SOME ASPECTS OF BEHAVIOR IN RISK AND RISK-AVOIDANCE SITUATIONS

In 1738, Bernoulli proposed that people choose among risky courses of action so as to maximize their expected utility. von Neuman and Morgenstern (1964) provided a sophisticated mathematical treatment of this concept which attracted a great deal of theoretical attention. The theory didn't do very well under experimental analysis, because people made decisions in risky situations not on the basis of objective probabilities, but on the basis of probabilities as they perceived them (subjective probabilities).

To a certain extent the concept of maximization of utility has been bastardized by simply assuming that any economic behavior that man exhibits is an attempt to maximize his utility. Thus the argument is substantiated but the usefulness of the concept is lost.

Little real experimental evidence is extant on the economic behavior under risk and risk-avoidance conditions. Friedman and Savage (1952) have extrapolated from the fact that low income consumer groups purchase both lottery tickets (risk) and insurance (risk-avoidance) to project the utility curve Figure 1 below:

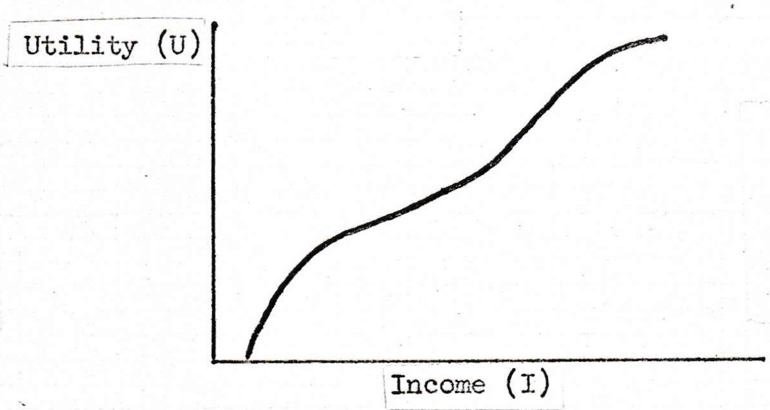


Figure 1

Although Friedman and Savage do not contend that they expect individuals to consult a utility curve before gambling or buying insurance, they do propose that individuals act "<u>as if</u> they calculated and compared expected utility and <u>as if</u> they knew the odds".

If the individuals know the odds then we would expect that they would behave in a reasonably prudent manner, i.e., would not take bets where the losing chances were orders of magnitude above the winning payoff.

In order to provide some insight into this question, a small survey was undertaken. Twenty-five interviewees were selected. Essentially, the population was homogeneous, in that they worked for the same corporation and were in approximately the same salary bracket, averaging about $12,000 per year. The selection of financial bracket was deliberate in that it was felt that this bracket should be able to devote some portion of income to investment if they so desired, but not a sufficiently large amount to be termed a large investor.

Since no statistical analysis of the data was planned, the interviews were conducted loosely in that the determination of general attitudes were of concern rather than specific experimental results. Interviewees were generally asked:

(1) Whether they invested in the securities market.
(2) If not, why not.
(3) If so, what plan did they follow, and
(4) What returns did they expect, or hope to achieve.

Of the 25 interviewees, 8 reported that their only investment in the security market was through the company salaried savings plan. (This is a management investment plan, allowing the employee to invest 5 percent of his salary to which the company contributes an additional 50 percent of that which the employee invests.) In general, the reasons given for not investing were:

(1) I do not have enough money to invest in the securities market.
(2) I don't understand the whole process and wouldn't know how to go about making an investment.
(3) I can get between 4 and 5 percent at a bank or savings and loan safely. If I add this to the 6 percent brokerage fee, I would have to realize at least 10 percent to break even.
(4) Its like gambling at Las Vegas and I don't go to Las Vegas because I am a sore loser.

The seventeen interviewees who reported investing in securities were rather diverse in their approach to choosing a portfolio. Some of the approaches are given below.

<u>Interviewee R.M.</u> - R.M. had a list of some 40 stocks whose prices he plotted on a weekly basis. Through some formula, which he had devised, he developed a rating which seemed to go from (100) when the stock price was rising to (0) as the price reached a low ebb in the formula cycle. At this point he would buy, assuming he had the money to spare at the time. When asked how successful the system was, he replied that he had over the past two years recovered $3,000 of the $20,000 he had lost in 1962 (using the formula).

Interviewee B.L. - B.L. indicated that he generally bought blue chips, but once in a while would speculate on a speculative stock if he did not have to invest over 200 to 300 dollars.

