

THE USE OF VISICALC IN AGRICULTURAL ENGINEERING ADVISORY WORK

By T. J. MURRAY

SA Sugar Association Experiment Station, Mount Edgecombe, 4300

Abstract

VisiCalc is an interactive worksheet computer language which is useful in solving problems encountered in agricultural engineering. The application of VisiCalc to the selection and costing of machinery and its value in advisory work is discussed.

Introduction

VisiCalc is a computer language which can be used to solve problems even if one has no knowledge of the classical computer languages. It is available on many micro and mini computers and can be considered as an "electronic worksheet".

The worksheet consists of intersecting columns and rows which form cells into which alphabetic titles, numbers or formulae can be entered. There are 63 columns and 254 rows to give 16 002 numbered cells. The volume of data which is entered, or the length of a particular equation, will determine how much of the memory is used. The size of the worksheet is therefore not clearly defined and varies from one application to another.

Any portion of the worksheet can be seen on the visual display unit (VDU), usually four columns and 12 rows. The VDU can accommodate 32 characters which is the maximum width of one column. The number of characters visible in each column can, however, be specified, eg if a column width of 8 characters is specified, then four columns would be visible.

A VisiCalc worksheet is easy to compile and is particularly suited to "what if" types of problems, where the values of one or more variables can be changed. An important feature is that the answer to new problems can be calculated rapidly.

A simple worksheet consists of three cells; two of which contain a number and the third contains the product of the two numbers. For example, if cell A1 = 15.3 and cell B1 = 10.1, then the result of that equation would be displayed in cell C1, ie $(A1 \times B1) = 156.55$. A cell can have reference to any other cell provided the contents are mathematically compatible; for example, an alphabetic title and a number cannot be multiplied. It is possible to draw bar and pie charts and normal graphs using VisiCalc and a graph plotter.

Data from a VisiCalc programme can be transferred to any programme in Basic language and it has facilities for all the conventional mathematical and trigonometrical functions and a limited number of logical operations.

Applications

VisiCalc has been used in two exercises in agricultural engineering where it is particularly suitable for advisory work.

Programme planning and machinery selection

The number of machines which a farm should have is dependent on the schedule of operations on the farm. A programme plan is therefore a pre-requisite for mechanization. The choice and timing of operations must be based on agronomic factors. A technique of VisiCalc, which lists in tabular form the area that should be devoted to a particular operation each month, has been developed (see Table 1). In the second column of the table, the rate at which a certain size of tractor could complete a task, is expressed in hectares per month. If the area in which each operation is being carried out is divided by the rate at which it is done, the sum of the quotients will indicate the number of tractors required for each operation each month.

Because tractor requirements for each month are needed to assess annual requirements, a second table of 13 columns has been drawn up for this purpose. The sum of the figures along the row gives the number of months per operation per year for which a tractor is required (see Table 2).

There is generally some flexibility in the timing of operations and it is sometimes possible to re-arrange the programme to reduce the number of tractors required. This facility is what makes VisiCalc so valuable to engineers, extension officers and growers as it enables them to alter the programme in such a way that the mechanical operations are planned more efficiently.

Tables 1 and 2 show the programme that was proposed initially (numbers in parentheses) and the programme that was finally decided upon. After recalculating the machinery requirements it was found that the demand for tractors dropped from 8,5 to 5,1 by re-timing some operations, not ripping and using a contractor to apply the backlog of herbicides in September. There was a reduction of 23% in tractor time; from 38,9 to 29,8 months.

It is not essential to use a computer for any of these calculations since they are all very simple but it does save time when evaluating a number of options.

