Obtaining, Wranging and Analysing Messy Data

Unit 3

Nepal Data Literacy Program, 2019

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Module 1

Scraping Data from the Web

What is Scraping?

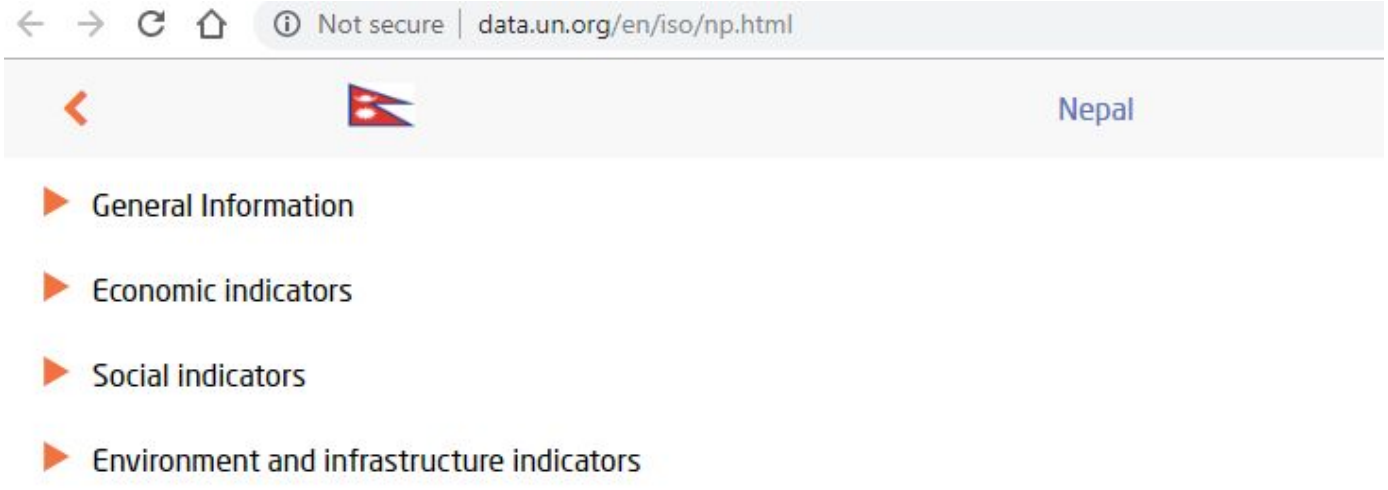
- Many times data is not easily accessible – although it does exist and is available on the web, but most times in formats that are not easily usable for analysis
- **Scraping** describes the method to extract data hidden in documents – such as Web Pages and PDFs and make it useable for further processing
- It is among the most useful skills if you set out to investigate data – and most of the time it’s not especially challenging. For the most simple ways of scraping you don’t even need to know how to write code

What we will cover

Scraping data from the Web

- Scraping using Scraper extension on Chrome
- Scraping using Table2Clipboard2 on Firefox
- Two lab exercises

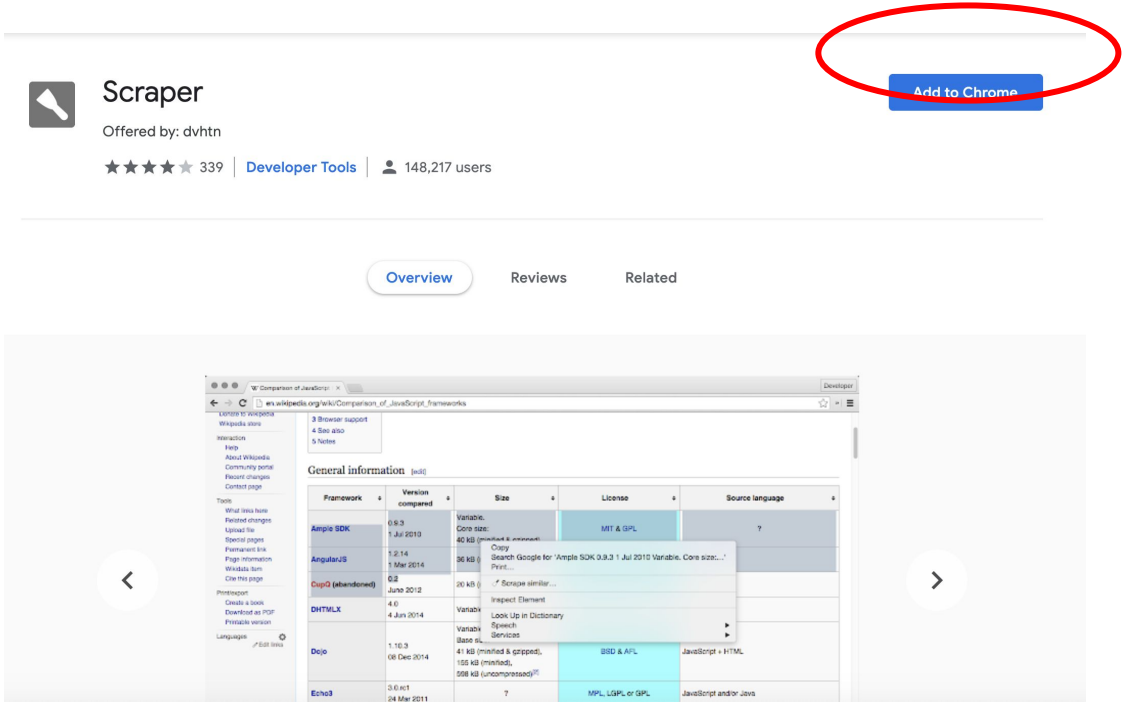
Getting Started



Source: http://data.un.org/en/iso/np.html

Download Scraper on

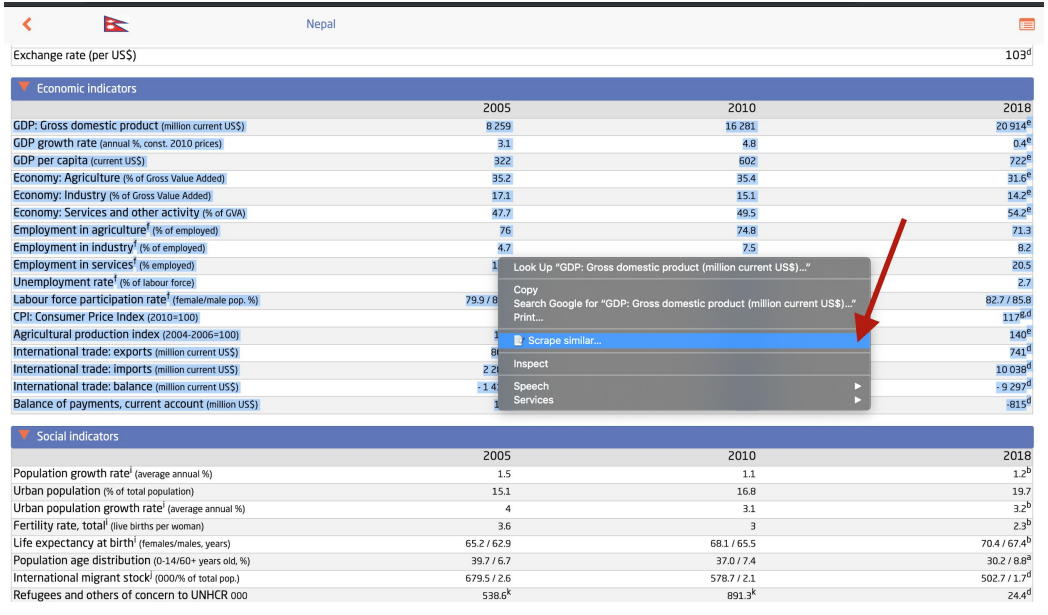
1. Open Chrome browser
2. To download **Scraper Extension**, go to Chrome webstore
3. Search for ‘Scraper’
4. In the ‘Scraper’ window that opens, click the blue **+ ADD TO CHROME** button



https://chrome.google.com/webstore/detail/scraper/mbigbapnjcgaffohmbkdlecaccepngjd?hl=en-GB&utm_source=chrome-ntp-launcher

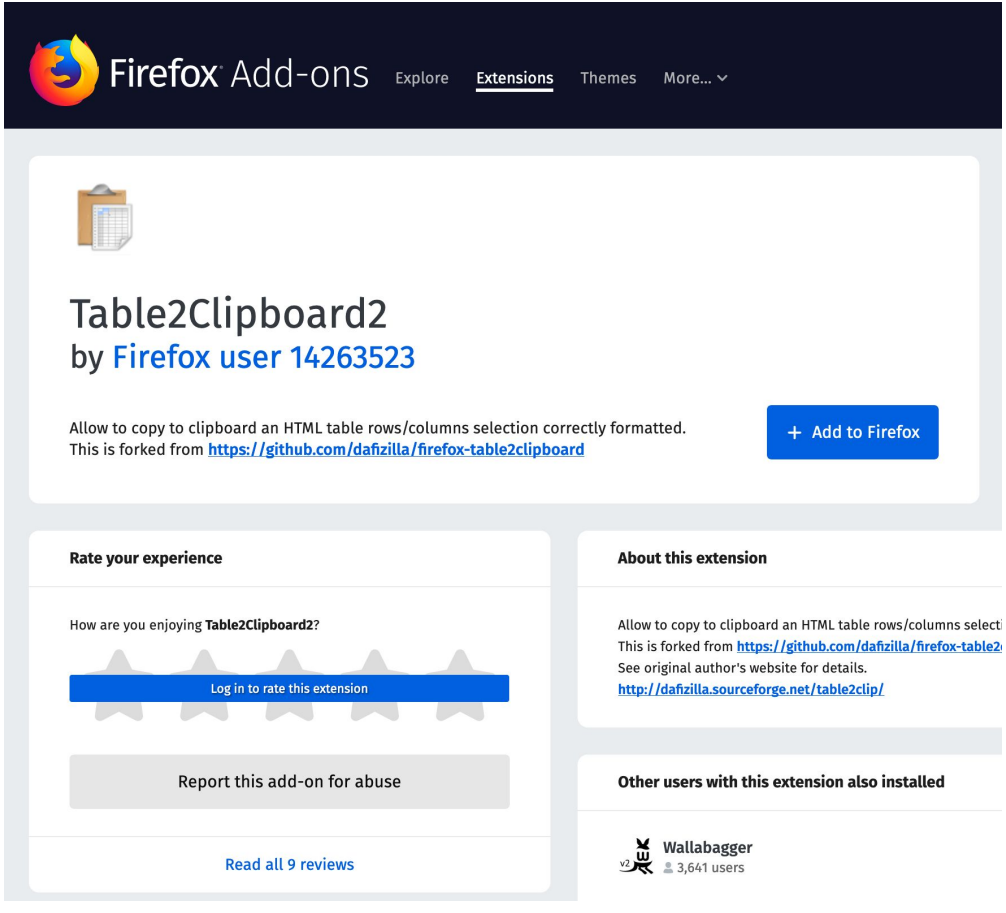
Using Chrome Extension:

1. Open a new Chrome window and go to: http://data.un.org/en/iso/np.html
2. Open table with the heading "Economic Indicators"
3. Highlight the rows of the "Economic Indicators" table, then right-click and select Scrape similar.
4. In the Scraper window that opens, click the **Export to Google Docs**



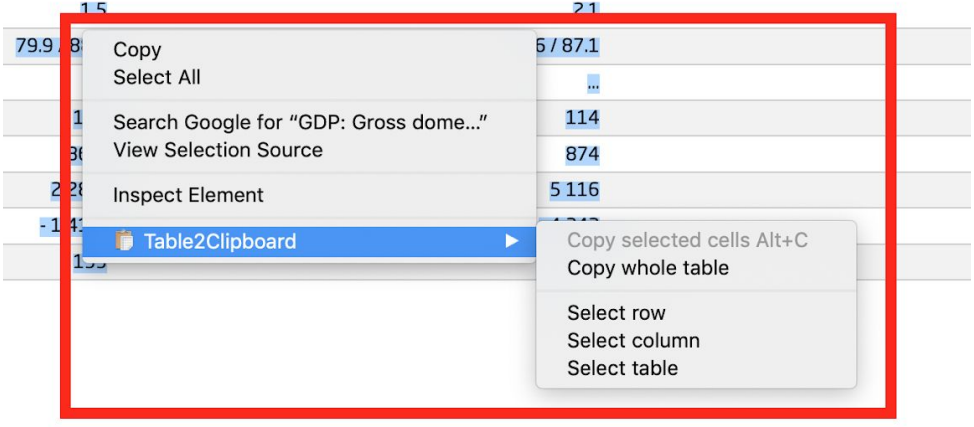
Download Table2clipboard

1. Open Firefox browser
2. Download an add-on called Table2Clipboard2
3. On this webpage, click Continue to Download
4. On the next page that opens, click + Add to Firefox



Using Firefox Extension

1. Open a new Firefox window and go to: http://data.un.org/en/iso/np.html
2. Open table with the heading “Economic Indicators”
3. Highlight table, then right-click and select Table2Clipboard > Copy whole table
4. Open a new spreadsheet. In the cell, paste the copied table (Ctrl+V)



Lab 1: Scrape Data Using Browser Extension

WIKIPEDIA
The Free Encyclopedia

Main page
Contents
Featured content
Current events
Random article
Donate to Wikipedia
Wikipedia store

Interaction
Help
About Wikipedia
Community portal
Recent changes
Contact page

Tools
What links here
Related changes
Upload file
Special pages
Permanent link
Page information
Wikidata item
Cite this page

Print/export
Create a book
Download as PDF
Printable version

Article | Talk | Read | Edit | View history

List of Nepal government organizations

From Wikipedia, the free encyclopedia

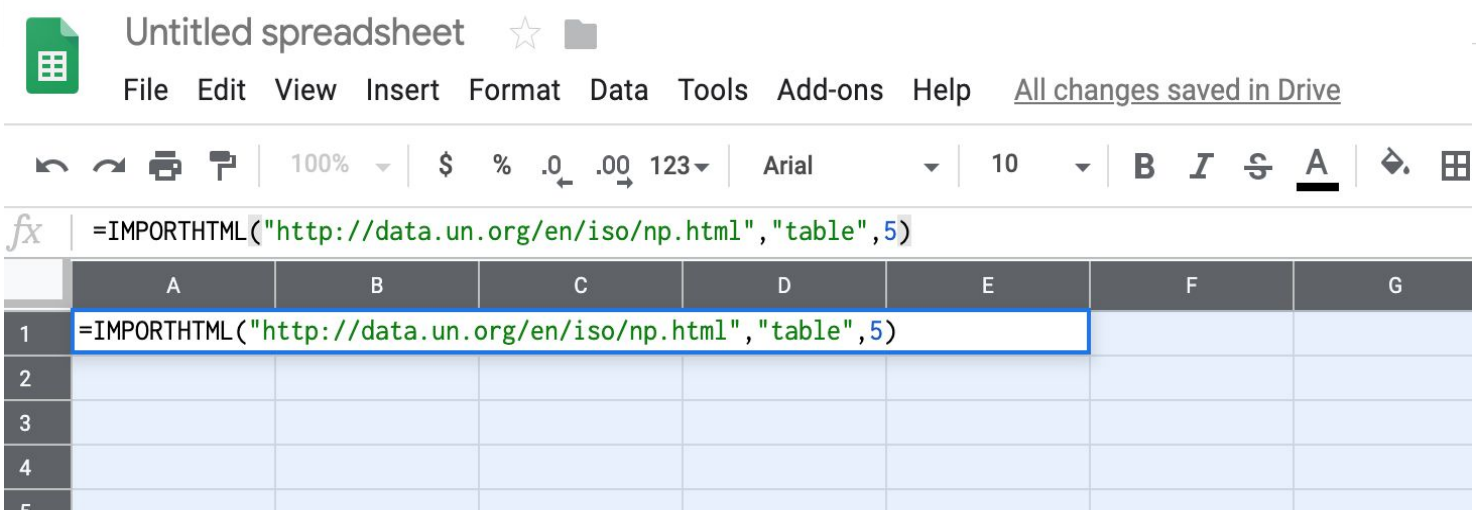
The following is a list of Government Organizations of Nepal:[1]

Government Office	Website URL
Government of Nepal	www.nepal.gov.np
Office of the President & V. President	www.presidentofnepal.gov.np
Commission for the Investigation of Abuse of Authority (CIAA)	www.ciaa.gov.np
Ministry of Federal Affairs and General Administration (MoFAGA)	www.mofaga.gov.np
Election Commission	www.election.gov.np
Office of the Auditor General	www.oagnep.gov.np
Public Service Commission	www.psc.gov.np
Supreme Court	www.supremecourt.gov.np
National Human Rights Commission	www.nhrcnepal.org
Office of the Prime Minister and Council of Ministers	www.opmcm.gov.np
Ministry of Finance	www.mof.gov.np
Financial Comptroller General Office	www.fcgo.gov.np
Department of Custom	www.[http://customs.gov.np customs.gov.np]customs.gov.np
Inland Revenue Department	www.ird.gov.np
Department of Revenue Investigation	www.dri.gov.np
Department of Revenue	ratc.gov.np
Ministry of Industry	www.moi.gov.np
Department of Industry	www.doind.gov.np
Department of Mines and Geology	www.dmgnepal.gov.np

Data source: https://en.wikipedia.org/wiki/List_of_Nepal_government_organizations

Lab 2 :Scraping Data Using Google Spreadsheets

Environment and infrastructure indicators			
	2005	2010	2018
Individuals using the Internet (per 100 inhabitants)	0.8	7.9[q]	19.7[f,e]
Research & Development expenditure (% of GDP)	...	0.3[r,s]	...
Threatened species (number)	77[m]	93	104[d]
Forested area (% of land area)	25.4	25.4	25.4[b]
CO_2 emission estimates (million tons/tons per capita)	3.1 / 0.1	5.1 / 0.2	8.0 / 0.3[n]
Energy production, primary (Petajoules)	349	384	430[b]
Energy supply per capita (Gigajoules)	14	17	18[b]
Tourist/visitor arrivals at national borders[t] 000	375	603	753[e]
Important sites for terrestrial biodiversity protected (%)	50.3	54.6	54.6
Pop. using improved drinking water (urban/rural, %)	93.1 / 80.2	92.0 / 86.0	90.9 / 91.8[b]
Pop. using improved sanitation facilities (urban/rural, %)	47.8 / 26.7	51.9 / 35.1	56.0 / 43.5[b]
			4.94[e]



Data Source: http://data.un.org/en/iso/np.html

Module 2

Scraping Data from PDFs and Images

What we will cover

Extracting data hidden in PDF documents to make it useable for further processing

- **Scraping data from PDF using online tools**
  - Sodapdf - Splitting PDFs
  - Zamzar
  - Cometdocs
- **Scraping data from PDf using offline tools**
  - Using Tabula
- **Scraping data from images**
  - Using Google doc OCR

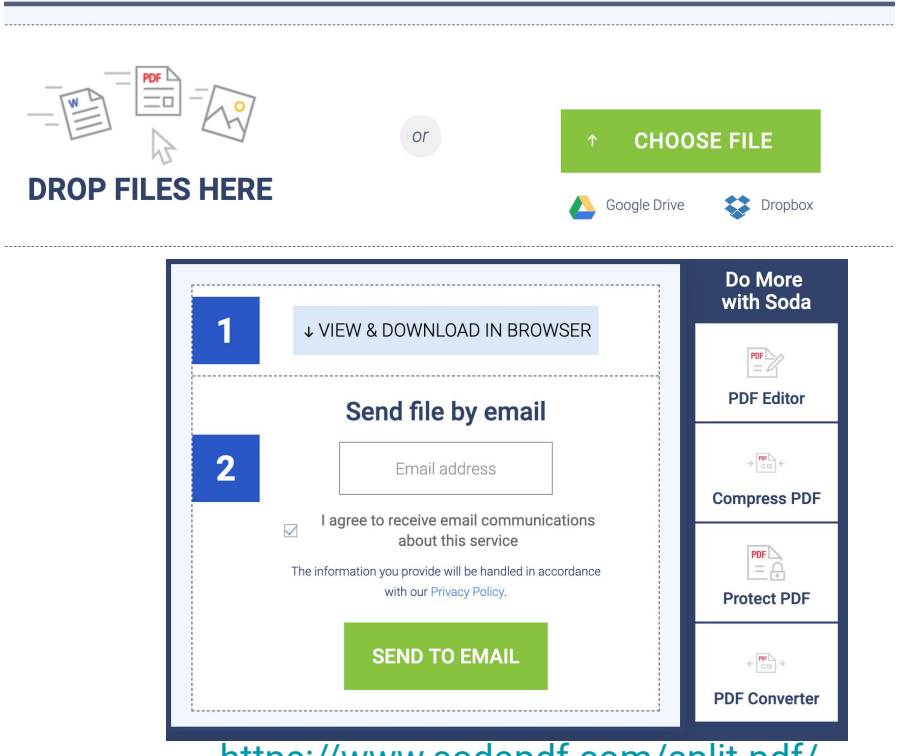
Getting Started

Before we move forward, here is a reminder about data formats:

- **Machine readable, structured:** generated by a computer, and are organized in rows and columns. e.g - CSV (comma-separated values), TSV (tab-separated values), Excel (.xls)
- **Unstructured:** These are sometimes generated by a computer, but are not organized as data table by computer. For example - PDF, Word, and bitmap images (GIF, JPEG, PNG, BMP)
- **Portable Document Format (PDF):** These files may include charts that contain data, but the data is saved in an unified document with text.
- **Excel file (XLS):** files save data as tables readable by Microsoft Excel
- **Comma separated values (CSV):** Plain text files with each data point separated by a comma

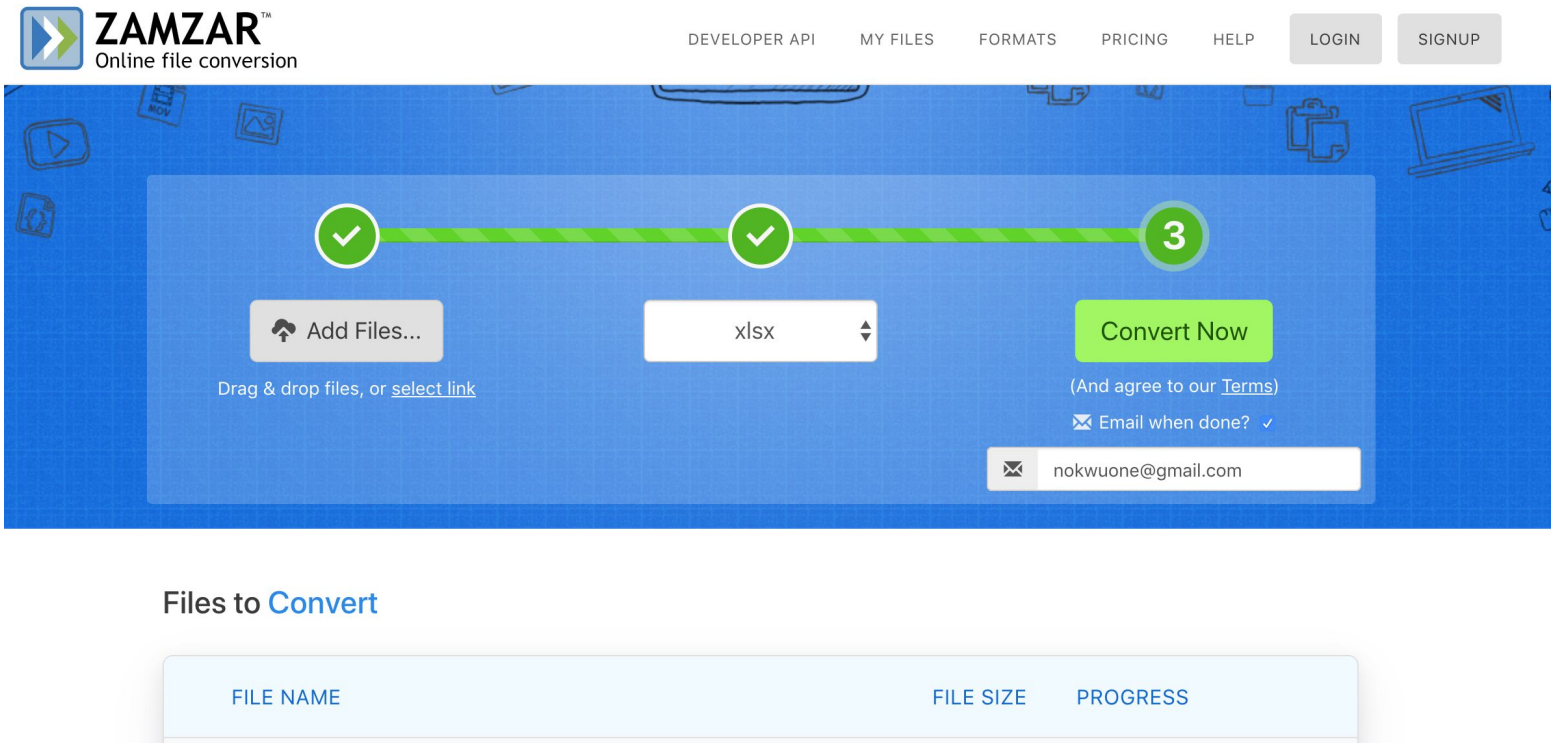
Extracting the Required Page in PDFs

1. Go to https://www.sodapdf.com/split-pdf/
2. Upload the Nepal-Labour-Force-Survey-2017_18-Report.pdf
3. Select page 29, click Split! “Then view and download”
4. Save file with title Table 2.1



https://www.sodapdf.com/split-pdf/

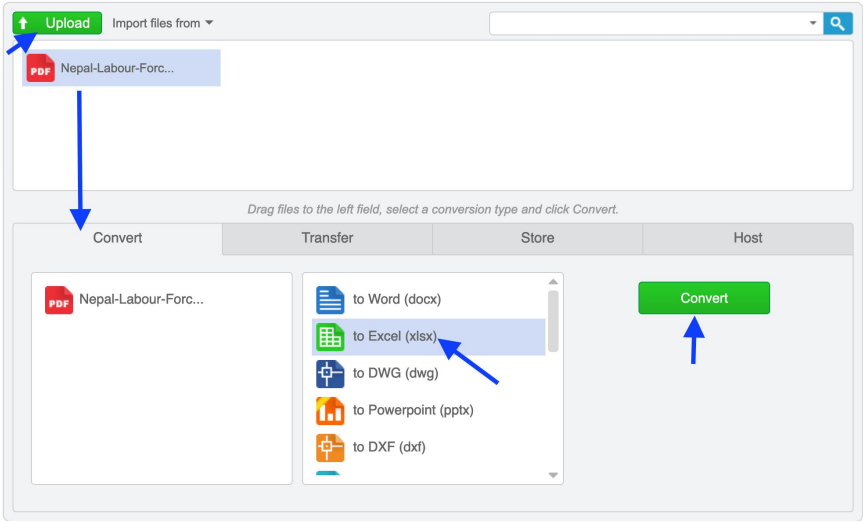
Convert PDF to CSV online Using Zamzar

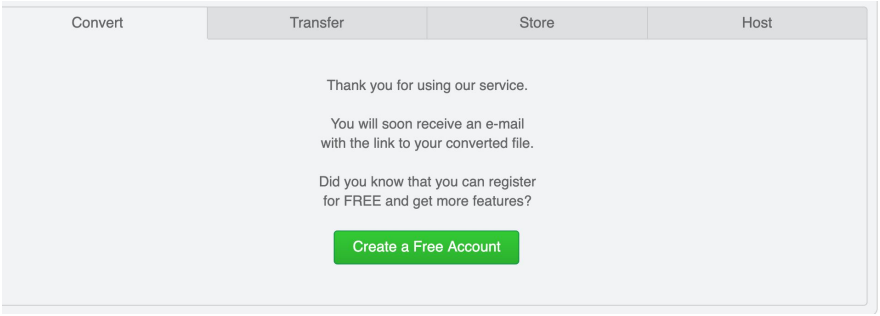


http://www.zamzar.com/

Converting PDF to Excel Online with Cometdocs:

