Introduction

Farmers make decisions in a risky, ever-changing environment. The consequences of their decisions are generally not known when the decisions are made, and the outcome may be better or worse than expected. Variability of prices and yields are major sources of risk in agriculture. Changes in technology, legal and social concerns and the human factor itself also contribute to the risky environment for farmers. Risky situations of concern are typically those in which 1) there is a high probability of adverse consequences and/or 2) the adverse consequences, should they occur, would cause significant disruptions.

Farmers and other business people generally do not get into risky situations unless there is a probability of making money. It is to their advantage that these risky but potentially profitable situations be managed as carefully as possible. Effective risk management involves anticipating possible difficulties and planning to reduce their consequences, not just reacting to unfavorable events after they occur. The two primary aspects of risk management are: 1) anticipating that an unfavorable event may occur and acting to reduce the probability of its occurrence and 2) taking actions which will reduce the adverse consequences should the unfavorable event occur.
For example, risk management in the machinery area might involve a complete overhaul of an old tractor before the busy season to reduce the chances of a major breakdown. Also, during planting and harvesting, most farmers keep some key spare parts readily available. While these parts do not prevent a breakdown from occurring, the unfavorable consequences are reduced. However, risk management techniques—no matter how effective—cannot resolve serious, chronic cash-flow difficulties.

Individuals are not the same, nor are their personal and financial circumstances. This series of publications is designed to help farmers develop their own risk management strategies, ones appropriate to their own attitudes and circumstances. Included in this series on risk management in agriculture are the following three publications.

EC-647, Decision-Making in a Risky Environment (this publication), discusses goals and risk attitudes which differ among individuals. It explains some of the concepts involved in decision-making under risk. These include probabilities, measures of variability, expected values and expectations. Many farmers use these concepts, often without recognizing them. This publication is intended to help farmers recognize some of the factors underlying the decision-making process and also to facilitate understanding of the other publications in the series.

EC-648, Variability and Risk in Indian a Agriculture, identifies sources of risk in agriculture and discusses producers' views of the importance of variability in crop and livestock production. Data on the historical variability of prices and yields of the primary Indiana commodities are presented, and some managerial implications are discussed.

EC-649, Risk Management Strategies, examines production, marketing and financial responses farmers use to deal with risk. Producers' views of the importance of these risk responses and their use of them are reported. The concept of risk balancing is introduced, and the need for an integrated risk management strategy combining production, marketing and financial responses is discussed.

Decision-Making

Making decisions would be easy if we knew what the outcome was going to be. We have all probably made statements like: "If I'd known this was going to happen, I never would have done it;" "If I'd known that corn was going to drop $.10 a bushel, I'd have sold last week or "If I'd known that hog prices were going that high, I'd have bred more sows." The consequences of a decision are generally not known when the decision is made. However, decisions are made and actions are taken (taking no action is also a decision).

Decision-making involves setting your goals and objectives, identifying the problem, determining your alternatives, evaluating these alternatives, selecting an alternative, implementing that alternative and bearing responsibility. Decision-making in a risky environment also involves attitudes toward risk, assessment of probabilities and formation of expectations about the future. The decision-making process is complex, and farmers differ both in how they make decisions and in the decisions they make.

This publication does not discuss the entire decision-making process. Attention is first briefly directed at
setting farm family goals. Second, a "quiz" is included to help an individual gain a better understanding of his or her attitudes toward risk. The third section, elements for decision-making under risk, deals with probabilities, measures of variability and how expected values can be calculated. The fourth section deals with the formulation of expectations. A brief summary concludes the publication.

Setting Farm Family Goals

Where are you headed? What do you want? These are questions which face everybody. Most of us do not have very definite answers to these questions. Often, unless there is some kind of pressure (family crisis, job opportunity, etc.), we tend not to think about our goals and objectives very much. We may have a list of things to do, but commonly our goals or objectives are vague and indefinite.

Setting goals requires some time and thought. If we think about our goals and objectives, we would probably find that we could identify a number of goals, some short-term and others long-term goals. Most people have family, business and personal goals. Often some of our goals conflict with one another. This is an important point. Typically we will have some goals that compete and others that complement one another. We need to be aware of these interrelationships among our goals.

