Managing the Modern Farm Business:
Agricultural Investment Analysis

Take AIM
The Annualized Incremental Method

Module 1
Introduction to Agricultural Investment Analysis

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and
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Faculty of Extension
University of Alberta

Special Funding from
Alberta Agriculture, Food
and Rural Development

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Set - ISBN 1-55091-040-X
Module 1: Introduction to Investment Analysis - ISBN 1-55091-041-8
Module 2: Preparing Investment Data for Analysis - ISBN 1-55091-042-6
Module 3: Advanced Investment Analysis - ISBN 1-55091-043-4
Module 4: The Annualized Incremental Method - ISBN 1-55091-044-2
Module 5: Technical Appendix - ISBN 1-55091-045-0

Canadian Cataloguing in Publication Data

Bauer, Leonard, 1937 – 2004

Bushe, Donald, 1944 -

(Managing the modern farm business)

ISBN 1-55091-034-5 (set) ISBN 1-55091-035-3 (Module 1)

1. Agriculture – Economic aspects. 2. Farm investment. 3. Farm management.

I. University of Alberta, Faculty of Extension. II. Title. III. Series.

S561-B38 2003 630'.68 C03-910890-1

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PREFACE

Most of what I think I know about the basics of investment analysis and risk assessment I learned from my friend and mentor, Len Bauer. Len's work and teaching has influenced farm managers and their advisors around the world. I consider it an honour and a privilege to write a short forward for this series of modules on investment analysis.

So, why should managers be interested in this series of investment analysis modules? The answer is because the consequences of poor capital investment decisions can directly determine the financial viability of a business enterprise. One need look no further than the North American hog industry investment boom of the 1980's and 90's and watch the fallout occurring today to see a classic example of capital investment decisions gone wrong. The failure to apply sound management principles invites the market place to solve your management problems for you. The market plays no favorites, treating both big and small businesses the same.

These self-directed learning modules demonstrate the basic tools used in the business world today; they are the language and practice of modern business. My biases on the importance of having a strong understanding of management concepts come from over a decade spent as a researcher and instructor at the University of Alberta blended more recently by several years as manager of a commodity production business.

I have worked with many excellent business managers and if there is a central theme it is this: they distinguish themselves by their knowledge and ability to apply the basic principles of economic decision making and risk management. These modules outline the basic principles and give practical insights, through illustrations and exercises, on how the material can be applied in practical situations.

The following modules lay out the process of analyzing investment decisions. Although the discussion in the modules is restricted to simplified cases, the tools can be applied to any business enterprise. Even if a manager does not use the actual detailed methods in every situation (for example some of the tools contained in the technical appendix) there is power in understanding the proper process for collecting and analyzing the information required for making sound investment decisions. It is impossible to build sound strategies without a solid foundation.

I use these principles in my day to day operations. I strongly encourage managers and those who work with and advise managers in any capacity, to make use of Dr. Len Bauer's work. Today's managers must be able to master these methods and the instructional design provided by Don Bushe makes it easy for busy managers to assimilate the ideas efficiently.

Frank Novak, Managing Director

Alberta Pig Company

FOREWORD

Farm business management is the art and science of making decisions about the use of available resources and acting on those decisions in an uncertain world so that the short- and long-term goals of the business owners are as fully satisfied as possible.

This definition is not new, but rather a distillation of the thoughts and philosophies of many writers on the topic. The definition contains several key words. Management is concerned with achieving goals. Decision-making and action are crucial. Resources are limited and the world is uncertain.

As the general manager of your business, you need to plan, organize, control, co-ordinate, and motivate your management team. You must see to it that the details of production, marketing, financing, and personnel management are carried out.

As production manager, you must decide what to produce, how to produce it, and how much of it to produce, and you must set the production process in motion. As marketing manager, you must form expectations of product prices, and you need to carry out the functions of buying inputs and selling the products. As financial manager, you need to decide which assets to acquire, how to raise the funds to acquire them, and also when to exercise financial control. As personnel manager, you need to find and keep the right staff and then make sure they are properly trained to do the job.

'Managing the Modern Farm Business' is a series of modules designed to help in developing the necessary concepts and skills essential to effectively manage the production, marketing, financing, and human resource aspects of the farm business. If you are the owner-manager of a farm, these modules will improve your chances of operating a successful business. If you are a farm management advisor, or an instructor, these modules are useful in reviewing and enhancing your understanding of management principles. They also provide an excellent resource of study materials, examples, and exercises for your students and clients.

Management is a process of gathering information, making decisions, and taking action. This module will help you take part in this process.

Leonard Bauer, PAg

Technical Editor

ACKNOWLEDGEMENTS

This set of modules came about because of Bill Clinton.

Don Bushe In 1995, Len and I traveled to Ukraine to conduct a symposium on developing curriculum materials in agricultural economics. Our journey was delayed in Frankfurt because the president was visiting Kiev - closing the airport. While waiting, we considered *Managing the Modern Farm Business* and outlined 'NPV for Farm Managers'. We drafted the four modules during 'slack time' at the symposium. We planned to circulate them on our return to seek their publication, but they went onto the back burner. In the fall of 2003, the *Take Aim: The Annualized Incremental Method* project took on immediacy as Len battled cancer. The project was close to completion at his death in the summer of 2004. At his memorial, his former students and I resolved to complete 'Len's Last Project'.

Ted Darling I met Len in the late 1980's when he agreed to take me on as a forty-year-old graduate student. He liked to call it "warranty work" when former students came back for upgrading. Over the next two years I gained a deep appreciation for Len as a teacher, a colleague and a friend. Later on, I got to know him even better, especially when we worked together to publish of some of his earlier work. Len believed that this final set of modules provided the capstone for the entire Managing the Farm Business series, and I am very proud to have been a part of getting them published.

Dean Dyck I had the privilege of meeting Len in the late 1990's through the Alberta Agricultural Economics Association. I was familiar with his teaching and contribution to business management as a university student in Saskatchewan. When I met him in person, I gained a new appreciation for his depth of knowledge, his ability to look at economic concepts at many angles, and his unique gift for teaching as an "exploration". When Len was recognized with the Wilson Loree Award from the Canadian Farm Business Management Council, I think the qualifications were written for him - "a role model, a mentor and an individual who has made significant contributions in the area of agricultural business management". I am very proud to bring these modules to fruition.

Dale A. Kaliel My first encounter with Len was in the late 70's as a new graduate student. This is where we began a "student - teacher" relationship that spanned nearly three decades. Len taught me more than the "music" of production economics and business management. He taught me the value of "teaching", conveying a valuable message to those whose lot could be improved by applying the simple fundamentals of economics to complement their applied, practical production knowledge. He taught me that the message had to be understandable and he was a master at taking the most complex concepts and presenting them in a common sense, intuitive fashion. On top of this, he taught me to "let the students find their path". The principles of economics and business management are to be "absorbed" not memorized by rote and Len had the creativity, patience and perseverance to lead the discovery process of students and producers. It has been my honour to assist in bringing this set to press. And, even though he has passed on, he left me with "teachable moments" reviewing his last volumes.

Brian Radke While I knew Len only in the last few years of his life, I was impressed by the strong rapport between Len and his former students. This bond was the result of the obvious importance Len placed on teaching. His teaching excellence was the culmination of a number of personal attributes. Len was dedicated and fascinated with farm management as indicated by his continued active work on the topic as a Professor Emeritus and during his illness. As these modules show, he placed great importance on making the new information available and useful for his target audience of farm managers. Finally, Len was genuinely interested in the welfare of his students and colleagues. The respect others and I have for Len mirrors his attitude towards us. I am proud to have made a small contribution to the work that Len was so passionate about.

Closing Alberta Agriculture, Food and Rural Development provided special funding for the publication of *Take Aim: The Annualized Incremental Method*. We know that Len is pleased to see his last project completed. While we (his students and collaborators) have taken care to ensure accuracy of the material, we freely accept responsibility for any errors remaining - none of which can be attributed to Len Bauer … or Bill Clinton.

Don Bushe
March, 2005

Analyzing Agricultural Investments

What is financial management? What constitutes investment in agriculture? What is it that financial managers do? There are at least three topics that financial managers must deal with: acquiring assets [i.e. making investments], financing assets [raising the funds to make the investment] and exerting financial control. Financial management and financial managers are needed in old established businesses, in thriving growing businesses and in businesses just starting up. They play important roles as businesses expand or retract. This financial management requires attention to three topics:

First of all the financial manager must make asset acquisition decisions. Decisions must be made to determine whether a particular asset should be acquired; whether an investment should be made. This means that the manager must have confidence that the asset in question will contribute towards the financial goals of the owners.

Secondly the financial manager must make financing decisions. Decisions must be made about how funds should be raised to acquire the asset. This decision comes second in the list of duties for a very important reason; the manager needs to ration his or her time. There is no purpose wondering about how to finance an asset that is not worthwhile in the first place.

The final task for the financial manager is financial control. The financial situation must be monitored and corrective action taken whenever actual results differ from those desired. Control is a much simpler task if sound acquisition and financing decisions are made in the first place.

Purpose and Organization of these Modules

The purpose of this set of modules is to focus attention on the above financial management topics, acquisition, financing and control. It has been our observation that while the financing and control aspects have been well attended to by public and commercial advisory services we have been negligent, as a profession, in analyzing investment prospects. Accordingly this set of modules will concentrate mostly on budgeting techniques for making informed agricultural investment decisions.

