WELCOME

Svein Børre Solvang
Translation Service
Program & list of attendees are now available online

www.beekast.com/nordic18
Improving Health and Wellness will contribute to the society as a whole

Health is the new wealth

As we believe in the active role of the life (re)insurance industry in offering policyholder benefits that promote healthy lifestyle choices and help manage medical conditions.
Pace of change increasing in the Life insurance industry

Moving from traditional risk-driven value chains...

- Pools of consumers
  - "Life insurance is sold, not bought"
- Distribution
- Insurer / Risk carrier
- Broker
- Reinsurer
- Bank
- Retrocessionaire
- Capital market

...to new consumers’ needs ecosystem

- Consumer
  - Data-driven need analysis
  - Health-as-a-service
- Consumer Gateway (Health)
  - Mobility gateway
  - Housing gateway
- Insurers / risk carriers
- Wellness platforms
- Para-medical services
- Reinsurers
- Health providers

The change in the life insurance industry is challenging the traditional role of life reinsurers while offering new opportunities for growth.
SCOR continues to leverage on its proven strategic cornerstones

**Strong Franchise**
- Make SCOR the preferred choice for its clients
  - Strong client relationships
  - Best-in-class services
  - Product innovation
  - Consistent expansion into new markets

**High Diversification**
- Increase the return on equity through required capital diversification benefits
  - Between Life and P&C
  - By geography
  - By lines of business
  - By types of retrocession

**Robust Capital Shield**
- Improve the stability of results
  - No annuities in the Life portfolio
  - Limited U.S. casualty business
  - Low U.S. cat exposure
  - Conservative asset management

**Controlled Risk Appetite**
- Protect shareholders’ equity
  - Traditional retrocession
  - Alternative risk transfer solutions
  - Buffer capital
  - Contingent capital facility
SCOR maintains a well-balanced risk composition that provides superior diversification benefit

**H1 2018 risk capital breakdown by risk category**

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Required Capital Before Diversification and Taxes</th>
<th>Diversification</th>
<th>SCOR SCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>P&amp;C Underwriting</td>
<td>3.2</td>
<td></td>
<td>41%</td>
</tr>
<tr>
<td>Life Underwriting</td>
<td>3.4</td>
<td></td>
<td>46%</td>
</tr>
<tr>
<td>Market</td>
<td>1.9</td>
<td></td>
<td>9%</td>
</tr>
<tr>
<td>Credit</td>
<td>0.4</td>
<td></td>
<td>3%</td>
</tr>
<tr>
<td>Operational</td>
<td>0.3</td>
<td></td>
<td>1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9.2</strong></td>
<td><strong>-47%</strong></td>
<td><strong>4.3</strong></td>
</tr>
</tbody>
</table>

Remarks:

- SCOR’s balanced P&C and Life portfolio and business model strength reflect a very strong diversification benefit which is stable since YE 2017.
- There is further substantial diversification within the risk categories shown.
- SCOR’s required capital is mainly driven by underwriting risks.
- Market, credit and operational risks make a minor contribution to required capital.
SCOR Global Life business is built on a strong protection base

A diversified book with a core Protection business

<table>
<thead>
<tr>
<th>2018E GWP – in EUR billions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longevity</td>
</tr>
<tr>
<td>Financial Solutions</td>
</tr>
<tr>
<td>Protection</td>
</tr>
<tr>
<td>Americas</td>
</tr>
<tr>
<td>EMEA</td>
</tr>
<tr>
<td>APAC</td>
</tr>
</tbody>
</table>

A complete offering to support our clients

Helping our clients across the entire product lifecycle
- Develop Product
- Distribute
- Underwrite
- Monitor and engage
- Claim

A customer centric approach to the way we do business

Significant uplift in advocacy scores over the last three years as cited by clients

2014 | 59%
2017 | 77%

Significant improvements in capability ratings as perceived by clients

| Peer #1 | 2017 |
| Peer #2 | 2017 |
| Peer #3 | 2017 |
| Peer #4 | 2017 |

Note: growth rates at constant FX – 2018 estimate at June 30, 2018 FX
1) NMG Consulting Global Life & Health Reinsurance Study 2017 Client Advocacy Score (CAS) - SCOR Target market; CAS = (Promoters – Detractors) / All citations
2) NMG Consulting Global Life & Health Reinsurance Study 2017 Business Capability Index - SCOR Target market
Medical Underwriting

