extent as the actual rainfall amounts. In Fig. 4, the difference between calculated methods is less than the previous figure. The actual rainfall values show variations like the ones in the previous figures. In Fig. 5, the RMS method shows a declining trend whereas the Time Series method shows an increasing trend. The FFT method results fluctuate just like the actual rainfall values. The variation in the actual rainfall is larger as compared to the FFT method.

The total value of rain is shown in Fig. 6. In this figure, the Time Series method shows increasing trend. The difference between all the results is much smaller in this figure. The actual rainfall varies from year to year is just like before. Fig. 7 shows the amplitude versus frequency number. In this figure the frequency numbers 1, 3, 5, 9 and 10 have amplitudes greater than 4 centimeters. All other frequency numbers exhibit their amplitudes less than 4. This shows that there are enough frequencies whose amplitudes are significant

IV. CONCLUSION

The amount of rainfall prediction was caried out in two parts, in the 1st part Saran's method (Table 1) was used where the average of four methods which are, ANN, RMS, FFT and time series were calculated. In the 2nd part the average of Saran's method and LP Neuro method was calculated, and this value is considered as an overall prediction (Table 2) for the next year's rainfall.

Based on this study one can conclude the following:
1. There are sharp variations in the actual rainfall values from year to year.
2. The Time Series method and the RMS method show linear variation due to linear regression. Both curves show increasing trend.
3. The FFT method results are sum of various harmonics, and they fluctuate fair bit from year to year. The total variation in this method is more than that of the actual rain values.
4. This year - overall there will be more rain than the 32-year average as shown in Table 1.
5. The ANN method yields the least result.

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TABLE 1: RAIN FORECAST IN CENTIMETERS FOR JHARKHAND DURING 2025 MONSOON MONTHS

METHOD	YEAR	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL	COMMENTS
TIME SERIES	2025.0	7.2	19.8	32.1	19.8	78.9	
FFT	2025.0	31.6	35.5	28.8	20.3	116.2	
RMS	2025.0	8.8	29.1	30.0	21.8	89.6	
ANN	2025.0	8.9	27.3	27.5	20.0	83.6	
PREDICTED AVERAGE	2025	14.1	27.9	29.6	20.5	92.1	This year the predicted value is less than the 32 – year average shown below
32 YEAR AVERAGE	2025	18.9	31.4	29.8	21.8	101.8	

TABLE 2: OVERALL PREDICTION

METHOD	AMOUNT (cms)
SHARAN	107.5
LP NEURO	60.6
OVERALL PREDICTION (AVERAAGE)	84.2

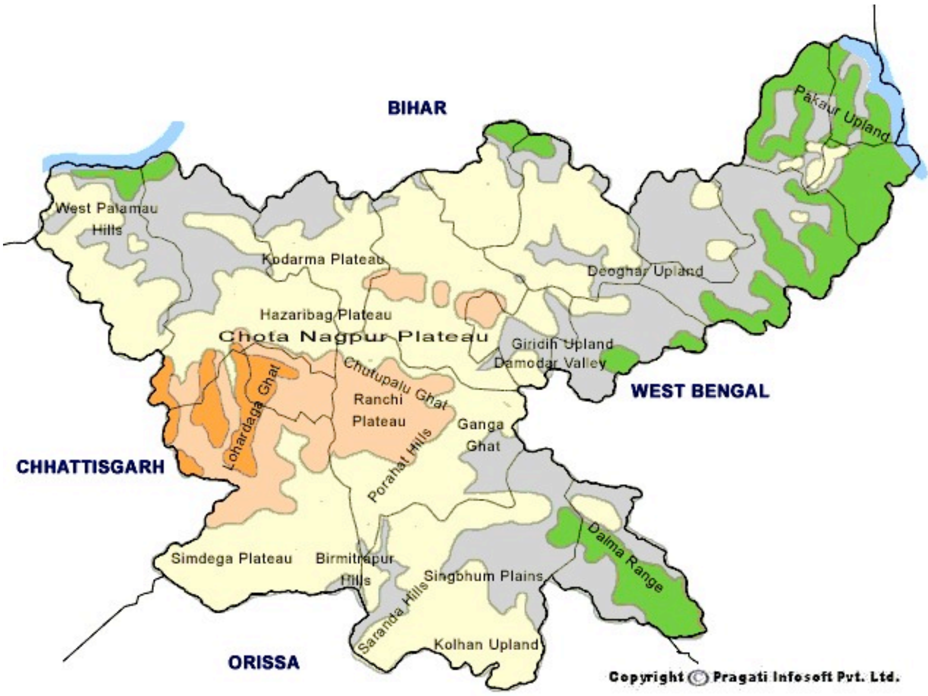
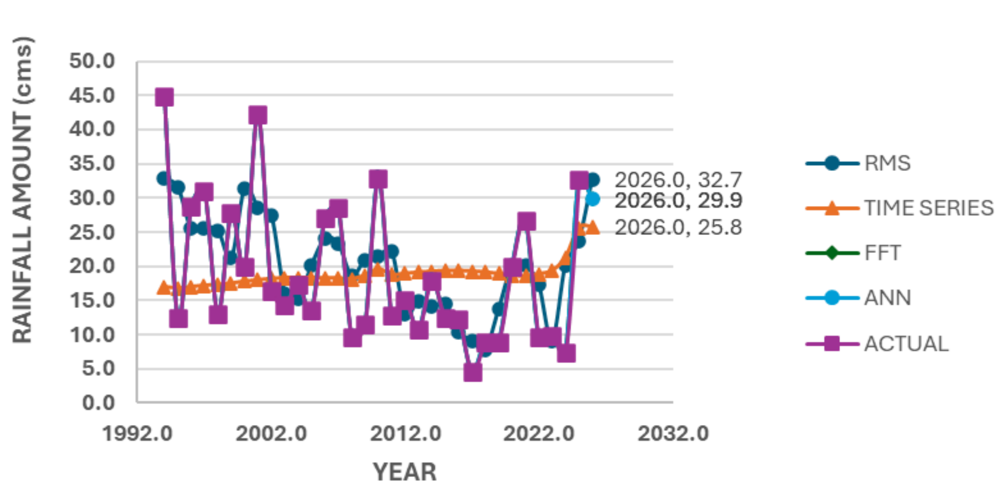


