Module: Introduction to Statistics

Module Outline

- Introduction
- Where do data come from?
- Types of variables
- Visual representations of data

Statistics: Introduction

- Social science questions:

  Normative: "What ought to be"

  Positive: "What is"

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- Social science questions:

  Normative: "What ought to be"

  Positive: "What is"

- Answering "What is" question:

  (a) *theory*

  (b) *empirical* i.e. using data i.e. **statistics**

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- *Make predictions:* can provide competitive advantage
- *Age of "big data"*

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- *Examples*:

  What web-pages is a consumer viewing?

  Police records: number of crimes in a city

  OECD/World Bank Macroeconomic data

  TV Ratings...........

THE WORLD BANK

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- *Examples*:

  Canadian Labour Force Survey

  Current Population Survey (US)

  many, many COVID-related surveys

  Electoral Polls (e.g. 338canada.com.......)

  Opinion surveys (e.g. Pew Research Center..........)

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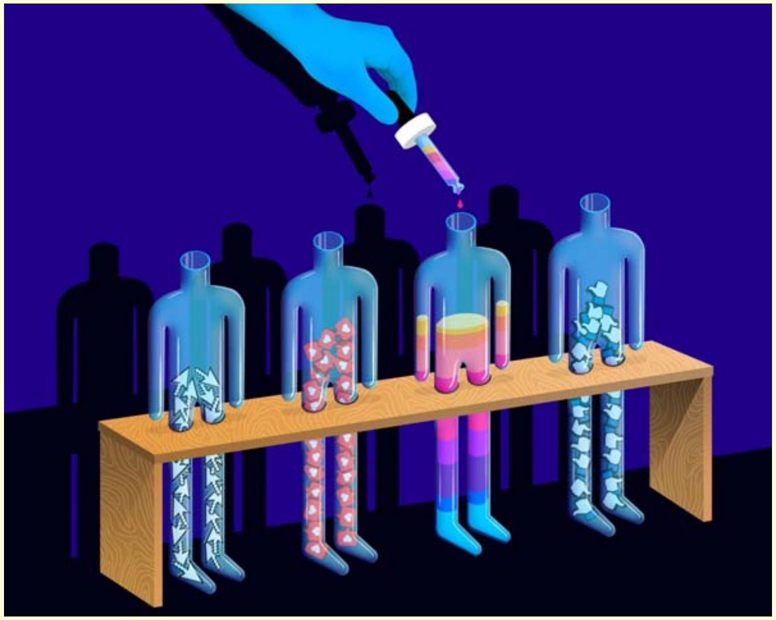
- (i) Collection/observation (ii) Surveys
- (iii) **Experiments**



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- (i) Collection/observation (ii) Surveys
- (iii) **Experiments**
- *Examples*:

  Lab experiments: In the lab.

  Field experiments: In real life settings

  Natural experiments: Takes advantage of a natural/policy occurrence

Variables and data

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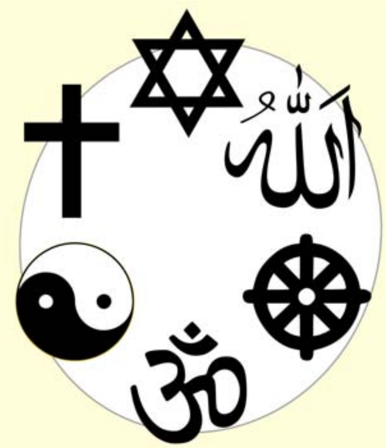
  Amount of rainfall, snowfall, water level,....

  Number of protests, votes, crime rate,......



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- *3 elements*:
  - What is it? *description*
  - Unit of measurment? *cm / feet, $ (CAD / US), number,....*
  - Unit of observation? *per day, per month, city, village,.....*

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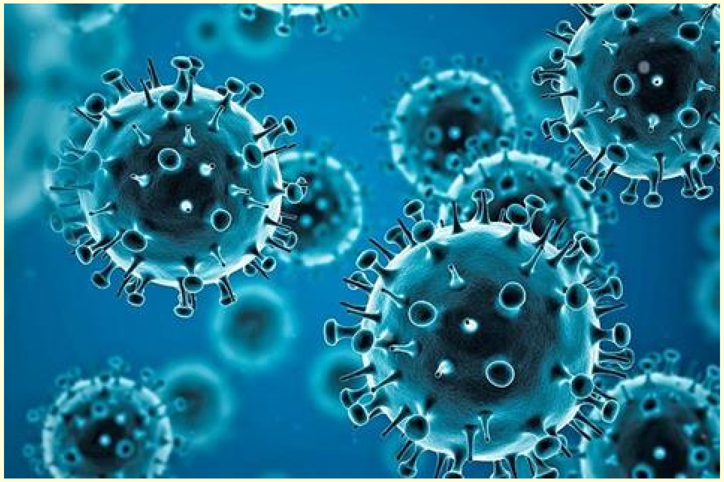

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- Data (*over past 7 days*: Dec. 7, 2021):

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Types of Variables

Quantitative (numeric)	**Qualitative (categorical)**
Data is numeric	Data is categorical
Examples:	*Examples*:
income, rainfall, cases,....	religion, major, opinion,....

