CAN COTTON COMPETE? EVAULATING COTTON CROP ROTATIONS IN NORTHEASTERN LOUISIANA

Michael A. Deliberto
Michael E. Salassi
Louisiana State University Agricultural Center
Baton Rouge, LA

Abstract

Crop acreage in the Mississippi River delta region of Louisiana has witnessed a decline in cotton plantings in recent years as more cotton producers favor more profitable cropping alternatives-namely corn and soybeans. Evaluating net returns at the producer level through a farm financial simulation model allows for a comparison to be made on the basis of farm profitability when comparing corn, cotton, and soybean crop rotations. Historical prices and yields coupled with current farm management practices for northeastern Louisiana are used in model development. This research focuses on understanding the effect that competing grain prices have on cotton acres in northeastern Louisiana. Two modeling approaches are constructed to evaluate profitability of multiple predetermined crop mixes as well as examine the effect that corn and soybean prices have on cotton plantings in this region of Louisiana.

Introduction

The Mississippi River delta region of Louisiana is a diverse agricultural region of the state. Corn, cotton, soybeans, wheat, rice, and grain sorghum are commonly produced in a rotational-based system. In 2011, corn in the region accounted for nearly 72% of total state plantings, while cotton and soybeans represented 54% and 34% of state plantings, respectively. Cotton plantings in northeastern Louisiana (USDA NASS District 3) were estimated at 158,500 acres in 2011, compared to 416,000 acres of corn and 377,000 acres of soybeans. Table 1. Yield per acre for corn, cotton, and soybeans produced in northeastern Louisiana in 2011 were: 141 bushels per acre for corn, 832 pounds per acre for cotton, and 42 bushels per acre for soybeans. Table 2.

Table 1. Planted acreage for selected crops in the Mississippi River delta region of Louisiana, 2002-2011.

Year	Corn	Cotton	Soybeans
2002	379,000	333,000	258,000
2003	355,000	332,000	300,000
2004	277,000	320,000	416,000
2005	222,000	401,000	371,000
2006	213,000	399,000	371,000
2007	546,000	179,000	207,000
2008	364,500	162,000	416,500
2009	448,500	122,000	380,000
2010	365,000	145,000	418,000
2011	416,000	158,500	377,000

Table 2. Yield per planted acre for selected crops in the Mississippi River delta region of Louisiana, 2002-2011.

Year	Corn (bu/ac)	Cotton (lbs/ac)	Soybeans (bu/ac)
2002	120.32	710.92	29.73
2003	135.35	960.29	34.50
2004	137.11	873.45	38.92
2005	142.25	864.24	34.72
2006	142.35	930.41	35.42
2007	161.43	1,020.17	41.88
2008	146.01	563.26	31.31
2009	133.09	747.54	40.00
2010	143.18	820.30	41.92
2011	141.39	917.29	41.43
Average	140.24	840.77	36.98
St. Dev.	10.44	135.37	4.46
C.V.	7.45%	16.10%	12.08%

A significant planting decrease in cotton acres is observed following the 2006 crop year. Figure 1. The 2006 planted cotton acreage in the region was 399,000 acres but fell to 179,000 acres in 2007 (a 55% decrease). Soybean planted acreage, like cotton, decreased by 164,000 acres (a 44% reduction). From 2006 to 2007, corn plantings increased by 333,000 acres (156%), to a total of 546,000 acres. The increase in corn plantings within the region corresponded to the increased demand for corn-based ethanol in addition to the traditional market outlets. The sentiment of Louisiana cotton producers was representative of the nationwide trend of reduced acreage in favor of competing commodities produced in rotation with cotton-specifically corn. Input prices, lower market prices versus narrowing profit margins, and high global stocks also contributed to a reduction in cotton plantings. Since 2006, cotton acreage in the region continues to decline as producers elect to plant corn and soybeans. Corn and soybean crops that are produced in northeastern Louisiana have lower management intensity when compared to cotton. A noticeable production cost difference exists in fertilizer, seed, insect control programs, as well as with harvesting systems when cotton is compared to grain crops in the region.