Cost estimation

Most problems concerned with selecting machinery are solved by comparing costs. A VisiCalc programme which is based on

TABLE 1
Final programme plan of area (ha) per operation per month

	Rates	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Harvst	190				192	192	192	192	192	192	192	192	192	1 728
Top Dr	342	215						70(0)	285	215(285)	215	215	215	1 430
Herb	240									192(672)	192	192	192	768
Plow(1)	24					100	100	100						300
Rip	24					0(85)	0(85)							0
Lime	342					64	64	64						192
Disc(1)	110					64	64	64						192
Disc(2)	110								(100)	75(100)	75(100)	75	75	300
Ridge	110								(100)	75(100)	75(100)	75	75	300
Herb	240	60								60	60	60	60	300
Top Dr	342	100										100	100	300

Initial values are indicated in parentheses

TABLE 2

Tractor months required for the programme plan in Table 1, expressed in tractor months per operation per month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Harvst	0	0	0	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	9.09
Top Dr	.62	0	0	0	0	0	.20	.83	.62	.62	.62	.62	4.18
Herb	0	0	0	0	0	0	0	0	.8	.8	.8	.8	3.2
Plow(1)	0	0	0	0	4.16	4.16	4.16	0	0	0	0	0	12.5
Rip	0	0	0	0	0	0	0	0	0	0	0	0	0
Lime	0	0	0	0	.18	.18	.18	0	0	0	0	0	.56
Disc(1)	0	0	0	0	.58	.58	.58	0	0	0	0	0	1.74
Disc(2)	0	0	0	0	0	0	0	0	.68	.68	.68	.68	2.72
Ridge	0	0	0	0	0	0	0	0	.68	.68	.68	.68	2.72
Herb	.25	0	0	0	0	0	0	0	.25	.25	.25	.25	1.25
Top Dr	.29	0	0	0	0	0	0	0	0	0	.29	.29	.87
Total No. Tractors per month	1.17	0	0	0	(8,5) 4.93	(8,5) 4.93	(4,9) 5.14	.83	(5,2) 3.04	3.04	3.33	3.33	(38,9) 29.77

the standards used at the Experiment Station has been developed to determine the cost of a single machine or a system of machines. The costing system is used primarily to evaluate transport problems, which are the problems dealt with most often by the advisory specialists. The programme can be used to determine the approximate fixed and variable costs of a system which contains one or all of the following: a tractor, trailer, loader and/or a truck.

Data such as daily rateable deliveries (DRD), are the same for all stages of costing but the haulage distance and speed of a tractor and trailer will be different from those of a truck.

TABLE 3
Transport system costing sheet

Tractors	Bell 1206	Trailer	Bell 14t	Loaders	Bell	Truck	MB2624
Hours	0	Price	14890	DRD	1	Km's	0
km/h	.30	Tyres	2772	Rate (t/h)	20	km/h	45
Dist km	10	Conductor	1500	Units	1.33	Dist km	40
Load t/h	25	Life (h)	12000	Price	32000	Load t/h	60
Oload t/h	60	Tyrelife (h)	3000	Tyres	836	Oload t/h	30
D Time %	.15	Licence	60	Operator	2250	D Time	.15
Pay Load	12	Life (y)	10	Life (h)	6000	Pay Load	20
Quota (t)	60000	Resale	1489	Tyrelife	3000	DRD	
Price	33980	Depreciati	1340.1	Used	1	Price	78000
Tyres	1044	Interest	1116.75	#Units	2	Tyres	7866
Fuel (1/h)	15	Fixed	4016.85	Hours	1500	Fuel (1/100)	65
Operator	2250	Tyre Cost	1059.52	RSale%	.5	Operator	4000
Life (h)	10000	Maintenanc	744.5	Interest	2400	Life km	600000
Days/yr	200	Total	5820.87	Licence	70	Day/yr	180
h/Day	9	R/h	5.07	Life	4	h/Day	16
Interest	.15	R/t	.48	Depreciati	4000	Tyrelife	50000
Fuel Price	.45	R/t.km	.04	L/t	.2	Lic & Ins et	4290
Tyrelife	3000	Sum tr	A&Tral	Fuel cost	6000	Cycle	3.19
Licence	70	R/h	21.70	Tyres	418	t/Day	100
Cycle	1.58	R/t	2.07	Maint	4000	Used	3.33
t/Day	60	R/t.km	.20	Running	10418	Units	4
Units	5	Total	24888.52	Fixed	8720	km/yr	60000
Roundg	.2			Total	19138	t/Unit	15000
Used	5			R/h	12.75	Life yr	10
Cycle	1.58			R/t	.63	Resale	11700
Units	5			t/Unit	30000	Dep	6630
h/Year	1146.66	R/h	5.07	R/h	12.75	Interest	5850
t/Unit	12000	R/t	.48	R/t	.63	Fixed	20770
Life (yr)	8.72	R/t.km	.04	t/Unit	30000	Fuel C	17550
Resale	5571.13	R/h	21.70			Tyre C	9439.2
Depreciati	3137.83	R/t	2.07			Maint	11700
Interest	2548.5	R/t.km	.20			Total	59459.2
Fixed	8006.33					R/km	.99
Fuel C	7740.00					R.t	3.96
Tyre C	399.04					R.t.km	.09
Maint	2922.28					#Units	4
Total	19067.65					km/yr	60000
R/h	16.62	R/h	5.07	R/h	12.75	t/unit	1500
R/t	1.58	R/t	.48	R/t	.63	R/t	3.96
R/t.km	.15	R/t.km	.04				
Units	5	R/h	21.70				
h/Year	1146.66	R/t	2.07	R/t	2.71		6.67
t/Unit	12000	R/t.km	.20				
Lifeyr	8.72						

