INTRODUCTORY TUTORIAL PART 2: A SECOND DATA SET

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CONTENTS

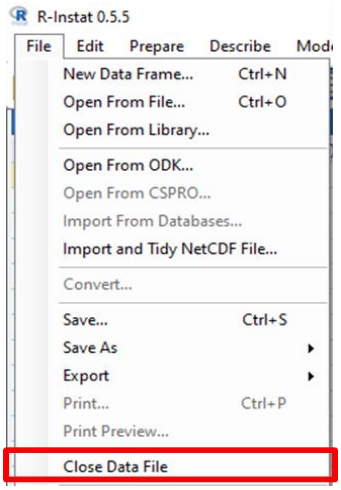
This tutorial guide follows on from Part 1 of the introductory tutorial. We recommend starting with Part 1, though this part is independent of the data and steps from Part 1.

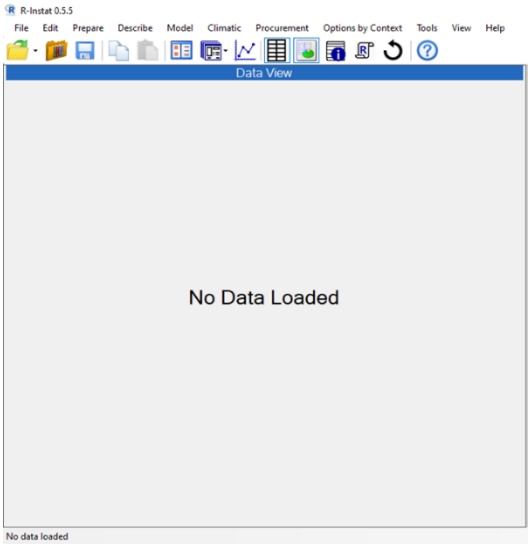
CHAPTER 1 — THE DODOMA DATA SET

This tutorial uses daily climatic data from Dodoma in Tanzania, from 1935 to 2013. We are very grateful to the Tanzania Met Authority who have given permission for these data to be used for training purposes.

- If the diamonds data are still in R-Instat then use **File > Close Data File** (Fig. 15)
- You will be asked if you are sure. Respond **Yes**.