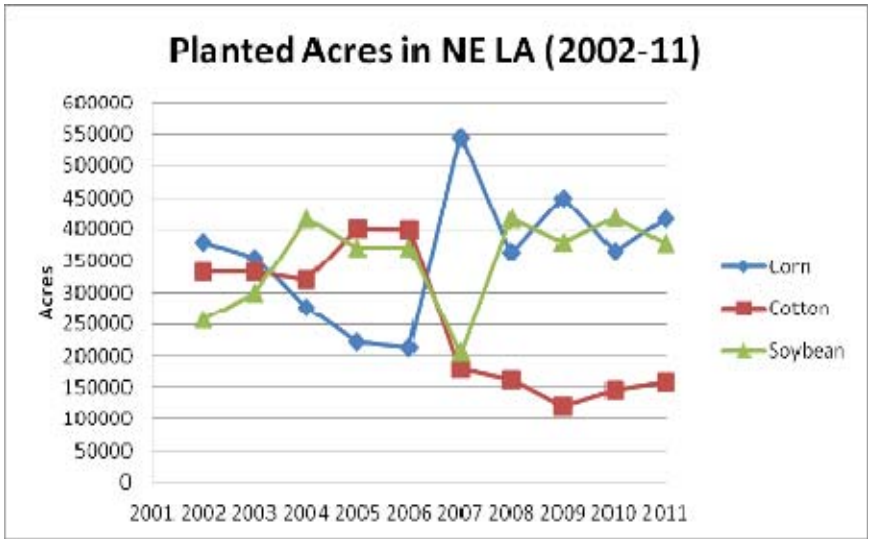

Figure 1. Planted acres in northeast Louisiana for corn, cotton, and soybeans , 2002-2011.

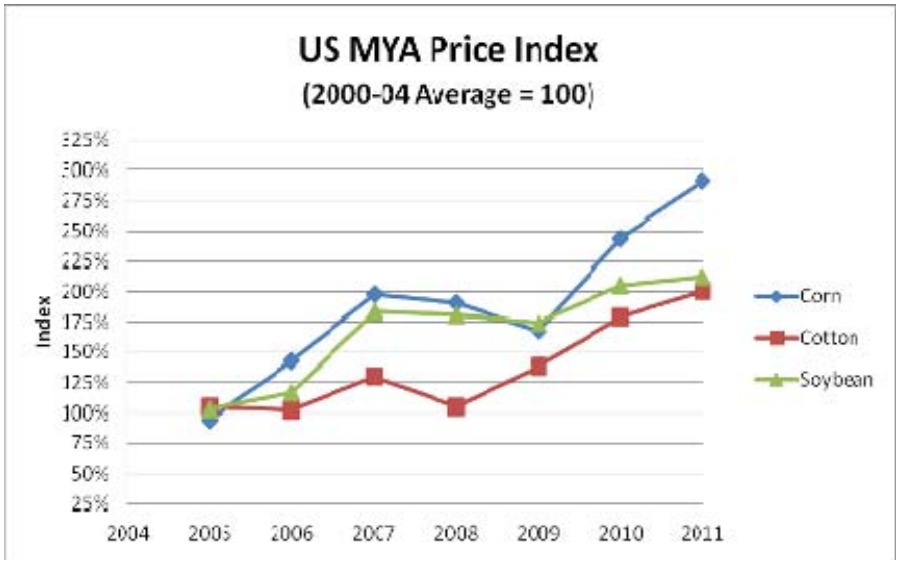

Figure 2. Marketing year price index for corn, cotton, and soybeans, 2004-2011.

As a result of production input prices, the futures prices for both corn and soybeans greatly influenced planting decisions in the region. This was highlighted during 2006 to 2007, when the national marketing year average price for corn increased from $3.04 per bushel to $4.20 ($1.16 or 38% per unit) and the per bushel soybean price

increased from $5.94 to $8.43 ($2.49 or 42% per unit). These price increases contrast the cotton price, which increased from $0.465 cents per pound to $0.593 ($0.128 or 28% per unit). However, since 2007, national market prices for each crop have exceeded this average price level-further illustrating crop price volatility. Post 2007 crop year average prices are calculated to be $4.66; $0.68; and $10.08 per unit for corn, cotton, and soybeans. In 2011, national marketing year prices reached record highs across all crops; $6.10 corn, $0.92 cotton, and $11.90 soybeans. The 2005 to 2011 average national marketing year average (MYA) price index for corn, cotton, and soybeans appears in Figure 2. In examining the price indices from 2010 and 2011, corn was calculated at an average of 268% of its 2000-04 index price. Soybeans followed at 209% with cotton at 190% of its respected index.

