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Analyzing Crop Revenue Safety Net Program Alternatives and Implications on Marketing Decisions

Jim A. Jansen, Bradley D. Lubben, and Matthew C. Stockton

This study evaluates the crop revenue effects of combining federal farm income safety net programs, crop insurance policies, and marketing arrangements. Eight representative farms across Nebraska are used to stochastically simulate the financial impact of nine risk management strategies to determine the optimal outcome during the 2011 production year. Procedures utilized to evaluate the stochastic results included the Expected Value, Coefficient of Variation, Stochastic Dominance, StopLight, and Stochastic Efficiency with Respect to a Function. Results indicate that out of the set of predefined strategies, the portfolio combination involving the government program choice of the Direct and Counter-Cyclical Program, crop revenue insurance with the fall harvest option, and hedging for the simulated time period provides the optimal outcome across the majority of representative farm scenarios in 2011.

Keywords: agricultural policy, commodity programs, crop insurance, farm bill, marketing, risk management

Objectives

This study evaluates the crop revenue and marketing effects of alternative program or product combinations on eight representative grain and oilseed operations across Nebraska. This research extends previous studies that have focused on interactions between government programs, crop insurance, and marketing tools. This study uses a stochastic model to simulate the potential economic impacts on farm-level crop revenue of different combinations of Average Crop Revenue Election (ACRE), Counter-Cyclical Payment (CCP), Direct Payment (DP), and Marketing Loan (ML) Programs; crop insurance policies consisting of Yield Protection (YP), Revenue Protection (RP), and Revenue Protections with a Harvest Price Exclusion (RP-HPE), and marketing strategies using either cash sales or futures hedging strategies. Results of the simulation and analysis provide insight on the economic consequences of product, program, or marketing selection. Implications may be extrapolated to other crops and regions of the country.

Background

Grain and oilseed producers in the United States have a variety of price and revenue-based income support programs available to deal with averse price or yield variability. Coupling these programs or products together remains a challenge due to the complexity and wide variation of productivity factors on individual farms. Government programs introduced or reauthorized as part of the 2008 Farm Bill relevant to this discussion include the ACRE, CCP, DP and ML Program (USDA Farm Service Agency, 2008 and 2009). Privately delivered crop insurance products administered by the USDA Risk Management Agency (2011a) include YP, RP, and RP-HPE. Also, equally important to the discussion are marketing strategies involving hedging with futures through exchanges or cash-market alternatives through local terminals (CME Group, 2011).

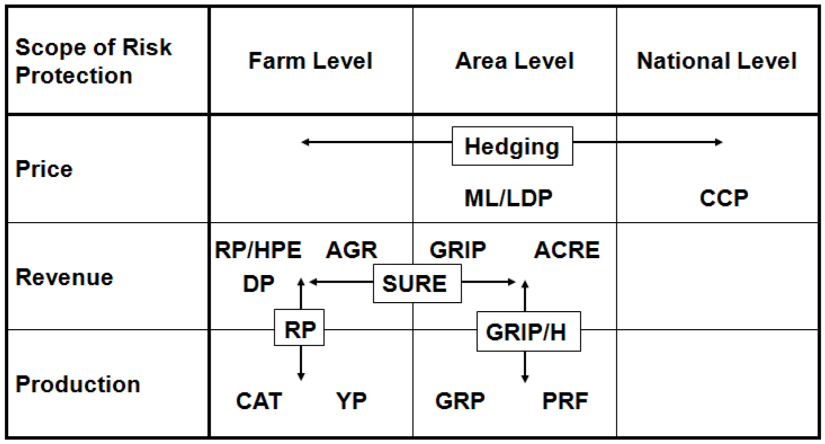


Figure 1. The Farm Income Safety Net

Lubben and Novak (2010) present an overview of the various safety nets and price support options relevant to producers. In their analysis, these options are either classified as affecting the farm, area, or national levels of risk along with the scope of protection guarding against price, revenue, or production declines. Figure 1, adapted and revised from Lubben and Novak, updates the decision aid schematic showing the various options available to producers during the 2011 production year. This Figure demonstrates how the various tools overlap and integrate to form the farm income safety net.

Crop insurance participation rates in Nebraska shows RP, RP-HPE, and YP acount for about 99% of all policies written during 2011. Aggregating insured corn, soybean, and wheat acreage indicates RP was written on 84.5% on all units, YP at 11.6%, and RP-HPE at 3.9% (USDA Risk Management Agency, 2011b). Simlar analysis may be drawn about USDA FSA programs denoted in Figure 1. Direct and Counter-Cyclical Program (DCP) participation during the 2010 production year in Nebraska represents 74.2% of total farm enrollment verses only 25.8% for ACRE (USDA Farm Service Agency, 2011). These statistics highlight the underlying assumptions and conclusions producers make regarding the performance and expected level of protection when selecting government programs and crop insurance products.

Zulauf (2011) expands further on the elements of a farm income safety net when describing the interactions between government programs and private insurance products. By design, these tools create overlap, but crop insurance includes farm-specific idiosyncratic hazards, whereas government programs primarily cover widespread systemic losses. Declines in crop revenue may be attributed to a loss that falls under both areas. A comprehensive analysis of farm-level crop revenenue must include a study of the tools and stratigies producers are currently using.

Crop producers face a multitude of farm program, crop insurance and marketing choices when devising a risk management strategy. Pennings, et al. (2008) note potential combinations of risk management tools to consider in the decision-making process increase at a factorial rate with each additional instrument, but underlying factors influence the process. Through analyzing the 2001 Agricultural and Resource Management Surveys (ARMS), Uematsu and Mishra (2010) found operator characteristics such as age, being raised on a farm, off-farm labor, total acres, and capital costs all had a positive influence on the adoption of risk management tools. Their analysis also found participation rates with crop insurance and government programs increased in proportion to an operator's size.

Velandia, et al. (2009) found similar results utilizing a 2001 survey of Illinois, Indiana, and Iowa corn and soybean farmers about operator's characteristics and utilization of different strategies. A second finding shows producers consider how net return distributions interact with various revenue stabilization instruments. Connections between revenue stabilization mechanisms and idiosyncratic and systemic risk serve as the basis for a producer's use of the tool. Operator characteristics also guide preferences and selection of different risk management tools.

Policy discussions during the 2008 Farm Bill formation period created the ACRE program in addition to the CCP and DP programs previously available. Cooper (2009) discussed how revenue-based ACRE program was initially projected to be more effective than previously-established price-based income support and ad hoc disaster programs for a producer's bottom line. Although moving towards greater protection against revenue declines, ACRE does not serve as a direct substitute for crop insurance or disaster programs. ACRE and CCP focus on state revenue or national price risk coming from aggregated systemic risk. Crop insurance or disaster programs focus on the farm-level production risk advancing from idiosyncratic risk (Shields, Monke, and Schnepf, 2010).

While keeping these risk attributes in mind, Woolverton and Young (2009) outlined ACRE enrollment questions which producers must evaluate when deciding to participate. Primary factors to consider include price and yield expectations, state versus farm-level yield correlation, cash flow changes with a reduction in rates with the DPs or ML program, and risk preferences. Coble, Dismukes, and Thomas (2007) elaborated on the issue of farm-level correlations with state yields. Strong correlation between individual farm yields and state averages may generate large program payments. Low correlations between farm and state crop revenue can lead to poor program performance.

Campiche and Harris (2010) cited previous sources on overlap between potential payments from revenue protection under ACRE and crop insurance, but the true risk distributions show overlap limited to 5% or less. Taking this factor into account, producers may gain the greatest protection by selecting both ACRE and crop revenue insurance. Revenue guarantees with ACRE reflect price and yield levels closer to actual production, whereas CCP supports tied to price coupled with historical bases may not reflect current cropping patterns and productivity levels.

Given these fundamental differences in ACRE and DCP, low participation rates suggest producers in Nebraska must expect potential ACRE risk reduction benefits to be less than the foregone DPs. Discrepancies between producer actions and literature on decision-making suggest areas for further inquiry.

Participation in different hedging activities remains correlated with purchases of crop insurance products (Velandia, et al., 2009). Selection of different tools from the portfolio of programs or products shows these activities do not have mutually-exclusive properties. Operator characteristics coupled with expectations about currently-available tools serve as the basis to guide risk decisions. The production aspects of producers across Nebraska may lead to one strategy being preferable for a particular region, but not necessarily across the entire state. These questions may be answered through the stochastic simulation modeling of yields and prices.

With the diversity in size, numbers, and locations of crop farms throughout Nebraska, previous studies and research are not sufficient upon which to base decisions for all producers in the state. Previous models and procedures serve as a basis to develop a system to evaluate risk management decisions involving the portfolio of options available. A theme common throughout procedures remains using past variability to predict future yield and price distributions. Understanding interactions among the various programs, products, or marketing arrangements provides insight on how the optimal risk management strategy may vary across different regions of the state.

Data and Methods

This study models eight representative grain and oilseed farms across Nebraska to simulate expected crop revenue impacts under nine different risk management strategies. The representative farms were created to depict average cropping patterns and productivity factors seen across the eight USDA National Agricultural Statistical Service (NASS) Agricultural Statistics Districts (ASDs) of Nebraska in Figure 2. One county per district has been identified with a lighter outline as the representative county within a district which also includes the representative farm. The districts with these counties in Figure 2 include: Norwest 10 – Morrill, North 20 – Holt, Northeast 30 – Wayne, Central 50 - Sherman, East 60 – Butler, Southwest 70 – Hayes, South 80 – Kearney, and Southeast 90 – Saline.

