TRAINING COMMERCIAL FARMERS HOW TO ANALYSE AND RANK RISKY ALTERNATIVES

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Abstract

Risk management is a major challenge for farm managers. Monte Carlo simulation models can be used to teach commercial farmers how to manage risk. However, the decision tools for ranking risky alternatives have long been an impediment to learning the art of ranking risky alternatives. New risk ranking tools available in a Microsoft® Excel add-in, Simetar, take the art out of ranking risky alternatives. SERF and StopLight charts in Simetar are demonstrated by ranking risky alternative marketing, crop mixes and crop insurance strategies available to a representative crop farm.

***Key Words**: Risk Management, SERF, Stochastic Efficiency, StopLight, Simetar, Simulation*

Introduction

Risk management is a major challenge facing farm managers. In the future, price risk is likely to increase with globalization of agricultural commodity markets. Production risk may increase as farmers experiment with growing different crops and new varieties that require a different bundle of management skills.

Farm size will not be a reliable predictor of which farms will survive in the future. Rather, the farmers who survive and prosper will be those who are good risk managers. Risk management skills are not inherited and are not proportional to the size of farm a farmer inherits or marries. Rather risk management skills are learned. With the increased need to manage risk and the fact that risk management skills are learned, there is a growing need to train commercial farmers how to analyze and rank risky alternatives.

The increased demand for risk management training comes at a time when there are more tools available for training farm managers than ever before. Microsoft 7 Excel is widely used by farm managers to develop budgets, project cash flows, and evaluate Awhat if ...@ management options. Adding risk to Excel spreadsheet budgets, cash flow models, and Awhat if ...@ analyzers is easy due to add-ins, such as Simetar[1] and @Risk.

Simply adding risk to an Excel spreadsheet model, however, does not help farm managers analyze and rank their risky alternatives. Farm managers need a straightforward method to analyze and rank their preferred choice among risky alternatives that is easy to use.

The objective of this paper is to demonstrate how the risk ranking tools in Simetar can be used to rank alternative risk management strategies so the results are easily understood and useful to farm managers. The steps for developing a spreadsheet model of a representative mid-west grain farm are presented using the equations in simple pro-forma financial statements. The steps for making the model stochastic are described using functions in Simetar. Alternative management strategies are simulated and ranked using rigorous risk ranking procedures in Simetar to show how farm managers can apply advanced risk analysis tools to farming decisions.

Steps to Develop a Simulation Model

The steps to develop a Monte Carlo simulation model are outlined by Richardson (2006). The first step is to determine the purpose of the model; in this case, it is to develop a probabilistic forecast of the economic viability for a representative farm. The second step is to identify the key output variables (KOVs) necessary to satisfy the objective of the model, e.g., net present value (NPV), rate of return on investment (ROI), annual net cash income, and annual ending cash reserves. The third step is to write out the equations necessary to calculate the KOVs and in the process identify the stochastic and exogenous variables in the model. The equations to calculate the KOVs for a crop farm are the accounting equations in the pro-forma financial statements: income statement, cash flow and balance sheet.

[1] Simetar, Simulation & Econometrics To Analyze Risk, is an Excel add-in for estimating parameters of probability distributions, simulating Monte Carlo models, developing charts of stochastic results and ranking risky alternatives. Simetar was developed by Richardson, Schumann, and Feldman (2005) for teaching risk analysis and conducting risk analyses at Texas A&M University.

After identifying the stochastic variables, the analyst must estimate the parameters to describe and simulate the probability distributions for the random variables. Richardson, Klose and Gray (2000) recommend using a multivariate empirical (MVE) distribution expressed as fractional deviations from trend or mean to simulate random variables when dealing with limited data. The MVE distribution appropriately correlates random variables so the historical correlation among the random variables is maintained in the simulated variables.[2]

The analyst should validate that the simulated random variables reproduce their respective means and the historical correlation. The final step in model development is programming the equations for the pro-forma financial statements using the stochastic variables, forecasts of exogenous variables, and assumed management values for the farm.

Demonstrate the Steps for Model Development

The steps for developing a farm simulation model are demonstrated using an Excel model of a representative grain farm. The purpose of the model is to analyze the benefits of alternative management practices on economic viability over a five year planning horizon. The next section describes the process used to gather the data and the management scenarios to be analyzed and ranked.

Subsequent sections describe parameter estimation for the stochastic variables and validation, followed by a discussion of the equations for the model. The final section of the paper presents examples of the results and demonstrates how the risky alternatives can be ranked with risk ranking tools in Simetar.

Representative Grain Farm

Data for a Midwest representative grain farm was developed using a focus group interview process by the Agricultural and Food Policy Center (Outlaw, et. al., 2007). The focus group was made up of five grain farmers selected by the county agent who are representative of commercial-scale farmers in the area in that they are full-time farmers, typical in size, crop mix, soil type, and tillage system. The focus group interview provided information regarding farm size, crop mix, variable production and harvesting costs, fixed costs, yield histories, farm program history, land tenure arrangement, asset values, rental costs, and machinery inventory.

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[2] Simetar has a one step function to simulate MVE distributions which estimates the parameters and simulates the random variables. As a consequence this step in model development is perhaps the easiest step in developing a Monte Carlo simulation model for risk analysis.

The representative grain farm model was simplified for the example by excluding farm program payments and machinery replacement over the five year planning horizon. The data to describe and simulate the farm are presented in the first 60 lines in the printout of the model presented in the Appendix[3]. The Appendix is a printout of the simulation model for one realization (or iteration). The bold values in the input section (lines 1-60) can be changed by the user to test alternative "what if…" questions[4].

The model is designed to simulate the farm for four different combinations of cash sales/forward contracting (lines 46-48), four different crop mixes (lines 50-52), and four levels of crop insurance coverage levels (lines 56-59). The SCENARIO() function in cells C47, C48, C51, C52, and C56-C59 show the values for the Base scenario. During simulation Simetar uses the values for the other three scenarios in order.

