Required Readings:


Decision Context for Supply Forecasting

One way of modeling supply response for an agricultural crop is to relate ____________ to ______ and other supply-related variables.

Another way of modeling supply response is to directly relate ____________ to ______ and other supply-related variables.

- This approach is generally followed in forecasting agricultural supplies.
- Acreage planted is part of quantity produced that is ____________ by farmer.

- Yield will depend on weather, pests, and diseases and has ______ relationship to variables under a farmer's ________, once the acreage decision is made.
Planted and Harvested Acreage

All ________ acres will not be ___________ due to drought, flooding, disease and insect infestations

• Since acreage losses generally are due to _______ causes, farmers’ have little control over the ____________ of losses

• However, this does not mean acreage losses are ____________

![Graph showing US Planted and Harvested Acreage for Corn, 1975/76-2011/12](source: USDA)
Two approaches to estimating the ________ planted acreage ________

- Fixed number of acres abandoned
- Loss ratio for abandoned acres
Fixed Acreage Approach

- Some analyst’s argue that a relatively _____
  number of planted acres are ________ to be lost
  each year

  - _______ acreage in corn varies little from
    year-to- year

  - Acreage lost to flooding, insects, poor
    growing conditions in “normal” weather
    years also _______ little

Difference between US Planted and Harvested Acreage for Corn, 1975/76-2011/12

1989/90-2011/12 average w/out 1993/94 & 2002/03 = 7,099

Source: USDA
Loss Ratio Approach

- Some analyst’s argue it is better to assume that a ____ percentage of planted acres is ________ to be lost each year

- Abandoned acreage is then proportional to planted acreage

- Derive harvested acreage forecast based on ________ or ________ loss ratio
Ratio of US Planted to Harvested Acreage for Corn, 1975/76-2011/12

\[ y = 0.0015x + 0.8671 \]
\[ R^2 = 0.5386 \]

Ratio of US Planted to Harvested Acreage for Soybeans, 1975/76-2011/12

\[ y = 0.0002x + 0.9769 \]
\[ R^2 = 0.1165 \]

Source: USDA
• Previous evidence suggests it is reasonable to assume that acreage loss ratio is reasonably _______ over the last decade
  • ______ for corn
  • ______ for soybeans

Economic Theory and Planted Acreage Decisions

• __________ suggests that farmers maximize expected net profit when making ____________ decisions

• Decision rule to __________________________: equate marginal cost to marginal revenue
  • Marginal cost: increment to __________ associated with producing ___________ of output (planting one more acre)
  • Marginal revenue: increment to __________ associated with producing ___________ of output (planting one more acre)
• In a competitive market, each farmer’s ________________ is the prevailing market _______ (price takers)

• As market price changes, the marginal revenue confronting a farmer changes

• With an upward sloping marginal cost curve and ________________, a profit maximizing farmer will ________ production (plant more acres) as market price increases

Figure 4-1. Cost curves and optimum output at alternative prices
Market Supply

Market supply is based on the ______ response of all farm firms

In technical terms, the market supply curve under perfect competition is the ______________ of the marginal cost curve for each farm firm above average variable cost

The responsive of market supply to price depends on the ______________ allowed for ___________
Price Elasticity of Acreage Supply

The price elasticity of acreage supply is the _____________ in acreage supplied by farmers for a ____ percent change in price

\[ E_s = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}} = \left( \frac{\Delta Q}{\Delta P} \right) \left( \frac{P}{Q} \right) \]
To estimate supply elasticity, we must control for the effect of other ________________

Most typically done by specifying regression models, where annual crop acreage is a function of

- Expected _____ price
- ______ prices
- __________________________
- Expected price for products that _______ in production
- Risk
- Government _________ effects
- Lagged effects

The regression slope estimate on expected price is the term \( \frac{\Delta Q}{\Delta P} \) and mean values for \( P \) and \( Q \) are usually plugged into the second term \( \frac{P}{Q} \)

Most estimates of acreage response elasticities for major crops (corn, soybeans, and wheat) for ______ or less are in the range of ________
Difficulties in Estimating Acreage Supplied Elasticities

The long list of variables that need to be included in supply regressions suggests predicting supply elasticity will be ________ due to the ____________ involved

