AGRICULTURAL ECONOMICS RESEARCH UNIT

Lincoln College

COMPUTER METHODS FOR DEVELOPMENT BUDGETS

by

K. T. SANDERSON and A. T. G. McARTHUR

Publication No. 45
1967
COMPUTER METHODS FOR FARM DEVELOPMENT BUDGETS

by

K. T. SANDERSON
Research Economist
Agricultural Economics Research Unit

and

A. T. G. McARTHUR
Senior Lecturer in Rural Education
Lincoln College
(University of Canterbury)
THE AGRICULTURAL ECONOMICS RESEARCH UNIT

The Unit was established in 1962 at Lincoln College with an annual grant from the Department of Scientific and Industrial Research. This general grant has been supplemented by grants from the Wool Research Organisation, the Nuffield Foundation and the New Zealand Forest Service for specific research projects.

The Unit has on hand a long-term programme of research in the fields of agricultural marketing and agricultural production, resource economics, and the relationship between agriculture and the general economy. The results of these research studies will be published as Unit reports from time to time as projects are completed. In addition, it is intended to produce other bulletins which may range from discussion papers outlining proposed studies to reprints of papers published or delivered elsewhere. All publications will be available to the public on request.

Director
Professor B. P. Philpott, M.Com., M.A.(Leeds), A.R.A.N.Z.

Senior Research Officer
R. W. M. Johnson, M.Agr.Sc., B.Litt.(Oxon.)

Research Officers

Research Assistants

UNIVERSITY LECTURING STAFF ASSOCIATED WITH THE UNIT'S RESEARCH PROJECTS:

J. D. Stewart, M.A., Ph.D.(Reading)
Professor of Farm Management

Senior Lecturer in Rural Education

P. Hampton, Ph.D.(Ott.), M.A.
Lecturer in Economics, University of Canterbury
PREFACE

In line with the Agricultural Economics Research Unit's continued interest in the economics of individual farm intensification, this publication sets out procedures for bringing automation to farm budgeting procedures. In New Zealand, the majority of farms are freehold and owner-occupied, and highly dependent on family labour. Farm intensification is necessary, not only to raise family income, but also to counteract fluctuating prices and generally adverse movements in the farmers' terms of exchange. In the agricultural colleges and in the various extension services, it is customary to explore the intensification or development problem by means of detailed forecast budgets. Publication No. 35 of the Research Unit is an example of these procedures. The number of farms which can be planned in detail by this method is strictly limited by the time involved. In the present publication, Messrs Sanderson and McArthur show how these budgeting procedures can be speeded up by the use of electronic data processing.

The specific examples used in the paper are drawn from the Northland area of the North Island. But with suitable modifications the general principles of data processing described are applicable in any farming area. If these procedures are generally adopted, the organisation of farm management centres or laboratories, with all the necessary data processing facilities, will be the next logical development.

We are grateful to the Commercial Bank of Australia for financing the economic survey of Northland. This publication is a direct product of the investigating procedures used in that survey.

Lincoln College, R.W.M. Johnson
October 1967
1

COMPUTER METHODS FOR FARM DEVELOPMENT BUDGETS

1.0 INTRODUCTION

In recent years farm economists and extension workers have turned their attention to the usefulness of the computer in farm planning and control (McArthur (1964)). Stewart and Nuthall (1964) have explored the practical use of linear programming (for which a computer is essential), and the University of Canterbury Accountancy Department and the Farm Management Department at Lincoln College are now investigating the use of the computer for control budgeting by farmers. At Massey University Townsley and Schroder (1964) have published computer methods for calculating stock reconciliations.

This bulletin explores a further use of the computer. It will demonstrate how the computer can be used to calculate forecast budgets for farm development. The whole purpose of the forecast budget is to predict the implications of a given development plan, and thus to explore the feasibility of such a plan for the individual farmer. Farm advisers already calculate forecast budgets of this type, but because the work is onerous and time-consuming, it is only done in special cases, over a short time horizon, with one set of data.

This paper outlines the general approach to the budgeting problem, then it describes the computer programs for dairy and sheep development budgeting (with details provided in an appendix). Finally it discusses some development coefficients for use in these programs.

1 We refer to computer "programs" but development "programmes".
2.0 DEVELOPMENT BUDGETING

2.1 The Context

The computer programs have been designed specifically for Northland farm advisory officers though they have a wider use than this. After walking round the farm with his client the experienced adviser draws up a target for stock increases over a number of years. From a knowledge of the farm and the district the adviser and his client decide upon the requirements for achieving this rate of increase. For instance most advisers have "rules of thumb" relating stocking numbers to fertiliser requirements (see Section 3, page 8). The farmer is usually able to estimate his labour requirements for the increased stock numbers. Estimates can also be made of the capital inputs required such as herringbone sheds for cows, improved handling facilities for sheep, and other feed and labour-saving devices. The plan drawn up must be a balanced one. It should include the expansion of present farm facilities sufficient to handle the extra stock and this may require further water reticulation, drainage schemes, tracks, airstrips and other necessary improvements. The plan should even include the capital cost of improvements to the farmer's house if this is likely to be necessary.

Once the adviser and the farmer have decided upon the physical requirements of the development plan, they must determine whether or not it is financially feasible. At present the process involves repetitive calculation of stock reconciliations, cash budgets and mortgage and tax payments for each year of development. Even with the use of an electric desk calculator this work can take the adviser many hours for each farm. Using the programs described in this bulletin, the adviser can record the details of the planned development in a few minutes - the computer does the calculation in seconds.¹

¹ The IBM 1130 calculates and prints results for a 7 year sheep development plan in 35 seconds; the dairy calculation is even quicker.
The adviser can write directly on to a card-punching sheet the relevant details of the development plan as outlined in the appendices. These details are the planned dairy cows, ewes or breeding cows to be run in each year, the fertiliser required for extra stock units and the requirements for capital items, labour and personal drawings. Finally he records his estimates of expected prices for the farmer's products. The card-punching sheet would be posted to a computer centre, where the information would be punched on to computer cards, and processed on the computer to give a typed result sheet which would be returned to the adviser immediately.

The results would show stock numbers, stock purchases and sales, net income, tax payments and overdraft levels in each year. These projected results are set out clearly on a sheet which also lists the main assumptions about development which the adviser has made - the lambing percentage, development costs, prices, etc. Using manual budgeting, the assumptions made and the yearly results are spread through a number of budget working sheets: using this computer method, all the assumptions made and the projected results are concisely shown on the one sheet. The adviser will find this results sheet extremely valuable for follow-up discussions with the farmer and for credit negotiations with lending institutions. (The appendices explain in detail how these results sheets are to be interpreted.)

The adviser would have the projected results from farm development within 4-5 days of his visiting the farm - depending on postage times.

Advisers who become proficient with this system could well do an analysis on each developing farm in successive years. The plan would be constantly modified in the light of further experience and changing circumstances. This "rolling plan" approach has the advantage over single-year forecast budgets, in that it pinpoints development bottle-necks (in the form of large replacement stock purchases, or credit requirements) long before they occur.
In writing the computer programs the authors have adopted a stock orientated approach. This approach differs from the feed orientated method outlined by Frewley, Tonkin and Johnson (1966) whose development budgeting procedure starts by increasing feed supply then raises stock numbers to eat it. Their method is suitable in areas where there is no winter pasture growth and farmers have to grow supplementary crops to feed their stock. The adviser can estimate the winter feed provision from known data about the yield of these supplementary crops. As there is no relevant information about seasonal grass growth in Northland, the feed orientated approach is unfeasible in this all-grass environment.

However, the adviser often knows the level of fertiliser that will provide at least enough feed for a given rate of stocking (Currie (1965)). No doubt future research will determine fertiliser programmes which more nearly approach the minimum cost at each stocking level.

The main purpose of the development budget is to estimate the outcomes of the plan to see if it is feasible. The most important limitation to development in Northland is credit. Consequently the computer programs predict the level of overdraft, given the farmer's required cash drawings over the future years. This overdraft prediction may give the farmer confidence to execute the plan he and the adviser have agreed on and may also remove doubt from the minds of lending agencies whose participation in the plan is often essential. In order to overcome uncertainty associated with future prices the program can be re-run with pessimistic prices to see if it still remains feasible under those conditions.

2.2 The Cope Approach

The mnemonic "COPE" is the code identification of the series of programs which the authors are developing to automate budgeting. Cope stands for Computer Overdraft Projection and Evaluation. The flow diagram (Diagram 1) shows the logical steps in a COPE program.
FLOW DIAGRAM OF GENERALIZED "COPE" PROGRAM

START

READ INPUT DATA

PRINT OUT INPUT DATA

PRELIMINARY STOCK CALCULATIONS

CALCULATE PRESENT MORTGAGE SITUATION

SWEEP THROUGH N YEARS

CALCULATE STOCK RECONCILIATION

REPAY MORTGAGES AND DEBTS

ANY NEW MORTGAGES?