Leading provider of medical underwriting services in the Nordic market

PRIO
Web based juvenile medical manual

solem
Web based medical manual

Via outsourcing we do everything from Second Opinion to a full Medical Underwriting Service.
Customer Portal

- A quick, secure and reliable way of exchanging files and information with SCOR Sweden Re
- Provides functionality to report
  - Individual life
  - Claims
  - Outsourcing
  - Referrals
  - Digihealth
  - Files
  - Etc.
ON THE ROAD OF DIGITALIZATION

DIGIHEALTH

Provides Perfect Client Service

Short Time To Market

Decreasing Lead Time

Integrated with Medical Underwriting Services

No involvement from cedent IT

No infrastructure cost for cedent

Details
Implementation about 4-10 weeks
How does it work?

Client logs in on Cedent website and applies for insurance.

Client clicks on a link to reach the health declaration.

Client answers questions in the dynamic form.

Client clicks **Send** and is asked to sign the form electronically.

Cedent views the health declaration in SCOR Sweden Re Customer Portal.

**Any remarks?**

Complete health declaration is available on SCOR Sweden Re Customer Portal.

SCOR Sweden Re Medical Underwriter picks up the case and gives a recommendation.

Cedent receives recommendation on SCOR Sweden Re Customer Portal and contacts the Client.

Cedent contacts the Client and finishes the application.
Marknadsanalyser, Benchmarking och Aktuariellt stöd

**Nordiska och landspecifika benchmarksurveys**

Variabelanvändning för sjukavvecklingsantaganden

- Älder
- Yrke
- Kön
- Belopp
- Duration

**Kundexklusiva analyser och service**

- **Ad hoc analyser**
  - Sjukavvecklingsantaganden
  - Dödlighet och insjuknande
  - Tariff-benchmarking
  - Produktjämförelser

- **Knowledge sharing**
  - Marknadsöversikter och rapporter
  - Produktutveckling
  - Stöd vid villkorsskrivning
  - Perspektiv från flera marknader

- **Kontinuerlig service**
  - Resultatanalyser
  - Reservsättning
  - Avräkningar

---

**Högsta försäkringsbelopp utan hälsodeklaration**

- Bolag A
- Bolag B
- Bolag C
- Bolag D
- Bolag E
- Nordiskt genomsnitt
INBJUDAN

TORSDAGEN DEN
15 NOVEMBER 2018
Kl.14:00-17:00 inkl. kaffepaus
Välkommen till GT30/Dome,
Grev Turegatan 30, Stockholm

Hjärtsjukdomar
hos barn

Dags för SCOR Sweden Re:s
medicinska höstföreläsning-
"Hjärtsjukdomar hos barn"

Föreläsare: Ulf Ergander,
Barnhjärtläkare,
Astrid Lindgrens Barnsjukhus

Anmälan till mig senast den 9 november 2018

Contact with
johan.lidstrom@swedenre.se
Tel:0707-585330
SCOR Innovations
From Around the World

Gavin MAGUIRE
Marketing Actuary – UK & Ireland
Consumers are looking for insurers to help them being healthy…

Support for shift in insurer focus to keeping people healthy
... willing to share data with a potential wearable adoption > 50% in most countries
WHAT ROLE DO WE WANT TO PLAY?
HONG KONG - diabetes

10% OF THE POPULATION HAS THE DISEASE
HONG KONG - diabetes

- App providing tracking of blood glucose
- Collects data and personalize care service

Health 2 Sync

- Dashboard 14 days
- Blood Glucose
- Blood Pressure
- Weight
- Distribution
- Low
- Comparison
- Before vs. After Meal
- Δ 42
- 04/02 Dinner
- 04/02 Breakfast
- 04/02 Lunch
- 04/02 Snack
- 04/02 Add
- 04/02 Remove
- 04/02 Other
- 04/02 Note
DAILY STEPS
DAILY ACTIVITY

Enables high-level of accuracy in mortality risk

Reinventing underwriting with the simple input of 7 days of lifestyle data predicting a tailored mortality and morbidity risk.