Materials and Methods

The first modeling approach chosen for this project was a financial farm simulation model that was constructed using SAS (SAS Institute Inc. 2008) for cotton producing parishes in northeastern Louisiana to evaluate the effect that corn, cotton, and soybean crop rotations have on grower profitability (net returns above variable costs). Stochastic prices and yields utilized in the risk analysis were generated using the SIMETAR software program (Richardson et al. 2008). Yield per planted acre for each crop was simulated based on the past ten years of data to provide an accurate depiction of the variability within the region. Production cost data for corn, cotton, and soybeans was obtained from *Projected Cotton Costs and Returns for Northeast Louisiana* (Deliberto and Salassi 2012) and applied to this regional analysis model. Production costs in the model were assumed to be consistent with suggested recommendations for all input cost categories with exception to fertilizer and fuel. Reductions in input costs and the potential for yield increases have been associated with rotational crops in this region of Louisiana. When cotton is produced in rotation with corn, the nitrogen fertilizer rate was reduced by 25 pounds per acre. There exists a positive yield response associated with a crop rotation versus a mono-crop system (Guidry et. al 2001). For instance, cotton yield, when in a rotation with corn and soybeans, can be upwards of 15% greater when compared to a cotton mono-crop. Similar, a 10% yield benefit exists to corn and soybeans when these crops are produced in rotation with one another as opposed to farm acreage being devoted to a continuous cropping pattern.

It is noted that this research was conducted in June of 2012, therefore harvest month contracts for corn was $5.30 per bushel for a September 2012 contract; $0.6765 per pound for an October 2012 cotton contract, and $13.28 per bushel for a November 2012 soybean contract. Mean crop yields for the simulation model were selected at 150 bu/ac for corn, 1,000 lbs/ac for cotton, and 40 bu/ac for soybeans. These yield levels are representative of the region as well as consistent with the trend yield patterns for the 2002 to 2011 crop years. Simulated model input parameters included: diesel fuel along with nitrogen (N), phosphate (P), and potash (K) fertilizers. Mean prices were set at $3.50/gal and $0.63/lb, $0.70/lb, and $0.51/lb respectively. Market prices were selected based on near-by futures contracts as of mid-June 2012. A standard land rent of 20% is assumed in this analysis where the landlord receives 20% of the crop in exchange for land privileges. The landlord assumes a 20% cost share in the hauling and drying expense categories for corn and only the hauling category for soybeans. The cotton gin is assumed to take the cotton seed as payment for ginning. It is commonly assumed that the type of share rental arrangements vary with a particular production region, as well as for the same crop, so this rental rate is intended to serves as proxy.

To further evaluate the competitiveness of cotton under alternative market prices and yield levels in northeastern Louisiana, data from Tensas Parish, Louisiana was selected to construct a representative mixed crop farming operation. This approach, undertaken in November 2012, is intended to work in conjunction with the farm financial simulation model that was constructed prior to harvest season for the region. Given current production costs and expected yields for producers in Tensas Parish, the question of under what price and yield situations can cotton compete economically for crop production acres relative to corn and soybeans was posed. This research question expands on the above mentioned “predetermined” or specified crop selection model. Tensas Parish has recorded an above average cotton yield when compared to surrounding parishes located in the northeastern Louisiana Mississippi River delta region (USDA NASAS District 3), so it was necessary to account a cotton yield increase in model parameter identification. Corn and soybean yields were consistent with regional averages over the past decade. Figures 3 through 5. As an alternative to the simulation approach that was used for the predetermined crop mix model, the previous ten years of data for Tensas Parish was detrended and the residuals were calculated and applied to the means of the selected input prices, market price, and yield level for each crop for each observation (i.e. year). This second modeling approach considers the contribution that poly-pipe irrigation has to cotton yields when implemented on-farm. Hence, this production expenditure must be weighted and applied to the appropriate acres that are devoted to cotton in each rotational model when warranted. Yield scenarios were 850, 1,000, and

1,200 lbs/ac for cotton; 130 bu/ac for corn; and 40 bu/ac for soybeans. Four price scenarios were used in this approach: (a) $0.72/lb cotton, $7.00/bu corn, and $14.00/bu soybeans, (b) $0.72/lb cotton, $6.00/bu corn, and $13.00/bu soybeans, (c) $0.82/lb cotton, $7.00/bu corn, and $14.00/bu soybeans, and (d) $0.82/lb cotton, $6.00/bu corn, and $13.00/bu soybeans. Each price scenario that is represented can be further explained as: (a) year-end 2012 commodity prices, (b) a slight decline in grain prices as we move into 2013, (c) year-ending 2012 grain prices coupled with an increased cotton price, and (d) increased cotton price with decreased grain prices. Incorporation of price movements for both corn and soybeans presents the rationale for cotton being able to compete for farm acres.

