# easy statistics with jamovi



## Use of Jamovi for beginners

Vishal D. Pajankar

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Title:

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Dedicated to My Teacher

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# Preface

Analysis of data is a very important activity in a quantitative research study. Planning of statistical analysis of research data is as important as designing and conducting a research study. With the proper planning for conducting a study, the identification of accurate statistical procedures, techniques, and statistical tests is also important. At this stage, accurate analysis of data helps to draw correct inferences about the study. With such ability, a researcher can make use of software packages for analyzing large data files with thousands of variables instead of manual calculations.

A lot of statistical software are available in priced (paid) and un-priced ways. A paid software is difficult to purchase for an individual researcher or scholar due to its high price. Some statistical software has a low price but its annual renewal or maintenance cost may not be affordable to them. So, the preference of researchers or scholars is moving towards unpriced software or free software, or Open Source Software.

Nowadays, the use of free software or Open Source Software (OSS) platforms is growing very fast. The main advantage of OSS is that anyone can download the software without paying any single paisa and can improve and modify its source code. This characteristic enables the OSS to attract many contributors to voluntarily contribute to the development of the software project in the form of a group called OSS Communities. Few good OSS statistical software is available for data analysis such as R, Jamovi, JASP, GNU PSPP, SciLab, etc.

Among the number of Open Source software, 'R' is one of the most popular software in academics, especially among statistics faculty and scholars. One major advantage is that R is a dynamic software while the major disadvantage is that it is a code-based software i.e. command-based software which makes it difficult to understand non-programming or non – mathematics/statistics researchers.

**Jamovi**, is a free and Open Source software, has Graphical User Interface (GUI). So, its presentation is completely menu-driven. Its GUI helps the non-programming researchers to do their data analysis is a ***click – drag – result*** way. It is developed on the 'R' platform which makes it easy to access and use. It is developed by a team that was earlier worked with other statistical software company. With Jamovi, we can perform all the advanced analyses. Some salient features of the Jamovi are that we can view data, its processing, and result in a single window at a time; text data can also be

analyzed, the output is interactive, updating on the fly as the variables are added and options set, and as data is filtered or changed, variable transformations can be saved and modify as per requirement, parallelly R syntax can be used.

In this project, we are using Jamovi 2.2.5 version. However, same time higher version of Jamovi may be available but as suggested by the Jamovi community, it is highly recommended and mostly used by the researchers that why we preferred it. Jamovi recommend which version is stable and can be installed.

The project will be very much useful for the students of any discipline who wants to conduct statistical analysis with their software. It will also be beneficial to students of graduate and master courses and also to the research scholars. The Universities and academicians can also refer to it in their courses.

This project is to learn how to use Jamovi software for data analysis. We are not giving any explanation about statistical tools, which may be a limitation of this project. Through this project, we are trying to teach how easily one can learn to use this software. We are covering all basic statistics from frequency calculation, central tendencies (mean, median, mode, etc.) to Correlation, Regression to t-test, and ANOVA.

Finally, I wish to express my special acknowledgment and gratitude to the team Jamovi for providing such wonderful and user-friendly data analysis software. My special thanks to Jonathon Love, Director and Co-Founder of the Jamovi Project Pty Ltd. to permit this project. Thanks.

**22.05.2022**

**New Delhi** **Vishal D. Pajankar**

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# 1. What is Jamovi?

Jamovi is a new "3rd generation" statistical spreadsheet. It is a free and Open Source software. It is built on the 'R' statistical language, to give access to the best statistics community for easy to use. Jamovi is made by the scientific community, for the scientific community which is intuitive to use and can provide the latest developments in statistical methodology. Jamovi is developed with Graphical User Interface (GUI). Its GUI feature helps to become a compelling alternative to costly statistical products such as SPSS and SAS. This feature helps the non-programmer researchers and scholars to do their statistical data analysis in a ***click-drag – result*** way.

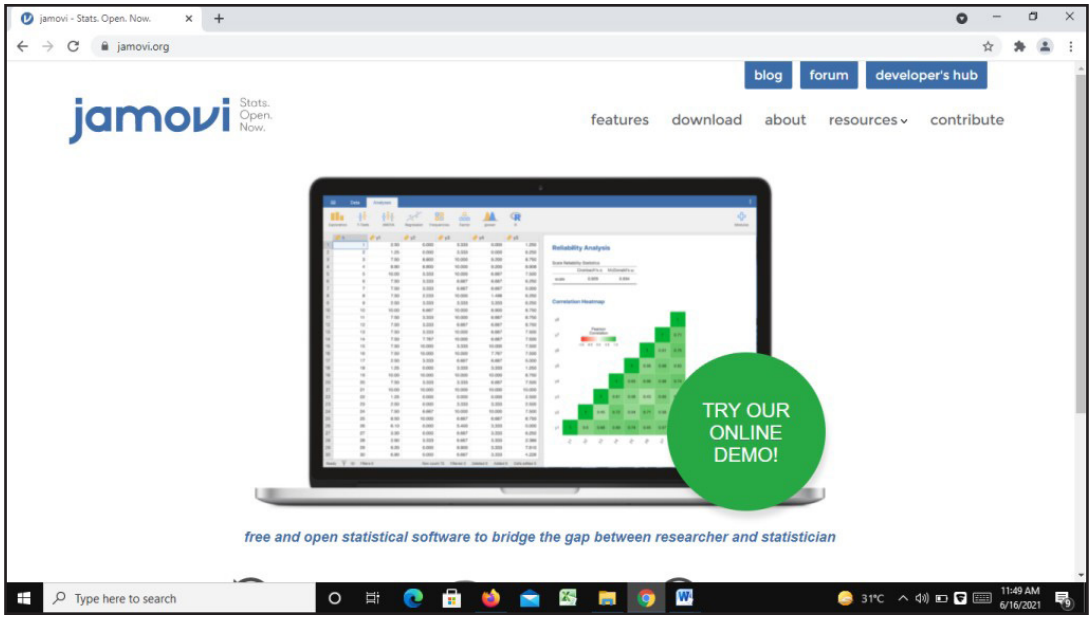



*Fig. 1: Home page of Jamovi*

# 2. How to install Jamovi?

Jamovi software is freely available for download through any search engine. It is available for Microsoft Windows, macOS, and Linux Chrome platforms.

Installation through Windows OS is quite easy for the users because most of the users are having Microsoft Windows operating system. To install the Jamovi, just type https://www.jamovi.org/ at the address bar you will get the home page of the Jamovi.

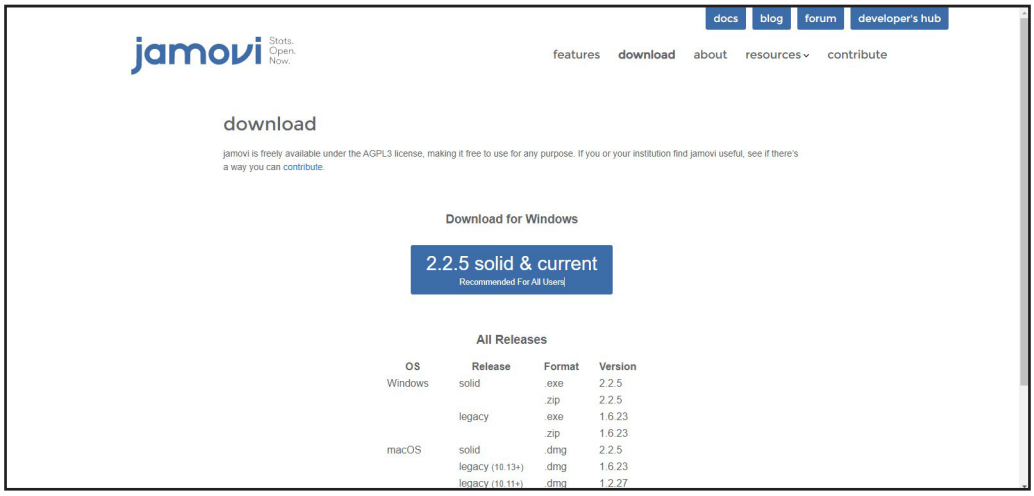



*Fig. 2: Jamovi – Download page*

On the home page of the Jamovi, you will get the following menus, namely - features, download, about, resources, and contribute. Explore each menu for more information by just clicking on it. To download the Jamovi software, click on the ***download*** option and the following page (shown in Fig. 2) will appears with the latest version of the software for different operating systems.

This page can also be appeared by simply typing the link https://www.jamovi.org/download.html on the address bar.

Different files for installation of software appear along with information or Operating Systems, its release, format, and version of the available files. Jamovi also recommends you which file have to install.

Files are in two formats .exe and .zip in addition to recommended version and the latest version of the Jamovi. On double-clicking .exe version, the Jamovi will automatically start downloading. For .zip version, download the .zip version then unzip it at a defined location on the computer system/laptop. Open the unzipped folder by double click on .exe file.

# 3. Basic View of Jamovi

In an earlier chapter, we have seen how to install the Jamovi software. After installation of Jamovi, it will appear in the programme files. Now click on START (Windows icon appears at the lower-left corner of the Computer/Laptop), we will get Jamovi.

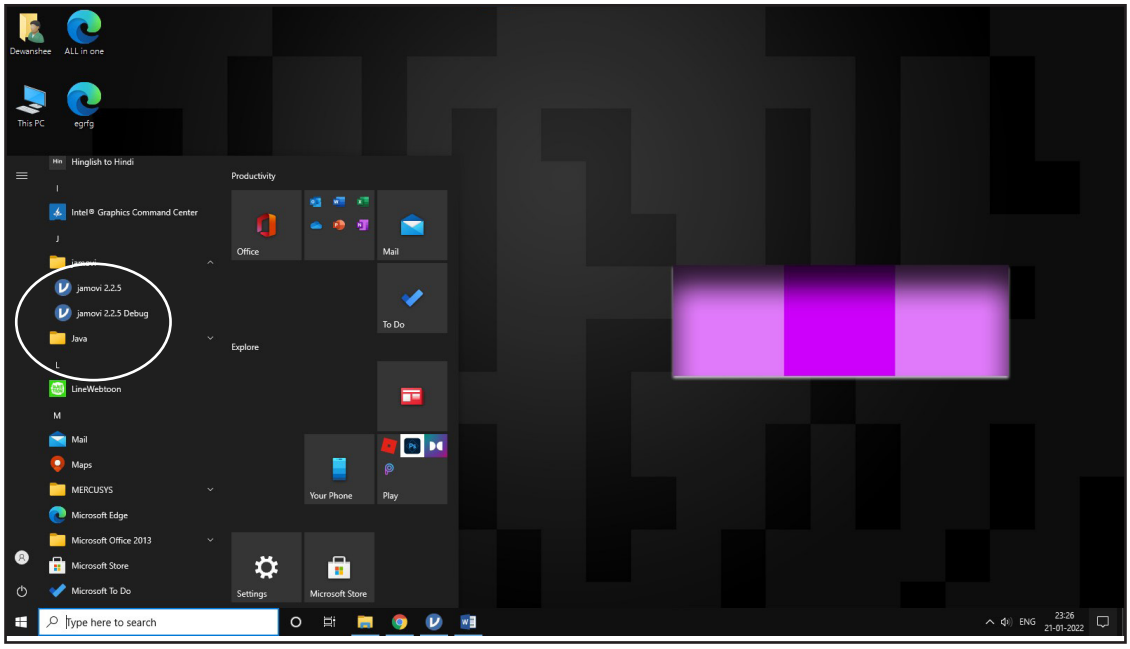



*Fig. 3: Jamovi – from your Operating System*

Click on Jamovi 2.2.5 to open the Jamovi spreadsheet. Jamovi version may be different on your computer/laptop depending on the version you downloaded. After clicking, the Jamovi spreadsheet will be appeared and be ready to analyse it.

Very first look of Jamovi will be as below in the figure

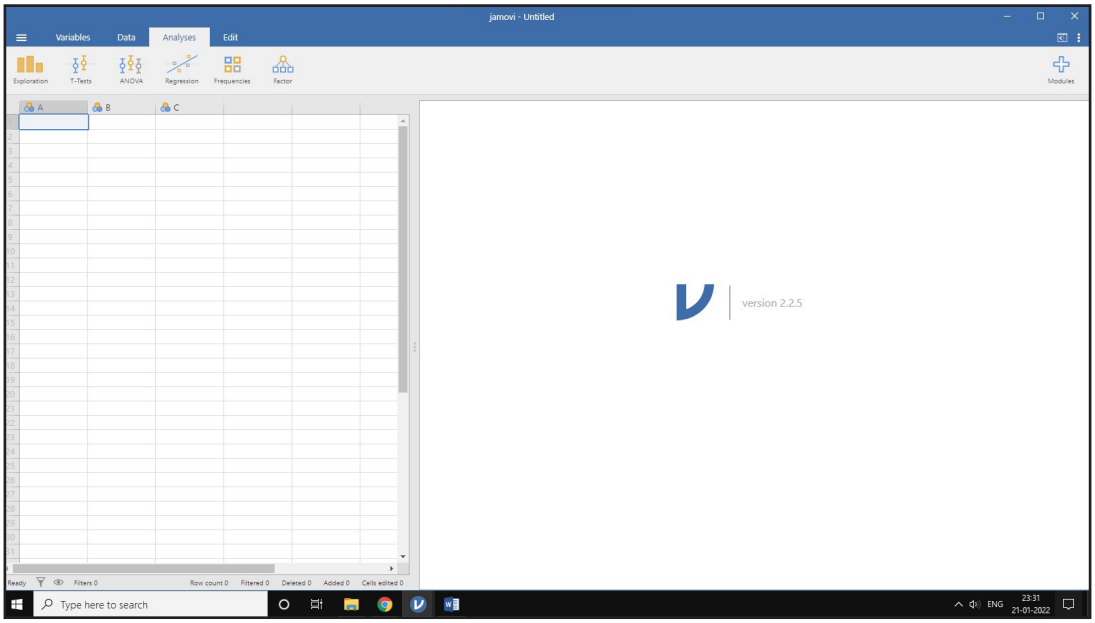



*Fig. 4: Jamovi – first look of Jamovi's Spreadsheet*

We can see, at the left top corner on the Jamovi page, there are five options namely File tab, Variable ribbon, Data ribbon, Analyses ribbon, and Edit ribbon.

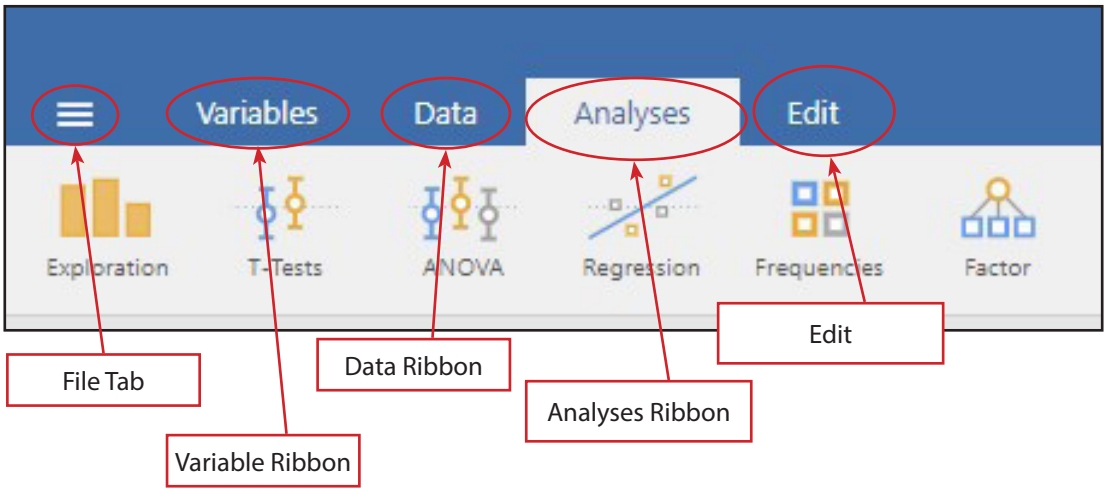



*Fig 5: Jamovi: Main Menus*

## (i) File Tab

The file tab is used to open a new file, to open an existing file, import or export the files, and save the file.

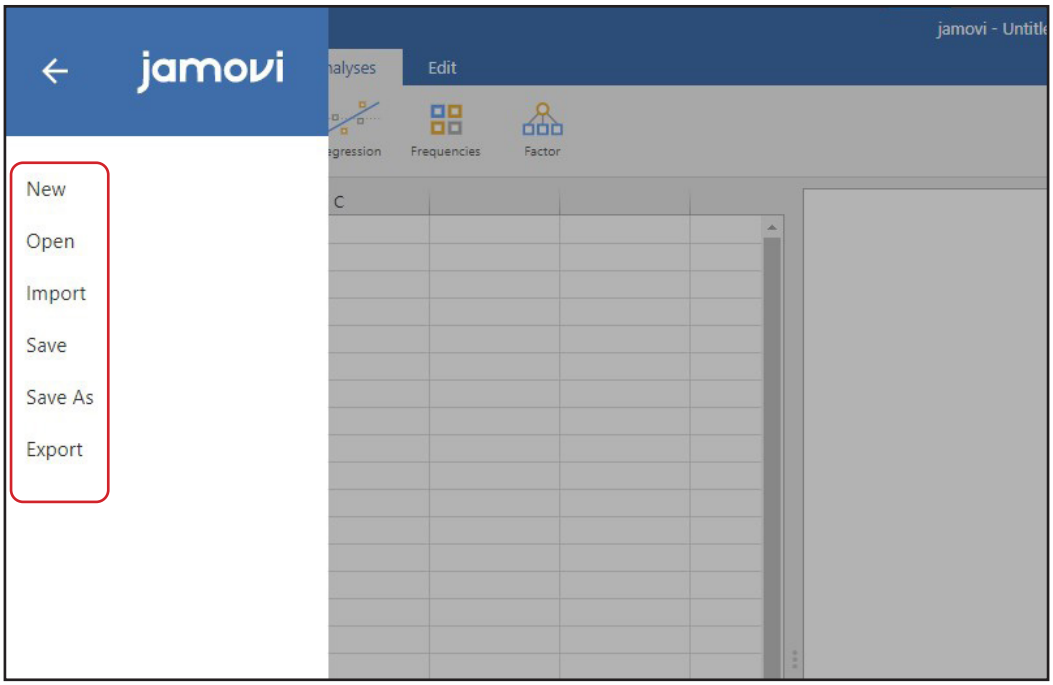



*Fig 6: Jamovi: File Tab*

Six options will display after clicking on the **File tab** shown above in the figure; New, Open, Import, Save, Save As, and Export.