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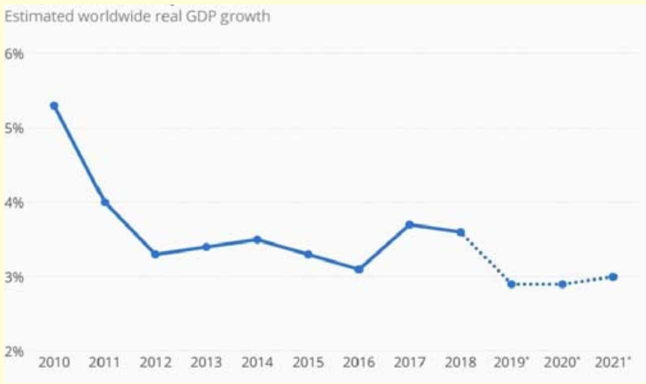
  Fraction of the population vaccinated......



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- *Discrete to continuous*: e.g. number of crimes and crime-rate

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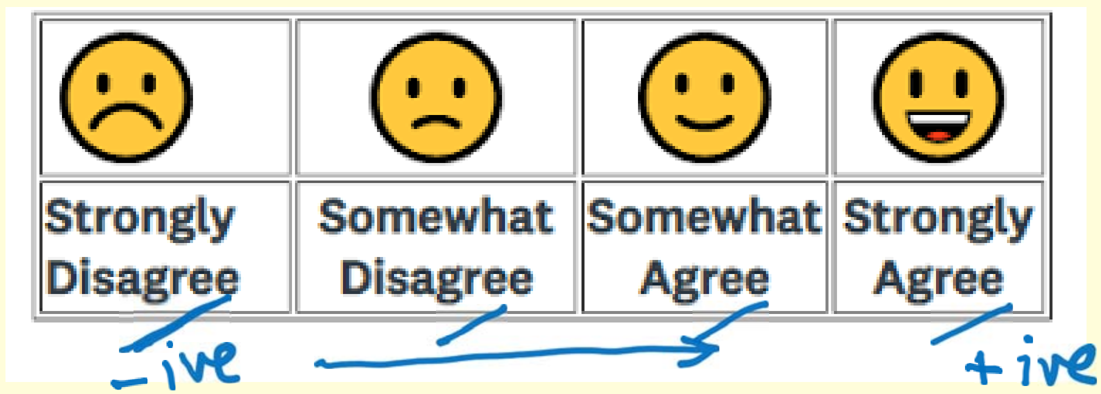

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- *Examples*:

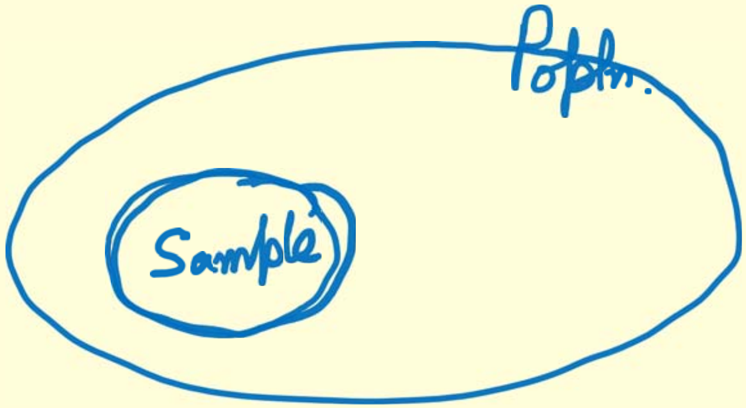
  Religion: Catholic, Muslim, Jewish, Hindu,......

  Major: Biology, Economics, Geography, Sociology,.......

