

I-V Curve Statistic Package User Manual

Load I-V curve statistic package:

This R package has a user interface built with package "Shiny". In order to load this package, you need to open an R session, **set working directory at where this document is in**, and run the following :

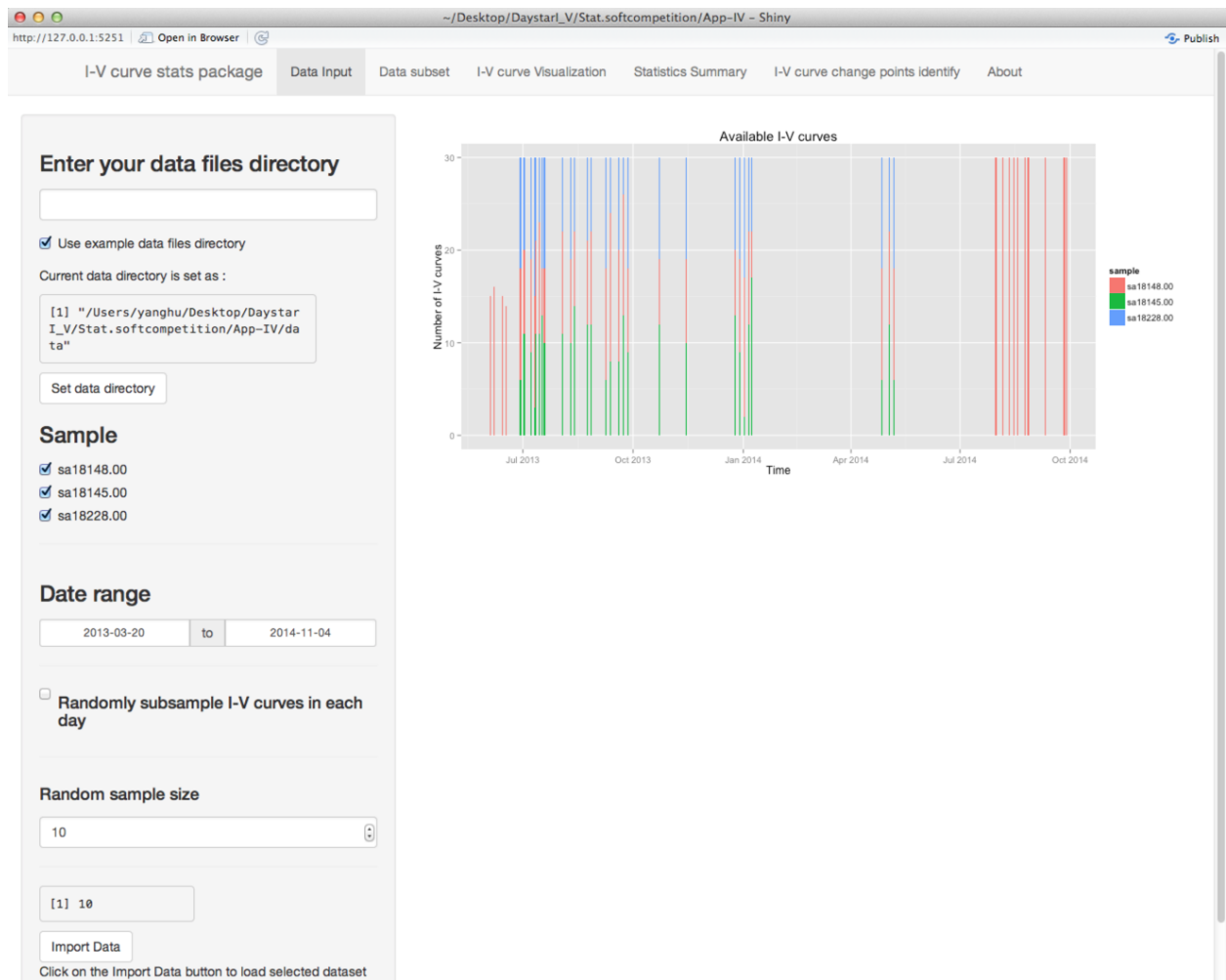
```
> install.packages("shiny")
```

```
> library("shiny")
```

```
> runApp("APP-IV")
```

This user interface is designed to follow the workflow of analyzing a large amount of I-V curves data. Researchers need to follow the workflow step by step.