**New** option helps you to start work on a new spreadsheet where you can enter your data, can define variables, etc.

**Open** option helps to open or to call different types of existing data files from where the files are stored on your working computer/laptop. These files were opened in Jamovi, sometimes. These files may be Jamovi (.omv) files, common separate values (.csv) files, EXCEL (.xls) files, SPSS (.sav) files and SAS (.sas) files. To open a file, first, click on the 'Open' option and then browse the file from the location where you stored that file. These files are classified into three categories.

(i) Native Data files

(ii) Unformatted Data files

(iii) Spreadsheet files

(i) **Native Data file:** Native Data files are files that are created by Jamovi itself with the extension ***.omv***. These files are Jamovi's files. It is created after saving the file in Jamovi. Jamovi uses such files to store data, variables, and analysis.

(ii) **Unformatted Data file:** Unformatted Data files are the most commonly used format all over the World for data analysis on any data analysis software. It is commonly known as Comma Separated Value (CSV) files. It has ***.csv*** as file extension.

A CSV file is a plain text file that stores tables and spreadsheet information. The contents are often a table of text, numbers, or dates. CSV files can be easily imported and exported using programs that store data in tables. These are just regular old text files and they can be opened with many different software programs. It's quite typical for people to store data in CSV files, precisely because they're so simple *(Navarro and Foxcroft, 2019)*.

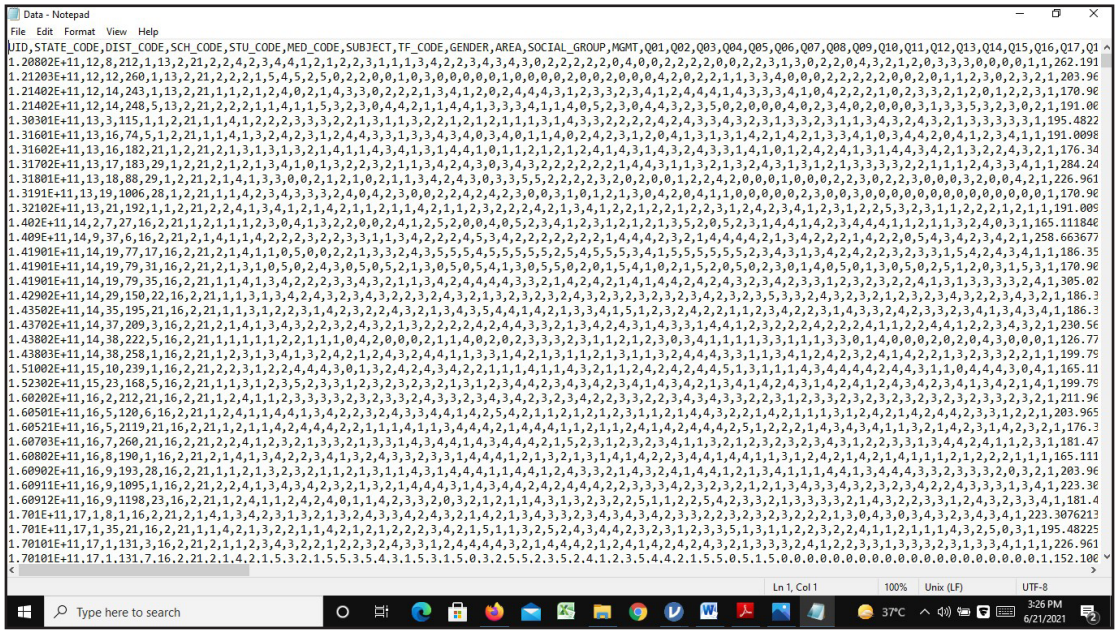



*Fig. 7: Comma Separated Value (CSV) file*

(iii) **Spreadsheet files:** Spreadsheet files are the files generated by the spreadsheet software such as Microsoft Excel with .xls file extension, SPSS with .sav file extension, SAS with .sas file extension, etc. These files can also be used in Jamovi to perform the statistical analysis.

**Import Option** is used to import a file into the Jamovi atmosphere. It also helps to import an external data set into the existing open data file. When a file is an import for an existing data set (file), then

- all the rows of the existing data set are deleted;
- values of matched columns of imported file replaced into the existing data set columns, keeping the data and measure types from the existing data set; and
- unmatched columns of the existing data set remain in the dataset with empty cells.

**Save and Save as:** Save or Save as option helps to store the data file in the computer/ laptop at the defined location. Save option store the file at the current location with the current name attach with to the file whereas Save as option ask the users to define the name of the working file and the location where it wants to store.

## (ii) Variable Ribbon

The variable ribbon is used to define the variables such as variable names, additional information about the variables as descriptions, etc. you can also edit the variable, add or delete the variable, transformed the variable, etc. The detail is given in the next chapter.

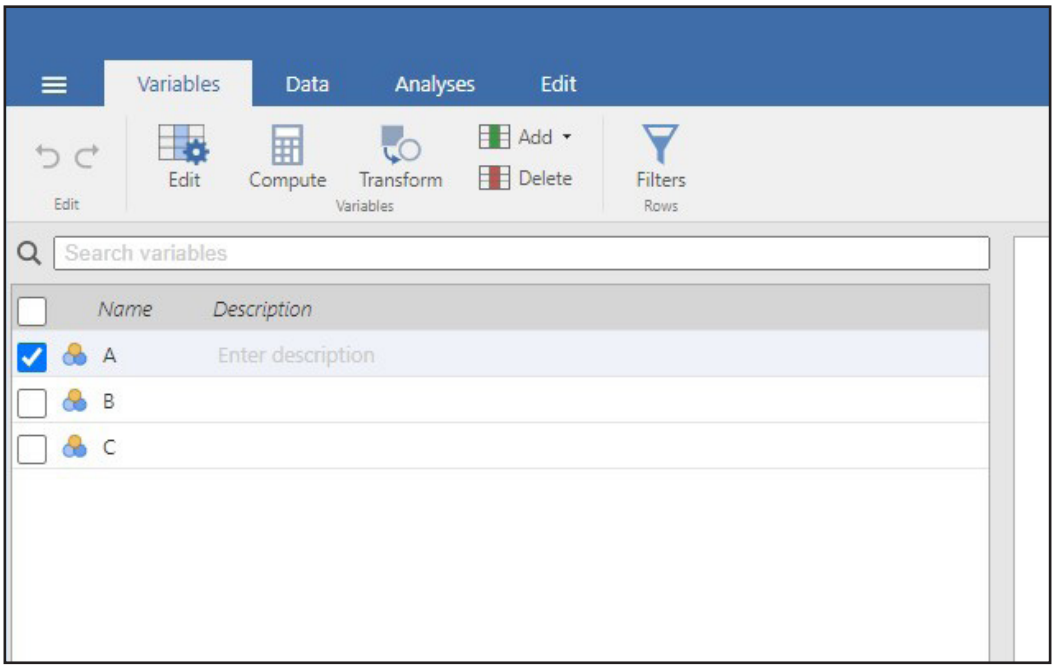



*Fig 8: Jamovi: Variable Ribbon*

## (iii) Data Ribbon

Data ribbon is used to manage the matrix information as per the requirement of the users i.e. to add/delete the columns, compute variables, filter the variable according to the given conditions, and define data types.

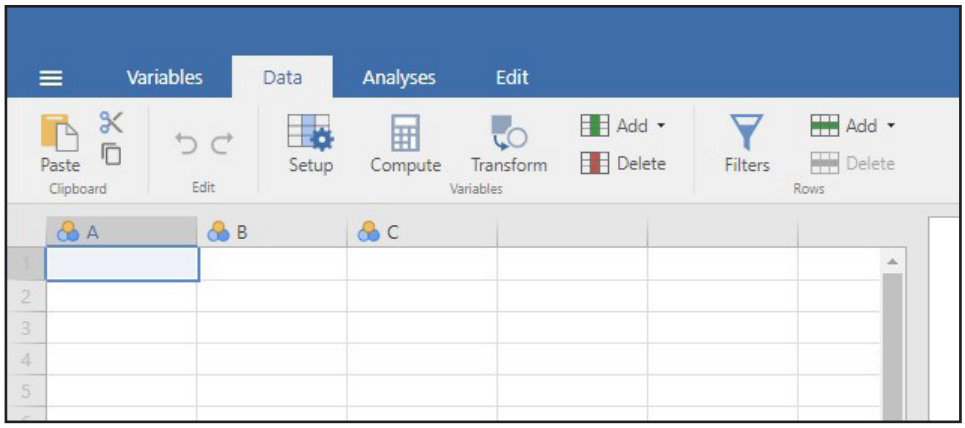



*Fig 9: Jamovi: Data Ribbon*

## (iv) Analysis Ribbon

The analysis ribbon is used to perform different statistical analyses on the data files. When you click on the Analysis ribbon, six menus will appear below the ribbons as the base module of the software. This base module includes Exploration, T-tests, ANOVA, Regression, Frequencies, and Factors. We can add more modules for advanced statistical analysis by installing available modules in the software. For this just click on the '+' sign ('+'Modules) at the right top corner of the Jamovi software. Details about each analysis will be discussed in the analysis chapter.

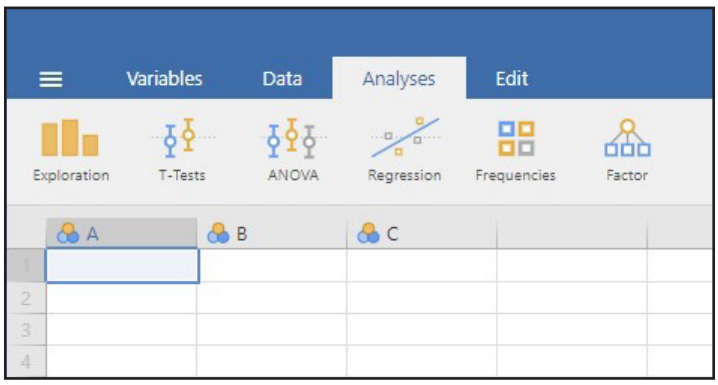



*Fig 10: Jamovi: Analysis Ribbon*

## (v) Edit Ribbon

Edit ribbon is used to modify and align the variables in a particular format. Using options available in the Edit ribbon such as clipboard, edit, font, paragraph, etc., we can change the view of a variable as per users' requirements. We can also edit the format of a variable by doing undo and redo; can change the view to bold, italic, underline, add superscript, subscript, can set alignment as left align, right align, center align, justify; and also to left, right, center or to justify, can insert numbering, bullets, etc.

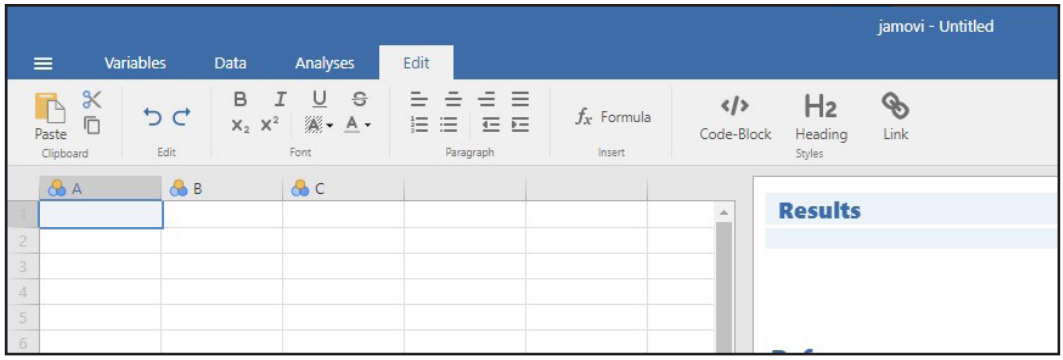



*Fig 11: Jamovi: Edit Ribbon*

This chapter helps you to understand the basic view of the Jamovi software. It will help to get a view of Jamovi functioning.

# 4. Defining the Variable / Setting the scale

In the previous chapter, we **learned** how to open a new spreadsheet or existing file of a different format. Now in this chapter, we will see how to define a variable name, its data types, etc.

If we are dealing with new data set or entering the data in a new spreadsheet. First of all, we have to SAVE the spreadsheet with a meaningful NAME. The name should be associated with the data of the file so that we can recall it correctly whenever required.

Once we saved the spreadsheet with a meaningful name then the next step is to define the ***variable*** and its type. Now, just click on ***Variable***, your spreadsheet will replace with a ***variable defining*** section. Hereby default three rows will appear with variable names as A, B, and C. To give a new name, just click on a variable and write its name. For example, select A and start to overwrite with a new variable name. We can write brief information about this newly defined variable in the description row.

To define the measurement and data type of the variable, ***double click*** on the variable, the **DATA VARIABLE** window will appear on the screen to write the variable information. During the same time, we can use the window for EDIT purposes also.

Here we can

- write or edit the variable name;
- add or modify a brief description of the variable;
- select or edit the measurement and data type of the variable; and
- add or edit different levels/labels of the variable.

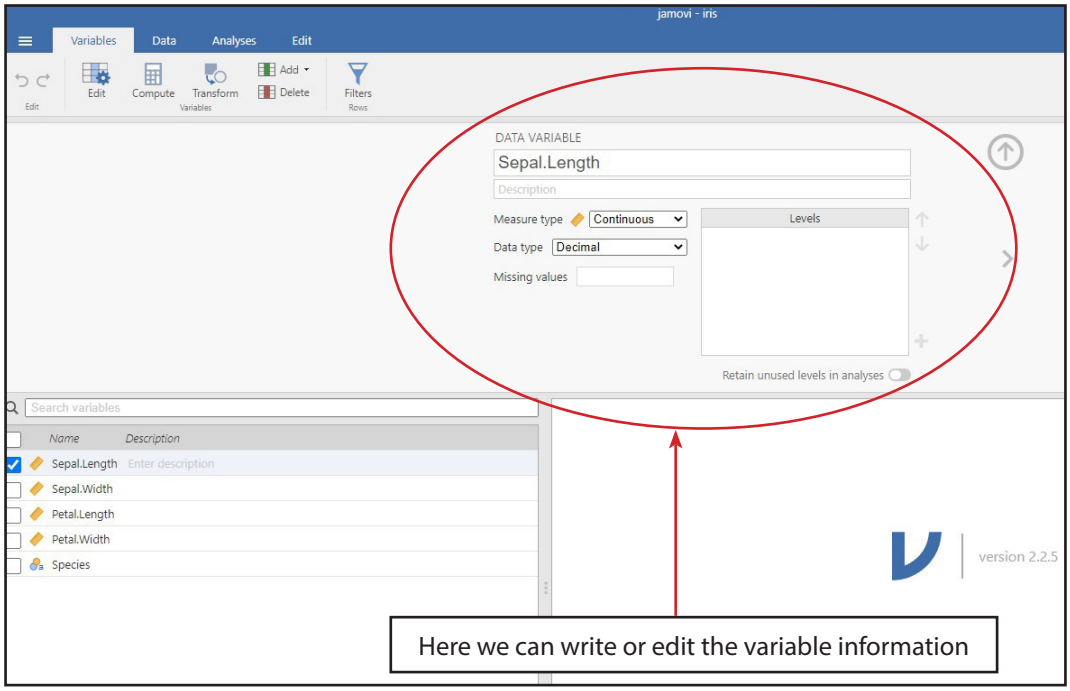



*Fig 12: Jamovi: Defining or Editing the variable*

As shown in the figure, ***Data Variable*** allows us the following task for a variable:

(i) to give a ***unique name*** to the variable;

(ii) to write a description for eg. purpose of variable, etc.;

(iii) to write variable's measure types with their labels;

(iv) to write variable's data types with their labels;

(v) to write a missing value, (if any) in the data set.

## Write Variable Name:

We can give a unique name to the undefined variable (or new variable) and also can rename a variable by writing the name in the first box of the Data variable as shown below:

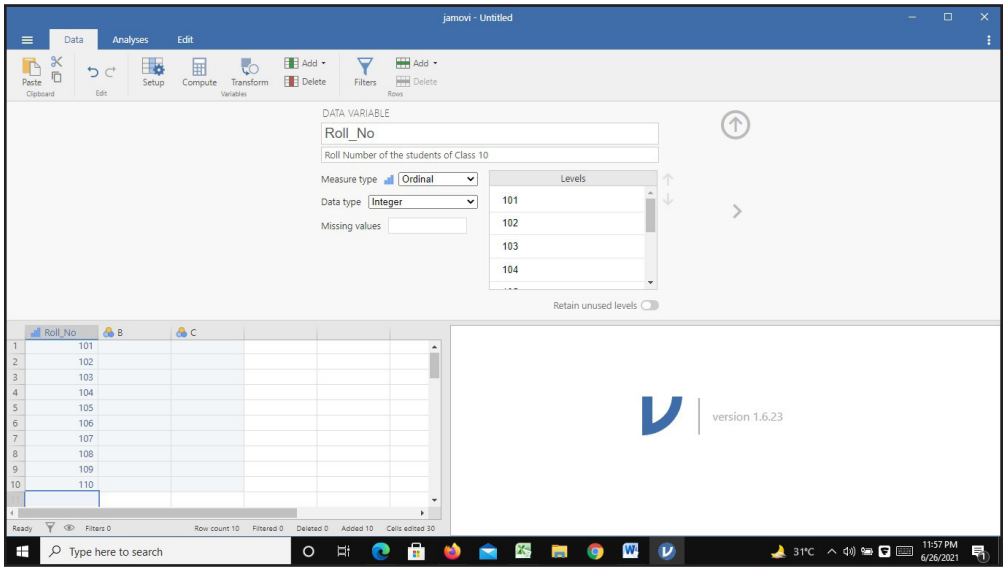



*Fig 13: Jamovi: Defining the variable*

Here, a new variable is added and named as **Roll_No** in the first box whereas in the next box a brief description of the variable is given.

## Variable Measure Type:

Defining the type of measure is a very important task during data analysis. Incorrectly defined measure type of a variable could result in incorrect analysis output. So defining of correct measure type is a very important and very crucial activity for data analysis.

Like other analysis software, we have to define the variables. In Jamovi, there are FOUR types of data measures.

## (1) Nominal data type

**(i)** **Nominal Text data type measure** is the text value used to define factors of a variable. For example, factors - male and female for a variable Gender, factors - preparatory, foundation, middle, secondary in variable Education Levels, etc. These text values can be used in the analysis.