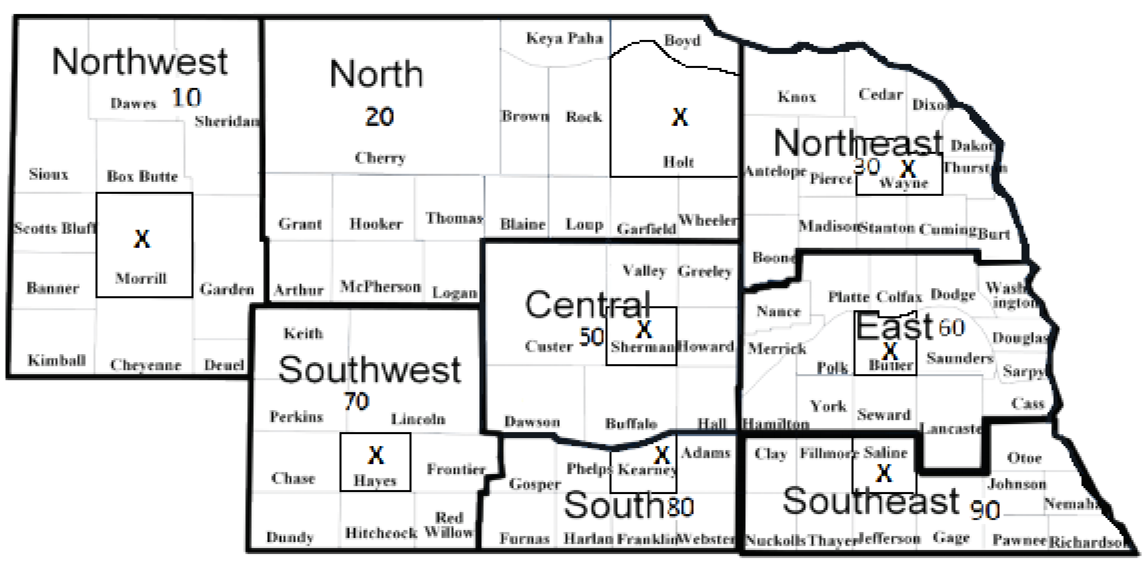


Figure 2. Nebraska Agricultural Statistics Districts, Representative Counties, and Representative Farms

To define average size and scale of Nebraska farm operations, the 2007 Census of Agriculture conducted by NASS provided cropland acres and total number of operators sorted according to farm income ranges (National Agricultural Statistics Service 2009). Using operations with a gross income range classification above $100,000, the total cropland acres and producers at the district level were aggregated from county-level data to determine the number of cropland acres per representative farm. Annual yield and harvested acreage data maintained by NASS for the nation, state, districts, and counties allowed for identification of recent cropping and irrigation practices across different aggregations (USDA National Agricultural Statistical Service 2011). Table 1 presents the size and cropping mixture of the eight representative farms developed for the simulation. Also, expected and Actual Production History (APH) yields are noted.

Table 1. Representative Farm Sites with Cropland Acres, Expected Yields, and Actual Production History

Cropland Acres	District 10 Farm	District 20 Farm	District 30 Farm	District 50 Farm	District 60 Farm	District 70 Farm	District 80 Farm	District 90 Farm
Corn Irrigated	372.9	891.0	230.1	794.7	318.9	702.6	558.6	280.4
Corn Dryland	-	157.2	380.2	126.8	273.4	282.6	171.5	377.7
Soybeans Irrigated	-	329.1	147.7	206.0	173.7	96.9	303.7	173.8
Soybeans Dryland	-	-	303.9	-	259.8	-	-	377.5
Winter Wheat	874.4	-	-	-	-	522.3	167.0	-
Total	1247.3	1377.3	1062.0	1127.5	1025.8	1604.3	1200.8	1209.3
Expected Yields 2011 (bu./acre)								
Corn Irrigated	166.0	188.1	205.7	194.9	190.5	193.4	204.6	195.8
Corn Dryland	-	76.5	155.5	94.0	129.9	71.1	112.5	111.3
Soybeans Irrigated	-	58.0	56.0	60.0	60.0	58.6	63.0	58.7
Soybeans Dryland	-	-	47.5	-	42.7	-	-	39.3
Winter Wheat	42.0	-	-	-	-	41.0	48.1	-
Actual Production History 2001-2010 (bu./acre)								
Corn Irrigated	156.9	175.0	185.4	181.8	183.2	183.0	193.0	186.2
Corn Dryland	-	71.5	131.9	81.4	123.4	68.4	89.2	111.5
Soybeans Irrigated	-	51.6	53.3	55.9	56.6	55.6	59.0	56.6
Soybeans Dryland	-	-	42.1	-	42.1	-	-	38.7
Winter Wheat	35.4	-	-	-	-	43.0	46.7	-

Farm-level sizes and crop mixtures are based upon the tabulated averages and analysis of NASS data. Table 2 presents harvested cropland averages used to derive the crop mix for each of the representative farms.

Table 2. Total Average Harvested Cropland Acres by Agricultural Statistics District in Nebraska

Cropland Acres	District 10	District 20	District 30	District 50	District 60	District 70	District 80	District 90	State
Corn Irrigated	293,000	327,333	661,667	980,000	1,085,667	677,000	671,000	552,667	5,248,334
Corn Dryland	40,867	50,933	983,333	169,533	893,333	360,833	245,833	757,000	3,501,665
Soybeans Irrigated	3,000	118,333	414,667	288,500	617,000	133,433	372,667	343,000	2,290,600
Soybeans Dryland	0 *	28,367	794,000	66,467	876,000	0 *	106,567	744,667	2,616,068
Winter Wheat	691,600	24,300	17,000	34,033	33,000	456,100	177,600	153,033	1,586,666
Total	1,028,467	549,266	2,870,667	1,538,533	3,505,000	1,627,366	1,573,667	2,550,367	15,243,333

* All soybean acres assumed to all be irrigated in the denoted District.

The simulation involving the representative farms was constructed and analyzed in the Microsoft Office 2010 Excel platform using the software add-on Simulation & Econometrics to Analyze Risk (SIMETAR) developed at Texas A&M University (Richardson, Schumann, and Feldman, 2008). Stochastic components include price and yield expectations, variability, and correlations, including prices at the national level and yields at the national, state, district, county, and farm level. At the base of the simulations is a correlated national and state yield and price deviation matrix based on previous relationships identified by Lubben and Jansen (2010).

This matrix provides the core of the model and guides the directionality of the yields and prices for a particular outcome. Once state and national yields and national prices are simulated, the district yields are ordered by a Directed Acyclical Graph (DAG) search to properly regress them to each other and their related state deviations. Counties selected as representing typical attributes of a district are regressed on corresponding district yield variables according to commodity type and cropping practice. Representative farms were simulated around county yields using a stochastic component representing farm level expectations implied by crop insurance premium rates consistent with Miranda's (1991) implied volatility model for the 2011 production year.

Data for the crop yields in the simulation came from historical yield data published by USDA NASS (2011) and farm-level yield variability estimates implied from crop insurance premium estimates for the 2011 production year (Farmdoc, 2011). Historical commodity futures data was collected and obtained from the Commodity Research Bureau (2011) to determine seasonal volatility of prices. Marketing Year Average (MYA) prices maintained by NASS (2011) provided the data for estimates of basis patterns and cash market prices. Based on the historical data, trend projections, and variability from trend, the stochastic model generates yield and price distributions allowing for analysis of expected crop revenue under alternative farm program, crop insurance, and marketing scenarios. Expected crop revenue is the average crop revenue summed across individual enterprise revenues from 500 randomly drawn outcomes for each representative operation.

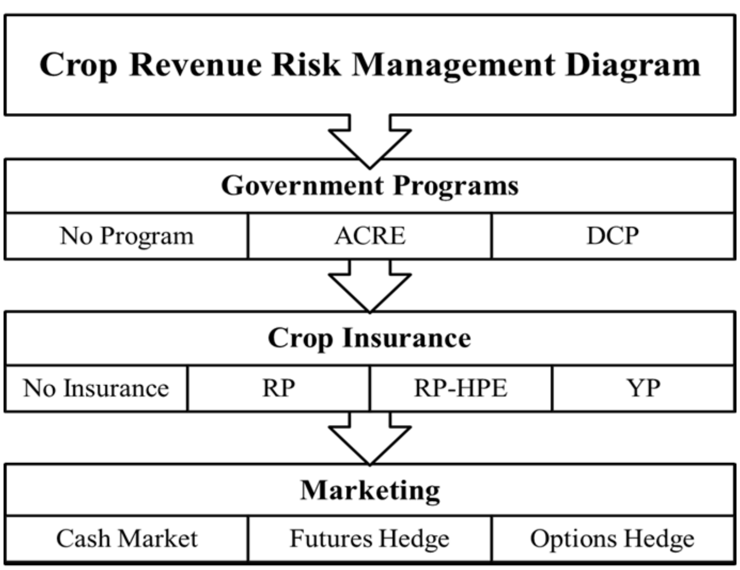


Figure 3. Crop Revenue Risk Management Diagram

Figure 3 documents the decisions producers must make during the 2011 production year regarding government programs, crop insurance, and marketing strategies. For a given price and yield base, a total of 36 different scenarios exist. Analyzing all 36 scenarios would be infeasible for each of the representative farms. However, the diagram also implies that farmers must optimize within each risk management section while noting the previous interaction of decisions across different levels. Based upon the diagram and the previous discussion on participation rates for farm programs, crop insurance products, and marketing strategies, nine scenarios are developed for analysis. Table 3 displays the nine alternatives for the eight representative farms across Nebraska. These scenarios serve as the basis for discussion involving specified risk management strategies for the following analysis and results and conclusion discussion.

Table 3. Simulation Scenarios including Government Programs, Crop Insurance, and Marketing Parameters

Alternative	Abbreviations[1]	Government Program[2]	Crop Insurance[3]	Marketing
Scenario 1	NP-NI-CM	No Program	No Insurance	Cash Market
Scenario 2	DCP-RP-CM	DCP	RP 70%	Cash Market
Scenario 3	DCP-RP-FH	DCP	RP 70%	Futures Hedge
Scenario 4	DCP-YP-CM	DCP	YP 70%	Cash Market
Scenario 5	DCP-YP-FH	DCP	YP 70%	Futures Hedge
Scenario 6	ACRE-RP-CM	ACRE	RP 70%	Cash Market
Scenario 7	ACRE-RP-FH	ACRE	RP 70%	Futures Hedge
Scenario 8	ACRE-YP-CM	ACRE	YP 70%	Cash Market
Scenario 9	ACRE-YP-FH	ACRE	YP 70%	Futures Hedge

[1] Government Program-Crop Insurance-Marketing

[2] DCP = Direct and Counter-Cyclical Program
ACRE = Average Crop Revenue Election

[3] RP 70% = Revenue Protection 70%
YP 70%= Yield Protection 70%
Noted with corresponding levels of coverage.

Scenarios 1-9 in Table 3 show the base comparison and alternative strategies involving the three different groups of risk management tools. All scenarios use the same starting 2011 expected futures-yield projections and planting-time price averages. Also, guarantees for government programs and crop insurance products are consistent with those available during the 2011 production year. The control case of scenario 1 does not participate in any government program or purchase any crop insurance product and all commodities are cash marketed at harvest time. Next, scenarios 2-5 and 6-9 group the scenarios according to whether a producer participates in the government program options of DCP or ACRE. Producers participating in either of these options have a guaranteed DP; thus producers would be expected to participate in one of the two.

Separate from the guaranteed revenue, producers make assumptions about the performance of DCP verse ACRE in stabilizing systemic losses through either revenue or price guarantees

After government program selection, producers must decide upon a crop insurance choice with a respective level of coverage. Participation rates indicate the top three policies underwritten for grain and oilseed producers in Nebraska during the 2010 production year in order include RP, YP, and RP-HPE. When examining coverage levels for these products on insured cropland acres, 70% protection accounts for the largest percentage of RP and YP units underwritten in the state. Due to very low sales of RP-HPE (USDA Risk Management Agency, 2011b), the product is excluded from the analysis. After taking these factors into account, an appropriate pair of crop insurance tools to evaluate includes RP and YP with a 70% protection level.

