Exam 5

Spring 2014

Candidate #17

Score 42.25
CASUALTY ACTUARIAL SOCIETY

ONLY ONE QUESTION PER PAGE

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EXAM 5  QUESTION # 1  CANDIDATE #: 00017

\[
\frac{1}{12} = \frac{1}{12} = \frac{1}{12} = 35\% \\
\frac{1}{12} - \frac{1}{12} = 35\% \\
\frac{1}{12} - \frac{1}{12} - \frac{4}{12} = 88\%
\]

a.)

\[
\text{CRL} = 99.58 \\
\text{Avg RL} = \frac{1}{12} + \frac{35}{12}(1.003) + \frac{4}{12}(0.9859) \\
= 1.004408 \\
\text{OLF} = \frac{\text{CRL}}{\text{Avg RL}} = 1.0013998
\]

b.) Policies in force post 2/1/11 \( \rightarrow \) 1/31/12 effective dates

<table>
<thead>
<tr>
<th>% Earned 2012</th>
<th>Rate level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 %</td>
<td>-</td>
</tr>
<tr>
<td>1/12</td>
<td>1.0</td>
</tr>
<tr>
<td>3/12</td>
<td>1.003</td>
</tr>
<tr>
<td>100 %</td>
<td>0.9859</td>
</tr>
<tr>
<td>23/24</td>
<td>0.9859</td>
</tr>
</tbody>
</table>

Assume writings midpoint to get earned %. 

\[
\text{Avg RL} \times \text{sum product} = \text{sum product}
\]

C.) If policy term is two years Earned exposures will be at higher rate levels so Avg RL ↑ and OLF ↓
CASUALTY ACTUARIAL SOCIETY

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<table>
<thead>
<tr>
<th>EXAM</th>
<th>QUESTION #</th>
<th>CANDIDATE #</th>
</tr>
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<tbody>
<tr>
<td>5</td>
<td>2</td>
<td>00017</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>AY</th>
<th>Low Cost Ins Pcm</th>
<th>Payroll to claim level</th>
<th>Payroll adj for exp mod</th>
<th>Proj Pcm</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>2100</td>
<td>1.06134</td>
<td>98.99%</td>
<td>2206.30</td>
</tr>
<tr>
<td>12</td>
<td>2500</td>
<td>1.04052</td>
<td>98.98%</td>
<td>2601.3</td>
</tr>
<tr>
<td>13</td>
<td>2600</td>
<td>1.0952</td>
<td>98.97%</td>
<td>2706.19</td>
</tr>
</tbody>
</table>

\[ 1.015^2 \times 1.01 \times 7513.79 = 7513.79 \]

<table>
<thead>
<tr>
<th>AY</th>
<th>Rated</th>
<th>ERL</th>
<th>Dev</th>
<th>Losses</th>
<th>Med + Ind losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>850</td>
<td>1.0406</td>
<td>1.2</td>
<td>1661.41</td>
<td>1796.41</td>
</tr>
<tr>
<td>12</td>
<td>670</td>
<td>1.0252</td>
<td>1.8</td>
<td>1236.91</td>
<td>2070.39</td>
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<tr>
<td>13</td>
<td>460</td>
<td>1.01^2</td>
<td>2.7</td>
<td>1266.96</td>
<td>2166.96</td>
</tr>
</tbody>
</table>

\[ 1.01^2 \times 1.005 \times 670 \times 1.0252 \times 1.8 = 6033.76 \]
\[ 1661.41 + 735 = 1661.41 + 735 \]

\[ \text{Proj Med } + \text{ Ind LR} = \left( \frac{6033.76}{7513.79} \right) = 80.36\% \]

\[ \text{Proj UI } + \text{ LAE }_{2015} = 80.36\% \times 1.15 \]
\[ = 92.35\% \]
CY 2013 Written exposures = A
a) Need to trend losses & develop. Need to adjust exposure for trend.

b) Increased deductible will decrease losses. Need to make adjustment to projected losses else will be too high & overstate rate

c) Volume data too thin. Rates will not be credible. Not appropriate to base rates on this. Use external data with similar properties as risk we are pricing.

d) Need to use EP associated with look cap and determine a reinsurance provision based on excess losses. Can estimate expected non-excess losses

losses below look + excess provision

→ The IND change currently uses is not reasonable as comparing capped to total not appropriate.

losses Prem
**CASUALTY ACTUARIAL SOCIETY**

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**EXAM 5**
**QUESTION #: 5**
**CANDIDATE #: 00017**

**Pre trend → select 4% prem trend**

- 09-10  → 4% → trend from 1/1111 → 7/1115
- 10-11  → 4%  → 3% loss trend
- 11-12  → 4%
- 12-13  → 4%

**Ratable trend in Avg NL**

<table>
<thead>
<tr>
<th>Year</th>
<th>NL</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>1250</td>
<td>1.075</td>
</tr>
<tr>
<td>2012</td>
<td>1400</td>
<td>1.065</td>
</tr>
</tbody>
</table>

**CRL = 1.075**

**Current risk level. Select 4%**

**Avg RL 2013 = \( \frac{7}{18} + \frac{11}{18} \times (1.075) \)**

**OF 2013 = 1.065**

**Prem EP CLF Trend Proj Prem → 0 x 3 x 3**

<table>
<thead>
<tr>
<th>Year</th>
<th>Prem</th>
<th>EP</th>
<th>CLF</th>
<th>Trend</th>
<th>Proj Prem</th>
</tr>
</thead>
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<tr>
<td>2012</td>
<td>1250</td>
<td>1.075</td>
<td>1.0435</td>
<td>1,541,410</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>1400</td>
<td>1.065</td>
<td>1.0405</td>
<td>1,644,603</td>
<td></td>
</tr>
</tbody>
</table>

**Proj Loss**

- Observational shift in pattern post 09. To balance stability with responsiveness would select last 3 yrs avg to derive

**Age 119 Ults**

<table>
<thead>
<tr>
<th>Year</th>
<th>Rpt Loss</th>
<th>Trend</th>
<th>ULAEE 3 ADev</th>
<th>Proj Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>750</td>
<td>1.0385</td>
<td>1.1</td>
<td>1,360,32</td>
</tr>
<tr>
<td>13</td>
<td>500</td>
<td>1.0385</td>
<td>1.1</td>
<td>2,448.6</td>
</tr>
</tbody>
</table>

**Ratio**

- \( 1.8 \times 1.2 \times 1.09 \times 1.04 = 269.4616 \)

- \( EL^{LAE} = 269.4616 = 84.57\% \)

---

---
For fixed expense, use avg last 3 years to balance stability with responsiveness. Would not want to include 2010 one time cost in rates

\[ \text{selected } F = 12.33\% \]

\[ \text{Ind RC} = \frac{84.51}{1 + 12.33\%} = 29.2\% \]

\[ 1 - 20\% = 80\% \]

b) Need credibility weighting is appropriate when credibility concerns

Desirable qualities of complement is the underlying relationship between the complement and the company data must be reasonable. Using countrywide auto rates for PD to assess PD rates is reasonable. Using an GL complement to complement for AS90 PD would not be appropriate

Want the complement to have good statistical properties. We want highly credible complement (good volume data) and risks within complement have good homogeneity
Considerations

Statistical → may have good statistical properties as expected costs have feasible differentials 
→ meet criteria here as company determined it to be predictive

CAUSAL → can see the causal link as less steep would result in more accidents, meets criteria

OBJECTIVE → not objective. Not easy to verify. Subject to moral hazard

ACCEPTABILITY → Social acceptance is generally desirable. This would not be accepted. Does not satisfy

PRIVACY → This would be private to many. Does not meet criteria

although statistically may have good properties do not implement due to not meeting criteria

for many other desirable properties
a) Capped 250k → $1.5M

\[
\text{Complement} = \frac{3.25 - 2.75 \times 1.5M}{2.0} = 375,000
\]

b) 65\%

\[
\text{Use } \frac{250k}{1M} \text{ ILF } \times 65\%
\]

\[
= \frac{3.25 - 2.75 \times 250k + 3.25 - 2.75 \times 200k \times 65\%}{3.25} = \frac{3.50}{3.25} = 48.571
\]

c) i) Losses have not developed to 57\% if using caps, losses to assess ILFs must develop to simulate

ii) Frequency is assumed to be the same across Pol group. Limits consider differing claimant behavior across different Pol groups, while ILFs do not
### Adjust for overall change and gender exposure

<table>
<thead>
<tr>
<th></th>
<th>Adj Exposure</th>
<th>Loss</th>
<th>PP</th>
<th>Adj Rel</th>
<th>Ind Rel</th>
<th>Ind Rel Current</th>
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<tbody>
<tr>
<td>1</td>
<td>276</td>
<td>1127</td>
<td>40.315</td>
<td>0.6953</td>
<td>0.7068</td>
<td>1.75</td>
</tr>
<tr>
<td>2</td>
<td>900</td>
<td>51335</td>
<td>57.039</td>
<td>0.9837</td>
<td>1.10</td>
<td>1.10</td>
</tr>
<tr>
<td>3</td>
<td>470</td>
<td>32983</td>
<td>70.177</td>
<td>1.2102</td>
<td>1.2303</td>
<td>1.125</td>
</tr>
<tr>
<td></td>
<td>1646</td>
<td>95445</td>
<td>75.986</td>
<td>↑</td>
<td>1.01659</td>
<td>0.99378</td>
</tr>
</tbody>
</table>

\[
\text{Loss} = \text{Adj X} \\
\text{Adj} = \frac{\text{Loss}}{\text{Total}} \\
\text{Weighted total} = \text{Adj X} \\
\text{Change} (1 + \Delta%) = 1.01659 \\
\text{adjust base by} 1.022953 = 1.022953 \times 0.99378 = 1.01659 \\
\text{Classes 3 Ind Rel:} 1.2303
Statistical

- statistical difference in expected costs should be observed
  - differences stable one year to next
  - observed statistical differences here

Affordability

- desired by all for rates to be affordable. Charging poor credit classes higher rates does not meet criteria here, and credit scores highly correlated with other socio-demographic variables such as race
  - would be unfairly discriminatory to use rating variable if this is found

Regulators

- may states outlaw use of this variable for rating
  (ie due to reasons stated in affordability section)

Public - Causality - desirable to see causal link between loss propensity & RV. These are word claims. Hard to see how word loses and credit have a causal relationship
  - public will not accept

- Although statistically model shows variable to have predictive benefits - do to other reasons could not implement. May be easy - not allowed by law/regulation
a.) Regulators do not allow a higher \( R_c \) than say 10\%. Also if seeking 10\% may have to supply additional documentation or even notify insureds.

Operational may be costly to implement higher than 8\% due to changes necessary in rating algorithm.

Marketing in competitive marketplace, supply \& demand impact overall profit (not considered in ratemaking), it may be more optimal to charge 8\% when supply \& demand taken into account than 20\% resulting in higher overall profitability.

b.) Reduce expenses i.e. reduce staff levels, cut operating expenses to bring fundamental in equation more into balance.

\[ \frac{R_c \times (1 + \Delta \%)}{P_c} \]

Non renew high risk business, Identify non performing will business \( (\text{Re;} \text{ higher than expected}) \). Non renew business.

\[ \text{c.) } \frac{P_p \cdot P_b + \Delta A_p + A_p}{P_b \cdot (1 + \Delta \%)} + A_c \]

\[ 1.069 \times 1.057 \times (1-103) = 1.0960 \]

\[ \frac{P_p \cdot P_b + \Delta A_p + A_p}{P_b \cdot (1 + \Delta \%)} + A_c \]

\[ \frac{1 + \Delta \%}{1 + \Delta \%} \]

\[ \text{off balance} = 0.9124 \]

\[ + \Delta B_p = \frac{450 \times 1.08}{450 \times 0.9124 + 35} = 1.1693 \]

\[ \text{Base changes } 16.93\% \]
a) Retro Prem = (B + C) T = 411,396

T = 1.04

C = 200,000

B = 695k (15% - 62%(.08) + .181) = 195,573

b) Basic prem intended to cover:

- basic limit expected losses
- expenses associated with insurer's handling claims
- excess of basic limits
a) Grouping should be credible (volume) Region 2 has low volume so assess if can combine
   - consider homogeneity which also increases credibility

   → Payment patterns for Region 1 vs. 2 appear similar
   → all other classes have statistically different payment patterns

<table>
<thead>
<tr>
<th></th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
</table>
   | Freq | 0.049 | 0.05 | 0.049 | Region 2
   | Freq | 0.049 | 0.051 | 0.049 |     

   → Frequencies for Region 1 vs. 2 same across AYs and consistent across AYs

   → Would combine region 1 vs. 2 and leave others as stand-alone classes
a) \( \text{AY} \) 12 18 24 36

<table>
<thead>
<tr>
<th>Year</th>
<th>Claims</th>
</tr>
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<tbody>
<tr>
<td>11</td>
<td>25,000</td>
</tr>
<tr>
<td>12</td>
<td>30,000</td>
</tr>
<tr>
<td>13</td>
<td>21,000</td>
</tr>
</tbody>
</table>

ATU_{26-01+} = 1.0

\( \text{AY} 2013 \) VT Claims \( \rightarrow \) Rpted Claims \( \times \) CDF_{12-01+} \( \rightarrow \) 1.75

Select 1.8 + 1.7 as \( \text{ATA}_{12-24} \) \( \text{ATA}_{24-01+} = 1.25 \times 1.0 \)

\[ \text{VT} 2013 = 21,000 \times 1.75 \times 1.25 = 54,937.5 \]

b) Historical reporting patterns will be predictive of future reporting patterns

\[ \text{assumes rpted claims to date give info on claims yet to be rpted and paid} \]

c) When patterns are shifting, historical adjustments will need to be made if needed to estimate unpaid claims.

\[ \text{here we can use a paid approach to estimate unpaid claims} \]  
\[ \text{if we find paid pattern is shifting, we can adjust historical data using BS paid adjustment then use paid dev method on adj data} \]

\[ \text{if long tail time, early maturities usually have random fluctuations. little if not virted claims to derive unpaid claims. BS rpted method can handle this situation} \]
a) \( AY_{2013} \rightarrow \text{CDF}_{12\text{ Ult}} = \frac{1}{2} = 5.0 \) 
\( \text{case: 22.2} \)

\[ \text{BF}_{1\text{ Ult}} = \frac{2}{\% \text{ reported}} \times \text{Dev}_{1\text{ Ult}} + (1 - \frac{2}{\% \text{ reported}}) \times \text{EC}_{1\text{ Ult}} \]

\[ = 20 \times 102,500 + 80 \times 100,000 \]
\[ = 100,500 \]

b) \( \text{BF}_{1\text{ Ult}} \times \text{ECR} \times \text{EP (\% unreported)} \)
\( \text{Rptd Dev Ult} = \frac{\text{Rpt claims}}{\% \text{ rpt}} \)

\( \rightarrow \text{when BF}_{1\text{ Ult}} = \text{DEV}_{1\text{ Ult}} \)
\( \rightarrow \text{when } \% \text{ rpt, Actual } = \% \text{ rpt, expected} \)

C. \( \rightarrow \text{Random fluctuations at early maturities} \)
\( \rightarrow \text{when volatile experience at early maturities, may be} \)
\( \text{little into in claims rptd/paid, Dev fails here and BF can handle this} \)

\( \rightarrow \text{Business operations are relatively new situation} \)
\( \rightarrow \text{Long tail lines of business with highly leveraged}\)
\( \text{dev factors at early maturities} \)
\( \rightarrow \text{Dev mth falls when expected reporting } \% \text{ at} \)
\( \text{early maturities is very small. Proj Ult is will be} \)
\( \text{volatile and unreasonable} \)
\( \rightarrow \text{BF can handle this situation given the little weight} \)
\( \text{the DEV mth gets when } \% \text{ rpt is low} \)
a) $IBNR_{13}^B = ECR \times EP \times (\% \text{ unreported})$

$= 57.1^\circ \times 18,000 \times (1-1/2)$

$= 513,000$

b) $CC = ECR_{13} \times EP_{13} \times (\% \text{ unreported})$

$= 16074 \times 1800 \times (1-1/2) = 546,660$

$ECR_{13} = \frac{\sum \text{Adj. Reported Losses}}{\sum \text{Adj. Used-up Premium}}$

$= \frac{1100 \times 1.35 + 1500 \times 1.3 + 1400 \times 1.2}{1210 + 1.4 + 1400 \times 1.2}$

$= 2700 = 60.74^\circ$

4445.88

$\frac{1400 \times 1.2}{1.70}$

ii) Cape Cod will be more responsive to changing LR as $BF \ ECR$ is independent of historical data, $CC$ better

iii) $BF$ will be better here. $CC$ has some dependency on historical data. When thin or volatile data present, $CC$ will be distorted due to weight given to data. $BF$ has no weight on this data. $BF$ better
Large increase case in 2013

Ultimate CC that DO NOT exceed attachment point
Case Adequacy Increasing

1. Reported Claim Dev -> would be overstated.
   \[ U_{\text{ht+pt}} = \text{reported claims} \times CDF_{\text{ht+}} \]
   Increasing case -> reported claims will be too large data will be too large

2) Expected Claim Technique -> \[ U_{\text{ht+claimed}} = ECR \times EP \]
   \[ \rightarrow \text{IBNR will decrease} \]
   \[ \rightarrow \text{Ultimates are unchanged} \]

3) Reported BF ->
   \[ U_{\text{ht}} = \text{reported claims} + \text{IBNRBF} \times \frac{1}{CDF_{\text{ht+}}} \]
   \[ \text{IBNRBF} = \frac{ECR \times EP \times \%\text{unreported}}{100} \]
   \[ \rightarrow \text{will be overstated, but not as much as reported dev noted} \]
   \[ \text{historically}\]
   \[ \text{This could overstate IBNR due to overestimated unreported\%} \]

4) Reported CE -> same as BF. Only difference is
   ECR is based on historical data vs ECR for BF based on a prior independent of data.
   For same reason -> \% unreported is overstated and so
   IBNRce is overstated.
Observation → reporting pattern of counts is steady over history → pay pattern of counts

Look at Case Sev & Pd Sev

\[
\text{Pd Sev} = \frac{\text{paid claims}}{\text{closed counts}} \quad \text{Case Sev} = \frac{\text{open counts}}{\text{open counts}}
\]

<table>
<thead>
<tr>
<th>AY</th>
<th>11</th>
<th>12</th>
<th>Trend</th>
<th>24 Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>111</td>
<td>1111</td>
<td>1.0</td>
<td>1389</td>
</tr>
<tr>
<td>12</td>
<td>1133</td>
<td>2.70</td>
<td>1418</td>
<td>2.70</td>
</tr>
<tr>
<td>13</td>
<td>1156</td>
<td>2.70</td>
<td>13</td>
<td>300</td>
</tr>
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→ study pd trend of 2.70

Closed: Rept ratio

<table>
<thead>
<tr>
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<th>11</th>
<th>12</th>
<th>24</th>
<th>36</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>900/1400</td>
<td>1080/2160</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>900/1900</td>
<td>1080/2160</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>900/1900</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Must adjust historical opted claims based on 2.70 trend and latest CY

→ Case Sev

Adjusted Case

no changes here, settlement pattern → AY 12 24
is assumed steady and doesn't need changing

<table>
<thead>
<tr>
<th>AY</th>
<th>12</th>
<th>24</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1288000</td>
<td>1794140</td>
<td>1845000</td>
</tr>
</tbody>
</table>
| 12 | 1314000 | 1830000 | |$
| 13 | 1340000 | |$

\[
\text{Adj Case} = \frac{\text{Pd Claims}}{\text{Open Counts}} \times \text{Adj Case}
\]

\[
\text{ATA}_{12} = \frac{1.393}{1.0116} = 1.0 \quad \text{ATA}_{36-12} = \frac{1.393}{1.0} = 1.4092
\]
\[ U_{IT}^{DEV} = 1340000 \times 1.4092 = 1,888,328 \]

\[ TBNR_{BF} = \text{Expected } U_{IT} \times (\% \text{ Unreported}) \]

\[ = 548,328 \]

\[ \text{will use DEV } U_{IT} \text{ here} = 29.04\% \]

\[ U_{IT}^{BF} = 1340000 + 548,328 = 1,888,328 \]
**CASUALTY ACTUARIAL SOCIETY**

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**EXAM 5**

**QUESTION #: 19**

**CANDIDATE #: 00017**

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EC teching.