**(ii)** **Nominal value data type measure** is the numerical value used to define factors in numerical values. For example, factors – male and female in variable Gender as 1 and 2, factors – preparatory, foundation, middle, secondary in variable Education levels as 1, 2, 3, and 4, respectively, etc.

### (2) Ordinal data type

Ordinal data type measure is used to define the degree of the variables. For example, the level of satisfaction – strongly agree, agree, disagree, and strongly disagree can be defined as 1, 2, 3, and 4 respectively. The symbol of ordinal data type is .

### (3) Continuous data type

Continuous data type measure is the numeric values that are considered to be interval or ratio scales. For example, age, weight, marks, etc. The symbol of continuous data type is .

### (4) ID data type

ID data type measure is only available in Jamovi. It intends that the variable is a non-processing (non analyze) variable i.e. it is a non-executable data type. For example, a person's name, roll number, etc. The symbol of continuous data type is .

Transform Variable

Compute Variable

Filter Rows

## Compute Variable

There are two types of variables. One variable where we entered the data which remains unchanged. Another variable can be defined using one or more source variables, this variable is called a **Compute Variable**. The value of Compute variable will be dynamic. Its value depends on the value of the source variable. As the value of the source variable changes, the source variable value will also be changed. The Compute variable may have a formula, multiplier, etc. such as total, percentage, salary based on basic, etc.

In an example of 'Result of Students' where we have to calculate the Total Marks obtained in different subjects or the Percentage of students. In such case, we define a new variable as **'Total'** as **compute variable** where it takes the sum of marks obtained in different subjects (say) English, Mathematics, Science, etc. Here source variables are Eng_Marks, Maths_Marks, Sci_Marks, etc.

For example: Total = *Eng_Marks* + *Maths_Marks* + *Sci_Marks*

If the value in these source variables changes the Total will also change.

Similarly, to calculate the percentage obtained by the students we define another variable **'Percentage'** as a new compute variable where it calculates the percentage value from the Total variable. Here source variable is Total. For example, Percentage = (Total * 100) / 300

To define the compute variable, first, click on ***Data*** and then ***Compute***. A new window will appears (see fig. 14).

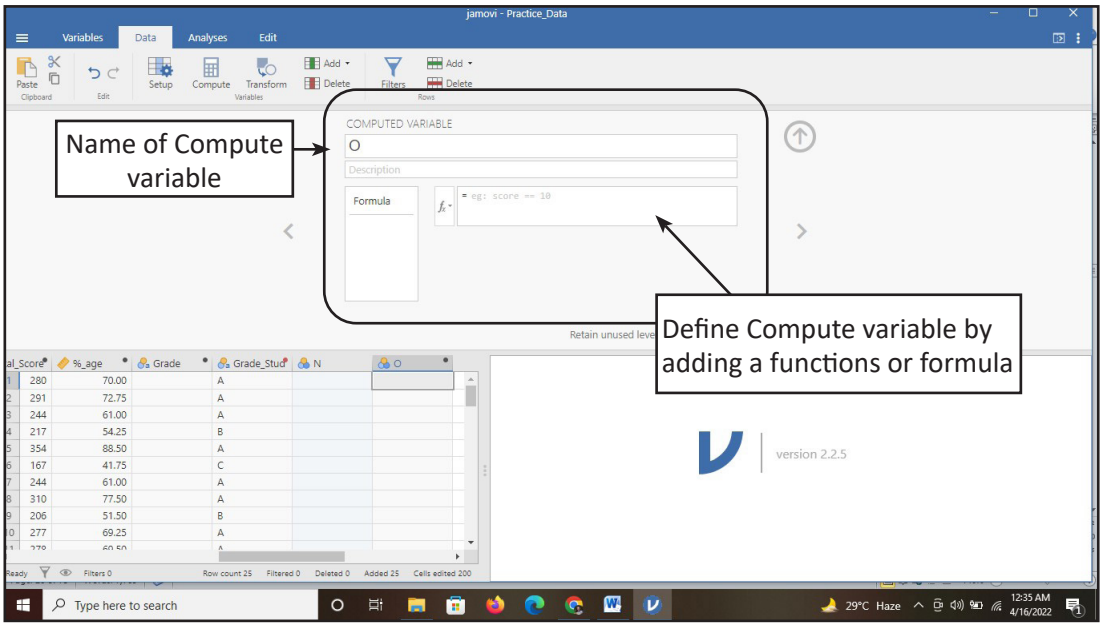



*Fig 14: Jamovi: Compute Variable*

Write the name of the new Compute variable in the first row. In the next row, write additional information about the variable such as the purpose of the variable, etc.

In the next row with the 'equal (=)' sign, write the function or formula for the Compute Variable with source variables.

For example Total = Eng_Marks + Maths_Marks + Sci_Marks

Here 'Total' is a new Compute Variable and Eng_Marks, Maths_Marks, and Sci_Marks are source variables that are already defined in the database.

One can also search all source variables in the present database and the mathematical/ statistical functions, operators, etc. may be used to define the compute variable, by clicking the $f_x$ icon.

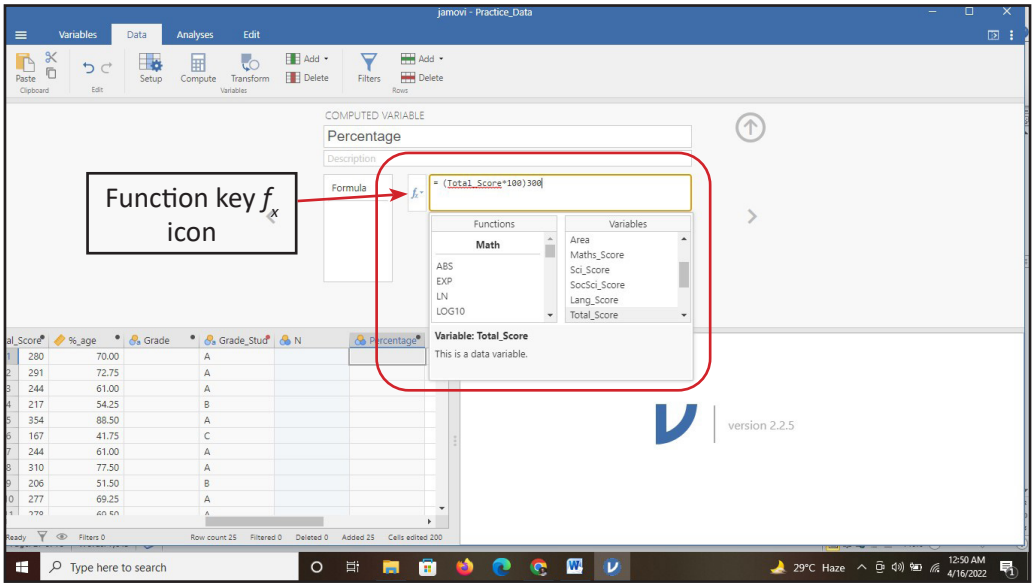



*Fig 15: Jamovi: Compute Variable with f_x icon*

## Transform Variable

'Transformed variables', allowing you to easily recode existing variables and apply transforms across many variables at once. When we want to create a transformed variable, first identify the source variable used for your transformation. It is better that always have access to the original, untransformed data if need be.

To define the **Transform Variable**, first select a variable you would like to transform. This variable will act as the source variable for this transform variable. Then click on ***Data*** and then on the ***Transform*** option, we will get this window. (see fig. 16)

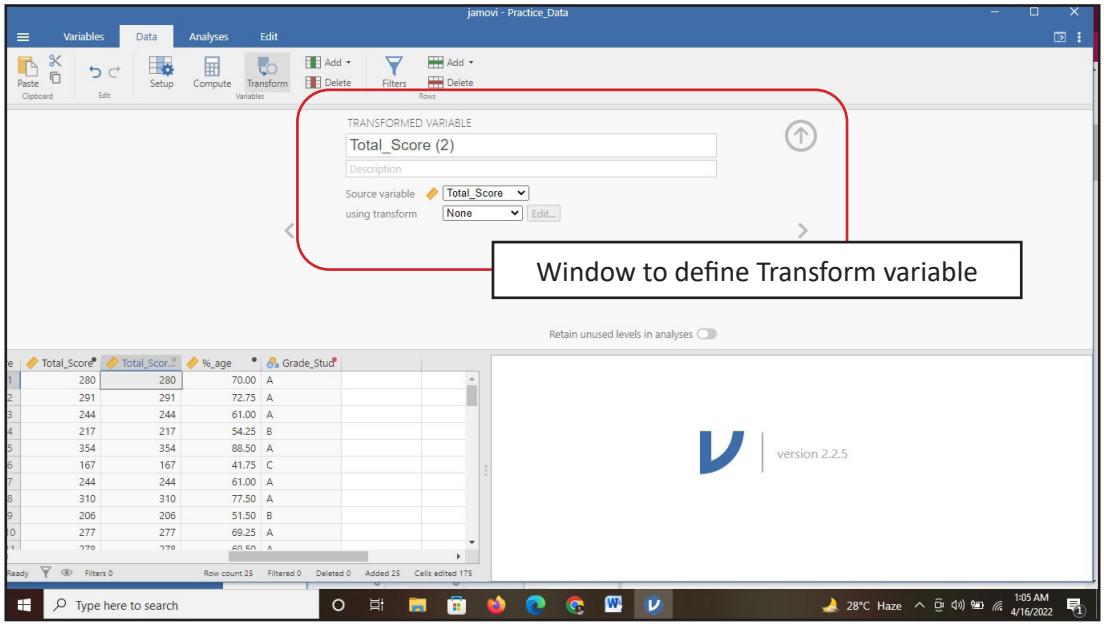



*Fig 16: Jamovi: Transform Variable*

Type the name of the transform variable in the first row. In the next row, write additional information about the variable such as the purpose of the variable, etc.

Now define the source variable in the next row. By default, the source variable will be the same variable used to create the transform variable. We can define a new source variable as per the requirement of the analysis. We can get the list of variables for the source variables by clicking on the down arrow.

Now, it is important to define the transformation information under the heading '***using transform***'. Under '***using transform***', we can define the condition for the transform variables. The condition can be used as per our requirement for the analysis of the study. For example, as given in fig. 17.

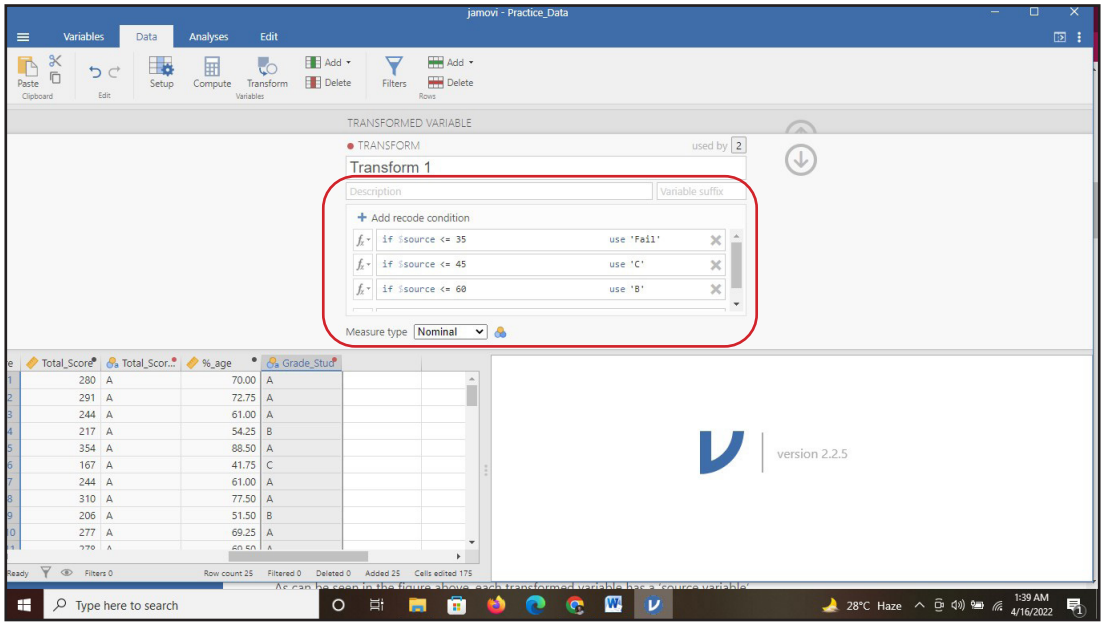



*Fig 17: Jamovi: Transform Variable with conditions*

# 5. Descriptive Statistics

In this section, we will see the descriptive statistics including the frequency distribution table, central tendency values (mean, median, and mode), dispersions (standard deviation, variance, range, standard error mean, maximum value, minimum value), distribution of data, graphs, etc.

To initiate the descriptive statistics, first click on ***Analysis*** then ***Exploration*** we get a pop-down menu with three options namely Descriptive, Scatterplot and Chart, see fig. 14.

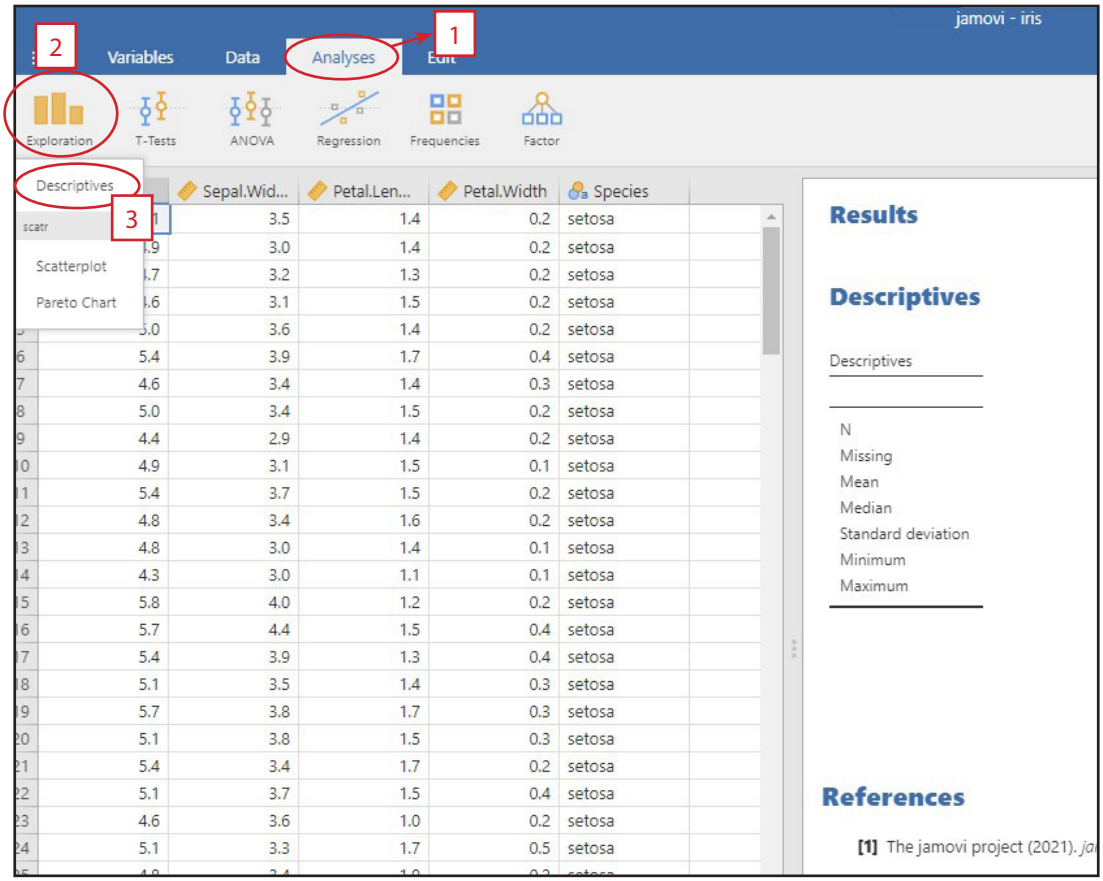



*Fig 14: Jamovi: Analysis Exploration*

On clicking on ***Descriptive***, the complete screen will split into two panels that appears side by side. The first panel is for instruction purposes or processing purposes i.e. what we want to do or what we have to estimate e.g. mean, median, standard deviation, etc. and the second panel gives us the final result of the analysis. Hence in Jamovi, we can select the variables as well as gets output result on a single screen only.

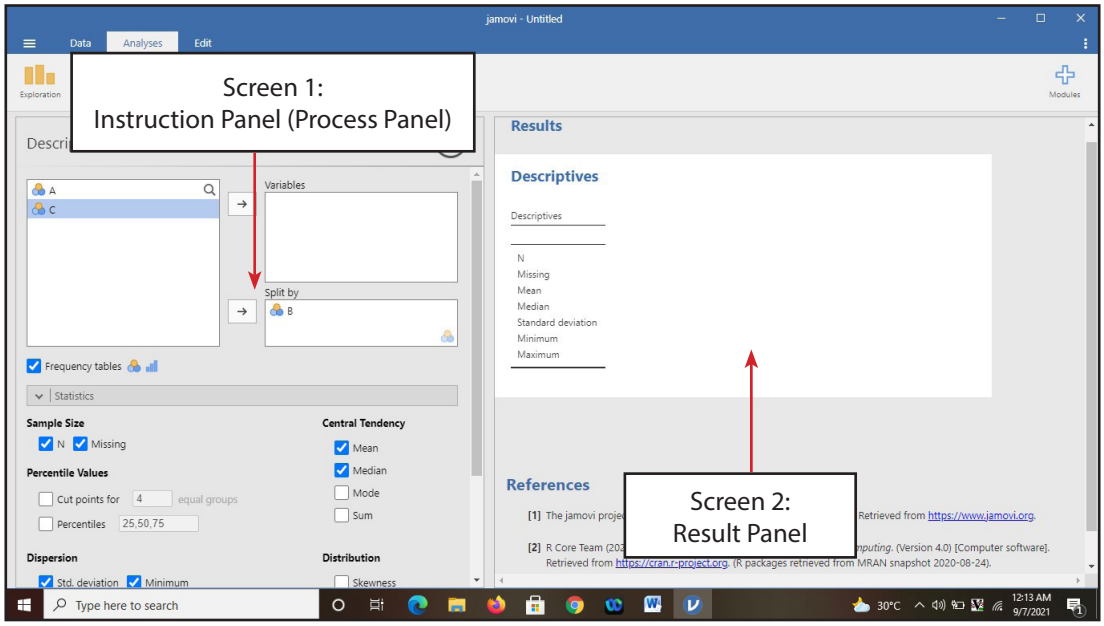



*Fig 15: Jamovi: Instructional Panel and Result Panel*

The above figure is showing two panels, the first panel we may call as *Instruction Panel (Process Panel)* and the second panel may be called the *Result panel*.