Fig. 15. Closing the previous data file To start again

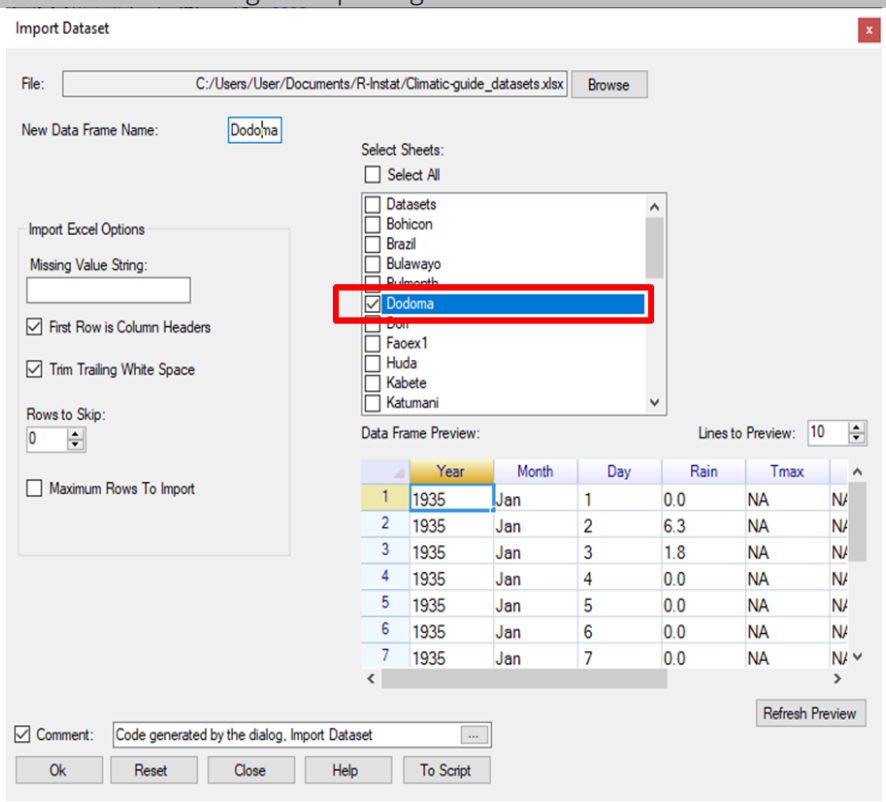




1.1 OPENING THE NEW DATA SET

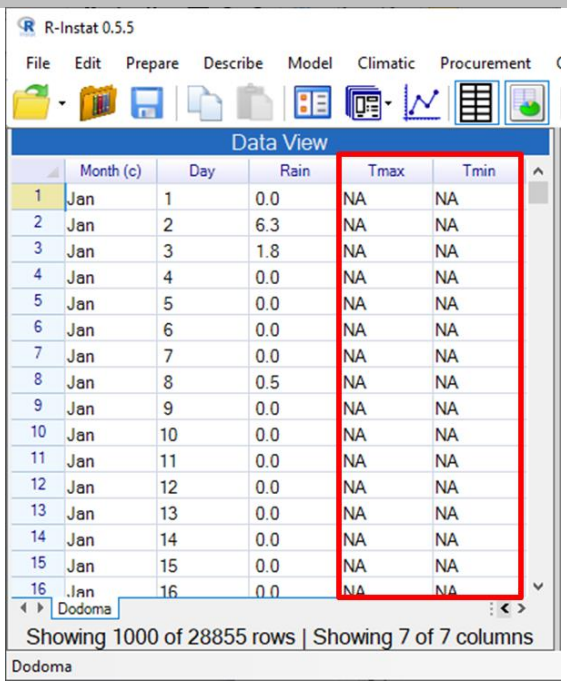
- Use **File > Open from Library**. Take the option to **Load from Instat Collection** and then press **Browse**.
- Choose **Climatic** and select the Excel file **Climatic_guide_dataset**
- This Excel file has multiple sheets. Choose the one called **Dodoma**, see Fig. 16.

Fig 16: Opening the Dodoma sheet



The preview (Fig. 16) indicates this is ready to import. There are sensible names and the data starting on January 1st .

Fig 17: The Dodoma Daily Data



The data are shown in Fig. 17. These are daily data on rainfall, temperatures, and sunshine hours. There are 28,855 observations.

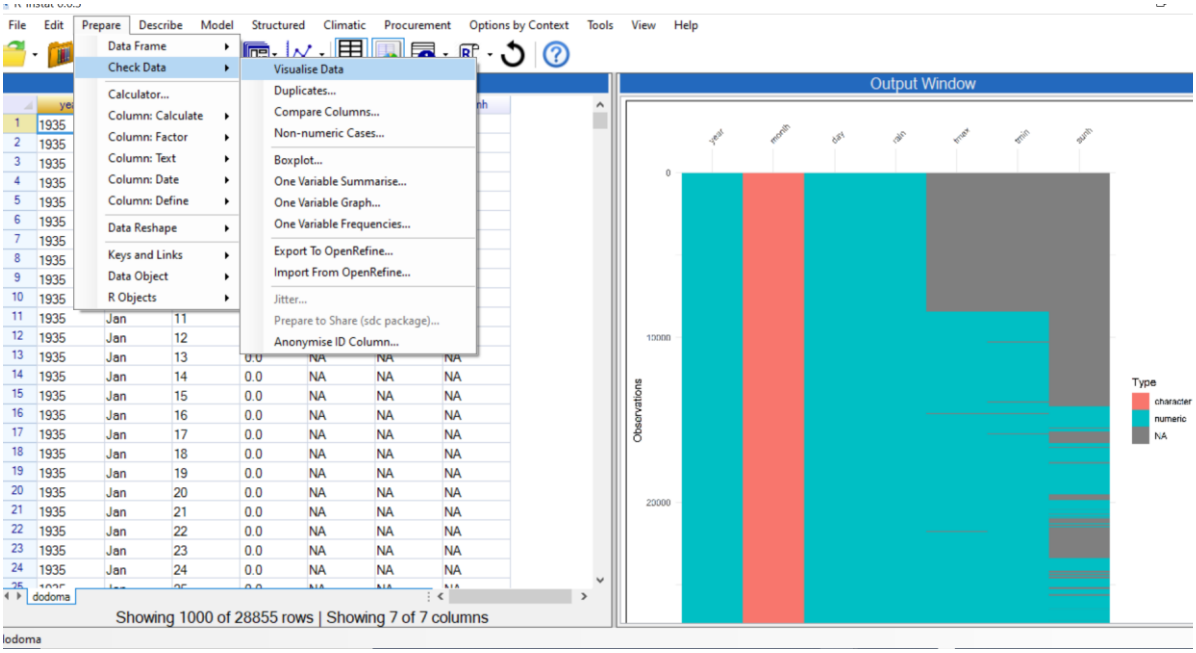
1.2 CHECKING THE DATA SET

One difference from the diamonds example in Part 1 is that missing values are immediately visible in the data.