There are five modules in the set.

Module 1 Introduction to Investment Analysis
The first is of an introductory nature. It examines the basic techniques, dismisses those that are inferior, namely urgency, payback period and accounting rate of return. The module then provides a comprehensive review of the tried and true systematic approach, net present value.

Module 2 Preparing Investment Data for Analysis
The second module deals with the advanced topics of discount rates, cash flow estimates, and inflation in preparation for calculating the net present value.

Module 3 Advanced Investment Analysis
The third module presents the topics of differential rates of inflation, risk, and income taxes within the net present value framework.

Module 4 The Annualized Incremental Method (a.k.a. The Partial Budget)
The fourth module covers the topic of partial budgeting. The point is made that the partial budget process is really an annualized net present value method.

Module 5 The Technical Appendix
The final module is a technical appendix organized much like a glossary of terms. Financial mathematics formulae and financial tables are an important part of this module. Although some attention is paid in these modules to financing and control issues these topics are left to further development, for another time. As was pointed out good work has been done by the advisory professionals, government agents, bankers and accountants, and we refer the reader to those sources.

This Module

In this module, *Introduction to Agriculture Investment Analysis*, we examine issues surrounding the asset acquisition decision. It is worth stressing again that this is the starting place in financial management. Obviously, it is the first question to be asked. Only if the question is answered 'yes' should attention be given to finding the funds for making the investment. Just because one can borrow the money is insufficient reason for acquiring an asset. The asset must be worth more to the business than the cost to acquire it.

Farmers, like all business people are required to make investment decisions. And, as in all businesses a systematic approach can add much to the ultimate success of the operation. The purpose of this first module in the series on making sound investment decisions is to outline the basic components of a systematic approach.

Objectives

When you have completed this module you should be able to:

- Apply the partial budgeting procedure to a variety of farm management investment situations.
- Identify and describe investment opportunities in terms of actions to be taken.
- Calculate the economic advantages and disadvantages of investment opportunities.
- Assess the affordability of investment opportunities.
- Assess the acceptability of investment opportunities and make the decision with confidence.

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The Asset Acquisition Decision

History is replete with example of excessive debt loads. The debt crisis of the 1980s remains fresh in our minds two and a half decades later. But not to rub salt into an enduring wound, it may not have been so much the case of borrowing too much money but rather investing money into the wrong assets.

Investment in agriculture might involve establishing an abattoir, an ethanol production plant or formation of an agricultural commodity marketing company. It might be an investment in primary agriculture, for example expanding a traditional farm business. It might mean starting up a new farm business or transferring asset ownership from one generation to another. The case that will illustrate the principles of investing in agriculture is that of an early retired farming couple ready to expand a second career.

In a few moments you will meet Rudy and Helga Würtzel. They have been farmers for a number of years, but have recently decided to expand their root vegetable enterprise. Rudy was a high school mathematics teacher and Helga, a pharmacist by background, works for the local pharmacist, Zino's Apotheke. They call their farming enterprise Rudy's Roots. Now that Rudy is retired from active teaching he spends some of his spare time down at the local coffee hangout called Kathy's Kaffee Klatch.

The characters that hang out here are not reluctant to offer opinion and advice on life's most challenging aspects. For example, the local philosopher Phil Hautparleur, noted, "I just read this book – *Understanding Capital Budgeting*" he explained. "This book provides a lot of insight into the state of affairs."

"It sounds interesting if a little dull", a couple of patrons remarked "why not try to get your head around *Ulysses*".

Winners and Losers

In this module we present a number of methods for investment analysis and the decision rules upon which they rest. For each method we provide a critical review stressing strengths and weaknesses. Because investment analysis requires us to deal with future events, events not yet revealed, we should not be surprised that there are no foolproof methods. But some are sounder than others. Others have built-in biases. In the end the financial manager must select investments that show sound promise towards fulfilling the financial goals of the business owners. We suppose that profit and security are two goals that score high in the business owners' minds.

In doing their jobs financial managers can make two kinds of mistakes. They might choose investments which turn out to be losers or they might reject investments which would have turned out to be winners.

If the investment that is chosen is a winner, the manager has made the right choice and the business moves ahead at full speed to take advantage of the situation. Should it turn out to be a loser, the manager has made the wrong choice. Not only is money wasted by the investment, the future of the business could be jeopardized by the loss.

	Winner	Loser
Chosen	Correct choice: Full steam ahead.	Incorrect choice: Money thrown away!

When the rejected investment turns out to have been a winner, the manager has made an incorrect choice. This lost opportunity could cost the business a chance of success and put it behind competitors who have made the correct decision. On the other hand, if the choice turned out to be a loser, the consequent loss was avoided by correctly rejecting the investment. This process of choosing winners and rejecting losers can be shown by a simple diagram called a 'payoff chart'. It clearly shows the alternatives and the results of each position.

	Winner	Loser
Chosen	Correct choice: Full steam ahead.	Incorrect choice: Money thrown away!
Rejected	Incorrect choice: Lost opportunity.	Correct choice: Loss avoided.

Question

Phil the philosopher, not always reluctant to offer up a bit of gossip pointed out Gaston Autruche's unfortunate encounter with raising ostriches. It seems Gaston invested in some very high-priced breeding stock, and by the time he got the operation operating ostrich prices had dropped to commercial meat prices, not quite strong enough to retire the debt accompanying the ill-fated venture.

Complete the payoff chart to match the experience of Gaston Autriche.

	Winner	Loser
Chosen		
Rejected		

Answer

Compare your result to the chart that Phil Hautparleur and the folks at the Kaffee Klatch prepared. Correct any discrepancies.

	Winner	Loser
Chosen	**Correct Choice** **High Prices**	**Incorrect Choice** **Low Prices**
Rejected	**Incorrect Choice** **High Prices**	**Correct Choice** **Low Prices**

The Autruche family was able to recover from the financial stress but not without considerable family discord.

"It was a case of enthusiasm and lack of sound investment analysis crowded out by money and security being too easily being come by", Phil went on. The Bunyan Brothers cleared their throats about this time suggesting that Phil's point had been adequately made. The conversation moved onto other topics.

There is more to picking the winners and rejecting the losers than just 'good luck'. Applying a set of appropriate Decision Rules will help to minimize the chances of these errors.

The Notion of Investment

An investment involves making an expenditure of funds with the expectation of return at some time in the future. The future may be a long way off. For example, making an investment like planting an orchard will not provide a return for perhaps three or four years. Results from establishing a woodlot might not appear until twenty years have elapsed. On the other hand, investing in fertilizer and seed for a crop of wheat or barley will provide return within the year.

Because investments are made today with results expected way off sometime in the future uncertainty is ever present. Consequently an organized approach to investment analysis, to reduce the chance of error becomes very important.

Economic Analysis

Investment decisions are made at one point in time whereas the results of those decisions, whether they are a success or failure, will not be known for some time. This underlines the need to be organized in attempting the analysis. Four steps come readily to mind for making organized investment decisions.

Step 1 - What is to be done?

Here the key is to be as specific as possible. Define the investment. What problems are to be solved? What alternative solutions exist?

Step 2 – Will it pay?

Investments are usually made in anticipation of financial gain. Therefore considerable effort can be invested to determine the profit potential. Will the investment be profitable? What expenses will be encountered. How much revenue will be added? What will the impact of the investment be on revenues? It is necessary to quantify the net economic advantages and disadvantages of the investment.

Step 3 – Can I afford it?

Now analyze the financial risk of the investment. How will financial ratios be affected? Will leverage be unduly increased? Will the business come under undue financial stress?

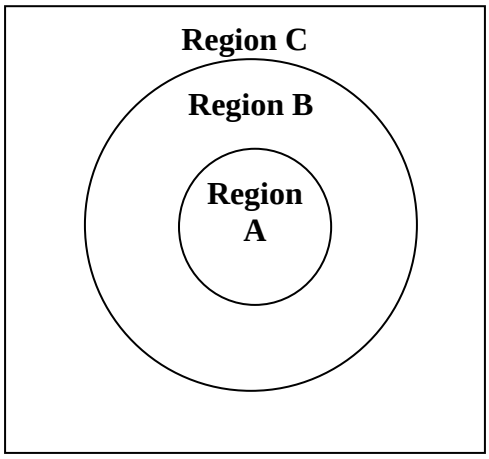
Step 4 – Do I want to do it?

Obviously there was some interest in the investment; otherwise you would not have done the analysis. But now that you have seriously considered profit potential and affordability; what is your decision?

What Is To Be Done

It is difficult to stress too strongly the need to clearly specify the problem to be solved; even so, it is a step that is not infrequently glossed over. Time spent in analyzing a situation saves time in directing the manager's effort into solving the underlying problem; it saves time and avoids chasing after non-existing problems. The manager's attention must be directed to those things that matter.

Defining the Problem

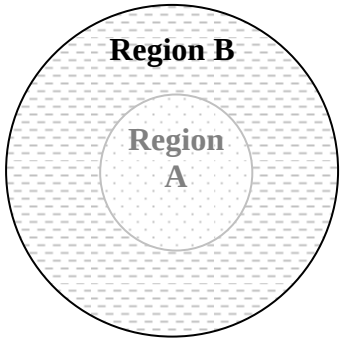


Every situation presents us with at least three areas or regions where decisions can be made. We show these on a diagram depicting them as rings on a target. Region A at the center represents those things within our control. Region B denotes those things over which we may have influence but no control. And region C represents those things over which we have neither control nor influence.