Transforming the customer experience by refunding to the customer the savings from the insurance risk through premium discount.
SOUTH EAST ASIA - Biological Age Model

Concept

- Use input from wearables to determine a ‘biological age’ from which premiums are calculated; and reward healthy lifestyles
- Simplify Underwriting and enable Continuous Underwriting
- Greater consumer engagement which can lead to improved lapse and claim experience
In the U.S. working with Hero to increase survival rates in case of cardiac arrest

A device that monitors heart rate, detects cardiac arrest and triggers emergency response

“Hero network” (voluntary) of 1.3 million people with CPR Knowledge already in place

Note: SCOR Global Life launches SCOR Life & Health Ventures and announces the venture’s first strategic investment in and partnership with iBeat - https://www.scor.com/fr/medias/actualites-communiques-de-presse/scor-global-life-launches-scor-life-health-ventures-and CPR = Cardiopulmonary Resuscitation; AED = Automated External Defibrillator
IRELAND – In Ireland, SCOR Global Life partnered with a global insurer to launch a wearable-enabled wellness proposition.
In Ireland, SCOR Global Life partnered with a global insurer to launch a wearable-enabled wellness proposition.

**Partnering in development with leading companies**

- **Market leader in wearable technology devices**: GARMIN
- **Platform & social web service that motivates to exercise**: HeiaHeia

**Step-by-step market penetration and analysis**

- **Experiment**: Experiment within SCOR London with 70 employees
- **Encourage the adoption**: Brokers promote to customers
- **Customer incentive**: Premium reimbursement
- **Launch**: 650 customers received a free wearable device (up from the 500 planned)
- **Connect to the Heia Heia platform**: Retrieves the data from the device and passes it on to the insurer
- **Follow-up**: Customer feedback collected

**Completed stages**

- SMART
- NOTIFICATION
- DIAL
- AMBIT
- PULSE
- SLEEP
- WATER
- REM
- VIBRATION
- AUDIT
- TIME
- HEART

**Stages to be completed**
IRELAND - Advantages of using a platform such as Heia Heia

- For pilot Heia Heia brought a platform to the pilot that will:
  1. Handle all data collection and aggregation
  2. Invite and issue reminders to Zurich customers to join the pilot group
  3. Capture consents
  4. Allow bespoking of apps and pilot groups
  5. Allow Zurich target marketing messages at participants during the course of the pilot.

- End to end and customisable solution for the pilot.

- Zero impacts on the Zurich Life Ireland IT department!!!
Digital engagement for better life and lower risk
Our Customer Segments

Insurance & Service Providers
Digital engagement solutions for wellbeing promotion at scale

High Performance Organisations
Coaching of leaders and knowledge workers in high-performance industries

Formula 1 & Motorsport
Coaching and medical services for Formula 1 drivers, teams and factories
New Customer Value through Digital Engagement

1. Personalized Health Improvement & Gratifying Customer Experience
   - Better Interaction
   - Personalized Experience
   - New Products

2. Improved Loyalty & Satisfaction
   - Data
   - Higher Premiums & New Revenue Streams

Insurer
Enabling Value Ecosystems

End users

Employers

Wellbeing & Health professionals

Insurer
Enabling Value Ecosystems

Value:
Lower health cost, better productivity, engagement, and employer brand

End users

Employers

Wellbeing & Health professionals

Insurer
Enabling Value Ecosystems

Value: more clients, revenue and efficiency through digitally powered remote engagement
Promoting healthy habits
A true daily companion

- Log activities
- Start training programs
- Connect your wearable
Everything counts
Rewarding long term success

Users earn points and unlock levels by being active.

The scoring system supports personal long-term holistic wellbeing goals and can be linked to the insurer’s pricing and policies.
Support from your like-minded friends, family and colleagues increases engagement and sense of achievement.

