DECISION SUPPORT SOFTWARE UPDATE: TRANSPORTING SEED COTTON FROM THE FIELD TO GIN

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Abstract

The number of cotton gins in the state of Texas has declined from over 1400 gins in 1960 to less than 232 gins in 2011. Texas has experienced an increase in cotton production since that time, and now remains relatively constant at 5.5 million bales ginned annually. A decision support software package was produced and published for cotton ginners to determine the economic risks and benefits of transporting seed cotton modules from the field to the gin. Using gin data from USDA-ARS and the Texas Cotton Ginner's Association from 2005-2010, the software package has aided the cotton industry in determining the economic viability of transporting seed cotton modules long distances. The increased production of cotton, along with the decreasing number of cotton gins in Texas, justifies the need for an updated software package with the goal of more efficient cotton handling and ginning systems. Specifically, fewer gins and increased production will likely result in transporting seed cotton longer distances. Using reported 2010 gin data from USDA-ARS and surveys conducted by the Biological and Agricultural Engineering Department at Texas A&M University, the previous transportation model produced in 2008 is being updated to reflect current economic conditions. This paper explores the need to incorporate non-conventional module types into the transportation calculator to aid cotton ginners and producers in making sound management decisions relating to module transportation.

Introduction

Historically, cotton producers had a gin within close proximity. Texas has seen a drastic reduction in the number of operating cotton gins since the 1960's; from more than 1400 to 232 active gins in 2011. This reduction has caused gins to transport seed cotton longer distances, grow larger, and/or operate for a longer season in order to process on average 5 million bales annually.

Since the module builder was developed & adopted in the early 1970's, eliminating the need for cotton trailers and allowing the storage of seed cotton at the gin site, module transportation has been a great concern to gin managers and primarily accomplished through a live bottom module truck. The adoption of module systems allowed for the advancement of cotton harvesting equipment to quickly gather the crop and ready it for storage & ginning with minimal damage to fiber quality due to forming modules in the field.

In the late 2000's both Case IH and John Deere released cotton pickers that had the ability to build modules on-board. The Case IH produces an 8 ft by 16 ft by 8 ft block type module, and the John Deere produces a round module that has a diameter of 7.5 ft and a width of 8 ft. These changes in modules shapes and dimensions have given cotton ginners the ability to use means other than a traditional module truck to transport modules from the field to the gin. A better understanding of the cost and logistical constraints associated with each method is critically needed by gin managers when making management decisions regarding module transportation.

These new module types could potentially allow cotton ginners to travel further distances to pick up seed cotton without having a negative impact on the total ginning costs that will be passed along to the producer. The advantage of this is that cotton ginners can work towards a point that is considered optimal, or where total ginning costs are least. This optimal point will vary from gin to gin and based on ginning capacity

Background Information

Decision support software (DSS) was developed and released in 2008 to aid cotton ginners in making management decisions regarding transporting seed cotton modules further distances from field to gin by showing the impact on total ginning cost. The initial release of the DSS did not include the variable cost per bale in the calculation of sum of costs per bale and has been added to more accurately reflect the total cost of ginning the manager might expect.

The idea of decision support software is not novel, but continuing to maintain up to date and relevant information is critical to ensure that cotton gin managers are able to make well-informed decisions.

Emsoff et al. (2007) published researched findings that included models and algorithms for determining optimal season lengths in terms of percent utilization (%U) and minimal ginning cost for four different ginning rate categories as seen in Table 1. The concept of %U, as defined by Fuller et al. (1993), is that a gin operating at 100 %U would on average process seed cotton at 80% of its rated capacity (GR) for 1000 hours per season.

Table 1. Season Lengths

Category	Rating (BPH)	Optimal %U
I	<15	170%
II	15-25	180%
III	25-40	190%
IV	>40	200%

Variable Ginning Cost

Variable costs are described as the cost that will increase or decrease with the number of bales ginned during the season. USDA-ARS in conjunction with several regional ginning associations surveyed gins and reported the average variable ginning cost for the cotton belt. This paper will only take into account the variable cost of the southwest region as defined by Valco et al. (2012). Table 2 shows the average variable cost per bale for each gin category during the 2010 ginning season. The variable cost reported include: 1) Bagging and Ties, 2) repairs, 3) Electricity, 4) Dryer Fuel, 5) Seasonal Labor. For this analysis, a conservative estimate of $25.00 per bale was used for variable cost.

Table 2. 2010 Variable Ginning Costs- Southwest.

Category	Average Cost per Bale ($/bale)					
	Bag/Ties	Repairs	Elec.	Dryer Fuel	Seasonal Labor	Total Variable
I	$5.13	$3.95	$3.41	$2.10	$9.89	$24.47
II	$4.80	$3.97	$3.83	$1.08	$8.79	$22.47
III	$4.34	$5.91	$3.69	$0.85	$7.07	$21.85
IV	$4.38	$3.69	$3.20	$0.75	$5.76	$17.77

Fixed Ginning Cost

Fixed costs are assumed to be independent of the number of bales ginned and include: 1) Depreciation, 2) Interest, 3) Insurance, 4) Taxes, 5) Management. Fixed ginning costs were calculated based on equations used by Emsoff et al. (2007). Table 3 gives a summary of the average fixed cost per bale for each gin category that was calculated for the southwest region using 2010 ginning cost data.