Things We Control

The things within your control are the only things about which you can make decisions and take direct action. For example, as a farm manager you can decide whether to market your barley directly or to feed it to a pen of beef steers. This is shown as region A, the center or bulls-eye of the diagram

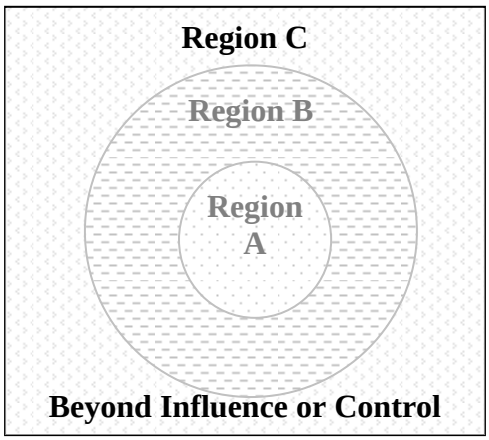
Influence - But Not Control



You may, of course, use your influence to develop a more favourable situation; perhaps even to the point where you can be in control. For example, you won't have control of the price you will ultimately receive for your finished cattle, but you might have some influence through judicious bargaining with a cattle broker. These actions would be those falling into region B, the circle around the center of the diagram.

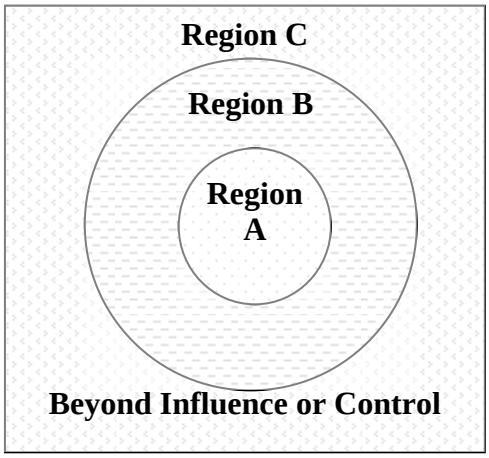
No Influence or Control

Identifying areas of control and influence for specific situations is an important managerial task; worrying about things beyond your control or influence is counter productive. These are represented as the areas outside the two circles. That does not mean you can ignore such things. After all, adverse events can have a profound effect on the business. Examples of events beyond your sphere of control and influence might include livestock disease outbreaks, trade embargos, closed markets and plummeting prices.



Focus in problem identification and solution is important. We can all think back to a public meeting (possibly one with a weak chairman) where a group decision was to be made. People would have much to say. A few people stuck to the topical region A. Some more wandered into the territory of region B. But a lot of folks wasted the time of the rest by wallowing in region C.

Being able to identify those things which are controllable or at least likely to be influenced is a major managerial task. Remember, it is in Region A that the problem must be identified and solved.



Once the problem has been identified alternative solutions must be specified. Very few problems have only a single correct solution. It is an important function of the manager to determine potential solutions to the problem. Brain storming for possible solutions with business partners, management team colleagues or others who have faced similar problems can often be a valuable exercise. Professional help may also be available in identifying alternative solutions to a problem.

Sometimes the solution is immediately recognizable as the correct one and can be implemented without much analysis. In other cases a suggested solution can be dismissed quickly after only cursory examination because it is so obviously undesirable. Most of the time, especially where large amounts of money or effort are at stake a thorough analysis of the likely consequences must be undertaken.

Especially in these latter cases, care should be taken to clearly write out the alternative solution to be examined. This ensures that the correct information will be gathered and that it will be analyzed properly. In specifying alternative solutions to a problem be as specific as possible; preferably do it in writing. For example, expressing the alternative as "Should I take 160 acres out of barley production and put it into wheat?" is more clearly stated than is "Should I grow wheat or barley?" "Should I acquire a combine?" is not as informative as "Should I buy a combine to replace the custom operator I have been using?"

Question

Remember Gaston Autruche's unfortunate encounter with raising ostriches? He invested in some very high-priced breeding stock, and by the time he got the operation under way ostrich prices had dropped to commercial meat prices, not quite strong enough to retire the debt accompanying the ill-fated venture.
Pick the 'best answers' for each of the questions by selecting the letter of the answer that applies:

1. What is the problem Gaston is trying to solve?

_____

2. What things could Gaston control (region A)?

_____

3. What things could Gaston influence but not control (region B)?

_____

4. What things are beyond Gaston's control (region C)?

_____

a) Take advantage of the high prices for ostrich stock.
b) Diversify the Autruche operation by breeding ostriches.
c) Join the ostrich breeding bandwagon.
d) Retire debt from other ventures with a quick profit on ostriches.
e) Determine the number of ostrich stock obtained.
f) The amount of debt incurred in stock acquisition and facilities preparation.
g) Fix the price paid for ostrich breeding stock.
h) The price obtained by ostrich meat in the marketplace.
i) The speed at which the breeding stock market became saturated
j) The acceptance of ostrich meat by consumers.

Answer

1. Define the problem
a) Take advantage of high prices for ostrich stock.
c) Join the ostrich breeding bandwagon.
This is the area that may have been the source of Gaston's misfortune. Had the problem been defined in terms of diversification or reduction of single crop dependence rather than on short term opportunity advantage, the threat may have been avoided.

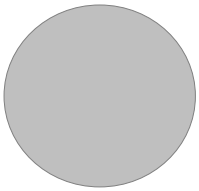
2. What things could Gaston control (region A)?
e) The number of ostrich stock obtained.
f) The amount of debt incurred in stock acquisition and facilities preparation.

3. What things could Gaston influence but not control (region B)?
g) The price paid for ostrich breeding stock.
h) The price obtained by ostrich meat in the marketplace.

4. What things are beyond Gaston's control (region C)?
i) The speed at which the breeding stock market became saturated
j) The acceptance of ostrich meat by consumers.

Will it Pay?

Profitability



The 'does it pay' question is one of profitability; you are trying to determine if an alternative course of action will have a favourable economic outcome. And it is a question that must be answered about the future before all the information is completely known. Because of the futuristic setting in an uncertain environment an organized approach is called for. The profitability question on the partial budget form is divided into four quadrants; any situation will involve some combination of added expenses, added revenue, reduced revenue or reduced expenses. An important set of decision rules guides the manager in three production categories.

The *How Much, How,* and *What to Produce* questions are the topic of three modules in this series. The Decision Rules that are developed in those titles are reproduced here. For a full explanation of these rules the reader is encouraged to refer to those modules to see a full explanation of how the decision rules are developed and applied.

How much to produce

Decision Rule I
Increase the use of an input as long as the added cost associated with its use is more than compensated for by the added revenue from the extra output produced. Stated another way, the alternative is profitable if added revenue exceeds added expenses.

A frequently encountered set of problems is the resource intensity question. How much fertilizer should be used in producing barley? How much milk should be produced from a given cow? To what weight category should a steer be fed? How heavily should the pasture be grazed? These are called input/output problems in that we have an input [fertilizer] and an output [barley]. The manager must decide how much fertilizer to apply thereby determining the amount of barley to produce. Problems of this sort involve added expenses and added revenues.

How to produce

Another set of problems involves resource trade off issues. Should we feed a high energy low roughage diet to beef cattle? Should we be highly mechanized or should we rely more on manual labour? These are called input/input problems in that we have one resource like mechanization that we might substitute for another resource like labour. The manager must decide what combination of mechanization and labour to use; should he invest in machinery or labour? Problems of this sort involve added expenses and reduced expenses.

What to Produce

The final set of problems deals with product trade off situations. Should we follow a low forage high grain crop rotation? Should we increase the production of canola at the expense of barley? These are called output/output in that we have one output like forage that we might produce in place of another like grain. The manager must decide what combination of products to produce. Problems of this sort involve reduced revenue and added revenue.

Decision Rule III

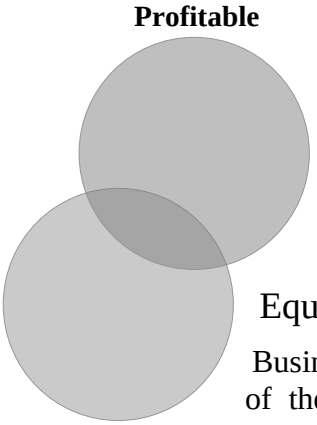
Increase the amount of one output as long as the added revenue associated with its production more than compensates for the reduced revenue associated with the output being replaced. Stated another way, the alternative is profitable if added revenue exceeds reduced revenue.

In practical situations we often encounter alternatives where dimensions of all three problems are involved. For example increasing grain production at the expense of forage output will also cause a shifting of costs. Although the added revenue and reduced revenue quadrants play the major roles there will also be added expenses and reduced expenses. As the form shows the sum of added expenses and reduced revenues represent economic disadvantages. In like manner the sum of added revenue and reduced expenses accounts for economic advantages.

The result is the general decision rule.

General Decision Rule

Accept only those alternatives where the economic advantages exceed the economic disadvantages."



Can I Afford It?

This question poses the affordability question. Affordability refers to the ability of the business to actually raise the funds to make the investment. Funds typically come from one of two sources, namely equity or debt.

Equity Sources

Businesses that have generated profits over the years may have retained some of their earnings in the business; after all this is how a business grows. Retained earnings may be held in different forms, in various kinds of assets like land, buildings, machinery or cash. Assets can be converted to cash thus providing funds to finance the investment. Business owners may also contribute additional capital into the business thus providing the necessary equity funds for investment.