FIG 1 MAP of JHARKHAND

FIG 2 RAINFALL AMOUNT IN JUNE , 2026 (cms)



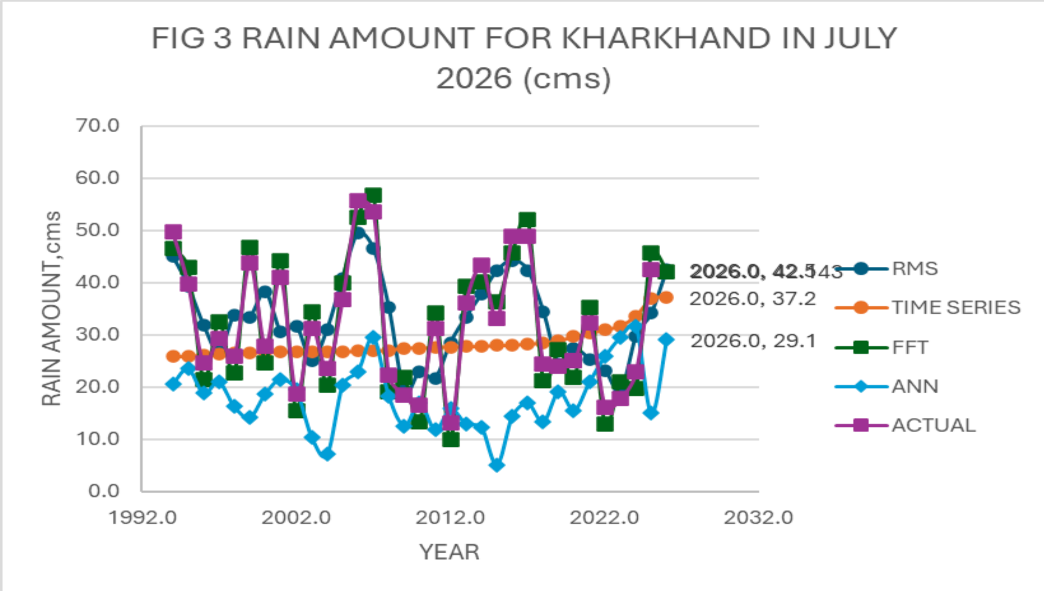


FIG 3 RAIN AMOUNT FOR KHARKHAND IN JULY 2026 (cms)

