

*Managing the Modern Farm Business:
Agricultural Investment Analysis*

Take AIM
The Annualized Incremental Method

Module 2
Preparing Investment Data for Analysis

*Leonard Bauer
and
Don Bushe*

Faculty of Extension
University of Alberta

Special Funding from
Alberta Agriculture, Food
and Rural Development

Copyright © 2005
University of Alberta
Faculty of Extension
Edmonton, Alberta T6G 2T4

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without prior permission of the copyright owners.

Managing the Modern Farm Business
Agricultural Investment Analysis

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

Technical Editor

Leonard Bauer

Instructional Designer

Don Bushe

Technical Reviewer

Frank Novak

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

NET PRESENT VALUE

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.

Purpose and Organization of these Modules

The purpose of this set of modules is to focus attention on the above financial management topics, i.e. 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 technical piece as are detailed explanations of issues thought too complex for the main modules.

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 advisory professionals, government agents, bankers and accountants, and we refer the reader to those sources.

Preparing Investment Data for Analysis

In this module we examine more advanced 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 and only if 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 it costs to acquire it.

In determining whether a particular asset is worthwhile we must deal with a number of related issues. Discount Rate, Cash Flow, and Inflation are all factors to be considered.

- **Discount Rate** or the ‘time value’ of money is the foundation of investment analysis.
- **Cash Flow Estimates:** considerable time and effort must be taken to ensure that the cash flows that are projected are both accurate and relevant.
- **Inflation** or the changing purchasing power of money over time must be considered.

The Asset Acquisition Case

An opportunity exists for Rudy and Helga, owner managers of Rudy’s Roots to replace seasonal labour with a mechanical root vegetable harvester. Both Rudy and Helga have professional backgrounds. Helga is an accountant employed by a local manufacturing company. Rudy has recently retired from his position as a high school math teacher; he is thus able to devote more of his time to managing Rudy’s Roots. In this module attention is paid to the advanced topics of inflation, taxes and risk.

Objectives

In the previous module we completed the net present value analysis of the contemplated root vegetable harvester acquisition. In doing this analysis, however, we have ignored a number of key issues.

When you have completed your studies, you will be able to:

- Determine the appropriate discount rate for each situation
- Project the cash flows that represent the situation truly and fairly.
- Estimate the effect of inflation.
- Compensate for risk by adding a risk premium to the discount rate
- Verify the accuracy and appropriateness of multi-year cash flows

Each of these topics (discount rate, cash flows, risk, and inflation) must be addressed before we are ready to advise Rudy’s Roots on whether or not to acquire the root vegetable harvester.

Table of Contents

Table of Contents.....	1
The Discount Rate.....	2
Adding a Risk Premium.....	4
The Cash Flows.....	5
Accuracy in Estimating Cash Flows.....	7
Operating Items.....	9
Correcting for Inflation.....	11
Nominal vs. Real Discount Rates.....	11
Nominal vs. Real Cash Flows.....	12
Discounted Cash Flows.....	14
Conclusion.....	19
About the Authors.....	20
About the Collaborating Reviewers.....	20

The Discount Rate

Why does time have value? What do we mean by the ‘time value of money?’ Why is a dollar today worth more than a dollar in a year’s time? Answers to these questions underlie the basis of the discount rate.

If you had the dollar today you could consume it. If you have to wait you have to withhold consumption until you receive it next year. You must be promised more than one dollar in a year’s time to compel you to wait.

Suppose the promise was in the form of a one thousand dollar (\$1,000) government bond paying 7% making the situation virtually riskless; you are guaranteed your original principal plus interest. If you bought this bond you would be saying, “I’m indifferent between spending \$1,000 today on consumption, say a holiday trip, or delaying my spending for a year when I will have \$1,070.” You have declared your ‘time preference for money’. In a risk-less situation you can say: “I will postpone consumption for a year if I am compensated by 7%.”

