A Possible Crude way to measure Rational Thought using Maths

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1 Newcomb's Problem

Newcomb's Problem is a thought experiment proposed by William Newcomb; the problem follows this structure:

Two boxes are designated A and B. The player is given a choice between taking only box B or taking both boxes A and B. The player knows the following:

- Box A is transparent, or open, and always contains a visible £1,000.
- Box B is opaque, or closed, and its content has already been set by the predictor:
    - If the predictor has predicted that the player will take both boxes A and B, then box B contains nothing.
    - If the predictor has predicted that the player will take only box B, then box B contains £1,000,000.

Figure 1 explains the different outcomes of this problem.

The player does not know what the predictor predicted or what box B contains while making the choice.

Using this problem, you can categorise two types of players: One-Boxers (players who only pick box B) and Two-Boxers (players who picked both boxes).

Figure 1:

Predicted Choice / Actual Choice	A + B (B has £0)	B (B has £1,000,000)
A+B	£1,000	£1,001,000
B	£0	£1,000,000

2 Links to Decision Theory

Expected utility: Due to the high accuracy of the predictor, it can seem that it is not realistically open to the player to make a choice that the predictor did not predict. Considering the expected

utility in such conditions, the player should choose to take only box B. This choice, statistically maximizes the player's winnings, resulting in approximately £1,000,000 per game.

Strategic dominance: Since the predictor has already made its prediction, it can seem that choosing both boxes A and B will always yield £1,000 more than only choosing B, and that if this turns out to equal exactly £1,000, then the option of getting a million from box B was simply not open to the player. Under the strategic dominance principle, the player should then choose the strategy that is always better and take both boxes.

However, using the strategies and the choices made the player, does causation cause correlation?

3 Measuring Rational thought using Maths

Using the Newcomb's Problem, you can determine whether someone is using their Rational Thought (R) or Intuition(I).

However, how can you link one-boxers and two-boxers to R and I?

It is extremely straightforward, one-boxers use the Expected Utility Function which is from Statistical and Decision Mathematics so we can link this to Intuition.

Likewise, two-boxers use their deductive reasoning (Strategic dominance) to reason that you will at least win £1000 after every iteration.

One-Boxers: Intuition

Two-Boxers: Rational Thought

However, using the stated above it can also be questioned whether age can correlate Rational Thought and Intuition. In the circumstances, I will only be conducted the Hypothesis Test on Teachers and Students.

4 Hypothesis Testing

Using the following on Measuring Rational Thought using Maths, we can conduct a Chi-Squared Test to answer the question:

[Opportunity Sampling Used]

$$\chi^2 = \sum \left(\frac{(O-E)^2}{E} \right)$$

H_0: There is no association between age and answer to the Newcomb's problem

H_1: There is an association between age and answer to the Newcomb's problem.

Significance Level: 5%

Figure 2a:

Answer / Age Group	One-Boxer	Two-Boxer
Student (<19)	27	23
Teacher (>19)	24	26

Figure 2a Represents the data collected from 10/3/26 to 13/3/26.

Figure 2b:

Expected Value	One-Boxer	Two-Boxer
Student (<19)	$\frac{(50)(51)}{100} = 25.5$	$\frac{(50)(49)}{100} = 24.5$
Teacher (>19)	$\frac{(50)(51)}{100} = 25.5$	$\frac{(50)(49)}{100} = 24.5$

$$\chi^2 = \sum \left(\frac{(O-E)^2}{E} \right) = \frac{(27-25.5)^2}{25.5} + \frac{(24-25.5)^2}{25.5} + \frac{(23-24.5)^2}{24.5} + \frac{(26-24.5)^2}{24.5}$$

$$\chi^2 = \frac{300}{833}$$

Calculating Degrees of Freedom:

$$\nu = (2-1)(2-1) = 1$$

The value of degrees of freedom of 1 at the 5% significance level is 3.841

$$0.360 < 3.841$$

Therefore, we must not reject H_0 and determine that there is no association between age and answer to Newcomb's paradox at the 5% significance level.

The Critique to this hypothesis test, is that I assumed teachers are older than the students which in my Sixth Form College is true. But I must carefully on defining which is which; and it should also be noted that I was restricted to just the Sixth Form College which may cause bias.

5 Conclusion

Overall, my study of the Newcomb's Paradox and seeing whether age has something to do with the answer of the Paradox. Although I have concluded that there is no association between age and the answer to Newcomb's Paradox. But due to all of the assumptions I have made it can conducted more perfectly and perhaps there could be an association.

Bibliography:

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