Comprehensive Risk Management Strategies: Putting it All Together

An Education Training Manual for County Agents and Specialists
In the Southern Region

July, 2006

Nicholas E. Piggott, Michele C. Marra, Barry K. Goodwin,
Paul L. Fackler, and David Denaux*

The authors Piggott and Marra are extension specialists and Associate Professor and Professor, respectively, Goodwin and Fackler are William Neal Reynolds and Associate Professor, and Denaux is a former Research Associate in the Department of Agricultural and Resource Economics at North Carolina State University, Box 8109, Raleigh, NC 27695-8109. We wish to thank the Risk Management Agency, the Southern Region Risk Management Center and NC Cooperative Extension for supporting this project.

EXTENSION
RISK MANAGEMENT
EDUCATION
PROGRAM

Table of Contents

Comprehensive Risk Management Strategies: Putting it All Together

An Education Training Manual for County Agents and Specialists
In the Southern Region

Nicholas E. Piggott, Michele C. Marra, Barry K. Goodwin, Paul L. Fackler, and David Denaux*

"Take calculated risks - that is quite different from being rash."
General George S. Patton

1. Introduction

Farmers, like most people, don't want to take on any more risk than they have to. In fact, they have been shown time and again to be willing to trade less profit for a reduction in the risk they face. The more farmers learn about probability and the arsenal of risk management tools available to them, the better armed they will be in the battle to manage risk. Moreover, learning about how to combine risk management tools to form a risk management strategy will help them to achieve even better results.

A farmer almost always is operating under risky conditions. Is risk a bad thing? If we lived and worked in a world without risk, there would be no such thing as above-normal profits. Everyone would receive the same, normal, return which would be just enough to cover all expenses, but *no more than that*. Entrepreneurs, those who are willing to take on some risk in order to earn above-normal profits, would not exist. If the world is risky, then there is an opportunity to make higher than normal profits become wealthy. So, risk isn't all bad. We just have to learn to manage it, while leaving some upside potential.

We know intuitively what "risky" means, but in order to develop the tools for risk management, we must be able to describe degrees of riskiness. So, we must define it formally. *Risk* means that there is more than one possible outcome as a result of an action or decision. If all actions or decisions in farming led to profitable outcomes, then risk management wouldn't matter so much. It's the downside risk, or risk of loss, that matters to us. Farmers can increase the odds in their favor if by taking calculated risks and learning to manage risks successfully.

The purpose of this volume is to provide a basic understanding of probability and risk management tools and a slightly more advanced treatment of crop risk management strategies. It is written especially for extension specialists and county agents in the southeastern U.S. to use as a resource for their risk management extension programs. We hope that this volume will become the basis for development of workshops and county meetings that will enhance farmers' ability to understand and manage risk in their crop enterprises.

2. Understanding and Visualizing Risk: A Probability Overview

The factor of interest (yield, price, revenue, etc.) in the probability distribution is called a *random variable*. A particular level that you observe for a random variable is called an *outcome or event*.
The probabilities of the whole set of possible outcomes that might occur must add to 1.0. For example, if you consider rain and no rain as the only random events in the whole set of possible precipitation outcomes, then if the probability of rain today is 0.3, the probability that it won't rain today must be 1 – 0.30 = 0.70, since rain and no rain are the only two events that can occur. If you are interested in the probabilities of no rain, some rain, and heavy rain today, then the probability that any of these three events occurring must add to 1.0, but knowing one probability doesn't fully define either of the others as in the first example, unless the probability of one of the events is 1.0.

Probabilities can range in value from 0 to 1. If you believe that an event will never occur then you would assign a zero value to its probability. If you believe that an event is certain to occur, then its probability is one and the probability that any other event in the set of outcomes can occur is zero. If you assign a probability of 0.50 to event A and 0.25 to event B, then you believe the event A is twice as likely to occur as event B. The probability that *either* event A *or* event B occurs is 0.75, since the probabilities can be added together. Since the probability of event A is 0.50 and event B is 0.25, there must be at least one more outcome with positive probability in the set of possible outcomes. The sum of the probabilities for all possible events that you believe can occur must equal one, since it is certain that one of them will occur.

The range of possible outcomes and your beliefs about the probabilities of achieving different outcomes within that range can be formalized by specifying a probability distribution. A probability distribution is an illustration of the probabilities assigned to all possible outcomes. There are several ways to describe probability distributions.

2.1 Describing Probability Distributions

If the set of all possible outcomes of a random variable is small, such as the number of possible outcomes when you flip a fair coin, then the probability distribution for that variable can best be illustrated by constructing a table.

Figure 2.1 A probability distribution for one flip of a fair coin

Event	*Outcome*	*Probability*
E1	H	0.5
E2	T	0.5
		1

There are only two possible events that can take place when flipping the coin - the outcome is heads or the outcome is tails. Each event occurs with probability 0.50. Notice in Figure 2.1 that the sum of the probabilities of all possible outcomes equals one.

Figure 2.2 A probability distribution for two flips of a fair coin.

Event	*First Flip*	*Second Flip*	*Probability*
E1	H	H	0.25
E2	H	T	0.25
E3	T	T	0.25
E4	T	H	0.25
			1.00

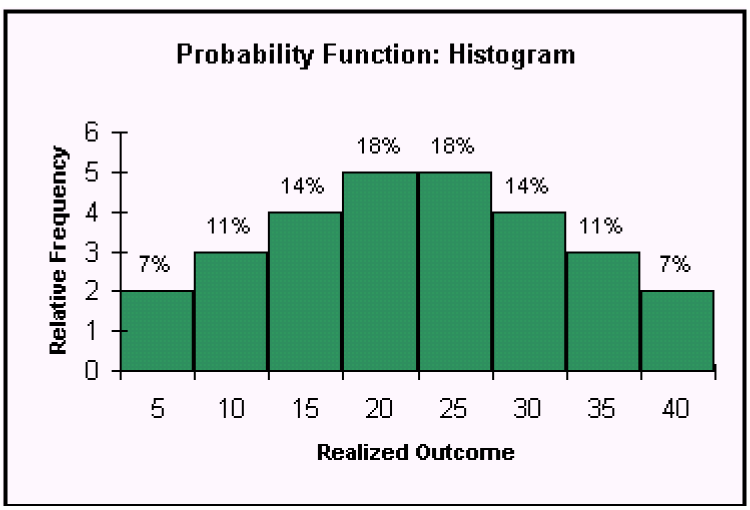
Figure 2.2 shows the probability distribution of two flips of a fair coin. As with Figure 2.1, the sum of the probabilities of all possible events is equal to 1.00. Notice also that the probability of any one event occurring equals the probability of all the observed outcomes that make up that event multiplied together. For example, the probability of both observed outcomes resulting in heads (E1) = 0.50 * 0.50 = 0.25.

When the number of possible outcomes for a particular random variable is large, then a tabular representation is not useful and a different way to describe the probability distribution is needed. Four such ways are described below.

2.1.1. Probability Functions

A probability function is the mathematical relationship between a specified range of outcomes of a random variable and the probability that the outcome will fall within that range. A probability function can be illustrated by a mathematical formula, approximated by a table if the number of ranges is not too large (as in the section above), or by a graph. Graphically, a probability function might look like the following:

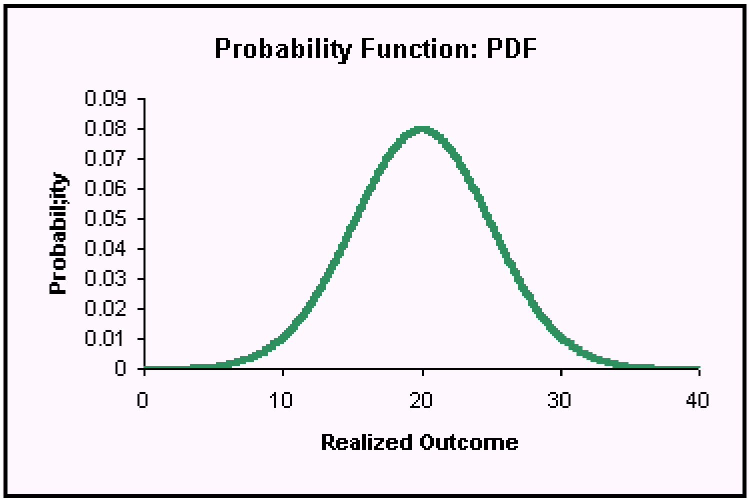
Figure 2.3 Relative Frequency Histogram



This histogram might be representing soybean yields per acre on a farm. Notice that 18 percent of the time the yield is (roundly) 25 bushels per acre (the probability that yield will round out to be 25 is 0.18). The probability that yield is 15 bushels per acre or below is 0.32 (0.14 + 0.11 + 0.07). The probability that yield is in the range 20 – 30 bushels per acre is 0.50 (0.18 + 0.18 + 0.14).

Now, imagine that the number of bars in the above histogram becomes very large and the range of outcomes within each bar becomes very small (i.e. each bar is very skinny, but there are a lot of them), then the probability function can be represented by a smoothed curve like the one below.

Figure 2.4 Probability Density Function (PDF)



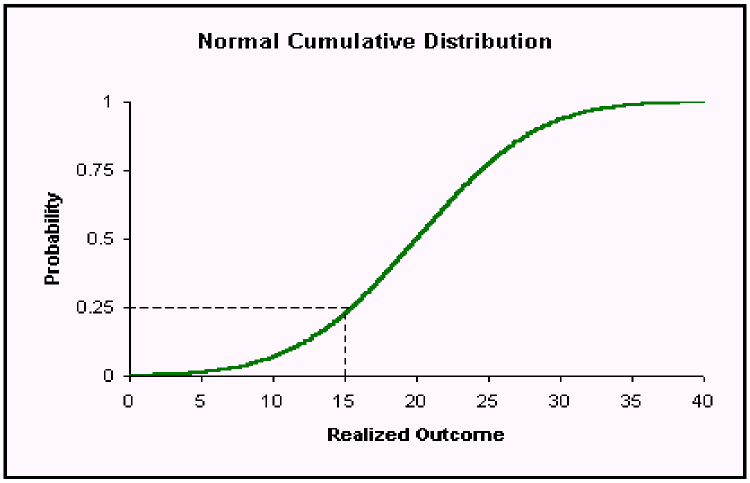
Notice some features of this probability distribution. First, it is symmetric around the mid-point (20) of the range of all possible outcomes. That means that the probability of an outcome lower than the mid-point is 0.5 and the probability of an outcome occurring that is higher than the mid-point is also 0.5. Also, that ranges of outcomes occurring equal distances from the mid-point say for instance, between 5 and 10 and between 30 and 35 will have the same probability of occurrence.

A symmetric distribution is just one of the many shapes that a random variable's underlying distribution can conform to. It is possible for realizations of a random variable to occur more frequently at lower values than at higher values, or vice-versa, in the population of all-possible values that the variable can assume. In this case the underlying probability distribution is *skewed* in one direction or the other. These shapes of distributions are discussed later.

2.1.2. Using Cumulative Distribution Functions (CDF)

Another way to look at the same information about the possible outcomes and probabilities of their occurrence is to construct the cumulative distribution function, or CDF. Sometimes, this graph is a little easier to understand than a probability function when you want to think of the probability that an outcome will be *less than* some number, which is what you're worried about when you are concerned about losses. In other words, this distribution cumulates, or adds up, all the probabilities of outcomes less than any specific outcome. The highest possible outcome will have a cumulative probability of 1.0. You can read the probability less than some number directly from this graph. For example, the probability of an outcome occurring that is less than 15 is 0.25, or in percentage terms, 25%.

Figure 2.5 Cumulative Distribution Function (CDF)



2.1.3. Statistical Moments and Other Characteristics of Probability Distributions

There are several features of probability distributions that are of interest to a decision-maker who is managing risk. These descriptive measures fall into four general categories.

1. Describing Percentiles
2. Measures of Central Location
3. Measures of Data Dispersion
4. Shapes of Distributions

2.1.3.a. Percentiles

Percentiles relate to where a particular observation within a distribution lies relative to all the other points within that distribution.

When observations are ordered in terms of magnitude, the p^{th} percentile has at least p% of the values below that point and at least (100 - p)% of the data values above that point.

For example, the 5^{th} percentile is the value below which 5% of the observations fall and 95% are greater than that value. The $75^{th\ percentile}$ is the value below which 75% of the observations fall and 25% are greater than that value.

1. Median

The Median value, while generally thought of as a measure of central location, is also a divider that parses the distribution in half, at most 50% below the median and at most 50% above the median. It is also called the Second Quartile, as well as the 50^{th} percentile.

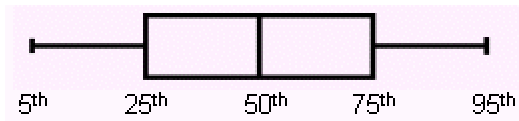
2. Quartiles

Quartiles divide a data distribution into fourths.

- **First Quartile**, or 25^{th} percentile, is the value for which at most 25% of the observations are smaller and at most 75% of the observations are larger.
- **Second Quartile** is the median value or 50^{th} percentile.
- **Third Quartile**, or 75^{th} percentile, is the value in which at most 75% of the observations are smaller and at most 25% are larger.

These quartiles, combined with the 5^{th} and 95^{th} percentiles, are used as a five-number summary to describe a data distribution. The graphical representation below is referred to as a "Box Plot."

Figure 2.6 Box Plot



It is important to remember that 10% of all possible outcomes are "implied" in the above graph. Namely, the 5 percent that is below the 5^{th} percentile and the 5 percent that is above the 95^{th} percentile.

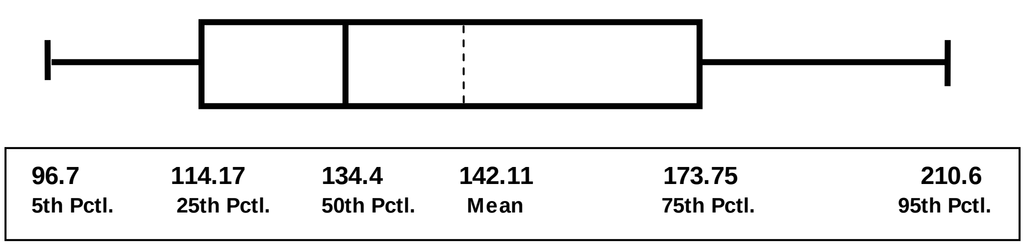
2.1.3.b Box Plots

Box plots are one of the graphical tools used to display probability information. These plots succinctly describe a probability distribution by using a five-number summary of critical points taken from a randomly sampled data distribution.

- Low Value (5^{th} percentile)
- First Quartile (25^{th} percentile)
- Second Quartile - Median (50^{th} percentile)
- Third Quartile (75^{th} percentile)
- High Value (95^{th} percentile)

The interquartile range represents the middle 50 percent of the distribution defined as the 3^{rd} quartile minus the 1st quartile, values from 114.17 to 173.95 in the plot below).

Figure 2.7 Box Plot of the Distribution of Soybean Revenue in Cumberland County, NC 1980-1999 ($/Acre)



What can we tell about the historical soybean revenue distribution through this box plot?

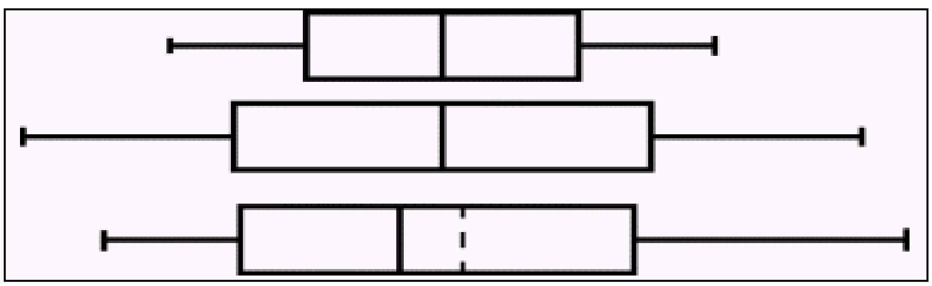
- The range of the soybean revenue distribution is approximately $113.9/ac (210.6 - 96.7).
- Half the values lie below the median (134.4) and half lie above this point. This means that, over the last 20 years, soybean revenue from the farm has been below $134.4/ac. 50% of the time (10 years out of 20) and above $134.4/ac 50% of the time.

- Soybean revenue for this farm has also been less than $173.95/ac., 75% of the time and more than this value only 25% of the time.
- Also, 50% of the historical revenue values fall into the interquartile range (114.17 – 173.95).
- The distribution is positively skewed, with a bunching of data values in the lower 50 percentile, more dispersion of data values in the upper 50 percentile, and a long whisker beyond the third quartile.
- Also note, that, the mean value (142.11) lies to the right of the median value, further suggesting positive skewness. The mean value is generally not displayed on a box plot. It is done so here for illustrative purposes.

2.2 Comparing Different Distributions with Box Plots

Below are three different box plots, two of which represent symmetrical distributions with the same median value, but different interquartile ranges, and the other which has a positively skewed distribution.

Figure 2.8 Three box plots representing three probability distributions



Certain facts about these box plots.

1) Plots #1 and #2 are symmetrically distributed with the same median and mean outcomes.
2) Plot #3 is positively skewed with a higher mean value (designated by the dotted line) but has a lower median value than the other two plots.
3) Plot #1 has a narrower spread than the other two plots. This means that outcomes tend to occur closer to the median value relative to the other plots.
4) The downside potential of Plot #1 is less than the other two.
5) Plot #3 has the largest upside potential.
6) Plot # 2 has the greatest downside potential.

Which graph any individual person thinks is the best, depends on their tolerance for risk, the objective that they are trying to realize, and the financial consequences of an unfavorable outcome. Suppose each of the three box plots in Figure 2.8 represent the expected distribution of a random variable of interest after some strategy is employed. For example, suppose the random variable of interest is cotton yield. The distributions of outcomes might result from three different pest control strategies.

- If you have a high tolerance for risk, you may find that Strategy #3 is the best for you as it has the highest upside potential.

- Strategy #2 has a slightly lower upside potential and a higher median but the downside potential is greater than both strategies #1 and #3.

- Strategy #1 has both the lowest upside potential and downside risk, with a median outcome that is as high as any other strategy. If you are a risk averse individual, then this strategy may be the strategy that you find the most attractive. Outcomes tend to occur closer to the median value than in any of the other plots. Thus, you may feel more confident about decision making with this distribution relative to the other plots. You might prefer strategy #1 if you are very risk averse or you have an unusually high debt level.

- Risk neutral individuals may find the strategy associated with Plot #2 to be the most attractive as it has a median outcome as high as any other strategy and also has a relatively high upside potential, but also it should be noted that it has the greatest downside potential.