Suppose that, although the situation is essentially risk-less, price levels in the economy are subject to change. Now, the \$1,070 you are to receive might not buy as much as you expect in a year’s time because of inflation. Ideally you want to be compensated for postponing consumption [your holiday trip for example] and you want your money to go as far in a year’s time as today.

From published information you have been informed that inflation in the economy is expected to run at 5%. From the \$70 earned you will receive \$50 to preserve your purchasing power plus \$20 as compensation for waiting. The interest rate of 7% can be broken into its three components. These are:

- the market or nominal rate
- the real rate and
- the inflation rate

These can be determined by examining the available information. In this case, the market rate is 7%. That is the rate at which the government is selling its bond. This market rate is usually called the ‘nominal rate.’

Next, we check with Statistics Canada (by such measures as the Consumer Price Index or CPI) to find that the inflation rate is 5%.

Now, the question is to find out what the ‘real rate’ is for the pure time value of money? In this case the relationship is to deflate the nominal rate to its real counterpart. Dividing the nominal rate by the inflation rate gives a real rate of 1.019. [that is, $1.07 / 1.05 = 1.019$]. This means the real rate is 1.905%. We call this the real riskless discount rate.

The distribution of earnings is shown in the table.

Question

Refer to the information in the table to complete the statement.

Distribution of Government Bond Earnings	
Original principal	1000.00
Compensation for inflation on principal	50.00
Interest earned	19.05
Compensation inflation on interest	0.95
Total received in one year's time	1070.00

The real rate is (_____). The nominal rate is (_____). And the rate of return is (_____).

Answer

Compare your answers to that given below. Correct any errors.

The real rate is (1.019%). The nominal rate is (7%). And the rate of return is (7%).

Adding a Risk Premium

In examining the root vegetable harvester case further we need to ask the question, “Would we be willing to invest \$50,000 into this venture to be compensated at the 7% government bond rate?” The probable answer would be, “not likely!” The government bond was riskless except for inflation. The harvester case has risk involved. Wages might rise or fall beyond our expectations. More repairs than anticipated might be needed. In short there is business risk. In making the harvester investment Rudy’s Roots Farms would like some compensation for the risk involved. One way of doing this is to add a ‘risk premium’ to the discount rate.

In the government bond example we were willing to take 7%. The real return adequately compensated us for delaying consumption and our purchasing power was preserved. There was no risk of default by the government so the investment was virtually riskless. What if we were to invest in a well-diversified mutual fund? Would we do this for a promise of 7%? Likely not! We would be exposed to the risk of market fluctuations, even to the point of losing our original investment. The return expected for a riskless investment would be insufficient; we need compensation for the risk exposure.

Suppose a well-diversified mutual fund was offered by a reputable investment dealer. The fund tracked a major stock index (the TSX or the Dow Jones Industrials, for example) and was expected to return 12%. There is risk involved in this investment but because of its diversified nature and its reputation in a broadly traded securities market, the risk is manageable. This mutual fund is expected to return 5 percentage points above the risk free government bond. The 5 percentage points are the ‘risk premium’ needed to persuade reasonable investors to place their funds into the stock market.

The Cash Flows

Considerable time and effort may be needed to make sure that cash flows are both accurate and relevant. In the first place remember we are making projections and whenever we make projections into the future the best we can do is make estimates; the future is unknown to us. Secondly we must make sure to include all of the cash flow items, and only those cash flow items, that apply to the situation.

Summary of Cash Flows				
Time	Capital Items	Repair Costs	Maintenance Costs	Labour Costs
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

Rudy, on behalf of Rudy's Roots has summarized the flows but let's dig into the figures a bit further.

Rudy prepared the table after doing considerable research. Helga had already obtained much of the information directly from machine dealers; however some was found in local farm papers and on the internet as well. Rudy soon agreed with Helga that there was a shortage of information for particular years. This meant that inflation was an issue he needed to deal with.

