ITCS451, Semester 1/2020 **Mini Project**

Bayesian Networks

Group members:

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1. Description of the problem you are modeling.
   We use Bayesian network to determine which physiochemical make red wine 'good', such as alcohol, chlorides, sulphates, etc.

2. Did you use real data?

   ☑ Yes ☐ No

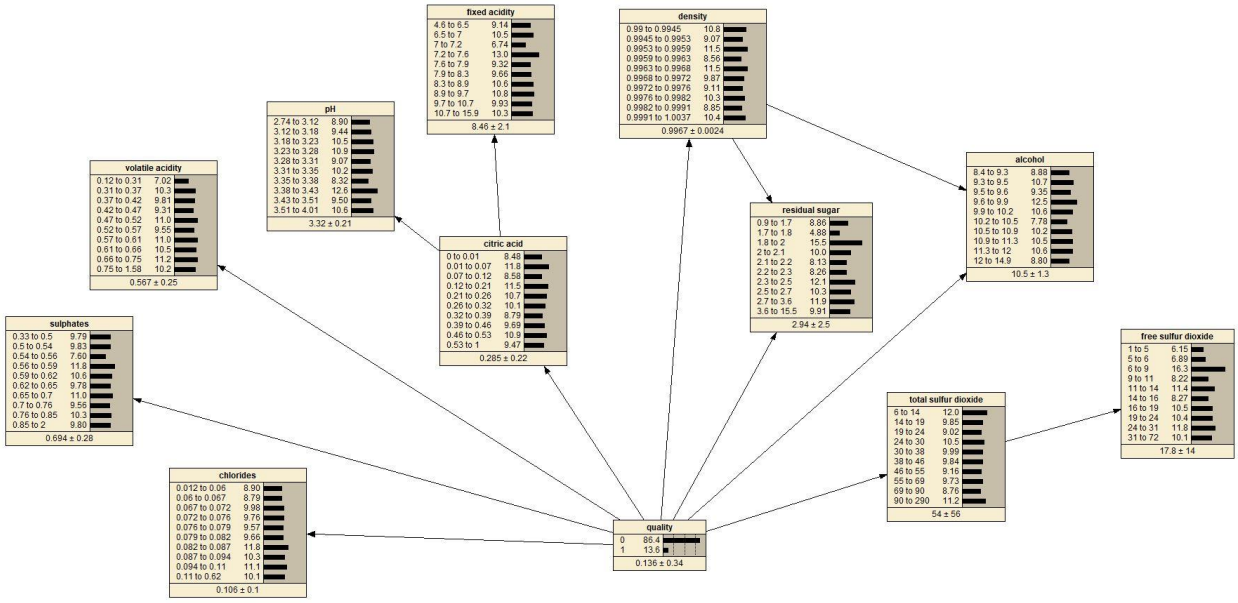
   If yes, describe your data in the following table.

Source of data	https://www.kaggle.com/uciml/red-wine-quality-cortez-et-al-2009
Type of data	☑ raw data ☐ published statistics
Modification to the data (If any)	The 'quality' variable is modified from range (0,9) to (0,1) where 0 is considered as 'not good' (score < 7) and 1 is considered as 'good' (score >= 7)

3. Bayes net description.
   a. Bayes net description

   This Bayesian network determine which physiochemical make red wine 'good'. The nodes represent the factors which are responsible for determining the quality of red wine. The relations are formed based on the description provide below. However, the source of data noted that "Also, we are not sure if all input variables are relevant. So, it could be interesting to test feature selection methods".

