MIDAS: A Dynamic Financial Model of a Property and Casualty Insurer

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MIDAS

A Dynamic Financial Model of a Property and Casualty Insurer

ABSTRACT

This paper discusses the development of a dynamic financial planning model of a Property and Casualty insurer. The model provides management with a tool to instantaneously determine the impact of various actions on key financial ratios. It has helped management analyze pricing, reserving, catastrophe and investment risks.

The theoretical basis of the model is the accounting equation (Assets = Liabilities + Surplus). The model incorporates both known and unknown components of the equation. The known components, such as premiums and losses, are developed using various forecasting techniques. The model determines the unknown components of investment income and assets by solving a series of simultaneous equations using linear programming.

In order to integrate the model into the organization's financial planning process, it was necessary for management to agree to the theoretical basis; however, that was only the first step. Throughout the model's five year evolution, it became apparent that the method of delivery was as important as the theoretical basis. Management felt it was important to develop a financial model that was mobile, integrated numerous companies, provided dynamic change capability, analyzed instantaneously the impact on key financial ratios, all in a compact system.

Thus the **M**obile **I**ntegrated **D**ynamic **A**nalysis **S**ystem, **MIDAS**, was born.

ACKNOWLEDGEMENTS

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1.0 INTRODUCTION

This paper describes the development of a financial planning model that determines investment income and assets given certain assumptions of revenues, expenses, portfolio mix and yield. It begins with an overall view of financial forecasting. Then it introduces the historical events which led to the development of the **M**obile **I**ntegrated **D**ynamic **A**nalysis **S**ystem, referred to as the MIDAS Model. After the historical background of events is discussed, examples of actual applications performed by the model to analyze financial problems are presented. The theoretical basis is reviewed next with a sample problem. Finally, the limitations of the model and suggestions for future refinements are presented.

2.0 FINANCIAL FORECASTING

In the past management had expressed frustration that the financial forecasting process was too cumbersome and time-consuming. By the time a thorough analysis of a problem was performed, the opportunity to make an informed decision had passed and management had reacted by the "seat of the pants".

The following quotation further reflects management's historical frustration with financial forecasting:

> Indeed it (financial forecasting) has been likened to driving a car blindfolded while following directions given by a person looking out the back window. Nevertheless, if this is the best we could do, it is important that it should be done properly, with the appreciation of the potential errors involved. In this way it should at least be possible to negotiate straight stretches of road without a major disaster.
>
> Andrew C. Harvey [1]

With all the uncertainty the business environment has to offer, it is a pity that management would resign themselves to such low expectations. This model has assisted management to negotiate not only through the straight stretches but over, under and around many potential pitfalls by enlightening them immediately of various options and combinations of options.

3.0 BACKGROUND

3.1 Focus on Underwriting

Historically, financial forecasting for a Property and Casualty insurance company consisted of consolidating the various underwriting components to develop a proforma underwriting profit/loss statement. Various departments in the company, called principals, applied the appropriate forecasting technique to project the component for which they were responsible. Some principals, such as Actuary and Loss Reserving, incorporated sophisticated techniques to develop premiums and losses. Others found it more appropriate to use experience and judgement. The underwriting components are listed below in Exhibit 1.

Exhibit 1
Underwriting Components

Premiums
Losses
Underwriting Expenses
Loss Adjustment Expenses
Dividends

The data provided by the principals was very detailed. Each component was broken down by risk and line of business. The proforma underwriting statement allowed

management to monitor, by line of business and risk, the operating expense ratio (OER) and the combined ratio to determine the efficiency of the organization and pricing adequacy.

3.2 Focus on Underwriting and Investment Cycles

Due to the external pressures of regulation and competition, the company found it difficult to obtain an underwriting profit. This placed pressure on the yield from the investment portfolio to support surplus growth. Now management required a proforma income statement and balance sheet to monitor both the underwriting and investment cycles of the business and the impact of decisions on the key financial strength ratios of surplus and liquidity.

The additional components of the income statement and balance sheet were developed in a manner similar to the underwriting proforma. Exhibit 2 lists the additional components of the income statement and balance sheet.

Exhibit 2
Income Statement and Balance Sheet Components

Income Statement	Balance Sheet
Investment Income	Investment Assets
Investment Expenses	Cash
Other Income	Other Assets
Federal Income Taxes	Insurance Reserves
	Other Liabilities

With written premiums as a guide, the Investment Company developed a forecast of investment income and assets. This method of projecting investment income and assets before all the other components of the income statement and balance sheet were known worked quite well for some time. However, the company had diversified and made some major changes. A large portion of profits were invested into non-income producing fixed assets. These investments made it difficult to project investment income and assets based solely on written premiums.

Another problem with the method of projecting investment income and assets was the inability to quickly assess the impact of changing variables such as policyholder dividends on the investment portfolio. Under this method, the impact on the investment portfolio was reviewed by the Investment Company then incorporated with the other forecast components to determine the impact on the key financial ratios. Because of the time required for this process, management was unable to use this information to make timely decisions.

As a result, the company developed a new way of projecting investment income and assets based on cash flow. The basic premise of the cash flow forecast was:

> If the forecast could determine how much cash would be generated and used for operating expenses, investment in subsidiaries, and fixed assets, the excess cash could be assumed to be available for investment in stocks and bonds.

Consequently an integrated model that would adjust investment income and assets as a result of a change to any other component in the forecast was built.

3.3 *Focus on an Integrated and Dynamic Model*

The original proforma underwriting model was a Dynaplan spreadsheet into which all components were keyed. This method was appropriate at the time and worked significantly better than any model previously used. When the income statement and balance sheet were completed, the Dynaplan spreadsheet(s) were expanded to incorporate the new components. The level of detail expanded significantly.

The development of investment income and assets added another dimension to the model. Dynaplan was used to consolidate the income statement and balance sheet components from the principals. The statistical software, SAS, was used to solve for investment income and assets. This was extremely time-consuming and error-prone.

To overcome the timing and validity problems, a data base was set up. The Dynaplan spreadsheets were also converted to Lotus which simplified the retrieval, manipulation and reporting of forecasted information. Then Lotus commands replaced SAS as the method to calculate investment income and assets. This worked very well but was still time-consuming. Macro instructions were written which reduced the execution time by automating many of the manual steps but required extensive maintenance.