A second point is that our goals are not independent of other people and their goals. Spouses, children, parents and others play an important role. Even our purely personal goals are likely to have effects on these other individuals. If we are vague about our own goals, how much do we know about others' goals? How many times have family difficulties developed because one person did not know what another was trying to accomplish? When the high priority goals of individuals who are trying to cooperate are competitive, there can be TROUBLE.

Goal setting is important because goals are a major part of our guidance system. Decisions can be made concerning the likely effects that alternative actions will have on our goals. Goal setting is a dynamic process. A goal may be achieved, and this should be a source of a feeling of accomplishment. New goals may become important to us. The priorities of various goals can also change over time. Individuals may have unrealistic goals which, if not revised, may be a source of frustration and stress.

Goal setting and review are important for all individuals and families (Setting Farm Family Goals, EC-514, is a publication designed to help families in the process. It is available from county Extension offices). However, goal setting is especially important for farm families because of the dose interrelationship of the family and the farm business. The business and family goals of a farm family are likely to be much more intertwined than the family and job related goals of most other families. Various members of the farm family are commonly involved in the business, and the economic results of the farm business impact directly on the family.

Risk Attitudes

Risk has many meanings. Webster's dictionary defines "risk" as "the possibility of injury, damage or loss." Economists argued about "risk" vs. "uncertainty" for years. They finally decided that the lack of knowledge about the future is what is important in both risk and uncertainty. For example, we don't know what the price of corn will be next December. Perhaps corn will be $2.50, with a range of $2.00 to $3.00. Economists tend to give equal weights to the $2.00 and $3.00 prices. However, corn producers are much more concerned about the possibility of a $2.00 price than they are about the $3.00 price. In contrast,
livestock producers buying corn to feed are more concerned about the possibility of the $3.00 price.

Jerry Robinson, Jr., professor of sociology and rural sociology at the University of Illinois, classifies individuals in the following risk-taking categories:

2. "Daredevils"  4. "Calculators"

The "Avoiders" are the most cautious risk takers, but they do take some risks. They expect the worst to happen and will not take the slightest chance that they can avoid. They lose because they miss economic opportunities to profit. Farmers who are Avoiders may not be forced out of business, but they just manage to survive. Their farms usually disappear (being absorbed by a neighboring farm) when they retire or die.

"Daredevils" are the opposite of the Avoiders and take many unnecessary chances. Daredevils are the plungers who close their eyes to risk, ignore facts and go ahead. Daredevils commonly fall because they refuse to take precautions. Daredevils typically do not get involved in farming.

"Adventurers" are individuals who enjoy risks. To Adventurers, risks are challenging and exciting. Often Adventurers look for the chance to take risks. Adventurers differ in their mental outlook. Some Adventurers enjoy the excitement of risk taking, but keep the stakes to reasonable levels. Many farmers may be in this category with respect to their marketing plans. As long as financial survival is not at stake, they may enjoy the adventure of playing the market. Many speculators are in this category. However, some Adventurers may get in over their heads. This may be from peer pressure or from a change in external conditions. Many farmers who bought moderate parcels of land in the late 1970s have found experiences in the 1980s considerably different than they expected because of the change in land price trends.

"Calculators" understand they must take some chances to get ahead, but recognize that there are degrees of risk in every situation. Before making a decision or taking action they gather information and analyze the odds. Calculators try to be realistic, recognize the risks and try to reduce risks to acceptable levels. Most farmers are Calculators. If they were not, adverse conditions of recent years would have eliminated them or changed their behavior.

Risk Quiz

The following quiz may be helpful in determining your risk attitudes (Adapted from D. Lynn Forester, Ohio State University, "Interfacing Farm Finance and Marketing," Workshop for Extension Specialists on Marketing, Risk and Financial Management, Minneapolis, April 2-3, 1984). Knowledge of your risk attitudes can be helpful in understanding both your feelings in certain situations and why you make particular decisions. There are no right or wrong answers; answer according to your own preference.

What are your attitudes toward these risky situations?