The Instruction Panel has six sections for processing the data, while in the Result panel, the result will appear according to the selection of tools. The sections of the Instruction panel are

1. Base Variables section
2. Processing Variables Section
   (i) Variable selection, and (ii) Split by
3. Frequency Tables
4. Descriptive
5. Statistics
6. Plots

## 1. Base Variable Section

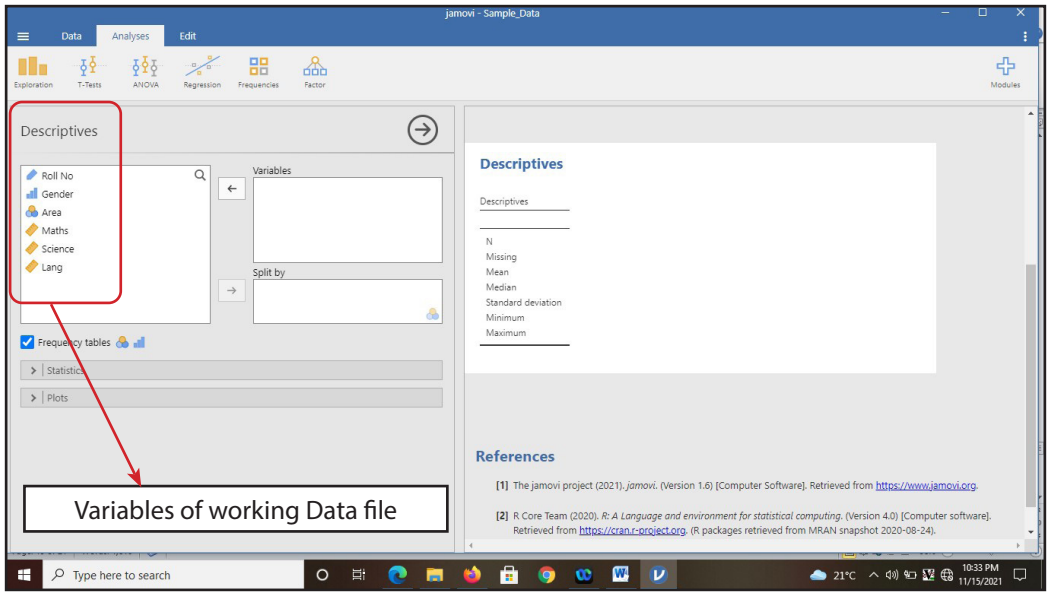



Fig 16: Jamovi: Descriptive and Base Variable section

If you are working on a data file (say) sample_data.omv and select ***Descriptive*** for doing analysis, the variables of the opened file will automatically appear in the Base Variable section. In Fig. 16, the variables of this file appear in the Base Variable section.

## 2. Processing Variables Section

To find the statistics of certain variables, we will **drag** the required variable(s) in the ***Processing Variables Section***. As soon as the required variable(s) is dragged into the Processing variables section, processing will start on the variable(s). The analysis will automatically appear in the Result panel under the heading ***Descriptives***. It displays the basic descriptive statistics, number of cases (N), missing cases, and so on.

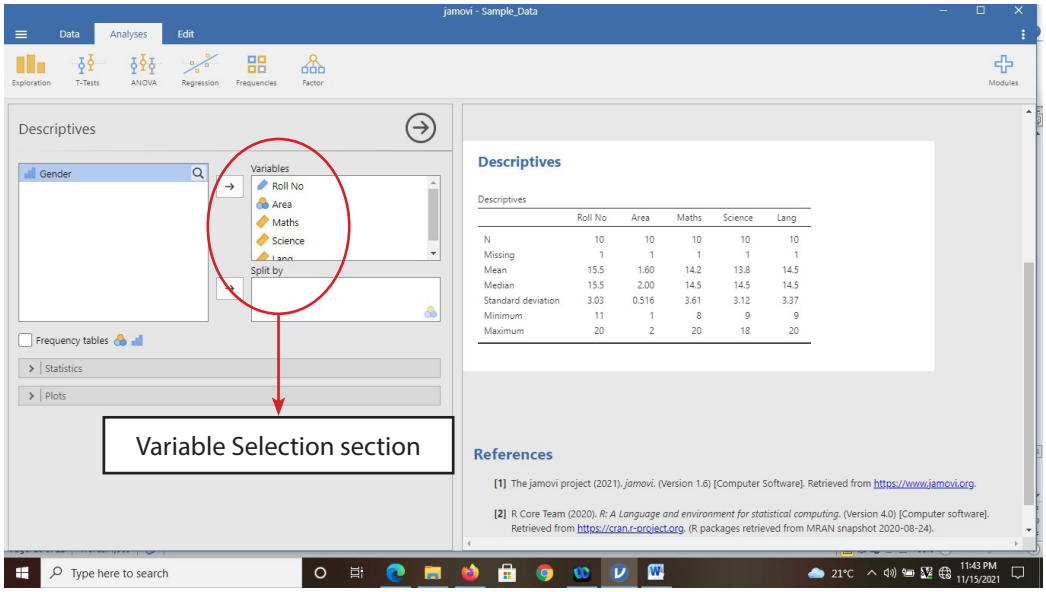



*Fig. 17: Jamovi: Processing of the variables for Descriptives*

***Split by*** is a subsection of the **Processing Variables Section** used to present the value of the variable in subdivision (if given in data). For example, *Roll No* of students splitting by their *Gender* or *Areas*, etc. Here we simply drag the splitting variable in the *Split by* subsection.

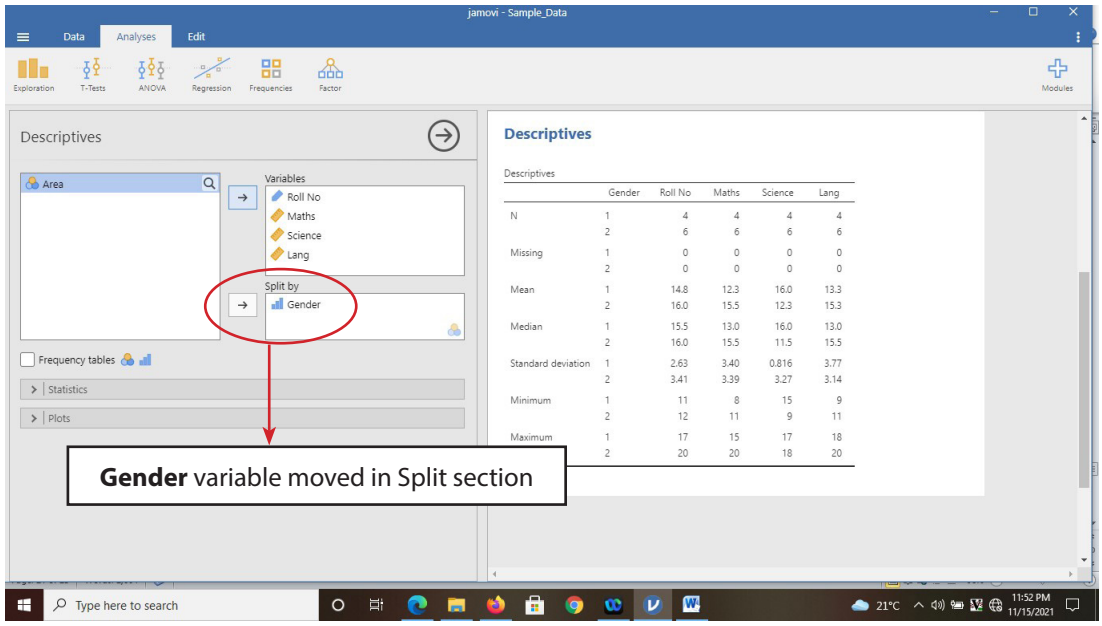



*Fig. 18: Jamovi: Processing of the variables in their groups*

## 3. Descriptives

It displayed Descriptive Statistics in the Result panel. In the base structure, there are 7 statistic values displayed. There are two options to visualize the Descriptive Statistics in the Result panel; (i) Variables across rows; and (ii) Variables across columns. By default, Descriptives appear in column structure, as shown in fig. 17 and 18.

## 4. Frequency Table

If the variables are nominal or ordinal types then we can calculate their frequency. To find the frequency of the variables, first drag the nominal or ordinal variable in the Processing section. Then mark the checkbox at the **Frequency table**, above the Statistics bar. Frequency values of all dragged variables will process in the Result panel.

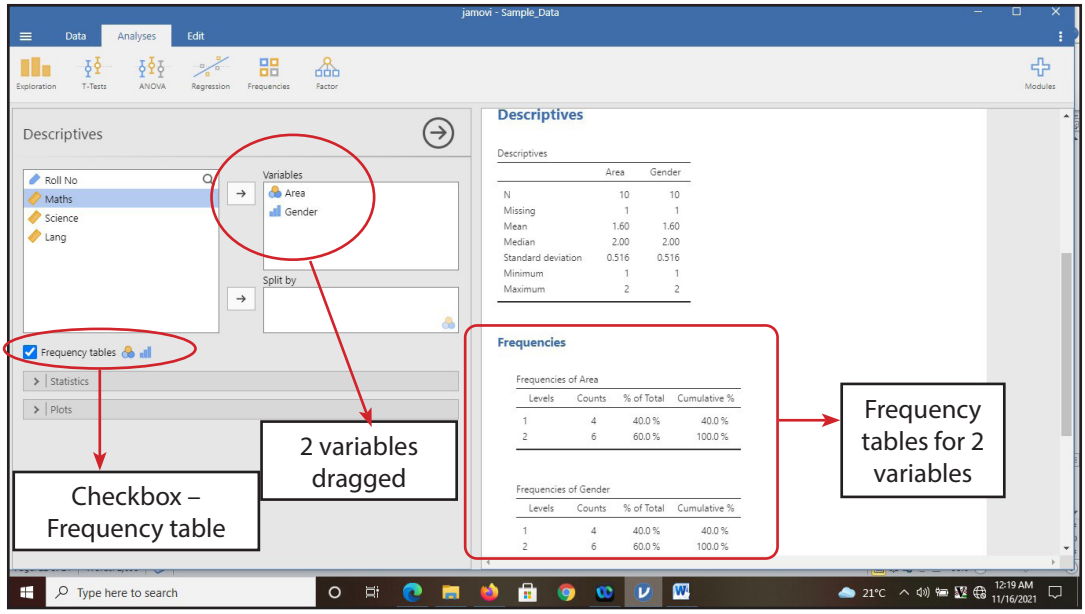



*Fig. 19: Jamovi: Frequency Tables*

## 5. Statistics

To find the statistical value of the variable, we just simply select the statistic which we are required for the analysis. Few statistics are by default appear in the descriptive table. We can add more statistics to the descriptive table by selecting them as per our requirements.

Apart from central tendency, dispersion, cases, missing cases, Jamovi also gives skewness and its standard error value as well as kurtosis and its standard error value. It also gives the value of IQR (Inter Quartile Range).

Jamovi also gives different percentile values and values as per cut points in the data. In the case of the Normality value, Jamovi produces two normality values, Shapiro Wilk W and Shapiro Wilk p.

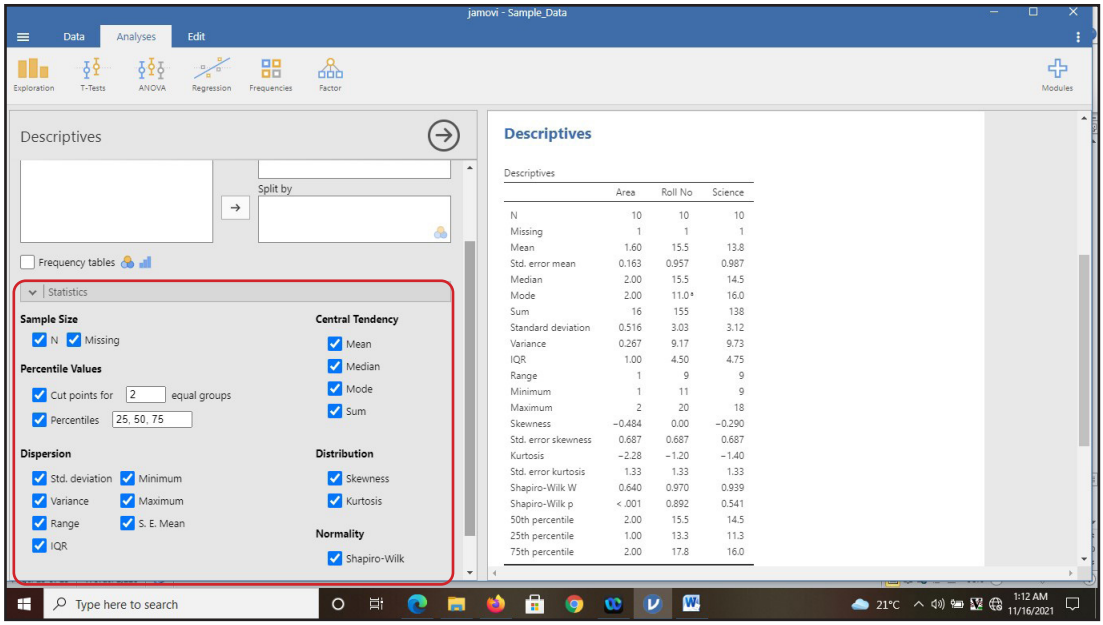



*Fig. 19: Jamovi: Statistics*

## 6. Plots

To construct the plots for the required variable, first click on the **Plots**, below the ***Statistics***. Checkboxes for a different forms of plots will appear. Here we can find different plots distributed into four categories. The detail about the plots is given in the next chapter.

# 6. Representation of data through Plots

In this section, we will see how to construct different plots in Jamovi. In Jamovi, we can find plot options at two places. Under ***Exploration***, in addition to Descriptives, we can see two plots options, namely (i) Scatterplot and (ii) Pareto Chart. Also in ***Analysis***, we can see different plots option.

In continuation to the previous chapter's content, here we can see how to construct plots using the ***Plots*** option under ***Analysis***. Then we will study how to construct Scatterplot and Pareto Chart of Exploration.

It is in continuation of the Descriptive from the previous chapter. To construct the plot, we just simply select the Plots option appearing after the Statistics option in Descriptives. On clicking Plots, we can see the following different plots classified into four categories, namely

(i) Histograms
- Histogram
- Density

(ii) Box Plots
- Box Plot
- Violin
- Data

(iii) Bar Plots
- Bar plot

(iv) Q-Q Plots
- Q – Q

To plot the ***Histogram***, drog the variable of continuous type and select ***Histogram*** in Plots option, as we select Histogram, the plot of Histogram will appear in the Result panel, as shown in fig. 20.

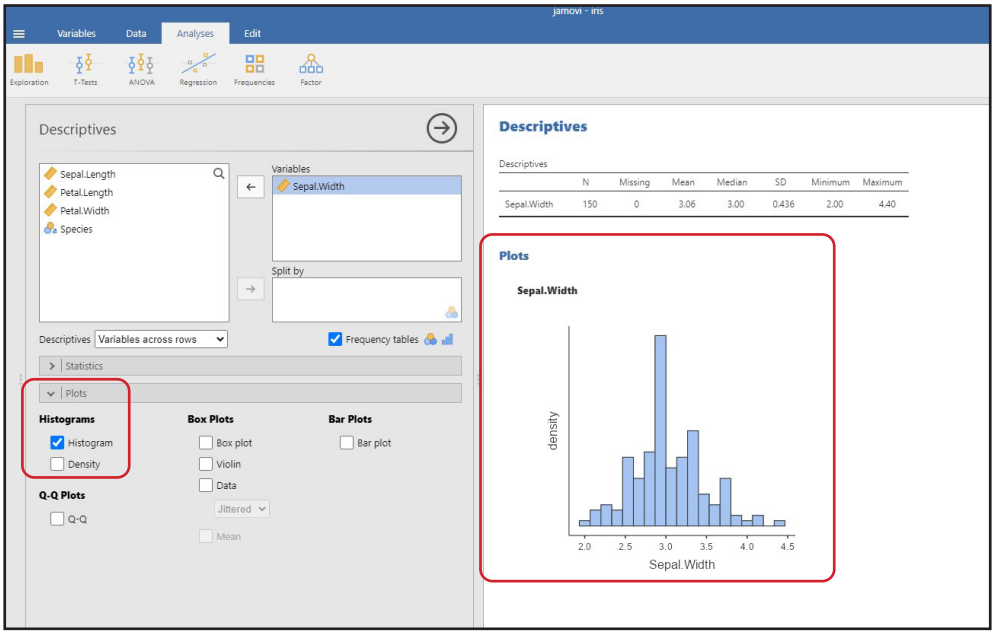



*Fig. 20: Jamovi: Plots - Histogram*

Similarly, to plot the ***Density curve*** dragged the variable of continuous type and select the ***Density*** in Plots option, as we select ***Density***, the plot of the ***Density curve*** will appear in the Result panel, as shown in fig. 21.

If we like to plot the ***Density curve*** on ***Histogram*** and both in a single plot then simply select both at a time. Now we will get both in a single plot, as shown in fig. 22.

