



Institute of Actuaries of Australia

**4th Financial Services Forum**

*Innovation in Financial Markets*

19 and 20 May 2008 – Melbourne

# **ANNUITIES ALM – A PRACTICAL APPROACH**

**(Understanding risk and volatility in the real world  
of credit crises)**

**Chris Seddon FIA FIAA**

**Kelvin Mo FIAA**



# AGENDA

- 1) Introduction – the credit crisis
- 2) Setting the scene
- 3) Attribution model
- 4) Tricks for the beginner
- 5) Conclusion



Institute of Actuaries of Australia

**4th Financial Services Forum**

*Innovation in Financial Markets*

19 and 20 May 2008 – Melbourne

008

# **INTRODUCTION – THE CREDIT CRISIS**



## The credit crisis

- The recent credit crisis has had a significant impact on fixed interest assets through:
  - Credit spread margin changes
  - Credit rating downgrades (limited)
  - Credit defaults (very limited)
- Credit spreads over government bonds increased by:
  - 133bp for AAA, 171bp for AA (Mar 07 – Mar 08)
- Credit spreads over swap yields increased by:
  - 56bp for AAA, 96bp for AA (Mar 07 – Mar 08)



## Impact of credit spread margins - example

Characteristic	Annuity Portfolio
Average Duration (matched)	3 Years
FUM	\$1 billion
Credit Rating of Assets	50% AAA, 50% AA
Expected Profitability	0.1% of FUM

---

### Impact of Credit Spread Changes

---

Risk Free Rate	Government Bond Yields	Swap Yields
Expected Profit (\$ million)	\$1.0	\$1.0
Capital Loss (\$ million)	(\$45.60)	(\$22.80)

---



## Other impacts

- The investment profit of an annuity portfolio during the credit crisis would also have been impacted by:
  - Losses from credit rating migrations
  - Losses from credit defaults
  - Yield curve changes (if not cash flow matched)
- In practice it is generally difficult to understand the investment profit due to the number of possible factors impacting it.
- Investment profit can be multiples (several) of the expected profit margin.
- Conclusion - need a systematic methodology for attributing investment returns



Institute of Actuaries of Australia

# 4th Financial Services Forum

*Innovation in Financial Markets*

19 and 20 May 2008 – Melbourne

## SETTING THE SCENE



## Context - ALM defined

- Understanding and managing the interaction between asset-related risk drivers and liability-related risk drivers
- Objective: align the risks of the asset portfolio and liabilities within the risk objectives and appetite of the business





## **ALM NOT Matching**

ALM includes but is not limited to matching

*“Our portfolio is well matched”*

What does that mean?

- Duration matching
- Cash flow matching
- Bucket hedging



## Assumptions

- Business drivers have been defined:
  - Eg minimising capital, target ROC, target profit and profit volatility
- Investment strategy has been developed according to the nature of the liabilities, taking into account:
  - Expectations of policyholders - return, security
  - Expectations of shareholders - return, volatility, availability and amount of capital



## Analysis of profits

- It is assumed that a full analysis is being performed:
  - Profit margins, loss reversal for lifetime annuities, model changes
  - Investments
  - Mortality, expenses, commission etc
- This presentation focuses on the question: what caused the investment profits?
- The actions to be taken as a result are outside the scope of this presentation



## Investment profit volatility

- Caused by:
  - IFRS – valuing liabilities using risk-free discount rates and assets at market yields
  - Changes to yield curves
  - Changes to credit spreads
- Need to understand: how much of the investment profit/loss is attributable to which of these reasons (and others...)



Institute of Actuaries of Australia

**4th Financial Services Forum**

*Innovation in Financial Markets*

19 and 20 May 2008 – Melbourne

# ATTRIBUTION MODEL



## Attribution analysis

- Objective is to break down the investment profit/loss into:
  - Income factors: unwinding of discount
  - Market value factors: changes in market yields and discount rates
- Forms part of the overall analysis of profit for an annuity portfolio



## Income factors

- Unwinding of yield/discount
- Market yield can be broken down further into:
  - the risk-free rate
  - the credit spread
- Residual component, due to shape of the yield curve (“calendar” income)



