An Economic Analysis of Three Stockering Systems in the Southeastern United States

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Abstract

Deterministic and probabilistic models were developed to calculate returns over variable costs for three stockering systems in the Southeastern United States. Purchasing 350 pound calves in October-November and selling calves weighing 750 pounds in March-April using cool-season forages was determined to be the superior system in terms of projected returns.

Key Words: stocker calves, grazing systems, Southeast, forages

Introduction

The Southeastern United States is a region that enjoys a comparative advantage in beef production due to its favorable environmental conditions. Abundant rainfall and forage availability, along with a temperate climate, create conditions that are conducive to beef cattle production. Southeastern cattle producers generally receive a discount for their beef calves because of the additional freight costs and morbidity and mortality costs associated with long shipping distances to cattle feeding states (Rhinehart and Poore, 2013). Because of this, stockering beef calves (generally defined as the intermediate step between the cow calf phase and the feed-yard finishing phase of beef production) is often touted as a way to increase ranch income and add value to Southeastern beef cattle.

Overview of the U.S beef supply chain.

Commercial beef cattle production in the US can be broadly divided into four phases—cow-calf operations, stocker operations, feedlot operations, and meat packing operations. Cow-calf producers maintain a herd of brood females used for calf production. Calves born from these females are typically raised to an age of 5-8 months, weaned, and then marketed to either stocker operations or feedlots. Stocker operations utilize a variety of available forages to grow calves to an acceptable feedlot entry weight. Due to the biological nature of cattle production, stockering is often used as a speculative strategy to hold cattle until favorable prices exist. Feedlot operations utilize high-energy rations to finish cattle, increasing overall meat quality and uniformity. The finished products of feedlots are fed-cattle, which are sold to beef packers. The beef-packing sector is responsible for harvesting the product and supplying it to retailers in a manageable form. Wholesale beef (boxed beef) is then marketed to supermarkets, grocery stores, fast food outlets, and restaurants, which then sell to consumers.

Stockering Beef Calves

One of the overarching principles of stockering beef cattle is to achieve increases in bodyweight (BW) at a cost that is lower than the cost of gain incurred by a feedlot. The aforementioned climatic conditions in the Southeastern United States, along with the discounted purchase price of weaned calves, allow cattle producers in this region to achieve these increases in BW by utilizing forage (cool season and warm season) based systems. The use of forages to achieve increases in BW is what differentiates these types of systems from backgrounding, which predominantly involves feeding a concentrated diet in confinement or a semi-confinement setting.

Literature Review

There is a fairly limited amount of published research literature related to an economic assessment of different stockering systems. Rankins and Prevatt (2012) evaluated 37 different grazing experiments and concluded that the systems that were most likely to result in lower costs of production were limited to tall fescue with legumes or ryegrass and small-grains. These findings seem to confirm much of the conventional wisdom associated with stocker production. However, this analysis does not account for the risk of establishing the winter annuals, buy-sell margin price risk, or the production risk associated with growing animals (morbidity and mortality). This paper contributes to the body of literature by using production data from the 2000-2012 time periods to simulate returns using key stochastic variables for three levels of risk-aversion.

Data and Methods

Deterministic and probabilistic models were developed to calculate returns over variable costs (ROVC) for each production scenario. Models were developed using published UGA Extension stocker budgets (see variable costs examples in Table 1) in order to incorporate collected production data. Once the deterministic model was developed, stochastic variables were incorporated to represent the historical volatility associated with these variables. A Monte Carlo Simulation model was designed for each production scenario using @Risk (http://www.palisade.com/risk/) simulation software. Stochastic variables include average daily gain (ADG), buy-sell margin (BSM), feed costs, fertilizer costs, and veterinarian expenses (morbidity and mortality). Stocking rate, seed prices, labor, and interest rates were set as deterministic variables. Data for production variables were obtained from published research trials and interviews with stocker producers in the region. ADG parameters were calculated for each production scenario based on published research and personal interviews with Animal and Crop Science extension specialists from the University of Georgia. Feed and fertilizer prices were obtained from USDA-AMS for the Southeastern US for 2006-2012. Average steer calf and feeder steer prices in Georgia were obtained from published USDA-AMS (Market News Service) for the months of October-November, November-December, March-April, and July-August (years 2000-2012) and were used to calculate BSM in this analysis. This implies that calves were bought one at a time in an auction setting, and sold one at a time under similar conditions; however, most stocker producers do not market their cattle in this way. Weaned, preconditioned, healthy animals achieve a premium in the market place and are typically sold in load lots that fit transportation requirements (Rankins and Prevatt, 2012). Data from the Southwest Georgia Feeder Cattle Marketing Association was obtained describing load lot sales values from 2009-2012. This data was used to compare ROVC for feeder cattle marketed at a conventional livestock auction with those marketed as load lots. Variable costs for each scenario are available in Table 1 and scenario descriptions can be seen in Table 2.

