OPTIMAL MARKETING STRATEGIES FOR ARIZONA COTTON PRODUCERS, 1975-1985

Order Number 1331401

Optimal marketing strategies for Arizona cotton producers, 1975–1985

Goldberg, Andra Kay Kellum, M.S.

The University of Arizona, 1987

U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

PLEASE NOTE:

In all cases this material has been filmed in the best possible way from the available copy. Problems encountered with this document have been identified here with a check mark __√__.

1. Glossy photographs or pages _____
2. Colored illustrations, paper or print _____
3. Photographs with dark background _____
4. Illustrations are poor copy _____
5. Pages with black marks, not original copy __√__
6. Print shows through as there is text on both sides of page _____
7. Indistinct, broken or small print on several pages __√__
8. Print exceeds margin requirements _____
9. Tightly bound copy with print lost in spine _____
10. Computer printout pages with indistinct print _____
11. Page(s) ________ lacking when material received, and not available from school or author.
12. Page(s) ________ seem to be missing in numbering only as text follows.
13. Two pages numbered _____. Text follows.
14. Curling and wrinkled pages _____
15. Dissertation contains pages with print at a slant, filmed as received ______
16. Other __________________________________

OPTIMAL MARKETING STRATEGIES
FOR ARIZONA COTTON PRODUCERS, 1975-1985

by

Andra Kellum Goldberg

A Thesis submitted to the Faculty of the

DEPARTMENT OF AGRICULTURAL ECONOMICS

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE

In the Graduate College

THE UNIVERSITY OF ARIZONA

1 9 8 7

STATEMENT BY AUTHOR

This thesis has been submitted in partial fulfillment of requirements for an advanced degree at The University of Arzona and is deposited in the University Library to be made available to borrowers under rules of the Library.

SIGNED *Arden K. Goldberg*

APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

Paul N. Wilson — *7/27/87*

Dr. Paul N. Wilson — Date
Associate Professor

ACKNOWLEDGMENTS

The author wishes to express her appreciation to Dr. Paul N. Wilson for his patience, understanding, and assistance during the course of this research. His ideas and suggestions were essential to the development of this thesis. Also appreciated is the assistance of Dr. Robert Firch whose knowledge of the cotton industry was invaluable. Thanks also to Dr. Merle Faminow for his marketing expertise and for the final review of this paper.

Special recognition goes to Mr. Lon Emerson of CALCOT,Inc., and to Mrs. Anne Hudecek and Lew Daugherty for their help in the computer laboratory. Thanks also to the cotton producers, brokers, and merchants whose knowledge of the industry, and their willingness to share this information made this research possible.

A most special word of thanks to my husband, Jeff, and my son, Bryan, whose sacrifices and encouragement were given abundantly and lovingly. I couldn't have done it without you! Thanks to the rest of my family for their encouragement, prayers and financial support. Thank you - Mr. and Mrs. Andy Kellum, Attny. and Mrs. Martin Goldberg, and Ms. Ida Hale.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

ABSTRACT

This study concerns the analysis of marketing strategies for Arizona cotton producers. Cash sale, forward contracting, futures contracting, and cooperative marketing strategies were evaluated for the years 1975 through 1985. Unique to this study was the use of variable cotton quality to calculate revenues for Arizona growers. Stochastic dominance and mean-variance analysis were the tools used to analyze the data. The results indicate that: 1) stochastic dominance was successful in reducing the efficient set found with mean-variance analysis; 2) given the model assumptions, forward contracting early in the production year was the dominant strategy for the grower defined by the model as risk averse; and 3) the results of the analysis were not significantly different when only strict low middling was used.

CHAPTER 1

INTRODUCTION

Because cotton producers are unable to set the price for their product, farmers are vulnerable to the erratic commodity price changes occurring after land, equipment, and planting costs have been incurred. Such producers are commonly referred to as "price takers" and U.S. farmers are in this category. Price takers are usually characterized by having a large number of relatively small producers. However, Ferguson and Gould (1975) feel the most important idea concerning price takers is that "each economic agent acts as if prices are given" regardless of the firm market structure. Therefore, either definition agrees that individual decisions do not affect the market price of the commodity being produced.

Reducing risks of price changes has become increasingly important to cotton growers, especially since 1973. Prior to this time, the government actively stabilized prices through the use of price supports and acreage limitations. After 1973, changes in government programs and general economic conditions caused cotton prices to be much more volatile than before 1973. As will be discussed in greater detail later, international developments in the cotton industry have lowered profit margins and changed this market considerably.

Consequently, farmers have been forced to include another item to their list of risks, namely - government programs and the rapid changes in policies. Not only has policy become less involved in market activity, but increased uncertainty has developed about the level and targets of activity. With the long term planning horizon associated with many crops, this risk can be a determining factor in the survival of marginal firms.

U.S. Agricultural Policy

Historically, the United States agricultural policy was formed almost as soon as independence from Britain was won. Beginning in 1785, ordinances encouraged more land to be developed in the western and northwestern areas of the country (Rasmussen 1984). The farm dominated society of the 1800s requested more government assistance than their predecessors. Through subsequent policy actions, railroads expanded, statistical data were collected, land grant colleges were established, and agricultural experiment stations were created. The first regulatory programs of the Department of Agriculture began late in this decade with emphasis on animal disease control.

Regulation of marketing activity began in 1916. The stated purpose was to insure fair trade and to prevent market manipulation in cotton and grain futures marketing. However, all previous programs cannot compare to the reform measures enacted under the New Deal of the 1930's. Economic conditions caused farmers to push for policy changes that have become important in many aspects of American agriculture. The Agricultural Adjustment Act of 1933 gave the Secretary of Agriculture the authority to give direct benefit payments to farmers, to reduce acreage or production by voluntary agreements, to spend tax revenues to increase markets or to decrease surpluses, along with other regulatory powers. The objective of this Act was to raise prices to farmers by decreasing product supply (Cochrane 1981). Except for a short time during World War II, the conservation programs have not changed significantly until 1973. In 1973 the acreage controls were lifted and producers became subjected to supply and demand fluctuations not only domestically, but on a world wide scale (White and Davis 1979).

The Cotton Marketing System

Others, such as market speculators, have entered the cotton pricing arena. The producer is primarily seeking maximize profits, the basic contrast from simple market speculation (Johnson and Shafer 1984). Therefore, producers need to know not only current production innovations, but marketing alternatives as well.

The marketing system for cotton is complex. (Dahl and Hammond 1977). Cotton moves from farms to gins, an intermediate processor, to textile and industrial products before reaching consumers as shown in table 1. Farmers are forced to have an understanding of the different marketing strategies available. This information will assist producers in making difficult marketing decisions and in dealing more effectively with buyers (Thompson and Hudson 1983).

Arizona Cotton Farming

Cotton farming in Arizona has a significant impact on Arizona's economy. Approximately 1300 cotton growers and 17,000 farm support workers constitute the employment force (not including input and processing employees). Their efforts in 1984 generated about $750 million for Arizona's economy (Arizona Cotton Growers Association 1986). Cotton accounts for about fifty percent of the acreage in crop production, 480,500 acres in 1984, with a market value of $395,541,000 (USDA 1985b). Following, Texas, California, and Mississippi, Arizona ranks fourth in total production, 1,020,000 bales in 1985 (USDA 1985a). However, at 1,255 pounds of lint per harvested acre, Arizona cotton farmers have the highest average yield among the cotton producing states (see Tables 2 and

Table 1: Market Structure of the Cotton Industry

```
                           farmers producing cotton
                                        .
                                        .
                                  active gins
                                        .
                                        .
                                        .
warehouses        < < < < < < < < < <.> > > > > > > >   government-Commodity
and compresses                          .                Credit Corporation
    .      .                            .                     .
    .                                                         .
    . <  <  <  < <  <  <  <  <  merchants < < < < < < < .
 (export)  .                            .
    .                                   .  > > > > > > > > > > >.
    .      .                                                     .
    .                           yarn mills                    industrial uses
    .      . > > > >           thread mills    > > > > > >                .
                      cotton broadwoven fabric mills                      .
foreign    < < < < <        narrow fabric mills                           .
countries                     knitting mills   > > > > garment and home   .
    .                         finishing mills          furnishings ind.   .
    .                                   .               .       .         .
yarn mills                              .               .       .         .
thread mills                                            .       .         .
knitting mills> > > > > >     wholesalers               .       .         .
finishing mills                         .               .       .         .
    .                                   .               .       .         .
    .        manufacturing sales branches of textile mills      .         .
    .  > > > merchant wholesalers of dry goods and apparel< < .           .
    .                                   .                       .         .
    .                                   .                       .         .
    .                                                           .         .
    .                              retailers                    .         .
    .                                   .                       .         .
    .                                   .                       .         .
    .                                                           .         .
    . > > > > > > >   general merchandise stores   < < < < <  .           .
                    apparel and accessories stores                        .
                  furniture and home furnishings stores                   .
                                        .                                 .
                                        .                                 .
                              U.S. consumers   < < < < < < < < < < < <    .
```

Source: adapted from Kohls and Downey, 1972.

3). Also, because of the high quality lint produced, Arizona growers enjoy a price advantage when compared to most domestic cotton producers (University of Arizona 1986). The major areas and trends of cotton production in Arizona are illustrated in table 4.

Lint production per acre has increased 44% since 1970. However, since 1980 the per acre yields have remained stable (USDA 1980, USDA 1984, Stedman 1986). Harvested acres in Arizona almost tripled from 1970 to 1979. However, this increase in acreage did not continue into the 1980's and has since declined by 43%. Only 324,000 acres were planted in 1986 (see figure 1) (USDA 1984, Stedman, 1986). This decline is not unexpected as producers face not only higher costs of production, but higher processing costs as well. Ginning charges alone increased by 26% since 1978, with compressing charges increasing by an equal percentage.

Farmable land has been taken out of production for other reasons not directly associated with production costs. One reason for the decreased production is urban growth. The dramatic increase in Arizona's population has transformed many acres of farm land into urbanized areas.

A second major cause of decreased production is government programs. These programs may restrict the number of planted acres. This restriction occurs because

Table 2: Acreage, yield, production, and value of Upland Cotton in Arizona

YEAR	PLANTED	HARVESTED	YIELD/ACRE	LINT PROD.	PRICE	VALUE OF PROD.
	1,000 acres		lbs.	1,000 bales	cents	$1,000
1981	600	599	1247	1556	56.0	418,253
1982	471	470	1118	1095	60.5	317,988
1983	291	284	1225	725	68.2	237,336
1984	430	429	1227	1097	59.8	314,883
1985	360	359	1241	928	53.9	240,092

Source: USDA 1986
Price is estimated for average market price August through July

Table 3: Harvested Acres and Yields per Acre for Top Upland Cotton Producing States

STATE	HARVESTED ACRES 1976-80 AVG.	1982	1983	1984	1985	YIELD PER ACRE 1976-80 AVG.	1982	1983	1984	1985
				1000 ACRES						
TEXAS	6160	4300	3550	4700	4700	333	301	322	376	409
CALIF.	1427	1370	950	1400	1340	924	1077	996	999	1128
MISS.	1237	990	675	1032	1040	524	853	640	767	762
ARIZONA	504	465	284	429	365	1068	1130	1225	1227	1236

Source: International Cotton Advisory Committee 1986.

Table 4: Acreage and Yields for Arizona Upland Cotton by County

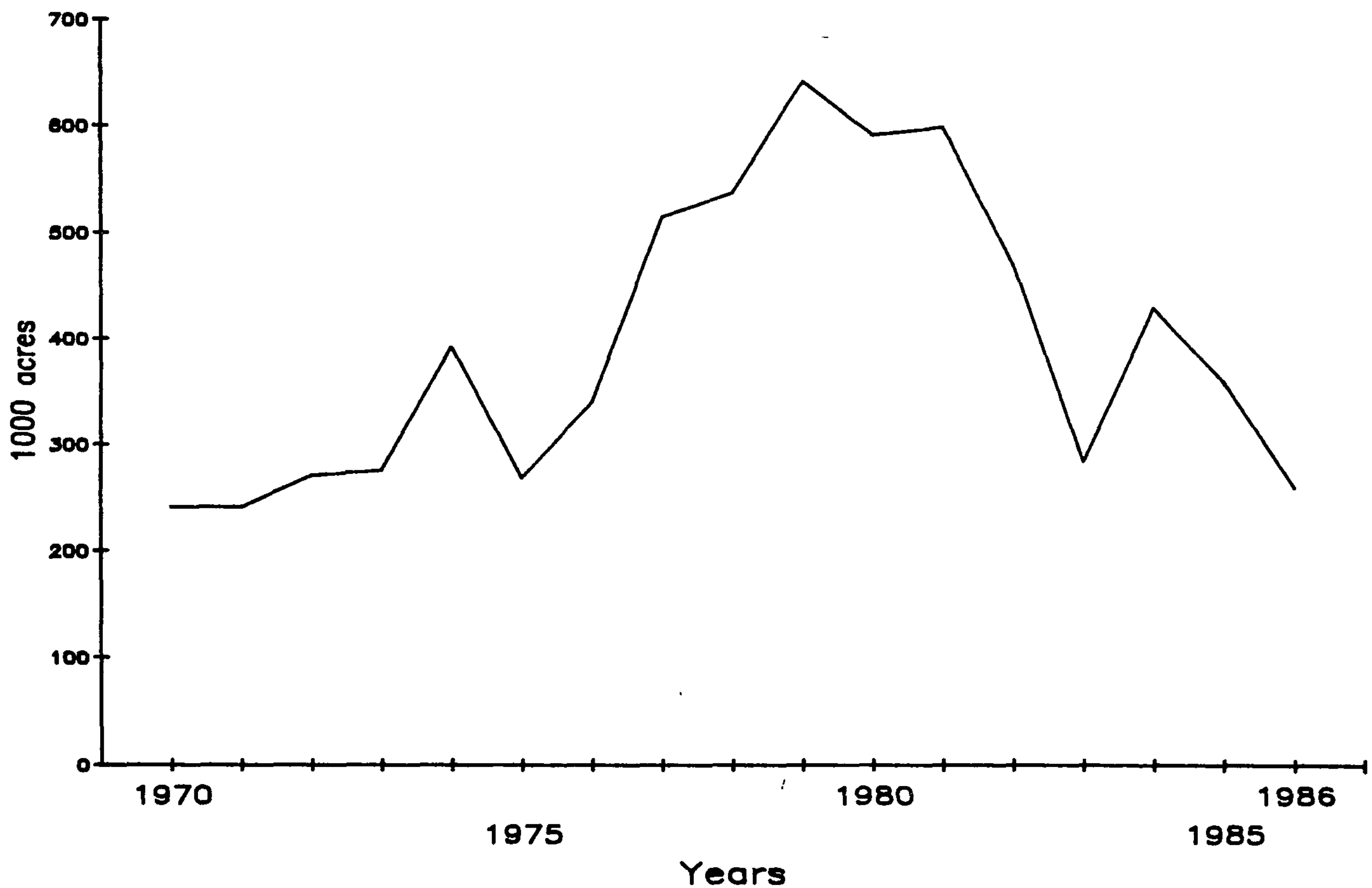
HARV. ACRES LBS./ACRE	1981	1982	1983	1984	1985
COUNTY					
APACHE	0	0	0	0	0
COCHISE	35,200 682	28,100 530	16,400 720	16,600 671	15,000 784
COCONINO	0	0	0	0	0
GILA	0	0	0	0	0
GRAHAM	16,500 954	12,000 856	7,850 783	12,000 828	10,600 860
GREENLEE	900 907	1,100 698	660 989	1,020 871	800 870
LA PAZ			20,800 1,191	34,300 1,122	28,500 1,196
MARICOPA	239,400 1,390	186,000 1,214	114,300 1,340	185,300 1,300	151,400 1,297
Mohave	6,500 849	5,500 969	3,540 968	5,680 883	3,600 1,000
NAVAJO	0	0	0	0	0
PIMA	19,800 812	15,700 911	8,250 931	15,300 1,089	13,000 947
PINAL	153,600 1,372	134,200 1,112	76,400 1,246	120,200 1,306	106,700 1,310
SANTA CRUZ	0	0	0	0	0
YAVAPAI	0	0	0	0	0
YUMA	127,100 1,110	87,400 1,200	35,800 1,262	38,600 1,205	29,400 1,283

Source: Arizona Crop and Livestock Reporting Service

figure 1

Harvested Upland Cotton Acreage in Arizona

Source: U.S.D.A.,Statiscal Reporting Service



government programs provide financial incentives for farmers to plant fewer acres of cotton.