b. Bayes net figure



4. Explanation of your network
    a. Node representation

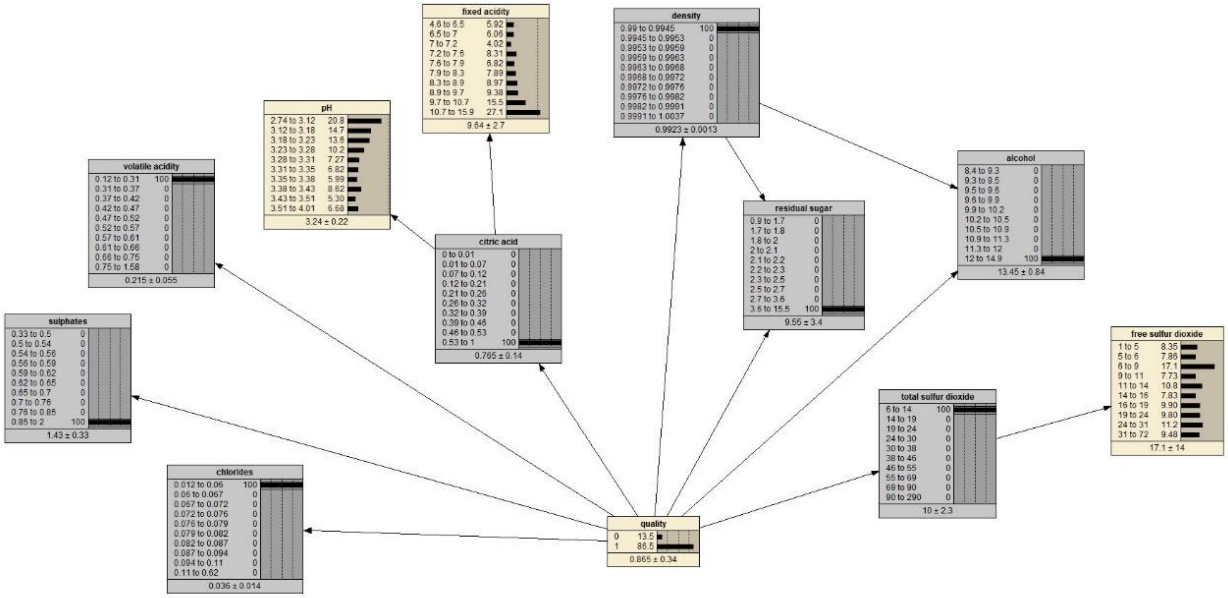
No.	Node Name	Node Description
1.	fixed acidity	Most acids involved with wine or fixed or nonvolatile (do not evaporate readily)
2.	volatile acidity	The amount of acetic acid in wine, which at too high of levels can lead to an unpleasant, vinegar taste
3.	citric acid	Found in small quantities, citric acid can add 'freshness' and flavor to wines
4.	residual sugar	The amount of sugar remaining after fermentation stops, it's rare to find wines with less than 1 gram/liter and wines with greater than 45 grams/liter are considered sweet
5.	chlorides	The amount of salt in the wine
6.	free sulfur dioxide	The free form of SO2 exists in equilibrium between molecular SO2 (as a dissolved gas) and bisulfite ion; it prevents microbial growth and the oxidation of wine

7.	total sulfur dioxide	Amount of free and bound forms of S02; in low concentrations, SO2 is mostly undetectable in wine, but at free SO2 concentrations over 50 ppm, SO2 becomes evident in the nose and taste of wine
8.	density	The density of water is close to that of water depending on the percent alcohol and sugar content
9.	pH	Describes how acidic or basic a wine is on a scale from 0 (very acidic) to 14 (very basic); most wines are between 3-4 on the pH scale
10.	sulphates	A wine additive which can contribute to sulfur dioxide gas (S02) levels, which acts as an antimicrobial and antioxidant
11.	alcohol	The percent alcohol content of the wine
12.	quality	Output variable, based on sensory data (0 = 'not good', 1 = 'good')

6. Two examples of inference: Enter some evidence and show the updated probabilities of the main hypothesis node(s). Explain what each example is showing.
    a. Example1

Evidence: Having 0.012 to 0.06 chlorides (low), 0.85 to 2 sulphates (high), 0.12 to 0.31 volatile acidity (low), 0.53 to 1 citric acid (high), 0.99 to 0.9945 density (low), 3.6 to 15.5 residual sugar (high), 12 to 14.9 alcohol (high), and 6 to 14 total sulfur dioxide (low)

Result: The updated probabilities show that there is a higher chance to get a good quality of wine.



b. Example2

Evidence: Having 0.11 to 0.62 chlorides (high), 0.9991 to 1.0037 density (high), and 8.4 to 9.3 alcohol (low)

Result: The updated probabilities show that there is a lower chance to get a good quality of wine.