Parameter Estimation for MVE Distribution

The stochastic variables for the representative farm are annual prices and yields for both corn and soybeans. The historical data for these four random variables are presented in lines 69-82 in the Appendix. The yields are annual values for any farmer in the focus group rather than using county average yields that have less variability than would be experienced by a single farmer. The prices are national season average prices. The variables were tested for the presence of a linear trend (lines 91-98) using the trend icon in Simetar and a statistical trend was not found for any of the variables, based on the high p values (Prob(T) greater than 0.05).

A correlation matrix of the four random variables (lines 100-105) was estimated using the Correlation Matrix icon in Simetar. The results of the correlation matrix showed that two of the correlation coefficients are statistically different from zero (bold values). Once it is determined that significant correlation is present among the random variables, a multivariate distribution must be used to avoid biasing the means and variance for the KOVs.

Parameter estimation and simulation for an MVE distribution is handled internally in Simetar using the MVEMP() function. The MVEMP() function uses as its input: the historical data for the random

3 The line numbers and cell names in the Appendix printout of the model are referred to throughout the paper to indicate how the simulation model is organized and the types of equations included.

4 The complete model and a Free Trial copy of Simetar are available on the www.simetar.com website.

variables (lines 71-82), the forecasted means for a particular year (lines 116-119),[5] and an option to estimate the parameters as fractional deviations from the mean[6]. The function is repeated for each year (B123:B126, C123:C126, … , F123:F126) with that year's respective means. The =MVEMP( ) functions for simulating the four random variables for the fifth year (F123-126) are displayed in cell G123.

Statistical validation tests included in Simetar were used to validate a 500 iteration sample of random values for the MVE distribution. The validation tests failed to reject the null hypotheses that the simulated data reproduced the historical correlation and the simulated means were equal to their assumed values.

Financial Statements

Once the random variables are simulated they are used in the equations to calculate variables in the pro-forma financial statements. For a representative farm, annual crop production is the first variable to calculate (lines 130-132), using the equation for crop i in year t:

$\textbf{ProdCrop}^{7}_{it} = \textbf{Yield}_{it} * \text{Planted Area}_{it}$

Market receipts for each crop (lines 139-141) are calculated using a weighted price based on the marketing scenario (fraction of the crop sold at market and the fraction of the crop contracted at a fixed price):

$\textbf{Receipts}_{it} = \textbf{ProdCrop}_{it} * ((\textbf{National Price}_{it} + \textit{Local Basis}_{i}) * (1 - \text{Contract Fract}_{i}) + \textit{Contract Price}_{it} * \text{Contract Fract}_{i})$

The formulas for simulating crop insurance scenarios are programmed in lines 146-154 so the indemnities are available for use in the Income Statement. Updated annual production costs per hectare, harvesting costs per kg, and fixed costs are calculated using their base values for 2007 plus an inflation rate adjustment fraction for each year (lines 157-166).

5 Projected values for the farmer's expected yields over the planning horizon (lines 29-30) and projected mean prices, prime interest rate, and rate of inflation (lines 63-67) from the FAPRI January 2007 Baseline are used to simulate the 2007-2011 horizon.

6 Given that the historical data does not show the presence of a linear trend, the MVE was estimated and simulated as fractional deviations from the mean using option 1. The MVEMP() function is an array function so the random values it simulates are simulated simultaneously using the implicit correlation matrix in the historical data.

[7] Variable names in bold indicate the variable is either stochastic or is a function of a stochastic variable. Variable names in italics are constants assumed for the farm.

The Income Statement (lines 171-190) has two parts: receipts and expenses. The values in the receipts section are calculated earlier so they are cell referenced into the Income Statement (see G173-G176). The formulas displayed in column G of the Appendix indicate the actual formulas for the last year in column F of the spreadsheet model.

Expenses for crop production and harvesting are calculated individually for each crop (lines 179-182) for ease in verifying the model. Expenses for annual land rent and fixed costs are added to variable costs to calculate the operating loan interest expense using the formula:

$$\textbf{Operating Interest}_t = \Sigma\ (\textbf{Variable Costs}_t + \textit{Fixed Costs}_t) * \text{Interest Rate}_t + \textit{Fraction of Year}$$

where: Fraction of Year is the average length of time the operating loan accrues interest, usually 0.6 for crop farms. To account for negative cash flows, the analyst must include line 188 in the Income Statement to calculate interest for cash flow deficit loans in the previous year. Net cash farm income is calculated as total receipts minus total expenses (line 190).

The Cash Flow Statement (lines 191-203) calculates cash inflows and outflows. Inflows of cash (line 195) include net cash income from line 190, beginning cash reserves, and interest earned on cash reserves. Beginning cash reserves on January 1 (line 192) equal cash assets on December 31 of the previous year (line 205). For a stochastic farm model one must include line 198 which forces the farm to repay short-term loans from the previous year's cash flow deficit (line 210).

Ending cash reserves (line 203) can be positive or negative. If ending cash is positive it is an asset in the Balance Sheet (line 205). If ending cash is negative it is a liability (line 210) and must be included as such in the Balance Sheet. Land value is inflated using an assumed rate of inflation in cell B9. Land debt is reduced each year as the current loan is repaid. Net worth equals assets minus liabilities.

Financial ratios and summary variables are calculated last in the simulation model (lines 214-229). NPV is calculated using the formula:

$$\text{NPV} = -\textit{Beginning Net Worth} + \Sigma[\textbf{Family Living}_t/(1 + i)^t] + \textbf{Ending Net Worth}/(1 + i)^5$$

where: i is the discount rate of 0.125. Any financial ratio of interest which is a function of variables included in the pro-forma financial tables can be calculated and used to rank risky alternatives. A KOV table (lines 231-257) is a list of all output variables for the statistical summary of a stochastic analysis. The simulated values for a variable provide an empirical estimate of the variable's probability distribution. The empirical distributions can be presented in charts and used with various risk ranking procedures to rank risky alternatives.