Debt Sources

Businesses have the ability to borrow funds, i.e. to go into debt; they can raise debt capital. Liquidating assets to raise cash may prove disruptive to the business so borrowing may turn out to be a practical solution. A word of caution is appropriate. Using debt capital increases the leverage of the business and thereby the financial risk exposure.

How do you evaluate affordability? Obviously affordability is a non-issue for a business with lots of cash and few investment opportunities; does such a business exist? In a more typical situation the manager should look at the balance sheet of the business as it will appear after the investment has been made, especially if debt capital is to be involved. Calculate the basic financial ratios; the capital ratio, the current ratio, the leverage ratio. Is the business moving into a financially stressed situation? Does the new leverage ratio [after the potential investment will have been made] forewarn of difficult or unmanageable financial risk? Is your banker nervous about your financial condition as he assesses how your business will look after the investment is in place? If he is, maybe that's your answer?

You must also look at the investment itself, especially at the size and timing of cash flows. Will there be sufficient cash generated in a timely fashion to retire the debt? Will you have to dig into other parts of the business to raise enough cash to remain liquid?

When should you evaluate affordability? Strictly speaking you need to evaluate the affordability of only those investment alternatives that show the potential of profit. In normal circumstances only paying investment alternatives would be implemented. In other words don't waste time on alternatives that do not pay.

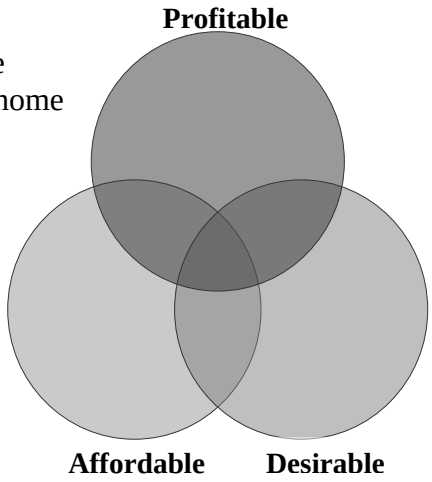
It is unfortunate but sometimes only the affordability analysis is done; the profitability question can easily be overlooked if one concentrates on the ability to

pay back the loan to the exclusion of other factors, especially those dealing with profit.

Do I Want To Do It?

The decision embodied in the 'do I want to do it' component answers the question of desirability.

John Venn (1834-1923), the creator of the Venn diagram, entered Cambridge in 1853. He graduated in 1857, and returned to Cambridge in 1862 as a lecturer in Moral Science, teaching logic and probability theory. He is best known for his diagrammatic way of representing sets - their unions and intersections. [Taken from the web]



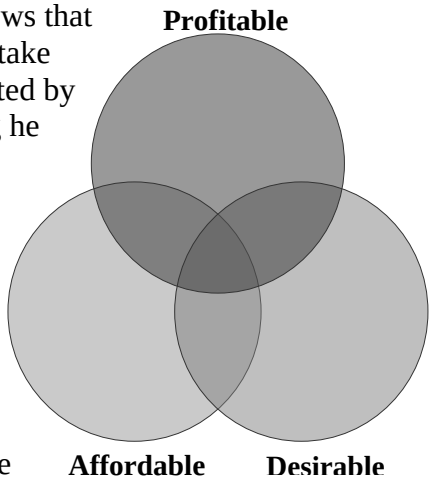
These components of profitability, affordability and desirability can be placed in a Venn diagram to bring home the relationship further. The three interlocking circles of the diagram illustrate the interconnectedness of the concepts. The lesson lies at the intersections of the circles. The overlap of the three components, profitability, affordability and desirability, is the focus of attention. Just because something is desirable (that is, we really want to do it) we would be foolhardy to do it if it were not affordable. Bankruptcy would be the result.

We might run into situations where something is affordable and desirable, but not profitable. Would we do it? We might, but in the knowledge that we were subsidizing the investment from somewhere else in the business.

Obviously, in a competitive world we can't make too many unprofitable investments with out economic consequences. Ideally we want investments that are profitable, affordable and desirable.

Question

John has an opportunity to grow organic grains for a local bakery, which in turn has a market outlet in a large metropolitan city. John knows that organic prices can provide a profitable return, but it will take time to get organic status and the market might be saturated by that time. John really wants to do this and it is something he believes in.



Which point n the Venn diagram [A / B / C / D] best describes where John might start.

A This opportunity is profitable and affordable

B. This opportunity is affordable and desirable

C. This opportunity is desirable and profitable

D. This opportunity is desirable, profitable and affordable

Answer

D. This opportunity is affordable, profitable, and desirable.

The choice of organic production tends towards the desirable component of the decision making process. Even when we really want to do something, to ignore the profitability and affordability components to a decision puts the success of the operation at risk.

A Spirited Community

The patrons of Katie's Kaffee Klatch (usually just called the Klatch) include neighbourhood farmers as well as local business folks. It's a great place to generate new ideas and talk over problems. Katie got tired of tablecloths being ruined by the doodlers so she put up a blackboard for the gang to use for 'heavy' discussion. In fact Katie has a mission for the Klatch – to provide a place for dispensing knowledge, stamping out ignorance or just wasting time. She lets her patrons choose the topic of the day.

You've already met the Würtzels. Rudy Würtzel, who recently retired as a high school principal, together with his wife, Helga, has long had a dream to make their 80 acre residential farm into a retirement business. Rudy now has sufficient time to manage the operation and provide most of the labour needed. Helga is a pharmacist employed by the local drug store, "Zino Apotheke's Drugstore", and helps out on the farm as time permits.

Income Statement for Rudy's Roots for the Year ending December 31, xx01

REVENUE:		
root vegetable sales	130,000	
OPERATING REVENUE	130,000	
PLUS: Term deposit Interest	107	
PLUS: Ending Product Inventory	10,000	
LESS: Beginning Product Inventory	10,000	
GROSS INCOME		130,107
EXPENSES:		
Herbicides	17,000	
Fertilizer	11,000	
Seed	18,000	
crop insurance	1,000	
other crop supplies	3,500	
Total Crop Expense		50,500
fuels & lubricants	4,000	
harvester maintenance and fuel	0	
crop equipment repairs	5,000	
harvester repairs	0	
building repairs	400	
miscellaneous labour	2,000	
harvest labour	15,000	
Utilities	1,000	
property taxes	1,000	
other supply & service	1,500	
term interest	9,600	
Total Other Expenses		39,500
OPERATING EXPENSE		90,000
PLUS: Operating Capital Interest	3,087	
PLUS: Beginning supply Inventory	5,000	
PLUS: Depreciation	19,000	
LESS: Ending supply Inventory	5,000	
TOTAL EXPENSES		112,087
NET INCOME		18,021
LESS: VALUE OPERATOR LABOUR	12,000	
RETURN TO EQUITY		6,021

Since retirement the Würtzels have become specialized in their farming venture, which they now call Rudy's Roots. They grow a variety of root vegetables. Rudy is still able to do most of the work on the place. At harvest time they hire part time labour to get through the crunch.

The Investment Decision – the Problem and Background Information

An opportunity exists for Rudy and Helga, owners and managers of Rudy's Roots, to replace the hired harvest labour with a mechanical root vegetable harvester. The root vegetable harvesting machine costs $50,000 new and will have a salvage value of $2,816 in ten years time. Rudy noted that ten-year old machines sell for $2,816 at the present time. The technology of root vegetable harvesters is expected to remain pretty much as it is today; no revolutionary, high tech inventions for vegetable harvesters are on the horizon.

Statement of Assets, Liabilities and Equity for Rudy's Roots as at January 1, xx01 and as at December 31, xx01

BALANCE SHEET:	beginning balance	increases	decreases	market adjustment	ending balance
Cash	500	190,008	190,008		500
accounts receivable		0	0		0
Term deposits		22,618	590		22,028
supply inventory	5,000	5,000	5,000		5,000
product inventory	10,000	10,000	10,000		10,000
TOTAL CURRENT ASSETS	15,500				37,528
Land	200,000	0	0	0	200,000
Buildings	40,000	0	4,000	0	36,000
Machinery	60,000	0	15,000	0	45,000
TOTAL FIXED ASSETS	300,000				281,000
other assets	25,000	0	0	0	25,000
TOTAL OTHER ASSETS	25,000				25,000
TOTAL ASSETS	340,500				343,528
operating loans		59,310	59,310		0
accounts payable		0	0		0
current portion of term loans	12,593	14,104	12,593		14,104
TOTAL CURRENT LIABILITIES	12,593				14,104
Term loans	67,407	0	14,104		53,303
TOTAL TERM LIABILITIES	67,407				53,303
TOTAL LIABILITIES	80,000				67,407
BEGINNING EQUITY	260,500				
Income		130,107			
Expenses			112,087		
Contributions		0			
Withdrawals			12,000		
market adjustments				0	
ENDING EQUITY					266,520
TOTAL LIABILITIES. & EQUITY	340,500				343,528

Question

Refer to the information in the Income Statement and Balance Sheet to complete the missing calculations in the table. Then use the completed table to complete the statement.

