

XLCOTSIM A COTTON HARVESTING SYSTEM SIMULATOR

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Abstract

XLCOTSIM is a simulator package that is embedded into a Spreadsheet file of the Microsoft Excel[®] software. It is a technology upgrade from the original COTSIM program (Chen et. al., 1992) with a new user interface and an improved capability. It is a software tool that allows growers to do "what-if" comparisons on the harvesting of a given farm to determine the most appropriate amount of resources required to harvest the cotton. It is a software tool that an equipment manufacturer can use to determine whether or not a new harvesting technology can be economically introduced into the market place. The simulator uses economic information and time-and-motion data obtained from the field operation of different equipment. These variables may be easily modified to reflect changes in harvesting technology.

Acknowledgement

This project was partly supported by the Cotton Incorporated, agreement number 00-878

Introduction

COTSIM was developed (Chen et. al., 1992) to simulate cotton harvesting and handling that includes harvesters, module builders, boll buggies, and trailers. The simulator was developed to run on personal computers with DOS operating system. The program used a total of sixty input parameters and it used yield curves to simulate the day-to-day harvesting of a season. The economic parameters and computation were based on published reports and publications in machinery management and economic analyses (Chen et. al, 1990, Hamill et. al, 1989, and Spurlock et. al. 1987). The simulator was an event driven simulator which the time-and-motion events of all the field equipment were simulated and the time, labor, and other costs were then computed to give output information such as revenue, costs, wait times, number of waits, etc. The simulator was a useful tool for growers, custom pickers, equipment manufacturers, and the extension service to predict the requirements and outcome of a cotton harvesting operation. The advances of computing technology have necessitated the evolution of the simulator to match the current economic and operating environments. XLCOTSIM was developed to facilitate the migration to newer computing technology and to make the program more user friendly.

Discussion

XLCOTSIM was developed with the goal of making the simulator user-friendlier and to make it more extensible. The major shortcomings of the original COTSIM program include:

- Character based user interface - Some of the sixty input parameters mentioned above must be entered from the keyboard and some could be read from a file. The user must repeat the keyboard entry for each simulation session even though he or she is not changing many of the values. This process was the most aggravating to the user. One misplaced character entry resulted in an error necessitating the process be reinitiated from the beginning.
- Equipment cost was based on values of the early nineties - some of the cost parameters were embedded into the program code making it impossible to change to reflect current cost values.
- Yield curve and time-and-motion data were hidden - The simulator used yield curves to simulate yield of different weather scenarios, the original yield curves were created for the southern region of the U.S. It would be difficult to incorporate a new yield curve without an intimate knowledge of the program. Time-and-motion study data were also embedded into the program making it impossible to adapt the simulator for different field environments that may be different in different cotton growing regions.

The improvements made by XLCOTSIM include:

- The use of spreadsheet technology - A spreadsheet program is normally bundled with every computer purchased. It is a software package with extensive resources that allows the user to develop a new application based on it. The user interface presented in a spreadsheet format is natural for a program

like COTSIM, where all of the inputs can be presented to the user in one sheet and extensive comments (tips) can be embedded to help explain to the user the meaning of each input parameter. XLCOTSIM puts all the input parameters in a sheet and all of the inputs are pre-filled with default values. The user only needs to change those values he/she wants to change. The number of owned and leased pickers, boll buggies, and trailers are pre-filled with additional "Y/N" cells to allow the user to include or exclude certain equipment from the simulation. A comparison of the user interfaces between the old and new programs is shown in figures 1 and 2.

- Expose all parameters - all of the parameters that were previously embedded into the program are now exposed to the user in the form of a "locked" sheet. The user can unlock the sheet and modify the additional parameters. The parameters that are in this category include: the yield curves of different weather scenarios, and the time-and-motion parameters of harvesters, trailers, boll buggies and the module builders. A true random number generator has been included in this version to more realistically simulate weather and yield variations when running multiple replications (simulates more than one year's harvesting).
- Reporting - the reporting of results is done in a tagged file format to facilitate electronic parsing and extraction of selective information. This feature will simplify the generation of customized reports, a feature that will be implemented in the future.

The results produced by XLCOTSIM are comparable to the results generated by the original COTSIM.

Conclusion

XLCOTSIM is a much easier cotton harvesting system simulator to use than its predecessor. It has a vastly improved user interface with almost all of the simulation parameters and the harvesting environments exposed to the user to allow the user to modify or define new environments.

More improvements can be incorporated into XLCOTSIM, among the possibilities planned for the future are: Improving the output capabilities to allow the user to produce output information that is more focused to the particular user; add-on tools to help the user to develop new weather scenarios and yield curves; capabilities to read yield maps for generation of yield curves and to suggest optimal logistics schemes; and convert it into a platform independent web-base tool.