Distinction between Population and Sample

- *Population* : entire unit of study

  Sample : a subset of the population



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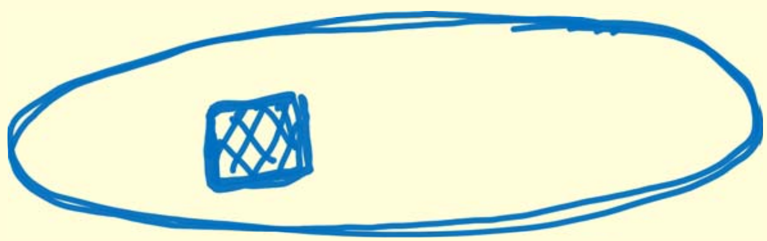
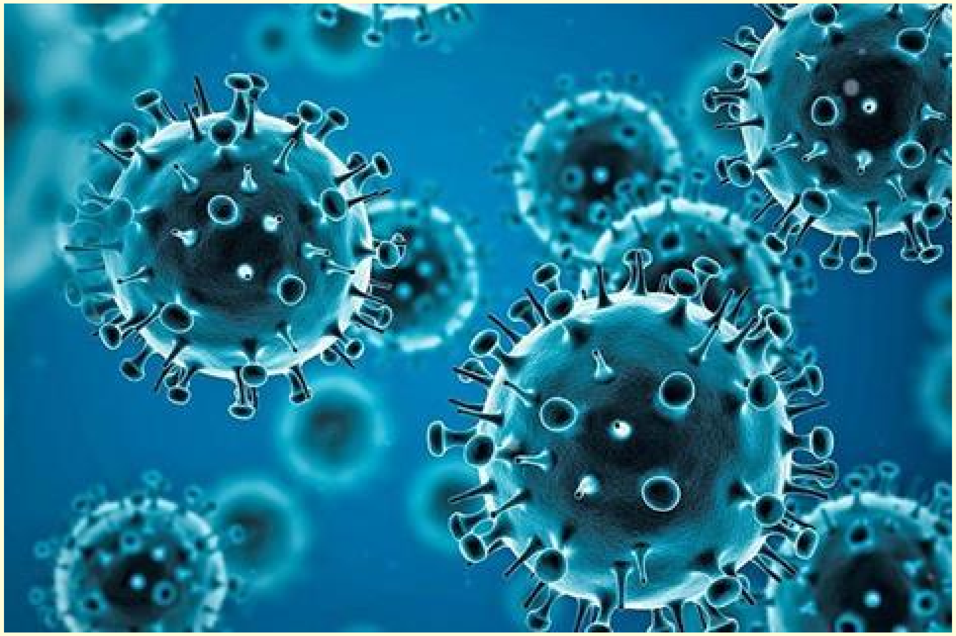
- Question: how to present/analyze the data? + how to make **inferences about the population**?.



Getting a sense of the data visually

- X is a **qualititative / categorical variable** e.g. vaccination status of Covid cases in ON on Dec. 7, 2021



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- *Frequency distribution:*

Unvaccnd.	Partially vaccnd.	Fully vaccnd.	Unknown status
424	26	401	77

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- Bar graph / Column chart

Getting a sense of the data: Column chart / Bar Graph

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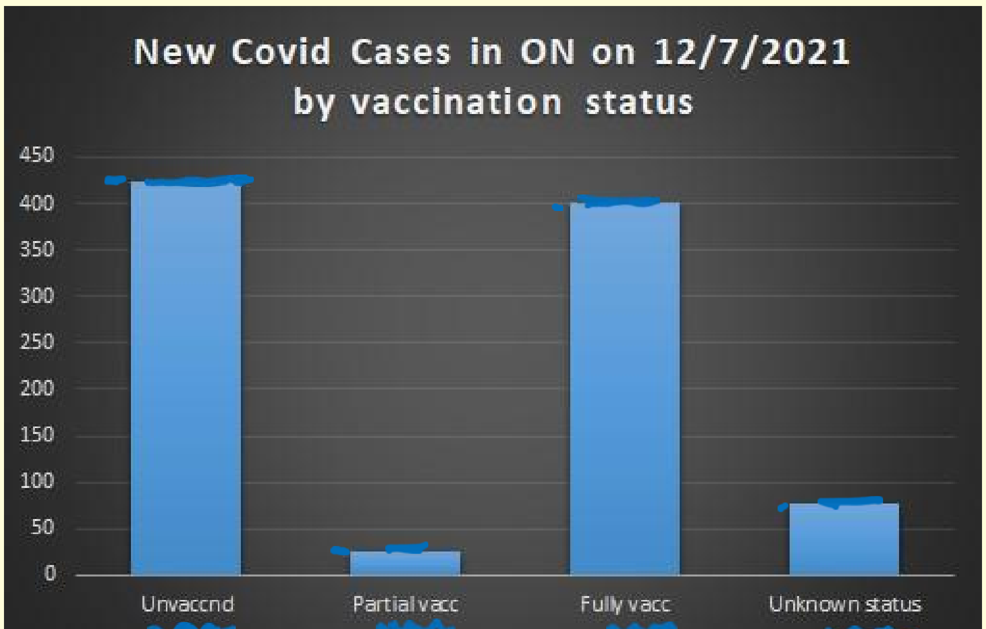
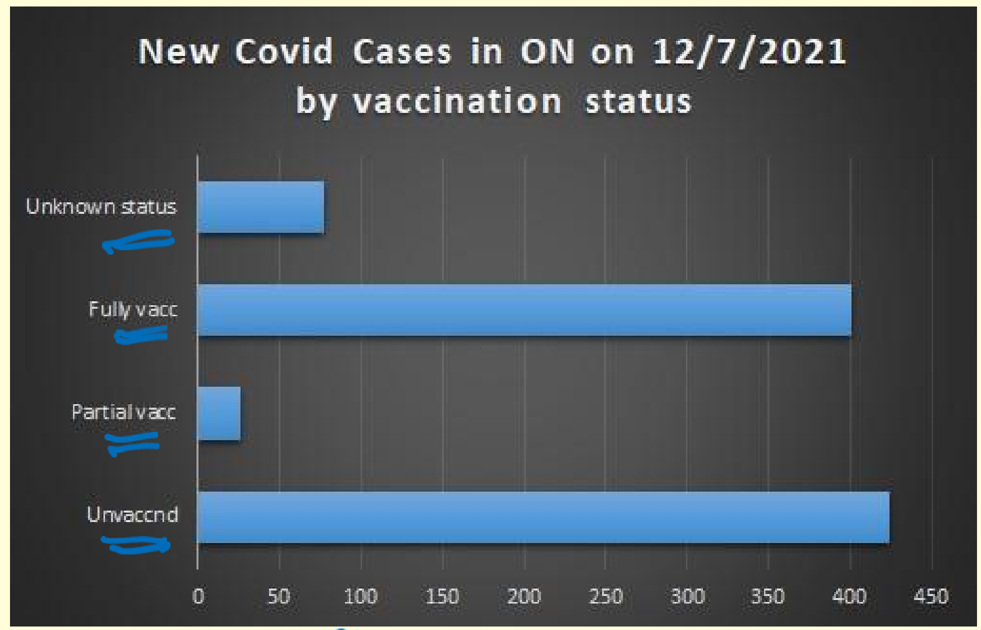


