National University of Computer & Emerging Sciences, Karachi

Spring 2017/18 CS-Department

Midterm 1

26th May 2018, 10:30 am – 11:30 am

Course Code: CS481	**Course Name:** Data Science
Instructor Name: Dr Muhammad Atif Tahir	
Student Roll No:	**Section No:**

Instructions:

- Return the question paper.
- Read each question completely before answering it. There are 2 **questions and 1 page**
- In case of any ambiguity, you may make assumption. But your assumption should not contradict any statement in the question paper.
- Show all steps clearly.

Time: 60 minutes. **Max Marks**: 10 points

Question 1: Briefly answer the following questions. Each question should be answered in 3 – 4 lines including articles. Otherwise, answer will not be checked. [4 Points]

a) What is data science?

Ans: Data science is an interdisciplinary field about processes and systems to extract knowledge or insights from data in various forms. (Wikipedia)

Data Science closes the circle from collecting real-world data, to processing and analyzing it, to influence the real world again

b) Briefly discuss any two issues to consider during data integration.

Answer: Data integration involves combining data from multiple sources into a coherent data store. Issues that must be considered during such integration include: • Schema integration: The metadata from the different data sources must be integrated in order to match up equivalent real-world entities. This is referred to as the entity identification problem. • Handling redundant data: Derived attributes may be redundant, and inconsistent attribute naming may also lead to redundancies in the resulting data set. Duplications at the tuple level may occur and thus need to be detected and resolved. • Detection and resolution of data value conflicts: Differences in representation, scaling, or encoding may cause the same real-world entity attribute values to differ in the data sources being integrated.

c) What are the main steps of Data transformation (Any 2 are good)

Aggregating data
Extrapolating data
Derived measures
Creating dummies
Reducing number of variables

d) Discuss 2 ways to handle missing data

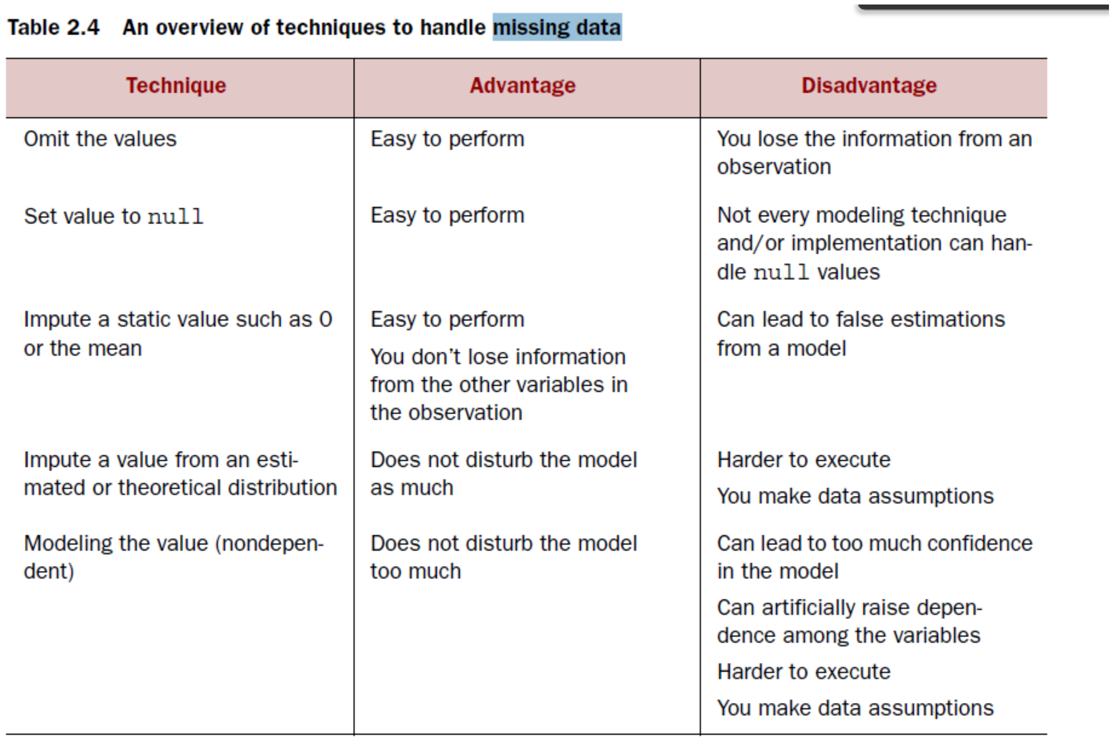


Table 2.4 An overview of techniques to handle missing data

Technique	Advantage	Disadvantage
Omit the values	Easy to perform	You lose the information from an observation
Set value to `null`	Easy to perform	Not every modeling technique and/or implementation can handle `null` values
Impute a static value such as 0 or the mean	Easy to perform You don't lose information from the other variables in the observation	Can lead to false estimations from a model
Impute a value from an estimated or theoretical distribution	Does not disturb the model as much	Harder to execute You make data assumptions
Modeling the value (nondependent)	Does not disturb the model too much	Can lead to too much confidence in the model Can artificially raise dependence among the variables Harder to execute You make data assumptions