In 1986, the estimated total cost per acre to grow upland cotton (furrow irrigation in Maricopa county) was $806.76, an increase of $235.70 per acre from just ten years ago (Hathorn and Farr 1986, Hathorn and Farr 1976). The 1986 cost was 7.6% less than the average cost in 1985, because a 9.5% increase in water assessment was more than offset by decreases in taxes and management services (Hathorn and Farr 1986).

Water costs have risen substantially since the 1970's and are expected to continue to follow this upward trend. As illustrated in figure 2, Water costs account for 20 to 30 percent of the total variable costs of production for Pima, Maricopa, and Pinal counties and rises to a high of nearly 40 percent in Cochise county (Hathorn, et. al. 1985). Therefore, the concern about water costs and availability is a major issue to Arizona producers (University of Arizona 1986).

Another important development is the noticeable, downward trend in real upland cotton market prices, the season average has declined 21% from 74.2 to 58.9 cents per pound in 1985 (see figure 3)(USDA Agriculture Marketing Service, Ayer 1986, USDA 1985b). When prices are

Figure 2
Water costs as Percent of Total Variable Costs of Cotton Production, Arizona Counties, 1985
Source: Hathorn 1985

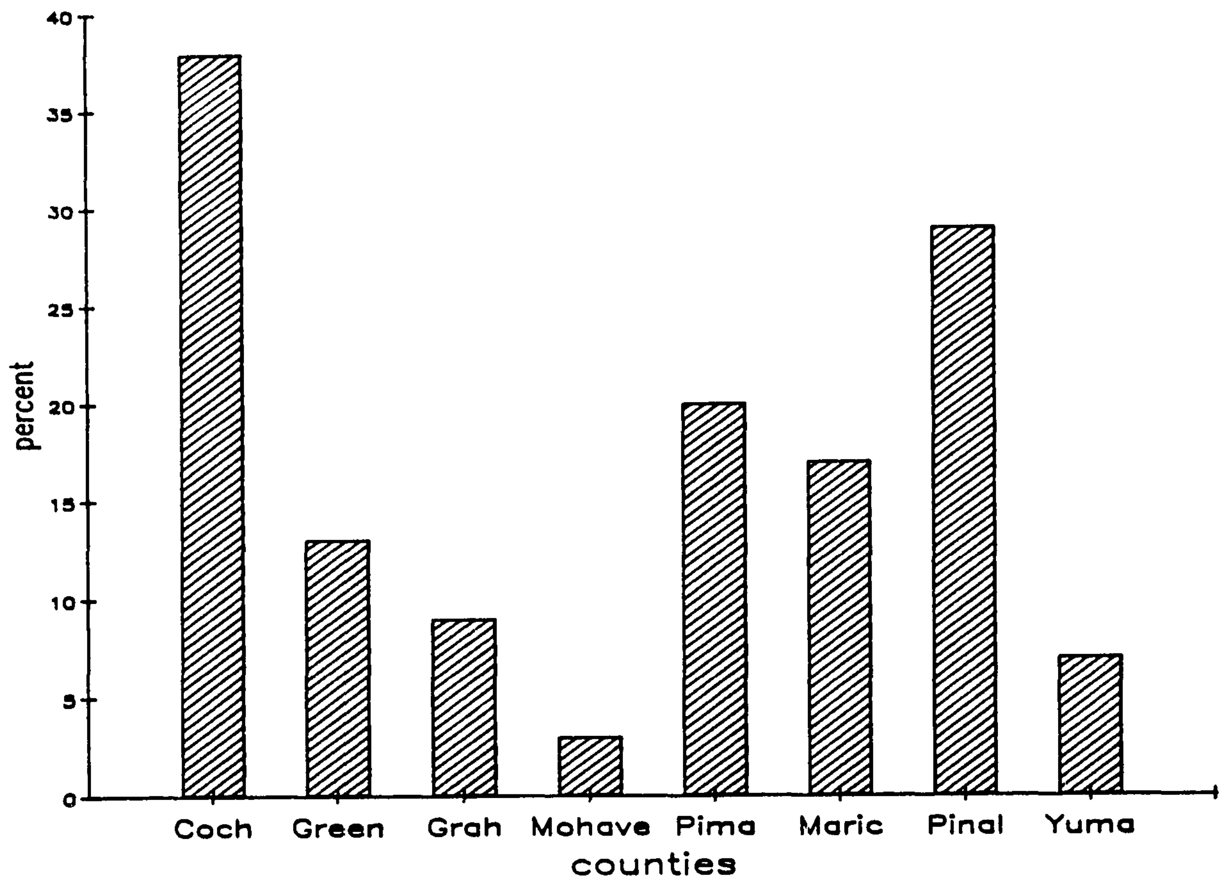
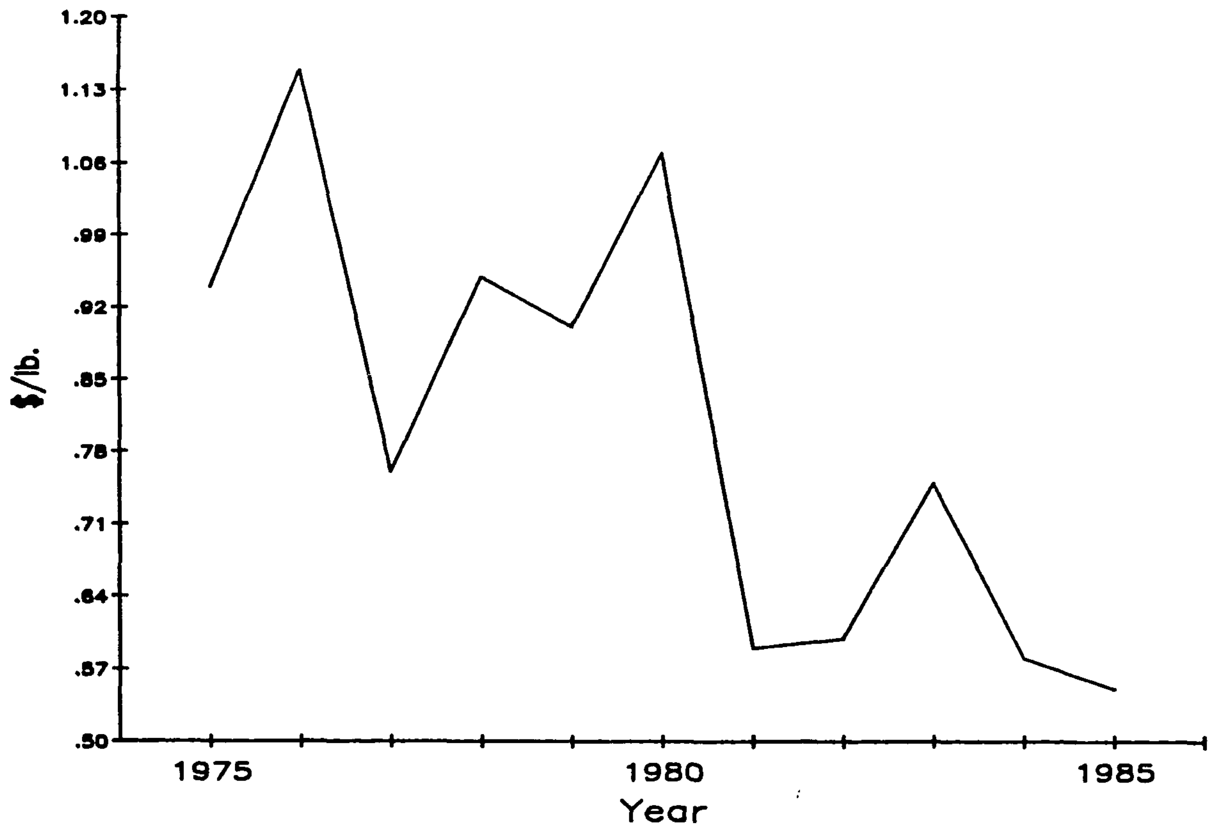


Figure 3

Upland Cotton Prices
(1984 Dollars) Arizona

Source: USDA, Agricultural Marketing Service



adjusted to the value of the dollar in 1984, real cash prices have declined 38% since 1973 (USDA 1975, USDA 1986).

The International Cotton Situation

The loss of the export markets is a major reason for the change in the domestic cotton environment. A 30% increase in total world cotton production from the previous growing season resulted in 87.86 million bales (500 lbs. of lint) of production for 1984/85 (ICAC 1986) In 1985, U.S. cotton delivered to Northern Europe was about 69.25 cents a pound while Guatemala, USSR, Australia, French West Africa, and Mexico averaged 48 cents a pound (USDA 1985a).

China's production change - from being a major importer of 4 million bales in 1979 to exporting over one million bales in 1984 - has had a major impact on world markets (National Cotton Council 1985). Their cotton exports are expected to increase as their marketing and processing systems improve. Second only to India, China has 18% of the world's total cotton acreage, the U.S., in third place, is currently holding 13%. As a percentage of the world's total acreage, the U.S. has declined by 20% in the last 7 years with China's percentage increasing by 30%. India's per acre yield is extremely low at 187 lbs., China and the U.S. per acre yields are 624 and 630 lbs. respectively (ICAC 1986). All three countries have seen improvements in yields over the last 10 years. China shows the greatest improvement, producing 63% more per acre than in 1977.

U.S. exports during the past five years have varied between 28 to 35 percent of the world export market (ICAC 1986). During 1985/86, the prediction is a low 12% of the world trade claimed by U.S. producers (USDA 1986). Korea, Indonesia, Taiwan, and Japan absorb nearly 60% of U.S. exports. China, Pakistan, Australia, and India are the major contributors to the larger foreign exports. Despite India's low per acre yield, their exports are expected to increase 425%, Australia is expanding their sales by nearly 74%. Compounding the problem is U.S. textile imports which represented 3,053,100 bales in 1984. This figure represents an increase six times the amount imported in 1960 (USDA 1985c).

However, with shifts in consumers' tastes and lower cotton prices, cotton use is continuing to rise (USDA 1985a). This trend began in 1980, and cotton's portion of the domestic clothing market increased from 39% to 42% in 1985. This increase in market share helped U.S. mills usage, as textile imports remained about equal in 1984. High yields have met this increased demand. In 1985 cotton production was 22% above the current 5 year average.

Government policy is supporting the change to a market-oriented economy for domestic cotton producers by making U.S. prices competitive in world markets and supporting farm income during the transition (USDA 1986). This support is not without costs. In 1983, $123 million went to Arizona growers in the form of cotton program payments, this figure was equal to 52% of the value of all the upland lint produced that year (Ayer and Wade 1986). As seen in table 5, this figure was unusually high.

Table 5. Arizona's Participation in the U.S. Government's Upland Cotton Program

	Enrollment in Upland Program	Cotton Program Payments	Value of Lint Prod.	Cotton Program Payments as % of lint value
	% of Base	---$1,000,000------		
1982	86	55	318	17
1983	96	123	237	52
1984	69	44	310	14
1985	79	n/a	n/a	n/a

Source: Agricultural Stabilization and Conservation Service (ASCS)and Arizona Crop and Livestock Reporting Service. Ayer and Wade 1986.
Note: Cotton Program Payments include deficiency, voluntary diversion and PIK payments. Cotton disaster payments not included.

Production and Marketing Practices

Arizona farmers benefit from a long growing season. Planting begins in March and is completed by mid June.

First picking, depending on weather conditions, is usually begun in October with final rood cotton gathering completed in November or December (Hathorn and Farr 1986).

Pre-irrigation is recommended in February with subsequent irrigations performed from May through September, totaling 66 acre inches of water applied per acre (in Maricopa County). Marketing patterns have not changed significantly in the last eight years, most of the cotton is sold between November and February (USDA 1984). Many farmers intensify production by double cropping with wheat and barley before planting a later cotton crop. However, traditional crop rotation systems are not practiced by many producers because of economic considerations (Taylor 1986).

Alternative crops for cotton producers in Arizona's arid climate have not yet proved economically enticing enough for farmers to make any major acreage changes. Suggested new crops include almonds, kiwi, jojoba, and sunflower. Some commercially grown plants that have yet to be fully exploited are: apricots, dates, guar, and soybeans (University of Arizona 1986). Therefore, cotton producers are seeking better management systems utilizing computers, improved varieties that are more water efficient and pest resistant, and improved irrigation systems including increased laser leveling practices and limited drip irrigation projects.

It's not surprising that cotton acreage is predicted to further decline in Arizona (University of Arizona 1986). Current breakeven price figures are not encouraging. Returns to profit for 1986 were predicted to be a minus $179.08/acre for upland cotton in Maricopa County and a minus $182.74/acre in Yuma County (Hathorn, Howell, and Tickes 1986; Hathorn and Farr 1986). However, when analyzing cotton industry concerns of the past, researchers have seen recovery in spite of gloomy predictions. In 1970, synthetics were regarded as the ultimate competition for U.S. cotton producers. At this time predictions indicated that growers were "to find other uses for their land and other productive resources", a strong recommendation for promoting their product was advised (Cable and Alstad 1970, p.20). Apparently, the warning did not go unnoticed as currently the threat of synthetics is not as prominent as it was in the 1965-75 period.

Will Arizona cotton producers meet the current challenges of increased urbanization, higher variable costs, and increased foreign competition? The future is more hopeful as more information is disseminated and data collected concerning this industry. In recent meetings with Arizona producers, a very strong need was indicated for more marketing information (University of Arizona

1986). The difference between profit and loss of a farmer's business may only be a few cents per pound. Effective marketing can be this difference. Cotton producers can assume some control over prices and increase their incomes by developing their marketing knowledge and skills. The purpose of this research project is to determine optimal or dominant cotton marketing strategies for local farmers, under alternative assumptions about risk preferences.

Objectives

The primary goal of this thesis is to compare gross returns over time for alternative marketing strategies for three representative Arizona cotton farms. The procedures that will be used to accomplish the objective will include: 1) a literature review and 2) an estimation of the annual total revenues for these three farms in Pinal County for 1974 - 1985.

The first objective is to review the current literature available. This review will not be exclusively for cotton but include grain marketing studies when applicable. Each article will be reviewed for its objectives, model used for analysis, results found, and critique of the findings.

For the second objective, cotton yield, price and quality (grade and staple length) data will be analyzed for the specified time period. Mean-variance decision rules and stochastic dominance analysis are the analytical techniques that will be used. Using the results found with these analytical tools, cash sale, forward contracting, and futures marketing will be compared to cooperative marketing. This comparison will attempt to apply a monetary value to the worth of expertise in marketing cotton in Arizona.

CHAPTER 2

LITERATURE REVIEW

Agriculture is often characterized by firms operating in a purely competitive environment. The reason for this association is because producers act as price - takers and many farm products are homogeneous. As previously discussed, individual marketing decisions have little or no impact on the aggregate price.

Farm prices are known to be more unstable than most prices of nonfarm products (Tomek and Robinson 1975). The biological production process is one cause of this instability. Another possible reason for this pricing difference is the dissimilarity in marketing structures. This difference gives nonfarm producers a measure of control over prices and an ability to make production adjustments quickly in response to price changes.