ADD NEW MORTGAGES TO PRESENT ONES

CALCULATE BUDGET

CALCULATE TAX

FIND ACCUMULATED OVERDRAFT OR ANNUAL SURPLUS

PRINT YEARS RESULTS

REACHED Nth YEAR?

MORE FARMS?

STOP
The blocks in the diagram show the separate operations in the calculation. The arrow from each block denotes the next operation. An operation surrounded by a diamond indicates a decision.

The first operation reads into the computer the punch card data for the individual farm. Next this information is printed out so that the adviser has a permanent record of both data and results. "Preliminary stock calculations" estimates the age structure of the existing flock in the sheep program - a step which was not considered necessary for the dairy situation. The next step "calculate present mortgage situation" determines the present indebtedness from data about the initial conditions of the loan.\(^1\)

"Sweep through N years" means that the calculations down to the diamond ("Reached Nth year?) are repeated for each year as indicated by the return arrow which creates a loop.

Within this loop, the first operation calculates the stock reconciliation for the particular type of farm. The reconciliation updates the number of stock in each class and calculates sales and purchases for the year. The next operation computes the repayment of debts and mortgages and determines the interest for the year. If the adviser arranged for a new mortgage in the particular year, the program loops to the left adding the new mortgage to the set of existing ones. "Calculate Budget" means multiply the quantities of farm inputs and outputs by their prices, subtract depreciation and interest, add changes in stock values which in total gives an estimate of assessable income for tax purposes.

Next the program calculates tax according to the present New Zealand tax code.\(^2\) It is possible to alter this program if the rules change. In the penultimate

---

\(^1\) Farmers seldom know their present mortgage liabilities but they can usually remember the amount and terms of the initial mortgage.

\(^2\) We are most grateful to Mr W. Payne of Massey University who designed the basic elements of a most efficient tax sub-routine which is called upon by our programs.
step in the loop, the program finds the farmer's overdraft position assuming that any negative cash balance after meeting the needs of the plan and his cash drawings will be added to his overdraft. If the balance is positive the overdraft reduces, but once this is repaid there is a "surplus". This is the surplus over and above living expenses and only occurs when the overdraft is zero.

More detailed information about using the COPE program is shown in Appendices A and B.

Essentially the COPE approach is to define a rate of farm development and a level of required living expenses and then to calculate the overdraft implications of such a plan. It makes no attempt to optimize within the program and assumes that the farmer and the adviser have decided on their priorities. It can also use farm development coefficients to simplify the budgeting.

3.0 TECHNICAL AND ECONOMIC COEFFICIENTS

Technical and economic coefficients are required by the COPE programs. Figures like 200 lb. of butterfat per acre and 300 lb. of butterfat per cow are examples of technical coefficients, while "repairs and maintenance per cow", is an example of an economic coefficient. All can be derived from past observations on the same farm and/or observations from similar farms.

The use of coefficients from cross-section surveys as farm standards, has been criticised widely (Stewart (1962) and Candler and Sargent (1962)). By definition, a farm standard is a level of performance which the farmer should aim to reach. We agree that there is no one set of coefficients which all farmers should aim for. There is no recipe of farm inputs and outputs which will maximize the profit of all farmers, if indeed this is the farmer's objective. By emulating the average farmer who spends $0.63 per sheep on wages and $0.40 on contracting, an individual farmer will not necessarily make the optimum use of labour on his farm.
However, a farmer who wishes to increase his stock numbers above his present level and who wants to know how much fertiliser he will need to achieve this, has only two sources of information available to him:

(a) research results

and (b) the experience of other farmers who have already successfully carried out a similar increase in stock numbers.

The whole basis of extension and advisory services is the dissemination of this sort of information from research workers and innovating farmers to the general farming community. In the absence of relevant research results, the authors believe that the next best coefficients for predicting requirements for development can be obtained by studying a group of recently developed farms. The coefficients so obtained from a large number of developing farms would be expected to be more accurate than the figures which the individual adviser has derived from a smaller number of casual observations. Thus, the coefficients derived from a sample of developing farms will not tell another farmer the optimum stock increases he should aim for. Once he has decided on a desirable rate of increase, the coefficients will indicate some of the requirements which will support that rate of increase. These coefficients are a useful benchmark from which individual advisers may in time derive a series of higher or lower figures for specific development conditions.

In this section we present technical and economic coefficients derived from fast developing sheep and dairy farms in Northland. These coefficients may be used in the COPE programs, to replace individual budgeting of each development situation.

3.1 Northland Farm Development Coefficients

The development coefficients described below were derived from study of a purposive sample of farmers in Northland who have increased production rapidly over recent years. The actual measures derived quantify two of the main rules of thumb used by advisers.
The sample was selected from those farmers who had carried out development along lines recommended by advisers. The inputs used and results obtained by them should thus provide a guide to other farmers embarking on the development strategies recommended at present. In fact the parameters derived describe indirectly the advice given in the past which has been successful and this is likely to be just the advice which advisers are likely to give to farmers embarking on development in the future.

Using the stock orientated approach to budgeting for pastoral development the most useful rules of thumb are those which, on a per animal or per stock unit basis, describe the fertiliser required for feed provision and the extra general costs incurred by the extra animals. The corresponding coefficients are "fertiliser per ewe equivalent" and "Costs per dairy cow in milk", "Costs per ewe" or possibly "Costs per breeding cow".

3.1.1 Fertiliser per ewe equivalent. This is the quantity of fertiliser (in hundredweights) which farmers have used during the year in order to increase carrying capacity by one ewe equivalent. It applies purely to the addition of stock to existing pasture and in fact the fertiliser is probably used to grow more grass at critical times (such as in the early spring) rather than purely increasing the total annual feed production. This figure does not include "capital" fertiliser used in breaking in new land,¹ neither is it strictly the "maintenance" requirement for a stable stocking rate. It contains an average or maintenance component and a marginal component to ensure feed provision for stock added. The figure derived from the Northland sample of developing farms supported a reasonably high rate of increase on most soil types in Northland (stock numbers were doubled in an average of 6 years).

¹ In the COPE budgeting system this cost will properly be included as "Extra development expenses".
Tables 1 and 2 show the requirements of fertiliser per ewe equivalent derived for developing farms in Northland. Average figures from other surveys are included for comparison as is a figure suggested for use in budgeting, published by the Auckland and Whangarei Agricultural Advisory Committees. As would be expected our "development farm coefficient" of 0.7 cwt/e.e. for sheep and 1.0 cwt/e.e. for dairy development is slightly higher than the average figures from other sources.

3.1.2 "General expenses per cow" and "General expenses per ewe". These expenses are the amount by which general farm expenses have increased for each cow or ewe added. General farm expenses are here defined as administrative, animal health, contracting, shed expenses, feed, weed and pest control (except development), vehicles, repairs and maintenance, farm insurance, rates, land tax and sundry. They do not include the main farm expenses of fertiliser, stock purchases, wages of permanent employees, tax-deductible development expenses (fencing, airstrips, drainage schemes), capital expenses, depreciation, interest or taxation.

Tables 1 and 2 show that there are only small differences between the Northland development coefficients of $2.9/ewe and $30.0 per dairy cow, and the average figures from other sources. The Advisory Committee's figures are generally higher which may reflect a more cautious approach to budgeting.

At this stage of analysis we have found no consistent differences between development on different soil types, at different stages of development or for different rates of increase in stock carried. In fact most farm cases studied had parameters close to the average for the sample.¹

¹ For statistical analysis, see forthcoming publication by the authors.
### TABLE 1
Development Coefficients for Northland Dairy Farms

<table>
<thead>
<tr>
<th>Survey</th>
<th>Fertiliser</th>
<th>General Expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cwt/ee</td>
<td>cwt/cow $/cow</td>
</tr>
<tr>
<td>Northland Project (1)</td>
<td>1.0</td>
<td>8.1</td>
</tr>
<tr>
<td>Advisory Committee (2)</td>
<td></td>
<td>12.0-15.0</td>
</tr>
<tr>
<td>Dairy Board (Milk) (3)</td>
<td></td>
<td>9.2</td>
</tr>
<tr>
<td>Dairy Board (Cream) (4)</td>
<td></td>
<td>12.4</td>
</tr>
</tbody>
</table>

**Sources of Data:**

(1) Data from 32 farms which have developed in Northland in the last 5-10 years.


(3) Farm Economics Section, New Zealand Dairy Board. "A Survey of the Economic Structure of Factory Supply Dairy Farms in New Zealand in 1964/65", August 1967, page 33, Table 25 - Income and Expenditure per Milk Supply Farm - by Region. (The figures used are from a sample of 35 Northland farms.)

