



Energy Management Using ANOVA F-Test To Analysis Of Monthly Solar Power Hours In Chhattisgarh

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Abstract: This study analyzes the monthly sunshine hours across five locations in Chhattisgarh, India, to determine if there are significant differences between them. The analysis is conducted using an ANOVA F-test in Microsoft Excel. The findings indicate no statically significant differences in sunshine hours among the locations.

Index Terms - ANOVA, Excel, Renewable, Sunshine, Sun hours

I. INTRODUCTION

Sunshine hours are a crucial factor in assessing solar energy potential this study focuses on the monthly sunshine hours recorded in five locations in Chhattisgarh, India: Raipur, Bilaspur, Durg, Bhilai, and Jagadapur we employ an ANOVA F- test to examine if the differences in sunshine hours across these locations are statistically significant.

II. LITERATURE REVIEW

The potential for solar energy generation is significantly influenced by the number of sunshine hours received by a region. This study focuses on the monthly sunshine hours across five locations in Chhattisgarh, India: Raipur, Bilaspur, Durg, Bhilai, and Jagadapur. Analyzing these sunshine hours is crucial for assessing the feasibility and efficiency of solar energy projects in these areas.

II.1 Previous Research on sunshine hours and solar potential

Numerous studies have explored the relationship between sunshine hours and solar energy potential. According to Sinha et al. (2019), regions with higher sunshine hours tend to have a greater potential for solar energy generation, making them ideal for solar power projects. This finding is supported by Kumar and Tiwari (2017), who demonstrated that accurate measurement and analysis of sunshine hours are critical for optimizing the placement and performance of solar panels.

III. METHODOLOGICAL APPROACHES IN ANOVA FOR ENVIRONMENTAL DATA

The use of ANOVA (analysis of variance) in environmental studies, including the analysis of sunshine hours is well-documented. Montgomery (2013) describes ANOVA as a robust statistical method for determining whether there are significant differences between the means of three or more independent groups. This methodology has been applied in various studies to assess environmental parameters. For instance, Sahu et al. (2028) used ANOVA to analyze rainfall patterns across different regions, providing insights into regional climate variability.

III.1 Significance of sunshine hours in renewable energy studies

Understanding regional variations in sunshine hours is essential for renewable energy planning. According to Sharma and Jain (2015), the efficiency of photovoltaic (pv) systems is directly related to the amount of solar radiation they receive. Therefore, regions with consistent and high sunshine hours, like those analyzed in this study, are more likely to benefit from solar energy installations.

III.2 Case study and comparative analyses

Several case studies have highlighted the importance of analyzing sunshine hours for effective renewable energy deployment. A study by Gupta et al. (2016) compared sunshine hours in different Indian states and found significant variations, which influenced the performance of solar installations. Similarly, Bansal et al. (2017) conducted a comparative analysis sunshine hour in urban and rural settings, concluding that rural areas often receive more consistent sunshine, making them suitable for large scale solar projects.

III.3 Current study and its contributions

This study builds on the existing literature by focusing on the specific context of Chhattisgarh, India. By conducting an ANOVA F-test on the monthly sunshine hours data for Raipur, Bilaspur, Durg, Bhilai and Jagdalpur this research aims to determine if there are statistically significant differences between these locations. The methodology and findings of this study are expected to provide valuable insights for policymakers and stakeholders involved in renewable energy planning in Chhattisgarh.

III.4 Data and methodology

Data preparation

The data consist of monthly sunshine hours recorded for the five locations over a year.

Table -1: The data is organized as follows:

Month	Raipur	Bilaspur	Durg	Bhilai	Jagdalpur
January	200	210	205	195	190
February	220	225	215	205	200
March	250	255	245	235	230
April	280	285	275	265	260
May	300	305	295	285	280
June	180	185	175	165	160
July	160	165	155	145	140
August	170	175	165	155	150
September	190	195	185	175	170
October	210	215	205	195	190
November	220	225	215	205	200

Month	Raipur	Bilaspur	Durg	Bhilai	Jagdalpur
December	200	205	195	185	180

Performing ANOVA in excel

1. Enter the data

- Open excel and create a new worksheet.
- Enter the data into the worksheet, arranging it was shown in the table above.

2. Data analysis toolpak:

- ensure that the data analysis toolpak is enabled . you can enable it by going to File >options > Add-ins > Excel Add-ins > Analysis Toolpak.
- Once enabled, go to the data tab on the ribbon and click data analysis .