Bargaining by individuals remains the most commonly used marketing method for farm products, such as cotton (Tomek and Robinson). Individuals can: 1) sell for the prevailing cash price at harvest; 2) use some method of forward contracting sometime during the season (Forward contracting is defined as setting a selling price for all or part of the crop and determining the buyer of the crop.); and/or 3) utilize storage facilities and sell at a later date (Cable 1979). Group bargaining is another marketing alternative and many producers take advantage of cooperative marketing and trading in organized commodity exchanges.

In organized markets, farmers can either trade in actual commodities or can sell their product using futures contracts. Hedging is the term commonly used when producers sell sell futures contracts before the price has been set on their commodities. Growers sometimes indirectly hedge their crops when forward cash contracting as the buyer of their crop will usually cover his purchase with a futures contract.

The study of crop marketing is not new to agricultural research. Most studies compare and contrast the different marketing strategies available to producers. The analysis of cotton marketing studies will focus on yield and quality variability. Many of the grain marketing studies have been conducted on midwestern crops. These articles will be the first to be reviewed, followed with the cotton marketing studies. All material will be analyzed with emphasis on the researcher's objectives, models, and results.

Review of Grain Marketing Studies

Rarely do producers utilize only one method of marketing or attempt to market an entire crop before harvesting. Therefore, the variety of possible strategies is infinite and analysis can become extremely complex. Since much of the work in marketing strategies has been concentrated in grain studies, an indirect application to cotton is necessary. Fortunately, grain's homogeneous quality and storability allow for this application to cotton marketing.

Riggins, Reed, and Skees (1986) found low net prices for Kentucky grain producers utilizing traditional marketing techniques for the years 1970 through 1980. Their study involved nine marketing strategies using market information versus strategies not using this information. The "no information strategies" included: 1) cash sale at harvest, 2) store and sell 1/12 each month beginning at harvest, 3) half stored and sold equally throughout the year with the balance being sold in August for corn and June for soybeans, 4) store at harvest and price 1/3 of the crop for sell in June, July and August, 5) store at harvest with a December cash price delivery. Strategies #3 and #4 are assuming the specified months to be the historically higher priced months for the commodities.

The four "marketing with information" strategies were: 1) store at harvest, pricing and delivering for cash each time the average monthly price increases by a specified percentage above the predicted average price for the season, 2) store and sell in equal halves each time a sell signal (developed by the authors) develops in the futures market, 3) hedge 1/3 of the crop during March, July, and September for delivery in December (corn) or November (soybeans) future contracts, 4) hedge 1/3 of the crop in April, July, and September using March futures contracts for February delivery.

This study utilized a fixed amount of production for the analysis. The researchers justify this simplification because a variable production program did not significantly alter their results. However, this study observes that the constant production statistic was acceptable for all but the forward pricing strategies. Riggins, Reed, and Skees do not clarify this ambiguity or do they present the results of the inclusion of variable production.

In analyzing these strategies, a simple method of comparing the standard deviations and the average prices (mean-variance analysis) for the different alternatives was used. Not only did the use of the information reduce risk, utilizing the marketing data also resulted in higher net returns. Because mean-variance decision rules could not rank the strategies, no one strategy proved superior for soybeans. The #4 strategy which utilizes marketing information did prove optimal for corn.

A similar study was conducted by Sogn, Vollmers, and Baatz (1981) for corn and soybean producers in South Dakota. These researchers emphasized the need for farmers to be flexible and well informed:

"Farmers must carefully evaluate their personal needs and constantly monitor market information so they can adjust marketing strategies to increase their yearly net return .... a well-planned marketing program should increase the chance of above-average returns over time (p.11 & 14)."

For their discussion, the market information referred to involves knowledge on current prices, short term in nature; longer run information about trends and outlooks; and communication concerning abrupt changes in public policy.

This report recommended market plans which maximize income consistent with the farmer's risk acceptance levels. The analysis involved comparing the net returns, which were found by subtracting the marketing costs from the per bushel price received, of eleven marketing strategies for five years (1972 - 1977). The marketing methods were divided into two categories. The first group was cash marketing alternatives which included storage options and/or multiple sales. Forward pricing strategies using futures trading composed the balance of the alternatives.

Unfortunately, no single marketing method consistently proved successful when compared to the others for either corn or soybeans. The highest returns were found when strategies were allowed to be variable. This result would apparently endorse their recommendation to adjust marketing decisions to market conditions. However, a single optimal decision rule was not discovered. In critical evaluation of this study, variability in net income or in yields was not evaluated, no analytical model was used, and the findings were inconclusive. This study simply recommends to use differing strategies. The researchers failed to provide producers with adequate criteria for making marketing decisions.

Another study analyzing the value of marketing information is found in an article by Johnson and Shafer (1984). Their Texas wheat marketing study discovered greater returns for producers who utilized strategies based on price movement indicators instead of on arbitrary patterns. This article compared net mean returns and standard deviations of seven selected strategies for wheat prices received between 1974 and 1980.

Analogous to Sogn, Vollmers, and Baatz's study, the results were inconclusive with no one strategy prevailing with the highest net price. Although they indicate that the "Cost per unit of output is a product of both input prices and yield", yield variability is not included in the analysis (p.52). Other limitations discussed by Johnson and Shafer include the short observation time and the moving average combination technique in developing the time pattern of producer's selling decisions.

Greenhall's (1983) study found the mean variance analysis used by most to rank marketing strategies to be unrealistic. Therefore, stochastic dominance techniques were used to analyze producer's marketing decisions for his research. Two published corn marketing studies were analyzed comparing each with mean - variance and stochastic dominance results. Mean - variance efficient sets had marketing plans excluded from second order stochastic dominance. Furthermore, mean - variance analysis was found to misjudge the ranking of risky alternatives for risk averse producers. Stochastic dominance techniques were found preferable because it appeared to be a stronger verification of dominance while also being more flexible to use in this study of corn prices.

The advantages of stochastic dominance analysis are further validated when it is noted that one of the two studies in Greenhall's analysis was the Sogn, Vollmers, and Baatz research previously reviewed. When the identical data was analyzed using stochastic dominance, conclusive results were found. Greenhall documented several marketing strategies that were overall, superior to the others. For example, Greenhall found that producers preferred a strategy of multiple sales after extended storage if their risk aversion level was high.

Review of Selected Cotton Studies

Arizona cotton producers may choose from many marketing strategies all of which involve two actions: 1) finding a buyer, and 2) accepting a price (Cable 1979). Table 6 summarizes the most commonly used methods along with their advantages and disadvantages. Approximately half of Arizona's producers utilize cooperative marketing (Emerson 1986). In this case, farmers choose to concentrate on production practices, shifting market decision responsibilities to others.

Cooperative marketing was not included as a marketing strategy in any of the literature reviewed. Brooker and Gray (1985) did not utilize this alternative in their Tennessee cotton marketing study. Cooperative marketing was omitted from the study because of its infrequent use by area farmers. However, their study did include a unique formula in developing their strategy combinations. This formula included a scale that minimized risk as income increased.

The program was structured to produce the efficient marketing strategies that minimized the variance for a stated income figure. Brooker and Gray refer to this

Table 6. Cotton Marketing Strategies: Advantages and Disadvantages

Strategy	Advantage	Disadvantage
Selling spot cotton at ginning time	simple, inexpensive, immediate cash	price risk uncertainty, inflexible
Store for later sell	tax advantage of deferring income, possible cotton price increase	cash flow problems, requires careful market analysis, storage costs, possible price decrease
forward cash contracts	reduce risk of price decline, low cost, assists in financing	do not receive benefits of price increase, must produce at least number of bales contracted for, complicated contractual agreements
cotton futures contracts	flexible pricing, standardized contracts, assists in financing	specific quantity of 50,000 lb. for exchange, higher costs of marketing, must monitor price activity, requires more information to be known by seller
cooperative marketing	average prices received are usually higher than independent marketing decisions, increased market strength,lower unit marketing costs, decisions made by experienced market analysts	decisions are not in seller's control, cost per bale to be a member, seasonal prices may be lower than other strategies, receipts are received throughout the year instead of all at one time

Source: (Cable 1979)

program as the "E-V solution". Mean-variance analysis is the methodology they used in their analysis. However, Brooker and Gray denote E and V to represent income maximization and risk minimization respectively.

Their program generated 31 marketing strategies. The complexity of these alternatives is unique. These alternatives included singular strategies, and combinations of: forward contract sales, spot market sales, storage sales, and hedging on the futures market. The discussion of the strategies is complete and well researched. Brooker and Gray attempted to portray producer marketing decisions as accurately as possible.

A variable lacking in many of the other research articles but found in Brooker and Gray was yield variation. This variation was represented as the average yield per acre for Crockett County over the 10 years. However, their study was analyzed on a per acre basis. This simplification could possibly distort some marketing strategy results. Specifically, futures contracting would be difficult to represent on a per acre basis. Grade variation is not mentioned in the study. Therefore, omission of this variable is assumed.

Their E-V analysis did not give conclusive results. Their mean income was greatest when the crop was forward cash contracted in October, almost at harvest.

Unfortunately, risk was the highest for this alternative. Brooker and Gray report the difficulty a producer may have in even locating a broker willing to complete this transaction this late in the year.

Futures contracting and storage/sales alternatives reduced risk, but decreased income as well. The authors conclude that producers must decide on the risk-return tradeoff that best suites their business.

A generalized cotton price study involving the use of the dynamic stochastic simulation technique discussed earlier found that hedging was not a tool for increasing expected income (Bailey, Brorsen, and Richardson 1984, Greenhall 1983). Bailey, Brorsen, and Richardson's analysis utilized a recursive Monte Carlo simulation model for cotton prices from 1975 to 1982. A possible criticism of their model could be in their pretesting action, therefore fitting the model to the data and not vice versa. The researchers sought to correct this weakness with comparison runs to a firm simulation model. As a result of this modification, they found closely related results for actual and simulated data.

Prices only were being analyzed, therefore, yield variation was not included in the model. Two grade/staple length combinations were utilized. 42/32 for cash prices and 41/34 for futures prices. However, these two combinations are not a significant inclusion of quality variation.

Bailey, Brorsen, and Richardson further analyzed two marketing strategies, a technical hedging strategy versus selling at harvest. When the mean net incomes were compared, the results indicated no significant difference between the two strategies. However, the variance was lower for the hedging strategy. The researchers felt that this result verifies that the purpose of hedging is not primarily for increasing net income but for decreasing risk.

Other studies involving hedging as a cotton marketing strategy are inconclusive. Shafer and Howard (1979) recommend hedging for large producers, while Firch and Al-Sakkaf (1986) found lower net incomes for futures hedges when hedging was compared with other strategies. Both studies included mean-variance in their models. While differing on net income results, the researchers agreed that hedging reduced variability. The type of variability reduced in Shafer and Howard's results is termed "risk shifting effectiveness" (p. 187), a proportional measure of profit variance. Average income variability was the focus for the Firch and Al-Sakkaf report. Neither study included yield or quality variability.

However, Shafer and Firch again found differing results in studies concerning forward contracting, a commonly used cotton marketing strategy (Shafer and Howard 1979; Firch 1982). Both studies simply compared cotton prices received under different marketing methods. Shafer and Howard included risk and variance analysis in their report, however, Firch's study did not include dispersion analysis. The study by Shafer and Howard which included Mississippi Delta, Texas High Plains, and Fresno, California contracts found cash sell in December to be more profitable than forward pricing for the study period from 1971 to 1978.

Firch found forward contracting to raise average selling prices by more than one cent per pound during 1974 to 1979. The limitations on the Arizona study is the brief time frame. Shafer and Howard observe that early year prices were high between 1974 and 1977, perhaps giving the reason for the differing conclusions. The ambiguity created by Shafer and Howard's use of terms "forward pricing", "hedging", and "forward contracting" made analysis and comparison extremely difficult. Shafer and Howard have assumed a hedge is made by the broker when the producer forward contracts, and then lcosely used the term "hedging" when referring to forward contracting. This interpretation was used for the comparison to the Firch study.

In contrast to Firch's previous study on forward contracting, a more comprehensive report found a slight reduction in average income when forward contracting strategy was compared to cash sale (Firch and Al-Sakkaf 1986). This recently completed project further analyzed five cotton pricing strategies in Arizona. Their methods included fitting the data to a dummy-variable regression function and then adapting the Black Model of option pricing to compute premiums (Black 1976). Average prices and standard deviations of incomes from the various marketing strategies were compared as a percentage of cash sale averages. A unique aspect of their study was the incorporation of put options as a cotton marketing strategy. A put option is defined as the right to sell a futures contract, within a specific time frame, at a fixed price, called the strike price (Ware 1984). Previously banned, this alternative method of marketing cotton has only been available since October,1984. Firch and Al-Sakkaf concluded that options are an advisable part of a producer's marketing strategy when prices are highly variable.

Again, this study and the previous report (Firch 1982) lacked quality and yield variability. This omission could possibly alter the results of their analysis.

A whole-farm simulation approach for marketing analysis was introduced by Bailey and Richardson (1985) for

Texas cotton farmers. The project sought to evaluate effects of different marketing methods on the financial health of the whole farm. The study incorporated marketing strategies and risk behavior associated with the different methods. Higher net income was not the only goal, but the farm's long-run survival as well. The writers recommend using the whole-farm simulation approach "when the farm operator faces significant yield, quality, and timing risk, in addition to price risk" (p. 820).

Bailey and Richardson's study involved the use of a dynamic Monte Carlo simulation model (FLIPSIM V) to analyze nine generally used marketing strategies (Richardson and Nixon 1984). Technical indicators were applied to indicate when transactions were to take place. For example, if the closing price exceeded all sixty-two previous closing prices in the futures market, a futures market buy would be indicated. Two of the strategies were classified as a discretionary hedge of 50% of the expected crop with different technical indicators to signal transactions. Similarly, three strategies were developed for a no hedge classification and two developed in each of the remaining categories: hedge and hold; and seller's call contract.

The evaluation of the simulation was extremely comprehensive. Mean incomes and variances were compared and applied to success and survival probabilities. Stochastic dominance analysis was used to rank strategies for risk neutral and risk averse producers.

A seller's call contract was found to be the best overall strategy. Under this agreement, the producer delivers 90% of his cotton to a gin before a final price is established. Prior to the close of a March futures contract, the gin pays the futures price for March, subtracting a prespecified discount. The simulated program utilized a technical indicator which allowed for the seller's call decisions to set the final price. In the simulation, if future's prices decreased, the farmer would set the final contract price and cash sale the remaining 10%.

A possible limitation of Bailey and Richardson's project is that they assumed only cotton was produced on the model farm. Unique to this report, however, is the consideration of cotton's quality with cash prices adjusted for grade variation. Random values which considered yield and grade variations were artificially generated using their model. This addition was included in an effort to add a more realistic environment to this marketing study. Actual fluctuations may be significantly different than the simulated fluctuations. However, the futuristic planning horizon would not be possible except with simulated statistics.

Ethridge and Davis (1982) developed a model of hedonic prices, implicit prices of embodied quality attributes, in an application to cotton lint. This study emphasizes the relationship between cotton quality and price, an important exception to marketing analysis. Previously, this exception has been ignored as a factor. Cotton has been assumed to be a homogeneous product and grade differences were not considered in pricing results. However, quality differences are extremely significant in cotton pricing and should not be excluded in analysis.

The data used by Ethridge and Davis consisted of sales observations from the Texas High Plains area for the 1976/77 and 1977/78 seasons. Cotton lint is graded by government graders for three quality attributes. These areas are:

1. Grade, a two-digit number for trash content and color. The first number increases as more trash is found, the second number is lower for whiter cotton.
2. Staple, indicates cotton fiber length in 32nds of an inch. For example, a 1-inch fiber length is categorized as staple 32.
3. Micronaire is the attribute of fiber fineness and matureness. This quality is the only one that is measured by instruments and not visually by the grader. The numbers assigned range from 2.5 to 5.4.