He was able to find inflation information on Statistics Canada's website. He summarized the past decade of price indices into the following table. This provided him with both the consumer price index and the rate of inflation needed to evaluate the cash flow information.

The Consumer Price Index or CPI is a measure of the value of a basket of consumer goods; it measures a base year, in this case 'this year,' to any one of 'other years' in the past. The base year has an index of 100. This is interpreted to mean that the basket we can buy for \$100.00 today could have been bought for \$95.89 last year. The same basket could have been bought for \$80.09 five years ago. Stated another way, a basket costing \$100.00 five years ago would cost \$124.86.

This would be calculated in the following manner.

$$\$124.86 = 100 \times \frac{\$100.00}{\$80.09}$$

The rate of inflation is measured by the change in the index from one year to the next. For example, five years ago the CPI was 80.09 while four years ago it was 83.54. The rate of change over the period is 4.31%, calculated in the following manner.

$$4.31\% = 100 \times \frac{(83.54 - 80.09)}{80.09}$$

Question

Helga was interested in the average rate of inflation over the eleven-year period, [this year plus the ten years past]. She put each of the figures that had been calculated into a table along with the related CPI and calculated the remaining inflation rates. Then she calculated the average in the usual way for arithmetic averages.

Consumer Price Indices and Inflation		
	CPI	Rate of Inflation
Eleven years ago	58.62	
Ten years ago	65.24	
Nine years ago	68.91	
Eight years ago	71.88	
Seven years ago	74.68	
Six years ago	77.89	
Five years ago	80.09	
Four years ago	83.54	4.31%
Three years ago	88.61	6.07%
Two years ago	90.36	1.97%
Last year	95.89	6.12%
This year	100.00	4.29%
Sum		
Average		

Complete the missing information in the table. Then complete the statement.

From her calculations, Helga could see that the average rate of inflation over the past decade was [_____].

Answer

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

Consumer Price Indices and Inflation		
	CPI	Rate of Inflation
Eleven years ago	58.62	
Ten years ago	65.24	11.29%
Nine years ago	68.91	5.63%
Eight years ago	71.88	4.31%
Seven years ago	74.68	3.90%
Six years ago	77.89	4.30%
Five years ago	80.09	2.82%
Four years ago	83.54	4.31%
Three years ago	88.61	6.07%
Two years ago	90.36	1.97%
Last year	95.89	6.12%
This year	100.00	4.29%
Sum		55.00%
Average		5.00%

From her calculations, Helga could see that the average rate of inflation over the past decade was [**5.0%**].

The average is an important ingredient in forming expectations about future rates of inflation.

Accuracy in Estimating Cash Flows

Rudy has identified four categories of cash flows;

- capital items,
- repair costs,
- maintenance costs and
- labour savings

An important rule in ensuring accuracy is to use expected values rather than extreme values. Let's examine the cash flow items in turn.

Capital Items

The capital items in this situation come in two parts. First there is the initial investment of \$50,000. Secondly there is the terminal value of the machine. The initial investment would be negotiated by Rudy and Helga, and therefore is a number known with complete certainty; unfortunately the terminal value is not so easily obtained.

Rudy has done a survey of used root vegetable harvesters sold over the past three years. The information he found is shown in the table. From the rough work, Rudy determined that the average price is \$2,685. Helga thinks that more analysis is warranted. She has some misgivings about the numbers because some, although accurate enough, are a bit dated.

Ten Year-Old Harvester Sales	
Date of Sale	Nominal Price
Two years ago	2,536
Two years ago	2,523
Last year	2,634
This year	2,897
This year	2,836
Sum	13,426
Average	2,685

What can be done to improve the quality of these data? The prices in the table are nominal numbers. This means that they are expressed in the ‘dollars of the day’ in which they were sold. As Rudy and Helga both know, today a dollar doesn’t buy as much as it did three years ago. In fact it took only \$90.36 two years ago to buy the basket of consumer goods that costs \$100.00 today.

