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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.

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**.



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.

Import Dataset							_
File: C:/Users/Use	er/Documents/R	R-Instat/Climatic	guide_datasets.xls>	Browse			
New Data Frame Name: Dodom	a						
		Select Sheets:					
	ſ						
Import Excel Options		Bohicon			^		
Missing Value Chines		Brazil					
	_						
		Dodoma					
First Row is Column Headers							
		Faoex1					
Trim Trailing White Space		Facex1					
Trim Trailing White Space		Faoex1 Huda Kabete Katumani			•		
Trim Trailing White Space Rows to Skip:		☐ Faoex1 ☐ Huda ☐ Kabete ☐ Katumani Data Frame Prev	view:		✓ Lines 1	to Preview:	10 🌲
Trim Trailing White Space Rows to Skip:		☐ Faoex1 ☐ Huda ☐ Kabete ☐ Katumani Data Frame Prev ∠ Ye	view: ar Month	Day	V Lines t Rain	to Preview:	10 💠
Trim Trailing White Space Rows to Skip:		Faoex 1 Huda Kabete Katumani Data Frame Prev Ye 1 1935	view: ar Month Jan	Day 1	Lines t Rain 0.0	to Preview:	10 ≑ N/
Trim Trailing White Space Rows to Skip:		Faoex1 Huda Kabete Katumani Data Frame Prev Ye 1 1935 2 1935	riew: ar Month Jan Jan	Day 1 2	Lines 1 Rain 0.0 6.3	to Preview: [Tmax NA NA	10 ¢
Trim Trailing White Space Rows to Skip:		Faoex1 Huda Kabete Katumani Data Frame Prev 1 1935 2 1935 3 1935 3 1935	view: ar Month Jan Jan Jan	Day 1 2 3	Lines t Rain 0.0 6.3 1.8	to Preview: [Tmax NA NA NA	10 ÷
Trim Trailing White Space Rows to Skip:		☐ Faoex1	riew: ar Month Jan Jan Jan Jan	Day 1 2 3 4	Linest Rain 0.0 6.3 1.8 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	to Preview: [Tmax NA NA NA NA	10 ¢ N/ N/ N/
Trim Trailing White Space Rows to Skip:		☐ Faoex1 ☐ Huda ☐ Kabete ☐ Kabete ☐ Kabete ☐ Kabete ☐ Ve 1 1935 2 1935 3 1935 5 1935 6	riew: Jan Jan Jan Jan Jan Jan	Day 1 2 3 4 5 2	Lines t Rain 0.0 6.3 1.8 0.0 0.0 0.0	to Preview: [Tmax NA NA NA NA NA	10 ÷
Trim Trailing White Space Rows to Skip:		□ Faoex1 □ Huda □ Kabete □ Kabete □ Kabete □ Kabete □ Tara □ Tara □ 1935 2 1 1935 3 1935 4 1935 5 1935 6 1935 7 1025	riew: Jan Jan Jan Jan Jan Jan Jan	Day 1 2 3 4 5 6 6	Lines 1 Rain 0.0 6.3 1.8 0.0 0.0 0.0 0.0 0.0	to Preview: [Tmax NA NA NA NA NA NA NA	10 \$
Trim Trailing White Space Rows to Skip:		Faoex1 Huda Kabete Kabete Katumani Data Frame Prev 1 1935 2 1935 3 1935 4 1935 6 1935 7 1935	riew: Jan Jan Jan Jan Jan Jan Jan Jan Jan	Day 1 2 3 4 5 6 7	Lines 1 Rain 0.0 6.3 1.8 0.0 0.0 0.0 0.0 0.0	to Preview: [Tmax NA NA NA NA NA NA NA NA	10 ÷

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

	Fig 1	7: The [Dodoma	a Daily [Data	
R R	Instat 0.5.5					
File	Edit Pre	epare Descr	ibe Model	Climatic	Procuremen	nt
	- 📁 🖥		î II	•		•
)ata View			
	Month (c)	Day	Rain	Tmax	Tmin	^
1	Jan	1	0.0	NA	NA	
2	Jan	2	6.3	NA	NA	
3	Jan	3	1.8	NA	NA	
4	Jan	4	0.0	NA	NA	
5	Jan	5	0.0	NA	NA	
6	Jan	6	0.0	NA	NA	
7	Jan	7	0.0	NA	NA	
8	Jan	8	0.5	NA	NA	
9	Jan	9	0.0	NA	NA	
10	Jan	10	0.0	NA	NA	
11	Jan	11	0.0	NA	NA	
12	Jan	12	0.0	NA	NA	
13	Jan	13	0.0	NA	NA	
14	Jan	14	0.0	NA	NA	
15	Jan	15	0.0	NA	NA	
	lan	16	0.0	NΔ	NΔ	V