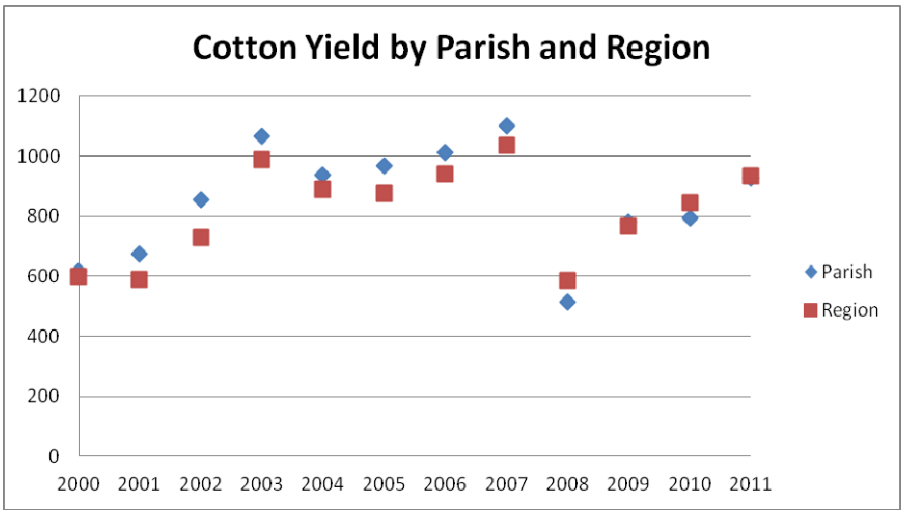

Figure 3. Cotton yield (in pounds per acre) for Tensas Parish, Louisiana compared to USDA NASS District 3 yields for northeastern Louisiana, 2000-2011.

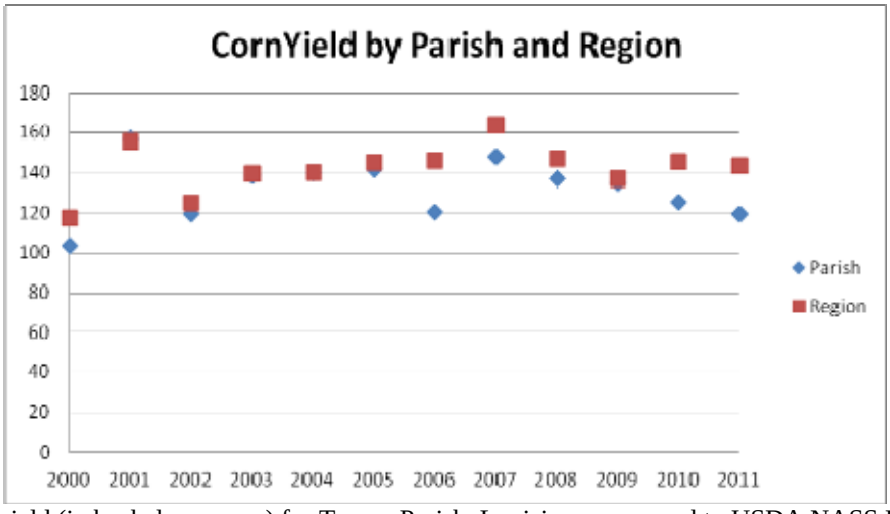

Figure 4. Corn yield (in bushels per acre) for Tensas Parish, Louisiana compared to USDA NASS District 3 yields for northeastern Louisiana, 2000-2011.