Rudy proceeded to convert the nominal prices to their real counterparts. He determined that the machine selling for \$2,536 two years ago is worth \$2,807 in current dollars, [$100 \times \$2,536 / 90.36 = \$2,807$]. Noting the difference that this made, he added two columns to the table. In one column he listed the CPI figures for each of the past two years and proceeded to calculate the real prices.

Question

The remaining values in the table were calculated in the same manner. Finish the calculations and place the results in the table. Then refer to the information in the table to complete the statement.

Sale Values of Ten-Year Old Harvesters			
Date of Sale	Nominal Price	CPI	Real Price
Two years ago	2,536	90.36	2,807
Two years ago	2,523	90.36	
Last year	2,634	95.89	
This year	2,897	100.00	
This year	2,836	100.00	
Sum	13,426		
Average	2,685		

Once Rudy did the conversions he was readily able to determine the average of the five sales observations was [_____].

Answer

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

Sale Value of Ten-Year Old Harvesters			
Date of Sale	Nominal Price	CPI	Real Price
Two years ago	2,536	90.36	2,807
Two years ago	2,523	90.36	2,792
Last year	2,634	95.89	2,747
This year	2,897	100.00	2,897
This year	2,836	100.00	2,836
Sum	13,426		14,079
Average	2,685		2,816

Once Rudy did the conversions he was readily able to determine the average of the five sales observations was [**\$2,816**].

Helga was in agreement with the result. In fact she offered to tackle the operating cash flows.

Operating Items

The major advantage of acquiring the root vegetable harvester is the potential saving in labour expenses estimated to be \$15,000 per year. Rudy and Helga are well aware that this annual saving needs to be verified. To do this Helga examined the annual size of the harvest; she searched their records on the number of tonnes harvested. The result of her effort is shown in the table.

Annual Root Vegetable Tonnes Harvested		
Year	Tonnes	Hours
Four years ago	1080	3,240
Three years ago	960	2,880
Two years ago	920	2,760
Last year	1050	3,150
This year	990	2,970
Sum	5,000	15,000
Average	1000	3000

A good place to begin in estimating cash flows is to examine the underlying physical quantities, e.g. hours, tonnes, acres, etc. This enables the one making the projections to verify estimates as to reasonableness. Helga began with the number of tonnes harvested and the amount of labour required to do so. Her method of payment was based on the number of tonnes harvested multiplied by a standard three hours per tonne. It was a piece-work system; if the labourer was able to work faster, he or she would receive the benefit.

The wage rate was set according to the prevailing neighbourhood employment situation. In some years rates were higher than in others because of competition from other industries in the local community. Rudy's Roots liked to pay just a little above the going rate to get good helpers from the summer labour pool. The wage rates are in the table. As with the cash flow estimates for the terminal value, Helga noted that the wage rates ran through time. This immediately alerted her to the need for converting nominal wage rates to their real counterparts. She already had the needed CPI information.

Historic Community Hourly Wage Rates			
Year	Nominal Wage	CPI	Real Wage
Four years ago	4.65	83.54	5.57
Three years ago	3.95	88.61	4.46
Two years ago	4.00	90.36	4.43
Last year	5.10	95.89	5.32
This year	5.25	100.00	5.25
Sum	22.95		25.02
Average	4.59		5.00

A real wage rate of \$5.00 per hour seemed reasonable to Helga so she proceeded with this figure as a projection into the future. Accordingly she verified that \$15,000, [1,000 tonnes x 3 hours per tonne x \$5.00 per hour = \$15,000], as a saving per year in labour expenses is reasonable. She worked on the remaining expense elements in the cash flow estimates with her characteristic enthusiasm and vigour.

