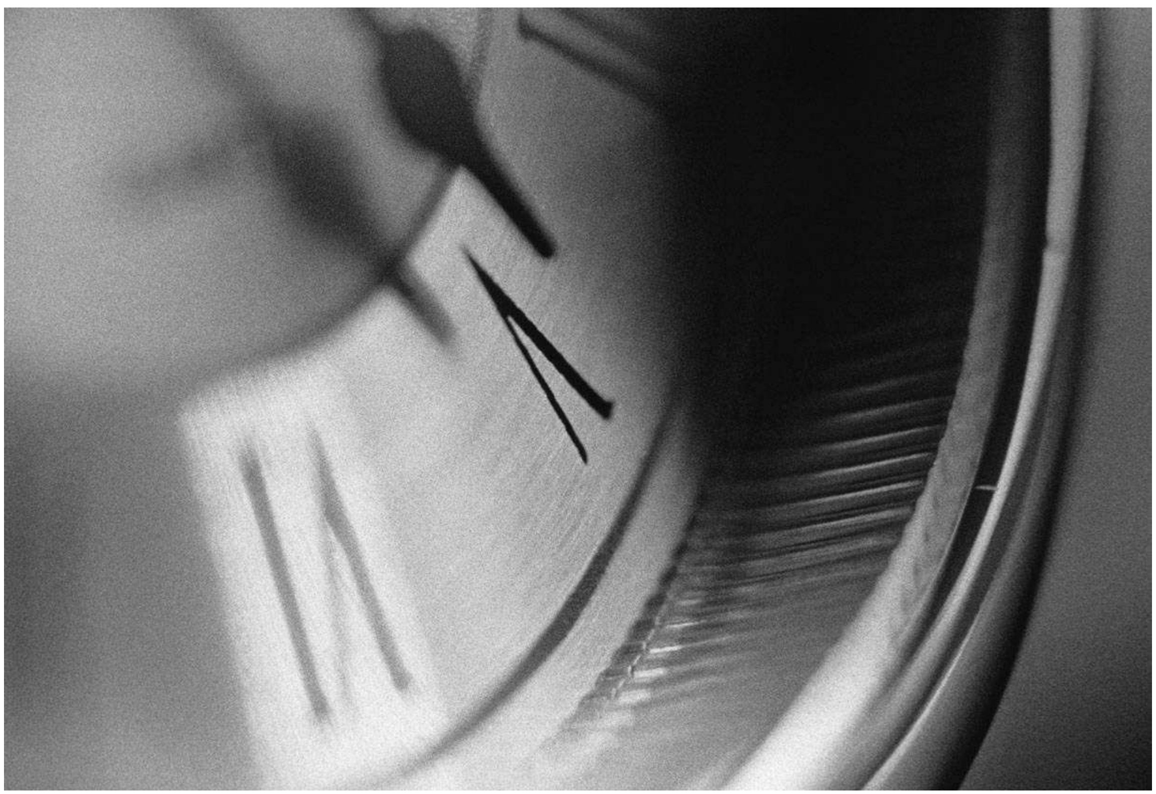
Revenue Management & Insurance Cycle

2009 CAS Ratemaking Seminar CP1 – JB Crozet



Agenda

1 **What is revenue management?**

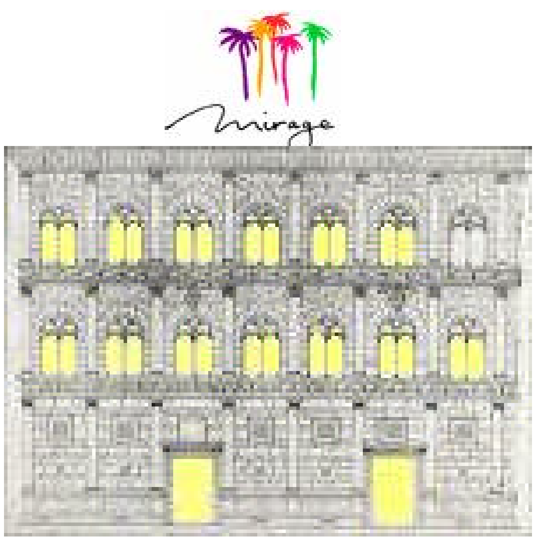
2 The modelling framework

3 A case study

4 Managing the insurance cycle

An accommodating example...