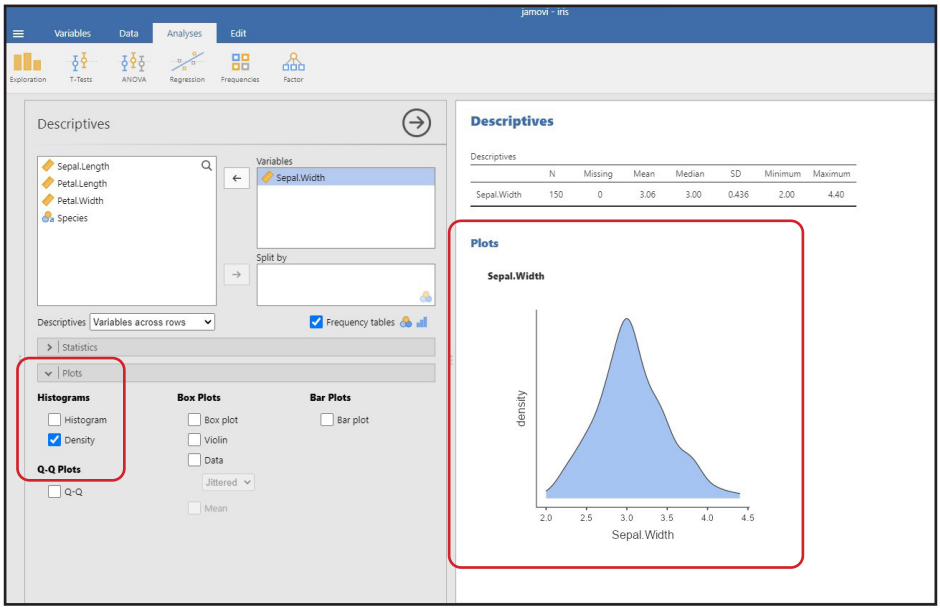



*Fig. 21: Jamovi: Plots – Density curve*

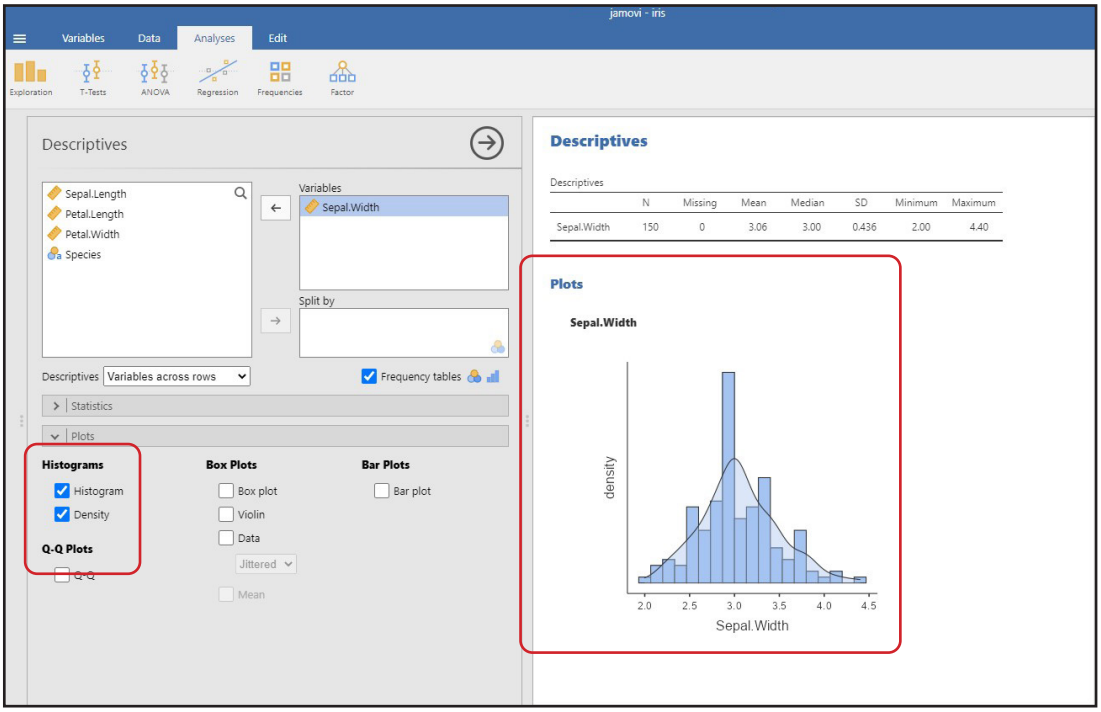



*Fig. 22: Jamovi: Plots –Density Curve on Histogram*

Similarly, we can plot Box plots, Bar plots, and Q-Q plots.

While constructing the plots, care must be taken that the selection of proper data type should be there. If the data type is properly selected then we will get an accurate result. So following instructions must be followed

| | | |
|---|---|---|
| (i) | Histograms | Continuous Data Type |
| (ii) | Box Plots | Continuous Data Type |
| (iii) | Bar Plots | Nominal and Ordinal data type |
| (iv) | Q-Q Plots | Continuous Data Type |

As we informed at the beginning of this chapter, the plot options are at two places in the Jamovi software. The first option of plots we already studied is explained above. Now we will see the second plot option with Exploration.

First, click on ***Analysis*** then ***Exploration***. Here in addition to the Description, two types of plots are given, namely

(i) Scatterplot and

(ii) Pareto Chart.

To learn about ***Scatterplot***, select ***Scatterplot***. We will get a new screen with two panels, the first panel for the ***Instructional (Processing) Panel*** and the second ***Result Panel***, as we discussed earlier in chapter 5.

For the scatter plot, we required two variables. One for the x-axis and another for the y-axis. Here the data of both variables will plot against these two axes. A point notes that both variables must be continuous type variables.

Now drag the required variables on the x-axis and y-axis. We will get the Scatter plot in the Result panel.

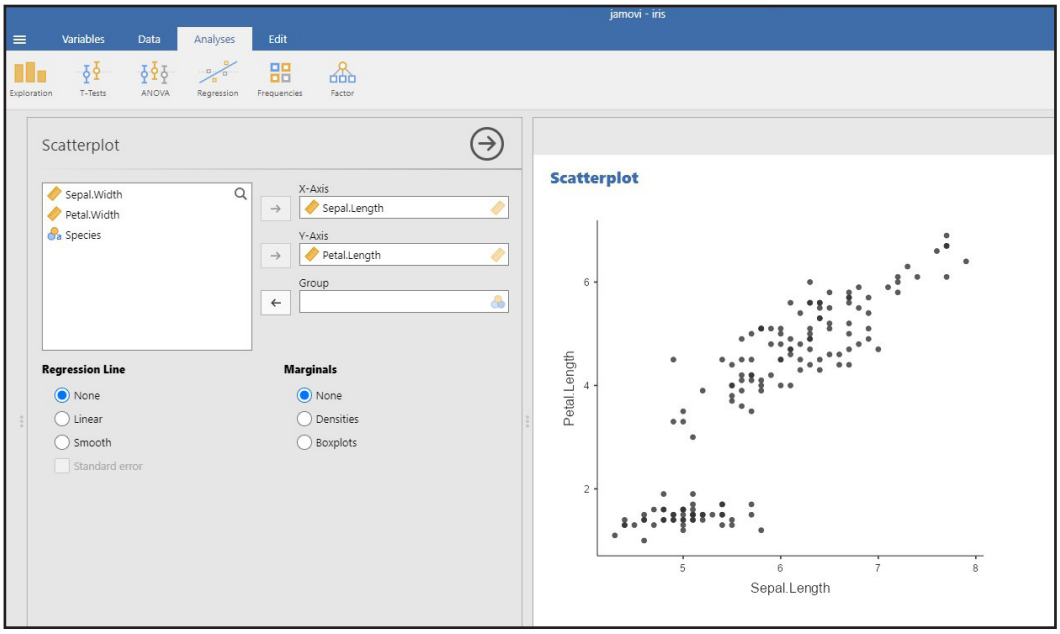



*Fig. 23: Jamovi: Scatterplot*

We can define categories or groups of the variables in the ***Group***. By dragging the group variable, the distribution of data in the plot will change its display color as per its group.

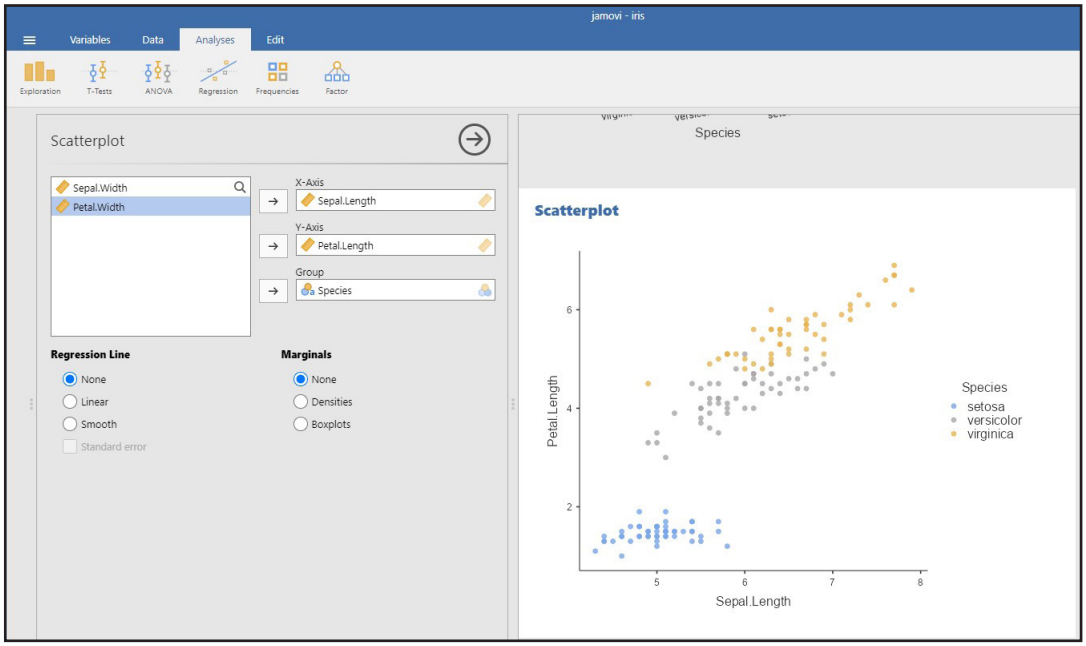
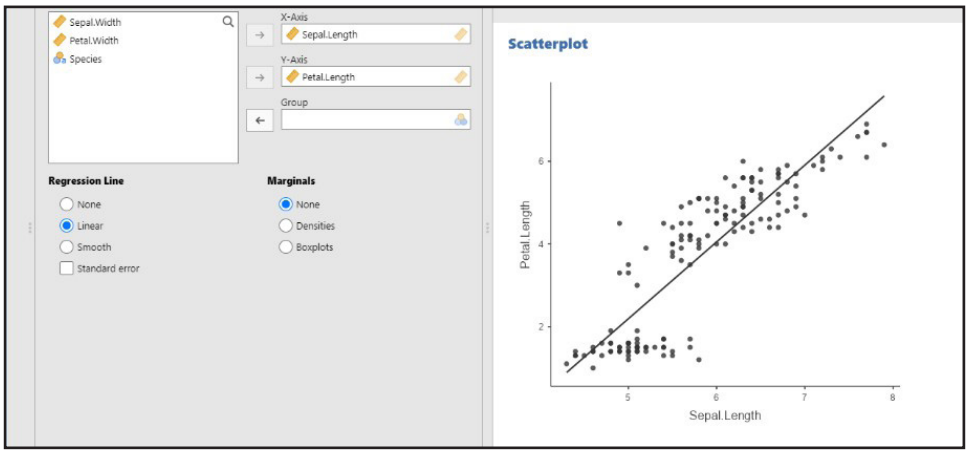



*Fig. 24: Jamovi: Scatterplot with groups*

We can see that in fig. 23, the Scatter plot is constructed against two variables. When we add a group variable, the data is divided into group characteristics and the Scatter plot is now showing the distribution of data in the respective group variable, as shown in fig. 24.

Here we can add a Regression line on the scattered observation in the plot. Linear Regression line and Non-Linear Regression line i.e. Smooth Regression line. We can select the Regression line option as per our requirement. The image of both lines is given in fig. 25



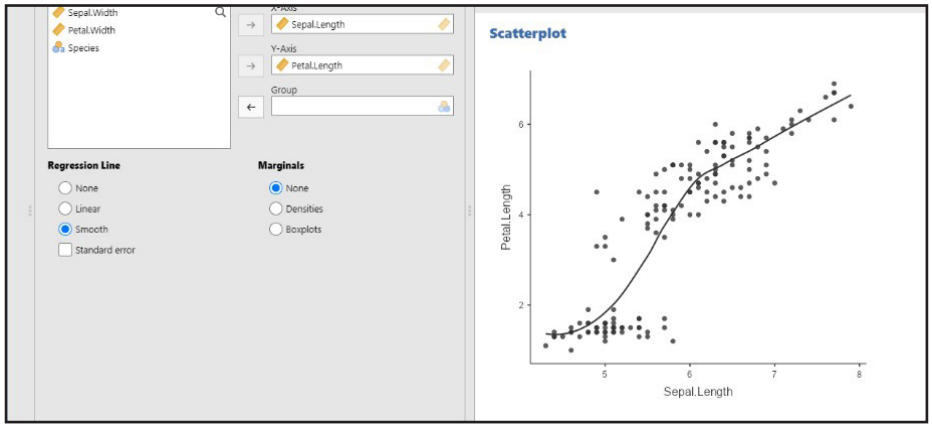



*Fig. 25: Jamovi: Scatterplot with Regression lines*

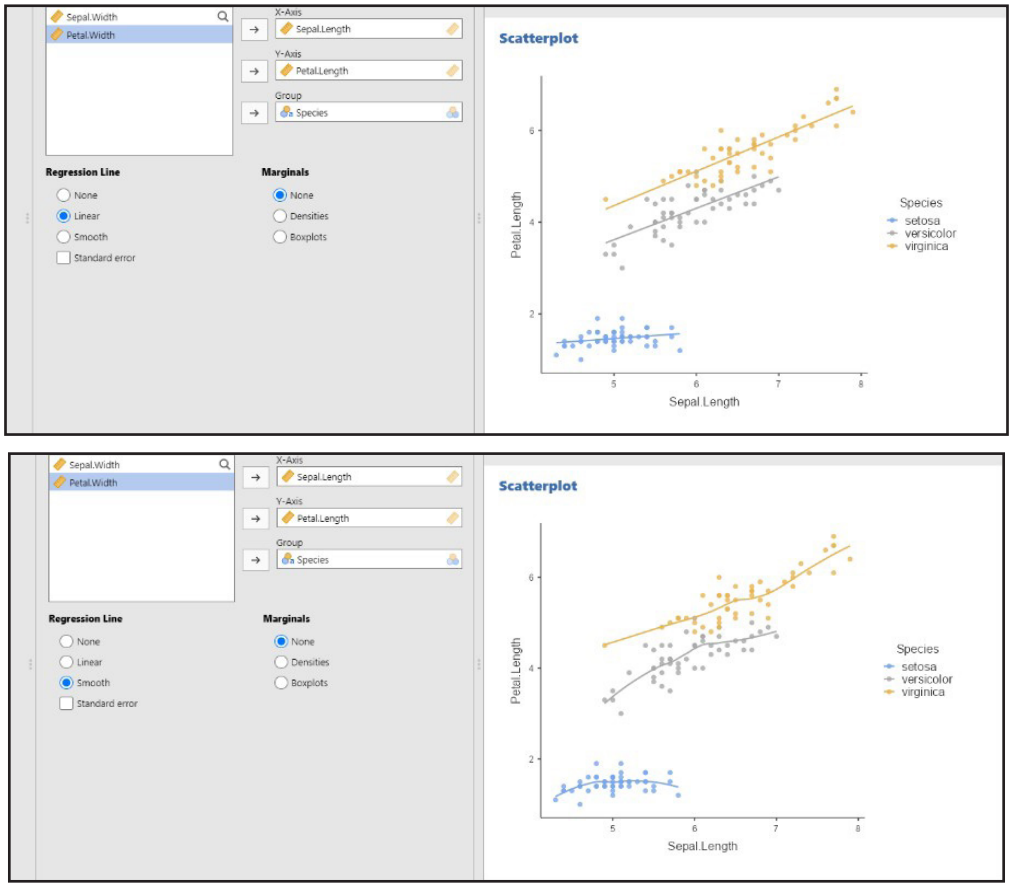



*Fig. 26: Jamovi: Scatterplot with Regression lines among groups*

We can also add some other options given in the panel such as **Standard Error**. Also, we can add the **Densities** and **Boxplot** in the same Regression plot.

# 7. T-Test

In this session, we will discuss the t-test. The T-test is one of the very important tests in the research area. It is used to find the difference of means between two variables or from the hypothetical mean.

There are three types of t-tests we can perform in the Jamovi. They are

(i) Independent samples

(ii) Paired samples

(iii) Single sample

## Independent samples

Let's see how to do an independent sample t-test in Jamovi. To find an independent samples t-test, we need two variables. One variable is categorized into two groups (e.g. area or gender, etc.) and another variable will be the continuous outcome variable. Make sure that the measurement levels are set correctly such that the grouping variable should be nominal type and the continuous variable should be continuous-type data set.

To find an independent t-test click on ***Analysis*** then ***T-test***. On clicking ***T-tests***, three options will appear namely (i) independent samples t-test; (ii) paired-samples t-test; and (iii) one-sample t-test.

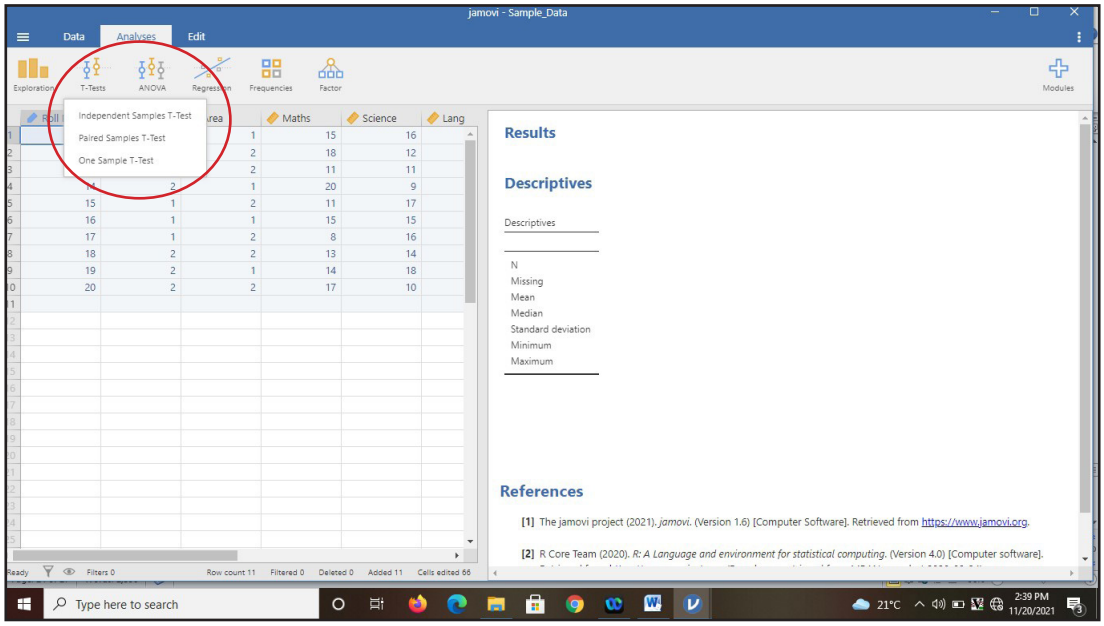



*Fig. 27: Jamovi: T-Test*

Now click on ***Independent Samples T-Test***, we will get two panels as discussed earlier. Then identify the required continuous variable and drag it into the ***Dependent variable*** box and identify the categorized variable and drag it into the ***Grouping variable*** box.