(4) Same publication as (3). Table 26, page 34. Income and expenditure per cream supply farm - by region. (The figures are from a sample of 202 Northland cream supply farms.)
### TABLE 2
Development Coefficients for Northland Sheep Farms

<table>
<thead>
<tr>
<th>Survey</th>
<th>Fertiliser</th>
<th>General Expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cwt/ee</td>
<td>$/ee</td>
</tr>
<tr>
<td>Northland Project (1)</td>
<td>0.7</td>
<td>1.05</td>
</tr>
<tr>
<td>Advisory Committee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat Lamb (2)</td>
<td>0.91-0.97</td>
<td>1.73</td>
</tr>
<tr>
<td>Extensive (2)</td>
<td>0.90-1.50</td>
<td>1.16</td>
</tr>
<tr>
<td>Average (3)</td>
<td>0.94</td>
<td>1.45</td>
</tr>
<tr>
<td>Meat &amp; Wool Board (4)</td>
<td>0.66</td>
<td>1.7</td>
</tr>
</tbody>
</table>

**Sources of Data:**

(1) Data from 20 farms which have developed in Northland in the last 5-10 years.


(3) Average between "fat lamb" and "extensive" figures, which would apply to Northland. As the $1.5 per e.e. figure is acknowledged to contain some capital development fertiliser, the average fat lamb figure is used.

In summary our data derived from fast developing dairy farms did not differ greatly from the parameters derived from the Dairy Board's cross-section of Northland butterfat farms. The fertiliser usage in 1964/65 on the cross-section of Northland milk supply farms were much lower. Values for general expenses were similar from all sources. Our figure for fertiliser weights per ewe equivalent on fast developing sheep farms was considerably higher than the Meat and Wool Boards' figure. The use of their figure for developing farmers would be misleading, as it is an average of the cross section of farms surveyed by them.

3.2 Development Coefficients in Budgeting

The development coefficients described in the previous section are useful to save time on each farm, and increase the accuracy of present budgeting methods.

The fertiliser requirement per ewe equivalent describes an important technical relationship. The logic behind the use of this is to help ensure that the extra feed grown by additional fertiliser is eaten by extra stock. Quite often extra feed grown by putting on more manure is wasted because there are not enough stock on hand to convert it all to meat and wool or milk.

There is a danger however, that through repeated use, the coefficients (1.0 cwt and 0.7 cwt per ewe equivalent for cows and sheep respectively) may become accepted as the "true" or "optimal" rates of fertiliser. These levels have been used by farmers who have made substantial increases in output in Northland. Lower levels of use might have given as good results, and we hope that scientists will continue to search for fertiliser levels which give an improved economic outcome.

Errors from using the coefficients for "general farm expenses" per cow and per ewe of $30.00 and $3.00 respectively will be small. The estimated general expenses using these parameters only differs by ± 20% from the actual general expenses on the extremely high and low cost farms. Further, these general farm expenses make up only about 30% of total outgoings, so that even in extreme cases, use of these
coefficients will give an error of only 6% to the estimate of total outgoings.

It is intended that the development coefficients should be treated by advisers and farmers as a guide rather than a rule and that advisers will, from continuing experience, develop a more accurate series of coefficients for different stocking rates, rates of increase and soil types, for their areas.

3.3 COPE's Use of Development Coefficients

The COPE programs give the adviser considerable flexibility in his method of estimating farm expenses. He can either make maximum use of the coefficients derived from developing farms or he can make individual estimates for each farm. The latter takes him longer.

A number of expenses must be calculated by the adviser and written on to the card-punching sheet (see Appendix A, page 19 and Appendix B, page 31). These expenses are capital items (non tax-deductible), wages of permanent employees and the farmer's personal cash drawings.

Other expenses are always calculated by the program, working from basic information the adviser has supplied. The program calculates stock purchases from the target number of stock, lambing percentage etc., and calculates interest, depreciation, taxation and mortgage repayment for each year from mortgage information, tax exemptions etc., described by the adviser.

Finally there are some expenses which can either be calculated by the program, or may be estimated for each year by the adviser and entered separately on the card-punching sheet. These expenses are fertiliser, general farm expenses, and extra development (tax deductible) expenses. If development coefficients are used, the year-by-year calculation is done by the computer which saves time.
This quick method of including farm expenses in the program requires

(1) the fertiliser requirement to be expressed in hundredweights per ewe equivalent (see section 3.1.1);

(2) general farm expenses to be expressed in $ per ewe or $ per dairy cow (see section 3.1.2);

(3) the extra development expenses incurred in each year to be calculated separately and entered in the relevant row in the card punching sheet (see Diagrams 2 and 3, pages 19 and 31).

The slower method requires that

(a) the total tons of fertiliser required for each year be calculated and costed, and this cost added to the extra development expenses for that year; (the fertiliser per ewe equivalent space would be left blank on the card-punching sheet);

(b) the specific direct costs per animal of shearing, dipping, shed expenses, is to be estimated and shown in the spaces marked "$ per ewe", "$ per hgt" or "$ per cow". Remaining general farm expenses like repairs and maintenance must be calculated for each year and added to the extra development expenses;

(c) the actual extra development expenses must be calculated separately as in the quick method, but in this slower method these expenses must be added to the fertiliser costs and the "fixed" component of general farm expenses described in points (a) and (b) above. This total figure is then written in the tax-deductible extra development expenses row on the card-punching sheet.

The choice of the method used to incorporate fertiliser, general farm expenses and extra development expense in the COPE program, is over to the individual adviser.
SUMMARY

This paper presents the COPE system for automating the budgeting procedures for Sheep and Dairy farms in Northland. The system follows the budgeting techniques already used by advisers. The computer's capacity, however, enables us to expand and refine existing practical procedures. This automated system projects the outcome of a previously defined development plan to determine if it is financially feasible.

The paper also presents development coefficients suitable for use in the COPE system. These coefficients were derived from rapidly developing farms in Northland, and will not necessarily be applicable in other areas of New Zealand. Use of these coefficients speeds up the budgeting process.
REFERENCES


A.1 GENERAL

The program has been written for the simplest dairy farm situation - the farm on tanker collection with no income from pigs or any other major source except the sale of cull cows and bobby calves. The adviser and the farmer must agree on a target number of cows for the farm in the future. This is not a difficult prediction to make in Northland. This target figure is the critical determinant in the stock reconciliation.

If the cows and heifers surviving from the previous year are insufficient to bring the herd up to the target figure, the needed cows are bought. The program calculates the number of calves which need to be reared to give the target herd size two years hence. If this number is beyond the capacity of the herd to produce rearable heifer calves, then just the maximum number of rearable heifer calves are reared. This is an artificial constraint as a farmer can usually buy neighbours' surplus bobby calves. Nevertheless as there must be some constraint to the number of calves reared this seems an acceptable one. The program calculates the residual bobby calves for sale and the cull cows.

A.2 INFORMATION REQUIRED BY THE PROGRAM

Diagram 2 shows a card-punching sheet overprinted for COPE Dairy Development 1 and filled in with example data. The overprinting makes sure that the digits go into the correct columns to be read by the computer. Figures must be kept up against the overprinted decimal points with, of course, one digit per column. The meaning of the headings on the sheet in Diagram 2 are defined below.

---

1 The term "bobby calf" is used in New Zealand to describe a calf which is sold from the dairy herd one or two days after birth.
Ref: (101): This can be any 4 digit numbers to provide a reference for the job.

Years a'hd: (7)
This means years ahead the farmer wishes to budget. Ten years ahead is the limit of this program.

Cows: (40)
This tells the computer the number of cows on hand now. The program assumes that the farmer's balance date is the 31st March - the most common practice amongst dairy farms. "Cows" refer to the number of cows on hand at the 31st March. Users need either to estimate the number at the 31st March or give the number that were on hand then if March is over.

Heifers: (15)
Here is recorded the number of heifers on hand at the 31st March. They will be about 18 months old and will be due to calve in the spring for the first time.

Calves: (16)
This records the number of calves on hand.

Fat price: (0.30)
This is the estimated payout price by the dairy factory for the years ahead. In the example it is recorded in decimals of a dollar.

Cull price: (36)
This gives an estimate of the price of all cows sold to the works. The program, as set up, assumes a 15% culling rate.

Cow price: (70)
This sets down an estimate of the cost of buying cows for the herd.
XS/Cow: (30)
This means "expenses" per cow, expressed in dollars. These "expenses" are those normally shown on the profit and loss account such as shed expenses, repairs and maintenance and so on. However, they exclude the major items of wages, fertiliser, interest and depreciation which are estimated separately. Section 3 of this bulletin deals with this, and the next figure, in detail.

Cwt/EE: (1.0)
This means hundredweights of fertiliser per ewe equivalent.

Fert./ton: (30)
Records fertiliser cost (not lime) per ton spread on the ground.

Exemptions: (1916)
These are the taxation exemptions - personal exemptions and those for his wife and children. He can add insurance premiums and charitable donations and school fees. The program assumes that these exemptions will be constant over the years.

Deprec: (450)
This is the amount of ordinary depreciation taken from a recent balance sheet. The program uses estimating procedures for depreciation over future years.

O'draft: (100)
Here is recorded the present level of the overdraft. If the farm has a credit balance with the bank or the stock firm the figure should have a minus sign in front of it.

Val./lb: (1.4)
This is the value of the farm as a going concern per lb. of butter fat produced, expressed in dollars. This is another frequently used rule of thumb.