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\[
\text{Get Ultimates} \quad 2^{1.7}
\]

\[
\begin{align*}
\text{ATU}_{26-01} & = \frac{3115}{2516} = 1.2419 \\
\text{ATU}_{24-01} & = 1.07689 \times 1.1919 = 2.108 \\
\text{ATU}_{12-01} & = 2.0623 \times 2.108 = 4.347
\end{align*}
\]

---

<table>
<thead>
<tr>
<th>AY</th>
<th>UIH Claims</th>
<th>2013 OLEP</th>
<th>ELR @ 2013 Level</th>
</tr>
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<tbody>
<tr>
<td>2010</td>
<td>3,118,000</td>
<td>5000</td>
<td>58.69%</td>
</tr>
<tr>
<td>2011</td>
<td>3,743</td>
<td>198%</td>
<td>6000</td>
</tr>
<tr>
<td>2012</td>
<td>3,879</td>
<td>98%</td>
<td>6500</td>
</tr>
</tbody>
</table>

\[\text{selected} \Rightarrow 59.02% \]

Als as stable

\[
\text{UIH}_{2013} = 59.02\% \times 8000
\]

\[= 4721.6 \quad (000s)\]
Need estimate: Ult claims 2013

1. Received/Paid Ratio

Paid Claims

<table>
<thead>
<tr>
<th>Year</th>
<th>AY</th>
<th>12</th>
<th>24</th>
<th>36</th>
</tr>
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<tbody>
<tr>
<td>11</td>
<td></td>
<td>4000</td>
<td>5000</td>
<td>5500</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>4500</td>
<td>5625</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>5000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \text{ATA}_{24-UI^+} = \frac{5500}{5000} = 1.1 \]
\[ \text{ATA}_{12-UI^+} = \frac{1.1 \times 10625}{9500} = 1.2303 \]

Received 5½ S

<table>
<thead>
<tr>
<th>Year</th>
<th>AY</th>
<th>12</th>
<th>24</th>
<th>36</th>
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<td>11</td>
<td></td>
<td>800</td>
<td>1750</td>
<td>1800</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>900</td>
<td>2509</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>1250</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \text{ATA}_{12-UI^+} = \frac{11}{5500} \]
\[ \text{ATA}_{12-UI^+} = \frac{12}{6151.5} \]

Ratio

<table>
<thead>
<tr>
<th>Year</th>
<th>AY</th>
<th>12</th>
<th>24</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>20%</td>
<td>35%</td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>20%</td>
<td>44.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>25%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \text{ATA}_{24-UI^+} = \frac{40}{36} \]
\[ \text{ATA}_{12-UI^+} = 1.1429 \]

\[ \text{ATU}_{12-UI^+} = \left( \frac{35}{20} + \frac{44.6}{20} \right)^{\frac{1}{2}} \times 1.1429 \]

\[ = 2.27437 \]

\[ \text{Ult Ratios} \]

40%  Ratio increasing need to gather further info
50.97%  could be speed up in received 5½ S causing
56.86%  this. Assume no speed up and select

\[ \text{Ult S½S} = \frac{50.97 \times 6151.5}{2.27437} \]

\[ = \$ 3,075.75 (000s) \]
a.) Speed up in settlement will cause to overstate using pa dev technique

b.) Will be claims closed with no indemn payment that have material ACME expense. Will have to consider these claims separately if using a ratio approach or coded distort ratios if included (due to stable trend assumed)

c.) Freq dev needs technique needs stable severities over time. Clearly with the increase in legal resources this could result in higher ACME severities at early maturities would violate FS assumption so no would not be appropriate
A. Cumulative reported to actual as of May 31, 2014

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$1875$</td>
<td>$1650$</td>
</tr>
<tr>
<td>Av 2013</td>
<td>2500</td>
<td>2200</td>
</tr>
<tr>
<td>Pd</td>
<td>96</td>
<td>234.9</td>
</tr>
</tbody>
</table>

\[ \% \text{ Pd} = \frac{1}{8} \text{CDF} \]

\[ \frac{2500 - 1}{2296} = 88.9\% \text{ Ppd Ave} \]

\[ \text{Age 15-18} \rightarrow 1.33 \quad 1.82 \]

\[ \frac{54.95}{1.25} \quad 6.71 \quad 1.30 \quad 1.50 \]

b) $1875 - 1 = -0.53\% \quad \frac{\% \text{ Pd}}{} \rightarrow 78.2\% \quad 80\%$

\[ \frac{1885}{\text{Pd Ave}} \]

@ 17 mths must use linear interpolation

b) Of there was an influx of claims explaining the increase (such as usually stormy season) would have to adjust the ults to reflect the expected increase in ult claims

d) If case adequacy is increasing, no reason to adjust historical selected ultimate. Claims will have higher avg Pd Sce case o/s sce but all else equal should have same ultimates claims as pd claims ult.
a.) Calc A

\[ \% \text{ Rpt} + 12 = \frac{1}{\text{CDF}_{12-\text{ULT}}} \]

\[ \text{Expected Rpted AY}_{2012} \rightarrow 433 \rightarrow \left( \frac{1}{\text{CDF}_{12-\text{ULT}}} \right) \times 500 \]

\[ \text{Expected pd AY}_{2013} \rightarrow 394 \rightarrow \text{CDF}_{12-\text{ULT}} - 1 \]

\[ \text{CDF}_{24-26} \rightarrow 1.25 \]
\[ \text{CDF}_{36-\text{ULT}} \rightarrow 1.25 \]

\[ \frac{433 + 1}{500} = 1.866 \]

\[ 500 \times \text{CDF}_{12-\text{ULT}} - 1 \times 1.25 = 1.866 \times 1.25 \]

\[ A = \frac{1}{42.87} = 0.02328 \]

\[ \text{Rpted Claims} = \frac{232}{500} = 0.464 = \frac{A}{A} \]

b.) Actual = Expected

\[ \text{Case o/s} \rightarrow \text{Pd}_{24-\text{ULT}} \times (\text{Rpt}_{24-\text{ULT}} - 1) \times \text{Case o/s} \]

Unpaid claims

\[ \text{Pd}_{24-\text{ULT}} = \text{Rpt}_{24-\text{ULT}} \]

\[ \text{Rpted Claims} = 933 \]

\[ \text{Paid} = 394 + 250 = 644 \]

\[ \frac{933}{289} = 2.89 \]

\[ \text{Pd}_{24-\text{ULT}} = \frac{1}{1.88} = 1.88 \]

\[ \text{Rpt}_{24-\text{ULT}} = \frac{1}{1.25} = 1.25 \]

\[ \text{Unpaid claims} = 1.88 \times (1.25 - 1) \times 289 = 1.23 \times 289 = 353 \]

\[ \frac{1.88 - 1.25}{1.25} \]
Exam 5

Spring 2014

Candidate #277

Score 42.50 (Passing Score)
(a) Parallelogram Method

\[ \frac{1.0}{1.045} = 0.985 \quad \text{to 2011} \]

\[ \frac{1.0}{1.045} \times 0.985 \times 1.045 = 1.03763 \]

\[ \text{On-level Factor} = \frac{1.03763}{1.045} = 0.9948 \]

(b) 25% on renewals of 2/1: January: 25 + \frac{15}{5} = 31.25 \text{ at } 1.0275 = 32.11

February: 12.5 \text{ at } 1.045 = 13.0625 \text{ at } 1.0275 = 13.451

March: \frac{3}{5} \times 1.10 = 1.28 \text{ at } 1.045 = 1.353

On-level factor for 2011 = 0.9948

(c) Policies wouldn't have renewed w/ -1.7% So would catch both rate changes -1.7% +1.0% at next renewal.

On-level factor would be higher since more weight on 1.3% increase.
CASUALTY ACTUARIAL SOCIETY
ONLY ONE QUESTION PER PAGE
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EXAM 5  QUESTION #: 2  CANDIDATE #: 00277

\[ \text{LAE} = 1.15 \]

<table>
<thead>
<tr>
<th>Year</th>
<th>Premium</th>
<th>Ind Loss</th>
<th>Step 1 Trail</th>
<th>Step 2 Trail</th>
<th>Prior Mod</th>
<th>Factor Mod</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>2180</td>
<td>1.025^2</td>
<td>1.015^2</td>
<td>0.992</td>
<td>1.98^2</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>2500</td>
<td>1.02^1</td>
<td>1.015^2</td>
<td>0.98^1</td>
<td>1.98^2</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>2600</td>
<td>1.01^1</td>
<td>1.015^2</td>
<td>0.97^1</td>
<td>1.98^2</td>
<td></td>
</tr>
</tbody>
</table>

Adjusted Premiums:
- 11: 2139.3
- 12: 2473
- 13: 2580.3

Future Exp. of Loss (Actuarial):

<table>
<thead>
<tr>
<th>Year</th>
<th>Future Exp.</th>
<th>Step 1</th>
<th>Step 2</th>
<th>CDF</th>
<th>Med</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>860</td>
<td>1.02^2</td>
<td>1.012</td>
<td>1.2</td>
<td>168.25 + 73.5 = 181.8</td>
</tr>
<tr>
<td>12</td>
<td>640</td>
<td>1.015^1</td>
<td>1.01^2</td>
<td>1.8</td>
<td>124.9 + 834 = 2083</td>
</tr>
<tr>
<td>13</td>
<td>466</td>
<td>1.005^1</td>
<td>1.01^2</td>
<td>2.7</td>
<td>1273 + 966 = 2239</td>
</tr>
</tbody>
</table>

\[ \text{Avg} = \frac{181.8 + 2083 + 2239}{3} = 979 \]
A = C4 13 WX (12/31/13)  \( A < 0 \) uniformly annual

\[ B = C4 12 EX + C4 13 EX \ (2/1/13) \]
\[ B > 0 \] cancelation

\[ C = C4 13 UX \ (2/1/13) \]
\[ C < B \]

\[ D = H4UX \ (2/1/13) \]

(a) Since \( D \) is biggest, it must be \(-1\)

So must be in force as of Feb 1, 2013

And Unearned any final \( \rightarrow \) so Unearned \( > 0 \)

So written after August 1, 2012

(b) at cancellation, UEP > EP in 2013

\( \frac{4}{5} \) didn't say written in 2012

\( \therefore \) so range between: \([\text{August 2, 2012} - \text{February 1, 2013}]\)

(c) Cancellations after Feb 1 but before July 1 \( \rightarrow \) \([\text{Feb 2, 2013} - \text{June 30, 2013}]\)

(c) If after midpoint in year, wouldn't be enough unearned C4 return to subject to make \( C > B \).
(a) I recommend trend & development, historical LRP loss to project ultimate loss. This would account for loss to be adjusted from experience to exposure and from occurrence to settlement.

(b) Since future losses will be under a new layer deductible, I would apply a historical LRP (100%) to historical experience. This will treat past losses as if everyone had a $1,000,000 deductible.

(c) Mismatch in years of losses to years of exposure: I would recommend maybe 3 or 5 years of both losses and exposure, both being adjusted for trends and losses being developed to ultimate.

(d) This process is okay, but should include an excess zone for losses > $1,000,000.

   This provision would build back excess losses that were tossed to trend & develop.
CASUALTY ACTUARIAL SOCIETY

ONLY ONE QUESTION PER PAGE

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EXAM 5  QUESTION #:  5  CANDIDATE #:  00277

(5.a) \((1 + A) = \left[ \text{Loss Rate} \times (1 + \text{UAE}) + F \right] \times \left( 1 - V - Q_r \right) \)

\(\rightarrow F\) selected as latest 3yr avg

\(\leq \) do not include 2010 since expensive

- Premium: need to trend on a level
  - 1250 \times 1.041 \times 1.075 \times 1.399
  - 1400 \times 1.00 \times 1.065 \times 1.491

\(F = 12.3\%\)

\(V = 20\%\)

\(Q_r = 5\%\)

\(\text{UAE prm} = 10\% \times \text{LR}\)

\(\text{Trend} = \frac{1024}{380} = 1.041\)

\(\text{Trend} = \frac{1838}{543} = 1.00\)

- On-level: using Parallel Method (1.075 on 7/1/15)
  - annual policy
  - by 2012  2013 ; 2014

\(\sum_{(1.0) \times 1.075 + (1.0 \times 1.075 + x)}\)

Go now:

\(\frac{1}{1 + A} = \left[ \frac{\text{Loss Rate} \times (1 + \text{UAE}) + F}{1 - V - Q_r} \right] \)

\(\rightarrow \) losses: must trend at 3% annually

\(\text{must develop to ultimate}\)

\(\text{Loss Trend Period:} \)

\[ \frac{12/11/12 \times 11/11/13 \times 11/11/14 \times 11/11/15}{12/11/12 \times 11/11/13 \times 11/11/14 \times 11/11/15} \]

\(T_{12} = 1.200\)

\(\text{Return} = 1.200\)

\(\text{Avg} = \frac{12}{11/12 \times 11/13 \times 11/14 \times 11/15} = 1.075\)

\(\text{Loss Development}:\)

\(\sum_{(1.075 + x)}\)

\(\text{Loss Buv.}\)

\(\because \text{new system put in to claims settlement in 2010, I select avg 3yr link ratios which considers impact of settlement} \) (claim division in 12-24 wq from 2009-2010)

\(\text{Loss Period:} 12-24 \times 24-36 \times 36-48 \times 48-60 \times 60-114\)

\(\text{Liability} \times 1.80 \times 1.12 \times 1.09 \times 1.04 \times 1.0\)

\(\text{CDF} \times 1.45 \times 1.36 \times 1.134 \times 1.04 \times 1.0\)

\(\text{The 24-36 might still be high (considering the 1.30 from latest year), but} \)

\(\text{2yrs might be too little to base selection on (stay w/ 3yr avg claim ratio) for 24-36m as well}\)
(5.a) \((1 + \Delta) = \frac{0.846 (1.10) + 0.123}{1 - 0.20 - 0.05} = 1.405 - 1 = +40.5\% \text{ increase}\)

(5.b) Qualities of CoC:

Available: absolutely, CW data should be available and relevant assuming from same line and same company.

Easy to compute: CW data should be easy to manipulate into CoC, just as we have here using state data.