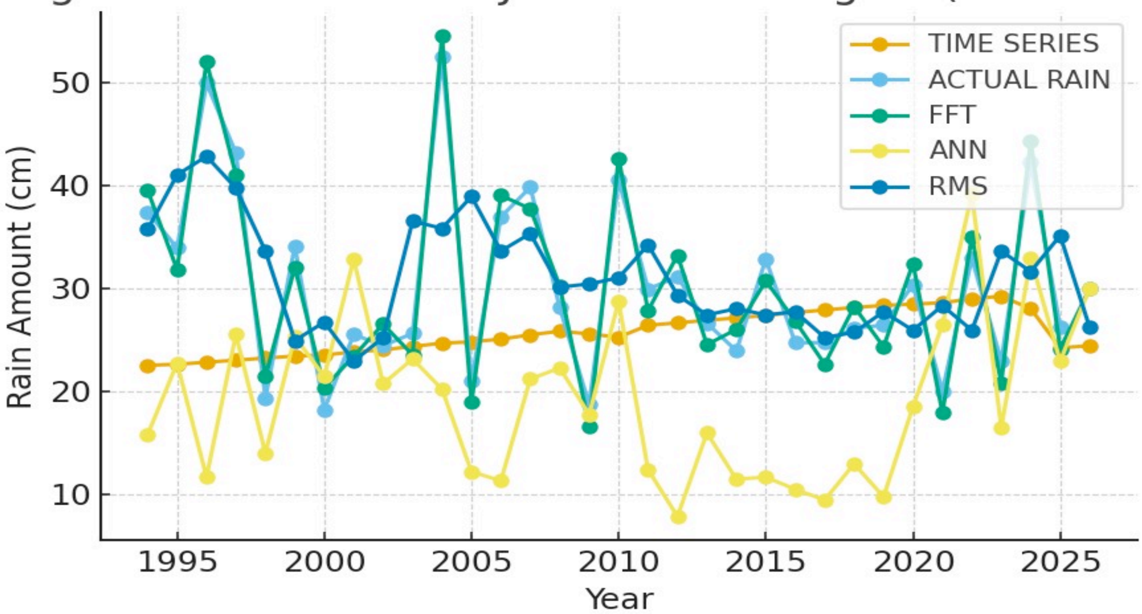


Fig 4: Rain Amount in Jharkhand – August (1994–202

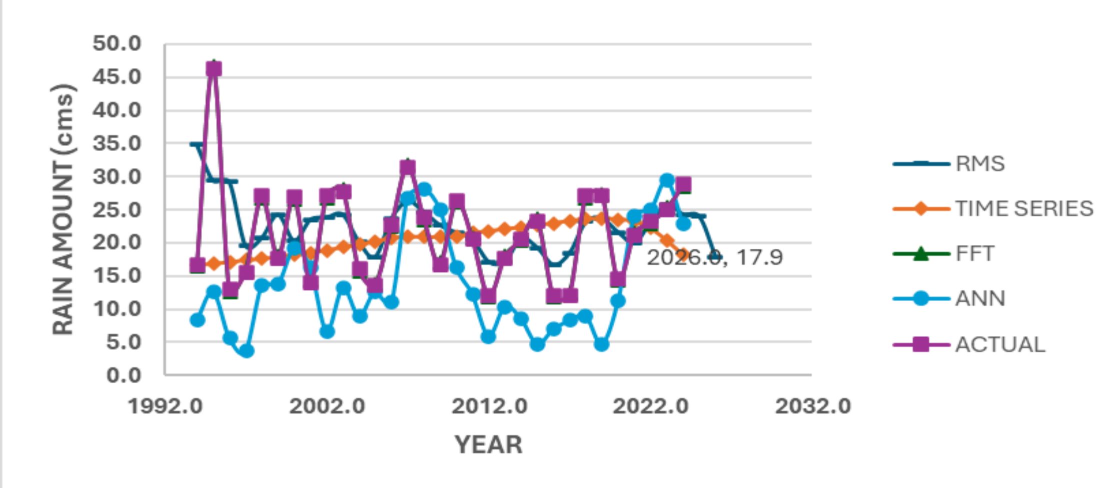


FIG 5 RAIN AMOUNT IN JHARKHAND IN SEPTEMBER IN YEAR 2026 (cms)