- Government _________ are a major complicating factor

  - 1970s and 1980s
    - Set-asides and target prices for corn
    - Conservation Reserve Program

  - 1990s
    - Starting in 1996, ____________ legislation allowed complete acreage flexibility
    - Price supports still maintained

- Often run into a “degrees of freedom” problem
First, we do not want to use data too remote in history as ____________ and government __________ have _______ substantially over time

• farmdoc website lists data for only the last 37 marketing years

• Given the change in farm programs instituted in 1996, it is not unreasonable to argue that only data since _____ is relevant to forecasting farmers’ _______ acreage decisions

Second, our theory discussion highlights the ________ variables that should be included in a supply regression model

But, with only 35 observations or so, using 6-10 variables leaves relatively few _______ observations

• This means that regression coefficients will be hard to estimate __________
• Not enough "free" variability, or

• Overall conclusion: estimating acreage response elasticity is ___________
Ratio Indicators

- Given the complexities, analysts often combine variables into _______ that provide important economic __________ for supply decisions

- For crops, one of the most widely-followed is the __________________________
  
  ▪ Corn and soybeans ____________ for the same resources in production

  ▪ _________________ concept

Soybean-Corn Price Ratio

- Indicator of incentive to _______ acreage between soybeans and corn

- Key is the breakeven ratio (BEPR)
  
  ▪ Ratio that equates the __________________ from producing corn and soybeans

  ▪ _____ typically is assumed BEPR
What is the Right Soybean-Corn Price Ratio?

To answer this question, we must delve into the topic of how farmer’s form price ______________ when making acreage ______________

- Traditional view is that expectation is the ____ price prevailing ____________________________ (cobweb model)

- More recent view is that farmers are forward looking and use ______________ for harvest delivery at the time the decision is made (rational expectations)
Essentially, the question is whether farmers base planting decisions on _________ or _________ prices.

Alt. Soybean-Corn Price Ratios, 1975/76-2011/12*

Old-crop price ratio slightly favors _________ to _________ acres

New crop price ratio also favors _________ to _________ acres

Note that relationship between old crop and new crop price ratios _________ after 1998/99
Limitations of Soybean-Corn Price Ratio

The relative level of government price supports can distort market price signals

- 2000:
  - National average loan rate for soybeans ______
  - National average loan rate for corn ______
  - Ratio: ____, soybean production encouraged relative to corn

Relative profitability of soybeans and corn can change

Key: BEPR assumes ______ relative level of production costs and yields

- ______ can improve for soybeans relative to corn, and vice versa
- ______ of soybean can rise relative to the price of corn, and vice versa
for soybeans can rise relative to those for corn, and vice versa.

Ratio of US Average Corn Yield to Soybean Yield, 1975/76-2011/12

1975/76-2009/10 avg. = 3.5

Source: USDA
Ratio of US Average Corn Yield to Soybean Yield, 1975/76-2011/12

Ratio of Corn-Soybean Yield

Marketing Year

Source: USDA

1975/76-1998/99 avg. = 3.4

1999/00-2011/12 avg. = 3.6
USDA Acreage Surveys

- An alternative approach that avoids many of the problems discussed above is to directly ________ farmers about their planting intentions.

- USDA surveys farmers about acreage planting intentions in _____ and ________

- Since the USDA acreage surveys are so widely followed, it is important to examine the _______ ________________

**Accuracy of USDA Acreage Surveys**

We are especially interested in two questions:

- ________: Is there any tendency for farmer's to systematically ______________ estimate acreage?

- ________: Are there any pronounced patterns in the forecast errors that would indicate less than ________ forecasts?
March USDA Planted Acreage Intentions for Corn vs. Actual Planted Acreage, 1975/76-2011/12

March USDA Planted Acreage Intentions for Soybeans vs. Actual Planted Acreage, 1975/76-2011/12

Source: USDA
June USDA Planted Acreage Estimate for Corn vs. Actual Planted Acreage, 1975/76-2011/12

Source: USDA

June USDA Planted Acreage Estimate for Soybeans vs. Actual Planted Acreage, 1975/76-2011/12

Source: USDA
Forecast Error for USDA Acreage Surveys

Define,

- $A_t$ as actual planted acreage in year $t$
- $PI_t$ as planting intentions (March or June) in year $t$