- Revenue management is an attempt to respond to the question: “which pricing strategy should I use to maximise my profits?”
- Revenue management has been adopted in several industries: airlines, hotels, car rentals… with fixed supplies of perishable goods/services.



… with insurance applications

- In insurance markets with full flexibility in price setting.
- Capacity is the fixed and perishable resource:
  - allocated capital: capacity consumed by writing the policy.
  - fixed, at least in the short-term.
  - perishable: unused capacity can not be transferred to next year.
- Price is defined by:
  - target required return on the allocated capital ("target ROE").
  - independent from expected losses and expenses.

A different pricing perspective

Traditional Approach	RM Approach
▪ Target ROE is fixed, determined by shareholders expectations.	▪ Target ROE is adjustable to meet the business flow and market conditions.
▪ Capacity is adjustable to meet the business flow and market conditions.	▪ Capacity is fixed, determined by the insurer's capital base.

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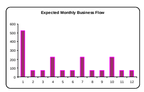
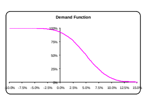
The revenue management approach

- Revenue management combines capacity, business flow and market conditions to derive the optimum price

business flow



demand function

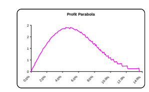


+

remaining capacity at time t

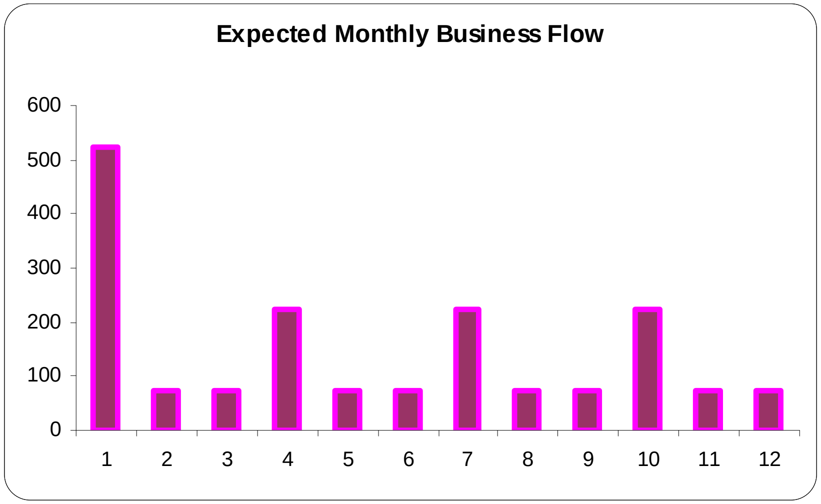
=

optimum price



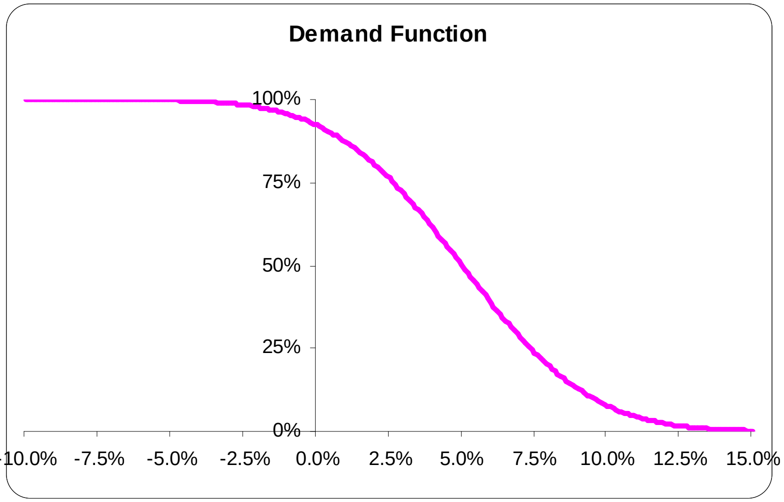
Business flow

- Business flow N(t) represents the requests for the insurer's capacity (i.e. quotes).
- N(t) depends on: overall demand for the insurer's products, effectiveness of marketing and distribution network and seasonal fluctuations.
- Parameterisation: business planning and historical observations, after allowing for anticipated trends and future changes in the business flow process.