- Now use Prepare > Check Data > Visualise Data.
- Just press Ok.

This gives a sort of "picture" of the data, see Fig. 18.

Fig: 18 Dodoma Daily Data and Data Visualisation



Grey is for the missing values. They indicate that the early years did not record the temperatures, and sunshine recording started later still. The figure also shows there aren't many missing values in the temperatures, once recording started, but the sunshine data is patchy.

- Return to the **Prepare** > **Check Data** menu.

The One Variable Summarise and Graph dialogues are repeated here. You used them from the Describe menu, but they are often also useful at the initial data checking stage.

- As before, with **One Variable** > **Summarise**, look at all the variables.

Fig: 19 Dodoma Data Summary

```
# Code generated by the dialog, One Variable Summarise

      year          month               day             rain        
 Min.   :1935   Length:28855       Min.   : 1.0   Min.   :  0.00  
 1st Qu.:1954   Class :character   1st Qu.: 8.0   1st Qu.:  0.00  
 Median :1974   Mode  :character   Median :16.0   Median :  0.00  
 Mean   :1974                      Mean   :15.7   Mean   :  1.57  
 3rd Qu.:1994                      3rd Qu.:23.0   3rd Qu.:  0.00  
 Max.   :2013                      Max.   :31.0   Max.   :119.80  
                                                  NA's   :91      

      tmax            tmin            sunh       
 Min.   :15      Min.   : 8      Min.   : 0      
 1st Qu.:27      1st Qu.:15      1st Qu.: 8      
 Median :29      Median :17      Median :10      
 Mean   :29      Mean   :17      Mean   : 9      
 3rd Qu.:30      3rd Qu.:18      3rd Qu.:11      
 Max.   :36      Max.   :26      Max.   :14      
 NA's   :8631    NA's   :8703    NA's   :18451   
```

This shows there were just **91 days when the rainfall** was missing. The visualisation (Fig 18) before indicated that there are a large number of missing values for the temperatures and sunshine. The summary confirms this, showing over **8 thousand values missing for temperature** and over **18 thousand missing from the sunshine data**.

On a positive note, there were over 20,000 days when the temperatures **were** measured, and more than 10,000 with sunshine data. Also notice there were no missing values on the year or day variables. That's comforting because, with a daily time series, you can't proceed if you don't know the date!

In hindsight, this presentation also implies that the diamonds data, in tutorial 1, did not have any missing values, or their presence would have been indicated.

The rainfall data in Fig. 17 are from 1935. The station added temperature records later.

- Use the **right-click** on the **bottom tab** and choose **View Data (the last option)** to view the whole data.
- Scroll down these data to confirm that the temperatures started from 1958.

This indicates that most of the 8 thousand missing temperature data in Fig. 18 are because of the later start of measuring these elements.

CHAPTER 2 — PREPARING THE DATA

Often preparing the data for analysis takes most of the time. We have tried to make the Prepare menu in R-Instat as simple to use as possible.

Our main work in this tutorial is to examine trends in the ***annual*** temperature data. This uses the Prepare menu because we don't yet have annual data. These are daily data.