Risk Ranking Tools in Simetar

Simetar includes utility based risk ranking tools as well as capabilities to develop charts for displaying risk associated with risky alternatives. Stochastic dominance is available in Simetar and can be run using a single icon on the toolbar. Stochastic dominance rankings, however, are difficult to interpret for lay users and may result in inconclusive rankings.

A more robust and easier to interpret method for ranking risky alternatives is stochastic efficiency with respect to a function or SERF (Hardaker, et al 2004). Simetar provides a toolbar icon for ranking risky alternatives using SERF. The SERF rankings are presented in a chart which shows the certainty equivalents (CE) for each scenario over a range of risk aversion levels, so we do not have to know a decision maker's risk aversion coefficient. Assuming the decision maker prefers more to less, the scenario with the highest CE line is the preferred risky alternative for decision makers with a particular level of risk aversion. The SERF chart can be developed using a range of risk aversion from risk neutral (RRAC of zero) to extremely risk averse (RRAC of 4.0) to cover the full range of rational decision makers[8].

StopLight charts can be developed to display and rank risky alternatives. StopLight charts are stacked bar charts which show the probability of a risky alternative failing to achieve a minimum goal and the probability of exceeding an upper goal. StopLight charts are easy to use for decision makers not comfortable with utility based risk ranking tools.

Ranking Risky Alternatives

The results for simulating the Base scenario are summarized in Table 1. Average NPV is $98,000 with a range from -$160,800 to $395,600. Average net cash income in year one ranges from -$74,300 to $289,300, so the farm faces considerable risk. The cumulative distribution function for NPV under the Base scenario is presented in Figure 1 and shows there is a 13 percent chance that the farm will have a negative NPV.

Four alternative marketing strategies were simulated to determine which would be preferred. The Base scenario assumed all of the crops were sold at harvest and each alternative scenario contracted a different fraction of the crops at a fixed price. The empirical probability distributions for NPV estimated from the

[8] Anderson and Dillon (1992) proposed the following schedule for indicating a person's relative risk aversion: zero is risk neutral, 1 is normal risk aversion, 2 is slightly risk averse, and 4 is extremely risk averse.

simulation are summarized in Figure 2. Because the CDFs cross one cannot determine which would be preferred by a risk averse decision maker using the CDF chart. The SERF chart for ranking the four marketing alternatives (Figure 3) presents the decision maker's CE at relative risk aversion levels ranging from risk neutral (zero) to extremely risk averse (four) for each risky alternative[9]. The decision-maker would prefer marketing alternative four regardless of their level of risk aversion, because scenarios four's CE line is the highest for each risk aversion level. If scenario four is not available, then scenario three would be preferred by all risk averse decision makers. A StopLight chart of the same four marketing scenarios indicates that scenario four is preferred because it has less red (probability of negative NPV is zero) than the other scenarios (Figure 4).

A second risk ranking example is provided for alternative crop mixes (lines 50-52). The risk ranking results are provided in Figure 5, where the second scenario is preferred by all risk averse decision makers.

The third example of ranking risky alternatives involves ranking four scenarios that include the marketing, crop mix and crop insurance scenarios in lines 46-59 of the Appendix. The summary statistics for the four risky alternatives are summarized in Table 2 to show the significant difference that the scenarios make on the relative risk for the farm's NPV and ROI. The estimated empirical distributions for the four NPV distributions are summarized as CDFs in Figure 6. SERF ranks the risky alternatives: four, two, three, and one (Figure 7). The StopLight chart ranking of the four scenarios shows that scenario four is ranked first because it has the most green and the least red (Figure 8).

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[9] The Power utility function with relative risk aversion coefficients ranging from 0 to 4 is used for the analysis because NPV reflects a multiple year income distribution. For annual decisions the Negative Exponential utility function with absolute risk aversion coefficients over the range of zero to four divided by net worth is suggested.

Table 1: Summary Statistics for the Base Sceenario

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	Net Present Value	Average Return On Investment	Present Value of Ending Net Worth		
Mean	98,058	18.1%	538,766		
Standard Deviation	87,581	6.3%	81,246		
Coefficient of Variati	89	34.75	15		
Minimum	(160,865)	1.8%	294,183		
Maximum	395,600	41.5%	811,756		
Probability Less than Zero					
P(X<0)	13.0%	0.0%	0.0%		
Net Cash Income	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Mean	66,933	85,095	81,836	77,232	72,609
Standard Deviation	78,830	82,339	79,630	84,801	86,091
Coefficient of Variati	118	97	97	110	119
Minimum	(74,337)	(62,040)	(50,241)	(79,984)	(75,567)
Maximum	289,319	308,159	314,815	313,561	307,744
Ending Cash Reserve	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Mean	63,078	72,767	79,076	79,320	73,978
Standard Deviation	57,544	83,985	105,149	127,004	146,408
Coefficient of Variati	91	115	133	160	198
Minimum	(61,731)	(163,465)	(252,941)	(260,329)	(366,770)
Maximum	202,685	295,674	390,399	450,601	565,914
Probability of Negative Ending Cash					
P(EC<0)	16.0%	20.2%	22.0%	27.2%	30.6%
Probability of Negative Ending Cash for Two Years in a Row					
P(EC<0 for 2 Years)	N/A	11.0%	15.6%	17.4%	22.4%
Return on Investment	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Mean	16.3%	19.4%	19.0%	18.2%	17.4%
Standard Deviation	13.1%	13.7%	13.2%	14.1%	14.3%
Coefficient of Variati	8060.7%	7049.2%	6955.6%	7720.7%	8198.8%
Minimum	-7.3%	-5.1%	-3.2%	-6.6%	-5.1%
Maximum	53.2%	56.4%	57.6%	57.3%	56.2%

Table 2. Comparison of Risk Across Alternative Risk Management Scenarios for a Representative Farm.