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: 1	8 Doc	loma D	aily Da	ata	and	Data	Visu	alisat	ion				
a iv matu																		
File E	dit Pr	epare De	scribe Mod	el St	ructured Clim	atic Procu	rement Option	s by Context	Tools	View	Help							
	-	Data Fran	ne		■ 1.2 IE	E 🔲 f		5										
•		Check Da	sta i	•	Visualise Data													
		Calculate			Duplicates									Output	Window			
	yea	Calculate	Calaulata I		Compare Colu	mns	nh		^									
1 19	935	Column:	Calculate		Non-numeric	Cases					de la	ALL .	4	-0	at.	-A-	<i>a</i>	
2 19	935	Column:	Factor			coscom					Je-	H.L.	93.	(3)*	AL.	S.C.	40	
3 19	935	Column:	lext		Boxplot													
4 19	935	Column:	Date		One Variable S	ummarise												
5 19	935	Column:	Define		One Variable G	iraph												
6 19 7 10	935	Data Res	hape I	•	One Variable F	requencies												
/ 19	335	Keys and	Links		Export To Ope	nRefine												
9 10	135	Data Obi	ect		Import From C	penRefine												
10 19	35	R Objects			litter													
11 19	35	Jan	11	-	Drepare to Sha	re (rde nacka	(1)											
12 19	35	Jan	12		Anomina	Caluma	ge/			10000								
13 19	35	Jan	13	0.0	Anonymise ID	NA	NA											
14 19	935	Jan	14	0.0	NA NA	NA	NA											Turne
15 19	935	Jan	15	0.0	NA	NA	NA			tion								character
16 19	935	Jan	16	0.0	NA NA	NA	NA			22							-	numeric
17 19	935	Jan	17	0.0	NA	NA	NA			e e								NA
18 19	935	Jan	18	0.0	NA	NA	NA											
19 19	935	Jan	19	0.0) NA	NA	NA											
20 19	935	Jan	20	0.0) NA	NA	NA			20000								
21 19	935	Jan	21	0.0) NA	NA	NA											
22 19	935	Jan	22	0.0) NA	NA	NA											
23 19	935	Jan	23	0.0) NA	NA	NA											
24 19	935	Jan	24	0.0) NA	NA	NA		~									
< € dod	oma		inr.		NIA NIA		. <		>									
		Show	ing 1000 o	f 288	55 rows Sh	owing 7 of	7 columns											
lodoma																		

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	a Data Summar	у	
# Code generated by the	dialog, One Variable Summarise			
year Min. :1935 1st Qu.:1954 Median :1974 Mean :1974 3rd Qu.:1994 Max. :2013	month Length:28855 Class :character Mode :character	day Min. : 1.0 1st Qu.: 8.0 Median :16.0 Mean :15.7 3rd Qu.:23.0 Max. :31.0	rain Min. : 0.00 lst Qu.: 0.00 Median : 0.00 Mean : 1.57 3rd Qu.: 0.00 Max. :119.80 NA's :91	
tmax Min. :15 1st Qu.:27 Median :29 Mean :29 3rd Qu.:30 Max. :36 NA's :8631	tmin Min. : 8 Min 1st Qu.:15 1st Median :17 Med 3rd Qu.:18 3rd Max. :26 Max NA's :8703 NA	<pre>sunh 1. : 0 2 Qu.: 8 dian :10 an : 9 d Qu.:11 4. :14 's :18451</pre>		

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)

1	Year	Month (c) Day Rain Rename Column	Filter		
2 3 4	1935 1935 1935	Duplicate Column Reorder Column(s) Delete Column	Data Frame: dodoma	~	C *
5 6 7 8 9	1935 1935 1935 1935 1935	Convert to Factor Convert to Ordered Factor Convert to Character Convert to Logical	Filters no_filter	Add	Filter: Define New Filter
10 11	1935 1935	Convert to Numeric			Filter From Factors
12 13 14	1935 1935 1935	Freeze to Here Unfreeze		Data Options	Edit Filter
15 16 17	1935 1935 1935	Sort Filter Remove Current Filter	Apply Options Apply As Filter 		As Subset
1 18	1025		Selected Filter Preview: (Comment: code ger Ok Reset) nerated by the dialog t Close	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					
Define New Filter							Filter	x
Data Frame: dodoma Variables year month day date month_abbr doy_366 V	Filter By: year Add Condition	Numeri 7 4 1	 195 8 5 2 0 	9 6 3 ()	<pre>> / / * - +</pre>	· ^ Clear	Data Frame: dodoma	
Variable Condition	All Combined with & Edit Condition Remove Condition Clear Conditions						Apply Options Apply As Filter Apply As Subset Selected Filter Preview: ((year > 1957))	
Filter Preview:	Return	Comment: code generated by the dialog Filter						

- > 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.