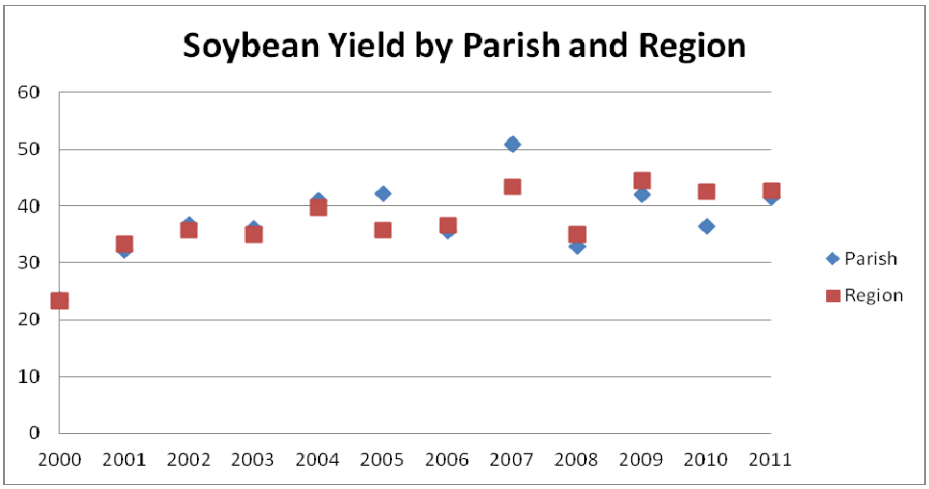

Figure 5. Soybean yield (in bushels per acre) for Tensas Parish, Louisiana compared to USDA NASS District 3 yields for northeastern Louisiana, 2000-2011.

Results and Discussion

Results from the farm simulation model for 13 predetermined crop mixes are presented in Table 3. These results are evaluated based on the grower's share of net returns above total variable costs per crop mix choice. Simulation of the 2012 yield level for each crop, selected production input parameters, and the near-by harvest month futures prices in mid-June indicate that a producer would favor a rotation consisting of a corn or a predominant corn-soybean mix of farm acres in the Mississippi River delta region of Louisiana. The crop mix that produced the highest level of net return per acre to the grower was a corn mono-crop (100CR) followed by: 66CR-33SY, 50CR-50SY, 33CT-66SY, and a 66CR-33CT mix. Four out of the top five crop mixes, in terms of grower net returns above variable costs, included a majority (greater than a 50%) of acres devoted to corn. The predetermined crop mix selection modeling approach suggest that predominant crop mixes that favor cotton (rotation numbers 2, 7, 11, and 13) exhibited the lowest net return level per acre while incorporating the highest degree of risk to the producer.

Table 3. Simulation results of predetermined crop mix models in the Mississippi River Delta Region of Louisiana.

Crop Mix No.	Corn	Cotton	Soybeans	GRW NRAVC/ac	Rank of Crop Mix	Return Difference
		(percent of farm acres)				
1	100	0	0	$255.11	1	--
2	0	100	0	$144.78	13	$110.33
3	0	0	100	$165.35	9	$89.76
4	33	33	33	$186.53	7	$68.58
5	50	50	0	$199.95	5	$55.16
6	50	0	50	$210.23	4	$44.88
7	0	50	50	$155.07	11	$100.04
8	66	0	33	$222.94	2	$32.17
9	66	33	0	$216.15	3	$38.96
10	33	0	66	$193.32	6	$61.79
11	33	66	0	$179.74	8	$75.37
12	0	33	66	$156.91	10	$98.20
13	0	66	33	$150.12	12	$104.99

The Tensas Parish Louisiana model results for evaluating cotton rotation competitiveness for each of the four pricing scenarios (a through d) appear in tables 4 through 7. This approach tackles some important management decisions such as acreage allocation based on competing crop prices and irrigation use. There are some conditions under which cotton can successfully compete for acres and that, in those cases where another crop rotation has the highest mean return, rotations with cotton have similar returns in some instances. Grower share of net returns above variable costs indicate that cotton can compete economically with corn and soybeans at the $0.82/lb and even "out-

compete" corn and soybeans when yield levels are in excess of 1,000 lbs/ac. However, the risk measure associated with cotton must be considered by the producer as this percentage represents the degree of variability in profit level. Rotations including cotton have higher net income variability due to the higher variability of cotton prices and yield when compared with corn and soybeans. Across cotton price levels of $0.72 and $0.82/lb levels, the coefficient of variation, which is interpreted as the variability in net income from one year to the next, is greatest when associated with the production of cotton. This indicates a higher degree of risk.