A **Risk Averse** person is characterized as cautious with preferences for less risky situations. Risk averse persons are willing to give-up some up-side potential for less downside potential.

A **Risk Neutral** person is characterized as someone who always chooses the decision with the highest expected return, regardless of the risk.

A **Risk Lover** has a preference for more risky alternatives and is willing to accept an alternative that has higher upside potential even if it means taking on more downside risk.

2.3 Measuring Central Location

Within any given probability distribution, we are generally interested in where the center of the distribution is located. Measures of central tendency are measures of central location.

1. **Mean**

   The mean value is by far the most popular and well-known measure of central tendency. The mean can be thought of as simply the long-run average outcome, or in other terms the expected long-run outcome. Thus, it is the "balance point" or center of gravity of the distribution.

2. **Median**

   The median value of a distribution of a set of outcomes is the value that falls in the middle when the outcomes are arranged in order of magnitude.

If a probability distribution is symmetric, the mean and the median are the same number. In Figure 3.4 above, both the mean and the median are equal to twenty. However, if skewness is a factor in the distribution then the two measures are different. For instance, say that over the last five years your soybean yields, in bushels per acre, were 34, 33, 31, 30, and a particularly bad yield, due to a weather related disaster, of 10 bu./ac. The mean of this sample distribution equals 27.6 bu./ac and the median equals 31 bu./ac. You can see how, in this example, one bad year has pulled the mean well below its normal yield and that the median value might be a more representative measure of central location. Agricultural commodity yields and output prices often display distributions that are skewed.

2.4 Measuring Data Dispersion

Measures of Central Tendency (mean and median), while important, do not give enough information about the distribution of interest, unless you are risk neutral. Other than a simple measure of central tendency it is sometimes useful to know something about how the distribution of events is spread out. That is, “How are the outcomes dispersed around the mean (or median) value?”

If outcomes of some random variable are dispersed compactly around the mean or median value of the distribution of all possible outcomes, then decisions based on future outcomes of the random event can be made with more confidence than decisions based on a distribution of a random event whose realizations are dispersed further from the mean or median value.

We introduce the following measures of dispersion.

1. Range
2. Variance
3. Interquartile Range

1. Range

In statistical terms, the *range* of a set of outcomes is the numerical difference between the largest and smallest possible outcome.

Range = (Maximum Possible Outcome– Minimum Possible Outcome).

The ease of computation makes this measure of spread handy. However, it does not give any information about how the outcomes between the maximum and minimum values are dispersed relative to the mean or median value.

2. Variance

Variance is another measure of dispersion within a distribution. It describes the degree of variability in a distribution, or how "spread out" the observations are relative to the mean value.

A particular outcome of a random variable can be viewed as being equal to the mean plus a *deviation* from this mean:

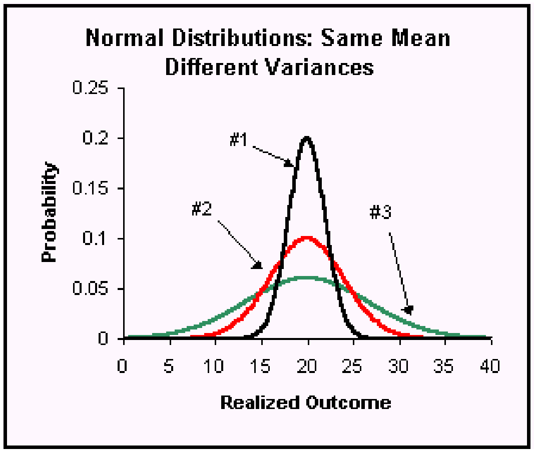
Outcome = mean + deviation

The effects of uncertain or random events, for instance, the effect of weather on yields, tend to result in outcomes deviating from their central tendency. The variance is calculated as:

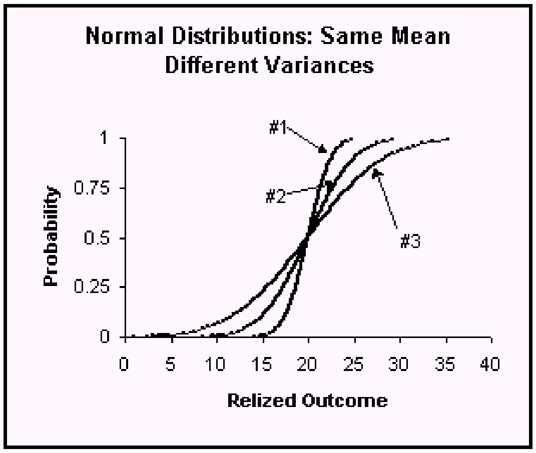
Variance = sum((outcome-mean)^2)/[# of observation in the sample]

or, the sum of the squared deviations from the mean. The deviations are squared because if we just summed up the deviations in a symmetric distribution, we would always get zero. In other words, the deviations on the left side of the mean cancel out the deviations on the right side of the mean. This is only true for symmetric distributions, but the variance for any distribution is calculated the same way.

Figure 2.8 Probability distributions: PDFs and CDFs with the same means, different variances



PDF



CDF

The two graphs above show the same three distributions exhibiting the same mean (and median) value but different levels of data dispersion about these measures of central location. Plot #1 has the smallest dispersion measure and plot #3 exhibits the greatest dispersion. **If you are trying to manage your risk, you are more confident about decisions made from the plot with the lowest dispersion.**

If the graphs above represent bushels per acre yield on the x-axis and you need to realize at least 15 bu./acre to cover your costs of production and harvest, then, if your yield distribution for this crop resembles plot #1 you can be more confident that you will cover your costs. **If you face a yield distribution similar to plot #3 with a large dispersion in the outcomes, then there is a 25% chance that you will not cover your cost and you need to incorporate risk management strategies into your management practices to "cut off the bottom tail" of the distribution to guard against possible devastating losses.**

3. Interquartile Range

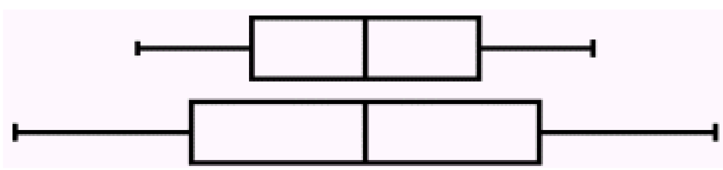
The interquartile range represents the middle 50% of a probability distribution. This 50% can be found as follows:

Interquartile Range = Third Quartile – First Quartile

Half the time (0.50 probability) a realized outcome will fall within the interquartile range.

This does **not** mean that if your yield is low this year, you can expect a high yield next year. It does mean that, over a large number of years, yield should be in the interquartile range about half the time and outside the interquartile range half the time.

Figure 2.9 Interquartile Range



A distribution that has a wider interquartile range than another is said to be more dispersed. Realized outcomes within the distribution are less centrally located than distributions with a smaller interquartile range.

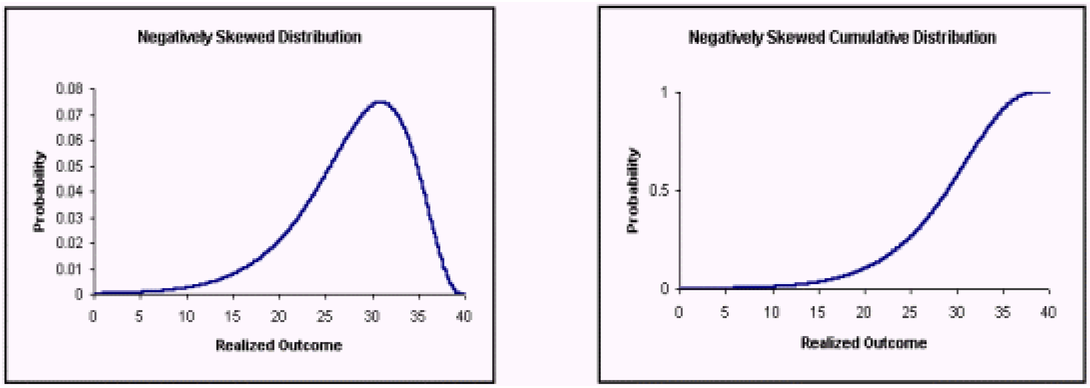
2.5 Skewness

Higher order moments (factors in addition to the mean and the spread) of a probability distribution also affect its underlying shape. We will discuss only the third moment here. Skewness, the third moment of a probability distribution, is a summary measure of the degree to which a distribution is not symmetric, on either side of the mean. Generally, distributions can be thought of as either symmetric, positively skewed, or negatively skewed.

a. Negatively Skewed Distribution

If there is a bunching of the probability above the mean value and a long tail below, then the distribution is considered negatively skewed. With negative skewness there is greater than 0.50 probability (greater than 50% chance) that the outcome will be above the mean value of the distribution. Think back to the small example in Section 3.1.3.b.2 (central location) were a disaster befell the soybean crop one year. That bad year pulled the mean value below the median value. If there is a 50 % probability at the median value, then there has to be a greater than 50% chance that a realized outcome will fall above the mean value.

Figure 2.10 Negatively Skewed Probability Distribution



PDF **CDF**

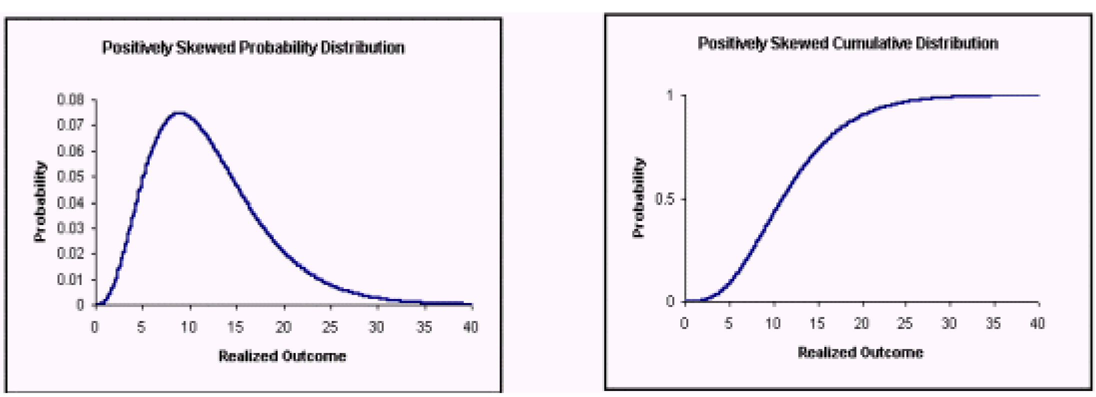
In the case of a negatively skewed distribution, the median value will lie to the right of the mean value and is a better measure of central tendency than the mean of the distribution. This case results from the fact that values on the lower (left side) portion of the distribution exert influence and pull the mean toward its long tail.

It is generally accepted that agricultural yields tend to be negatively skewed. Extreme weather conditions and pest infestation are typical random events that have adverse affects on commodity yields. These types of events tend to pull the distribution's mean yield below the normal level, but outcomes above the mean level occur with greater probability than do outcomes below the mean level.

b. Positively Skewed Distribution

If there is a bunching of the probability below the mean value of a random variable and a long tail extending above the mean value, then the distribution is considered positively skewed.

Figure 2.11 Positively Skewed Probability Distribution



PDF CDF

With positive skewness there is greater than a 0.5 probability (greater than 50% chance) that realized outcome will be below the mean value of the distribution. In the case of a positively skewed distribution, the median value will lie to the left of the mean value and is a better measure of central tendency than the mean of the distribution. This case results from the fact that values on the upper (right side) portion of the distribution exert influence and pull the mean toward its long tail.

Agricultural commodity prices tend to exhibit a level of positive skewness. Historically, governmental price supports established a price floor for individual crops. Occasionally, crop prices rise above this normal range due to supply and demand features associated with agricultural markets, but there is a higher probability associated with higher prices.

2.6 Sample Distributions

The last way to describe a probability distribution is to take a random sample of outcomes drawn from the underlying distribution and to construct a sample probability density function (PDF or sample histogram), sample cumulative density function (CDF), and/or sample descriptive statistics, but adjusted for the fact that you are using only a sample of the total population of possible outcomes.

Suppose that you have 20 years of detrended data on soybean yields. In the population of all possible soybean yields the minimum soybean yield is zero. The probability that your soybean yield will be zero is quite remote, but it is not impossible (impossible would be the same as a probability of zero). There is an upside constraint on your soybean yield as well (at least in the short run). In between these two extremes, your soybean yield could take on an infinite number of values. Thus, your 20 years of yield data is a relatively small sample taken from the underlying population of all possible yields.

"Small" random samples can be quite unreliable representations of the true probability distribution, so the more draws that can be taken from the underlying distribution, the better.
Most times, though, it is costly to take another draw, so cost must be weighed against increased reliability to achieve a balance between the two.

2.6.1 Measure of Association

If you are dealing with more than one random variable, then a joint probability distribution describing the way the two random events relate to one another can be defined.

A measure of association is used to specify how two random variables relate to one another. Correlation is a measure of the degree to which two random variables move together. It is important to understand that correlation does not imply causation, only that there exists a relationship between two variables, which may be used in projecting future outcomes of either variable.

There are many different types of correlation statistics, but the one used extensively is called the "concordance probability" among a set of random variables. The concordance probability value will always lie between 0 and 100.

When the concordance probability equals 100, then the variables ***always*** move perfectly together in unison and are said to exhibit - Perfectly Positive Correlation. High (low) realizations of a harvest season's corn yield, for instance, will be perfectly matched by high (low) realization of soybean yield, if corn and soybean yields are perfectly positively correlated. It should also be noted, that a variable is always perfectly correlated with itself.

Perfectly Negative Correlation exists when the concordance probability between random variables equals 0**,** then the variables ***always*** move perfectly in ***opposite*** directions. High(low) realizations of a harvest season's corn yield will be perfectly matched by low(high) realizations of soybean yield, if corn and soybean yields show perfectly negative correlation.

Independent correlation exists if the variables move independently of each other, and you cannot predict the movement of either one of the variables from the movement of the other. The concordance probability equals 50 in this instance.

Generally, the correlation statistic between random variables takes on a value other than the extreme values associated with perfectly positive (100) and perfectly negative (0) correlation. The relationship between two random variables is stronger the closer it is to either 100 or 0. As the concordance probability moves toward 50, from either direction, the weaker the relationship between the random variables becomes.

If you are working with more than two yield or price distributions, then a concordance probability for each pair of random variables needs specification. A concordance matrix with 100's on the main diagonal (a random variable is perfectly positively correlated with itself) is the best way to visualize these statistics.

Figure 2.12 Concordance Probability Matrix

		(1)	(2)	(3)
1)	Corn Yield	**100**	85	68
2)	Soybean Yield	85	**100**	76
3)	Cotton Yield	68	76	**100**

This is a pretty fancy phrase, but a simple and useful idea once you get used to it. Notice that the values below the main diagonal (highlighted) in Figure 2.12 are a mirror image of the values above the diagonal. The concordance between, say, corn yield and soybean yield is identical to that of soybean yield and corn yield. This fact being the case, the concordance matrix is totally specified when either the lower or upper triangular portion of the matrix is determined. A lower triangular specification concordance matrix is shown below in Figure 2.13.

Figure 2.13 Concordance Probability Matrix: Lower Triangular Specification

		(1)	(2)	(3)
1)	Corn Yield	**100**		
2)	Soybean Yield	85	**100**	
3)	Cotton Yield	68	76	**100**

When trying to manage your risk, you can lower the overall yield variability of your operation if you choose to plant crops with yields that are not perfectly positively or negatively correlated.

3. Measuring Your Risk

The measurement of yield and price risk, or any risk for that matter, involves examining the probability distributions associated with random events and estimating future outcomes drawn from these probability distributions. There are several sources of information that we could use here to accomplish this task, but all of them present some problems.

- Historical Data
- Subjective Beliefs

3.1. Historical Data

To get a sense of how risky an enterprise might be, historical data on yield and price in your geographic locality could be examined. If, however, there has been a lot of technological progress that has been applied to the enterprise in recent years, yield data from before that time might be misleading.

There are ways to adjust for technological progress in a series of historical *yield* data by "detrending" it. Inflation and market shifts may affect the price series in ways that make a long historical *price* series less useful for measuring current and future price risk. One needs to be careful when using historical data to adjust it for these types of events that could affect the risk measure derived from them.

Market shifts, such as the introduction of hybrid corn back in the 1950s, would cause a discrete rise in the whole yield series of corn in, say Iowa. But from then on, the yield series may be similar in trend to the yield series previous to the introduction, but has jumped up in a few years to a new, higher level. It is important to recognize these shifts because they would be counted in your measure of variability, and so can distort the information underlying your risk management decisions. Be sure to not consider yields before such an event in your measure of yield variability.

Smaller technological change events can make your yield series trend upward over time. New, elite germplasm with higher yields are developed regularly and, as you adopt them for your operation, your yields will increase. One way to take care of this problem in your yield data is to “detrend” it. There are all sorts of complicated ways to do this, but a 3-year moving average of your yields has been shown to be as representative of the “de-trended” yield data as the more complicated fixes. A three-year moving average is calculated by taking the average of the first three years of yields and substituting that for the second year’s yield. Then the first year is dropped and the average of the second, third, and fourth years’ yields will be substituted for the third year and so on.

If inflation has been relatively high during the period of your price information, you might want to adjust for it. This is done by using a price index to discount each year’s price to the purchasing power of some base period. You can also use an index to adjust prices to reflect today’s purchasing power. USDA publishes price indices for all the major types of outputs and inputs associated with crop farming. They can be found in the publication called *Agricultural Prices*.

The 2006 publication can be found at the following url: http://usda.mannlib.cornell.edu/reports/nassr/price/pap-bb/2006/agpr0506.txt

Two possible sources for historical data are personal farm records and published historical records.

3.1.2. Using Personal Farm Records

If your farm records are accurate and complete for a long enough period of time, then those records will give us the best picture of your own historical yield and price risk. They will reflect what has happened on your farm, which is the risk you are trying to manage. It is important to keep accurate yield and price (both input and output) records for use in risk management. The problems of using historical data series to measure current and future risk apply to your own data also, so care should be taken to allow for any technological advances, inflation, and market shifts.

3.1.3. Published Historical Data

Prices and yields reported by the United States Department of Agriculture (USDA) or your state department of agriculture for your crops, cropping practices and area are a source for historical data series.