Annual Cash Flows for a Root Vegetable Harvester				
Year	Capital Items	Repair Costs	Maintenance & Fuel Cost	Labour Saved
0	50,000			
1		125	5,884	15,000
2		150	5,884	15,000
3		200	5,884	15,000
4		275	5,884	15,000
5		375	5,884	15,000
6		500	5,884	15,000
7		650	5,884	15,000
8		825	5,884	15,000
9		1,025	5,884	15,000
10	2,816	1,250	5,884	15,000
average		( )	( )	( )
midvalue	( )			

Should the investment be made the net capital outlay of $50,000, (i.e. $50,000 - $2,816 = $47,184) will be prorated over the ten-year lifetime of the vegetable harvester, following standard accounting procedures. This amounts to depreciation of $4,718 per year, [i.e. ($50,000 - _____/ 10 = $4,718].

If Rudy's Roots goes ahead with the acquisition it will have an investment of = $_____ at the midpoint.

This is to say that on average over the ten year period we have $_____ tied up in the harvester. This means we have to forgo other uses for these funds. The annual opportunity cost of the investment, at 12% per annum, amounts to

$_____ x 0.12 = $_____

Answer

Compare your work to Rudy's. Correct any errors.

Annual Cash Flows for a Root Vegetable Harvester				
Year	Capital Items	Repair Costs	Maintenance and Fuel Costs	Labour Saved
0	50,000			
1		125	5,884	15,000
2		150	5,884	15,000
3		200	5,884	15,000
4		275	5,884	15,000
5		375	5,884	15,000
6		500	5,884	15,000
7		650	5,884	15,000
8		825	5,884	15,000
9		1,025	5,884	15,000
10	2,816	1,250	5,884	15,000
Average		**538**	**5,884**	**15,000**
mid-value	**26,408**			

Should the investment be made the net capital outlay of $50,000, (i.e. $50,000 - $2,816 = $47,184) will be prorated over the ten year lifetime of the vegetable harvester, following standard accounting procedures. This amounts to depreciation of $4,718 per year, [i.e. ($50,000 - $2,816) / 10 = $4,718].

If Rudy's Roots goes ahead with the acquisition it will have an investment of $26,408 at mid-point, [($50,000 + $2,816) / 2 = $26,408]. This is to say that on average over the ten year period we have $26,408 tied up in the harvester. This means we have to forgo other uses for these funds. The annual opportunity cost of the investment, at 12% per annum, amounts to $3,169, [i.e. $26,408 x 0.12 = $3,169].

Using this approach to calculate costs results in a figure of $7,887, [i.e. $4,718 + $3,169 = $7,887], as the capital cost component associated with the root vegetable harvester. Later we will develop a better method for determining the capital costs.

Question

Complete the missing calculations in the table.

Capital Flows for Rudy's Roots		
Capital Investment	$50,000	
Salvage Value	$2,816	
Net Investment over Ten Years	$( )	
Net Investment per Year (Depreciation)		$4,718
Mid-point Investment (Mid-Value)	$( )	
Opportunity Cost of Capital @ 12%		$( )
Total Capital Cost of Capital		$7,887

Answer

Compare your work to Rudy's. Correct any errors

Capital Flows for Rudy's Roots		
Capital Investment	$50,000	
Salvage Value	$2,816	
Net Investment over Ten Years	**$47,184**	
Net Investment per Year (Depreciation)		$4,718
Mid-point Investment (Mid-Value)	**$26,408**	
Opportunity Cost of Capital @ 12%		**$3,169**
Total Capital Cost of Capital		$7,887

In addition to the capital cost it will cost an average of $538 per year in repair bills; it costs $125 in the first year, $150 in the second, $200 in the third, etc. amounting to $5,375 over the lifetime of the machine or $538 per year, [i.e. $5,375 / 10 = $537.50 or $538 per year]. The annual harvest of 1,000 tonnes of root vegetables per year is expected to remain unchanged. There will be a saving of $15.00 per tonne in labour cost amounting to $15,000 per year. There will be a cost of $5.88 per tonne or $5,884 per year for fuel and machine maintenance.

Average Annual Cash Flows for Rudy's Roots		
Annual Labour Saving		$15,000
Annual Repairs	$538	
Annual Fuel and Maintenance Expenses	$5,884	
Total Annual Operating Expenses		$6,422
Net Annual Cash Saving		$8,578

Is it a Good Investment?

Now the big question; is the acquisition of the root vegetable harvester a good investment for Rudy's Roots? We will examine a number of alternative methods of analysis to answer the question. Phil, the philosopher glanced in the direction of the Bunyan brothers and quietly suggested these methods to be:

- **Urgency**
- **Payback period**
- **Rate of return**
- **Net present value**

Remember, the issue is not whether raising root vegetables is profitable, only whether the change from the labour based approach to mechanical harvesting would be profitable. In this case we are interested only in incremental revenues and costs, i.e. those revenues and costs that result from acquiring the root vegetable harvester.

As we review the four methods we will discover that some of them are obviously inferior, as a matter of fact we discuss the first three methods only to demonstrate their flaws.

The Urgency Approach

Investment decisions are sometimes made in a crisis situation. For example, a machine breaks down during a critical operation when there is no time for thorough analysis before a replacement machine is purchased. This approach is obviously not an ideal to which very many managers would aspire. Nevertheless managers are human and cannot foresee all eventualities. Mistakes and accidents do happen but the urgency approach is the ultimate reactive approach.

As the "Urgency Approach" came under consideration Helga could not hold back a smile. She and Rudy had been in the USA for an international pharmacist's convention and now recalled an urgent situation on the return car trip home. "Do you remember the Montana Urgency, Rudy?" Helga asked. Rudy blushed and then nodded!

Rudy and Helga were motoring along famously, through Colorado, Utah and Idaho. In Idaho Helga sat upright, "What is that squeak? It's the front wheel!"

"Oh that's ok" consoled Rudy, "That's the early warning sign in the front brake pad. It tells us the brake pads need attention. We'll do it as soon as we're home". They motored along to Basin, Montana. Just on the outskirts there was a bang and a skid, then a wobble.

"What was that? Helga cried. "It sounds serious!"

"Brake pads, be darned!" Rudy exclaimed.

"My goodness," Helga echoed, "And it's 5:00 PM on a Friday!"

Basin is a rural ranching community south and west of Montana's capital city, Helena. The folks that live here are friendly and accommodating but rather under equipped to repair wheel bearings on a Friday night. Rudy and the garage proprietor searched the scrap yard for useable parts, but to no avail. Rudy and Helga discovered that Basin was $75.00 USA towing dollars from Helena!

Come Monday morning Rudy set out in an attitude of urgency to invest in a replacement front wheel bearing, spindle and installation labour; the brake pads were fine. By 2:00 PM the Würtzels were on their way; Helga was at the wheel. Rudy's only comment was "Let's keep Phil out of this".

Question

In the case of the contemplated vegetable harvester, suppose Rudy's Roots were to suddenly find itself in the position where there were no labourers available. Perhaps a new opportunity for labourers appeared in another industry and all available workers were attracted to jobs there. What effect would this have on the decision to purchase the root harvester? Select the appropriate response.
A. the harvester is purchased without further analysis.
B. the cost of the harvester must be less than the revenue that will be earned.
C. the labour cost saving must be compared to the revenue to be earned.
D. cost must be compared to revenue so that Rudy's Roots won't be jeopardized.

Answer

A. the harvester is purchased without further analysis.

The vegetables must be harvested and the situation is urgent. Costs and revenues play a secondary place to the immediate need to get things done. Unfortunately, urgency often begets urgency.

The Payback Approach

The payback approach is a quick if superficial way of analyzing investment proposals. It is often quoted when new projects are announced, for example, "The new refinery is expected to pay for itself in four years." What is meant by the announcement? Generally speaking it means that annual net revenue divided into capital outlay will be the designated payback period, here four years.

"Remember a couple of nights ago, just at supper time we had a telemarketer call concerning our telephone service", Rudy recalled. "We could buy a specific unit for a one time cost of $29.95 plus 7.00 % tax. If we did this we would stop paying the monthly rental levy of 5.95 plus 7.00 % tax." "What do you think, Helga? What is the payback period? Is it a good deal?"

Question

Going back to our vegetable harvester, complete the missing calculations in the table then refer to the table to select the appropriate answer in the statement.

Payback Approach for Rudy's Roots		
Capital Investment	$50,000	
Salvage Value	$2,816	
Net Capital Outlay	$	
Annual saving in labour (1000 tonnes at $15 per tonne)		$
Average annual repair cost		$538
Annual harvester repair cost ($5.88 per tonne on 1000 tonnes per year)		$
Annual cash savings	$8,578	
Payback period (years)		

The net capital outlay of the machine is $_____ [$50,000 less $2,816 equals $_____]. The saving in labour is $_____ per year [1,000 tonnes at $15.00 equals $_____ per year]. There is also the $538 average annual repair cost to be taken into account.

The maintenance cost of the machine is $5.88 per tonne, and on 1,000 tonnes per year this amounts to $_____. There is a net investment of $47,184 that generates an average of $8,578 cash annually, [$15,000 – ($538 + $5,884) = $8,578]. Hence the investment is paid back in _____ years [$47,184 / $8,578 = _____ years].

Answer

Compare your work to the table prepared at the Klatch. Correct any errors.