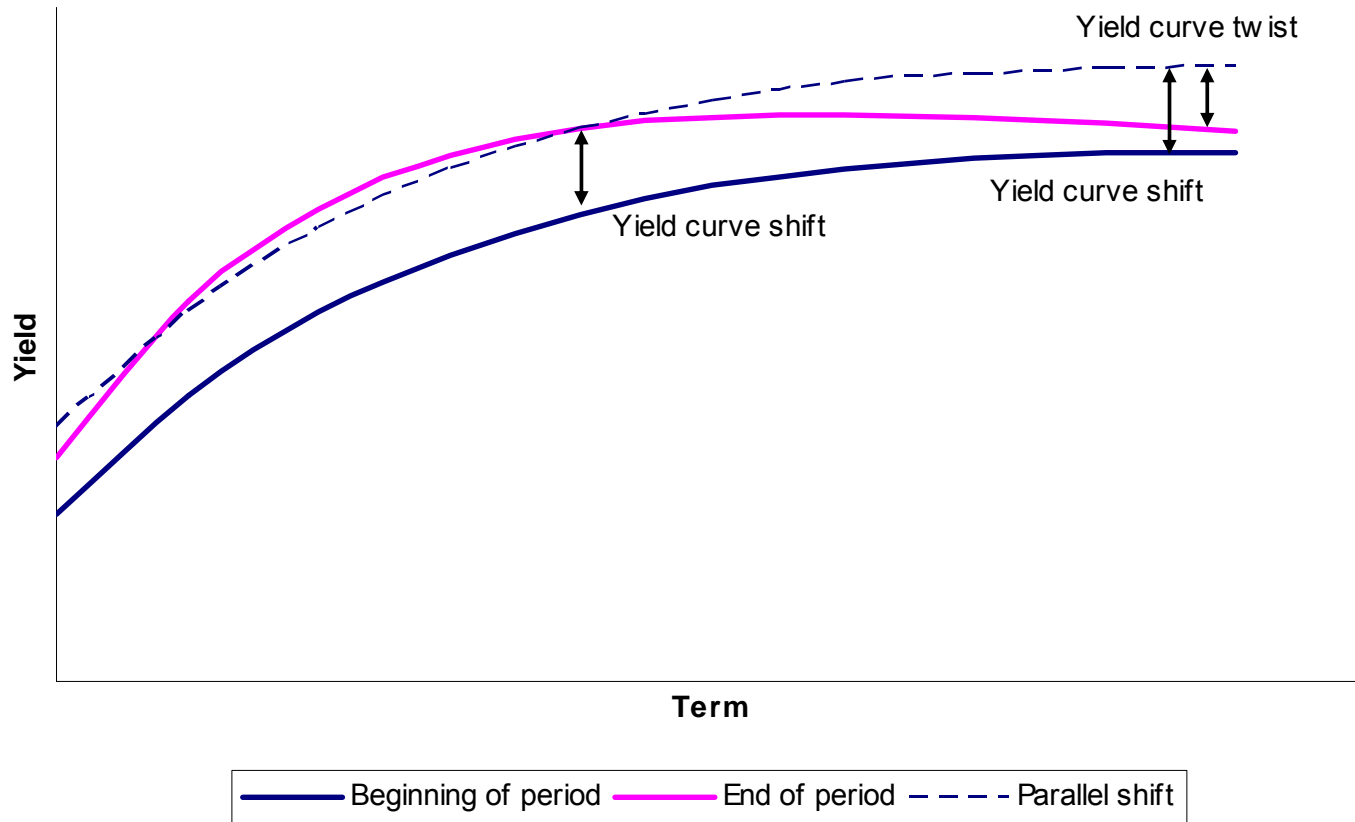
## Market value factors

- Changes due in risk-free yield curve:
  - Parallel movements (“shift” return)
  - Non-parallel movements (“twist” return)
- Changes in credit characteristics:
  - Credit migration
  - Movements in credit spreads
- Changes in inflation assumptions





# Main factors





## How to do it

- More than one way to do it
- Prerequisite: cash flow projections for assets and liabilities
- Performed at a security (ideal) or portfolio level



## How to do it

- Separate asset market yields into risk-free plus credit spread
- Income factors:  
 $(MV + \text{Weighted cash flows}) \times \text{Yield}$
- Market value factors
  - Value assets and liabilities using risk-free rates and credit spreads at the start of the period
  - Change these one at a time until they reach the ones applying at the end of the period