Yields reported by these agencies are county averages and may or may not reflect accurately the risk you face on your farm. County yield variability is less than the yield variability on an individual farm. This is because the county number is an average taken over all farms within that county and unusually high or low yields are “averaged out”. Nevertheless, county averages can be used to examine crop yield risk if there are not enough individual farm yield records available. You can find county crop yield information at http://www.nass.usda.gov

3.2 Subjective Beliefs and Probability Distributions

Most people have some idea of the relative likelihood of a set of outcomes, particularly if they’ve had a lot of experience with them, but quantifying and providing structure to those beliefs for risk management purposes is tricky. Your beliefs about probabilities are, ultimately, personal (or subjective). The probability distribution derived from your beliefs is called a subjective probability distribution.

There have been sets of questions developed by economists and psychologists that are designed to elicit a person's subjective probability distribution, or that person's beliefs about the relative likelihood of the various outcomes.

These methods can be divided into two broad categories:

Those that help you construct a Probability Density Function (PDF)
Those that help you construct a Cumulative Distribution Function (CDF)

The questionnaires reproduced below illustrate these two approaches. These were developed as part of a study on subjective probability conducted at Virginia Polytechnic and State University.

Method 1 guides you through the specification of a probability density function (PDF) by asking you to distribute 20 events across a number of yield intervals. Each event has a probability weight of 0.05 (5 percent).

3.2.1. Questionnaire used to determine subjective Probability Density Function (PDF)

Method 1:

The responses here are in relation to the number of times out of twenty (20) that YOU expect your non-irrigated corn yield this crop season to fall within the yield ranges specified below. They can be based on past experience and any differences you anticipate in the future. Figure 3.1 provides a template for you to use.

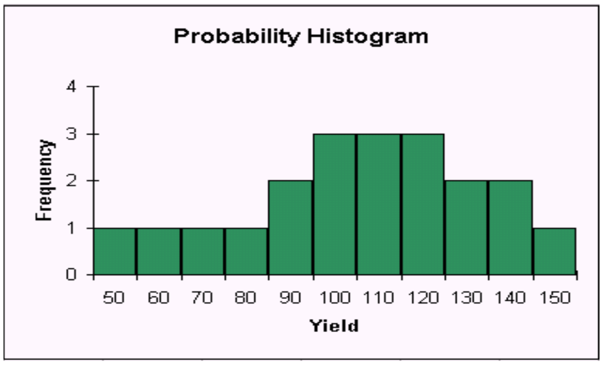
How many times out of 20 would you expect your non-irrigated corn yields to fall in each yield interval?

Figure 3.1 Elicitation of Subjective Probability Density Function (PDF): Method 1

	0–10	10–20	20–30	30–40	40–50	50–60	60–70	70–80	80–90	90–100	100–110	110–120	120–130	130–140	140–150	
Hypothetical Farmer:	0	0	0	0	1	1	1	1	2	3	3	3	2	2	1	
No:	__	__	__	__	__	__	__	__	__	__	__	__	__	__	__	= 20

In this method you fill the number of times out of twenty you expect your yield to fall in the 0-10 bin, 11-20 bin, and so on. Notice that the sum of the numbers equals 20. Thus, you are actually defining relative frequencies that can in turn be used to create relative frequency histograms (Figure 3.2).

Figure 3.2 Subjective Probability Histogram (PDF) from Method #1 Elicitation



Recall that a probability distribution is different from a histogram in that it has a lot of bars, each with a very small range. There are software packages that can turn this information into a probability distribution, but we can tell a lot just from this histogram. Is it positively or negatively skewed? If it is skewed, what does that imply about the mean value relative to the median value?

3.2.2. Questionnaire used to Determine Subjective Cumulative Distribution Function (CDF)

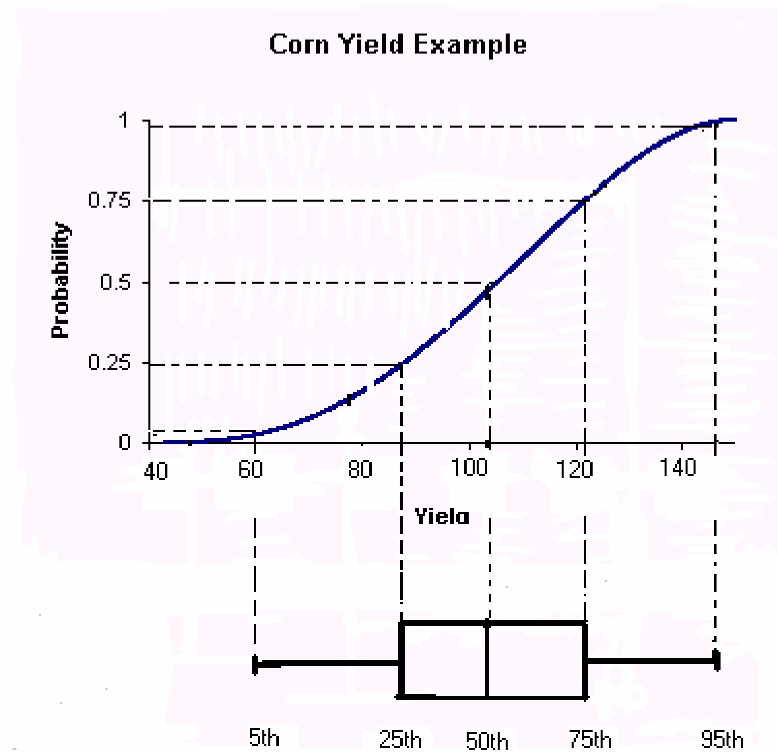
Method 2 guides you through the construction of a cumulative distribution function (CDF) by asking you to divide the yield distribution into ranges specified by chances (probability) of occurrence. The questions in this method are in terms of the chances of exceeding certain corn yields on YOUR farm this cropping season. This method involves dividing your yield distribution into segments according to the chances specified below.

Figure 3.3 Elicitation of Subjective Cumulative Distribution Function (CDF): Method 2

	Hypothetical Farmer	
What is the lowest your corn yield could be this cropping season?	34 (bu./ac.)	(minimum yield)
What is the highest your corn yield could be this cropping season?	152 (bu./ac.)	(maximum yield)
What is the corn yield that you have a 50% chance (i.e. 10 chances out of 20) of exceeding?	103 (bu./ac.)	(50th percentile)
What is the corn yield that you have a 75% chance (i.e. 15 chances out of 20) of exceeding?	83 (bu./ac.)	(25th percentile)
What is the corn yield that you have a 25% chance (i.e. 5 chances out of 20) of exceeding?	121 (bu./ac.)	(75th percentile)
What is the corn yield that you have a 95% chance (i.e. 19 chances out of 20) of exceeding?	60 (bu./ac.)	(5th percentile)
What is the corn yield that you have a 5% chance (i.e. 1 chance out of 20) of exceeding?	145 (bu./ac.)	(95th percentile)

This methodology essentially is asking you to break your yield distribution into percentiles. These percentiles can then be used to construct a cumulative distribution function (CDF) and also a box plot.

Figure 3.4 Subjective Probability Distribution from Method #2 Elicitation



Another way to construct a subjective probability distribution is to construct the probability distribution based on your county's historical yields. Then draw a histogram from the number of times out of 20 years the county yield falls into a certain range. The next step is to think about how your yield distribution might be different from the county distribution, based on your own experience. Then adjust the probability distribution accordingly.

3.4 Measure of Association, or the Relationships between Random Variables

Concordance Probability

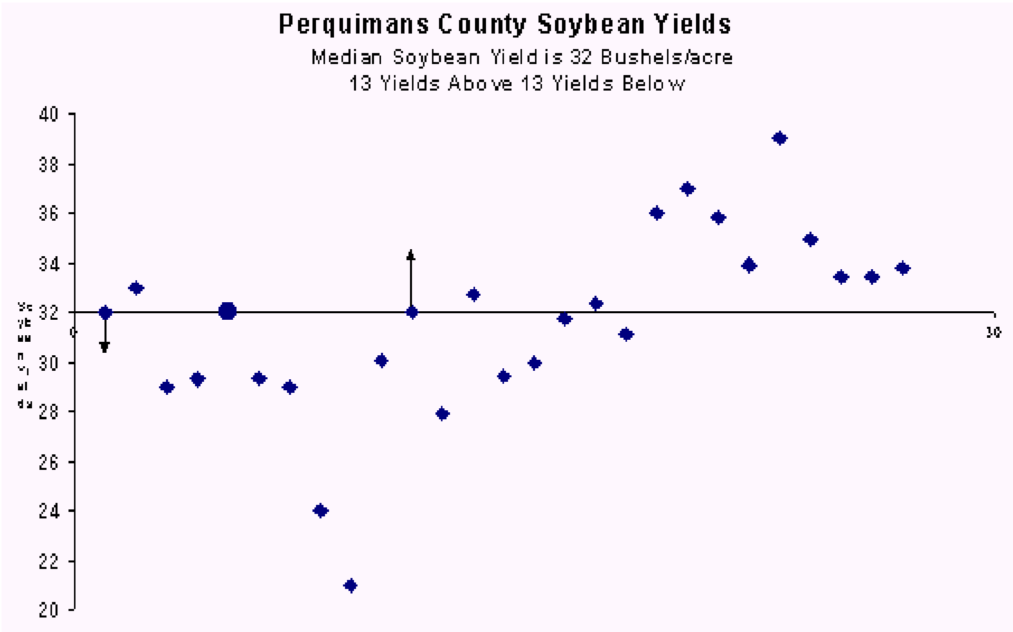
Concordant probabilities are a way to think about the strength and direction of the relationship between two variables. It forces you to ask the question, " How often are my yield realizations for a pair of crops both high or both low in the same harvest season. If, for instance, corn yields and soybean yields are generally high or low in the same harvest year, then this tells you something about the relationship between the two variables. A pair of variables is **concordant** if a high (low) yield for one is matched by a high (low) yield for the other. The *degree* of concordance (correlation) is stronger the higher the number of times that the variables are concordant. If, for instance, 17 out of 20 years your corn and soybean yields were both high or both low in the same harvest season, then your concordance probability is 85 -- ((17/20)*100 = 85) for this example.

Variables are said to be **discordant** if a high (low) realization of one variable is matched with a low (high) realization of the other. That is, in the same harvest year your corn yield is high (low) when your soybean yield is low (high), then the two variables are said to be discordant or have a negative relationship.

If you can gain no predictive capacity about one variable from the other, then the variables are **independently** related. That is, following the corn/soybean example, the same year's harvest of both corn and soybeans are equally likely to be concordant as they are to be discordant.

Figure 3.5 displays county average soybean yields from 1972 - 1998 for Perquimans County, North Carolina. The horizontal axis displays the number of years (28) that make-up the sample data set (to keep the graph less cluttered the values are suppressed). The vertical axis displays soybean yields. Note that the horizontal axis crosses the vertical axis at the median soybean yield , which is the large dot on the 32 bu./acre line.

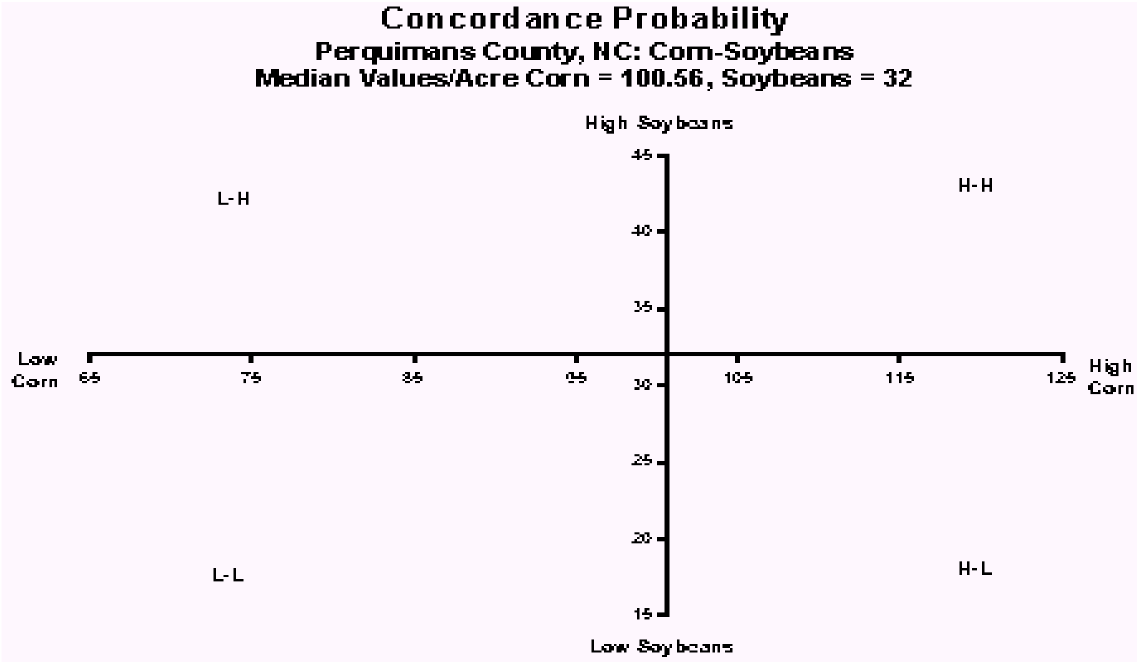
Figure 3.5 Understanding Concordance Probability: Step # 1



By definition, you expect that half of the data points are above the median and half of the outcomes are below (13 above, 13 below). The median soybean yield and is not included in the count. The same type of graph can be constructed for Perquimans County corn yields.

To visualize concordant probability we will construct a slightly different graph. In the next series of graphs (Figures 3.6 - 3.7) soybean yields are displayed on the vertical axis and corn yields on the horizontal axis. Each axis intersects the other at the other's median yield.

Figure 3.6 Understanding Concordance Probability: Step # 2



Notice that this graph forms four quadrants, labeled as follows:

H-H → High corn yield, High soybean yield
L-H → Low corn yield, High soybean yield
L-L → Low corn yield, Low soybean yield
H-L → High corn yield, Low soybean yield

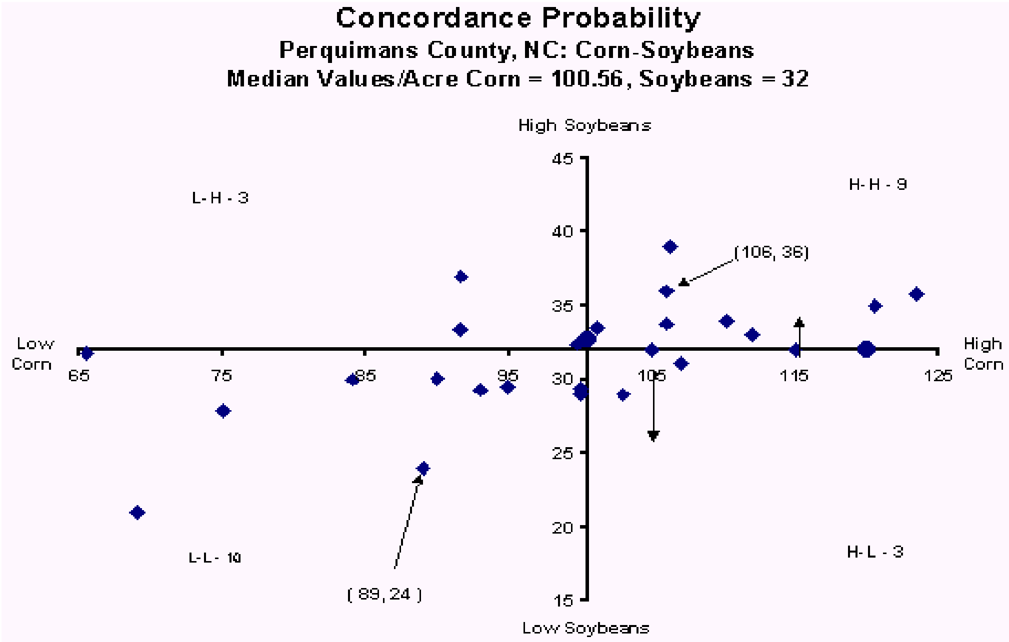
The H-H and L-L areas form the concordant quadrants. If both yields are high or both low in the same harvest year then this year falls in a concordance quadrant. If one yield is high(low) when the other is low (high) then this year falls in a discordance quadrant. The sum of all the years must equal the total number of years in your historical yield series. That is, if you think that corn and soybeans are 85 % concordant then 15% of time they must be discordant. Thus, if you know your concordance probability, then you automatically know your discordance probability and vice-versa.

Independent correlation arises when the concordant probability equals the discordant probability. If your concordant probability between corn and soybeans is 50, then you cannot predict future outcomes of one variable from historical outcomes of the other. In this instance, each quadrant in the above graph would have equal realizations.

When placing a value on for concordance probability you are telling us how often (in percentage terms) your yields or your output price realizations fall in the H-H and the L-L quadrant.

The actual data points are in place in Figure 3.7. The point marked in the L-L quadrant marks the occurrence in which yield values for the pair of crops equaled 89 bu./acre of corn and 24 bu./acre of soybeans. Both these values are below each crop's median yield level. Note that the year that each event took place is not represented in this graph and does not really matter when you are assigning a relationship value among a pair of random variables.