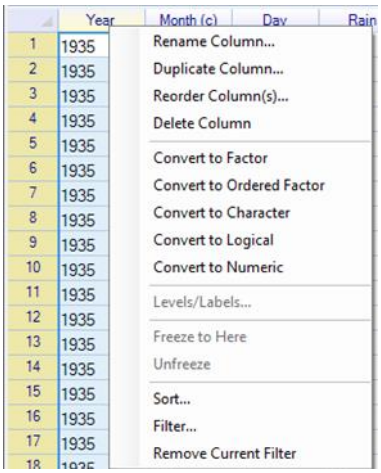
2.1 APPLYING A FILTER

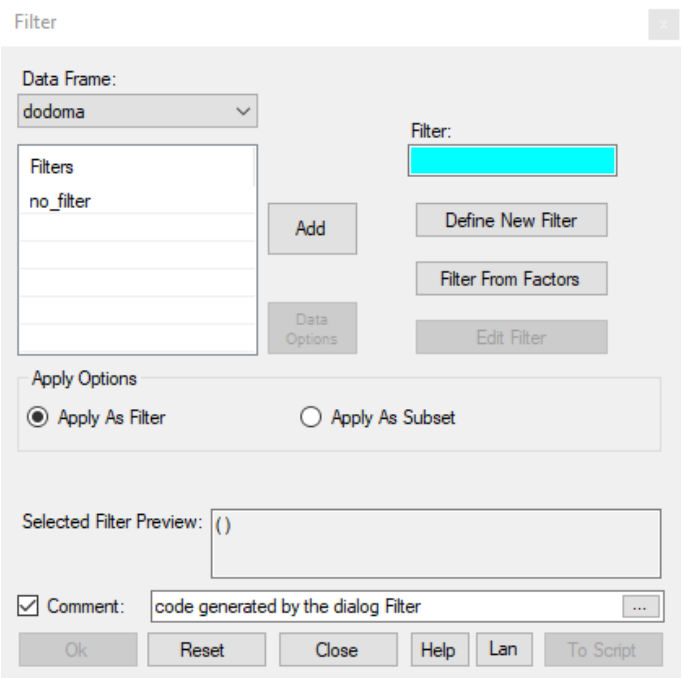
First, filter the data, so it starts in 1958, when the temperatures start. The filter dialogue is available in Prepare > Data Frame > Filter

However, many common tasks from the **Prepare** menu are quickly accessible through a special **right-click menu** which is shown in Fig. 20.

- Put the cursor in the top row (with the names) and **right-click** (Fig. 20)
- Choose the **Filter dialogue** from this menu (Fig 20)

Fig20: The Right-Click Menu Choose a Filter

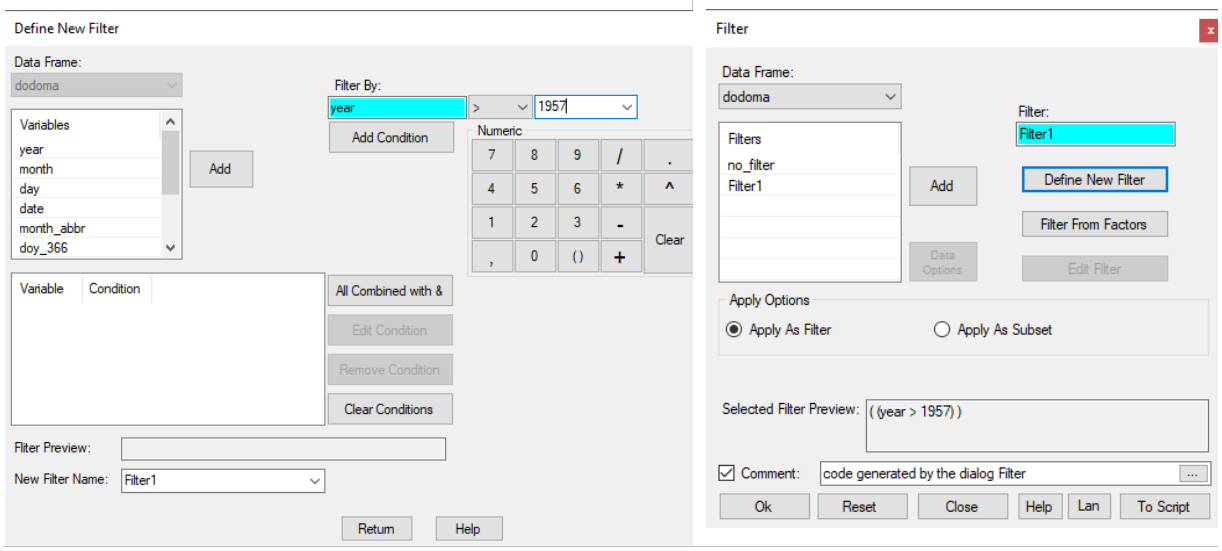




- Click on the button in Fig. 20 to **Define New Filter**.
- In the sub-dialogue, choose the **year variable** and the condition that **is greater than 1957.** (Fig 21)
- **Add the condition** and optionally **give the condition a name**, we call it ***from1958***. (Fig 21)

- Press **Return** and **OK.**

Fig 21: Define the Filter And then apply it



- Press the button to **Add Condition** (Fig. 21) and then press **Return**.
- On the main filter dialogue (Fig. 21) press **OK** to apply the filter.

On the left-hand-side the row numbers are now in red – which indicates a filter is in operation. The data now "start" in row 8402 with the temperature data., i.e. 1st January 1958.