Sharing accomplishments big and small and cheering friends also makes wellbeing fun and social.
Professional tools for coaching & interventions

- Managing client base (individuals, groups)
- Group coaching & comms
- Monitoring client activity
- Planning tasks for clients
Case Studies & Data
Wellbeing Is a Sticky Digital Concept

Weekly retention for sample user cohort

<table>
<thead>
<tr>
<th>Users retained (Week 1 = 100)</th>
<th>1</th>
<th>3</th>
<th>5</th>
<th>7</th>
<th>9</th>
<th>11</th>
<th>13</th>
<th>15</th>
<th>17</th>
<th>19</th>
<th>21</th>
<th>23</th>
<th>25</th>
<th>27</th>
<th>29</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital wellbeing app + connected wearable</td>
<td>98%</td>
<td>60%</td>
<td>29%</td>
<td></td>
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<tr>
<td>Digital wellbeing app</td>
<td>74%</td>
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<tr>
<td>Global mobile apps (average)*</td>
<td>38%</td>
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</tbody>
</table>

*Localytics 2017
Engaging 1,000+ Group Insurance Customers: Case Ilmarinen

**Service branding & content production**
- **Date**: 6/2016
- **Scope**: Internal pilot

**Feedback & Definition of commercial offering**
- **Date**: 9/2016
- **Scope**: 4 group customers

**Agile feature development, content production, analytics and marketing**
- **Date**: 1/2017
- **Scope**: 20 employers

**Full Marketing Launch (hundreds of employer groups)**
- **Date**: 4/2017
- **Scope**: 200+ employers

**Survey Feature & Dashboard Rollout**

**Frequent New Feature / Content Deployments**

**Milestones**
- **“Go” decision**
- **Pilot launch (4 employer groups)**

---

**Focus**

---
Case Deloitte

“I use the mobile application every day and also follow updates from other users. Thanks to its social nature, the app creates community spirit across team boundaries and brings colleagues together. It's also really easy to use.”

– HR Talent Partner, Deloitte

https://www.hintsa.com/case/deloitte/
Impact of Digital Habit Change Programs

Impact on wellbeing

Average impact on program participant wellbeing, by initial wellbeing profile

More than 70% of program participants would like to start a new program

- 0
- 1 to 3
- 4 to 6
- 7 to 10

Digital platform user survey 9/2018
Wrapping it up: recommendations

• **Pick the low-hanging fruit**
  - Major opportunity: the proactive wellbeing megatrend
  - Digital tools enable personalized, scalable and sticky concepts
  - Insurers well positioned to promote solutions

• **Start soon, start small; experiment and expand**
  - Immediate benefits from positioning, reference customers, data
  - Expand gradually based on learnings + keep iterating
Thank you
Doping as a public health issue.

Professor Arne Ljungqvist
Stockholm, October 12th 2018
Fundamental principles

Practically all doping substances and and methods are medicines and/or medical interventions which have been developed for the prevention and cure of disease, or alleviation of symptoms.

Their administration in the absence of medical indications (e.g., to healthy sportsmen) is medicinal malpractice against which legal action should be taken.
Two different aspects

- Doping in elite sport
- The use of doping substances in society
Doping in elite sport

- Ephedrines/Amphetamines 1940s – 60s
- AAS 1960s – 70s
- Hormones 1980s
- Oxygen carriers 1990s
- Gene transfer 2000 - (?)
Some key years

- 1928  IAAF-rules on stimulants
- 1960  Rome Olympic Games
- 1961-67  IOC Medical Commission
- 1968/72  Testing för stimulants at OG
- 1972  IAAF Medical Committee
Arnold Beckett
Manfred Donike
Further key years

1974  AAS banned and tested for by IAAF

1979  Doping control laboratories by IAAF

1984  Court of Arbitration for sports (CAS)

1988  Seoul OG
Further key years

1989    "Cold war" fades
1999    WADA
2004    WADA Code
2005-07 UNESCO Convention
2000 Sydney Games

The IAAF/US story

Bush’s "address to the nation"
Scandals

2002
Salt Lake City-OG
New generation of Epo (Aranesp)

2003
Balco

2004
Aten-OG
Scandals

2006
Torino Olympic Games
How will sport answer the Russia question?

Russian doping has rarely been away from the headlines in recent times, and it is still far from certain when the crisis will end. Liam Morgan investigates.

Sochi 2014
Kula, Diskus, Slägga

- Endast 3 av de 15 medaljörerna vid Rio-OS 2016 i dessa grenar hade kommit på prispallen i Seoul 28 år tidigare.