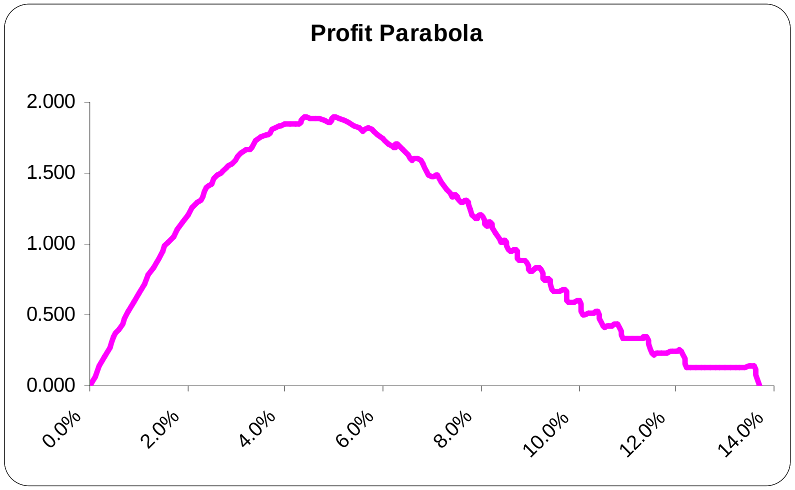
Demand function

- Demand function d(t,r(t)) reflects the price-elasticity relationship between the level of required return and the quantity of capacity sold at that level.
- It can be described as the probability distribution for transforming a quote into a policy, and depends on the market returns level.
- Parameterisation: empirical observations of ”hit ratios” or quotations systems.



Optimum price

- The optimum price results from the best balance between business volume and profit margins.



$\tau_{r,t,st}$: time when capacity is exhausted

$$\Pi^*(t,s_t) = \sup_r \Pi(t,s_t,r_t) = \sup_r E\left[\int_t^{\tau_{r,t,st}} e^{-\rho u} r(u)\, K(u,r(u))\, du\right]$$

ρ: discount rate

r(t): target return at time t

K(t, r(t)): volumes sold, given r(t), d(t,r(t)) and N(t)

Dynamic programming

- Dynamic programming is concerned with dynamic systems and their optimisation over time.
- Principle of Optimality: "An optimality policy has the property that whatever the initial state and initial decision are, the remaining decisions must constitute an optimal policy with regard to the state resulting from the first decision", with Bellman Equation:

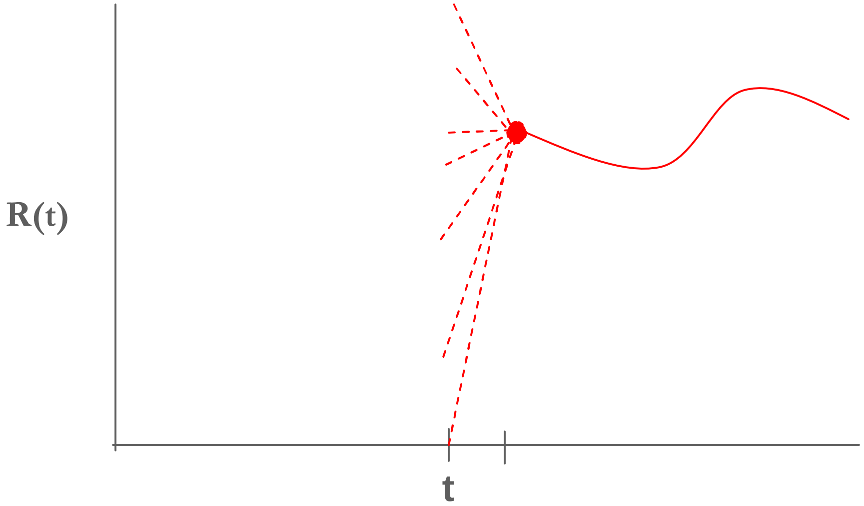
Optimisation equation until θ

$$\forall \theta \in [t,T], \quad \Pi^*(t,s_t) = \sup_r \left[E[\int_t^{\theta} e^{-\rho t} r(u) K(u, r(u))) du] + e^{-\rho(\theta - t)} \Pi^*(\theta, s_\theta) \right]$$

Optimum from θ onwards

Backward recursion algorithm

- We compute our numerical solutions to the “discretized” optimization problem using the backward recursion algorithm. This approach consists in:



- The advantage of the backward recursion approach is its computational efficiency, resulting from the principle of optimality.