1. Open www.cometdocs.com Click the Go to the Web App button.
2. **Sign in** and Upload the Nepal-Labour-Force-Survey-2017_18-Report.pdf report.
3. Click convert, drag-and-drop the file to the empty box.
4. Click conversion type Word/Excel and click convert
5. File downloads into your computer. Open file with google sheets to view.





www.cometdocs.com

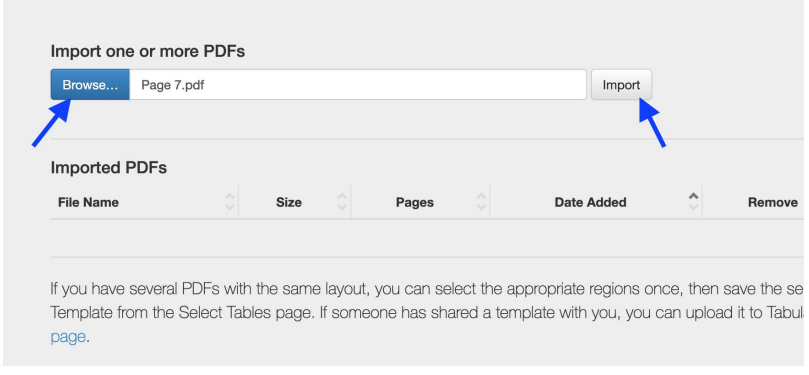
Offline data Scraping using Tabula:

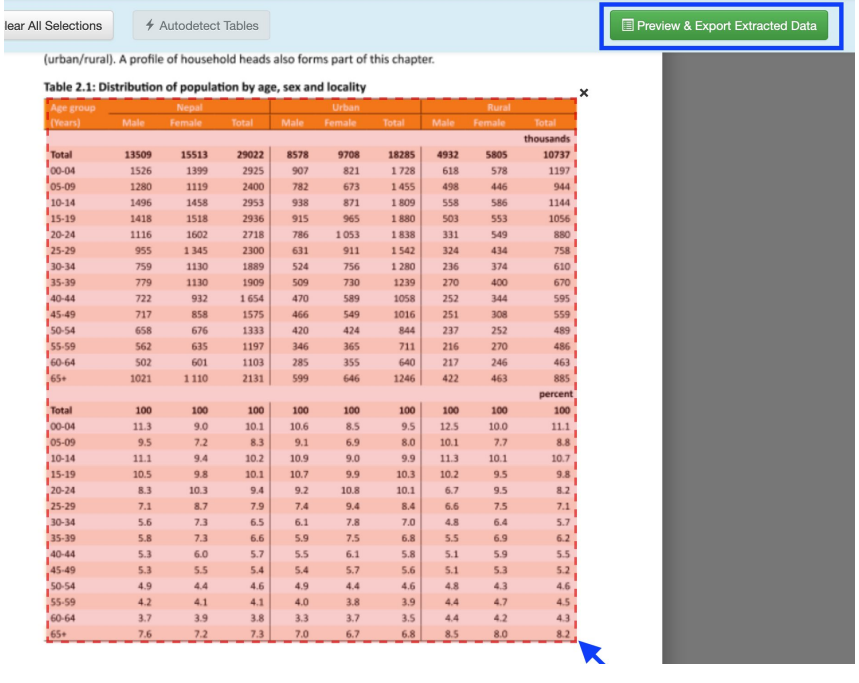
1. Install Java
2. Open Tabula website and install for your operating system.
3. Extract the downloaded zip file
4. Go into the "tabula" folder. Run the tabula.exe
5. A web browser will open – this is Tabula or go to: http://127.0.0.1:8080/

https://tabula.technology/

Using Tabula:

1. Import the file you split earlier called **page 29.pdf**
2. Select the data table
3. Click preview and export
4. A new window opens
5. On the window select lattice and click export format in CSV

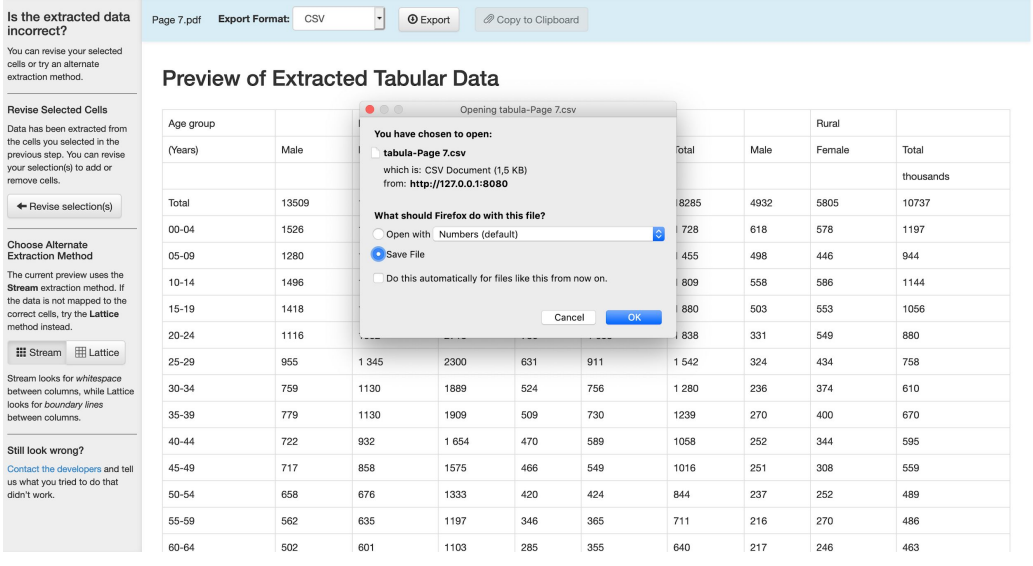




Age group (Years)	Nepal			Urban			Rural		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
									thousands
Total	13509	15513	29022	8578	9708	18285	4932	5805	10737
00-04	1526	1399	2925	907	821	1 728	618	578	1197
05-09	1280	1119	2400	782	673	1 455	498	446	944
10-14	1496	1458	2953	938	871	1 809	558	586	1144
15-19	1418	1518	2936	915	965	1 880	503	553	1056
20-24	1116	1602	2718	786	1 053	1 838	331	549	880
25-29	955	1 345	2300	631	911	1 542	324	434	758
30-34	759	1130	1889	524	756	1 280	236	374	610
35-39	779	1130	1909	509	730	1239	270	400	670
40-44	722	932	1 654	470	589	1058	252	344	595
45-49	717	858	1575	466	549	1016	251	308	559
50-54	658	676	1333	420	424	844	237	252	489
55-59	562	635	1197	346	365	711	216	270	486
60-64	502	601	1103	285	355	640	217	246	463
65+	1021	1 110	2131	599	646	1246	422	463	885
									percent
Total	100	100	100	100	100	100	100	100	100
00-04	11.3	9.0	10.1	10.6	8.5	9.5	12.5	10.0	11.1
05-09	9.5	7.2	8.3	9.1	6.9	8.0	10.1	7.7	8.8
10-14	11.1	9.4	10.2	10.9	9.0	9.9	11.3	10.1	10.7
15-19	10.5	9.8	10.1	10.7	9.9	10.3	10.2	9.5	9.8
20-24	8.3	10.3	9.4	9.2	10.8	10.1	6.7	9.5	8.2
25-29	7.1	8.7	7.9	7.4	9.4	8.4	6.6	7.5	7.1
30-34	5.6	7.3	6.5	6.1	7.8	7.0	4.8	6.4	5.7
35-39	5.8	7.3	6.6	5.9	7.5	6.8	5.5	6.9	6.2
40-44	5.3	6.0	5.7	5.5	6.1	5.8	5.1	5.9	5.5
45-49	5.3	5.5	5.4	5.4	5.7	5.6	5.1	5.3	5.2
50-54	4.9	4.4	4.6	4.9	4.4	4.6	4.8	4.3	4.6
55-59	4.2	4.1	4.1	4.0	3.8	3.9	4.4	4.7	4.5
60-64	3.7	3.9	3.8	3.3	3.7	3.5	4.4	4.2	4.3
65+	7.6	7.2	7.3	7.0	6.7	6.8	8.5	8.0	8.2

Using Tabula:

1. Your table to be exported looks like this.
2. File downloads to your computer as tabula-page 7.csv.
3. Open google sheet and import file and keep the default settings
4. Now you have successfully scraped this data.
5. Save your google sheet as the title of table 2.1 - **Distribution of population by age, sex and locality**. for future reference in our exercises

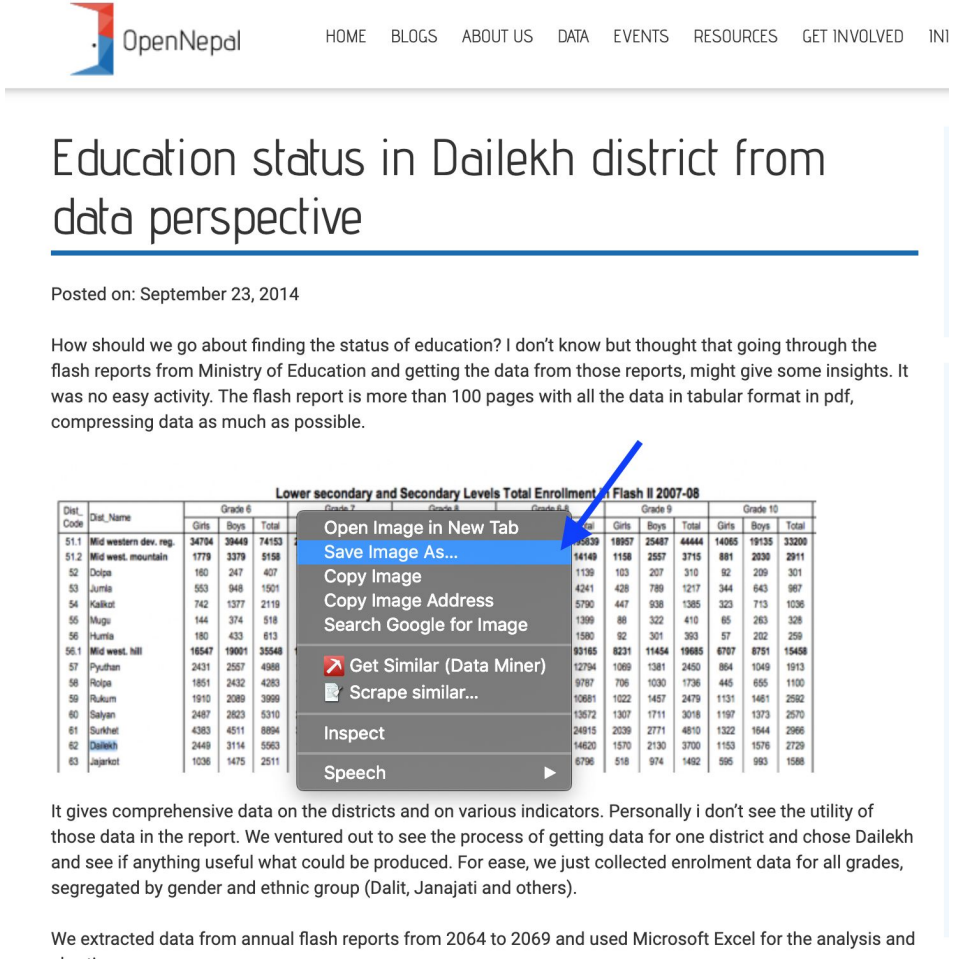


Age group								Rural	
(Years)	Male					Total	Male	Female	Total
									thousands
Total	13509					8285	4932	5805	10737
00-04	1526					728	618	578	1197
05-09	1280					455	498	446	944
10-14	1496					809	558	586	1144
15-19	1418					880	503	553	1056
20-24	1116					838	331	549	880
25-29	955	1 345	2300	631	911	1 542	324	434	758
30-34	759	1130	1889	524	756	1 280	236	374	610
35-39	779	1130	1909	509	730	1239	270	400	670
40-44	722	932	1 654	470	589	1058	252	344	595
45-49	717	858	1575	466	549	1016	251	308	559
50-54	658	676	1333	420	424	844	237	252	489
55-59	562	635	1197	346	365	711	216	270	486
60-64	502	601	1103	285	355	640	217	246	463

https://tabula.technology/

Extracting Data from Images Using Google Docs

1. Open link of this blog
2. Right-click on Table and "**Save image as"**
3. Open Google Drive, click new from the drop-down menu, select **File upload**
4. Browse and select **saved file**
5. Search for the uploaded file and right-click on **the file** icon, select **Open with** > **Google Docs**
6. Google Doc with the table opens in new window. You will see that the data is distorted.



Exercise

1. Go to this report - Innovative Strategies in Higher Education for Accelerated Human Resource Development in South Asia: Nepal
2. Extract Table 9 into google sheets
    1. Find the page where this table is located
    2. Split the PDF to extract the page
    3. Upload into Zamzar or Tabula and extract

Module 3

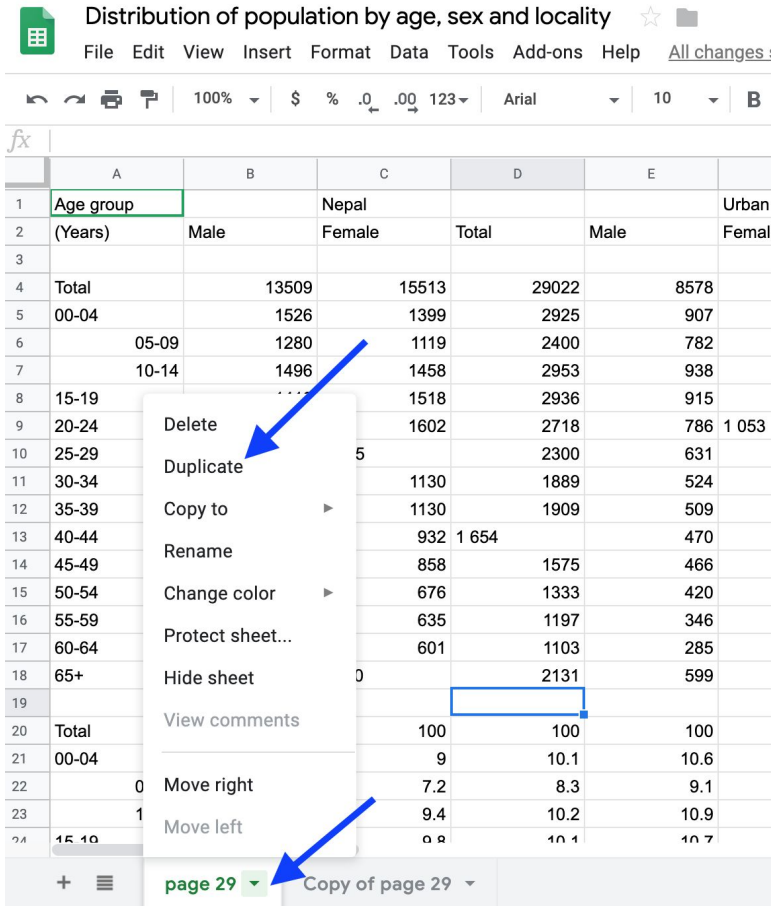
Cleaning Data

Steps to take when cleaning data

1. Understand the data in front of you and take notes of what you noticed and would like to fix.
2. Standardize the data formats this includes looking for errors like inconsistent age, dates, units formats etc.
3. Fix structural and formatting errors.
4. Remove irrelevant columns or rows and rearrange columns where necessary.
5. Pay attention to missing values by removing the variables that are missing or impute the missing values from based on the other variables
6. Check maths and fix any errors

Cleaning Your Scraped Data Table 2.1

1. Open **the Distribution of Population by Age, sex and Locality**
2. First make a copy of your data by right-click **Sheet 1** tab, and select **duplicate**
3. Right-click the sheet tab to **Rename**. Rename sheet 1 to **original** and the new tab to **working copy** rename sheets to avoid confusion.

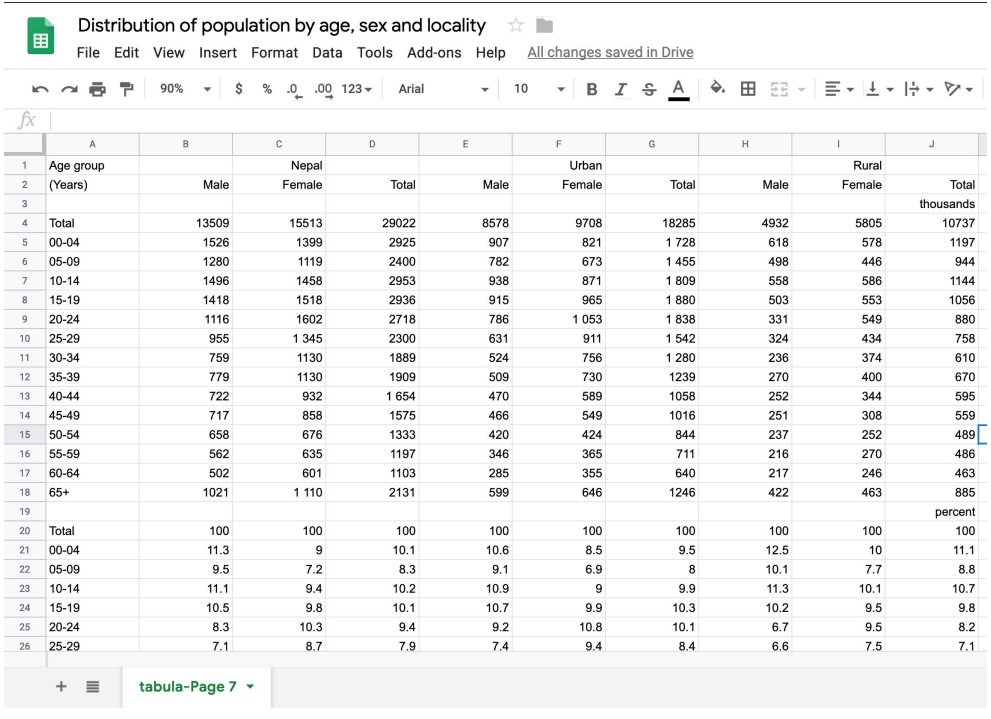


Understand the data in front of you.

Does the distribution of population data have information that may be useful for analysis to you or does it have any interesting observation?

1. Are there columns or values you don't understand?
2. Any missing or obviously wrong values?
3. Do we need to clean it?

Make note of your findings before you clean.



Distribution of population by age, sex and locality

File Edit View Insert Format Data Tools Add-ons Help All changes saved in Drive

	A	B	C	D	E	F	G	H	I	J
1	Age group		Nepal			Urban			Rural	
2	(Years)	Male	Female	Total	Male	Female	Total	Male	Female	Total
3										thousands
4	Total	13509	15513	29022	8578	9708	18285	4932	5805	10737
5	00-04	1526	1399	2925	907	821	1 728	618	578	1197
6	05-09	1280	1119	2400	782	673	1 455	498	446	944
7	10-14	1496	1458	2953	938	871	1 809	558	586	1144
8	15-19	1418	1518	2936	915	965	1 880	503	553	1056
9	20-24	1116	1602	2718	786	1 053	1 838	331	549	880
10	25-29	955	1 345	2300	631	911	1 542	324	434	758
11	30-34	759	1130	1889	524	756	1 280	236	374	610
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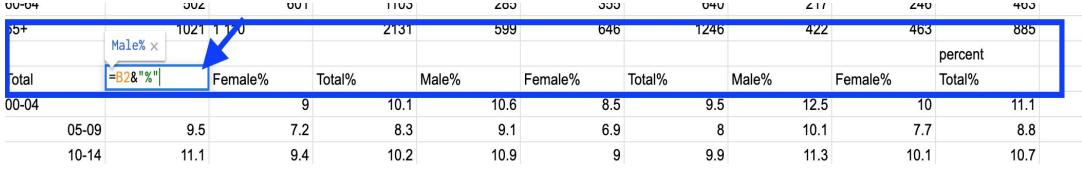
15	50-54	658	676	1333	420	424	844	237	252	489
16	55-59	562	635	1197	346	365	711	216	270	486
17	60-64	502	601	1103	285	355	640	217	246	463
18	65+	1021	1 110	2131	599	646	1246	422	463	885
19										percent
20	Total	100	100	100	100	100	100	100	100	100
21	00-04	11.3	9	10.1	10.6	8.5	9.5	12.5	10	11.1
22	05-09	9.5	7.2	8.3	9.1	6.9	8	10.1	7.7	8.8
23	10-14	11.1	9.4	10.2	10.9	9	9.9	11.3	10.1	10.7
24	15-19	10.5	9.8	10.1	10.7	9.9	10.3	10.2	9.5	9.8
25	20-24	8.3	10.3	9.4	9.2	10.8	10.1	6.7	9.5	8.2
26	25-29	7.1	8.7	7.9	7.4	9.4	8.4	6.6	7.5	7.1

tabula-Page 7

[Data source: Nepal Central Bureau of Statistics]

Standardize the data formats

1. **Let's standardize the percentage values** to have its own header and copy into a new page.
2. In cell B20, input the formula =B2&" %" then enter and drag the result up to J20
3. Other things to note include: Representing your dates, age, unit, addresses in the right uniform format.