Cloth production is most sensitive to the third quality index, micronaire, and this assumption was verified by the model using regression analysis. Ethridge and Davis further applied ordinary and generalized least squares estimation to their data. The results found producer prices sensitive to certain variations in cotton quality. Price was influenced the most by micronaire, color, and fiber length. However, each of these indexes had different impacts on price in different growing seasons. In one season, color was more important to price, in another year micronaire proved the greatest influence.

In process are various projects analyzing cotton marketing strategies for South Carolina, Mississippi, Arkansas, Texas, Alabama, and Louisiana (CRIS search,1986). Many of the studies incorporate optimal marketing strategies to avert risk. Several research proposals include yield variability with price variability. However, researchers have not been very successful in publishing their results. Perhaps, inconclusive findings or difficulties in programming methods and analysis have hampered publication.

Summary of Literature Review

The objectives of the previously discussed grain marketing studies have been to analyze current marketing methods and to attempt to recommend the best overall strategy. Many of the results were inconclusive. Successful marketing patterns are difficult to ascertain without including risk in the discussions. Variability in net incomes or market prices were often ignored and, therefore, limit the value of the study (see Appendix 3).

While the grain studies were applicable in many areas of marketing analysis, some areas were not similar enough for application. Cotton has a greater degree of quality variability than corn and other grains. This quality variability issue was not addressed in the grain research or in most of the cotton studies. The significance of this omission is apparent when viewing actual grade percentages. Figures from the U.S.D.A. Cotton Classing Office reveal a wide variation in the grades produced in the last two years alone (U.S.D.A. 1976-86). For the 1984/85 growing season, only 19% of the total cotton graded through the Phoenix office was grade #41 (strict low midland, all staple lengths). In 1985/86 the number rose to 40%, a significant difference. Many of the previous cotton marketing reports have analyzed yield to be 100% of the most marketable grade, #41, and assigned an average price for revenue calculation.

In 1983/84, the SLM price (#41) received was $.06 greater per pound than the next lesser grade (LM) (CALCOT 1985). Low middling differed from middling price by

$.10/lb. To prove the significance of these price differences, consider an acre of cotton that produces 1250 lbs. of lint. In 1983/84, only 25% of that yield was SLM (for all staple lengths). If we assume that the other prices received differed by approximately $.07, then we are neglecting a minimum decrease of $66/acre of lint revenue by ignoring grade consideration. For a 500 acre farm, this would mean an income difference of over $30,000.

Yield variation was also omitted from many of the studies. This omission may alter the ranking of the results. The conclusions and recommendations of these marketing studies rely on these rankings. Therefore, yield variation should be included to help produce realistic, conclusive recommendations.

Many of the cotton studies did not utilized the stochastic dominance approach in ranking strategies. The studies using only mean-variance analysis gave conflicting or confusing results.

Arizona's production is further characterized by high per acre costs and high output production, a unique feature not found in production east of the state. A recent, comprehensive marketing strategy study has yet to be completed for Arizona.

This study will attempt to incorporate the variables lacking in other studies. Specifically, the research presented will analyze Arizona cotton marketing programs, using mean-variance and stochastic dominance evaluation of the strategies. Furthermore, quality differences affecting prices received and yield variability will also be addressed. The researcher's objective is to make a contribution to the study of cotton marketing in Arizona using new and revised techniques of marketing analysis.

CHAPTER 3

ANALYTICAL FRAMEWORK

It has been argued that the main uncertainty that a producer faces is the sale price of his product (Knight 1921). However, because the farmer is willing to take this risk of producing without fixed prices, profit is now a possible result. Without risk and uncertainty, profit is not possible in the pure economic sense. The tendency of competition is to eliminate profit and with perfect knowledge of the future, risk does not exist. In reality, producers do not know the future. True uncertainty prevents the occurrence of perfect competition.

However, price uncertainty is only one of many factors affecting the level of farm production risk. Sonka and Patrick (1984) cite five major generators of agricultural business risk: (1) production or technical risk, (2) market or price risk; (3) technological risk; (4) legal and social risk; and (5) human sources of risk (p.97). Producers must strive to choose the routes that will best maximize income and minimize risks.

Conceptual Model

Including risk into cotton marketing analysis not only allows for a more realistic study but changes the predicted production patterns of the producer. In a situation where the producer appears risk averse, production will not be as high as compared to the risk neutral producer. As shown in Lin, Dean, and Moore's (1974) research, farmers are more risk averse than was initially assumed. Regardless of whether the goal was to maximize profit or utility, the level of aversion was higher than what other models have displayed. Also, other variables besides price uncertainty contribute to this increased level.

Mathematically, this production change can be shown by the following equations (Hey 1979,Sandmo 1971). $U = U(\pi)$ where U is utility and π is profits, and $U'(\pi) > 0$ and $U''(\pi)$ is <,=, or > 0 depending on whether the firm is risk averse, risk neutral or risk loving. $Y = f(L,K)$, output (Y) is a function of labor (L) and capital (K). Where $f_i > 0$, $f_{ii} < 0$, and $f_{ij} > 0$ (i does not equal j) and isoquants are convex to the origin.

$\pi = pY - wL - rK$ where p equals product price, w is the cost of labor, r is the cost of capital and p is random, f(p) with $E(p) = U$. (assume p is non-negative)

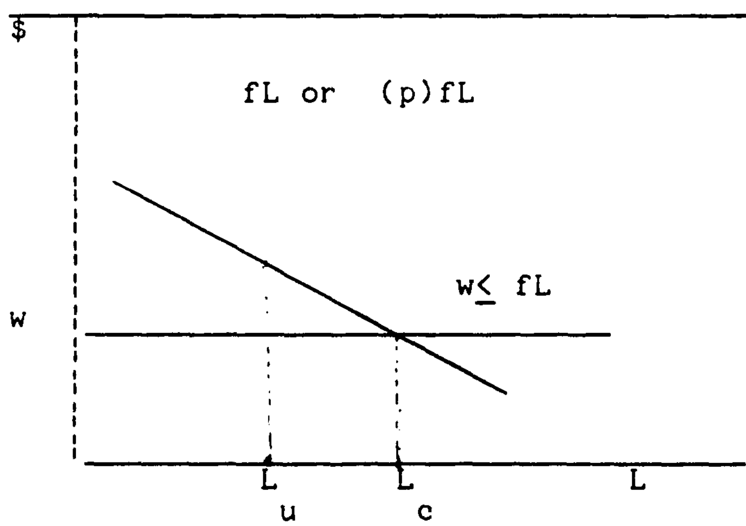
Maximizing the following equation:

$$E[U(\pi)] = E\{U[pf(L,K) - wL - rK]\}$$

gives first order conditions that imply :

$w \leq uf_L$ and $r \leq uf_K$. These first-order conditions for utility maximization imply that under uncertainty equilibrium, the expected marginal value product of each factor exceeds its price or E(p) > MC. Under certainty, equilibrium is defined by the equality between marginal value productivity of each factor with its price. The implication is that when $f_{ii} < 0$, then the optimal quantity demanded of each input is lower than the certainty case and output will be subsequently less, also. Graphical representation of this concept is shown in figure 4.

Figure 4. Graphical representation of the optimal quantity of input demand in a case of uncertainty.



L_u and L_c respectively represent the level of labor demanded under uncertainty and certainty.

The existence of forward markets also affects production when price uncertainty is incorporated into analysis. Holthausen (1979) found increased production when hedging was possible. Production decisions were discovered to be based on the forward price, not on the probability distribution of the commodity price.

The model used by Holthausen (p.989-90) was constructed as:

(1) $\text{Max } EU(\pi) = \int_0^{\infty} U[p(x-h) + bh - c(x)]\, f(p)\, dp$

The variables are defined as

p = the stochastic market price for the single output x

c(x) = the cost of output produced with FOC being greater than zero

b = certain forward price at which output can be sold

h = amount of output hedged in forward market

π = profit

A von Neumann-Morgenstern utility function U defined on profit II was assumed. The firm's goal is to maximize its expected utility of profit.

First order conditions are:

(2) $d\, EU(\pi) / dx = \int_0^{\infty} U'(\quad) [p - c'(x)]\, f(p)\, dp = 0$

and

(3) $d\, EU(\pi) / dh = \int_0^{\infty} U'(\quad) (b - p)\, f(p)\, dp = 0$

where $U'(\pi) = dU(\pi) / d\pi$.

Interpretation of FOC indicates that the risk averse firm chooses to produce less than a risk neutral firm. If conditions (2) and (3) are added:

(4) $U'(\pi)\,[b - c'(x)]\,f(p)\,dp =$

$[b - c'(x)]\;U'(\pi)\,f(p)\,d(p) = 0.$

Because $U'(\pi)$ cannot be negative, (4) is valid only if $c'(x) = b$. Therefore, production is chosen where marginal cost equals the certain forward price. "Thus, all risk-averse firms in the market will key their production decisions to the forward price. Differences in risk aversion or in price expectations do not affect production decisions, although they do affect hedging decisions..." (p.990).

The firm's hedging decision will depend upon the relationship between the expected price, E(p), and the forward price, b. Holthausen rewrote (3) as:

(5) $E[U'(\pi)\,(b - p) = EU'(\pi)\,E(b - p)$

$+ \text{cov}\,[U'(\pi), -p] = 0$

This equation assists in determining the amount the producer will hedge.

The following chart will summarize the results of the preceding equations.

IF	THEN
$[b = E(p)]$	entire output will be hedged
$[b < E(p)]$	either less than entire output will be hedged, or, speculation will occur in forward market
$[b > E(p)]$	speculation by selling forward more than what is produced

Holthausen used the Pratt-Arrow index to evaluate his model of the competitive firm under price uncertainty. He advises to include general equilibrium analysis, production uncertainty and price uncertainty in any subsequent studies. These factors are not utilized in his paper.

Traditionally, the firm is willing to accept a lower forward than expected price thus avoiding uncertainty. This price difference is called an insurance premium the hedger pays to the speculator providing the transaction. Certainly, boundaries exist on the minimum forward price that is acceptable. However, general micro-economic conditions of competition usually enforce an acceptable level of forward prices.

An interesting study on the optimal size of the hedge was done by McKinnon in 1967. The object of the research was to help the operator reduce yield risk in forward or futures contracting. Yield risk is defined as the chance the producer accepts of not producing enough of the crop to fulfill the contract. If this situation occurs, the grower is forced to buy more of the commodity from the market place. When buying at the current cash price on the delivery date, the possible gain from hedging is greatly diminished. Therefore, yield risk is an important consideration of forward pricing. The formula used to compute this optimal percentage is: $S_f = 1 + (Z) CV_q / CV_p$, where Z indicates the correlation coefficient between the probability distributions for yields and prices. CV_q and CV_p respectively represent the coefficients of variation for yields and prices (market). This strategy gives protection to the producer from being forced into a futures contract "bail out". The disadvantage of this protection is that a limit is placed on the total revenue received when actual exceeds expected production.

Decision Analysis Methods

"Decision making, by definition, involves a choice among alternative courses of action that offer different consequences or outcomes" (Zentner et.al.1981, p.1). To have a decision problem, the following must be included: 1) acts or risky prospects, 2) states of nature, 3) prior probabilities, 4) consequences, 5) the choice criterion, 6) additional information or experiments, 7) likelihood probabilities, and 8) strategies or the predetermined action in response to a future signal (Anderson, Dillon and Hardaker 1977, Zentner et.al. 1981). Therefore, neoclassical assumptions that exclude risk and suppose a linear utility function are not realistic when analyzing agricultural production. Decision analysis methods available include :

1) the general approach utilizing Bernoulli's principle and Bayes' theorem
2) discrete decision analysis, the most commonly used method found in the review of the literature.
3) decision flow representation
4) utility function approach, limited in current applications, also referred to as stochastic dominance analysis in previous articles discussed.

The whole-farm planning problem requires the use of mathematical programming models. If the utility function is linear, linear programming is advised (Anderson, Dillon, and Hardaker 1977, p.230). Nonlinear utility functions require quadratic risk programming. If randomization is desired, the Monte Carlo program would be recommended, allowing for a large number of portfolios from which to choose the best alternative.

Stochastic Dominance and Mean-Variance Analysis: A Comparison

The advantage of stochastic dominance (SD) becomes apparent when compared to mean-variance (E-V) rules (Selley 1984). Maximizing the following equation is the mean variance decision rule:

$E(U[M]) = E(M) - (\lambda/2)\ V(M)$; where $E(U[M])$ is the expected utility model, $E(M)$ is expected profits, $V(M)$ is the variance of profit, and λ represents lambda.

$U[M] = a - be^{\lambda M}$ is the exponential utility function, where b and λ exceed zero. When profit (M) is normally distributed, then :

$E(U[M]) = a - be - \lambda E(M) + (\lambda^2/2)v((M)$, the size of λ represents the amount of risk aversion under exponential utility. The more risk averse producer will have a larger λ with more penalty placed on large variances.

E-V analysis is a popular method of analysis (King and Robinson 1984). Because of the method's practicability and familiarity, most of the previous decision studies used this method. In addition, E-V analysis is well suited to quadratic programming. However, large efficient sets can result when the mean-variance method is used in marketing analysis. Studies containing a large number of marketing strategies become impossible to rank because of this weakness in the method. High means and high variances, or low means and low variances receive equal treatment under E-V analysis. Inconclusive results found in reports completed by Al-Sakkaf (1986); Sogn, Vollmers, and Baatz (1981); and Johnson and Shafer (1984) exemplify this difficulty.

Stochastic Dominance

The majority of published marketing models have used net revenues as the only stochastic variable. Stochastic programming allows for this variable and evaluation of resource factor risk as well. The stochastic dominance (SD) method evaluates the entire probability distribution. The SD approach for efficiency analysis

"provides a means of ordering risky prospects for groups of decision makers whose utility functions possess similar behavioral properties ...Stochastic dominance is said to occur if the expected utility of one risky prospect exceeds the expected utility of another for all possible utility functions within a defined class." (Zentner et.al. 1981,p.16).

Basically, stochastic dominance analysis involves the area beneath a probability distribution. This area is calculated and compared to the other probability distributions that are being analyzed. Three degrees related to the utility function are specified as FSD (first degree stochastic dominance), SSD (second degree stochastic dominance), and TSD (third degree stochastic dominance). Summarizing the meaning attached to each degree is not difficult, FSD, $U'(m) > 0$, assumes producers prefer more income to less of it. SSD adds $U''(m) < 0$, and can be interpreted that the decision maker is risk averse and is not willing to take a fair gamble. TSD restricts the utility function further by adding $U'''(m) > 0$. This restriction implies that as the producer increases income, risk aversion declines.

The selection rules for FSD, SSD, and TSD are presented in discrete formulation only (Zentner 1981):

First Order Stochastic Dominance (Ordinary):

a'_j and a''_j are two prospects that are risky, with cumulative distribution functions $F_1(m)$ and $G_1(m)$, respectively, defined over $[m_1, m_I]$ some closed interval. If $G_1(m) \geq F_1(m)$, then act a'_j is said to dominate act a''_j holding that a strong inequality exists for a least one m.

Second Order Stochastic Dominance (Ordinary):

(assume the same prospects and functions),

$$F_2(m) = \sum_{m_i = m_2} F_1(m_{i-1}) \Delta m_i,$$

for all m in the set of $(m_2, m_3, \ldots, m_I)$ and $F_2(m_1) = 0$, where $\Delta m_i = m_i - m_{i-1}$.

