



ANOVA-Based Variance Analysis in Smart Home Energy Consumption Data Using a Case Study of Darmstadt Smart City, Germany

This study proposes and implements a statistical variance analysis on smart home energy consumption data to help smart grid stakeholders optimize energy management, forecast future requirements and detect anomalies or consumer behavior patterns.

The variables examined are Y = Number of measurements, as a dependent variable and X = Day of the month (with 31 levels). For easier implementation and cleaner plots, we only consider data from August 2011. The data is modified from the original dataset and now contain the number of measurements per hour for each day of the month.

Isalos version used: 2.1.2

Scientific article: <https://www.mdpi.com/2673-4591/82/1/31>

Step 1: Bar chart with variance

In the first tab named “Action” (can be renamed to “Plot”), import the corresponding data, with columns “Date”, “Hour” and “Readings”. To make the bar chart, go to **Plot** → **Comparison Charts** → **Bar Chart** and enter the chart title as well as the horizontal and vertical axis titles, then, click **Execute**

	Col1	Col2 (S)	Col3 (I)	Col4 (I)
User Header	User Row ID	Date	Hour	Readings
1		2011-08-01	9	607
2		2011-08-01	11	998
3		2011-08-01	12	3204
4		2011-08-01	13	3370
5		2011-08-01	14	3440
6		2011-08-01	15	3591
7		2011-08-01	16	3553
8		2011-08-01	17	3604

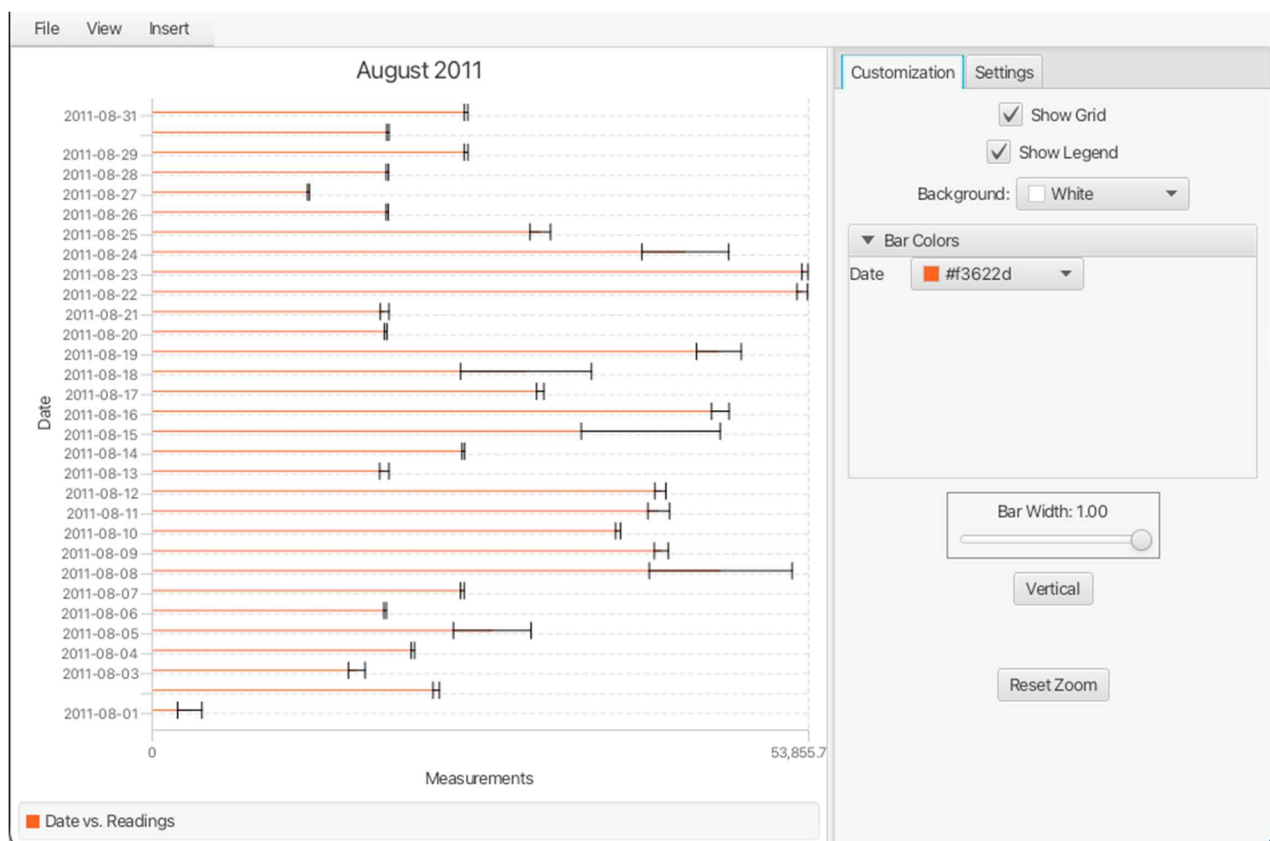


A configuration dialog box titled "Bar Chart" with a close button (x) and a help button (?). It contains the following settings:

- Chart Title: August 2011
- Horizontal Axis Title: Date
- Vertical Axis Title: Measurements
- Category: Col2 -- Date
- Value: Col4 -- Readings
- ☐ Include Subcategory
- Subcategory: (empty dropdown)
- ☐ Stacked Bar Chart

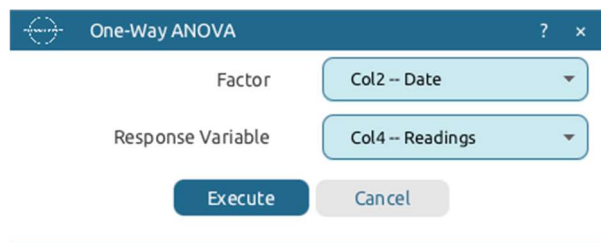
At the bottom are "Execute" and "Cancel" buttons.

Then, in the plot window go to the Settings tab and select Mean under Aggregation and choose SD as the Error Bar Type. The Horizontal option is available in the Customization tab to make the labels align nicely.



Step 2: One Way ANOVA

Close the plot window and add a new tab named “ANOVA”. Import data from the same file and go to Statistics → Analysis of (Co)Variance → One Way ANOVA, select “Date” as Factor and “Readings” as Response Variable and click Execute



The image shows a dialog box titled "One-Way ANOVA". It has two dropdown menus: "Factor" set to "Col2 -- Date" and "Response Variable" set to "Col4 -- Readings". At the bottom, there are two buttons: "Execute" and "Cancel".

Results (right spreadsheet):

	Col1	Col2 (D)	Col3 (D)	Col4 (D)	Col5 (D)	Col6 (D)	Col7 (D)	Col8 (D)	Col9 (D)	Col10 (D)
User Header	User Row ID	SSB (Between Groups):	SSW (Within Groups):	SST (Total):	dfB (Between):	dfW (Within):	MSB:	MSW:	F-statistic:	p-value:
1		1109626083 44.43694	2903784513 2142906	1138663928 57.65123	30.0	703.0	3698753611. 481231	4130561.185 2266	895.460312 9	0.0

Final Isalos Workflow:



References:

Kodali, Y., & Kumar, Y. V. P. (2024). ANOVA-Based Variance Analysis in Smart Home Energy Consumption Data Using a Case Study of Darmstadt Smart City, Germany. *Engineering Proceedings*, 82(1), 31. <https://doi.org/10.3390/ecsa-11-20354>