## How to do it

- Profit/loss associated with the factor is:
  - Change in assets – Change in liabilities
- Example: Profit due to parallel yield curve movements
  - Value assets and liabilities using risk-free yield curve at the beginning of period
  - Revalue them using risk-free yield curve shifted up or down by a defined amount (e.g. at portfolio duration)



## Simple example

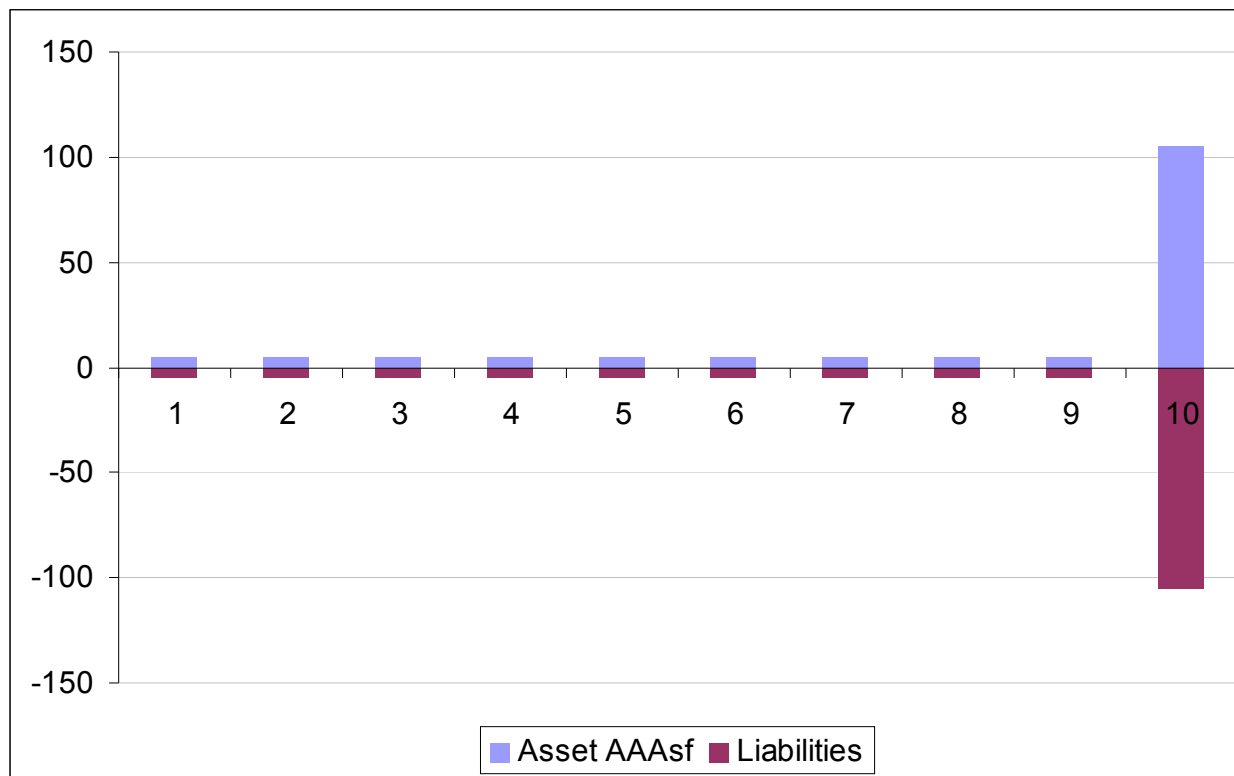
- How different matching approaches deliver different profit and loss outcomes
- How attribution analysis can be used to explain these outcomes to management