Finally, marketing strategies encompass the third component in this analysis. Producers have the ability to use cash marketing, futures, or option hedges in marketing of grain. Setting price protection at different levels remains a process reflecting a producer's cost of production, personal perception, and anticipation of future events. Also, placement of options remains subjective depending upon strike prices and premium values or costs for a particular commodity. Directly cash marketing or hedging a fall delivery price remain less complicated to place and carryout. These two alternatives are feasible choices to evaluate the basic marketing actions.

Under the cash marketing strategy, producers are assumed to sell the entire production at the state Marketing Year Average (MYA) price. Common hedging practices limit the amount of grain marketed before harvest in a particular production year up to the crop's insurance guarantee and therefore placing a hedge involving 70% of the expected yield would fit within industry standards. Based upon this reasoning, the two marketing strategies include cash marketing all production at the MYA price or hedging 70% of expected yield at the 30-day planting-time average futures price for a particular commodity, lifting the hedge at harvest time, and subsequently selling the actual production at state MYA price.

Results

Multiple methods exist to examine stochastic financial simulations. Each approach has various advantages and disadvantages associated with corresponding assumptions utilized to analyze a particular scenario. The five procedures utilized in this analysis include: Expected Value (EV), Coefficient of Variation (CV), Stochastic Dominance (SD), StopLight (SL), and Stochastic Efficiency with Respect to a Function (SERF). Each section evaluates the various assumptions necessary to employ one of the five stochastic procedures. Based upon these parameters, each analysis highlights the optimal scenario for a given farm and implications on the selection risk management tools across the state.

An EV represents the mean under a specific statistical distribution given a set of probabilities for occurrences involving each specific event. When applied to one of the nine different simulation scenarios for a particular representative farm, an EV for this case indicates the anticipated average gross farm revenue under a specific alternative for each farm. This mean is the average gross farm revenue over the 500 randomized draws where each event has the same statistical probability of occurring for a specific scenario. In the case of expected gross farm revenue, the highest EV represents the most desired outcome. Gross farm revenue in the following analysis refers to income adjusted for net crop insurance and marketing costs.

Table 4. Expected Gross Farm Revenue by Representative Farm under Simulation Scenarios[1]

Representative Farm	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
District 10 Farm	$604,574	$644,894	$641,226	$643,533	$639,865	$640,624	$636,956	$639,263	$635,595
District 20 Farm	1,359,031	1,401,590	1,411,524	1,402,079	1,412,012	1,395,248	1,405,182	1,395,736	1,405,670
District 30 Farm	1,007,463	1,032,497	1,036,303	1,031,480	1,035,286	1,028,682	1,032,488	1,027,665	1,031,472
District 50 Farm	1,190,801	1,229,695	1,239,896	1,229,884	1,240,086	1,224,142	1,234,343	1,224,332	1,234,533
District 60 Farm	900,449	935,833	939,096	933,758	937,022	931,515	934,778	929,441	932,704
District 70 Farm	1,175,721	1,232,241	1,238,018	1,230,367	1,236,144	1,225,559	1,231,336	1,223,685	1,229,462
District 80 Farm	1,136,410	1,172,856	1,177,524	1,172,099	1,176,767	1,167,120	1,171,788	1,166,364	1,171,032
District 90 Farm	946,216	988,838	991,511	986,875	989,548	984,143	986,817	982,180	984,854

[1] Refer to Table 3 for a description on simulation scenarios and abbreviations.

Statistics provided in Table 4 highlight the expected gross farm revenue for the eight representative farms in Nebraska under the nine alternative simulation scenarios. The highest EV by representative farm includes: DCP-RP-CM for District 10, DCP-YP-FH in District 20 and 50, and DCP-RP-FH in Districts 30, 60, 70, 80, and 90. A basic point noted by the EV shows participating in any of the risk management scenarios other than the NP-NI-CM provides larger expected gross farm revenue. Also, none of the four scenarios containing ACRE were preferred using the EV procedure.

Table 5. Expected Gross Farm Revenue per Acre by Representative Farm under Simulation Scenarios[1]

Representative Farm	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
District 10 Farm	$484.70	$517.03	$514.09	$515.94	$512.99	$513.60	$510.66	$512.51	$509.57
District 20 Farm	986.72	1,017.62	1,024.83	1,017.97	1,025.18	1,013.01	1,020.22	1,013.37	1,020.58
District 30 Farm	948.66	972.23	975.81	971.27	974.86	968.64	972.22	967.68	971.26
District 50 Farm	1,056.14	1,090.63	1,099.68	1,090.80	1,099.85	1,085.71	1,094.76	1,085.88	1,094.92
District 60 Farm	877.83	912.32	915.51	910.30	913.48	908.11	911.30	906.09	909.27
District 70 Farm	732.84	768.07	771.67	766.90	770.50	763.91	767.51	762.74	766.34
District 80 Farm	946.39	976.74	980.63	976.11	980.00	971.97	975.85	971.34	975.22
District 90 Farm	782.42	817.67	819.88	816.04	818.26	813.79	816.00	812.16	814.37

[1] Refer to Table 3 for a description on simulation scenarios and abbreviations.

Analyzing the expected gross farm revenue on a per acre basis in Table 5 provides the same results as given in Table 4. Per acre average revenue comes from the expected gross farm revenue divided by the total number of cropland acres per farm. Evaluating per acre revenue shows how the anticipated revenue varies across the state due to cropping practices and productivity differences. At the most basic level, crop revenue equals yield multiplied by price. APH yields Table 1verify how historical yields by crop and practice are typically lower in the more arid western regions of the state.

One limitation of the EV procedure remains the inability to take into consideration the variability of gross farm revenue. Some producers may be more receptive to reducing revenue variability. The ability of producers to tolerate detrimental losses may be subject to the variability of farm revenue when suffering rapid yield or price declines. When analyzing the gross farm revenue with a CV measurement a level of variability may be defined for the set or risk management scenarios.

The CV measures the proportion of the standard deviation to the mean (EV) for a set of data. A standard deviation indicates the probability for a given range of numbers to fall within a specific interval. When interpreting the CV over a given set of scenarios, the smallest percentage value indicates the distribution with the least variation. Producers seeking the lowest revenue variability across the set of simulation scenarios would choose the outcome with the lowest CV value. The lowest CV measurement may or may not have the highest expected value.

Table 6. Expected Gross Farm Revenue and Coefficient of Variation (CV) involving Simulation Scenarios[1] by Representative Farm

Representative Farm	Variable[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
District 10 Farm	GFR ($)	604,574	644,894	641,226	643,533	639,865	640,624	636,956	639,263	635,595
	CV (%)	26.61	20.71	19.81	21.29	20.38	20.83	19.93	21.41	20.50
District 20 Farm	GFR ($)	1,359,031	1,401,590	1,411,524	1,402,079	1,412,012	1,395,248	1,405,182	1,395,736	1,405,670
	CV (%)	21.90	19.11	17.50	19.44	17.81	19.19	17.58	19.52	17.89
District 30 Farm	GFR ($)	1,007,463	1,032,497	1,036,303	1,031,480	1,035,286	1,028,682	1,032,488	1,027,665	1,031,472
	CV (%)	17.50	15.96	14.38	16.21	14.59	16.00	14.42	16.26	14.63
District 50 Farm	GFR ($)	1,190,801	1,229,695	1,239,896	1,229,884	1,240,086	1,224,142	1,234,343	1,224,332	1,234,533
	CV (%)	22.47	19.31	17.90	19.76	18.29	19.40	17.97	19.85	18.37
District 60 Farm	GFR ($)	900,449	935,833	939,096	933,758	937,022	931,515	934,778	929,441	932,704
	CV (%)	17.31	14.81	13.26	15.23	13.58	14.87	13.31	15.30	13.63
District 70 Farm	GFR ($)	1,175,721	1,232,241	1,238,018	1,230,367	1,236,144	1,225,559	1,231,336	1,223,685	1,229,462
	CV (%)	21.75	17.72	16.82	18.31	17.32	17.82	16.91	18.41	17.42
District 80 Farm	GFR ($)	1,136,410	1,172,856	1,177,524	1,172,099	1,176,767	1,167,120	1,171,788	1,166,364	1,171,032
	CV (%)	16.76	14.83	13.47	15.15	13.73	14.90	13.53	15.22	13.79
District 90 Farm	GFR ($)	946,216	988,838	991,511	986,875	989,548	984,143	986,817	982,180	984,854
	CV (%)	18.11	15.22	14.10	15.54	14.35	15.29	14.16	15.60	14.41

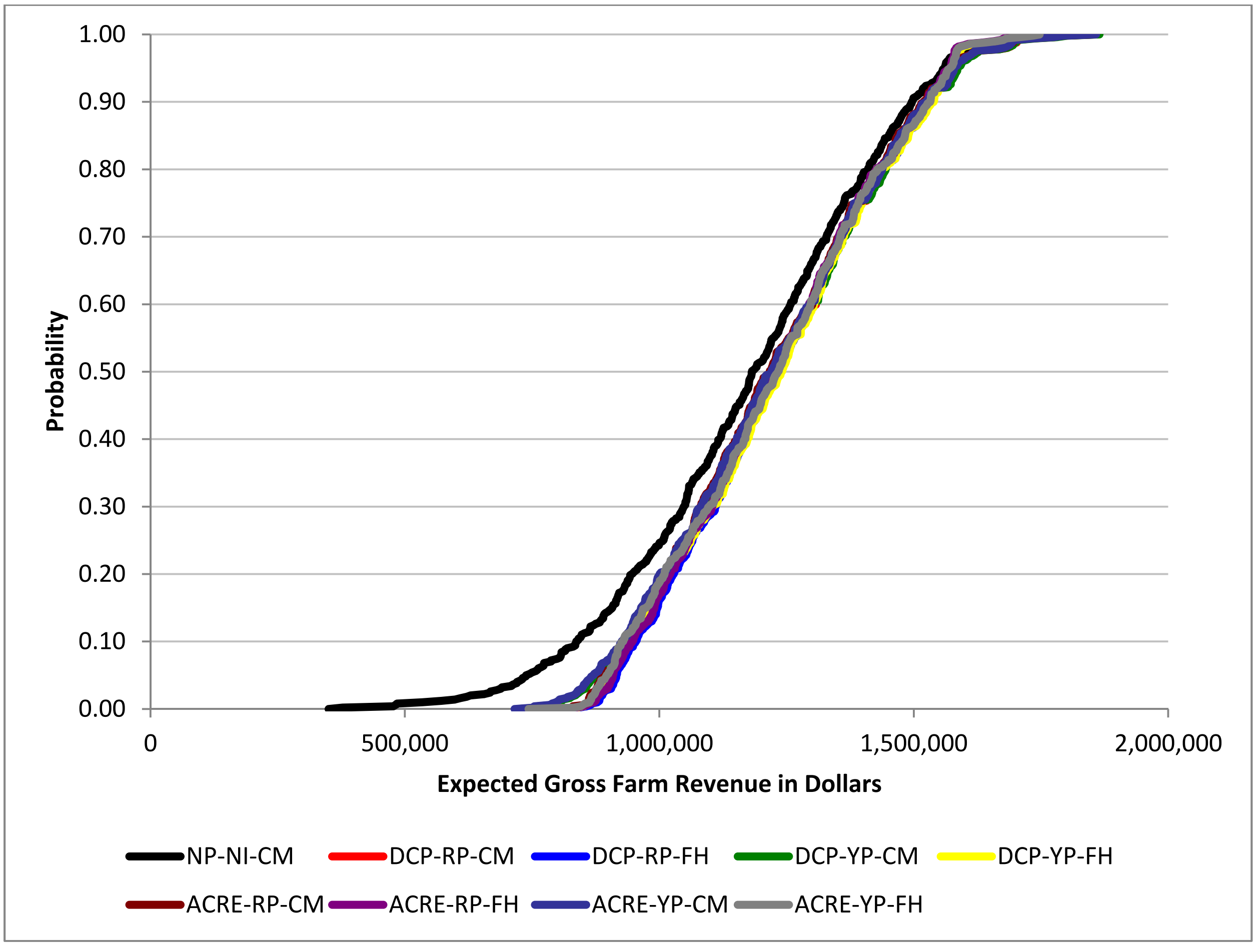
[1] Refer to Table 3 for a description on simulation scenarios and abbreviations.