12/06/2019
2019/06/12
19/12/06
12th June, 2019

Not Standardized

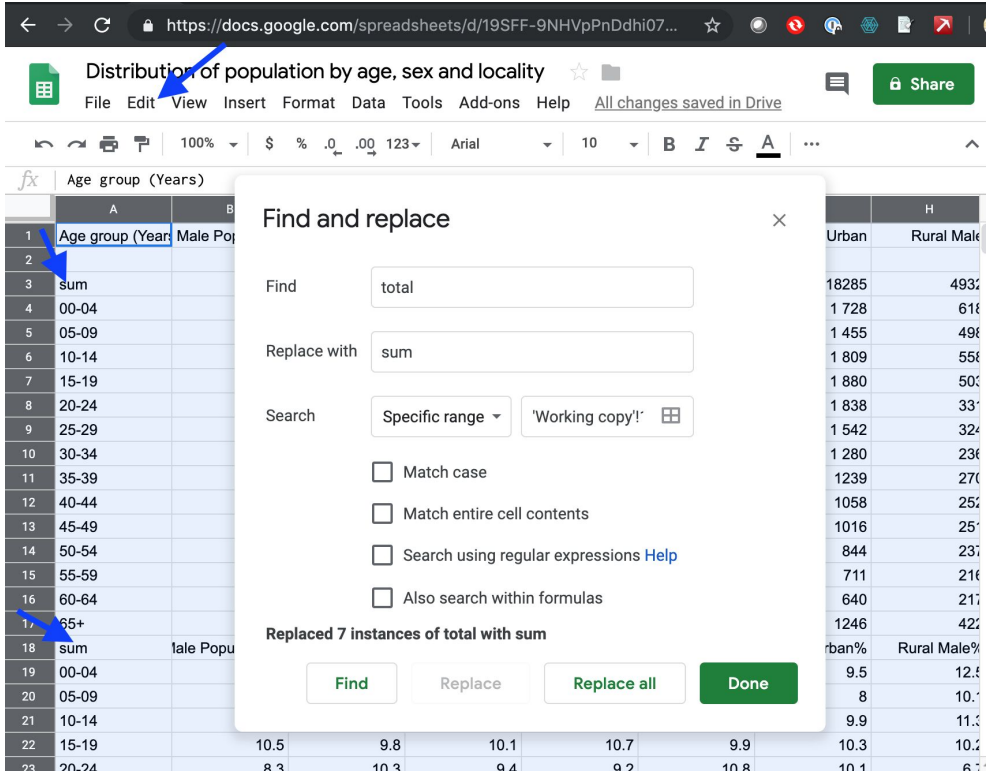
12/06/2019
12/06/2019
12/06/2019
12/06/2019

Standardized

Data source: Nepal Central Bureau of Statistics

Fix structural and formatting errors

1. Remove **merged cells**
2. Look for improper labelling and combine labels where necessary
3. **Combine row 1-2 to get uniformed column header. - Pg 36**
4. Now Let's fix the row labels.
5. **Remove duplicates** and rename where necessary.
6. **Find and Replace.**



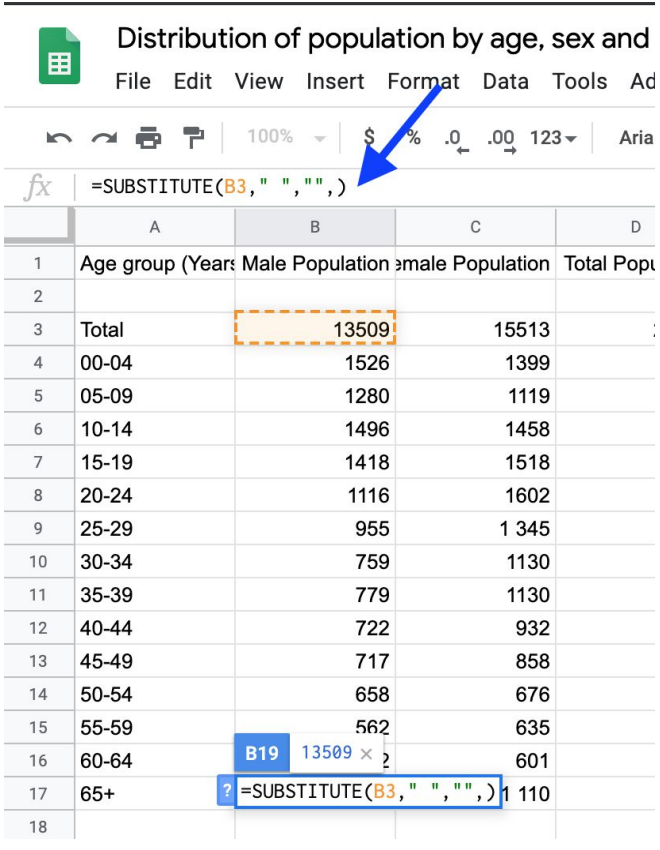
[Data source: Nepal Central Bureau of Statistics]

Fix structural and formatting errors Cont'd

1. **Check for spelling errors** and inconsistent capitalization
2. Remove white spaces and empty cells using **substitute function =SUBSTITUTE(B3," ","",)**

Others

3. Trim function: Trim function lets you remove trailing spaces =TRIM()
4. Split function lets you separate values by an identifier =SPLIT()
5. Concatenate function lets you join values =CONCAT()

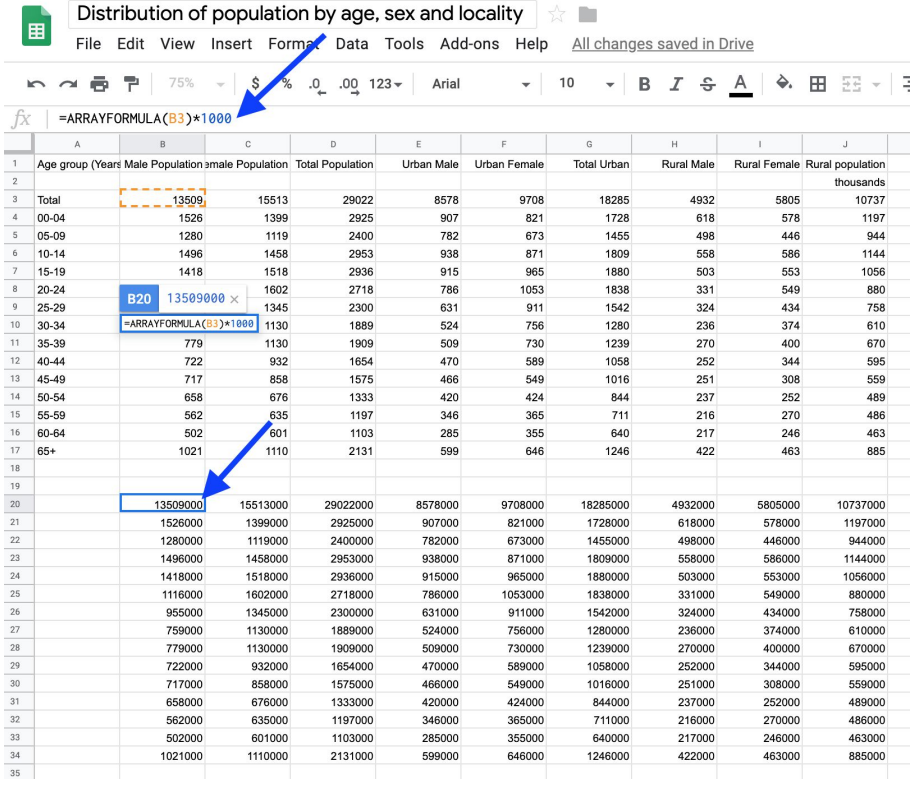


	A	B	C	D
1	Age group (Years	Male Population	emale Population	Total Popu
2				
3	Total	13509	15513	
4	00-04	1526	1399	
5	05-09	1280	1119	
6	10-14	1496	1458	
7	15-19	1418	1518	
8	20-24	1116	1602	
9	25-29	955	1 345	
10	30-34	759	1130	
11	35-39	779	1130	
12	40-44	722	932	
13	45-49	717	858	
14	50-54	658	676	
15	55-59	562	635	
16	60-64	2	601	
17	65+		1 110	
18				

[Data source: Nepal Central Bureau of Statistics]

Remove irrelevant columns/rows and rearrange columns where necessary

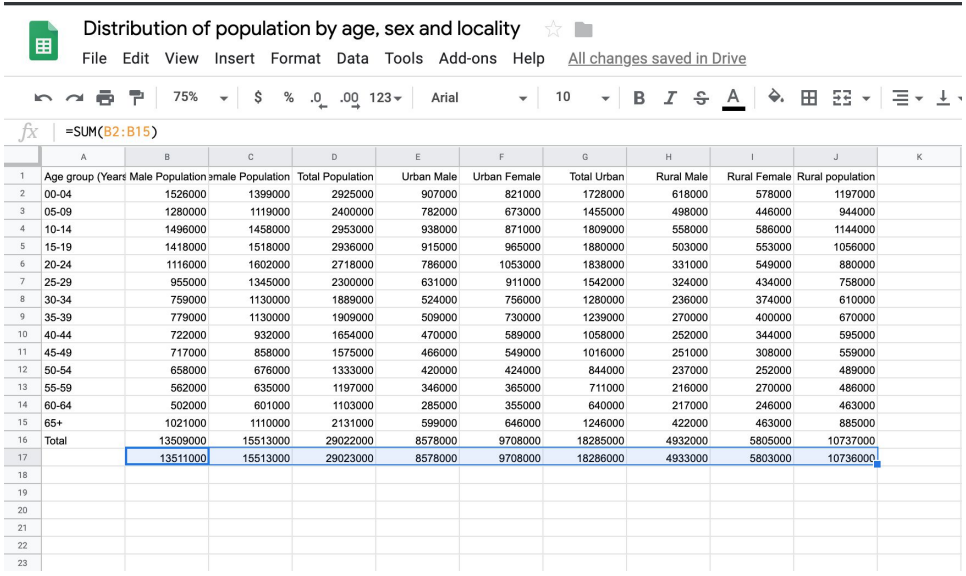
1. Here, you can move the percentage computed data to the next page
2. Cell J2 is showing that the values are to their thousands. Apply this to the whole data
3. In B18 input the arrayformula **=ARRAYFORMULA(B3)*1000** This means to multiply the cell by 1000. Drag through the range to apply to the other cells.
4. **Paste special** to clear formula and delete the thousand row
5. You can further arrange the data by moving the **total row** beneath



	A	B	C	D	E	F	G	H	I	J
1	Age group (Years	Male Population	emale Population	Total Population	Urban Male	Urban Female	Total Urban	Rural Male	Rural Female	Rural population
2										thousands
3	Total	13509	15513	29022	8578	9708	18285	4932	5805	10737
4	00-04	1526	1399	2925	907	821	1728	618	578	1197
5	05-09	1280	1119	2400	782	673	1455	498	446	944
6	10-14	1496	1458	2953	938	871	1809	558	586	1144
7	15-19	1418	1518	2936	915	965	1880	503	553	1056
8	20-24		1602	2718	786	1053	1838	331	549	880
9	25-29		1345	2300	631	911	1542	324	434	758
10	30-34		1130	1889	524	756	1280	236	374	610
11	35-39	779	1130	1909	509	730	1239	270	400	670
12	40-44	722	932	1654	470	589	1058	252	344	595
13	45-49	717	858	1575	466	549	1016	251	308	559
14	50-54	658	676	1333	420	424	844	237	252	489
15	55-59	562	635	1197	346	365	711	216	270	486
16	60-64	502	601	1103	285	355	640	217	246	463
17	65+	1021	1110	2131	599	646	1246	422	463	885
18										
19										
20		13509000	15513000	29022000	8578000	9708000	18285000	4932000	5805000	10737000
21		1526000	1399000	2925000	907000	821000	1728000	618000	578000	1197000
22		1280000	1119000	2400000	782000	673000	1455000	498000	446000	944000
23		1496000	1458000	2953000	938000	871000	1809000	558000	586000	1144000
24		1418000	1518000	2936000	915000	965000	1880000	503000	553000	1056000
25		1116000	1602000	2718000	786000	1053000	1838000	331000	549000	880000
26		955000	1345000	2300000	631000	911000	1542000	324000	434000	758000
27		759000	1130000	1889000	524000	756000	1280000	236000	374000	610000
28		779000	1130000	1909000	509000	730000	1239000	270000	400000	670000
29		722000	932000	1654000	470000	589000	1058000	252000	344000	595000
30		717000	858000	1575000	466000	549000	1016000	251000	308000	559000
31		658000	676000	1333000	420000	424000	844000	237000	252000	489000
32		562000	635000	1197000	346000	365000	711000	216000	270000	486000
33		502000	601000	1103000	285000	355000	640000	217000	246000	463000
34		1021000	1110000	2131000	599000	646000	1246000	422000	463000	885000
35										

Check Maths

1. Insert a new row just below row 16.
2. Compute the sum for column B **=sum(B1:B15)**.
3. **You will see the disparity between the values.**
4. Go ahead and do this for the other totals by dragging the tip of the cell to the left to apply the formula in other cells.
5. This goes to show the importance of cleaning your datasets and verifying your Maths



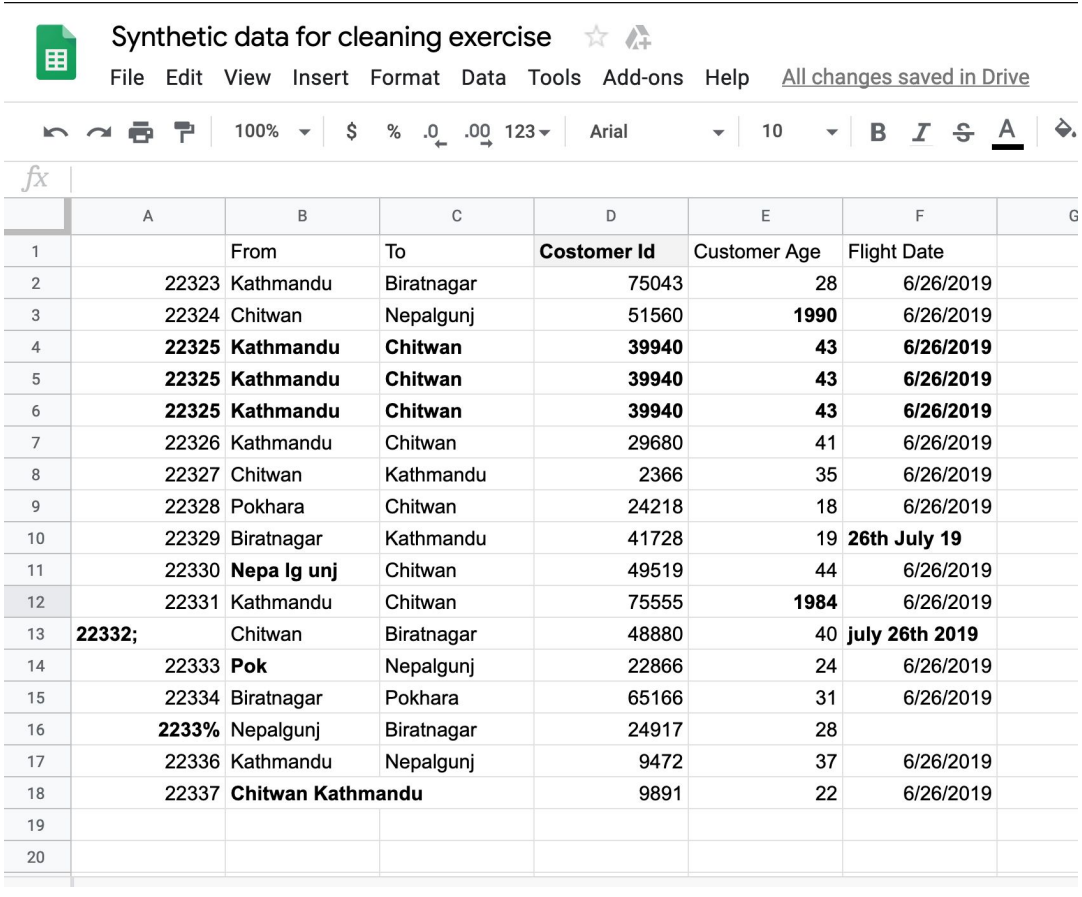
	A	B	C	D	E	F	G	H	I	J	K
1	Age group (Years	Male Population	emale Population	Total Population	Urban Male	Urban Female	Total Urban	Rural Male	Rural Female	Rural population	
2	00-04	1526000	1399000	2925000	907000	821000	1728000	618000	578000	1197000	
3	05-09	1280000	1119000	2400000	782000	673000	1455000	498000	446000	944000	
4	10-14	1496000	1458000	2953000	938000	871000	1809000	558000	586000	1144000	
5	15-19	1418000	1518000	2936000	915000	965000	1880000	503000	553000	1056000	
6	20-24	1116000	1602000	2718000	786000	1053000	1838000	331000	549000	880000	
7	25-29	955000	1345000	2300000	631000	911000	1542000	324000	434000	758000	
8	30-34	759000	1130000	1889000	524000	756000	1280000	236000	374000	610000	
9	35-39	779000	1130000	1909000	509000	730000	1239000	270000	400000	670000	
10	40-44	722000	932000	1654000	470000	589000	1058000	252000	344000	595000	
11	45-49	717000	858000	1575000	466000	549000	1016000	251000	308000	559000	
12	50-54	658000	676000	1333000	420000	424000	844000	237000	252000	489000	
13	55-59	562000	635000	1197000	346000	365000	711000	216000	270000	486000	
14	60-64	502000	601000	1103000	285000	355000	640000	217000	246000	463000	
15	65+	1021000	1110000	2131000	599000	646000	1246000	422000	463000	885000	
16	Total	13509000	15513000	29022000	8578000	9708000	18285000	4932000	5805000	10737000	
17		13511000	15513000	29023000	8578000	9708000	18286000	4933000	5803000	10736000	
18											
19											
20											
21											
22											
23											

[Data source: Nepal Central Bureau of Statistics]

Exercise

Take a look at the data on this link here and answer the following question.

- What errors or inconsistencies can you spot?
- What will you do to correct it?

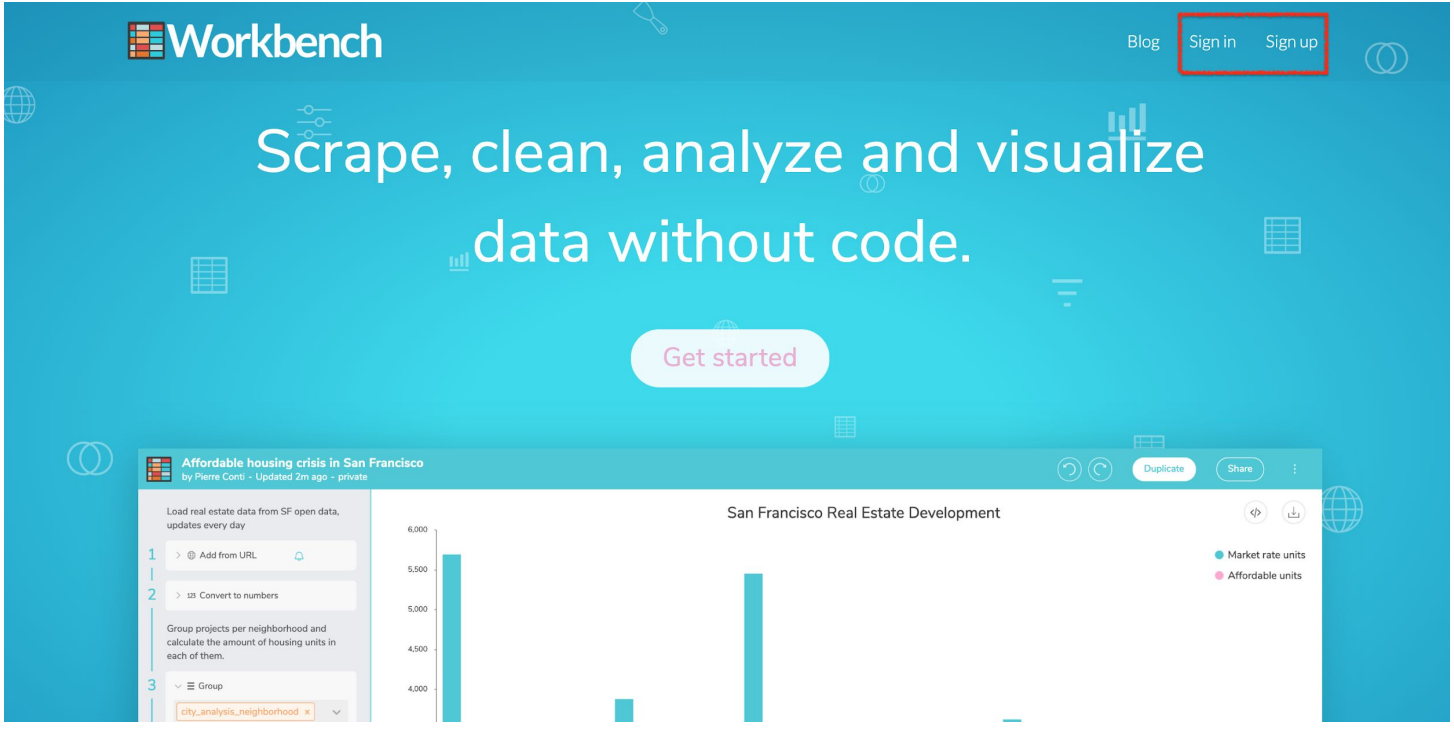


Synthetic data for cleaning exercise

File Edit View Insert Format Data Tools Add-ons Help All changes saved in Drive

	A	B	C	D	E	F	G
1		From	To	**Costomer Id**	Customer Age	Flight Date	
2	22323	Kathmandu	Biratnagar	75043	28	6/26/2019	
3	22324	Chitwan	Nepalgunj	51560	**1990**	6/26/2019	
4	**22325**	**Kathmandu**	**Chitwan**	**39940**	**43**	**6/26/2019**	
5	**22325**	**Kathmandu**	**Chitwan**	**39940**	**43**	**6/26/2019**	
6	**22325**	**Kathmandu**	**Chitwan**	**39940**	**43**	**6/26/2019**	
7	22326	Kathmandu	Chitwan	29680	41	6/26/2019	
8	22327	Chitwan	Kathmandu	2366	35	6/26/2019	
9	22328	Pokhara	Chitwan	24218	18	6/26/2019	
10	22329	Biratnagar	Kathmandu	41728	19	**26th July 19**	
11	22330	**Nepa lg unj**	Chitwan	49519	44	6/26/2019	
12	22331	Kathmandu	Chitwan	75555	**1984**	6/26/2019	
13	**22332;**	Chitwan	Biratnagar	48880	40	**july 26th 2019**	
14	22333	**Pok**	Nepalgunj	22866	24	6/26/2019	
15	22334	Biratnagar	Pokhara	65166	31	6/26/2019	
16	**2233%**	Nepalgunj	Biratnagar	24917	28		
17	22336	Kathmandu	Nepalgunj	9472	37	6/26/2019	
18	22337	**Chitwan Kathmandu**		9891	22	6/26/2019	
19							
20							

Cleaning Data with Workbench



https://workbenchdata.com/

Module 4

Strengthening your Data Reliability

Scenario

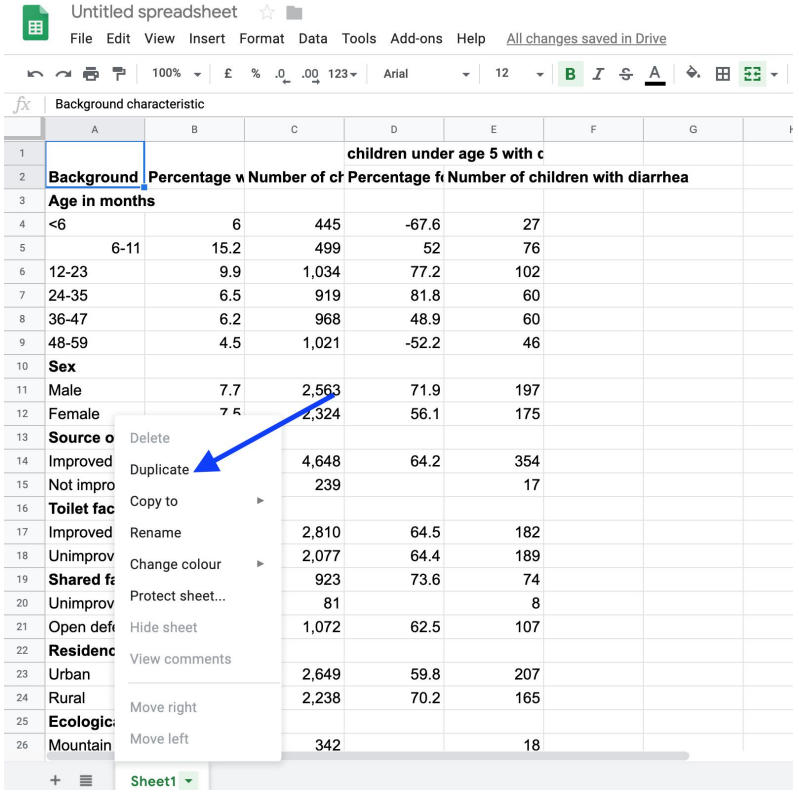
Here, you will use google sheet to investigate the prevalence and treatment of diarrhea among children in Nepal. You will Identify:

- Q1: Which age group are most affected by diarrhea in Nepal?
- Q2: Which Province in Nepal has the highest number of children living with diarrhea?
- Q3: What is the relationship between the level of Education of the mothers and the no of affect Children with this disease?
- Q4: What gender is most affected by this disease?

Nkechicoker@gmail.com

Task 1: Get Data

1. Open **Prevalence and Treatment of Diarrhea in Nepal**
2. Create a Duplicate of your original data.
3. Name your sheets.



Data source: National Demographic and Health Survey Data - 2016

Task 2: Clean data Using the Six Steps:

Hint

1. Copy and duplicate your sheet
2. Understand your data and male a note of the rows and columns that may be most helpful and are inline with the lines of enquiries
3. Standardize the data formats
4. Unmerge cells where necessary
5. Fix your header and rows, rename ensure that your naming reflects the true content of the data
6. Rearrange and remove redundant columns and rows
7. Check maths

Task 3: Analyse data to answer the following questions

- **Q1: What age group is most affected in Nepal?**

  Hint: To answer the first question, you need to filter the data to see the age group of children most affected by diarrhea. To do this: **Filter** out the data of the age group and sort the values from A-Z

- **Q2: Which Province in Nepal has the highest number of children living with diarrhea?**

  Hint: The procedure to answer the second question is similar to how you answered the first question. To do this:You need to filter the data to see the **province** and not **Age.** This shows you Province that the highest No of children with the disease at 112 Children.

Data source: National Demographic and Health Survey Data - 2016

Task 3: Analyse data to answer the following questions

Q4: What gender is most affected by this disease?

Hint: The procedure is similar to the last question – just that in this case you will filter the data and transpose it.

Sometimes it is helpful to transpose your dataset for better insight.

1. Filter out the data by gender.
2. Copy the selection of the filtered data,
3. Go to a new section of your sheet or open a new sheet, right click and paste special. on the drop down menu, click transpose
4. This will transpose the data and now you can sort from A-z.