Fig 22: Filtered Data

Data View

	year	month (c)	day	rain	tmax	tmin	sunh	yr_temp (L)
8402	1958	Jan	1	0.0	28.6	18.7	NA	TRUE
8403	1958	Jan	2	0.0	29.7	18.8	NA	TRUE
8404	1958	Jan	3	0.0	29.7	17.6	NA	TRUE
8405	1958	Jan	4	7.1	30.5	18.8	NA	TRUE
8406	1958	Jan	5	8.9	31.2	19.2	NA	TRUE
8407	1958	Jan	6	2.0	31.1	19.1	NA	TRUE
8408	1958	Jan	7	0.0	27.2	18.1	NA	TRUE
8409	1958	Jan	8	0.0	28.9	18.8	NA	TRUE
8410	1958	Jan	9	0.0	30.0	16.7	NA	TRUE
8411	1958	Jan	10	0.0	30.1	17.3	NA	TRUE
8412	1958	Jan	11	0.0	31.2	19.3	NA	TRUE
8413	1958	Jan	12	0.0	31.2	19.1	NA	TRUE
8414	1958	Jan	13	0.0	32.1	18.3	NA	TRUE
8415	1958	Jan	14	0.0	31.8	18.6	NA	TRUE
8416	1958	Jan	15	0.0	32.9	18.3	NA	TRUE
8417	1958	Jan	16	0.0	33.6	17.8	NA	TRUE
8418	1958	Jan	17	0.0	34.1	19.2	NA	TRUE
8419	1958	Jan	18	0.3	32.6	18.9	NA	TRUE
8420	1958	Jan	19	0.0	33.3	19.4	NA	TRUE
8421	1958	Jan	20	0.0	32.7	20.0	NA	TRUE
8422	1958	Jan	21	0.0	33.2	19.9	NA	TRUE

- Return to the **Prepare** > **Check Data** > **One Variable Summarise** dialogue (You can use the toolbar icon for recalling the last ten dialogues.
- Press Ok.

Fig: 23 Summary of Filtered Data

```
      year          month           day              date
 Min.   :1958   1      :1736   Min.   : 1.0   Min.   :1958-01-01
 1st Qu.:1972   3      :1736   1st Qu.: 8.0   1st Qu.:1972-01-01
 Median :1986   5      :1736   Median :16.0   Median :1985-12-31
 Mean   :1986   7      :1736   Mean   :15.7   Mean   :1985-12-31
 3rd Qu.:2000   8      :1736   3rd Qu.:23.0   3rd Qu.:1999-12-31
 Max.   :2013   10     :1736   Max.   :31.0   Max.   :2013-12-31
                12     :1736
                4      :1680
                6      :1680
                (Other):4942
  month_abbr      doy_366           rain              tmax            tmin
 Jan    :1736   Min.   :  1   Min.   :  0.00   Min.   :15.2   Min.   : 7.9
 Mar    :1736   1st Qu.: 93   1st Qu.:  0.00   1st Qu.:27.4   1st Qu.:15.1
 May    :1736   Median :184   Median :  0.00   Median :29.0   Median :17.2
 Jul    :1736   Mean   :184   Mean   :  1.58   Mean   :28.9   Mean   :16.8
 Aug    :1736   3rd Qu.:275   3rd Qu.:  0.00   3rd Qu.:30.5   3rd Qu.:18.5
 Oct    :1736   Max.   :366   Max.   :119.80   Max.   :35.5   Max.   :25.5
 Dec    :1736                 NA's   :91       NA's   :230    NA's   :302
 Apr    :1680
 Jun    :1680
 (Other):4942
```

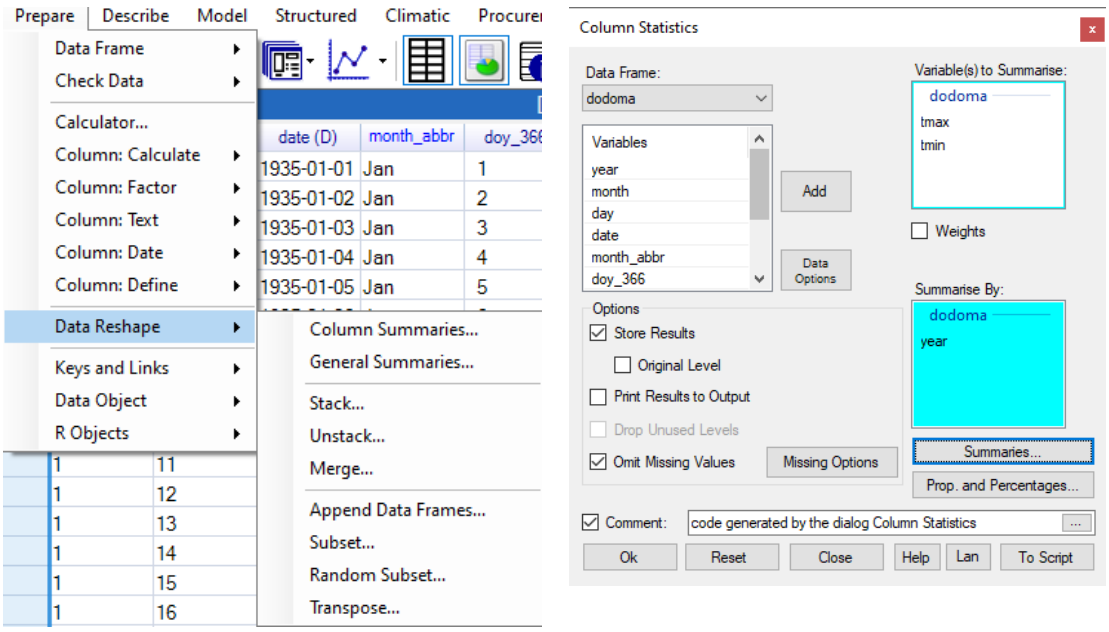
The results (Fig 23) include that there were only 230 missing days in tmax, from when temperatures were measured. A few more were missing in tmin.