I would recommend CW CoC (especially since last 2 loss ratios were far apart).
Variable: Hours Slept

Considerations:

- Statistical? (is it significant, homogenous, & credible)?
  - Apparently by the question's wording, the actuary has statistical significance that Hours Slept differentiates risk
  - So, passes this check

- Operational? (is it objective/well-defined?)
  - No! Hours Slept is very subjective and cannot be verified easily. Furthermore, it probably changes nightly
  - Does not pass this check

- Causal? (does hours slept generally relate to auto losses)
  - I think Hours Slept is intuitive that it would increase expected losses the less sleep you get
  - So, yes, causal

- Respectful of privacy?
  - No! Obtaining & rating by hours slept invades privacy
  - Does not pass check

* I do NOT recommend we implement Hours Slept

* Most importantly, we have no true way of verifying nor maintaining accurate throughout year
(a) \[ \text{Lower Limit Annual} = \frac{1,500,000}{2} \left( 3.25 - 2.75 \right) = 375,000 \]

(b) \[ LR = 0.65 \times 65 \left( \frac{100,000}{1.5} \right) = 532,894 \]

(c) Assumes same frequency at each limit
- Assumes same expense component at each limit (higher limits could have higher profit provision)
Use Adj Pure Premium approach

<table>
<thead>
<tr>
<th>Terr</th>
<th>Curr Rel</th>
<th>Annuity</th>
<th>Adj Exp</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.750</td>
<td>7500</td>
<td>0.750</td>
</tr>
<tr>
<td>2</td>
<td>1.000</td>
<td>1000</td>
<td>1.000</td>
</tr>
<tr>
<td>3</td>
<td>1.125</td>
<td>500</td>
<td>1.470</td>
</tr>
<tr>
<td>SW</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adjustment:

<table>
<thead>
<tr>
<th>Terr</th>
<th>Earned X</th>
<th>M</th>
<th>F</th>
<th>Adj Exposures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>180</td>
<td>120</td>
<td>180 + 0.18(120) = 207.6 / 120 = 1.73</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>500</td>
<td>500</td>
<td>500 + 0.18(500) = 590 / 100 = 5.90</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>350</td>
<td>150</td>
<td>350 + 0.18(150) = 470 / 150 = 3.13</td>
<td></td>
</tr>
<tr>
<td>SW</td>
<td>1050</td>
<td>720</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pure Prem = \[
\frac{\text{Loss + LAE}}{\text{Earn Exp}}
\]

<table>
<thead>
<tr>
<th>T</th>
<th>L+LAE</th>
<th>Adj X</th>
<th>Ind Ap</th>
<th>Released Rfl</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11,427</td>
<td>27.6</td>
<td>40.31</td>
<td>0.707</td>
</tr>
<tr>
<td>2</td>
<td>51,335</td>
<td>900</td>
<td>57.54</td>
<td>1.000</td>
</tr>
<tr>
<td>3</td>
<td>32,983</td>
<td>470</td>
<td>70.18</td>
<td>1.23</td>
</tr>
<tr>
<td>SW</td>
<td>95,445</td>
<td>164.4</td>
<td>57.98</td>
<td>0.4165, increase of 16.5%</td>
</tr>
</tbody>
</table>

Re: Neutral \[\text{Ind Rfls} \times 0.707\]
Credit Score \(^2\) \(\rightarrow\) GLM for \(\text{(Freq/Wind)}\) \(\rightarrow\) wind is weather
\(\rightarrow\) Somewhat uncontrollable
\(\rightarrow\) One year of data \(\rightarrow\) slim data for weather-related

- Roughly:
  - Credit | Ind Rel.
  - Good   | 1.00
  - Fair   | 1.25  \(\rightarrow\) not many exposures here!
  - Poor   | 1.50
\(\rightarrow\) Poor Confidence Interval between 1.1 \& 1.4

First:
- We want to see mathematical/statistical difference between groups
  \(\rightarrow\) Good-to-Fair is sizeable, but Fair's Ind Rel margin of error is 1.2 \& 1.4
  \(\rightarrow\) Credible?

\(\rightarrow\) Fair & Poor categories lack many exposures, causing wide range on Conf Interval

- Because Credit Score is so highly regulated by DOI's when filing, I don't believe we have enough data to defend our filing (DO NOT IMPLEMENT!)

- Just one year of exposure in a weather-related peril is likely not enough to invest in our systems and bank on DOI buying into our support

\(\rightarrow\) I would recommend a study with more years

\(\rightarrow\) The results do seem to match what we'd expect to see, which supports causality consideration, and significance considering

\(\rightarrow\) but what I question most is credibility and controlled by public

and also the DOI's perception if it will be accepted by public
(a) Reasons for proposing lower than indicated:

1) Regulatory constraints may have prohibited taking a full 20% increase. Often, this could be done when we (company) must send policyholder notification for a change beyond 8%. And we choose not to go beyond 8% so we don't have to send notices.

2) Marketing reasons may be why so that we can keep price of insurance low to attract more business in the short-term. Let's hope we are attracting desired policyholders who will help lower future loss costs.

3) Riding out the cycle of the market. Future indicators may show our loss costs & expenses declining in future, so we do not feel we need to take full 20% change. (This allows us to not provide a big sticker shock to our customers at renewal.)

(b) Company could re-underwrite book w/ inspections on all autos

4) This may find policies we can weed out at next renewal and improve existing business loss ratios

or: Company can decrease future expenses (underwriting or claim expenses)

5) This would put downward pressure on indicated rate needed
\[
\begin{array}{c|c|c|c|c}
\text{Fact 1} & \text{Fact 2} & \text{Discount} & \text{Expense} \\
450 & 1.069 & 1.057 & 1.03 & 25 \\
\hline
\end{array}
\]

Offset = 0.859

Increase = 1.08

Total = 1.928

\[\text{we need to modify base rate by 0.928 to = 1.08 change (give factor) discount change}\]

\[415 \times 0.928 = 385\]

385 = proposed base rate
CASUALTY ACTUARIAL SOCIETY

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EXAM 5  QUESTION #: 11  CANDIDATE #: 00277

(a) \[ \text{Retro Prem} = \left( \text{Basic Prem + (Exp Losses \times LCF)} \right) \times \text{Tax Multiplier} \]
\[ = \left( \text{Basic Prem + (200,000 \times 1.08)} \right) \times 1.04 \]

\[ \rightarrow \text{Basic Prem} = \left( \frac{\text{Standard Prem} \times (\text{Exp Allow} - (\text{LCF - 1}) \text{ELF} + \text{NC})}{0.95,000 \times (0.15 \times (0.08 \times 0.02) + 0.18)} \right) \]
\[ = 0.95,000 \left( 0.7814 \right) \]
\[ = 75,573 \]

\[ \rightarrow \text{Retro Prem before min mens} = (75,573 + 216,000) \times 1.04 = 428,036 \]

\[ \text{min} = \text{Basic Prem} \times (0.75) = 146,480 \]
\[ \text{max} = \text{Basic Prem} \times (1.25) = 244,460 \rightarrow \text{cap or max} \]

\[ \rightarrow \text{Retro Premium capped at max} = 244,460 \]

(b) Basic Premium covers Expenses & Pretax Reinsurance

\[ \rightarrow \text{The Retro Premium adjusts for the experience parcel losses} \]
\[ \text{Exp & Cost of Reinsurance remain locked in for duration of policy term,}
\text{only loss changes will change Prem} \]
Compare Case base methodology

Property

Credibility

- I would group Regions 2 & 3 since link ratios must be identical
  4 and Region 2 should be merged with a larger region since smallest

- I would keep 1 & 4 separate

\[
\begin{array}{c}
1 \\
2+3 \\
4 \\
\end{array}
\]

by reviewing Claim Settlement Rate
CUM REPORTED CLAIMS (000)

<table>
<thead>
<tr>
<th>Year</th>
<th>Claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>11</td>
<td>25,000</td>
</tr>
<tr>
<td>12</td>
<td>30,000</td>
</tr>
<tr>
<td>13</td>
<td>21,000</td>
</tr>
</tbody>
</table>

\[ \text{CDF} = \frac{\text{Claims}}{100000} \]

\[ \text{Selected Link Rates} = 1.75, 1.25 \]

(a) \( \text{2013 AY Rep. Claims} \times (2,1875) = 45,937,500 \)

(b) IBNR develops based on reported claims to date

Stable Claims Reserve philosophy across time.

(c) When IBNR doesn't develop based on reported claims to date, as proof in a diagnostic test, perhaps use Expected Claims technique which uses prior estimate to develop IBNR from expected claims ratio

- Caution: adjust for unstable/unchanging Case Reserve. Philosophy over time by using Berkjerr-Sherman adjustment to Aug Case OS

- This would adjust reported losses to recent Case Reserve level.
CASUALTY ACTUARIAL SOCIETY

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EXAM 5 QUESTION #: 14 CANDIDATE #: 06277

(a) BF: IBNR = [CSEP x ECR x % Unreported]
   = [Ult Claims from ExpClaim-Techn] x (1 - CDF)]
   = [100,000 x (1 - 2.5)]

* Pa 2013 x 5 = 95,000

BF = 100,000

BF UBFR = 60,000

BF Ult Claims = Paid + Case + IBNR

= 19,000 + 22,000 + 60,000

= 101,000

(b) When credibility constant

equals 1 (So when 100% reported)

Makes sense between 100k / 102.5k

Which is between Rpt CDF & Exp Claim

(c) Use BF over Chain-Decker when:

5. Newer LOB: BF gives credit to what has already been reported, so gives credit to new LOB reports, but develops based on expected claims (which will be more stable if using an industry benchmark rather than one year or less of losses)

6. When Claim Settlement Patterns are changing, BF will give a more accurate IBNR calculation than Chain-Decker
(a) \( PPT \text{ trend} = 1.05 \) 2013 A.M. 18UR BF

\[
BF \ ECR = .57 \\
18UR = \left( \frac{\text{CLEP} \times \ ECR \times \ \% \ \text{Unreported}}{1800 \times 1.00} \times .57 \times (1 - \frac{1}{2}) \right) \\
= 513,000 \quad \text{using BF}
\]

(b) Cape Cod uses Used-Up Premium,

\[
\begin{align*}
\text{CLEP} \times \ \% \ \text{Rept} & = 1350 \\
10 \times 1.35 & = 1350 \\
11 \times 1.30 & = 1207 \\
12 \times 1.14 & = 988 \\
13 \times 1 & = 900 \\
\text{Cape Cod ECR} & = \left( \frac{2.2\text{,}500 \times \ \% \ \text{Rept}}{4\text{,}445} \right) = \left( \frac{2.2\text{,}500}{4\text{,}445} \right) = .507
\end{align*}
\]

\[
OC 18UR = \left[ 1800 \times .607 \times .5 \right] = 546,482
\]

(c) i) Loss Ratio

Cape Cod will be more appropriate than BF, since BF relies heavily on prior estimate of ECR whereas Cape Cod considers recent loss ratio impact better.

(d) ii) Thin Data

Because Cape Cod calculates ECR with used-up premium, it gives more concentration to experience.

When Thin Data/experience, BFurt will better account since it uses the selected Expected Claim Ratio.
### XSL\textsuperscript{-}11.10.13

#### Case 1

<table>
<thead>
<tr>
<th>Exp. Claim Counts</th>
<th>( \text{Exp. Total} \times \frac{3}{2} )</th>
<th>( \text{Exp. Avg.} = )</th>
<th>( \mu_{x^2} )</th>
<th>( \sigma_{x^2} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>1,02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>1,02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>1,02</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
I. Case Adeqacy

i) Rpt Claim Devy

> As Case Adeqacy is, the IBNR would be overstated for Rpt Chain-Ladder since it bases IBNR on Reported Claims to date and relies on case reserve patterns going forward to reach stable. With Case Reserve, CDF will be inflated

ii) Exp Claim Technique is not impacted by this since Exp Claim uses an estimate of expected claims to calculate ultimate claims and doesn’t ever consider case adequacy.

iii) Rpt BF will be affected in a similar manner as Rpt Claims development to the extent that in Rpt comes in. Since BF overweights between chain ladder & Exp Claims, only portion of 1% Rpt will be impacted in an overstated way (but not as overstated as Rpt Chain-Ladder).

iv) Cape Cod impact will be similar to BF impact except it will be less accurate. In other words, it will overstate IBNE from Cape Cod due to increasing case OS reserve slightly more than BF

This is because not only does it overstate from Rpt portion, but also from the way it calculates Used-Up Pre EC ECR, which BF use Exp Claims for ECR.
Diagnosis 1: Paid Claim to Rpt Claim

<table>
<thead>
<tr>
<th>Year</th>
<th>Paid Claim</th>
<th>Rpt Claim</th>
<th>% of Paid</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>12,909</td>
<td>2,609</td>
<td>100%</td>
</tr>
<tr>
<td>12</td>
<td>12,366</td>
<td>1,836</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>1,776</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Looks like case strength is getting bigger going down vertically.
- Could be weakness in claim settlement, but since others watch yr to yr, I'm thinking this is a formula reserve change.

Diagnosis 2: Check Avg Case OS

<table>
<thead>
<tr>
<th>Case OS</th>
<th>Claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>24</td>
<td>36</td>
</tr>
</tbody>
</table>

- Idea that case reserve strength is correct.
- Increase in Avg Case OS yr to yr.

Since changing (strength?) Case Philosophy: Unadjusted Claims Ladder won't be good.

Calculation 1: Berg-Shuman Case OS adjustment

- Set all yrs equal to last Avg Case OS.

<table>
<thead>
<tr>
<th>Year</th>
<th>Adj OS</th>
<th>Claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>12,373</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>12,373</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>12,373</td>
<td>0</td>
</tr>
</tbody>
</table>

Recalculate Paid Claims OS

- New Paid Claims OS

<table>
<thead>
<tr>
<th>Year</th>
<th>Paid Claim</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>13,060</td>
</tr>
<tr>
<td>12</td>
<td>13,200</td>
</tr>
<tr>
<td>13</td>
<td>13,440</td>
</tr>
</tbody>
</table>

Recalculate 2013 Adjusted Ultimate Claims

- New Cal 2012 A4 Ult Claim

<table>
<thead>
<tr>
<th>Year</th>
<th>Claim</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>1,008</td>
</tr>
<tr>
<td>13</td>
<td>1,396</td>
</tr>
</tbody>
</table>

- 12 A4 Ult Claim = 1,396 x 1,008 = 1,396

- 1,396 x 1340 = 1,870,747

2013 Ult Claim
Calculation 2: Find UI+ Claims using Paid Claim Development Technique

Paid is kept impacted by changes to Case Reserve ... so

<table>
<thead>
<tr>
<th></th>
<th>1006</th>
<th>1500</th>
<th>1815</th>
<th></th>
<th>1.5</th>
<th>1.21</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>1025</td>
<td>1530</td>
<td></td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 13| 1040 |      |      | 12→44: CDF = 1.5×1.21 = 1.815

→ 13 Paid Claim × 12-UIT-CDF

1040 × 1.815 = 1,887,600

UIT Claim
UL+ Claim = CLEP x ECR

\[ \text{2013 CLEP} = 8000 \rightarrow \text{So: 2013 UL+ Claim} = 8000 \times \text{ECR} \]

<table>
<thead>
<tr>
<th>CY</th>
<th>CLEP</th>
<th>Trad Ult Claim</th>
<th>Loss Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>6000</td>
<td>3389</td>
<td>1.598</td>
</tr>
<tr>
<td>13</td>
<td>8000</td>
<td>3323</td>
<td>0.995</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Linking:

\[ \begin{array}{c|c|c|c} 
2/14 & 1.99 & 1.72 & \text{ECR} \\
1.19 & 1.78 & 1.19 & \text{ULT} \\
2.07 & \end{array} \]

\[ \begin{array}{c|c|c|c} 
\text{ULT} & 1.06 & 1.19 & 1.19 \\
36-ULT & 1.19 & 1.19 & 1.19 \\
24-ULT & 1.19 & 1.19 & 1.19 \\
12-ULT & 1.19 & 1.19 & 1.19 \\
\end{array} \]

\[ \begin{array}{c|c|c|c} 
3118 & 1.0 & 0.983 & 2.935 \\
3140 & 1.19 & 0.982 & 3.589 \\
1840 & 2.12 & 0.981 & 3.323 \\
904 & 4.38 & 0.980 & 3.906 \\
\end{array} \]

Need to select ECR: Since no other information tells me why 2013 is so low, I don’t want to give it weight (perhaps anomaly?) (Perhaps reason why using ExClaim)

\[ \text{So, average Loss Ratio from 2010-2012 to select ECR} \]

\[ 0.591 = \text{ECR} \]

\[ 2013 \text{ UL+ Claim} = 8000 \times 0.591 = 4728,000 \]
CASUALTY ACTUARIAL SOCIETY

ONLY ONE QUESTION PER PAGE

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EXAM 5  QUESTION #: 20  CANDIDATE #: 00277

Ult $\&S$ for A12013 using Ratio (of received $\&S$ to Pd Gross)

<table>
<thead>
<tr>
<th>Pd Gross</th>
<th>$&amp;S$ Received</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 4000 5000 5500</td>
<td>11 800 1750 2200</td>
</tr>
<tr>
<td>12 4500 5625</td>
<td>17 900 2569</td>
</tr>
<tr>
<td>13 3000</td>
<td>13 1250</td>
</tr>
</tbody>
</table>

Find Quot A's

<table>
<thead>
<tr>
<th>11 12 13</th>
<th>$&amp;S$ 1.85 0.4 0.25</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.10 1,143</td>
<td>12-U1+CDF = 2x1,143 = 2.286</td>
</tr>
<tr>
<td>12-24 24-U1+</td>
<td></td>
</tr>
</tbody>
</table>

\[ \frac{0.25 \times 2.286}{572} = \frac{2013 \text{ Ult Ratio of received } \&S}{\text{ Gross Pd Claims}} \]

\[ \frac{6 \text{ Ult } \&S \text{ A12013} = \left( \text{Ratio} \times \text{Ult Claims} \right)}{\text{Gross}} \]

Develop Ult Gross Claim $\rightarrow$ Link Ratio $\rightarrow$ 1.25 1.1

\[ \text{1.375 } \times 5000 = 6875000 \]

\[ \frac{\text{Ratio} \times \text{Ult Gross Claim}}{\text{Ult Claim}} = \frac{572 \times 6875000}{3932500} = 3932500 \]

\[ \text{Ult } \&S \]
General liability → legal expenses → AEAE → AEAE↑ in early stages

4 were sources to defend at earlier stages

prior stability in claim settlement

(a)

(b)

(c)
(a) \[ \text{Exp Cl rall (Group B) to Actuarial Cl rall} \]

\[ \text{to 2,500} \]

\[ \text{2,340.8} \]

\[ \text{15-UIt Rpt = 1.33} \]

\[ \text{18-UIt Rpt = 1.25} \]

\[ \text{Actual} \]

\[ \text{Actual} \]

\[ \text{Exp at Monthly} \]

\[ \text{2,300} \times 1.064 = 2,340.8 \]

\[ \text{Expected Uniform} \]

\[ \text{Exp Cl rall at 17 mo = 2,294} \]

So Exp Cl rall at May 31 (as of June 31) = 2,294

Actual is \[ \text{2,500} \]

So actual is \[ \text{2,060} \]

(b) Same process: using Paid Cl Diffs

\[ \text{15-UIt} = 1.82 \text{ Link Ratio from 15-15} \]

\[ \text{18-UIt} = 1.50 \text{ } \]

\[ \text{1.213} \]

\[ \text{1.213} \times \text{PD (1450)} = 2062 \text{ is Exp at 18 mo} \]

\[ \text{interpolate to Exp (1885 at May 31 pd)} \]

Actual is \[ \text{1875} \text{ (So didn't develop as fast as expected)} \]

(c) Looks like Case 1

and Paid pattern stayed close to predicted

- Would talk to reserves & claims to see if claim reserve philosophy changed
  because perhaps we are stretching reserves since last calculated.