Column chart



Bar

Warning: Be careful with statistics

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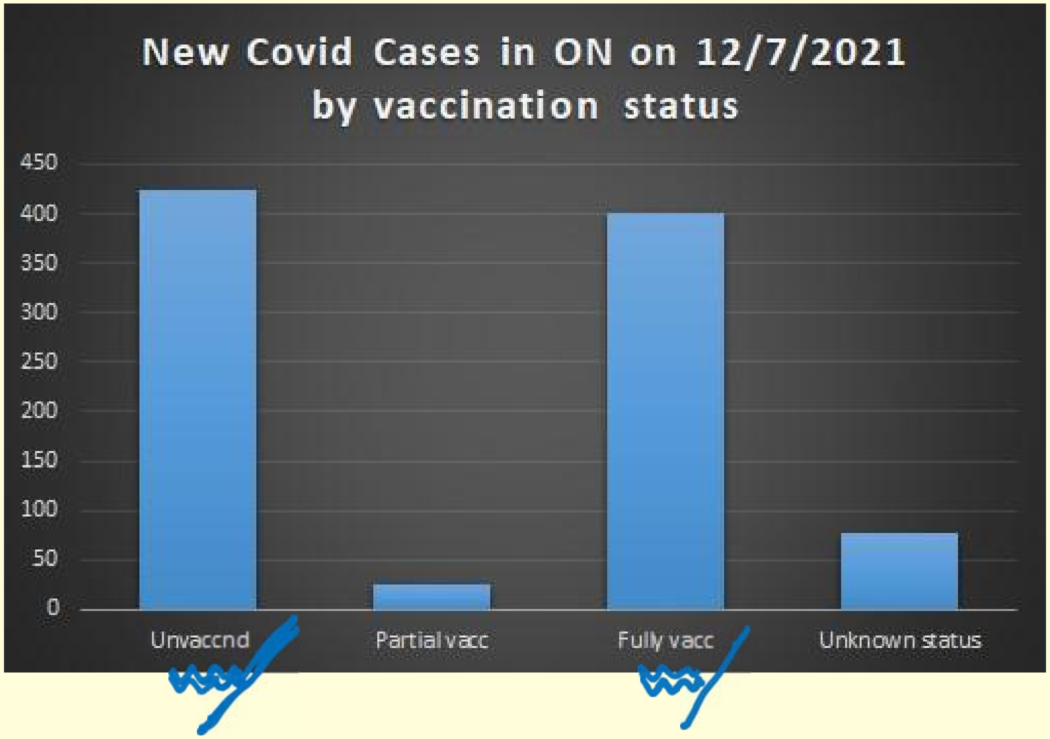