Lab: Analyse data

- Open **Migration Data- Nepal Labour Force Survey 2017/2018**
- Open the sheets
    - Distribution of migrants (all ages) by sex and province in which they currently reside
    - Age and sex distribution of migrants by current location

Now use the skills learnt so far, to clean and answer the following question:

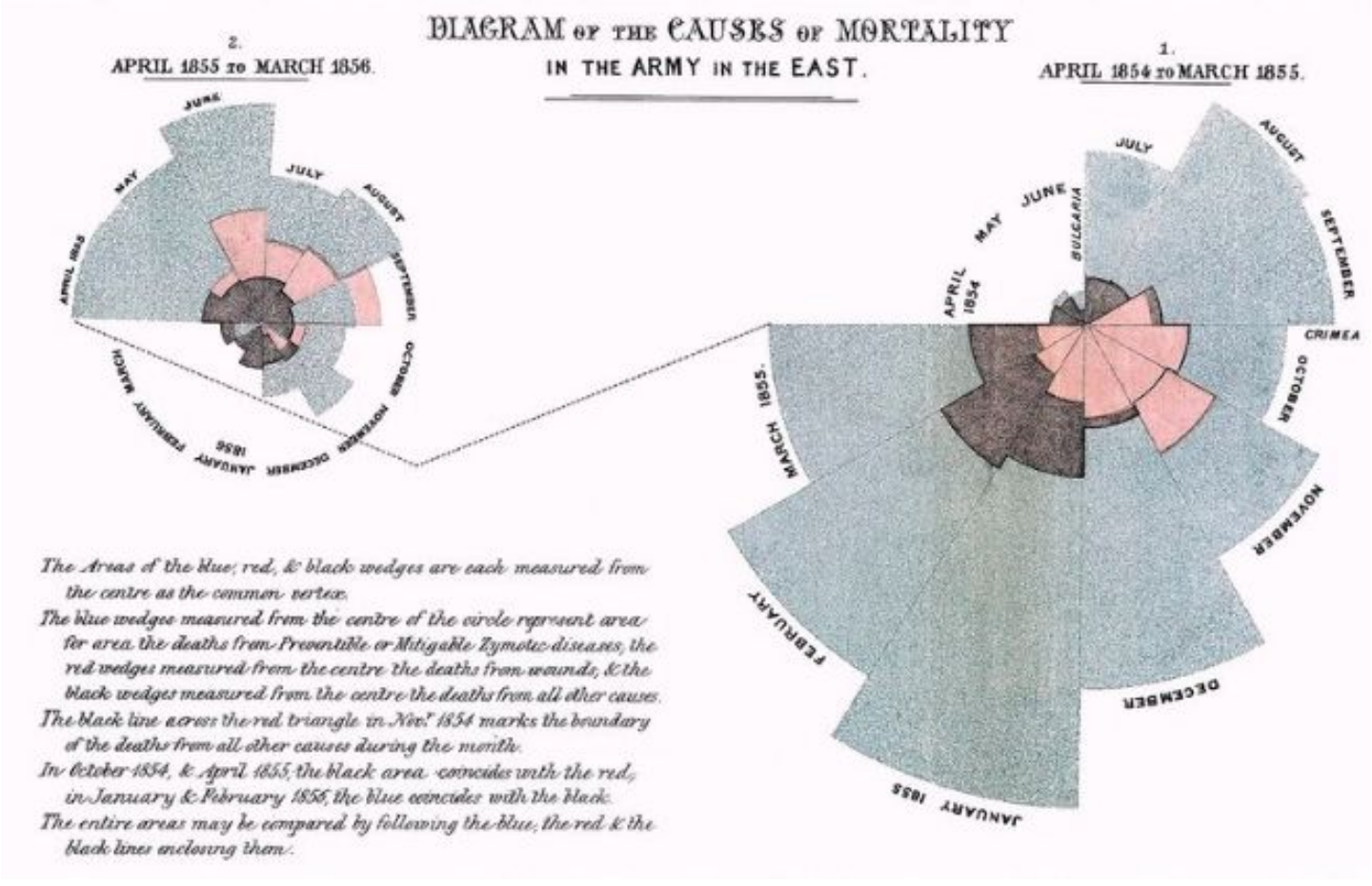
- Which of the Provinces have the highest migration and which gender migrates has the higher migration?
- What is the average number of migrants by sex?
- Which age group has the highest migration of each gender?
- Analyse the migration distribution of people from 60+ age group

Credit: http://bit.ly/2N4wniG

Module 5

Finding Stories in Facts by Visualizing Data

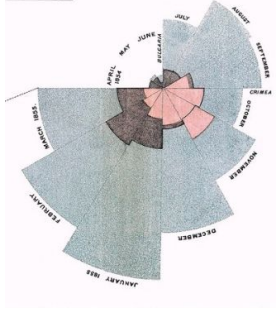
Part 1:
Introduction to Exploratory Data Analysis



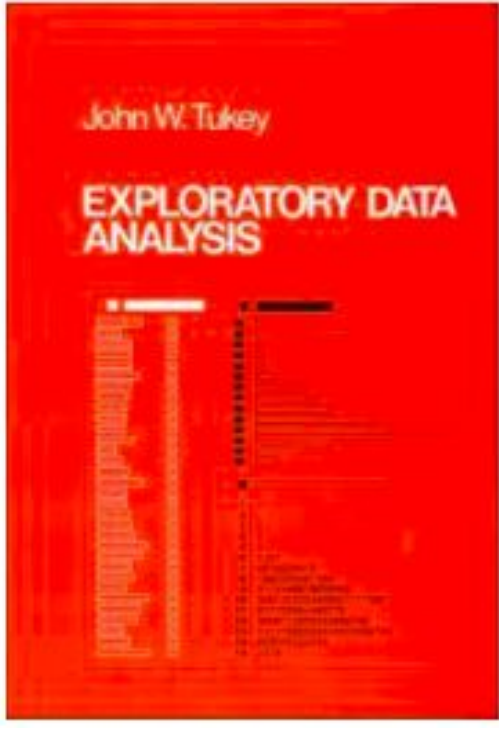
Credit: http://bit.ly/2XjeZej, http://bit.ly/2Yc0s0U

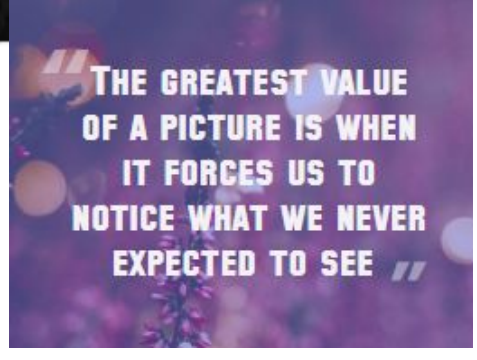
What is EDA ?

- Disease, colored blue, killed far more soldiers than either “wounds” (red) or “other” (black)
- Reduced from 60% to 42% by February 1855
- From ~160 years ago … shows the sheer impact of data, without all the technology behind it



What is EDA ?





Credit: http://bit.ly/2FoJtkR, http://bit.ly/2Y4OpTd, http://bit.ly/2WYyeFE

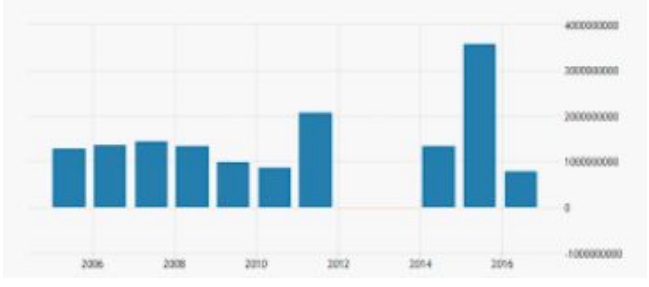
What is EDA ?

- An approach to analysing datasets to summarize their main characteristics
- A first look at data ...

Credit: http://bit.ly/2L6ENDN, http://bit.ly/2RwbOuf

What is EDA ?

- A first look at data:
  - Omissions
  - Context
  - Patterns
  - Anomalies



Credit: http://bit.ly/2FuZ6aj

What is EDA ?

- A first look at data:
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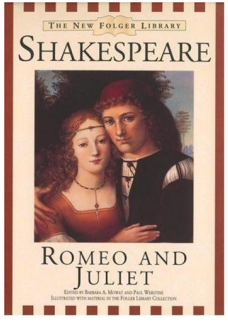
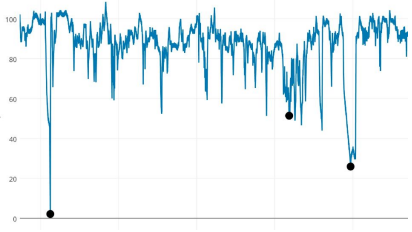
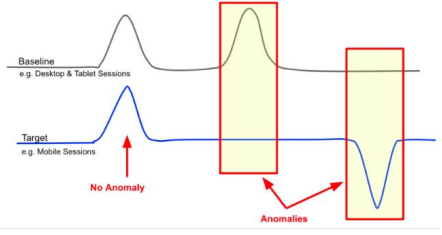


Credit: http://bit.ly/2IEULUa, http://bit.ly/2X2DTiF

What is EDA ?

- A first look at data:
  - Omissions
  - Context
  - Patterns
  - Anomalies

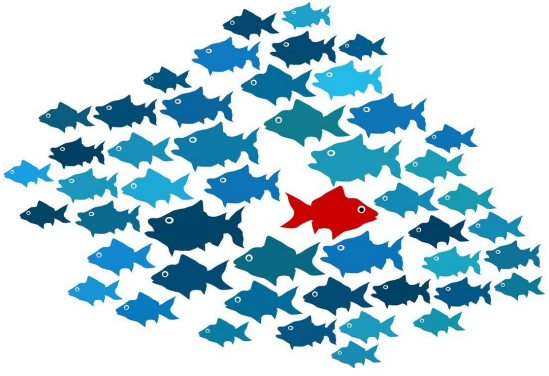


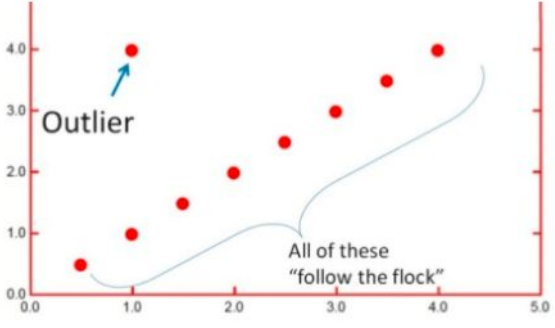


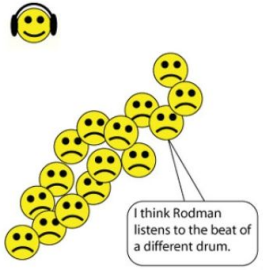
Credit: http://bit.ly/2FnbJ7u, https://bwnews.pr/2x7jiKL

Anomalies / Outliers

- An observation that diverges or differs significantly from an overall pattern in the data set

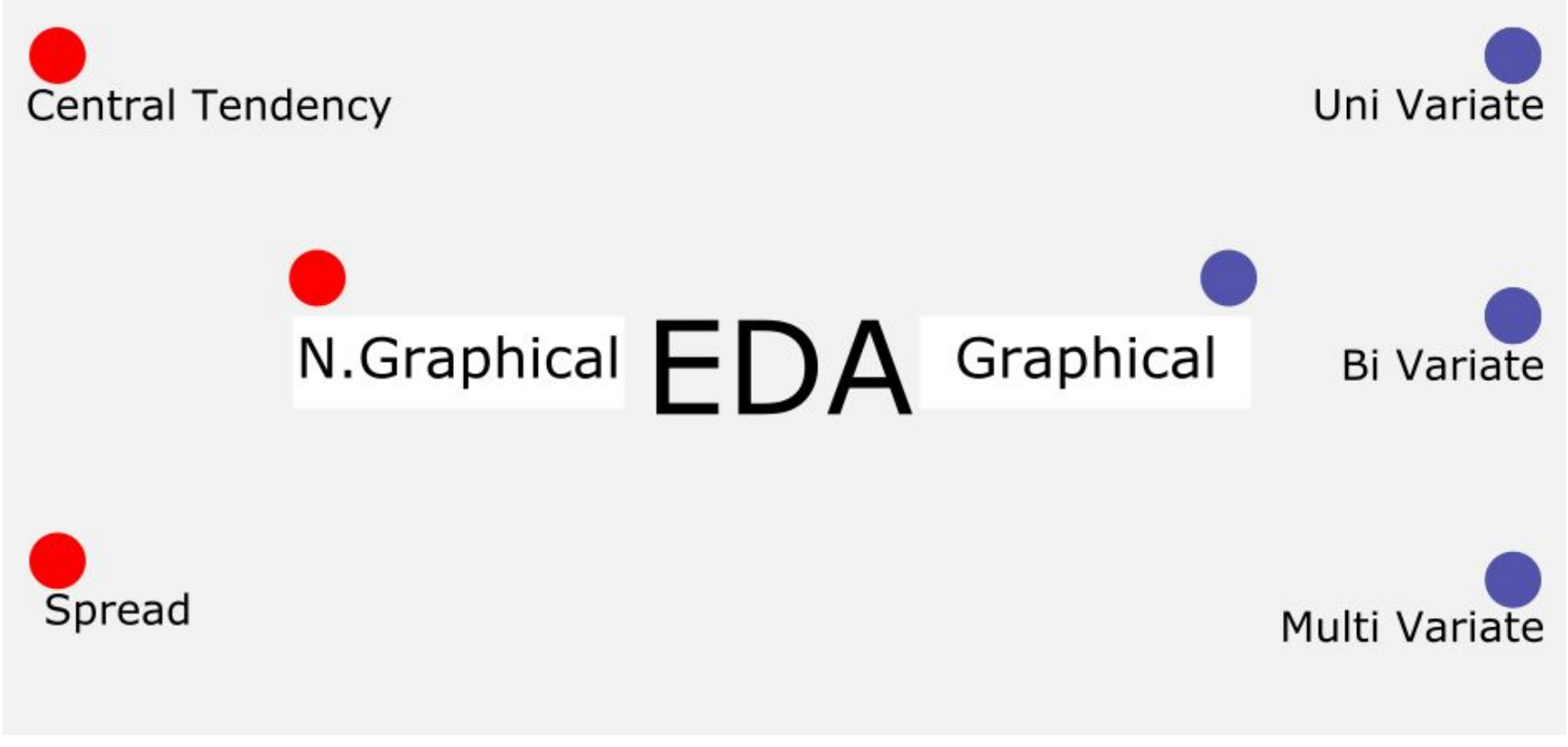






Credit: http://bit.ly/2IZSf9R, http://bit.ly/2N25s7d

Understanding EDA



Credit: http://bit.ly/2IZSf9R, http://bit.ly/2N25s7d

Understanding EDA

Credit: http://bit.ly/2IZSf9R, http://bit.ly/2N25s7d

Understanding EDA

QUALITATIVE

are

COUNTED *

QUANTITATIVE

are

MEASURED*

* MOSTLY

Credit: http://tiny.cc/rc0w7y

Understanding EDA

Determine Quantitative or Qualitative ?

- Heights of Players in Nepal Football Team
- Hours of sleep on the previous weekend for WB Team
- Ravi's favorite ice cream
- Number of apps used by students of Kathmandu University
- Football Clubs represented by Lionel Messi

Understanding EDA

Determine Quantitative or Qualitative ?

- Heights of Players in Nepal Football Team #
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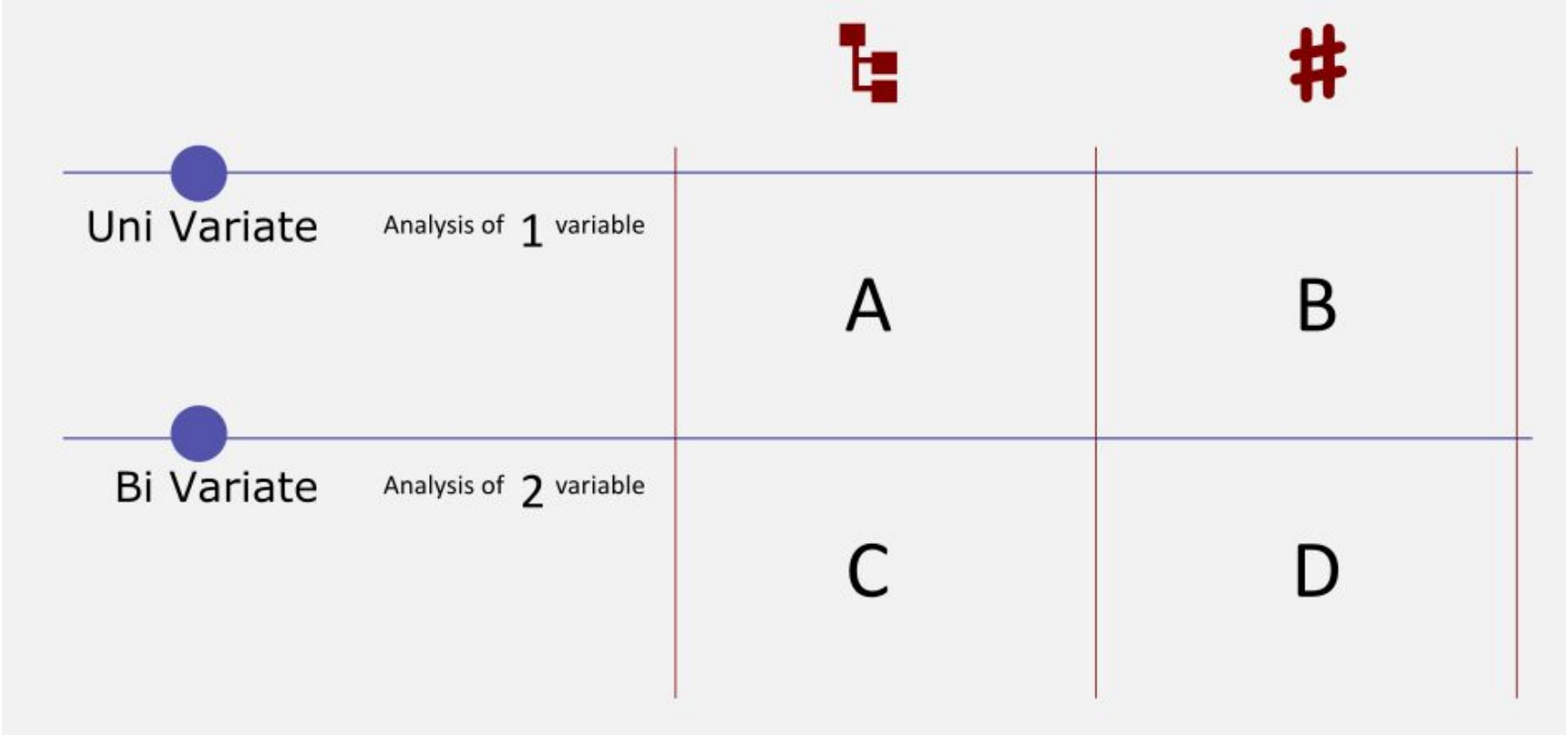
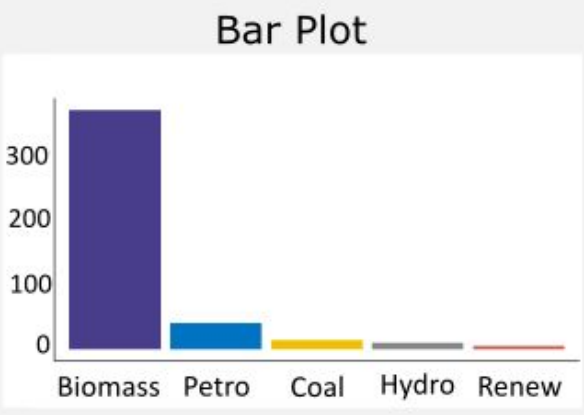
- Football Clubs represented by Lionel Messi

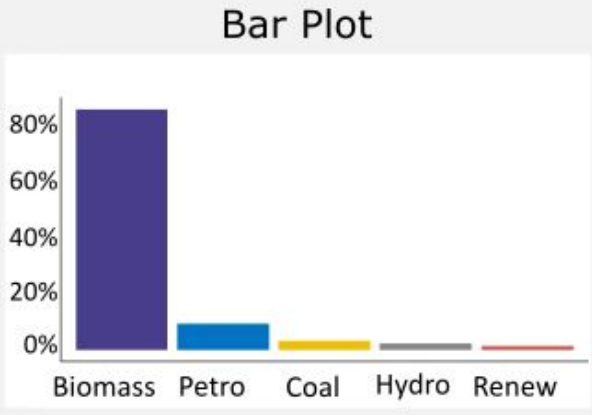
Understanding EDA

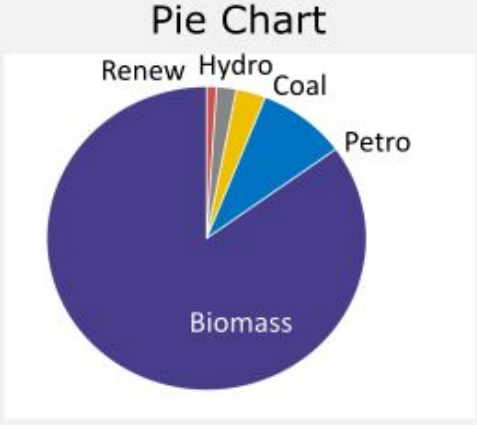


Credit: http://bit.ly/2IZSf9R, http://bit.ly/2N25s7d

Understanding EDA







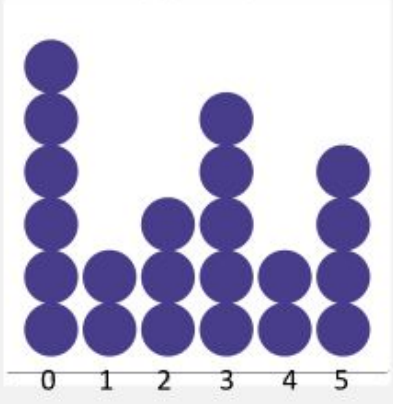
Uni Var

Qualitative

Credit: http://bit.ly/2IZSf9R, http://bit.ly/2N25s7d

Understanding EDA

Dot PLOT

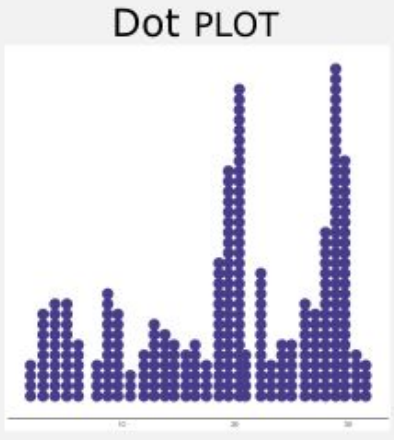


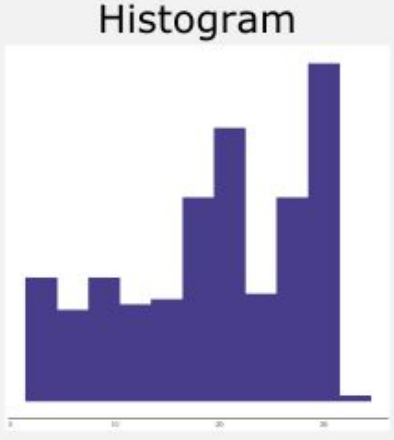
Minutes	0	1	2	3	4	5
People	6	2	3	5	2	4

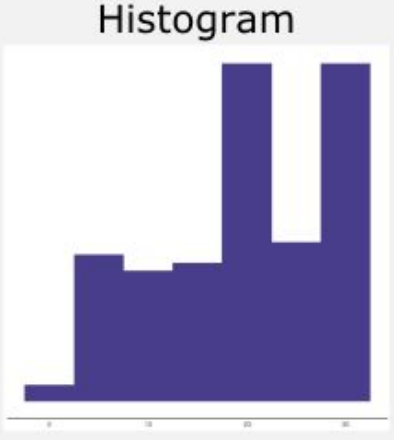
Uni Var Quantitative

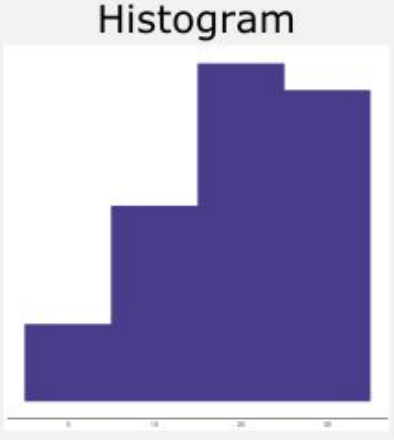
Credit: http://bit.ly/2IZSf9R, http://bit.ly/2N25s7d

Understanding EDA







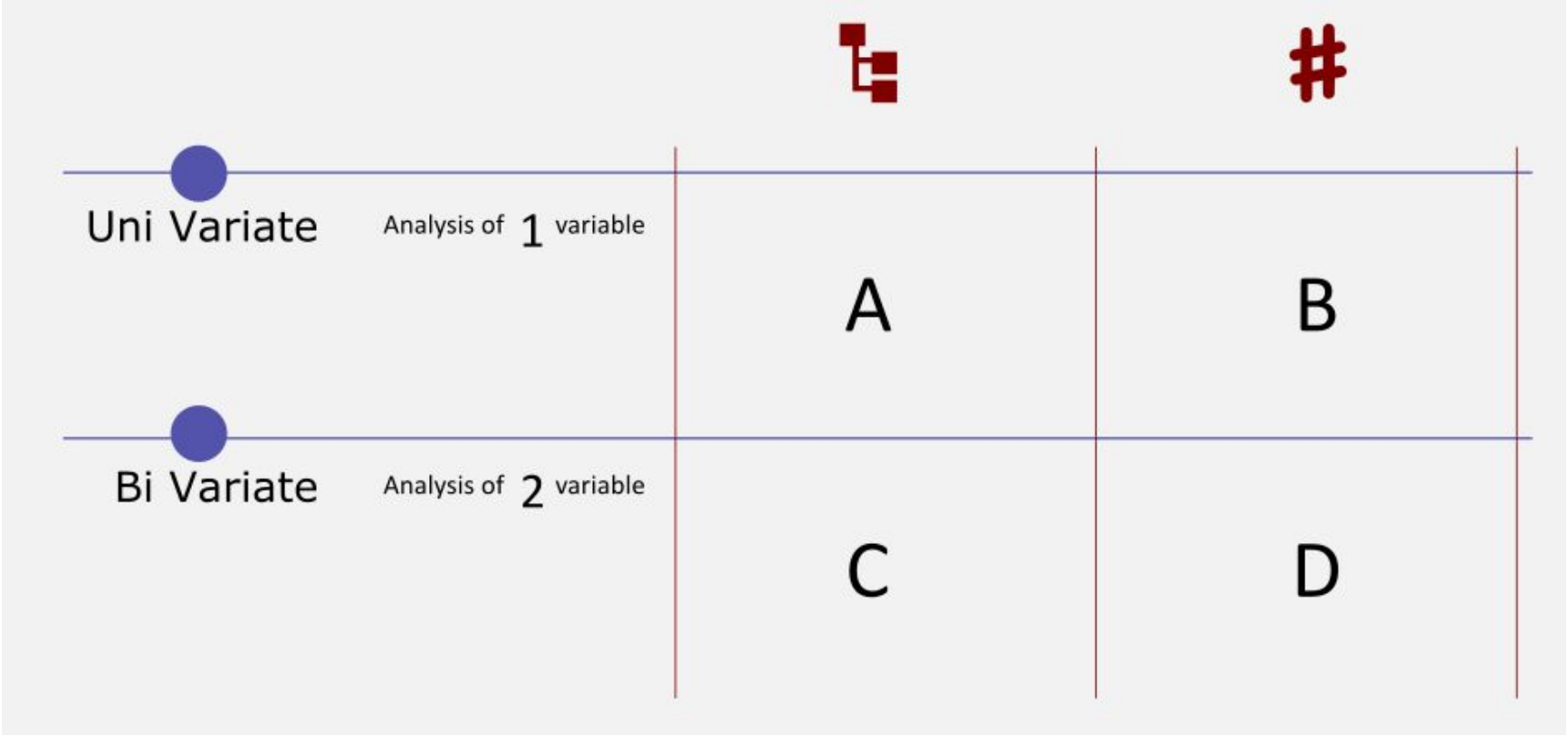


Uni Var Quantitative

Age group (Years)	Nepal	
	Male	Female
Nepal	4701	1900
10-14	3	1
15-19	50	50
20-24	178	188
25-29	347	265
30-34	432	314
35-39	574	277
40-44	579	209
45-49	588	146
50-54	512	113
55-59	448	100
60-64	370	84
65+	622	153

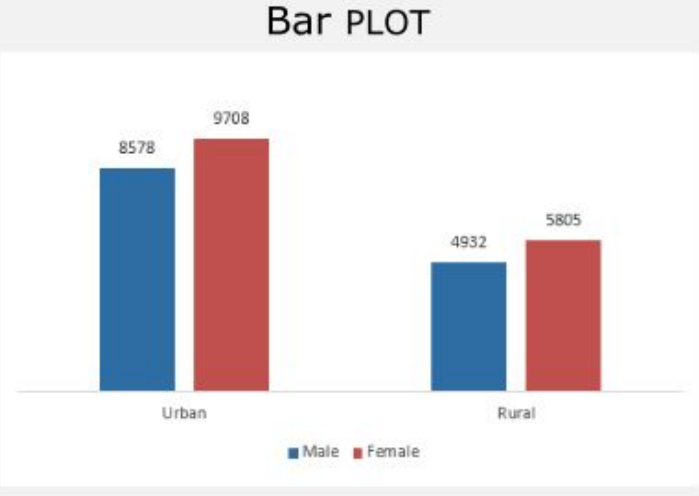
Credit: http://bit.ly/2IZSf9R, http://bit.ly/2N25s7d