Interviewee L.D. - L.D. reported that he based his buying decisions on tips from friends, but additionally looked for major contract awards in the aerospace field as an indicator for investment.

Interviewee Reports Overall - All interviewees expected a rate of return ranging from 10 percent to 20 percent. However, time was not a consideration. They generally agreed that they held their investment until it had reached some preset point and then sold. It seemed to make no difference whether this was six months or two years, or any other period. L.D. reported one security which had appreciated 25 percent but that he had held it for five years to achieve this. Rate of return did not seem to be based on a per annum concept.

Interviewees generally concluded that they were perfectly happy to purchase completely speculative stock as long as (1) they thought it could go "sky high" (no one seemed to be able to define "sky high"), and (2) they could make the purchase for a small cash outlay (they all agreed that "small" was the amount of money they would be willing to "throw away").

The findings that people seemed to be willing to take unfavorable gambles provided the possible rewards were extremely large and the invested sums were small led to a second hypothesis; namely, that people will make bets at extremely unfavorable odds provided 1) the cash outlay represented a very small portion of their wealth, and 2) there could be a large proportionate return if they won.

To test this hypothesis, a second group of 25 subjects were interviewed and asked which of the following odds they would be willing to take in betting that their local high school would beat the Los Angeles Rams. The results are shown in Table I. The numbers shown in the interspaces are the amount of interviewees who would be willing to take the bets.

		WIN OFFERED					
		$1.00	$10.00	$100.00	$1,000	$10,000	Any Amount
Interviewee Bet	$ 0.10	2	25	N/T	N/T	N/T	N/T
	1.00	N/A	0	16	25	N/T	N/T
	10.00	N/A	N/A	0	6	9	15
	100.00	N/A	N/A	N/A	0	0	0

TABLE I

N/T = Not tested since interviewees were willing to take the bet at the given odds for that amount it was assumed they would also take better odds.

N/A = Not Applicable - It was assumed that no interviewee would take an even money bet or give odds.

Any Amount - Indicates the number of interviewees that would bet the given amount provided the odds were large enough. The balance would not wager the given amount no matter what the odds.

Interviewees were asked afterwards what they felt the Rams chances of winning were. The responses ranged from a low of 10,000 to 1 to the majority reporting 1,000,000 to 1.

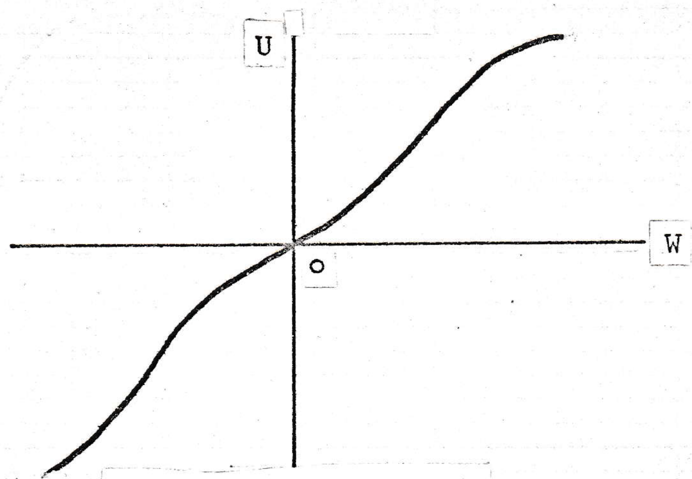
Though no statistical tests were run, it is obvious the results would indicate that the hypothesis previously stated could not be rejected if it is assumed that the interviewees would act as they indicated they would.

In other words, people will be willing to accept completely unfavorable odds providing the amount invested is "throw away" money and the possible returns are far out of proportion to the amount invested. Explicitly, they all would take a 100 to 1 payoff on a ten cent bet though they felt that the odds were 1,000,000 to 1 against their winning and all would take 1000 to 1 on a one dollar bet with the same 1,000,000 to 1 odds against them.

The behavior can be partially explained by the reinforcement situation. Consider a situation in which a subject (S) has to make a prediction of an event with an uncertain outcome. Siegel and Goldstein (1959) propose that, It is reasonable to suppose that when S is in a situation in which the only payoff attached to the outcomes is the satisfaction of having his prediction confirmed by the event or the dissatisfaction of having his prediction dis-confirmed by it, making a correct prediction of the rarer event has greater utility for S than making a correct prediction of the more frequent event."