[2] GFR = Expected Gross Farm Revenue
CV = Coefficient of Variation

CV values for the eight representative farms under the nine different simulation scenarios are displayed in Table 6. Further detail on the minimums, maximums, and standard deviations of the revenue distributions may be viewed in Table A.1 of the Appendix. Analysis of Table 6 shows the lowest CV for all representative farms as DCP-RP-FH. This is counter to the EV analysis, where the most optimal outcomes for representative farms were DCP-RP-CM in District 10 and DCP-YP-FH in District 20 or 50. EV for these farms and scenarios each has higher monetary values, but also higher CV. In comparison to the gross farm revenue the differences are relatively small, but show a fundamental difference in the two procedure results.

Reducing revenue variability verses seeking the highest expected value introduces probability in forming confidence intervals of revenue distributions. Having the lowest coefficient of variation in one of the nine scenarios shows the operation may have the least variability, but may limit beneficial movements in commodity price with a futures hedge. For certain operations the least variability in gross farm revenue may be the most desired. Coupling distributional probabilities with expected values presents another manner in which to analyze the nine scenarios. SD represents the methodology to evaluate the probability and expected value of a distribution under a given risk preference, which overcomes the limitations of the expected value and coefficient of variation.

Analysis tools included under the SD category include First Degree Stochastic Dominance (FSD), Second Degree Stochastic Dominance (SDS), and Stochastic Dominance with Respect to a Function (SDRF). In the FSD methodology the basic assumption is that the risk taker prefers more money to less (Richardson and Outlaw, 2008). When related to probability theory, this concept implies that a producer prefers the scenario with the higher likelihood for revenue to occur when the scenarios are ranked on a CDF chart.



[1] Refer to Table 3 for a description on simulation scenarios and abbreviations.

Figure 4. Gross Farm Revenue Cumulative Distribution Function (CDF) Approximation in District 70 for Alternative Scenarios[1]

As an example CDF chart, Figure 4 displays the nine simulation scenarios for the representative farm in District 70 with the correlating statistical probability and ranking of each alternative. An approximation for the probability of receiving a certain level of gross farm revenue or less under a given scenario may be identified by locating dollar value on the x-axis, tracing vertically up to the appropriate CDF curve, and then following horizontally over to the corresponding probability on the y-axis. FSD shows the most preferred scenario as the alternative furthest to the right on CDF chart, which has the largest probability of obtaining the greatest level of farm revenue.

Analysis of the CDFs for the other seven representative farms follows a similar pattern to Figure 4. In all of the CDFs, the ability to identify one scenario FSD to the other alternatives cannot be identified. FSD requires all elements of a particular scenario to not overlap an opposing alterative when graphed on a CDF chart. Clearly overlap occurs for the nine alternative risk management scenarios. One interesting point to note regarding the CDF charts involves the NP-NI-CM scenario which does not utilize an active crop insurance or government program. The horizontal distance between the noted and opposing scenarios may be attributed to direct payments and yield or revenue guarantees. FSD does not provide an optimal recommendation for the representative farms because of the overlaps in the gross farm revenue CDFs involving the 9 alternative scenarios. SDS methodology overcomes the limitations of FSD, but requires two major assumptions. First, the technique assumes the decision-maker has constant absolute risk aversion with decreasing preferences for more risky alternatives. Secondly, this process disregards a decision-maker's utility function. Also, SDS has to rank all of the possible pairs of risk management scenarios which may result in an analyzed set with more than one optimal outcome (Richardson and Outlaw, 2008).

The third stochastic dominance procedure relevant to analysis of CDF charts incorporates utility. SDRF couples SDS with utility by introducing constant Risk Aversion Coefficients (RACs). Lower and upper RAC values are set according to an individual's risk preference. Problems with this process occur when the decision-maker has preferences which are different for the lower and upper RAC values, as more than one optimal outcome may exist in a set of alternatives. Similar to SDS, all pairwise correlations of the simulation scenarios must be analyzed and could result in an efficient set being very small (Richardson and Outlaw, 2008). Due to these issues, SDS and SDRF do not provide clear abilities to analyze the nine different risk management scenarios.

CDF charts display the probability of ascertaining a certain level of revenue under a particular simulation scenario. Without a concise stochastic dominance methodology to rank these approaches, the shortcomings of expected value and coefficient of variation analysis still presents problems. The StopLight procedure provides an approach not limited by the issues of stochastic dominance, yet still represents the probability of achieving a defined level of revenue and allows the analysis to take into consideration different risk preferences. Stoplight charts measure the probability of favorable and unfavorable events given critical cut-off values. These limits are placed according to the decision-maker's preference. In financial simulations, the values may represent the ability to achieve a certain level of revenue or income. An appropriate parameter for many revenue purposes relates to the ability to cover different types of expenses. Based upon the probability of reaching these levels of income an optimal strategy may be identified depending upon the decision-maker's risk preference.

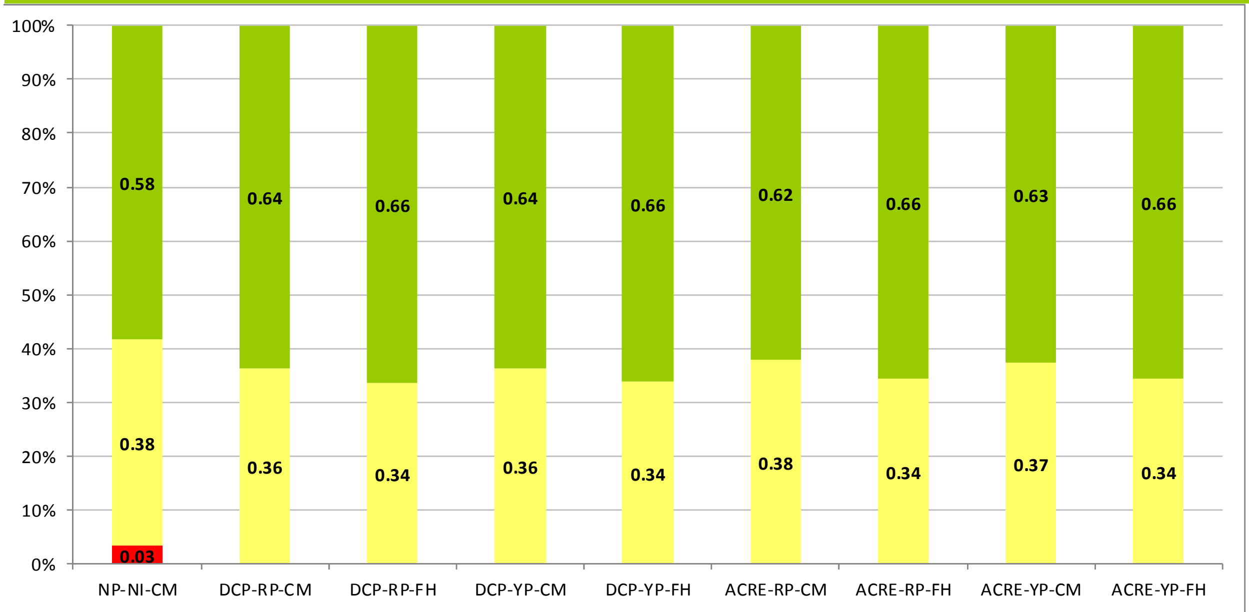
The probabilities of achieving benchmark parameters in a StopLight chart correspond to red (unfavorable), yellow (cautionary), and green (favorable) events in a bar chart format. Unfavorable events represent the likelihood of falling below the lower cut-off value. Next, cautionary developments show the probability of an outcome occurring between the lower and upper cut-off value. Finally, the favorable events happen when the simulation draw exceeds the upper cut-off value (Outlaw and Richardson, 2008). Depending upon the critical lower and upper cut-off values used in the analysis of scenarios, the probabilities may change significantly. In general, for risk-averse individuals, the most preferred alternative appears as the scenario containing the least red (unfavorable) and most green (favorable). Using this methodology to select the optimal outcome remains consistent with utility theory. Individuals are assumed to gain more satisfaction for more revenue compared to less (Outlaw and Richardson, 2008). StopLight charts combine probability and risk preferences in a manner which overcomes the shortcomings of EV, CV, and SD techniques. For the purpose of analyzing the nine alternative risk management scenarios, a set of critical values and preferences are assumed.

Approximations for variable and total crop production expenses come from USDA Economic Research Service (ERS) ARMS 2009-2010 Annual Cost and Return Estimates for corn, soybeans, and wheat. These surveys group Nebraska crop producers into three different regions. From the 2009-2010 analysis, these reports allowed for the estimation of variable and total economic expenses on a percentage basis of per-acre crop values of production. Variable costs include the operating costs of seed, fertilizer, chemicals, custom operations, fuel, lube, electricity, repairs, purchases of irrigation water, and interest on operating costs. Total costs include all variable costs in addition to hired labor, opportunity costs of unpaid labor, capital recovery of machinery and equipment, opportunity costs of land (rental rate), taxes and insurance, and general farm overhead (USDA Economic Research Service, 2012).

Next, expenses for the representative farms are estimated as a percentage of expected revenue under the NP-NI-CM scenario on a per acres basis according to the ARMS region in which these farms would be found. By multiplying these estimates by the corresponding number of acres by crop type, costs were summed for the entire operation. Approximations for these variable and total economic expenses provide critical cut-off values to gauge stochastic gross farm revenues.

