Monday Group Presentation on Missing Data

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Overview

1. Missing data
   - Types of Missing Data
   - Why it is important
   - Common ways to deal with missing data
2. Methods

Types of Missing Data

supposed you want to model weight Y as a function of gender X and you do a survey asking for Y and X, in the end there are some missing values(data point missing or data attribute missing), below are possible scenarios,

- Missing completely at random(MCAR)
  No particular reasons why the data is missing, such as, it can be someone dropped the survey paper, hard recognizable hand-writting, etc. (data are rarely MCAR)
- Missing at random(MAR)
  It can happen that one gender X would less likely to disclose their weight information than the other.
- Missing not at random(MNAR)
  Missing value itself is related to why it is missing, e.g. a person with higher weight Y would more likely not fill out the weight blank on survey.

why it is important

- Easy to occur very common

	Division		
	Alpha	Bravo	Charlie
Sales		$ 11,500,000	
Net operating income		$ 920,000	$ 210,000
Average operating assets	$ 800,000		
Margin	4 %	%	7 %
Turnover	5		
Return on investment (ROI)	%	20 %	14 %

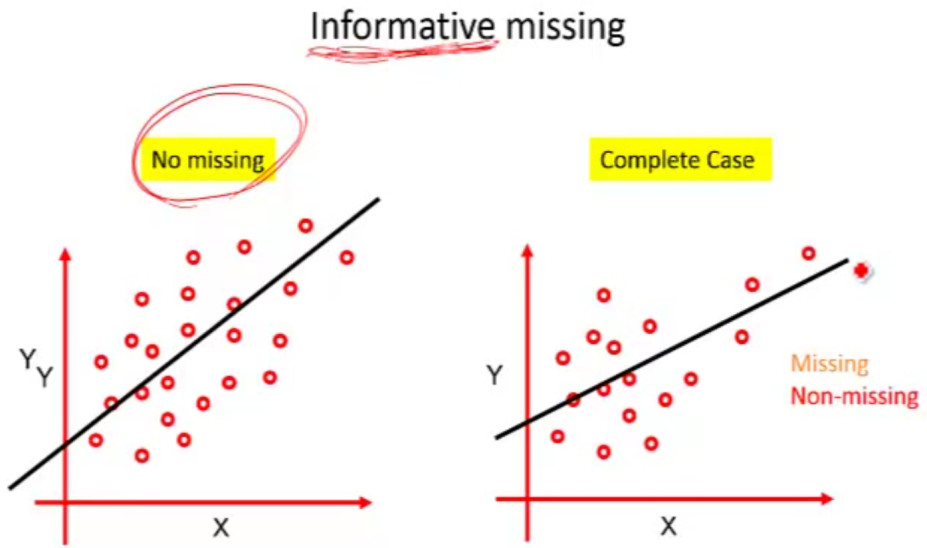
- Nearly all standard statistical methods presume complete information for all the variables included in the analysis; Machine learning models need to have complete input.[Wiki, C4.5]

Improvements from ID.3 algorithm [edit]

C4.5 made a number of improvements to ID3. Some of these are:

- Handling both continuous and discrete attributes - In order to handle continuous attributes, C4.5 creates a threshold and then splits the list into those whose attribute value is above the thresh
- Handling training data with missing attribute values - C4.5 allows attribute values to be marked as ? for missing. Missing attribute values are simply not used in gain and entropy calculations.
- Handling attributes with differing costs.
- Pruning trees after creation - C4.5 goes back through the tree once it's been created and attempts to remove branches that do not help by replacing them with leaf nodes.

- Create bias [Missing Data Analysis]



1. Loss of statistical power
2. Regression slope is biased

Common ways to deal with missing data

A quick summary before we introudce dealing methods, [Computerphile]

- Listwise deletion (or complete case analysis)
- Imputation methods
- Multiple Imputation
- Maximum Likelihood
- Bayesian simulation methods
- Hot deck imputation methods

Listwise deletion

Subject	Age	Gender	Income
1	29	M	$40,000
2	45	M	$36,000
3	81	M	--missing--
4	22	--missing--	$16,000
5	41	M	$98,000
6	33	F	$60,000
7	22	F	$24,000
8	--missing--	F	$81,000
9	33	F	$55,000
10	45	F	$80,000

– picture from Wiki

Advantage:

- Easy to implement, no special computation metod requires
- It is valid if the missing data is MCAR
- If the proportion of deleted data is small, e.g. $< 5\%$

Disadvantage:

- Can exclude a large portion of data
- Missing data are MCAR rarely happens in reality
- Introduce bias

References


C4.5: https://en.wikipedia.org/wiki/C4.5_algorithm


Missing Data Analysis: https://www.youtube.com/watch?v=QAvSj2TWZy0


The Trouble with Missing Data
https://www.youtube.com/watch?v=oCQbC818KKU