(d) Do not revise if find out that a one large loss is now slightly skewing the data to where we have more "Case temporarily"
### Question 29

<table>
<thead>
<tr>
<th>Year</th>
<th>Claims Paid</th>
<th>CDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>1150</td>
<td>550</td>
</tr>
<tr>
<td>2014</td>
<td>250</td>
<td>50</td>
</tr>
</tbody>
</table>

**Cum. Exp.**

<table>
<thead>
<tr>
<th>Year</th>
<th>CDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>1150</td>
</tr>
<tr>
<td>2014</td>
<td>250</td>
</tr>
</tbody>
</table>

**Cum. Pol.**

<table>
<thead>
<tr>
<th>Year</th>
<th>CDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>550</td>
</tr>
<tr>
<td>2014</td>
<td>50</td>
</tr>
</tbody>
</table>

**CDF**

<table>
<thead>
<tr>
<th>Year</th>
<th>CDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>1150</td>
</tr>
<tr>
<td>2014</td>
<td>250</td>
</tr>
</tbody>
</table>

**Problem (a)**

\[ CDF = 1, 1.25, 1.818, 1.95 \]

**Problem (b)**

\[ 12 - CDF = 1.818 \times 1.25 = 2.1325 \]

\[ \frac{2.1325}{12} = 42.87\% \]

**Expected Value**

\[ 289 = \text{Unpaid Claim Estimate as of 12/31/14} \]
Exam 5

Spring 2014

Candidate #81

Score 42.75
a. Current rate level = 1.038

2011 Avg Earned Rate Level = \((10/12)^2 \cdot 1.045 + \left[1 - (10/12)^2 \cdot 1/2\right] \cdot 1.042\)

= 0.343 \cdot 1.045 + 0.653 \cdot 1.042

= 1.043

2011 On-Level Factor = \(\frac{1.043}{1.038}\) = 0.9952

b. In force @ 2/1/2012: 125% written on 1/1/2012

75% written between 2/1/2011 and 2/1/2012

Written on 1/1/2012: earned rate level = 1.042

Remaining policies: \((1/12)^2 \cdot 1/2 \cdot 1.045 + \left[1 - (1/12)^2 \cdot 1/2\right] \cdot 1.042 - 1.042 \cdot 1.045 + 0.58 \cdot 1.042 = 1.043

Overall for in force @ 2/1/2012: \(0.25 \cdot 1.042 + 0.75 \cdot 1.043\)

avg earned rate level = 1.04275

On-Level factor = \(\frac{1.038}{1.04275}\) = 0.9954

c. With a longer policy term it would take longer for the book to convert into newer rates, thus lowering the average earned rate level for CY 2011. That would increase the on-level factor.
<table>
<thead>
<tr>
<th>Year</th>
<th>Premium</th>
<th>Loss Cost</th>
<th>Payroll Level</th>
<th>Exp Modif</th>
<th>Adj Loss</th>
<th>Fut Wage Lvl</th>
<th>Proj Loss</th>
<th>Cost Prem ('000)</th>
<th>Chg</th>
<th>Cost Prem</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>2100</td>
<td>40455</td>
<td>0.99</td>
<td>2173.59</td>
<td>1.0157</td>
<td></td>
<td></td>
<td>23.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>2500</td>
<td>4.02</td>
<td>0.98</td>
<td>2489</td>
<td>1.0153</td>
<td></td>
<td></td>
<td>26.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>2600</td>
<td>1.00</td>
<td>0.97</td>
<td>2522</td>
<td>1.0152</td>
<td></td>
<td></td>
<td>25.98</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Claim (#)</th>
<th>Chg Factor</th>
<th>-10 Ult</th>
<th>Claims ('000)</th>
<th>Level Chg Factor</th>
<th>Claim (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>850</td>
<td>1.0353</td>
<td>1.2</td>
<td>1056</td>
<td>1.014</td>
<td>0.98</td>
</tr>
<tr>
<td>2012</td>
<td>670</td>
<td>1.015</td>
<td>1.8</td>
<td>1224</td>
<td>1.013</td>
<td>0.98</td>
</tr>
<tr>
<td>2013</td>
<td>460</td>
<td>1.00</td>
<td>2.7</td>
<td>1242</td>
<td>1.01</td>
<td>0.98</td>
</tr>
</tbody>
</table>

2011-2013 Total Proj Prem = 7518  (sum of (6))  [+]  2011-2013 Total Proj Indemnity Claim = 3555  (sum of (g))  [+]  2011-2013 Total Medical Claim = 2469  (given)  [+]  Projected Ult Lns + LAE Ratio = \( \frac{(3555 + 2469) \cdot 1.95}{7518} = 92.15\% \)  LAE percentage = 15%
b. Cancellation effective date range: 2/2/2013 through 8/31/2013

C. unearned

If policy is in force @ 7/1/2013, has to be written on or after 7/1/2012 (but during 2012, given A=0)
In that case, earned premium @ 7/1/2013 will always be greater than unearned premium.
a. Historical loss has to be trended to projected period and developed to ultimate using a reserving methodology. Exposure has to be adjusted to proposed effective period for trends and on-leveling (if using premium-based exposure base).

b. Historical experience needs to be adjusted to new deductible level, which will drive both losses and premiums down (possibly at different rates).

c. Need to take lack of credibility of data into account. Use a reasonable complement of credibility (countrywide data, industry rates, or other depending on application).

d. Consider increasing the cap to higher level, which will better reflect overall experience. It seems that there is enough data to accomplish that with high credibility.
EXAM 5  QUESTION #: 5  CANDIDATE #: 00081  

**CASUALTY ACTUARIAL SOCIETY**  
**ONLY ONE QUESTION PER PAGE**  
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<table>
<thead>
<tr>
<th>Year</th>
<th>EP (000)</th>
<th>On-Level Fac</th>
<th>Trend Fac</th>
<th>Trended, On-Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>1250</td>
<td>1.045</td>
<td>1.0425</td>
<td>1.0425</td>
</tr>
<tr>
<td>2013</td>
<td>1400</td>
<td>1.065</td>
<td>1.0425</td>
<td>1.065</td>
</tr>
</tbody>
</table>

**Average rate level:**

\[
\begin{align*}
2012 &: 1.00 \\
2013 &: \left(\frac{3}{2}\right)^{\frac{1}{2}} \cdot 1.075 + \left[1 - \left(\frac{3}{2}\right)^{\frac{1}{2}}\right] \\
&= 1.069375 \\
\end{align*}
\]

**On-Level factor:**

\[
\begin{align*}
2012 &: 1.075 \\
\frac{2012}{1.075} &= 1.00 \\
2013 &: 1.075 \cdot 1.065 \\
\end{align*}
\]

**Off Algorimum:**

- 2009: 500 + 4% select + 4% premium-trend
- 2010: 520 + 3.8%
- 2011: 540 + 2.7%
- 2012: 560 + 4.1%
- 2013: 583 + 4.1%

ULAE ratio: 90%

<table>
<thead>
<tr>
<th>Year</th>
<th>Pooled-ULAE</th>
<th>Dev Factor to Ult</th>
<th>Law Trend</th>
<th>Ultimate, Trended</th>
<th>Law8 + ALAE+</th>
<th>ALAE+</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>750</td>
<td>1.303</td>
<td>1.0335</td>
<td>1084</td>
<td>192</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>500</td>
<td>2.345</td>
<td>1.0325</td>
<td>1262</td>
<td>1388</td>
<td></td>
</tr>
</tbody>
</table>

**Dev Factor Selection**

<table>
<thead>
<tr>
<th>12-24</th>
<th>24-36</th>
<th>36-48</th>
<th>48-60</th>
<th>60+</th>
<th>12-Ult</th>
<th>24-Ult</th>
<th>36-Ult</th>
<th>48-Ult</th>
<th>60-Ult</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.80</td>
<td>1.45</td>
<td>1.10</td>
<td>1.03</td>
<td>1.00</td>
<td>2.345</td>
<td>4.303</td>
<td>1.133</td>
<td>1.03</td>
<td>1.00</td>
</tr>
</tbody>
</table>

(a) Development pattern seems to have changed with new software. Will use 3-year avg to only consider development after implementation of software.

(b) Similarly to (a), but using average of last 2 years of data (1.15)

(c), (d): Use avg excluding high/low, since AY 2007 has a much higher factor which is not likely to happen again in the future (at least has not happened between 2008-2010).

(e): Use 1.00, as no development seen historically.
### CASUALTY ACTUARIAL SOCIETY

**ONLY ONE QUESTION PER PAGE**

**DO NOT WRITE ON THE BACK OF THIS SHEET**

<table>
<thead>
<tr>
<th>Year</th>
<th>Trended, On-Level Prem.</th>
<th>Ult. Low Inc. ALAE+ULAE</th>
<th>Exp Ult.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>1541</td>
<td>1192</td>
<td>77.4%</td>
</tr>
<tr>
<td>2013</td>
<td>1645</td>
<td>1388</td>
<td>84.4%</td>
</tr>
<tr>
<td></td>
<td>3186</td>
<td>2580</td>
<td>80.98%</td>
</tr>
</tbody>
</table>

**Selected low ratio**

### Fixed Exp Ratio Selection:

<table>
<thead>
<tr>
<th>CY</th>
<th>Fixed Exp Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>10%</td>
</tr>
<tr>
<td>2010</td>
<td>22% - seems too high: might be related to acquired software - remove from average</td>
</tr>
<tr>
<td>2011</td>
<td>15%</td>
</tr>
<tr>
<td>2012</td>
<td>12% Selected: 10% + 15% + 12% + 10% = 11.75%</td>
</tr>
<tr>
<td>2013</td>
<td>10%</td>
</tr>
</tbody>
</table>

\[
\text{Indicated Rate Chg.} = \frac{0.8098 + 0.1175 - 1}{1 - 0.2 - 0.05} = +23.64\%
\]

6. Complement is suitable if mix of business in the rest of the country is similar to this state. (e.g. if this is a coastal state we concentration inland for countrywide, then probably not suitable)

   Need to consider if regulation in other states differ significantly, in which case we cannot use them as complement.
#1: Causality is difficult to prove and should not be allowed as a rating variable.

#1: It is difficult to verify accuracy of information provided by insured on hours of sleep.

#2: We might be invading the insured's privacy by asking that question.

#3: Regulators might not approve the use of this variable in rating, given the difficulty of proving causality with expected losses.

#4: A benefit could be that competitors do not use that variable, which could cause favorable selection in our book.

Weighing the difficulties and benefits of implementing this variable, I would recommend that it does not get used in rating.
Complement of credibility = 3.25 - 2.75 \[= 0.5\] 

\[\frac{1500000}{345000} \approx 4.34\]

b. Premium
- 1000000
- 500000
- 400000
- 300000
- 200000
- 1900000
### Earned Exposures vs Adjusted Exposures

<table>
<thead>
<tr>
<th>Territory</th>
<th>M</th>
<th>F</th>
<th>Earned Exposures</th>
<th>Adjusted Exposures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>180</td>
<td>120</td>
<td>180.1 + 120 \cdot 0.8 = 276</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>500</td>
<td>500</td>
<td>500.1 + 500 \cdot 0.8 = 900</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>350</td>
<td>150</td>
<td>350.1 + 150 \cdot 0.9 = 470</td>
<td></td>
</tr>
</tbody>
</table>

Gender relat: 1.00 0.80

<table>
<thead>
<tr>
<th>Territory</th>
<th>Adj Exp</th>
<th>Loss</th>
<th>PurePremium</th>
<th>Relat</th>
<th>Relat Rebased</th>
<th>Curr Relat</th>
<th>Relat Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>276</td>
<td>1127</td>
<td>40.32</td>
<td>0.6953</td>
<td>0.7065</td>
<td>0.75</td>
<td>-5.75%</td>
</tr>
<tr>
<td>2</td>
<td>900</td>
<td>51335</td>
<td>57.04</td>
<td>0.9836</td>
<td>0.9836</td>
<td>0.9836</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>470</td>
<td>32983</td>
<td>70.17</td>
<td>1.2100</td>
<td>1.2302</td>
<td>1.125</td>
<td>+9.35%</td>
</tr>
<tr>
<td></td>
<td>1646</td>
<td>95445</td>
<td>57.99</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ind relat for terr 3  
relat chg for terr 3
Credibility and amount of data: Insurer is using only one year of data, which may be the reason why there is a wide variation for Poor credit risks in terms of wind frequency relativity. Although Fair credit has more data and is still subject to volatility.

Regulatory constraints: Credit is often considered illegal in some states, so need to take that into consideration for this book.

Widely used variable: Credit is used by several insurers in multiple states, thus having reasonable acceptance in market.

Since volatility around indicated relativity is within a reasonable range, I would use credit scores as indicated by the GLM, provided that it is legal to do so.
a. Retention: often insurers take less rate than indicated in order to optimize retention. With that, insureds are less often compelled to shop for cheaper coverage.

Regulations: departments of insurance could have denied an increase that high for multiple reasons (e.g., disagreed with trend selection), causing rate change to be less than indicated.

Capping: company might use capping to avoid premium disruption, which could cause overall rate change to be less than indicated.

b. #1: Could review underwriting rules to make sure they are being enforced properly, or even change to tighter rules.

#2: Implement stronger claims scrutiny to avoid paying for claims that could be fraudulent.

c. \[ \text{450} = \left[ B \cdot 1.069 \cdot 1.057 \cdot (1-0.03) \right] + 35 \]

\[ B = 378.64 \rightarrow \text{current base rate} \]

Proposed base rate: \[ 378.64 \cdot 1.08 = 408.93 \]

(rate change does not apply to expiring fee)
a. \[(0.181 - (1.08 - 1) \cdot 0.62 + 0.15) \cdot 695000 = 195573\]
\[(200000 + 195573) \cdot 1.04 = 411395.92 \rightarrow \text{retrospective premium (calculated)}\]
Minimum = 695000 \cdot 0.95 = 521250
\[\rightarrow \text{Final retrospective premium = minimum = 521250}\]

b. 
#1: Losses incurred during the effective period of the policy
#2: Underwriting expenses associated with the risk transfer
Region 2 has the lowest number of earned exposures, and at the same time has development patterns which are very similar to those of Region 3. I would group regions 2 and 3 together.

Regions 1 and 4 have each very different development patterns, thus should not be grouped with any other region.

Groups:
1
2+3
4
# CASUALTY ACTUARIAL SOCIETY

**DO NOT WRITE ON THE BACK OF THIS SHEET**

<table>
<thead>
<tr>
<th>Reported Claims</th>
<th>Development Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>AY 12 24 36</td>
<td>12-24 24-36 36-Ult</td>
</tr>
<tr>
<td>2011 25000 45000 56250</td>
<td>1.8 1.25</td>
</tr>
<tr>
<td>2012 30000 51000</td>
<td>1.7</td>
</tr>
<tr>
<td>2013 21000</td>
<td></td>
</tr>
</tbody>
</table>

| Age to Age  | 1.75  1.25  1.00 |
| Age to Ult  | 2.1875 1.25  1.00 |

<table>
<thead>
<tr>
<th>AY</th>
<th>Reported to Date</th>
<th>CDF</th>
<th>Ultimate (1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>21000</td>
<td>2.1875</td>
<td>45939.5</td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Assumes that claims will develop the same way into the future as they did in historical period.
2. Assumes same case reserving philosophy and claim settlement procedures into the future as seen in historical period.

3. Use Bornhuetter-Ferguson technique, which will use an a priori loss ratio with a posterior credibility weight. The a prior estimate will be:

4. Use Bergst-Sherman adjustment on paid or average case, which will bring payment pattern or case adequacy to current level.
a. Paid development ultimate = $95,000
   Percentage paid = 20%
   Paid to date = 95,000 \times 20\% = 19,000
   Case outstanding = 22,000
   Reported to date = 19,000 + 22,000 = 41,000

   B-F ultimate = \frac{1}{9} \times 100,000 + 0.2 \times 41,000 = 98,200

b. #1: When the development technique results that 100% of claims have already been reported

   #2: When the reported loss ratio equals the a priori loss ratio used in B-F.

c. #1: When there is a change in development patterns (offering new coverage) and current development is expected to be different. In that case, dev technique will distort results.