1. Imagine yourself on your way to a ball game with a pair of tickets for which you have paid $30. After parking your car, you realize that you have lost the tickets. The box office has two tickets for sale for $30. Would you buy the tickets?

   a. yes
b. no

2. Imagine yourself on your way to a ballgame. You intend to spend $30 for the tickets at the box office. After parking your car, you realize you have lost $30. However, you still have enough cash to purchase the tickets. Would you buy the tickets to the game?

a. yes

b. no

3. Imagine you are given the choice between two options. The first is a sure gain of $700. The second is a risky prospect that offers a 75 percent chance of winning $1,000 and a 25 percent chance of winning nothing. Which option would you select?

a. a sure gain of $700

b. a 75 percent chance of winning $1,000 and a 25 percent chance of winning nothing

4. Imagine you are given the choice between two options. The first is a sure loss of $700. The second is a risky prospect that offers a 75 percent chance of losing $1,000 and a 25 percent chance of losing nothing. Which option would you select?

a. a sure loss of $700

b. a 75 percent chance of losing $1,000 and a 25 percent chance of losing nothing

5. Imagine the U.S. preparing for the outbreak of a rare Asian disease which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. If the first program is adopted, estimates are that 375 people will die. If the second program is adopted, there is a 1/3 probability that nobody will die and a 2/3 probability that 600 people will die. Which program would you select?

a. a sure loss of 375 lives

b. a 1/3 probability of nobody dying and a 2/3 probability of 600 people dying

6. Imagine you have been offered a choice between (a) winning a sure cash prize and (b) a risky option with a 50 percent chance of winning $100 and a 50 percent chance of winning nothing. How big would the sure cash prize have to be to make the prize just as attractive as the risky option for you?

a. $30  e. $50
b. $35  f. $55
c. $40  g. $60
d. $45  h. $65

7. Consider a situation in which you face a 50 percent chance of losing $100 and a 50 percent chance of winning a cash prize. What is the smallest cash prize that would make this risky option acceptable to you?

a. $50  e. $150
b. $75  f. $175
c. $100  g. $200 or more
d. $125
8. How many state lottery tickets do you buy each week, on the average?
   a. none  c. two
   b. one  d. three or more

9. Imagine you are about to buy a tie for $10. The salesman tells you that the tie you want to buy is on sale for $5 at the other branch of the store. It would cost you 20 minutes effort to buy the tie at the other store. Would you make the trip to the other store?
   a. yes
   b. no

10. Imagine you are about to purchase a new car. The dealer offers to sell you the car for $11,505 without the radio you want (radio A) and $11,595 with the radio you want (radio B). You can go to a stereo shop and have Radio B installed for $75 but it will require an hour of your effort. Which would you do?
   a. Buy the car equipped with radio B for $11,595
   b. Buy the car for $11,505 and have radio B installed at a stereo shop for $75.

11. Paul has an investment in money market funds. During the past year, he could have invested this money in the stock market, and he would have been $25,000 ahead. Unfortunately, Paul retained his money market funds. Dave had an investment in the stock market. But last year he sold all his shares and invested in money market funds. His investment is now worth $25,000 less than it would have been if the stock had been retained. Who feels worse?
   a. Paul
   b. Dave

**Analysis of Risk Quiz Responses**

The responses to these questions tell us quite a lot about how people think and react in situations involving risk.

**Questions 1 and 2**

Most people answer "no" to the first question and "yes" to the second. Individuals tend to establish mental accounts. In the first question you have already paid $30 for the lost tickets and you are considering spending an additional $30 for tickets. In the second question you lost some money and the tickets only cost $30. In either case, if you go to the ballgame, it will cost the equivalent of $60, but it seems less to many people in the second case. (This may be related to "saving" $50 when you buy a $149 jacket on sale for $99.)

**Question 3**

Most people opt for answer "a" in Question 3, the sure gain. Although answer "b" provides a higher
average or expected value if done repeatedly, most individuals are risk averse (opposed to risk) with respect to gains. Most people prefer a smaller gain which is certain to a larger gain which is uncertain.

Farmers are also generally risk averse with respect to gains. Many farmers diversify their production, preferring the lower, more stable income to the higher, more variable income associated with specialization. Many farmers also routinely use herbicides, insecticides and antibiotics to avoid the possibility of a major loss.

Questions 4 and 5

Most people pick answer "b" for both 4 and 5. Again, if done repeatedly, the "b" answers have higher average or expected loss values ($750 loss in question 4 and a loss of 400 lives in question 5) than the "a" answers. Most people are risk seeking when it comes to losses. We prefer to take a chance (hoping that we lose nothing or that nobody dies) rather than accept a smaller sure loss.