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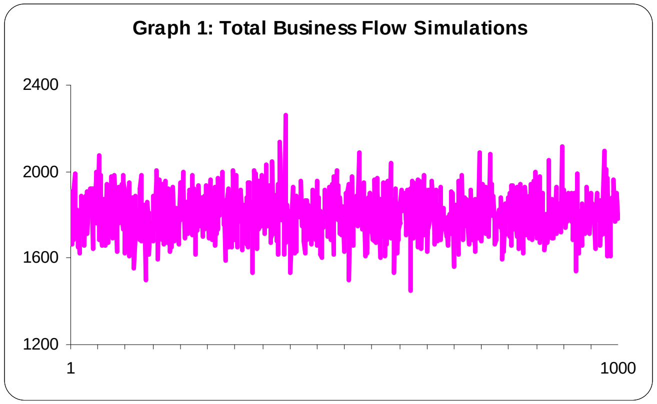
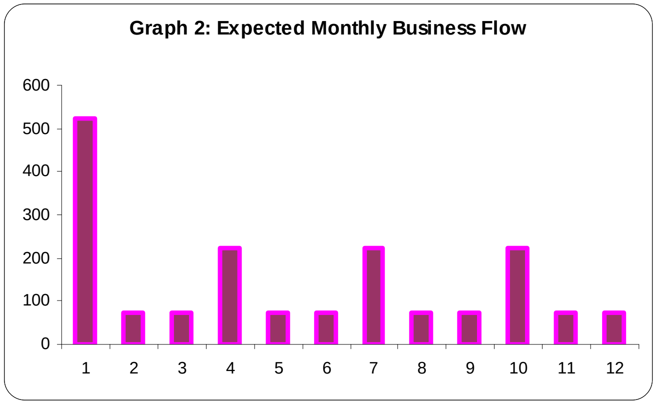
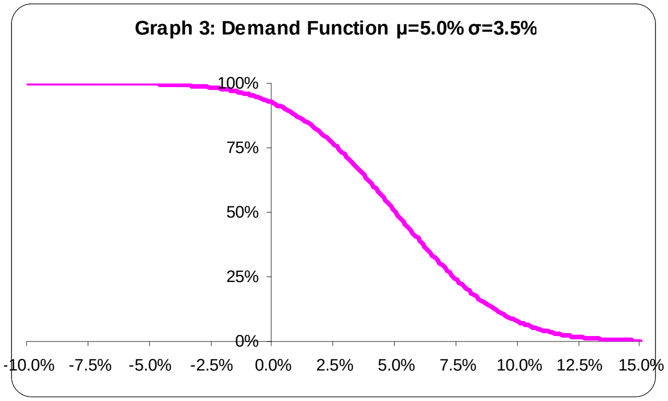
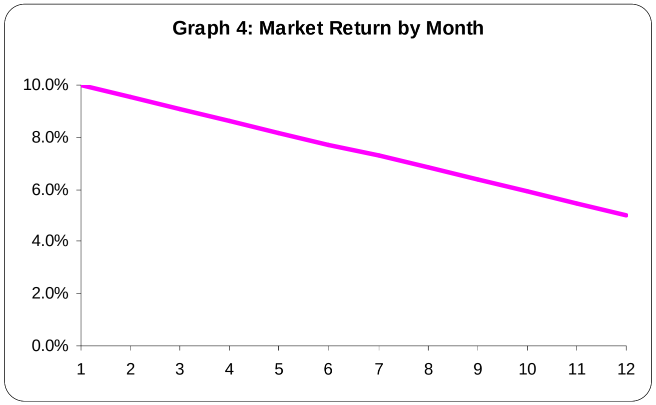
Case study scenario