- Alla världsrekord i dessa kastgrenar - män och kvinnor - är över ett kvarts sekel gamla (det yngsta från 1990 - mäns kula).
Summary

- An interesting 45 years’ journey from almost complete unawareness to general understanding and support, and to..........
- The creation of WADA in 1999
- USA president’s ”address to the nation” in 2004
- Global support in the form of a UNESCO-convention in record time 2005-2007
- National antidoping-organisations all over the world
Use of doping substances outside sport

International studies

"The use of doping agents, particularly anabolic androgenic steroids (AAS), has changed from being a problem restricted to sports to one of public health concerns".

"Use of Anabolic Androgenic Steroids and other similar doping substances is a substantial problem in Europe – primarily among young men – which until recently has not been given much attention."
In Strategy for stopping steroids, Anti-Doping Denmark, 2012
"The misuse of doping substances in the broader society is a health and security issue. Action must be taken by governments and organizations within a harmonized legal framework and policies."

DOPNING ÖVERSIKT

FAKTA 4. Psykiska biverkningar

- Depressiva besvär
- Ängest
- Oro
- Sömnstörningar
- Nedsatt impulskontroll
- Panikängest
- Affektinstabilitet
- Psykos

- Megarexi
- Empatistörning
- Sänkt mentaliseringsförmåga
- Svartsjuka
- Aggressivitet
- Paranoid misstänksamhet
- Våldsamhet

Rane, A. et al. Steroider ett växande problem på gymen.
Läkartidningen Nr 39-40, 2013, vol 110
”Det är vetenskapligt klarlagt att c:a 20 - 25% av alla kosttillskott som saluförs till idrottsmän som prestationsförhöjande innehåller dopingklassade substanser”.

1. ”14 av 85 undersökta kosttillskott bedömdes utan anmärkning. 21 av preparaten borde ha varit läkemedelsklassade och därmed förbjudna att saluföra.”

2. ”Bara 2 av 43 förpackningstexter uppfyllde märkningskraven. I 30 av 43 produkter ingick växtextrakt som kan innehålla hälsofarliga substanser. 8 av produkterna skulle kunna klassificeras som läkemedel.”

www.rf.se/Antidoping/Kosttillskott. 31 jan 2018
"New sources of doping substances are the market of adulterated nutritional supplements and unapproved pharmaceuticals. These are extremely fast-growing markets because of the readily available raw materials needed for doping substances and the ease of trading the products via Internet”.

## Food supplement sales in Sweden

<table>
<thead>
<tr>
<th>År</th>
<th>Millions (SEK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>4 569,0</td>
</tr>
<tr>
<td>2016</td>
<td>4 669,4</td>
</tr>
<tr>
<td>2017</td>
<td>4 876,2</td>
</tr>
</tbody>
</table>

Source: "Svensk Egenvård”. Pressrelease, 3 April 2018
"Dagens utseendefixerade och prestationssinriktade samhälle har skapat en lukrativ illegal marknad för anabola steroider (AAS). Denna omfattande men samtidigt nedprioriterade kriminella subkultur är betydande och de fysiska och psykiska skadeverkningarna av steroidmissbruket är ett folkhälsoproblem som samhället väljer att inte se."


Hermansson var tidigare narkotikapolis med särskilt ansvar för dopingområdet.
Conclusion

- Sport has conducted a fight against doping for about 50 years with reasonable success.

- Society has remained largely passive as the use of doping substances outside sport has become an increasingly important public health issue.
”Doping’s Nemesis
АРНЕ ЛЮНГКВИСТ
ВРАГ ДОПИНГА
Ёран Лагер
An Extension of Generalized Linear Models for dependent frequency and severity

Masar Al-Mosawi
October 12, 2018
Länsförsäkringar Fondliv
Introduction
In non-life pricing the pure premium is modeled as the product of the two estimates: Claim frequency and claim severity. A general problem is that the frequency and severity are traditionally assumed to be independent. This assumptions is not always vindicated, car insurance policyholders who tend to file several claims per year are often associated with lesser claim amounts than policyholder who tend to file lesser claims per year. There is thus a need to account for potential association between claim frequency and claim severity. In this thesis we will construct and analyze the classical model, and a proposed extension of the classical model where claim frequency and claim severity are dependent.
Model building
Variations can be estimated by a set of covariates. The range for each covariate are called classes. Let $M$ be the number of covariates, and let $m_i$ be the number of classes for covariate $i$. A tariff cell is denoted by the vector $(i_1, \ldots, i_M)$. We use the multiplicative model for the expected value of a response variable $Y$:

$$E[Y_{i_1, \ldots, i_M}] = \mu_{i_1, \ldots, i_M} = \gamma_0 \gamma_{i_1} \gamma_{i_2} \cdots \gamma_{i_M},$$  \hspace{1cm} (1)$$

where, the $\gamma$ is called the relativities. The relativities measure the effect when all other variables are held constant.
Generalized Linear Models (GLMs) is a class of statistical methods which generalizes the linear models. GLM solves two problems that occurs with linear models when applying it to non-life insurance pricing:

- GLM assumes general class of distribution instead of normal distribution
- GLM has a link function instead of the mean being a linear function. Multiplicative model is more reasonable for pricing

GLMs uses Exponential Dispersion Models (EDMs) that generalize the normal distribution, that are used in linear models, into a family of distributions for the GLMs.

\[
f_{Y_i}(y_i, \theta_i, \phi) = \exp\left\{ \frac{y_i \theta_i - b(\theta_i)}{\phi/w_i} + c(y_i, \phi, w_i) \right\},
\]

(2)
Inference
Inference

To estimate the parameters in GLM we use the **maximum-likelihood estimation (ML)**:

The method of maximum likelihood is based on the log-likelihood function \( l(\theta, \phi, y) \), which is a function of the parameters of a statistical model.

- Given a family of distributions, the method of ML finds the values of the model parameter \( \theta \), that maximize the log-likelihood function.
- Intuitively, the ML selects the parameters that make the data \( y \) most probable.
For testing a ML-estimated parameters significance, we use the null hypothesis method:

The null hypothesis method is the use of statistics to determine the probability that a given hypothesis is true

1. Formulate the null hypothesis \( \theta = \theta_0 \)
2. Identify a test statistic that can be used to assess the truth of the null hypothesis
3. Compute the \( p \)-value, which is the probability that a test statistic at least as significant as the one observed would be obtained assuming that the null hypothesis is true. The smaller the \( p \)-value, the stronger the evidence against the null hypothesis
4. Compare the \( p \)-value to an acceptable confidence level \( 1 - \alpha \). If \( p \leq \alpha \), the null hypothesis is rejected
Inference

In GLM a generalization of the idea of using the sum of squares of residuals for a good measure of goodness-of-fit is the **deviance function**. It can assess which model fits the data best.

\[ D(y, \mu) = 2(l(\theta, \phi, y) - l(\theta, \phi, \mu)). \]  (3)

- The saturated model is used as a benchmark in measuring the goodness-of-fit of other models, since it has the perfect fit.
- One can view the deviance function as a distance between two probability distributions and can be used to perform model comparison.
- The deviance functions will generate deviance plots for model validation, they can assess which model fits the data best.
Another criteria for estimating the quality of models in purpose for model selection is the Akaike information criteria (AIC).

\[
AIC = -2l(\hat{\theta}, \phi, y) + 2K,
\]

- AIC rewards goodness of fit (as assessed by the log-likelihood function), but it also includes a penalty that is an increasing function of the number of estimated parameters.
- In other words, AIC value is used to determine which model minimizes the loss of information when approximating reality given the data at hand.
- \( \Delta_i = AIC_i - AIC_{min} \) is a measure of each model relative to the best model.
Generalized Linear Models
For a fixed time period $w = 1$, the total amount paid out in claims is:

$$S = \sum_{j=1}^{N} Y_j.$$ 

$S$ the total amount paid out in claims, $N$ is the number of claims, $Y_j$ is the claim amount for the $j$th incurred claim.

Assuming that the claim frequency and claim severity is independent:

$$E[S] = E[N]E[Y].$$

- The number of claims is assumed to be poisson distributed,
  $$N \sim P(\nu_i)$$

- The claim amount is assumed to be gamma distributed,
  $$Y \sim G(\alpha, \beta)$$

The poisson distribution and the gamma distribution are members of the EDM family.
For number of claims $N_i$, let $v_i = E[N_i]$. Then:

- The ML-equations: $\sum_i x_{ij} (n_i - v_i) = 0$.
- The deviance function: $D(n, v) = 2 \sum_i (n_i \log(n_i/v_i) + (v_i - n_i))$.