2.2 PRODUCING YEARLY SUMMARIES

The daily data are now ready to be summarized to produce the yearly means.

- Open the **Prepare > Column: Reshape > Column Summaries** dialogue (Fig 24)

Fig 24: Menu for Column Summaries With the resulting dialog

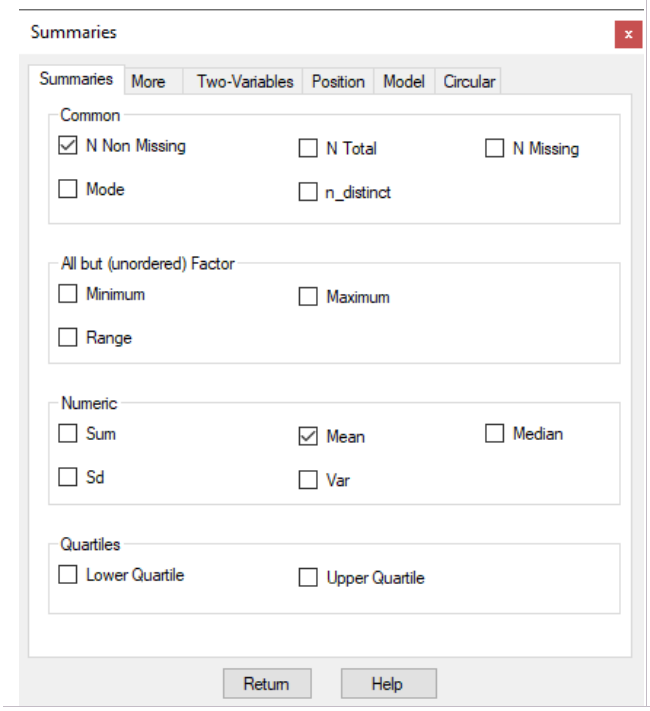


- Complete the dialogue (Fig. 24), i.e. **Tmin and Tmax** into the main receiver, **Year** into the other receiver, and the option ticked to **Omit Missing Values**.

- Then press the **Summaries button** to move to the sub-dialogue (Fig. 25)

➢ Complete the sub-dialogue as shown in Fig 25, i.e. with only two summaries for the **N Not Missing** and the **Mean**. Then press **Return and OK to produce the summaries**.

Fig 25: Summaries Sub-dialog With the Resulting Data



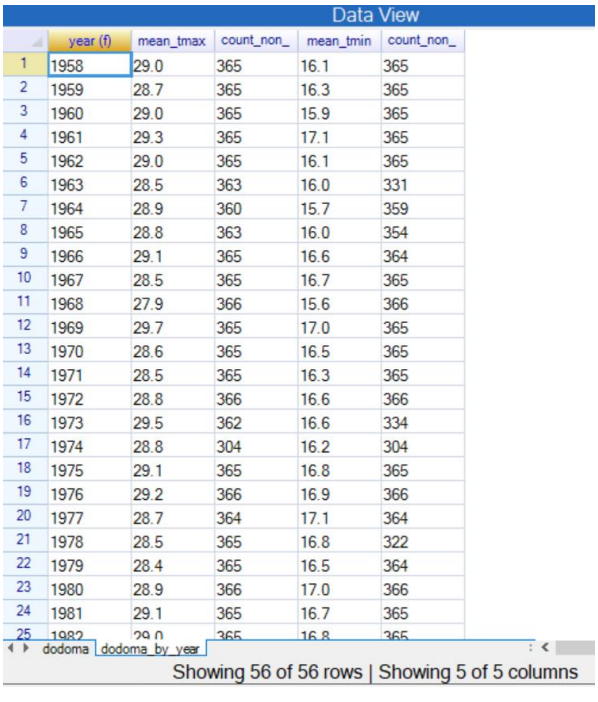


Fig. 25 The results are in a new sheet – or data frame in R terminology. There are just 56 rows, with one for each year. And they start in 1958. (Video: Indicate the number of years at the bottom of the data frame.)