Figure 3.7 Understanding Concordance Probability: Step # 3



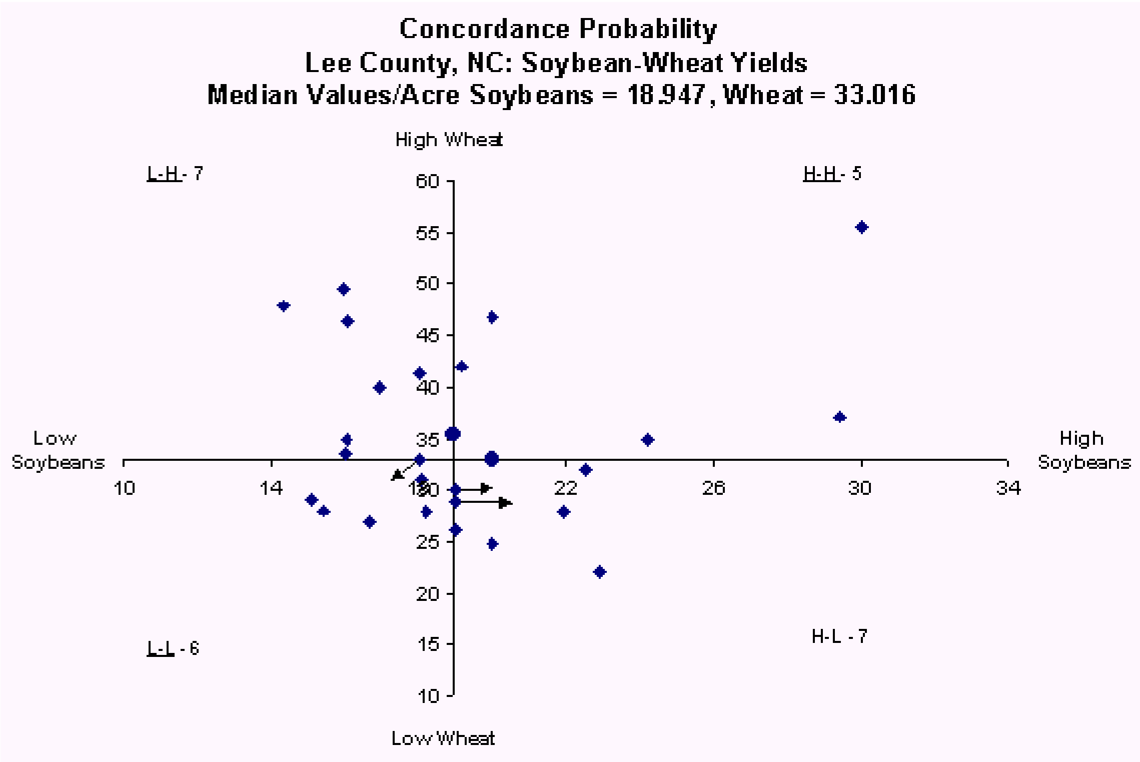
Each quadrants' label specifies the number of harvest seasons that fall into that quadrant. You would expect that the numbers in each quadrant that form a diagonal (H-H to L-L for instance) to be the same (they are slightly different because of the number of years used in the sample (27 - 2 for the medians = 25 years). You expect this because of the way the graph is designed, with the axes crossing at the median outcomes.

For corn and soybeans yields in Perquimans County, NC, the concordance probability equals 76. (19 years in the H-H and L-L quadrants divided 25, the total number of years, multiplied by 100).

Figure 3.8 shows the quadrant graphs for soybeans and wheat in Lee County, North Carolina over the same span of years (1972 - 1998). The concordance probability between the two variables equals 44. Eleven years fall on the H-H to L-L diagonal, thus 11 divided by 25, multiplied by 100 equals 44.

This graph shows an instance in which the two variables are fairly independently related (i.e. close to 50).

Figure 3.8 Concordance Probability



When you are defining the concordance probability between two variables for your farm you need to ask yourself, **"How often are my yields (or prices) for these two crops both high in the same harvest year or both low in the same harvest year?"** Frame the question in terms of the number of years out of so many that these events occur. If you have kept accurate records of your crop yields or prices received, then you can always construct a graph similar to the above graphs.

The subjective beliefs that you define for yield and price, and the concordance values you specify between these random variables can be used to generate a probability distribution of revenue resulting from your choices of risk management tools bundled together.

4. Managing Risk - An Overview

Managing risk does not mean eliminating the risk in most cases. It means ensuring that the risk you face is at acceptable levels for you and your financial situation. For example, if you are heavily in debt because you just purchased a new tractor, you may not be able to tolerate a high probability of a large loss.

Risk management involves understanding the sources of risk, setting risk management priorities, and an understanding of the tools available to make educated decisions pertaining to risk reduction.

Risk management uses the risk reducing tools available to you so that the probability of loss is reduced. These tools include:

Enterprise Diversification (Section 4.1)
Crop Insurance (Section 4.2)
Marketing (Section 4.3)

All risk management tools come at a cost, so you must balance the expected advantages from a risk management strategy against its cost.

4.1 Enterprise Diversification

Diversification is an effective way of reducing income variability. The motivation for diversification results from the fact that revenue from various sources are not perfectly positively correlated. Revenue loss from one crop may be offset by revenue gains from another crop. Enterprise diversification can be accomplished through the use of multiple cropping activities.

Farming disjoint parcels of land (i.e. land in different regions of the county or even different counties) can effectively decrease the adverse affects of localized weather conditions.

Diversification can also be obtained from incomes outside of farming. Enterprise diversification is about reducing the risks associated with farming. Since different income generating enterprises are not generally perfectly positively correlated, combing more than one income source into the overall farm management strategy reduces risk.

4.2 Crop Insurance - Overview

A farm faces risk from four primary sources: yield, output prices, input prices, and general liability. Crop insurance is generally provided under a federally subsidized program to assist producers in dealing with the first two of these sources of risk.

In its simplest form, crop insurance will allow producers to guarantee themselves a minimum level of output. This yield guarantee is based upon an assessment of the producer's expected yield. Subsidies for the insurance are quite high, reflecting the government's strong desire to provide enhancements to farmers' incomes and to aid farmers in developing risk management strategies.

Various revenue insurance programs provide producers with the means to also insure against price risk. Revenues are insured against losses that are caused by either low yields or prices. In the event a farm's revenues fall beneath a guaranteed level, farmers will receive an indemnity payment from the insurer.

Crop insurance can be an important ingredient in a farm's portfolio of risk management instruments. Insurance may provide a hedge against crop losses brought about by unfavorable weather or other circumstances that result in low yields. Revenue insurance products also provide a means for insuring against revenue losses brought about by unfavorable market conditions, which result in low prices. In the event of yield or revenue losses, crop insurance will provide payments to producers that will compensate for the lost revenue. The various insurance products may be used in conjunction with other risk management instruments such as futures contracts and forward pricing.

4.2.1. The Federal Crop Insurance Program

Federally subsidized crop insurance has been in existence since the 1930s. Crop insurance can play an important role in a farm's overall management of risk. Current crop insurance programs address three aspects of a farm's risk: yield risk, price risk, and revenue risk.

A number of insurance plans, differing in their coverage provisions, are currently available. This program includes the principal crop and revenue insurance options currently available to farmers. The federal government heavily subsidizes all programs.

Multiple peril crop insurance (MPCI) has been in existence since the 1930s. Although provisions of MPCI varied over time, the current program retains many of the features of earlier programs. These policies insure producers against losses due to natural causes such as drought, excessive moisture, hail, wind, frost, insects, and disease. The farmer selects the coverage level he or she wishes to insure, from 50 to 75 percent (in some areas to 85 percent) of his or her average yield (APH). The farmer also selects a price election as a percentage of the predicted crop price established annually by the Risk Management Agency.

If the harvest is less than the yield insured, the farmer is paid an indemnity based on the difference. Indemnities are calculated by multiplying this difference by the insured percentage of the established price selected when crop insurance was purchased. All acreage of the insured crop in the county must be insured if insurance is purchased.

Farmers may select from various types of policies. Multiple Peril Crop Insurance (MPCI) policies are available for most insured crops. Other plans may not be available for some insured crops in some areas. In addition, some of the policies listed below are not available nationwide; they are being tested in pilot programs and are only available in selected states and counties in 2006.

4.2.2 Types of Insurance Plans Available

The following insurance programs are currently available to farmers and can be categorized into these types of plans:

Yield-based (APH) Insurance Plans

Actual Production History (APH)
Group Risk Plan (GRP)
Dollar Plan

Revenue Insurance Plans

Group Risk Income Protection (GRIP)
Adjusted Gross Revenue (AGR and AGR-Lite)
Crop Revenue Coverage (CRC)
Income Protection (IP)
Revenue Assurance (RA)

Policy Endorsements

Catastrophic Coverage (CAT)

A more detailed listing of policies and their characteristics can be found at:
http://www.rma.usda.gov/policies/

Since the features of the policies change over time as they are improved and new policies are approved regularly, consult this site often to see what's new for your area.

4.2.2.1 Yield-Based (APH) Insurance Coverage

Actual Production History (APH) – These policies insure producers against yield losses due to natural causes such as drought, excessive moisture, hail, wind, frost, insects, and disease. The farmer selects the amount of average yield he or she wishes to insure; from 50 to 75 percent (85 percent in some areas). The farmer also selects the percent of the predicted price he of she wants to insure; between 55 and 100 percent of the crop price established annually by RMA. If the harvest is less than the yield insured, the farmer is paid an indemnity based on the difference. Indemnities are calculated by multiplying this difference by the insured percentage of the established price selected when the insurance was purchased.

Group Risk Program (GRP) - These policies use a county index as the basis for determining a loss. When the county yield for the insured crop, as determined by the National Agricultural Statistics Service (NASS), falls below the trigger level chosen by the farmer, an indemnity is paid. Payments are not based on the individual farmer's loss records. Yield levels are available for up to 90 percent of the expected county yield. GRP protection involves less paperwork and costs less than the farm-level coverage described above. However, individual crop losses may not be

covered if the county yield does not suffer a similar level of loss. This type of insurance is most often selected by farmers whose crop losses typically follow the county pattern.

Dollar Plan – The dollar plan provides protection against declining value due to damage that causes a yield shortfall. The amount of insurance is based on the cost of growing a crop in a specific area. A loss occurs when the annual value of the crop is less than the amount of insurance. The maximum dollar amount of insurance is stated on the actuarial document. The insured may select a percent of the maximum dollar amount equal to CAT (catastrophic level of coverage), or additional coverage levels. The dollar plan is available for several crops, including fresh market tomatoes, strawberries, and cherries (on a pilot program basis in limited areas only in 2006).

4.2.2.2 Revenue-based Plans

Note: All revenue-based options determine revenue differently. See each policy's provisions for their definition of revenue.

Group Risk Income Protection (GRIP) – GRIP makes indemnity payments only when the average county revenue for the insured crop falls below the revenue chosen by the farmer.

Adjusted Gross Revenue (AGR) – insures the revenue of the entire farm rather than an individual crop by guaranteeing a percentage of average gross farm revenue, including a small amount of livestock revenue. The plan uses information from a producer's Schedule F tax forms, and the current year's expected farm revenue to calculate the policy revenue guarantee.

Adjusted Gross Revenue-Lite (AGR-Lite) – is a whole-farm revenue protection plan of insurance. The plan provides protection against low revenue due to unavoidable natural disasters and market fluctuations that affect income during the insurance year. In contrast to AGR, most farm-raised crops, animals, and animal products are eligible. AGR-Lite can stand alone or be used in conjunction with the other Federal crop insurance plans, except AGR.

Crop Revenue Coverage (CRC) – provides revenue protection for one crop based on price and yield expectations by paying for losses below the guarantee at the higher of an early-season price or the harvest price.

Income Protection (IP) – protects producers against reductions in gross income when either a crop's price or yield declines from early-season expectations. To determine coverage, see the policy provisions that are available on the RMA website or consult your insurance agent.

Revenue Assurance (RA) – provides dollar-denominated coverage by the producer selecting a dollar amount of target revenue from a range defined by 65-75 percent of expected revenue. To determine coverage, see the policy provisions or consult your insurance agent.

4.2.3. Policy Endorsements - Catastrophic Coverage (CAT)

Catastrophic Coverage (CAT)--A plan of insurance established by the Federal Crop Insurance Program that provides coverage comparable to a level for a single crop that is equal to 50 percent (50%) of the approved yield indemnified at 55 percent (55%) of the expected market price. This is the minimum level of coverage required for a person to qualify for certain other USDA program benefits unless the producer executes a waiver of any eligibility for emergency crop loss assistance. Coverage for CAT insurance requires no premium payment, but the purchaser pays an administrative fee determined by the Risk Management Agency annually. Currently in 2006 the fee is $100 for each crop insured in each county. Limited resource farmers may have the fee waived. CAT coverage is not available on all types of policies.

The Noninsured Crop Disaster Assistance Program (NAP), managed by USDA's Farm Service Agency, provides financial assistance to producers of non-insurable crops when low yields, loss of inventory, or prevented planting occurs due to natural disasters.

5. Marketing Overview

Agriculture is a risky business. On a daily basis farmers are confronted with events that affect commodity yields and prices and in turn affect their financial returns and overall welfare. With the changing role of trade negotiations and their impacts on U.S. Agricultural policy, it is difficult to predict the shape of farm policy for the future. One program that has persisted is the Commodity Loan Program. This program provides *some* downward price protection for major U.S. commodities through government loans at a fixed price, called the loan rate. The result is that farmers can get a loan deficiency payment (LDP) on each unit produced that is equal to the loan rate less the market price.

The loan rate is essentially a price floor that has been established by the government for producers. This price floor should not be thought of, however, as a substitute for a well-defined marketing plan. If a producer adds to their net price with a futures hedge, a put option, or by locking in a better price above the loan rate with a forward contract, they are still entitled to the LDP payment. At this writing, one must sign up for the commodity programs that include the loan program each year. This program may not be available in the future because it is tied to production of the commodity, which is contrary to the “production distortion free” goal of the WTO. If this program is dismantled, it is even more important to consider participating in the futures markets to establish your price floor.

The ability to recognize and take advantage of these opportunities requires a well-thought out plan and a good understanding of the tools and options available. Locking-in these "better-pricing" opportunities requires several key factors:

> ***Understanding*** - Understanding the tools that are available that allow you to lock-in prices such as forward contracts, hedging with futures or options and some of the revenue insurance products available. In addition, understanding the current farm programs offered by the government and the rules and eligibility requirements for these programs is essential.
>
> ***Knowing*** **-** Knowing what price and yield you need to at least break-even and earn a reasonable rate of return.
>
> ***Having*** - Having the discipline and confidence to "pull the trigger" when the opportunity arises and not being tempted by the thoughts of “it is going to go higher tomorrow” and missing the chance when it plummets - "being content with locking in a profit".

Adopting some strategy for mitigating risk is not free and usually requires trading off additional profits from possible favorable outcomes in return for a reduction in risk exposure from possible adverse outcomes.

Furthermore, because each individual varies in their attitude toward risk, risk management cannot be viewed with a "one size fits all" approach. That is, there is no golden rule that, for example, all soybean farmers in North Carolina should hedge 50 percent of their crop by selling futures contracts or buying a put option. Every producer’s situation is different and so is their preference for risk and their risk-return trade-off. Each individual producer needs to have their own tailored marketing strategies that best fits their situation and circumstances.

5.1. The Marketing Plan

A crucial first step in developing an effective marketing strategy is to establish the current financial position of the farm enterprise. That is, one needs to establish the following:

- A cash flow budget.
- Determine the liquidity of the enterprise.
- Determine whether the farm enterprise is profitable

With this information in hand, a farmer is in a better position to determine how much risk they can take-on in developing marketing strategies.

A second crucial step is to determine the cost of producing each of the commodities in each enterprise (on a per acre and per unit basis). This estimate of the cost of production serves as a useful tool in setting minimum price objectives that must be achieved for breaking-even. It is not possible to evaluate the merits of locking-in a particular pricing opportunity unless the break-even price has been established.

Finally, a marketing plan should be tailored to each individual producer to meet their own:

- ✓ Price objectives
- ✓ Risk comfort level
- ✓ Costs of production and other market considerations

5.1.1. Marketing Grain and Soybeans in the Southeast - Some Important Details

Marketing alternatives in the Southeast region of the United States are essentially the same as that available to other regions such as the Midwest. However, there are several unique features in relation to demand and supply in the Southeast that influence the effective use and timing of certain strategies.

These unique features need to be well understood by agricultural producers and "influencers" in order to make informed agricultural marketing decisions in the Southeast region.

- Net Importer
- Different Timing
- More Volatile Yields
- Transportation Cost
- Low Yield-Price Correlation

5.1.1.1 Net Importer

The unique demand and supply conditions stem from the Southeast being a grain-deficit region. That is, the Southeast does not produce enough grain to support the poultry and livestock industries located in the region. The significant proportion of the grain that is consumed by the livestock and poultry industries is imported with the majority coming from production out of the Midwest region. This state-of-affairs means that for a majority of the marketing year we should observe grain prices in the Southeast at approximately the Midwest grain price plus the cost of freight.

In addition, because there is only limited storage capacity in the Southeast, and the market must clear, harvest time prices are often lower than the harvest price in the Midwest. These low harvest time prices, due to limited storage, are then typically followed by a strengthening in basis for several months after harvest (usually up to around February for corn and soybeans). Producers who are able to store their commodity as the local prices settle into the more favorable Midwest plus freight price relationship can take advantage of this strengthening basis.

5.1.1.2. Different Timing

Generally, the timing of crops in the Southeast is slightly different than the Midwest. Wheat and feed grains are usually harvested earlier while the reverse is true for soybeans, which are typically planted and harvested later. This difference in timing can also mean that some marketing strategies might be more or less appealing than others in different regions.

For example, new crop pricing alternatives for wheat and feed grains might be enhanced significantly in the early harvesting Southeast regions in years when the ending stocks from the previous year were depleted and there remains uncertainty about the new crop production in the major producing areas.

5.1.1.3. More Volatile Yields

Yields tend to be more variable in the Southeast compared to the Midwest. This property has the effect of making strategies that involve locking in a certain quantity, such as a forward contract, less attractive compared to the Midwest where yields are less volatile, and where they can be fairly confident that they can deliver the contracted quantity.

5.1.1.4. Transportation Costs

Due to the Southeast being heavily reliant on Midwest grain to be transported here to fulfill demand, there is a small premium captured by local producers whose grain does not have to be hauled as far.

Furthermore, when there are transportation glitches or a sudden increase in fuel costs there may be opportunities for local grain producers to sell their grain at higher price levels. However, often these opportunities are difficult to predict and are usually short-lived and require having grain on hand to take advantage of them.

Nonetheless, the fact that the Southeast region is a major importer means that such factors as freight rates and logistics play a larger role in the price discovery process than other regions.

5.1.1.5 Yield-Price Correlation Low

Perhaps, most importantly, is the modest yield-price correlation that exists in the Southeast. That is, if yields in the Midwest plummet, there is typically a national price offsetting response with rising prices having a stabilizing effect on revenues for farmers - a lower quantity but a higher price.

There is stronger correlation between national yields and prices and Midwest yields and prices than Southeast and National yields and prices. The Midwest is significant in terms of production. So, adverse or favorable yields in this region significantly impact national supply and thus, prices.

This is not the case for production in the Southeast. Since, agricultural production in the Southeast accounts for a such small share of the national agricultural market, adverse weather that greatly affects yields in the Southeast will have little effect, if any, on national supply and thus prices.

This lack of the yield-price tradeoff in the Southeast means that producers may need to consider alternative strategies than what might be appropriate for a Midwest producer. Southeast producers cannot rely on much of a counterbalancing impact from price on revenues when yields are lower.

5.2 Cash Markets

All producers of grain and soybeans must at sometime find a buyer for their commodity unless they are producing the commodity for on-farm use. The "actual" physical exchange of the commodity for payment is typically referred to as the cash market. This can be compared to the futures market where actual physical exchange of a commodity is rare where instead offsetting is most commonly adopted.