Lower Cut-Off Value 699,198 **Cut-Off Value** 1,131,710

	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
P(U)[2]	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P(C)	0.38	0.36	0.34	0.36	0.34	0.38	0.34	0.37	0.34
P(F)	0.58	0.64	0.66	0.64	0.66	0.62	0.66	0.63	0.66



[1] Refer to Table 3 for a description on simulation scenarios and abbreviations.

[2] P(U) = Probability of Unfavorable Event
P(C) = Probability of Cautionary Event
P(F) = Probability of Favorable Event

Figure 5. Gross Farm Revenue StopLight Chart in District 70 for Alternative Scenarios[1]

As an example StopLight chart, Figure 5 displays the nine simulation scenarios for the representative farm in District 70 with lower and upper cut-off values of $699,198 and $1,131,710. The lower and upper cut-off values represent estimated variable and total economic costs of production for the representative farm in District 70. As an example scenario in Figure 5, NP-NI-CM shows the distribution of the simulated crop revenue distribution without participating in government programs, crop insurance, or hedging arrangements. Under this depiction only about a 3.0% probability exists in not being able to cover variable expenses, of falling between, and 41% is the probability of not meeting total costs. More interestingly a 58.0% chance exists in exceeding estimated total costs. The remaining eight scenarios all exceed estimated variable costs and do not show any unfavorable (red) regions on the respected bars of the alternatives.

Assuming each operation has risk-averse preferences, the optimal scenario is the one which has the highest probability of exceeding total costs. In the event two scenarios have the same probability in exceeding total costs, the one alternative having the higher expected value serves as the optimal outcome. For the entire set of representative farms, DCP-RP-FH serves as the optimal outcome, except District 50 where DCP-YP-FH provides the most desired outcome. The only difference between the two scenarios comes from the crop insurance selection of YP instead of RP in District 50.

Table 7. Expected Gross Farm Revenue (GFR) and StopLight Chart Analysis Summarizing Simulation Scenarios[1]

District 10 Farm

StopLight Cut-Offs[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Expected GFR	$604,574	$644,894	$641,226	$643,533	$639,865	$640,624	$636,956	$639,263	$635,595
Prob(GFR > TC)	66.4%	74.6%	76.8%	74.6%	76.6%	73.4%	76.0%	73.4%	75.6%
Prob(VC < GFR ≤ TC)	31.8%	25.4%	23.2%	25.4%	23.4%	26.6%	24.0%	26.6%	24.4%
Prob(GFR ≤ VC)	1.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Critical Values		Variable Costs (VC) =	$249,543		Total Costs (TC) =	$539,213			

District 20 Farm

StopLight Cut-Offs[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Expected GFR	$1,359,031	$1,401,590	$1,411,524	$1,402,079	$1,412,012	$1,395,248	$1,405,182	$1,395,736	$1,405,670
Prob(GFR > TC)	80.2%	86.6%	86.8%	86.0%	86.4%	84.6%	86.4%	85.2%	85.8%
Prob(VC < GFR ≤ TC)	19.4%	13.4%	13.2%	14.0%	13.6%	15.4%	13.6%	14.8%	14.2%
Prob(GFR ≤ VC)	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Critical Values		Variable Costs (VC) =	$533,515		Total Costs (TC) =	$1,089,536			

District 30 Farm

StopLight Cut-Offs[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Expected GFR	$1,007,463	$1,032,497	$1,036,303	$1,031,480	$1,035,286	$1,028,682	$1,032,488	$1,027,665	$1,031,472
Prob(GFR > TC)	89.2%	93.8%	94.8%	93.0%	94.0%	93.4%	94.4%	92.6%	93.6%
Prob(VC < GFR ≤ TC)	10.8%	6.2%	5.2%	7.0%	6.0%	6.6%	5.6%	7.4%	6.4%
Prob(GFR ≤ VC)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Critical Values		Variable Costs (VC) =	$352,428		Total Costs (TC) =	$796,831			

District 50 Farm

StopLight Cut-Offs[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Expected GFR	$1,190,801	$1,229,695	$1,239,896	$1,229,884	$1,240,086	$1,224,142	$1,234,343	$1,224,332	$1,234,533
Prob(GFR > TC)	66.6%	70.0%	73.2%	70.0%	73.2%	69.4%	72.4%	69.4%	72.6%
Prob(VC < GFR ≤ TC)	32.0%	30.0%	26.8%	30.0%	26.8%	30.6%	27.6%	30.6%	27.4%
Prob(GFR ≤ VC)	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Critical Values		Variable Costs (VC) =	$553,746		Total Costs (TC) =	$1,078,379			

District 60 Farm

StopLight Cut-Offs[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Expected GFR	$900,449	$935,833	$939,096	$933,758	$937,022	$931,515	$934,778	$929,441	$932,704
Prob(GFR > TC)	88.4%	97.2%	98.2%	96.0%	97.8%	96.6%	98.2%	95.8%	98.0%
Prob(VC < GFR ≤ TC)	11.6%	2.8%	1.8%	4.0%	2.2%	3.4%	1.8%	4.2%	2.0%
Prob(GFR ≤ VC)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Critical Values		Variable Costs (VC) =	$311,692		Total Costs (TC) =	$711,338			

District 70 Farm

StopLight Cut-Offs[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Expected GFR	$1,175,721	$1,232,241	$1,238,018	$1,230,367	$1,236,144	$1,225,559	$1,231,336	$1,223,685	$1,229,462
Prob(GFR > TC)	58.2%	63.6%	66.4%	63.6%	66.2%	62.2%	65.6%	62.6%	65.6%
Prob(VC < GFR ≤ TC)	38.4%	36.4%	33.6%	36.4%	33.8%	37.8%	34.4%	37.4%	34.4%
Prob(GFR ≤ VC)	3.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Critical Values		Variable Costs (VC) =	$699,198		Total Costs (TC) =	$1,131,710			

District 80 Farm

StopLight Cut-Offs[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Expected GFR	$1,136,410	$1,172,856	$1,177,524	$1,172,099	$1,176,767	$1,167,120	$1,171,788	$1,166,364	$1,171,032
Prob(GFR > TC)	68.0%	74.0%	75.2%	74.2%	75.2%	72.6%	74.8%	72.8%	74.4%
Prob(VC < GFR ≤ TC)	32.0%	26.0%	24.8%	25.8%	24.8%	27.4%	25.2%	27.2%	25.6%
Prob(GFR ≤ VC)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Critical Values		Variable Costs (VC) =	$562,166		Total Costs (TC) =	$1,051,547			

District 90 Farm

StopLight Cut-Offs[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Expected GFR	$946,216	$988,838	$991,511	$986,875	$989,548	$984,143	$986,817	$982,180	$984,854
Prob(GFR > TC)	67.4%	80.4%	83.0%	79.8%	81.8%	79.6%	82.0%	78.4%	81.0%
Prob(VC < GFR ≤ TC)	32.4%	19.6%	17.0%	20.2%	18.2%	20.4%	18.0%	21.6%	19.0%
Prob(GFR ≤ VC)	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Critical Values		Variable Costs (VC) =	$408,343		Total Costs (TC) =	$855,988			

[1] Refer to Table 3.3 for a description on simulation scenarios and abbreviations.

[2] GFR = Gross Farm Revenue

TC = Total Costs include variable and estimated hired labor, opportunity cost of unpaid labor, capital recovery of machinery and equipment, opportunity costs of land (rental rate), taxes, insurance, and general farm overhead expenses.

VC = Variable Costs including estimated seed, fertilizer, chemicals, custom operations, fuel, lube, electricity, repairs, purchased irrigation water and interests on operating capital expenses.

Table 7 provides a summary of all of the StopLight charts for the set of eight representative farms under the nine different simulation scenarios. Intervals shown in the Table represent the likelihood of expected gross farm revenue exceeding total costs, greater than variable costs and less than total costs, and falling below variable costs. These levels represent the probability of favorable, cautionary, and unfavorable event depictions of the StopLight Charts.

General observations show the probability of expected gross farm revenue falling below variable costs at negligible values. Given starting yield and price scenario baselines, the amount of simulated variation has an extremely low probability on not being able to cover variable costs. Risk management scenarios excluding the NP-NI-CM alternative show participating in one of these arrangements allows for guarantees to exceed all estimated variable costs for the eight representative farms. Results vary considerably on the probability of these operations covering variables expenses, but failing to exceed total costs. Several factors attribute to this observance including crop mix and production practices modeled for each representative farm. In example, those representative farms with more irrigated acres and located on the eastern portion of the state have less negative revenue variable compared to those of the western panhandle. Similar results may be drawn for the likelihood on exceeding total costs for the operations.

StopLight charts provide a stochastic analysis procedure which couples probability and expected outcomes together. Shortcomings of previous analysis tools including EV, CV, and SD are overcome by the StopLight chart analysis. One assumption introducing limitations with StopLight charts comes from the constant risk aversion assumption. Being able to evaluate risk preferences over a range of different preferences and drawn references from these depictions serves as fundamental goal of this analysis. Similar to SDRF, SERF allows for the ranking of multiple scenarios over different risk preferences given a defined level of wealth.

SERF represents the processes to analyze stochastic scenarios given a particular range of risk preferences and wealth. Unlike SDRF which requires a specified aversion level, SERF allow for the ranking of multiple scenarios typically ranging from over a neutral to extremely risk averse range. Summaries drawn can then be ranked according to the particular aversion class (Richardson and Outlaw, 2008). Also, across the general classes of preferences summaries may be drawn regarding the performance of the nine risk management scenarios.