This completes the first line of data.
Proposed Cows Xmas: (60, 70, 80, 85, 90, 95, 100)
This is the number of cows the farmer wants to milk at Christmas in the first, second and third years etc. This row of figures is the key to the program. The 'cows at Christmas time' is used because this is the dairy industry's census time.

Fat per Cow (Factory): (200, 190, 250, 250, 275, 300, 300)
This is self-explanatory.

Extra Devel. Expenses: (126, 650, 0, 130, 150, 0, 10)
These are non-recurring major items of expenditure which can be claimed against taxation.

Capital Expenses: (0, 1700, 300, 0, 700, 480, 0)
These are the expenses which cannot be claimed against taxation.

Wages: (0, 0, 0, 0, 0, 0, 0)
Like the above two items, these will vary from situation to situation. Like fertiliser they usually make up a substantial share of farm costs and hence the separate row for them.

New Mortgages Raised:
Rate of Interest:
Term of New Mortgages:
These three rows contain zeros in the example given in Diagram 2 because no new mortgages were raised to cover development and capital expenses. These rows are useful, when after a first computer run, the overdraft level is outside the level the lending institution is prepared to meet and it becomes necessary to raise a long term development loan to cover development costs.

Living Expenses Required:
(1600, 1600, 1600, 1600, 1600, 1600, 1600)
This is self explanatory.
Present Table Morts: (4000. .06 25. .1)

In this row there is room for details of up to three mortgages which the farmer may have on his property. As few farmers know the present level of the outstanding mortgage, all that needs to be put in is the initial mortgage, the interest rate, the term of the mortgage, and the number of years gone (the number of years the mortgage has been in operation). The program works out the annual charges and the present level of the mortgage.

Debts: (200. .10 50.)

There is room for three debts. An equal amount is repaid each year. Debts which do not have to be repaid can be entered here by placing a zero in "repay/year".

The last two rows contain overprinted constant data which includes 'book values' for stock, and several other constants for the stock reconciliation together with some taxation parameters. (See Appendix A.5 for Fortran statement listing.)

The completed card-punching sheet should be sent to a computer bureau where all the figures on the sheet will be punched on to computer cards. This input information will be fed into a computer along with the COPE Dairy program. The COPE program instructs the computer how to do the budget calculations, on the individual farm information. The computer then prints out the important figures obtained from each year's budget.

A.3 RESULTS FROM THE COMPUTER

Table 3 shows an example of the results sheet which the adviser will receive back from the computer. The input information is printed out to give the adviser and farmer a permanent record of the assumptions they have made. The computer then prints out the projected results found from the year-by-year budgets. These results give details of
### TABLE 3  
**AN EXAMPLE OF COPE DAIRY RESULTS**

**COPE DAIRY DEVELOPMENT 1**

<table>
<thead>
<tr>
<th>Input Information</th>
<th>REF Cows</th>
<th>HEIF Calf</th>
<th>PAY XS A</th>
<th>CWT Fert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Now</td>
<td>101</td>
<td>40.</td>
<td>15.</td>
<td>16.</td>
</tr>
<tr>
<td>1st</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4th</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5th</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6th</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7th</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8th</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9th</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10th</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Projected Results**

<table>
<thead>
<tr>
<th>Yr</th>
<th>Cow</th>
<th>Heifer Calf</th>
<th>5000</th>
<th>10000</th>
<th>15000</th>
<th>20000</th>
<th>25000</th>
<th>30000</th>
<th>35000</th>
<th>40000</th>
<th>45000</th>
<th>50000</th>
<th>55000</th>
<th>60000</th>
<th>65000</th>
<th>70000</th>
<th>75000</th>
<th>80000</th>
<th>85000</th>
<th>90000</th>
<th>95000</th>
<th>100000</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60</td>
<td>15.</td>
<td>24.</td>
<td>12000</td>
<td>18.</td>
<td>28.</td>
<td>4440</td>
<td>34.</td>
<td>0.</td>
<td>0.</td>
<td>2055</td>
<td>6055</td>
<td>10744 .</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>70</td>
<td>22.</td>
<td>24.</td>
<td>13300</td>
<td>10.</td>
<td>34.</td>
<td>6575</td>
<td>-367</td>
<td>0.</td>
<td>0.</td>
<td>5788</td>
<td>9656</td>
<td>8963</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>23.</td>
<td>26.</td>
<td>20000</td>
<td>4.</td>
<td>38.</td>
<td>4778</td>
<td>2378</td>
<td>225</td>
<td>0.</td>
<td>5865</td>
<td>9596</td>
<td>18403</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>85</td>
<td>24.</td>
<td>27.</td>
<td>21250</td>
<td>0.</td>
<td>40.</td>
<td>4554</td>
<td>2705</td>
<td>293</td>
<td>0.</td>
<td>5303</td>
<td>8892</td>
<td>20857</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>90</td>
<td>25.</td>
<td>28.</td>
<td>24750</td>
<td>0.</td>
<td>42.</td>
<td>5625</td>
<td>3492</td>
<td>484</td>
<td>0.</td>
<td>4681</td>
<td>8173</td>
<td>26476</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>95</td>
<td>26.</td>
<td>23.</td>
<td>28500</td>
<td>0.</td>
<td>43.</td>
<td>5803</td>
<td>4618</td>
<td>850</td>
<td>0.</td>
<td>3002</td>
<td>6390</td>
<td>33509</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>100</td>
<td>21.</td>
<td>23.</td>
<td>30000</td>
<td>0.</td>
<td>43.</td>
<td>5604</td>
<td>4975</td>
<td>981</td>
<td>0.</td>
<td>515</td>
<td>3794</td>
<td>38205</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
important purchases - fertiliser and cows - the total outgoings of the farmer, and probably most important, the level of overdraft required in each year to carry out the proposed plan.

The headings of the main tabulation of the year-by-year results are now explained in detail (the values are in dollars).

**YR:** means year.

**COW:** This gives the "proposed cows" which eventuated.

**HEFR:** This gives the number of heifers in herd, at the end of the first, second, third year of development. These are the survivors of the calves from the previous year.

**CALF:** This gives the number of calves to be reared.

**FAT:** This is estimated total pounds of butterfat produced.

**BT COW:** This means number of cows bought-in each year. If the farm has insufficient heifer replacements to give him his proposed cows for a year, then the program assumes he buys them. In this example the cows are bought for the first three years.

**FERT:** This shows the tons of fertiliser used each year.

**COST:** $ This includes all cash expenses including buying stock, capital expenses, interest and mortgage repayment and taxation, i.e. total cash costs.

**PROFIT:** $ This is the profit as assessed by the Inland Revenue Department.

**TAX:** $ This is a function of profit and exemptions.

**SURPLUS:** $ There is no surplus cash until the overdraft has been eliminated.

**O'DRAFT:** $ In the program the overdraft at the end of the year is the buffer for the system.
DEBT: $  This is the sum of all the farmer's debts at the end of each year including his overdraft, mortgages and other debts.

EQUITY: $  Valuing the farm as a going concern on the basis of its butterfat output and subtracting the debts gives the equity which the farmer owns. This is only a general indication of equity changes.

A.4 VARIATIONS FOR USE OF COPE DAIRY 1.

This program was primarily designed for the farm owner who is thinking about a development plan and wonders if it is feasible. The program can also be used by those wishing to buy farms. If they own no stock they can write zeros in the first row under the appropriate stock headings. A share milker bringing his herd north can enter them appropriately here too. The capital cost of the farm must go under capital expenses and his positive cash position needs entering or a negative value in the overdraft box.

The program can also be used by farmers who wish to buy more land. This cost must be entered in 'capital expenses' and values will need to be inserted in the 'new mortgage' row if one is necessary.