	Base	Scenario 2	Scenario 3	Scenario 4
Net Present Value				
Mean ($)	86,486	107,567	100,467	120,332
Standard Deviation ($)	139,399	105,458	108,116	94,138
Coefficient of Variation (%	161.2	98.0	107.6	78.2
Minimum ($)	(339,093)	(249,204)	(288,638)	(209,499)
Maximum ($)	490,380	403,397	414,870	373,552
Prob(NPV < 0)	26.4%	13.6%	17.5%	10.7%
Average Return on Investment				
Mean (%)	18.9%	19.0%	19.1%	20.2%
Standard Deviation ($)	9.8%	7.3%	7.5%	6.6%
Coefficient of Variation (%	51.9	38.5	39.4	32.8
Minimum ($)	-5.8%	-1.1%	-2.9%	0.4%
Maximum ($)	50.3%	41.9%	42.9%	39.5%
Prob(ROI < 0)	2.3%	0.8%	0.5%	0.0%
Present Value of Ending Net Worth				
Mean ($)	524,156.1	546,251.0	539,168.9	558,509.4
Standard Deviation ($)	130,803.7	98,907.2	101,430.4	88,131.7
Coefficient of Variation (%	25.0	18.1	18.8	15.8
Minimum ($)	115,507.9	204,555.5	166,355.9	245,044.7
Maximum ($)	897,017.2	817,501.1	827,788.0	791,116.3
Prob(PVENW<Beg NW)	72.7%	70.9%	73.7%	69.0%

Base assumes selling all of the crops at market without contracting, 50% of land planted to corn and 50% planted to soybeans with no crop insurance.
Scenario2 assumes contracting 20% at a fixed price, 66% of cropland planted to soybeans and 75% yield coverage is elected for crop insurance.
Scenario 3 assumes that 60% of cropland is planted to corn, 50% of the crop is contracted at a fixed price and 70% yield coverage is elected for crop insurance.
Scenario 4 assumes that 66% of cropland is planted to corn, 100% of the crop is contracted at a fixed price and 65% yield coverage is elected for crop insurance.

Figures: 1 – 8

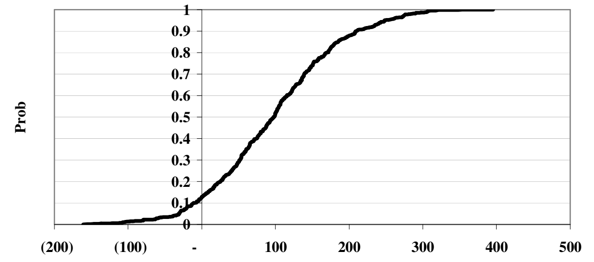

Figure 1. Cumulative Distribution Function of Net Present Value for the Base Scenario

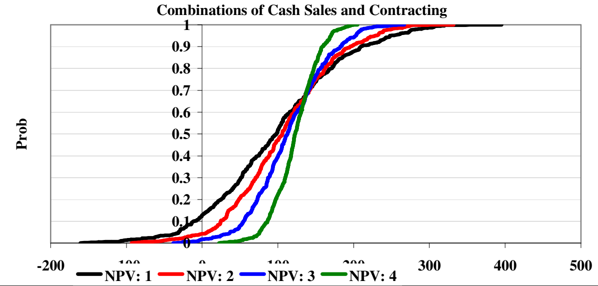

Figure 2. CDF of NPV for Four Alternative Marketing Options Using Combinations of Cash Sales and Contracting

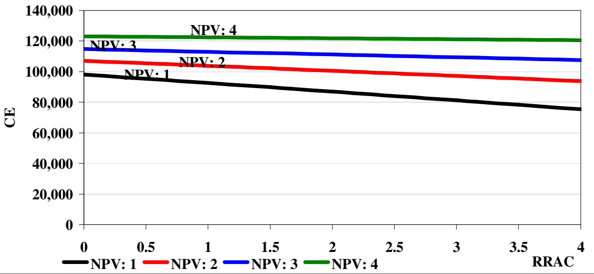

Figure 3. SERF Ranking of Alternative Marketing Strategies Using Probability Distributions of NPV

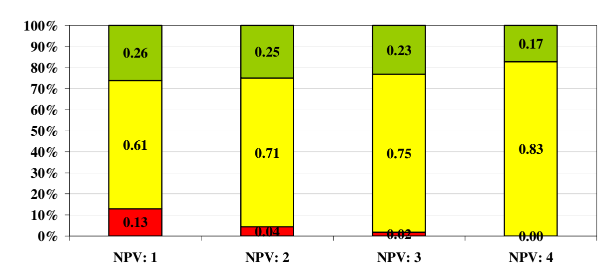

Figure 4. Probability of NPV Being Less Than $0 and Greater Than $150,000 for Alternative Crop Marketing Options

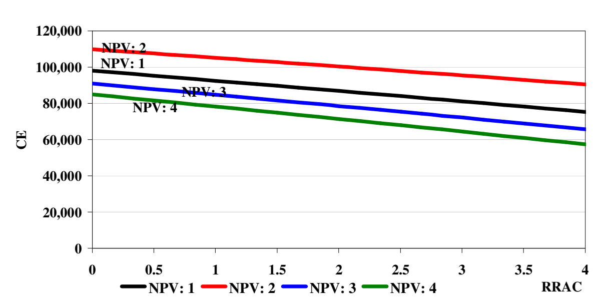

Figure 5. SERF Ranking of Four Scenarios for Alternative Crop Mixes

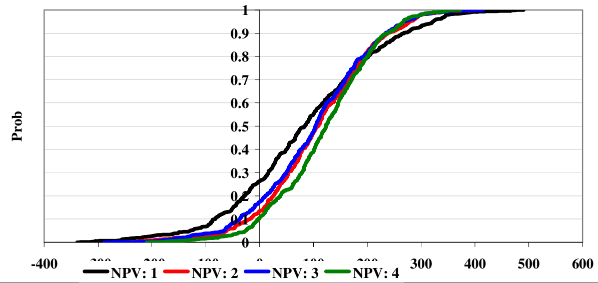

Figure 6. CDF of NPV for Four Crop Mixes, Marketing Options, and Insurance Scenarios