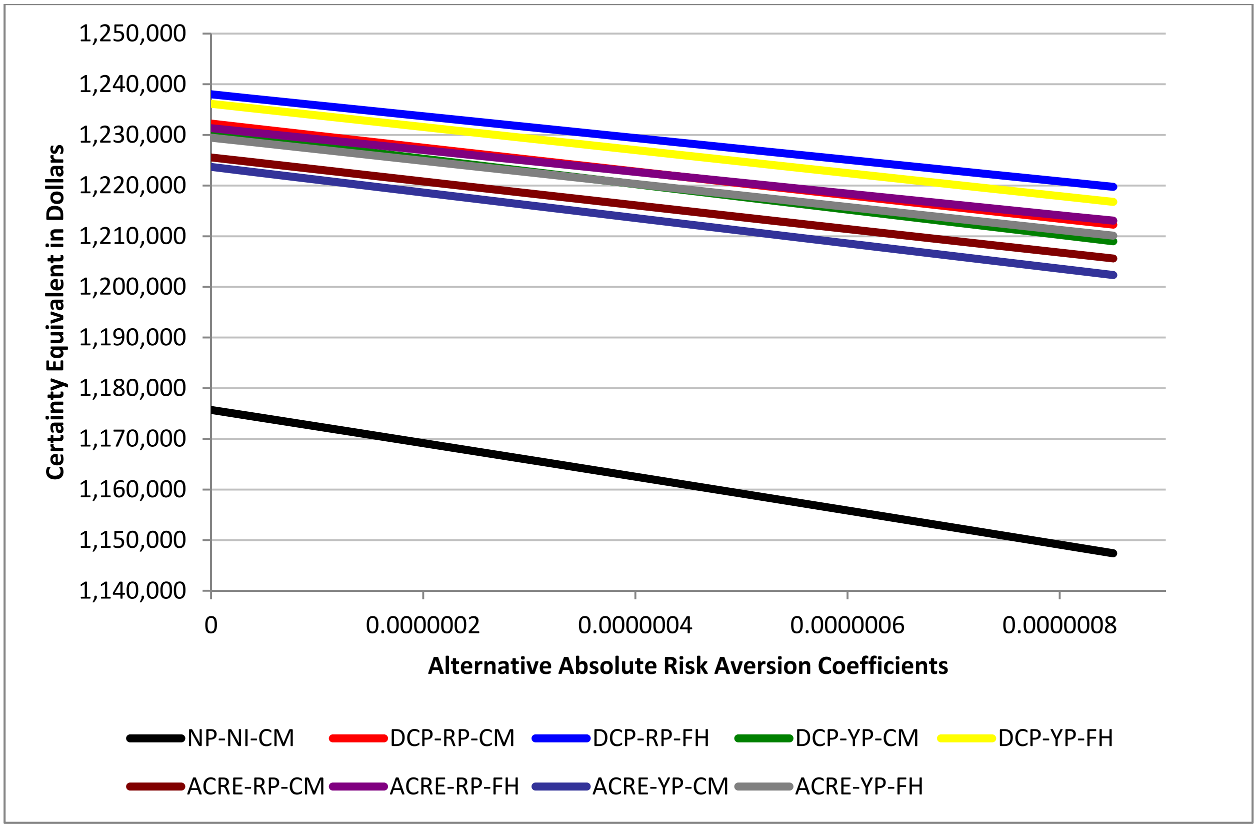
The range of risk preferences ranked by the SERF analysis includes risk neutral and slightly, normally, moderately, and extremely risk averse. These classes either rank preferences in SERF according to RAC or Absolute Risk Aversion Coefficients (ARAC). The difference between the two coefficients involves the assumptions behind the levels of wealth. RAC ranks preferences according to a relative or generalized level, whereas ARAC accounts for the decision-maker's level of wealth. In the case of the representative farms, the level of wealth (assets) is estimated for ARAC values to use in the SERF analysis.

Approximations for asset values on each of the eight representative farms come from the average asset turnover ratio in Nebraska. This ratio comes from the weighted summation of income and assets on farms with a gross farm income classification above $100,000 in the USDA ERS ARMS Farm Financial and Crop Production Practices: Farm Structure and Finance 2010-2011 section in Nebraska. These operations represent producers in all eight NASS Statistical districts

(USDA Economic Research Service, 2011). Dividing these two summed values equates to an average asset turnover of 25.23% in Nebraska during the 2010 production year. Income and asset values during the 2010 production year represent comparable economic forces as those expected in 2011 allowing for this value to serve as a comparable approximation.

Applying the average asset turnover ratio to each representative farm's expected gross income under the NP-NI-CM scenario generates estimated asset values reflecting the size and scope of each operation. SERF analysis uses these estimates to establish a level of wealth in calculating the ARAC values. To generate the ARAC values the constant relative RAC for each respected preference level was divided by the estimated wealth level for each individual farm. The constant relative RAC values include 0 for risk neutral and 0.5 for slightly, 1 for normally, 2 for moderately, and 4 for extremely risk averse.

Based upon the range of ARAC values, the SERF procedure ranks the Certainty Equivalents (CEs) for each scenario on the representative farm. A CE represents the sum of wealth necessary to achieve a particular level of utility under a negative exponential utility function. This equation takes into consideration a particular wealth and ARAC value when estimating the utility achieved under a particular risk preferences (Richardson and Outlaw, 2008). The resulting SERF chart ranks each alternative risk management scenario under the range of specified ARAC values. For a given ARAC level, the most desired alterative remains the one with highest CE value. The difference between two particular lines on a SERF charts represents the level of wealth necessary to equal higher CE scenario.



[1] Refer to Table 3 for a description on simulation scenarios and abbreviations.

Figure 6. Gross Farm Revenue Stochastic Efficiency with Respects to a Function (SERF) Analysis in District 70 for Alternative Scenarios[1]

As an example SERF chart, Figure 6 displays the nine alternative risk management scenarios under a negative exponential utility function with ARAC values ranging from 0 (risk neutral) to 0.0000009 (extremely risk averse) for the representative farm of District 70. Review of Figure 6 shows the DCP-RP-FH (light blue line) alternative ranks as the optimal strategy across all ARAC preferences. Under this scenario, each position on the utility function achieves the highest CE values under each ARAC position. The DCP-YP-FH scenario ranks second under this particular SERF analysis.

Scenarios do not rank the same across all risk preferences if one risk management CE equation crosses another risk management CE equation. As an example in Figure 6 when determining the third and fourth most desired outcomes, the utility function for the DCP-RP-CM and ACRE-RP-FH cross approximately half way through the ARAC spectrum. For approximately the first half of the ARACs, the DCP-RP-CM ranks as the third most preferred, but when ACRE-RP-FH crosses above this scenario the second alternative then has higher preferences. The ability of different utility functions to cross in a SERF chart highlights the value of noting that ranking the optimal choice needs to be noted for one particular position on the ARAC spectrum. A reference can still be drawn about how the optimal choice varied across the range of RAC values.

Table 8. Representative Farms Stochastic Efficiency with Respects to a Function (SERF) Summaries for Alternative Scenarios[1]

District 10 Farm

Risk Preference	ARAC[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Neutral	0.0000000	9	1	3	2	5	4	7	6	8
Slightly	0.0000002	9	1	3	2	5	4	7	6	8
Normal	0.0000004	9	1	3	2	5	4	7	6	8
Moderately	0.0000008	9	1	3	2	5	4	7	6	8
Extremely	0.0000017	9	1	3	2	5	4	7	6	8

District 20 Farm

Risk Preference	ARAC[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Neutral	0.0000000	9	6	2	5	1	8	4	7	3
Slightly	0.0000001	9	6	2	5	1	8	4	7	3
Normal	0.0000002	9	6	2	5	1	8	4	7	3
Moderately	0.0000004	9	5	2	6	1	7	4	8	3
Extremely	0.0000007	9	5	1	6	2	7	3	8	4

District 30 Farm

Risk Preference	ARAC[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Neutral	0.0000000	9	4	1	6	2	7	3	8	5
Slightly	0.0000001	9	4	1	6	2	7	3	8	5
Normal	0.0000002	9	4	1	6	2	7	3	8	5
Moderately	0.0000005	9	5	1	6	2	7	3	8	4
Extremely	0.0000010	9	5	1	6	2	7	3	8	4

District 50 Farm

Risk Preference	ARAC[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Neutral	0.0000000	9	6	2	5	1	8	4	7	3
Slightly	0.0000001	9	6	2	5	1	8	4	7	3
Normal	0.0000002	9	5	1	6	2	7	3	8	4
Moderately	0.0000004	9	5	1	6	2	7	3	8	4
Extremely	0.0000008	9	5	1	6	2	7	3	8	4

District 60 Farm

Risk Preference	ARAC[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Neutral	0.0000000	9	3	1	5	2	7	4	8	6
Slightly	0.0000001	9	3	1	5	2	7	4	8	6
Normal	0.0000003	9	3	1	5	2	7	4	8	6
Moderately	0.0000006	9	4	1	6	2	7	3	8	5
Extremely	0.0000011	9	4	1	6	2	7	3	8	5

District 70 Farm

Risk Preference	ARAC[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Neutral	0.0000000	9	3	1	5	2	7	4	8	6
Slightly	0.0000001	9	3	1	5	2	7	4	8	6
Normal	0.0000002	9	3	1	5	2	7	4	8	6
Moderately	0.0000004	9	3	1	6	2	7	4	8	5
Extremely	0.0000009	9	4	1	6	2	7	3	8	5

District 80 Farm

Risk Preference	ARAC[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Neutral	0.0000000	9	3	1	4	2	7	5	8	6
Slightly	0.0000001	9	3	1	4	2	7	5	8	6
Normal	0.0000002	9	3	1	5	2	7	4	8	6
Moderately	0.0000004	9	3	1	5	2	7	4	8	6
Extremely	0.0000009	9	4	1	6	2	7	3	8	5

District 90 Farm

Risk Preference	ARAC[2]	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Neutral	0.0000000	9	3	1	4	2	7	5	8	6
Slightly	0.0000001	9	3	1	5	2	7	4	8	6
Normal	0.0000003	9	3	1	5	2	7	4	8	6
Moderately	0.0000005	9	3	1	5	2	7	4	8	6
Extremely	0.0000011	9	3	1	5	2	7	4	8	6

[1] Refer to Table 3.3 for a description on simulation scenarios and abbreviations.

[2] ARAC = Absolute Risk Aversion Coefficient. Refer to Richardson and Outlaw (2009) for further discussion on ARAC.

Table 8 summarizes the eight SERF analyses of the eight representative farm simulation scenarios. Each summary ranks the nine risk management scenarios with a given risk preference and ARAC value. These rankings sorted the alternatives by assigning those with the highest CE the greatest preference. The optimal choice and ranking of the scenarios varies depending upon the preference and representative farm. CE displayed with the negative exponential utility functions cross periodically in analysis. When drawing an overall summary of Table 8, a specific ARAC level must be defined or assumptions regarding the crossing inverse utility functions have to be taken into consideration to define the optimal set of strategies.

For individual risk preference and associated ARAC levels, the SERF procedure appropriately identifies the dominant strategy for each alternative choice. Trying to rank the optimal strategy for each individual farm causes conflicting results due to crossing CE equations in District 20 and 50. Only three cases involving these two representative farms exist where the CE lines cross for the optimal choice. Assuming the most desired risk management choice is the alternative which has the most number-one rankings across the five ARACs in each farm level analysis allows for identification of an optimal strategy. Observations drawn from Table 8 with the given assumption and limitations shows the optimal choices include: DCP-RP-CM for District 10, DCP-YP-FH for District 20, and DCP-RP-FH for Districts 30 through 90. Once again not participating in any government programs, crop insurance products, or marketing strategies represented by the NP-NI-CM scenario provides the least desired alternative consistently across all preferences and outcomes. Ranking of alternatives between the most and least desired management scenarios shows mixed results.

