On Maximizing Expected Utility

This essay will be concerned with the principle of Maximizing Expected Utility. This is meant to be a way to decide what action one should take when presented with a decision. It involves picking the choice that will maximize your benefits.

First, we should define a few terms. Maximizing the benefits means picking the decision that will involve the greatest rewards for the decision maker. This is calculated with a formula that involves assigning values to the various outcomes. It is especially useful when the outcomes involve monetary values. If they don't, however, one can speak of how much he would pay to ensure a certain outcome. You then multiply this value by the probability that you believe this outcome will occur. Whichever action's sum of expected outcomes has the highest value should be the course of action taken.

When applying the principle of Maximizing Expected Utility it is assumed that the person applying it is only interested in maximizing his own benefits independent of the effects which his decision might have on others. John Stuart Mill felt that this behavior was inherent in the decision making process. In his essay, "On Liberty", he states, "To an ordinary man, however, his own preference, thus supported, is…a perfectly satisfactory reason…"[1] As Mill sees it, as long as any rational person can prove to himself that his reasons for doing something provide the maximum benefit, he needs no other reason on which to base this decision. The good of the individual is the most important part of the decision process. Of course, however, it may be in the best interest of the individual to help someone else. For example, as a minor it may be in your best interests to assist your parents because they may then be more willing to lend you money.

[1] "On Liberty", *Bartleby.com,* htttp://www.bartleby.com/130.1.html

The important thing is that, in the end, you are trying to gain a better situation for yourself.

Now that we have the basic principles down, we can apply it to a situation. Let us suppose that you have one thousand dollars that you don't need for any specific purpose. In other words, you don't need this money to pay the rent. You decide to invest this money into the stock market deciding that you will follow Merrill Lynch's advice since he is very reliable in his predictions. In our simplified model of the stock market the worst that could happen is that you lose the money that you invested. You can't end up losing more money than you invested. On the other hand, you can gain as much as five times the amount that you invested by following Lynch's advice. What should you do? By applying the principle of Maximizing Expected Utility you have to analyze the possible outcomes of your decisions. If you don't invest your money you can't lose your thousand dollars. However, by not investing it you can't gain any money either. If you invest your money you could end up with five thousand dollars or you could end up with no money. What does the principle of MEU dictate that you should do? Well, the amount that you chance to gain far outweighs the amount that you could lose. At the same time, you know that the person whose advice you are taking for investing is very reliable. It is very likely that you will not lose your money, but that you will, in fact, multiply the money. You would be maximizing your expected utility by investing.

Newcomb poses a similar situation. Suppose that there is a certain Predictor. This Predictor has placed two boxes before you. After a process where he gets to know you (which may be an interview or some other such method, the details of which are not important) he tells you that he can predict your future actions. You also know that he has

been successful in all past attempts at guessing the actions of the person choosing. If you choose to open boxes A and B, box B will be empty and box A will contain one thousand dollars. If you choose to open box B it will contain one million dollars and box A remains closed. In some way such that you cannot know what the boxes hold he fills them and seals them. You must now choose whether to open just box B or both boxes.[2]

Which box do you choose? A key piece of information is that the Predictor is not 100% guaranteed to guess correctly. He has always been infallible in the past, but this doesn't mean that he won't fail this time. If he is wrong and you select just box B you will end up without any prize. Also, if he is wrong and you select both boxes you will end up with one million one thousand dollars. What, therefore, is the rational choice to make? One possible way to decide what to do is to use the principle of MEU. As mentioned above the amount you expect to gain is multiplied by the likelihood that you believe it will occur. We have 1,000,000*h for opening box B and 1,000*h+1001000*(1-h) for opening boxes A and B. As long as h is not exceptionally small, box B will always give a larger value and should always be chosen.