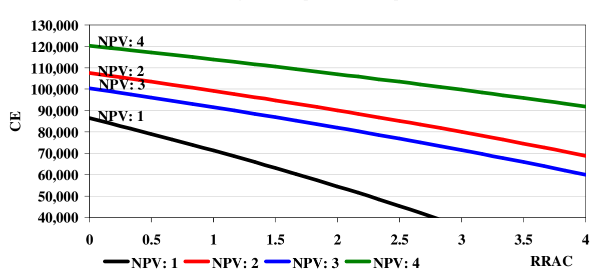

Figure 7. SERF Ranking of Four Scenarios for Alternative Crop Mixes, Contracting, and Crop Insurance Options

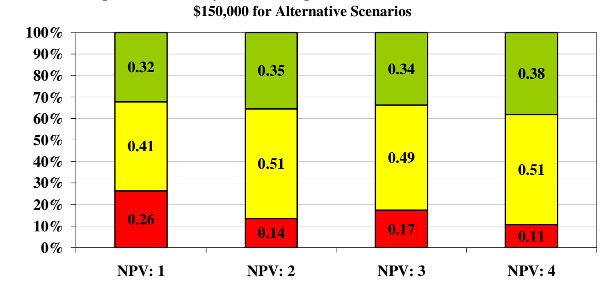

Figure 8. Probability of NPV Being Less Than $0 and Greater Than $150,000 for Alternative Scenarios

Summary and Conclusions

Risk management will continue to be a major challenge facing farm managers in the future. With the increased need to manage risk and the fact that risk management skills are learned, there is a growing need to train commercial farmers how to analyze and rank risky alternatives. Monte Carlo simulation models of the pro-form financial statements for a farm can be used to by farmers to evaluate risky alternatives. However, the decision tools available for ranking risky alternatives have long been an impediment to training farmers how to choose among risky alternatives once their alternatives have been simulated.

The objective of this paper was to demonstrate how new risk ranking tools available for Microsoft® Excel can be used to teach farmers how to rank risky alternatives. A new Excel add-in, Simetar, includes new and innovative risk ranking tools that are easy to use and interpret in the familiar environment of Excel spreadsheets. The steps for developing a Monte Carlo simulation model are demonstrated for a representative crop farm and StopLight charts and SERF risk ranking methods are demonstrated for alternative marketing, crop mixes and crop insurance strategies.

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Appendix: Printout of a Monte Carlo Simulation Model for a Representative Crop Farm.

	A	B	C	D	E	F	G	H	I
1	**Appendix Representative Grain Farm Simulation Model.xls**								
2	James W. Richardson © March 2007								
3									
4	**Manager's Input Data to Simulate a Hypothetical Farm are in Bold**								
5	First year to simulate	**2007**							
6	Hectares Owned	**97.2**							
7	Hectares Cash Rented	**449.4**							
8	Land & Building Value	**1,000,000**							
9	% Change Land Value	**5%**							
10	Beginning Cash Reserves	**65,000**							
11	Base Family Living	**40,000**							
12	Bonus Fam. Living % NCFI	**5%**							
13	Discount Rate for NPV	**0.125**							
14	Depreciation Tax Deduction	**25,000**							
15	Other Tax Deductions	**4,000**							
16	Local Interest Rate Basis	**0.05**							
17	Operating Loan % Year	**50%**							
18	Interest for Cash Reserves	**0.03**							
19	**Variable Production Costs per Hectare**								
20	Corn	**407.55**							
21	Soybean	**244.53**							
22	**Harvest Cost per Kg**								
23	Corn	**0.01516**							
24	Soybean	**0.01157**							
25	**Fixed Costs for the Whole Farm**								
26	Cash Rent for Land	**142,500**							
27	Fixed Cost	**63,360**							
28	**Producer's Average Yields**	2007	2008	2009	2010	2011			
29	Corn Yield	**9724.9**	**10038.6**	**10164.1**	**10289.6**	**10415.1**			
30	Soybean Yield	**3325.3**	**3513.5**	**3576.3**	**3639.0**	**3701.8**			
31	**Price Basis between Local and National Prices**								
32	Corn	**-0.00591**							
33	Soybean	**-0.00394**							
34	**Land Loan Information**								
35	Amount Borrowed	**500,000**							
36	Interest Rate	**0.075**							
37	Number of Years	**20**							
38	First Year of Loan	**2004**							
39	**Crop Insurance Assumptions**								
40		APH Yield Kg	Price Guarantee $/Kg						
41	Corn	**3683.21**	**0.1181**						
42	Soybean	**1270.07**	**0.2362**						
43									
44	**Define the Base and Alternative Scenarios to Analyze**								
45	**Fraction of Crop to Contract for a Fixed Price**				**Base and Alternative Scenarios for % of Crop Contracted**				
46		Contract Price	Fraction Contracted			Base Mktg.	Contract 1	Contract 2	Contract 3
47	Corn	**0.1260**	0.00	=SCENARIO(F47:I47)		**0%**	**25%**	**50%**	**100%**
48	Soybeans	**0.2520**	0.00	=SCENARIO(F48:I48)		**0%**	**25%**	**50%**	**100%**
49					**Base and Alternative Crop Mixes Under Consideration (ha)**				
50	**Crop Mix to Analyze**	Current Crop Mix				Base Crop Mix	Crop Mix 1	Crop Mix 2	Crop Mix 3
51	Corn Hectares		273.28	=SCENARIO(F51:I51)		**273.3**	**182.2**	**323.9**	**364.4**
52	Soybean Hectares		273.28	=SCENARIO(F52:I52)		**273.3**	**364.4**	**222.7**	**182.2**
53						546.56	546.56	546.56	546.56
54	**Crop Insurance Yield Coverage Fractions and Premiums**				**Base and Alternative Crop Insurance Scenarios**				
55			Current Crop Insurance Coverage			Base Insurance	Insurance 1	Insurance 2	Insurance 3
56	Corn Yield Coverage %		0.00	=SCENARIO(F56:I56)		**0**	**0.75**	**0.70**	**0.65**
57	SB Yield Coverage %		0.00	=SCENARIO(F57:I57)		**0**	**0.75**	**0.70**	**0.65**
58	Corn Premium $/Hectar		0.00	=SCENARIO(F58:I58)		**0.0000**	**1.0121**	**0.9109**	**0.6073**
59	Soybean Premium $/Hectar		0.00	=SCENARIO(F59:I59)		**0.0000**	**0.4858**	**0.4453**	**0.3239**
60									
61	**Projected Season Average Annual Prices, Rates of Inflation and Interest Rates from FAPRI, University of Missouri-Columbia**								
62		2007	2008	2009	2010	2011			
63	Corn Prices	**0.1274**	**0.1277**	**0.1278**	**0.1269**	**0.1256**			
64	Soybean Prices	**0.2631**	**0.2765**	**0.2762**	**0.2717**	**0.2687**			
65	Price Paid Index	**0.047**	**0.020**	**0.014**	**0.012**	**0.014**			
66	Consumer Price Index	**206.049**	**210.181**	**213.947**	**217.706**	**221.709**			
67	Prime Interest Rate	**0.048**	**0.051**	**0.054**	**0.056**	**0.057**			
68									

