**Probability Revision**

Summary: while integrating two uncertain sources represented by logical expression the probability calculation of the possible worlds of the integrate result is our concern. Previously it has been proven that the probabilities of the two sources are not dependent and there are some constraints which should be met. In real world, there are some situations in which these constraints are not met. In this paper this problem has been addressed and the way to revise the probabilities to meet the constraints has been proposed.

**Positives:**

* The paper is well written and well documented. Writer was able to clearly convey his idea to the readers.
* The problem well defined and.
* The clarity of the definition of closed world assumption and open world assumption makes the definition of compatible possible worlds more clear. In addition it helps to justify the integration process; so far we were thinking of one possible world which is common between two sources as the possible world which implies the same information no matter to which source it belongs. This makes an integration process incorrect. In the sense that all the possible worlds of one uncertain relation are mutually exclusive. So a common possible world cannot be integrated with any other possible worlds except that possible world which is exactly identical to itself. Right now if there are two identical possible worlds, both are giving information about the presence of the same tuples. However, they are talking about the absence of different tuples based on their corresponding tuple set. As a consequence common possible worlds follow the same rule as others in order to integrate with compatible possible worlds.

**Issues:**

* Lacks some examples
* The author doesn’t provide enough supports for his idea.
* We realized that the probability revision doesn’t change the probabilities of the integrated result. It can’t revise the probabilities of the sources permanently either. So meeting that probability constraint is not a must to enable us to compute the probabilities of the integrated result.
* Based on the proposed solution, in the case there is no total confidence in either sources we consider probability factor to revise the probabilities. However, as far as this treatment is defined to be applied on each connected component we can’t guarantee that the revised probabilities results in total confidence in either sources.

Following are the examples to support the issues.

**Example1:**

**S**  **S’**

P (E1) = 0.3 p (E’1) = 0.3

P (E2) = 0.45 p (E’2) = 0.4

P (E3) = 0.25 p (E’3) = 0.3

In the example the sum of the probabilities of both sources is one.

Sum of the probabilities of possible worlds of two sources in each connected component of the compatibility graph is not equal.

In the first connected component:

P (E1) + p (E2) ≠ p (E’1) + p (E’2)

P (E3) ≠ p (E’3)

As both sources have total confidence we can choose either of them as evidence.

Supposed S’ is an evidence so we revise the probabilities of possible worlds and the probabilities of possible worlds of S’ remain unchanged.

Q(E1)=p(E’1)\*p(E1|E’1)+p(E’2)\*p(E1|E’2)= p(E’1)\*(p(E1)/p(E1)+p(E2))\* p(E’2)\*(p(E1)/p(E1)+p(E2))=0.28

Q(E2)=p(E’1)\*p(E2|E’1)+p(E’2)\*p(E2|E’2)= p(E’1)\*(p(E2)/p(E1)+p(E2))\* p(E’2)\*(p(E2)/p(E1)+p(E2))=0.42

Having revised the probabilities of the possible worlds of the first source which are present in the first connected component of the graph we will have:

Q (E1) + Q (E2) =p (E’1) + p (E’2)

Now, we compute the probabilities of the possible worlds of the integrated result before and after probability revision.