3.4 Focus on the MIDAS Model

Management requested a further refinement of the financial forecasting process that would allow for dynamic changes and instantaneous evaluation of the key financial ratios. This led to development of the **M**obile **I**ntegrated **D**ynamic **A**nalysis **S**ystem, the MIDAS Model.

First, to decrease the processing time, the level of data was rolled-up to a company

level. The detailed line of business and risk would no longer be available for immediate review. Management believed that this would be appropriate due to their global view of the organization. Then the model was further refined to allow for dynamic changes by modifying user access through a "front-end" written in Visual Basic. The Visual Basic front-end made it easier for management to change assumptions or variables such as premiums, expenses and investment mix/yields and instantaneously determine the impact on the key financial ratios.

Next the model was loaded onto a laptop computer. This made the model portable and further expanded management's ability to incorporate the model into financial discussions at planning conferences or financial presentations. Management now was not dependent upon an analyst to run the model every time a financial option arose. Management could take the laptop and review various financial scenarios on demand. MIDAS also expanded management's ability to easily save each scenario and retrieve previous versions if the situation warranted.

MIDAS currently projects quarterly data for one year and annual information for the next five years. Scenarios can be run to determine the impact on an individual company or on a consolidated basis. A consolidation process including elimination entries is built into the MIDAS model. Outputs of the MIDAS model include summarized income statements and balance sheets along with key financial ratios on either a Statutory or GAAP basis. These reports are provided both by company and on a consolidated basis. Appendix I - III include sample reports. Ad hoc reports are developed as needed when additional information is required. The Appendix IV - VI include sample screens from the Visual Basic front-end.

4.0 ACTUAL APPLICATIONS

The model has helped in the analysis of numerous financial scenarios. Below, in Exhibit 3, is a list of some of the applications of the model. All options are measured at a minimum on the key financial ratios of operating expense, combined, surplus and liquidity.

Exhibit 3

Actual Applications

Investment risk:	
Investment yields	Investment yields for stocks and bonds have been adjusted to determine the impact of swings in the market on the portfolio.
Investment mix	The investment mix between common and preferred stocks and taxable and tax exempt bonds have been adjusted to determine the impact on investment income.
Subsidiary dividends	Subsidiary dividends have been adjusted to determine the impact on investment income.
Taxes	The mix of taxable vs. tax exempt bonds have been examined to determine the optimum mix to minimize taxes.
Pricing risk:	
Premiums	Premiums have been adjusted for competitive scenarios, volume growth, and new markets to determine the impact on financial ratios.

Expenses	Corresponding expenses are adjusted for each scenario to determine the impact on the operating expense and combined ratios.
Policyholder dividends	Various dividend options have been reviewed to determine the impact on the financial ratios.
New Companies	Diversification into new companies and new markets have been reviewed to determine appropriate pricing and capitalization.

Reserving risk:

Loss reserves	Loss reserves have been adjusted to determine the impact of both favorable and unfavorable development on the financial ratios.

Catastrophe risk:

Probable Maximum Loss (PML)	The PML or exposure of the organization to a large catastrophe loss has been adjusted to allow management to develop methods to reduce risk exposure and prepare contingency plans.
Reinsurance	Various reinsurance options have been reviewed both for cost and benefits and the impact on the financial ratios once the reinsurance is purchased.

Throughout its evolution, MIDAS has proven to be comprehensive, yet flexible enough to analyze an infinite number of scenarios.

5.0 THE ACCOUNTING EQUATION

In this section we discuss the fundamental theoretical accounting assumptions of the model.

5.1 Basic Accounting Equation Assumptions

The basis of the model is the accounting equation:

Assets = Liabilities + Surplus

The general approach of the model is to develop a projected income statement and balance sheet from data provided from various principals. These are the known components of the accounting equation. The unknown components are investment income and assets. This creates a dilemma because investment income cannot be determined until investment assets are known and vice versa. To solve this problem, numerous algebraic equations are developed for each unknown component and linear programming is applied to solve for the unknown values.

Exhibit 4

Components of the Accounting Equation

Assets	=	Liabilities	+	Surplus
Known Components				
Existing Portfolio		Loss Reserves		Beginning Surplus
Bonds		LAE Reserves		Premiums
Stocks		Unearned Premium		Losses
Affiliated Stocks		Other Liabilities		Underwriting Expenses
Cash				LAE Expenses
Other Invested Assets				Policyholder Dividends
Other Assets				Existing Portfolio
				Bond Interest
				Stock Dividends
				Other Investment Income
Unknown Components				
New Portfolio				New Portfolio Income
Bonds				Bond Interest
Stocks				Stock Dividends

5.2 Development of the Accounting Equation

The model assumes a sources and uses (cash flow) approach to project investment income and assets based on the accounting equation.

Assets = Liabilities + Surplus

If surplus, liabilities and all assets other than stocks and bonds can be projected, the remainder is stocks and bonds.

Stocks + Bonds + All other Assets = Liabilities + Surplus

Or

Stocks + Bonds = Liabilities + Surplus - All other Assets

The projections for liabilities and all other assets are known components supplied by principals. Surplus can be defined as:

Ending Surplus = Beginning Surplus + Net Income + Other Surplus Changes

The projection for other surplus changes is a known component provided by principals and the beginning surplus is the latest actual surplus. All the components that make up net income are also known and provided by principals with the exception of investment income. Net income can be further divided as follows:

Net Income = Investment income + All other income - All expenses

Investment income is referred to as interest and dividends from bonds and stocks. Substituting the above definitions, the resulting equation is defined as follows:

Stocks + Bonds = Liabilities+(Beginning Surplus+Bond Interest + Stock Dividends + All other income-All expenses+Other Surplus Changes) -All other assets

Note that bond interest and stock dividends must be calculated to determine the amount of investment in stocks and bonds. Also the amount of investment in stocks and bonds must be known to determine bond interest and stock dividends. This is a circular argument, so the solution is to resolve the conflicting arguments simultaneously.

5.3 Investment Issues

The following is a discussion of further refinements to the basic theory discussed in section 5.2.