Appendix: Continued

	A	B	C	D	E	F	G	H	I
69	**Historical National Season Average Prices and Producer's Actual Yield History**								
70		Corn Price	SB Price	Corn Yield	SB Yield				
71	1995	**0.128**	**0.265**	**4089.6**	**1270.1**				
72	1996	**0.107**	**0.289**	**3200.6**	**1066.9**				
73	1997	**0.096**	**0.255**	**3226.0**	**1117.7**				
74	1998	**0.076**	**0.194**	**3556.2**	**1371.7**				
75	1999	**0.072**	**0.182**	**2489.3**	**533.4**				
76	2000	**0.073**	**0.179**	**4927.9**	**1524.1**				
77	2001	**0.078**	**0.172**	**3124.4**	**1371.7**				
78	2002	**0.091**	**0.218**	**4496.1**	**1295.5**				
79	2003	**0.095**	**0.289**	**3403.8**	**1193.9**				
80	2004	**0.076**	**0.203**	**2387.7**	**1295.5**				
81	2005	**0.079**	**0.223**	**4877.1**	**1422.5**				
82	2006	**0.125**	**0.240**	**4445.3**	**1219.3**				
83									
84	**Calculate Summary Statistics for the Random Variables**								
85		Corn Price	SB Price	Corn Yield	SB Yield				
86	**Mean**	0.091	0.226	3685.325	1223.502				
87	**StDev**	0.020	0.042	870.378	252.121				
88	**Min**	0.072	0.172	2387.735	533.430				
89	**Max**	0.128	0.289	4927.878	1524.086				
90									
91	**Test for Presence of a Trend**								
92		Corn Price	SB Price	Corn Yield	SB Yield				
93	**Intercept**	1.954928798	4.810808419	-112337.6318	-34667.2131				
94	**Slope**	-0.000931655	-0.002291966	57.99697898	17.94087252				
95	**R-Square**	0.029292377	0.039289236	0.057721648	0.065828051				
96	**S.E.**	0.001695986	0.003583998	74.10126399	21.37231044				
97	**T-Test**	-0.549329709	-0.639499874	0.782671926	0.83944469				
98	**Prob(T)**	0.593755524	0.535588735	0.45034093	0.419089949				
99									
100	**Calculate a Correlation Matrix for the Random Variables and test for Statistical Significance to Determine if Need a MV Distribution**								
101		Corn Price	SB Price	Corn Yield	SB Yield				
102	**Corn Prices**	1	**0.73**	0.24	-0.02				
103	**Soybean Price**		1	0.03	-0.11				
104	**Corn Yield**			1	**0.60**				
105	**Soybean Yield**				1				
106	**Correlation Coefficient t-values. Bold values indicate statistical significance at the specified level.**								
107	**Significance**	95%		t-critical	2.23				
108		Corn Price	SB Price	Corn Yield	SB Yield				
109	**Corn Price**		**3.36**	0.78	0.08				
110	**SB Price**			0.09	0.35				
111	**Corn Yield**				**2.37**				
112									
113	**Simulate Five Years of Stochastic Prices and Yields using a Multivariate Empirical (MVE) Distribution**								
114	**Assemble the Projected Mean Prices and Assumed Average Annual Yields**								
115		**2007**	**2008**	**2009**	**2010**	**2011**			
116	**Corn Prices $/kg**	0.1274	0.1277	0.1278	0.1269	0.1256	=F63		
117	**Soybean Price $/kg**	0.2631	0.2765	0.2762	0.2717	0.2687	=F64		
118	**Corn Yield kg/ha**	9724.939	10038.646	10164.130	10289.613	10415.096	=F29		
119	**Soybean Yield kg/ha**	3325.302	3513.526	3576.268	3639.009	3701.751	=F30		
120									
121	**Simulate the MVE Stochastic Values for the Random Variables as Fractional Deviations from Trend in One Step**								
122		**2007**	**2008**	**2009**	**2010**	**2011**			
123	**Corn Prices $/kg**	0.1315	0.1292	0.1098	0.1740	0.1113	=MVEMP($B$71:$E$82,,,,F116:F119,1)		
124	**Soybean Price $/kg**	0.2814	0.2920	0.2194	0.2672	0.2943			
125	**Corn Yield kg/ha**	8356.69	8519.84	8318.91	11525.87	8106.64			
126	**Soybean Yield kg/ha**	3779.53	3720.20	3259.73	4298.68	3395.17			
127									
128									
129	**Calculations for the Financial Part of the Farm Model Begin Here**								
130	**Stochastic Production (kg) = Stochastic Yield * Planted Area**								
131	Corn	2,283,710	2,328,297	2,273,386	3,149,782	2,215,377	=F125*$C$51		
132	Soybean	1,032,867	1,016,655	890,818	1,174,740	927,829	=F126*$C$52		
133	**Localized Stochastic Market Prices = Stochastic Price plus the Local Price Wedge**								
134	Corn	0.1256	0.1233	0.1039	0.1680	0.1054	=$B$32+F123		
135	Soybeans	0.2775	0.2881	0.2155	0.2632	0.2904	=$B$33+F124		