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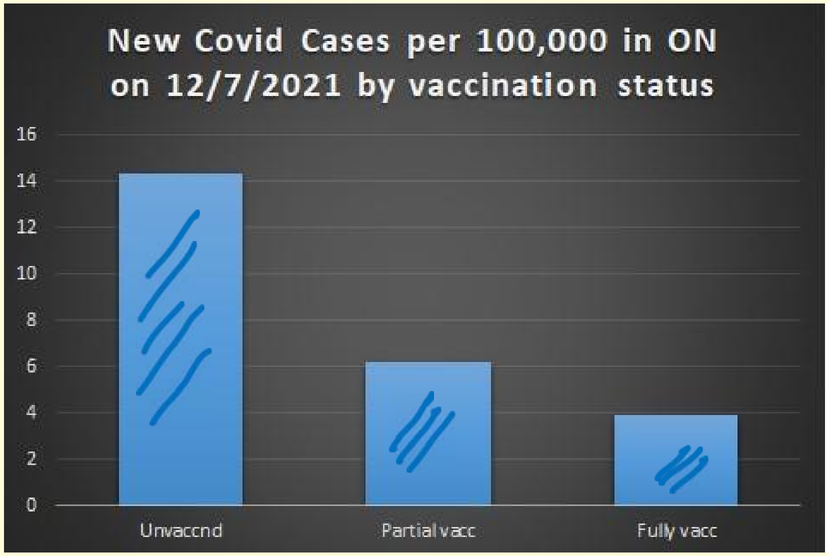
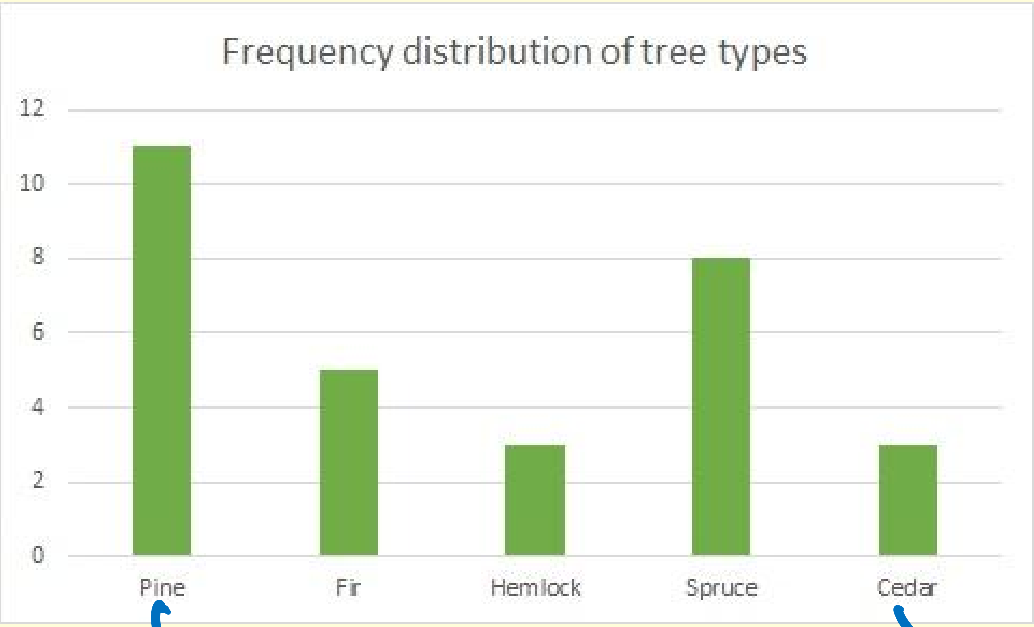


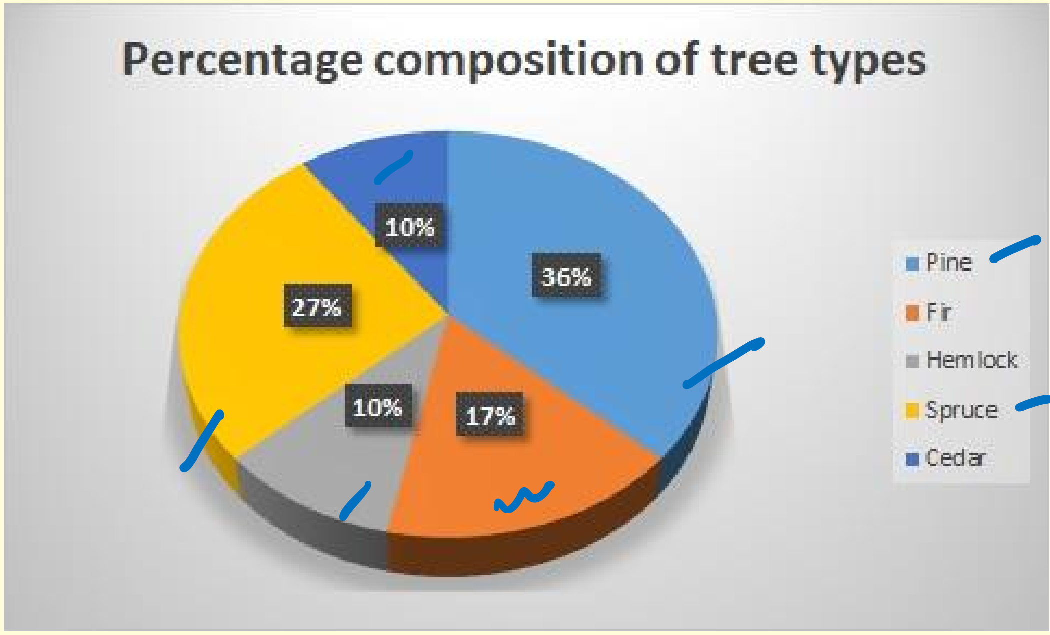
How to create a Column chart / Bar Graph using Excel?

- 3 examples:
  - Frequency distribution already given
  - Create a frequency distribution from data
  - *Pie chart*: shows composition as percentages

Ways of visually presenting data on a qualitative variable

- X is a **qualititative / categorical variable**
- *Bar graph / Column chart*: Frequency distribution
- *Pie chart*: Percentage composition





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- What if 2 or more qualitative variables? *e.g. data on different types of crimes, by province*