5.3.1 Stock and Bond Yields

The stock portfolio was further subdivided into common stocks and preferred stocks, each with a unique yield. Bonds were subdivided into taxable and tax exempt with corresponding yields.

The portfolio for stocks and bonds is split into existing and new. Existing portfolio is the beginning (Actual) portfolio for the planning period. The yield on the existing portfolio is what the current portfolio is actually returning. The new portfolio yield is provided by the Investment Company and is the best estimate of the current market yield.

Management wanted the model to assume that all stocks and bonds would be purchased throughout the period and not on one day in the period. In order to calculate the appropriate dividend or interest to stocks and bonds, a mid-period convention was applied. The following is the calculation for common stock dividends.

Common Stock dividends = ((Common Stock current period + Common stock previous period)/2) * Yield

The calculation for preferred stock, taxable and tax exempt bonds would be very similar.

5.3.2 Portfolio Mix

The mix of portfolio assets refers to the dollar value of stocks and bonds to total investment assets. There are many ways to split the various components of the portfolio. MIDAS currently calculates portfolio mix as a percentage of total surplus.

The common stock mix is limited to be X% of surplus. The remaining portfolio is further divided into preferred stock, taxable and tax exempt bonds.

Preferred stock	X%
Taxable bonds	X%
Tax exempt bonds	X%
	100% of the remaining portfolio

The investment mix can be easily modified for various options. The mix strategy is currently provided by the Investment Company and the Tax department.

5.3.3 Selling from the Portfolio

Sometimes it is necessary to sell either stocks or bonds from the portfolio to maintain the desired portfolio mix. Selling from the portfolio can occur for two reasons. The first occurs when the actual investment mix is different from the investment mix assumptions included in MIDAS. The second is when management desires to change the portfolio mix assumptions. MIDAS automatically calculates the amount to sell from the portfolio to achieve the desired portfolio balance.

5.4 Examples of Additional Refinements

These issues and many other contingent solutions can be easily incorporated into MIDAS.

5.4.1 Realized Gains

Realized gains have become a significant component in the growth of surplus. Consequently, management has requested that realized gains be incorporated into the model as an unknown component. This would allow MIDAS to solve for this amount with the other unknowns. The following is the calculation for realized gains on common stock.

Realized Gains = (Existing Common Stock + New common Stock)*RealizedGains Yield

Realized gains on the other investment components such as preferred stock and bonds would be calculated in a similar manner.

5.4.2 Taxes

MIDAS also calculates Federal Income Taxes as an unknown component. This enables management to determine the tax effect of various actions immediately instead of waiting for an analysis from the Tax department. Taxes are computed by the following calculation.

Income Taxes =Tax Rate*Taxable Income

Taxable income is adjusted for tax credits and deferrals.

6.0 AN EXAMPLE OF SOLVING THE BASIC ACCOUNTING EQUATION

The following is an example of the theoretical basis of the MIDAS model. For simplicity purposes, this example solves for only eight unknowns of one company for one period. The unknowns are:

Investment Income	Common Stock Dividends
	Preferred Stock Dividends
	Tax Exempt Bonds Interest
	Taxable Bonds Interest
Investment Assets	Common Stock
	Preferred Stock
	Tax Exempt Bonds
	Taxable Bonds

The unknowns may be expanded or contracted as needed for each situation. For example, to calculate taxes, an additional equation would be added to define the calculation. To add multiple companies, separate equations may be developed for each company and then the results consolidated for the insurance group.

6.1 Example Assumptions

Listed below are sample values for the example.

Exhibit 5
Example Assumptions

Variable		Values
A = Dividends on Common Stock	New portfolio	Unknown
B = Dividends on Preferred Stock	New portfolio	Unknown
C = Interest on Tax Exempt Bonds	New portfolio	Unknown
D = Interest on Taxable Bonds	New portfolio	Unknown
E = Common Stock	New portfolio current period	Unknown
F = Preferred Stock	New portfolio current period	Unknown
G = Tax Exempt Bonds	New portfolio current period	Unknown
H = Taxable Bonds	New portfolio current period	Unknown
I = Dividends on Common Stock	Existing portfolio	12
J = Dividends on Preferred Stock	Existing portfolio	7
K = Interest on Tax Exempt Bonds	Existing portfolio	16
L = Interest on Taxable Bonds	Existing portfolio	47
M = Common Stock	Existing portfolio	1,010
N = Preferred Stock	Existing portfolio	247
O = Tax Exempt Bonds	Existing portfolio	752
P = Taxable Bonds	Existing portfolio	1,826
Q = Common Stock	New portfolio previous period	23
R = Preferred Stock	New portfolio previous period	87
S = Tax Exempt Bonds	New portfolio previous period	150
T = Taxable Bonds	New portfolio previous period	278
YCN = Yield on new Common Stock		.035
YPN = Yield on new Preferred Stock		.085
YEN = Yield on new Tax Exempt Bonds		.090
YTN = Yield on new Taxable Bonds		.070
Z = (Net income - Investment income) + Surplus changes		25
AA = Previous surplus		2,951

Example Assumptions

Variable	Values
BB = Total liabilities	4,257
CC = All assets other than stocks and bonds	2,780
MC = Common stocks to surplus mix	.35
MP = Preferred stocks to remaining surplus mix	.10
ME = Tax exempt to remaining surplus mix	.27
MT = Taxable bonds to remaining surplus mix	.63

6.2 Calculation of Unknown Variables

The following algebraic equations incorporate the values for the example.