Institute of Actuaries of Australia

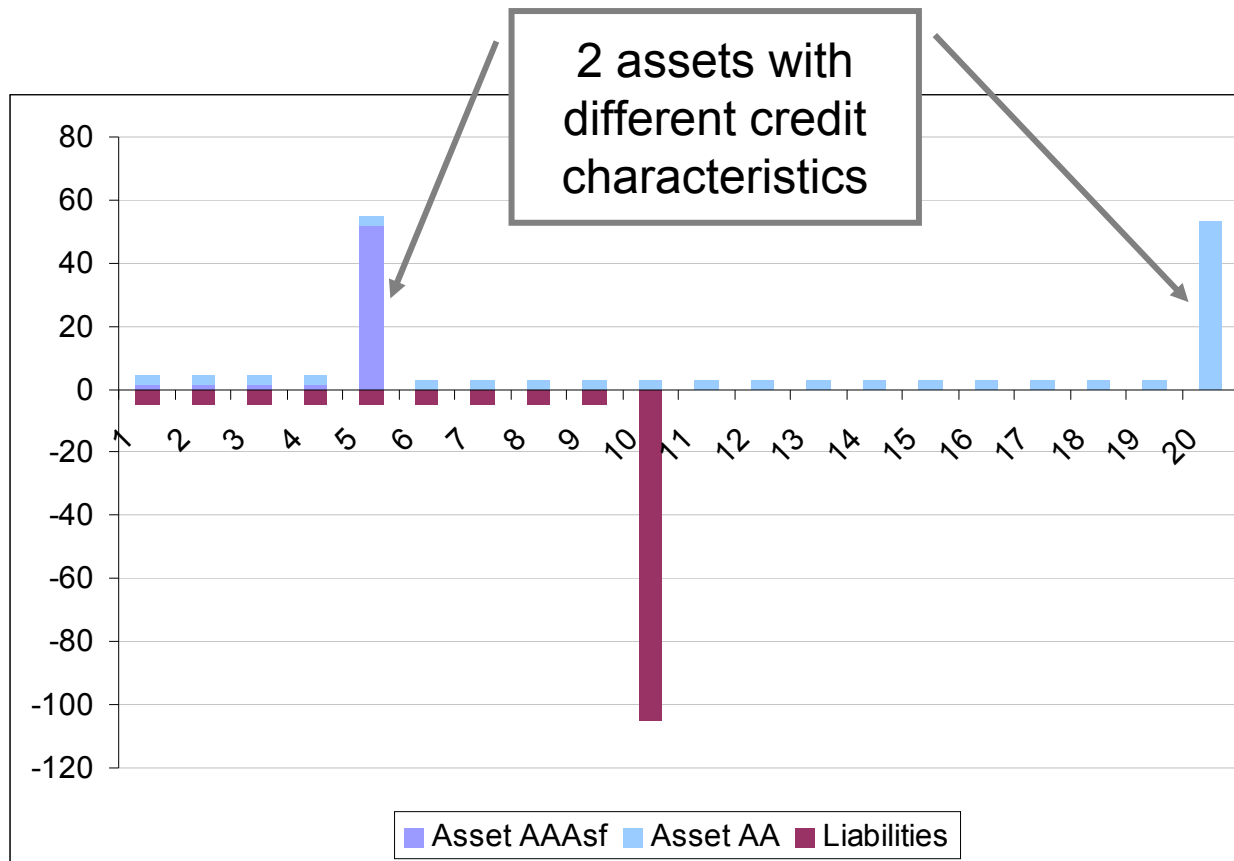
**4th Financial Services Forum**  
*Innovation in Financial Markets*  
19 and 20 May 2008 – Melbourne