However, if the reward for making a correct prediction or the cost of making an incorrect prediction is increased subjects tend to maximize by matching their predictions with the observed probabilities of occurence of the event.

Markowitz (1952) finds that people generally prefer owing ten cents for sure rather than a one in ten chance of owing $1: owing $1 for sure rather than a one in ten chance of owing $10: $10 for sure rather than one in ten of owing $100. However he feels that there is a point where the individual is willing to take a chance. As a consequence he differs with the Friedman-Savage curve (Figure 1) and proposes the curve of Figure 2.



MARKOWITZ UTILITY CURVE

Figure 2

The origin is present wealth and the function is concave immediately above present wealth; convex immediately below. In his concept the amount of wealth would merely move the inflection points closer or further from the origin, the inflection points moving closer to the origin for the chooser who is poor.

Above all the detail discussion as to the shape of the utility curve, there still arises the problem as to whether a <u>single</u> utility curve, regardless of shape, can mirror risk and/or risk-avoidance behavior. For if it can it must be able to contend with following exhibited behavior in addition to the Friedman-Savage Markowitz, etc. proposals:

1) It must provide a descriptor of the Mosteller and Nogee (1951) findings that people tend to risk more when winning than when losing; the "streak" syndrome.

2) It must provide a descriptor of the "craps insurance" behavior, that is when someone has made one pass he bets on craps at the same time that he bets the pass line to insure against a total loss even though the craps odds are unfavorable.

3) It must provide a descriptor of the willingness to buy "catastrophic insurance" at the same time as an unwillingness to buy insurance for small premiums against small losses even though actuarily fair.

4) It must provide a descriptor of the "throwaway money" concept previously discussed.

The formulation of the Mosteller-Nogee findings in (1) above can be illustrated by Figure 3 below. Starting from A on the ordinate (the amount the individual starts with) he will tend to risk less and less money on each successive trial based on a loss on the previous trial. Conversely, he will increase his betting sum after a win on a previous trial, but the winning increase will rise more sharply than the losing decrease. In addition, another element of personal probability tends to bring the win curve up more sharply. There is a good deal of experimental evidence to indicate that people consider an event more likely to occur if its consequences are favorable than if its consequences are unfavorable, (Crandall, Solomon and Kellaway, 1955; Irwin, 1953; Marks, 1951).

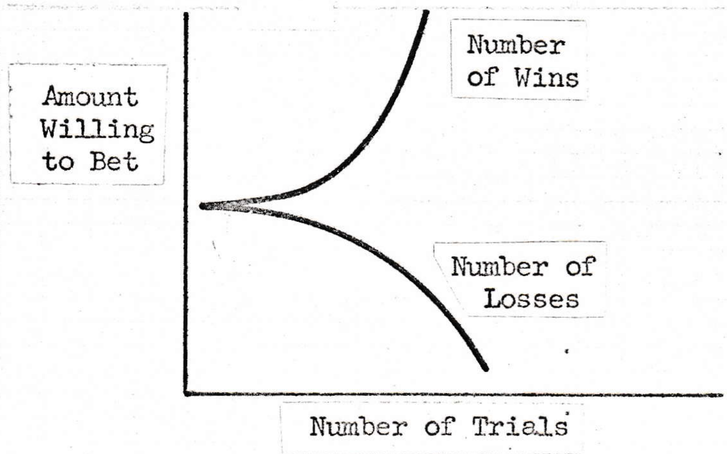


Figure 3

Since the mathematical probabilities remain the same in a game of chance, assuming unbiased elements; and since the bettor is acting as if his probabilities of win or loss are changing after.each trial, t here must be a personal expectation entering the scene. The overall notion can thus be formed as a Bayesian model with an element of subjective probability which the individual raises or lowers based on the evidence of the previous trial. The degree of rise or decay of the curve is a result of the subjective probability numbers which the individual assigns. The model would take the following form:

$$\pi(W/w_o) = \frac{p(w_o/W)\,\pi(W)}{p(w_o/W)\,\pi(W) + p\,(w_o/\bar{W})\,\pi(\bar{W})}$$

Where:
π = prior personal prabability
W = win probability
w_o = evidence of previous win
$\bar{W}$ = loss probability

It is to be noted that the model is written for the win betting line. The loss betting line would be satisfied by exchanging W with $\bar{W}$.