Step 1:Data Input



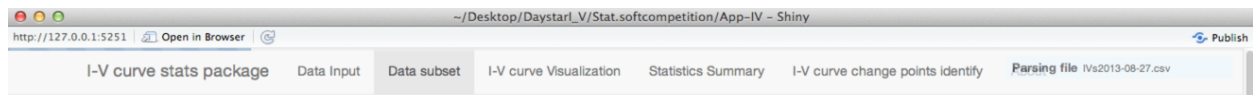
Enter the path where your data files at in the input text box. For demonstration, this package has a small dataset, which is randomly sampled from a large real-world I-V curve measurements. The real-world data

were collected from Solar Durability and Lifetime Extension (SDLE) center's outdoor PV module reliability test center -- SDLE SunFarm, at Case Western Reserve University, Cleveland OH.

Click on "Set data directory" to get a plot of all the I-V curves available for the researchers.

Select the sample/samples you want to study, and the period of time, the plot will automatically update. The package gives an option to randomly subsample I-V curves in each day. You need to specify the sample size according to the plot one the right.

Click on "import data " at the bottom left corner to import dataset for further analysis, and go to next page. You will see a progress bar on top, and a text box showing which data files is being read on the top right corner.



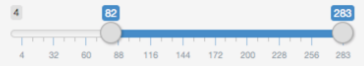
Step 2: Data subset

After data import process is done, you will see a message "Data have been imported" on the top of data subset page. The purpose of this page is to identify abnormal records (i.e. NAs, extreme records like -9999 or 9999) and eliminate errors of instruments. The box plot and table on the right provide a summary of number of data points in each I-V curve, average ambient temperature before and after the measurement, average global horizontal irradiance, and the differences of irradiance before and after measurement. For a valid measurement, the number of points in a I-V curve should above 180, ambient temperature varies from - 20 to 70 degree C, irradiance varies from 0 to 1300 w/m², and the difference of irradiance around 0 (within 10w/m²).

After changing the range of subsetting data, click on the "subset data" button on the bottom left corner, and go to next page.

Data have been imported

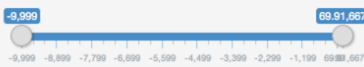
Number of data points



Current Value:

[1] 4 283

Ambient Temperature(Avg)



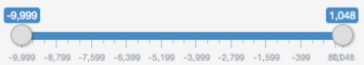
Current Value:

[1] -9999.00000 69.91667

☒ Eliminate extreme temperature records

☒ Eliminate NA temperature records

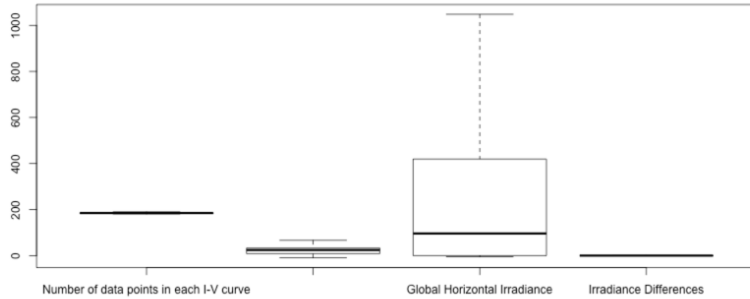
Global Horizontal Irradiance (Avg)



Current Value:

[1] -9999 1048

☒ Eliminate extreme irradiance records



	Number of data points	Ambient Temperature	Global Horizontal Irradiance	Irradiance Differences
1	Min. : 4.0	Min. : -9999.000	Min. : -9999.000	Min. : -183.29830
2	1st Qu.: 183.0	1st Qu.: 8.714	1st Qu.: 0.006	1st Qu.: -0.10650
3	Median : 185.0	Median : 24.273	Median : 96.231	Median : 0.00000
4	Mean : 171.5	Mean : -393.202	Mean : -105.873	Mean : -0.13757
5	3rd Qu.: 186.0	3rd Qu.: 32.814	3rd Qu.: 419.227	3rd Qu.: 0.08716
6	Max. : 283.0	Max. : 69.917	Max. : 1048.083	Max. : 125.34950
7		NA's : 120		