Distribution fitting tools available in @Risk were used to assign distributions to stochastic variables. Distribution fit rankings are arranged according to Akaike Information Criterion (AIC) values. ADG and BSM were assigned normal distributions, fertilizer costs were assigned triangular distributions, and fuel and feed (including hay) prices were best fitted to uniform distributions. Correlations between fuel, fertilizer and feed costs were established to avoid unrealistic combinations of these inputs. To generate a probabilistic variable for death loss, a gamma distribution was assigned [(α=5.33, β=.375)] with a mean of 2% and a standard deviation of 0 .75. These death loss parameters were obtained from Anderson, Lacy, Forrest and Little, 2004.

The simulated ROVC were utilized to calculate an end of period wealth to determine ending utility. The ending wealth formula used was:

(1) $$W_e = ROVC + W_0$$

Where beginning wealth, W_0=$10,00. Ending wealth was then used to calculate ending utility values utilizing a constant relative risk aversion (CRRA) utility function as in Pruitt and Riley (2011). These formulas are as follows:

(2) $$E(U)_r = \sum_{i=1}^{n} \frac{1}{n} \frac{W_i^{1-r}}{1-r}, r \neq 1$$

or,

$$E(U)_r = \sum_{i=1}^{n} \frac{1}{n} \ln(W_1), r = 1$$

Where, *r* is a risk aversion coefficient of 1, 2 or 3. An *r* of 1 represents a slightly risk averse person, and *r* of 2 a moderately risk averse person, and an *r* of 3 an extremely risk averse. The ending utility values were then utilized to calculate certainty equivalents (CE). The CE represents the highest payment a decision maker would be willing to accept to avoid a risky outcome. For any two alternatives *i* and *j*, if the $CE_i > CE_j$ the alternative *i* is superior to *j* (Pruitt and Riley, 2011). Therefore the best production system option is that which results in the highest CE. The CE were calculated using the following formulas:

(3) $$CE_r = [U(1-r)]^{\frac{1}{1-r}} - W_0, r \neq 1$$

or

$$CE_r = e^U - W_0, r = 1$$

(Where *U* is the utility value calculated by the CRRA utility functions)

Management assumptions for the three scenarios

350_SPR

The 350_SPR scenario consists of purchasing 350lb #1-2 muscled calves in October/November and holding them in confinement or semi-confinement until cool season annuals (rye and oats) have reached adequate levels of establishment and maturity. Once these levels have been reached, cattle are then turned out at a stocking rate of 2.25 animals to an acre. Hay supplementation during this period is calculated at 5lb/day for sixty days. During this time calves are assumed to receive a 50:50 corn gluten feed (CGF) and soybean hulls (SH) supplemental feed ration at a rate of 1.5% of animal BW for sixty days. Although we assume that this ration is fed equally across this sixty day period, a more realistic assumption would be that initially 25% of the ration would be fed and increased every two days to allow for adjustment to the concentrate ration. In this case, towards the end of the confinement period rations would be augmented to adjust for the decreased intake during the receiving period. In this scenario calves then graze over-seeded cool season forages until March/April when they are sold. Also, a mineral + ionophore (common antimicrobial compounds fed to ruminant animals to increase feed efficiency) mix is provided *ad libitum* and expected consumption is 4 oz. /day for the length of stockering period.