Care should be taken that the dependent variable should continuous type and the grouping variable should nominal type.

As soon as, the variables are dragged in the dependent variables and grouping variables boxes, the result will automatically process and will display in the ***Result Panel***. This result will appear on the right side ***Result Panel*** on the screen.

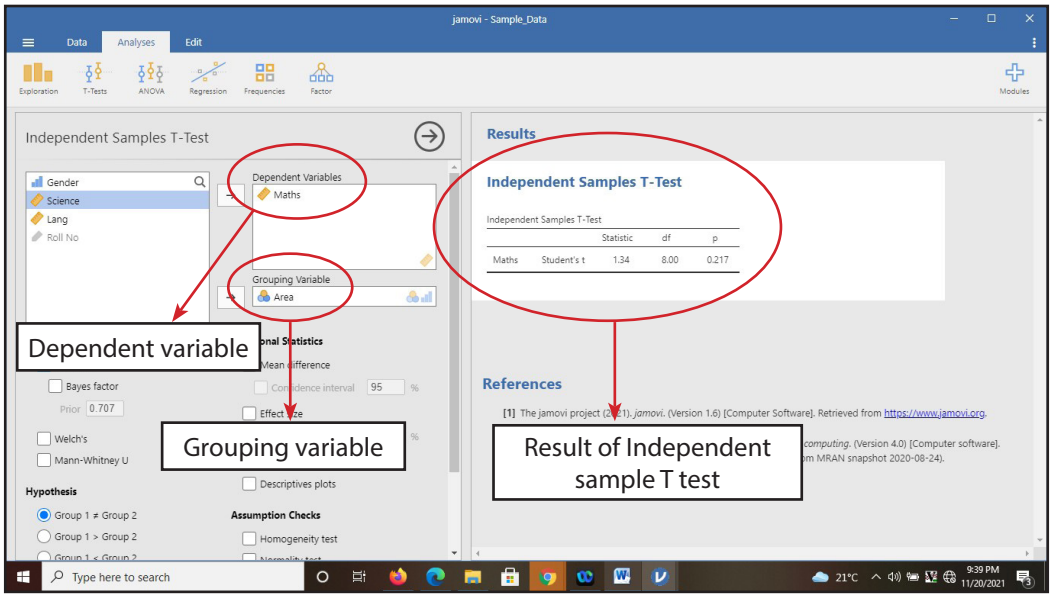



*Fig. 28: Jamovi: Independent Samples T – Test*

The base result of the independent samples t – test:

## Independent Samples T-Test

Independent Samples T-Test

| | | Statistic | df | p |
|---|---|---|---|---|
| Maths | Student's t | 1.34 | 8.00 | 0.217 |

The base structure gives results on 3 statistic

(i) T - statistic value (***Statistic***)

(ii) Degree of Freedom (***df***)

(iii) P-value (***p***)

We can find and add more statistic value by selecting other options given in the Instruction panel, as given in fig. 29.

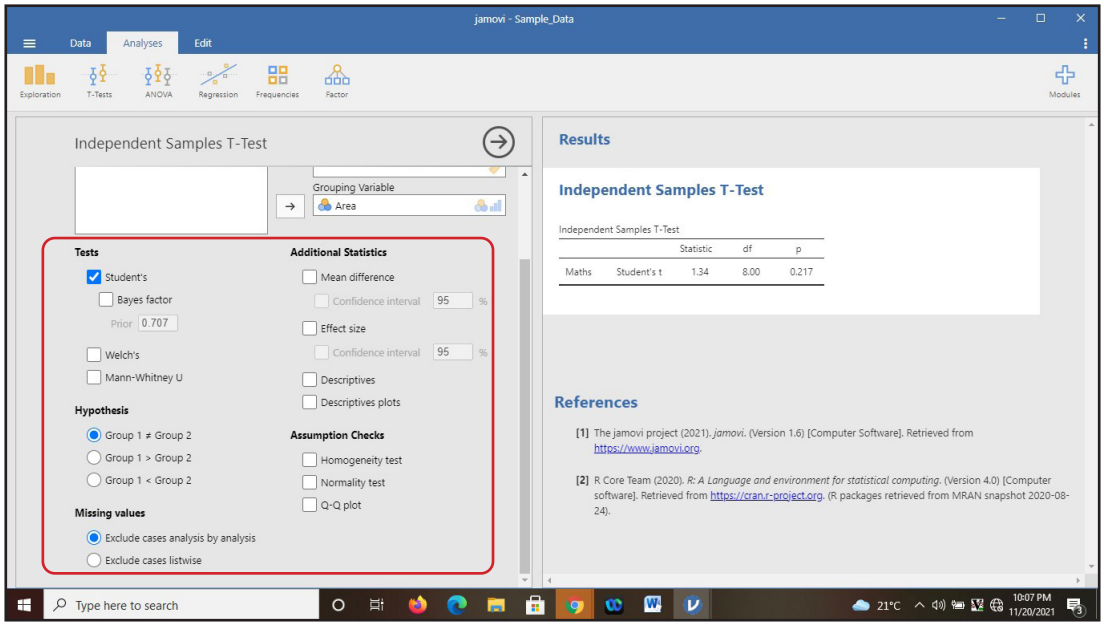



*Fig. 29: Jamovi: Independent Samples T-Test with different options*

## Paired sample T-test

Let's see now how to do paired sample t-test with Jamovi. To find a paired sample t-test, we need two variables of the same types. Make sure that the measurement levels are set correctly both variables should be of continuous type data. To find paired sample t-test statistic, now we click on ***Paired Sample T-Test***.

Now identify the required pair of continuous variables whose means we are like to compare. Drag the pair of identified variables into the ***Paired Variables*** box of the ***Instructional panel***.

As soon as, the variables are dragged into the paired variables boxes, the result will automatically process and will display in the ***Result Panel*** on the screen.

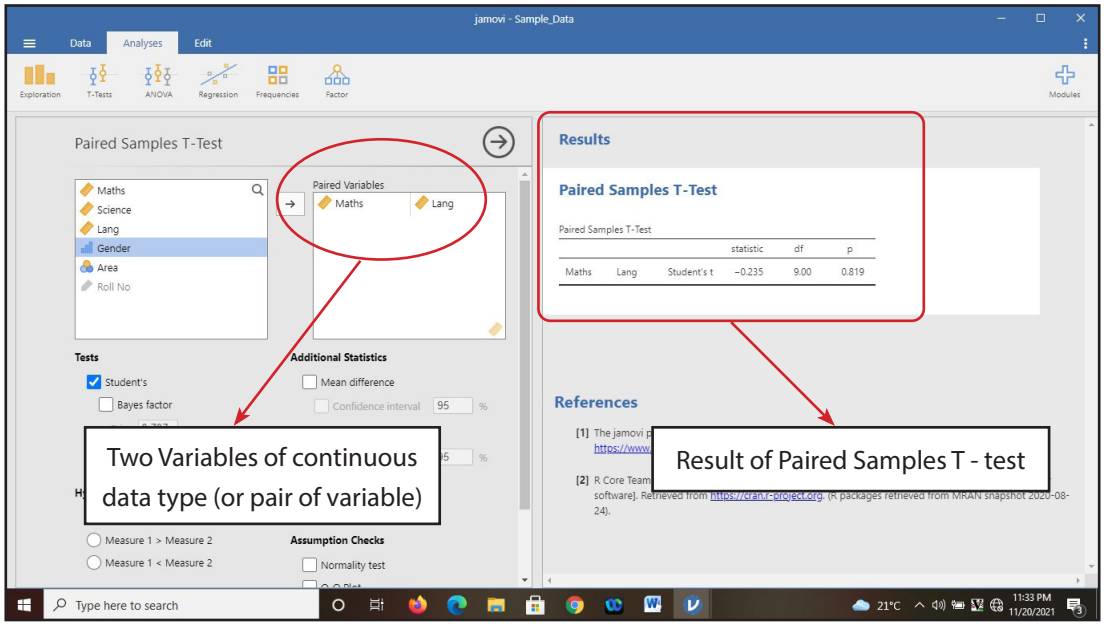



*Fig. 27: Jamovi: Paired Samples T – Test*

The base result of the paired-samples t-test:

## Paired Samples T-Test

Paired Samples T-Test

| | | | statistic | df | p |
|---|---|---|---|---|---|
| Maths | Lang | Student's t | -0.235 | 9.00 | 0.819 |

Like the Independent Samples T-test, the base structure of Paired Samples T-test is also giving results on 3 statistics; namely (i) T - statistic value (***Statistic***); (ii) Degree of Freedom (***df***); and (iii) P-value (***p***).

Here also we can add and find more statistic values by selecting other options given in the Instruction panel, as explained earlier.

## One Sample T-test

Let's see now how to do a one-sample t-test with Jamovi. To find one-sample t-test, we need one variable of continuous type data.

To find one sample t-test statistic, we click on ***One-Sample T-Test***. Now identify the required continuous variable, drag the variable into the ***One Variables*** box of the

***Instructional panel***. Here we are comparing the mean of the identified variable with a hypothetical mean value. So after dragging the variable we have to define the value of that hypothetical mean.

As soon as, the variable is dragged in the one sample variable boxes, the result will automatically process and will display in the ***Result Panel*** on the screen.

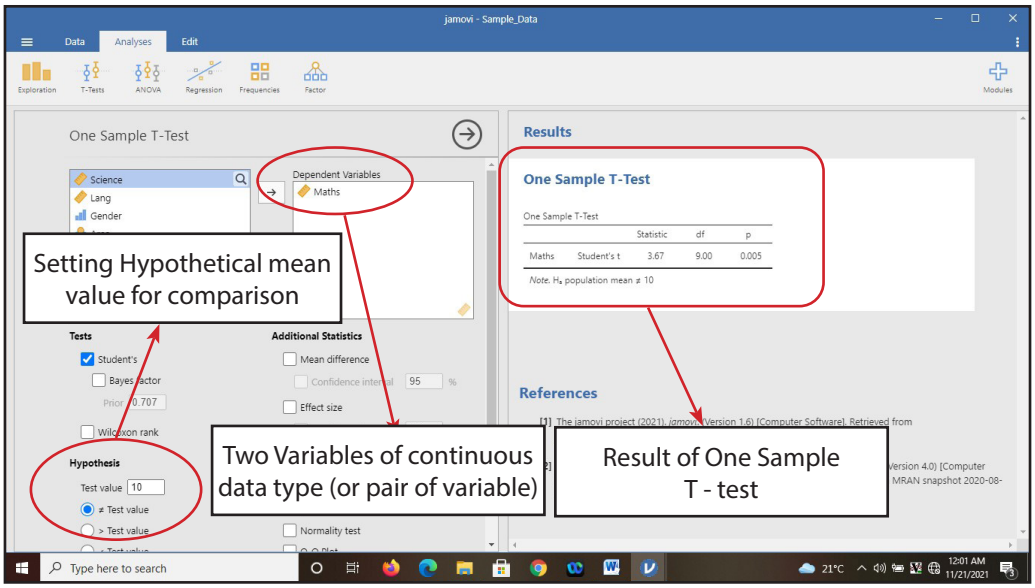



*Fig. 27: Jamovi: One Sample T – Test*

The base result of the one-sample t-test:

## One-Sample T-Test

One-Sample T-Test

| | | Statistic | df | p |
|---|---|---|---|---|
| Maths | Student's t | 3.67 | 9.00 | 0.005 |

Note. $H_a$ population mean ≠ 10

Like the Independent Samples T-test, the base structure of Paired Samples T-test also gives results on 3 statistics; namely (i) T - statistic value (***Statistic***); (ii) Degree of Freedom (***df***); and (iii) P-value (***p***).

Here also we can find more statistic values by selecting other options given in the Instruction panel, as explained earlier.

# 8. ANOVA

In this session, we will discuss the ANOVA. The full form of ANOVA is **An**alysis **o**f **Va**riance. It is also one of the very important tests. It is used to analyze the differences among means. It is an extension of a t-test where we compare the variable among more than two groups or categories.

Here, we will see the following forms of ANOVA namely

(i) One way ANOVA

(ii) Two way ANOVA or Multi-way ANOVA

(iii) Repeated Measure ANOVA

(iv) ANCOVA

(v) MANCOVA

## (I) One way ANOVA

Let's see how to do One Way ANOVA with Jamovi. To find the One Way ANOVA, we need two variables. One variable is categorized into more than two groups (e.g. gender as male, female and transgender, or division as first, second and third, etc.) and another variable will be continuous. Make sure that the measurement levels are set correctly such that the grouping variable should be nominal type and the continuous variable should be continuous-type data set.

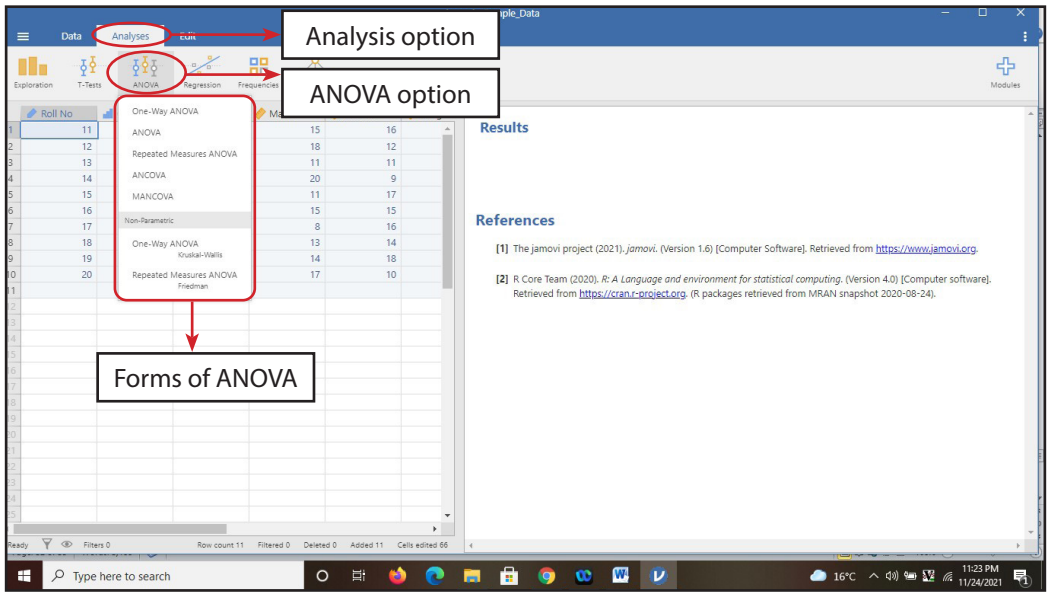



*Fig. 28: Jamovi: ANOVA*

To find the One Way ANOVA click on ***Analysis*** then ***ANOVA***. On clicking ***ANOVA***, some options will appear namely (i) One-way ANOVA; (ii) ANOVA; (iii) Repeated Measure ANOVA; (iv) ANCOVA (v) MANCOVA, and (vi) Non –parametric ANOVA tests.

Now click on ***One Way ANOVA***. Then select the required continuous variable and drag it into the ***Dependent variable*** box, as shown in fig. 29. Also, select the categorized variable and drag it into the ***Grouping variable*** box. Care should be taken that the dependent variable should continuous type and the grouping variable should nominal type.

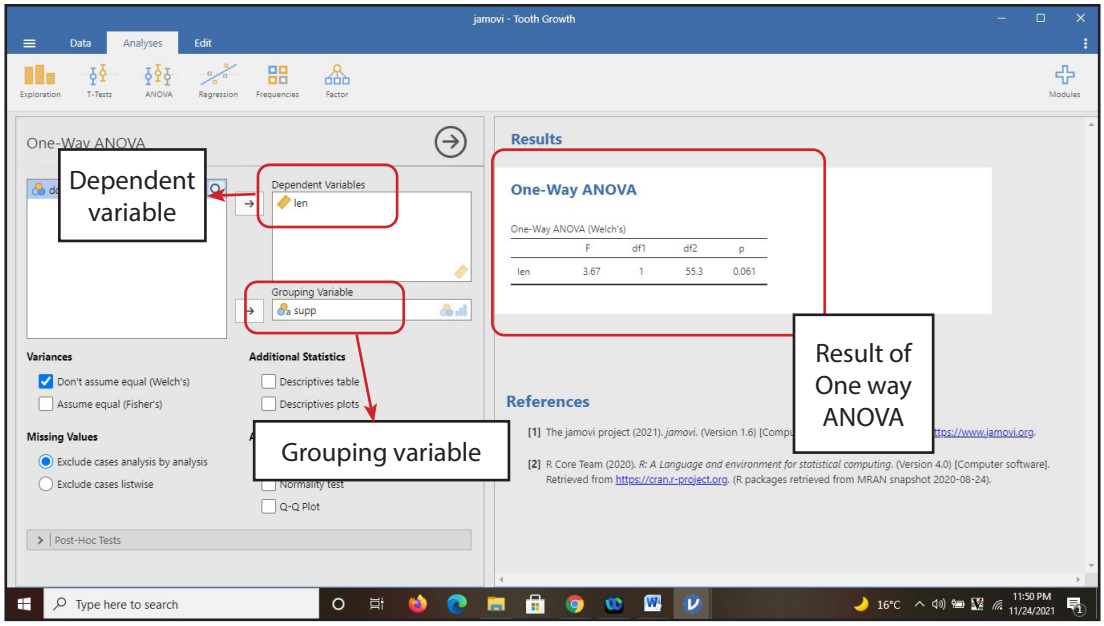



*Fig. 28: Jamovi: One Way ANOVA*

As soon as, the variables are dragged in the dependent variables and grouping variables boxes, the result will automatically process and displayed in the ***Result Panel***. The base result for One way ANOVA test will appear this way

## One-Way ANOVA

One-Way ANOVA (Welch's)

| | F | df1 | df2 | p |
|---|---|---|---|---|
| len | 68.4 | 2 | 37.7 | < .001 |

The base structure gives results on 3 statistics

(i) F - value (Statistic)

(ii) Degree of Freedom (df) for 2 variables

(iii) P-value (p)

We can find more statistic values by selecting other options given in the Instruction panel (see fig. 29.) Also clicking on Post Hoc Tests, we can get some more statistics.