Many farmers follow this principle in their marketing. They hesitate to lock in a sure loss by forward contracting for a price below their cost of production. They prefer to gamble that prices might increase. In many instances the gamble will result in even larger losses than those associated with the forward contracting strategy.

Question 6

Most people answer "a", "b", "c" or "d" or ($45 or less). The lower the amount of money you need for the sure thing, the more risk averse you are. If you answered "e," $50, that is the expected value of the prize and indicates neutrality with respect to risk. Answers "f," "g," and "h" ($55 to $65) indicate you are willing to pay for the opportunity to win an expected value of $50. Adventurers and Daredevils would probably come in this category. Slot machines, roulette and shooting craps are examples in which the expected return, the average outcome of repeated tries, is less than the cost of playing. An individual pays for the privilege of gambling. (Sort of like farming recently!)

Farmers differ in their degree of risk aversion. Some farmers follow more conservative risk-avoiding strategies than others. The lower the amount of money needed for you to accept the sure thing, the more you would probably avoid risks in your farm decision-making.

Question 7

Most people will answer more than $100, choosing answer "d" and beyond. For most people the pain of losing a sum of money is more intense than the pleasure of winning the same sum. Most people will take a risky option at even odds only when the possible gain is substantially larger than the possible loss.

An individual who takes a speculative position in the market and loses $10,000 will typically feel the loss more intensely than the pleasure associated with a gain of the same amount.

Question 8

Although there are no state lotteries in Indiana, many tickets for lotteries in neighboring states are sold to Indiana residents. Lotteries are a form of tax. Payoffs to individuals are considerably less than the income to a state. However, many people will buy one or more lottery tickets a week. This illustrates that low probabilities of an occurrence (your chance of winning) are commonly over-weighted in decision-making.
Other individuals may look at buying lottery tickets as a form of entertainment.

**Questions 9 and 10**

Most people answer question 9 with "a" and question 10 with "b," indicating that one's frame of reference is important. In question 9 you can save 50 percent, $5 for 20 minutes effort. In question 10 the extra $15 it costs to have the radio installed at the dealer's is very small relative to the cost of the car. However, note that the savings by having the radio installed at the stereo shop, $15 for one hour's effort, is the same return for your time as buying the tie at half price.

Individuals differ in their ability to handle risky situations involving large sums of money. Experience can also be important. Making a decision the first time may involve restless nights, agony over the decision and worry about the outcome. The next time the decision is easier to make. A farmer's decisions have generally grown over time as responsibility and size of the farm increased. Gradual expansion of a farmer's frame of reference makes risky decisions easier.

**Question 11**

Who feels worse, Paul or Dave? Most people answer "Dave." For most people, the regret associated with a loss from taking an action is greater than that from inaction.

This principle helps to explain some farmers' marketing behavior. Many farmers regret the loss associated with selling corn at $2.50 and seeing the market go to $3.00 more than not selling at $2.50 and the market going to $2.00. People tend to be more critical of their decisions to act than their decisions to be passive or to do nothing.

**Implications**

As indicated before, there are no "right" or "wrong" answers to these questions. The typical answers help explain the attitudes of many people toward risky situations. Gains and losses do tend to be viewed differently by individuals. The particular context in which a risky choice is presented can also be important. If your answers were generally the same as the typical answers, it suggests that your risk attitudes are like those of many other people. If your answers were different, it suggests that your attitude toward risk may also be different. These differences in our risk attitudes help explain why people in similar situations reach different decisions.

**Elements of Decision-Making Under Risk**

Decision-making under risk involves probabilities, measures of variability, expected values and expectations. Many farmers utilize these concepts, often without recognizing them. The following sections are designed to help farmers recognize and understand these concepts which are elements of their decision-making.

**Understanding and Using Probabilities**

Probabilities are simply a way of expressing the chances of various outcomes (This section draws on Kim B. Anderson and John E. Ikerd, *Risk Rated Management Strategies for Farm and Ranch Decisions*,...
Extension Circular E-41, Oklahoma State University Cooperative Extension Service). Many current weather forecasts use probabilities. For example they may indicate a 20 percent chance of rain or a 40 percent chance of snow. At the start of a football game, a coin is flipped. What are the chances or probabilities that it will come up "heads"? Fifty percent or one-half. The chances for "tails" are exactly the same.

We flip a coin and it comes up heads. If we flip it again, what is the probability that it will come up heads a second time? Assuming it is a fair coin, the probability is still one-half. Each flip of a coin is independent of the previous flips.