Payback Approach for Rudy's Roots		
Capital Investment	$50,000	
Salvage Value	$2,816	
Net Capital Outlay	$**47,184**	
Annual saving in labour		$**15,000**
Average annual repair cost		$538
Annual harvester repair cost ($5.88 per tonne on 1000 tonnes per year)		$**5,884**
Annual cash savings	$8,578	
Payback period (years)	**5.50**	

The net capital outlay of the machine is $**47,184** [$50,000 less $2,816 equals $**47,184**]. The saving in labour is $**15,000** per year [1,000 tonnes at $15.00 equals $**15,000** per year]. There is also the $538 average annual repair cost to be taken into account. The maintenance cost of the machine is $5.88 per tonne, and on 1,000 tonnes per year this amounts to $**5,884**. There is a net investment of $47,184 that generates an average of $8,578 cash annually, [$15,000 – ($538 + $5,884) = $8,578]. Hence the investment is paid back in **5.50** years [$47,184 / $8,578 = **5.50** years].

Would we accept this as a sound investment? That would depend on the minimum payback period required. If we had a required payback period of say 6.0 years a period of 5.50 years would be acceptable. If the required period were 4.0 years this investment would be rejected.

The payback approach, while simple to use and effective in screening out obvious losers, has some built in difficulties. In the first place there is no way, other than by arbitrary means, to determine what would be a satisfactory payback period. Secondly the method deals only with generating cash to recover the investment of capital. It says nothing about benefits or costs beyond the payback period. In the third place it treats a dollar today as having the same value as one to be received some time off in the future.

Even with shortcomings, the payback method remains as a popular first level guide in preparing a list of priorities. It is easy to understand and easy to compute; it gets the analytical processes going. Sometimes, this is as far as the analysis goes. Obvious winners are taken losers are rejected. There is no need to go further in the analysis. The mistake is not to go on when further examination is needed.

Rate of Return Approach

"Rudy, do you remember when the Hirsch boys invested in exotic deer farming," Helga reminisced. "Yes, I think they went belly up," Rudy added. "Watch your mouth," Helga corrected. "I think the prospectus offered with the deer venture looked very much like the rate of return approach suggested in this manual; I drew up a table with this information, but I can't make much sense out of it!" Rudy offered.

"I checked with our bank manager and he can't make much of it either as a decision tool for the investor, but he would like to think about it a bit more. It might be more useful as a schedule of our ability to repay the loan we might take out to finance the investment," Rudy explained.

I guess, with the book values of assets we have remnants of a balance sheet," Helga observed." "Yes," Rudy noticed, "and sort of an income statement with the profit (or returns) column. Bob said that some analysts use pro forma statements as a way of analyzing investment situations but these prove woefully inadequate." Rudy's mathematical mind spun into action. "On these pro forma statements we have ten rates of return? Which one do we use? An average in this case makes no sense, does it?" "Remember we need at least 12% on our investment to justify acquiring the root vegetable harvester."

	asset book value					
	Beginning	end	net cash	depreciation	profit (ret)	% ret
1	50,000	45,282	8,991	4,718	4,273	8.55%
2	45,282	40,563	8,966	4,718	4,248	9.38%
3	40,563	35,845	8,916	4,718	4,198	10.35%
4	35,845	31,127	8,841	4,718	4,123	11.50%
5	31,127	26,408	8,741	4,718	4,023	12.92%
6	26,408	21,690	8,616	4,718	3,898	14.76%
7	21,690	16,971	8,466	4,718	3,748	17.28%
8	16,971	12,253	8,291	4,718	3,573	21.05%
9	12,253	7,535	8,091	4,718	3,373	27.52%
10	7,535	0	10,682	7,535	3,147	41.77%

Suppose the required rate of return on investment was 12%. Any investment returning this rate or greater would be acceptable. Any investment returning less would be rejected. As it turns out, a sort of average is sometimes used to make a decision in such a situation. Instead of averaging out the percent figures of each individual year the return is calculated on the average situation.

Question

Calculate the missing items in the table and the statement below.

Rate of Return Approach for Rudy's Roots		
Capital Investment	$50,000	
Salvage Value	$2,816	
Average investment	$_____	
Annual cash savings		$8,578
Depreciation		$4,718
Net increase in income	$_____	
Average rate of return	_____%	

The annual net cash saving, as shown in the table would be $8,578, [$15,000 – ($538 + $5,884) = $8,578]. On top of this there would be depreciation of $4,718 for a net increase in income of $_____, [$8,578 – $4,718 = $_____]. This net return would be earned on an average investment of $_____, [($50,000 + $2,816) / 2 = $_____]. Consequently the average rate of return would be _____%, [($3,861 x 100) / $26,408 = _____]. Since the acceptance rate is 12.00% we [would, would not] accept the investment.

Answer

Compare your answers to Rudy's. Correct any errors.

Rate of Return Approach for Rudy's Roots		
Capital Investment	$50,000	
Salvage Value	$2,816	
Average investment	**$26,508**	
Annual cash savings		$8,578
Depreciation		$4,718
Net increase in income	**$3,860**	
Average rate of return	**14.62%**	

The annual net cash saving, as shown in the table would be $8,578, [$15,000 – ($538 + $5,884) = $8,578]. On top of this there would be depreciation of $4,718 for a net increase in income of **$3,860**, [$8,578 – $4,718 = $**3,860**]. This net return would be earned on an average investment of **$26,408**, [($50,000 + $2,816) / 2 = **$26,408**]. Consequently the average rate of return would be **14.62%**, [($3,861 x 100) / $26,408 = **14.6171**]. Since the acceptance rate is 12.00% we **would** accept the investment.

In general terms we can deduce a very useful decision rule from the rate of return approach to deciding on whether to acquire a particular asset or making a specific investment.

A natural extension of the rate of return approach is the partial budget. The following partial budget form illustrates the technique.

In the root vegetable harvester case we would only be concerned with added and reduced expenses. The added expenses take two forms; capital costs which are spread over a number of years, in this case ten, and operating expenses which would occur each year.

The capital costs consist of two components. The first component is the opportunity cost of money tied up in the machine. The second component is the annual loss in value due to depreciation.

The opportunity cost, using the rate of return method, is the percent required rate of return multiplied by the average investment in the asset. Since Rudy's Roots would have an average investment of $26,408, [i.e. ($50,000 + $2,816) /2 = $26,408]. Thus the opportunity cost of capital would be $3,169, [i.e. $26,408 x 0.12 = $3,169]. Depreciation, which is usually calculated on the straight line method when the rate of return approach is used, amounts to $4,718, [i.e. ($50,000 - $2,816) / 10 =$4,718]. Total capital costs associated with the root vegetable harvester are $7,887.

The other component of added expenses is the operating costs. The average annual repair costs are $538 [i.e. ($125 + $150 +$200 + … + $1025 + $1,250) = $5375 / 10 = $537.50]. The average annual maintenance costs are $5,884 [i.e. 1,000 tonnes @ $5.88 per tonne = $5,884]. Total added operating expenses are then $6,422.

Reduced expenses in this example are of an operating nature. If the machine is purchased the $15,000 labour cost (i.e. 1,000 tonnes @ $15.00 per tonne) will no longer be incurred.

Total disadvantages of the acquisition amount to $14,309 [i.e. ($3,169 + $4,718) + $538 + $5,884) = $14,309]. Total advantages are $15,000. There is a net advantage of $691 so the decision would be to acquire the vegetable harvester barring financing concerns. The results are summarized in the partial budgeting form.

The rate of return approach might be considered an improvement on the payback method because it does deal with the revenue and expenses over the lifetime of the investment.

It too ignores the time value of money, and for this reason systematically biases the answer; it has a built-in bias towards understating the capital costs.

It is perhaps an even more inappropriate method than the payback method because it gives the illusion of greater rigour.

Obviously, if the advantages outweigh the disadvantages by a considerable margin (or vice versa) the method will lead to the same (correct) decision as a superior unbiased method. But there is the ever-present danger of accepting unprofitable investments because of the biased analysis emanating from an understatement of capital costs.

The Net Present Value Approach

The net present value approach attempts to overcome the deficiencies of the two previous methods, the payback method and the rate of return method. The time value of money is explicitly considered as a part of the method. This allows us to allow for inflation, risk and income taxes.

The Undiscounted Cash Flows					
Time	Capital	Repair	Maintenance	Labour	Total
0	-50,000	0	0	0	-50,000
1		-125	-5,884	15,000	8,991
2		-150	-5,884	15,000	8,966
3		-200	-5,884	15,000	8,916
4		-275	-5,884	15,000	8,841
5		-375	-5,884	15,000	8,741
6		-500	-5,884	15,000	8,616
7		-650	-5,884	15,000	8,466
8		-825	-5,884	15,000	8,291
9		-1,025	-5,884	15,000	8,091
10	2,816	-1,250	-5,884	15,000	10,682

Because timing is such a critical part of investment analysis we need to begin the evaluation by organizing the information relative to the time line as in the table. Each component is listed at the end of the year (time period) in which it occurs.

The Cash Flows

The initial outlay of capital (the purchase of the root vegetable harvester in this case) occurs at the start of the process, at the start of year 1 which is the end of year 0. The salvage value represents an inflow of $2,816 at the end of year 10. Repairs are outflows of cash at the end of each year from year one through ten as are fuel and maintenance costs. The saving in labour expense is treated as an inflow of $15,000 at the end of each year. The table shows the flows of cash occurring at the end of each year.

Once the cash flows have been established they must be expressed in present value terms.