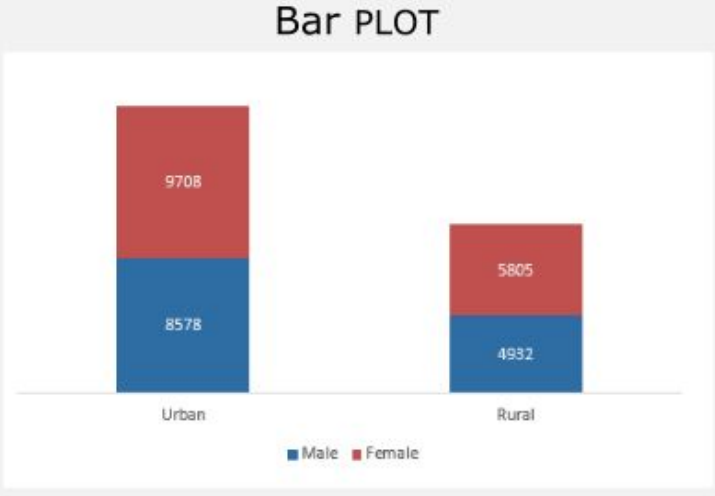
Understanding EDA



Credit: http://bit.ly/2IZSf9R, http://bit.ly/2N25s7d

Understanding EDA

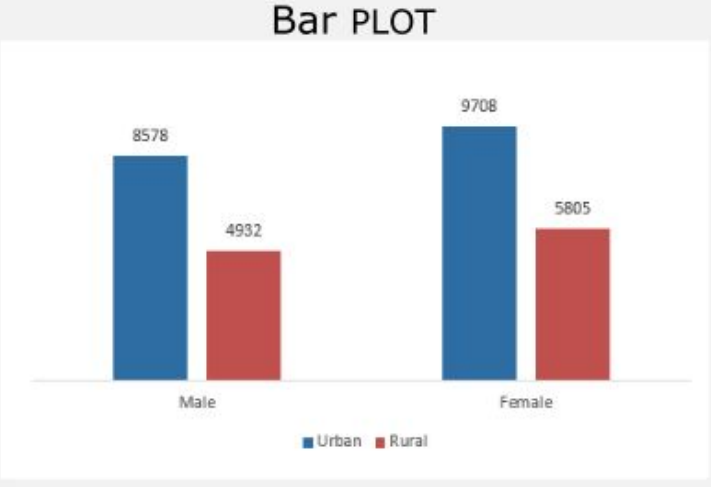


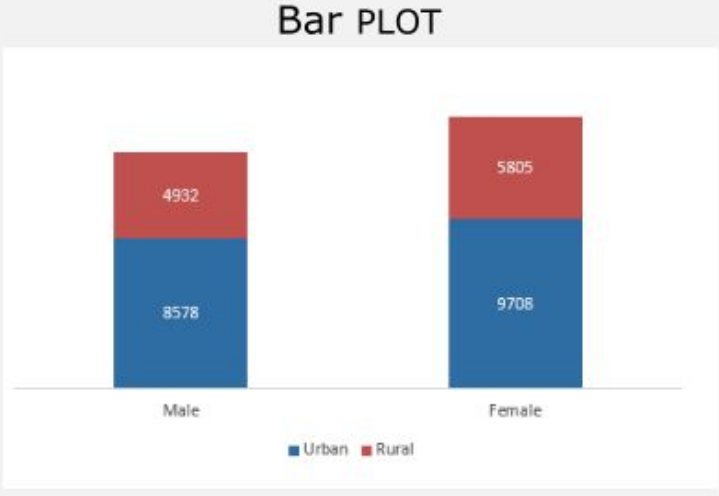


Bi Var Qualitative

Credit: http://bit.ly/2XsRwr3

Understanding EDA

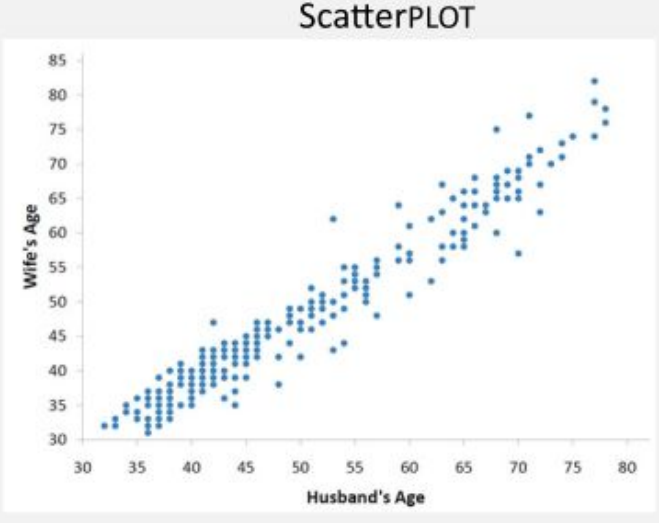




Bi Var Qualitative

Credit: http://bit.ly/2XsRwr3

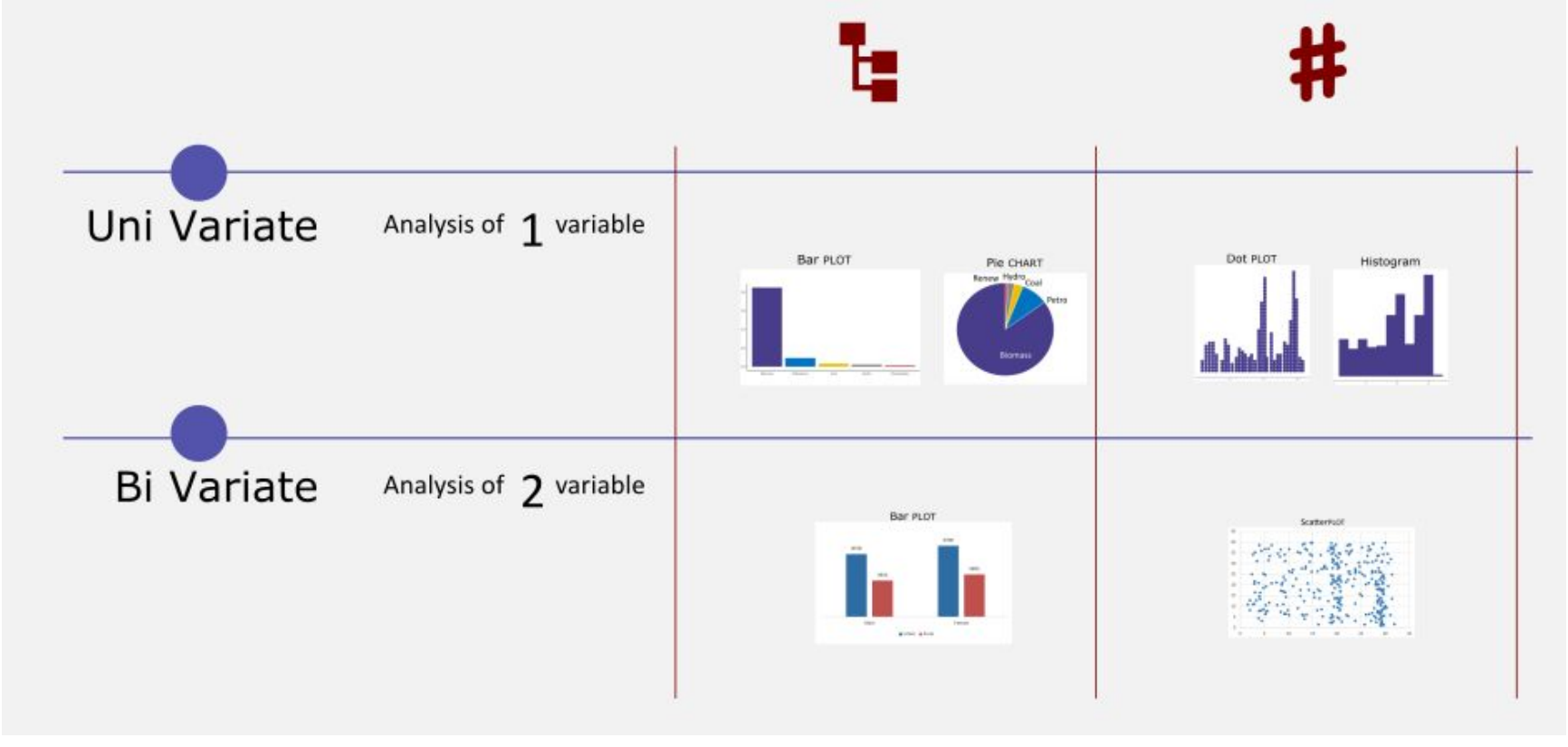
Understanding EDA



Bi Var Quantitative

Credit: http://bit.ly/2NbcUxc

Understanding EDA



Credit: http://bit.ly/2N4wniG

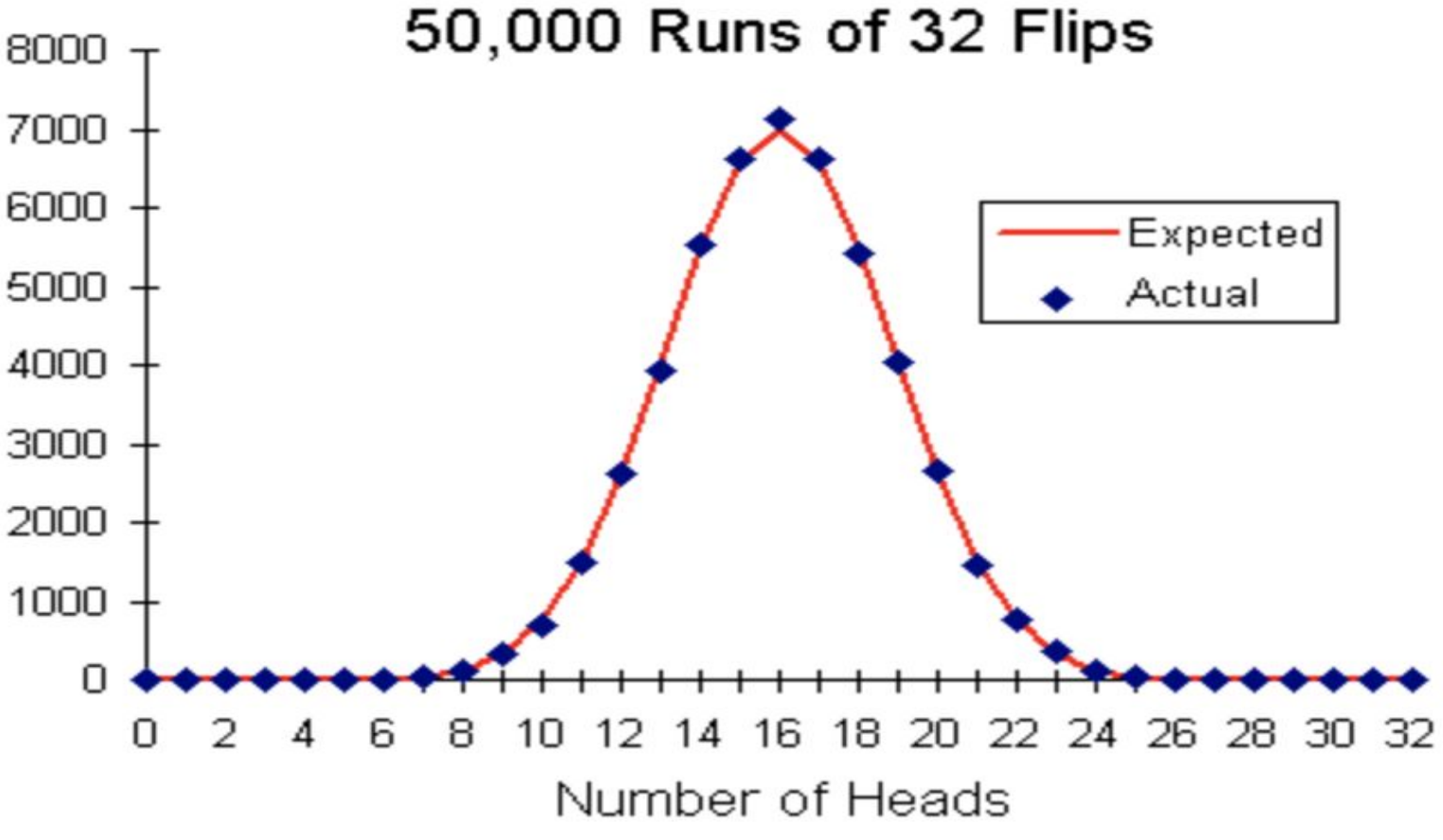
Numerical Summaries of Data

- Central Tendency Measures
- Variability Measures

Flipping a Coin Exercise

Flip a coin
10 times

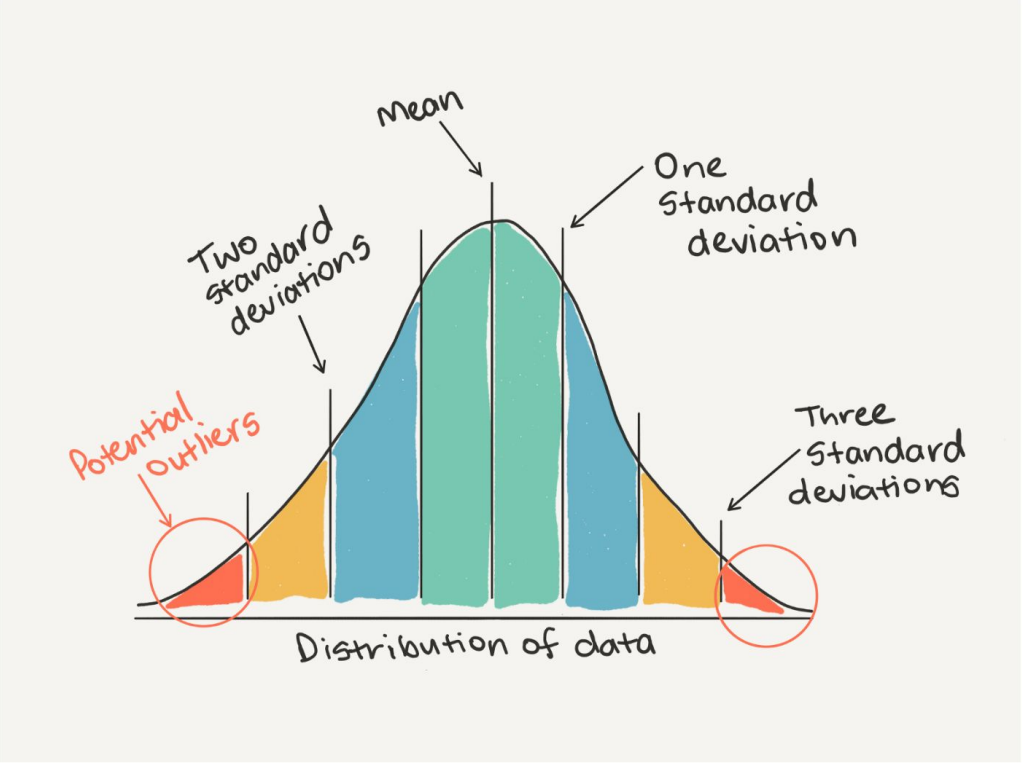
Let’s flip 32 coins, count the number of heads. Repeat 50,000 times.



Source: https://www.fourmilab.ch/rpkp/experiments/statistics.html

Definition of terms: Central Tendency

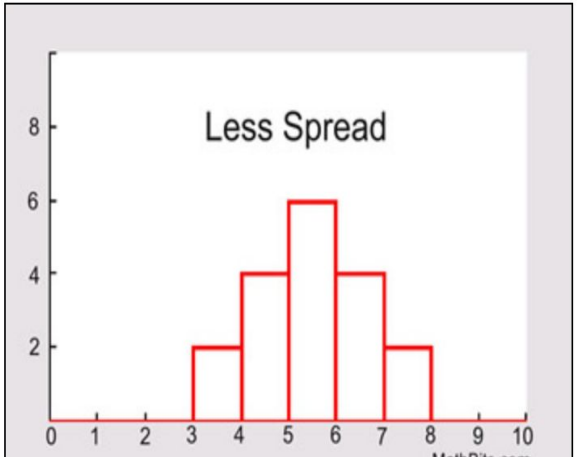
- This is a value that describes where most of the set of a data falls or clusters. Mean, Median, Mode are used to measure this.

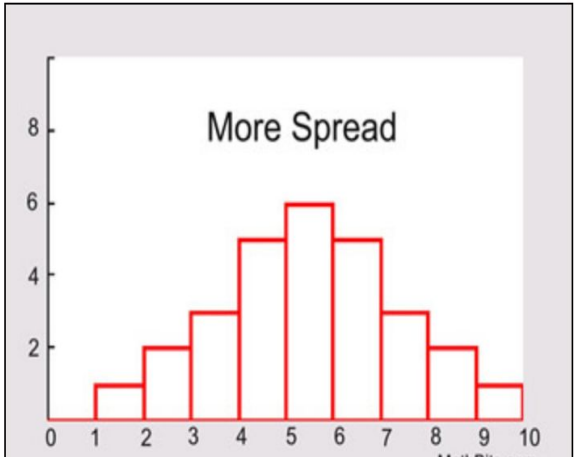


Source: Towards Data Science

Definition of terms: Spread

It is an indicator of how far away from the center/mean/median data values are and is measured by variance, standard deviation, and interquartile range





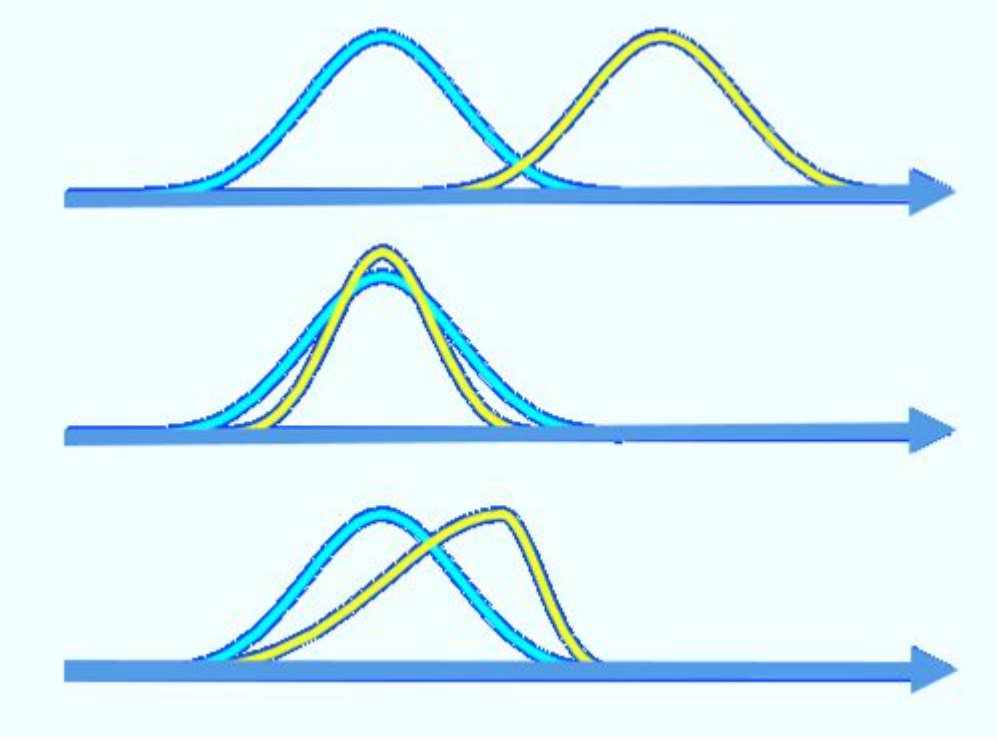
Source: https://mathbitsnotebook.com/

Numerical Summaries of Data

Central Tendency
(LOCATION)

Variation
(DISPERSION)

Shape



Credit: http://tiny.cc/9ywe8y

Central Tendency Measures

- Mean/Average
- Median
- Mode

Mean/Average

- Sum of data points divided by Number of data points

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \ldots + x_n}{n} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

- A balance point for the distribution

Credit: http://bit.ly/2ZwNsn6

Median

- Midpoint of the list if the measures are listed in ascending order

- The point on the measurement scale below which 50% of the score are located

Age of participants: 17 19 21 22 23 23 23 38

Median = (22+23)/2 = 22.5

NOTE: IF THE NUMBER OF DATA POINTS IS EVEN, THE MEDIAN IS THE MEAN OF THE MIDDLE TWO NUMBERS

Credit: http://bit.ly/2ZwNsn6

Mode

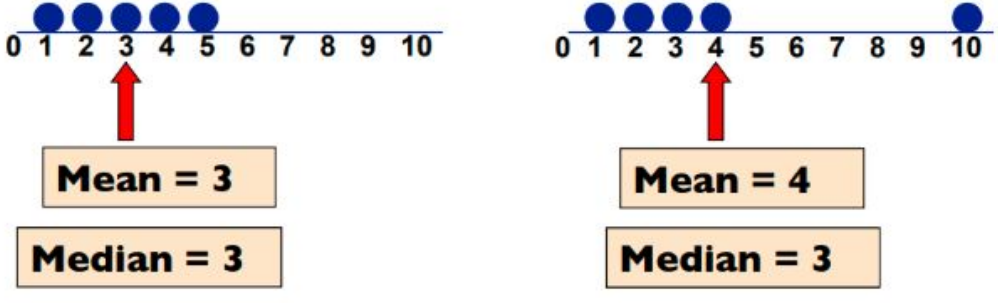
- The value that has the greatest frequency
- It is not unique

Credit: http://bit.ly/2x2mbN6

Mean or Median ?

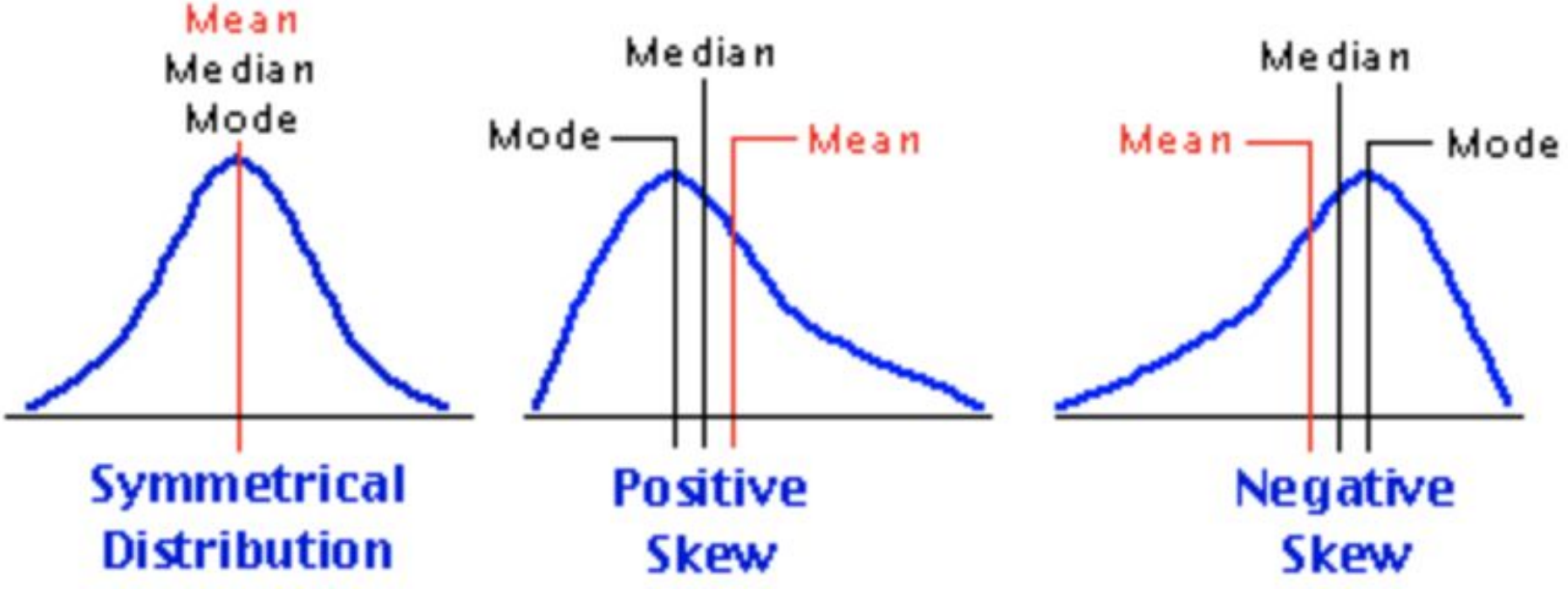
- MEAN is best for symmetric distributions without outliers

- MEDIAN is useful for skewed distributions or those with outliers

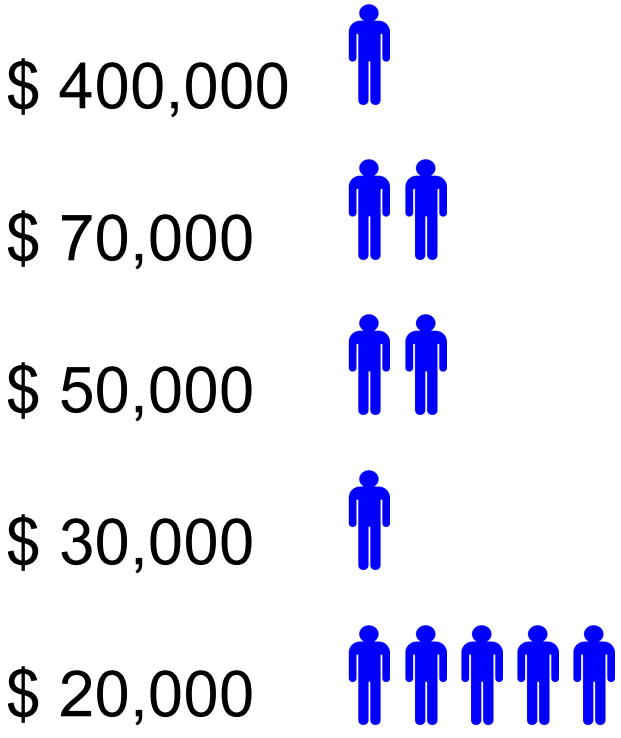


Credit: http://bit.ly/2ZwNsn6

Skewed Data



Credit: http://vassarstats.net/textbook/ch2pt1.html



- Company board claims average pay is $70,000
- Employees cite low pay - is it possible ?