We think that this program could well provide a service to prospective outside investors in Northland and perhaps local development committees will make use of it.
A.5

FORTRAN IV LISTING OF COPE DAIRY DEVELOPMENT

// JOB
// FOR
// LIST ALL
// ONE WORD INTEGERS
// TRANSFER TRACE
// ARITHMETIC TRACE

// I/O DATA
DIMENSION A(15), B(15), C(15), D(15), E(15), F(15), G(15)
COMMON A*, B*, C*, D*, E*, F*, G*

// READ DATA
READ (2) (I,J) A(I,J)
READ (2) (I,J) B(I,J)
READ (2) (I,J) C(I,J)
READ (2) (I,J) D(I,J)
READ (2) (I,J) E(I,J)
READ (2) (I,J) F(I,J)
READ (2) (I,J) G(I,J)

// WRITE DATA
WRITE (1) (I,J) A(I,J)
WRITE (1) (I,J) B(I,J)
WRITE (1) (I,J) C(I,J)
WRITE (1) (I,J) D(I,J)
WRITE (1) (I,J) E(I,J)
WRITE (1) (I,J) F(I,J)
WRITE (1) (I,J) G(I,J)
**A.5 FORTRAN IV LISTING OF COPE DAIRY DEVELOPMENT 1 (Cont'd)**

```
17 CONTINUE  
C DENT REPAYMENT  
DO1191=1,3  
IF(FD(1:11)=1.19)19,920  
20 T=0(1:11)=0(1:2)  
KESI=KESI+T  
D(1:1)=D(1:1)-D(1:3)  
PAY=PAY+D(1:3)  
19 CONTINUE  
IF(KECAP(NOW)=172.72.73)  
73 N=TERM(NOW)  
FACT=1/1+HOOK(NOW)+FACT=1/1/HOOK(NOW)+FACT)  
KESI=KESI+1  
KESI=KESI+1  
72 IF(KEQ(1:74.74.75)  
75 DO761=1,8  
T=0(1:18)=0(1:2)  
KESI=KESI+T  
H(1:1)=H(1:1)+H(1:3)  
76 PAY=PAY+T  
74 SPEC=R  
C CASH BUDGET  
TOX=TOX+1/20  
COST=A14.15.16+D(1:14)+1/20+D(1:2)+1/20  
FACT=FACT+1/20+D(1:14)+1/20  
SPF=SPF+D(1:14)+1/20  
64 IF(IN(1:1)=1.101)10,12  
10 SPEC=R  
IF(IN(1:1)=0.00)11,2  
2 SPEC=R  
11 CONTINUE  
CALL DAT59(14.1+JOFF)  
GO TO(1300.1399.1)  
139 CALL EXIT  
END  

// FOR  
* LIST ALL  
* ONE WORD INTEGERS  
* TRANSFER TRACE  
* ARITHMETIC TRACE

SUBROUTINE CTAX1  
COMMON AS, EXM, TAX, SSRM, T1, T2, T3, T4, T5, T6, T7, NS1, NS2  
IFIAS=SSRM(1:1+12)  
1 TAX=0  
:return  
2 SSRM(AS)=SSRM(1:1)  
3 T=AS-EXM  
4 IFIT(1:13.1+14)  
14 TAX=T  
5 CONTINUE  
DO 6 1=1,NS1  
T=T+T  
6 CONTINUE  
3 RED+TAX>T6  
IFIT(1:3.3+5)  
5 CONTINUE  
DO 7 1=1,NS2  
T=T+TAX  
7 TAX=TAX+TAX  
RETURN
```
APPENDIX B.

COPE SHEEP DEVELOPMENT (VERSION 1)

B.1 THE APPLICABLE SITUATION

This version of the COPE program is applicable to sheep with cattle development, with a basically "breeding replacements" stock policy. As with the dairy program, the development plan can include buying the farm. Stock expansion during development can be brought about by increasing ewe numbers or breeding cow numbers or both. This program will not handle cash cropping.

B.2 THE SHEEP RECONCILIATION

The sheep reconciliation can manage a variety of breeding policies using the different culling values. It also adjusts the farmer's figures for "average lambing %" and "average death rates" by employing standard figures to calculate these parameters for each age class of ewes (Hickey, 1960).

In order to achieve the target number of ewes, the program allows for deaths and sales of cull ewes from each age group. It then brings the farmer's two-tooths into the flock. If the target is more than reached, the extra two-tooths are sold. If not, the program buys two-tooths in that year.

Lamb production is calculated for each age group of ewes and the lambs of each sex totalled. Wether lambs are sold either fat-off-mother (before shearing) or during the following autumn. It is assumed that the price is the same for both groups, but wool sales are calculated for those shorn. Killers required by the farmer are subtracted from wether lamb sales. Cull ewe lambs are sold either as stores or fats (depending only on the price used) and all the rest are carried through to two-tooth stage.
B.3 THE CATTLE RECONCILIATION

The target breeding cow numbers are reached by keeping up to a maximum of 80% of all heifer calves. If still more cows are required, they are bought. All steer calves and at least 20% of heifer calves are sold in their first year. This is the most common practice in Northland.

B.4 INFORMATION REQUIRED BY THE SHEEP PROGRAM

Diagram 3 shows a card punching sheet overprinted for COPE Sheep Development 1, and filled in with data for a sheep farm example. As with the Dairy sheet, the overprinting is intended to help the adviser quickly become familiar with data requirements of the program. Figures should be kept hard up to the overprinted decimal point and further decimal points should not be added. A full definition of the headings on the sheet follows.

Ref: (601)
This can be any 4 digit number to reference the job.

Years ahead: (6) 1 The number of years of development.

Ewes Now: (1000) This tells the computer the number of ewes on hand now. In fact this will be the ewes put to the ram last March.

Ewe hghts now: (300) This is the number of ewe lambs kept at the last ewe lamb culling.

Rams: (20) This figure is the rams on hand.

1 It is advisable to include information for the next year after development has been completed to allow the plan to achieve a measure of stability. The proposed ewes and proposed breeding cows entered for that year would be the same as for the previous year.
### Description: Sheep Development

**Programme No.:** COPS 1 (€)

**Name:** P.M. Adams

**Programme Name:** K.T. Sanderson

**Date:** 11-67

---

**Proposed Ewes:**
- Year 1: 6
- Year 6: 1,000
- Year 7: 500
- Year 10: 200

**Proposed Breeding Cows:**
- Year 1: 10
- Year 6: 100
- Year 7: 100
- Year 10: 100

**Extra Development Expenses:**
- Year 1: 900
- Year 6: 2,000
- Year 7: 1,000
- Year 10: 500

**Capital Expenses:**
- Year 1: 1,000
- Year 6: 1,000
- Year 7: 1,000
- Year 10: 1,000

**Wages:**
- Year 1: 0
- Year 6: 100
- Year 7: 600
- Year 10: 1,000

**New Mortgage Raised:**
- Year 1: 5,000
- Year 6: 1,000
- Year 7: 500
- Year 10: 100

**Rate of Interest:**
- Year 1: 0
- Year 6: 0.05
- Year 7: 0
- Year 10: 0

**Term of New Mortgage:**
- Year 1: 2
- Year 6: 0
- Year 7: 0
- Year 10: 0

**Living Expenses Required:**
- Year 1: 1,600
- Year 6: 1,600
- Year 7: 1,600
- Year 10: 1,600

**Existing Table Morts:**
- Year 1: 100
- Year 6: 100
- Year 7: 100
- Year 10: 100

**Existing Debts:**
- Year 1: 0
- Year 6: 0
- Year 7: 0
- Year 10: 0

**Past Culling Rates:**
- Year 1: 0.1
- Year 6: 0.1
- Year 7: 0.1
- Year 10: 0.1

**Minimum Culling (Dev):**
- Year 1: 0.1
- Year 6: 0.1
- Year 7: 0.1
- Year 10: 0.1

**Culling After Devel:**
- Year 1: 0.1
- Year 6: 0.1
- Year 7: 0.1
- Year 10: 0.1

**Price:**
- Year 1: 0.1
- Year 6: 0.1
- Year 7: 0.1
- Year 10: 0.1

**Standing Death Rates:**
- Year 1: 0.1
- Year 6: 0.1
- Year 7: 0.1
- Year 10: 0.1

**Standing Lambs Percentages:**
- Year 1: 0.1
- Year 6: 0.1
- Year 7: 0.1
- Year 10: 0.1

<table>
<thead>
<tr>
<th>Year</th>
<th>Ewes</th>
<th>Ewes</th>
<th>Ewes</th>
<th>Ewes</th>
<th>Ewes</th>
<th>Ewes</th>
<th>Ewes</th>
<th>Ewes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.092</td>
<td>1.086</td>
<td>1.094</td>
<td>0.936</td>
<td>0.918</td>
<td>0.866</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1.092</td>
<td>1.086</td>
<td>1.094</td>
<td>0.936</td>
<td>0.918</td>
<td>0.866</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1.092</td>
<td>1.086</td>
<td>1.094</td>
<td>0.936</td>
<td>0.918</td>
<td>0.866</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1.092</td>
<td>1.086</td>
<td>1.094</td>
<td>0.936</td>
<td>0.918</td>
<td>0.866</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PDEP:**
- Year 1: 204
- Year 6: 204
- Year 7: 204
- Year 10: 204

**SSXM:**
- Year 1: 428
- Year 6: 428
- Year 7: 428
- Year 10: 428

**SDP:**
- Year 1: 120
- Year 6: 120
- Year 7: 120
- Year 10: 120

**SDP:**
- Year 1: 120
- Year 6: 120
- Year 7: 120
- Year 10: 120

---

**Notes:**
- The above figures are new ewes, ewes, and lambs for the years given.
- The figures are based on projections and actual data from previous years.
- The program is designed to optimize sheep development and maximize profit.
Cows Now: (100)
This number of breeding cows were put to the bull recently.

Heifers: (20)
This is the number of heifers kept from last year's crop of calves.

Proposed Ewes: (1200, 1400, 1600, 1900, 2000, 2000)
This series is the number of breeding ewes which the farmer aims to put to the ram after the first, second, third etc., year of development.