- Insurer with $ 1bn capacity to deploy over 12 months







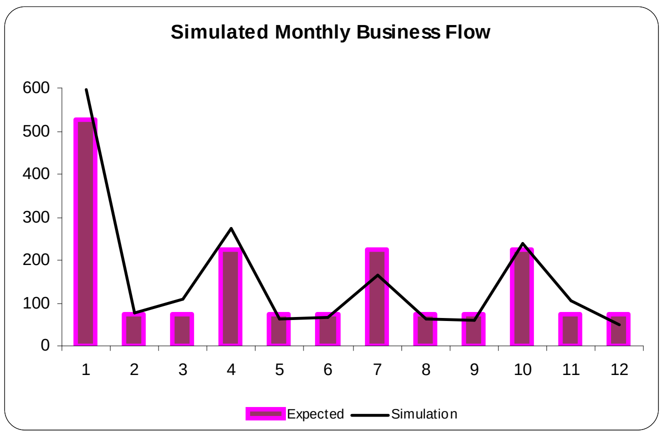


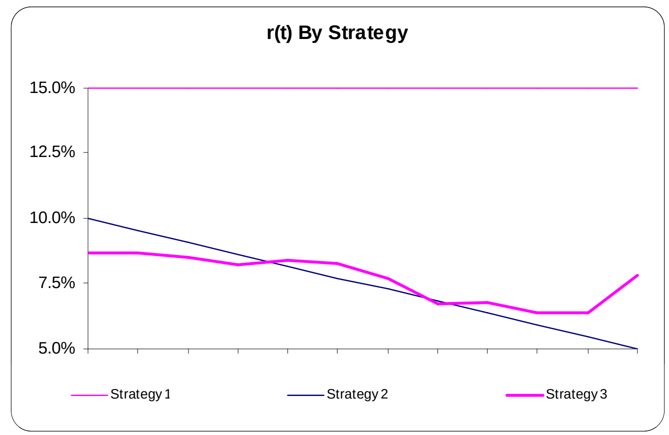
Alternative strategies

- We have contrasted the following strategies:
  - Strategy 1: “charge 15% return for the year”, based on target return to shareholders.
  - Strategy 2: “charge the market return each month”, based on anticipated market conditions for each month.
  - Strategy 3: “charge the target return each month”, dynamically adjusted to reflect actual writings, remaining capacity and anticipated demand conditions.

Comparative results

- Each strategy yields a different pricing approach and result:





	Strategy 1	**Strategy 2**	**Strategy 3**
$\bar{r}$	15.0%	8.1%	7.6%
Sales $m	65	920	995
Profit $m	9.7	71.6	75.7