For most producers, their cash market constitutes a local commercial elevator, a feed mill, a crushing facility, or possibly another producer. Transactions in the cash market occur under many different arrangements including forward price contracts (price is determined before delivery) and delayed pricing (price is determined sometime after delivery).

When transactions occur in the cash market there are many details that must be negotiated between the buyer and seller other than price, which include:

- The quantity
- Dates of delivery
- Time and place
- Grade requirements

- Premiums and discounts
- A method of settling differences in opinion if a disagreement arises.

These details can be compared to the futures contract where the only variable not standardized is the futures price.

5.3 Commodity Exchanges

A market place where participants exchange futures and option contracts in agricultural commodities. The two major exchanges in the United States for agricultural commodities are the:

- Chicago Board of Trade (CBOT) - The Chicago Board of Trade provides futures and options markets for a vast array of agricultural commodities, including, wheat, corn, and soybeans.

- New York Board of Trade (NYBOT) - The New York Board of Trade provides futures and option markets for cocoa, coffee, cotton, sugar, and frozen concentrate orange juice. Also, a futures and options market for the dairy industry is maintained

These commodity exchanges act as clearinghouses for transactions from all around the world.

The trading of futures and options in the United States is highly regulated and monitored by such agencies as the Commodity Futures Trading Commission (CFTC) to ensure the financial integrity of every transaction. The crucial roles of commodity price discovery and risk transference take place within these exchanges.

5.3.1 Futures Contracts

A futures contract is a commitment to either make or take delivery of a specific quantity and quality of a given commodity at a predetermined time and place sometime in the future.

The only term of the contract that is not standardized is the price, which is determined by open outcry on a commodity exchange floor or an exchanges electronic trading system. Such a standardized contract thus permits the efficient and fluent exchange of the contract in a fashion that minimizes transaction costs.

All contracts are settled by either offsetting purchases (almost always) or by actually delivery of the commodity (very rare).

5.3.2 Option Contracts

An option contract gives the buyer the right, but not the obligation (hence the name option) to buy or sell a futures contract at some predetermined price (the strike price) anytime within a specified time period (until the contract date on the particular option expires). An option to buy a futures contract is called a call option, while an option to sell a futures contract is a put option. The price "per unit" basis it costs to purchase an option is referred to as a premium.

The value of an option is the sum of two parts.

Intrinsic Value - The intrinsic value is the amount of money that could be realized if an option is exercised. For example a put option has intrinsic value if its strike price is above the futures price. If the futures price is above the strike price then the put option has no intrinsic value.

Time Value - The time value is the additional value above the intrinsic value that is associated with the possibility that the intrinsic value of the option may increase before expiration. At expiration the time value is equal to zero.

5.4. Government Programs

Government programs have historically been in place to provide assistance to agricultural producers. This assistance is meant to supplement producers' income and should not be considered as a substitute for a well thought out marketing plan. The programs that are available vary from year to year and so it is in the producer's best interest to be in touch with the local Farm Service Agency (FSA) or Cooperative Extension office to keep abreast of currently available programs.

5.4 Alternative Marketing Strategies

5.4.1 Cash Sale

This strategy tends to be the most common way that producers sell their crops. Spot selling is the simplest method but also tends to be one of the most risky. Harvest time cash prices can be the lowest prices of the year due to local supply and demand conditions during this period. Basis around harvest time tends to be weak. Producers benefit greatest selling their crop when basis is strong. Furthermore, relying on harvest time cash sales offers no flexibility to the producer. Despite some of these disadvantages spot selling is popular because:

- It is simple
- Requires no storage
- Provides instance cash flow

5.4.2 Cash Forward Price Contract

This type of agricultural marketing contract is a cash contract much like spot selling, except the grower and elevator agree, in advance, to the transaction of a specified quantity to be delivered on a certain date, at a specified price.

All forward pricing by elevators is done using futures markets. Typically, we expect a cash forward offer by an elevator to closely follow with the following formula:

Forward Price = Futures Price + Basis.

This formula can also be used by farmers to localize the current futures prices. Knowing the historical basis for a particular location, combined with the above formula, can be extremely useful when evaluating the merits of a forward price offer.

Advantages of Cash Forward Price Contract

- Farmers can lock-in both the price level and the basis.
- The farmer can forward contract "odd-lots" instead of specified quantity as dictated by a futures contract
- No initial deposit is required as there is in the case of a margin requirement with a futures position.
- Elevators may be willing to contract with a producer before a crop is planted. A signed contract might be sufficient for a lender to serve as collateral on an operating loan for a producer.

Disadvantages of Cash Forward Price Contract

- Because the producer has essentially locked in both price and basis, if there is improvement in either, the producer cannot benefit. That is, this contract not only eliminates the downside risk (the desired effect), it also eliminates the upside potential.

- Because the contract stipulates the delivery of a specified quantity, if there is an unforeseen cut in production (i.e., a drought or storm damages) a producer may find it difficult to fill their contracts. This may require purchasing grain to fulfill the commitment; which, may require paying a higher price than the already agreed upon delivery prices. In this case the difference is borne by the producer.

It is this uncertainty with production that typically leads producers to allow for contracting a modest amount of their anticipated production, such as 50-60%.

5.4.3 Using Basis To Evaluate Cash Forward Price Offers

If a farmer in Washington County, North Carolina is interested in locking-in a price for soybeans in June for harvest delivery in late October, knowing the historical basis can be helpful in evaluating current harvest delivery offers. To illustrate, lets say the November soybean futures contract (the nearby contract to the time the farmer is planning to sell their soybeans) is trading around $6.00 in June. In addition, the farmer calls the local buyer at Pantego (the closest local elevator) and a forward harvest delivery price offer of $5.85 is made. The local buyer is quoting a price that is 15 cents under the futures price. In other words, it has included a basis of -15 cents (-$0.15). Is this a reasonable price? Should the farmer go ahead and contract some of their anticipated production at this price?

A knowledge of the historical basis can help the farmer decide whether to either accept or reject the offer. Figure 5.1 shows the monthly historical basis for Pantego over the period 1980-1998. It also provides the average, minimum, and maximum values by month, and by year. Using this information, the farmer can make an informed decision about whether to accept the current offer of $5.85.

Figure 5.1 Average Monthly Soybean Basis with Nearby Futures

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.	Min.	Max.
1980	-0.26	-0.07	-0.16	-0.15	-0.22	-0.20	-0.22	-0.18	-0.28	-0.29	-0.54	-0.34	-0.24	-0.54	-0.07
1981	-0.14	-0.04	-0.16	-0.08	-0.21	-0.14	-0.11	-0.06	-0.16	-0.41	-0.50	-0.21	-0.19	-0.50	-0.04
1982	-0.08	-0.05	-0.07	-0.07	0.00	0.06	0.10	-0.10	-0.10	-0.19	-0.24	-0.09	-0.07	-0.24	0.10
1983	-0.10	-0.11	-0.13	-0.08	-0.09	0.09	-0.03	-0.10	-0.13	-0.08	-0.16	0.02	-0.08	-0.16	0.09
1984	0.00	0.06	0.05	0.05	-0.02	-0.01	-0.07	-0.07	0.04	-0.10	-0.22	-0.11	-0.03	-0.22	0.06
1985	-0.05	0.05	0.05	0.05	0.04	0.10	0.18	0.15	0.17	-0.15	-0.18	-0.03	0.03	-0.18	0.18
1986	-0.10	-0.02	-0.01	-0.10	-0.15	-0.01	0.09	0.23	0.06	-0.22	-0.15	-0.11	-0.04	-0.22	0.23
1987	-0.11	-0.10	-0.05	-0.04	-0.12	-0.11	-0.06	0.07	-0.08	-0.24	-0.20	-0.19	-0.10	-0.24	0.07
1988	-0.15	-0.02	0.00	0.01	-0.04	-0.33	-0.36	-0.10	-0.25	-0.33	-0.35	-0.28	-0.18	-0.36	0.01
1989	-0.21	-0.08	-0.12	-0.08	-0.06	-0.31	0.04	0.33	0.10	-0.13	-0.24	-0.15	-0.08	-0.31	0.33
1990	-0.17	-0.13	-0.21	-0.18	-0.24	-0.20	-0.04	-0.04	-0.20	-0.19	-0.27	-0.25	-0.18	-0.27	-0.04
1991	-0.31	-0.11	-0.21	-0.12	-0.11	-0.10	-0.12	-0.15	-0.21	-0.19	-0.23	-0.25	-0.18	-0.31	-0.10
1992	-0.19	-0.16	-0.16	-0.12	-0.15	-0.15	-0.11	-0.08	-0.20	-0.25	-0.35	-0.30	-0.19	-0.35	-0.08
1993	-0.23	-0.15	-0.15	-0.20	-0.15	-0.15	-0.18	-0.18	-0.24	-0.24	-0.22	-0.15	-0.19	-0.24	-0.15
1994	-0.20	-0.16	-0.10	-0.08	-0.05	-0.04	-0.08	-0.19	-0.20	-0.23	-0.36	-0.27	-0.16	-0.36	-0.04
1995	-0.18	-0.10	-0.20	-0.17	-0.21	-0.20	-0.20	-0.36	-0.33	-0.26	-0.28	-0.22	-0.23	-0.36	-0.10
1996	-0.17	-0.12	-0.15	-0.16	-0.25	-0.25	-0.30	-0.18	-0.06	-0.18	-0.24	-0.29	-0.20	-0.30	-0.06
1997	-0.25	-0.25	-0.20	-0.16	-0.10	-0.05	0.39	-0.04	0.09	-0.21	-0.24	-0.20	-0.10	-0.25	0.39
1998	-0.15	-0.09	-0.05	-0.05	0.00	-0.03	-0.41	-0.10	-0.15	-0.22	-0.31	-0.25	-0.15	-0.41	0.00
Avg.	-0.16	-0.09	-0.11	-0.09	-0.11	-0.11	-0.08	-0.06	-0.11	-0.22	-0.28	-0.19	-0.13	-0.31	0.04
Min.	-0.31	-0.25	-0.21	-0.20	-0.25	-0.33	-0.41	-0.36	-0.33	-0.41	-0.54	-0.34	-0.33	-0.54	-0.15
Max.	0.00	0.06	0.05	0.05	0.04	0.10	0.39	0.33	0.17	-0.08	-0.15	0.02	0.08	-0.16	0.39

Over its nineteen-year history, the average basis in October at Pantego has been -22 cents (-$0.22) with a maximum of -8 cents (1983) and minimum of -41 cents (1981). If we had anticipated the elevator to make an offer using the average basis, we would have expected an offer of $5.78 ($6.00 + [-$0.22] = $5.78), but the current offer is 7 cents above this level ($5.85 - $5.78 = $0.07). In this case the farmer has an opportunity to lock-in a basis that is close to the historical high of -8 cents for this nineteen-year period for this time of the marketing year. Assuming that the price level is also acceptable, the current offer gives the farmer an opportunity to eliminate both price and basis risk on the amount of their expected production that they elect to contract.

5.4.4 Hedging

Hedging is the practice of trading futures or options with the objective of reducing or controlling risk. It involves trading off additional profits, due to favorable price changes, in return for a reduction in risk exposure, due to adverse changes in prices. This is done by taking an offsetting (i.e., opposite) position in the futures market than in cash market meaning that gains and losses in each are offset.

5.4.4.1 Hedging with Futures

Hedging with futures contracts involves selling the appropriate number of contracts today with the idea of offsetting this position at the same time the cash sale of the physical commodity — this practice is sometimes referred to as a short hedge.

The way to remember whether you must buy or sell futures is to use the following rule:

Do today in the futures market what you must do in the cash market later.

For a producer of a commodity this means selling futures today and then offsetting the futures position by buying them back at the time of the cash sale.

If commodity prices subsequently decline between when the futures contracts were sold and the cash sale is completed, the producer buys the futures contracts back at the lower price, profiting by the difference, which then, offsets the drop in the value of commodity in the cash market.

If instead futures prices rise, the producer will have to pay margin calls until this position is offset. However, since the cash market should also be rising in concert with the futures market, producers should recapture the cost of the margin calls when they complete the cash sale at the higher price.

Being hedged in a rising market and having to pay margin calls can place a strain on an operation's cash flow. It is important that lenders are well informed and understand the principles involved.

Hedging hinges on the premise that local prices and futures prices are highly correlated. Stated differently, this means that local prices and futures prices move together. The more the two markets are correlated (i.e., the closer they move together) the better the hedge will work.

It is important to also point out that hedging eliminates price risk in return for accepting basis risk. It is generally thought that basis is less volatile than prices hence the willingness to trade price risk for basis risk.

Hedging with futures does offer protection from downward price movements and does not require paying a premium but it also has the disadvantage that if the market price increases the producer must pay margin calls. The margin calls or "a losing position" in the futures market essentially eliminates any upside potential with respect to price if hedging with a futures strategy. It is the threat of possible margin calls and the limiting upside potential of this strategy that is the primary reason some producers prefer hedging with options rather than futures.

5.4.4.2 Mechanics of a Short Hedge with Futures

The example below illustrates the mechanics of short hedge for soybeans. In May the November soybean contract is trading at $6.30 and the basis at Soy City tends to be around 30 cents under (-0.30) the November contract in October.

Thus, the current $6.30 price on the futures equates to a predicted local price of $6.00 in October with a typical basis.

Local Price = Futures Price + Local Basis

Farmer Bill from Soy City finds this price acceptable and wants to hedge a portion of his crop to lock-in this price level. He does this by selling the appropriate number of futures contracts at the $6.30 level in May.

When October rolls around and farmer Bill is harvesting his crop the market has weakened with the November contract now only trading at $5.70, which equates to $5.40 local price with the same typical basis of 30 cents under.

So when farmer Bill takes his beans to the elevator he will only receive $5.40 for the cash sale.

In addition, because of the hedge he placed in May farmer Bill can offset his futures position by buying back the same number of contracts that he sold in May at the lower $5.70. Adding the $0.60 profit ($6.30 - $5.70) to the net sale ($5.40), results in a net price of $6.00.

This example illustrates a perfect hedge by assuming no basis risk, which is almost never the case in practice. In a short hedge a producer benefits from a strengthening in basis but loses from a weakening in basis. That is, if the basis had strengthened to say 20 cents under (-20 cents) then farmer Bill's local and subsequent net price would have been 10 cents higher, a net $6.10. Conversely, if the basis had weakened to say 40 cents under (-40 cents) then farmer Bill's local and net price would have been 10 cents lower, a net $5.90.

Figure 5.2 Mechanics of a Short Hedge with Futures

Soybean Short Hedge with Futures

	Cash market—Soy City	Futures—Nov Contract	Basis
May	$6.00	$6.30 (sell)	(-0.30)
October	$5.40	$5.70 (buy)	(-0.30)
	Profit/Loss	$0.50	

Cash Price Received: $5.40
Futures Profit/Loss: $0.60
Net Price: $6.00

5.4.4.3 Hedging with Option Contracts

Options contracts are considered a more attractive alternative for hedging than futures since they:

- eliminate the threat of margin calls
- allow the farmer to benefit in a strengthening market

For these privileges, the producer must pay a premium up front.

Buying a **put option** establishes a floor price but also allows the producer to benefit from a strengthening market. The floor price that can be established using a put option equals:

Floor = Strike Price + Basis – Premium

When hedging using a put option the producer can still benefit from upward price movements. When the futures price exceeds the strike price the option has no intrinsic value, and the producer can simply let the option expire.

The absence of margin calls when the market price is increasing is what allows the producer to prosper from the favorable upward price movements. Thus, by hedging with a put option you can enjoy the offsetting position when you need it (when futures price falls below the strike price) and are not penalized by margin calls when the futures price is rising. This privilege of course is not free. The cost amounts to the premium paid up front.

When you hedge with a put, a producer receives a net price that will be lower by the amount of the premium. In this sense, the put option is not as effective as hedging with futures. The maximum net price you will receive will be the futures price adjusted for the basis less the premium paid for the option.

Maximum Price = Futures Price + Basis – Premium

The 100 percent coverage on production when hedging with a put option stems from the property that if there is a reduction in yield and prices rise, the producer merely lets the option expire and sells the crop at the higher price. Since there are no margin calls, the most the producer stands to lose is the premium, and need not produce all of the commodity that they hedged to cover the margin calls that they would have had to pay out.

The disadvantage of hedging with option contracts is they can be less profitable than hedging with futures contacts. The premium paid for an option contact can often be prohibitively expensive. The further a put option's strike price is in the money, the more expensive is the premium. In many circumstances the premiums for the strike prices that a producer would like to establish a floor with are either in-the-money or at-the-money, making them quite expensive. The out-of-the-money puts, although cheaper, may not provide an adequate enough price floor for the producer.

Basis Contract

Basis contracts permit the capturing of a favorable basis. The basis contract is essentially a forward price contract in which the basis level is guaranteed instead of the price level.

The producer locks in the basis that they will receive on the day they deliver their grain. At the time of settlement, the price that the producer will receive will be equal to whatever the price of the agreed upon futures contract is trading plus the agreed up basis.

This contract allows the producer to benefit from strengthening in the price level between when the contract was entered into and the day the final settlement made. Under this contract, there is no price protection, merely basis, and most consider basis the more predictable of the two.

Furthermore, there is no opportunity to capture any further gains in basis. Before entering into this contract it is advisable that the producer be quite familiar with the historical basis so that they can be certain that the basis that they are locking into is truly exceptional.

5.5 Loan Deficiency Payment (LDP)

The 2002 Farm Bill legislation provided support for loan deficiency payments for numerous commodities including corn, soybeans, wheat, and cotton. These loan deficiency payments establish a floor price for producers at the county loan rate. Average national loan rates that have been established for all program crops:

Soybeans	Barley	Mustard seed	Sunflower seed (Oil)
Corn	Canola	Oats	Sunflower seed (other)
Wheat	Flaxseed	Rapeseed	Other minor oilseeds
Upland cotton	Grain sorghum	Safflower	

These loan rates vary by county, and individual producers must be familiar with their county's specific rate.

Each day a Posted County Price (PCP) is published at the local FSA office. The formula for how the PCP is calculated varies but it should closely resemble current local cash prices.

The LDP is the difference between the county loan rate and the posted county price. The LDP provisions are active when the payment rate is greater than zero. An eligible producer may choose to receive an LDP in lieu of receiving a Nonrecourse Marketing Assistance Loan if the quantity of a commodity is eligible.

Payments are capped at $75,000 per person per year. The value of the cap is legislated and has changed in some years. This figure includes the sum of all marketing loan gains and LDP payments for all crops. LDP provisions are in effect for a given crop until the final loan availability date for that commodity.

5.6 Futures and Option Contracts

This section goes into detail about how to read the "open outcry" display for different futures and options trading boards (Chicago Board of Trade (CBOT) and the New York Cotton Exchange (NYCE)). The specifications of agricultural futures and options contracts traded on these boards are also discussed.