Act a'_j is said to dominate act a''_j in terms of SSD if $G_2(m) \geq F_2(m)$ for all possible m, inequality for at least one m still holding (Fishburn 1964, Hanoch and Levy 1969, and Hadar and Russell 1969).

Third Order Stochastic Dominance (ordinary):

$$F_3(m) = 1/2 \sum_{m_i = m_2}^{m} [F_2(m_i) + F_2(m_{i-1})] \Delta m_i,$$

for all m in the set $(m_2, m_3, \ldots, m_I)$ and $F_3(m_1) = 0$.

In conclusion, E-V requires a normal distribution when ordering risky decisions, where as SD rules apply to all distributions. For more complete results when ordering marketing alternatives, it becomes necessary to choose SD as the method for analysis.

Generalized Stochastic Dominance Analysis

The term "stochastic dominance" has been used in this chapter as a synonym for ordinary stochastic dominance analysis. Because risk levels are unspecified when ordinary stochastic dominance is used, Meyer (1977a,b) developed a generalization of the previously discussed rules.

Meyer's criterion, or SSD with respect to a function, assigns risk aversion levels to decision analysis. Arrow-Pratt values, "the negative ratio of the second and first derivatives of the utility-of-money function", is defined as $r(m_i) = -U''(m_i) / U'(m_i)$ (Zentner, et al. p.7). These values are assigned to specifically represent the levels of risk preferring, risk neutral, and risk averse when used in analysis. These levels may be constant over the income range. Or, levels of income can be specified and corresponding Arrow-Pratt values assigned to produce variations of these risk preferences. Absolute decreasing risk aversion would be one example. An explanation of this type of risk preference would be that as income increases and the agent becomes wealthier, he or she is more willing to take a gamble.

When using generalized SD, it is extremely important to state the risk intervals being used (Raskin and Cochran 1986). In their analysis of commonly used risk aversion coefficients, it is astounding to observe the number of different values being employed. An example of this specification is found in Wilson and Eidman (1985). The complexity of deciding such levels is reported in an earlier publication of Wilson and Eidman (1983).

Therefore, because of its increased flexibility, generalized stochastic dominance will be used to analyze the gross incomes resulting from different cotton marketing alternatives. The Arrow-Pratt coefficients will be stated explicitly for levels of risk preferring, risk neutral, risk averse, and absolute decreasing risk aversion.

Empirical Model

The time period studied for this analysis is the 1975/76 through the 1985/86 growing seasons. Three Pinal County farmers actual yields were chosen and used in the marketing strategy analysis. They are distinguished as high, average, and low producers for the area. These farmers participate in the various government programs administered by the A.S.C.S. office in Casa Grande, Arizona. The yield figures were obtained from that office. An adjustment was necessary for the 1975 - 1978 reported yields. Acreage data was not saved for those years, only yield per acre data was recorded. Therefore, the upland cotton acreage reported in 1979 was used and multiplied times the yield/acre for the years 1975 - 1978.

The marketing alternatives to be analyzed are as follows:

1. Cash sale entire crop on the week before Thanksgiving in November.

2. Cash sale the entire crop the week before Christmas.

3. Cash sale the entire crop the last week in January.

4. Cash sale one-third of the crop in each of the following months: November, December, and January. These months were chosen because market activity is greatest during this time (U.S.D.A. 1986). The weeks were selected based on the empirical observation of producer's marketing behavior (Firch 1987).

5. Forward contract #1, contract 100% of crop during the preplanning months of the crop year (from April through November before the crop is planted)(Firch 1982 and 1986). These prices will be the December cash sale prices adjusted to the average gain or loss of forward contracts for that year (Firch 1982 and 1986). The average December cash price (week before Christmas) for SLM, staple length 34 was adjusted, then the other grade/staple length combinations were calculated from this base. Forward contracts are written specifying three to eight grades with the other grades being priced at delivery (Ford 1987). For this analysis, delivery was in December.

As shown in Appendix 1, the McKinnon formula computes an optimal contract of 95%. Therefore, a 100% contract is not unrealistic for a theoretical marketing strategy. In Arizona, these contracts are written for a certain number of bales to be delivered. In other states, cotton in contracted on an acreage basis (Rouse 1979). However, Arizona primarily uses bale contracts (Firch 1986).

6. Forward contract #2, contract 100% during the planning period (December through February before the crop is planted). This price is calculated in the same manner as #4.

7. Forward contract #3, contract 100% during the planting period (March through the first week of June).

8. Forward contract #4, contract 100% during the growing period (from the end of the first week in June through the first week in December).

9. Forward contract #5, contract 100% of the crop. For this strategy, the prices were calculated by subtracting 4.5 cents from the average December futures price for that year. A similar marketing study used this method to approximate forward contract prices (Firch and Al-Sakkaf 1986).

10. Contract 75% of Forward contract #1, cash sale the remainder in December.

11. Contract 75% of Forward contract #2, cash sale

the remainder in December.

12. Contract 75% of Forward contract #3, cash sale the remainder in December.

13. Contract 75% of Forward contract #4, cash sale the remainder in December.

14. Contract 75% of Forward contract #5, cash sale the remainder in December.

15. Contract 50% of Forward contract #1, cash sale 50% in the following December.

16. Contract 50% of Forward contract #2, cash sale the remainder in December.

17. Contract 50% of Forward contract #3, cash sale the remainder in December.

18. Contract 50% of Forward contract #4, cash sale the remainder in December.

19. Contract 50% of Forward contract #5, cash sale the remainder in December.

20. Futures #1: Sell December and March Futures contracts in December : sell 1/3 of the possible number of contracts in December and 2/3 of this number as March futures contracts in December (average price in the week before Christmas); buy the December futures contracts at time of November cash sale; buy half of the March futures contracts at time of December cash sale; buy the remaining March futures contract at time of January cash sale (Firch and Al-Sakkaf 1986).

The number of contracts possible were calculated on the yield produced in that crop year. Obviously, farmers would not be aware of this number until after harvest. However, for this analysis the current yield figures were used. When yields were not sufficient to make three equal contracts, December futures sold in December, bought in November was given priority, followed by the other March alternatives. Cash sale of the entire crop in December was used as the base strategy from which the futures transactions were added or subtracted.

Included into the initial gain or loss resulting from the futures price differences was the costs of negotiating such contracts. Ninety dollars per contract was used as the brokerage fee and $7.50 was the opportunity cost (10%) of a $750 deposit that is customary to open such accounts (Firch and Al-Sakkaf 1986). Ten percent interest was charged to half of the loss (if the prices increased) because this amount would have been an average balance over the contract life. Similarly, this interest was added if the transaction netted a profit. The justification for this inclusion is that this money could have been withdrawn and deposited in interest bearing checking accounts.

21. Futures #2: Sell December and March Futures Contracts in March: sell 1/3 of the possible number of contracts in December and 2/3 of this number as March futures contracts in March (average price in the middle

week of March); buy 1/3 of the December futures contracts at time of November cash sale; buy 1/3 of the March futures contracts at time of December cash sale; buy the remaining March futures contracts at time of January cash sale. Cash sale in December is the base strategy to which these transactions are compared.

22. Futures #3: This strategy is identical to number 20, however only half of the possible number of contracts will be bought and sold. This adjustment would represent a more realistic marketing strategy when yields are not known.

23. Futures #4: Identical to strategy number 21, only contracting half of the possible number of contracts.

24. Futures #1A: Identical to strategy number 20, except the base strategy for comparison is to cash sale the entire crop in one-thirds over the following months: November, December, and January.

25. Futures #2A: Identical to strategy number 21, except the base strategy is one-third cash sale the crop over November, December, and January.

26. Futures #3A: Identical to strategy number 22, except the base strategy is one-third cash sale the crop over November, December, and January.

27. Futures #4A: Identical to strategy number 23, except the base strategy is one-third cash sale the crop

over November, December, and January.

28. Sell cotton through a cooperative marketing organization. Prices analyzed are net prices received by Arizona growers from Calcot, Inc., Glendale, Arizona. Prices were only available for the years 1980 through 1985. Therefore, it was not possible to analyze this strategy completely. Where possible, analysis is made comparing cooperative marketing with the other strategies, using only the years 1980 - 1985.

A storage for delayed cash sale strategy was not included in this analysis because of its proven unprofitability (Ethridge and Caillavet 1985). Delayed cash sale is represented somewhat by strategy #4. However, a postponed cash sale any later than January is not modeled in this study.

The grades chosen for strategy analysis are: 21,31,40,41,51,32,42, 52, 62 and Below Grade (BG). These grades were selected because of their high frequency in production. Likewise, the staple lengths chosen are: 33, 34, 35, and 36. These percentages are illustrated in Appendix 2.

The grade percentages are for entire state of Arizona. Phoenix is the locality where most Arizona cotton is classed. Cotton produced in the southeastern part of the state is classed in Texas, and cotton produced in southwestern Arizona is classed in California. The

U.S.D.A. Cotton Marketing Service includes these bales into the percentages used for this analysis. Therefore, the grades are reported for the state as a whole.

These percentages were adjusted upward because not all of the possible grade/staple length combinations were analyzed. This adjustment was made because many of these combinations were produced in minute amounts, and the prices of these grades were unavailable. The most drastic change was the combining of staple length 36 into the 35 category. Prices are not published for length 36. This omission is the reason for staple length merger.

Another important change was the inclusion of grades 62 and Below Grade (BG) cotton grades into the grade 52 category. Again, price availability is one of the adjustment reasons. The BG category description was changed during this ten year period, therefore, changes in data arrangement was necessary. Staple length 32 was not chosen for analysis because of its minimal occurrence in production. Staple length 32 did exceed length 36 for three years in the study period. However, 36 was a greater percentage than 32 for 7 of those years.

General price data were based on the "Daily Spot Cotton Quotations" (U.S.D.A. 1976-1986). Weekly averaging was calculated from the daily prices since these averages are not produced by the U.S.D.A.

CHAPTER 4

MEAN-VARIANCE AND STOCHASTIC DOMINANCE ANALYSIS

Mean-Variance Analysis

The data used for the E-V analysis concerned the farmer whose yields and size were considered average for Pinal County. "Variable yields" refers to the different yields produced each year by a particular grower. "Size" identifies each of the three yield levels of farmers evaluated for this study. The three sizes evaluated are the below average, average, and above average producer.

The nominal and real results are displayed in tables 7 and 8. Because of the lack of price information, cooperative marketing was not included in this model.

The highest mean for both nominal and deflated results is for strategy #7, forward contracting 100% of the crop during the planting period. The standard deviation is relatively high for this strategy. The lowest mean for both tables is for strategy #20, futures #1, contracting 100% of the possible number of contracts, with a base strategy of cash sale in December. The standard deviations are extremely high for marketing through futures contracts.

The lowest standard deviation for real prices was for strategy #23, futures #4, contracting 50% of the possible

TABLE 7. MEAN-VARIANCE ANALYSIS OF MARKETING STRATEGIES (NOMINAL)

STRATEGY	MIN	MAX	MEAN	STD.DEV.	SKEWNESS	KURTOSIS
1. CASH NOVEMBER	256,554	1,009.770	596,612	190,836	.40025	3.24973
2. CASH DECEMBER	252,998	967,849	600,897	179,134.5	.06628	3.24218
3. CASH JANUARY	246,472	949,792	612,486	181,585.2	-.13753	2.93164
4. CASH THIRDS	252,008	975,805	603,332	181,974.1	.10192	3.18915
5. FORWARD #1 100%	263,345	940,497	646,023	195,146.8	-.36775	2.26428
6. FORWARD #2 100%	212,649	950,724	643,464	211,570.3	-.48438	2.38166
7. FORWARD #3 100%	238,403	931,765	655,327	213,449	-.41486	2.08350
8. FORWARD #4 100%	262,409	942,498	644,993	194,456.4	-.42789	2.26782
9. FORWARD #5 100%	211,876	924,525	594,254	201,919	-.26671	2.23179
10.FORWARD #1 75%	260,758	863,131	634,742	181,134.7	-.61855	2.35880
11.FORWARD #2 75%	222,736	870,801	632,822	195,315.1	-.63799	2.47159
12.FORWARD #3 75%	242,052	899,356	641,719	197,787	-.52113	2.26397
13.FORWARD #4 75%	260,056	948,836	633,969	187,673.3	-.37829	2.52666
14.FORWARD #5 75%	222,156	851,152	595,915	184,240.8	-.42150	2.42723
15.FORWARD #1 50%	258,172	867,113	623,460	173,359.1	-.65413	2.56942
16.FORWARD #2 50%	232,823	894,045	622,181	183,932.5	-.62035	2.66021
17.FORWARD #3 50%	245,701	922,187	628,112	186,353.4	-.49096	2.55953
18.FORWARD #4 50%	257,704	955,174	622,945	182,765.4	-.27407	2.79975
19.FORWARD #5 50%	232,437	879,973	597,575	173,845.3	-.42557	2.78915
20.FUTURES #1	183,542	110,592	555,615	284,524.1	.36184	1.98593
21.FUTURES #2	200,762	107,643	591,569	273,475.5	.15613	1.71425
22.FUTURES #3	224,031	869,587	579,336	188,634	-.23498	2.08001
23.FUTURES #4	231,452	854,837	597,163	183,578.5	-.43162	2.21508
24.FUTURES #1A	182,952	1,115,640	558,090	287,794	.33883	2.00301
25.FUTURES #2A	200,172	1,086,140	594,044	275,820.7	.14478	1.74842
26.FUTURES #3A	223,441	879,297	581,810	192,395.4	-.24101	2.05602
27.FUTURES #4A	230,862	864,547	599,638	186,665.4	-.43274	2.20020

TABLE 8. MEAN-VARIANCE ANALYSIS OF MARKETING STRATEGIES (REAL, 1982=100)

STRATEGY	MIN	MAX	MEAN	STD.DEV.	SKEWNESS	KURTOSIS
1. CASH NOVEMBER	246,687	1,172,790	739,365	260,493.5	-.11413	2.26715
2. CASH DECEMBER	243,267	1,124,100	745,848	252,419.6	-.36415	2.24588
3. CASH JANUARY	227,163	1,009,340	714,823	235,906.7	-.56356	2.28030
4. CASH THIRDS	239,039	1,102,080	733,345	247,204.5	-.37836	2.28079
5. FORWARD #1 100%	253,217	1,004,940	787,823	219,734.6	-1.25435	3.71598
6. FORWARD #2 100%	204,470	1,010,330	785,612	237,859.6	-1.28127	3.75094
7. FORWARD #3 100%	229,234	1,018,030	797,919	234,948.5	-1.24113	3.63565
8. FORWARD #4 100%	252,317	1,094,660	788,928	232,416.8	-.931603	3.24901
9. FORWARD #5 100%	203,727	982,492	722,530	220,715.2	-1.02136	3.36521
10.FORWARD #1 75%	250,729	1,005,290	777,329	218,935.1	-1.20797	3.54850
11.FORWARD #2 75%	214,169	998,979	775,671	233,644.8	-1.19682	3.53942
12.FORWARD #3 75%	232,742	1,044,550	784,901	232,601.5	-1.11600	3.44005
13.FORWARD #4 75%	250,054	1,102,020	778,158	235,057.6	-.788373	3.02622
14.FORWARD #5 75%	213,612	971,005	728,360	211,550.4	-1.22423	3.74824
15.FORWARD #1 50%	248,242	1,007,100	766,836	224,471.8	-.98804	3.14360
16.FORWARD #2 50%	223,869	1,038,380	765,730	234,770.3	-.97181	3.15285
17.FORWARD #3 50%	236,251	1,071,060	771,884	234,854.8	-.88978	3.09152
18.FORWARD #4 50%	247,792	1,109,380	767,388	239,331.9	-.63857	2.77057
19.FORWARD #5 50%	223,497	1,022,040	734,189	214,320.3	-1.09805	3.59273
20.FUTURES #1	176,483	1,175,270	658,094	291,151.3	.18406	2.09246
21.FUTURES #2	193,041	1,143,920	706,508	287,840.5	.02855	2.10318
22.FUTURES #3	215,414	924,109	703,202	199,838.9	-1.17682	3.84422
23.FUTURES #4	222,550	929,000	727,260	202,324.4	-1.32636	4.08350
24.FUTURES #1A	175,915	1,185,590	661,284	298,644.9	.19107	2.04878
25.FUTURES #2A	192,473	1,158,600	709,698	293,718.9	.60240	2.10823
26.FUTURES #3A	214,847	934,428	706,392	206,696.6	-1.06252	3.50331
27.FUTURES #4A	221,982	938,240	730,450	207,905.5	-1.22411	3.81217

number of contracts, with cash sale in December as a base strategy. For nominal prices, the low standard deviation occurred for strategy #15, forward contracting during the pre-planning period at 50%, selling the other half of the crop at the December cash prices. Strategy #24, futures #1A (contracting 100% of the possible number of contracts, base strategy of one-third cash sale over November, December, and January) had the lowest standard deviation for both tables.