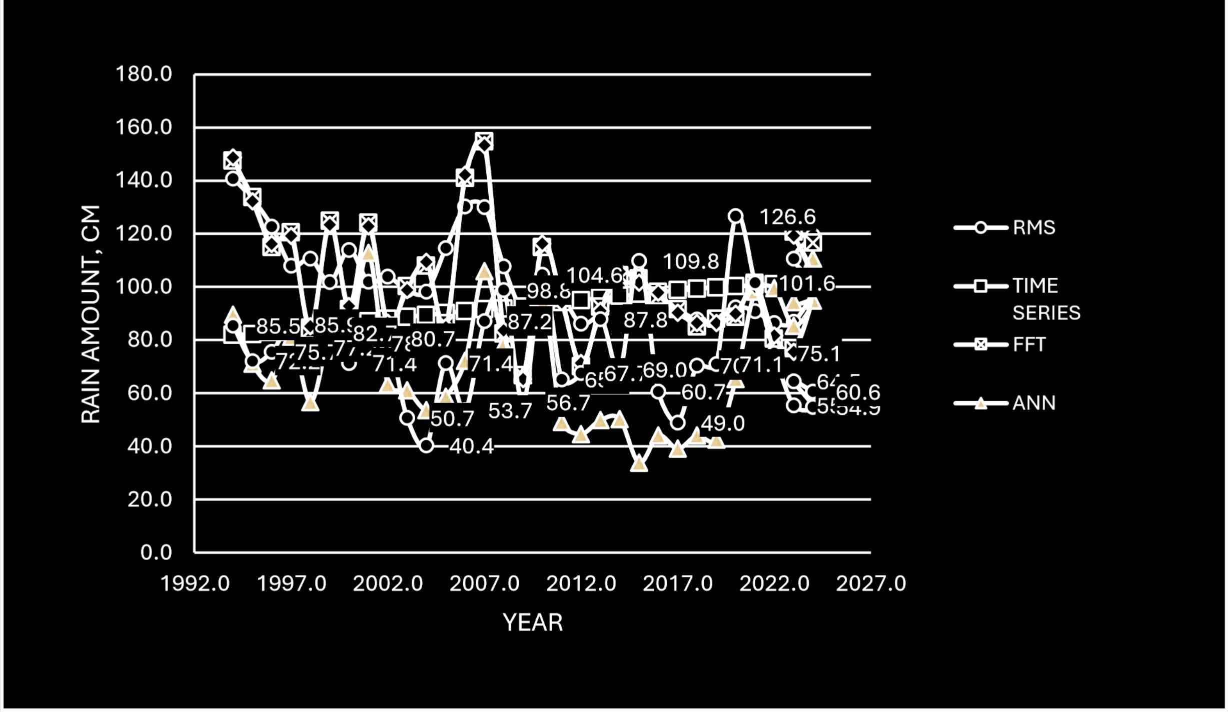


FIG 6 TOTAL RAIN AMOUNT IN 2026

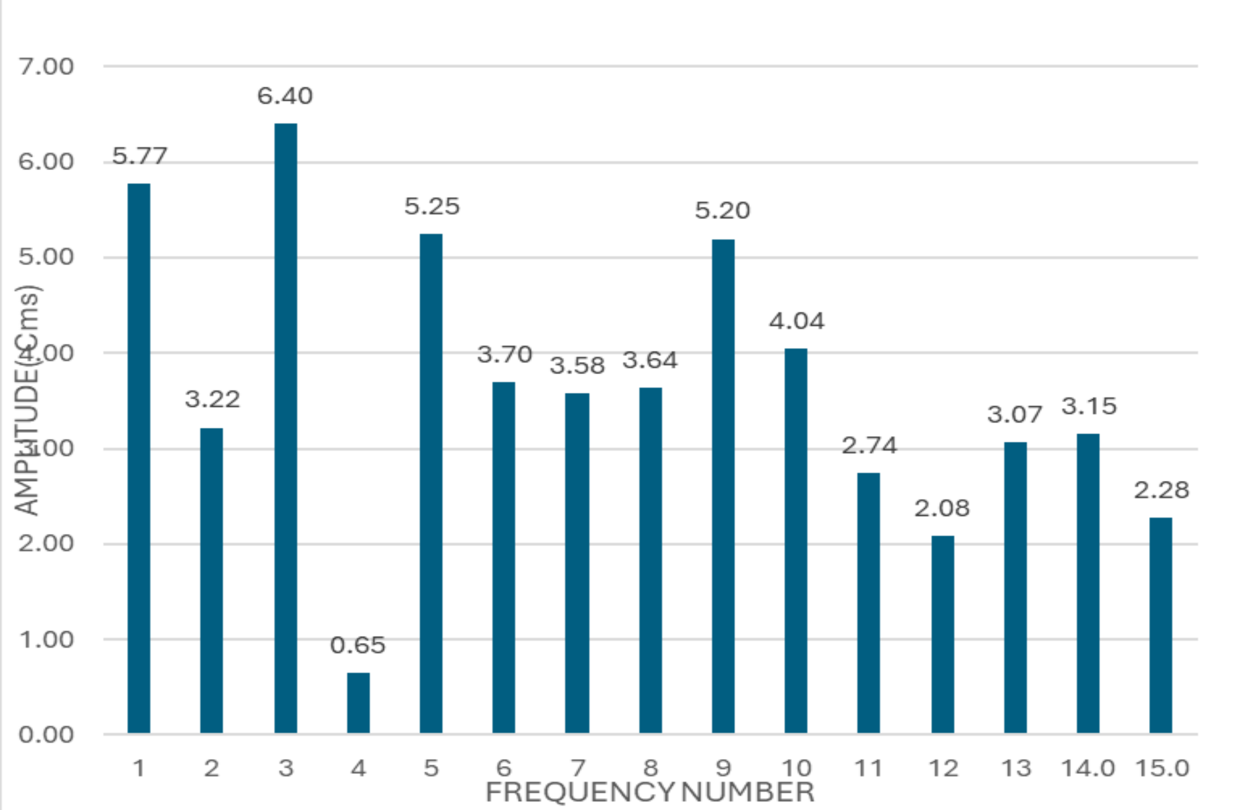


FIG 7 AMPLITUDE (CMS) VERSUS FREQUENCY NUMBERS