Or

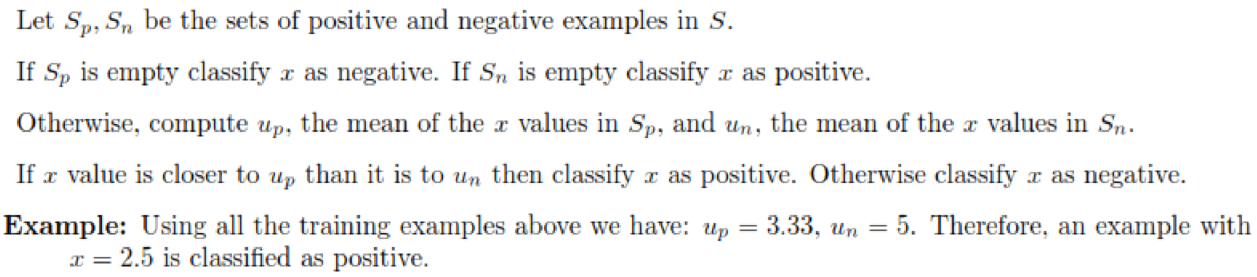
1. Select TWO ways to handle missing data
   a. **Delete instances with missing values**
   b. **Replace with mean value etc**

Question 2: You are given the following training examples. Each example has only one attribute, and the classification into positive / negative **[6 Points]**

Index	*X*	*Label*
1	*1.0*	*Positive*
2	*2.0*	*Negative*
3	*4.0*	*Positive*
4	*5.0*	*Positive*
5	*6.0*	*Negative*
6	*7.0*	*Negative*

Your main task is to evaluate the following algorithm that use a set *S* of training examples to classify the example with attribute value of *x.*

Algorithm:



Let S_p, S_n be the sets of positive and negative examples in S.

If S_p is empty classify x as negative. If S_n is empty classify x as positive.

Otherwise, compute u_p, the mean of the x values in S_p, and u_n, the mean of the x values in S_n.

If x value is closer to u_p than it is to u_n then classify x as positive. Otherwise classify x as negative.

Example: Using all the training examples above we have: $u_p = 3.33$, $u_n = 5$. Therefore, an example with $x = 2.5$ is classified as positive.

(a) Use leave-one-out cross validation to estimate the errors of Algorithm above [3 Points]
(b) Use 3 Fold CV to estimate the errors of Algorithm above. [3 Points]

Solution (a) Error = 0.5;
Example a: test, 1.0 +ve; Sp={4,5}, Sn={2,6,7}, thus mean(p) = 4.5; mean(n) = 5, Thus 1 is near to mean(p). Correct

Example b: test, 2.0 -ve; Sp={1,4,5}, Sn={6,7}, thus mean(p) = 3.33; mean(n) = 6.5, Thus 2 is near to mean(p). Incorrect
Example c: test, 4.0 +ve; Sp={1, 5}, Sn={2, 6,7}, thus mean(p) = 3; mean(n) = 5, Thus 4 is near to both. Tie. Incorrect
Example d: test, 5.0 +ve; Sp={1, 4}, Sn={2, 6,7}, thus mean(p) = 2.5; mean(n) = 5, Thus 5 is near to mean(n). Incorrect
Example e: test, 6.0 -ve; Sp={1, 4, 5}, Sn={2, 7}, thus mean(p) = 3.33; mean(n) = 4.5, Thus 6 is near to mean(n). Correct

Example f: test, 7.0 -ve; Sp={1, 4, 5}, Sn={2, 6}, thus mean(p) = 3.33; mean(n) = 4, Thus 7 is near to mean(n). Correct

Index	*X*	*Label*	*Predicted*	*Mean*
A	*1.0*	*Positive*	*Positive*	*4.5,5*
B	*2.0*	*Negative*	*Positive*	*3.33, 6.5*
C	*4.0*	*Positive*	*Negative / Positive*	*3,5*
D	*5.0*	*Positive*	*Negative*	*2.5,5*
E	*6.0*	*Negative*	*Negative*	*3.33,4.5*
F	*7.0*	*Negative*	*Negative*	*3.33,4*

Solution (b)

Index	*X*	*Label*
A	*1.0*	*Positive*
B	*2.0*	*Negative*
C	*4.0*	*Positive*
D	*5.0*	*Positive*
E	*6.0*	*Negative*
F	*7.0*	*Negative*

b. Use 3 Fold CV to estimate the errors of Algorithm above.) [3 Points]

Ist Fold; train.index = {A,B,C,D} ; test.index = {E,F} => train.sample ={1,2,4,5}; test.sample = {6,7}
SP = {1,4,5}, Sn = {2}, mean(p) = 3.33; mean(n) = 2. Both {6,7} i.e. E, F near to positives thus both examples incorrect

2st Fold; train.index = {A, B, E, F} ; test.index = {C,D} => train.sample ={1,2,6,7}; test.sample = {4,5}
SP = {1}, Sn = {2,6,7}, mean(p) = 1; mean(n) = 3. 4 and 5 near to 3 thus both incorrect

3rd Fold; train.index = {C, D, E, F} ; test.index = {A,B} => train.sample ={4, 5, 6, 7}; test.sample = {1,2}
SP = {4,5}, Sn = {6,7} = mean(p) = 4.5, mean(n) = 6.5. One correct and one incorrect

Total Error = 5/6

Index	*X*	*Label*	*Predicted*	*Mean*
A	*1.0*	*Positive*	*Positive*	*4.5, 6.5*
B	*2.0*	*Negative*	*Positive*	*4.5, 6.5*
C	*4.0*	*Positive*	*Negative*	*1.0,3.0*
D	*5.0*	*Positive*	*Negative*	*1.0, 3.0*
E	*6.0*	*Negative*	*Positive*	*3.33, 2*
F	*7.0*	*Negative*	*Positive*	*3.33,2*

BEST OF LUCK!