Limitations and shortcomings posed by the expected value, coefficient of variation, stochastic dominance, and StopLight analysis procedures are overcome with the SERF methodology given certain assumptions and limitations. SERF allows for the ranking of revenue distributions through the use of expected values, variability of revenue, and different risk preferences. One single methodology cannot provide the exclusive means to analyze simulation results without shortcomings. SERF provided the most effective procedure given the scope of the analysis, but drawing references from the previous four procedures still has value.

Five different analysis procedures including EV, CV, SD, StopLight charts and SERF were used to analyze the nine different simulation scenarios across the eight representative farms. Using the various assumptions and limitations of each procedure, an optimal set of alternatives were identified under each procedure. SD techniques either provided inconsistent techniques or did not meet the needs of this analysis and their results are not included in the following summary. Table 9 and Figure 7 present the results from the four procedures utilized. Table 9 presents the summary of the optimal scenarios involving the EV, CV, StopLight, and SERF analysis. The optimal strategy involving each farm and the particular analysis procedure are denoted with the number one. Also, each scenario’s total is summed across the eight representative farms in each analysis. These totals are then displayed in Figure 7 as a bar chart depiction.

Table 9. Summary of Preferred Stochastic Results for Representative Farms under Alternative Scenarios[1]

Expected Gross Farm Revenue (GFR)

Region	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
District 10 Farm		1							
District 20 Farm					1				
District 30 Farm			1						
District 50 Farm					1				
District 60 Farm			1						
District 70 Farm			1						
District 80 Farm			1						
District 90 Farm			1						
Total	0	1	5	0	2	0	0	0	0

Coefficient of Variation (CV)

Region	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
District 10 Farm			1						
District 20 Farm			1						
District 30 Farm			1						
District 50 Farm			1						
District 60 Farm			1						
District 70 Farm			1						
District 80 Farm			1						
District 90 Farm			1						
Total	0	0	8	0	0	0	0	0	0

StopLight Charts

Region	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
District 10 Farm			1						
District 20 Farm			1						
District 30 Farm			1						
District 50 Farm					1				
District 60 Farm			1						
District 70 Farm			1						
District 80 Farm			1						
District 90 Farm			1						
Total	0	0	7	0	1	0	0	0	0

Stochastic Efficiency with Respects to a Function (SERF)

Region	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
District 10 Farm		1							
District 20 Farm					1				
District 30 Farm			1						
District 50 Farm			1						
District 60 Farm			1						
District 70 Farm			1						
District 80 Farm			1						
District 90 Farm			1						
Total	0	1	6	0	1	0	0	0	0

[1] Refer to Table 3 for a description on simulation scenarios and abbreviations.

At the most basic analysis level in Table 9, the EV procedure's optimal choice was the scenario producing the highest average expected gross farm revenue. Results showed the highest EV by scenario and representative farm included: DCP-RP-CM for District 10, DCP-YP-FH in District 20 and 50, and DCP-RP-FH in Districts 30, 60, 70, 80, and 90. These results had an indication that the alternatives involving the DCP as the government program choice and RP as the crop insurance product had the greatest preference for the representative farms. Another element of risk farms are concerned about involves the variability of revenue, which the EV procedure does not take into consideration when analyzing the alternative scenarios.

CV overcomes some of the limitations imposed by the EV analysis, by combining the mean (EV) and standard deviation of gross farm revenue. With this evaluation process, the alternative showing the lowest CV provides the least revenue variability on a farm. The DCP-RP-FH alternative proved to be the optimal scenario across all farms for the CV analysis as Table 9 summarizes. However the CV did not determine the optimal choice on all of the representative farms to necessarily have the highest EV. Under that analysis DCP-RP-CM in District 10 and DCP-YP-FH in District 20 or 50 provided the most desired results. These scenarios provided slightly higher anticipated averages under the set of alternative available by $3,668 in District 10, $488 in District 20, and $190 in District 50. Although negligible in value when compared to the overall expected gross farm revenue, the results still present a fundamental difference between the two methodologies.

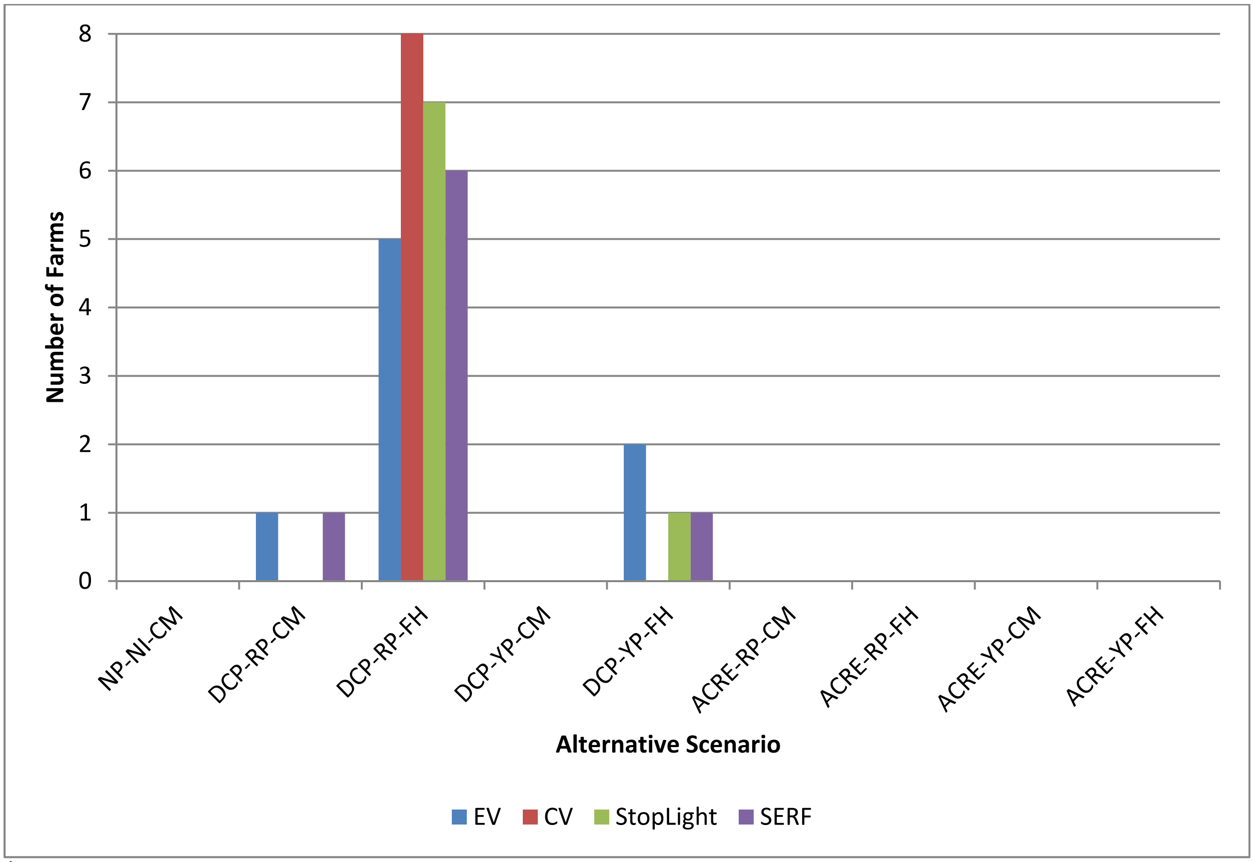
Solely relying on the highest EV or lowest CV does not take into consideration the probability of achieving a certain level of revenue. SD involves FSD, SDS, and SDRF allows for the ranking of stochastic distributions under various probability levels and assumptions. Analysis of the CDF charts showed each representative farm's revenue distribution under one scenario overlaps multiple times with another alternative, which eliminates the FSD and SDS methodologies from analyzing the revenue distributions. SDRF could analyze the various scenarios, but requires a predefined RAC level that only encompasses one particular risk aversion level.

Shortcomings introduced by EV, CV, or SD acted as the motivation to consider other analysis procedures. StopLight charts introduced the methodology to evaluate the probability of achieving different levels of revenue involving a stochastic distribution. Critical cut-off values established under this process represented estimated variable and total crop production expenses. The optimal choice with this process involved the outcome with the highest probability of covering total crop production expenses. Table 9 indicates that the DCP-RP-FH served as the optimal strategy for all representative farms except District 10 where the preferred alternative was DCP-YP-FH. Although each individual can interpret each StopLight chart independently, the scope of the analysis seeks to rank different risk management scenarios with a variety of risk preferences.

Introduced as the final technique to analyze the nine stochastic scenarios, SERF allowed for the ranking of different alternatives and risk preferences. Each farm had a level of asset estimated to determine the ARACs necessary for the SERF analysis. Preferences established from the ARAC ranged from risk neutral to extremely risk averse. Under this procedure the optimal scenario served as the one with the highest rank amongst all of the preferences. Under the SERF analysis optimum scenarios by representative farm included: DCP-RP-CM for District 10, DCP-YP-FH in District 20 and DCP-RP-FH in Districts 30, 50, 60, 70, 80, and 90 as shown in Table 9.

Conclusion

Individual farm level stochastic analysis results presented in Table 9 were compiled to draw overall summaries involving all of the procedures. From these results, the bar chart in Figure 7 presents the optimal choices involving the EV, CV, StopLight charts and SERF. Definite trends may be observed from the overall performance of these programs across the set of representative farms.



[1] Refer to Table 3 for a description on simulation scenarios and abbreviations.

[2] GFR = Expected Gross Farm Revenue, CV = Coefficient of Variation, StopLight = Stoplight Analysis Charts, and SERF = Stochastic Efficiency with Respects to A Function

Figure 7. Bar Chart Depiction of Preferred Stochastic Results for Representative Farms under Alternative Scenarios[1]

Overall, Figure 7 shows the DCP-RP-FH scenario provided the greatest number of optimal outcomes across the four different stochastic analysis procedures. All representative farms were better off participating in a scenario involving a government program and crop insurance product instead of the NP-NI-CM alternative. One can ascertain from this result that participating in government program and purchasing a crop insurance policy increases and stabilizes gross farm revenue to a certain degree. Several reasons may explain and suggest why participating in the various risk management strategies provided greater protection to the representative farm's revenue.

As part of the Farm Bill for through the end of the 2012 crop production year, producers may choose to either participate in DCP or ACRE. Either of these programs have DPs, which distribute direct monetary payments based upon historical base acres and yields. DP under ACRE are at a reduced rate, but in either case monetary payments received by the operations are a guaranteed source of income subject to FSA compliance requirements. Implications for crop producers in Nebraska point to participation in DCP or ACRE as beneficial to their gross farm revenue.

Another observation shows participation in scenarios involving DCP are more desired over the ACRE alternative for the representative farms as Figure 7 summarizes. Price and yield expectations during the 2011 production year are considerably higher than guarantees or price support levels established under the ACRE and DCPs. The performances of these programs are influenced by the yield and price distributions simulated in the model.