Proposed Breeding Cows: (100, 100, 100, 100, 100, 100)
This is the number of breeding cows intended to be put to the bull in succeeding years.

Extra Devel. Expenses: (900, 2000, 1600, 0, 0, 0)
These are tax-deductible development expenses. (Main items of expense are fertiliser and wages and these are entered separately in this example. Annually recurring expenses such as repairs and maintenance, accounting, insurance, contracting charges, etc., are included in a figure for "expenses per ewe".) These expenses would include breaking in new land, fencing, drainage schemes, airstrip etc.

Capital Expenses: (0, 1000, 1000, 0, 0, 0)
These expenses cannot be claimed for taxation, e.g. new buildings, machinery and plant.

Wages: (0, 400, 600, 800, 1000, 1000)
This row shows the wages which the farmer expects to pay to his permanent labour, as distinct from contract shearing labour.

<table>
<thead>
<tr>
<th>New mortgage raised</th>
<th>Rate of interest</th>
<th>Term of new mortgage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0. 5000. 0. 0. 0. 0.</td>
<td>.0 .05 .0 .0 .0 .0</td>
<td>0. 25. 0. 0. 0. 0.</td>
</tr>
</tbody>
</table>

1 For an explanation of alternative methods of including farm expenses in the program, see section 3.3 of this bulletin.
These three rows allow the farmer to specify new mortgages which he intends to raise to cover some of the larger development and capital expenses. Before proceeding with a development plan, the farmer and adviser should make sure that in fact these mortgages will become available when required. (The results from a COPE analysis will be useful in approaches to lending institutions.)

Living Expenses Req.: (1600,1600,1600,1600,1600,1600)
In effect, this is the minimum level of cash drawings which the farmer is willing and able to tolerate.

Existing Table Morts: (10000. .06 25. 1.)
In this row there is room for details of up to three mortgages which the farmer may already have on his property. The actual information here is a table mortgage of $10,000 at an interest rate of 6% for 25 years. It has already run one year.

Existing debts: (0. .0 0.)
These will be debts like hire purchase agreements.

Ram Ratio: (.02)
The number of rams as a fraction of the number of ewes. (2% or 1 ram for every 50 ewes.)

Lamb %: (.95)
The average lambing percentage recorded in the past, i.e.
Lambing percentage = \[ \frac{\text{lambs tailed}}{\text{ewes put to ram}} \]
\[ \text{e.g.} \quad \frac{950 \text{ lambs tailed}}{1000 \text{ ewes to ram}} = 0.95 \]

W.lamb shorn: (0.4)
The fraction of wether lambs which are shorn before sale. In this case 60% of wether lambs were sold before shearing and 40% after, thus 0.4 of the wether lambs were shorn.
e. lamb dth: (.03)
This is the fraction of ewe lambs which die between tailing and culling. In this case 97% of the ewe lambs tailed survived through the summer to culling. (This is often a very small loss.)

e. hgt. dth: (.05)
This records the expected average deaths of ewe hoggets between ewe lamb culling (or shearing) and two-tooth culling. Usually the second figure is available from the two-tooth shearing tally. This is purely a figure for deaths and does not include two-tooths culled.

Ewe death: (.03)
Average death rate of breeding ewes on this farm. It should include all ewes which are removed from the breeding flock, but not sold, i.e. deaths and "dog tuckers". This figure above is 3% or .03.

Lambings per ewe: (5)
This figure is the maximum number of lambings which a farmer can get out of a ewe (on average) and still sell it as a "c.f.a." ewe. This is purely used to distinguish between ewes which will be sold at the price for "c.f.a." ewes sold to other farmers and the lower priced "works" ewes. In this case the farmer can get 5 lambings out of his ewes and sell as "c.f.a.'s". If he kept them all for 6 lambings he would have to sell most of them to the works. (Note that there is no decimal point required.)

Wool/ewe: (10.0)
Average lb. weight of wool per ewe per year.

Wool/lamb: (2.5)
Average lb. weight of wool per wether and ewe lamb shorn.
Killers/yr: (30.)
Number of wether lambs held back each year to be killed for the farmer's needs.

Ram wastage: (0.2)
The average fraction of rams replaced because of old age, infertility etc., each year. The figure of 0.2 shows that on this farm rams last on average 5 years.

Calving %: (0.85)
Average calves weaned divided by cows put to the bull.

Cow deaths: (.02)
Average fraction of breeding cows which die.

Cows sold: (0.15)
Average fraction of breeding cows culled each year. If a cow lasts 5 years the figure would be 1/5 or 0.2. On this farm the cows last 7-8 years.

Past Culling Rates: 1 (0.0, 0, 0.0, 0.4, 1.0, 1.0, 1.0, 1.0)
This row tells the computer the fraction of ewes of each age class which have normally been culled in past years. It is used by the program to calculate the number of ewes of each age in the present ewe flock - the "ewes now". The ewe lamb culling rate is not used, so is set to zero. This particular farmer has sold no ewes in the past from the rising 4th, rising 6th or rising "full mouth" classes. Any culls have been used for dog feeding and are included in the 3% deaths. Of the ewes which lambed down as "full mouths" he culled 40% (0.4), so that 60% of these are kept to lamb down as 5 year ewes. He culled all his five year ewes (1.0) and sold them in their rising

1 Culling rates for different breeding policies are discussed in section B.6.
6 year season. **Note** the program requires that culling rates for all further age classes should be put in at a value of 1.0.

**Minimum Culling (Dev.):** (0.2, 0, 0, 0.4, 0.6, 1, 1, 1, 1)

This row has been included to allow the farmer to cull less heavily while he is rapidly expanding his flock. The figures used are the **minimum culling rates acceptable** to the farmer during development.

In this example the farmer had decided to increase as fast as possible by keeping ewe lambs. Thus he allows himself to cull only the worst 1/5 (0.2) of his ewe lambs. As before he culls no rising 4th, rising 6th, or rising full mouths, and culls 40% of his rising 5 yr. ewes. During development he is willing to keep 40% of his rising 6 yr. ewes to lamb down as 6 yr. old ewes, thus culling is 0.6. He culls all 6 yr. old ewes and sells them as rising 7 yr. ewes to the works.

These rates are used by the program to calculate the cull ewes of each age class sold during the years of development until the second-to-last and last years.

**Culling after Dev.:** (0.6, 0, 0, 0, 0.4, 1, 1, 1, 1, 1)

This row allows the farmer to return to a more vigorous culling program after the initial, rapid expansion is complete. These culling rates are used in the last two years of the program and so should return the flock to a fairly stable position in the last year. In the example the farmer has decided to heavily cull his ewe lambs after development, keeping only 40% for replacements. In fact over the years even a "stable" farmer will vary this culling rate to reduce the number of two-tooths bought or to regulate the number of two-tooths sold. A figure of 0.6 represents a fairly heavy culling.

The farmer's ewe culling policy in this case returns to exactly the same as before development.
Price: These are all expressed in dollars and are estimates of average prices this farmer would expect over the next six years. They are all expressed at "farm gate" prices with corresponding adjustments for cartage.

Wthr lamb: (5.0)
The price the farmer would expect for fat lambs sold to the works or for wether hoggets sold during the winter is usually about the same.

ewe lamb: (4.4)
Expected price for store or fat ewe lambs.

2th ewe: (9.0)
The price which the farmer would normally have to pay for bought two-tooths, or would receive for ones he sold.

c.f.a. ewe: (5.6)
An average price for ewes sold at the yards as breeding ewes.

works ewe: (3.0)
The price for old ewes sold to the works.

ram: (40.0)
The price paid for rams bought. The program assumes that old rams are used for feeding dogs.

ewe wool: (0.25)
This is a "net" figure for an average, expected price for wool. The one used here is 30 pence per lb. which would be optimistic for next year but would be a reasonable average over a longer period, in the authors' opinion.

lamb wool: (0.20)
The net price of lambs wool.
calves: (36.0)  
In this case the price for calves sold in January. This figure can be increased to show the sale of calves even up to 15 months without much inaccuracy.

Cull cows: (60.0)  
Old cows sold as "boners".

Cows bought: (70.0)  
These cows would normally be heifers, that had been run with the bull and hence be in calf (r.w.b. heifers).

The next row includes some costing devices which are often used as "rules of thumb" by farm advisers to take account of farm expenses.

xs/ewe: (3.0)  
In the example this represents a cost per ewe of covering all sundry farm expenses except fertiliser, wages, capital costs, tax-free development costs and interest and depreciation.

xs/hgt: (0.0)  
Direct costs per hogget.

xs/cow: (0.0)  
Direct costs per cow.

cwt/ee: (0.7)  
Hundredweights of fertiliser needed for each ewe equivalent run. This figure is probably a little higher than "true maintenance" but will ensure that feed is spread over the pinch feed periods.

fert/ton: (30.0)  
The cost per ton of the fertiliser used "on the ground".

---

1 See also section 3.3 of the bulletin.
exemptions: (1970)
These are taxation exemptions (see COPE Dairy Information Required).

dепrec'n: (400)
This is the level of farm depreciation before development.

overdraft: (400.)
The level of overdraft before development.