450_FES

The 450_FES scenario differs from the 350_SPR scenario in that novel endophyte (NE) stockpiled fescue, a variety of fescue containing an endophyte strain that does not produce toxic ergot alkaloids, is utilized. Stockpiling forages can be defined as the process of saving a portion of the forage produced in one time period to be used at a later predetermined date. In the Southeastern United States, fescue is typically clipped or uniformly grazed in September to stimulate growth, and then fertilized. Forages are then allowed to accumulate for 60-90 days before grazing. Stockpiling forages reduces the amount of and reliance on stored feeds in an operation and additionally minimizes labor and infrastructure costs associated with feeding livestock (Hancock and Josey, 2010). In this scenario, cattle graze on stockpiled fescue for sixty days, and then receive supplementation during thirty days when forages are not available, and finally graze cool season forages (rye, ryegrass, crimson, and arrow-leaf clover grazing) until April/May when calves are sold. Supplemental feed rations in this scenario are identical to the 350_SPR scenario, but only given for thirty days when no grazing is available.

350_SUM

The 350_SUM scenario utilizes cool season forages that are seeded over hybrid Bermuda pastures. The principle behind this system is that it is designed to result in lower ADG over a longer period of time. Therefore the supplementation ration is adjusted to only provide an ADG of 1.5 lbs./day. The ration is comprised of 50:50 CGF and SH, and fed at a rate of 1% of animal BW for sixty days. After the supplementation period calves will graze cool season forages as in 350_SPR, but then graze hybrid Bermuda pastures until they are sold in July/August.

Results and Discussion

A summary of simulated ROVC is presented in Table 3. The 350_SPR system results in the highest average ROVC with the least variability in returns. 350_SUM results in ROVC that exceeds $0, however it results in the most variable returns. 450_FES results in an average loss of $13.90 per head marketed. These results assumed that individual calves were sold one at a time in a traditional auction setting. Although this does not represent the reality of most producers marketing strategies, it allows for a comparison of the three grazing systems. The data obtained from the Southwest Georgia Feeder Cattle Marketing Association indicates that selling calves in load lots results in a narrowing of the BSM by $13.55/cwt with a standard deviation of $4.77. The results of incorporating this into the model can be seen in the lower portion of Table 3. Marketing decisions by stocker operators can have significant effects on the returns received for their livestock, however, this does not change the superiority of the 350_SPR scenario.

Table 4 displays the probability of experiencing positive and negative ROVC, and the effect that load lot marketing has on these probabilities. Not surprisingly, 350_SPR has the greatest probability of attaining positive ROVC, followed by 350_SUM and 450_FES. Also of interest are the influences that controllable inputs or factors have on output variables (in this case ROVC). The figures in the appendix display the cumulative density function graphs for all of the evaluated scenarios and both corresponding marketing strategies. Table 5 shows descriptive statistics and regression coefficients for the response of ROVC to changes in ADG, death loss, and nitrogen costs for each scenario. A one standard deviation increase in ADG (roughly .25 lbs.) results in an increase in ROVC/head of $33.07, $14.41, and $44.92 (or .31, .14, .41 standard deviations) for 350_SPR, 450_FES, and 350_SUM, respectively. A one standard deviation increase in death loss (roughly 1%, or one calf) results in a decrease in ROVC/head of $25.60, $23.67, $18.63 (or -.24, -.23, -.17 standard deviations) for 350_SPR, 450_FES, and 350_SUM, respectively. Nitrogen costs only impacted the 350_ SUM and 450_FES scenarios sufficiently enough to be listed in the @Risk output of regression coefficients, therefore, we calculate that for a $0.09 cent increase in the cost of nitrogen, ROVC will decrease by -.15, and -.14 standard deviation, or $15.44 and $15.34 per head, respectively. These metrics clearly have significant implications for management; the effects of carefully planned animal health, handling, and nutrition programs are essential to having a successful stocker operation. Available growth stimulants such as implants and ionophores are tools proven to increase ADG in a very cost effective manner and should form part of any profit-oriented stockering operation's animal receiving and nutrition protocols. Additionally, performing soil and forage analyses and adjusting nitrogen application based on their results can significantly affect ROVC. Alternatives to conventional nitrogen application, such as the use of poultry litter and legumes, could also serve as a nitrogen cost-reducing strategy. However, producers must remember to analyze the poultry litter often, seeing as its composition is highly variable. Also, included in Table 5, are the responses of ROVC to changes in certain BSM. The BSMs that affect each scenario are those most likely to occur in the specific production system, based on the projected ending BW for each scenario. This highlights the importance of the utilization of risk management tools such as forward, futures and/or, options contracts. These results also allow us to highlight the importance of employee and manager competency in timely identification and treatment of sick cattle. It also quantifies the potential benefit of sourcing lower risk, but higher priced calves for operations that cannot devote sufficient attention to animal health issues due to inexperience, or a lack of time/labor/infrastructure. Table 6 displays the CE calculated for each production scenario for marketing as singles or selling load lots. Not surprisingly, SPR_350 is clearly preferred at any level of risk aversion. It is also interesting to observe that at all three levels of risk aversion, individuals would prefer to pay to avoid the risk associated with the 450_FES scenario in which calves are sold one at a time.