Appendix: Continued

	A	B	C	D	E	F	G	H	I
136	**Localized Contract Prices Specified for the Marketing Scenarios**								
137	Corn	0.1260	0.1260	0.1260	0.1260	0.13	=$B$47		
138	Soybeans	0.2520	0.2520	0.2520	0.2520	0.25	=$B$48		
139	**Calculate Market Receipts = Wted. Average of Stochastic and Contract Prices * Stochastic Production**								
140	Corn	286,831	286,966	236,186	529,305	233,486	=F131*($C$47*F137+(1-$C$47)*F134)		
141	Soybeans	286,628	292,902	191,927	309,213	269,406	=F132*($C$48*F138+(1-$C$48)*F135)		
142	**Crop Insurance Assumptions for this Scenario**								
143		APH Yield	Yld Fraction	Insured Yld	Prem/Acre	Guaranteed Price			
144	Corn	3,683	0	-	0.00	0.12			
145	Soybeans	1,270	0	-	0.00	0.24			
146	**Calculate Crop Insurance Indemnity = IF(Stochastic Yield < Insured Yield, then Lost Yield * Guaranteed Price)**								
147	Corn Stoch Yield	8,356.69	8,519.84	8,318.91	11,525.87	8,106.64	=F125		
148	Corn Insured Yield	-	-	-	-	-	=$D$144		
149	Corn Lost Yield	-	-	-	-	-	=IF(F147<F148,F148-F147,0)		
150	Corn Indemnity	-	-	-	-	-	=F149*$F$144*$C$51		
151	SB Stoch Yield	3,779.53	3,720.20	3,259.73	4,298.68	3,395.17	=F126		
152	SB Insured Yield	-	-	-	-	-	=$D$145		
153	SB Lost Yield	-	-	-	-	-	=IF(F151<F152,F152-F151,0)		
154	SB Indemnity	-	-	-	-	-	=F153*$F$145*$C$52		
155	**Minimum Annual Family Withdrawals = Base Value for 2007 Inflated by Annual Percentage Change in CPI**								
156	Family Withdrawals	40,000	40,802	41,533	42,263	43,040	=E156*(1+(F66-E66)/E66)		
157	**Costs of Production = Base Cost in 2007 Inflated by Percentage Change in Prices Paid Index**								
158	**VC per Hectare**	Estimate '07	Inflated '08	Inflated '09	Inflated '10	Inflated '11	Inflated '11		
159	Corn inflated by PPI	407.55	426.70	435.37	441.33	446.41	=E159*(1+E$65)		
160	SB inflated by PPI	244.53	256.02	261.22	264.80	267.84	=E160*(1+E$65)		
161	**Harvest Cost per Kg**								
162	Corn inflated by PPI	0.02	0.02	0.02	0.02	0.02	=E162*(1+E$65)		
163	SB inflated by PPI	0.01	0.01	0.01	0.01	0.01	=E163*(1+E$65)		
164	**Fixed Costs for the Whole Farm**								
165	Land rent inflate by CPI	142,500	145,357	147,962	150,562	153,330	=E165*(1+(F66-E66)/E66)		
166	Fixed cost inflate by PPI	63,360	66,338	67,685	68,612	69,401	=E166*(1+E$65)		
167									
168									
169	**Financial Statements**								
170									
171	**Income Statement**	**2007**	**2008**	**2009**	**2010**	**2011**	Formula in Col. F		
172	Receipts								
173	Corn Mkt Receipts	286,831	286,966	236,186	529,305	233,486	=F140		
174	SB Mkt Receipts	286,628	292,902	191,927	309,213	269,406	=F141		
175	Corn Indemnity	-	-	-	-	-	=F150		
176	SB Indemnity	-	-	-	-	-	=F154		
177	Total Receipts	573,459	579,868	428,113	838,517	502,892	=SUM(F173:F176)		
178	Expenses								
179	Corn Variable Cost	111,375	116,610	118,977	120,607	121,994	=$C$51*F159		
180	SB Variable Cost	66,825	69,966	71,386	72,364	73,196	=$C$52*F160		
181	Corn Harvest Cost	34,613	36,948	36,809	51,697	36,779	=$C$51*F125*F162		
182	SB Harvest Cost	11,955	12,320	11,014	14,724	11,763	=$C$52*F126*F163		
183	Crop Insurance Prem	-	-	-	-	-	=$C$51*$E$144+$C$52*$E$145		
184	Land Rent	142,500	145,357	147,962	150,562	153,330	=F165		
185	Fixed Costs	63,360	66,338	67,685	68,612	69,401	=F166		
186	Operating Interest	21,036	22,489	23,690	25,268	24,839	=SUM(F179:F185)*(F67+$B$16)*$B$17		
187	Land Debt Interest	34,702	33,627	32,470	31,227	29,891	=G309		
188	Carryover Debt Interest	-	-	-	4,179	-	=(F67+$B$16)*E210		
189	Total Expense	486,366	503,654	509,993	539,239	521,193	=SUM(F179:F188)		
190	**Net Cash Farm Income**	87,092	76,214	(81,880)	299,278	(18,301)	=F177-F189		
191	**Cash Flow Statement**								
192	Beginning Cash Jan 1	65,000	85,821	97,495	-	96,004	=E205		
193	Net Cash Income	87,092	76,214	(81,880)	299,278	(18,301)	=F190		
194	Interest Earned	1,950	2,575	2,925	-	2,880	=$B$18*F192		
195	Cash Inflows	154,042	164,610	18,540	299,278	80,584	=SUM(F192:F194)		
196									
197	Land Debt Payments	14,344	15,419	16,576	17,819	19,156	=G310		
198	Repay Deficit Loans	-	-	-	39,569	-	=E210		
199	Family Living	40,000	40,802	41,533	42,263	43,040	=F156		
200	Family Living Bonus	4,355	3,811	-	14,964	-	=IF(F190>0,F190*$B$12,0)		
201	Income Taxes	9,523	7,082	-	88,658	-	=F341		
202	Cash Outflows	68,221	67,114	58,109	203,274	62,196	=SUM(F197:F201)		
203	**Ending Cash Dec 31**	85,821	97,495	(39,569)	96,004	18,388	=F195-F202		