Therefore, adjusting the prices for inflation did not significantly vary the results of the mean-variance decision rules. The efficient set when ranking the strategies (nominal) are numbers: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 23, 26, and 27. All the strategies with the exception of four of the futures strategies are ranked equally with mean-variance analysis.

If the issue of risk is ignored, then the strategies could be ranked according to the means only. If this is the case, the farmer who forward contracted 100% of his crop during the planting period would have the highest probability of receiving the highest average gross revenue over the last ten years.

The skewness of the strategies is negative for most of the observations. Therefore, the distributions are skewed to the left for the majority of the strategies.

This interpretation indicates that the producer has a higher than average probability of receiving lower gross returns for many of the strategies.

The model for this measure of the distribution's symmetry is calculated from the formula (Law and Vincent 1985):

$$B_1 = \Sigma[(X - \mu)^3] / (\sigma^2)^{3/2}$$

If $B_1 > 0$, then the distribution is skewed to the right. If this number is negative, then the distribution is skewed to the left.

The kurtosis coefficients measures the "relative peakedness" of the distributions (Clark and Schkade 1969). This measurement is defined by (Law and Vincent):

$$B_2 = \Sigma [(X - \mu)^4] / (\sigma^2)^2$$

The more peaked distributions will have a greater value of B_2. Normal distributions have a B_2 value of 3. The nominal values of kurtosis show to be less than 3 for all but two of the marketing strategies. Therefore, most of the nominal gross revenues received are platykurtic, displaying a relatively flat distribution. When the values are adjusted into real numbers, the distributions appear closer to normal or mesokurtic. However, many of the observations remain less than 3, giving the platykurtic curves of the previous nominal figures. One observation is much greater than 3, strategy #23 (real). This type of kurtosis measurement is called leptokurtic, a high peaked distribution (Clark and Schkade).

Tables 9 and 10 study the same marketing strategies but with a fixed quality variable. By substituting SLM cotton (grade 41/34) as 100% of the crop, the quality of the cotton is constant. Table 10 further fixes the yield variable. The farmer's 1975 production amount was used throughout the ten year study for this table. Therefore, the number of possible futures contracts were held constant for the years 1975 through 1985. Twenty futures contracts were used to compute the gross revenues for futures 1 and 2 marketing strategies, ten contracts were used for futures 3 and 4.

When mean-variance analysis is employed, the efficient set for table 9 is the same as if quality is variable (table 7) When yields are also fixed (table 10), only one marketing strategy is eliminated from the group. Cash sale in November was not in the efficient set when yields are held constant. The mean values are higher when quality is held constant. Forward 1 (100%) is $4711 and Cash January is $4883 higher than the same strategies using variable yields.

Fixed quality and yields give higher means and less variance than any of the other variations. If only a few strategies were being evaluated, i.e. cash versus forward contracting, the difference in ranking could be

Table 9: Mean Variance Analysis of Marketing Strategies
SLM Cotton Only with Variable Yields

MARKETING STRATEGY	MIN	MAX	MEAN	STD.DEV.
1. CASH NOVEMBER	258,436	997,614	593,942	177,231
2. CASH DECEMBER	253,109	951,841	596,014	165,938
3. CASH JANUARY	249,239	935,749	609,774	168,831
4. CASH THIRDS	253,595	961,735	599,910	168,659
5. FORWARD 1 100%	263,836	929,223	641,312	182,814
6. FORWARD 2 100%	213,256	939,424	638,699	198,037
7. FORWARD 3 100%	238,948	920,512	650,469	199,805
8. FORWARD 4 100%	262,897	926,827	640,074	181,326
9. FORWARD 5 100%	212,484	913,291	589,866	188,879
10.FORWARD 1 75%	261,154	852,049	629,987	169,083
11.FORWARD 2 75%	223,219	859,700	628,028	182,274
12.FORWARD 3 75%	242,849	884,256	636,855	184,603
13.FORWARD 4 75%	260,450	933,081	629,059	174,655
14.FORWARD 5 75%	222,640	840,100	591,403	171,687
15.FORWARD 1 50%	258,473	852,444	618,663	161,237
16.FORWARD 2 50%	233,182	879,018	617,356	171,108
17.FORWARD 3 50%	246,029	906,786	623,241	173,396
18.FORWARD 4 50%	258,003	939,334	618,044	169,771
19.FORWARD 5 50%	232,797	865,133	592,240	161,410
20.FUTURES 1	184,053	1,095,422	550,772	269,048
21.FUTURES 2	201,273	1,065,923	586,726	258,848
22.FUTURES 3	224,542	859,084	574,492	176,387
23.FUTURES 4	231,963	844,344	592,230	171,753
24.FUTURES 1A	184,538	1,111,477	554,669	273,310
25.FUTURES 2A	201,758	1,081,977	591,623	262,095
26.FUTURES 3A	225,027	875,138	578,389	180,895
27.FUTURES 4A	232,448	860,389	596,217	175,502

Table 10: Mean Variance Analysis of Marketing Strategies SLM Cotton Only with Constant Yields

MARKETING STRATEGY	MIN	MAX	MEAN	STD.DEV.
1. CASH NOVEMBER	489,576	889,640	648,394	121,957
2. CASH DECEMBER	487,039	848,822	649,618	104,005
3. CASH JANUARY	533,459	834,472	662,475	98,918
4. CASH THIRDS	507,282	857,645	653,496	105,246
5. FORWARD 1 100%	490,185	871.068	695,838	110,194
6. FORWARD 2 100%	483,081	857,266	682,076	106,067
7. FORWARD 3 100%	479,727	890,655	698,679	112,392
8. FORWARD 4 100%	476,992	826,515	693,757	103,461
9. FORWARD 5 100%	380,477	808,653	632,804	107,953
10.FORWARD 1 75%	489,399	811,216	684,283	94,686
11.FORWARD 2 75%	484,070	800,864	673,961	90,303
12.FORWARD 3 75%	481,330	825,906	686,414	98,326
13.FORWARD 4 75%	479,504	832,092	682,722	99,054
14.FORWARD 5 75%	424,979	743,848	637,007	85,256
15.FORWARD 1 50%	488,612	782,074	672,728	87,666
16.FORWARD 2 50%	485,060	783,880	665,847	83,968
17.FORWARD 3 50%	483,233	808,643	674,149	91,528
18.FORWARD 4 50%	482,015	837,669	671,688	97,637
19.FORWARD 5 50%	469,482	771,499	641,211	75,282
20.FUTURES 1	234,757	981,919	586,685	216,329
21.FUTURES 2	296,964	955,115	628,060	206,566
22.FUTURES 3	399,688	767,979	618,504	100,112
23.FUTURES 4	430,725	754,551	639,139	93,426
24.FUTURES 1A	218,147	996,134	590,562	220,251
25.FUTURES 2A	280,354	969,330	631,937	209,136
26.FUTURES 3A	383,078	782,194	622,381	105,323
27.FUTURES 4A	414,115	768,766	643,017	97,346

significant. However, the E-V results for constant yields and quality do not differ significantly than if quality and yields are variable.

Generalized Stochastic Dominance Analysis

The stochastic dominance analysis for the average producer is shown in Table 11. When a number appears more than once, this should be interpreted as an equal ranking of that order. For example, the risk neutral producer would rank strategy numbers 5 and 7 equally as the dominant strategies. Figure 5 illustrates graphically the probability distribution of three marketing strategies. Visually, it is apparent that Cash November is not dominated by the other strategies. However, it would be difficult to decide the ranking of the futures and forward strategies from graphical analysis. A further complexity would develop if all 27 strategies were represented. Therefore, SD analysis is dependent upon mathematical computations to rank marketing strategies.

Apparently, the risk averse farmer would have found forward contracting as early as possible (pre-planning) to be the dominant strategy. A risk preferring producer would have favored futures marketing, or a cash sale strategy. Risk neutral producers would have found forward contracting to dominate. No difference in risk averse rankings are caused by adjusting the program to model a decreasing

CUMMULATIVE PROBABILITY DISTRIBUTION

OF 3 MARKETING STRATEGIES

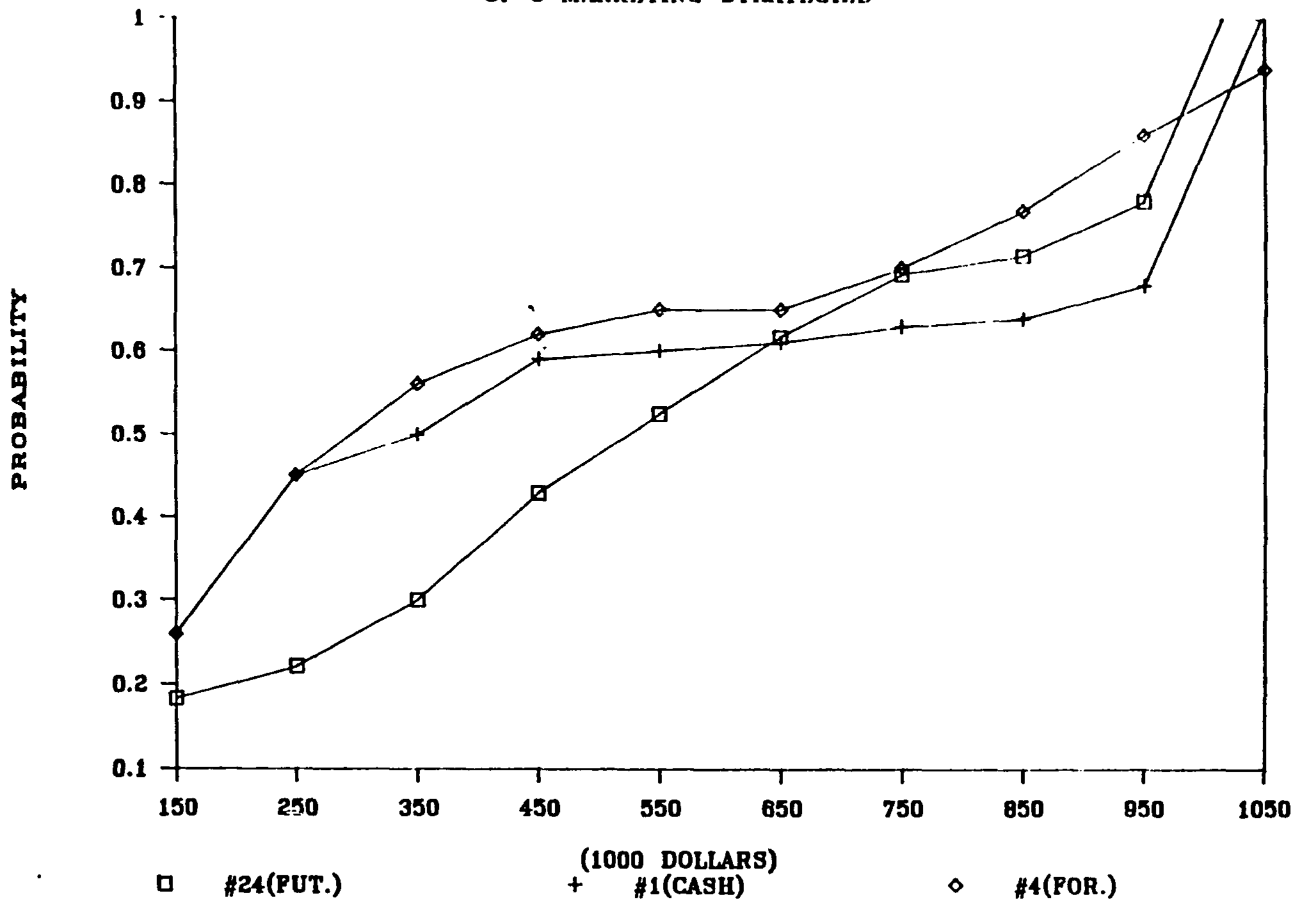


FIGURE 5

Table 11. Stochastic Dominance Analysis of Marketing Strategies: VARIABLE QUALITY AND VARIABLE YIELDS (Average Producer)

MARKETING STRATEGY	EFFICIENT SET				
		DOMINANT STRATEGIES			
	E-V	R.A.	R.P.	R.N.	D.A.R.A.^
1. CASH NOV.	*		5		
2. CASH DEC.	*				
3. CASH JAN.	*				
4. CASH THIRDS	*				
5. FOR.1 (100%)	*	1		1	1
6. FOR.2 (100%)	*				
7. FOR.3 (100%)	*			1	
8. FOR.4 (100%)	*	2		2	2
9. FOR.5 (100%)	*				
10.FOR.1 (75%)	*	3			3
11.FOR.2 (75%)	*				
12.FOR.3 (75%)	*			2	
13.FOR.4 (75%)	*	4			4
14.FOR.5 (75%)	*				
15.FOR.1 (50%)	*	5			5
16.FOR.2 (50%)	*				
17.FOR.3 (50%)	*				
18.FOR.4 (50%)	*				
19.FOR.5 (50%)	*				
20.FUTURES 1			2		
21.FUTURES 2			4		
22.FUTURES 3	*				
23.FUTURES 4	*				
24.FUTURES 1A			1		
25.FUTURES 2A			3		
26.FUTURES 3A	*				
27.FUTURES 4A	*				

^R.A. represents risk averse,Arrow Pratt Coefficients of [.0002 .001]
R.P. represents risk preffered, [-.001 -.0002]
R.N. represents risk neutral, [-.0002 .0002]
D.A.R.A. represent decreasing absolute risk aversion,
for income levels 182,952 to 493,847 [.001 .0002]
493,848 to 804,743 [-.0002 .0002]
804,744 to 1,115,640 [-.001 -.0002]

absolute risk averse decision maker.

The marketing strategy of forward contracting #5 does not represent the behavior of the other forward contracting methods. Forward #1, #2, #3, and #4 were actual prices recorded from surveying cotton gins of the area (Firch 1982,1986). Forward #5 was the formula price of the December futures price of SLM minus $.045. When contracting at Forward #5 (100%, 75%, and 50%) the average revenue is lower than with the other forward strategies. This observation is valid regardless whether quality and yields are held constant or allowed to vary.

When SD analysis was completed, forward #5 (100%) was almost totally dominated by all of the other strategies for the risk averse grower (the exceptions were four of the futures contracting strategies). As discussed earlier, the risk averse decision maker favored forward contracting as a dominant strategy. Therefore, estimating forward prices as $.045 less than the December futures price is not representative of actual forward price behavior for this study.

To test the sensitivity of the Arrow-Pratt coefficients used, risk averse coefficients were changed to [0, .001], and risk preferred to [-.001, 0]. This change did not significantly affect the risk averse results. However, the risk preferrer illustrated a completely new ranking. The rankings were not as definite as with the previous R.P. coefficients, as no single strategy totally dominated the others. When the new coefficients were used, forward contracting strategies were the most dominant. Specifically, forward contracting 100% during the planning time was the preferred strategy, illustrating the greatest number of times dominant.