While ACRE had guarantees closer to price expectations of 2011 when compared to the DCP supports, the risk reduction effects gained with this program do not exceed the reduction in DPs. Recommendations drawn on this analysis regarding current government program options suggest the DCP program outperforms ACRE under current price and yield expectations and variability levels expressed in the representative farm model. Commodity programs provided through the USDA FSA beyond 2012 remain unknown, but serve as an area for future research.

Figure 7 highlights that beside the most preferable scenario of DCP-RP-FH; the DCP-YP-FH and DCP-RP-CM alternatives are the second and third most desirable outcomes, but were far behind. Representative farms in district 30, 60, 70, 80, and 90 had results consecutively picking the DCP-RP-FH scenario as the optimal outcome. The only difference for the representative farms in district 20 and 50 selecting the DCP-YP-FH scenario as the most preferred scenario relates to the crop insurance choice of RP versus YP in the risk management strategy. Also, the optimal outcome DCP-RP-CM for district 50 differs from the DCP-RP-FH by using a CM strategy instead of a FH. This summary shows that the representative farms in District 10, 20, and 50 act as the outliers in the analysis.

Differences between the expected gross farm revenue of the DCP-RP-FH scenario and optimal strategies identified in District 10, 20, and 50's representative farms amount to $3,668, $488, and $190. In relative comparison to the expected gross farm revenue, these amounts are small and insignificant. Still evaluating the difference in marketing or crop insurance strategies provide some explanation. Underlying acreage distributions and yield expectations across the three farms leads to the differences in performance of these strategies.

NASS-ASDs 10, 20, and 50 lie in the western, north central, and central regions of Nebraska. The representative farm in district 10 has unique cropland acres in comparison to the other eight operations. Similar to other representative farms in size, District 10's representative farm has approximately 30 and 70 percent of the cropland acres in corn and winter wheat. District 20's representative farms has a cropland acre distribution of 65, 24, and 11 percent involving irrigated corn, irrigated soybeans, and dryland corn. Also, the representative farm in District 50's acreage distribution follows a similar distribution where 71, 18, and 11 percent of the land is in irrigated corn, irrigated soybeans, and dryland corn once again. The location of these representative farm districts and distribution of total cropland acres varies from the five other farms.

The representative farm in District 10 with a negative FH gain under the DCP-RP-FH scenario leads to stronger performance of CM with the DCP-RP-CM alternative. Evaluation of the base planting-time average versus harvest-time average futures price shows on average the winter wheat contract ends higher for hard red winter wheat, but only slightly lower for corn. These differences show the futures hedge loss and gain for the two crops raised on the representative farm partially offset each other, but in net ends with a negative gain. Several reasons may lead to the notably higher average hard red winter wheat futures harvest price. Contract performance, liquidity, and number of market participants may influence the historical price deviations and ultimately lead to the higher harvest-time prices simulated.

Finally, the representative farms in District 20 and 50 where the YP under the DCP-YP-FH strategy outperforms the RP in the DCP-RP-FH alternative remain the last arrangement to examine. In each case either representative farm has about 90% of the total cropland acres irrigated. Assuming the crop insurance premium rates are actuarially fair, representative farms should prefer the RP crop insurance policy due to the rate of government subsidization and methodology used to calibrate farm level yield variability.

RP and YP crop insurance have subsidization rates at levels greater than 50 percent of the policy. Assuming farm level yield deviations are calibrated appropriately, producers should choose the product providing the greatest level of protection being RP. YP only provides protection to yield losses, whereas RP covers both yield and price risk which encompasses both systemic and idiosyncratic elements. The relatively small differences in expected revenue between the two scenarios shows a producer would be just as well off to participate in the DCP-RP-FH policy. Also, since both sites encompass predominately irrigated practices this leads to lower yield risk, but little protection to systemic price shocks. A risk averse operation would prefer the greater level of protection with the DCP-RP-FH instead of the DCP-YP-FH.

In summary, the DCP-RP-FH strategy serves as the dominant strategy across the majority of representative farms given price and yield expectations of 2011. Simulation procedures utilized to evaluate the results included: EV, CV, SD, StopLight charts, and SERF. These procedures did show that the optimal strategy did not carry through to all of the procedures for representative farms in District 10, 20, and 50. Differences were negligible in comparison to overall farm revenue. Unique yield and price parameters of these farms may have led to the differences.

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Appendix

Table A.1 Representative Farm Simulation Summary Statistics for Alternative Scenarios[1]

District 10 Farm

Variable	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Mean	604,574.20	644,894.21	641,226.06	643,533.15	639,865.00	640,624.49	636,956.34	639,263.43	635,595.29
StDev	160,866.02	133,579.07	127,017.63	137,026.24	130,387.63	133,467.39	126,961.85	136,895.14	130,309.95
CV	26.61	20.71	19.81	21.29	20.38	20.83	19.93	21.41	20.50
Min	68,516.84	406,772.62	394,831.70	382,369.98	386,203.54	402,341.69	390,400.77	377,939.05	381,772.61
Max	1,048,753.81	1,062,383.08	988,425.65	1,065,125.55	991,168.12	1,057,952.15	983,994.71	1,060,694.62	986,737.18

District 20 Farm

Variable	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Mean	1,359,031.26	1,401,590.34	1,411,523.92	1,402,078.55	1,412,012.14	1,395,248.26	1,405,181.84	1,395,736.47	1,405,670.06
StDev	297,567.91	267,779.44	246,992.43	272,534.87	251,504.61	267,750.53	246,961.28	272,506.38	251,473.92
CV	21.90	19.11	17.50	19.44	17.81	19.19	17.58	19.52	17.89
Min	464,913.79	902,414.03	893,880.09	824,266.49	884,746.21	896,050.28	887,516.34	817,902.74	878,382.46
Max	2,129,762.99	2,146,513.45	1,955,441.38	2,151,003.64	1,959,931.57	2,140,149.70	1,949,077.63	2,144,639.89	1,953,567.82

District 30 Farm

Variable	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Mean	1,007,462.83	1,032,496.72	1,036,303.04	1,031,480.02	1,035,286.34	1,028,682.18	1,032,488.49	1,027,665.48	1,031,471.79
StDev	176,336.44	164,773.97	149,036.96	167,245.37	151,016.14	164,639.73	148,901.38	167,108.79	150,877.55
CV	17.50	15.96	14.38	16.21	14.59	16.00	14.42	16.26	14.63
Min	491,627.03	655,714.24	677,650.01	620,167.19	676,267.34	651,830.44	673,766.21	616,283.39	672,383.54
Max	1,586,734.77	1,599,230.52	1,456,417.64	1,600,584.97	1,457,772.09	1,595,346.72	1,452,533.84	1,596,701.18	1,453,888.30

District 50 Farm

Variable	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Mean	1,190,801.24	1,229,694.55	1,239,896.15	1,229,884.30	1,240,085.90	1,224,141.90	1,234,343.50	1,224,331.65	1,234,533.25
StDev	267,607.89	237,471.20	221,886.96	243,039.86	226,792.31	237,439.74	221,852.61	243,009.40	226,759.01
CV	22.47	19.31	17.90	19.76	18.29	19.40	17.97	19.85	18.37
Min	300,478.85	773,731.97	771,073.42	683,532.78	729,992.31	768,153.41	765,494.86	677,954.22	724,413.75
Max	1,746,749.47	1,804,378.49	1,655,036.96	1,800,512.00	1,659,479.42	1,798,799.93	1,649,458.40	1,794,933.44	1,653,900.86

District 60 Farm

Variable	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Mean	900,449.03	935,832.61	939,096.12	933,758.48	937,021.99	931,514.74	934,778.25	929,440.60	932,704.12
StDev	155,902.96	138,566.56	124,525.43	142,237.35	127,234.48	138,509.05	124,456.29	142,179.68	127,164.98
CV	17.31	14.81	13.26	15.23	13.58	14.87	13.31	15.30	13.63
Min	501,945.98	656,542.69	649,949.42	567,290.26	635,955.01	652,169.59	645,576.32	562,917.17	631,581.91
Max	1,389,554.77	1,404,953.64	1,347,471.56	1,406,797.04	1,349,314.96	1,399,513.68	1,342,031.60	1,401,357.09	1,343,875.01

District 70 Farm

Variable	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Mean	1,175,720.85	1,232,240.98	1,238,017.77	1,230,367.25	1,236,144.04	1,225,558.87	1,231,335.66	1,223,685.14	1,229,461.93
StDev	255,731.14	218,403.78	208,294.37	225,282.68	214,151.98	218,346.15	208,265.99	225,224.23	214,121.67
CV	21.75	17.72	16.82	18.31	17.32	17.82	16.91	18.41	17.42
Min	350,181.69	831,422.99	823,311.36	722,593.65	749,740.96	824,592.41	816,480.78	715,763.08	742,910.38
Max	1,842,281.21	1,860,427.75	1,749,523.53	1,865,040.18	1,754,135.96	1,853,597.17	1,742,692.95	1,858,209.60	1,747,305.38

District 80 Farm

Variable	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Mean	1,136,409.57	1,172,855.88	1,177,523.96	1,172,099.30	1,176,767.38	1,167,120.24	1,171,788.31	1,166,363.65	1,171,031.73
StDev	190,419.26	173,980.89	158,577.09	177,595.53	161,552.23	173,947.44	158,557.42	177,562.93	161,533.11
CV	16.76	14.83	13.47	15.15	13.73	14.90	13.53	15.22	13.79
Min	589,762.08	775,717.32	795,179.11	665,343.20	795,235.96	769,925.48	789,387.27	659,551.36	789,444.12
Max	1,712,964.67	1,735,290.14	1,575,314.40	1,737,462.71	1,577,486.98	1,729,498.29	1,569,522.56	1,731,670.87	1,571,695.13

District 90 Farm

Variable	NP-NI-CM	DCP-RP-CM	DCP-RP-FH	DCP-YP-CM	DCP-YP-FH	ACRE-RP-CM	ACRE-RP-FH	ACRE-YP-CM	ACRE-YP-FH
Mean	946,216.15	988,837.68	991,511.49	986,874.59	989,548.40	984,143.49	986,817.30	982,180.40	984,854.21
StDev	171,326.46	150,511.96	139,801.61	153,323.40	141,956.85	150,452.28	139,743.81	153,262.01	141,896.91
CV	18.11	15.22	14.10	15.54	14.35	15.29	14.16	15.60	14.41
Min	399,432.37	642,955.23	662,057.97	630,413.36	649,516.10	638,162.31	657,265.05	625,620.44	644,723.18
Max	1,473,128.17	1,488,633.63	1,447,130.91	1,490,513.38	1,449,010.66	1,483,840.71	1,442,337.99	1,485,720.47	1,444,217.74

[1] Refer to Table 3 for a description on simulation scenarios and abbreviations.