Correcting for Inflation

We have now introduced the notion of inflation into the discount rate. The task of adjusting the net present value analysis remains to be done. Expressing the net present value analysis correctly requires a number of adjustments. Specifically we need to make sure that if the cash flows are in real terms, i.e. with inflation removed, then we must also use a real discount rate. On the other hand, if we use nominal cash flows we must also use nominal discount rates.

Nominal vs. Real Discount Rates

In the absence of risk and income taxes an investor would expect to be compensated for two things: for the fact that he or she would need to wait to receive the earnings from the investment and for the fact that the purchasing power of the dollar might erode over the period of waiting. Suppose, for the moment, that the market rate of interest is 12% and that the expectation of inflation is 5%. What do these two facts imply as to the compensation the investor would get for the cost of waiting for the return? We can readily ‘deflate’ the market rate by the rate of inflation.

The interest rate is known from the behaviour of investors in the market place [i.e. their buying and selling activities] and the rate of inflation is known from publicly available information, e.g. the consumer price index [CPI]. From this reasoning we conclude that, because investors expect a market rate return of 12% in the face of a dollar eroding through inflation at 5%, they are willing to accept a return of 6.67%, after inflation, as the return for waiting to get their money back. The rate of return after inflation is known as the ‘Real Rate of Return.’ The relationship among the three components of real rates, nominal rates and rates of inflation can be stated succinctly.

$$\frac{1.12}{1.05} - 1 = 0.0667 = 6.67\%$$

One plus the real rate of return times one plus the rate of inflation equals one plus the nominal or market rate of return.

In the present case, the numerical relationship is as shown here:

$$1.0667 \times 1.05 = 1.12$$

Question

Nominal Rates vs. Real Rates		
Nominal Rate	Inflation Rate	Real Rate
12.00%		9.80%
12.00%	3.00%	
	4.00%	7.69%
12.00%	5.00%	6.67%
12.00%		5.66%
12.00%	7.00%	

Using the information provided, calculate the missing values in order to complete the table.

Using the first blank as an example, $1 +$ the inflation rate = $[1 + \text{the nominal rate}] / [1 + \text{the real rate}]$, or $[1 + \text{___}] / [1 + \text{___}]$. The result is $[\text{___}]$. Subtracting 1, the inflation rate is $[\text{___}]$, or $[\text{___}]\%$.

Answer

Nominal Rates vs. Real Rates		
Nominal Rate	Inflation Rate	Real Rate
12.00%	2.00%	9.80%
12.00%	3.00%	8.74%
12.00%	4.00%	7.69%
12.00%	5.00%	6.67%
12.00%	6.00%	5.66%
12.00%	7.00%	4.67%

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

Using the first blank as an example, $1 +$ the inflation rate = $[1 + \text{the nominal rate}] / [1 + \text{the real rate}]$, or $[1 + \underline{.12}] / [1 + \underline{.098}]$. The result is $[\underline{1.02}]$. Subtracting 1, the inflation rate is $[\underline{.02}]$, or $[\underline{2}]$ %.

Nominal vs. Real Cash Flows

As with discount rates, where we were concerned with real and nominal discount rates we must also be concerned with real and nominal cash flows.

Before going further Helga decided to examine the way in which inflation occurs. She wrestled with the question, "What would a \$100 article cost next year if the rate of inflation was 5% per year?" She reasoned that, "Since 5% on \$100 is \$5.00 it would cost \$105." "What would it cost two years hence?" was her next question. The answer, she reasoned would be \$110.25, [i.e. $\$100.00 \times 1.05 \times 1.05 = \110.25]. As a matter of fact she prepared the following table.

Question

Use Helga's method to calculate the missing information in the table. Then refer to the completed table to fill in the blanks in the statement.