## Portfolio 1: Cash flow matched



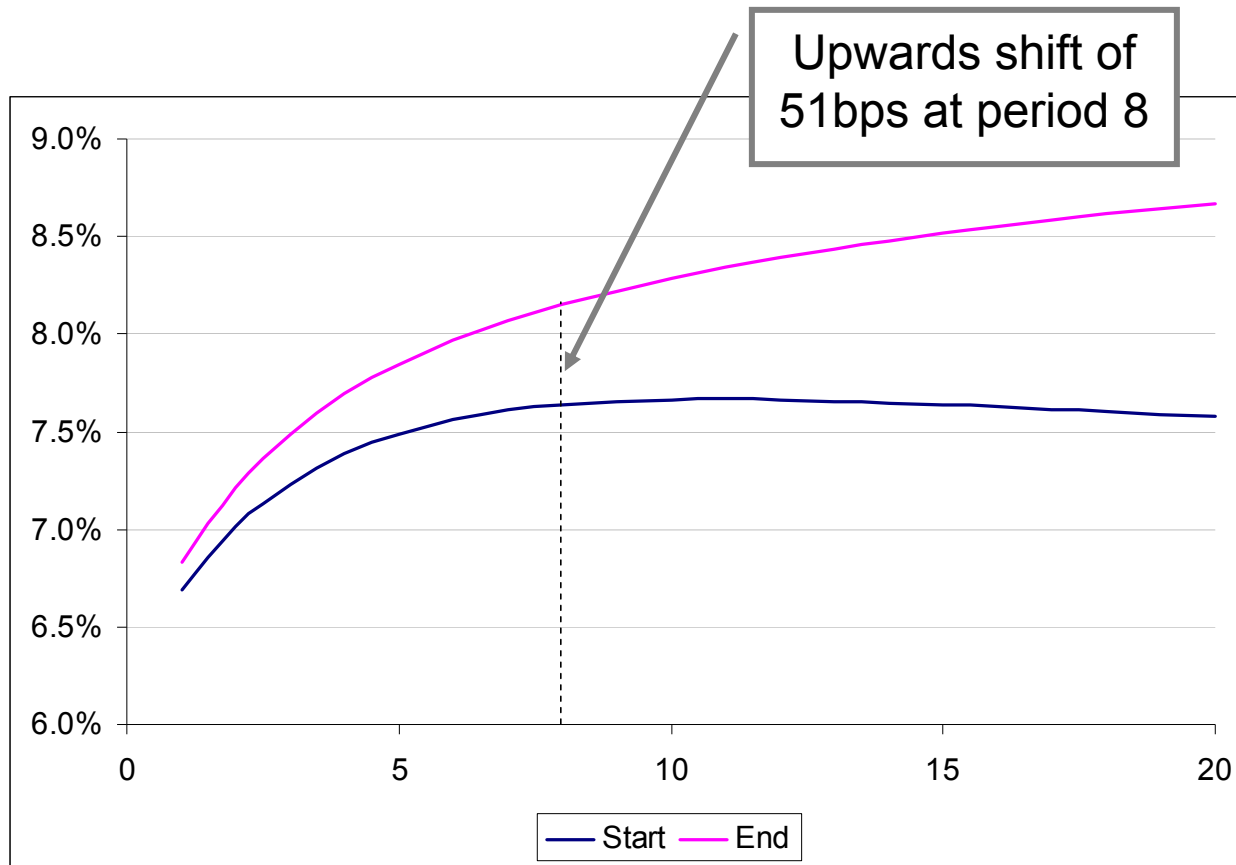


## Portfolio 2: Duration matched





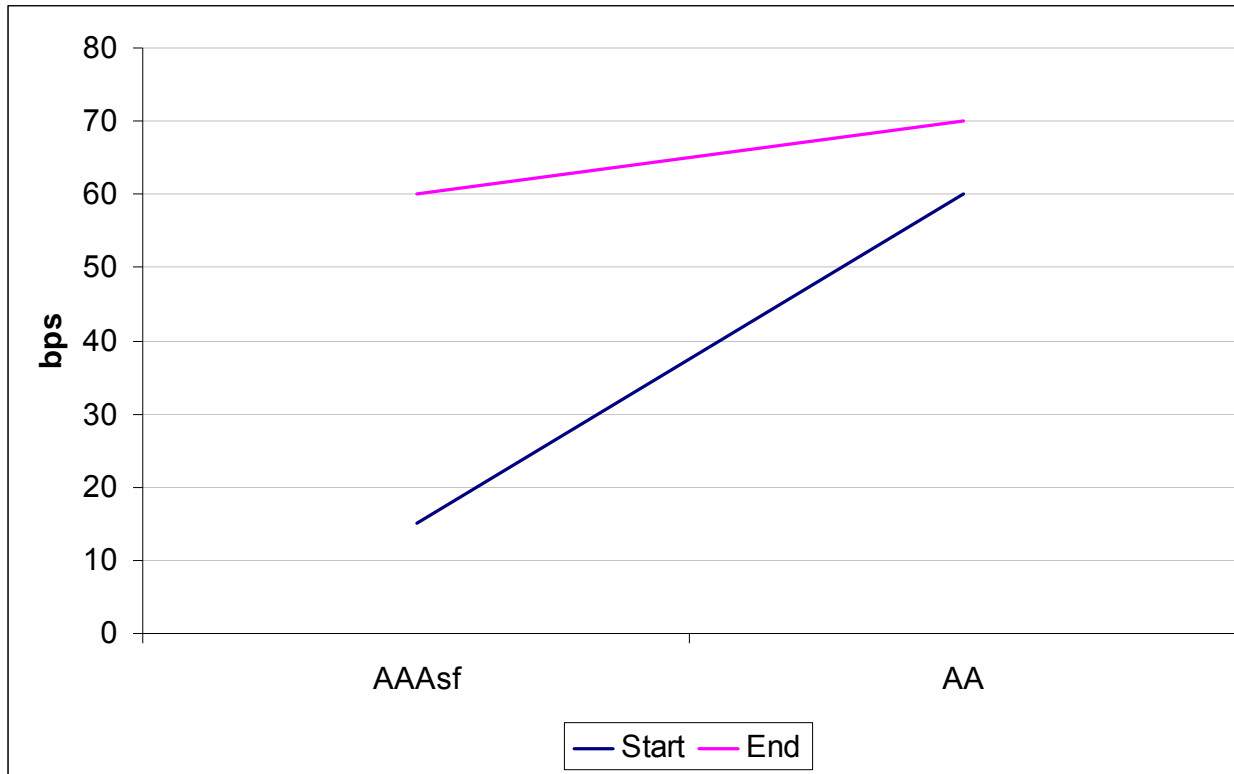
# Yield curve movements







# Spread movements





## Results: Portfolio 1

Item	Assets	Liabilities	Profit
Risk free income	6.2	6.3	-0.1
Credit income	0.1	0.0	0.1
Calendar income	0.1	0.1	0.0
Shift return	-2.8	-2.8	0.0
Twist return	-0.4	-0.4	0.0
Spread return	-2.3	0.0	-2.3
Residual	-0.1	-0.1	0.0
<b>Total</b>	<b>0.8</b>	<b>3.0</b>	<b>-2.2</b>

No impact from yield curve movements...

... but credit spreads can still provide significant impact

P&L impact can be significant when compared against an asset value of about 80

Numbers may not add up due to rounding.



## Results: Portfolio 2

Item	Assets	Liabilities	Profit
Risk free income	6.1	6.3	-0.2
Credit income	0.3	0.0	0.3
Calendar income	0.1	0.1	0.1
Shift return	-2.8	-2.8	0.1
Twist return	-1.2	-0.4	-0.8
Spread return	-1.0	0.0	-1.0
Residual	-0.2	-0.1	0.0
<b>Total</b>	<b>1.4</b>	<b>3.0</b>	<b>-1.6</b>

Duration matching provides some protection against parallel shifts of yield curve (51 bps) ...

... but not non-parallel twists, ...

... plus additional impact from credit spreads

Numbers may not add up due to rounding.



## Findings

- Almost all investment income can be broken down to a number of factors
- Duration matching may not provide protection during significant volatility in interest rate markets



## Stress testing

- The same process can be used to test the portfolio, using stressed yield curve and credit spread scenarios



Institute of Actuaries of Australia

**4th Financial Services Forum**

*Innovation in Financial Markets*

19 and 20 May 2008 – Melbourne