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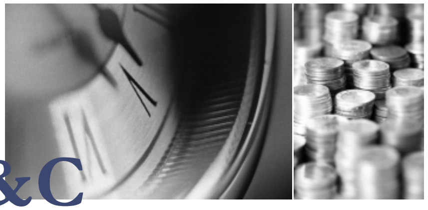
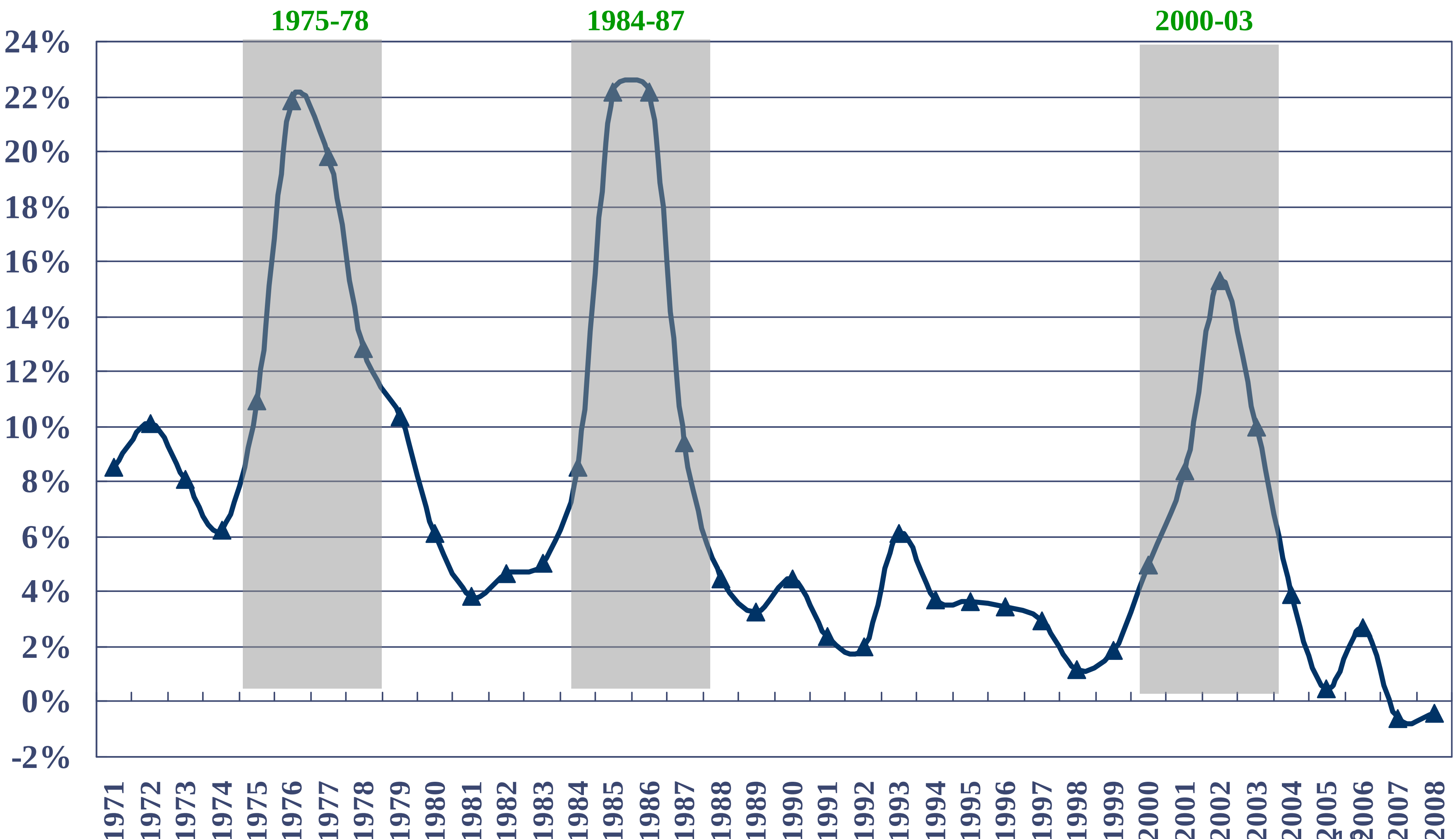
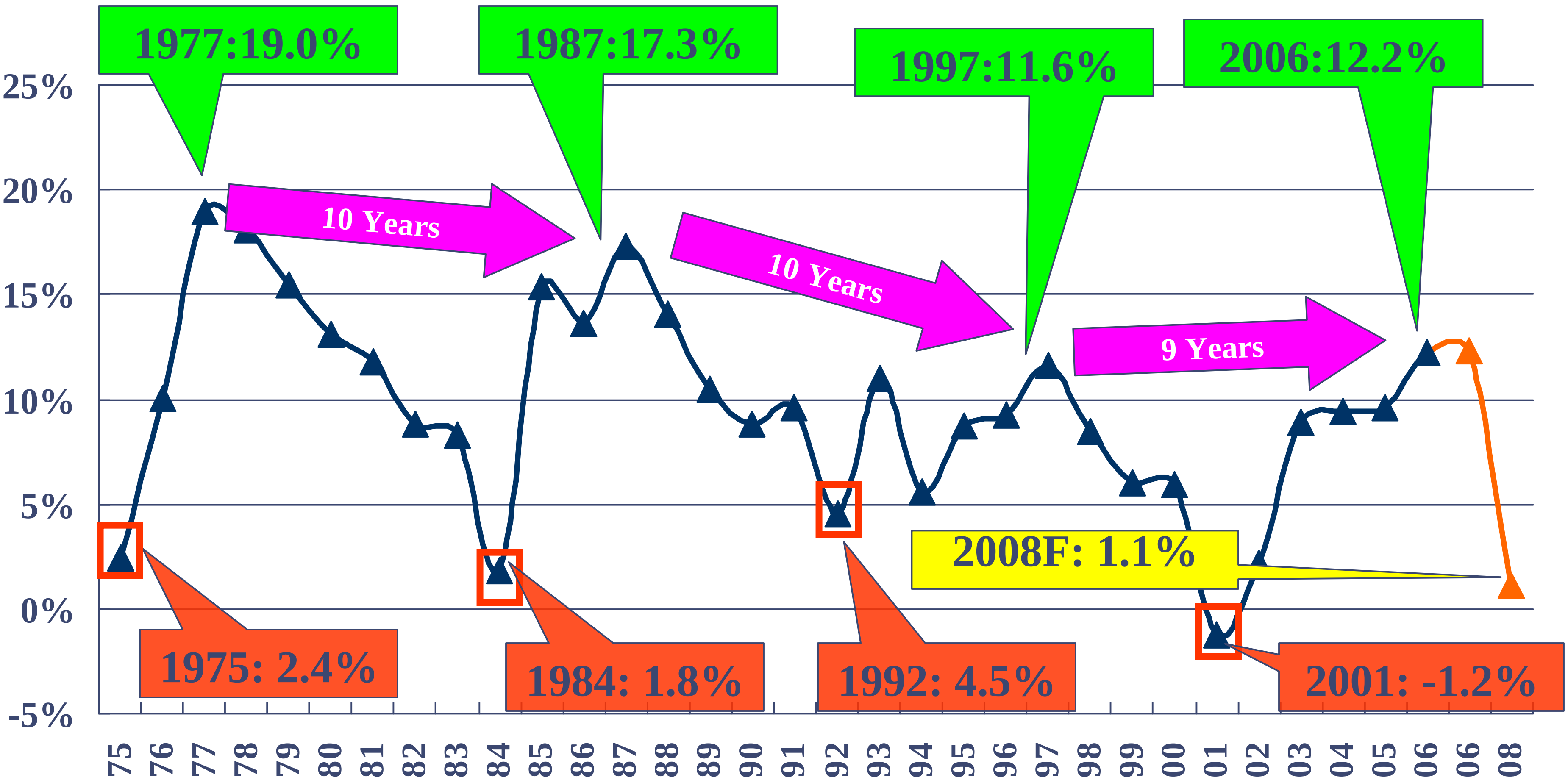


