**CSU44062 – Computational Linguistics**

**Assignment 1**

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**Question 1**

**(i) implies (ii)**

The definition of conditional probability is:

By re-writing (i) in terms of P(A) we can get:

Therefore we can imply:

Q.E.D

**(ii) implies (ii)**

We can derive the chain rule by re-arranging the definition of conditional probability as stated above to give us:

As shown above we also know that:

Therefore, by substitution we can imply:

**Question 2**

**(a)**

The definition of conditional probability is:

Therefore, for our problem we can write:

From the table we know the following:

Plugging this into the above equation gives us:

**(b)**

The definition of conditional probability is:

Therefore, for our problem we can write:

From the table we know the following:

Plugging this into the above equation gives us:

**Question 3**

**(a)**

Letting *vmel* stand for Speaker = ‘Victor Meldrew’ and *dbi* stand for DBI = true

Given the following:

First, let us calculate . This can be done using the following formula:

From this we can then calculate using the definition of conditional probability as follows:

Following the same structure we can also calculate as follows:

Therefore, from this it is clear that is more likely given *dbi*.

**Question 3**

**(b)**

Given the following:

First, let us calculate . This can be done using the following formula:

From this we can then calculate using the definition of conditional probability as follows:

Following the same structure we can also calculate as follows:

Therefore, in this scenario it is clear that is much more likely given *dbi*.

**Question 3**

**(c)**

Given the following:

First, let us calculate . This can be done using the following formula:

From this we can then calculate using the definition of conditional probability as follows:

Following the same structure we can also calculate as follows:

Therefore, in this scenario it is clear that is much more likely given *dbi*.

**Question 4**

To calculate we can consider the scenarios where it is both cool AND noisy, and the scenarios where it is both cool AND NOT noisy as follows:

To calculate we can use the definition of conditional independence similar to the previous questions as follows:

From the table we can calculate quite simply as:

Similarly, to calculate we can consider the scenarios where it is both noisy AND cool, and the scenarios where it is both noisy AND NOT cool as follows:

Plugging these values back into the formula for conditional independence above gives us:

Two events are independent if , therefore for to be independent of it must satisfy the following:

Therefore, is not independent of .

**Question 5**

**(i) – Using table (2)**

First let us do:

Then find :

Then find :

Now, using these values we can calculate as follows:

Therefore, we can infer that is conditionally independent of given since = .

**ii) – Using table (3)**

First let us do:

Then find :

Then find :

Now, using these values we can calculate as follows:

Therefore, we can infer that is conditionally independent of given since = .