Sources of Risk and Uncertainty

- **Production & Technical Risk**
  - Crop & Livestock Performance (output)
  - Input Availability
  - Incorporating New Technologies

- **Price & Market Risk**
  - Commodity Prices (input & output)
  - Supply & Demand Conditions
  - Reliable Market Outlet or Source

- **Financial Risk**
  - Interest Rates
  - Loan Requirements
  - Lender Reliability

- **Legal Risk**
  - Food Safety
  - Environmental Concerns
  - Farm Policy
  - International Trade

- **Personal Risk**
  - Health
  - Family disputes

These are all things that can cause Net Farm Income and Net Cash Flow to fluctuate.

How do we evaluate risk?

Compare the *Expectations & Variability* of different alternatives.
What is our “Best Estimate” of an outcome?

- **Most Likely** – choose outcome with the highest probability of occurring. Can be objective (historical data), subjective (expert opinion) or combination of both.

- **Averages** or “expected value”
  - Simple average
    - What time period?
    - What about introduction of new technology?
  - Weighted average, uses probabilities
    - Objective
    - Subjective
  - Example in Table 15-2 (pg. 257)

- **Expert Opinions**
  - Professional forecasting

- **Futures Markets**
  - Consensus of market participants.
  - Useful for prices of commodities with high trading volumes.

How do we measure variability?

- **Range** – list highest value and lowest value
  - Smaller range is preferred to wider range.
  - May not be the best measure of risk because there are no probabilities assigned (equal chance of each outcome).

- **Standard Deviation** – statistical measure of dispersion.
  - Large standard deviations indicates more variability
  - Usually use historical information, but how long?

- **Coefficient of Variation (CV)**
  - Useful when comparing alternatives with different means (averages).

\[
CV = \frac{\text{Standard Deviation}}{\text{Mean}}
\]
- Measures variability relative to mean.
- Higher value has greater relative variability.

Table 15-3 (pg. 258): Historical Corn and Soybean Yields for an Individual Farm

<table>
<thead>
<tr>
<th>Year</th>
<th>Corn (bu/a)</th>
<th>Soybean (bu/a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>125</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>145</td>
<td>45</td>
</tr>
<tr>
<td>3</td>
<td>141</td>
<td>38</td>
</tr>
<tr>
<td>4</td>
<td>88</td>
<td>28</td>
</tr>
<tr>
<td>5</td>
<td>105</td>
<td>33</td>
</tr>
<tr>
<td>6</td>
<td>129</td>
<td>44</td>
</tr>
<tr>
<td>7</td>
<td>118</td>
<td>40</td>
</tr>
<tr>
<td>8</td>
<td>75</td>
<td>21</td>
</tr>
<tr>
<td>9</td>
<td>132</td>
<td>37</td>
</tr>
<tr>
<td>10</td>
<td>127</td>
<td>48</td>
</tr>
<tr>
<td>Mean (E)</td>
<td>118.5</td>
<td>36.9</td>
</tr>
</tbody>
</table>

Standard Deviation (SD)  | 22.7 | 8.2 |
CV = SD/E                | 0.19 | 0.22 |

- *Cumulative Distribution Function* (CDF): Helps to evaluate a situation with a large number of possible outcomes.

Steps to prepare a CDF: (pg. 258 -259)

1. List all possible values for an outcome, event or strategy
2. Assign a probability to each outcome (objective or subjective)
3. List the possible values from lowest to highest
4. Assign a *cumulative probability* to the lowest value, which is ½ of the range it represents. This assumes that the value falls within the middle of the range.
5. Calculate the cumulative probabilities for each value by adding the probabilities
6. Graph each pair of values and connect the points.
Table 15-4 (pg. 259): Cumulative Probability Distribution for Corn & Soybean Yields

<table>
<thead>
<tr>
<th>Corn (bu/a)</th>
<th>Soybean (bu/a)</th>
<th>Cumulative Probability (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>21</td>
<td>5</td>
</tr>
<tr>
<td>88</td>
<td>28</td>
<td>15</td>
</tr>
<tr>
<td>105</td>
<td>33</td>
<td>25</td>
</tr>
<tr>
<td>118</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>125</td>
<td>37</td>
<td>45</td>
</tr>
<tr>
<td>127</td>
<td>38</td>
<td>55</td>
</tr>
<tr>
<td>129</td>
<td>40</td>
<td>65</td>
</tr>
<tr>
<td>132</td>
<td>44</td>
<td>75</td>
</tr>
<tr>
<td>141</td>
<td>45</td>
<td>85</td>
</tr>
<tr>
<td>145</td>
<td>48</td>
<td>95</td>
</tr>
</tbody>
</table>

See Figure 15-2 on Page 260.

Cumulative distribution function (CDF) with the most vertical graph (more steep) is less variable. BE CAREFUL OF SCALING!

DECISION MAKING UNDER RISK:

1. Identify the possible sources of risk.
2. Identify the possible outcomes that can occur from an event.
3. List the alternative strategies available.
4. Quantify the results (consequences) of each possible outcome for each strategy.
5. Estimate the risk and expected returns for each strategy and evaluate the trade-offs.