Selected Inflation Factors		
Year	Inflation Factor @ 5%	Calculation
0		1.00×1.05^0
1	1.0500	1.00×1.05^1
2	1.1025	$1.00 \times 1.05 \times 1.05 = 1.00 \times 1.05^2$
3	1.1576	1.00×1.05^3
4		1.00×1.05^4
5		
6	1.3401	
7	1.4071	
8	1.4775	
9	1.5513	
10	1.6289	

Using Year 4 in the table as an example, $1.00 \times [\underline{\quad}]$, or 1.00×1.05 multiplied by itself $[\underline{\quad}]$ times = $[\underline{\quad}]$

Answer

Compare your work to Helga's answers. Correct any errors.

Using Year 4 in the table as an example, $1.00 \times [1.05^4]$, or 1.00×1.05 multiplied by itself [**4**] times = [**1.2155**]

Selected Inflation Factors		
Year	Inflation Factor @ 5%	Calculation
0	1.0000	1.00×1.05^0
1	1.0500	1.00×1.05^1
2	1.1025	$1.00 \times 1.05 \times 1.05 = 1.00 \times 1.05^2$
3	1.1576	1.00×1.05^3
4	1.2155	1.00×1.05^4
5	1.2763	1.00×1.05^5
6	1.3401	1.00×1.05^6
7	1.4071	1.00×1.05^7
8	1.4775	1.00×1.05^8
9	1.5513	1.05×1.05^9
10	1.6289	1.00×1.05^{10}

Suppose that the cash flows researched by Helga are expressed in the 'dollars of the day.' For example, suppose she went to the dealer and asked him for the service records of numerous root vegetable harvesters in the past year. In her research she found that ten-year old machines were worth \$2,816 in the market place at the present time. The \$2,816 salvage value would thus be a 'real value' because this is its value now; if Helga had a ten-year old machine she could sell it for \$2,816 today. If the economy was inflating at 5% per year, a ten-year old machine next year would have a market value of \$2,957, 5% more than the value this year, [i.e. $2,816 \times 1.05 = 2,957$]; the underlying assumption is that market value keeps up exactly with inflation. Ten years from now we would expect ten-year old root vegetable harvesters to sell for \$4,587, [i.e. $2,816 \times 1.05^{10} = 2,816 \times 1.6289 = 4,587$]. From the table we see that the inflation factor of 5% over ten years is 1.6289. Nominal cash flows have been derived by multiplying the real cash flows by the inflation factor.

From the table we see that the inflation factor of 5% over ten years is 1.6289. Nominal cash flows have been derived by multiplying the real cash flows by the inflation factor.

Nominal Cash Flows						
Time	Inflation Factor	Capital	Repair	Maintenance	Labour	Total
0	1.0000	-50,000				-50,000
1	1.0500		-131		15,750	9,441
2	1.1025		-165	-6,487	16,538	9,885
3	1.1576		-232	-6,811	17,364	10,321
4	1.2155		-334	-7,152	18,233	10,746
5	1.2763			-7,510	19,144	11,156
6	1.3401		-670	-7,885	20,101	11,546
7	1.4071		-915	-8,279	21,107	11,912
8	1.4775		-1,219	-8,693		12,250
9	1.5513		-1,590	-9,128	23,270	12,552
10	1.6289	4,587	-2,036	-9,584	24,433	

Question

Using Helga's method, calculate the values of the missing cells in the table. Then refer to the information in the table to complete the statement.

Using year 5 as an example, real repair costs [_____] x the inflation factor [_____] = [_____].

Answer

Compare your work to Helga's answers. Correct any errors.

Nominal Cash Flows						
Time	Inflation Factor	Capital	Repair	Maintenance	Labour	Total
0	1.0000	-50,000				-50,000
1	1.0500		-131	-6,178	15,750	9,441
2	1.1025		-165	-6,487	16,538	9,885
3	1.1576		-232	-6,811	17,364	10,321
4	1.2155		-334	-7,152	18,233	10,746
5	1.2763		-479	-7,510	19,144	11,156
6	1.3401		-670	-7,885	20,101	11,546
7	1.4071		-915	-8,279	21,107	11,912
8	1.4775		-1,219	-8,693	22,162	12,250
9	1.5513		-1,590	-9,128	23,270	12,552
10	1.6289	4,587	-2,036	-9,584	24,433	17,400

Using year 5 as an example, real repair costs [**-375**] x the inflation factor [**1.2763**] = [**-479**].