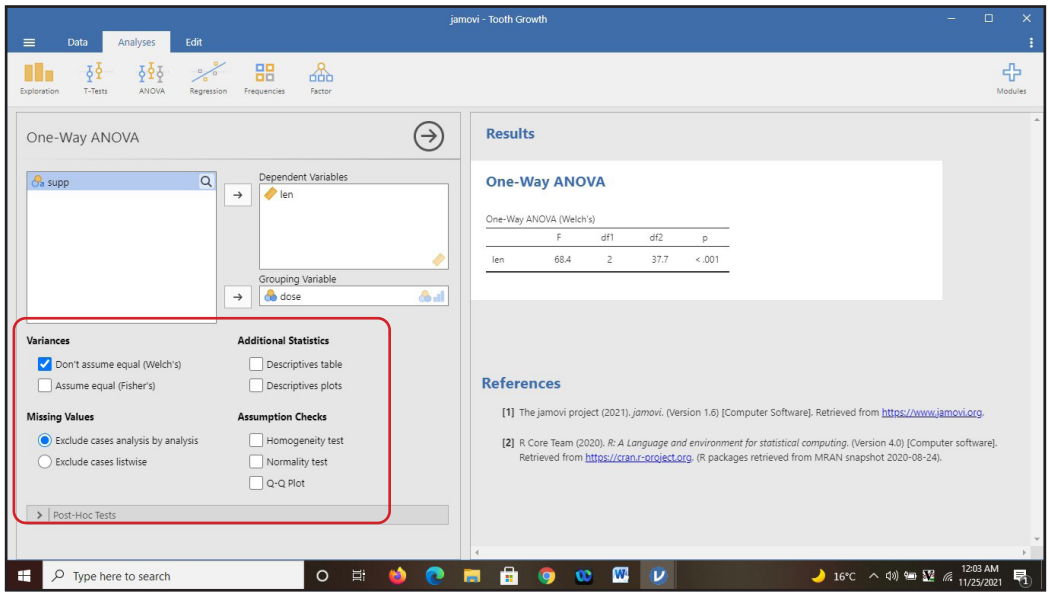



*Fig. 29: Jamovi: One Way ANOVA with addition options*

## (II) ANOVA

In ANOVA, we can perform ANOVA with the '***n***' number of grouping variables in Jamovi. Such ANOVA is called Two Way ANOVA (if two grouping variables are used) or Multi-Way ANOVA (if more than two grouping variables are being used).

To perform the ANOVA test, we need two or more variables, one continuous variable and other variables of the nominal type. These nominal variables may be categorized into more than two groups (e.g. gender (male, female and transgender), or division (first, second and third), etc.). Make sure that the measurement levels are set correctly such that grouping variables should be nominal type and the continuous variable should be continuous-type data set.

To perform the ANOVA test, select ***ANOVA***. (second option below One way ANOVA). Now identify the required set of variables (continuous type variables and grouped

variables) to perform the ANOVA. Drag these continuous type variables in the ***Dependent Variable*** box and group variables into the ***Fixed Variable*** box.

As soon as, the variables are dragged in both variables boxes, the result will automatically process and will display in the ***Result Panel*** on the screen. Please see fig. 30.

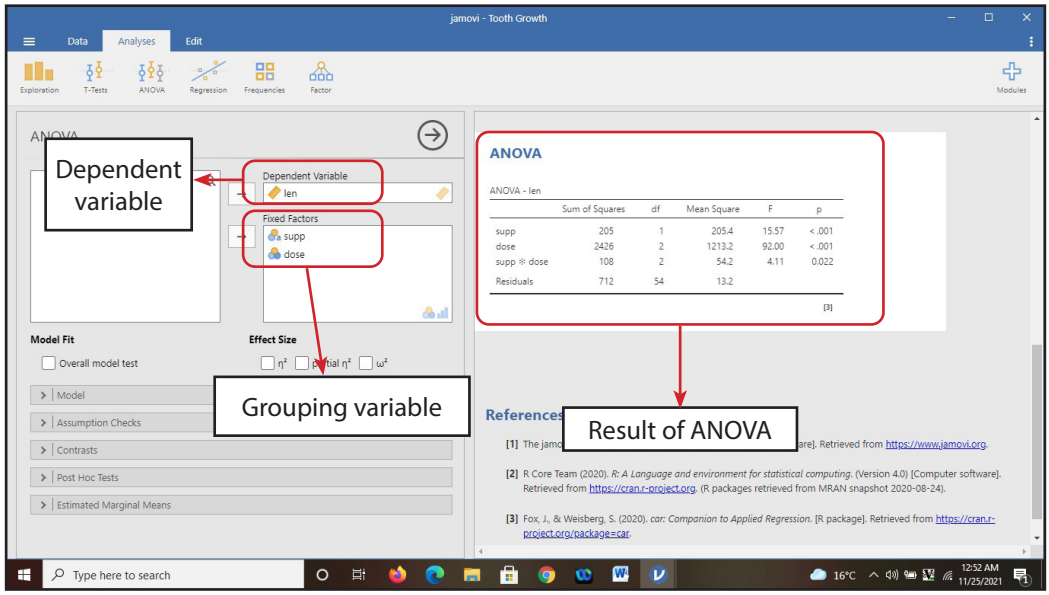



*Fig. 30: Jamovi: ANOVA with multi-group (factors) variables*

## ANOVA

ANOVA – len

| | Sum of Squares | df | Mean Square | F | p |
|---|---|---|---|---|---|
| Sup | 205 | 1 | 205.4 | 15.57 | <.001 |
| Dose | 2426 | 2 | 1213.2 | 92.00 | <.001 |
| supp* dose | 108 | 2 | 54.2 | 4.11 | 0.022 |
| Residuals | 712 | 54 | 13.2 | | |

The base structure gives results on 5 statistics for each grouping variable, namely Sum of Squares (***SS***), Degree of Freedom (***df***), Mean square (***MS***), F - value (***F***), and P-value (***p***).

We can find more statistic values by selecting other options given in the Instruction panel. Also clicking on Post Hoc Tests, we can get some more statistics.

## (III) Repeated Measures ANOVA

Repeated measures ANOVA is an equivalent of the one-way ANOVA, but for related, not independent groups. It is the extension of the paired t-test. The repeated measures ANOVA compares means across one or more variables that are based on repeated observations (or within-subjects ANOVA or ANOVA for correlated samples). A repeated-measures ANOVA model can also include zero or more independent variables.

Here to perform repeated measures ANOVA, we required more than two variables (groups) of the same subject. These variables should be continuous data types. For example, a set of teachers divides into three groups namely, pre-training, online training, and face-to-face training programme and we want to study the changes in their performance.

To perform the repeated measures ANOVA test, now we click on ***Repeated Measures ANOVA***. The window appears will be different from its normal view. In the Instructional process panel, the first box is showing all defined variables. In the side-upper box titled ***Repeated Measures Factors*** by default two levels are given. Here, we can add more levels or rename the levels as per our requirement. We can also define more factors as RM Factor in the analysis. The Repeated Measures Cells allow to drag the variables equal to the number of levels defined in the Repeated Measures Factors.

Once the additional level and RM Factor (optional) are defined and then required variables dragged into the ***Repeated Measures Cells***, the result will automatically process and will display in the ***Result Panel*** on the screen. In Jamovi, the result of Repeated Measures ANOVA is given in two sections, one for within effects and another for between effects.

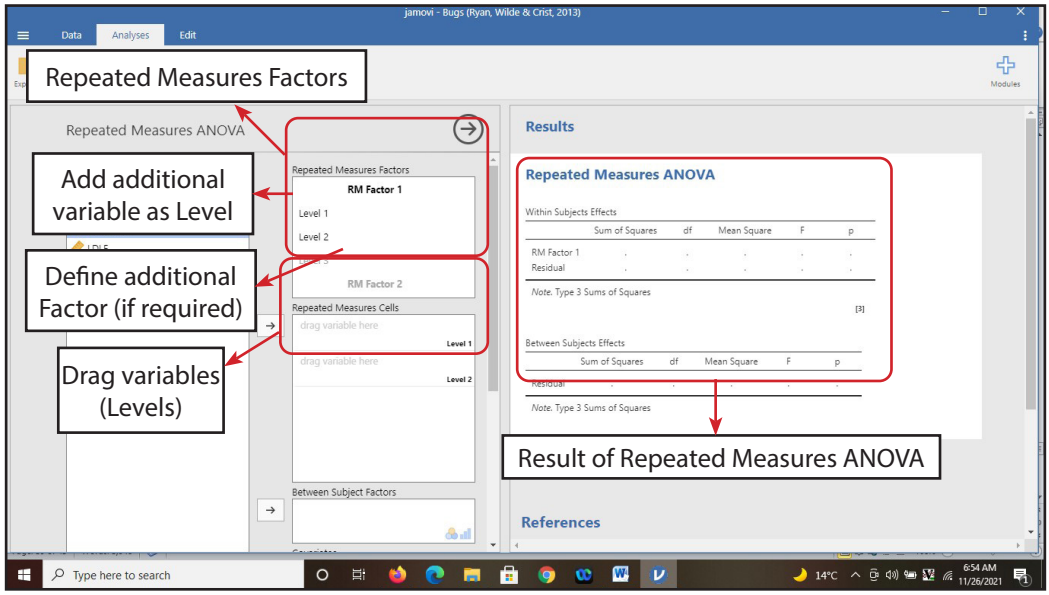


*Fig. 30: Jamovi: Repeated Measures ANOVA*

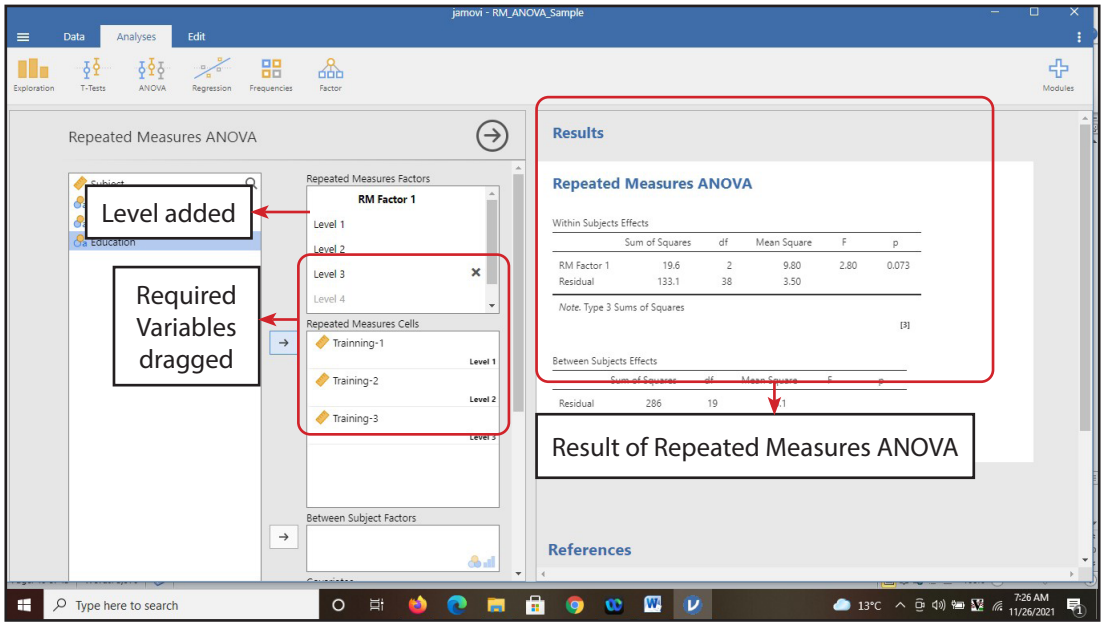



*Fig. 31: Jamovi: Repeated Measures ANOVA*

## Repeated Measures ANOVA

Within Subjects Effects

| | Sum of Squares | df | Mean Square | F | p |
|---|---|---|---|---|---|
| RM Factor 1 | 19.6 | 2 | 9.80 | 2.80 | 0.073 |
| Residual | 133.1 | 38 | 3.50 | | |

Note. Type 3 Sums of Squares

Between Subjects Effects

| | Sum of Squares | df | Mean Square | F | p |
|---|---|---|---|---|---|
| Residual | 286 | 19 | 15.1 | | |

Note. Type 3 Sums of Squares

The base structure gives results on 5 statistics for both effects, within-subjects Effects, and between subjects effects

(i) Sum of Squares (***SS***)

(ii) Degree of Freedom (***df***)

(iii) Mean square (***MS***)

(iv) F - value (***F***)

(v) P-value (***p***)

We can also find the effects on grouping variables such as gender, area, education level, etc., and also can covariate with variables. Here grouping variables should be nominal type and covariate variables should be continuous-type data.

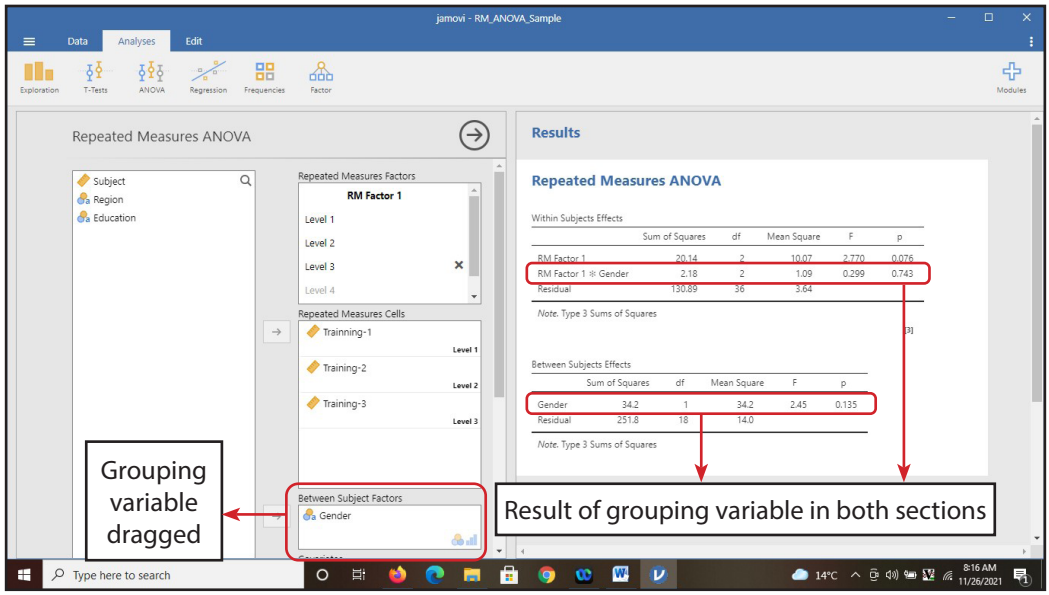



*Fig. 32: Jamovi: Repeated Measures ANOVA with grouping variable*

We can find more statistics values by selecting other options given in the Instruction panel such as Effect Size, Dependent Variables, etc. Drop-down options are also given to select more statistical results as per the requirement of the study.

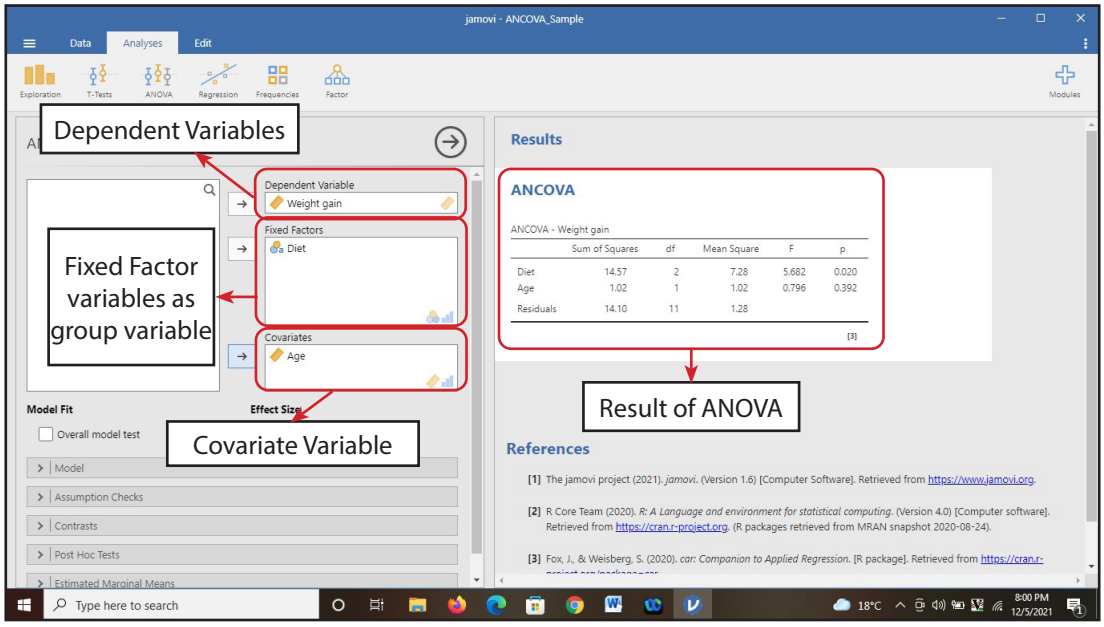
## (IV) ANCOVA

The ANCOVA is the abbreviation of the Analysis of Covariance. ANCOVA is an extension of ANOVA. In ANCOVA the values of the dependent variable are "adjusted" for the influence of the covariate, and then the "adjusted" score means are tested between groups in the usual way [1]. It is used to explore the relationship between a dependent variable, one or more grouping variables, and one or more covariate variables.

Make sure that the measurement levels are set correctly such that the dependent variable should be continuous type, the grouping variable should be nominal type and the covariate variable should be continuous-type data set.

To perform the repeated measures ANOVA test, now we click on ***ANCOVA***. The window will appear similar to ANOVA with one additional box for ***Covariate variables***.

Now identify the required set of variables (continuous type variables and grouped variables) to perform the ANOVA. Drag the required variables into respective boxes. Drag required dependent variable in Dependent Variable box, grouping variable in Factor variable box and Covariate variable in Covariate box.




*Here data set used from [3]*

*Fig. 33: Jamovi: ANCOVA*

As soon as, the variables are dragged into the boxes, the result will automatically process and will display in the ***Result Pane***l on the screen.

