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Grayson C. Brown
University of Kentucky

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ABSTRACT

A simple model of an integrated pest management (IPM) program is presented. The model incorporates most common sources of income and expenditure encountered by scouting programs. It has been validated in the 30-county Kentucky IPM program using county-specific parameters and agrees very well with current pricing policies in those counties. This indicates that it should be a reliable indicator of future policies as labor and fuel costs rise. Other applications of the model are discussed.

Individuals coordinating integrated pest management (IPM) scouting programs are often confronted with an array of management decisions such as what increase in acreage rates is necessary to meet increasing fuel and labor costs? What rates must be charged for different cropping systems? What effects will new techniques or methodologies have on the program?

The answers to these questions are important but not always easy to deduce. To help answer such questions, a simple model of the IPM scouting program in Kentucky has been developed and validated. The purpose of this paper is to describe this model and discuss its use.

MODEL FORMULATION

The annual cost of scouting a field may generally be described as

$$S_c = T_c + O_c + I_c$$

where S_c is the annual expenditure ($) by the program for scouting activities, T_c the total travel cost incurred by the scouts, O_c the observation costs, and I_c the program's incidental costs which are shared by each field (management personnel, supplies, etc.). These three costs will be treated individually.

Travel Costs. The costs of transporting scouts between fields is the sum of mileage costs and time costs. This can be written as

$$T_c = \overline{D}\, F\, \overline{S}_v\, (M_r + \frac{H_r}{S_p})$$

where $\overline{D}$ is the average distance between fields (mi), F the number of fields in the program, $\overline{S}_v$ the average number of visits or scouting dates/field/season (units of fields^{-1}), M_r the mileage allowance of driving ($/mi), H_r the hourly wage paid the scouts ($/h), and S_p the average travel speed (mi/h). The unit of T_c is dollars and represents the annual travel cost to the total program.

Observation Costs. The costs incurred in scouting fields depend primarily on average field size, which determines the amount of scout time required. This cost can be stated as

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[1]Scientific Paper No. 81-7-215 of the Kentucky Agricultural Experiment Station, Lexington, in connection with project No. 493.

[2]Department of Entomology, University of Kentucky, Lexington, KY 40546.

$$O_c = \frac{H_r\ D_a\ \overline{S}_v\ \overline{A}\ F}{S_a}$$

where D_a is the h/day a scout works, $\overline{A}$ the average field size in acres (units of A/field), S_a the average A/day scout assignments, and other variables are as before. As with T_c, O_c is in units of dollars and represents the seasonal cost.

Incidental Costs. Incidental costs are those management and operating costs which must be shared by all fields. These costs may be described as

$$I_c = S_u + M_f F + M_t$$

where S_u is the scout supervisor or foreman's annual salary (including fringe benefits), M_f the management costs/field ($/field), and M_t the management travel costs ($) calculated similar to T_c above. Again, I_c is in units of dollars.

Using these equations, the annual expenses of a scouting program can be written as

$$S_c = S_u + M_f F + M_t + \frac{H_r\ D_a\ \overline{S}_v \overline{A}\ F}{S_a} + \overline{D}\ F\ \overline{S}_v\ (M_r + \frac{H_r}{S_p})$$

APPLICATIONS

Although extremely simple, the above model has several important applications. Some of these applications have been implemented in the Kentucky IPM program while others are available.

Determining Rate Charges. For new and expanding programs the model can serve as a guide to assessing minimum rates ($/A) which must be charged to cooperators for the program to remain solvent. This is done by writing the income from a scouting program, S_i, as

$$S_i = \overline{A}\ F\ R$$

where R is the $/A charge to the farmer or cooperator, $\overline{A}$ and F are as before. Since a necessary condition is

$$S_i \geq S_c$$

the minimum rate to be charged to the cooperator is

$$R = \frac{S_u + M_f F + M_t}{\overline{A}\ F} + \frac{H_r\ D_a\ S_r}{S_a} + \frac{\overline{D}\ \overline{S}_v\ (M_r + \frac{H_r}{S_p})}{\overline{A}}$$

This formula has been used in the Kentucky program to produce a book of minimum rate charges depending on scout and supervisor wages, mileage allowances, and the number of fields in a county's program. The values of the parameters used in determining these charges for the Kentucky program are given in Table 1 for illustrative purposes. The resultant minimum rate charges have been shown to the county agents in the 30-county program in Kentucky, each with its own wage and mileage policy. The results of comparing current prices with the model's estimates show that the model is consistently within 2–3% of current prices. This indicates that it will be a reliable indicator of the future charges as wages and mileage allowances increase. A limited number of these rate charge booklets are available from the author on request.

Assessing the Impact of Program Alterations. Some of the smaller county programs in Kentucky have no supervisor but realize that, as they expand, one will be required. This model has been helpful in determining the point at which a supervisor is economically feasible. Another example pertinent to many IPM programs is evaluating the increased cost of new technology such as data processing. This is done by adding an appropriate expression to the incidental costs component, I_c. This has been done for the IPM Data Base Management System in Kentucky (Brown et al. 1980) indicating that if this system was financed entirely through acreage charges in 1980, an additional 4¢/A would be required.

Table 1. Sample parameter values used in determining rate charges for counties in the Kentucky IPM program.

Variable	Description	Value
	FIXED PARAMETERS	
$\overline{A}$	Average field size in acres	40
$\overline{D}$	Average distance between fields in miles	5
D_a	Hours worked/scout/day	8
$\underline{S}_a$	Acres scouted/scout/day	400
$\overline{S}_v$	Scout visits/field/season	10
S_p	Travel speed between fields (mi/h)	30
	VARIABLE PARAMETERS[a]	
F	Numbers fields in a county program	25–500
H_r	Hourly scout wage ($/h)	3.00–4.00
M_r	Mileage allowance ($/mi)	0.10–0.20
M_t	Supervisory travel costs ($/yr)	0–1567
S_u	Supervisor's salary ($/yr)	0–15,000

[a]These parameters were varied over the indicated ranges to encompass the current and anticipated conditions of each of the 30 counties in the Kentucky IPM program.

Subdivision of Program Components. This model can be applied to specific components of the IPM program. For example, one may wish to treat different cropping systems separately (e.g. conventional field crops vs. double crops). One may even treat individual fields separately to identify fields that represent net profits vs. those that represent net losses. In this case, field specific parameters are used with distance for field *i* represented as

$$D_i = (D_{i-1} + D_{i+1})/2$$

where D_i is the field-specific distance for field *i* (replacing $\overline{D}$), D_{i-1} is the distance from the previous field, $i-1$, to field *i*, and D_{i+1} the distance from field *i* to the next field, $i+1$. This equation is used to give equal weight to distance to and from a scouted field.

SUMMARY

A very simple, yet accurate and flexible, model has been proposed to describe an IPM program. A few of its current and potential uses have been illustrated.

Though the structure of this model would probably vary with different IPM programs, the general concepts and approaches used here should still be valid. Moreover, this approach can be used by most IPM personnel and should aid IPM coordinators in management decisions.

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LITERATURE CITED

Brown, G. C., A. Lutgardo, and S. H. Gage. 1980. Data base management systems in IPM programs. Environ. Entomol. 9:475–482.