Summary and Conclusions

Discounted calf values, a temperate climate, forage availability and abundant rainfall allow Southeastern cattle producers to enjoy a comparative advantage in stockering beef calves. In this study, deterministic and probabilistic models were used to perform an economic analysis of three stockering systems in the Southeastern United States. The 350_SPR scenario resulted in the highest ROVC and CE, and is clearly the superior system of the three evaluated. Marketing cattle as load lots is highly recommended and can define the difference between positive and negative ROVC. Clear and effective animal health, nutrition, and receiving protocols are essential to the success of a stockering operation. Input costs, and market risk minimization can additionally have significant effects on ROVC.

Table 1: Variable Costs for Three Different Stockering Systems in the Southeastern US

	$/Hd marketed					
VARIABLE COSTS:	**350_SPR**		**450_FES**		**350_SUM**	
CALF	$	480.33	$	574.90	$	480.34
PROCUREMENT COST	$	7.34	$	8.59	$	7.34
TALL FESCUE GRAZING		n/a	$	17.36		n/a
WINTER GRAZING	$	49.66	$	42.82	$	54.49
SUMMER GRAZING		n/a	$	n/a	$	82.10
HAY	$	24.07	$	11.93	$	32.45
RECEIVING RATION	$	10.67	$	6.31	$	4.35
SUPPLEMENTAL FEED	$	27.04	$	13.52	$	18.65
MINERAL + IONOPHORE	$	12.86	$	12.86	$	17.14
MEDICATION,WORM,VAC.	$	8.16	$	8.16	$	8.16
GROW.STIMULANT	$	2.04	$	2.04	$	2.04
REPAIRS	$	0.82	$	1.06	$	0.82
LABOR	$	18.41	$	24.85	$	18.41
DEATH LOSS	$	45.33	$	57.82	$	58.12
INTEREST ON OP. CAP.	$	13.55	$	15.43	$	20.63
AUCTION AND HAULING	$	25.13	$	25.13	$	25.13
Total Variable Costs	**$**	**725.41**	**$**	**822.78**	**$**	**830.17**

Table 2: Description of Scenarios

	Scenarios		
	350_SPR	**450_FES**	**350_SUM**
Entry date	1-Nov	1-Nov	1-Dec
Entry weight in lbs.	350	450	350
Days of supplement feeding	60	30	60
Days of stockpiled (NE) fescue grazing		60	
Days of rye and oat grazing	120		60
Days of rye, ryegrass, crimson, & arrowleaf clover grazing		90	
Days of hybrid Bermuda grazing			120
Stocking Rate (calves per acre)	2.25	2.00	2.25
Pay weight to pay weight ADG	2.17	2.10	1.8
Total days in system	180	180	240
Total lb. increase in BW	389.83	382.13	431.21
Out weight in lbs.	739.83	828.15	781.21

350_SPR
Purchasing 350 pound #1&2 muscled calves in October-November, selling calves weighing 750 pounds in March-April using cool-season forages

450_FES
Purchasing 450 pound #1&2 muscled calves in October-November, selling them at a weight of 830 pounds in the April-May, using novel endophyte (NE) tall-fescue and cool season forages.