6.2.1 Investment Income New Portfolio

Dividends on common stock of the new portfolio

Basic Equation	A = .5*((YCN*(Q+E))
Assign Values	A = .5*((.035*(23+E))
Simplify Equation	A = .403+.018E

Dividends on preferred stock of the new portfolio

Basic Equation	B = .5*((YPN*(R+F))
Assign Values	B = .5*((.085*(87+F))
Simplify Equation	B = 3.70+.043F

Interest on tax exempt bonds of the new portfolio

Basic Equation	C = .5*((YEN*(S+G))
Assign Values	C = .5*((.090*(150+G))
Simplify Equation	C = 6.75+.045G

Interest on taxable bonds of the new portfolio

Basic Equation	D = .5*((YTN*(T+H))
Assign Values	D = .5*((.070*(278+H))
Simplify Equation	D = 9.73+.035H

6.2.2 Investment Assets New Portfolio

Common stock new portfolio

Basic Equation	E = MC*((A+B+C+D)+(I+J+K+L+Z+AA))-M
Assign Values	E = .35*((A+B+C+D)+(12+7+16+47+25+2,951))-1,010
Simplify Equation	E = (.35*(A+B+C+D))+60

Preferred Stock new portfolio

Basic Equation	F = MP*((A+B+C+D)+(I+J+K+L+Z+AA+BB-CC-E-M))-N
Assign Values	F = .10*((A+B+C+D)+12+7+16+47+25+2,951+4,257-2,780-E-1,010)-247
Simplify Equation	F = (.10*(A+B+C+D-E))+106

Tax exempt bond interest on new portfolio

Basic Equation	G = ME*((A+B+C+D-E)+I+J+K+L+Z+AA+BB-CC-E-M)-O
Assign Values	G = .27*((A+B+C+D)+12+7+16+47+25+2,951+4,257-2,780-E-1,010)-752
Simplify Equation	G = (.27*(A+B+C+D-E))+200

Taxable bond interest on new portfolio

Basic Equation	H = MT*((A+B+C+D-E)+I+J+K+L+Z+AA+BB-CC-E-M)-P
Assign Values	H =.63*((A+B+C+D)+12+7+16+47+25+2,951+4,257-2,780-E-1,010)-1,826
Simplify Equation	H = (.63*(A+B+C+D))+395

6.3 Simultaneous Linear Equations

This is the resulting set of simultaneous linear equations which has eight unknowns and will be used to determine one unique solution as follows:

A = .403 + .018E
B = 3.70 + .043F
C = 6.75+.045G
D = 9.73+.035H
E = (.35*(A+B+C+D))+60
F = (.10*(A+B+C+D-E))+106
G = (.27*(A+B+C+D-E))+200
H = (.63*(A+B+C+D-E))+395

Refining and simplifying for the coefficient matrix derives the following equations.

A-.018E = .403
B-.043F = 3.70
C-.045G = 6.75
D-.035H = 9.73
-.35A-.35B-.35C-.35D+E = 60
-.10A-.10B-.10C-.10D+.10E+F = 106
-.27A-.27B-.27C-.27D+.27E+G = 200
-.63A-.63B-.63C-.63D+.63E+H = 395

6.4 Linear Programming

To determine the simultaneous solutions for the unknowns, the equations must be expanded to determine the relationships between each unknown variable. Applying the equations to matrices is the easiest technique to accomplish this relationship.

6.4.1 Coefficient Matrix

Assigning the variables in the equations to a matrix results in the following coefficient matrix.

Exhibit 6
Coefficient Matrix

A	B	C	D	E	F	G	H
1	0	0	0	-.018	0	0	0
0	1	0	0	0	-.043	0	0
0	0	1	0	0	0	-.045	0
0	0	0	1	0	0	0	-.035
-.35	-.35	-.35	-.35	1	0	0	0
-.10	-.10	-.10	-.10	+.10	1	0	0
-.27	-.27	-.27	-.27	+.27	0	1	0
-.63	-.63	-.63	-.63	+.63	0	0	1

6.4.2 Constant Matrix

Assigning the constants from the equations to a matrix produces the following constant matrix.

Exhibit 7
Constant Matrix

A	.403
B	3.70
C	6.75
D	9.73
E	60
F	106
G	200
H	395

6.5 Lotus Commands

Lotus matrix commands were incorporated into MIDAS to perform the matrix calculations of linear programming. The two matrix commands are:

DMI - Data Matrix Invert
DMM - Data Matrix Multiply

The solution matrix must first be inverted using the data matrix invert command (DMI). The basic format is:

DMI"Range of solution matrix"~"Beginning position of resulting inverted matrix"

Then the inverted matrix is multiplied by the coefficient matrix using the data matrix multiply command. The format is as follows:

DMM"Range of inverted matrix"~"Range of coefficient matrix"~"Beginning position of resulting coefficient matrix"

These Lotus commands were required for each period projected. The commands were automated by macro routines which decreased processing time and the exposure to errors.

6.6 Results

The results of the example are as follows:

Variable	Unknown	Value
A	Common stock dividend new portfolio	2
B	Preferred stock dividend new portfolio	8
C	Tax Exempt interest new portfolio	15
D	Taxable interest new portfolio	23
E	Common stock new portfolio	77
F	Preferred stock new portfolio	103
G	Tax Exempt bonds new portfolio	192
H	Taxable bonds new portfolio	377

6.7 Proof of Results

The solutions of the algebraic equations follow incorporating the example results. The results have been rounded to whole numbers.

Dividends on common stock of the new portfolio

Basic Equation	A = .5*((YCN*(Q+E))
Assign Values	A = .5*((.035*(23+E))
Simplify Equation	A = .403+.018E
Solution	2 = .403 + .018(77)

Dividends on preferred stock of the new portfolio

Basic Equation	B = .5*((YPN*(R+F))
Assign Values	B = .5*((.085*(87+F))
Simplify Equation	B = 3.70+.043F
Solution	8 = 3.70 + .043(103)

Interest on tax exempt bonds of the new portfolio

Basic Equation	C = .5*(YEN*(S+G))
Assign Values	C = .5*(.090*(150+G))
Simplify Equation	C = 6.75+.045G
Solution	15 = 6.75+.045(192)

Interest on taxable bonds of the new portfolio

Basic Equation	D = .5*(YTN*(T+H))
Assign Values	D = .5*(.070*(278+H))
Simplify Equation	D = 9.73+.035H
Solution	23 = 9.73 + .035(377)

Common stock new portfolio

Simplify Equation	E = (.35*(A+B+C+D))+60
Assign Values	E = (.35*(A+B+C+D)+(12+7+16+47+25+2,951))-1,010
Simplify Equation	E = (.35*(A+B+C+D))+60
Solution	77 = (.35*(2+8+15+23))+60

Preferred Stock new portfolio

Basic Equation	F = MP*(A+B+C+D)+(I+J+K+L+Z+AA+BB-CC-E-M)-N
Assign Values	F = (.10*(A+B+C+D)+12+7+16+47+25+2,951+4,257-2,780-E-1,010)-247
Simplify Equation	F = (.10*(A+B+C+D-E))+106
Solution	103 = (.10*(2+8+15+23-77))+106