Irradiance Differences



Current Value:

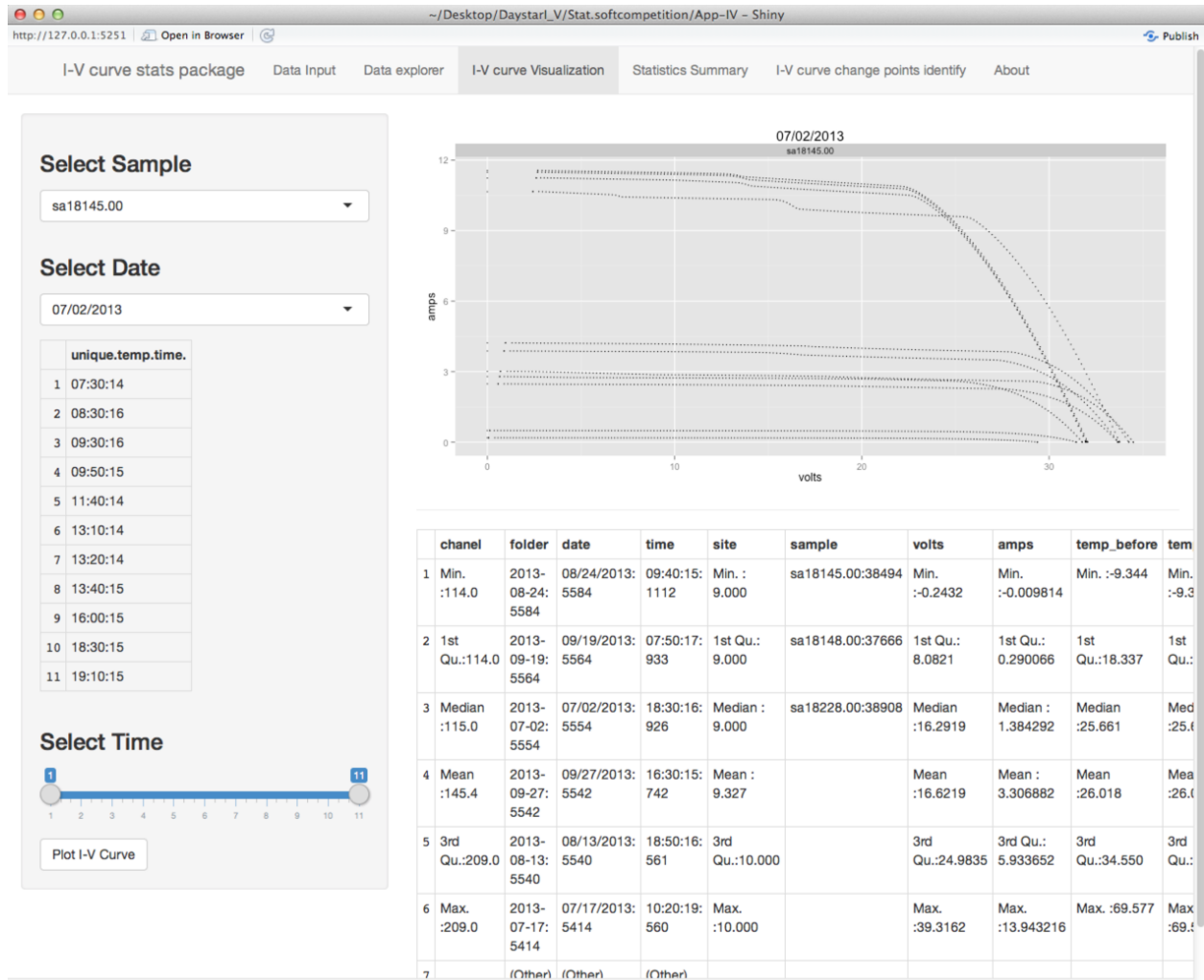
[1] -63.2983 16.7017

Subset Data

Click on Subset Data button to trim the data set according to the range selected above