Decision Tree: (pg. 248 – 249) This is a great tool, but time limitations do not allow us to cover this topic thoroughly.

Sensitivity Analysis: Not covered in text, but is another great tool. Spreadsheets allow us to play the “What If?” game very easily.
So, what is “best” choice?

Example: Table 15-5 (pg. 262)

Table 15-5: Payoff Matrix for Stocker Steer Problem.

<table>
<thead>
<tr>
<th>Weather Outcomes</th>
<th>Probability</th>
<th>Purchase Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Buy 300 Head</td>
</tr>
<tr>
<td>Good</td>
<td>0.2</td>
<td>$20,000</td>
</tr>
<tr>
<td>Average</td>
<td>0.5</td>
<td>10,000</td>
</tr>
<tr>
<td>Poor</td>
<td>0.3</td>
<td>6,000</td>
</tr>
</tbody>
</table>

| Expected Value   | 10,800      | 12,200      | 11,300      |
| Minimum Value    | 6,000       | 0           | -10,000     |
| Maximum Value    | 20,000      | 26,000      | 34,000      |
| Range            | 14,000      | 26,000      | 44,000      |

Most Likely?

Maximum Expected Value?

Safety First?

Break Even Probability?

Common Decision Rules:

- **Most Likely Outcome**: What has the highest probability of occurring? Choose the strategy the best deals with this situation or set of conditions.
  - Is easy to use.
  - Does not consider the consequences of variability nor the probability of possible “bad” outcomes.

- **Maximum Expected Value**: What strategy has the highest expected value (mean value) given the situation or set of conditions? Should be weighted by the estimated probabilities.
  - Results in strategy with highest average return over time.
  - Ignores the variability of outcomes.
  - Should be used by managers who have good risk bearing ability.
• **Safety First**: Concentrates on the worst possible outcome. Views outcomes above the worst case will not pose serious problems. Select strategy with the highest worst-case outcome (what is “least bad”).
  - Appropriate for businesses that are not positioned to survive even one bad year.

• **Break-Even Probability**: Can create and use cumulative distribution function (CDF) to estimate what the probability of breaking even is.
  - Requires manager to assign or estimate probabilities and construct CDF.
  - Must weigh the risk of loss against the benefits from higher returns.

**TOOLS FOR MANAGING RISK:**

Four general management strategies for dealing with risk:

1. Reduce the variability of possible outcomes. There is typically a trade-off between reducing “bad” outcomes and maintaining access to “good” outcomes.
2. Set a minimum income or price level, usually for a fixed charge.
3. Maintain flexibility of decision making.
4. Improve the risk bearing ability of the business, so “bad” outcomes do not affect the survivability of the farm.

**Production Risk Tools:**

• Select stable enterprises and production technologies.
  - Irrigation
  - Confinement Livestock

• Diversification:
  - Choose enterprises that have low or negative income correlations.
  - May require additional management expertise.

• Insurance:
  - Can be self insured, but requires manager to maintain strong liquid financial reserves.
  - Property Insurance (fire, storms, theft, vandalism...)
  - Multiple Peril Crop Insurance (MPCI).
    - Offered by private insurance companies, but partially underwritten by USDA.
- Covers losses due to natural occurrences.
- Additional hail insurance can be purchased from private carriers.
  - Revenue Insurance.
    - Relatively new type of policy.
    - Guarantees a specified level of gross income per acre.
    - Being evaluated for livestock producers also.

- Extra Production Capacity: Newer and/or larger capacity equipment and/or facilities.

- Share Leases: Crop or Livestock share leases. Can include both output and price variability.

- Custom Farming and Feeding: Perform custom operations for a fixed payment. Custom feeding contracts may include adjustments for excessive death loss.

- Input Procurement: Long term contracts for key inputs, which may or may not include price adjustments.

Market Risk Tools:

- Spreading Sales: This is a type of “average” pricing strategy. May not be available for all enterprises.

- Contract Sales:
  - Specialty crop, seed, nursery stock, fruits, vegetables…
  - May specify “best management practices”
  - Forward Pricing Contracts are also offered for many field crops and some livestock commodities.
  - Minimum Price Contracts guarantees a minimum price but allows sale at realized market price if higher. Guaranteed price is usually lower than expected price (risk premium).
  - Contracts usually have penalty if the producer cannot deliver quantity and/or quality agreed upon in contract.

- Hedging: Requires purchase or sale of commodity futures contract.
  - Cash prices and “near-by” futures contract prices tend to move together.
  - Offset “sale” in one market with ”purchase” in other market to lock in price.
  - Reverse the transactions when the cash commodity is actually sold or purchased.
• Commodity Options: Purchasing an option (call or put) gives the owner “the right but not the obligation” to purchase or sell a specified futures contract at a specified price within a specified time period.

• Flexibility:
  o Rent or lease rather than buy
  o Multi-purpose buildings
  o Grain Storage

Financial Risk Tools:

• Fixed Interest Rates
• Self-liquidating loans
• Liquid reserves
• Credit reserves
• Owner equity

Legal Risk Tools:

• Business Organization
• Estate Planning
• Liability Insurance

Personal Risk Tools:

• Health Insurance & Life Insurance
• Safety Precautions
• Backup Management