Tax exempt bond interest on new portfolio

Basic Equation	G = ME*((A+B+C+D-E)+I+J+K+L+Z+AA+BB-CC-E-M)-O
Assign Values	G = (.27*(A+B+C+D)+12+7+16+47+25+2,951+4,257-2,780-E-1,010)-752
Simplify Equation	G = (.27*(A+B+C+D-E))+200
Solution	192 = (.27*(2+8+15+23-77))+200

Taxable bond interest on new portfolio

Basic Equation	H = MT*((A+B+C+D-E)+I+J+K+L+Z+AA+BB-CC-E-M) - P
Assign Values	H =.63*((A+B+C+D)+12+7+16+47+25+2,951+4,257-2,780-E-1,010)-1,826
Simplify Equation	H = (.63*(A+B+C+D))+395
Solution	377 = (.63*(2+8+15+23-77))+395

7.0 LIMITATIONS

This section discusses the limitations of the MIDAS model.

7.1 Quality of Data

The quality of data incorporated in the model has a direct impact on the quality of output. For example, when incurred losses are developed, losses paid and losses outstanding must be developed together. A mismatch of paid to outstanding losses would generate an inappropriate buy or sell from the portfolio. To minimize this limitation, data is reviewed by the analyst prior to inputting into MIDAS for reasonableness and integrity. Once a good base case is developed, it is easy for management to manipulate variables and run scenarios.

7.2 Investment Assumptions

Actual investment income and assets will be different from those projected in MIDAS. If part of the portfolio needs to be sold, the Investment Company might sell a different type of security (stocks or bonds) than the security the model is indicating should be sold. The constraints in the model ensure the assumed portfolio mix is correct while the actual Investment Company transactions are based on current market conditions.

7.3 Noncash Transactions

Noncash transactions, such as depreciation, are not taken into consideration in the model. Normally depreciation is an immaterial figure. However, management may discredit the model due to misunderstanding the impact of assumptions. Non-cash transactions can be incorporated as known components if they become material to the financial results or key ratios.

7.4 Double Entry Accounting

MIDAS is a cell-referenced spreadsheet and not a double entry accounting system. When management requests changes to a component in the model, analysis is required to ensure that the impact on the accounting equation impact is reflected. For example, a dividend from a subsidiary would require the following adjustments:

Income statement impact	Increase dividends from subsidiaries
Balance Sheet impact	Reduce investment in subsidiaries

An analyst must modify the model to incorporate both entries or management will misinterpret the impact of this alternative.

7.5 Overall Model Assumptions

The model is built to reflect a basic set of assumptions. If management desires to change a basic assumption, it may take time to review and incorporate the request into the model. Management must communicate the issues to be reviewed so that the analyst can ensure that the assumptions are appropriate for the problem to be studied.

7.6 User Education

MIDAS is a complex tool although the Visual Basic front-end is very user friendly. Users must understand the relationships among components so the correct adjustments are made when running scenarios. For example, growth in premiums could have an impact on both losses and expenses. The analyst may customize the front-end for specific issues so that all effected components are adjusted. An extensive amount of time is spent educating the users of the model to ensure that they understand its theoretical basis and can interpret results correctly.

7.7 Loss of Control

Once the model was made dynamically mobile, its use exploded. Consequently, the analyst had difficulty reconciling the various versions of the model to the original. To minimize this limitation, the analyst must ensure that all users are starting with the same base case and overall model assumptions. This information is coordinated quarterly or as needed to support planning conferences and financial presentations.

8.0 WHERE DO WE GO FROM HERE?

As the regulatory and competitive environment changes, management will be interested in incorporating changes to stay abreast of the times. The analyst will need to respond to these requests by continually refining MIDAS. Some modifications to MIDAS may include incorporating additional companies, more detailed subsidiary analysis, risk-based capital calculations, increased PML analysis, and the latest tax planning strategies.

REFERENCES

[1] Harvey, A.C. (1990). Forecasting, structural time series models and the Kalman filter. Cambridge University Press, New York.

Appendix I

4q95ff
Actuals through the 3th Qtr. 1995

STATUTORY CONSOLIDATED INCOME STATEMENT SCORECARD
($ in thousands)