The insurance cycle: NWP Change for US P&C



Sources: A.M. Best, ISO, Insurance Information Institute

The insurance cycle: ROE for US P&C



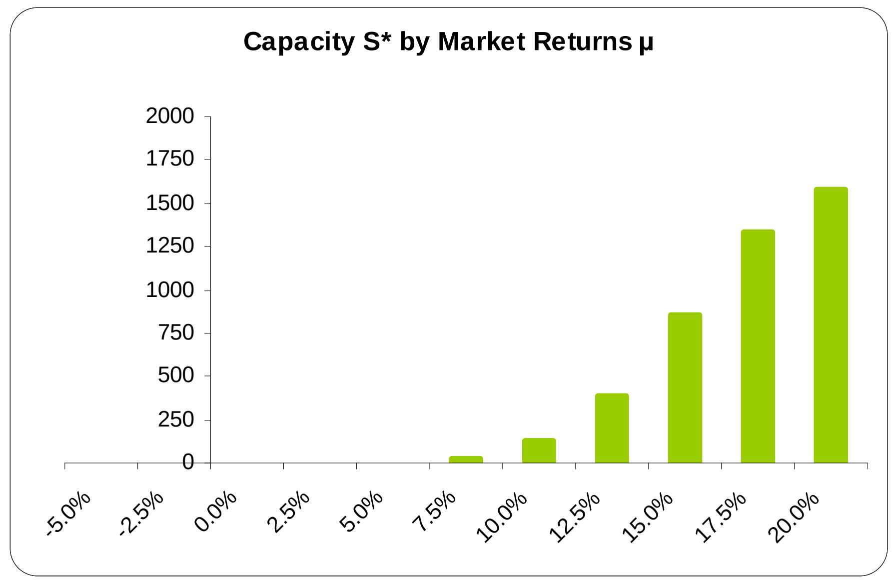
Note: 2008 figure is actual 9-month result.
Sources: ISO; Insurance Information Institute.

Capitalisation strategy

- Raise capital and increase volumes when the market is hard, reduce capital and write less when rates soften.

Capitalisation Strategies

- Target ROE is fixed, determined by shareholders expectations.
- Capacity is adjustable to meet the business flow and market conditions.



Capitalisation strategy

- Popular approach with an increasing number of companies adjusting their capacity in response to fluctuations in supply/demand: capital raising activity post-9/11 and post Katrina, active dividend policies, share buy-back strategies., broad support from the investment community.

- Practical limitations: 1) require frequent and large adjustments to avoid idle capital and deliver the required returns; 2) raising and returning capital is cumbersome and expensive, and can be interpreted negatively by the markets, 3) timing issues, when raising capital post-catastrophe; and 4) little flexibility for fine-tuning, if the assumptions turned out to be wrong.

- These obstacles limit the usage of capitalisation strategies to large fluctuations in the cycle, such as large catastrophe.

Active pricing strategy

- Often used by insurers through a fairly informal process, largely uncoordinated and not aligned with technical pricing.
- Revenue management techniques can help formalise underwriters' intuition and judgment.