If we have had five heads in a row, what is the probability of getting a sixth head? It is still on-half! Over a repeated number of flips of a coin the number of heads and tails will tend to even out. The "gambler's fallacy" sometimes leads people to think that after five heads in a row that tails is "due," but the probability of heads on any given flip is one half. Weather in a year is largely independent of weather in the preceding crop year. The chances of a good year following a good year are essentially the same as the chances of a good year following a bad year.

If we flip a coin twice, which is the more likely sequence: heads (H) and then tails (T), H-T, or two heads, H-H? We know that if we flip a coin twice there are four possible outcomes:

\[
\begin{align*}
\text{H - H} & \quad \text{T - H} \\
\text{H - T} & \quad \text{T - T}.
\end{align*}
\]

All are equally likely! There is a 25 percent chance of any one specific sequence occurring. However, a head and a tails without considering the order of the outcomes is twice as likely as two heads or two tails.

If we consider three flips, things become a little more complicated. There are a total of eight possible sequences. They are:

\[
\begin{align*}
\text{H - H - H} & \quad \text{T - T - H} \\
\text{H - H - T} & \quad \text{T - H - T} \\
\text{H - T - H} & \quad \text{H - T - T} \\
\text{T - H - H} & \quad \text{T - T - T}.
\end{align*}
\]

Again the probability of any given sequence of outcomes is the same (1 in 8 or 12.5 percent). The probability of three heads is the same as the sequence heads, tails and then heads. However, there are three ways to have two heads and a tail. If the frequency of the outcomes or number of times a result occurs is plotted as in Figure 1, the frequency humps up in the middle. The frequency of getting a combination of heads and tails is much more likely than getting strictly heads or strictly tails. Thus, a combination of good and bad years weatherwise is more likely than a run of good or bad years.
Figure 1. Frequency of combinations of heads and tails from flipping a coin.

Now let's consider tossing a die. With six sides, there are six possible outcomes and all are equally likely. If we combine two six-sided dice, the possible outcomes in terms of the total number of spots showing are as follows:

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These possible outcomes can also be expressed in graphical form (Figure 2) as the number of chances of occurrence in 36. Getting a 7 is the most likely outcome (6 in 36). "Snake-eyes" (double ones) are uncommon (1 in 36), as are double sixes. The probability of an outcome of 4 or less (a pessimistic outcome) is 6 of 36 or one-sixth. Likewise, the probability of a 10 or more (an optimistic outcome) is one-sixth. Two-thirds of the time the outcome will be a 5, 6, 7, 8 or 9.

The normal curve distribution (Figure 3) is closely related to the outcomes of tossing two dice. The normal curve is bell-shaped, with the most common outcome being the average or mean value. Two-thirds of the time, the outcome will be in the 5 through 9 range. One-sixth of the time the outcome
will be 4 or less. On the other side, one-sixth of the time the outcome will be 10 or more. These less frequent outcomes may be considered "optimistic" and "pessimistic" depending on whether they are good or bad.

![Figure 3. Normal curve distribution of frequency of occurrence of possible outcomes from two dice.](image)

Crop yields per acre and annual average prices received by farmers, as well as many other economic outcomes, occur much like the normal curve distribution. The average value tends to be the most frequent outcome, and the pessimistic and optimistic values are much less frequent. Sometimes corrections for yield increases due to technology or price changes associated with inflation may be necessary to get a distribution of outcomes which more nearly approximates the normal curve. Distributions of outcomes which have the bell-shape, like the normal curve, are called "normally distributed." The normal distribution emphasizes that yields or prices which are near the average are much more frequent (more likely) than either very high or very low prices or yields.

**Measuring Variability**

Variability of outcomes is generally associated with risk, and typically riskier situations have greater variability of outcomes. The average outcome is the most frequent or most likely if outcomes are normally distributed, but the average does not provide information about variability. The range—the highest and lowest values-combined with the average does provide some information about variability. However, it is difficult to make comparisons of variability between crops or prices.

If corn yields averaged 110 bushels per acre with a range from 73 to 129 bushels per acre and soybean yields averaged 38 bushels per acre with a range from 28 to 47 bushels, which is more variable?

One could say that corn yields ranged from 66 to 117 percent of average and soybean yields ranged from 74 to 124 percent of average. However, this would not be especially useful because the frequency with which different yields occur is not considered.