Then, the forecast error in year $t$ is,

$$Errort = A_t - PI_t$$

- Note: We will always define the forecast error as ACTUAL VALUE – FORECAST VALUE

Forecast Error Example

March 1999 Corn Error

Actual: ________ thousand acres

Intentions: ________ thousand acres

Error = ____________ = + 675 thousand acres
Error for March USDA Planted Acreage Intentions in Corn, 1975/76-2011/12

+ = Underestimate of Acreage

- = Overestimate of Acreage

Source: USDA

Error for March USDA Planted Acreage Intentions and June Planted Acreage Estimate in Corn, 1975/76-2011/12

+ = Underestimate of Acreage

- = Overestimate of Acreage

Source: USDA
Error for March USDA Planted Acreage Intentions in Soybeans, 1975/76-2011/12

Error for March USDA Planted Acreage Intentions and June Planted Acreage Estimate in Soybeans, 1975/76-2011/12

Source: USDA
Conclusions

- Overall, evidence suggests that USDA acreage surveys provide reasonably _______ forecasts of actual planted acreage

- Typically, only _______ changes in corn and soybean planted acreage forecasts after the USDA releases the June acreage survey

- The USDA acreage surveys are used as the __________ for private and public estimates once they are released

- Limitation of this approach is that surveys usually cannot be done much in advance of planting a crop
**Forecasting Corn Harvested Acreage**

USDA March 2012 Planting Intentions

94.0 million acres (expected)

Fixed Loss

7.1 million acres

Harvested Acreage Forecast

\[ 94.0 - 7.1 = 86.9 \text{ million acres} \]

**Forecasting Soybean Harvested Acreage**

USDA March 2012 Soybean Planting Intentions

75.0 million acres (expected)

Fixed Loss

1 million acres

Harvested Acreage Forecast

\[ 75.0 - 1 = 74 \text{ million acres} \]
Forecasting Yield per Acre

- The remaining task in forecasting crop supply during the pre-harvest period is forecasting yield per acre

- Different _________ have to be used at various ______ during the pre-harvest period

- It is very helpful to have some background on the _____________ of crops before discussing yield forecasting methods

- Corn and soybeans are ______ plant species and have quite different growth characteristics and stages

- These characteristics and stages have important _________ for the _________ of appropriate yield forecasting methods
Brief Guide to Corn Production

- Corn typically is _____ in US Corn Belt during the second half of ______ and early _____

- Corn plants tend to develop 20 to 21 total leaves, silk about ___ days after emergence, and mature around ____ days after emergence
• Corn is a __________ plant, which means that once reproduction (fruit production) starts the plant basically __________ all vegetative growth

• This implies the plant has limited means of __________ fruit production potential if ________ weather hits during the critical reproduction period

Effects of Drought on Corn Yield

<table>
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<tr>
<th>Stage of development</th>
<th>Percent yield reduction from four consecutive days of visible wilting</th>
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<tr>
<td>Early vegetative</td>
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<td>Tassel emergence</td>
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<td>Silk emergence, pollen shedding</td>
<td>40-50</td>
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<td>Dough</td>
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Brief Guide to Soybean Production

- Soybeans typically are planted in US Corn Belt during the late _____ and the first half of _____

- Soybean plant growth is regulated by ______________ or the length of_______ in each day

- Flowering usually begins in late July and early August, with _____ formation and bean growth generally occurring in August
• Soybeans grown in the Midwest generally are ___________ plants, which means that once reproduction (fruit production) starts the plants _______ some vegetative growth

• This indicates the plant has some means of __________ fruit production potential if adverse weather hits during the initial stages of reproduction

*Early Forecasts of Yield*

Consider this question: Do we have any information before the summer growing season that is useful for __________ corn and soybean yields?