# TRICKS FOR THE BEGINNER



## Practical issues

### Alignment with management reporting

- Ensure asset values in attribution model agree with values in investments asset registry system and in general ledger
- Ensure investment income being analysed agrees with investment income in ledger
- Ensure liability values in attribution model agree with actuarial valuation



## Swap curve

- Need continuous swap curve to derive appropriate discount rates but swap rates are only available at certain points
- Consider interpolation methods
- Consider how to set assumptions for long term liabilities (eg beyond 20 years) where swap curve data is poor





## Inflation

- Potential mismatch between quantum of indexed-linked assets and CPI-linked liabilities
- Mismatch of cash flows of indexed assets and liabilities
- Differences among:
  - Inflation assumed in current market value of indexed-linked assets
  - Future inflation assumption for cash flows of indexed-linked assets
  - Future inflation assumption for CPI-linked liabilities



## Transactions and cash flows

- Analysis typically based on end of month data
- Adjustment required for new business during the period under review
- Adjustment required for asset transactions during the period



## Frequency of analysis

- Monthly results more accurate as assumption changes and residual items of the attribution have less impact
- Assumptions on cash flows are less accurate if analysis is over longer period
- Monthly analysis is more labour intensive than producing results on a YTD basis



## CONCLUSION

- For annuities the investment profit can be very large, relative to other experience items.
- Attribution model provides insight into causes of investment profit/loss
- This enhances management's understanding of drivers of business
- Leads to review of risk appetite, investment strategy