11-Nov-95
03:58 PM

ACCOUNT DESCRIPTION	Total 1993	Total 1994	Total 1995	Total 1996	Total 1997	Total 1998	Total 1999	Total 2000	Total 2001
PREMIUMS WRITTEN	1,461,593	1,523,516	1,581,251	1,626,419	4,671,648	1,822,738	1,983,597	2,164,515	2,368,824
PREMIUMS EARNED	1,418,648	1,500,731	1,561,364	1,605,436	1,669,786	1,775,079	1,923,369	2,097,095	2,293,450
CAT LOSSES	58,398	115,301	96,357	105,958	114,238	125,880	139,066	153,306	169,182
NON-CAT LOSSES	915,339	935,013	808,473	930,927	1,067,697	1,133,411	1,232,812	1,345,444	1,474,341
TOTAL LOSSES	973,951	1,050,631	904,830	1,036,884	1,181,935	1,259,291	1,371,878	1,498,750	1,643,523
CAT LAE	3,019	12,823	11,280	4,857	5,264	5,478	5,472	5,465	5,458
NON-CAT LAE	215,074	199,986	186,339	229,285	268,799	274,388	297,044	324,165	355,358
TOTAL LOSS ADJUSTMENT EX	218,093	212,809	197,619	234,141	274,064	279,865	302,516	329,630	360,815
UNDERWRITING EXP	180,978	209,331	202,845	212,590	215,915	231,525	252,030	274,971	299,802
OPERATING EXPENSES	399,071	422,140	400,464	446,731	489,979	511,390	554,545	604,601	660,617
DIVIDENDS	28,084	49,663	218,774	50,229	48,328	48,188	49,098	50,589	52,378
U/W GAIN (LOSS)	17,542	(21,703)	37,297	71,592	(50,456)	(43,790)	(52,152)	(56,844)	(63,068)
INVESTMENT INCOME	163,467	159,033	187,929	201,534	216,347	232,191	250,086	267,174	287,166
REALIZED GAINS (LOSSES)	57,119	14,430	14,278	48,645	52,829	57,362	62,102	66,246	71,276
SUBSIDIARY DIVIDENDS	44,513	91,862	113,554	102,797	97,088	126,319	137,723	145,269	156,120
INVESTMENT EXPENSES	35,394	37,965	41,136	45,776	46,693	48,768	52,885	57,655	63,000
NET INVEST GAIN(LOSS)	175,191	174,525	199,569	229,429	228,958	271,650	295,481	313,110	337,179
OTHER INCOME	1,614	(1,740)	1,355	323	451	79	(271)	(698)	(1,239)
INCOME BEFORE TAXES	149,833	98,246	163,166	223,573	88,340	132,486	141,514	147,644	158,488
FIT (BENEFIT)	5,583	(14,093)	(756)	7,074	10,413	12,345	11,672	4,993	14,492
NET INCOME	144,251	112,340	163,921	216,499	77,927	120,141	129,843	142,651	143,997
NET WORTH PREV PERIOD	1,072,393	1,228,823	1,282,644	1,570,253	1,814,738	1,945,586	2,105,839	2,278,414	2,469,692
NET INCOME	144,251	112,340	163,921	216,499	77,927	120,141	129,843	142,651	143,997
CHANGE IN SUB NET WORTH	28,680	(17,539)	9,571	23,330	52,578	36,738	40,482	48,614	54,691
UNREALIZED GAIN (LOSS)	(22,266)	(28,788)	101,047	0	0	0	0	0	0
OTHER NET WORTH CHANGE	5,737	(12,193)	13,071	4,655	343	3,374	2,251	13	(333)
TOTAL NET WORTH CHANGE	156,401	53,821	287,611	244,484	130,849	160,253	172,575	191,278	198,355
NET WORTH CURR PERIOD	1,228,823	1,282,644	1,570,253	1,814,738	1,945,586	2,105,839	2,278,414	2,469,692	2,668,047
ASSETS	3,015,652	3,361,865	3,502,445	3,795,777	4,148,042	4,487,070	4,825,777	5,199,495	5,596,114
LIABILITIES	1,786,830	2,079,221	1,962,193	1,981,040	2,202,456	2,381,231	2,547,362	2,729,803	2,928,068
OER	28.1%	28.1%	25.6%	27.8%	29.3%	28.8%	28.8%	28.8%	28.8%
COMBINED RATIO	98.4%	101.2%	97.4%	95.4%	94.5%	102.1%	102.3%	102.3%	102.3%
U/W GAIN TO EP	1.2%	-1.4%	2.4%	4.5%	-3.0%	-2.5%	-2.7%	-2.7%	-2.7%
LOSSES TO EP	68.7%	70.0%	58.0%	64.6%	70.8%	70.9%	71.3%	71.5%	71.7%
LAE TO EP	15.4%	14.2%	12.7%	14.6%	16.4%	15.8%	15.7%	15.7%	15.7%
U/W TO EP	12.8%	13.9%	13.0%	13.2%	12.9%	13.0%	13.1%	13.1%	13.1%
U/W TO WP	12.4%	13.7%	12.8%	13.1%	4.4%	12.7%	12.7%	12.7%	12.7%
DIV TO EP	2.0%	3.3%	14.0%	3.1%	2.9%	2.7%	2.6%	2.4%	2.3%
LAE TO LOSSES	22.4%	20.3%	21.8%	22.6%	23.2%	22.2%	22.1%	22.0%	22.0%
LIQUIDITY RATIO	1.24	1.16	1.34	1.46	1.41	1.41	1.41	1.41	1.41
SURPLUS RATIO	84.1%	84.2%	99.3%	111.6%	39.9%	115.5%	114.9%	114.1%	112.6%

Appendix II

4q95ff
Actuals through the 3rd Qtr. 1995

STATUTORY CONSOLIDATED BALANCE SHEET SCORECARD
($ in thousands)

11-Nov-95
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ACCOUNT DESCRIPTION	Total 1993	Total 1994	Total 1995	Total 1996	Total 1997	Total 1998	Total 1999	Total 2000	Total 2001
ASSETS:									
TAXABLE BONDS	877,775	1,152,431	1,606,443	1,771,870	1,962,253	2,185,312	2,393,400	2,631,338	2,866,871
TAX EXEMPT BONDS	601,531	481,772	161,388	160,648	159,242	158,427	157,176	156,616	156,616
PREFERRED STOCK	117,057	109,288	32,745	42,302	44,651	47,268	50,018	53,008	56,236
COMMON STOCK	387,947	401,306	530,716	643,558	689,081	745,039	803,558	854,725	916,824
CASH & SHORT TERM	48,180	97,853	95,341	47,507	51,707	55,907	60,107	64,307	68,507
TOTAL OTHER INV ASSETS	47,676	49,409	56,448	49,835	50,492	50,977	51,657	52,130	52,617
REAL ESTATE	203,988	206,837	214,308	226,799	227,607	224,194	220,920	216,801	212,808
EXCESS RE (5% LIAB LESS RE	(59,763)	(78,839)	(61,720)	(56,207)	(87,029)	(115,982)	(142,989)	(173,171)	(205,487)
TOTAL QUALIFIED ASSETS	2,224,390	2,420,057	2,635,669	2,886,310	3,098,005	3,351,162	3,593,847	3,855,755	4,124,992
INVESTMENT IN SUBSIDIARIE	501,212	484,479	494,924	520,005	596,957	633,695	674,177	722,791	777,483
PREMIUM BALANCES	223,149	226,750	250,479	241,229	276,817	298,918	326,094	356,678	391,235
FURN, EQUIP & EDP	34,234	29,470	31,050	56,725	53,296	49,961	49,112	48,899	50,078
OTHER ASSETS	92,429	122,270	28,603	35,302	35,938	37,352	39,557	42,201	46,841
EXCESS REAL ESTATE	59,763	78,839	61,720	56,207	87,029	115,982	142,989	173,171	205,487
TOTAL ASSETS	3,015,652	3,361,865	3,502,445	3,795,777	4,148,042	4,487,070	4,825,777	5,199,495	5,596,114
LIABILITIES:									
LOSS RESERVES	893,745	1,105,422	973,713	951,623	1,057,779	1,163,874	1,238,560	1,318,420	1,402,699
LAE RESERVES	232,731	242,785	224,539	219,749	249,201	260,441	272,452	285,144	298,562
UNEARNED PREMIUMS	483,935	506,722	526,609	547,592	582,883	630,542	690,771	758,190	833,565
OUTSTANDING CHECKS	7,140	45,557	0	5,390	5,390	5,390	5,390	5,390	5,390
OUTSTANDING DRAFTS	39,456	45,777	50,036	47,023	53,274	56,577	60,322	64,262	68,616
DIVIDENDS PAYABLE	13,407	14,050	14,262	11,610	49,438	49,525	50,267	51,692	53,508
OTHER LIABILITIES	116,415	118,908	173,034	198,053	204,491	214,882	229,601	246,704	265,727
TOTAL LIABILITIES	1,786,830	2,079,221	1,962,193	1,981,040	2,202,456	2,381,231	2,547,362	2,729,803	2,928,068
SURPLUS:									
TOTAL SURPLUS	1,228,823	1,282,645	1,570,253	1,814,738	1,945,586	2,105,839	2,278,414	2,469,692	2,668,047
LIABILITIES & SURPLUS	3,015,652	3,361,865	3,532,445	3,795,777	4,148,042	4,487,070	4,825,777	5,199,495	5,596,114

