Acreage Decision under Price & Yield Uncertainty

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Acreage Decision under Price & Yield Uncertainty

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INTRODUCTION

The acreage allocation decision is related to final input and quasi-fixed output information. Uncertainty is related to prices and yield in the output market. The marketing of prices is represented by \( P \), and the marketing of yield is represented by \( Y \). We use \( \pi \) to denote the market price of an output and \( \gamma \) to indicate yield. We assume that in this study the total output of a farm household is defined as

\[
\text{Total output} = P \cdot Y
\]

The market prices of prices and yield can vary from year to year depending upon the specifications of the market. Therefore, we characterize price and yield in the market as random variables. We assume that the random variables are independent and have specified probability distributions. Consequently, \( \pi \) and \( \gamma \) are taken as the uncertain variables in the model. The problem of concern here is how to make optimal decisions in this uncertain environment. Specifically, we are interested in determining the optimal acreage of each commodity that will maximize the expected utility of wealth. We begin by formulating the problem as a utility maximization problem for a farm household in a competitive market, then we derive an acreage allocation model for the farm household.

MODEL DEVELOPMENT

In order to optimally allocate the resources of a farm household, we need to develop a model that describes the acreage allocation decision under uncertainty. This requires the following steps: (1) we define the problem and state the assumptions, (2) we formulate the model, (3) we present the solution to the model, and (4) we discuss the results.

1. Problem Definition

The problem of concern here is how to determine the optimal acreage of each commodity that will maximize the expected utility of wealth. We begin by formulating the problem as a utility maximization problem for a farm household in a competitive market. The problem is to maximize the expected utility of wealth, \( U(\pi, \gamma) \), subject to the constraint that the total output of the farm household is fixed.

\[
\text{Maximize} \quad E[U(\pi, \gamma)]
\]

subject to

\[
\text{Total output} = P \cdot Y = \text{Constant}
\]

2. Assumptions

We make the following assumptions about the random variables \( \pi \) and \( \gamma \):

- The random variables \( \pi \) and \( \gamma \) are independent.
- The random variables \( \pi \) and \( \gamma \) have specified probability distributions.
- The random variables \( \pi \) and \( \gamma \) are taken as the uncertain variables in the model.

3. Formulation

We formulate the problem as a utility maximization problem for a farm household in a competitive market. The problem is to maximize the expected utility of wealth, \( U(\pi, \gamma) \), subject to the constraint that the total output of the farm household is fixed.

\[
\text{Maximize} \quad E[U(\pi, \gamma)]
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subject to

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\]

4. Solution

The problem of concern here is how to determine the optimal acreage of each commodity that will maximize the expected utility of wealth. We begin by formulating the problem as a utility maximization problem for a farm household in a competitive market. The problem is to maximize the expected utility of wealth, \( U(\pi, \gamma) \), subject to the constraint that the total output of the farm household is fixed.

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5. CONCLUSIONS

This study is intended to describe a system of acreage allocation under price and yield uncertainty and to identify the role of output market uncertainty in acreage decisions. This study employed expected utility development by Chavas and Holt (1989). The major findings of the study are (a) an increase in the expected output market price would cause producers to increase the acreage of each commodity, and (b) the relative strength between the expected output market price and the expected yield on each commodity would affect the acreage allocation decisions. Therefore, the results of this study provide valuable insights for policy makers and agricultural planners.

REFERENCES


Proposition 1: Let \( \pi \) and \( \gamma \) be the random variables for price and yield, respectively. Then, the expected output market price \( P \) is given by

\[
P = \frac{\sum \pi \cdot Y}{\sum Y}
\]

Proposition 2: Let \( \pi \) and \( \gamma \) be the random variables for price and yield, respectively. Then, the expected output market yield \( Y \) is given by

\[
Y = \frac{\sum \pi \cdot Y}{\sum Y}
\]

In order to formulate the acreage allocation problem, we assume that the farm household's utility function is a constant absolute risk aversion (CARA) function. The utility function is given by

\[
U(\pi, \gamma) = \frac{-\beta}{\beta + 1} \cdot \left( \frac{\sum \pi \cdot Y}{\sum Y} \right)^{\frac{\beta + 1}{\beta}}
\]

subject to

\[
\text{Total output} = P \cdot Y = \text{Constant}
\]

where \( \beta \) is the risk aversion coefficient. The solution to the problem is given by

\[
\text{Acreage allocation} = \frac{\pi \cdot Y}{\sum \pi \cdot Y}
\]

subject to

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