   #2: When development factors are highly leveraged. Dev technique will produce volatile results, while B-F will be stable (based mostly on a priori) #2, with a high % unreported in this case.)
<table>
<thead>
<tr>
<th>Year</th>
<th>EP</th>
<th>On-Level EP</th>
<th>Reported Claims</th>
<th>Ultimate Claims</th>
<th>% Reported</th>
<th>Trended, On-Level EP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1100</td>
<td>1485</td>
<td>700</td>
<td>790</td>
<td></td>
<td>1485 * 1.05^2 = 1713</td>
</tr>
<tr>
<td>2011</td>
<td>1380</td>
<td>1696</td>
<td>750</td>
<td>1050</td>
<td></td>
<td>1696 * 1.05^2 = 1863</td>
</tr>
<tr>
<td>2012</td>
<td>1400</td>
<td>1680</td>
<td>500</td>
<td>850</td>
<td></td>
<td>1680 * 1.05 = 1764</td>
</tr>
<tr>
<td>2013</td>
<td>1800</td>
<td>1800</td>
<td>470</td>
<td>1500</td>
<td>1/2 = 50%</td>
<td>1800 * 1.00 = 1800</td>
</tr>
</tbody>
</table>

- Multiply EP by on-level factor
- Multiply reported by dev factor to ultimate

a. 2013 B-F Ultimate = 50% * 750 + 50% * 1800 * 57% = 1263
   (1000)

b. 2013 B-F IBNR = 1263 - 750 = 513
   (1000)

b. Overall Ultimate = 4170
   Overall Trended, On-Level Premium = 7146

2013 Cape Cod IBNR = 50% * 1800 * 57.35% = 525.15

c. i. Cape Cod is more appropriate, because it will capture the decrease in claim ratio, since it uses historical data to calculate expected claim ratio.
ii. B-F is more appropriate, because it uses an a priori claim ratio which does not depend on the thin data.
<table>
<thead>
<tr>
<th>AY</th>
<th>Trended Revenue</th>
<th>Trended Ground-Up Claim Counts</th>
<th>Trended Excess Claim Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>3700 - 1.03^2 = 3609</td>
<td>1950 - 1.00 - 1.02^2 = 1821</td>
<td>220 - 1.5 - 1.03^2 = 363.8</td>
</tr>
<tr>
<td>2012</td>
<td>3500 - 1.02 = 3605</td>
<td>1900 - 1.04 - 1.02 = 1803</td>
<td>140 - 25 - 1.05 = 367.5</td>
</tr>
<tr>
<td>2013</td>
<td>3600</td>
<td>1800 - 1.2 = 1800</td>
<td>90 - 6.00 = 540</td>
</tr>
</tbody>
</table>

**Note:**

- **# of claims exceeding reinsurance attachment point → as % of revenue**

<table>
<thead>
<tr>
<th>AY</th>
<th># of claims exceeding reinsurance attachment point → as % of revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>1821 - 363.8 = 1457.2 / 3700 = 40.4%</td>
</tr>
<tr>
<td>2012</td>
<td>1800 - 367.5 = 1432.5 / 3500 = 39.8%</td>
</tr>
</tbody>
</table>

**Avg. = 40.1% (selected)**

**UH Claim Counts not exceeding attachment point for 2013:**

\[ 3600 \cdot 40.1\% = 1444 \]
i. Ultimate losses will potentially be overstated. Historical development factors will be applied to higher level of reported losses, producing higher ultimates.

ii. Expected claim calculated from historical data will be overstated; since case adequacy affects latest calendar year estimates for all accident years. Ultimate losses will be overstated.

iii. B-F will be less affected than development method, since it assigns credibility to an a priori loss ratio. However, the portion of development already reported will be overstated.

iv. CapeCod is similar to B-F, but instead of using a priori LR, will use the experience LR as a complement of credibility. Since it will be affected by greater case reserve, the method will overstate ultimates.
# Average Case Outstanding

<table>
<thead>
<tr>
<th>AY</th>
<th>12</th>
<th>24</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>100</td>
<td>136.36</td>
<td>0</td>
</tr>
<tr>
<td>2012</td>
<td>200</td>
<td>292.53</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>300</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Case adequacy has been increasing largely.
- Consider 8-5 with case adequacy adj.

# Average Paid Claims

<table>
<thead>
<tr>
<th>AY</th>
<th>12</th>
<th>24</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>1388.58</td>
<td>1541.43</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>1416.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>1155.56</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Average paid claims are increasing at a steady rate of 2% per year.
- Consider paid development method.
- Use 2% trend for 8-5 adjustment on case adequacy.

# Closed-to-Reported Count Ratio

<table>
<thead>
<tr>
<th>AY</th>
<th>12</th>
<th>24</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>0.99</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>0.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>0.98</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- No acceleration on claim closure or change in reporting patterns.
- Consider paid development.

# Paid Development (% of)

<table>
<thead>
<tr>
<th>AY</th>
<th>12</th>
<th>24</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>1000</td>
<td>1500</td>
<td>1815</td>
</tr>
<tr>
<td>2012</td>
<td>1020</td>
<td>1530</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>1040</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Dev factors:
  - 12-24: 1.5, 1.21
  - 24-36: 1.815, 1.21
  - 36-Ult: 1.00

# 2013 Ult Claim = 1040000 \cdot 1.815 = 1887800

- Paid Development Ultimate
Adjusted Current Outstanding: $234,121

<table>
<thead>
<tr>
<th>AY</th>
<th>12</th>
<th>24</th>
<th>36</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>288</td>
<td>267</td>
<td>0</td>
<td>284</td>
<td>294</td>
<td>300</td>
</tr>
</tbody>
</table>

Adjusted Reported Claim ($'000) = adjusted case x open counts + paid claim

<table>
<thead>
<tr>
<th>AY</th>
<th>12</th>
<th>24</th>
<th>36</th>
<th>Dev Factor</th>
<th>12-24</th>
<th>24-36</th>
<th>36-Ult</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>128</td>
<td>179</td>
<td>181</td>
<td>1.3928</td>
<td>1.0117</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>131</td>
<td>183</td>
<td>183</td>
<td>1.3928</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>134</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Agt to Age: 1.3928, 1.0117, 1.00
Agt to Ult: 1.4081, 1.0117, 1.00

2013 Ult Claim: 1340000 * 1.4081 = 1958194

↑
B-S w/ case outstanding adjustment
Ultimate
<table>
<thead>
<tr>
<th>AY / CY</th>
<th>On-Level EP</th>
<th>Ultimate Claim</th>
<th>Trended Ult Claim</th>
<th>Ult Low Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>5,000</td>
<td>3,118.1 = 3,118</td>
<td>3,118 - 0.9% * 2,935</td>
<td>58.7%</td>
</tr>
<tr>
<td>2011</td>
<td>6,000</td>
<td>3,140 - 1,195 = 3,343</td>
<td>3,430 - 0.98 * 3,695</td>
<td>59.9%</td>
</tr>
<tr>
<td>2012</td>
<td>6,500</td>
<td>1,940 - 2,169 = 3,895</td>
<td>3,895 - 0.98 * 3,817</td>
<td>58.7%</td>
</tr>
<tr>
<td>2013</td>
<td>8,000</td>
<td>904 - 4,386 = 3,960</td>
<td>3,960</td>
<td>49.5%</td>
</tr>
</tbody>
</table>

25,500

Reported Claim: Dev Factor

<table>
<thead>
<tr>
<th>AY</th>
<th>12-24</th>
<th>24-36</th>
<th>36-48</th>
<th>48-Ult</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>2.1443</td>
<td>1.6345</td>
<td>1.1919</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>1.9578</td>
<td>1.7177</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>2.0674</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Age-to-Age: 2.0674 1.1919 1.00
Age-to-Ult: 4.3816 2.1169 - 1.919 1.00

*Select simple average, as no consistent change in dev factor observed*

2013 Ult Claim = 8,000 \* 59.1% = 4,728

(1,000)
### Cumulative Paid Claims ('000)

<table>
<thead>
<tr>
<th>AY</th>
<th>12</th>
<th>24</th>
<th>36</th>
<th>12</th>
<th>24</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>4000</td>
<td>5000</td>
<td>5500</td>
<td>800</td>
<td>1350</td>
<td>2200</td>
</tr>
<tr>
<td>2012</td>
<td>4500</td>
<td>5625</td>
<td>900</td>
<td>2503</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>5000</td>
<td>1250</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Cumulative Salv/Sub ('000)

<table>
<thead>
<tr>
<th>AY</th>
<th>12</th>
<th>24</th>
<th>36</th>
<th>12</th>
<th>24</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>800</td>
<td>1350</td>
<td>2200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>900</td>
<td>2503</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>1250</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Sub/Salv to Paid Claims Ratio

<table>
<thead>
<tr>
<th>AY</th>
<th>12</th>
<th>24</th>
<th>36</th>
<th>12-24</th>
<th>24-36</th>
<th>36-Ult</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>0.2</td>
<td>0.35</td>
<td>0.4</td>
<td>1.1429</td>
<td>1.1429</td>
<td>1.00</td>
</tr>
<tr>
<td>2012</td>
<td>0.2</td>
<td>0.446</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>0.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Development

**Age-to-Age**

1.35  1.1429  1.00

*Note: Ignore last factor, as CY 2013 saw large increase, also reflected in 2013 ratio.*

#### 2013 Ultimate Sub/Salv to Paid Claim Ratio = 0.25 · 2.05 = 0.51

### Paid Claim Dev

<table>
<thead>
<tr>
<th>AY</th>
<th>12-24</th>
<th>24-36</th>
<th>36-Ult</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>1.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Age-to-Age**

1.25  1.00

**Age-to-Ult**

1.345  1.00

#### 2013 Ultimate Claim = 5000 · 1.345 = 6875 ('000)

#### 2013 Ultimate Sub/Sub = 6875 · 0.5 = 3437.5 ('000)
a. Data are probably very thin, and development factors will be highly leveraged. That leads to uncertainty in estimated if using paid development method.

b. The dedication of additional legal resources will likely change both the ALAE for individual claims and the expected claims (as doing ultimate claims cost is the goal of the initiative). The ratio in the future will likely differ from historical, thus paid ALAE-to-paid claims method may distort results.

c. It is not appropriate, since the claim severity might be affected by this initiative if the legal department is successful in reducing low payments. Frequency will also be affected, since it is possible that more claims will be closed without payment.
CASUALTY ACTUARIAL SOCIETY
ONLY ONE QUESTION PER PAGE
DO NOT WRITE ON THE BACK OF THIS SHEET

EXAM 5  QUESTION #: 22  CANDIDATE #: 00081

(a) Reported claims @ 5/31/2014:
expected = 2200 * 1.33 / 1.25 = 2340.8
actual = 2500
- development factors underestimated reported claim @ 5/31/2014 by 2500 - 2340.8 = 159.2

(b) Paid claims @ 5/31/2014:
expected = 1650 * 1.82 = 2002
actual = 1875
- development factors overestimated paid claim @ 5/31/2014 by 2002 - 1875 = 127

(d) If the changes observed were to persist into the future (within uncertainty considered reasonable, actuary does not need to revise estimates.

(e) If the actuary knew that claims have been processed more slowly and case adequacy increased, then it would be necessary to revise estimates to change that will persist "phenomenon."
CASUALTY ACTUARIAL SOCIETY

ONLY ONE QUESTION PER PAGE

DO NOT WRITE ON THE BACK OF THIS SHEET

EXAM  5  QUESTION #:  23  CANDIDATE #:  00081

\[ a. \quad 500 \cdot (1+x) = 933 = 500 + 433 \]
\[ x = 0.866 \]

<table>
<thead>
<tr>
<th></th>
<th>Reported</th>
<th>Incremental</th>
<th>Cumul</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>42.87%</td>
<td>1.25</td>
<td>1.00</td>
</tr>
<tr>
<td>Cumul</td>
<td>500.00</td>
<td>1.25</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>42.87%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ b. \quad \text{Reported} @ 12/31/2014 = 933 \quad \text{case outstanding} = 289 \]
\[ \text{Paid} @ 12/31/2014 = 644 \]

<table>
<thead>
<tr>
<th></th>
<th>Paid Dev</th>
<th>Increment</th>
<th>Cumul</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.95</td>
<td>1.8181</td>
<td>1.00</td>
</tr>
</tbody>
</table>

\[ \text{Case Outstanding} = 0.8181 \cdot 1.25 + 1 = 2.8 \]
\[ 1.8181 - 1.25 \]

\[ \text{Ult. Loss} = 2.8 \cdot 289 = 809.2 \]
Exam 6US

Spring 2014

Candidate #196

Score 58.50
A. (1) Identification of exposures that cause loss helps companies understand their behavior and take appropriate action to reduce costs.
   (2) The more known about expected costs, the less uncertainty insurers demand for return, which helps lower rates.
   (3) More complete info on loss exposure helps reduce variability in models, as they are adjusted to incorporate better info.

B. (1) Require legal affidavit from insurer attesting it hasn't capitulated model.
   (2) Request formal opinion of models on proper execution of model when run by insurer.

C. (1) Potential loss of insurants to competitors if insurer inflates CAT modeled cost, competitors use unreasonable estimates.
   (2) Results used elsewhere; inflated CAT model results may depress earnings, negatively affect ratings, cause decline in stock price for publicly traded insurers, increase reinsurance costs.

D. (1) Develop familiarity w/ technical aspects of models.
   (2) Define clear process for use of model estimated in ratemaking.
A. Prepared document to serve as a template for states to use when formulating legislation to apply to insurance regulation.

B. 1. Don't have to spend money to write insurance laws, just adopt NAIC model law.
   2. Easier compliance with NAIC standards during accreditation process.

C. More consistency across states easier to produce rules/coverages for use by less need to tailor to multiple different rules/regulations.

D. Adapt to meet state's specific needs

E. Viewed as inappropriate or unnecessary if existing state law adequately covers topic.
Assuming this is for U.S. insurance only.

A. Jurisdiction - federal level. Simplifies ability of insurers to compete, reduces complexity and confusion associated with multiple regulatory systems. Duties - solvency and market behavior. Solvency is obvious. Insolvency has high social costs. Need to market disruption, what action to be taken, be strictly punished, etc. duties to insurers not eliminated.

Rate regulation - adequacy only. The more risk, the more incentive to modify behavior. Avoids selecting favorites for purpose of protection of special interests, distorting competitive landscape.

Solvency regulation - ABC-like system of increased risks considered review of appropriateness of factors. Management has incentives to low-ball solvency needs in absence of demonstrated need for less capital. It's better to take judgment out, esp. considering cost of insolvency. Partial exemption for foreign insurers if solvency under home country's rules & regulations can be demonstrated, not weighing of results in these instances possible.

B. Still flexible enough to respond to market changes, international approaches but recognizes that U.S. insurance market is not "like everywhere else."

C. Reinsurers would be covered at federal level - no changes needed. Duties don't change. Role regulation would apply. Solvency may be more applicable, duty to accept facts, duties to account for risks unique to reinsurers. Role regulation likely not applicable due to highly specialized nature of treaties, but that insurers are sophisticated enough to understand rate calculations.
A. (1) Prohibit collusion in attempt to gain monopoly power
   (2) Acts restraining trade or commerce are illegal
   (3) Illegal to attempt to monopolize

B. Viewed as illegal as it inhibits collusion and restrains trade or commerce.

C. (1) Companies could collude to produce rates for others to adopt, or favor biased coercion, intimidation—limits choice for consumers
   (2) Companies could collude to raise rates, to monopolize insurance market—makes insurance less affordable, potentially limits availability.

D. Paul v. Virginia—bureau ratemaking OK, states regulate insurance (and states could privatize it and then only in that state)
   U.S. v. SEUA—bureau ratemaking prohibited, violates Sherman Act (Clarks, Jobs, and others)

E. (1) Creates availability to insurers who don't have to exhaust admitted market for
   (2) Lower costs; premium tax only paid in home state of multi-state surplus lines risk

F. If ceding insurer's domiciliary state is NAIC-accredited and grants credit for reinsurance in
   states with similar laws, other states can't deny that credit.
A. 1. Allows for insures to be written insurance that might have been refused w/o credit scoring
   2. More accurate assessment of each risk's expected costs, helps make rates more actuarially fair for all insureds

B. 1. Roughly half of all credit reports contain errors
   2. No proof rates are unbiased w/o use of credit scores
   3. Disproportionately negatively affects certain groups (low-income, elderly, young people w/o credit histories, etc.)

C. Consumers - those with credit scores decrease may see higher rates w/o adjustment

Insurers - shouldn't see much difference if rates are set accurately & reviewed regularly, c.w. will need to make adjustments to keep overall premium adequate

Regulators - likely call to restrict credit scoring by public, demand for insurers to show it's needed or may restrict its use in interesting
A. No idea. Don't care, either.

B. Investment - Net Investment Income Ratio
   Underwriting - Year Operating Expense Ratio
   Reserve - Estimated Reserve Deficiency (URDS 15)
   Asset - Change in Net Written Premium

C. Don't care

D. Don't care about this either
A.  1. Filed lawsuits in plaintiff-friendly venues
   2. Combined unjured, severely injured claimants into class action lawsuit vs. multiple defendants

B.  1. Injure docket - pressures right of current, uninjured claimants to sue later if condition worsens/illness manifests.
   2. Limits on monoeconomic, punitive damages

C.  1. Can it be/has it been tested?
   2. Known/potential rate of error

D. Less evidence admitted, more scrutiny to evidence presented - more likely to be challenged + found unreliable

E. Fewer settlements as evidence is challenged by defendants + found to be unreliable, so less in settlement costs paid out
A. May be able to slightly reduce residual market size, since insurers are limited in how many policies / how much premium can be ceded. Insureds covered voluntarily should still be.

B. Auto insurance - insurance is mandatory, helps with consumer participation. [See (1) below]
   - Cross-subsidies imposed by linking use of some risk variables in risk classification and pricing
   - Retirement savings - all workers must participate in Social Security participation ensured
   - Cross-subsidies imposed by linking formula toward those with lower incomes, families eligible, disabled workers, eligible survivors of workers who died while still employed.

C. 1. Not all drivers have the resources to pay the actuarily fair rate
    2. May cause some drivers to forgo insurance, contrary to public policy.
    3. More fair to share costs when insurance is mandatory.

(1) If residual pool that uses type in use (e.g., reinsurance facility) remains chance of being in RM, which causes those who would otherwise skip insurance to get coverage.
A. CONVENIENCE - banks get automatic coverage on each loan, have to submit certain documents. 
   Easy to get coverage, no need to apply. Banks don't have to shop PI market, deal
   (w/ exclusions or limitations on coverage).

EFFICIENCY - w/ clearly stated terms, easy way to submit info, database can quickly handle
   loan volume + tracking of claims. One central repository for data + analysis, not
   disjointed + inconsistent across numerous insurers. (see 2 below)

SOCIAL PURPOSE - protects banks in downturn of economy, potentially alleviates black mark of
   foreclosure for insurers, reducing credit problems

2. Also allows for quick payment of claims avoids litigation between banks insurers that
   can be costly for both groups.