Appendix III

4QFF95
Actuals through 3th Quarter 1995

P&C CONSOLIDATED GAAP SCORECARD
($ IN THOUSANDS)

11-Nov-95
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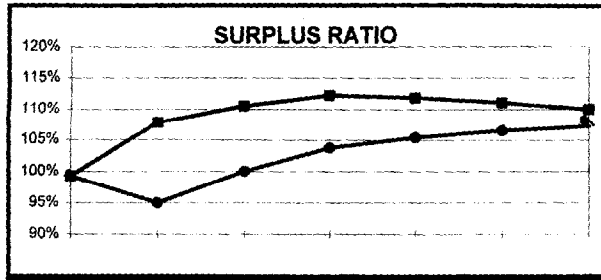
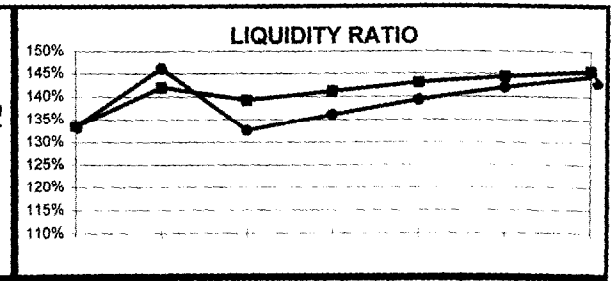
	TOTAL 1993	TOTAL 1994	TOTAL 1995	TOTAL 1996	TOTAL 1997	TOTAL 1998	TOTAL 1999	TOTAL 2000	TOTAL 2001
STATEMENTS									
REVENUES	1,639,457	1,682,509	1,766,605	1,879,067	1,962,816	2,088,628	2,257,526	2,449,881	2,668,615
EXPENSES	1,444,596	1,523,632	1,558,347	1,590,193	1,797,486	1,900,671	2,059,423	2,242,643	2,450,142
P&C OPERATING INCOME	**194,860**	**158,878**	**208,259**	**288,875**	**165,330**	**187,957**	**198,103**	**207,237**	**218,473**
NET INCOME OF SUBS	40,137	38,669	47,359	59,147	71,486	81,829	93,086	104,662	117,026
NET INCOME	234,997	197,546	255,617	348,022	236,816	269,785	291,189	311,899	335,499
ASSETS	**3,418,647**	**3,559,539**	**3,950,593**	**4,121,149**	**4,476,079**	**4,812,139**	**5,149,881**	**5,520,370**	**5,922,661**
LIABILITIES	1,931,711	2,133,729	2,125,339	2,025,050	2,232,562	2,393,029	2,539,791	2,704,916	2,888,908
NET WORTH	1,486,936	1,425,810	1,825,254	2,096,100	2,243,518	2,419,110	2,610,090	2,815,454	3,033,753
TOTAL LIABILITIES & NET WORTH	**3,418,647**	**3,559,539**	**3,950,593**	**4,121,149**	**4,476,079**	**4,812,139**	**5,149,881**	**5,520,370**	**5,922,661**
RECONCILIATIONS									
STATUTORY NET INCOME	**144,251**	**112,340**	**163,921**	**216,499**	**77,927**	**120,141**	**129,843**	**142,651**	**143,997**
DEFERRED POLICY ACQ COSTS	1,096	1,525	(2,946)	5,204	3,554	4,823	6,113	6,849	7,665
DEFERRED TAXES	4,974	41,240	(14,926)	16,323	43	96	(1,078)	(9,450)	(254)
SUBSIDIARY DIVIDEND	44,513	13,809	36,556	52,746	84,138	64,589	65,366	70,577	71,226
OTHER ADJUSTMENTS	144,277	102,303	189,574	214,603	77,594	118,449	127,702	139,261	139,836
P&C OPERATING INCOME	**194,860**	**158,877**	**208,258**	**288,875**	**165,330**	**187,956**	**198,103**	**207,237**	**218,473**
EQUITY IN EARNINGS OF SUBS	40,137	38,669	47,359	59,147	71,486	81,829	93,086	104,662	117,026
GAAP NET INCOME	234,997	197,546	255,617	348,022	236,816	269,785	291,189	311,899	335,499
STATUTORY SURPLUS	**1,763,933**	**1,412,183**	**1,521,176**	**1,763,477**	**1,994,325**	**2,054,578**	**2,988,190**	**3,179,469**	**2,616,756**
VALUATION OF BONDS	340	(113,306)	75,503	78,864	78,864	78,864	78,864	78,864	78,864
NON-ADMITTED ASSETS	56,851	62,164	65,489	60,634	60,491	57,117	54,666	54,854	55,187
DEF POLICY ACQUISITION COSTS	17,731	521,848	17,233	19,054	20,298	21,987	24,127	26,524	29,207
DEFERRED TAXES	58,536	133,988	14,906	31,229	31,271	31,367	30,289	20,839	20,586
OTHER ADJUSTMENTS	(410,453)	(591,067)	130,946	142,643	158,269	175,197	(566,246)	(545,096)	233,123
GAAP SURPLUS	**1,486,936**	**1,425,809**	**1,825,253**	**2,096,101**	**2,343,519**	**2,419,110**	**2,610,090**	**2,815,453**	**3,033,722**