Table 3. 2010 Fixed Ginning Costs.

Category	Average Fixed Cost per Bale ($/bale)				
	Depreciation	Interest on Annuities	Tax, Shelter, Insurance	Management	Total Fixed
I	$8.43	$18.00	$3.97	$11.39	$41.79
II	$6.78	$14.48	$3.19	$10.93	$35.38
III	$6.25	$12.78	$2.78	$8.28	$30.09
IV	$3.99	$0.99	$1.88	$3.79	$10.64

Interest on annuities was calculated by using equation 1 (ASABE Standard EP496.3: FEB 2006, Section 6.2.2, Interest). An interest rate of 7%, a salvage rate of 15%, and 20 years of investment were assumed

$$R = (P - S)\left[\frac{\frac{i}{q}}{1 - (1 + \frac{i}{q})^{-nq}}\right] + S\left(\frac{i}{q}\right) \tag{1}$$

where:

R = one of a series of equal payments due at the end of each compounding period, q times per year;
P = principal amount;
i = annual interest rate in decimal;
q = compounding periods per year;
n = life of the investment in years; and
S = salvage value.

Depreciation (D) was calculated by using the straight-line depreciation method. The principal amount of the equipment is represented by (P); the salvage value is represented by (S); and the life of the equipment is represented by (L). The same vales used for the salvage value in the interest on annuities equation were also applied here.

$$D = \frac{P - S}{L} \quad (2)$$

where:

D = depreciation
P = purchase Price
S = salvage Value
L = life of the equipment.

Management (M) was calculated by using an equation that was acquired through a personal contact with Dr. Sergio Capareda at Texas A&M University where (B) represents the number of bales ginned in a season; (RF1) is a constant 5591.5; (%U) represents the percent utilization ginned by a gin in a specific season; and (RF2) is a constant 1.5 (equation 4). For example, if a 40 bph gin ginned 32,000 bales, this would be 100 %U and the cost of management would be calculated to be 32,000 * 5591.5 * ($100^{-1.5)}$ which equals $178,928. This equation only holds true if RF1*($\%U^{-RF2}$) is greater than $4.00, otherwise, assume $4.00 per bale (Capareda, 2010).

$$M = B \times RF1 \times (\%U^{-RF2}) \quad (3)$$

where:

M = management costs
B = bales ginned
RF1 = 5591.5
RF2 = 1.5
%U = percent utilization

Taxes, shelter, and insurance (TSI) was calculated by simply taking 2% of the principle value of the gin. For example, if a gin had a principle of $1,000,000 then TSI would equal $20,000 per year.

<u>Transportation Costs</u>

Transportation of cotton modules was assumed to be achieved solely by a module truck. Cost associated with module transportation was calculated using the model developed by Simpson et al. (2007):

$$TC_M = \$60 + 3.25(d-15) \quad (4)$$

where:

TC_M = transportation cost using a module truck
D = total miles driven.

The model was based upon the assumptions listed below:

- A used module truck will cost $50,000 @ 6% interest for a 5 year period
- Straight line depreciation of the module truck over 10 years
- Fuel mileage of 5 mpg
- Diesel cost @ $2.50/gal

- Module truck average speed 40 mph
- Maintenance costs $1000/yr
- Insurance costs $1000/yr
- License cost $500
- Driver can work a 12 hour day and is paid $15 per hour including benefits;
- 1 shift per day, 10 hours per shift
- 15 bales per module
- 20 minute loading & unloading time per module.

Results & Procedures

A hypothetical example of a ginning operation was developed below to show the usefulness of the information that was output by the decision support software given the information input by the gin manager.

A 40 bale per hour gin operating at 141 %U, or 45,000 bales, has the opportunity to bring in an estimated additional 17,000 bales due to a nearby gin not opening for the season. Although this would increase the gin %U to 194%, or 62,000 bales, the gin manager is concerned the cost of transportation will surpass the potential savings in ginning cost due to the modules being outside of the normal service area of 35 miles. The baseline information of the current gin operating parameters is input into "Scenario 1" as seen below in Figure 1.

