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THE PACKING SIMULATION MODEL

Constance L. Falk, Daniel S. Tilley, and R. Joe Schatzer

Abstract

The Packing Simulation Model is a micro-computer application program designed for researchers, extension personnel, bankers, packing managers, or other specialists who plan the operations of a packing facility or simulate its financial performance. PACKSIM produces pro forma financial statements for packing facilities based on flexible crop mixes and packing assumptions. Variations can be made in the product harvest schedule, price, quality, quantity, input costs and requirements, packing efficiency, overhead, and loan terms.

Key words: financial statements, electronic spreadsheets, packing facility, sensitivity analysis.

Financial planning for various price, quality, and volume scenarios in a packing facility is tedious when done by hand. Computerized spreadsheets to generate pro forma financial statements should be useful to packing facilities because they must make numerous assumptions in any given packing season. Microcomputer simulation should be beneficial for agribusiness researchers, extension personnel, bankers, and teaching faculty interested in packing facility feasibility.

The Packing Simulation Model (PACKSIM) consists of two templates constructed with the spreadsheet software Lotus 1-2-3.¹ PACKSIM produces pro forma financial statements based on flexible crop mixes and packing assumptions. Variations can be made in prod-

uct quality and yield, packing labor requirements and wage rates, packout rates, plant capacity, overhead, and loan terms. The effects of changes in these parameters are computed in individual crop packing budgets, cash flow and income statements, a balance sheet, breakeven analyses, financial ratios, labor usage, payment to farmer calculations, and a credit report. These statements are pro forma reports; PACKSIM is not a bookkeeping program.

The need for PACKSIM grew out of a research project to determine the feasibility of developing a fresh vegetable industry in southeastern Oklahoma. Many of the assumptions underlying business plans changed often as the producers and packing managers learned more about the production and marketing system for new crops. Produce packing managers in private business and a regional development project have used PACKSIM to prepare loan application materials and to analyze long-term expansion plans. Researchers have used PACKSIM to analyze the impact of variations in quality and yield on packing costs. The packing managers found that working within a framework such as PACKSIM made the planning process more systematic. They were less likely to overlook important assumptions because PACKSIM leads the user through all of the input requirements. Although the number of data inputs may seem extensive for the first-time user of PACKSIM, these inputs were generally known to the packing managers who worked with PACKSIM.

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¹Lotus 1-2-3 is a trademark of Lotus Development Corporation.

OPERATING PROCEDURES AND INPUT DATA REQUIREMENTS

Each of PACKSIM's two menu-driven templates is located in a separate file. Sixteen additional files transfer loan information between the two main files, PACK and LOAN. The PACK file contains all of the input screens and output statements with the exception of the loan analysis which is conducted in the LOAN file. There is also an auto-boot file containing preliminary instructions.

Data are entered in each of the Parts A through P of the PACK file menu (Figure 1). For example, designation of the product mix and the percentage of total harvest expected each month is entered in Part B (Figure 2). A few of the output statements like the cash flow and the income statement require input data such as taxes, lease incomes, or bank loans to be entered directly in the output statement. Other than the latter data requirements, all of the output statements are complete and ready for viewing immediately upon completion of Part P of the PACK file menu.

The loan analysis produces monthly, quarterly, semi-annual, and annual loan schedules for up to 30 years. The payment schedule can begin in any month indicated by the user. The annual interest costs and remaining liability for up to 16 assets or sets of assets with similar loan terms are saved, transferred to the PACK file from the LOAN file, and included in the appropriate financial

statements. The LOAN file provides the user the option of retrieving previously saved loan terms to facilitate updating loan schedules. PACKSIM also accommodates users who prefer to enter loan information directly in the PACK file rather than conduct loan analyses in the LOAN file and transfer the data.

Input data requirements are listed in an appendix of the user's manual accompanying the model. The data needs of PACKSIM can be divided into those that are crop specific, such as the harvest flow schedule and special equipment needs, and those that are not, like loan terms and standard equipment costs.

Accounts payable and receivable are entered as percentages to adjust cash flow figures. Accounts payable are divided in two groups: payments to farmers and payments to raw material suppliers.