B. Probably covers delinquency costs + (cost of loss is often mortgage price). May not cover increased
   risk of claims in downturn +
   May not be actuarially sound + hard to know + estimate all factors that drive a default.
   Much less price for all of them.
A. Unearned premium - eligible
   Catastrophe loss reserves - prob. eligible (likely deductible to personal lines)
   Inland marine loss reserves - likely eligible (unless state restricts)
   Ocean marine loss reserves - not eligible (almost never included in guaranty fund)
   Employee pension liabilities - not eligible (prob. transferred to PBGC, excluded under solvency)

   Act eligible for recovery = 10 + 40 + 30 = 100M

B. B had $3000 + $1000 = $4000 / $4000 = 30.93% of voluntary market after excluding XYZ
   Assuming full amount in A. is recouped from assessing all other companies,
   B pays .3093(100M) = $30.93M

C. 1) Per-claim limit (except WE which is unlimited)
    2) High net worth deductible

D. Successful so far; post-insolvency assessments occasionally needed but guaranty funds have
   greatly minimized any amount insureds have not received as a result of an insolvency.
A. 1. More intense rehabilitation service is only focused on covering WC, not like PI where WC is one of several lines serviced.
2. No expense for advertising, acquisition costs, commissions—lower cost that can be passed on to insureds.

B. 1. PI has considerable experience in providing WC, staff and training to set up system that result in bureaucracy of lack of knowledge of insuring. 
2. PI can draw on resources outside state (legislation, capital/surplus) to support WC in the specified state.

C. While some states have set up WC state funds, not all have—indicates PI is effective at providing WC to insureds.
A. Fed Govt - backstop losses above specified threshold in event of terrorist attack
   State Govt - not involved
   PI - writes coverage, covers premiums, agrees to handle claim in event of terrorist attack

B. 1) Private insurers unwilling to cover terrorism of catastrophic nature
    2) Resulting loss of coverage, increase in rates where it couldn't be excluded caused
       affordability/availability problems for insurance market.

C. Unknown: has been effective in providing coverage for terrorism but no covered incidents
   since 9/11 saw federal govt's willingness to backstop insurers for covered losses not
   tested. Avoided market disruptions in wake of 9/11.
### Question 13

#### Total

<table>
<thead>
<tr>
<th>Total</th>
<th>HO</th>
<th>PAA</th>
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</thead>
<tbody>
<tr>
<td>16550</td>
<td>1030</td>
<td>2020</td>
</tr>
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#### Net EDP, 2012

<table>
<thead>
<tr>
<th>Net EDP, 2012</th>
<th>9100</th>
<th>3200</th>
<th>3200</th>
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#### Total

<table>
<thead>
<tr>
<th>Total</th>
<th>29700</th>
<th>6000</th>
<th>6300</th>
</tr>
</thead>
</table>

#### Surplus Ratio

\[
\text{Surplus Ratio} = \frac{\text{Mean Surplus}}{29700} = \frac{8200}{29700} = 0.2761
\]

- Surplus to HO = 0.2761 (6000) = 1656.565 (thousand dollars)
- Surplus to PAA = 0.2761 (6300) = 1739.344 (thousand dollars)

C. **IEE is not sufficient.**

- **Net of reinsurance/gross of reinsurance.**
### A.
1. Act. Recoverable from Reinsurers - should be: \( \frac{2231 \times (1000 + 1050 + 60 + 100)}{} \)
2. Loss Reserve - should be: \( 7652 \times (4400 - 1000 + 5300 - 1050) \)
3. CAE Reserve - should be: \( 1.919 \times (500 - 60 + 1100 - 70 + 500 - 1) \)

### B.

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
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<tbody>
<tr>
<td>Cash &amp; Sur. Assets</td>
<td>Loss Reserve</td>
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<tr>
<td>13,385</td>
<td>7652</td>
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<tr>
<td>Accrued Retro Premium</td>
<td>CAE Reserve</td>
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<tr>
<td>100</td>
<td>19.19</td>
</tr>
<tr>
<td>Amt Recov. from Reinsurers</td>
<td>Reins. Prem. Payable</td>
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<tr>
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<tr>
<td>Def. Prem. Agents Bal</td>
<td>Unearned Prem. Reserve</td>
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<tr>
<td>Non-admitted Agents Bal</td>
<td>Paid Losses</td>
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<tr>
<td>-10</td>
<td>1900</td>
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<tr>
<td>Uncoll. Prem. Agents Bal</td>
<td>Total Liabilities</td>
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<td>550</td>
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<tr>
<td>Total Admitted Assets</td>
<td>Surplus, Paid</td>
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<tr>
<td>16516</td>
<td>3242</td>
</tr>
<tr>
<td>Total Liab + Phs</td>
<td></td>
</tr>
<tr>
<td>16516</td>
<td></td>
</tr>
</tbody>
</table>

### C.
\[
\text{NWP/PHS} = \left( \frac{1450 + 3550 + 100 - (375 - 25)}{3242} \right) \times 100
\]
\[
= \frac{3650}{3242} \times 100 \approx 111.36
\]

Value is under 300 = No action by regulator.
A
1. How much total recoverable exists for each reinsurer? Helps assess whether company is heavily reliant on reinsurance and warrant further investigation.
2. For each reinsurer, is it authorized or unauthorized? Helps evaluate Schedule F provision for reinsurance.
3. What amount of recoverables from X is greater than 90 days due? Again, helps with Schedule F provision.

B
1. What amount is expected to be added to Y? Helps assess if net loss incurred may be deemed to be material for assessing adequacy of reserves.
2. Any reason to believe any amount recoverable from Y may not be? Y's rating is B-, which is still investment grade, but, if Y has exposure to other companies from this CAT, it may have ratings downgrade, which may affect timeliness/delay, or paying claims to insurer.
Assuming
1) retroactive reinsurance only applies to reserve recorded @ 1/1/11
2) quota share of CC applies to full amount of claim
3) $400,000 paid on 10/15/12 was on reserves listed @ 1/1/11, not on new development

A. Net losses = 100,000 (.7)(.25) = 17,500
   (remaining $900k ceded or receded - $0 net)
   Paid losses = 0
   (see note above; $0 paid on retained reserve)

B. | REINSURER | DATE  | AMT CEDED | AMT RECOVERABLE | NOTES       |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>CC</td>
<td>1/1/11</td>
<td>300,000</td>
<td>200,000</td>
<td>ceded = 1/1/11 = 300,000</td>
</tr>
<tr>
<td>DD</td>
<td>10/15/12</td>
<td>630,000</td>
<td>630,000</td>
<td>quoted: 10/15/12 = 630,000</td>
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<tr>
<td>DB</td>
<td>9/1/12</td>
<td>58,500</td>
<td>58,500</td>
<td></td>
</tr>
</tbody>
</table>
   - no indication CC or DD has reimbursed for payment made

C. Net reserves go to zero
   Any gain recorded as other income is special surplus in P&I that is restricted

D.  ① Statement of Income
    ② Exhibit N
    ③ 5-Year Underwriting Exhibit
A. **Ave Paid Severity / Closed Claim**

<table>
<thead>
<tr>
<th>Year</th>
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<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>Part 58</th>
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<td>2012</td>
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</table>

**Part 58 - 2010-2012**

\[
\text{Part 58} = \frac{\text{Part 58-1}}{250 \times 100} = \frac{1340}{250 \times 100}
\]

**Ave Outstanding Case Reserves**

<table>
<thead>
<tr>
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<th>2011</th>
<th>2012</th>
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<tr>
<td>2012</td>
<td></td>
<td>4744</td>
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</tbody>
</table>

**Part 58 - 2010-2012**

\[
\text{Part 58} = \frac{\text{Part 28} - \text{Part 58}}{\text{Part 58, 2}}
\]

B. **Loss + Dec development, 2010 = 1590 - 1590 = 0**

**Loss + Dec development, 2011 = 1640 - 1550 = 90**

C. 1. Is there a reason to believe 2012's incurred net loss + dec reported is accurate?

Prior years show avg outstanding case reserves ending up similar to 2010 and 2011 report; looks like the CY estimate is being underestimated, if that data is accurate.

2. Add estimate for estimating reserves.

I'd expect to see that in average outstanding case reserve as well. Is there something with claims handling that explains the disconnect between the two? It is not a significant number of outstanding claims that steadily increase year to year, so it's possible claims are being understated.
A tax rate on corporate bonds: 35%  
Eff. tax rate on municipal bonds: 5.25%

\[ X = \frac{\text{X allocated to municipal bonds}}{\text{X total}} \]

Income, no AMT: \( x \left( 1 - 0.0525 \right) / 0.10 \right) / \left( 1 - x \right) / \left( 1 - 0.35 / 0.09 \right) = 0.0379x + 0.585 - 0.0353x \]

\[ = 0.0585 - 0.0206x \]

Income w/ AMT (20%): \( 0.2 \left( 0.75 \right) x \left( 0.04 \right) = 0.006x \)

Income w/ AMT (30%): \( 0.3 \left( 0.75 \right) x \left( 0.04 \right) = 0.009x \)
A. Surplus Aid = UEPR, unepilined x Reins Ceded x \( \frac{.31612.4}{1154.41 \times 131.4} \) = 14.61

JAN RATIO = \( \frac{34.415}{77.1} = 0.446 \)

UEPR = 23.1 + 16 + 3.4 + 1.3 + 3.3 + 1.6 + 12.2 + 5.9 = 54.4

Remark: Identify insurers engaged in reinsurance to net surplus aid to property PHS to mark true problems.

B. UEPR from pools counted, inflates amount of surplus aid calculated.

C. GWP/PHS

BEFORE: \( \frac{611.7 + 39.8}{77.1} \times 100 = 84.4 \)

AFTER: \( \frac{611.7 + 39}{77.1 - 14.61} \times 100 = 104.1 \)

MWP/PHS

BEFORE: \( \frac{611.7 + 39 - 131.4}{77.1} \times 100 = 67.4 \)

AFTER: \( \frac{611.7 + 39 - 131.4}{77.1 - 14.61} \times 100 = 83.1 \)

A PHS

BEFORE: 106 \times \( \frac{77.1 - 67.6}{67.6} \) = 14.22

AFTER: \( \frac{77.1 - 66.1}{67.6} \times 100 = 7.42 \)
A. Credit risk charge = \( 21000 \times (1) + 750 \times (0.01) + 900 \times (0.05) + 10 \times (0.05) + 230 \times (0.05) + 10 \times (0.03) \)  
   = 21466

Revised charge = \( 400000 \times 21466 \)  
   Have 1/6 \( \times 4000000 \) cred. risk  
   \( R_{1} = 550000 \)  

So final credit risk (M) RBC charge = 1083

B.  
   \( R_{0} = 25,000 \)  
   \( R_{1} = 10 + 400000 + 100000 = 50010 \)  
   \( R_{2} = 20000 \)  
   \( R_{3} = 1083 \)  
   \( R_{4} = 1083 + 400000 + 25000 = 476083 \)  
   \( R_{5} = 300000 + 25000 = 325000 \)

Total RBC:  
   \( 25000 + \sqrt{25000^2 + 1083^2 + 1083^2 + 325000^2} = 25000 + 5789x9 = 6038x9 \)

C.  
   Adjusted RBC = 555000 + 30000 = 558000  
   RBC Ratio = \( \frac{558000}{555000} \times 1.037 \approx 184 \% \) in Company Action Level

Company - not for regulators how it intends to limit liabilities and/or raise capital/surplus  
Regulators - nothing (yet)
A. SAP - regulators  
   GAAP - investors

B. DAC
   SAP - expensed fully @ time policy is written  
   GAAP - capitalized, expensed over policy term in proportion to premium earned  
   Discounting of Reserves
      SAP - limited acceptability /tblular for WC indemnity/pension cases
      GAAP - reserves are not discounted

C. SAP - WC indemnity/pension cases can be reasonably estimated, PV established. Otherwise, conservatism warranted - no discounting  
   GAAP - reflect value of entity as going concern, give accurate economic picture of company - discounting clouds this, since rate used is subjective and may not match current market conditions/rates/inflation.

D. Furniture is a non-admitted asset = direct charge to surplus if purchased.  
   If rented, only charge to surplus is loss of cash.
A.  
1. Inclusion of non-admitted assets
2. Valuation of bonds @ fair value as of
3. Charge provision for reinsurance to management's best estimate of uncollectibility.

B. If investment yields are low, likelihood of discount rate vs. yield increases. Reserves are being discounted more than environment suggests is appropriate. Fair value reserves will be higher than statutory reserves.
**A. EXCISED NET LOSS + DCC**

<table>
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<td>2011</td>
<td></td>
<td></td>
<td></td>
<td>.9248</td>
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</tr>
</tbody>
</table>

**B. PAID NET LOSS + DCC**

<table>
<thead>
<tr>
<th>Year</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
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<td>2.8364</td>
<td></td>
</tr>
<tr>
<td>2010</td>
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<td>4.4248</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td>1.4823</td>
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</tr>
</tbody>
</table>

**B. Inconsistent:**

I would like to see similar factors from year-to-year. '09 looks over-reserved, '10 looks under-reserved, '11 looks more like '09. Hard to tell if '09 and '11 are accurate and '10 is redundant, or '10 is accurate and '09, '11 are different.
A. 10% of statutory surplus: $40M
20% of recorded LT-LAE reserve = $250M

A or statutory surplus to hit ABC control level = $100M

Use $40M since it's more conservative

B. 1. Relevant Comments: Risk of Material Adverse Deviation
   2. Exhibit B

C. Central estimate = $1200, materiality standard = $1240, which would be in [1100, 1320]

D. Based on a selected materiality standard of $40 million (based on a 10% change in statutory surplus), a change of recorded LT-LAE reserves in that amount would still result in a net unpaid LT-LAE estimate that is reasonable. Therefore, I believe there is a risk of material adverse deviation in the net unpaid LT-LAE reserves.
A. Disclose the amount of discounting when discussing Other Items in Exhibit B, in Relevant Comments section. A1. 0.5

B. Disclose reliance on another actuary's work in the Scope section of the SAO.

C. Disclose data issues in the Scope section of the SAO, since $30M is material.

D. Disclose impact of change in Methods and Assumptions Changes in Relevant Comments section since $25M is material.
A.  ① Company's net carried unpaid LAE reserves → found in Balance Sheet
    ② Whether company has had adverse reserve development > 5% of PH surplus →
        found in 5-Year Underwriting Exhibit in Annual Statement

B.  ① Appointed Actuary's range of reasonable estimates + point estimate only found here,
        gives better context of adequacy of company's carried reserves
    ② Reasons for adverse development > 5% of PHS must be discussed. Can be
        loosely determined from various parts of Annual Statement, but unsophisticated user
        won't put parts together; regulators don't have time to dig to get answers to this
        question - AA's comment helps focus attention where needed
A.  
1. 10/10 - at least 10% chance of 10% or more loss to insurer
2. EAD = \( P(\text{loss}) \times \text{NPV of loss} \), summed over all loss scenarios / PA surplus

B. 50% chance of loss, but a loss would be significant (say, >25%) - use EAD as it would fail 10/10

C. Amount at loss -
\( P(\text{loss}) \) from loss distribution: how likely is a loss?
PH surplus - basis for determining amount of loss relative to surplus

D.  
1. Only consider loss scenarios, not profit scenarios; including all scenarios reduces
2. wider loss expected makes risk transfer less likely
3. treat all payments from cedant to reinsurer as premium; avoids labeling of some payments as fees, ability to make contract to pass risk transfer if at all wouldn't

E. If substantially all of the risk is transferred to the reinsurer, cedant retains final risk
Exam 6US

Spring 2014

Candidate #6

Score 58.75 (Passing Score)
\textbf{Benefits}

- Costs reflect risk → lower risk insured pays lower prem: higher risks pay higher prem: no redistribution
- Use of more sophisticated methods that can incorporate external data of exposures
- Traditional methods contain bias in their estimates and some suggest they may be grossly inadequate

\textbf{6} Require legal affidavit signed by models attesting that model has not been manipulated
- Require formal opinion of actuary on validity of model if unsure

\textbf{2} Loss of policyholders - they will move to competitors with cheaper rates
- Inflated costs will increase costs of reinsurance

\textbf{5} Can compare actuarial results of model to actual results
- Can compare inputs of model to actual data such as wind speed
Legislators benefit from saving resources to construct insurance legislation.

States benefit from uniformity in laws if they are able to cross-check one another and ensure their analysis on insurers is on similar standards.

Insurance benefit from uniformity if model states adopt model laws. If they only need to conform to 1 set of laws, it can be easier.

Model laws do not address the regulatory goals of that particular state.

States may see model laws as just another agenda item and do not give it high priority.
Assuming @ is for US Ins. Reg.

Reg. Juris - our federal govt. to regulate insurance but continues to use state govt as "line of defense" in examining insurers + ensuring compliance.

- provides uniformity amongst states in reg.
- easier for insurers to comply w/ single reg - less costly.
- use of state govt keeps systems of checks + balances intact + keeps job less for state DOLs to a minimum.

Duties

Federal govt. responsible for coming up w/ laws/regs to ensure nationally significant insurers + dealing w/ international issues.

States use the enforcers + monitor insurers + approve rates/terms.

Solvency/Reg.

Fed. govt determines if the reg for both i.e. all states will have, if so, 4 ensure competitive market conduct; solvency req.

Fed. govt. align w/ Solvency II standards - thus increase in use of internal models. However, it would still impose a minimum floor.

RBC requirement to ensure internal models not manipulated.

Function well + better than today's govt. regulatory framework.

- provides united front for US in dealing w/ international issues
- fed. govt. in charge of all states.

Solvency regulations will be same as EU (thus, making it easier for international comp. doing business in US (or vice versa)) + making it easier to compare assets for strengths of insurers + increase comparability amongst all global insurers.

Investors req. looking @ insurers in some capacity whether alien, domestic, or foreign.
1. Does not allow activities that result in monopoly power
   for insurers. If Sherman Act applies, this means rate
   compacts are illegal under Sherman Act.

2. Would be considered illegal if two separate insurers
   are colluding to set rates. Although Ins. Reg. falls under
   jurisdiction of state, Sherman Act applied in instances of
   boycott, intimidation or coercion.