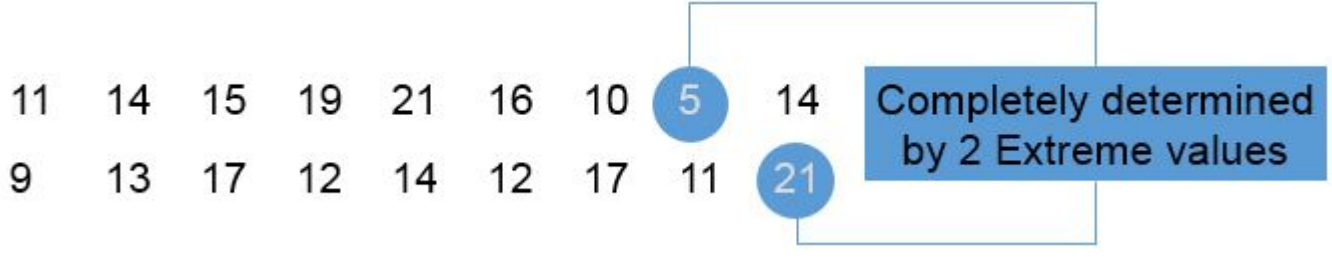
Credit: http://tiny.cc/l5iw7y

Variability Measures

- Range
- Percentiles
- Standard Deviation
- Variance

Range

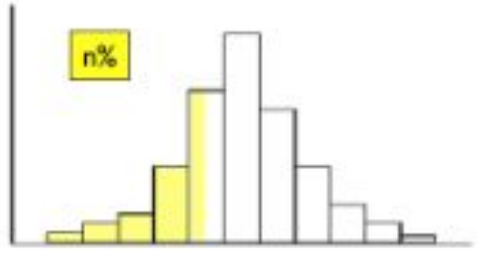
- Easy to compute and understand
- Non-Robust measure - influenced by extreme values
- Minimum value of the data set
- Maximum value of the data set



Credit: http://tiny.cc/u8iw7y

Percentiles

- In general, the nth percentile is a value such that n% of the observations fall below it



Q_1 = 25th percentile

Median = 50th percentile

Q_2 = 75th percentile

Q1:= 25th percentile
25% of data fall below this value

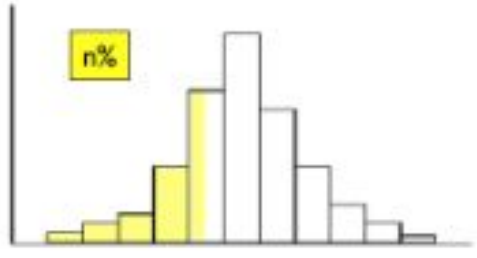
Q2 := 50th percentile
50% of data fall below this value

Q3 := 75th percentile
75% of data fall below this value

Credit: http://bit.ly/2ZwNsn6

Percentiles

- In general, the nth percentile is a value such that n% of the observations fall below it



Q_1 = 25th percentile

Median = 50th percentile

Q_2 = 75th percentile

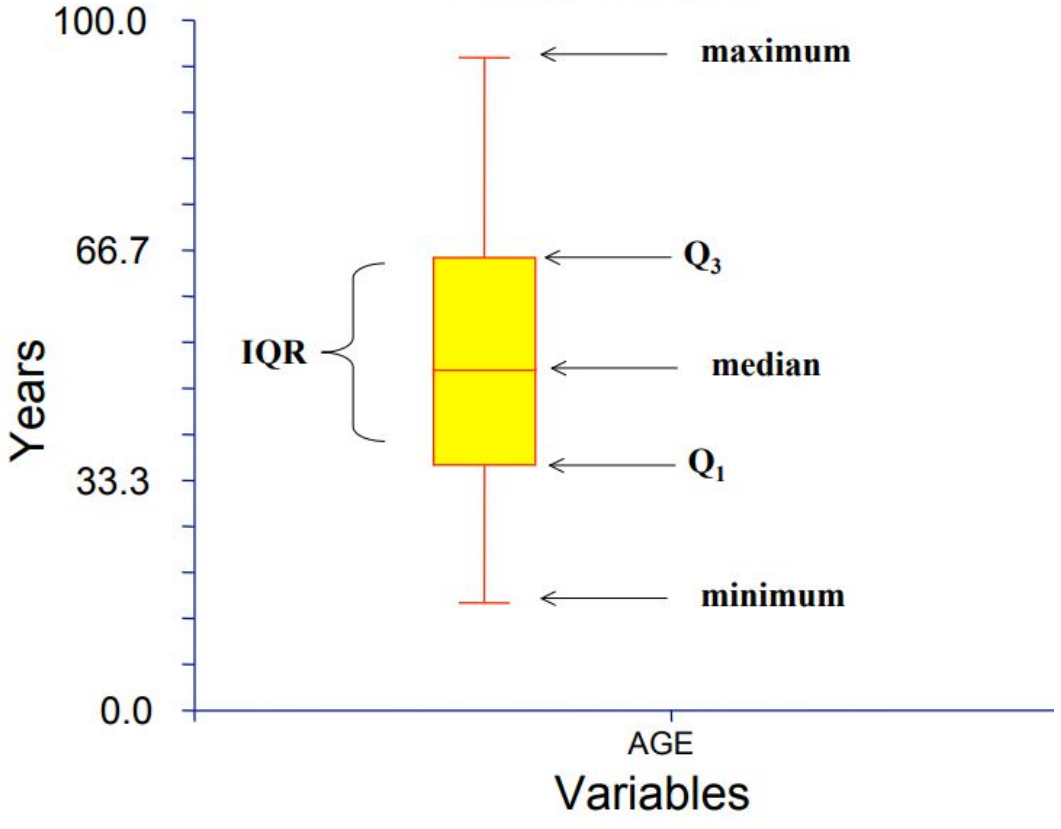
Q1:= 25th percentile
Median to the left of the median

Q2 := **MEDIAN**

Q3 := 75th percentile
Median to the right of the median

Credit: http://bit.ly/2ZwNsn6

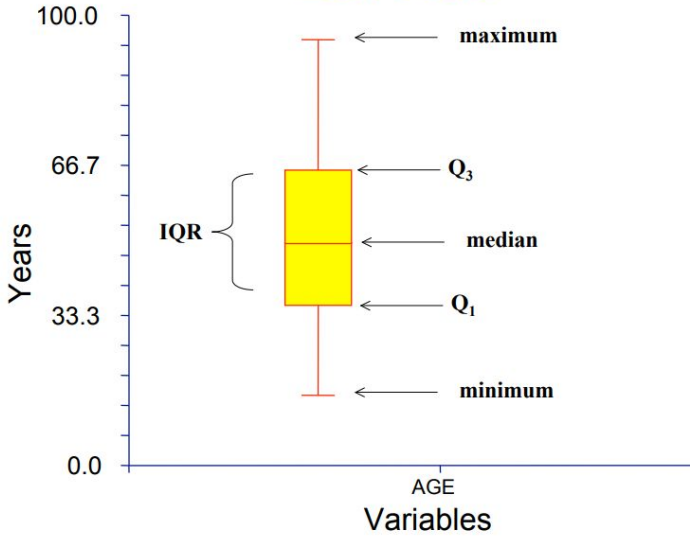
Box Plot



Credit: http://bit.ly/2ZwNsn6

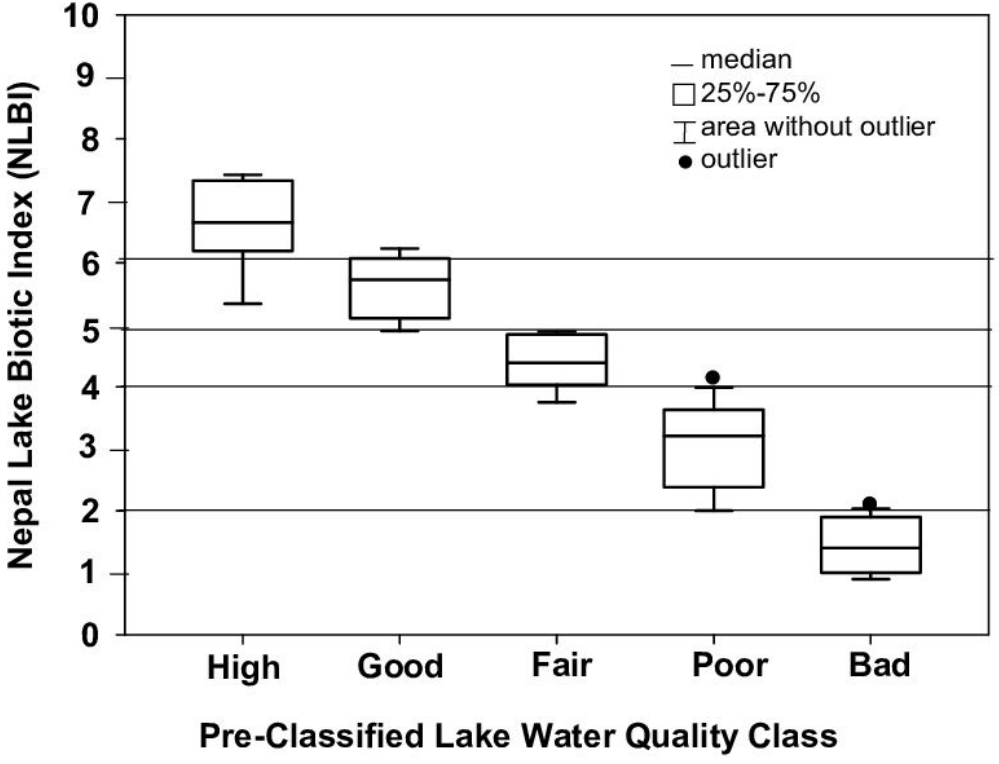
Box Plot

1. Range
2. Median
3. Q1
4. Q3



Credit: http://bit.ly/2ZwNsn6

Box Plot



Credit: http://bit.ly/2WVhxQs

Box Plot

- Make a box plot for the following data:
  - Minimum 1
  - Q1: 7
  - Median: 10
  - Q3: 17
  - Maximum: 30
  - n: 100

Part 2:
Visualizing Data

Data Visualization

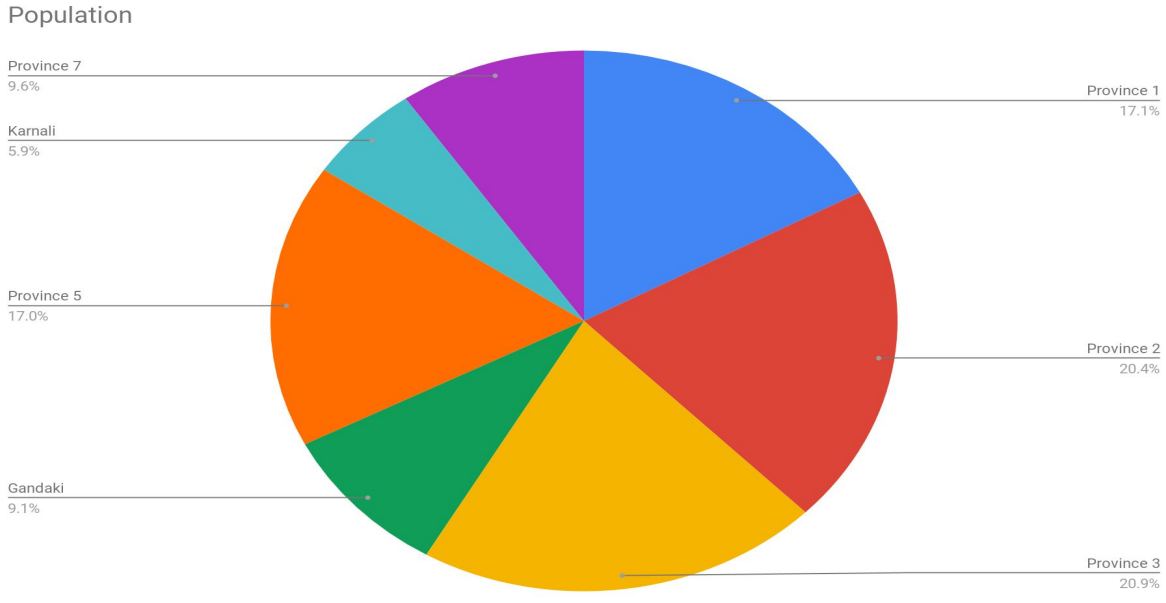
Data visualization is the graphical representation of information and data. By using visual elements like charts, graphs, and maps, data visualization tools provide an accessible way to see and understand trends, outliers, and patterns in data. here are many kinds of chart and plots that helps us understand data better. Here are a few examples:

- Line charts
- Scattered plots
- Bar charts and Stacked bar charts
- Pie charts
- Histograms
- Infographics and Maps

Pie Chart: A chart that uses pie slices to show relative sizes of data, percentage or proportion. They are used for categorical data

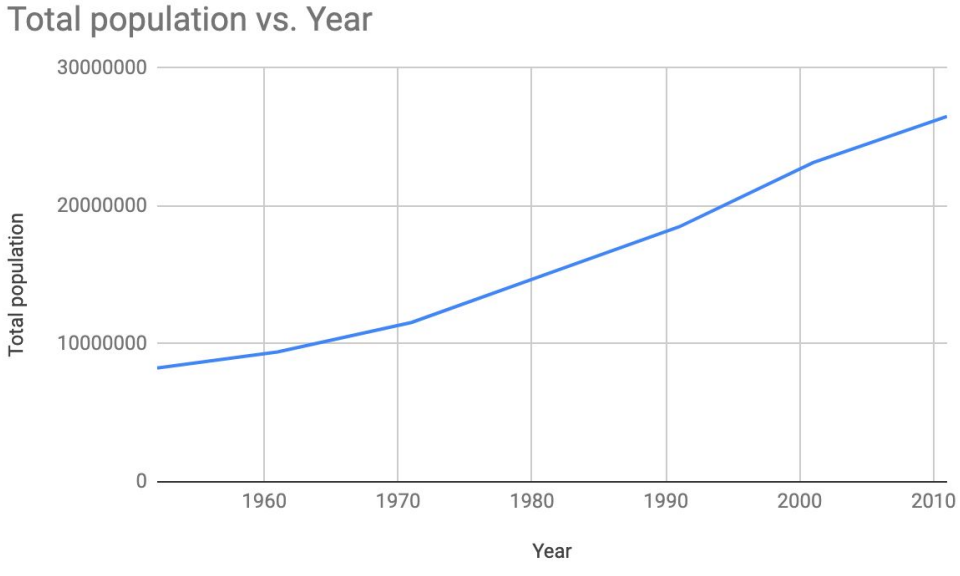
SN	Province	Population
1	Province 1	4,534,943
2	Province 2	5,404,145
3	Province 3	5,529,452
4	Gandaki	2,403,757
5	Province 5	4,499,272
6	Karnali	1,570,418
7	Province 7	2,552,517
	Nepal	26,494,504

Source: CBS 2011



Line Chart: It is used to visualize changes and trends in data over time. It is mostly used for Numerical data

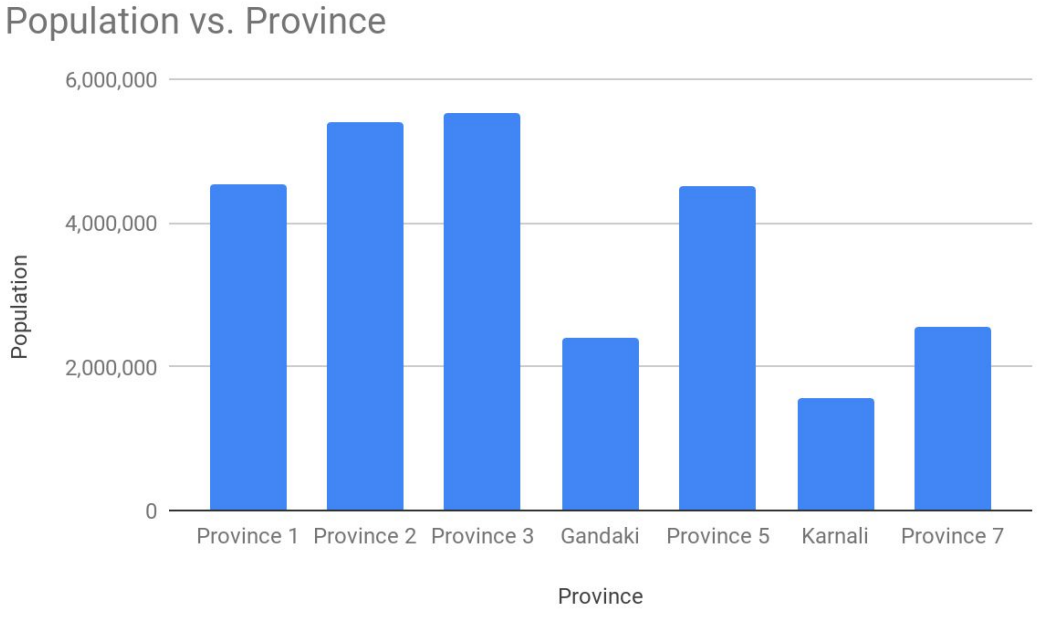
Year	Total population
1952	8256625
1961	9412962
1971	11555983
1981	15022839
1991	18491097
2001	23151423
2011	26494504
Source: Nepal in Data	



Bar Chart: A graphical display of data using bars of different heights used to show comparison in categorical data

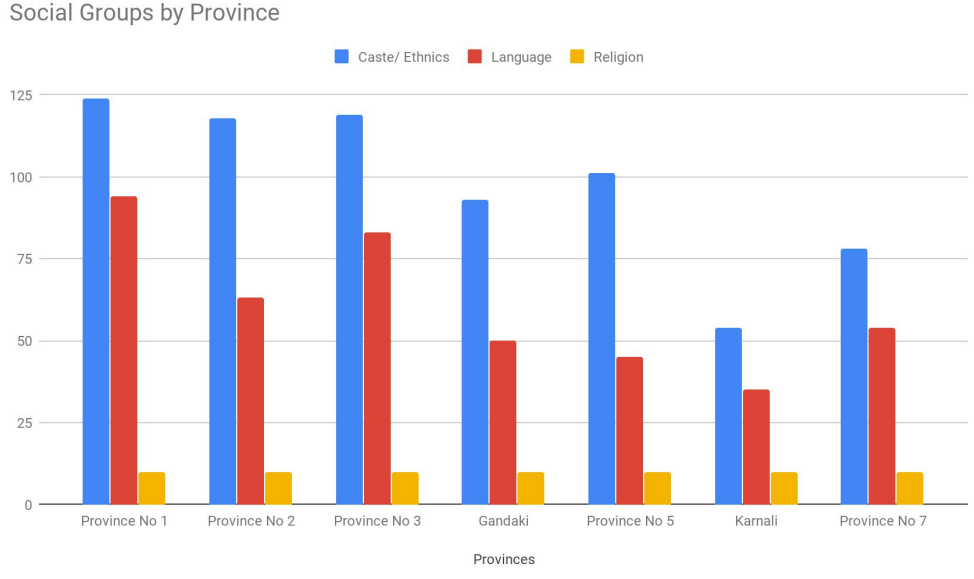
SN	Province	Population
1	Province 1	4,534,943
2	Province 2	5,404,145
3	Province 3	5,529,452
4	Gandaki	2,403,757
5	Province 5	4,499,272
6	Karnali	1,570,418
7	Province 7	2,552,517
	Nepal	26,494,504

Source: CBS 2011

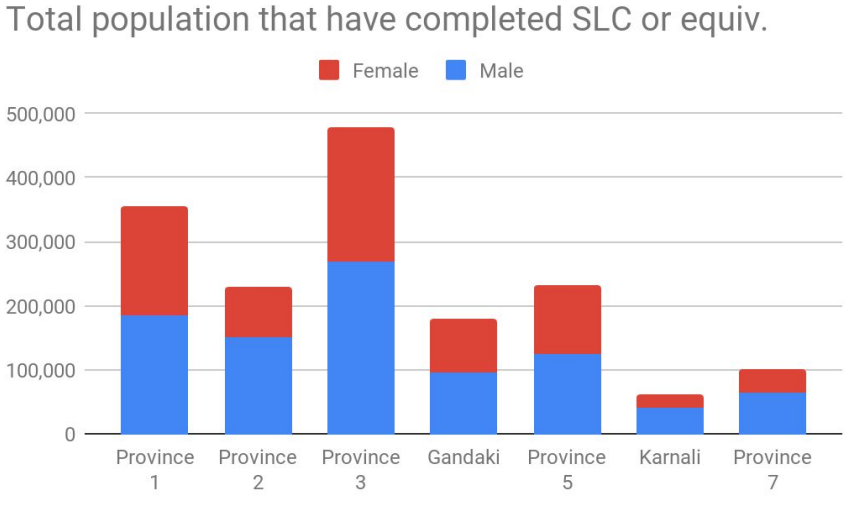


Grouped Bar Chart: A graphical display of data using bars of different heights

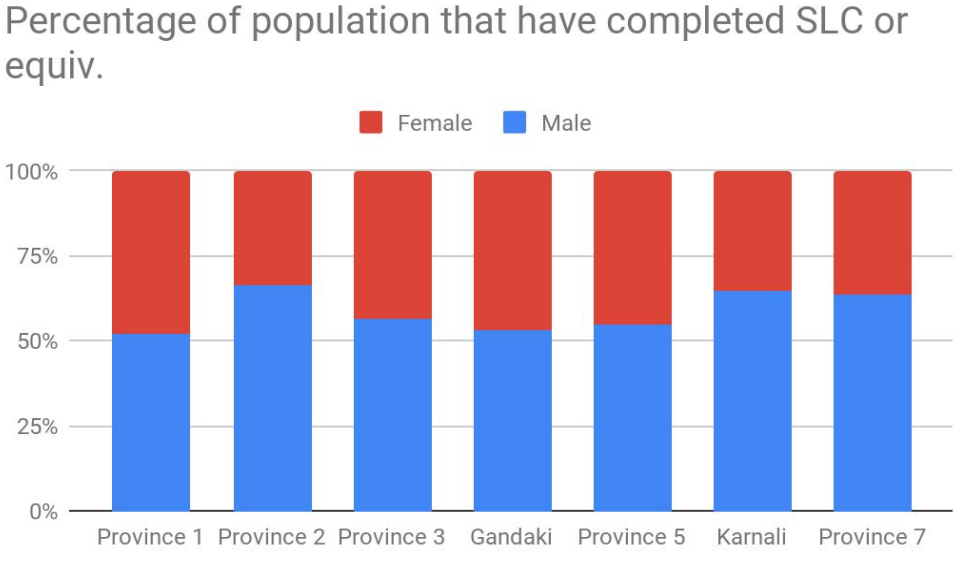
Description	Nepal	Province No 1	Province No 2	Province No 3	Gandaki	Province No 5	Karnali	Province No 7
Caste/ Ethnics	125	124	118	119	93	101	54	78
Language	123	94	63	83	50	45	35	54
Religion	10	10	10	10	10	10	10	10
Source: CBS, 2011								



Stacked Bar Chart: A bar graph with segments in each bar, and each segment represents different categories

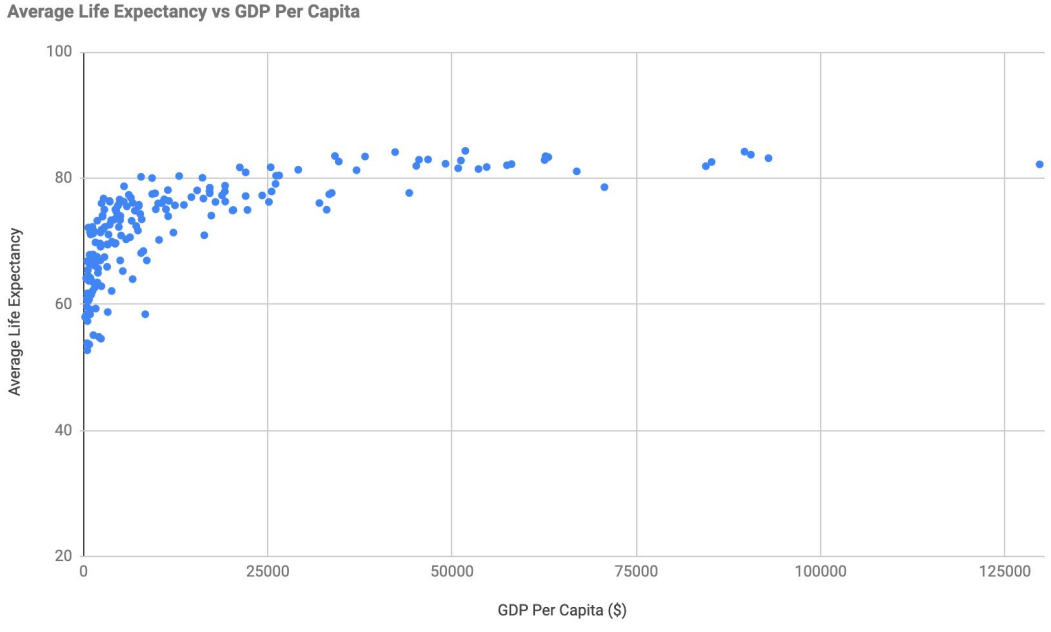


Source: Education in figures 2017



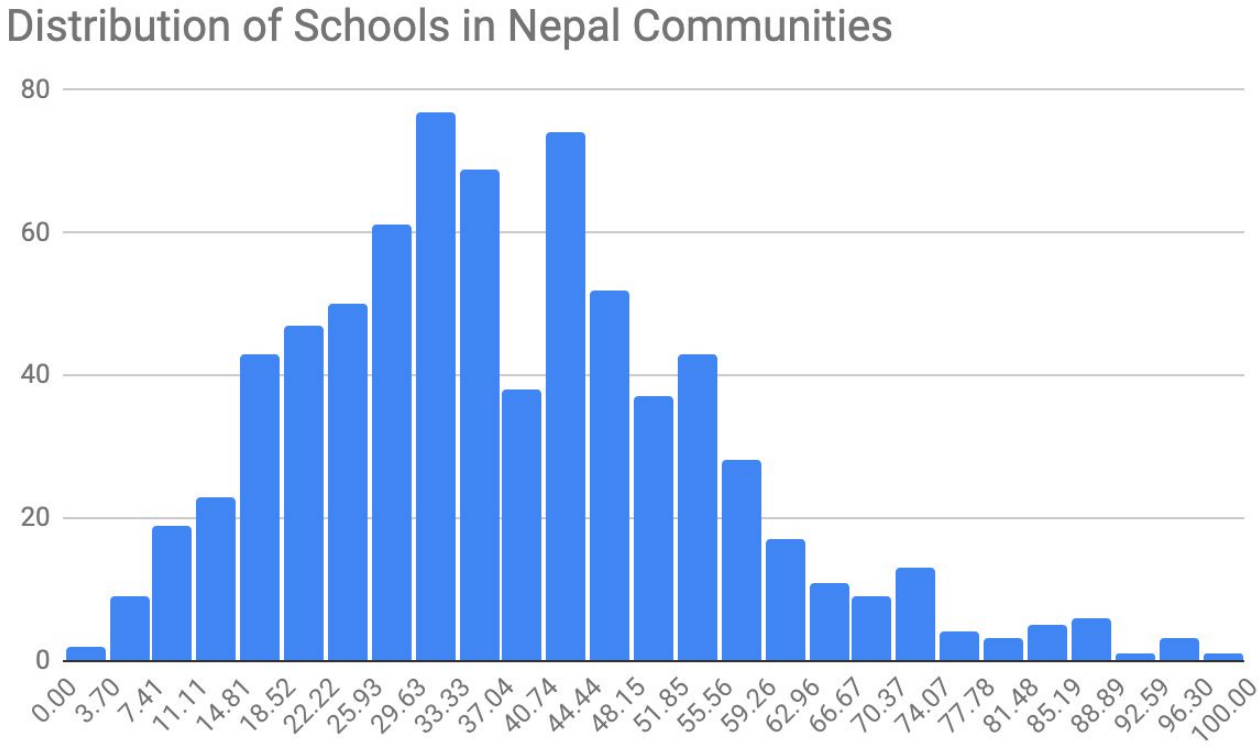
Scatter Plot: It is a two-dimensional data visualization that is used to find the relationship between two variables, often quantities.