Table 4. Evaluation of cotton rotation competitiveness (a) in the Mississippi River Delta Region of Louisiana.

Crop Mix Model (Acreage Allocation %)	Mean Cotton Yield per Acre		
	850 lbs/ac	1,000 lbs/ac	1,200 lbs/ac
		GRW NRAVC/ac	
CT/CR/SY = 50/50/0	$121	$164	$222
CT/CR/SY = 33/33/33	$163	$178	$197
CT/CR/SY = 0/50/50	$185	$185	$185

Table 5. Evaluation of cotton rotation competitiveness (b) in the Mississippi River Delta Region of Louisiana.

Crop Mix Model (Acreage Allocation %)	Mean Cotton Yield per Acre		
	850 lbs/ac	1,000 lbs/ac	1,200 lbs/ac
		GRW NRAVC/ac	
CT/CR/SY = 50/50/0	$69	$112	$170
CT/CR/SY = 33/33/33	$101	$115	$134
CT/CR/SY = 0/50/50	$117	$117	$111

Table 6. Evaluation of cotton rotation competitiveness (c) in the Mississippi River Delta Region of Louisiana.

Crop Mix Model (Acreage Allocation %)	Mean Cotton Yield per Acre		
	850 lbs/ac	1,000 lbs/ac	1,200 lbs/ac
		GRW NRAVC/ac	
CT/CR/SY = 50/50/0	$155	$204	$270
CT/CR/SY = 33/33/33	$175	$191	$213
CT/CR/SY = 0/50/50	$185	$185	$185

Table 7. Evaluation of cotton rotation competitiveness (d) in the Mississippi River Delta Region of Louisiana.

Crop Mix Model (Acreage Allocation %)	Mean Cotton Yield per Acre		
	850 lbs/ac	1,000 lbs/ac	1,200 lbs/ac
		GRW NRAVC/ac	
CT/CR/SY = 50/50/0	$103	$152	$218
CT/CR/SY = 33/33/33	$112	$129	$150
CT/CR/SY = 0/50/50	$117	$117	$117

Summary

Over the past decade, there exists a lower net return margin associated with cotton production compared to corn and soybean profit margins in northeastern Louisiana. Results from two economic models indicate that cotton production in the Mississippi River delta region of Louisiana has the greatest degree of variability in net returns to the grower from one year to the next. This risk measure is in contrast to soybean production that exhibits the lowest level of risk, due to the fact that fuel and fertilizer compose a smaller percentage of the variable costs per acre for this crop as compared to corn and cotton. When examining current production conditions in Tensas Parish, a comparison of the models suggest that cotton can compete economically with corn and soybeans when factors such as irrigation, near-by futures prices, and location-specific yield observations are incorporated into model development. Predetermined crop mixes are a starting point to understanding all of the factors that influence a producer's management decision to devote limited production acres to cotton planting. Results indicate that this research can be intensified to consider additional production factors such as the probability of a sustained cotton price level greater than $0.72/lb, warranting consideration of additional crop mixes, perhaps relative to a target (or specified) desired farm income level. Preliminary results from this modeling suggest that if a Tensas Parish Louisiana cotton producer can generate consistent cotton yields above 850 lbs/ac, then cotton can contribute into the overall profitability to the

farming operation. When discussing the potential of increased cotton yields, the utilization of irrigation (e.g. economic cost of poly-pipe) must be weighted across cotton acres.

References

Deliberto, M.A. and M.E. Salassi. *2012 Projected Costs and Returns for Cotton, Soybeans, Corn, Grain Sorghum, and Wheat Production in Northeastern Louisiana*. Louisiana State University Agricultural Center. Department of Agricultural Economics and Agribusiness. A.E.A. Information Series No. 283. January 2012.

Guidry, K.M., A. Bechtel, S. Hague, R. Hutchinson, and D. Boquet. "Profitability of Cotton Crop Rotation Systems in Northeast Louisiana". *Louisiana Agriculture Magazine.* Summer 2001.

Richardson, James W., K.D. Schumann, and P.A. Feldman. SIMETAR. Simulation and Econometrics to Analyze Risk. ©2008 Simetar, Inc. College Station, TX.

SAS Institute. 2008. SAS Online Documentation 9.1.3