When quality was fixed, the ranking for the average producer was basically the same as for variable quality for the preferred, neutral and averse risk levels. When quality and yields were held constant, risk preferred at coefficients [-.001, -.0002] ranked all but strategy #1 the same. This time fifth placed ranking was strategy #7.

When risk preferred was changed to [-.001, 0], forward contracting remained the dominant strategy. However, futures contracting was now ranked higher at third place. Overall, quality and yield variations did not change the SD rankings of the average producer.

When cooperative marketing was included in the analysis, results were not affected. For risk preferring producers, cooperative marketing would have been dominant to strategies #10, 11, 14, 15, 19, 22, 23, 26, and 27. For a farmer illustrating risk averse behavior, cooperative marketing would have dominated strategies #3, 6, 7, 9, 11, 12, 14, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26, and 27. A risk neutral producer was indifferent to cooperative marketing for most of the strategies. For this risk level, 3 of the forward contracting strategies dominated the cooperative strategy.

Therefore, a risk averse producer would possibly prefer to market through a cooperative rather than follow a constant method of another marketing strategy. For this very limited five year analysis, these less dominant strategies would have been to always cash sale in November or December, or futures marketing, or to consistently forward market in certain months of the growing season. Clarifying this observation, the farmer could have picked one marketing strategy such as futures 1 and always have marketed his crop throughout the five years in this manner. The farmer could have used this strategy regardless of the external price factors he or she may have known about. This assumption is not realistic and may have distorted the results of the analysis.

Overall, the average, below average, and above average producers had similar strategy rankings. The main difference occurred with the R.A. below average producer. This producer preferred to cash sale his crop in January over the forward contracting strategies. Furthermore, Cash January dominated all of the other strategies. This observation indicates that the size of the operation did make a difference in strategy ranking.

CHAPTER 5

SUMMARY AND CONCLUSIONS

Arizona cotton producers operate in an arena of uncertainties. Because of irrigation, farmers in this area do not have as much weather risk as other U.S. cotton farmers. However, risks such as pests, government policies, and interest rate fluctuations affect all domestic producers.

Ranking high on this list of uncertainties is the market price of cotton. The farmers are forced to decide in what manner to sell crops. This decision affects the profitability of producers. Therefore, an analysis of these marketing strategies provides useful information to those interested in modeling cotton market activity. Conceivably this information could be used to assist farmers in their marketing decisions.

When analyzing the different marketing strategies available to Arizona cotton farmers, the focus was not exclusively on income maximization. Included in the study was the evaluation of other cotton marketing studies. Other similar reports have used constant quality and/ or fixed yields when considering cotton markets. Secondly, some studies have used formula pricing systems to model a strategy, i.e. forward contract prices. A third area of interest was the tools of analysis used by these earlier researchers. Dominating the earlier reports was mean-variance analysis which often produces inconclusive results.

A fourth consideration was the inclusion of cooperative marketing into the strategy analysis. Other reports have not used group marketing as an alternative strategy. However, with approximately half the Arizona growers belonging to cooperatives, it was important to include this marketing method.

In this report it was hypothesized that quality and yields variation would make an impact on the ranking of market strategies. Formula pricing was not expected to follow actual price trends. Stochastic dominance analysis was hypothesized to decrease the efficient set generated by mean-variance analysis. This ranking was expected to give conclusive results for different producer risk levels. A final hypothesis was that cooperative marketing would be found dominant over simple cash marketing of cotton.

Results

Stochastic dominance was found to be more useful in ranking the strategies than mean-variance analysis. Using 27 marketing strategies, E-V analysis only reduced the efficient set to 24 of these strategies. If the study had terminated with these results, the findings would have been inconclusive. Stochastic dominance analysis resulted in ranking many of the strategies. The reader is cautioned to realize that the results for this analysis are only for the indicated risk and yield levels.

Different rankings occurred as the risk levels were adjusted. When modeling risk averse behavior, forward contracting appeared as a dominant strategy for the average producer: specifically, to forward contract 100% of the crop quite early in the production period. The practicality of this strategy is questionable since Arizona operates on bale contracts. Also, most farmers prefer to contract later in the year. This program did not allow for farmers to forward contract part of the crop at different times in the year. Such a pattern may occur as contracting a percentage during the planning time, increasing the percentage as the market would dictate.

When the representative farm was considered to be a risk averse producer with a below average yield level, a different ranking in strategies occurred. Given the conditions of the model, this type of grower would rank strategy #3, cash sale in January, as the dominant strategy. Early forward contracting of the crop would be the next marginally dominant strategy.

When the time period studied was reduced to five years (to consider the cooperative marketing prices), rankings changed as different grower yields were modeled.

Given the assumptions and conditions of the model, the above average and the below average yield producers would have considered forward contracting (100%) during the growing season to be dominant when risk neutral levels were programmed. An average producer would have favored the pre-planning forward contracting strategy.

If the farmer who produced an average yield level was modeled with the indicated Arrow-Pratt coefficients for risk preferring, then he would consider futures contracting to be a dominant strategy. (This observation is only valid if the Arrow-Pratt coefficients were a true measure of this growers risk level.) However, futures contracting has obvious disadvantages. The size of the contracts and possible margin calls eliminates this strategy for many producers. However, a producer may still consider this method of marketing if higher returns appear to be worth the added risks.

Interesting changes occurred in these rankings when the yield level size was adjusted. When the producer was below average in this model, forward contracting (100%) during the planning stage ranked fifth in degree of dominance instead of selling the crop for cash in November. These observations indicate that yields and the length of the time period have a definite impact on the results.

While not performing well in ranking strategies, mean-variance analysis did reveal a deficiency in limiting the analysis with a constant quality variable. Average gross revenues were higher and variance was lower than when quality was allowed to vary. Further, using constant yields caused this trend to continue. With each added restraint, mean values increased and standard variations decreased. This finding may have important implications for other cotton research projects.

Stochastic dominance analysis did not significantly change its rankings when restraints were added. Therefore, if researchers wish to work with constant variables, it would be advisable to employ other tools in addition to mean-variance analysis. This additional analysis would help to insure that the conclusions reached were valid.

The one formula pricing method studied involved forward contract prices. The formula discounted the December futures contract price by $.045. Because of the formula price's statistical behavior, it was concluded that this method of modeling did not follow the price behavior of the other recorded forward prices. A possible reason for this occurrence is that forward prices do not follow the December futures prices in a consistent manner. Therefore, a researcher should be careful when modeling or simulating price behavior, especially cotton forward prices.

When analyzed with the model assumptions, cooperative marketing analysis did not totally dominate simple cash marketing of cotton. Marketing in this fashion dominated only two of the cash sale strategies (January and Thirds) for the risk averse average producer. Instead, cooperative marketing was dominant over most of the forward and futures marketing strategies for the same producer (see Appendix 4). Risk neutral decision makers ranked cooperative marketing equally with most of the other marketing strategies. Risk loving growers preferred cash sale, or some of the forward and futures marketing methods over cooperative marketing.

A limitation in studying cooperative marketing was the extremely small time period. Pricing data for the quality variations was difficult to obtain. To analyze this strategy correctly, a much longer planning horizon would be necessary.

Other areas of difficulty in this marketing study was the lack of pricing data for all strategies. Summary data are nonexistent. Forward prices are not recorded with any agency. Fortunately for this study, Firch had contacted and recorded these price fluctuations for the years 1975 through 1985.

Cash prices are not recorded for all the possible grade and staple length combinations. It was necessary to manipulate the data to fit the available price information.

Another area found lacking in data availability concerned the quality variable of the model. Percentages of grade/staple length distributions are not distinguished on a county or district basis. State averages as a whole may not be representative of Pinal County farmers. Especially distorting may be the fact that these averages include the southeast and southwest corners of cotton production in Arizona. Rarely, would farmers keep actual records of this type for more than a few years. Therefore, quality percentages for individual farms or counties are not available.

Complete yield data are not available. Furthermore, data is not recorded in a truly representative manner. Marketing could possibly be studied on a per acre basis. This adjustment would solve the problem with the lack of yield data. However, the results of this cotton study reveal that yield variation does significantly alter findings. Therefore, better yield information is advisable for any other analysis.

Areas for Further Study

Suggestions for further research concerns four major areas. First, the time period studied would need to be increased to twenty years or more. The performance trends of the different strategies would be better analyzed by lengthening the planning horizon,. This may reveal some changes in the strategy rankings. Secondly, many strategies could be added to those studied in this analysis. An interesting extension would be to have combinations of forward contracting throughout the growing season to be part of the model. Technical indicators of when to forward contract or futures contract would be much more realistic of actual behavior.

A third area that needs more research concerns the risk level coefficients used in this study. Although the risk levels chosen are in the range of acceptance, more sensitivity analysis needs to be completed with other Arrow -Pratt coefficients. To date, a risk preference analysis of Arizona cotton producers has not been completed. These empirical findings would be essential in further cotton price analysis.

The fourth target of concern is the yield information used in this research. Only three farms were chosen to represent all of the farms in Pinal County. An extension involving many more of the growers in this county, and the state as a whole, would be useful. This extension is strongly indicated because of the impact yields have on marketing results.

Yields should be further analyzed to model expected yielas rather than actual yields. The actual yields used in the model may distort the forward and futures marketing strategies.

Conclusions

In conclusion, stochastic dominance analysis indicates that, for the risk levels indicated, risk averse growers would find that futures and cash sale of the crop was dominated by the forward contracting strategies. If the Arrow-Pratt coefficients correctly model risk loving behavior, then forward contracting and most of the cash sale strategies were dominated by futures contracting. These observations are only valid under the conditions and assumptions of the model.

Cooperative marketing was dominated by two of the cash sale strategies and several of the forward contracting techniques for the level of risk aversion indicated in this model. However, cooperative marketing appears to dominate futures marketing. More than half of the forward marketing techniques were also dominated by a cooperative marketing strategy. Therefore, it could be concluded that growers who would have the risk aversion levels as described in this model, may prefer to market their crop through a cooperative rather than to use forward or futures contracts.

While quality did not significantly affect the rankings of strategies, yield levels apparently do have an impact on these results. Changing the Arrow-Pratt coefficients may alter the results as well.

When interviewing the farm operators for information to be used in this study, it was apparent that these farmers were very concerned with marketing their crop in the most informed, effective manner possible. Growers who do not participate in their cotton marketing may consider changing some of their decisions. First, a producer must decide the acceptable level of risk and, secondly, what income range is essential for survival. Marketing the crop should become an important part of the farm operation. Apparently, the fluctuations in average incomes received from differing strategies justifies this inclusion into any cotton farming operation.

APPENDIX 1

McKINNON'S FORMULA FOR AN OPTIMAL HEDGE IN FORWARD CONTRACTING

YEAR	BALES (THOUS.)	PRICE	DEFLATOR	DEFLATED PRICE
1955	705.7	62.31	27.2	229.08
1956	802.4	31.14	28.1	110.82
1957	720.6	32.43	29.1	111.44
1958	695.4	33.67	29.7	113.37
1959	684.3	32.51	30.4	106.94
1960	818.1	30.42	30.9	98.45
1961	799.9	32.89	31.2	105.42
1962	885.1	31.33	31.9	98.21
1963	761	31.3	32.4	96.6
1964	743	28.56	32.9	86.81
1965	740	29.35	33.8	86.83
1966	478	21.25	35	60.71
1967	418	29.71	35.9	82.76
1968	688	23.53	37.7	62.41
1969	595	22.31	39.8	56.06
1970	462.1	22.65	47.2	47.99
1971	466	29.95	48.8	61.37
1972	603	29.3	50.3	58.25
1973	611	43.3	53.1	81.54
1974	995	44.1	57.2	77.1
1975	573	53.1	61.8	85.92
1976	834	64.2	65.1	98.62
1977	1070	56.1	68.4	82.02
1978	1068	57.4	72.7	78.95
1979	1280	68.1	78.8	86.42
1980	1354	77.1	86.1	89.55
1981	1556	56	94.1	59.51
1982	1095	60.5	100	60.5
1983	725	68.2	104	65.58
1984	1097	59.8	108.5	55.12
1985	928	53.9	112.4	47.95

$$S_f = 1 + (Z)\,CV_q \,/\, Cv_p$$

Sf is the optimal hedging percentage, Z is the correlation coefficient between yields and prices, CVq and CVp are the coefficients of variations.

Coefficient of variation for yields = 271.32/817.79 = .33177

Coefficient of variation for price = 33.23/85.24 = .38984

Corr. Coefficient = .0551

S_f = 1 + (-.06) (.33177/.38984)

S_f = .948938 or 95%

APPENDIX 2

FARM BUDGET FOR MODEL FARM
PINAL COUNTY

LINT:YIELD	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85
LINT:GRADE/STAPLE	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent
21/33	0.00	0.00	0.01	0.04	0.07	0.03	0.09	0.03	0.05	0.05
/34	0.17	0.06	0.19	0.73	0.75	0.39	0.88	0.48	0.05	0.11
/35	1.69	0.63	0.48	1.07	5.15	2.76	1.14	1.53	0.76	2.55
31/33	0.14	0.10	0.15	0.39	0.72	1.01	1.33	0.29	0.05	0.11
/34	7.76	3.86	6.32	7.84	7.92	8.48	16.00	4.59	0.87	1.28
/35	44.85	26.89	15.07	20.61	44.48	46.58	20.99	24.43	24.92	50.58
40/33	0.02	0.02	0.03	0.17	0.13	0.15	0.10	0.03	0.05	0.05
/34	1.14	0.60	0.10	1.96	1.36	0.87	1.12	0.33	0.05	0.05
/35	5.96	4.25	2.58	4.90	10.09	7.24	2.52	2.84	0.98	1.49
41/33	0.26	0.22	0.63	0.71	0.78	1.25	2.12	0.72	0.05	0.64
/34	4.85	6.91	17.69	10.59	4.06	5.53	16.46	4.78	1.31	9.56
/35	15.22	32.96	34.79	27.61	16.19	19.46	17.20	25.80	24.70	9.56
51/33	0.28	0.34	0.66	0.63	0.61	0.55	0.76	0.70	0.05	0.05
/34	0.79	1.65	3.14	3.70	1.03	0.91	2.72	2.13	0.33	0.21
/35	0.59	2.58	3.50	4.40	1.36	1.64	2.64	7.62	2.50	1.59
32/33	0.22	0.12	0.16	0.29	0.19	0.27	0.58	0.19	0.11	0.11
/34	3.58	2.40	1.47	1.96	0.55	0.55	2.36	1.32	1.31	0.64
/35	7.02	7.09	2.32	3.97	1.83	1.03	1.76	4.12	14.36	11.69
42/33	0.53	0.44	0.60	0.50	0.36	0.21	1.14	0.94	0.33	0.11
/34	1.79	2.17	3.29	2.38	0.59	0.52	2.87	2.30	2.50	0.64
/35	1.47	4.48	3.43	2.99	1.11	0.76	2.12	6.46	15.02	4.68
52/33	1.05	1.39	1.27	1.79	0.90	0.67	1.84	3.90	3.04	0.47
/34	0.72	1.05	1.12	1.15	0.39	0.34	1.12	2.57	3.48	1.81
/35	0.10	0.34	0.43	0.34	0.22	0.15	0.39	2.24	3.37	2.13

APPENDIX 3

LITERATURE REVIEW

GRAIN STUDIES ARTICLE	STATE	ANALYTICAL TOOL	FIXED QUALITY	FIXED YIELD
RIGGINS, REED, & SKEES	KY	E-V	NA (SB & CORN)	YES
SOGN, VOLLMERS, BAATZ	S.DAK.	COMPARE NET INC.	NA (SB & CORN)	YES
JOHNSON & SHAFER	TX	E-V	NA (WHEAT)	YES
GREENHALL	S.DAK.	SD (ORD)	NA (CORN)	YES
COTTON				
BROOKER & GRAY	TENN.	E-V	YES	NO, PER/ACRE
BAILEY, BRORSEN, & RICHARDSON	TX	E-V	ONLY 2	YES
SHAFER & HOWARD	MISS. TX, & CA	E-V	YES	YES
FIRCH	AZ	COMPARED PRICES	YES	YES
FIRCH & AL-SAKKAF	AZ	E-V	YES	YES
BAILEY & RICHARDSON	TX	E-V & SD (GEN)	NO, RANDOM	NO, RANDOM

APPENDIX 4

COOPERATIVE MARKETING STRATEGY COMPARED TO THE OTHER STRATEGIES (RISK AVERSE, AVERAGE SIZE PRODUCER)

	COOP DOMINATES	COOP IS DOMINATED
1. CASH NOVEMBER		*
2. CASH DECEMBER		*
3. CASH JANUARY	*	
4. CASH THIRDS	*	
5. FORWARD 1 100%		*
6. FORWARD 2 100%	*	
7. FORWARD 3 100%	*	
8. FORWARD 4 100%		*
9. FORWARD 5 100%	*	
10.FORWARD 1 75%		*
11.FORWARD 2 75%	*	
12.FORWARD 3 75%	*	
13.FORWARD 4 75%		*
14.FORWARD 5 75%	*	
15.FORWARD 1 50%		*
16.FORWARD 2 50%	*	
17.FORWARD 3 50%	*	
18.FORWARD 4 50%		*
19.FORWARD 5 50%	*	
20.FUTURES 1	*	
21.FUTURES 2	*	
22.FUTURES 3	*	
23.FUTURES 4	*	
24.FUTURES 1A	*	
25.FUTURES 2A	*	
26.FUTURES 3A	*	
27.FUTURES 4A	*	

REFERENCES CITED

Al-Sakkaf, Ghazi Ahmed. "Put Options on Cotton Futures Contracts and Alternative Marketing Strategies". Masters Thesis, University of Arizona, Dept. of Ag. Economics, 1986.