Country	GDP Per Capita	Average Life Expectancy
United States	65058.27	79.772
China	10945.80	76.64
Japan	42270.55	84.118
Germany	53576.82	81.436
India	2305.21	69.118
France	46732.39	82.946
United Kingdom	45140.75	81.932
Italy	38189.68	83.416
Brazil	10625.84	76.018
Canada	51194.73	82.782



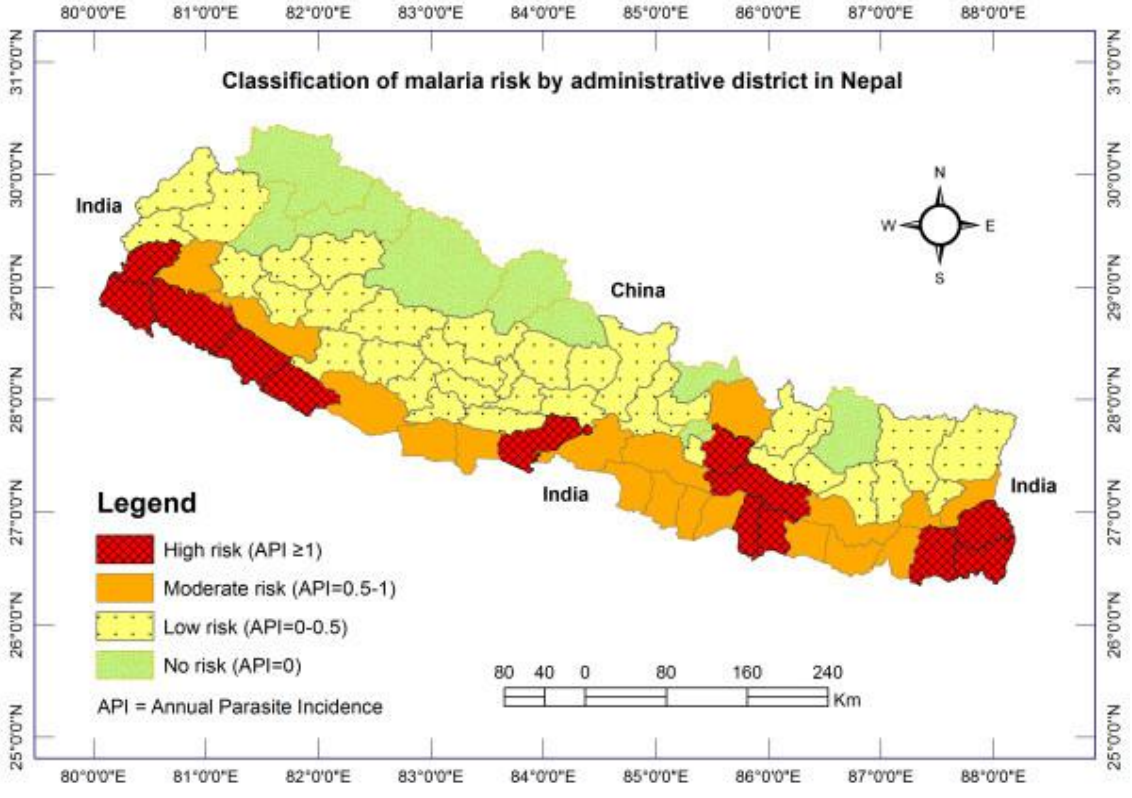
Data Source:
worldpopulationreview.com

Histogram: Used for numeric data in which each bar represents the frequency (count) allowing the inspection of the data for its underlying distribution



Data Source: Education in figures 2017

Map: This uses spatial data and geographic data to visualize data across several locations at a glance



Source: [Research Gate]

Lab 6: Create a Visualization in Google Sheets

1. Open your cleaned dataset - **Prevalence and Treatment of Diarrhea in Nepal**
2. Look through the sheets and **create charts showing**
    a. **Q1** Which age group are most affected by diarrhea in Nepal?
    b. Q2: Which Province in Nepal has the highest number of children living with diarrhea?
    c. Q3: What is the relationship between the level of Education of the mothers and the no of affect Children with this disease?
    d. Q4: What gender is most affected by this disease?

Hint:

1. Open dataset in google sheets and review the data.
2. Rearrange columns and rolls where necessary, highlight the **columns**.
3. Select **Insert** ☐ **Charts** and select **2-D Column** ☐ **Clustered Column** chart or pie chart A chart window displays on the spreadsheet.
4. Rename the chart where necessary

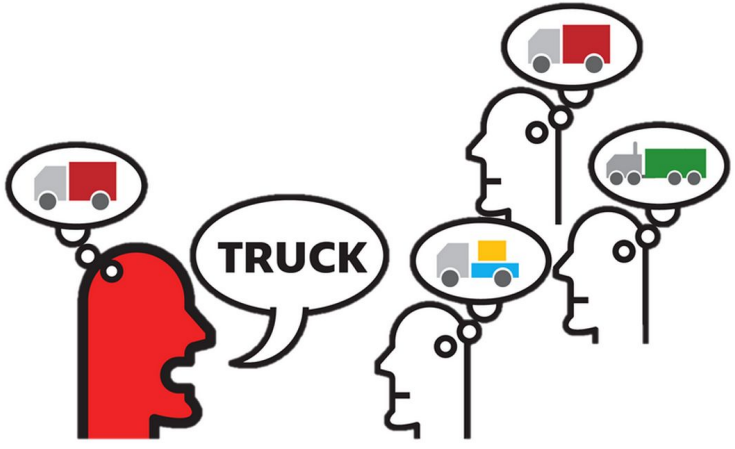
Evaluation of Each Other’s Visualizations

- Does the visualization tell a story or reveal an insight?
- Does the headline tell the reader what the story or trend is?
- Does the chart type match the data?
- Are there simple, clear fonts, colors and labels
- Did you cite the source of the data?

Principles and Ethics of Data Visualization

Styles of communication

Verbal Communication



Visual Communication

Image: Alberto Cairo

Why do we use data visualization?

1. It gives a **clearer understanding** of your data or story.
2. It **amplifies** the message you want to get across.
3. It can aid **quick decision** analysis
4. You can **identify trends** quickly.
5. You can **share easily** with others.

Staying Focused

- **What's the point?**
  Make sure to include only the data you want the reader to remember

- **Simplify the numbers!**
  When possible, reduce numbers to simplest form.

- **Make the angle clear**
  Titles and labels should be specific, easy to understand and true to the data, including citing the source of the data

- **Set the scene!**
  Styles and colors should aid understanding, not distract readers

Basic Design Concepts

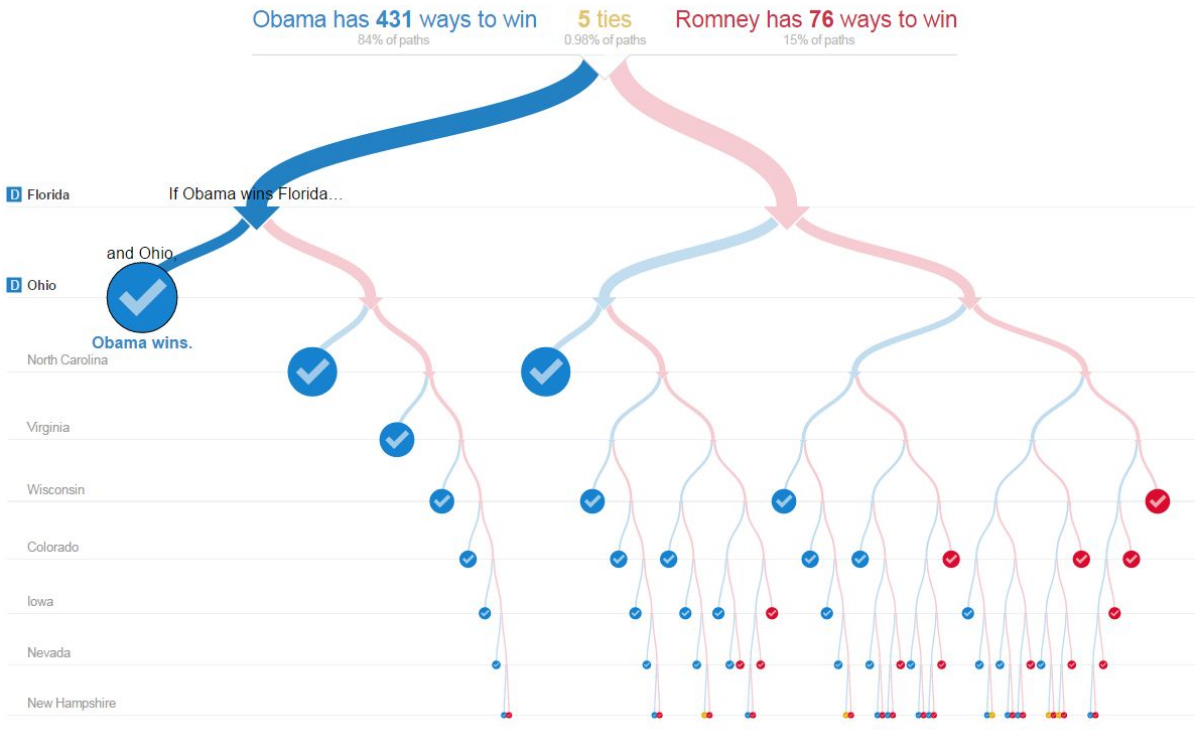
- **Simplicity:** Choose a maximum of three colors and fonts and stick with them consistently.
- **Brevity:** Keep text short and to the point.
- **Creativity:** Incorporate playful design that relates to the topic.
- **Two dimensions:** Avoid 3D graphics: they distort data and look.
- **Clarity:** Label clearly, specify units, use a legend when necessary.

Basic Design Concepts:

Look vs. Function:

Questions

- What story does the data visualization tell?
- What details do you understand from the visualization?
- Is there text to help you understand?



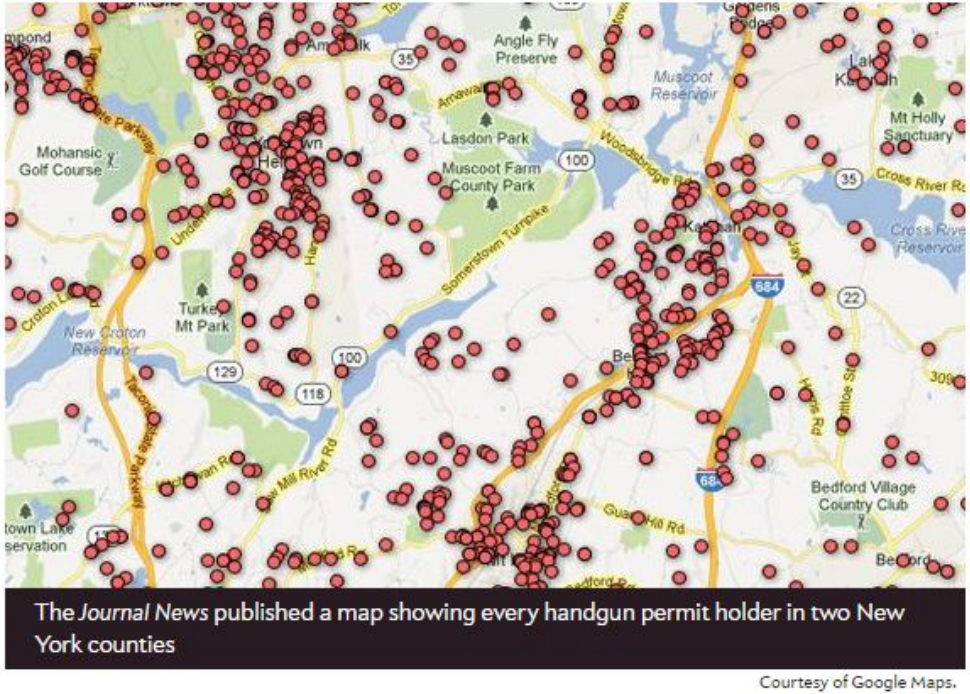
Source: New York Times

"The greatest value of a picture is when it forces us to notice what we never expected to see."

-John Tukey

Ethics of Data Visualization: Privacy

- The Journal News published a map showing he name and address of people with gun license.
- This sparked a debate on privacy vs public safety in the media.
- What is the news value of publishing personal details here?



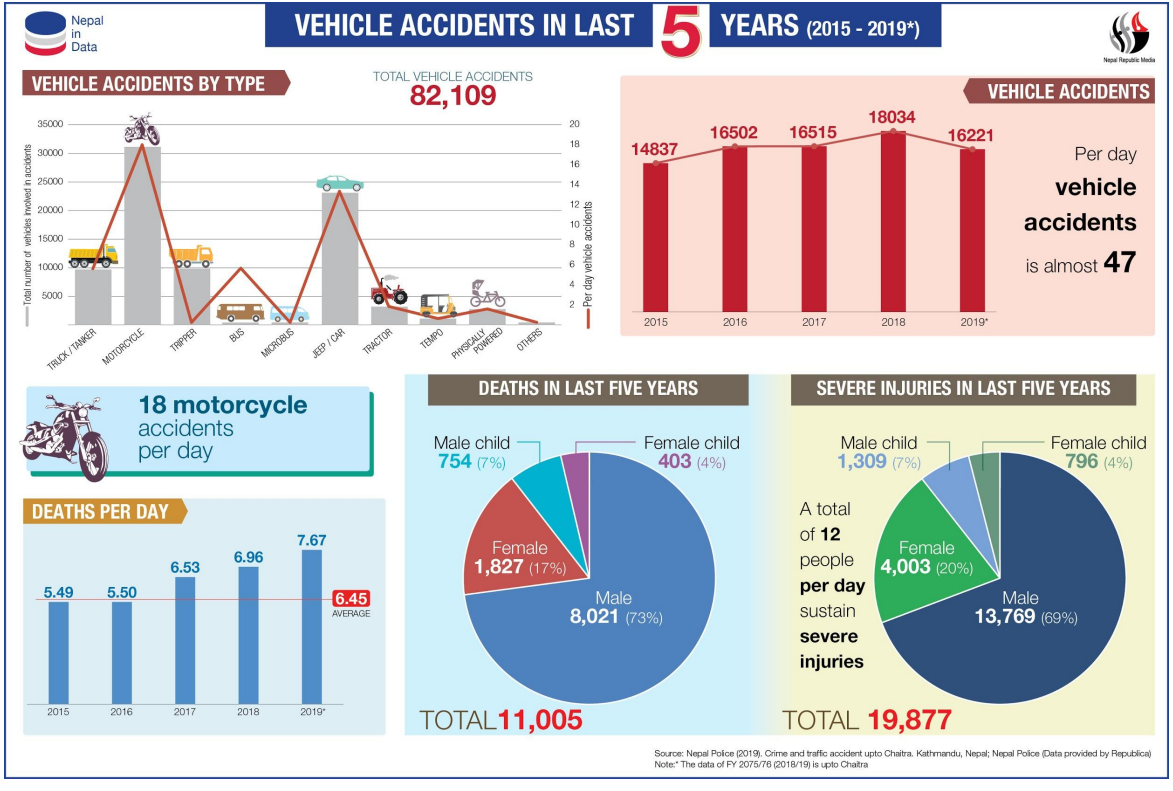
The *Journal News* published a map showing every handgun permit holder in two New York counties

Courtesy of Google Maps.

Creating infographics using Infogram

Infographics = Information + Graphics

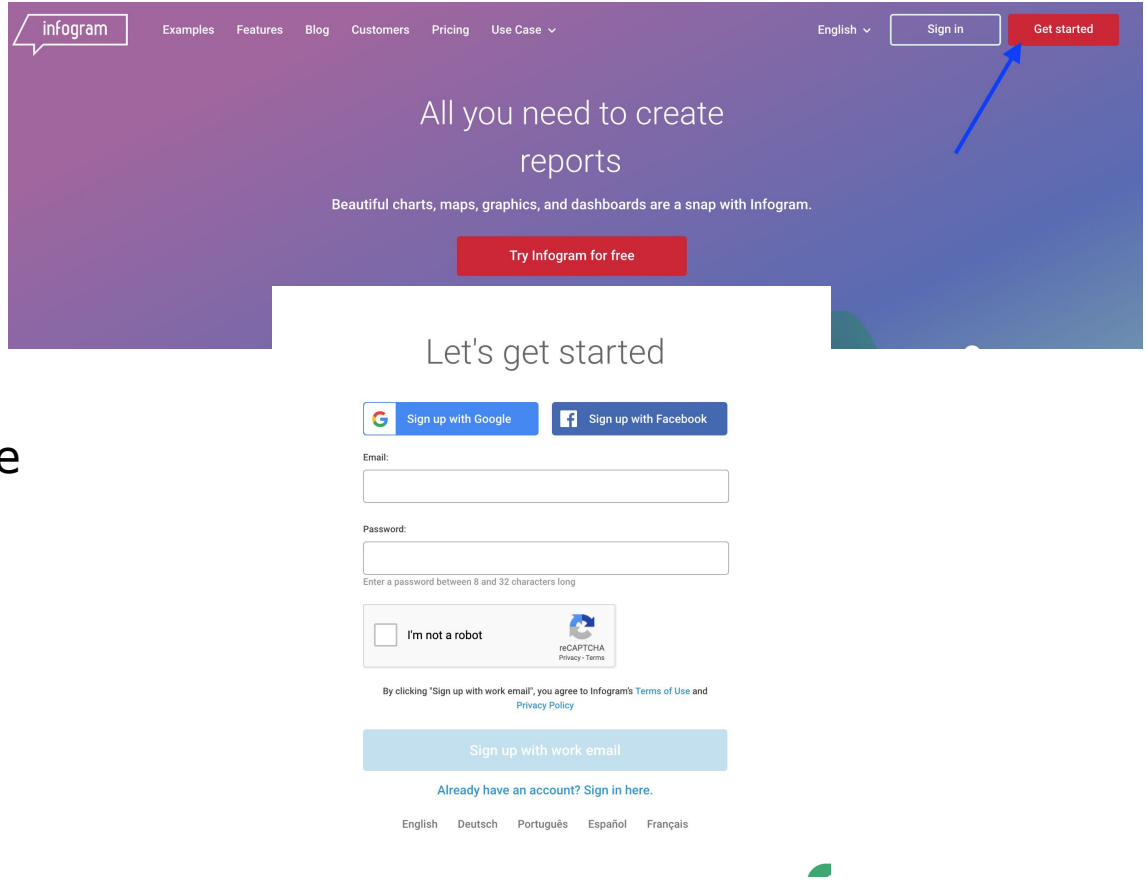
Graphical visual representations of information, data or knowledge intended to present information quickly and clearly.



Source: https://nepalindata.com/insight/vehicle-accidents-in-last-5-years-2015--2019*/

Getting Started with Infogram

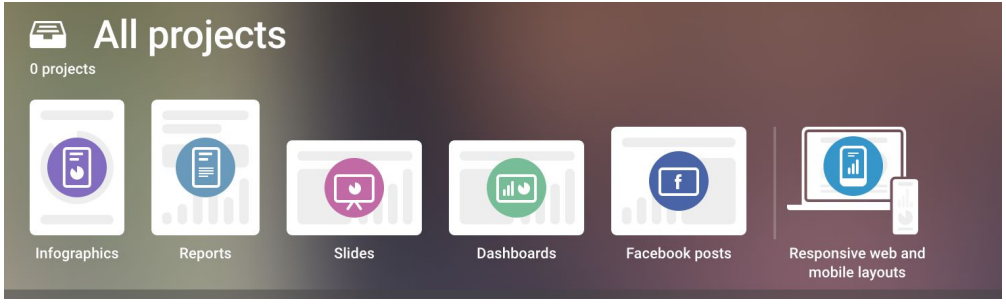
1. Open the following website, and register (free) to login: https://infogr.am/
2. Sign up using your google account of your facebook account.
3. Set up your account by clicking next and sharing the kind of organization you work for

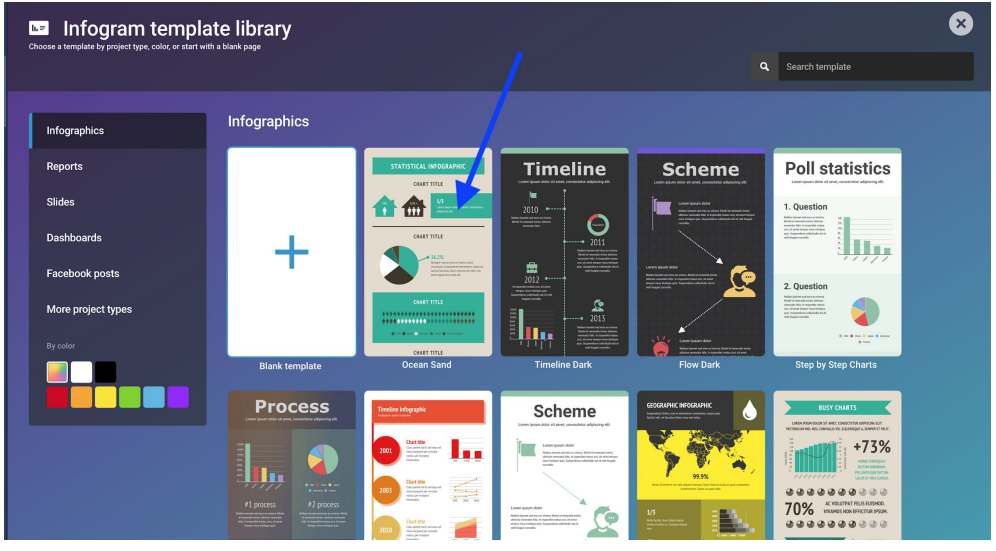


Source: Infogram

Using Infogram

1. Once signed in, Select **either an infographics, report, or slides or social media post**.
2. Click infographics, let us choose a template ‘statistical infographics’ from the menu and click on **use.**
3. Create a title for the chart and identify whether the chart will be public (free) or private (which will require upgrade).