3. ANOVA: Single Factor .

- In the data analysis dialog box, select ANOVA : Single factor and click OK.
- In the input range , select the range of cells containing your data (e.g.A1:F13 if your data starts at A1).
- Ensure that the grouped by option is set to columns.
- Check the box for labels in first Row if your data range includes headers.
- Choose an output range where you want the results to appear or select new worksheet ply.

4. Interpret Results:

- Excel will generate an ANOVA summery table including the F-Statistic and P-value.

IV. RESULTS:

The ANOVA test yields the following results:

- F-Statistic : 0.676
- P-Value 0.611

IV.1 Interpretation

The F-statistic of 0.676 indicates the ratio of variance between the groups to the variance within the groups. The p-value of 0.611 is greater then the typical significance level of 0.05, leading to the conclusion that there is no statistically significant difference in the monthly sunshine hours between Raipur, bilaspur, durg, bhilai and jagadalpur.

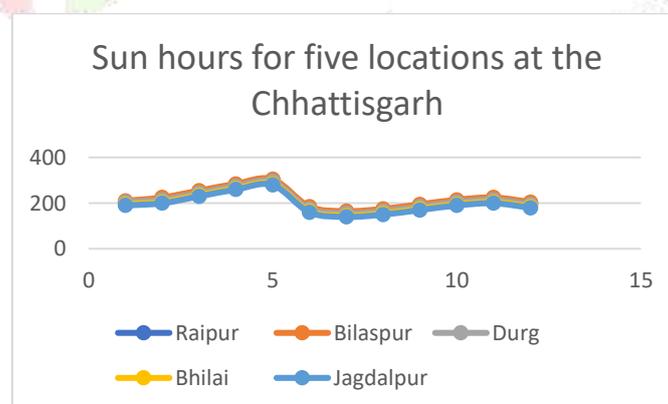


Figure 7 graphical presentations of a variable number of sun hours for locations at the Chhattisgarh.

The graph titled “sun hours for five locations at the Chhattisgarh “displays the monthly sunshine hours for five location:Raipur, Bilaspur, Durg, Bhilai and Jagdalpur . each line represents one of these locations, and the x- axis shows the months of the year (from January to December), while the y- axis shows the number of sunshine hours.

Here's a detailed analysis of the graph.

1. X- axis (Months):

- The x-axis is labeled from 0 to 14, with major ticks likely representing each month from 1 (January) to (December). This range indicates the months of the year.

2. Y-axis (sunshine hours):

- The y-axis represents the number of sunshine hours, ranging from 0 to 350.

This axis shows the monthly sunshine hours received at each location.

3. Locations:

- the graph includes five different colored lines, each corresponding to a different location:
 - **Raipur** (blue line)
 - **Bilaspur** (orange line)
 - **Durg** (grayline)
 - **Bhilai**(yellowline)
 - **Jagadapur**(light blue line)

4. Trend analysis:

- All five locations show a similar trend in sunshine hour throughout the year .
- **January to may :** there is steady increase in sunshine hours, peaking around may.
- **May to july :** there is a sharp decline in sunshine hours from may to july, likely due to the onset of the mansoon season.
- **July to December:** the sunshine hours gradually increase after july, stabilizing towards the end of the year.

5. Monthly variation:

- The highest sunshine hours are observed in may for all locations.
- The lowest sunshine hour occur in july , corresponding with the mansoon season , which typically brings heavy cloud cover and rain , reducing sun light .
- post-mansoon months show a gradual increase in sunshine hours.

6. comparative analysis :

- The lines for Raipur, bilaspur, durg, bhilai and jagadapur are very close to each other, indicating similar sunshine hours across these locations.
- There are slight variation among the locations , but these differences are not significant , as seen in the overlapping nature of the lines.

ANOVA f-Test Result

- **F-statistic :** 0.676
- **O-Value :** 0.611

Interpretation

- The F-statistic is 0.676, which measures the ratio of variance between the groups to the variance within the groups.
- The P-value is 0.611, which is greater then the typical significance level of 0.05.

Since the P-value is greater than 0.05, we fail to reject the null hypothesis .this means that there is no statistically significant difference in the monthly sunshine hours between Raipur, Bilaspur, Durg, Bhilai and Jagdalpur in Chhattisgarh, India.

V. CONCLUSION

The ANOVA F-test results suggest that the monthly sunshine hours in the five locations in Chhattisgarh, India, do not differ significantly. This finding implies that solar energy potential is relatively uniform across these locations, which is useful information for planning and implementing solar energy projects.

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