Discounted Cash Flows

It is essential that nominal cash flows be discounted with nominal discount rates. We can show this to be so by examining the construction of the real and nominal cash flow components. Consider maintenance in year one; in real terms Rudy's Roots would be spending \$5,884 for this item. In nominal terms, after a year of inflation has transpired, this cash item would amount to \$6,178, [i.e. \$5,884 x 1.0500 = \$6,178]. Its present value would be \$5,516, [i.e. \$6,178 / 1.12 = 5,516].

$$5,516 = \frac{6,178}{1.12} = \frac{5,884 \times 1.05}{1.05 \times 1.0667} = \frac{5,884}{1.0667}$$

When Helga examined the nominal discount rate of 12.0% she was reminded that it is composed of two parts; the real rate of 6.67% and the inflation rate of 5.0%, [i.e. 1.12 = 1.0667 x 1.05].

When she looked more closely at the present value of the first year's worth of maintenance she noticed something very interesting. She noticed that, in the calculation, the inflation factor appears in both the numerator and denominator. In the calculation these two factors divide out. As a result we have actually created Real Net Present Values. This will become a very important point when we annualize Net Present Value.

Question

Calculate the missing entries then answer the statement.

Nominal Cash Flows Discounted With Nominal Rates						
Time	Discount Factor	Capital	Repair	Maintenance	Labour	Total
0	1.0000	-50,000				-50,000
1	0.8929		-117	-5,516	14,063	8,429
2	0.7972			-5,172	13,184	7,880
3	0.7118		-165		12,360	7,347
4	0.6355		-212	-4,545	11,587	6,829
5	0.5674		-272	-4,261	10,863	6,330
6	0.5066		-339	-3,995	10,184	5,850
7	0.4523		-414	-3,745	9,548	5,389
8	0.4039		-492	-3,511	8,951	4,947
9	0.3606		-573	-3,292	8,391	4,526
10	0.3220	1,477	-656	-3,086	7,867	5,602
	Nominal NPV	-48,523	-3,372	-41,971	106,996	13,130

Using repair costs in line 2 as an example, the nominal maintenance costs [____] / [____] = [____]

Answer

Nominal Cash Flows Discounted With Nominal Rates						
Time	Discount Factor	Capital	Repair	Maintenance	Labour	Total
0	1.0000	-50,000				-50,000
1	0.8929		-117	-5,516	14,063	8,429
2	0.7972		-132	-5,172	13,184	7,880
3	0.7118		-165	-4,848	12,360	7,347
4	0.6355		-212	-4,545	11,587	6,829
5	0.5674		-272	-4,261	10,863	6,330
6	0.5066		-339	-3,995	10,184	5,850
7	0.4523		-414	-3,745	9,548	5,389
8	0.4039		-492	-3,511	8,951	4,947
9	0.3606		-573	-3,292	8,391	4,526
10	0.3220	1,477	-656	-3,086	7,867	5,602
	Nominal NPV	-48,523	-3,372	-41,971	106,996	13,130

Compare your work to Helga's. Correct any errors. Using repair costs in line 2 as an example, the

nominal maintenance costs $[165] / [1.12 \times 1.12] = [132]$

An easier way to discount the nominal cash flows is to use the Discount Factors in the table. They can be calculated using the following formula: $DF = \left[\frac{1}{(1+i)^n} \right]$

where DF is the discount factor, i is the nominal rate, and n is time period. For example, the discount factor for Time 2 = $1/(1+.12)^2 = 0.7972$

As was pointed out when we applied the nominal discount rate to nominal cash flows, the discounted cash flows that we have calculated are in fact real. This can be seen in the following tables where we have directly discounted real cash flows with a real discount rate.