Capitalisation Strategies	Active Pricing
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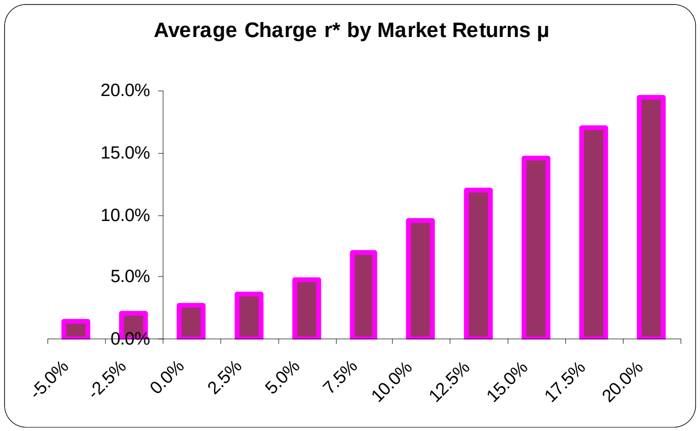
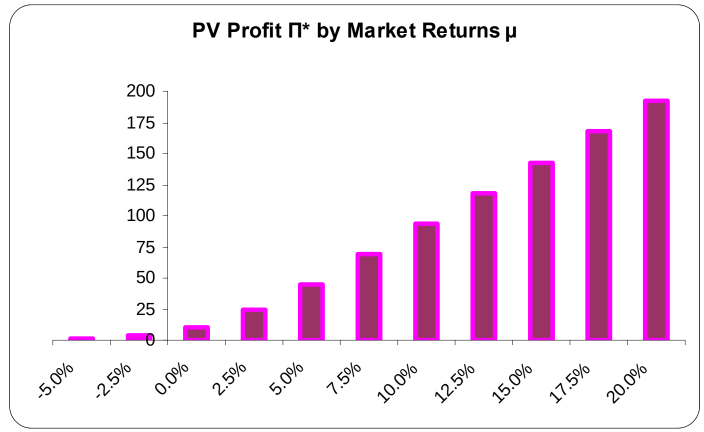
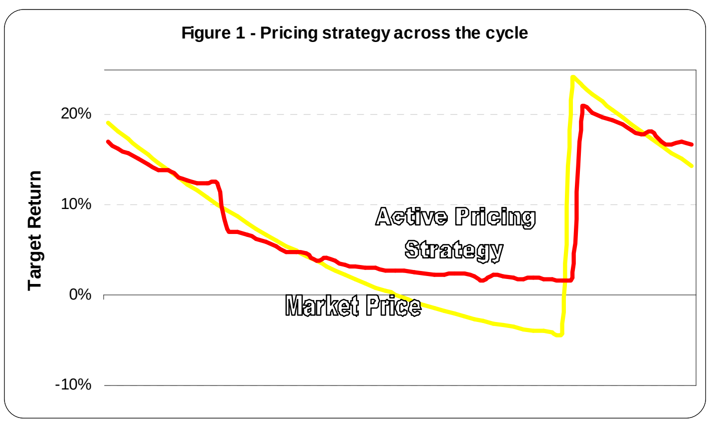
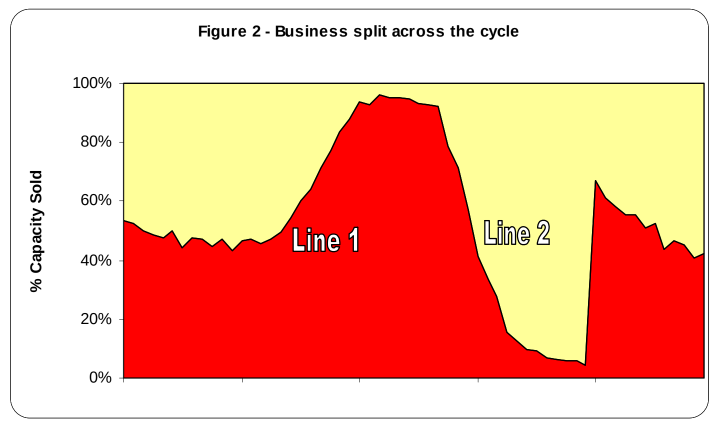
Active pricing strategy









Conclusions

- Insurance is facing the same constraints than other industries with a fixed capacity of perishable goods/services (e.g. hospitality, airlines).

- Revenue management techniques can be useful tools to determine the optimal pricing strategy in the market conditions, and could form part of the pricing actuary's toolkit.

- In particular, revenue management can provide a more flexible alternative to the capacity strategies currently used to manage the insurance cycle.

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