## ANCOVA

ANCOVA - Weight gain

| | Sum of Squares | df | Mean Square | F | p |
|---|---|---|---|---|---|
| Diet | 14.57 | 2 | 7.28 | 5.682 | 0.020 |
| Age | 1.02 | 1 | 1.02 | 0.796 | 0.392 |
| Residuals | 14.10 | 11 | 1.28 | | |

The base structure gives results on 5 statistics for each grouping variables

(i) Sum of Squares (***SS***)

(ii) Degree of Freedom (***df***)

(iii) Mean square (***MS***)

(iv) F - value (***F***)

(v) P-value (***p***)

We can find more statistics values by selecting other options given in the Instruction panel. Also clicking on Model fit, Effect size, Models, Assumption checks, Post Hoc Tests, etc., we can get some more statistics.

(V) MANCOVA

**Multivariate analysis of covariance** (MANCOVA) is the extension of the analysis of covariance (ANCOVA). It is the multivariate analysis of variance (MANOVA) with a covariate(s).). In MANCOVA, we assess for statistical differences on multiple continuous dependent variables by an independent grouping variable, while controlling for a third variable called the covariate; multiple covariates can be used, depending on the sample size. Covariates are added so that it can reduce error terms and so that the analysis eliminates the covariates' effect on the relationship between the independent grouping variable and the continuous dependent variables [4].

So, MANCOVA can be solved similar way to ANCOVA with multi continuous dependent variables by an independent grouping variable.

# 9. Correlation and Regression

In this session, we will discuss how we can find the value of Correlation and Regression. It is used to find the relation between two or more variables. Here we can perform the following analysis in the Jamovi.

(i) Correlation

(ii) Partial Correlation

(iii) Linear Regression

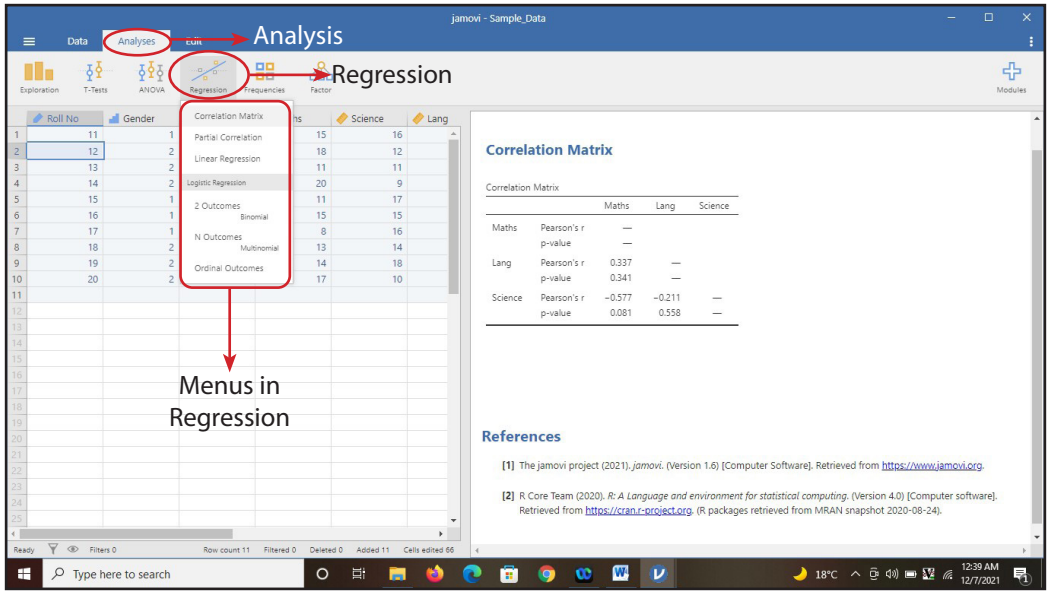



*Fig. 34: Jamovi: Regression including Correlation*

## Correlation

Correlation is used to find the relation between variables. Let us know how the correlation value can find with Jamovi. To find a Correlation, we need at least two variables. The variables should be continuous.

To find the correlation, click on ***Analysis*** then ***Regression***. On clicking ***Regression***, three options will appear namely

(i) Correlation Matrix;

(ii) Partial Correlation;

(iii) Linear Regression; and

(iv) Logistic Regressions.

To do the Correlation analysis, click on ***Correlation***. Then select the required continuous variables and drag them into the ***side box***.

As soon as, the variables are dragged into the second box, the result will automatically process and will display in the ***Result Panel***. This result will appear on the right side ***Result Panel*** on the screen. The base result of the correlation Matrix will appear this way

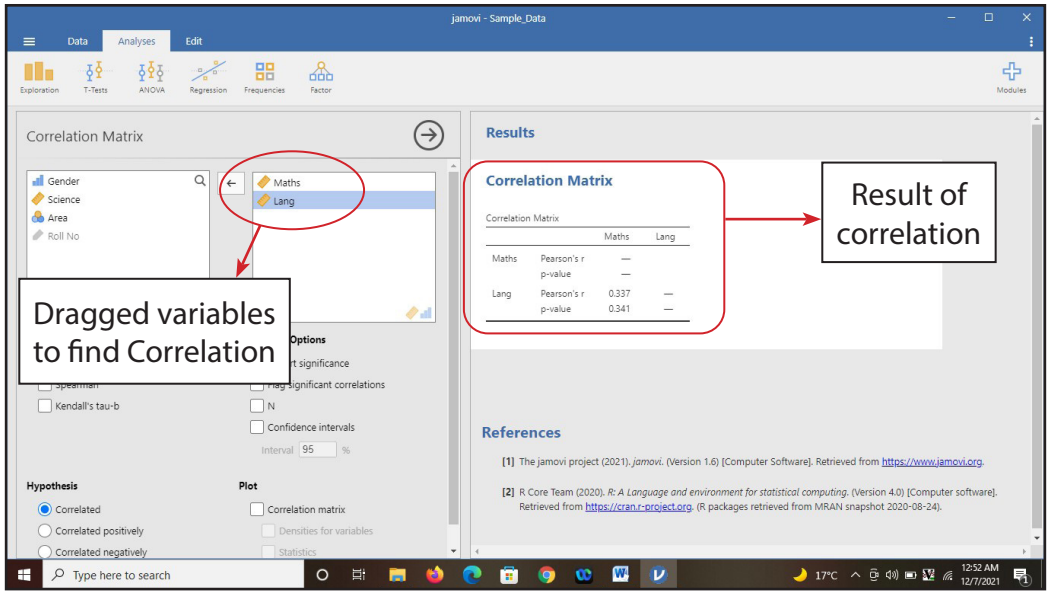



*Fig. 35: Jamovi: Correlation*

## Correlation Matrix

Correlation Matrix

| | | Maths | Lang |
|---|---|---|---|
| Maths | Pearson's r | — | |
| | p-value | — | |
| Lang | Pearson's r | 0.337 | — |
| | p-value | 0.341 | — |

Base structure gives results on 2 statistic

(i) Correction value between two variables (***r***) (***Pearson's r***)

(ii) P-value of Correlation (***p***)

We can find more statistic values and plots by selecting other options given in the Instruction panel. Also, we can find the relation between more than two variables. But note that at one time we can compare any two variables only.

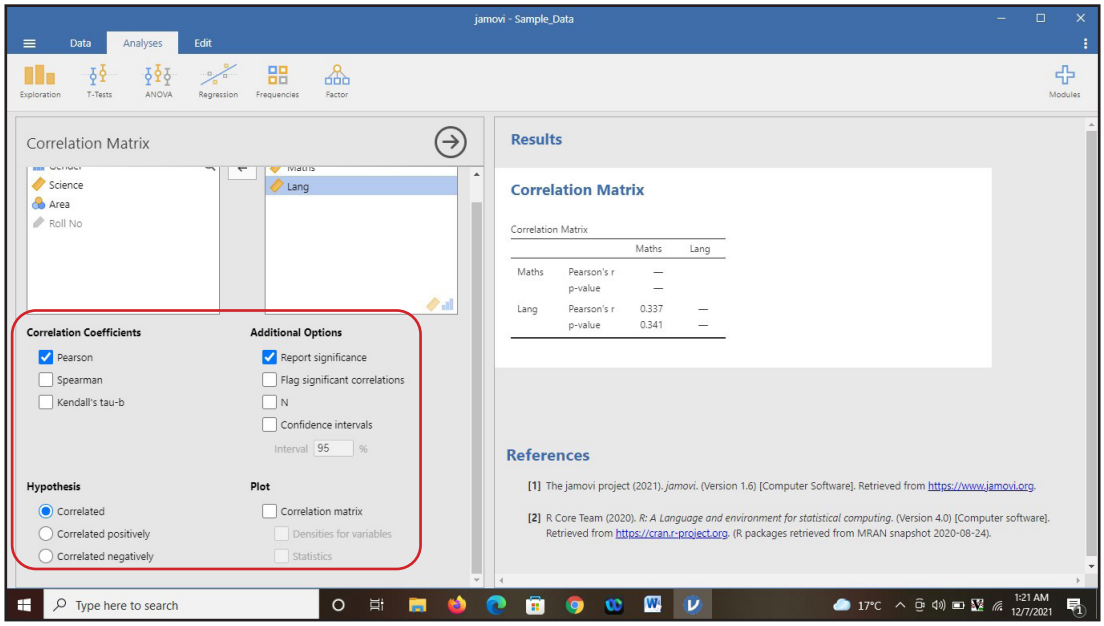



*Fig. 36: Jamovi: Correlation with more options*

## Partial Correlation

In Partial Correlation, we control the effect of one variable (fixed) and compare two variables to find the relation between these two variables. Let us know how a partial correlation value can be found with Jamovi. To find a Correlation, we need at least two variables. The variable should be continuous.

To find a partial correlation, click on ***Analysis*** then ***Regression***, and then ***Partial Correlation***. The window will appears with a new box of ***Control variables*** below the ***Variable*** box in the instructional panel.

Now, identify the required two continuous variables and drag them into the Variable box and also drag the control variable in the control variable box to control its effect on the two variables.

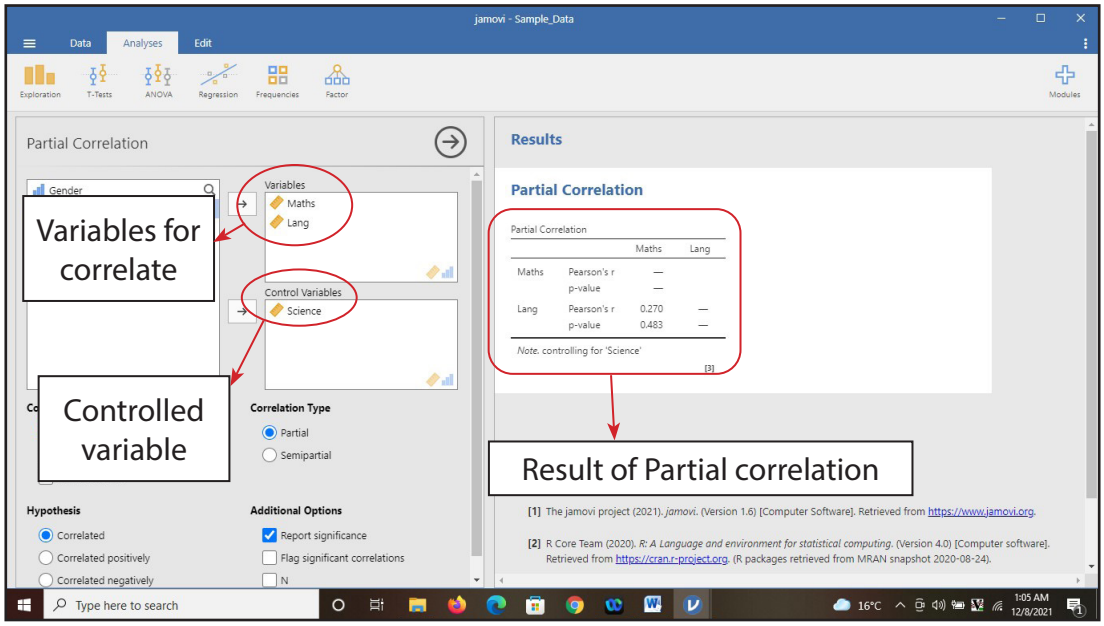



*Fig. 37: Jamovi: Correlation with more options*

As soon as, the variables are dragged into the Variables box and Control Variables box, the result will process and display in the *Result Panel*. This result will appear on the right side *Result Panel* on the screen.

The base result of the partial correlation will appear this way

## Partial Correlation

Partial Correlation

| | | Maths | Lang |
|---|---|---|---|
| Maths | Pearson's r | — | |
| | p-value | — | |
| Lang | Pearson's r | 0.270 | — |
| | p-value | 0.483 | — |

Note. controlling for 'Science'

Base structure gives results on 2 statistic

(i) Correction value between two variables under control variable (r) (*Pearson's r*)

(ii) P-value of Correlation (*p*)

(iii) The name of the Controlled variable will appear in the Note with the result table.

We can use more variables to find the relation between them. But note that at one time we can compare any two variables only. Also, we can find more statistic values and plots by selecting other options given in the Instruction panel, as discussed earlier.

## Linear Regression

Linear Regression, is a process for estimating the relationships between a dependent variable and one or more independent variables. Let us know how linear regression value can be found with Jamovi. To find linear regression, we need at least two variables, one dependent variable, and another independent variable or covariate variable. Variables should be continuous type.

To find linear regression, click on ***Analysis*** then ***Regression***, and then select *Linear Regression*. The window will appear with three boxes for ***Dependent variables***, ***Covariates variable***, and ***Factors variable*** in the instructional panel.

Now, identify the required dependent and independent variables and drag them into the Dependent Variable box and Covariate box respectively. Here adding of Factor variable is optional, depending on the problem taken into consideration.

As soon as, the variables are dragged into the boxes, the result will automatically process and will display in the ***Result Panel***. This result will appear on the right side ***Result Panel*** on the screen.

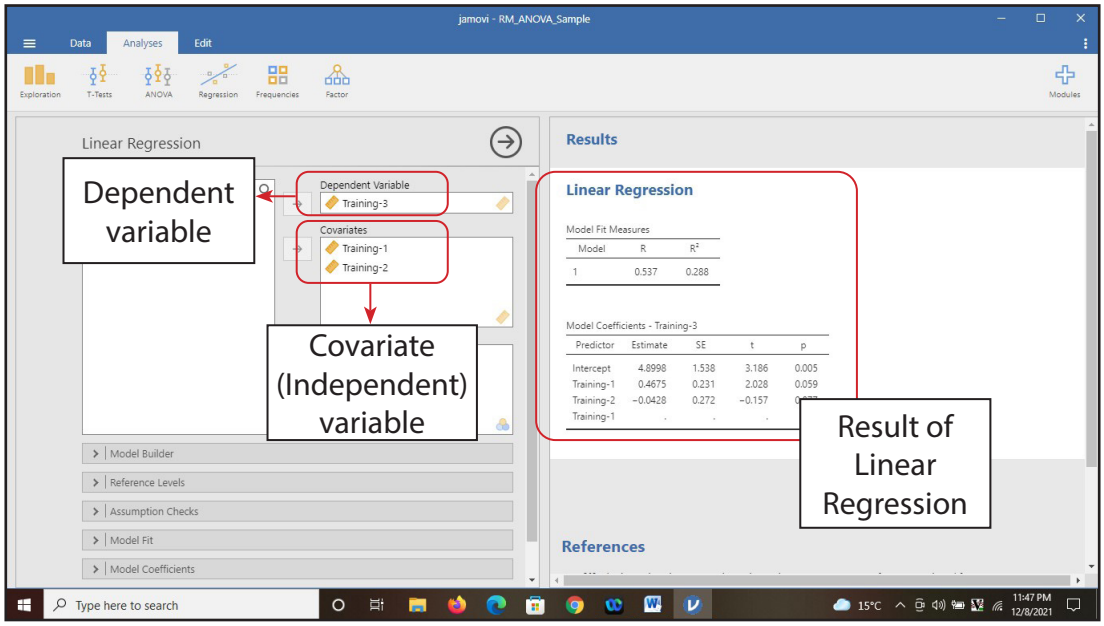



*Fig. 38: Jamovi: Linear Regression*

The base result of the partial correlation will appear this way

## Linear Regression

Model Fit Measures

| Model | R | R2 |
|---|---|---|
| 1 | 0.537 | 0.288 |

Model Coefficients – Training -3

| **Predictor** | **Estimate** | **SE** | **t** | **p** |
|---|---|---|---|---|
| Intercept | 4.8998 | 1.538 | 3.186 | 0.005 |
| Training-1 | 0.4675 | 0.231 | 2.028 | 0.059 |
| Training-2 | -0.0428 | 0.272 | -0.157 | 0.877 |
| Training-1 | | . | | . |

We can find more statistic values and plots by selecting other options given in the Instruction panel. Also, we can use more variables to find the relation between them.

# 10. References


1. Navarro DJ and Foxcroft DR (2019). Learning Statistics with Jamovi: A tutorial for psychology students and other beginners. (Version 0.70). DOI: 10.24384/hgc3-7p15 [Available from url: http://learnstatswithjamovi.com]
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Dr. Vishal D. Pajankar, faculty in Statistics at National Council of Educational Research and Training (NCERT), New Delhi has experience of 15+ years of active service including the institution at Govt. Vidarbha Institute of Science and Humanities, Amravati (MS). He taught different papers namely measure theory, statistical techniques, statistical inference, SQC, computer programming, etc. Dr. Pajankar completed M.Sc.(Statistics) from SGB Amravati University, Amravati, PhD from RTM Nagpur University, Nagpur and PGDBM from Sikkim Manipal University. At NCERT, he is involved in large scale surveys such as All India School Education Survey (AISES) and National Achievement Surveys (NAS). In 8th AISES, he was part of National Core Team and also the coordinator of Western region states. He was also coordinator of NAS Class 8 (Cycle 4); core team member of NAS 2017 at Class 3, 5 and 8; NAS Class X (Cycle 1 and 2). He is also involved in test designing, item development, assessment framework, planning, data quality management, and other related activities. He has organised several training programme and also delivered resource lectures in training programmes/ workshops on Statistical Methods, Sampling Techniques, Research Methods and Data Quality Management, Item Development-Analysis, management of surveys, etc. for the state officials as well as districts officials engaged in school education activities. He has published 40+ research articles in national/international journals, policy documents, several reports and 5 books with national and international publishers.

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