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- *Pie chart*: Percentage composition
- What if 2 or more qualitative variables? *e.g. data on different types of crimes, by province*
- Use **grouped bar/column charts** or

  stacked bar/column charts

Ways of visually presenting data on a Quantitative variable

- So far: X is a **qualititative / categorical variable**

  Examples: $X =$ type of tree, type of crime, subject major

- Now: **quantitative / numeric variable**

  Examples: $X =$ a person's income

  $X =$ a country's GDP per capita

  $X =$ height of a tree, $X =$ rainfall level

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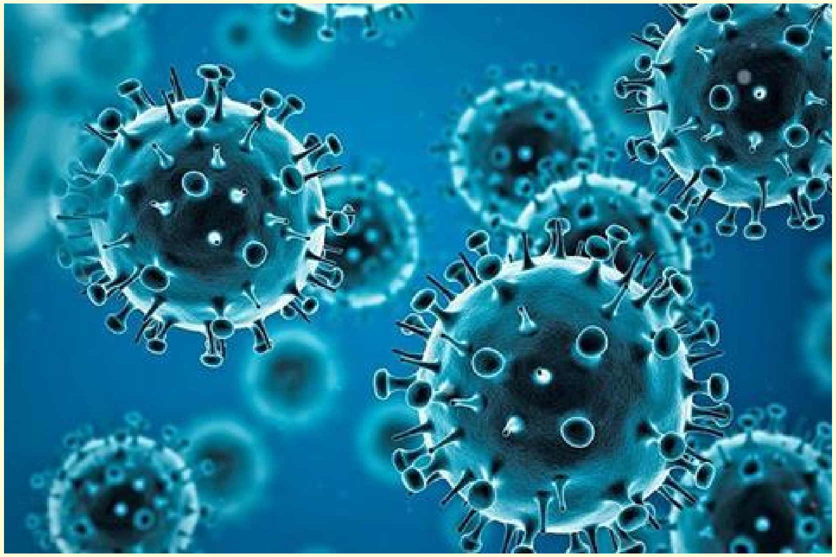

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- **Q:** *Trend*? Plot over time

Quantitative variable: Time trends

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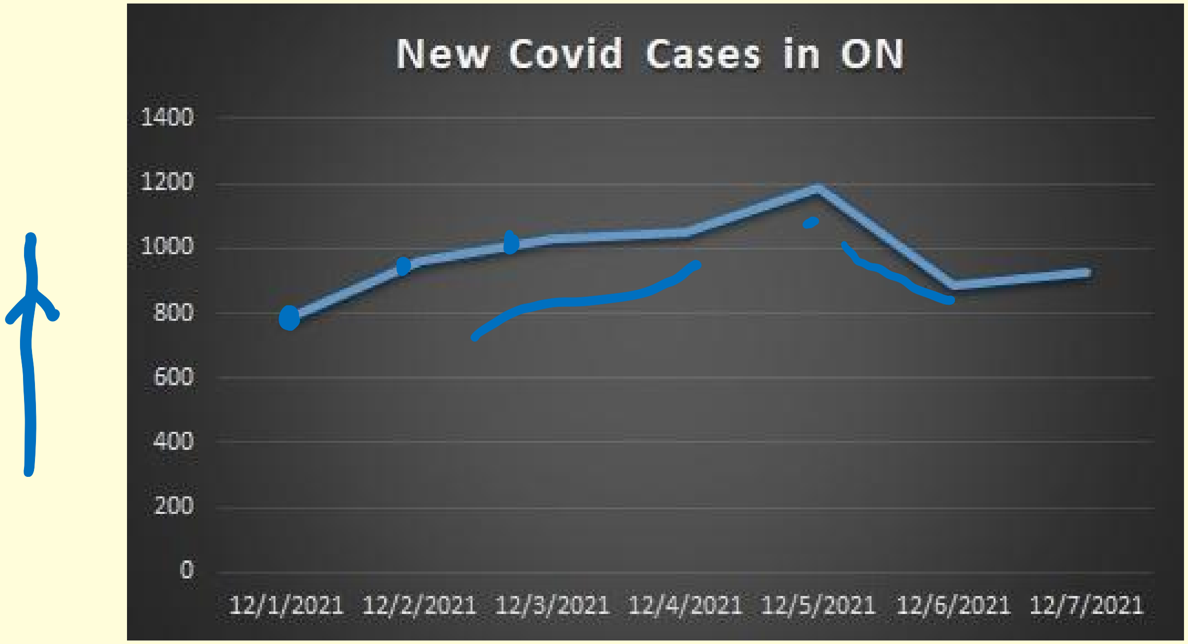

time

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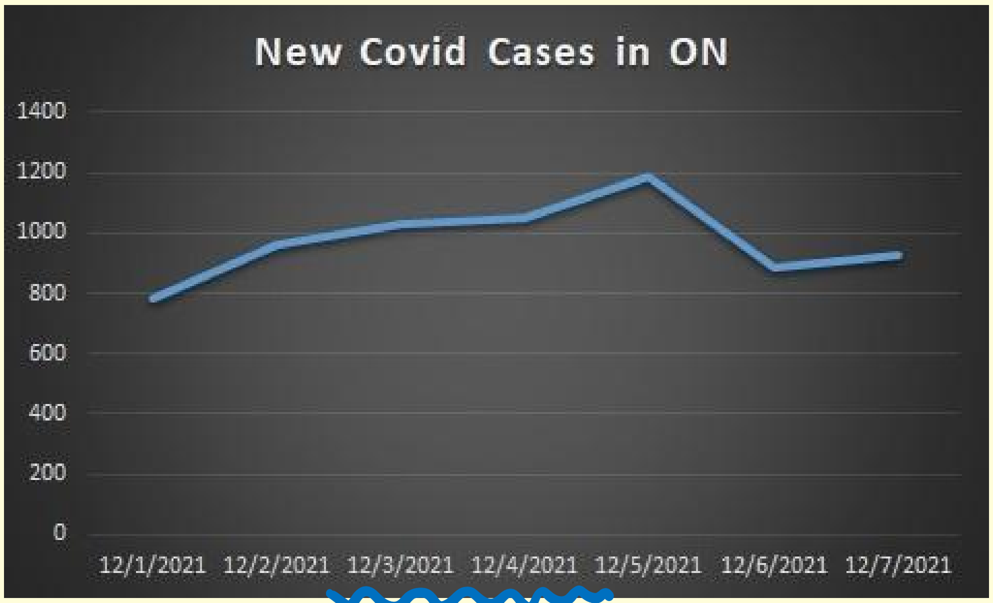
- **Q:** *Trend* : Relationship between time and X