The coefficient of variation is a statistical measure of variability based on all of the values for yields or prices, not just the high, low and average. The coefficient of variation is based on the standard deviation which is computed as
where \( x \) is the actual values, \( \bar{x} \) is the average or mean value and \( N \) is the number of observations. The coefficient of variation is simply the standard deviation divided by the average and multiplied by 100 to express it as a percent.

Do not panic if you cannot calculate a standard deviation and coefficient of variation! Many baseball fans do not know how to compute a pitcher's earned run average, but they use the earned run averages to make comparisons among pitchers. In a similar way, these coefficients of variation can be used to make comparisons of variability among crop yields or prices. The lower the coefficient of variation, the lower the variability.

For example, if Tippecanoe County corn yields averaged 110 bushels per acre with a standard deviation of 16.5 bushels, then the coefficient of variation is 15.0 percent \((16.5/110 \times 100)\). For soybeans, if average yields were 38 bushels per acre with a standard deviation of 3.8, the coefficient of variation would be 10.0 percent \((3.8/38 \times 100)\). In this hypothetical example, soybean yields are less variable from year-to-year than corn, as indicated by the smaller coefficient of variation.

Furthermore, if yields are distributed like the normal curve, two-thirds of the time soybean yields would be expected to fall within plus or minus 10 percent of 38 bushels. Two thirds of the time soybean yields would be expected to be in the 34.2 to 41.8 bushels per acre range. In contrast, for corn, the range is plus or minus 15 percent or from 93.5 to 126.5 bushels per acre. About one-sixth of the time yields would be below these lower levels and about one-sixth of the time above. Thus, optimistic outcomes, corn yields of over 126.5 bushels per acre or 41.8 bushels of soybeans per acre or more, would be expected 1 year in 6. Pessimistic outcomes, yields below 34.2 and 93.5 bushels per acre for soybeans and corn, respectively, would also be expected to occur 1 year in 6.

### Computing Expected Values

Sometimes, as in the risk attitude quiz, choices must be made among risky alternatives. Other times, comparisons must be made between a return which is certain (like the interest rate on a certificate of deposit) and one which is risky (like planting corn). Many people make these comparisons every day without recognizing the formal framework involved. The expected value is a mathematically derived value which weights the outcomes by their respective probabilities. Computing the expected value of an alternative is a means of assigning a value to a risky alternative.

What is the expected value of a ticket in a raffle with a prize worth $25,000 and 10,000 tickets? Because 9,999 tickets do not win the prize and only one does, we can compute the expected value of a ticket as:

\[
\begin{align*}
  \$0 \times .9999 & = 0 \\
  \$25,000 \times .0001 & = 2.50 \\
  \hline \\
  \$2.50
\end{align*}
\]

In this case the number of tickets and the prize are both known with certainty. Whether an individual buys a raffle ticket with an expected value of $2.50 for $2.50 depends on one's attitude toward risk in this situation. A risk-averse individual would not buy the ticket, but a risk preferrer would be willing to pay...
more than $2.50. (Even a risk avoider may buy a raffle ticket with an expected value of $2.50 for $5.00 if sold by a charitable organization, but risk concerns are unimportant in this situation.)

In other situations the probabilities and/or the outcomes may not be known with certainty. In this case, individuals typically use their expectations about the future to determine expected values. For example, assume that enterprise "A" is "most likely" to give a net return of $50 per acre. An "optimistic" estimate of net returns is $150, and a "pessimistic" estimate is a loss of $100 per acre. If the optimistic and pessimistic outcomes each occur 1 year in 6, the expected value of enterprise A can be computed as:

\[
\begin{align*}
150 \times \frac{1}{6} &= 25.00 \\
50 \times \frac{4}{6} &= 33.33 \\
-100 \times \frac{1}{6} &= -16.67 \\
\hline
&= 41.66
\end{align*}
\]

Note that the probabilities 1/6, 4/6 and 1/6 sum to 1. All of the outcomes which could occur have been accounted for in estimating the expected value.