COST ALLOCATION METHODS

Overhead cost allocations to individual crop packing budgets are based on the percentage of volume in tons that each crop represents of the total. This percentage is based on the acreage planted, pounds per crate, and crates-per-acre yield of each crop as provided by the user. Costs of special equipment used by particular crops are allocated only to those crops which are handled by the equipment. For example, the cost of a waxer used on cucumbers is assigned to the cucumbers in a special table accessed with the ALT J keys.

For every crop, the user sets an hourly

PACKING SIMULATION MODEL

MENU OF COMMANDS (PRESS ALT AND THE LETTER KEY)

A Name Crop Mix	L Run Loan Analysis
B Set Product Mix	M Transfer Loan Menu I
C Set Labor and Packing Assumptions	N Transfer Loan Menu II
D Set Raw Materials	O Transfer All Loans
E Set Selling Prices	
F Set Fixed Overhead / Fin. Inputs	P Set Packing / Trans. Charges
G Set Credit Terms / Carryover	
H Set General Expenses	Q View Menu
I List Assets and Values	R Print Menu
J Set Specialty Usage	T Invoke Titles
K Enter Loan Information Directly	U Clear Titles
V Save Worksheet and Exit Model	
W Exit Model Without Saving	

Figure 1. The PACK File Menu of Commands.

PART B. PRODUCT MIX

1986

CROP	FIBr	Cab	Cant	Cuc	Okra	Spin
POUNDS PER CRATE	22	50	38	50	15	25
CRATES PER ACRE	400	400	350	500	400	250
TOTAL ACRES	100	75	75	50	50	150
TOTAL CRATES	40000	30000	26250	25000	20000	37500
TOTAL TONS	440.0	750.0	498.8	625.0	150.0	468.8
PERCENT OF TOTAL	15.00	25.58	17.01	21.31	5.12	15.98

SET PERCENTAGE OF CROP HARVESTED EACH MONTH

JANUARY	0	0	0	0	0	0
FEBRUARY	0	0	0	0	0	0
MARCH	0	0	0	0	0	10
APRIL	0	0	0	0	0	50
MAY	0	75	0	0	0	40
JUNE	0	25	0	30	0	0
JULY	0	0	20	40	30	0
AUGUST	0	0	30	30	40	0
SEPTEMBER	0	0	30	0	20	0
OCTOBER	40	0	20	0	10	0
NOVEMBER	40	0	0	0	0	0
DECEMBER	20	0	0	0	0	0
TOTAL CROP	100% FIBr	100% Cab	100% Cant	100% Cuc	100% Okra	100% Spin

Figure 2. The Product Mix and Harvest Flow Schedule.

packout rate and capacity level. A plant operating at a 400 packout rate and 90% capacity means that 360 crates are being packed per hour but labor costs are incurred for 400 crates per hour. Thus, the model allows the user to estimate cost/volume relationships by varying either the rate or time of operation or both as suggested by French, Sammett, and Bressler. The function can be continuous or discontinuous depending on how the user specifies labor requirements for different rates of output.

To allocate costs of crates which are rejected at the packing facility for quality reasons, the user enters the percent packed. Since the rejected crates are handled and graded, labor costs are incurred by these crates. The user defines the labor categories in which costs are assigned to packed and rejected products, packed products only, or rejected products only. Overhead costs are automatically assigned in the packing budgets to both packed and rejected crates. Asset depreciation is calculated using the straight line method. Costs of leased equipment can also be accommodated in the model.

OUTPUT STATEMENTS

Most of the output statements are standard pro forma financial statements or expense summaries. An exception is the breakeven analysis shown in Figure 3.

Breakeven Analysis

Two breakeven statements are generated by PACKSIM. In the first (Figure 3), the user can view the breakeven table as produced by the assumptions set in the model. The second appears exactly like Figure 3, but allows variations in fixed and variable costs, average selling prices, and volume sold. In effect the user can conduct sensitivity analysis on breakeven sales volumes in crates and acres without having to return to the original input sections to alter certain key assumptions.

