

The History of ASTIN

Lecture at the 50th anniversary of ASTIN
ASTIN Colloquium Orlando (USA)

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Outline

Prologue

A First Attempt

The Successful Event

Early Ideas

Refinements

- Fluctuating basic probabilities

- Inclusion of Experience Rating and Interest

- Martingales

- Ideas from other sources

- Economics

Epilogue

Prologue

“**War** is the father of all **things**” (Heraklit)

- ▶ **things** ~ inventions
- ▶ **war** ~ World War II (1939-1945)
 - Nuclear Fission
 - Programmable Electronic Computer
 - Radar
 - Penicillin

In applied mathematics

- Game Theory (Neumann-Morgenstern 1944)
- Linear Programming (Dantzig 1947, Kantorovich 1939)
- Sequential Statistical Testing (Wald 1944)

Generally speaking:

Probability Theory
and
Mathematical Statistics



assumed important role

Mathematicians and Actuaries

Served in special units

- Cryptology Units
- Operations Research Units

After the war the new topics were continued

- Operations Research
- Linear Programming
- Quality Control
- Decision Theory

What about new orientation in the Insurance Sector

Big Step:

Filip Lundberg 1909: Insurance Activity \sim Stochastic Processes

Harald Cramér 1930

Role of practical actuaries:

Wanted to make use of new skills developed while serving:

- i) Applications of **Mathematical Statistics** in all areas of insurance
- ii) **Stochastic Modeling** of insurance process
- iii) **Decision Theoretic Analysis** of management activities

Groups forming in

Scandinavia (around Cramér)

Segerdahl, Johansen, Benckert, Philipson, Sternberg, Benktander, Pentikäinen, Ove Lundberg, Sparre Anderson, Wilhelmson

Italy

Cantelli, de Finetti, Giuseppe Ottaviani

France

Dubourdieu, Depoid

Important singletons

Beard (GB), Franckx (B), Ammeter (CH)

Inside the Casualty Actuarial Society

Arthur Bailey, Perryman, Longley-Cook

A First Attempt

International Congress of Actuaries, Madrid, **June 1954**

Meeting scheduled with lectures by

- **Ingvar Sternberg:** The fire frequency in relation to working hours in industry
- **Hans Ammeter:** Collective risk theory

Formal foundation of the new Association planned

- Foundation did **not** take place
- Discussion becoming **emotional**

The Successful Event

Inaugural Meeting of ASTIN

October 16, 1957 at 2.30 pm Hotel Commodore in New York

46 members

Still alive: Paul Johansen, Gunnar Benktander

Agenda

- ▶ Agreement on rules of section ASTIN
- ▶ Election of first committee
 - **Sir George Maddex:** representing Comité Permanent
 - **Robert Beard:** Secretary
 - **Edouard Franckx:** Editor
 - **Paul Johansen:** Chairman
 - **Boleslaw Monic**
 - **Francis Perryman:** soon replaced by Norton Masterson
 - **Carl Philipson**

MINUTES OF THE INAUGURAL MEETING OF ASTIN16th October 1957 - 2.30 p.m.Hotel Commodore, New York

Present: 46 members as follows:-

B. Almer	E. H. Klepetar
H. Ammeter	G. Lanteli
R. E. Beard	G. Cheneaux de Leyritz
L. Benckert	J. Linder
G. Benktander	Sir George Maddex
G. A. Berggren	N. E. Masterson
J. A. T. M. Brans	J. A. Mills
H. Cramer	B. Monic
P. Depoid	K. Munch
J. Edwards	E. Nicholson
B. de Finetti	R. W. Parlin
R. Fondiller	C. Philipson
E. Franckx	P. R. Qvale
N. M. Franklin	H. W. Schloss
J. L. Francois	C. Schweder
P. Francois	J. Sousselier
H. Harlen	I. Sternberg
F. Harwayne	R. Themptander
H. Hellemann	A. Thepaut
M. Henry	L. Wilhelmsen
P. Johansen	M. Wollner
B. H. de Jongh	Others
W. Kading	

Session Subject IV A of ICA New York

“Analytical Expressions of Risks Involved in General Insurance”