An alternative enterprise "B" may have a "most likely" net return of $40 per acre. The "optimistic" and "pessimistic" estimates of net returns are $90 and $20 per acre respectively. Assuming the same probabilities of outcomes for enterprises A and B, the expected value of enterprise B can be calculated as:

\[
\begin{align*}
90 \times \frac{1}{6} &= 15.00 \\
40 \times \frac{4}{6} &= 26.67 \\
20 \times \frac{1}{6} &= 3.33 \\
\hline
&= 45.00
\end{align*}
\]

In these examples, the expected value of enterprise B is greater than that of enterprise A. Although the estimates of the most likely and optimistic estimates of returns for enterprise A are higher than for enterprise B, this is more than offset by the differences in the pessimistic returns. In this situation, with other things being equal, most decision-makers would prefer enterprise B.

The expected value of an alternative is affected by estimates of both probabilities and net returns. The two calculations below indicate different assumptions for enterprise A. In the first, it is assumed that the optimistic returns will occur 2 years in 6 and the most likely 3 years in 6. In the second, it is assumed that the most likely return is $75 instead of $50 with the same probabilities as in the original example. The expected values are:

\[
\begin{align*}
\text{Calculation 1} & \quad \text{Calculation 2} \\
150 \times \frac{2}{6} &= 50.00 & 150 \times \frac{1}{6} &= 25.00 \\
50 \times \frac{3}{6} &= 25.00 & 75 \times \frac{4}{6} &= 50.00 \\
-100 \times \frac{1}{6} &= -16.67 & -100 \times \frac{1}{6} &= -16.67 \\
\hline
&= 58.33 & &= 58.33
\end{align*}
\]

The expected values in both calculations are exactly the same and are higher than the expected value for enterprise B.

Although computing an expected value of an alternative is a mathematically precise procedure, individuals may have different expected values for the same alternative. This occurs because people differ in their assessments of both the outcomes which may occur and the probabilities with which they may occur. Very few individuals will routinely compute the mathematical expected value, but the concept is useful in decision-making because both the range and probability of possible outcomes are considered.
Formulating Expectations

Expectations about the future are factors in decision-making. For instance, expected prices for corn and soybeans have some impact on farmers’ planting decisions. Investment decisions implicitly or explicitly involve expectations about future prices, costs, yields and a number of other factors. No doubt the past has a significant impact on most expectations for the future. However, exactly how individuals form their expectations is unknown. Furthermore, all individuals probably use somewhat different procedures.

Studies have shown that people tend to have selective memories. If the tractor recently broke down, they tend to overestimate the probability of a breakdown. Extreme events are sometimes remembered and given excessive weight in expectations. Many of the individuals who experienced the Depression of the 1930s have attitudes which are different from those who did not. Some people who have not experienced a particular event, like a severe drought, may underestimate the probability of that event.

The recent past tends to be weighted more heavily than events occurring some time ago. This is part of the explanation for the hog and cattle cycles. In other situations, when circumstances have changed, the past may provide very little basis for future expectations. Basing future expectations on the past implicitly assumes that the factors responsible for past events will continue in the future. Long-run expectations based on recent changes can be especially misleading. Some farmers assumed that land values would continue to increase based on their experiences in the 1970s. But very strong trends are likely to experience reversals, as recent land values have amply demonstrated.

Formulating expectations involves judgment. Short-run expectations are generally more precise than long-run expectations because more information is available. Expectations may be changed and revised as additional information becomes available.

Formulating expectations is an important phase of the decision-making process. Most farmers rely heavily on personal experience, but supplement this with other information. Futures prices and outlook information, as well as a view to the past, can be helpful in formulating price expectations. Technical materials and discussion with other farmers can play a major role in formulating other expectations. Expert opinions can also be important. However, expectations are personal, and each individual has his or her own.

Summary

Decision-making in a risky environment is difficult because the consequences are unknown when the decision is made. The probabilities and magnitudes of both gains and losses are considered by prudent farmers in making decisions. Several facets of decision-making in a risky environment are:

1. Farm family goals,
2. Risk attitudes,
3. Expectations about possible outcomes and
4. Probability assessments of these outcomes.
Given the possible differences in all of these factors among farmers, it is easy to see how individuals reach drastically different decisions when faced with what appear to be similar facts and circumstances.

The effort invested in decision-making should be related to possible gains and losses. Many decisions are routine and do not have major consequences. Other decisions do have major consequences and, once made, are not easily changed. It is these latter decisions which should receive more effort. An understanding of decision-making in a risky environment can be helpful to farmers in making more informed decisions.

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