XLCOTSIM can be obtained from the Mississippi State University Extension Service, Agricultural Engineering by calling 662-325-3103 or email to hw@abe.msstate.edu. The final release of XLCOTSIM will be made available at the TOOLS AND RESOURCES page of the following web site: <http://www.abe.msstate.edu>.

References

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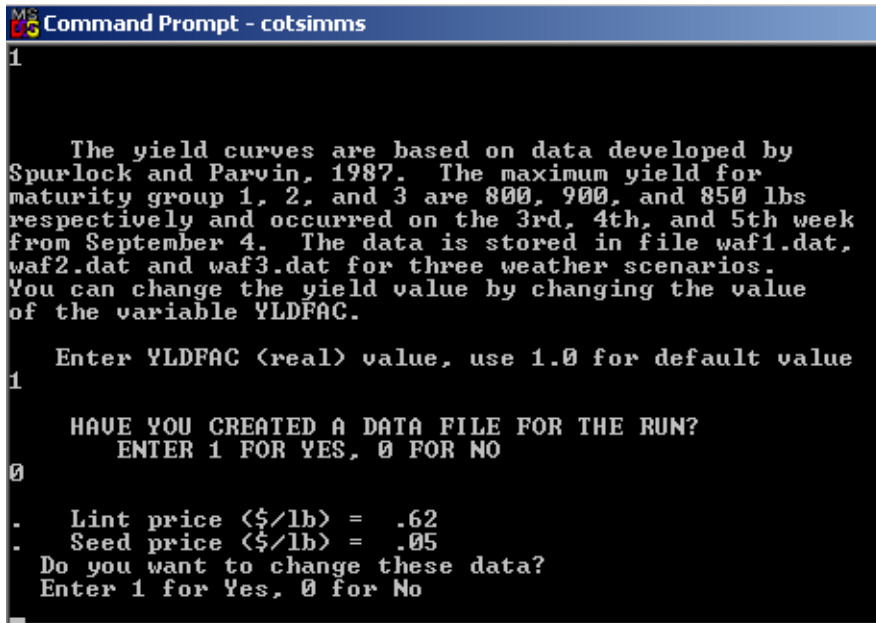


Figure 1. XLCOTSIM Character-based User Interface.

	A	B	C	D	E	F	G	H
1	Working Directory	C:\cotsim	RUN					
2	Expected Average Lint Yield (lb/acre)	850						
3	Lint Price (\$/Lb)	0.62						
4	Seed Price (\$/ ton)	100.00						
5	Interest rate (%)	10.00						
6	Permanent labor Rate (\$/hr)	10.00						
7	Temporary labor Rate (\$/hr)	7.50						
8	Diesel fuel cost (\$/gal)	1.00						
9	area of maturity group 1 (acres)	4000						
10	area of maturity group 2 (acres)	6000						
11	area of maturity group 3 (acres)	2000						
12	% of yield harvested in first picking	90%						
13	% of yield harvested in 2nd picking	5%						
14	Attributes of Pickers		Case 4 row #1	Case 4 row #2	Kenneth's homemate	Picker #4	Picker #5	Picker #6
15	Field capacity (ac/hr)		6.5	6.5	6.5	6.5	6.5	6
16	Basket capacity (lb)		8500	8500	8500	8500	8500	850
17	Purchase Price (\$)		\$ 330,000	\$ 330,000	\$ 330,000	\$ 330,000	\$ 330,000	\$ 330,000
18	Leasing cost for Leased picker (\$/hr)		\$ 200	\$ 200	\$ 200	\$ 200	\$ 200	\$ 200
19	Fuel Consumption (gal/hr)		14	14	14	14	14	1
20	Second Harvest Field capacity (ac/hr)		8	8	8	8	8	
21	Second Harvest Percent of Acreage Harvested		80.00%					
22	Leased or Owned (L/O)		O	O	O	O	O	O
23	Included in Simulation (Y/N)		Y	Y	Y	Y	Y	Y
24	Attributes of Bole Buggies		Buggy #1	Buggy #2	Buggy #3	Buggy #4	Buggy #5	Buggy #6
25	CAPACITY (lb)		10000	10000	10000	10000	10000	1000
26	Purchase Price (\$)		\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000
27	Included in Simulation (Y/N)		Y	Y	Y	Y	Y	Y
28	Attributes of Module Builders		Builder #1	Builder #2	Builder #3	Builder #4	Builder #5	Builder #6
29	Capacity (lb)		20000	20000	20000	20000	20000	2000

Figure 2. XLCOTSIM Graphical User Interface.