16 papers:

- ▶ 7 from Sweden
- ▶ 2 from Danmark
- ▶ 2 from Italy
- ▶ 1 from England
- ▶ 1 from Netherlands
- ▶ 1 from Belgium
- ▶ 1 from France
- ▶ 1 from Switzerland

Introductory report by C. A. Spoerl

Early Ideas

Two fundamental problems according to Cramér, 1955

- The distribution of total claims at fixed time t
- The stochastic process of the surplus

Problem 1: The distribution of total claims at time t

$$R(t) = \sum_{j=1}^{N(t)} Y_j,$$

$N(t)$: number of claims in $[0, t]$

Y_j : amount of claim number j

Typical assumption:

$\{N(t), Y_1, Y_2, \dots\}$ independent

$Y_j \sim F$ identically distributed

Find:

standard form

$$G_t(x) = \mathbb{P}[R(t) \leq x] = \sum_{n=0}^{\infty} p_n(t) F^{*n}(x) \stackrel{\downarrow}{=} \sum_{n=0}^{\infty} e^{-\lambda t} \frac{(\lambda t)^n}{n!} F^{*n}(x)$$

Brilliant idea: $N(t)$ homogeneous due to choice of time scale

► operational time

Task of Nonlife actuary

Find:

$F(x)$: distribution of single claim amount

$p_n(t)$: distribution of number of claims

Calculate:

$G_t(x) = \sum_{n=0}^{\infty} p_n(t) F^{*n}(x)$ distribution of total claims

Originally: Ingenious Exercise in Convolutions and/or Complex Analysis Approximations (e.g. NP method)

Harry Panjer, 1980: Risk theory numerics ► solution by recursion

Another way: Fast Fourier Transform

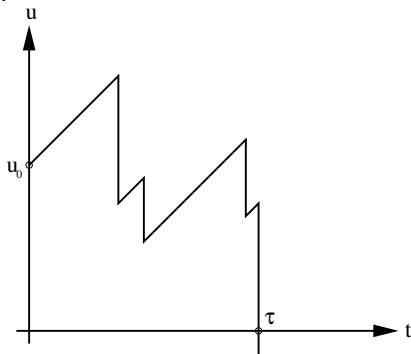
Problem 2: The stochastic process of the surplus

Given the process of the surplus

$$\{U(t) = u_0 + ct - R(t); t \geq 0\}$$

Find the probability of ruin:

$\psi(u_0) = \mathbb{P}[U(t) < 0, \text{ for one } t \in (0, \infty)] = \mathbb{P}[\tau < \infty]$,
with τ ruin time.



When is a risk process of an insurance company acceptable?

Founding fathers of risk theory:

Attitude of engineer

Control probability of failure

Other attitudes:

Profitability?

Fairness for the insured?

Alternative view by Bruno de Finetti

Refinements:

1. Fluctuating basic probabilities

Practitioners raise the question of parameter risk:

$$G_t(x) = \sum_{n=0}^{\infty} p_n(t) F^{*n}(x)$$

“Parameters”

λ , $F(x)$: uncertainty, not constant over time

Ove Lundberg, Hans Ammeter

chose λ **at random**

► model becomes **more realistic**

2. Inclusion of Experience Rating and Interest

Experience Rating: c depends on past experience

Interest: δ instantaneous rate

Surplus process in differential form:

$$U(0) = u_0$$

$$dU(t) = cdt + U(t)\delta dt - dR(t)$$

We have now **great freedom** of modeling:

Claims process $R(t)$	premium c	interest δ	
Compound Poisson	fixed	0	Lundberg/Cramér
Compound Poisson	fixed	fixed $\neq 0$	Segerdahl/Gerber
Weighted CP	Bayes	0	Dubey
Weighted CP	Bayes	fixed $\neq 0$	not solved
Compound Poisson	fixed	stochastic	not solved
Weighted CP	Bayes	stochastic	not solved