Value/e.e.: (24.0)
This is the value of the farm as a going concern expressed in dollars per ewe equivalent.\(^1\) It is used to calculate the farmer's equity in his farm.

The next four rows include extrinsic variables which should not normally be changed except by the programmer. The first two rows are standard death rates and lambing percentages for each age of ewes (Hickey, 1960).

The third row has five ewe equivalent figures adopted for Northland from Coop's work (Coop 1965). These are followed by the standard value (in $) for these five respective classes of stock. If the adviser feels very strongly that some of these ewe equivalents and standard value figures are widely removed from those on his particular farm, then he could overprint these numbers with his own.

---

\(^1\) It is likely that "going concern" value of a property is a complex function of a number of variables - area, buildings, location and stock production are a few possible ones. The actual mathematical function has not been discovered and so for the sake of our future equity calculations it is assumed that total value bears a direct relationship to ewe equivalents.
EU = ewe equivalent for ewes
EA = " " " ewe hoggets
ER = " " " rams
EC = " " " breeding cows
EH = " " " heifers

VE = standard value for ewes
VA = " " " ewe hoggets
VR = " " " rams
VC = " " " breeding cows
VH = " " " heifers

All other figures are connected with present tax rates and should only be changed by the programmer if the Government changes the tax laws.

The final figure is the rate of interest charged on overdraft and is here assumed to be 6.5% (.065). If the actual figure charged varies widely from this, then the adviser should oversplore with a revised figure.

The processes used to calculate the results may be followed in the Fortran listing of the program (Section B.7).

B.5 RESULTS FROM THE SHEEP PROGRAM

Table 4 shows the results which will be returned from the computer to the adviser. The actual input information used to obtain these results was that described in B.4.

The computer prints out a large amount of the input data to provide a permanent record for the adviser. These are self explanatory. The actual results are printed with one row representing each year. The headings for the individual items of each row are now explained.
### TABLE 4

#### AN EXAMPLE OF COPE SHEEP RESULTS

<table>
<thead>
<tr>
<th>COPE SHEEP DEVELOPMENT 1</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Information</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ewes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hgt RAMS COWS HEIF ING ING PER PER XPS CWT FERT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>601 1000 300 70 100 23</td>
<td>0.95</td>
<td>0.85</td>
<td>10.0 2.7 3.00</td>
<td>0.70</td>
<td>30.0</td>
<td></td>
</tr>
<tr>
<td>Prices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lamb Lamb Ewe Ewe Ewe Ram Ewe Wool Wool Calf Cows</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.00 8.40 9.00 3.40 3.60 4.00 4.25 0.20 36.0 64.0 10.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proposed ewes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1200 1400 1600 1900 2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proposed breeding cows</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 100 100 100 100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extra development expenses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>900 2000 1600 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital expenses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1000 1000 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New mortgages raised</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 5000 0 0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living expenses required</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1600 1600 1600 1600 1600</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Projected Results

<table>
<thead>
<tr>
<th>Yr</th>
<th>Ewe</th>
<th>Wthr</th>
<th>Cfa</th>
<th>Works</th>
<th>Wool Cull</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1200</td>
<td>36.5</td>
<td>29.1</td>
<td>100.</td>
<td>17. 93. 93. 39. 61. 42. 173. 67. 14. 0. 73. 8694. 2724. 290. 0. 306. 10131. 40608.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1400</td>
<td>36.5</td>
<td>29.1</td>
<td>100.</td>
<td>17. 93. 93. 39. 61. 42. 173. 67. 14. 0. 73. 8694. 2724. 290. 0. 306. 10131. 40608.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1600</td>
<td>36.5</td>
<td>29.1</td>
<td>100.</td>
<td>17. 93. 93. 39. 61. 42. 173. 67. 14. 0. 73. 8694. 2724. 290. 0. 306. 10131. 40608.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1800</td>
<td>36.5</td>
<td>29.1</td>
<td>100.</td>
<td>17. 93. 93. 39. 61. 42. 173. 67. 14. 0. 73. 8694. 2724. 290. 0. 306. 10131. 40608.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2000</td>
<td>36.5</td>
<td>29.1</td>
<td>100.</td>
<td>17. 93. 93. 39. 61. 42. 173. 67. 14. 0. 73. 8694. 2724. 290. 0. 306. 10131. 40608.</td>
<td></td>
</tr>
</tbody>
</table>
YR: Self explanatory.

EWES, EWE HGT, RAM, COWS, HEF: columns show the numbers of these class of animals on hand at the end of year 1, 2 etc.

WTHR LAMB SOLD, EWE LAMB SOLD, C.F.A. EWE SOLD, WORKS EWE SOLD, WOOL SOLD (LB) are self-explanatory.

2TH EWE SOLD: This column is used for purchases and sales of two-tooth ewes. Negative figures are purchases and positives are sales, so in this example the farmer buys two-tooths in five years out of six. The number of two-tooths purchased can be reduced by decreasing the ewe lamb culling rate.

Calf SOLD: Can be used to represent sale of beef stock up to the age of 12 or even 15 months according to the price selected.

CULL COW SOLD: These are boners sold to the works.

COW BT: These are breeding cows or r.w.b. heifers bought into the herd.

FERT (TON): This is tons of fertiliser used, and is derived from the ewe equivalents carried at the end of the year, and the fertiliser per ewe-equivalent input figure.

CASH COST: Total of all cash expenses including stock purchases, fertiliser, wages and general farm expenses and development expenses, capital expenses, interest and mortgage repayment, and taxation. In fact all of the farmer's cash outgoings.

PROFIT: Or assessable income as required by the Inland Revenue Department.

TAX: A function of profit and exemptions. The program makes no attempt to save tax by spreading losses.
SURPLUS: The annual cash surplus available after paying all expenses and paying living expenses or "drawings" to the farmer. There is no cash surplus until the overdraft has been eliminated.

O'DRAFT: The overdraft needed at the end of the year to cover farm expenses and farmer's drawings. This overdraft is cumulative over the years.

TOTAL DEBT: This total debt includes the overdraft, all mortgages and other debts at the end of the year.

EQUITY: This is found by valuing the farm as a going concern using the value per ewe equivalent, and subtracting the total debts to find the farmer's equity in the farm.

B.6 BREEDING EWE POLICIES

(1) Age Balance of flock before development

The ewe culling rates before development enable the computer to calculate the age balance of the present flock. For a farm which has maintained a fairly stable flock over years the culling rates used should be similar to those used in section B.4. The accurate age balance of the flock is seldom known, but if the flock has been greatly increased by buying in two-tooths in the year prior to programming, or if the present flock is composed entirely of two-tooths then the culling rates should be changed to show this. If the present stock is all two-tooths the culling rates used will be 1.0 for rising 4ths and for all older ewes. This will indicate to the computer that in the last year all ewes older than two-tooths have been sold.

(2) Buying and selling two-tooths

The number of two-tooths which have to be bought or sold is governed mainly by the rate of increase of breeding ewes and the culling rate of ewe lambs. Where the adviser increases ewe numbers rapidly, two-tooth buying will be kept to a minimum by keeping all possible ewe lambs. (Usually
relative prices indicate that ewe lamb culling should be kept to a minimum.) When ewe numbers are stabilised, the large number of ewe lambs kept will mean that the program will sell a large number of two-tooths. If required, two-tooth sales can be reduced in the last two years by increasing the ewe lamb culling rate in the "culling after development" row.