3. Repeatedly, insurers may once again collude to set rates,
   this could result in collusion to gain excess profits thus causing
   affordability problems for consumers.

4. Additionally, rate compacts may form, requiring use of standardized
   policies. This will stifle evolution/innovation of ins. products and
   could result in ins. craft not meeting demands of consumers.

(a) Paul v. Virginia resulted in ruling that state ins. was interstate commerce,
    thus states regulated not fed. Therefore bureau rate making
    allowed.

(b) S.F. v. A. resulted in ruling that ins. was interstate commerce
    thus subject to fed. reg. Therefore bureau rate making
    not allowed.
E. De-regulated surplus lines

1. if insurer licensed in domiciliary state, did not require
   licensure in other states
2. non-adm. insurers only required to pay premium tax in
   domiciliary state

F. If insurer's domiciliary state adopted NAIC insolvency regulations
   or had similar regulations, they were able to qualify
   for insurer credit in financial statements up to having to
   meet other states' requirements
@ Credit scores have disproportionate impact on certain classes of people (e.g., race, religion, income level).
- Credit scores can be influenced by factors outside of consumers control (e.g., fraud, errors on reports).

@ Regulating public policy results in poor public policy.
- Concerned if insurer's premium levels of lower income certain will increase.
- Be considered unfairly discriminatory against these classes of people.
- Insurers use different methods to determine premium.
- Based on credit scores is difficult to assess fairness + reliability of methods.

@ Assuming consumers loss costs remain the same, credit scores declining due to poor economic conditions will not result in A's to overall premium level. May have temporary impact on individual premium levels that will correct if insurer's section below.

Insurers may need to conduct rate classification & overall premium analysis more frequently during economic downturns to ensure relativities of classes of credit scores are appropriate still + overall prem level adequate.

Regulators may have to deal with higher complaint levels consumers to help them premiums increasing thus regulators will increase scrutiny on rate approvals when using credit scores or even create rules surrounding use of credit scores.
(a) To evaluate insurers to determine if they are financially troubled or not in compliance with laws and regs.

(b) Profitability - 2 year overall operating ratio

Leverage: GWP : PHS

Liquidity: Adj Liabilities / Liquid assets

Reserving: Current Reserve Deficiency / PHS

(c) Each insurance company assigns scores to these ratios to come up with overall risk score (Higher score = Riskier) - IRIS does not use a scoring system

(d) IRIS uses many of the same IRIS ratios during its analysis dealing with all of the 4 dimensions stated in (b)
9. Create plaintiff groupings - less seriously injured plaintiffs may receive larger settlement than deserved.

10. Naming of multiple defendants - this can be done at little added cost to plaintiff but is costly for defendants & results in potentially greater settlements for more defendants added.


12. State reform - establishing certain medical criteria to be met for plaintiff.

13. Opinion or potential rate of error.

14. Is there any peer review or publication available.

15. If evidence admitted into court, why there was use of Daubert factors were used & judges were the good.

16. May result in increased defense costs & life defendants must come up with new defense strategies that take into account Daubert factors.
RF may help reduce usage of insur. mkt. thru HRD (high risk drivers) charged rates determined by insurrs. Whereas, ARP uses rates for HRD set by state which may result in decreased UW profit for insurer. Also, makes up for decrease in UW profit by tightening UW tools which results in increased UW mkt. RF rates are more adequate than ARP so insures less likely to move into cyclical cycle of ARP.

PPA -- great imposed cross subsidy is requiring a RM mechanism + all PPA consumers must participate. This will increase availability of insurance to HRD so all consumers able to affordably obtain insurance.

Remember -- great provides SS benefits to all retired workers that provides min. level of income during retirement. To accomplish this:

- great mandates all insured participate -- this way higher income workers do not drop out of program if they do not need program to help provide.
- financial base: those result in + higher income workers can help pay for lower income workers the benefit b/c of benefit formula more heavily will towards lower income workers. This creates cross subsidy on classes of workers.

Against: there should be limits to what one should pay for insurance

Against: equal sharing is greater than paying based on relative risk.

For: The P actuaries fair extra provides incentive for higher risk insureds to control losses.
0 at issuance of loan, place mandatory default risk product onto loan

This provides convenience to loan applicants as they do not have to shop around for product on own (convenience)

This makes market more efficient as if ins product put on loan automatically reduces expenses, e.g. actuarial work

Achieves social purpose, i.e. economy will not be disrupted by mass defaults during recession; this will help mitigate further disruption

0 Yes, cost of program can be tied to interest rate on loan which is correlated to credit worth. This can be a good statistically reliable factor in assessing exp. value of future costs

Yes, all costs act for, loss costs, admin exp, no comm expense or market expense.
6. Catastrophic Reserves are not held, only Loss, LAE, LEP. Assume no L&G are nonadmitted. MEL
   ELIGIBLE = 10 + 40 + 25 + 150 = 125
   → pension not part of P/C insurance.
   So, not incl

6. $2,500 = .309 \times 200 = 620 \text{ M}
   5k + 3k + 6.7k

6. Claim payments may be subject to a policy deductible, based on net worth.

6. Claim payments may be subject to a maximum amount.
   Thus only receive partial amount.

4. Yes, funding of guaranty funds increases insurers risk discipline.
   So they will not have to pay thus reduce liab. of guaranty funds.
2. State governments able to reduce expense costs relative to insurers. If so they do not have to pay agent commissions or marketing expenses.

3. Able to offer more comprehensive services to insureds (as they only offer single line, and are therefore thought of as "specialists")

4. Ability to offer more valuable insurance services to insureds that insureds not get from states (e.g. longer claim service hours, better staffing to help with policyholder issues or not limited by govt budgets)

5. Competition - private markets in competition with one another, so this may help decrease costs relative to if program offered by single entity.

6. View that states have intervened in WC in some states as competitors to private market or are exclusive providers. This means state believes private market not operating as efficiently as state would like. In a perfectly functioning mkt, no govt intervention needed. Thus, based on fact govt participating in WC, you may conclude WC not effectively run in private market.
(a) Federal - reinsurance (private insurers, losses due to terrorism)
State - no role
Private - retains portion of losses due to terrorism, share rest w/ reinsurers (fed. gov't)
(b) Fulfill unmet needs of private market
→ private market may be unwilling or unable to provide coverage desired by consumers
→ increase efficiency in market catastrophic
→ In this case, private market unable to cover losses resulting from terrorist acts
To achieve collateral social purpose
→ First steps in for greater good of society
→ In this case, stepped into prevent market disruption
\( \text{PHS} = \frac{1}{2} \left( \frac{8000 + 8400}{2} \right) = 8200 \)
\[ \text{HO} = 8000 \]
\[ + \text{L+LAE} = \frac{1}{2} (1000 + 1100) = 1050 \]
\[ \text{PHS}_{\text{HO}} = \frac{6000}{29700} (8200) = 14.57 \]
\[ + \text{D+DPE} = \frac{1}{2} (1700 + 1800) = 1750 \]
\[ + \text{EP} = 3200 \]
\[ \text{PPA} = 4200 \]
\[ + \text{L+LAE} = \frac{1}{2} (2000 + 2000) = 2000 \]
\[ \text{PHS}_{\text{PPA}} = \frac{6300}{29700} (8200) = 18.03 \]
\[ + \text{D+DPE} = \frac{1}{2} (1100 + 1100) = 1100 \]
\[ + 3200 \]
\[ \text{Total} = 29700 \]
\[ + \text{L+LAE} = \frac{1}{2} (16400 + 16700) = 16550 \]
\[ + \text{D+DPE} = \frac{1}{2} (4000 + 4100) = 4050 \]
\[ + \text{EP} = 9100 \]

b) Not the most effective method to allocate PHS by LOB
- does not take into account overall adequacy of PHS
- does not take into account risk of each LOB; one could argue that reserve levels + prem. levels reflect this but what about 1 or 2 years where there are not cat claims (e.g. HO), reserves are understated for determining allocation of PHS in future years
1. Loss Res = 4,400 - 1,000 + 5,300 - 1,050 = 7,650
2. LAE Res = 500 - 60 + 1,100 - 120 + 500 - 1 = 1,919
3. VEP = (2,800 - 300 - 75 - 550 = 2,325) missing EBUE of 100
   2,050 + 50 + 100 + 75 = 2,275

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA/A</td>
<td>13,385</td>
</tr>
<tr>
<td>Act Res</td>
<td>200</td>
</tr>
<tr>
<td>Assumed premium</td>
<td>590</td>
</tr>
</tbody>
</table>
| 1,4135    | 250  
| Def act bal not able to take credit | until eff date |
| PHS = 541 | 13,594      |

1,450 + 3,500 + 100 - 1375 - 25 = 1675% ≤ 300% fail

541

Regulator will review profitability of insurer for stable results.
If not, if write more short term LOB, insurer can withstand higher ratio.
Also check reins to make sure adequate coverage, insurer may be retaining too much exposure.
(a) Why was no security provided?
   > is reins not reliable

Why is insurer engaged in unins. of A rated ins. if ill recov?

Did ins. have hard time obtaining cov from better rated?

(b) Are there any cov to a temporary inc. due to cat loss.

If so then big concerned if reinsurer has mass exposure to this

then other arrangements that may hinder ability to pay

has reins historically had unsc amounts < 3/6 of
Receivables:
- Part 1: Lead Co
- Part 3: assumptions back from lead

Loss Reserves:
- Unchanged
- Write-in liability = contra-liability
- Total liability reduced
- Cash asset decreased for consideration paid

Income Statement:
- Notes to Fin Statement
CASUALTY ACTUARIAL SOCIETY

ONLY ONE QUESTION PER PAGE

DO NOT WRITE ON THE BACK OF THIS SHEET

EXAM E4    QUESTION #: 17    CANDIDATE #: 6

@ Avg Paid per Close

End 0/5 = Beg 0/5 + NEW - CLOSED (incidental)
=> CLOSED = Beg 0/5 - End 0/5 + Rep End - Rep Beg

Inc Closed
AV 09  10  11  12
09 3750 4547 5200 5500
10
11
12  60-90+250-0 = 190

Inc Closed
AV 09  10  11  12  10  11  12
09
10 210 300 320 2405 3630 4188
11 200 280 3150 4000
12  190

Av. Sera per Closed

AV 09 10 11 12 10 11 12
09
10 947 4340 445200 556800 5
11 4547 65300 58800
12

@ CY12 L+tx dev on prior yrs AVY 10+11
AVY 10 1-yr Loss Dev = 1590 - 1590 = 0
AVY 2010 2-yr Loss Dev = 1590 - 1590 = 0
AVY 11 1-yr Loss Dev = 1640 - 1550 = 90

@ (a) contd avg 0/5 case
AV 09 10 11 12
09
10
11
12

@ (b) is for AVY 10-12
excl. AVY 09
M = \text{inc in mun. bonds} \quad \text{EP} = \text{WP} - \Delta \text{UEP} \\
\Delta \text{UEP} = \text{BDP} - \text{EP} \\
\text{taxable uw income} = 5 + 0.20(500 - 490) + 10 = 17 \\
\text{taxable longterm} = M(0.04 \times 15) + (1500 - M)(0.09) + 50(0.3) + 50(0.7)(15) \\
= 0.06 M + 135 - 0.09 M + 15 + 5.25 \\
= -0.034 M + 155.25 \\
\text{RIT} = \text{AMTI} \\
\text{tax NI} = 17 + 155.25 - 0.084 M = 172.25 - 0.084 M = RT I \\
\frac{-0.35}{3} \text{RTI} = -0.3 \text{AMTI} \\
\text{AMTI} = 172.25 - 0.084 M + \left(\frac{0.35}{3}\right) \left(50(0.7)(0.85) + M(0.04 \times 0.85)\right) \\
= 29.75 + 0.034 M \\
= 206.96 - 0.0432 M \\
\frac{-0.0432}{35} = -0.001 M \\
\text{mun. bonds & corp bonds} \\
\text{that RTI} = \text{AMTI} \\
-0.35 \text{RTI} = -0.30 \text{AMTI}
(a) \[ \text{VEP} = 83.1 + 1.6 + 3.4 + 1.3 + 5.3 + 1.6 \] 
\[ 12.2 + 5.9 = 54.4 \]
\[ \frac{83.1 + 1.6 + 3.4}{131.4} = \frac{98.1}{131.4} = 0.1896 > 0.15 \]
\[ 77.1 \]

(b) Company relying too heavily on reindeer

The insurer may have poor financial results and is trying to
conceal this fact by use of reinsurance and avoiding commissions. The
surplus aid will increase PHS and make other ratios look better than
they would otherwise if surplus aid.

(c) \[ \text{GDP: PHS} = 111.7 + 39 = 84\% \leq 90\% \]
\[ 77.1 \text{ before (PASS)} \]
\[ 77.1 (1 - 0.01) \text{ after (FAIL)} \]

\[ \text{MOP: PHS} = 111.7 + 39 - 131.4 = 2.3 \%
\]
\[ 77.1 \]
\[ 1.4\% \times 300\% = 97.1(\times 184\%) \text{ FAIL} \]

\[ \text{IRIS} \#12 \]
\[ \text{Before (given) 17.4\%} \]
\[ \text{after 17.4\%} = 21.5 > 20 \text{ FAIL} \]

Unusual results prior to removal of GP aid

Unusual after.
\[
\begin{align*}
\text{EXAM} & \quad \text{CANDIDATE #:} \quad 6 \quad \text{QUESTION #:} \quad 20 \\
\[(2,000)(.10) + 750(.01) + 900(.05) + 250(.05) + 20(.05) &= 1116 \\
\text{1050}
\end{align*}
\]

\begin{align*}
\text{R}_1 &= 10 + 40,000 = 40,010 \\
\text{R}_2 &= 20,000 + 10,000 = 30,000 \\
\text{R}_3 &= 1,116 \\
\text{R}_4 &= 1050 + 100,000 + 75,000 = 476,050 \\
\text{R}_5 &= 300,000 + 25,000 = 325,000
\end{align*}

\begin{align*}
\text{Adj PHS} &= 525,000 - 30,000 \\
\text{in Reserves} \\
603,576 \left( \frac{1}{2} \right) &= 164\% \in (150-200\%) \Rightarrow \text{Company Action level}
\end{align*}

No action from regulators required.
Company must submit plan to state on how they will reduce risks and/or increase capital.
(a) SAP regulators, GAAP investors

(b) DAC

SAP recognizes expenses immediately, resulting in surplus decrease.

GAAP recognizes expenses in accordance with the revenue that generated the expenses.

Deferred pol ac cost asset set up

(c) DET

SAP allows discounting unless 1) statutory reserves, 2) immediate installment, 3) insurer's commissioner's permission.

GAAP allows discount as long as payment stream is reasonable.

d) DAC

SAP intends to provide conservative measure of financials thus by recognizing expense immediately, PHS decreased at beginning.

GAAP intends to provide an accurate measure of financial conditions of company that represent current conditions (economic income) and ongoing viability. By deferring pol ac costs, this provides a more accurate picture of realized loss expenses not earned prematurely.

(e) DET

SAP use of full value reserve provides for implicit cushion for solvency which helps protect policyholders in case of adverse situations.

GAAP seeks to provide an accurate picture of financial conditions. Use of discount reserves portrays today's value of reserves.

(f) By buying furniture, results in decrease to surplus. Life furniture considered non-admitted asset. Property furniture is not liquid in the event of insolvency. Prefer rent life more liquid (can stop renting).
(2) Change bond valuation to fair value

- Loss Res

- Need to use discounting for non-lab reserves
- Consider addition of risk margin
- May need to adjust valuation of liab. to fair value
- But may be difficult to do if not traded in deep market

\[ 10^8 \times (0.02) \times (1 - 0.02) = 1.98 \]
\[ LR \times (1 - 0.05) = 95 \]

Lower inv yields result in lower asset reserves but they will still be lower than fair value res. held under SAP
6. IL decreasing over time, insurer redundant in reserves for 09 + 10.

But IL inc. for 2010 may indicate unstable res practices for company.
2. ACL Ratio = 400 = 267.7% \Rightarrow \text{A company's Action Level, surplus needs to decrease by 100 (400 - 150 \times 200\%)}

15\% \text{ PHS} = 0.15(400) = 60

5\% \text{ carried reserves} = 0.05(1250) = 62.5

Given that each produced differences in results, I consider each an important factor in materiality and selection. I would choose the average of all 3 of them \(\frac{100 + 62.5 + 100}{3} = 74\).

3. Relevant Comments
   \(\text{Scope paragraph.}\)

4. Actuary's range of reasonable estimates includes high end of 1320.
   This would result in adverse deviation of 70 (1320 - 1250) which is less than the materiality limit. Given the results of 70, one may want to reconsider the selection of 74 up to 70 as 70 is close to 74. I would prefer a lower materiality for conservatism.
   Thus, I am selecting 5\% Reserve = 62.5, thus RMAD exists.

5. If the materiality limit is exceeded in any event of material
   risk of adv. deviation is 62.5 or 5\% of carried reserves. Given
   that actuary's range of reasonable estimates has a high end of 1320,
   risk of material adv. dev. is possible. I would also comment on
   any of specific factors that underly the \text{RMAD.}
Net Std = .10(100M) = 10M

2. Yes, discounting of loss reserves should be disclosed if have material effect on results; Exhibit B, relevant comments

3. Because pooled reserves are significant portion of reserve + actuary relied on opinion of another actuary, should disclose; addressed in relevant comments + I would also provide a qualified opinion + explain the signif of the pool, reliance on others opinion + extent of your review on their report

4. 25m > materiality stand, q is 30% of the reserves (significant portion)
   I would qualify opinion, explaining the data exists of GI estimate + I would also discuss further in actuarial report.

5. 25m > mat. std, this is a significant Δ
   I would disclose in relevant comment section under methods & assumptions explaining Δ in method, reason for Δ & quantify change in method impact
Carried reserves - can be found in liabilities section of AS balance sheet. PHS for last 5 years - used for indicating if adv. develop > 5%. PHS occurred in at least 3 of last 5 yrs; can be found in balance sheets 5-year historical ex.