Present Values

Present value refers to the notion that a dollar in hand today is worth more than a dollar to be received a year from now. Suppose you are able to invest money at 12.0%, a rate selected arbitrarily for the moment, and you are given the choice of receiving $89.29 right now or $100.00 in one year. Which option would you choose? If you were to invest the $89.29 at 12.0% for one year you would earn $10.71, (i.e. 89.29 x 0.12 = 10.71). The total value would be $100.00, (i.e. 89.29 + 10.71 = 100.00). Consequently the two options would be equivalent. You would be indifferent between receiving $89.29 today or $100.00 in a year. The amount $89.29 is therefore said to be the present value of $100.00 to be received in one year with money worth 12.0%.

Term Deposit Statement			
Date	Beginning Balance	Interest Earned	Ending Balance
Year 1	79.72	9.57	89.29
Year 2	89.29	10.71	100.00

If you were given the choice of taking $79.72 today or waiting for two years to receive $100.00, which would you choose? Again money is worth 12.0%. The $79.72 would earn $9.57 in the first year so you would have $89.29 going into the second year. This $89.29 would earn $10.71 so that at the end of two rears you would have exactly $100.00. Consequently the present value of $100.00 to be received in two years at 12.0% per annum is $79.72.

Stated another way, a dollar tomorrow is worth less than a dollar today. Consequently we can calculate the present value of one dollar directly as shown in the table.

Present Value of One Dollar for Selected Years		
End of Year	Present Value	Calculation
1	0.8929	1.00 / (1.12)
2	0.7972	1.00 / (1.12 x 1.12) = 1.00 / (1.12^2)
3	0.7118	1.00 / (1.12^3)
4	0.6355	1.00 / (1.12^4)
5	0.5674	1.00 / (1.12^5)

Discounted Cash Flows

In the table below all values for the root vegetable harvester have been converted to their present values using a discount rate of 12.0%.

Discounted Cash Flows						
Time	Factor	Capital	Repair	Maintenance	Labour	Total
0	1.0000	-50,000	0	0	0	-50,000
1	0.8929	0	-112	-5,254	13,393	8,028
2	0.7972	0	-120	-4,691	11,958	7,148
3	0.7118	0	-142	-4,188	10,677	6,346
4	0.6355	0	-175	-3,739	9,533	5,619
5	0.5674	0	-213	-3,339	8,511	4,960
6	0.5066	0	-253	-2,981	7,599	4,365
7	0.4523	0	-294	-2,662	6,785	3,830
8	0.4039	0	-333	-2,376	6,058	3,349
9	0.3606	0	-370	-2,122	5,409	2,918
10	0.3220	907	-402	-1,894	4,830	3,439
NPV		-49,093	-2,414	-33,246	84,753	0

To illustrate the idea behind present values suppose we have been promised $2,500 one year from today and another $1,500 in two years. It would be incorrect to say that we are promised $4,000, [i.e. $2,500 + $1,500 = $4,000]; in fact the value of the promise in total is worth only $3,428. The $2,500 component is worth $2,232, [i.e. $2,500 x 0.8929 = $2,232], whereas the $1,500 component is worth $1,196, [i.e. $1,500 x 0.7972], for a total of $3,428.

"OK Rudy, enough diversion," Helga interjected. "Let's get back to the vegetable harvester." The capital outlay of $50,000 occurs right at the start [i.e. today or year zero] and is therefore already in present value terms, [i.e. its present value is $50,000]. This is to say that $1.00 today is worth $1.00 therefore the discount factor is 1.0000. On the other hand $1.00 to be received one year from today is worth only $0.8929. As we have mentioned, Rudy and Helga could invest $0.8929 at 12.0% for one year and have exactly $1.00 (0.8929 x 1.12 = 1.0000). The discount factor for year 1 is therefore 0.8929.

Question

Use the discount factor to calculate the missing items in the following statement. Consequently the $5,884 to be paid out for repairs and maintenance at the end of year 1 is only worth [$ _____] today ($5,884 x 0.8929 = [$ _____]). Similarly, the $15,000 labour saved at the end of the year is worth only [$ _____]. The total operating cash flow for year one, in present value terms, is [$ _____], (– ($112 + $5,254) + $13,393 = [$ _____]).

Just as an aside, you would never add a Canadian Dollar to a US Dollar, before conversion, and say you had two dollars. It is extremely important to convert monetary amounts to their present value equivalents before adding them up over time. To prove that yourself, get the conversion rate for the USD on any given date then do the conversion. Notice the difference before and after conversion.

Answer

Compare your work to Rudy's. Correct any errors.

Consequently the $5,884 to be paid out for repairs and maintenance at the end of year 1 is only worth $**5,254** today ($5,884 x 0.8929 = $**5,254**). Similarly, the $15,000 labour saved at the end of the year is worth only $**13,393**. The total operating cash flow for year one, in present value terms, is $**8,028**, [– ($112 + $5,254) + $13,393 = $**8,028**].

The discount factors for the end of each year are given in the table under the column headed 'factor.' The discounted cash flows for each item are also shown. They have been calculated by multiplying each undiscounted cash flow item in the undiscounted table by the appropriate discount factor.

The decision rule for accepting or rejecting a proposed investment relates directly to the net present value. The net present value is the sum of the present values for each of the years. In this case net present value is exactly zero.

"Well, except for any rounding errors," Phil quipped. The Bunyan Boys glared.

If the net present value is less than zero, the investment is to be rejected. A positive net present value means that the investment pays better than the opportunity cost of capital and should be accepted. The root vegetable harvester has a zero net present value and we should recommend to Rudy and Helga that they take on the investment; Rudy's Roots would be as well off purchasing the machine as hiring the labour.

Decision Rule: Choose only those investments with an expected net present value of zero or greater.

The same result can be obtained from the last row of the table. The initial capital outlay is -$50,000. Of this amount $2,816 is recovered as a salvage value at the end of year ten. The present value of $2,816 ten years away is $907, [$2,816 x 0.3220 = $907], hence the net capital outlay is -$49,093, [-$50,000 + $907 = -$49,093].

Operating cash flows consist of repairs, maintenance and labour saved. The total present value of repairs over the project lifetime is -$2,414. Maintenance expenses have a total present value of -$33,246. Labour saved amounts to $84,753 in present value terms. The net present value from the perspective of the components is -$0, [-$49,093 – $2,414 – $33,246 + $84,753 = -$0]. The result is, of course, exactly as before when we added up the cash flows year by year.

Annualized Net Present Values

In some instances the result is more easily understood if expressed on an annual basis. Expressing the result on an annual basis is more involved than simply dividing the net present value by the number of years. For example it would be wrong to conclude that the annual value of the net capital outlay for the machine itself, [$49,093] is simply $4,909, [$49,093 / 10 = $4,909].

To express the result on an annual basis correctly requires that the averages be calculated on a time-weighted basis. If effect we are asking the question, what uniform annual cash flow would be needed to obtain the same total net present value as was obtained from the non uniform pattern we actually encountered. The answer to this question would be the proper average. To answer the question we will look at the notion of paying off a debt in uniform payments of principal and interest.

Amortization Table @ 12% per annum	
Years	Factor
1	1.1200
2	0.5917
3	0.4163
4	0.3292
5	0.2774
6	0.2432
7	0.2191
8	0.2013
9	0.1877
10	0.1770

"OK, it's starting to make sense," Rudy observed. Suppose we were owed $100. If the interest rate were 12%, what annual amount would our debtor need to pay us at the end of each of six years to retire the debt? We can find the answer in a standard amortization table and in the formula for its calculation as found in the appendix. An abbreviated amortization table for 12% is reproduced here.

That an annual payment of $24.32, [$100 x 0.2432 = $24.32], at the end of each year for six years will discharge a debt of $100 at 12% can be seen from the repayment schedule.

We know from previous discussion that the sum of repair expenses over the lifetime of the harvester has a present value of $2,414. How much is this on an annual basis? We could think of it as an upfront lump sum investment in the business of $2,414. We then ask the question, how much would we have to invest at the end of each year to achieve the same result? In effect we would amortize this amount over ten years because this is the length of time we would be keeping the root vegetable harvester.

Repayment Schedule for $100 at 12% over Six Years					
	Beginning Balance	Total Payment	Interest Payment	Principal Payment	Ending Balance
1	100.00	24.32	12.00	12.32	87.68
2	87.68	24.32	10.52	13.80	73.88
3	73.88	24.32	8.87	15.46	58.42
4	58.42	24.32	7.01	17.31	41.11
5	41.11	24.32	4.93	19.39	21.72
6	21.72	24.32	2.61	21.72	0.00

Question

Refer to the tables to complete the calculations in the statement.

The amortization table tells us that at a rate of 12.0% we would be indifferent to accepting $1.00 today or $0.1770 at the end of each year for ten years. It tells us that we would be equally satisfied to spend $2,414 today or [$ _____] at the end of each of the next six years, ($2,414 x 0.1770 = [$ _____]).

Answer

Compare your answer to Rudy's. Correct any errors.
The amortization table tells us that at a rate of 12.0% we would be indifferent to accepting $1.00 today or $0.1770 at the end of each year for ten years. It tells us that we would be equally satisfied to spend $2,414 today or $**427** at the end of each of the next six years, [$2,414 x 0.1770 = $**427**].

We might also use the amortization formula. It gives much greater precision than is possible in a table. As a matter of fact, the tables have been calculated from the formula.

$$A = \left[\frac{i(1+i)^n}{(1+i)^n - 1} \right]$$

"A" represents the amortization factor, "i" the interest or discount rate and "n" the number of periods (normally years).