(3) Age of selling old ewes

The example in section B.4 shows the way the program can include keeping some ewes for another year. There are of course many variations which are possible here. (The older age-groups of ewes have a progressively higher death rate, so it becomes very important that the culling rate used refers to the ewes surviving in that age-group at the end of the year, i.e. the culling rate for rising 6 yr. ewes is the fraction of 5 yr. ewes surviving to the end of the year in which they are sold.)
D0201=Z.KNEC, sur',=SU~1+PEf< I
203 TOT=TuT+OTHII) I
XL=L
SU.'1=SU'/XL
TOT-TuT/XL
D02041=2010
"EI< I
I) =PRC*PEI< I)
ISU';
205 CUL I.J=
1.·"1
2Q4 DTMI
I
)=l.-D'*OTHII)
TOT
00206J=1.N
206 CULI1.JI)=1.-CULI1.JI)
OTHII)=1.-0THII)
C
AGE
DISTRIBUTE
ELSE:
207 DENOM=DENOM+TtMP
AI2.1)=A~Il)/UE~~M
002081=3010
1.,,,=1-1
iJ9 AI
I
d I=AI INo1 I*DTrli
,,'d
*CULI l'io1 1
C
FIND MORTGAGE SITUATION
D0301=x3
IF(j)+I.1)+30.31
31
FACT=I.)G(I)+I.1)*I.1
G(I)+I.1)*FACT=I.)G(I)+I.1)*FACT)
D0391=I.1
G(I)+I.1)*I.1)+I.1)+G(I)+I.1)
33
D(I)+I.1)*I.1)+T=U(I)+S1
30 CONTINUE
D0701=I.10
OUT(U+1.1)
71 (A.I.I)=A
70 CONTINUE
A8=0
C
SKEEP THROUGH N YEARS
C
STOCK RECONCILIATION
D0210=2M
LST=J
NX=J+1
C
LAMB SURVIVAL AND SALES
D0221=3+10
IN=I-1
211 A(I,J)*FA(NLST)*OTH(I)
S(I)+O.
215=O.
DD 220 I=3+10
IN=I-1
IF(I)=I2132212+12
217 S(I)+S(4)+A(I,J)*I.1-CULIN+J))
GO TO 220
213 S(5)=S(5)+A(I,J)+1.1-CULIN+J))
220 CONTINUE
C
NEW NUMBER IN EACH AGE GROUP
SU=O.
D0241=I.10
IN=I
A(I,J)=A(1,J)+CULIN+J)
214 SU=SUM(A(I,J))
C
TWO TUBS BOUGHT OR SOLD
IF(A(J)+SUH+215+215+216
216 A(I,J)+NANJ=SUM
S(3)+A(I+LST)+OTHII)+A(1,J)
GO TO 218
C
IN CASE OF ERROR
215 WRITE(3+217)
217 FORMAT(1HERNII 1) GO TO 300
C
C
LAMB CROP ETC
218 TOT=O.
D0219=2+10
219 TOT=TOT+AI2.LII)*PER(I)
S(I)+TOT/2.+30G
212 TOT/2.+1.1-CUL1(J))
A(1,J)=TOT/2.+1.1+OTH)
MAR(I,J)=AN(I,J)*R
S(I)+R+LSTI)+1.1-GST)*MAR(I,J)
S(I)+AX(LSTI)+1.1 +LJ)*GULJ
S(I)+S(3)+SMLA(AIJ)*GOL2
TWO(N+S(1)+S(17)
C
CATTLE RECONCILIATION
CALF=CN(LSTI)*CPER
S(I)+CALF*60
CLN=MAL+40
SL(1)+CN(LSTI)*1.1-DIE+SELL
CN+CN(LSTI)*1.1-DIE)+S(1)+CE(LSTI)+1.1-DIE)
IFCN=CN(LSTI)+250+50+251
251 S(I)+S(1)+CN(CNLSTI)
S(I)+O.
GO TO 255
250 S(11)+CN=CNJL
255 HEF(I)=CN(LSTI)*CHEN()+1.1-DIE)+1.1-SELL)/1.1-DIE)
IFCN=CN(LSTI)252+252+253
252 HEF(I)*CLN
GO TO 254
253 S(9)+S(9)+CLN+HEF(I)
254 EE=AN(I,J)+EM(I,J)+EA(AN(I,J)+ER+CNLSTI)*EO+HEF(I)+EN
STK=ANT(I)+AX(LSTI)+VE+1A(I,J)+1.1+LSTI)+VA+1AN(I,J)+MAR(LSTI)+VR
1=CN(I)+CN(LSTI)+VC+HEF(I)+MAR(LSTI)+1.1
C
C
BUDGET
C
MORTGAGE REPAYMENT
PAY=O.
HEST=O.
D071I=I.3
IFG(I)=I.1+I17+17+10
B.7  FORTRAN IV LISTING OF COPE SHEEP DEVELOPMENT 1 (Cont'd)

18 T=91+I*0(I,2)
   HE5T=HE5T+T
   G(I,1)=G(I,1)+T*G(I,3)
   PAY=PAY+G(I,3)*T
19 CONTINUE

C DEBT REPAYMENT
20 DO1=1,5
   IF(U(I,1)>1.19*V2
      T=D(I,1)+D(I,2)
   )HE5T=HE5T+T
   D(I,1)=D(I,1)-D(I,3)
   PAY=PAY+D(I,3)*T
21 CONTINUE

C FIX NEW MORTGAGES IF REQUIRED
22 IF(W>90)74+75
23 DO2=1,8
   IF(v>1.19*W2
      T=R(I,1)*R(I,2)
   )HE5T=HE5T+T
24 SPEC=O.

C CASH BUDGET
25 DU=0.
   DU=DU+M(I,1)*PR(1)
   GO TO 72
26 CONTINUE

C CASH BUDGET
27 DO3=1,5
   IF(v>1.19*W3
      T=C(I,1)*C(I,2)
   )HE5T=HE5T+T
28 SPEC=O.

C CASH BUDGET
29 DU=DU+M(I,1)*PR(1)
   GO TO 72
30 CONTINUE

C CASH BUDGET
31 DO4=1,5
   IF(v>1.19*W4
      T=AN(I,1)*AN(I,2)
   )HE5T=HE5T+T
32 SPEC=O.

C CASH BUDGET
33 DO5=1,5
   IF(v>1.19*W5
      T=AN(I,1)*AN(I,2)
   )HE5T=HE5T+T
34 SPEC=O.

C CASH BUDGET
35 DO6=1,5
   IF(v>1.19*W6
      T=AN(I,1)*AN(I,2)
   )HE5T=HE5T+T
36 SPEC=O.

C CASH BUDGET
37 DO7=1,5
   IF(v>1.19*W7
      T=AN(I,1)*AN(I,2)
   )HE5T=HE5T+T
38 SPEC=O.

C CASH BUDGET
39 DO8=1,5
   IF(v>1.19*W8
      T=AN(I,1)*AN(I,2)
   )HE5T=HE5T+T
39 SPEC=O.

C CASH BUDGET
40 DO9=1,5
   IF(v>1.19*W9
      T=AN(I,1)*AN(I,2)
   )HE5T=HE5T+T
41 SPEC=O.

C CASH BUDGET
42 DO10=1,5
   IF(v>1.19*W10
      T=AN(I,1)*AN(I,2)
   )HE5T=HE5T+T
43 SPEC=O.
PUBLICATIONS

1964
2. The New Agricultural Economics Research Unit, B. P. Philpott
3. Indicative Planning for the Poultry Industry in New Zealand, J. T. Ward
4. The International Sugar Situation and New Zealand's Sugar Policy, A. R. Frampton
5. Economic Implication of Increased Agricultural Production, B. P. Philpott
6. Profitability of Irrigation in Mid-Canterbury, J. D. Stewart and D. A. R. Haslam
7. Programming a Canterbury Mixed Farm, J. D. Stewart and P. Nuttall
8. Economic Implications of Increased Wool Production, B. P. Philpott
9. Investment Analysis for Farm Improvement, J. T. Ward
11. Factors Affecting Demand for Wool Textiles in New Zealand, B. P. Philpott
12. The Degree of Protection accorded by Import Licensing to New Zealand Manufacturing Industry, P. Hampton
13. Fluctuations in Wool Prices, 1870-1963, B. P. Philpott
15. The Problem of Scheduling Sales of New Zealand Butter on the United Kingdom Market, Robert Townsley
17. Breeding Flock Composition in Relation to Economic Criteria, R. J. Townsley and W. Schroder
18. Trends in Production, Trade and Consumption of Wool and Wool Textiles, B. P. Philpott and D. M. Beggs
19. Standardisation of Farm Accounts for Managerial Analysis, J. W. B. Guise
20. The Use of Linear Programming in Least-cost Feed Compounding, N. W. Taylor
21. The Maximisation of Revenue from New Zealand Sales of Butter on the United Kingdom Market—A Dynamic Programming Problem, R. J. Townsley (Reprint)
23. An Analysis of the Retail Demand for Meat in the United Kingdom, B. P. Philpott and M. J. Matheson
25. Strategic and Tactical Planning in International Marketing Policies, B. P. Philpott (Reprint)
27. An Economic Analysis of Large-scale Land Development for Agriculture and Forestry, J. T. Ward and E. D. Parkes
29. Aspects of Productivity and Economic Growth in New Zealand 1926-64, B. P. Philpott
31. The Regional Pattern of the Demand for Meat in the United Kingdom, Mary J. Matheson and B. P. Philpott (Published 1967.)
32. Long-Run Swings in Wool Prices, B. P. Philpott (In preparation)
33. The Economics of Hill Country Development, J. S. Holden (Reprint)
36. Productivity, Planning and the Price Mechanism in the New Zealand Manufacturing Industry, B. P. Philpott
37. Some Projections of Retail Consumption In New Zealand, R. H. Court
38. The Nature and Extent of the Farm Labour Shortage in Cheviot County, Canterbury, J. L. Morris and R. G. Cant

1965
40. High Country Development on Molesworth, R. W. M. Johnson.
41. The Inter-Industry Structure of the New Zealand Economy, B. P. Philpott and B. J. Ross (In preparation)
44. Fertiliser and Production on a sample of Intensive Sheep Farms in Southland 1953-64, R. C. Jenson and A. C. Lewis.

OUT OF PRINT: Numbers 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 14, 17, 21, 22 and 25.

While stocks last, single copies of the publications listed above are available to interested individuals, institutions and firms, on application.