**Before probability revision:**

P (E1 ∧ E ‘1) = p (E1 |E’1) \*p (E’1) = 0.3/0.75 \*0.3=0.12

P (E1 ∧ E ‘2) = p (E1 |E’2) \*p (E’2) = 0.3/0.75 \*0.4=0.16

P (E2 ∧ E ‘1) = p (E2 |E’1) \*p (E’1) = 0.45/0.75 \*0.3=0.18

P (E2 ∧ E ‘2) = p (E2 |E’2) \*p (E’2) = 0.45/0.75 \*0.4=0.24

**After probability revision:**

P (E1 ∧ E ‘1) = p (E1 |E’1) \*p (E’1) = 0.28/0.7 \*0.3=0.12

P (E1 ∧ E ‘2) = p (E1 |E’2) \*p (E’2) = 0.28/0.7 \*0.4=0.16

P (E2 ∧ E ‘1) = p (E2 |E’1) \*p (E’1) = 0.42/0.7 \*0.3=0.18

P (E2 ∧ E ‘2) = p (E2 |E’2) \*p (E’2) = 0.42/0.7 \*0.4=0.24

**Observation:** The probabilities of the possible worlds of the integrated result remain the same.

**Question:** Why do we need probability revision?

We can’t revise the probabilities of the sources permanently; the probability revision doesn’t change the probabilities of the possible worlds of the integrated result. The need to apply probability revision for this problem looks nonsense.

The reason is that the proportional probability p (E1) / (pE1) + p (E2) = Q (E1)/Q (E1) + Q (E2) is the same.

**Example2:** This example tries to illustrate the general case addressed in the paper:

**S**  **S’**

P (E1) = 0.2 p (E’1) = 0.1

P (E2) = 0.3 p (E’2) = 0.5

P (E3) = 0.2 p (E’3) = 0.2

None of the sources have total confidence. So we can’t consider one of them as an evidence.

Q(E1)+ Q(E2)=Q(E’1)+Q(E’2)=α (p(E1)+p(E2))+(1- α)(p(E’1)+p(E’2))

α =0.4

Q (E1) + Q (E2) = 0.4(0.5) +0.6(0.6) = 0.56

Q (E3) = Q (E’3) = α\* p (E3) + (1- α)\*p (E’3) = 0.4\*0.2+0.6\*0.2=0.2

P (E1)/ p (E2) = 2/3 -> p (E1) =2/3 p (E2) -> Q (E1) =2/3Q (E2)

Q (E1) + Q (E2) = 0.66 Q (E2) + Q (E2) = 0.56 -> Q(E2)= 0.34 ->Q(E1)=0.22

Q (E’1) + Q (E’2) = 0.4(0.5) +0.6(0.6) = 0.56

P (E’1)/ p (E’2) = 1/5 -> p (E’1) =1/5 p (E’2) -> Q (E’1) =1/5Q (E’2)

Q (E’1) + Q (E’2) = 0.2 Q (E2) + Q (E2) = 0.56 -> Q (E’2) = 0.47 ->Q (E’1) = 0.09

Q (E1) =0.22 Q (E’1)= 0.09

Q (E2) =0.34 Q (E’1)= 0.47

**Before probability revision:**

P (E1 ∧ E ‘1) = p (E1 |E’1) \*p (E’1) = 0.2/0.5 \*0.1=0.04

P (E1 ∧ E ‘2) = p (E1 |E’2) \*p (E’2) = 0.2/0.5\*0.5=0.2

P (E2 ∧ E ‘1) = p (E2 |E’1) \*p (E’1) = 0.3/0.5 \*0.1=0.06

P (E2 ∧ E ‘2) = p (E2 |E’2) \*p (E’2) = 0.3/0.5 \*0.5=0.3

**After probability revision:**

P (E1 ∧ E ‘1) = Q (E1 |E’1) \*Q (E’1) = 0.22/0.56 \*0.09=0.04

P (E1 ∧ E ‘2) = Q (E1 |E’2) \*Q (E’2) = 0.22/0.56 \*0.47=0.18

P (E2 ∧ E ‘1) = Q (E2 |E’1) \*Q (E’1) = 0.09/0.56 \*0.09=0.035

P (E2 ∧ E ‘2) = Q (E2 |E’2) \*Q (E’2) = 0.47/0.56 \*0.47=0.4

**Observation:** In this case where none of the sources we started with have total confidence the probabilities of the integrated result before and after the revision are different. However, we can’t get the total confidence for the probabilities of the integrated result. After revision still we can observe some gaps in probability distribution of sources we started with and either in probability distribution of the integrated result.