For claim amount $Y_i$, let $\mu_i = E[Y_i]$. Then:

- The ML-equations: $\sum_i \frac{x_{ij}}{\mu_i} (y_i - \mu_i) = 0$.
- The deviance function: $D(y, \mu) = 2 \sum_i (-1 + \frac{y_i}{\mu_i} + \log(\frac{\mu_i}{y_i}))$. 

Generalized Linear Models extension
For a fixed time period $w = 1$, the total amount paid out in claims is:

$$S = \sum_{j=1}^{N} Y_j.$$  

$S$ the total amount paid out in claims, $N$ is the number of claims, $Y_j$ is the claim amount for the $j$th incurred claim.

**To account for dependence, the mean of the severity distribution is allowed to depend on $N$**

$$E[S] = E[NE[\overline{Y} | N]],$$  \hspace{1cm} (5)

where $\overline{Y | N} = (Y_1 + \cdots + Y_N)/N$ is the average claim severity, $S$ is the aggregate losses incurred and $N$ is the number of claims.
Generalized Linear Models extension

Two reflections on the dependent setup:

- Claim count $N$ is modeled in exactly the same way as in the classical GLM approach.
- The average claim severity $\bar{Y}$ using claim $N$ as both covariate in the GLM, and weight factor in the EDM.

One has $E[S] = E[NE[\bar{Y}|N]] \neq E[N]E[Y]$.

- Independence: $E[S] = E[N]E[Y] = \nu \mu$
- Dependence: $E[S] = E[NE[\bar{Y}|N]] = \nu \mu e^{\nu(e^\theta - 1)+\theta}$

An dependence factor emerges: $e^{\nu(e^\theta - 1)+\theta}$, together with a dependence parameter $\theta$. It is the estimate of the covariate $N$. 
For number of claims $N_i$, let $v_i = E[N_i]$. Then:

- The ML-equations are same as in the classical GLM:
  $$\sum_i x_{ij}(n_i - v_i) = 0.$$
- The deviance function is same as in the classical GLM:
  $$D(n, v) = 2 \sum_i (n_i \log(n_i/v_i) + (v_i - n_i)).$$

For average claim severity $\bar{Y}_i$, let $\mu_{\theta i} = E[\bar{Y}_i]$. Then:

- The ML-equations:
  $$\sum_i^m \frac{n_i x_{ij}}{\mu_{\theta i}} (\bar{Y}_i - \mu_{\theta i}) = 0.$$
- Additional ML-equations:
  $$\sum_i^m \frac{n_i^2}{\mu_{\theta i}} (\bar{Y}_i - \mu_{\theta i}) = 0.$$
- The deviance function:
  $$D(\bar{Y}, \mu) = 2 \sum_i^m n_i (-1 + \frac{\bar{Y}_i}{\mu_{\theta i}} + \log(\frac{\mu_{\theta i}}{\bar{Y}_i})).$$
Results
Results

Data from the former Swedish insurance company Wasa, and concerns partial casco insurance for motorcycles.

<table>
<thead>
<tr>
<th>Covariates</th>
<th>Description</th>
<th>Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zon</td>
<td>Geographic zone</td>
<td>(1,2,3,4,5)</td>
</tr>
<tr>
<td>MC class</td>
<td>Mc class</td>
<td>(1,2,3,4)</td>
</tr>
<tr>
<td>Vehicle age</td>
<td>The vehicle age</td>
<td>(1,2,3,4)</td>
</tr>
</tbody>
</table>

Table 1:

<table>
<thead>
<tr>
<th>Claim count</th>
<th>Frequency</th>
<th>Percent</th>
<th>Average amount (Kr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>412</td>
<td>67 %</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>178</td>
<td>29%</td>
<td>83 372</td>
</tr>
<tr>
<td>2</td>
<td>26</td>
<td>4% (13%)</td>
<td>84 674</td>
</tr>
</tbody>
</table>

Table 2:
The dependence parameter $\theta$ was estimated to $\hat{\theta} = -0.3472$. The null hypothesis method yields:

1. The null hypothesis $H_0 : \hat{\theta} = \theta_0 = 0$
2. A statistic is identified as the test statistic for the underlying distribution.
3. $p$-value $= 0.0245$
4. Hence we reject the null hypothesis on confidence level of 97.5% with a $\alpha = 0.0250$, since $p < \alpha$
For the GLM extension, the AIC value is computed to:

- $AIC_{min} = 2637$
- but when we drop the claim count as an covariate the AIC value increases to $AIC_i = 2641$
- $\Delta_i = AIC_i - AIC_{min} = 4$
Figure 1: Comparison of the claim severity between the classic GLM and the GLM extension.
Figure 2: The deviance of the claim severity for the classical GLM.
Results

Figure 3: The deviance of the claim severity model for the GLM extension.
Conclusion
Claim count is a significant covariate for the GLM extension. 
\[ \Delta_i = 4 \] indicates that GLM extension model with claim count is the better model, than without the claim count. But it is not big enough to fully accept claim count as a covariate. 
Deviance figure for the severity has a lower variance, showing that the GLM extension model fit the observations better than the classical GLM. 
Small data to fully confirm that the GLM extension is the better model than the classic GLM, but we have strong evidence to support it. 
The structure for the dependence approaches makes it very easy to implement. 
Further studies can be made with greater data and different distributions on claim count and claim amount.
Thank you!

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CLOSING

Svein Børre Solvang
Sweden Re

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Product Development
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Health is the new wealth
Health is the new wealth
Münchenbryggeriet 13 oktober 2017

➢ Enkät på 8 frågor med fritext

![Livförsäkringskonferens - 13 Oktober 2017](image)

Vad tyckte du?

Stort tack för ditt deltagande i SCOR Sweden Re's Livförsäkringskonferens i fjärre veckan. Vi hoppas att du uppskattade årets program och innehåll.

Jag skulle vara tacksam om du kunde ta någon minut och ge oss feedback på konferensen och dess innehåll, då de intressepunkter är viktiga för oss.

Vänligen klicka här för utvärderingen

Vi kommer att skicka ut en dokumentation av konferensen till dig om några veckor. Årets presentationer kan du redan hitta på vår hemsida (www.svordenre.se) under publikationer.

Bästa hälsningar
Svein Barre Solvang, VD

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Eventenkät 2017

Kara konferensdeltagare, tack för ditt deltagande i årets konferens!
Vanliga svara i skala 1-5 där 1 anger dålig och 5 anger jättebra.

1. Introduktion och sammanfattning - Svein Barre Solvang, VD
SCOR Sweden Re
Hur bra var detta föredrag?
01. 02. 03. 04. 05.
Övriga kommentarer:

2. Peter Nowell - Solvency II - in full force
Hur bra var detta föredrag?
01. 02. 03. 04. 05.
Vill du att vi kontaktar dig med ytterligare information?
(om ja, vänligen ange kontaktuppgifter nedan)
0Ja Onej
Övriga kommentarer / kontaktuppgifter:

3. Jan Eliasson - Utveckling och hälsa i ett globalt perspektiv
Hur bra var detta föredrag?
01. 02. 03. 04. 05.
Övriga kommentarer:

4. Mouna Esmaeilzadeh - Långlevnad och framtidens hälsa
Hur bra var detta föredrag?
01. 02. 03. 04. 05.
Övriga kommentarer:
Feedback on the 2017 Conference

- Good speakers and a very nice venue
- The waiters heavily underperformed. No red wine
- Very good waiters and staff
- As always a fantastic conference. SCOR Sweden Re is best in class
- Not good to have similar brain speeches 2 consecutive years
- Finally an Actuary who could explain Solvency 2 (Peter Nowell) and his English was just beautiful……ahhhh
- Do you really need to have actuaries as speakers?
- Great to have a variety of speakers with different professions
- Difficult to find the venue
- Mouna (Esmaeilzadeh) & German (Ramirez) were pure entertainment, fun but nothing more
- Brilliant from German Ramirez. The old dinosaurs in the audience needed to hear this
- Get rid of paper. Bad for environment
- Jan Eliasson absolutely world class
- Keep the time better. Went over several times
- The CEO is definitely not a comedian. Not funny at all
- The CEO cannot spell. A lot of words are incorrect
- The CEO is nice to look at (and listen to)…
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Please give us your valuable feedback also in 2018

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