350_SUM
Purchasing 350 pound #1&2 muscled calves in November-December and selling them at a weight of 750 pounds in July-August using a combination of cool-season forages and permanent warm-season forages

Table 3: Simulated ROVC/head Estimates for Three Grazing Systems

Sold one at a time

	350_SPR	**450_FES**	**350_SUM**
Minimum	$ (299.85)	$ (354.51)	$ (332.54)
Maximum	$ 375.38	$ 336.73	$ 321.90
Mean	$ 58.11	$ (13.90)	$ 4.73
SD	$ 106.67	$ 102.91	$ 109.56

Sold as load lots

	350_SPR	**450_FES**	**350_SUM**
Minimum	$ (147.58)	$ (252.97)	$ (224.68)
Maximum	$ 530.62	$ 460.01	$ 533.38
Mean	$ 158.43	$ 98.20	$ 110.61
SD	$ 113.37	$ 112.08	$ 117.89

Table 4: Probability of +&- ROVC

	%ROVC>0	%ROVC<0
Sold one at a time		
350_SPR	67.00%	32.00%
450_FES	46.80%	53.20%
350_SUM	49.40%	50.60%
Sold as load lots		
350_SPR	92.40%	7.60%
450_FES	86.60%	13.40%
350_SUM	81.00%	19.00%

Table 5: Regression Coefficients for the response of ROVC to changes in ADG, Death loss, and Nitrogen Cost

		Mean	SD	Reg. Coef.	Change in ROVC
ADG	350_SPR	2.17	0.25	0.31	$33.07
	450_FES	2.1	0.25	0.14	$14.41
	350_SUM	1.8	0.25	0.41	$44.92
Death Loss	350_SPR	0.02	0.01	-0.24	($25.60)
	450_FES	0.02	0.01	-0.23	($23.67)
	350_SUM	0.02	0.01	-0.17	($18.63)
N. Cost	350_SPR	0.65	0.09	n/a	n/a
	450_FES	0.65	0.09	-0.15	($15.44)
	350_SUM	0.65	0.09	-0.14	($15.34)
BSM 700	350_SPR	-28.22	13.06	0.36	$38.40
	450_FES	-19.67	11.83	0.08	$8.23
	350_SUM	-28.45	13.2	0.14	$15.34
BSM 750	350_SPR	-31.44	13.24	0.4	$42.67
	450_FES	-22.92	11.91	0.22	$22.64
	350_SUM	-31.4	13.15	0.29	$31.77
BSM 800	350_SPR	n/a	n/a	n/a	n/a
	450_FES	-27.6	11.48	0.44	$45.28
	350_SUM	-32.91	13.19	0.29	$31.77
ROVC	350_SPR	58.11	106.67		
	450_FES	-13.9	102.91		
	350_SUM	4.73	109.56		

Table 6: CE for Three Levels of Risk Aversion

	Risk Aversion		
Sell as singles	**1**	**2**	**3**
350_SPR	$ 57.55	$ 56.99	$ 56.42
450_FES	$ (14.42)	$ (14.95)	$ (15.48)
350_SUM	$ 4.13	$ 3.53	$ 2.93
Sell as load lots			
350_SPR	$ 157.80	$ 157.17	$ 156.54
450_FES	$ 97.58	$ 96.96	$ 96.34
350_SUM	$ 109.93	$ 109.24	$ 108.56

References

Anderson, J.D., Lacy, C., Forrest, C.S., and Little, R.D. “ Expected Utility Analysis of Stocker Cattle Ownership Versus Contract Grazing in the Southeast.” *Journal of Agricultural and Applied Economics* 36,3(December 2004): 719-730.

Hancock, D.W., Josey, R.W. “Stockpiling Tall Fescue for Fall and Winter Grazing.” Georgia Extension Service Circular 861, 2010.

Hancock, D.W., Lacy, C., and Stewart, L.R. “Forage Systems for Stocker Cattle” University of Georgia Cooperative Extension Bulletin 1392. (2011).

Pruitt, J. Ross, and John Michael Riley. "Optimal Marketing Strategies for Southeastern Cattle Producers." In *2011 Annual Meeting, February 5-8, 2011, Corpus Christi, Texas*, no. 98849. Southern Agricultural Economics Association, 2009.