Appendix: Continued

	A	B	C	D	E	F	G	H	I
204	**Balance Sheet**								
205	Cash Dec 31st	85,821	97,495	-	96,004	18,388	=IF(F203>0,F203,0)		
206	Land Dec 31st	1,050,000	1,102,500	1,157,625	1,215,506	1,276,282	=E206*(1+$B$9)		
207	Total Assets	1,135,821	1,199,995	1,157,625	1,311,511	1,294,670	=SUM(F205:F206)		
208									
209	Land Debt	448,355	432,936	416,360	398,541	379,385	=G308		
210	Cash Flow Deficits	-	-	39,569	-	-	=IF(F203<0,-F203,0)		
211	Total Liabilities	448,355	432,936	455,929	398,541	379,385	=SUM(F209:F210)		
212	**Net Worth**	687,466	767,059	701,696	912,970	915,285	=F207-F211		
213									
214	**Financial Ratios and Key Output Variables**						Formula in Col. F		
215	**Net Present Value**								
216	Discount Factors	0.89	0.79	0.70	0.62	0.55	=1/((1+$B$13)^5)		
217	Beginning Net Worth	602,301							
218	PV Family Withdrawals	39,426	35,250	29,170	35,726	23,884	=F216*(F199+F200)		
219	**PV Ending Net Worth**					507,918	=F216*F212		
220	**Counter for Real Increase in Net Worth**					-	=IF(F219>B217,1,0)		
221									
222	**Rate of Return on Investment**								
223	**Net Returns**	62,092	51,214	(106,880)	274,278	(43,301)	=F190-F317		
224	**Interest Costs**	55,739	56,115	56,160	60,674	54,730	=SUM(F186:F188)		
225	**Annual ROI**	19.56%	17.82%	-8.42%	55.61%	1.90%	=(F223+F224)/$B$217		
226									
227	**Probability of Cash Flow Deficits for 1 year and for 2 Consecutive Years**								
228	**P(EC<0 one year)**	0	0	1	0	0	=IF(F203<0,1,0)		
229	**P(EC<0 two years)**		0	0	0	0	=IF(E228+F228=2,1,0)		
230	**KOV Table**								
231	**NPV**	69,074	=-B217+SUM(B218:F219)						
232	**Avg ROI**	0.173	=AVERAGE(B225:F225)						
233	**PVENW**	507,918	=F219						
234	**NCFI 1**	87,092	=TRANS(B190:F190)						
235	**NCFI 2**	76,214	=TRANS(B190:F190)						
236	**NCFI 3**	(81,880)	=TRANS(B190:F190)						
237	**NCFI 4**	299,278	=TRANS(B190:F190)						
238	**NCFI 5**	(18,301)	=TRANS(B190:F190)						
239	**EC 1**	85,821	=TRANS(B203:F203)						
240	**EC 2**	97,495	=TRANS(B203:F203)						
241	**EC 3**	(39,569)	=TRANS(B203:F203)						
242	**EC 4**	96,004	=TRANS(B203:F203)						
243	**EC 5**	18,388	=TRANS(B203:F203)						
244	**ROI 1**	0.20	=TRANS(B225:F225)						
245	**ROI 2**	0.18	=TRANS(B225:F225)						
246	**ROI 3**	(0.08)	=TRANS(B225:F225)						
247	**ROI 4**	0.56	=TRANS(B225:F225)						
248	**ROI 5**	0.02	=TRANS(B225:F225)						
249	**P(EC<0) Yr 1**	-	=TRANS(B228:F228)						
250	**P(EC<0) Yr 2**	-	=TRANS(B228:F228)						
251	**P(EC<0) Yr 3**	1.00	=TRANS(B228:F228)						
252	**P(EC<0) Yr 4**	-	=TRANS(B228:F228)						
253	**P(EC<0) Yr 5**	-	=TRANS(B228:F228)						
254	**P(EC<0 2 Yrs) Yr 2**	-	=TRANS(C229:F229)						
255	**P(EC<0 2 Yrs) Yr 3**	-	=TRANS(C229:F229)						
256	**P(EC<0 2 Yrs) Yr 4**	-	=TRANS(C229:F229)						
257	**P(EC<0 2 Yrs) Yr 5**	-	=TRANS(C229:F229)						