So, now the daily data are in the first data frame and the annual summaries are in a second one.

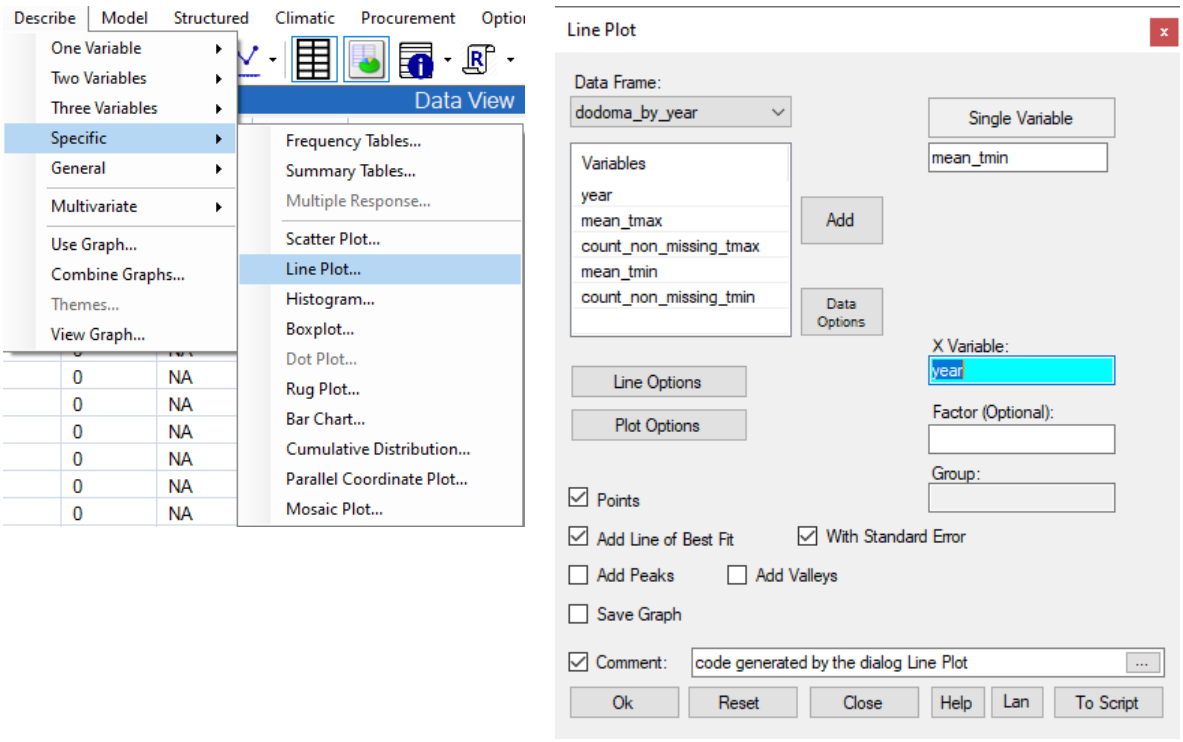
That was easy. The Prepare stage has not taken too long.