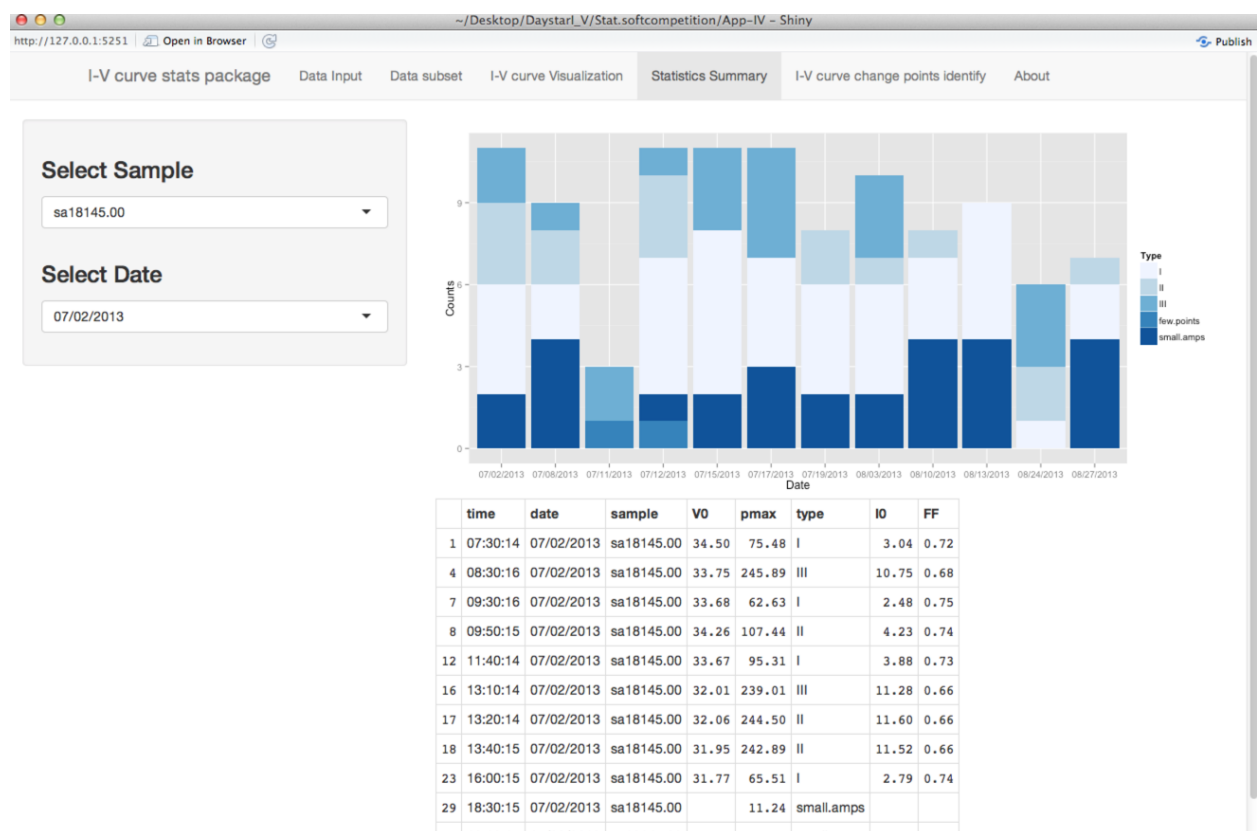
Step 3: I-V curve visualization

The process of subsetting data is shown as a processing bar on top. On the I-V curve visualization page, a summary of current dataset is shown in the table. By selecting the sample and date, you can plot multiple I-V curves from one day on right. The slide bar is used to choose observations being plotted in one day.



Step 4: Statistics Summary

When user proceed to this page, the software will run the two core function “mark_curves” and “getgoody” behind the scene, and summarize multiple variables of each I-V curve, including open circuit voltage **V0**, short circuit current **I0**, maximum power point **pmax**, fill factor **FF**, and most important the type of the curve. The bar plot shows the distribution of each type of curve in each day.



Step 5: I-V curve change point identify

From the previous step, the user would know when there are type I II or III I-V curves available. On the I-V curve change point identify page, you can further mark the change points on each I-V curve. After interested I-V curve is selected, click on “identify change points” button to update the plot on the right.