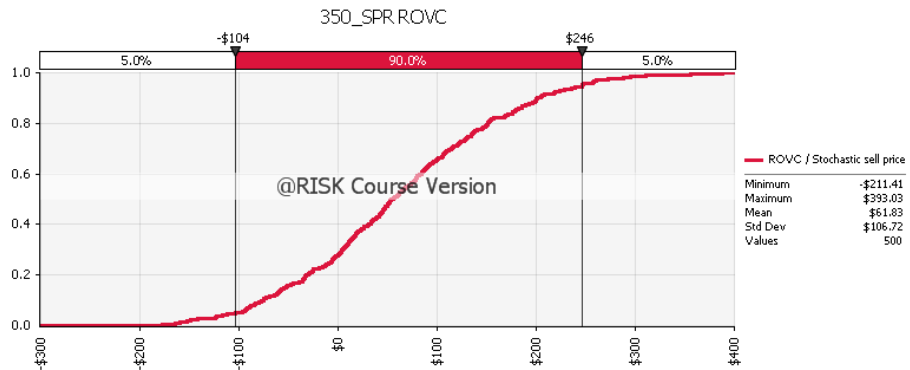
Rankins, D. L., and J. W. Prevatt. "SOUTHERN SECTION INTERDISCIPLINARY BEEF CATTLE SYMPOSIUM: Forage and co-product systems for stockers in the South: Have fundamental shifts in markets changed the optimal system?." *Journal of Animal Science* 91, no. 1 (2013): 503-507.

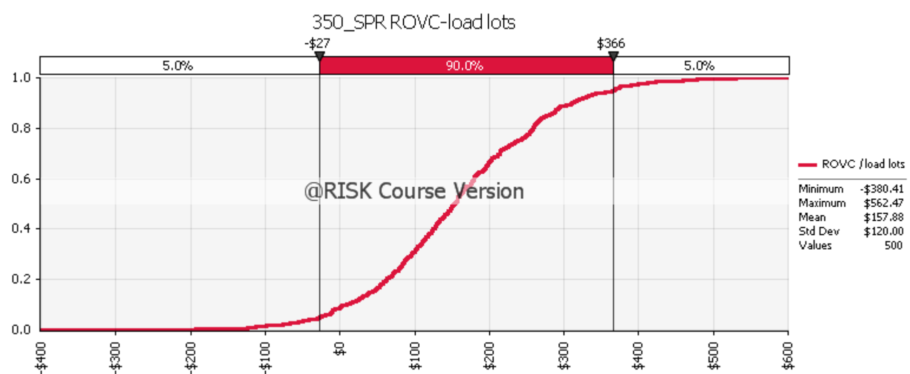
Rhinehart, J. D., and M. H. Poore. "SOUTHERN SECTION INTERDISCIPLINARY BEEF CATTLE SYMPOSIUM: Opportunities for stocker cattle in the southern United States." *Journal of Animal Science* 91, no. 1 (2013): 501-502.

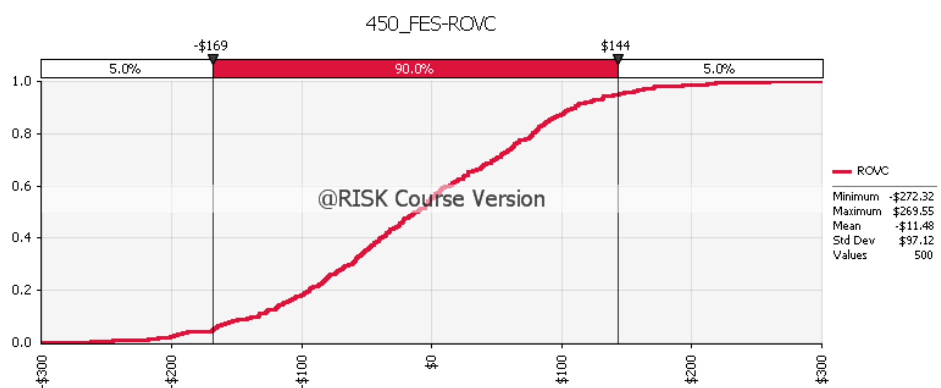
USDA National Agricultural Statistics. Internet site: http://www.nass.usda.gov (Accessed October 2013).