The "craps insurance" behavior of (2) above, is somewhat antithetical to the Mosteller-Nogee behavior. To insure against a loss following a win demands some belief that there is a reasonable likelihood of the loss occuring. The individual on the crap table will usually bet a smaller amount on the "any craps" than on the pass line, but a sufficiently large amount to assure a minimal overall loss should a craps occur. For example, a bettor who has just completed a pass and now has $2 on the pass line, is likely to throw 50¢ on "any craps". If he makes a pass he wins $1.50, the $2 he bet on the pass line less the 50¢ he bet on "any craps". If he throws craps he will win $1; the $3.50 he is returned for the craps less the 50¢ invested on the craps and the $2 he loses on the pass line. He recognizes that he can lose both bets, but he protects against an immediate "catastrophe". However, in its pure form this behavior is akin to buying annuities and life insurance at the same time and thus can be satisfied by the Markowitz hypothesis illustrated in Figure 2, provided the actuarial base is stretched to include disadvantageous odds.

The concept of willingness to buy "catastrophic insurance", (3) above, at the same time as unwillingness to protect against small losses can be shown in two ways. Poor people will pay the premium for both public liability and deductible collision insurance on their cars. They are protecting against a major loss from claims as well as repair bills on their own cars but are willing to pay the damage on their own car up to the deductible amount; usually $50 or $100. On the other hand wealthy people will pay a slightly larger premium to raise the liability amount, since they assume a claimant will sue them for a larger amount, but often will forego purchasing collision insurance. Since they know that insurance premiums are actuarily unfair to them, they are willing to risk against what is the loss of a relatively small amount that would be lost on the repair of their own car.

A second way that the concept can be illustrated is in response to a small survey that was undertaken. Ten individuals were asked if they purchased insurance. As they all responded affirmatively they were asked if they would be willing to insure against a 10 percent cut in salary assuming 1) the actuarial odds could be established, and 2) that there were no personal expectations to cloud the issue. They all responded "no" to the salary insurance, yet when questioned further four of the ten indicated that they carried a form of salary continuance plan other than governmental.

Fundamentally, outside of the betting behavior of "craps insurance" people seem generally willing to pay a premium for preventing a loss of a major portion of their wealth or income, butwill not pay a proportionate premium to insure against a loss of a small portion of their wealth or income.

Since the willingness to insure is a function of the amount of loss in terms of the portion of the individuals wealth or income, but has a lower boundary it can be illustrated by the curve of Figure 4 below.

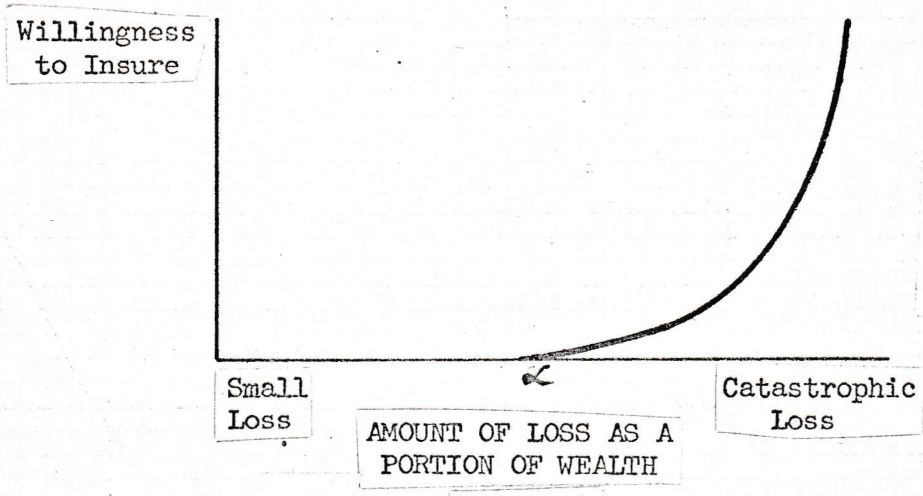


Figure 4

The closer the loss approaches that point (α) which the individual views as catastrophic to him the more willing the individual is to insure. This behavior can be described as:

$$I_W = f(L) \qquad \alpha \leq L \leq \infty, \; f(L) > 0$$

Where

I_W = willingness to insure
L = loss amount
α = catastrophic loss point

The "throwaway" money concept of (4) above has been discussed in the "Ram vs High School" betting in Table 1. Graphically it is represented in Figure 5 below:

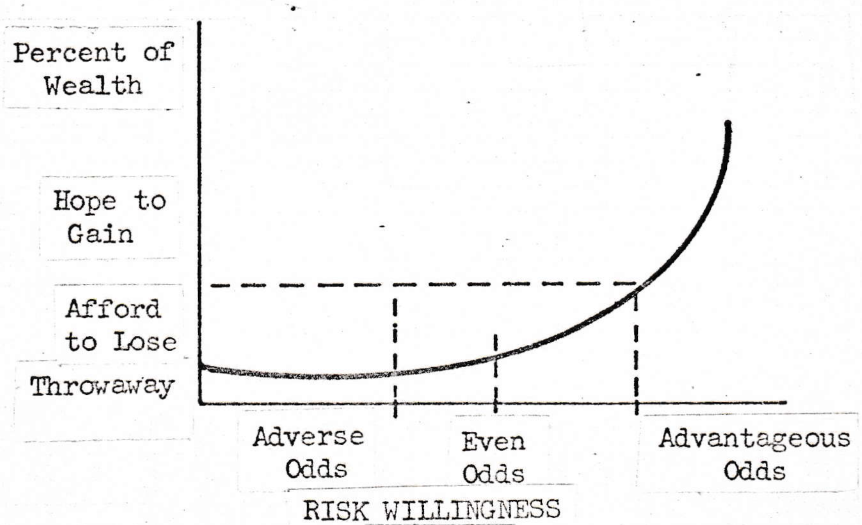


Figure 5

The curve assumes that there is some small portion of wealth or income which individuals are willing to risk against adverse odds. This is the "throwaway" portion. As the odds approach even the individual is willing to invest that which he can afford to lose. This portion corresponds to the Las Vegas gambling where the odds are close to even but are in favor of the house. The third portion of the curve begins to take over at better than even odds and starts to rise sharply as the odds approach the odds which are advantageous to the individual, and he begins to invest on a hope or belief that he will gain.

The model which describes this behavior can be formulated as follows:

$$A_R = \frac{kY}{Y}, \quad 0 < k < 1, \quad O_o > \alpha, \quad \beta < \frac{O_p}{O_o} < 1$$

Where A_R = Acceptable Risk
Y = Income or Wealth
O_o = Offered Odds Ratio
O_p = Perceived Odds Ratio
k, α, β, are constants which can be derived empirically

In essence, by keeping k at a small number the function is forced to a small portion of income or wealth. Even with O_p high the perceived odds to offered odds ratio must be unfavorable since the ratio is constrained to be less than 1.

Conclusions

It would be oonvenient for the economic model makers if individuals would behave in the real world in accord with the models. Unfortunately people tend to 1) be internally inconsistent as far as their risk and risk-avoidance behavior is concerned, 2) behave differently in different environmental situations, and 3) have cut-off points for classes of events which resist describing their behavior on a continuum. As a result, several models of risk and risk-avoidance behavior have been proposed. It is felt that no one model can describe the entire gamut, and in fact that possibly more models are needed to describe the behavior of interest.

Although no attempt was made in this study, it is recognized that these models delineated may possibly be incorporated into a lesser number. However it is felt that until a model can be developed which can in fact include the various behaviors pointed out in this paper there will be no useful paradigm of individual behavior under risk and risk-avoidance conditions.

REFERENCES

1 Crandall, V. J., Solomon, D., and Kellaway, R. "Expectancy Statements and Decision Times as Functions of Objective Probabilities and Reinforcement Values." Journal of Personality, 24 (1955) 192-203

2 Friedman, M., and Savage, L.J.,"The Utility of Choices Involving Risk", Readings in Price Theory, Stigler, and Boulding, Eds. Richard D. Irwin, Inc., Chicago, 1952

3 Irwin, F.W., "Stated Expectations as Functions of Probability and Desirability of Outcomes", Journal of Personality, 21 (1953) 329-335

4 Markowitz, H., "The Utility of Wealth", Journal of Political Economy, 60 (1952) 151-158

5 Marks, R. W., "The Effect of Probability, Desirability, and Privilege or the Stated Expectations of Children", Journal of Personality, 19 (1951) 332-351

6 Mosteller, F., and Nogee, W., "An Experimental Measurement of Utility", Journal of Political Economy 59 (1961) 389-396

7 Siegel, S., and Goldstein, D.A., "Decision-Making Behavior in a Two-Choice Uncertain Outcome Situation", Journal of Experimental Psychology, 57 (1959), 37-42

8 von Neuman, J., and Morgenstern, O., Theory of Games and Economic Behavior, John Wiley & Sons, Inc., New York, 1964