You may not be convinced by the mathematics, so let us consider the dominance principle. This principle hinges on the belief that you should do whichever act will *guarantee* that you will be better off than you were before committing the act.[3] This line of reasoning leads to a different solution to Newcomb's paradox. According to the dominance principle one should choose to open boxes A and B. If the Predictor is right you will receive one thousand dollars. If he is wrong you will receive one million one thousand dollars. If you chose to open just box B, then if the Predictor is right you

[2] Paradoxes by R.M. Sainsbury (p53)
[3] Paradoxes by R.M. Sainsbury (p58)

receive one million dollars. However, if the Predictor is wrong you receive no money. Therefore, choosing box B does not guarantee that you will be better off than before since there is a chance that you may not get any money.

Which provides the best solution? Let us first consider your possible reason for choosing the dominance principle. You may believe that there is a possibility that the Predictor is wrong. Therefore, in the interest of having at least a little more money than when the situation started you would choose to open both boxes because you are at least guaranteed one thousand dollars. However, this fear that he may be wrong can be presented in a different way. It could be presented as the fact that you have a less than 100% confidence in the results of your outcomes. Plugging this confidence into the MEU principle is it clear that even if you only think that there is a 50% chance that he is right, you should choose box B. Therefore, I feel that MEU is the correct solution to Newcomb's paradox. Unless you have a very small confidence in the Predictor you always stand the best chance with picking box B. Since the Predictor has always been right in the past you have no need for such a small belief in his skills. Therefore, you should apply MEU to Newcomb's paradox in order to maximize your winnings.

Does the principle of MEU always lead to the right answer? Let us examine another situation. Suppose that you and I are both jailed for drug trafficking. We are placed in separate cells and are not allowed to talk to each other. The DA decides to make each of us a deal. If we both stay silent the drug charges will be dropped. We will instead be charged with possession of weapons and will remain in jail for one year. If we both confess then we each get five years in prison. If one person confesses and the other

one stays silent, the one who confessed will be free and the other one will have to remain in jail for ten years. Finally you are told that I am being made the same deal. [4]

Which choice should you make? Again we are assuming that you will try to maximize your own gains and don't care about the other person. Since we are both rational we will very likely make the same decisions. At first it seems that the best option is to stay silent. You will only get one year in jail if we are both silent. However, there is a better deal for you. If I am silent it is best for you to confess. You will not receive any sentence. However, I am aware that you might confess to shorten your time. This will prompt me to confess too. Thus we spend five years in prison. Therefore the best course of action is to confess. If I stay silent you don't get any time. If I confess you only get five years. This is certainly better than the ten years you could get if you were silent and I confessed. To look out for your own well-being it seems best to always confess.

What does the principle of MEU suggest? The probability that you and I will both confess is high and equal to the probability that we will both remain silent. The probability of you remaining silent if I confess is very low and so is the converse situation. Therefore, depending upon the values that are placed upon h there may be situations where the MEU principle recommends staying silent. In fact, MEU fails in a very interesting way. As per the instructions in Sainsbury's book I am to give the outcomes negative values to show that they are undesirable outcomes. Let us say that I have a 100% confidence that I should confess. Then I would plug into the formula the following: -5*1+0*1 if I confess I get a value of negative five. This represents the five years that I must spend in prison. If I have 100% confidence that I should confess then I have 0% confidence that I should stay silent. Thus h will be zero. This gives me the

[4] Paradoxes by R.M. Sainsbury (p66)

value of zero. Zero is bigger than negative five, so the principle recommends staying silent. We already saw that the right answer is to confess. Thus, in this situation the principle of MEU fails to yield the correct answer.

What, then, is the usefulness of the principle of Maximizing Expected Utility? It would seem that the principle is most useful when dealing with preset and purely random situations. Sainsbury also cites the principle as useful if trying to figure out which lottery to play if given a choice.[5] There it recommends that you play the lottery where you have the greatest chance of winning given that the prizes are equal. This is obviously a rational thing to do. However, the principle seems to be worthless when dealing with other rational beings or entities. When used in a situation similar to the Prisoner's Dilemma composed of countries involved in a war, it also yields erroneous results. This seems to make sense since we are making a simple model of a complex situation.

[5] Paradoxes by R.M. Sainsbury (p54)