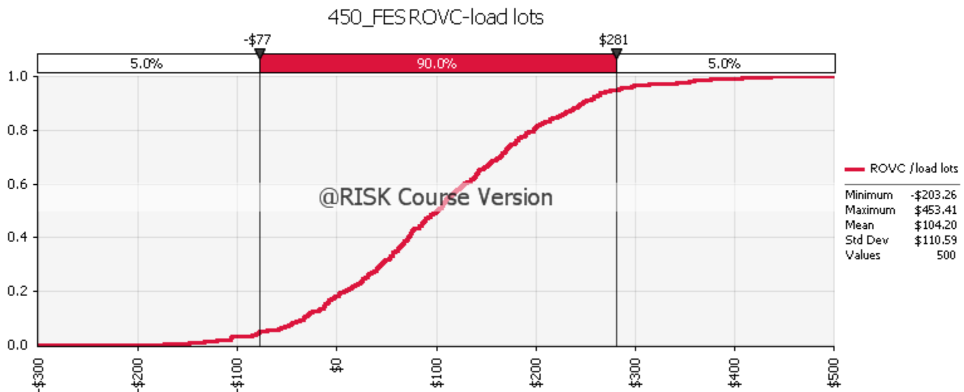
USDA-AL Dept of Ag Market News. Alabama Weekly Feedstuff/Production Cost Report, MG_GR210. Various dates

Appendix. CDF graphs of returns per head for both marketing alternatives in each of the three scenarios evaluated.








450_FES ROVC-load lots
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$281
5.0%
90.0%
5.0%
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ROVC /load lots
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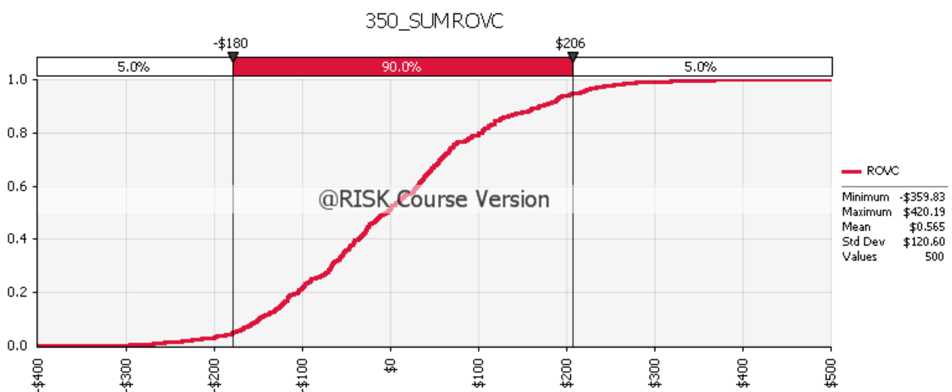
Std Dev $110.59
Values 500


350_SUM ROVC
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$206
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90.0%
5.0%
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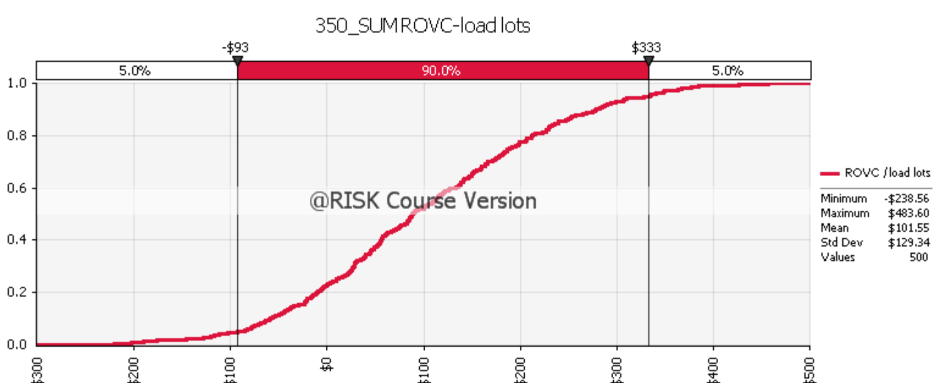
Values 500


350_SUM ROVC-load lots
-$93
$333
5.0%
90.0%
5.0%
@RISK Course Version
ROVC /load lots
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Maximum $483.60
Mean $101.55
Std Dev $129.34
Values 500