-			0 -					
				Dat	a 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
8422	1050	1 mm	22	05.4	21.0	10.0	ALC: NO	TOUE

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

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			
Prepare Describe Mod	el Structured Climatic Procure	Column Statistics	x		
Check Data	, 📴 · 📈 · 🔳 🕑 🕻	Data Frame:	Variable(s) to Summarise: dodoma		
Calculator Column: Calculate Column: Factor Column: Text Column: Date Column: Define	date (D) month_abbr doy_366 1935-01-01 Jan 1 1935-01-02 Jan 2 1935-01-03 Jan 3 1935-01-04 Jan 4 1935-01-05 Jan 5	Variables year month day date month_abbr doy_366	tmax tmin		
Data Reshape	Column Summaries	Options	dodoma		
Keys and Links Data Object R Objects	Stack Unstack	Original Level Print Results to Output Drop Unused Levels			
1 11 1 12	Merge	Omit Missing Values Missing Options	Summaries Prop. and Percentages		
1 13 1 14	Append Data Frames Subset	Comment: code generated by the dialog Colu	umn Statistics		
1 15 1 16	Random Subset Transpose				

- 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.

				Data View							
nmaries		2	د	year (f)	mean_tmax	count_non_	mean_tmin	count_non_			
mmaries Mana Tura V	Antablas Dasition Madel	Circuiden	1	1958	29.0	365	16.1	365			
Wore Iwo-v	anables Position Wodel	2	1959	28.7	365	16.3	365				
Common			3	1960	29.0	365	15.9	365			
N Non Missing	N Total	N Missing	4	1961	29.3	365	17.1	365			
		IN MISSING	5	1962	29.0	365	16.1	365			
Mode	n distinct		6	1963	28.5	363	16.0	331			
			7	1964	28.9	360	15.7	359			
			8	1965	28.8	363	16.0	354			
All but (unordered) Factor	9	1966	29.1	365	16.6	364					
Minimum	10	1967	28.5	365	16.7	365					
	Maximum		11	1968	27.9	366	15.6	366			
Range			12	1969	29.7	365	17.0	365			
			13	1970	28.6	365	16.5	365			
			14	1971	28.5	365	16.3	365			
Numeric			15	1972	28.8	366	16.6	366			
Sum	Maan	Median	16	1973	29.5	362	16.6	334			
		Modian	17	1974	28.8	304	16.2	304			
Sd	Var		18	1975	29.1	365	16.8	365			
			19	1976	29.2	366	16.9	366			
			20	1977	28.7	364	17.1	364			
Quartiles			21	1978	28.5	365	16.8	322			
Lower Quartile	Upper Quartile		22	1979	28.4	365	16.5	364			
			23	1980	28.9	366	17.0	366			
			24	1981	29.1	365	16.7	365			
			25	1982	29.0	365	16.8	365			

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 plo	ot menu	And the dialog
Describe Model Structur One Variable > Two Variables >	ed Climatic Procurement Option	Line Plot × Data Frame:
Three Variables	Data view	dodoma_by_year V Single Variable
Specific General Multivariate	Frequency Tables Summary Tables Multiple Response	Variables mean_tmin
Use Graph	Scatter Plot	count_non_missing_tmax
Combine Graphs	Line Plot	mean_tmin
Themes View Graph	Histogram Boxplot	count_non_missing_tmin Data Options X Variable:
0 NA 0 NA 0 NA 0 NA 0 NA 0 NA 0 NA	Dot Plot Rug Plot Bar Chart Cumulative Distribution Parallel Coordinate Plot Mosaic Plot	Line Options ycar Plot Options Factor (Optional): Group:
		Comment: code generated by the dialog Line Plot

The resulting graph is shown in Fig. 26.



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: 5	Saving	the D	ata set			
R -Instat 0.5.5 File Edit Prepare Describe Moo	el Climatic	Procure	ment Optio	Save Data As						
New Data Frame Ctrl+N Open From File Ctrl+O Open From Library		⊻ 📕 Data View	/ /	6 D. T	ſ	0.41	(1) (2)			
Open From ODK Open From CSPRO Import From Databases Import and Tidy NetCDE File	365	_ mean_Tr 16.1	min count_nor 365	Save Data To:		C:/Users	s/User/Documen	ts/R-Instat/dod	oma tutorial.RDS	Browse
	365	16.3	365		Click Ok to confirm the asve					
	365	15.9	365		CICK	Click OK to contain the save				
Convert	365	16.1	365	Comment:	Code generated by the dialog, Save Data As					
Convert	363	16.0	331							
Save Ar	360	15.7	359	-	-					
Export +	Save Output Window As			Ok	Res	et	Close	Help	To Script	
Print Ctrl+P	Save Log As									
Print Preview	Save Script Window As									
Close Data File	365	17.0	365							

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
- Our <u>issues page</u> on our <u>GitHub</u> 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: <u>https://github.com/africanmathsinitiative/R-Instat/issues</u>. 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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Wikipedia contributors (2019). R (programming language), *Wikipedia, The Free Encyclopedia*. https://en.wikipedia.org/w/index.php?title=R (programming language)&oldid=887219468