In the present case we have $i = 0.12$ and $n = 10$ so we can calculate A.

$$0.1769842 = \left[\frac{0.12(1+0.12)^{10}}{(1+0.12)^{10} - 1} \right] = 0.1770$$

So, what is the annual cost of a net capital outlay of $49,093? This net capital outlay represents a present value of -$49,093 in that we put out $50,000 today and recover a present value of $907 after ten years. If we apply the same reasoning as we did for the $100.00 loan over six years this is the annual equivalent, over ten years, of -$8,689, [i.e. -$49,093 x 0.1770 = -$8,689].

Discounted Cash Flows						
Time	Factor	Capital	Repair	Maintenance	Labour	Total
0	1.0000	-50,000	0	0	0	-50,000
1	0.8929	0	-112	-5,254	13,393	8,028
2	0.7972	0	-120	-4,691	11,958	7,148
3	0.7118	0	-142	-4,188	10,677	6,346
4	0.6355	0	-175	-3,739	9,533	5,619
5	0.5674	0	-213	-3,339	8,511	4,960
6	0.5066	0	-253	-2,981	7,599	4,365
7	0.4523	0	-294	-2,662	6,785	3,830
8	0.4039	0	-333	-2,376	6,058	3,349
9	0.3606	0	-370	-2,122	5,409	2,918
10	0.3220	907	-402	-1,894	4,830	3,439
NPV		-49,093	-2,414	-33,246	84,753	0
annuity factor		0.1770	0.1770	0.1770	0.1770	0.1770
ANPV		-8,689	-427	-5,884	15,000	0

The annual equivalent for repairs is -$427. We obtain this result by multiplying the NPV of -$2,414 by the annuity factor of 0.1770, [-$427 = -$2,414 x 0.1770 = -$427]. Notice that the amortized value for maintenance expenses is $5,884. Recall that there was a uniform amount of $5,884 incurred each year, a result that seems intuitive. The same argument follows for the annual labour savings of $15,000. The Annualized Net Present Values [ANPV] are shown as the last row of the table. The ANPV for the root vegetable project is zero suggesting again that Rudy's Roots would be justified in making the investment.

The AIM Process

For convenience we can place these amounts into a standardized format for budgeting purposes. This format is often called a partial budget because it is limited to only a part of an ongoing operation. It is simply a net present value analysis expressed on an annual basis. For this reason, we are calling this partial budget form the AIM (short for Annualized Incremental Method). The AIM for the root vegetable harvester is presented below.

<table>
<tr><td colspan="2">Annualized Incremental Method (AIM) Form</td></tr>
<tr><td colspan="2">Will it pay? Since the Net Disadvantage is $0, the project should be accepted.</td></tr>
<tr><td>Added Expense:
Capital Cost of Harvester
Opportunity Cost @12% $8,689
Operating Expenses
Repairs $427
Maintenance $5,884</td><td>Added Revenue:
nil</td></tr>
<tr><td>Reduced Revenue:
Nil</td><td>Reduced Expense:
Labour Saved $15,000</td></tr>
<tr><td>Total Economic Disadvantage: $15,000</td><td>Total Economic Advantage: $15,000</td></tr>
<tr><td>Net Disadvantage: $0</td><td></td></tr>
</table>

The partial budget, properly constructed, [that is, by obeying the rules associated with the time value of money and the concepts of net present value], brings us not only to the same conclusion as net present value analysis, it provides us with exactly the same numbers. The partial budget when properly constructed is simply a net present value analysis expressed on an annualized basis.

Conclusions

We examined four methods of analyzing investment decisions.

1. The urgency method:

This method was discarded because of its inadequacy in light of the seriousness of the situation. A contemplated investment of $50,000 requires a more serious approach; effective managers don't, or at least shouldn't, get themselves into such urgent or reactive situations that an urgent response is the only option.

2. The payback method:

This method treats the asset acquisition question as a short run cash flow situation. It asks, "When can I get my money back if I invest in this project?" We judged this method as inferior because it does not recognize the time value of money and because there are no real standards for acceptance or rejection.

3. The rate of return method:

This method is rooted in accounting methodology. It ignores the time value of money, and despite its apparent rigour it contains systematic biases. Because of these biases we rejected the approach.

4. The net present value method:

We extol the virtues of this method because it correctly recognizes that a dollar today is worth more than a dollar tomorrow. Furthermore, despite its initial look of complexity, it is derived from a rather simple logic. The logical but simple base allows for easy incorporation of inflation, risk and tax issues.

We dismissed the first three methods for a variety of reasons but mainly that they ignore the time value of money. We completed a rudimentary net present value analysis for acquiring the root vegetable harvester. In doing the analysis, however, we ignored a number of key issues.

We have not devoted sufficient care to choosing the discount rate; the rates we have used have been rather arbitrary.

We have taken the cash flows as simply given, when in fact considerable effort must be invested in making sure these represent the situation truly and fairly.

We have said nothing about the possibility of inflation.

We have ignored the possibility that the cash flows we predicted in our analysis might not materialize, i.e. error in our cash flow estimates is not accounted for.

Finally we have said nothing about income taxes.

Each of these topics, the discount rate, the cash flows, inflation, risk and taxes must be addressed before Rudy and Helga, owners and managers of Rudy's Roots, will be confident in deciding on whether or not to acquire the root vegetable harvester.

About the Authors

Leonard Bauer

Len Bauer joined the University of Alberta in 1977 to assume research and teaching duties in agricultural business management, finance, and production economics. He was instrumental in creating the Agricultural Business Management Program at the University and was its first director.

He was guest professor at the University of Hohenheim in West Germany and guest lecturer at FINAFRICA in Milan, Italy, and at Curtin University of Technology in Perth, Australia. In 1995 he was workshop leader for agricultural economics instructors in Ukraine.

After retiring in 1996, Len continued developing instructional materials in Agricultural Business Management. Len, the Professor Emeritus of Agricultural Business Management in the Department of Rural Economy was dedicated to stamping out ignorance – wherever it was found. This set 'Agricultural Investment Analysis' was virtually complete prior to his death in 2004.

Don Bushe

Don Bushe is a consultant, writer, teacher, and designer of interactive instructional materials. His products and publications have received recognition from the European Broadcasting Union, Ohio State Awards of Excellence, National Educational Broadcasters' Association, and the Japan Prize. Pipeline operators from Rio de Janeiro to Norman Wells have benefited from the training curriculum he analyzed and designed. His interactive DVD display systems operate in museums from the Royal Tyrrell to Arviat in Nunavut. He is most proud of his role in assisting college instructors and university faculty in Ukraine as they struggled to re-define their economics curriculum in the post-soviet era.

Don and Len have developed a number of self-instruction modules in farm management for the University of Alberta, Faculty of Extension. Together, they prepared what has become the standard textbook for agricultural economics in Ukraine. Their work has been reviewed and checked by Len's colleagues and former students.

About the Collaborating Reviewers

Ted Darling

Ted Darling has been with Alberta Agriculture, Food and Rural Development since the mid-1970's, first as District Agriculturist and later as Farm Management Specialist. In 1990 he returned to the U of A for a Masters degree in Ag. Economics and he is currently an Agricultural Risk Specialist for the department based in Airdrie. Ted's interests lie in the area of individual firm management, and include risk, strategic planning, and innovative business arrangements.

Dean Dyck

Dean is the Financial Business Analyst - New Ventures with Alberta Agriculture, Food and Rural Development. Dean graduated with a Bachelor of Science in Agriculture in 1982 from the University of Saskatchewan with a major in Agricultural Economics. He has over 20 years of experience in farm business management, including positions as a Production Economist and Farm Management Agrologist with Saskatchewan Agriculture, and Farm Management Specialist with Alberta Agriculture. Dean's main interest is in financial, economic and risk analysis and production costs for new agricultural ventures.

Dale A. Kaliel

Dale's life is firmly rooted in agriculture. Hearkening from a mixed farm in northern Alberta, Dale received his B.Sc. Agric. (Animal Science) in 1977 followed by a M. Sc. Agric. (Ag. Econ.) in 1982 under the tutelage of Dr. Len Bauer. He has worked with Alberta Agriculture, Food and Rural Development in a number of capacities since 1980 advancing to his current position of Sr. Economist: Production Economics.

The focus of Dale's career has revolved around creating economics, financial and business management information for Alberta producers and then striving to take them to the next, critical step ... showing them how to utilize their own "on-farm" information, applying fundamental economics principles and procedures, to make better business management decisions.

Frank Novak

Born and raised in Southern Alberta, Frank obtained his B. Sc. in Ag, and M. Sc. in Ag. Economics from the University of Alberta. Len Bauer was his advisor and mentor who urged him to continue to complete his Ph. D. in Ag. Econ. at the University of Illinois specializing in agricultural finance, farm management, and risk management. Frank taught at the U of A’s Department of Rural Economy from 1989 to 1999. He was a founding partner of Alberta Pig Company in 1995 and left the U of A to work full time in the industry in 1999. He is currently the managing director of Alberta Pig Company.

Brian Radke

Following graduation from the Western College of Veterinary Medicine in 1989, Brian practiced large animal medicine for 5 years, first in Ontario and then in BC’s Fraser Valley. He completed a Ph.D. in Agricultural Economics at Michigan State University in 1998. Brian is currently a Research Economist in the Economics and Competitiveness Division of Alberta Agriculture, Food and Rural Development, and previously held the position of Dairy Cattle Research Veterinarian with the Animal Industry Division. He is also an Adjunct Professor in the Department of Rural Economy, University of Alberta.