The section is divided into two sub-sections. Section 5.6.1 - open outcry - discusses how to read each board's display of daily price quotes for both futures and options contracts. Section 5.6.2 - Contract Specifications - goes into an abbreviated list of contract specifications as determined by the trading market of each commodity. For a full list of contract specifications contact the trading board in which the commodity is traded.

Contract specification details for each contract focus on the trading (ticker) symbol, contract months, trading unit, price quotes, and "tick" size for each supported agricultural futures and options commodity. Each commodity's futures contract is first discussed followed by its options contract.

5.6.1 Open Outcry

Futures Contracts

a) CBOT Futures

The first column in this display lists all the futures contracts available for trade on any given day for the commodity of interest. The contracts are identified by a two-digit year value and a month value. For example, a "02Sept" Corn contract has a delivery date in September, 2002 (check the contract specifications with the trading board for exact "last deliver day" possible).

The remaining columns list the following variables associated with each traded contract.

Settle - This value represents the settle price, i.e. the last price paid for the commodity on any given trading day. **Note:** The settle price heading only appears at the end of the day. During trading hours this column is listed as "Last."

Net Change (Net chg) represents the amount the commodity's settle price or "last price" has changed from the previous day's settle price.

Opening - The price at which the commodity opened trading for the day. Often reported as the range of prices that buy and sell transactions took place during the opening of the market.

High - The highest price of the day for the futures contract of interest.
Low - The lowest price of the day for the futures contract of interest.
Close - Is the range of prices that buy and sell transactions took place at the close of the market. The settle price is determined by averaging these quoted prices.
Previous Settle (Prev Setl) - Settlement price from the previous day.
High Limits - The maximum advance from the previous day's settlement permitted for a contract in the present trading session.
Low Limits - The maximum decline from the previous day's settlement permitted for a contract in the present trading session.

If the commodity tick size is in ¼ cent/bushel, then the price quotes are listed in "cents and ¼ cent" per bushel. Figure 5.4 is used to explain the price quotes displayed on the CBOT board for a few soybean futures contracts (These prices are not actual quotes but rather are created for illustrative purposes only. If they match any series of prices on any CBOT board for any given day, it is just coincidental).

Figure 5.4 Sample of Soybean Futures Price Quotes:

				(Daily)				
	Settle	Net Chg	Opening	High	Low	Prev Setl	High	Low
02Sep	4690	+52	4616	4690	4626	4636	5026	4226
02Nov	4662	+42	4610	4664	4606	4620	5120	4120
03Jan	4704	+26	4680	4704	4670	4676	5176	4176

The last digit of any value listed is the fractional part of the price quote. Any preceding digit is read in whole cent(s). So, for example, the settle price for the 02Nov soybean contract is $4.6625 per bushel.

The following mapping system for the last digit in any price quote is true for all contracts with price quotes listed in cents and ¼ cents/bu.: (soybeans, corn, wheat, & oats)

0 = 0	4 = ½
2 = ¼	6 = ¾

The settle price for the hypothetical 03Jan contract equals 4704. This value is read as 470 and ½ cents, or $4.7050/bu.

b) New York Cotton Exchange (NYCE) Futures

Just to make things a little more confusing, this exchange's display of the open outcry workings is slightly different than CBOT's display. Again the first column contains contracts by month and year. The remaining columns separate data into categories. Essentially, the data are the same as the CBOT just arranged in a different format.

Cotton is traded on the New York Cotton Exchange, which is a subsidiary of the NYBOT.

Figure 5.6 Sample Cotton Futures Contract Price Quotes:

Contract		Daily Price Range			Settle	
Month	Open	High	Low	Close	Price	Change
May2002	3647 3652	3688	3643	3670 3689	3678	+31
Jul 2002	3802 3809	3850	3797	3820 3825	3823	+11
Oct 2002	4040 4045	4050	4030	4040 4050	4045	+11
Dec2002	4170 4175	4195	4165	4180 0	4180	+4

The open and close quotes are reported as a range of prices at which buy and sell transactions took place during the opening and closing of the market. The settle price is the average of the two prices quoted under the "close" heading; or, if one price is quoted and the other is zero, then the settle is the one price quoted, such as the case with the Dec2002 contract above.
More details can be found at
http://www.nyce.com

Cotton price quotes are listed in terms of cents and hundredths (1/100) of a cent per pound.

For example, the hypothetical Oct 2002 contract's settlement price is 4045. This price quote is read as 40 and 45 one hundredths cents per pound or $0.4045/lb of cotton, which was a positive change of 11 one hundredths of a cent from the previous day's close.

Options Contracts

There are two different types of options contracts - put options and call options.

Put options give the buyer the right, but not the obligation, to sell the underlying futures contract at the specified strike price.
Call options give the buyer the right, but not the obligation, to buy the underlying futures contract at the specified strike price.

For this right, you must pay a premium. It is this premium price for the option that is traded daily on the commodity's options board.

a) CBOT Options

A display page for an options contract is slightly different from that of the underlying futures contract. Where the futures contract page lists all the available contracts for the specified commodity, the options page also lists all of the strike prices available for each contract.

Strike prices available for the option contract specified are listed in the first column. The remaining columns contain the same column headings as a futures contract (listed above in section 5.6.2.1).

Table 5.7 exhibits a few hypothetical strike prices available for a 02Nov Soybean Put option. Strike price intervals are defined in each commodity's specification listing. A brief listing of these specifications is shown below in Section 5.6.3.

Figure 5.7 Sample Soybean Put Options Price Quotes:

Settle	Net Chg	Opening	High	Low	Prev Setl	High	Low
4200	74	-5	74	74	74	81	581
4400	134	-10	150	150	130	144	644
4600	244	-2	244	246	242	246	746

The tick size for soybeans options price quotations is 1/8 cent/bu. Like futures contracts, the last digit of a quote is the fractional portion of the price. The remaining digits are in whole cents.

The mapping system for these quotes is as follows:

0 = 0	4 = 4/8 = .50
1 = 1/8 = .125	5 = 5/8 = .625
2 = 2/8 = .25	6 = 7/8 = .875
3 = 3/8 = .375	

Thus, the settlement price for the 4200 strike price, shown above, is 74, which translates into 7.5 cents/bu. The previous settle for the same strike price is 81, which translates into 8.125 cents/bu. The net change value of -5 translates into a 0.625 decrease from the previous day's settlement price. This value can be verified by subtracting the previous settle price from the current price:

7.5 cents/bu. - 8.125 cents/bu. = - 0.625 cent/bu., which translates into -5/8 = -5

As with futures contracts, options contracts for corn, wheat, and oats follow this same mapping scheme.

b) NYCE Options

Strike prices for cotton are listed in one-cent/lb increments. and the price quotations are in cents and hundredths of a cent per pound. The minimum price fluctuation or "tick" is one hundredth of a cent. The quote display for NYCE cotton price quotes are much like the underlying futures contracts' display. The difference is in the "Contract" category's display. This section of the display lists the contract month, the strike, whether it is a put or call, and delta. Calls are listed before Puts. The rest of the headings are the same as listed above for futures contracts and price quotations are read the same way also. The following url has a useful list of definitions:

http://www.nybot.com/education/glossaryOfTerms/indexGlossaryOfTerms.htm

For example, one cotton 38 Put contract at a settle price of 163, means you are buying the right to sell 50,000 pounds of cotton at 38 cents per pound. It costs you 1.63 cents per pound for this right. This cost is known as the option premium.

5.6.2 Contract Specifications

The specifications listed below are taken directly from the board that the commodity's futures and options contracts are traded. To the right of each commodity's name is the board's name in which each commodity is traded. These are not all of the contract specifications and or rules and regulations of the trading boards. Specifications can change. Thus, it is wise to keep abreast of current contract specifications.

Corn Futures - CBOT

Ticker Symbol	C
Trading Unit	5,000 bushels (bu.)
Price Quotes	Cents and ¼ cents/bu.
Tick Size	¼ cents/bu. ($12.50/contract)
Daily Price Limits	20 cents/bu. ($1,000/contract) above or below previous day's close. This limit is lifted two days before the spot month begins and the price moves unconstrained.
Deliverable Grades	No.2 Yellow @ par. No.1 Yellow @1½ cents/bu. **over** contract price. No.3 Yellow @1½ cents/bu. **under** contract price.
Active Contract Months	Mar (H), May (K), July (N), Sep (U), Nov (X)

Corn Options - CBOT

Ticker Symbol	MY - Call options MZ - Put options
Trading Unit	1 CBOT 5000 bu. corn futures contract of a specified contract month.
Tick Size	1/8 cent/bu. ($6.25/contract)
Strike Prices	5 cents/bu. for the first two months and 10 cents/bu. thereafter.
Daily Price Limit	20 cents/bu. ($1,000/contract) above or below previous day's close. This constraint is lifted the last trading day of the contract and the price is allowed to move unconstrained.

Active Contract Months	Mar (H), May (K), July (N), Sep (U), Nov (X)

Soybean Futures - CBOT

Ticker Symbol	S
Trading Unit	5,000 bushels (bu.)
Price Quotes	Cents and ¼ cents/bu.
Tick Size	¼ cents/bu. ($12.50/contract)
Daily Price Limits	50 cents/bu. ($2,500/contract) above or below previous day's settlement price. This limit is lifted two days before the spot month begins and the price moves unconstrained.
Deliverable Grades	No.2 Yellow @ par. No.1 Yellow @ 6 cents/bu. over contract price. No.3 Yellow @ 6 cents/bu. under contract price.
Active Contract Months	Jan (F), Mar (H), May (K), July (N), Aug (Q), Sep (U), Nov (X)

Soybean Options - CBOT

Ticker Symbol	CZ - Call options PZ - Put options
Trading Unit	1 CBOT 5000 bu. soybean futures contract of a specified contract month.
Tick Size	1/8 cent/bu. ($6.25/contract)
Strike Prices	10 cents/bu. for the first two months and 20 cents/bu. thereafter.
Daily Price Limit	50 cents/bu. ($2,500/contract) above or below previous day's settlement price. This constraint is lifted the last trading day of the contract and the price is allowed to move unconstrained.
Active Contract Months	Jan (F), Mar (H), May (K), July (N), Aug (Q), Sep (U), Nov (X)

Wheat Futures - CBOT

Ticker Symbol	W
Trading Unit	5,000 bushels (bu.)
Price Quotes	Cents and ¼ cents/bu.
Tick Size	¼ cents/bu. ($12.50/contract)
Daily Price Limits	30 cents/bu. ($1,500/contract) above or below preys day's settlement price. This limit is lifted two days before the spot month begins and the price moves unconstrained.
Deliverable Grades	No.2 Soft Red Winter @ par. No.2 Hard Red Winter @ par. No.2 Dark Northern Spring @ par. No.2 Northern Spring @ par. Differentials established by the exchange.
Active Contract Months	Mar (H), May (K), July (N), Sep (U). Dec (Z).

Wheat Options - CBOT

Ticker Symbol	WY - Call options WZ - Put options
Trading Unit	1 CBOT 5000 bu. wheat futures contract of a specified contract month.
Tick Size	1/8 cent/bu. ($6.25/contract).
Strike Prices	5 cents/bu. for the first two months and 10 cents/bu. thereafter.
Daily Price Limit	30 cents/bu. ($1,500/contract) above or below previous day's. settlement price. This constraint is lifted the last trading day of the contract and the price is allowed to move unconstrained.
Active Contract Months	Mar (H), May (K), July (N), Sep (U) Dec (Z).

Cotton No.2 Futures - NYCE (parent company is NYBOT)

Ticker Symbol	CT
Trading Unit	50,000 pounds (lbs.) (approximately 100 bales)
Price Quotes	Cents and hundredths of a cents (1/100 cents/lbs.).
Tick Size	1/100 of a cent/lb. below 95 cents. 5/100 cent at prices above 95 cents/lb.
Daily Price Limits	3 cents above or below previous day's settlement price. If any contract month settles above $1.10, then all contract months will trade with 4-cent limits.
Deliverable Grades	***Check with NYCE board.***
Active Contract Months	Mar (H), May (K), July (N), Oct (V). Dec (Z)

Cotton No.2 Options - NYCE (NYBOT)

Ticker Symbol	CT - Call options. Listed as C in the P/C column heading. CT - Put options. Listed as P in the P/C column heading.
Trading Unit	1 NYCE 50,000 lbs. cotton futures contract of a specified. contract month.
Tick Size	1/100 cent.
Strike Prices	One-cent increments.
Price Quotes	Cents and 1/100 cent.
Daily Price Limits	None
Active Contract Months	Mar (H), May (K), July (N), Sep (U). Dec (Z)

Oat Futures - CBOT

Ticker Symbol	O
Trading Unit	5,000 bushels (bu.)
Price Quotes	Cents and ¼ cents/bu.
Tick Size	¼ cents/bu. ($12.50/contract)
Daily Price Limits	20 cents/bu. ($1,000/contract) above or below previous day's settlement price. This limit is lifted two days before the spot month begins and the price moves unconstrained.
Deliverable Grades	No.2 Heavy @ par. No.1 @ par. No.1 Extra Heavy @ 7 cents/bu. over contract price. No.1 Extra Heavy @ 9 cents/bu. over contract price. No.1 Heavy @ 3 cents/bu. over contract price.
Active Contract Months	Mar (H), May (K), July (N), Sep (U), Dec (Z)

Oat Options - CBOT

Ticker Symbol	OO - Call options OV - Put options
Trading Unit	1 CBOT 5000 bu. oat futures contract of a specified contract month.
Tick Size	1/8 cent/bu. ($6.25/contract)
Strike Prices	5 cents/bu. for the first two months and 10 cents/bu. thereafter.
Daily Price Limits	20 cents/bu. ($1,000/contract) above or below previous day's settlement price. This constraint is lifted the last trading day of the contract and the price is allowed to move unconstrained.
Active Contract Months	Mar (H), May (K), July (N), Sep (U), Dec (Z)

6. Putting It All Together – Visualizing and Developing a Risk Management Strategy

Risk management education programs typically pigeonhole/isolate the following topics:

1. **Outlook** (gauging market conditions and possible risks ahead)

2. **Marketing tools** (forward contracts, hedging futures/options)

3. **Crop insurance** (establishing min. production or revenues levels)

4. **Safety net** (government programs)

An effective risk management strategy most likely includes all or *some combination* of the four components. The challenge is to first understand each *individually,* and second how they *interact.* Interactions might be complementary or offsetting. *This is not easy*. Now we can use the concepts developed in the first five sections of the manual to understand how we can combine risk management tools to achieve a good result. The remainder of Section 6 takes a simplified, graphical approach. It is intended to provide a start to formulating an *integrated* risk management strategy for crop revenues. It is also intended to give you another tool you can use to train others.

Figure 6.1 Visualizing Revenue

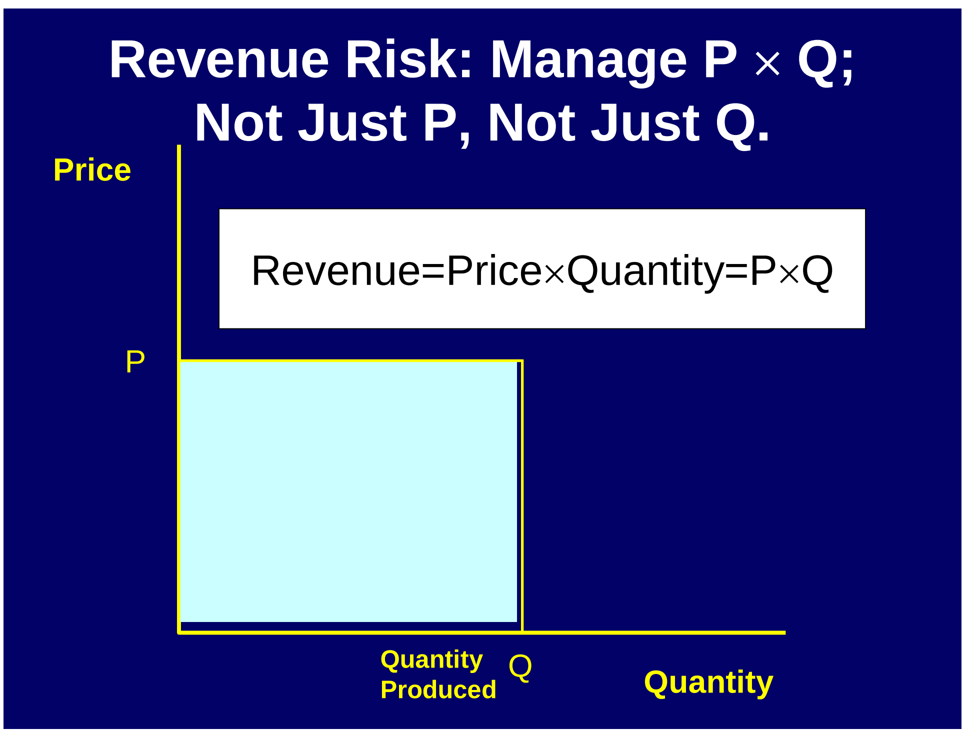
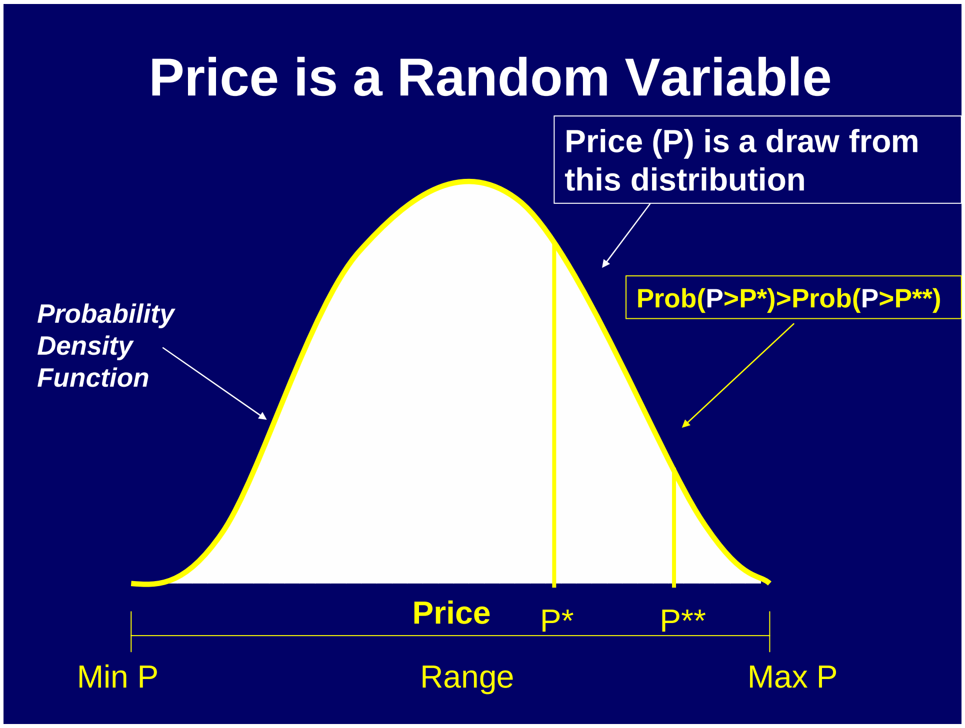


Figure 6.1 shows the amount of total revenue if the price received is P and the quantity produced is Q. The shaded box is PxQ, or total revenue, from this enterprise. Now we will discuss the features of price and quantity.