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- **Q:** *Trend* : Relationship between time and X

- *Other examples of trends*:

  GDP, population, immigration,.......over the years

  Sales, profits,.....over days / months / quarters

Plotting Time trends in Excel

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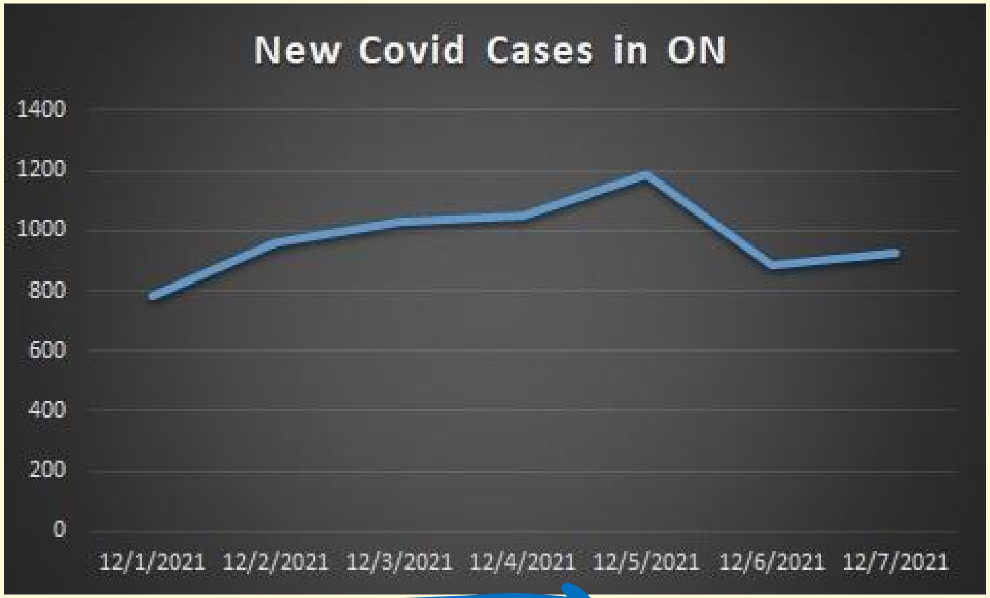
Use **Line Plot**



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  Use **Line Plot**

- *If Excel does not recognize a Date variable*:

  Use "Select Data" and change "Horizontal Axis Labels"

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- Example: X = yearly GDP per capita

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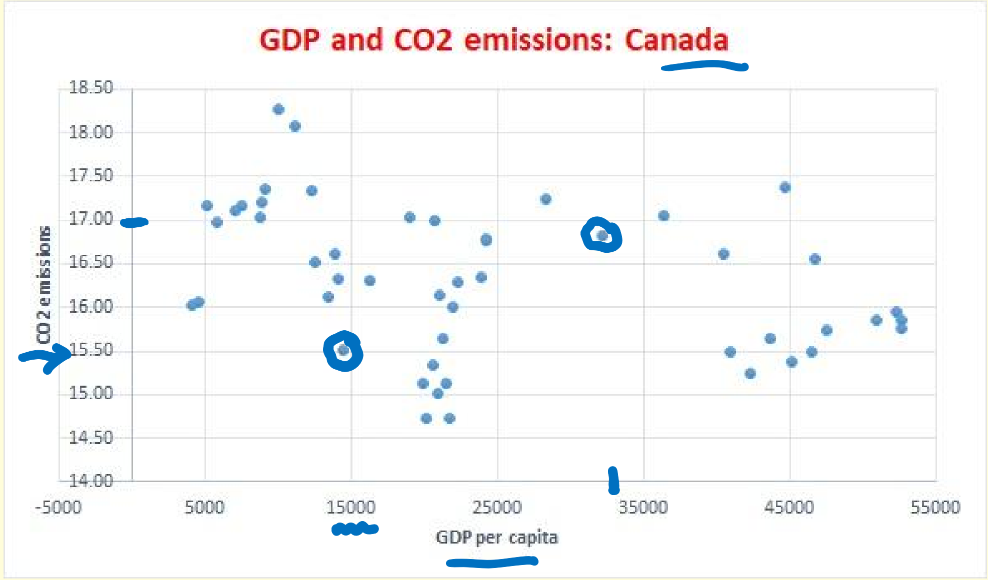
1970 → X Y
1971 X Y
1972 X Y
⋮
2018