Appendix IV
Summary Screen

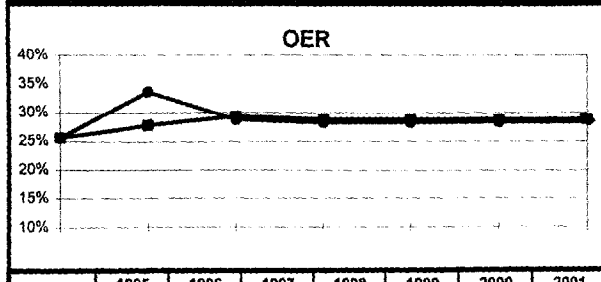
M I D A S

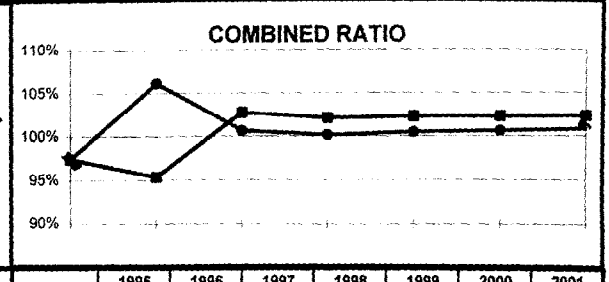




	1995	1996	1997	1998	1999	2000	2001
Base	99.3%	107.8%	110.6%	112.3%	111.9%	111.1%	110.0%
Scenario1	99.3%	95.0%	100.0%	103.8%	105.5%	106.6%	107.3%

	1995	1996	1997	1998	1999	2000	2001
Base	133.5%	142.1%	139.3%	141.2%	143.1%	144.4%	145.5%
Scenario1	133.5%	146.2%	132.6%	136.1%	139.3%	142.0%	144.4%



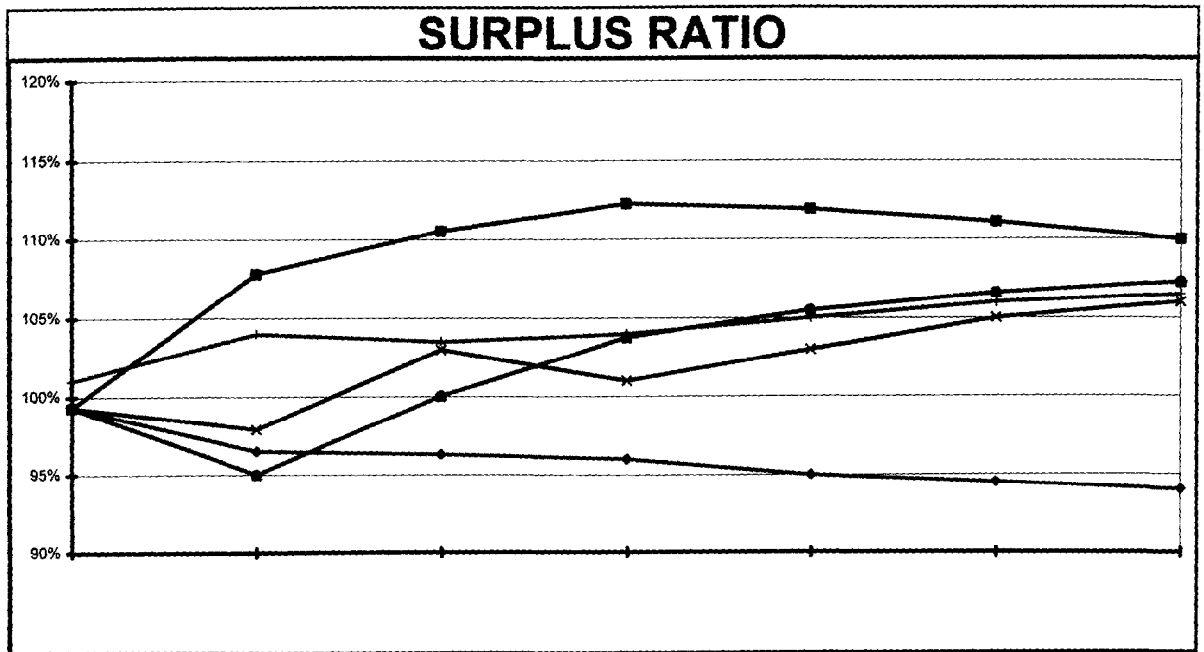


	1995	1996	1997	1998	1999	2000	2001
Base	25.6%	27.8%	29.3%	28.8%	28.8%	28.8%	28.8%
Scenario1	25.6%	33.6%	28.7%	28.3%	28.3%	28.4%	28.4%

	1995	1996	1997	1998	1999	2000	2001
Base	97.4%	95.4%	102.8%	102.1%	102.3%	102.3%	102.3%
Scenario1	97.4%	106.1%	100.6%	100.2%	100.5%	100.6%	100.8%

Clear Scenario | Scenario 1 | Changes | Run | Exit

Appendix V
Detail Screen



	1995	1996	1997	1998	1999	2000	2001
Base	99.3%	107.8%	110.5%	112.3%	111.9%	111.1%	110.0%
Scenario 1	99.3%	107.7%	112.7%	116.8%	118.5%	119.7%	120.3%
Scenario 2	99.3%	95.0%	100.0%	103.8%	105.5%	106.6%	107.3%
Scenario 3	99.3%	97.9%	103.0%	101.0%	103.0%	105.0%	106.0%
Scenario 4	99.3%	96.5%	96.3%	96.0%	95.0%	94.5%	94.0%
Scenario 5	101.0%	104.0%	103.5%	104.0%	105.0%	106.0%	106.5%

Appendix VI
Change Form

CHANGE OPTIONS