The costing sheet is illustrated in Table 3 where all the standards are used as input information and can be changed as easily as the DRD or payload. Costings for a tractor and trailer with a 12 ton payload and a truck with a 20 ton payload are shown as an example.

A summary of the results of changing the payloads from 12 to 15 tons and from 20 to 22 tons for the tractor and trailer and the truck respectively, are shown in Table 4. The number of tractors has been reduced from 5 to 4 and costs have been reduced from R2,07 to R1,76 per ton. This represents a saving of 15% on the cost of the tractor and trailer. Similarly the increase in the payload of a truck has not affected the number of trucks nor the life of a truck, but has reduced the cost per ton for the truck from R3,96 to R3,72. Overall, the cost of the system was reduced by R0,55 per ton.

TABLE 4
Revised costing sheet after changing the payloads of the tractor and trailer from 12 to 15 tons and the truck's payloads from 20 to 22 tons

	Tractor and trailer		Truck	
Payload (t)	12	15	20	22
No. of units	5	4	4	4
Cost/ton (R)	2,07	1,76	3,96	3,72
Cost/t km (R)	0,20	0,17	0,10	0,09

Total cost reduction from increasing payloads is R0,55/t

The facility of being able to change standards allows the engineer to estimate costs with the grower, using standards provided from the grower's own records. For example, wages vary from one area to another, as do interest rates, the proportion of time that a machine works and the number of days in a year that is it available to work. Prices of new equipment can be negotiated so it can be beneficial for the calculations to be done in the grower's presence using standards which are acceptable to all concerned.

The results of each costing are presented as cost per hour (R/h), per ton (R/t) and where applicable, per ton/km (R/t km). An accumulated cost is presented for the whole system and is expressed per hour (R/h) and per ton (R/t). Individual costings give the number of machine units required for each stage, and the annual utilization and the expected life in years of each vehicle in the system.

Future Development

A programme for labour, similar to that for mechanization, can be drawn up so that periods of peak demand can be identified. Other options can then be tested in attempts to reduce the peak demand. VisiCalc lends itself to "profit and loss" calculations for irrigation and would be particularly suitable for doing cash flow analyses to present to the banker.

Conclusion

VisiCalc is a very versatile tool to use in any "what if" calculation to evaluate the effects of alternative management decisions on a farming enterprise. The technique has been used

in the selection of machinery and in estimating the cost of machinery. Future developments could include the analysis of labour requirements, irrigation schedules, cash flow analyses and crop estimates.