The discounted values in the table have been calculated by multiplying the cash flow item by the specific discount factor. For example the present value of \$15,000 to be received in 4 years as a labour saving is \$11,587, [i.e. \$15,000 x 0.7725 = \$11,587].

Question

Calculate the missing values and the NPV in the table then complete the statement.

Real Cash Flows Discounted With Real Rates						
Time	Discount Factor	Capital	Repair	Maintenance	Labour	Total
0	1.0000	-50,000				-50,000
1	0.9375		-117	-5,516	14,063	8,429
2	0.8789		-132	-5,172	13,184	7,880
3	0.8240		-165	-4,848	12,360	7,347
4	0.7725		-212	-4,545	11,587	6,829
5	0.7242		-272	-4,261		6,330
6	0.6789		-339	-3,995	10,184	5,850
7	0.6365			-3,745	9,548	
8	0.5967		-492	-3,511	8,951	4,947
9	0.5594		-573	-3,292	8,391	4,526
10	0.5245	1,477	-656	-3,086	7,867	5,602
	real NPV	-48,523	-3,372	-41,971	106,996	

As was the case when nominal cash flows were discounted with the nominal discount rate, the net present value is [\$_____]. Rudy's Roots [is / is not] advised to make the investment unless there are other extenuating circumstances.

Answer

Compare your work with Helga's. Correct any errors.

Real Cash Flows Discounted With Real Rates						
Time	Discount Factor	Capital	Repair	Maintenance	Labour	Total
0	1.0000	-50,000				-50,000
1	0.9375		-117	-5,516	14,063	8,429
2	0.8789		-132	-5,172	13,184	7,880
3	0.8240		-165	-4,848	12,360	7,347
4	0.7725		-212	-4,545	11,587	6,829
5	0.7242		-272	-4,261	10,863	6,330
6	0.6789		-339	-3,995	10,184	5,850
7	0.6365		-414	-3,745	9,548	5,389
8	0.5967		-492	-3,511	8,951	4,947
9	0.5594		-573	-3,292	8,391	4,526
10	0.5245	1,477	-656	-3,086	7,867	5,602
	real NPV	-48,523	-3,372	-41,971	106,996	13,130

As was the case when nominal cash flows were discounted with the nominal discount rate, the net present value is [**\$13,130**]. Rudy's Roots [**is / is not**] advised to make the investment unless there are other extenuating circumstances, as dictated by the decision rule:

Decision Rule Reject those investments that have negative Net Present Values
--

Not only do we make the same decision by discounting real with real as we did by discounting nominal with nominal, we get the same numerical value for net present value. By discounting nominal flows with a nominal rate we have essentially arrived at a set of real cash flows.

Conclusion

This module builds on the earlier module, *Introduction to Investment Analysis*. First we stressed the amount of attention that needs to be paid to obtain good, practically derived estimates of the discount rate and the cash flows. Good information is the basis of sound decisions.

Next we explored the issues of inflation. Because different components of the investment situation may inflate at different rates we needed to allow for differential rates of inflation.

We noted especially that the analysis remains consistent throughout, i.e. we must use nominal discount rates with nominal cash flows and we must use real discount rates with real cash flows. It is also important to recognize whether the rates and flows are real or nominal and we must keep them pure.

This module takes a simple approach to handling risk, while the next module digs into more seriously. Risk is such an important component in investments. Our approach will be to take care in estimating the expected cash flows; then incorporate a risk premium into the discount rate.

We will need to cover income taxes. Since investors are primarily interested in after-tax performance we need to make adjustments to both the discount rate and to the cash flows. Capital cash flows present a particular challenge when all of these components are taken into account.

Finally the decision has to be made. The issues of inflation, risk and taxation will be applied in the final module in the series when we finally '*Take Aim*' and apply '*The Annualized Incremental Method*'.

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. Harkening 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.