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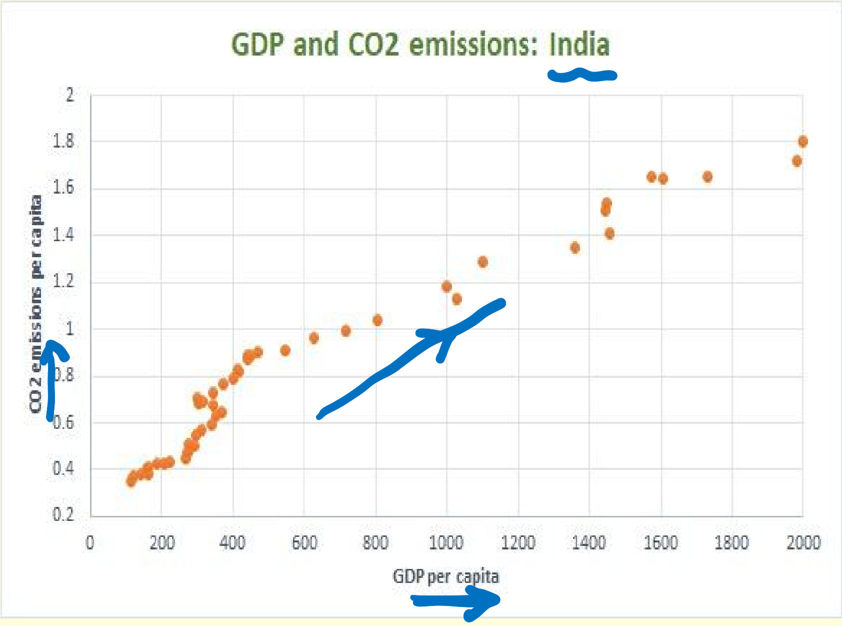

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- Adjust to make the plot easier to analyze

Quantitative variable: Showing its distribution

- *Example*: Marks in a class, tree heights in a forest, CO_2 emissions by countries, incomes in a country

  Q: How are these distributed?

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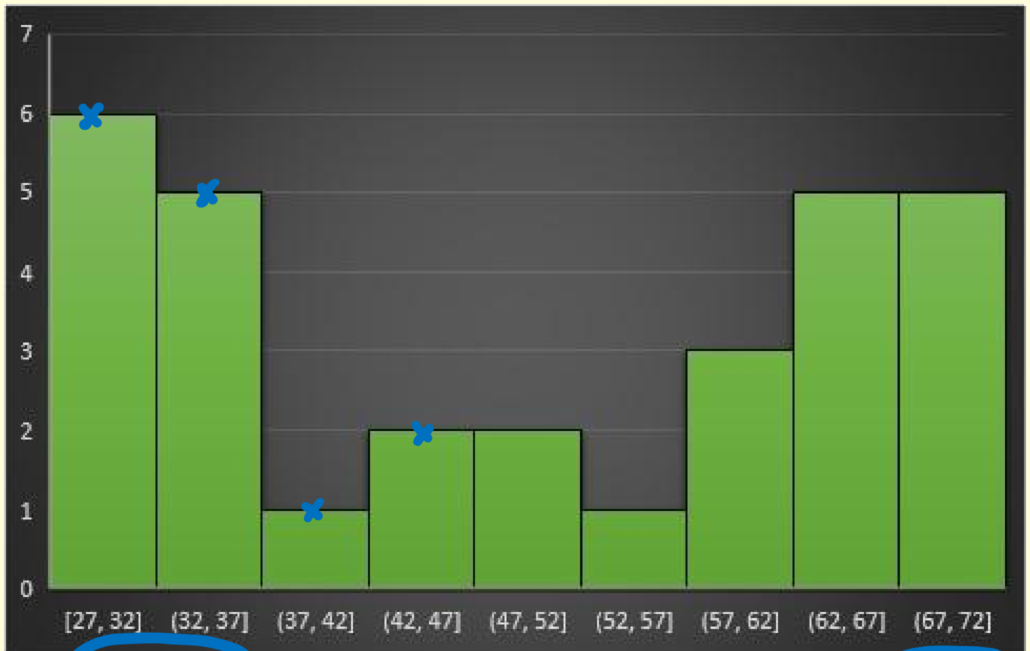
- *Histogram*:

  Create *equal sized* bins,

  and then look at the frequency in each bin

Creating a Histogram in Excel

- *Histogram*: automatic command OR



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- *Histogram*: automatic command OR
- Create *equal sized* bins (not too many, not too few)
- Get frequencies for each bin, and then plot bars relative to the frequency of each bin (no gaps)

Module Conclusion

- Introduction to data and variables
- Types of variables: *Qualitative* (*categorical*) OR *Quantitative* (*numeric*)
- Visual representations of data:

  Categorical variable: bar/column chart (grouped/stacked), pie chart (for percentages)
- *Numeric variable*: Line plot, scatter plot, Histogram