Figure 6.2 Price Distribution



In Figure 6.2 we show a picture of the probability density function for the price we could receive for our product (see section 2). Notice that the range of the distribution is marked at the bottom. The P from Figure 6.1 is a realization, or draw, from this price distribution. The area shaded lighter under the curved line is the probability of any P being realized and so it must equal to 1. From this picture we know that the probability of P being greater than P* is greater than the probability that P is greater than P**. That is, there is more probability area to the right of P* than there is to the right of P**.

Figure 6.3 depicts the distribution of quantity, which is a function of the distribution of yield, since yield is the random variable. Quantity is equal to yield x acres. This picture generally has the same characteristics as Figure 6.2 because it is a probability distribution. It is shaped differently because we generally assume that the distribution of yield is negatively skewed. This feature of the quantity distribution is shown by the longer left-hand tail. This means that there is a higher probability of realizing a “low” yield than there is a “high” yield. This makes sense because crop yield is somewhat constrained on the high end, at least in the short run, by the current seed genetics. However, several sources of disaster (insect or weed pests, hurricanes, hail, droughts, etc.) can befall the growing crop that would lead to “low” yields.

We really don’t care whether our revenue comes from P or Q. Total revenue is the important variable to us. We can see in Figure 6.4 that one could have a high realization of Q and a low realization of P and have the same total revenue than if Q were low and P were high. That is, the areas inside each of the boxes depicting total revenue are the same size. Of course, we would like P and Q to be as high as possible, everything else equal.

Figure 6.3 Quantity Distribution

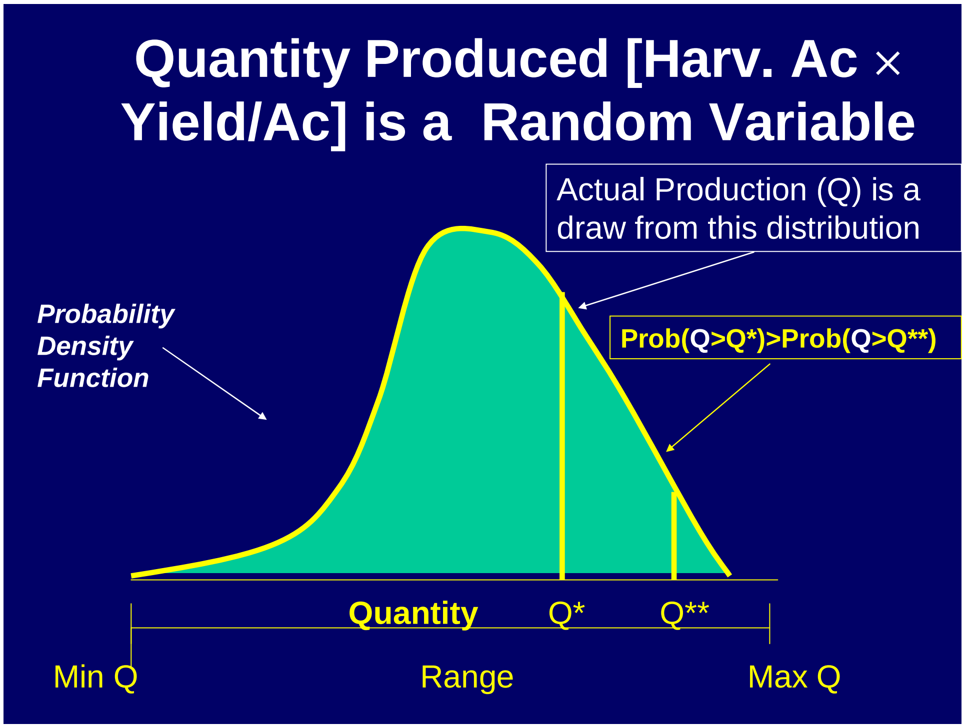
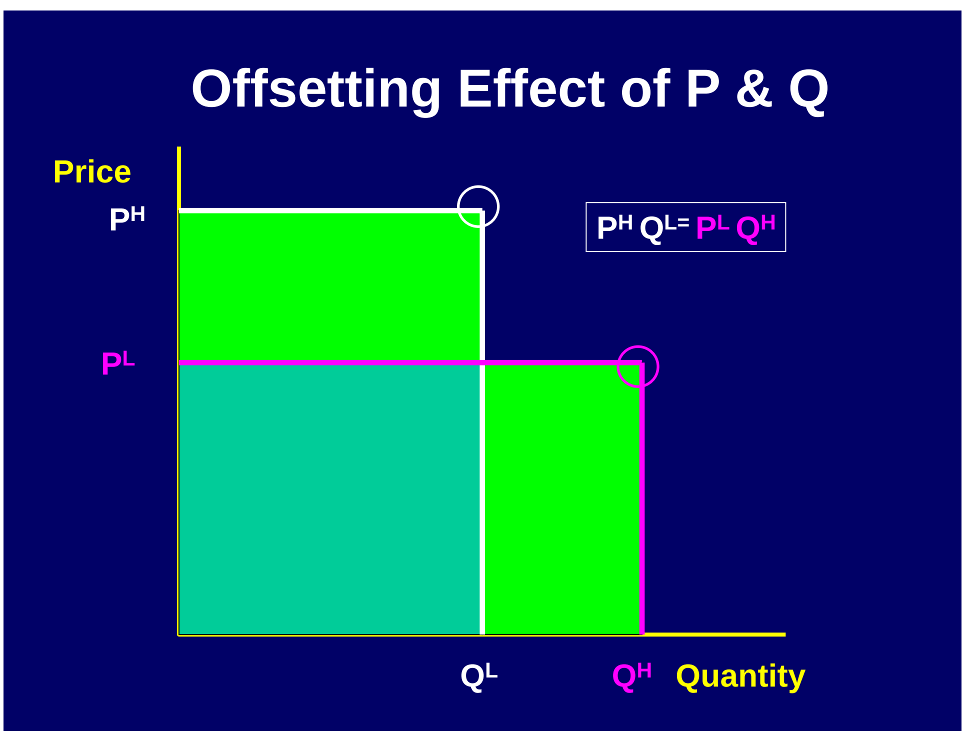
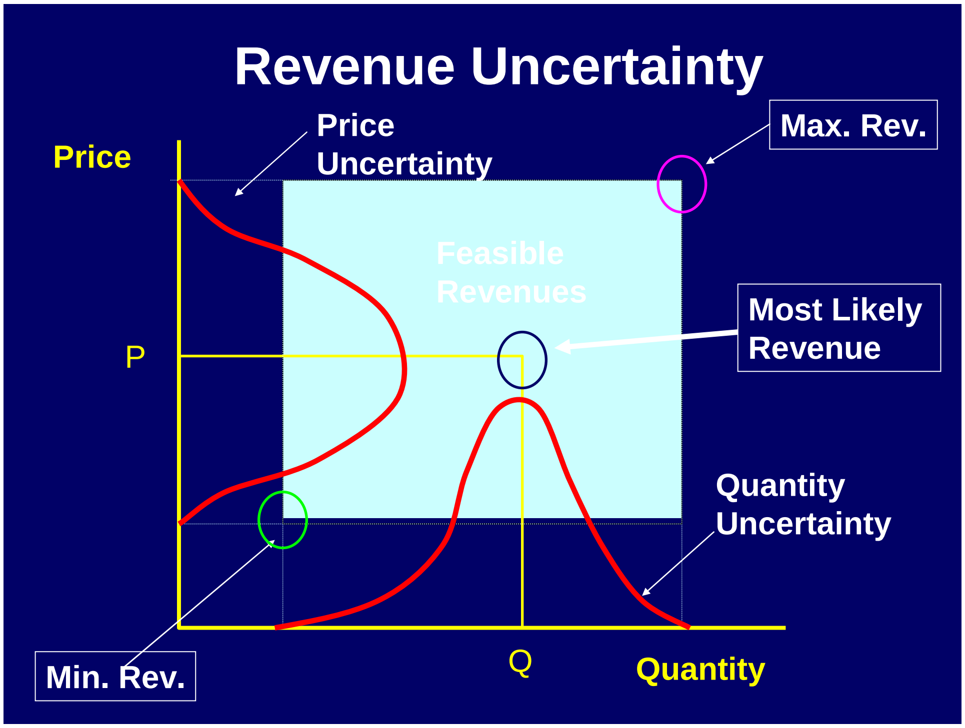


Figure 6.4 Offsetting Effect of P and Q



Now, let's put these concepts together and combine the fact that P and Q are random variables with the concept of total revenue.

Figure 6.5 Revenue Uncertainty



Both the price and quantity probability distributions are drawn in Figure 6.5. Higher values for each are farther out from the origin (the point where the axes of the graph come together in the lower left-hand corner). As P goes up, the values are higher. As Q goes to the right, its values are higher.

Notice that if P and Q are at their highest possible values, given the probability distribution of each, total revenue is at its maximum value. That is, the size of the shaded area representing total revenue is the largest. This is noted by a circle in the upper right-hand corner of the total revenue area. Conversely, if P and Q are at their lowest levels, then total revenue is minimized. If P and Q are at their most likely values, that is where the probability distributions are at their peak, the most likely total revenue (the total revenue that has the highest probability of occurring) is realized. This point is depicted by the circle inside the shaded area.

The revenue needed to break even is the revenue that just equals your production costs. If total revenue (PxQ) falls to the right of the downward-sloping line marked the Breakeven Revenue Line in Figure 6.6, then you are earning a profit. If total revenue turns out to be to the left of the line then you are incurring a loss.

The idea behind risk management is to cut off the lower tails of the price and quantity distributions so that a profit can be assured without losing any potential to reach higher total revenue (the upside potential).

Figure 6.7 shows where the value of expected revenue is, given the probability distributions of price and quantity in this example. Expected revenue is the mean price x mean quantity. If both probability distributions are symmetric (see section 2.5) then expected revenue is the same as the most likely revenue shown in Figure 6.6. If one or both of the probability distributions is skewed, then expected revenue and most likely revenue will different.

Figure 6.6 **Breakeven Revenue**

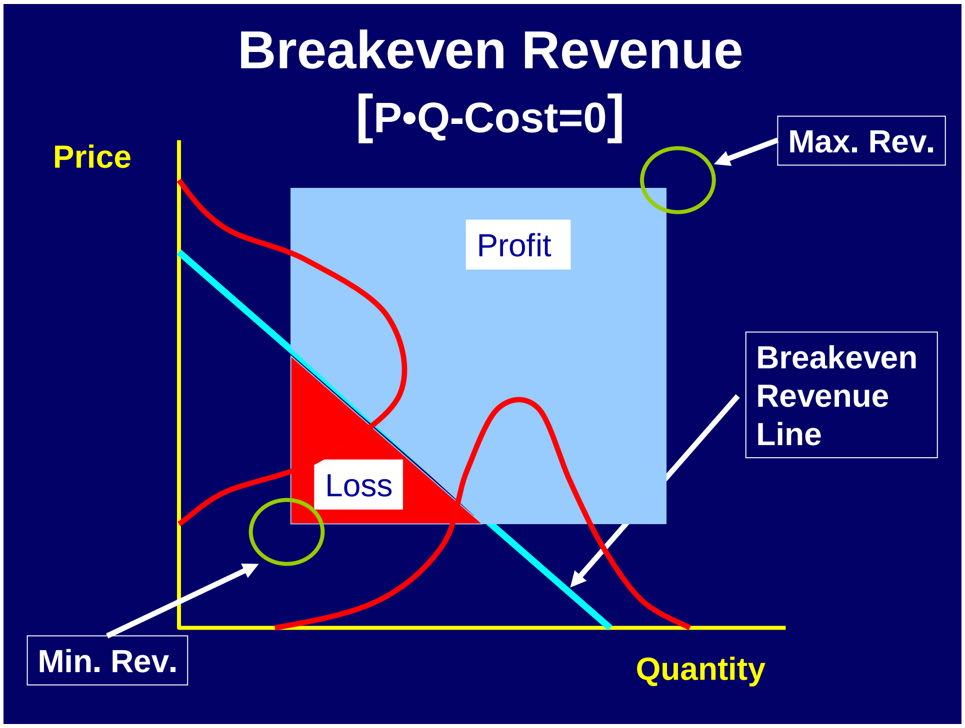


Figure 6.7 Expected Revenue

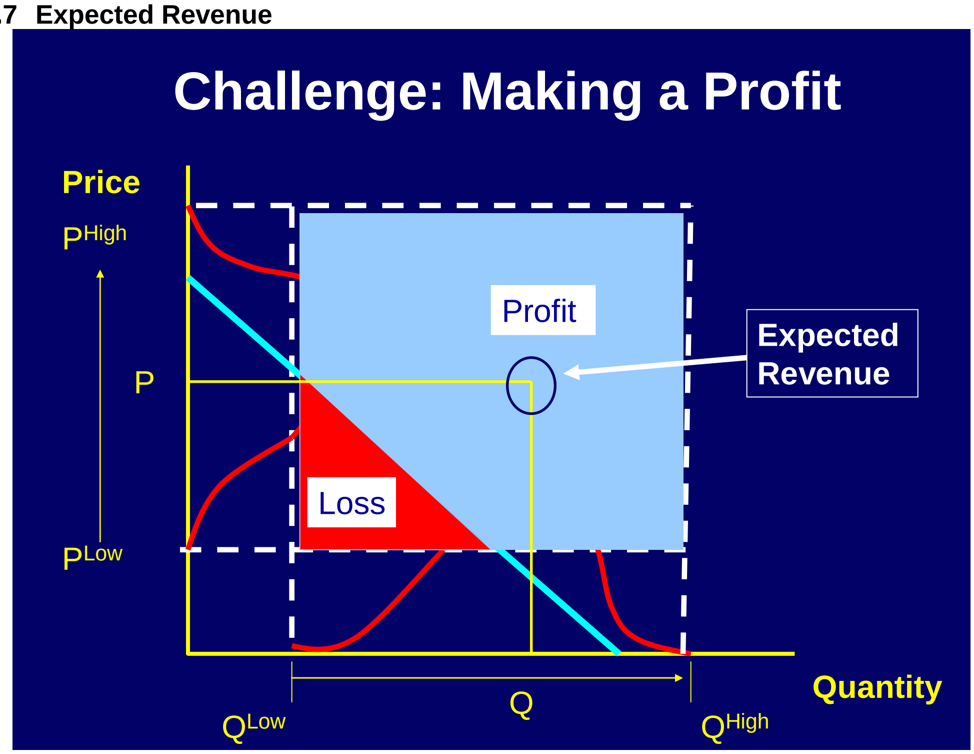


Figure 6.8 A Forward Contract

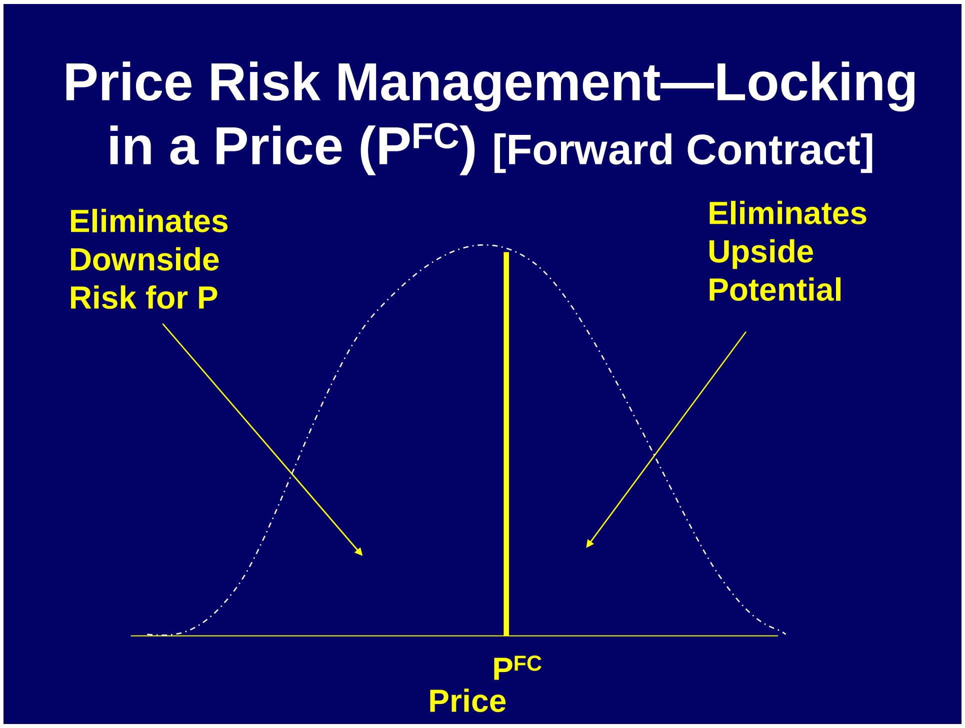


Figure 6.8 shows how both downside risk and upside potential are eliminated when a forward contract at a fixed price, P^{FC} is made. The dotted line shows the original price distribution before the forward contract is made. After the forward contract is made, the price distribution reduces to the vertical line at P^{FC}. This means that the probability of receiving price P^{FC} is equal to one.