CHAPTER 3 — ANALYSING THE DATA

3.1 PRODUCING GRAPHS

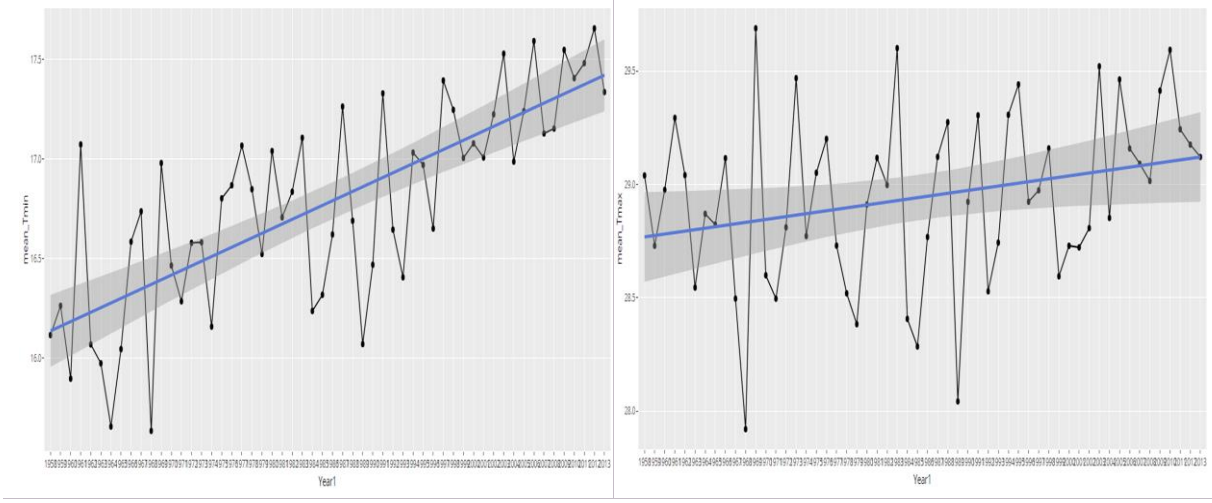
- Use **Describe > Specific > Line Plot**, Fig. 26.
- Complete the dialogue as shown in Fig. 26 for the with **mean_tmin as the y and year as the x**.
- Add **the points**, and **the fitted line.**
- Press **OK**.

Fig 26: The line plot menu And the dialog



The resulting graph is shown in Fig. 26.

Fig 26: The Graph for t-min And for t-max



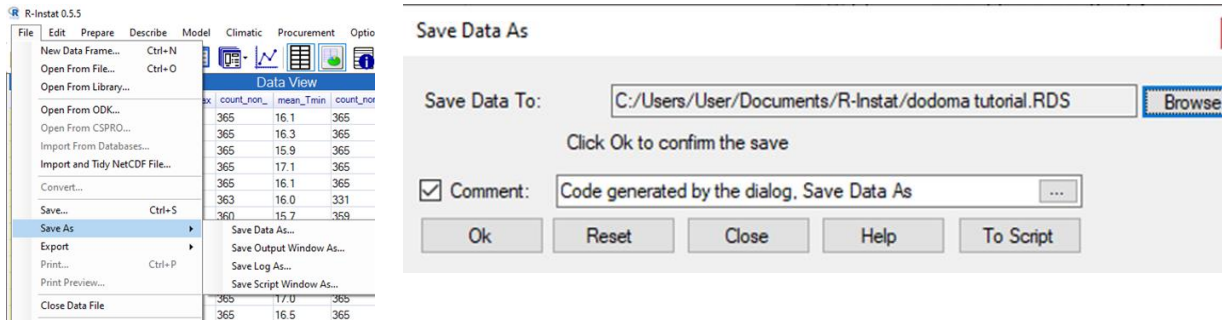
The result indicates that maximum temperatures have not increased so much.

3.2 SAVING THE DATA

Before using a different data set save these data, so you could resume later.

- Use the **File > Save As** dialog, Fig. 27. Choose the option **Save Data As**.
- Press on **Browse** in the dialogue, Fig. 27. Choose a suitable directory and name. Press **OK** when you return to the Save Data dialogue.

Fig 27: Saving the Data set



The RDS extension is added, to signify it is saved as an R data file. This is a "silver lining", if done well, the data only have to be organised once. Then the resulting file, with the two data frames, can be opened in the future, and the analysis can be continued.

There are more analyses that can be explored with this data in R-Instat and we encourage you now to try. The next part of the tutorial focuses on working with labelled data.

CHAPTER 4 FEEDBACK AND REPORTING BUGS

R-Instat is still under active development with many improvements and new features planned for future versions. We appreciate feedback you can have to help us improve R-Instat. There are several ways you can provide your feedback:

1. For general feedback you can contact us via email at R-Instat (at) AfricanMathsInitiative.net
2. Our issues page on our GitHub account can be used to report specific bugs or suggestions and this is the most direct way to contact the development team. Note that our issues page is publicly visible to anyone. It can be accessed here: https://github.com/africanmathsinitiative/R-Instat/issues. Click the green **New Issue** button on the right side to send your message.

When reporting a bug or problem, it's most helpful to us if you can be as specific as possible and detail how to reproduce the bug, pasting the R code from the log file and attaching data if possible.

R-Instat Team, African Data Initiative.

REFERENCES

R Core Team. (2018). *R: A language and environment for statistical computing.* Retrieved from https://www.R-project.org/.

Stern, R. D., Rijks, D., Dale, I. C., & Knock, J. (2006). *Instat Climatic Guide.*

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