• Both corn and soybeans have not yet reached their critical reproduction stages

• Unless we can forecast weather conditions during reproduction stages, we have _______ information that is relevant to predicting yield

• We will have to rely on ________ of yields as our best data for forecasting previous to about mid-June
Based on the assumption that weather ________ be predicted during the critical summer growing period, a reasonable prediction is obtained by simply __________ the ______________ in yields one year into the future

- The yield trend reflects improving “technology” in the broad sense of the word
  - Improved plant genetics
  - Higher fertilizer rates
  - Better production management
- At a national level, about 70% of the variation in yields explained by “trend”
- The remaining ______ of the variation in corn and soybean yield is almost solely explained by summer __________ and ___________
US Corn Yield, 1975/76-2010/11

\[ y = 1.9442x + 86.09 \]
\[ R^2 = 0.797 \]

Source: USDA

US Corn Yield, 1975/76-2010/11

\[ y = 0.0195x^2 + 1.2238x + 90.653 \]
\[ R^2 = 0.8039 \]

Source: USDA
US Soybean Yield, 1975/76-2010/11

\[ y = 0.4531x + 26.73 \]
\[ R^2 = 0.7812 \]

Source: USDA

US Soybean Yield, 1975/76-2010/11

\[ y = 0.0021x^2 + 0.3736x + 27.233 \]
\[ R^2 = 0.7828 \]

Source: USDA
Early Season Production Forecasts

Combine:

- March intentions ________ forecast
- Acreage ______ projection
- Trend ______ forecast
Improving on Trend Yield Forecasts

As the following information becomes available, we can use it to generate more ________ yield forecasts than trend forecasts

- Crop conditions
- Rainfall
- Temperature
- Disease
- ________ infestations
A Timeline of Corn and Soybean Yield Forecasts

Previous to June:

- Trend yield forecasts

Mid-June to July 31:

- USDA/NASS ______________ ratings
- Regression models based on ____________ and ____________ data
- Ratings by crop ____________
- Satellite imagery data

August 1 to November 1:

- ____________ yield forecasts
- USDA/NASS crop condition ratings
- Regression models based on temperature and rainfall data
- Ratings by crop “scouts”
- Satellite imagery data

**USDA/NASS Crop Conditions Ratings**

- ________ evaluation of crop conditions
- Non-random panel of local evaluators
- At most, about one per county
- _____________ are most frequently ag extension agents
Release Schedule

- Crop conditions are evaluated as of the most recent __________

- Released on the following Monday after the close of trading at the CBOT

- First crop conditions report generally about the first week of ______ and continue up to harvest

Crop conditions are reported as the __________ of the crop in the following __________

- Very poor
- Poor
- Fair
- Good
- Excellent
National summary for corn on July 15, 2003:

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18 Sts: 2 5 19 52 22

Prev Wk: 1 5 21 54 19
Prev Yr: 5 13 33 40 9
Ratings may be used as a ______________ of yield or as inputs to a __________ forecasting model:

\[ y_t = a + b_1 T_t + b_2 (G_t + E_t) \]

where

- \( y_t \) is the yield for year \( t \)
- \( T_t \) is a time index (1,2,3, 4,…,\( T \)) for year \( t \)
- \( G_t \) is the percentage of the crop for year \( t \) rated in good condition
- \( E_t \) is the percentage of the crop for year \( t \) rated in excellent condition

We use this type of model in the University of Illinois Marketing and Outlook Program
Regression Models Based on Temperature and Rainfall Data

For a given crop:

\[ y_t = a + b_1 T_t + b_2 JUP_t + b_3 JYP_t + b_4 AUP_t + b_5 JUT_t + b_6 JYT_t + b_7 AUT_t \]

\( \hat{y}_t \) is the forecast yield for year \( t \) in week \( j \)

\( T_t \) is a time index (1, 2, 3, 4, \ldots, \( T \)) for year \( t \)

\( JUP_t \) is June precipitation for year \( t \)

\( JYP_t \) is July precipitation for year \( t \)

\( AUP_t \) is August precipitation for year \( t \)

\( JUT_t \) is June temperature for year \( t \)

\( JYT_t \) is July temperature for year \( t \)

\( AUT_t \) is August temperature for year \( t \)
• ____________ yield forecasts are produced as rainfall and temperature data become available

• As the growing season progresses use a combination of __________ precipitation and temperatures and ______________ for unknown weather variables

• May be specified for a _______ or __________ __________ within a state

• May also include other __________ such as soil moisture level, soil type, crop maturity and planting date

_We also use this type of model in the University of Illinois Marketing and Outlook Program_