Figure 6.9 Hedging Price

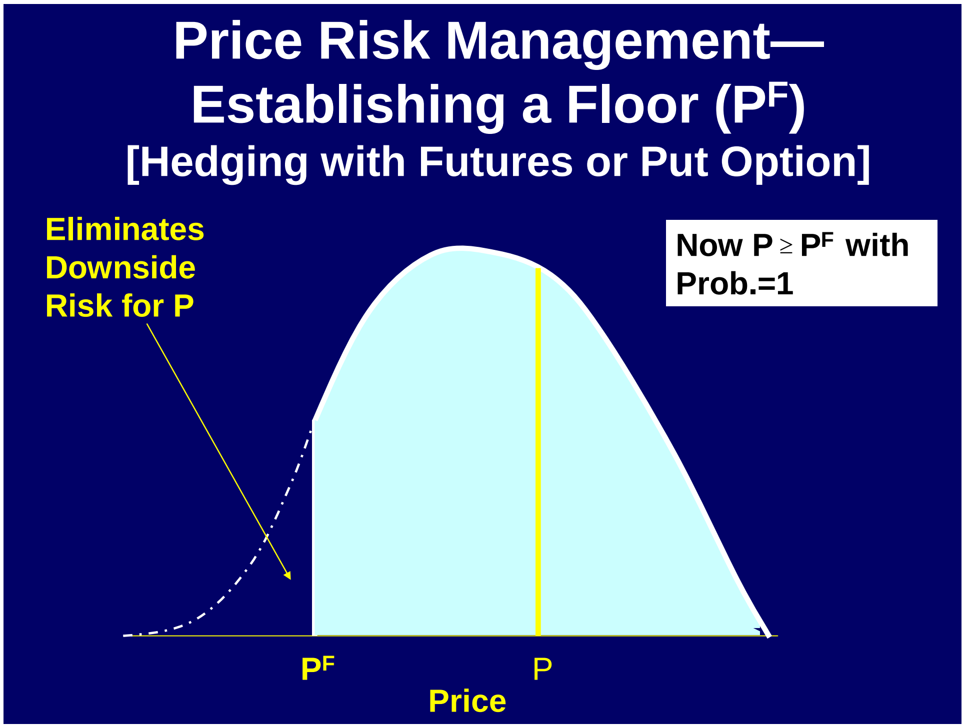


Figure 6.9 illustrates the effect of hedging with either a futures contract or a put option (see section 5.6). If either of these price risk management tools is used, then downside risk is eliminated, but the upside potential (the opportunity to take advantage of a higher realized price) remains. Now, let's see how this affects the distribution of total revenue.

In figure 6.10, notice the horizontal line at P^F. This is the value of the price floor established in the futures market with a hedge. This means that the probability of a loss is reduced to the small shaded area to the left of the breakeven line and that most of the risk of a loss has been eliminated. Also, notice that the shaded area of total revenue has become smaller, but better, now that we have a price floor that allows some upside potential.

Figure 6.11 illustrates how the government loan deficiency program acts as a price floor. If the price realization in a particular year falls below P^{LR}, then you can receive a payment called a loan deficiency (or pop) payment that will make up the difference between the market price and the loan rate. This price floor is lower than the price floor you can establish with a futures or options contract, but it does give you some downside risk protection.

Figure 6.10 **The Effect of Hedging on Total Revenue**

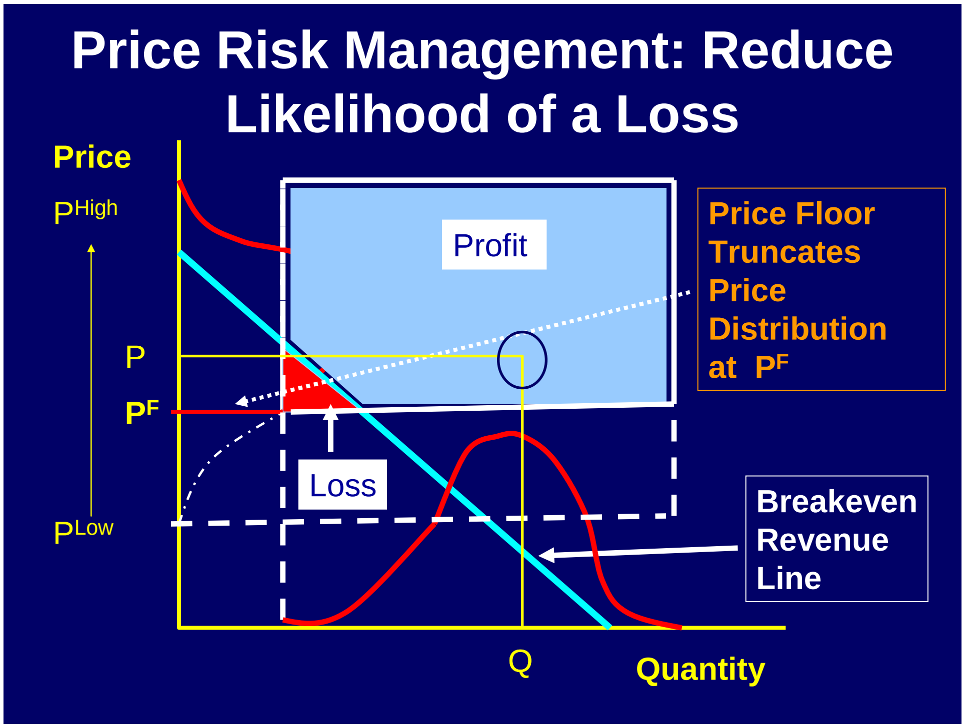


Figure 6.11 **The Effect of the Commodity Loan Program**

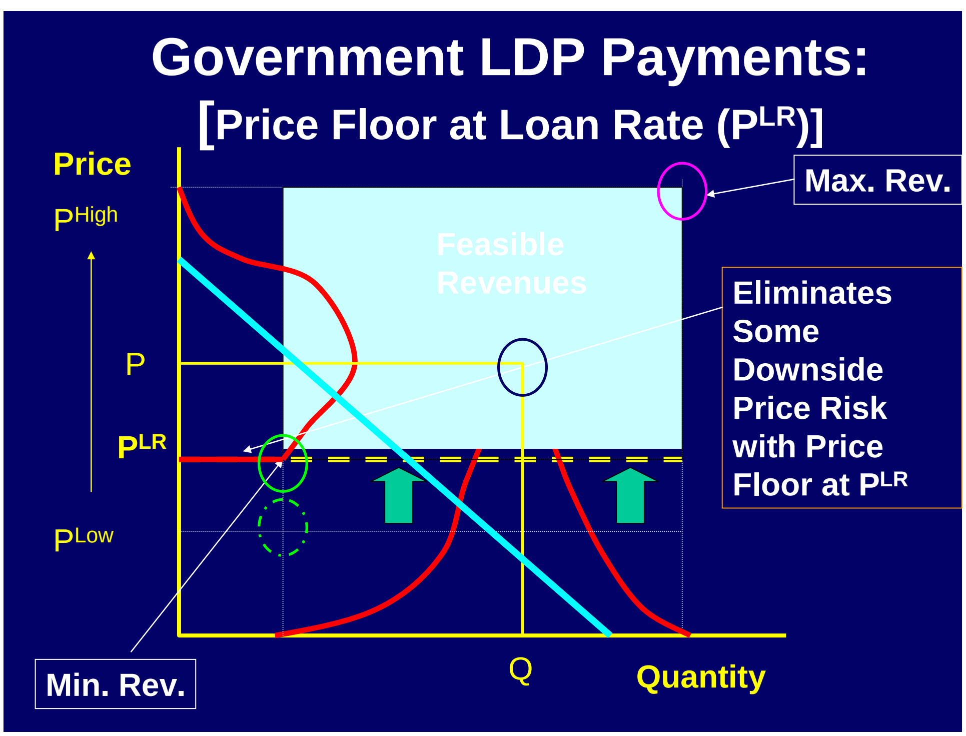


Figure 6.12 combines the two types of price floor – the loan rate and the options or futures contract. It is essentially an overlay of the concepts depicted in Figures 6.10 and 6.11. Notice that the futures

or options contract raises the price floor (P^F) above the loan rate (P^{LR}), but leaves the upside potential.

Figure 6.12 The Relative Effects of Loan Rates vs. Hedging

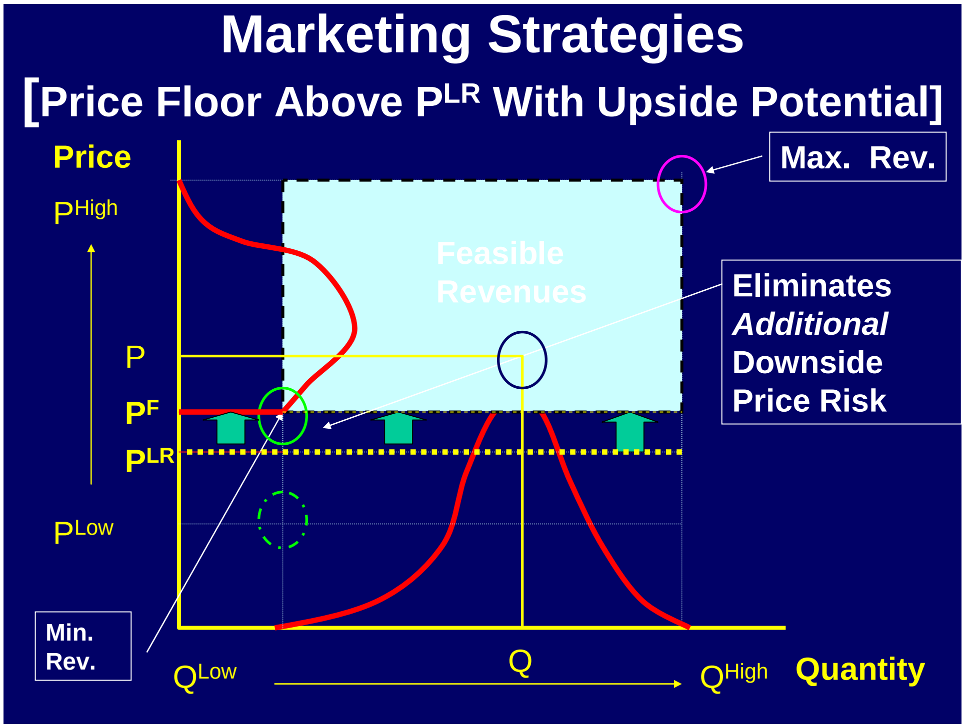
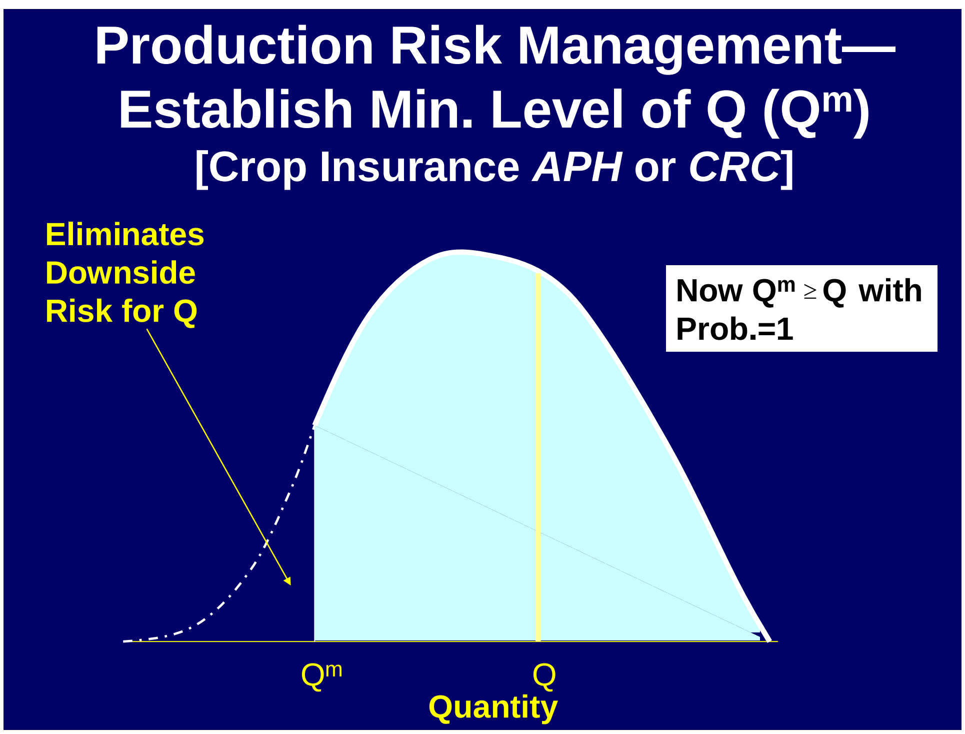
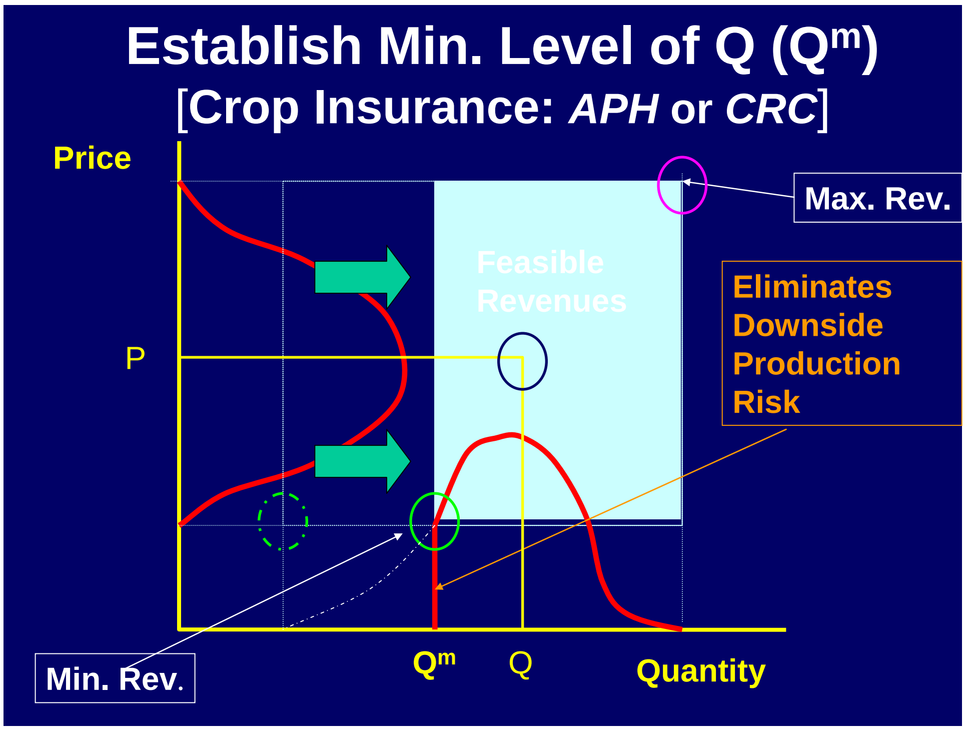


Figure 6.13 Crop Insurance for Quantity Risk Management



A “Quantity” floor is illustrated in Figure 6.13. If you purchase a crop insurance product that provides yield insurance, either on its own or in one of the revenue insurance products discussed in section 4, then you are establishing a quantity floor equal to the yield guarantee

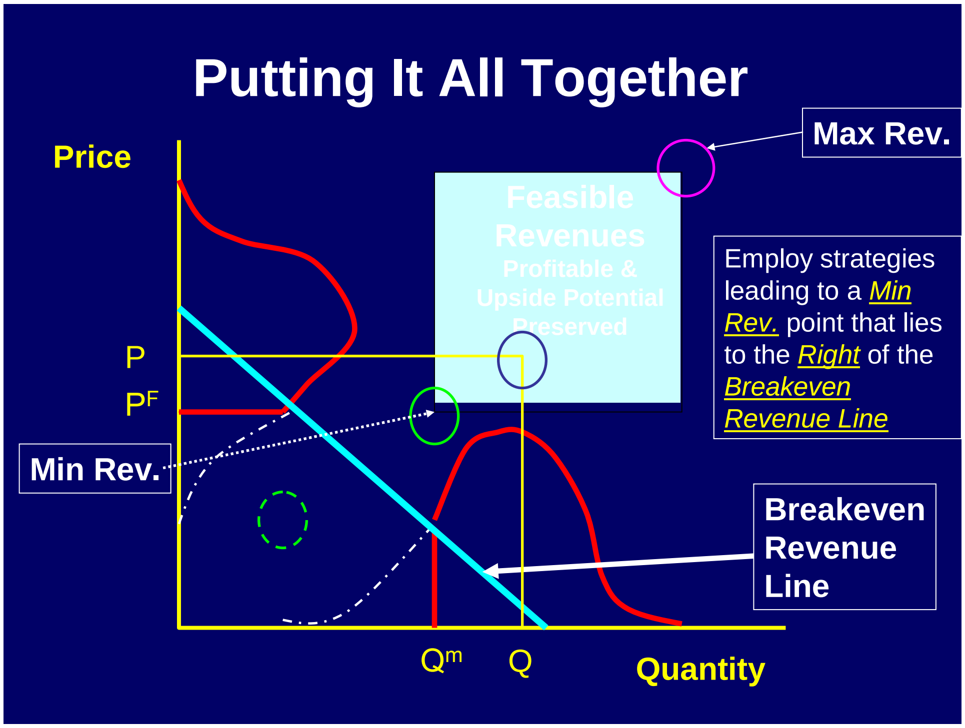
Figure 6.14 Effect of Crop Insurance on Total Revenue



Just as a price floor eliminates low total revenue from the price side, crop insurance eliminates low total revenue from the quantity side. The vertical line at Q^m is the lowest quantity that can be realized if yield insurance is purchased. Recall in figures 6.9 through 6.12 that the price floor eliminated prices below the price floor on the graph. A quantity floor eliminates quantities to the left of the quantity floor, while preserving the upside potential in the quantity direction.

Now we have used the risk management tools to eliminate downside price risk and downside quantity risk, as well. The shaded area of feasible revenues in figure 6.15 has moved upward and to the right, away from the breakeven line and toward the point of maximum revenue. In the case we’ve illustrated here, we have guaranteed ourselves a profit, while leaving all the possible upside potential, given the price and quantity probability distributions we face.

Figure 6.15 Putting It All Together



7. Some Parting Thoughts

Risk management is ***NOT*** free and will never prove to be the most profitable strategy in every marketing year.

- Over a longer horizon *[6 to 10 years]* an effective risk management plan will provide less volatile returns.
  - Potentially avoiding a catastrophic marketing year

- Establishing profitable minimum revenues and leaving upside potential is the key.
  - Most viable instruments to do this are: *put options, CRC insurance, basis contracts*

A NASCAR Analogy

To become Nextel Cup Champion you want to avoid hitting the wall and getting a DNF. You also want to do well in every race (run in the top five) and give yourself the opportunity to win and be with the leaders in the final laps.

The same is true with risk management. If you can establish a minimum revenue above your breakeven level then you will avoid a loss in any year [hitting the wall]. You also put yourself in a position to lock in a better than average profit if the opportunity arises in a given marketing year [taking the checkered flag].