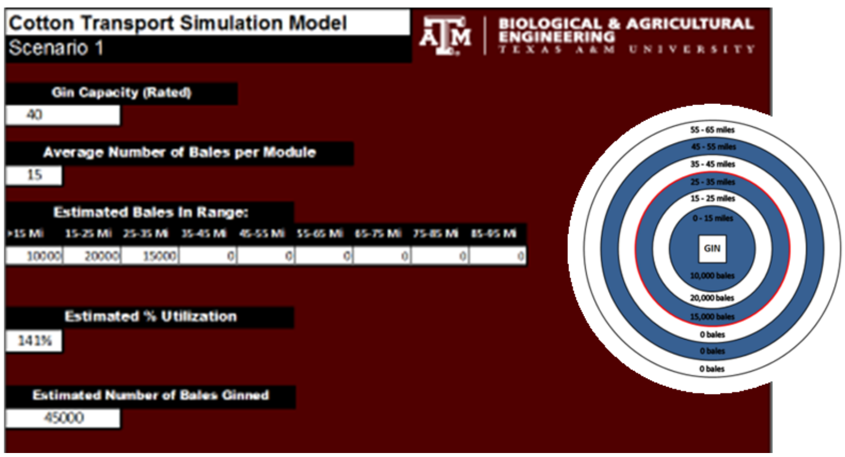

Figure 1. "Scenario 1" of the gins baseline operating conditions.

The potential operating parameters that the gin manager has expected for the upcoming season is input into "Scenario 2" as seen in figure 2. An additional 12,000 and 5000 bales have been acquired to gin from 35-45 miles and 55-65 miles away from the gin, respectively.

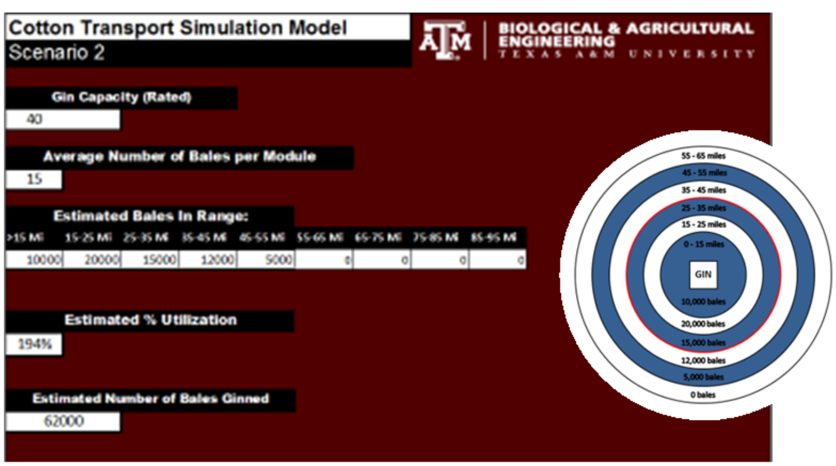

Figure 2. "Scenario 2" of the gins potential addition of bales.

Figure 3 shows a summary of the ginning costs associated with each scenario that was input. In this example, ginning an additional 17,000 bales could reduce the total ginning cost per bale from $54.94 to $49.35. This is a potential reduction of $5.59 in total ginning costs, although the additional bales acquired fell beyond the normal service area and increased the total transportation cost per bale by $1.27.

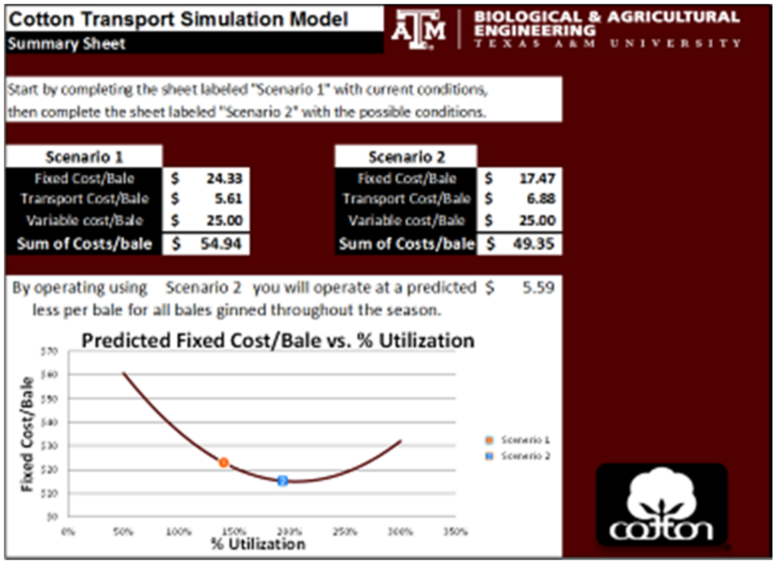

Figure 3. Ginning cost summary output by decision support software.

Conclusion

The Cotton Transportation Calculator developed in 2008 has provided cotton ginners and producers with valuable information that has aided them in making management decisions over the past 5 years. The need to update this tool is essential for it continue to be an aid to users. Although this paper depicts only hypothetical example, decision support software such as this can be used to evaluate many different situations that ginners and producers may experience through its simplicity and ease of use.

Future Work

It has been hypothesized the volume of round modules that Texas gins will process will continue to increase. This created the need to evaluate more economically feasible transportation systems than a traditional module truck to haul round modules. The Biological & Agricultural Engineering Department at Texas A&M University plans to begin collecting data in the spring of 2013 to further develop the transportation calculator and create new decision support software tools to provide guidance for cotton gin managers to make decisions about module transportation and other needs. The data collected will help validate or update existing calculation methods that are being used and to develop new ones for use.

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