Anderson, Jock R., John L. Dillon and Brian Hardaker. Agricultural Decision Analysis, The Iowa State University Press, Ames, Iowa. 1977.

Arizona Cotton Growers Association. "The Arizona Cotton Story." 4139 E. Broadway, Phoenix, Arizona 85040, 1986.

Ayer, Harry W. Arizona Agriculture and Forces of Changes. Cooperative Extension Service and Department of Ag. Econ., University of Arizona, Extension Report #8624, May, 1986.

Ayer, Harry W. and James C. Wade. The 1986 Upland Cotton Program and Profits for Arizona Producers, Dept. of Ag. Economics, University of Arizona, Extension Report No. 12, May, 1986.

Bailey, DeeVon, B. Wade Brorsen, and James W. Richardson. "Dynamic Stochastic Simulation of Daily Cash and Futures Cotton Prices". Southern Journal of Ag. Econ. v.16(2) December (1984):109-116.

Bailey, DeeVon, and James W. Richardson. "Analysis of Selected Marketing Strategies: A Whole-Farm Simulation Approach." Amer. J. Agr. Econ. 67(1985):813-20.

Black, Fischer. "The Pricing of Commodity Contracts". Journal of Finan. Econ. 3 (1976): 167-79.

Brooker John, R. and Morgan D. Gray. Marketing Strategies and Risk Aversion Analysis for Tennessee Cotton Producers University of Tennessee Agricultural Experiment Station, Knoxville, Tennessee, Bulletin 640, December 1985.

Cable, C. Curtis, Jr. Pricing and Marketing Alternatives for Cotton Producers. Cooperative Extension Service, Bulletin No. A-89, University of Arizona, September,1979.

Cable, C. Curtis, and George Alstad. "During Changing Times....Cotton Growers Must Meet Challenge!". Agriculture in Arizona Vol. XXII, No. 1. College of Agriculture, University of Arizona, Jan.-Feb., 1970.

CALCOT, LTD., Marketing Seminars, Bakersfield, CA., February, 1985.

Clark, Charles T. and Lawrence L. Schkade. Statistical Methods for Business Decisions South Western Publishing Co., Cincinnati, Ohio. p. 73. 1969.

Cochrane, Willard W. The Development of American Agriculture, A Historical Analysis. University of Minnesota Press, Minneapolis, 1981.

Current Research Information System / USDA (CRIS). Computer search conducted on April 9, 1986 with key words: cotton, marketing, strategy, price, prices, and pricing.

Dahl, Dale C., and Jerome W. Hammond. Market and Price Analysis. New York, McGraw-Hill, Inc. 1977.

DeeVon Bailey, B. Wade Brorsen, and James W. Richardson. "Dynamic Stochastic Simulation of Daily Cash and Futures Cotton Prices", Southern Journal of Ag. Econ. 16(2) 1984:109-116.

Emerson, Lon., Vice President, Cal Cot Inc., Glendale, AZ. Personal communication, May 30, 1986.

Ethridge, Don E., and Bob Davis. "Hedonic Price Estimation For Commodities: an Application to Cotton." Western Journal of Agricultural Economics. v. 7 (1982):293-300.

Ethridge, M. Dean and DeWitt F. Caillavet. "Effectiveness of the Loan Program for Increasing Net Price to Cotton Farmers". Beltwide Cotton Production Research Conferences, 1985 Proceedings. January 1985, ppgs. 226-31.

Farnsworth, Richard L. and L. Joe Moffitt. "Cotton Production Under Risk: An Analysis of Input Effects on Yield Variability and Factor Demand". Western

Journal of Ag. Econ. v. 6 (1981): 155-63.

Ferguson, C.E. and J.P. Gould, Microeconomic Theory. Richard D. Irwin,Homewood, Illinois,1975, ppgs. 223-4.

Fishburn, P.C., "Convex Stochastic Dominance with Continuous Distribution Functions." Journal of Economic Theory 7(1974): 143-158.

Firch, Robert S. Personal communication, February and March 1987, University of Arizona, Dept. of Ag. Econ.

Firch, Robert S. "Cotton Forward Contracting in Maricopa, Pima, and Pinal and Yuma Counties in the Years 1974-79", Cotton A College of Agriculture Report, University of Arizona, February, 1982.

Firch, Robert S. ""Cotton Forward Contracting Performance in 1980-84", Cotton - a College of Agriculture Report, University of Arizona, March, 1986.

Firch, Robert S., and Ghazi Al-Sakkaf. "Cotton Put Options: Low Price Insurance?." Paper presented at the Cotton Economics Meetings, Las Vegas, Nevada. Department of Agricultural Economics, University of Arizona, January, 1986.

Ford, John. Broker, W.B. Dunavant and Co. of Arizona, Phoenix, AZ, Personal Communication in his office, April 15, 1987.

Greenhall, Larry. An Application of Ordinary and General Stochastic Dominance Criteria in Ordering Risky Marketing Strategies for Corn Producers. Cornell University Agricultural Experiment Station, New York State College of Agriculture and Life Sciences, September, 1983.

Hadar, J., and W.R.Russell, "Rules for Ordering Uncertain Prospects." American Economic Review 59(1969):25-34.

Hanoch, G., and H. Levy, "The Efficiency Analysis of Choices Involving Risk." Review of Economic Studies 36(1969):335-346.

Hathorn, Scott Jr., and Charles R. Farr. 1976 Arizona Field Crop Budgets, Maricopa County. Department of Ag. Econ., College of Agriculture, University of Arizona, April 1976.

Hathorn, Scott Jr., and Charles R. Farr. 1986 Arizona

Field Crop Budgets, Maricopa County. Department of Ag. Econ., College of Agriculture, University of Arizona. January, 1986.

Hathorn, Scott Jr., Donald R. Howell, and Barry Tickes. 1986 Arizona Field Crop Budgets, Yuma County. Department of Ag. Econ., College of Agriculture, University of Arizona. January, 1986.

Hey, John D. Uncertainty in Microeconomics. New York University Press, New York, N.Y. 1979.

Holthausen, Duncan M. "Hedging and the Competitive Firm under Price Uncertainty". The American Economic Review, Vol 69:5 pp. 989-95, December 1979.

ICAC (International Cotton Advisory Committee), Cotton: World Statistics, Vol. 39, No.4, Part 2. April, 1986.

Johnson, Karl E., and Carl E. Shafer. "Wheat Marketing Strategies for the Texas Northern High Plains 1973-1980." Journal of the American Society of Farm Managers and Rural Appraisers. 48(1984):52-57.

Just, R.E. and R.D. Pope. "Production Function Estimation and Related Risk Considerations." American Journal of Agricultural Economics, 61(1979):276-84.

King, Robert P. and Lindon J. Robison. "Risk Efficiency Models", Risk Management in Agriculture, edited by Peter J. Barry, Iowa State University Press, Ames, Iowa, 1984.

Knight, Frank H. Risk, Uncertainty, and Profit, University of Chicago Press, Chicago, Ill. 1971 (originally published in 1921 by Houghton Mifflin Company).

Law, Averill M. and Stephen Vincent. Unifit: An Interactive Computer Package for fitting Probability Distributions to Observed Data. Select Software Services, pps.4-6,4-7. 1985.

Lin, William, G.W. Dean, and C.V. Moore. "An Empirical Test of Utility vs. Profit Maximization in Agricultural Production", American Journal of Agricultural Economics, 56(1974):497-508.

McKinnon, Ronald A., "Futures Markets, Buffer Stocks and Income," Journal of Political Economy, 75 (1967): 844-861.

Meyer, J., "Choice Among Distributions." Journal of Economic Theory 14(1977a):326-336.

Meyer, J., "Second Degree Stochastic Dominance with Respect to a Function." International Economic Review 18(1977b):477-487.

National Cotton Council, "The Economic Outlook for U.S. Cotton," 1985.

Penson, John B., and David A. Lins. Agricultural Finance: An Introduction to Micro and Macro Concepts. Prentice-Hall, Inc., Englewood Cliffs, N.J. 1980, ppgs. 171-3.

Raskin, Rob and Mark J. Cochran. "Interpretations and Transformations of Scale for the Pratt-Arrow Absolute Risk Aversion Coefficient: Implications for Generalized Stochastic Dominance. Western Journal of Ag. Econ. 11(2): 204-210. 1986

Rasmussen, Wayne, D. "The Historical Bases of Agricultural Policy". United States Agricultural Policy 1985 and Beyond, compiled and edited by Jimmye S. Hillman, Dept. of Ag. Econ. University of Arizona and Resources for the Future, 1984.

Richardson, J.W., and C. J. Nixon. "Description of FLIPSIM V: A General Firm Level Policy Simulator." Mimeographed. College Station, TX: Dep. Agr. Econ. Texas A&M University, 1984.

Riggins, Steven K., Michael R. Reed, and Jerry R. Skees. "Analysis of Grain Marketing/Pricing Strategies." Staff Paper No. 196, January, 1986. College of Agriculture,Univ. of Kentucky.

Rouse, Dennis R. Forward Contracting of Cotton, Ag. Experiment Station, Auburn University, Auburn Alabama. Bulletin 509, January 1979.

Sandmo, A., "On the Theory of the Competitive Firm Under Price Uncertainty", American Economic Review 41(1971):65-73.

Selley, Roger. "Decision Rules in Risk Analysis", Risk Management in Agriculture, edited by Peter J. Barry, Iowa State University Press, Ames, Iowa, 1984.

Shafer, C.E., and J.F. Howard. "Hedging for Target Prices with New York No. 2 Cotton Futures contracts:

Mississippi Delta, Texas High Plains, and Fresno, California Areas, 1971-78". 1979 Proceedings, Beltwide Cotton Production Research Conferences, Jan. 7 - 11, 1979 Phoenix, AZ., National Cotton Council, Memphis, Tenn. 1979.

Sogn, Arthur B., A. Clyde Vollmers, and Fred Baatz. Alternative Marketing Strategies for Corn and Soybeans. South Dakota Agricultural Experiment Station Bull. No. B 677, South Dakota State University, 1981.

Stedman, Sam. "Cotton". The Current Status of Arizona Agriculture, Cooperative Extension Service, University of Arizona, College of Agriculture, May, 1986.

Taylor, Brooks. Personal Communication in his office, University of Arizona on May 9, 1986, and phone conversation August 27, 1986.

Thompson, Cynthia V., and James F. Hudson. Cotton Marketing Alternatives, Louisiana, 1979 - 1981. Louisiana State University, Dept. of Ag. Economics and Agribusiness, D.A.E. Research Report No. 616, June 1983.

Tomek, William G., and Kenneth L. Robinson. Agricultural Product Prices, Cornell University Press, Ithaca, New York, second printing 1975.

University of Arizona. Arizona Agriculture, Now and a Vision of the Future. College of Agriculture, April 1986.

U.S.D.A., Agriculture Marketing Service, Cotton Division, "Arizona: Percentage Distribution of Grade, Staple, Mike and Fiber Strength for Upland Cotton Classed", (in table form), Memphis, Tennessee. 1976-86.

U.S.D.A., Agriculture Marketing Service, "Daily Spot Cotton Quotations," various dates (1976 - 1987).

U.S.D.A., Economic Research Service, Cotton and Wool Outlook and Situation Report. Bulletin CWS 44, November 1985a.

U.S.D.A., Economic Research Service, Cotton and Wool, Outlook and Situation Yearbook. Bulletin CWS 43, August 1985c.

U.S.D.A., Economic Research Service, Cotton and Wool Outlook and Situation Report. Bulletin CWS 45, May

1986.

U.S.D.A., Statistical Reporting Service, "1974 Arizona Agricultural Statistics", Arizona Crop and Livestock Reporting Service. Bulletin S-10, March 1975.

U.S.D.A., Statistical Reporting Service, "Arizona Agriculutural Statistics 1867 - 1965", Arizona Crop and Livestock Reporting Service, Phoenix, Az.

U.S.D.A., Statistical Reporting Service, "1979 Arizona Agricultural Statistics", Arizona Crop and Livestock Reporting Service. Bulletin S-15, April 1980.

U.S.D.A., Statistical Reporting Service,"1983 Arizona Agricultural Statistics", Arizona Crop and Livestock Reporting Service. Bulletin S-19, June 1984.

U.S.D.A., Statistical Reporting Service, "1984 Arizona Agricultural Statistics", Arizona Crop and Livestock Reporting Service. Bulletin S-20, July 1985b.

U.S.D.A., Statistical Reporting Service, "1985 Arizona Agricultural Statistics", Arizona Crop and Livestock Reporting Service. Bulletin S-21, July 1986.

U.S. Government Printing Office, Economic Report of the President transmit to Congress Feb. 1986, Washington, D.C. 1986, table B-3 Implicit Price Deflator for GNP 1929-85.

Ware, John, J. "New Options for Farmers", Journal of the American Society of Farm Managers and Rural Appraisers 48 (1984): 26-30.

White, Morris, and Michael A. Davis. Forward Contracting of Cotton. Agricultural Experiment Station, Auburn University, Bulletin 509, January 1979.

Wilson, Paul N. and Vernon R. Eidman. "An Empirical Test of the Interval Approach for Estimating Risk Preferences". Western Journal of Ag. Econ. 8(2): 170:182. 1983

Wilson, Paul N. and Vernon R. Eidman. "Dominant Enterprise Size in the Swine Production Industry". American Journal of Agricultural Economics. Vol.67, No.1, May 1985.

Zentner, R.P., D.D. Greene, T.L. Hickenbotham, and V.R. Eidman. "Ordinary and Generalized Stochastic

Dominance: A Primer", Dept. of Agricultural and Applied Economics, University of Minnesota, St. Paul. 1981.