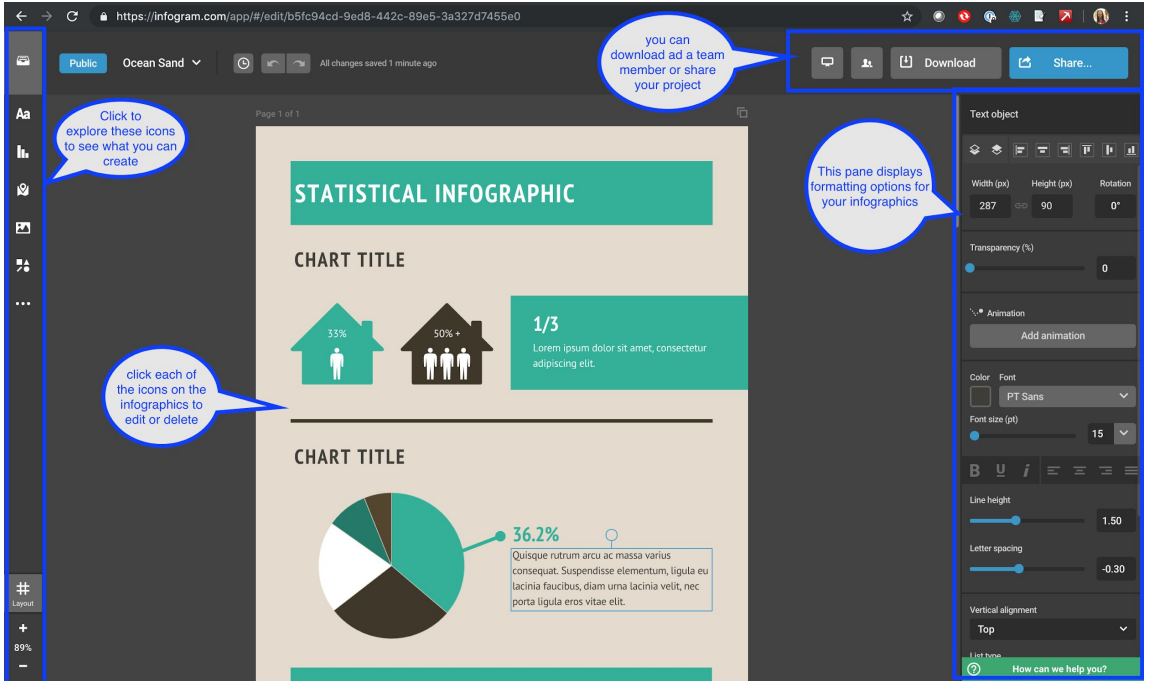




Source: Infogram

Using Infogram

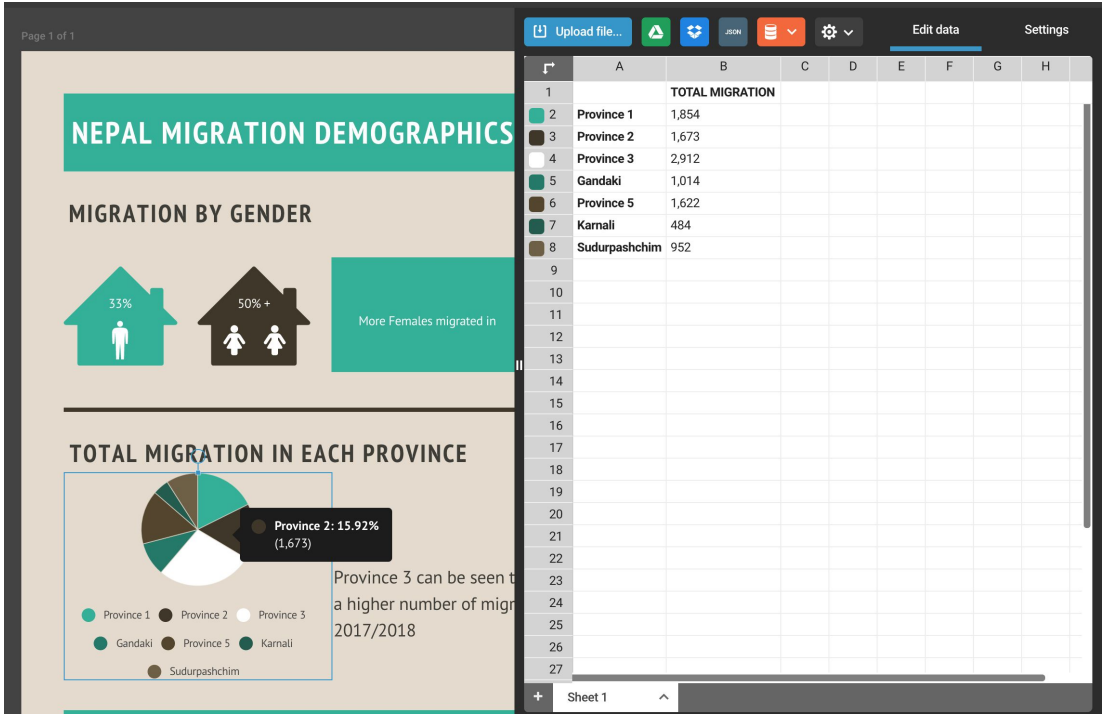
- NOTE: By default charts have some data, to change it, click on the chart, (it turn darker) and enable the option to edit.
- Change the chat titles by double clicking on the text box and naming it to reflect what infographics you want to show.



Source: [Infogram]

Using Infogram

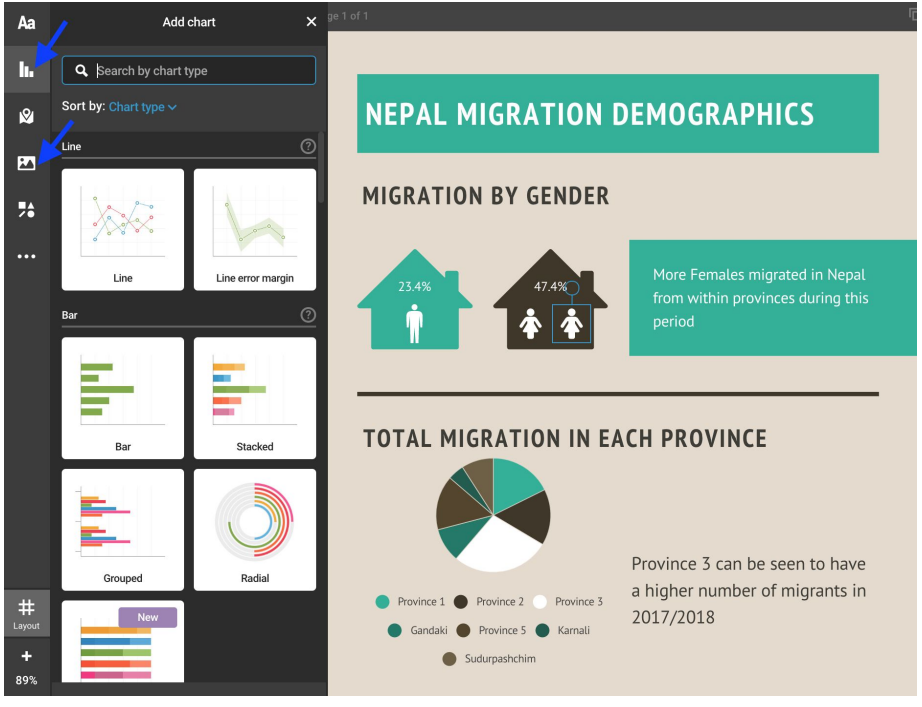
1. Update title by double clicking text box. **Name it Nepal Migration Demographics - We will be using data from your Exercise on Migration**
2. Update the data on the infographics with your own by clicking on the chart on the page, the **Edit data** window will open and you can now copy + paste from your spreadsheet.



Source: Infogram

Using Infogram

- Because Infogram works as storytelling application as well, it is possible to add charts, maps, text, videos, links, gifs etc.in the same visual package you can do this by navigating the left side menu of the page.
- Be sure to add source text under the chart. The source should include the title, data and link to the data source.

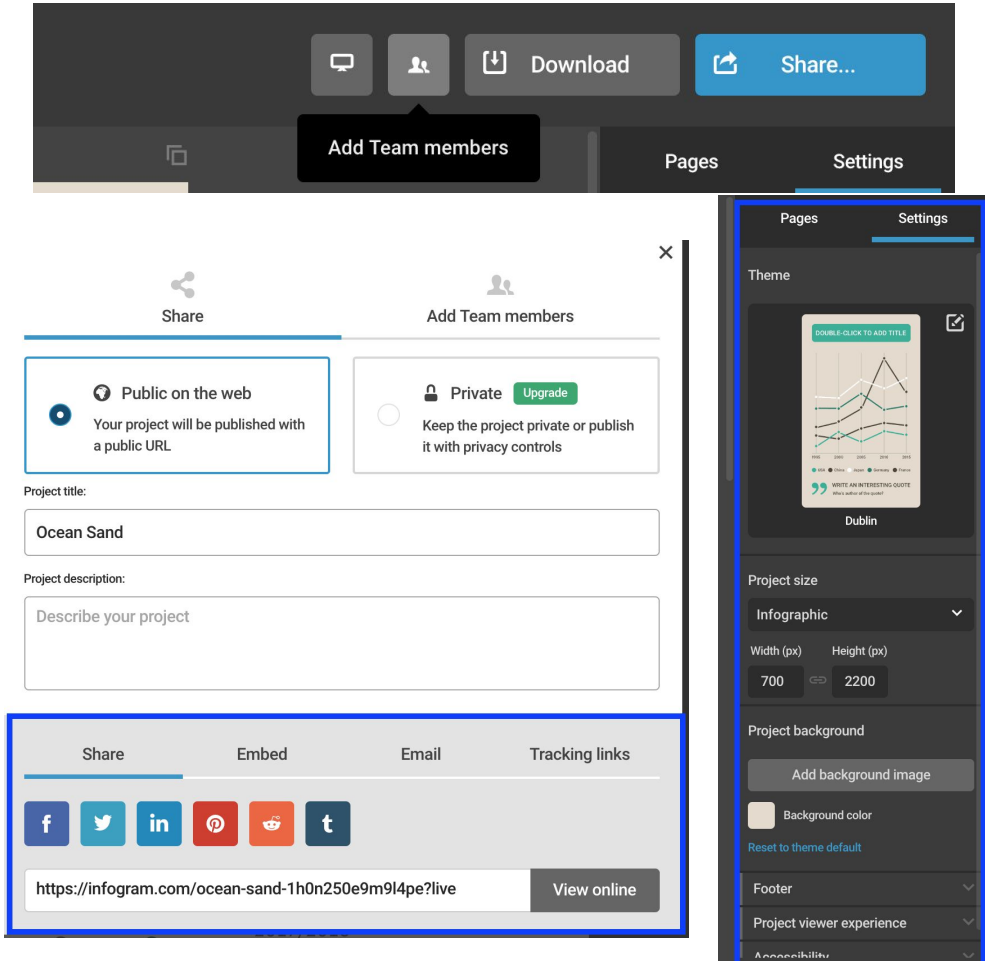


Source: Infogram

Using Infogram

1. To update colors, font size, and formatting relating to update colors (theme), width, font, etc. Click on the object on the infographics to get settings related to that object or click the settings icon on the right hand side of the page

2. Click **Share** to publish to share on the web. On the **Share** window, any of the option to share, embed, or email that best suits your use.



Source: [Infogram]

Lab : Creating Infographics

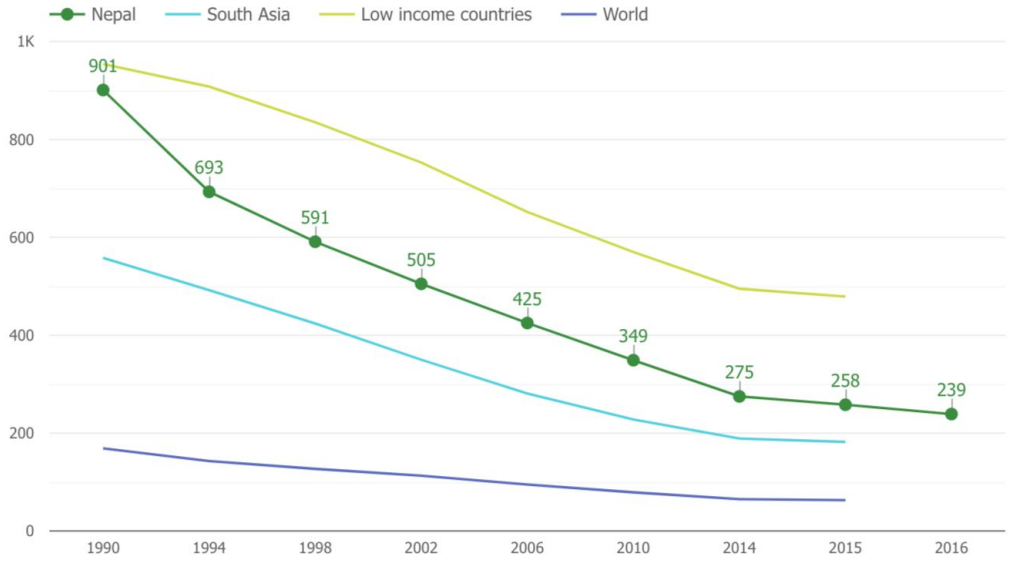
- Using your data on **Prevalence and Treatment of Diarrhea in Nepal**
- Using the Infogram, and the skills you have explored so far, create an infographics/story that raises awareness on findings.
- Feel free to research and add other data.
- You are allowed to be creative!

Module 6

Finding Insights in Data

SDGs Indicator 3.1.1: Maternal mortality ratio:

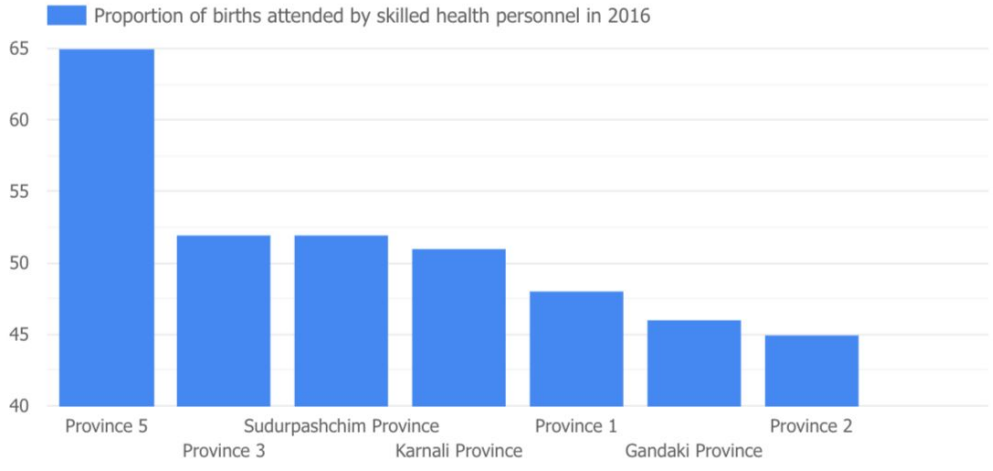
1. The ratio is the number of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births
2. The goal is to reduce maternal mortality to fewer than 70 per 100,000 live births by 2030
3. Summarize chart in one sentence



Source: Visualizing Nepal's Health Progress

SDGs Indicator 3.1.2: Proportion of births attended by skilled health personnel

1. Births attended by skilled health staff are the percentage of deliveries attended by personnel trained to give the necessary supervision, care, and advice
2. There is no specific goal by the UN regarding this indicator
3. Give a one sentence analysis of the chart.

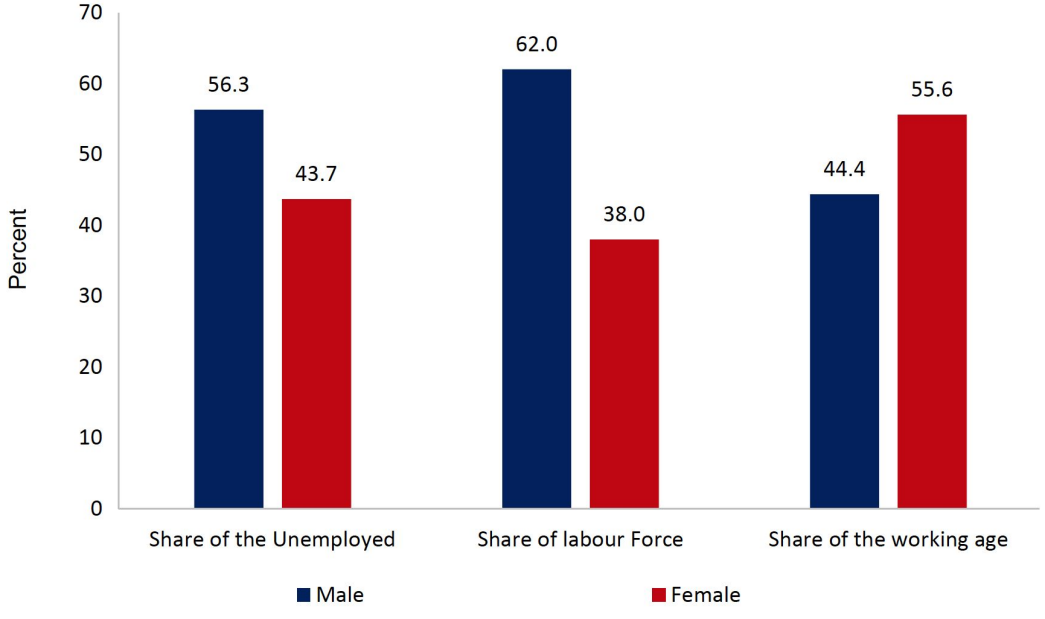


Source: Visualizing Nepal's Health Progress

Profile of the unemployed people in Nepal by sex

Give a one sentence analysis of the chart.

Figure 6.1: Distribution of unemployment, labour force and working age population by sex

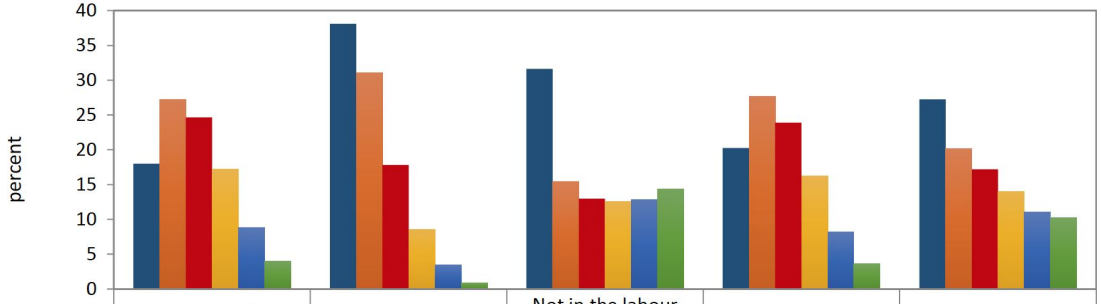


Data Source: Report on the Nepal Labour Force Survey 2017/18

The age profile of persons in each component of Nepal's working-age population

Give a one sentence analysis of the chart.

Figure 3.2: The age profile of persons in each component of the working-age population



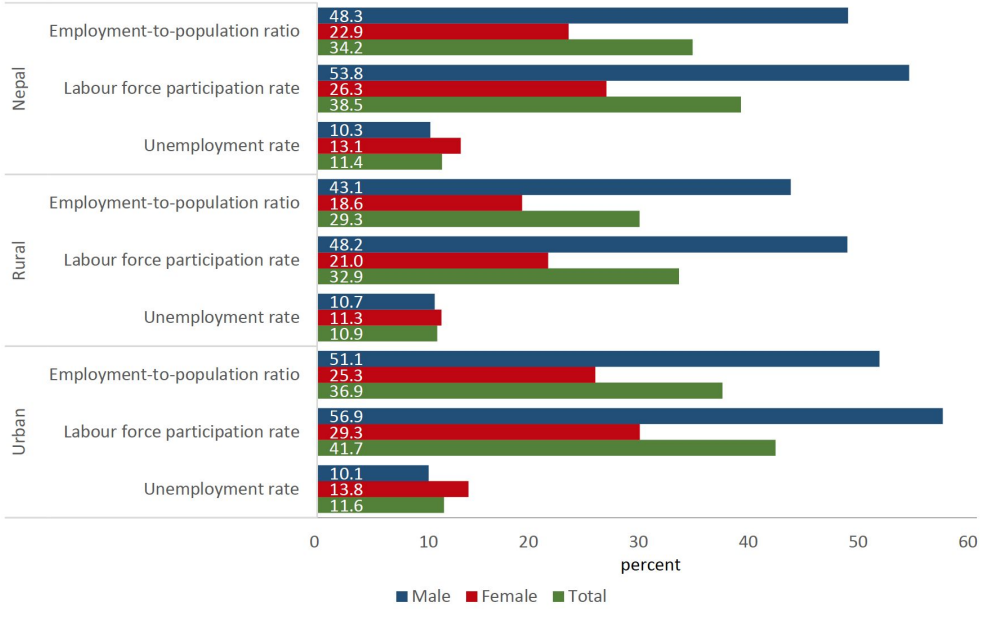
	Employed	Unemployed	Not in the labour force	Labour force	Working age
15-24 yrs	18.0	38.1	31.6	20.3	27.3
25-34 yrs	27.3	31.1	15.5	27.7	20.2
35-44 yrs	24.7	17.8	13.0	23.9	17.2
45-54 yrs	17.3	8.6	12.6	16.3	14.0
55-64 yrs	8.8	3.5	12.9	8.2	11.1
65+ yrs	4.0	0.9	14.4	3.7	10.3

Data Source: Report on the Nepal Labour Force Survey 2017/18

Key labour market indicators by sex and locality in Nepal

Give a one sentence analysis of the chart.

Figure 3.4: Key labour market indicators by sex and locality



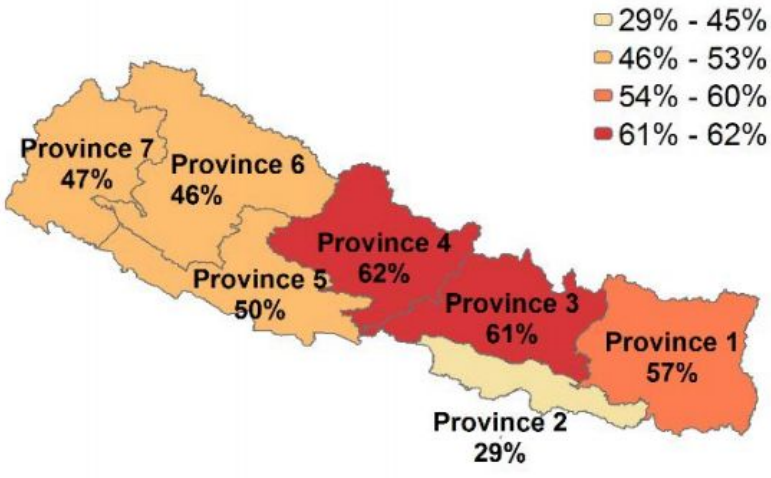
Source: Report on the Nepal Labour Force Survey 2017/18

Secondary Education in Nepal

Give a one sentence analysis of the chart.

Figure 3.2 Secondary education by province

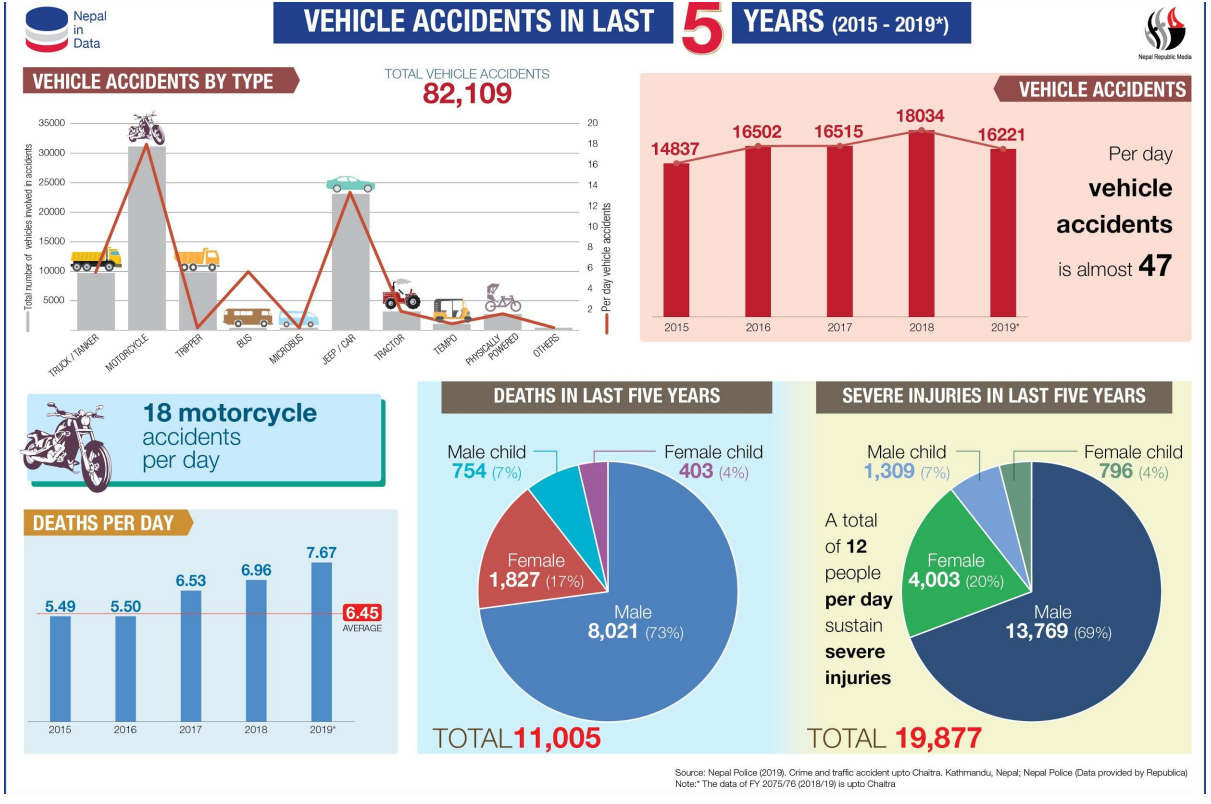
Percentage of women age 15-49 with secondary education complete or higher



Source: National Demographic and Health Survey 2016

Vehicle Accidents in Nepal for 5 years

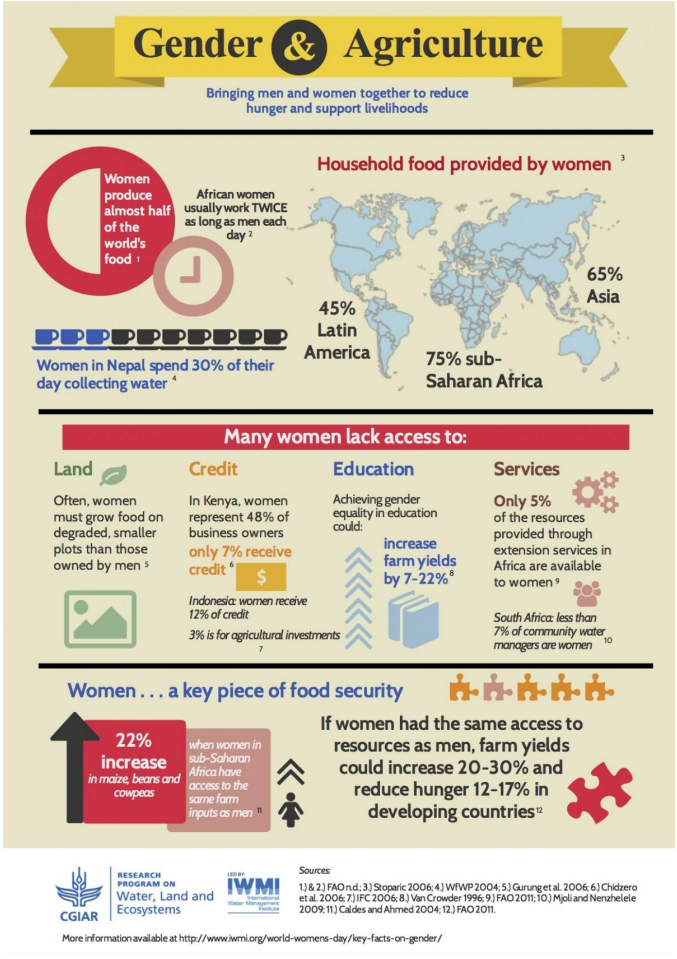
Give a one sentence analysis of the chart.



Source; [Nepal in Data]

Lab 9:Summarizing Gender and Agriculture.

Give a fresh insight Headline to this infographic



[Data Source: Research Program on Water, land and Ecosystem]

Questions