Evaluation of Investment in Agricultural Technology

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Theory basis for decision making

- Economists' model of the rational man
  - No emotion!
  - The ability to process large amount of information
  - Use sophisticated statistical models in processing information
- All decisions are made rationally!

But, in the real world:

Decision making is messy: Emotions interfere with rational processing!

Source: http://mag.rankmytattoos.com/top-20-outrageous-facial-tattoos.html
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Decision theory

- Mathematically complex
- Relies on rationality
- Requires subjective probability density functions
  - Difficult/impossible to elicit when more than 1or 2 random events
- Some events are ambiguous!
  - Cannot even assign probabilities to the event because of complexity or lack of familiarity
- Lots of published criticism

Criteria for real-world decisions and decision tools

- Criteria related to decision theory concepts, but less formal
- **Relative scale**: How big is the investment relative to wealth (net worth)?
- **Perceived risk**: How risky is the investment?
- **Degree of reversibility**: How easily can the investment decision be "undone?"

Relative scale

- Example 1: a 3000-acre US soybean farmer considering switching 160 to a new variety
  - Small relative scale
- Example 2: a 10-acre subsistence farmer consider switching 5 acres to a new variety
  - Large relative scale
- Scale matters because it is related to the *ability to take risks and survive adverse outcomes!*

Perceived risk

- How risky does the decision maker believe a investment alternative is?
  - What are the *potential* adverse consequences?
  - How likely are these potential adverse outcomes?
- Needs to be weighed relative to
  - potential upside and likelihood
  - the ability to weather adverse outcomes (relative scale)

Perceived risk continued

- Example 1: 3000-acre soybean farmer could probably survive a lower yield on 160 acres.
  - Likely markets for the new variety
  - Familiar with soybean production
  - LOW RISK
- Example 2 : 10-acre subsistence farmer might not survive lower yield
  - Not be able to feed his family
  - Could lose home and farm
  - HIGH RISK!

Degree of reversibility

- Can the decision be reversed low-cost, short-time frame?
- Example: Decision to move to black-hided cattle
  - Spend large amount to buy new breeding stock
  - Breed in different hide color over several years
  - **LOW degree of reversibility**
- Soybean example: can switch back to old variety next year. **HIGH degree of reversibility**

Why does reversibility matter?

- Reversibility is a “real” option
- Just as with futures options (put and calls), real options have value
- Difficult to compute value
- But, ignoring can over/under the costs of investment
  - Consider the option to build a feedlot. Multi-million $ investment. Very difficult to undue this decision once made!

Criteria

As a decision

- **Increases in Relative scale**
- **Increases in Perceived risk**
- **Decreases in Degree of reversibility**

Decision tools need to be more sophisticated.

And that means, require **more** information!

Tools discussed

- Partial budgeting
- Enterprise budgeting
- Whole farm budgeting
- Cashflow budgeting
- Capital budgeting
- Real option modeling

Partial budgeting

- Used for small-scale, low-risk, highly-reversible decisions (e.g., US soybean example)

Pros		Cons	
Reduced costs ($/acre or hd)		Increased costs ($/acre or hd)	
Increased revenue ($/acre or hd)		Decreased revenue ($/acre or hd)	
Total	(A)	Total	(B)
If (A-B) > 0, appear advisable			

Enterprise budget

- Used for somewhat larger-scale, low-to-moderate risk decisions
  - E.g., comparing two competing enterprises
- Also need for breakeven analysis—so can consider the impacts of adverse outcomes
- List all revenues and costs that are allocated to a given enterprise
- See your state's Cooperative Extension Service for local budgets

Whole farm budgeting

- Impact of decisions on *whole farm profitability*
  - Fairly large-scale decisions
  - E.g., investment in livestock feeding facilities
- Risk and reversibility informally considered with "what-if" type questions
  - What if costs are 25% higher than expected?
  - What if we must liquidate the investment?

Cashflow budgeting

- Other budgeting tools look at the advisability (profitability) of an investment
- Cashflow budgeting looks at the feasibility of an investment (can it be done?)
- Compares all sources of cash with all uses of cash
- Regardless of scale, risk or reversibility, cashflow budgeting is a must do!

Capital budgeting

- Larger-scale, long-lived investments
- Net Present Value (NPV) of investment
  - Time-value of money
  - Sum discounted annual cashflows
  - Covert into annualized equivalent to compare investments of differing life
- Consider risk and reversibility by asking what-if questions

Real option pricing models

- Only tool to formally consider reversibility!
- Not yet accessible to a wide audience
  - Mathematically complex
  - Stochastic calculus to solve (if even possible!)
  - Often must use simulation to find value
- Few (if any) Extension tools available
- No published research looking at genetic selection as a real option model
- Testament to the difficulty in using this tool

Tools on the shelf

- Many land grants publish enterprise budgets
  - National Budget Library
    http://www.agrisk.umn.edu/Budgets/CustomSearch.aspx
- Most state CES provide budgeting tools
- Examples from OSU www.beefextension.com
  - OSU Retained Ownership model
  - OSU RanchCalc
  - Wheat-stocker decision tools

Questions?

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