Analytical mathematics **reaches its limits**

Way out

- **Computer Simulation**
- **Dynamic Financial Analysis (DFA)**

Point of view of monograph by Daykin, Pentikäinen, Pesonen

3. Martingales

Hans Gerber (1973), idea de Moivre:

$$\{U(t) = u_0 + ct - R(t); t \geq 0\}$$

Associated Martingale:

$$M(t) = e^{-kU(t)},$$

with properly chosen k :

$$\lambda + ck = \lambda \mathbb{E}[e^{kY}]$$

- ▶ probability of **ruin** calculation becomes easy
- ▶ bridge to mathematical **finance**

4. Ideas from other sources

In 50 years **ASTIN**:

- enormous evolution
 - emancipated from ideas of founders
-
- ▶ **Credibility** Theory
 - ▶ Claims **Reserving**
 - ▶ **Tariff** Factorization
 - ▶ **Solvency** Margins
 - ▶ **Premium Calculation** Principles
 - ▶ **Extreme Values** – Catastrophes
 - ▶ **Reinsurance**
 - ▶ **Risk** Measures – Capital **Allocation**

5. Economics

New York, 1957:

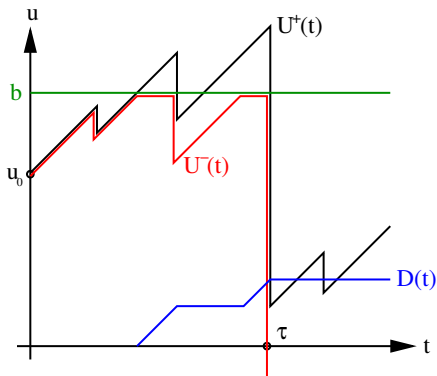
de Finetti proposes economic goal

“Maximize the Value of the Firm”

First volume of ASTIN Bulletin:

2 articles of Karl Borch, who has thought us

- utility theory
- risk exchanges - with the fundamental Theorem of Borch
- has also fully exploited de Finetti's proposal



$U^+(t)$: Surplus cum dividend

$U^-(t)$: Surplus without dividend

$D(t)$: accumulated dividends

Introduce:

$$V(u_0, b) = \mathbb{E} \left[\int_0^\tau e^{-\delta\tau} dD(\tau) \right]$$

Value of firm = Expected value of discounted dividends

Goal: Find b^* such that $V(u_0, b^*) = \max$

Shift of paradigm

“Probability of ruin” to “Value of the firm”
engineer \longleftrightarrow economist

Changes the behavior of the firm:






- risks with negative premium loading may be desirable
- early ruin may be desirable

Caveat: In practice economic paradigm needs side conditions.





Epilogue

- Many ideas of ASTIN today were already discussed at the time of foundation
- ASTIN ideas are driven:
 - not by short term urgency
 - but by long term persistence
- ASTIN is the trademark of a culture

References I

-  Lundberg, F. Zur Theorie der Rückversicherung. *Berichte des Internationalen Kongresses der Versicherungsmathematiker*, Wien, 1909.
-  Cramér, H. Collective Risk Theory, a survey from the point of view of the theory of stochastic processes. *Skandia Jubilee Volume*, Stockholm 1955.
-  Ammeter, H. A Generalization of the Collective Theory of Risk in Regard to Fluctuating Basic Probabilities. *Skandinavisk Aktuarietidskrift*, 1948.
-  Lundberg, O. On Random Processes and Their Application to Sickness and Accident Statistics. University of Stockholm Thesis, Uppsala, 1948.
-  Panjer, H.H. The aggregate claims distributions and Stop Loss in reinsurance. *Transactions Society of Actuaries*, 1980.

References II

-  Gerber, H.U. Martingales in Risk Theory. *Mitteilungen Vereinigung Schweizer Versicherungsmathematiker*, Heft 2, 1973.
-  de Finetti, B. Su un'impostazione alternativa della teoria collettiva del rischio. *Transactions XV Int. Congress of Actuaries*, New York, 1957.
-  Borch, K. Reciprocal Reinsurance Treaties. *ASTIN Bulletin*, Vol. 1, 1960.
-  Borch, K. The Utility Concept Applied to the Theory of Insurance. *ASTIN Bulletin*, Vol. 1, 1960.