In both tables, breakeven sales volume in dollars is computed using the weighted change to breakeven. The standard breakeven formula, total fixed cost divided by the difference between total sales revenue and total variable costs, is used to compute the weighted change to breakeven. When an as-

BREAKEVEN ANALYSIS FOR PACKING HOUSE: No User Input Permitted

1986
GROSS
SALES: 1,246,784

BREAKEVEN
SALES VOLUME: 1,120,837
TOT. FIXED COSTS: 270,057

WEIGHTED
CHANGE TO
BREAKEVEN: 10.10%

CROP	NUMBER OF CRATES SOLD	AVERAGE PER CRATE SELLING PRICE	PER CRATE VC: FREIGHT/ PACK/PYMT	WEIGHTED BREAKEVEN		UNWEIGHTED BREAKEVEN	
				CRATES	ACRES	CRATES	ACRES
FlBr	36000	\$6.81	\$5.451	32363	89.90	13633	37.87
Cab	27000	\$11.54	\$8.447	24273	67.42	17179	47.72
Cant	23625	\$6.58	\$4.714	21238	67.42	7320	23.24
Cuc	22500	\$8.28	\$5.686	20227	44.95	10777	23.95
Okra	18000	\$5.26	\$4.814	16182	44.95	-50697	-140.82
Spin	33750	\$7.53	\$5.810	30341	134.85	16081	71.47
C7	0	\$0.00	\$0.000	0	0.00	0	0.00
C8	0	\$0.00	\$0.000	0	0.00	0	0.00
C9	0	\$0.00	\$0.000	0	0.00	0	0.00
C10	0	\$0.00	\$0.000	0	0.00	0	0.00
C11	0	\$0.00	\$0.000	0	0.00	0	0.00
C12	0	\$0.00	\$0.000	0	0.00	0	0.00
C13	0	\$0.00	\$0.000	0	0.00	0	0.00
C14	0	\$0.00	\$0.000	0	0.00	0	0.00
C15	0	\$0.00	\$0.000	0	0.00	0	0.00

Figure 3. Breakeven Analysis Example.

sumption is changed, the weighted crates and acres figures are adjusted for all of the crops to arrive at the breakeven levels.

The unweighted figures isolate the effects of a change in only one crop, holding fixed at the original levels all other crop volumes, costs, and prices. For instance, one might be interested in knowing how many acres fewer of fall broccoli the packing facility could pack and still break even, given no changes in the rest of the crop mix.

Other Output Statements

Output statements produced besides the standard pro forma financial statements are the monthly labor summary, credit balance report, and payments to farmers by crop. The monthly labor summary aggregates the total number of hours needed each month to pack the proposed crop mix, which should facilitate labor hiring and scheduling. The credit balance report states the end of year balances for each outstanding loan and the accounts payable and receivable due in January and February of the following year. These balances are needed in the cash flow analysis in the following year.

The payment to farmers is the difference between the sales price and the sum of the packing charge and transportation cost. The payment to farmer table disaggregates the payments by crop. Such information is useful for packing facilities that also produce crops and indicates the incentive to grow a particular crop in a new production region. Farmer payment information generated by PACKSIM can be used in conjunction with farm-level production budgets to determine net farmer returns. PACKSIM does not generate production budgets.

HARDWARE AND SOFTWARE REQUIREMENTS

To accommodate specialized packers as well as those with a wider range of products, PACKSIM is available in four sizes based on the maximum number of crops that can be analyzed: 20, 15, 10 or 5 crops. An IBM² or IBM compatible microcomputer with 640K is needed to load Lotus 1-2-3 and the two larger versions of PACKSIM. The two smaller sizes can be used on a 512K machine. A hard drive is recommended for increased speed in saving and retrieving.

²IBM is a registered trademark of International Business Machines, Inc.

AVAILABILITY

The PACKSIM software and documentation are available from the Department of Agricultural Economics, Oklahoma State University, Stillwater, OK, 74078 for \$50.

SUMMARY AND CONCLUSIONS

The ability to simulate and analyze on the microcomputer the financial feasibility of a packing facility should have widespread appeal

to researchers, agribusiness extension personnel, teaching faculty, packing managers, and bankers throughout the southern region. Agricultural economists and horticultural extension personnel in Tennessee, Kentucky, Minnesota, Georgia, Florida, Mississippi, and Oklahoma are using PACKSIM in analyses of produce packing. The model's flexibility permits virtually any crop which must be packed, cooled, stored, or palletized in a central location to be accommodated.

REFERENCE

- French, B. C., L. L. Sammet, and R. G. Bressler. "Economic Efficiency in Plant Operations with Special Reference to the Marketing of California Pears." *Hilgardia*, 24, 19(1956):543-713.