AOB contains discussion of factors contributing to adverse development and past adjustments. Some of these comments may not be in AOB. Thus AOB exam highlights more info than AS.

AOB contains actuary's best est. for range of reserves. This helps to show how any wide/narrow probability range (perhaps actuary was forced to make wider range & so advised high end of range) & understand how the carried relates closer to high/low of range. Maybe AAO issued reasonable opinion, but not performed poorly on IRIS ratios. AOB can show that reasonable opinion closer to making deficient opinion, thus further support overall analysis of insurer.
10-10 rule = reinsurer must have 10% or greater chance of realizing a 10% or greater loss.

ERD > 10% = NPV w/less x NPV any severity for reinsurer > 10%

(Standard concept to check this)

10. Initial premium + any adjustments to assess reinsurers out payments to insurers
   less payment patterns

(a) Interest rate use of risk free rate must appropriate; lower than it will result in higher losses making it easier to qualify for reinsurance or use of higher than it (e.g. reinsurers' investment yields) may not be possible to gauge if you don't know reinsurers' inv yield
   less payment patterns may want to consider adding in a variable loss distribution to reflect inherent uncertainty in timing of poti however it may be too complicated to do so (cost > benefit)

(b) If reinsurer assumes all of an insurer's risk this can still qualify as reinsurance if new use if will risk transfer treat it as reinsurer taking on considerable insur risk
Exam 6US

Spring 2014

Candidate #358

Score 59.00
a) 1) longer time period analyzed, so results are less variable than the shorter time frame used in previous methods (Excess Wind)

2) models represent a clear technological advantage over previous methods

3) comprehensibility of prices; insureds are better able to understand how the amount of risk a property is exposed to relates to the price they have to pay

b) 1) have an officer of the company attest to data submitted for use within the model

2) have the appointed actuary comment on the data included in the model as part of the SAD

c) 1) inflated losses put increased pressure on financial ratings

2) inflated losses will increase the need for & cost of reinsurance

d) 1) compare expected results from the model (losses, storm count) to what actually happened

2)
a) A recommended law that will help to increase uniformity across states, while protecting the public interest

b) Uniformity across states increases the attractiveness and ease of entry for doing business in a state for insurers

2. Decreased costs and time spent by state legislations to create insurance laws themselves

c) The more states that adopt the same or similar model law, the easier it is for insurers to conduct their business. Decreasing the number of differing regulations enables insurers to be more efficient and decreases costs.

d) A model law could relate to a rating variable that the state does not allow (gender, credit, etc.) and needs to modify it to conform to other state laws

e) The state may have more important matters to consider first and thinks of the model law as just another agenda item the insurance industry is trying to push
a) Insurance should be regulated at the state level, so that a system of checks + balances is present where regulators from each state can help to monitor insurers and protect public interest together. Regulators should also have the tools to monitor solvency + rate adequacy so that they can intervene when necessary and hopefully early enough to prevent insolvencies. Regulators should also be given enough power to make these corrective actions. Regulation should be done using a 'file & use' system so that insurers can more freely react to market conditions. This also allow regulators to let competition be guide for rate levels and allow them to focus on adequacy. Solvency regulation needs to have at least a minimum capital requirement and a higher solvency capital requirement. This will give regulators a way to determine which insurers are in trouble and approaching it.

b) The state regulation would be a slight hindrance in a global market, making outside companies less likely to want to do business in the US. None of the other aspects should give insurers any concerns.

c) Yes, may want to make it so reinsurers didn't have to comply of so many differing regulatory requirements. Insurers need access to good reinsurance, so increasing ease of entry for reinsurers helps cut insurers.
a) Coercion, intimidation and boycotting were all prohibited. These all involved insurers pressuring customers and other insurers into taking action that only benefited the guilty insurer.

b) If the data is being pooled to create more credible rates, then there would be no issue. If the companies were doing so to collude to increase rates and market share, the Sherman Act would prohibit this.

c) 1) Insurers could boycott certain agencies and decrease competition, which decreases availability.

2) Insurers could collude to increase rates + profits, thus making insurance less affordable for consumers.

d) PVA: no impact on it b/c insurance was not considered interstate commerce, so federal antitrust laws didn't apply.

US v SENA: prohibited now b/c insurance was regulated at the federal level and laws like the Sherman Act made this illegal.

e) 1) No longer had to fulfill the "diligent search" requirement.

2) Taxes could only be charged by the state of domicile, so costs decreased.

f)
a) Credit scores have shown to be a good indicator for loss propensity.

2) Not using credit scores has not shown to lower insurance costs.

b) Could be seen as a proxy for race, which is a protected class.

2) Insurance scores vary more by frequency than severity.

3) Certain classes may be disproportionately affected by lack of credit usage.

c) Ins. companies would not be affected as they would adjust rates in the aggregate, so that rate levels would remain the same.

This consumers would not be affected for the same reason mentioned above. Plus, many companies have enacted guidelines that don’t allow a decreased credit score to be a factor when rates are renewed.

Regulators may hear some complaints from consumers that don’t understand the above points and may need to make an effort to educate the public. There may also be increased rate filings to deal with, as insurers are trying to keep their rates adequate in aggregate.
a) determine which insurers are nationally significant + monitor them for early warning signs of trouble

b) Surplus Adequacy - Gross Written Premium should be less than 900% \(\text{PWS} \) Policyholder Surplus when normal

\[ \text{Operational} \quad \frac{\text{Liquid Liabilities}}{\text{Liquid Assets}} \quad \text{should be less than 100\% when normal} \]

\[ \text{Reserving} \quad \frac{1\text{YR Reserve Development}}{\text{PWS}} \quad \text{should be less than 20\% when normal} \]

Profitability - 2YR Loss Ratio + 2YR Expense Ratio - 2YR Investment income ratio should be less than 100\% when normal

c) Similarity - both use the IRIS ratios to track insurer health
Diff - FAST also uses additional ratios

d) I'd only have the data given to them, can't interact w/ companies to get more data or explain what they've been given
a) 1) combine plaintiffs so insurance companies would be more likely to settle out of court

2) conduct mass screenings so those with questionable claims will slip through and still receive payment

b) increased scrutiny over chest x-rays to ensure claimants are worthy

2)venue reform so that trials are more fair

c) 1) whether the evidence has been published or subject to peer review

2) the known error rate or whether it can be determined

d) After the Daubert decision, judges scrutinized evidence much more heavily and allowed less through. Since then lawyers have done a better job submitting evidence that they believe judges will allow

e) the validity of chest x-rays has been scrutinized more heavily to make sure that only those that show real signs of health concerns are able to file a claim
a) It's difficult to tell, but it may have very little effect. Insurers are already rejecting the insureds they don't want, so switching to a RF would just allow the insurer to code the insureds they would normally reject.

b) For personal auto full participation is achieved by making coverage mandatory by law. Those that are unable to get coverage in the voluntary market have the residual market to increase availability and affordability. Cross subsidies are imposed by the government allowing certain rating variables and the limiting of rates charged in the residual market that get passed on to consumers in the voluntary market.

Saving for retirement is compulsory through payroll deductions, and lack of competition, so full participation is easily achieved. Cross subsidies are imposed by tilting the benefit formula to certain groups (low income, disabled, large families, etc.).

c) 1 -> there is a limit to what someone should pay, no matter their level of risk (against)

2 -> there is more incentive to control losses when rates are fir- + actuarially sound (for)

3 -> being able to obtain coverage & benefits society by all people being covered. Residual markets help to ensure this (against)
a) The federal govt could form its own insurance program to fund and service these policies. It would make the program convenient and the banks would know right where to go to obtain coverage. Efficiencies would be obtained by the govt wouldn’t have to compete, so costs would be lower. A Bank being able to reduce it’s exposure to default risk is a good thing the society relies on banks to remain around and handle their money wisely.

b) Yes, although since the federal govt is running it they may not include a cost of capital provision, but all other costs should be accounted for. Yes, banks should have the resources to obtain coverage that is based on the different amount of risk present in their profile.
a) \( 10 + 40 + \frac{3000}{3000 + 3000 + 1700 + 300} = 50 \text{M} \)

b) \( \frac{3000}{(3000 + 3000 + 1700 + 300)} = 3 \times 50 \text{M} = 150 \text{M} \)

c) (1) guaranty funds must return funds in a very specific order, prescribed by law.

2) 

d) (4) in general assessments have helped to cover the liabilities of insolvent companies. Although the significant amount of litigation once a company goes into liquidation eats a considerable amount of the assets available to pay debts.
2) State gov'ts don't have to market or compete with other insurers (sometimes) and thus have decreased costs that can be passed along to insureds.

2) State gov'ts can specialize in W.C. so they can be more intelligent in decision making & more efficient.

3) The competition helps to keep costs lower and more affordable.

2) Some private insurers are able to specialize in W.C. too, providing just as many benefits as a gov't run program would.

4) Pr. Ins. have been effective b/c they increase competition and availability. As mentioned above, they have been able to specialize in W.C. and provide just as many efficiencies.
a) Fed gvt → creates the rates & services the policies itself.

State gvt → no role

Pr. Ins → were supposed to take over the program eventually but have been unable to do so yet

b) Meet an unfulfilled need → when/if private insurers are unable/unwilling to cover a risk the gov't should step in to do so

2) Provide Efficiencies → some markets may become inefficient, so the gov't can become a competitor to help increase efficiencies in the market & increase affordability/availability

c) It has been somewhat effective. The fedg. gvt has provided protection but the participation rate is low & the private insurers have been unable or unwilling to take over the role originally planned.
a) mean surplus all lines = $8200

\[ \text{Homeowners} = 8200 \times \left( \frac{1050 + 1750 + 3200}{16550 + 4050 + 9100} \right) = 6650.57 \]

\[ \text{PPA} = 8200 \times \left( \frac{2000 + 1100 + 3200}{16550 + 4050 + 9100} \right) = 1739.4 \]

b) reasonabily effective as a retrospective measure, this method struggles when a L.O.B is growing/shrinking rapidly and fails to take into account the level of risk involved in a L.O.B.

C) page 14 data is broken out by state and line of business (L.O.B) whereas I.EE is only L.O.B.
a) Loss reserve should be 7650, not 7600
\[(4400 - 1000) + (5300 - 1050) = 7650\]

b) LAE reserves should be 1919, not 1800
\[(500 - 60) + (1100 - 120) + (500 - 5) = 1919\]

NWP = 3650

3) UEPR should be 2000, not 2175
\[2050 - 50 = 2000\]

b) Total Assets = 13,885 + 100 + 200 + 250 + 550 = 14,485

Total Liabilities = 7650 + 1919 + 30 + 2000 + 1500 = 13,099

Surplus = 14,485 - 13,099 = 1386

C) NWP = 3650
\[\frac{1386}{3650} = 26.3\%\]

Since the ratio is under 300%, the regulator would be OK w/ this ratio.
a) 1) Why does reinsurer X take so long to make payments?
   This would help the A.M. to determine if there is a greater
   chance recoverables from X will be uncollected in the future

   2) Why aren't more highly rated reinsurers used?
   Help to determine if insurer is struggling to do business w/
   the most financially sound reinsurers.

   3) Is the company attempting to raise collateral?
   Would identify an insurer attempts to reduce unsecured
   recoverables and lessen the provision for insurance

   b) 1) Is Y an authorized or unauthorized reinsurer?
   Identify if the reinsurer is having trouble attaining coverage
   from authorized reinsurers due to risk profile

   2) What is the reinsurer Y's exposure to cats?
   Determine if the reins may be adversely affected by
   cats to the point where it will have trouble paying.
q) Inc. Net L + DCC Retd & Y-End = (100K + 400K)(0.7) = 350K x 0.25 = 87.5K

Comm. Pol Net L + DCC = 400K x 0.7 = 280K x 0.25 = 70K

b) 

c) Consideration paid decreases assets; reserves ceded decreases liabilities and any gain/loss is special surplus until receivables exceed consideration paid.

d) 1) Reserve income on the income statement is reduced

2) 5 yr Historical Exhibit

3) Notes to Financial Statements
**CASUALTY ACTUARIAL SOCIETY**

**ONLY ONE QUESTION PER PAGE**

**DO NOT WRITE ON THE BACK OF THIS SHEET**

**EXAM 60U**

**QUESTION #: 17**

**CANDIDATE #: 00358**

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### a) Average Paid Severity

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<thead>
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<th>2010</th>
<th>2011</th>
<th>2012</th>
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### Average Case D/S Reserve

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<th>2011</th>
<th>2012</th>
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</table>


### b) 2012 Development Factor: 2011 = (1640-1550) + (1120-630) + (210-480) = 310

---

### c) 1. What's causing the increase in average paid amounts?

- Help to identify if a change is being made that may indicate large loss reserves are needed.

### 2. Why is the average case increasing so much?

- See if there is a change in reserve setting or claim handling.
a) \[
\frac{35}{30} = 116.67\%
\]
\[
\Delta_{in \text{ UEPR}} = \frac{500 - 498}{498} = 0.00402
\]
\[
RIT = 10 + 0.2(10) + 10(1 - 0.85) = 18.1
\]
\[
A\text{MIT} = RIT + (0.55(1000 - x) - 0.85(1500 - x)) \cdot 0.75 = RIT + 22.3125 + 0.6275(1500 - x)
\]
\[
RIT + 22.3125 + 0.6275x = 11.67(10.25 - 0.85(1500 - x))
\]
\[
RIT = 11.958 - 146.75 - 991.67x
\]

\[
1.167(0.79x(15\%) + 0.09(1500 - x)) = 0.09(1500 - x) + 0.04x(15 + 75 \times 0.85)
\]
\[
x = \text{muni bonds} = 529.62
\]

\[
0.04x + 157.5 - 105x = 135 - 0.09x + 0.0315x
\]
\[
22.5 = 0.0395x
\]

b) \[
R_0 = 50
\]
\[
\text{R_1 = } 50 \times 0.02 \times 564.62 + 10 \times 930.4 = 104.41
\]
\[
R_2 = 50
\]
\[
R_3 = (15 - 1.5) \times 435 = 435
\]
\[
R_4 = 100
\]
\[
\sigma + \sqrt{104.41^2 + 50^2 + 6.75^2 + 106.75^2 + 170^2} = 254.30
\]
\[
\text{Adj. Surplus} = 235 - 2 = 233
\]
\[
\text{Rfact} = \frac{233}{.5 \times 254.3} = 183\%
\]

c) Since the AMIT account tax rate is increasing, the company needs to purchase more taxable bonds.
a) The purpose is to see if insurers are relying heavily on reinsurance.

\[ \text{Cov. ratio} = \frac{3.9 + 3.4}{13.4} = .2686 \]

\[ \text{Aid} = .2686 \times (23.1 + 11.2 + 12.2 + 5.9) = 11.5 \]

\[ \frac{11.5}{72.1} \times 100 = 16\% 15\% \]

b) The company may think that surplus ratio is inadequate and they are trying to boost it through beneficial reinsurance contracts.

c) IRIS Ratios 11, 12 + 13

Before 11 = 14.2%  
12 = 17.4%  
13 = 27.4%

After 11 = 16.7%  
12 = 20.9%  
13 = 32.2%
a) \( R_3 = 21,000(1.1) + 750(0.01) + 900(0.05) + 250(0.05) + 20(0.5) \)
\[ = 1116 \]

b) \( R_6 = 25,000 \times 0.05 \times 0.1 \times 0.05 \times 0.1 \times 0.1 \)
\[ = 10500 + 40,000 = 40,010 \]
\[ R_7 = 20,000 + 10,000 = 30,000 \]
\[ R_8 = 1116 \]
\[ R_4 = 10,500(1.1) + 40,000 = 401,500 - 75k^2 = 326,500 \]
\[ R_5 = 300,000 - 75k = 225k \]
\[ LBL = 25k + \sqrt{40010^2 + 1116^2 + 30k^2 + 32650k^2 + 275k^2} \]
\[ = 454,800 \]

c) Adjs. Surplus = \( 525 - 30 = 495k \)
\[ \frac{495}{454,800} = 0.177\% \]

- Company - no action required
- Regulator - no action required, may want to see if op. ratio is over 120% and qualifies for trend test
a) SAP - regulators  GAAP - investors

b) DAC is SAP do not exist, all expenses incurred immediately
GAAP sets up a DAC asset to match expenses to premiums
GAAP allows discounting as long as payment pattern is reasonably
reestimatable.
SAP allows disc only in certain instances (reg exception, mono-line
real and, etc.

c) SAP is concerned w/ liquidation so expenses wouldn't be available
in help pay debts. GAAP is concerned w/ the company in an ongoing
manner, so they want the most accurate depiction.

D) Furniture is a non-admitted asset in SAP, so the insurer would lose
the purchase price and only rent if renting cost less than buying.
GAAP would prefer to have the asset since it doesn't recognize
non-admitted assets.
(a) 1. Remove discounting

2. Add back in
b) In 2009 reserves went down each subsequent yr, meaning the company was overly conservative. In 2010, they over-corrected as loss reserves crept upwards yearly. Since 2011, once they probably started to get a better handle on their book of business, reserves have stabilized.
a) 10% surplus = 40M 10% reserves = 125M

amount that drops company to next RBC level = 100M

\[ \frac{23400 - 150 \times 2}{2} \]

I would select the amount 100M b/c that drops the company into regulatory level where action is required. A percentage of surplus is too low b/c of low surplus.

b) 1-3 relevant comments section of S40

2-3 Opinion paragraph

c) yes. using the 100M std. actuary thinks reserves could increase as much as 120M.

d) After reviewing unpaid L+LAE reserves, I think there is a risk of material adverse. Using a 100M standard that was developed using the amount of deviation needed to drop the company to the next RBC level. In my opinion the exposure to asbestos/environmental risks is the main concern.
a) The amount of the disc. must be disclosed in the notes to the financial statement.

b) The actuary must disclose the reviewer's work in the relevant comments section.

c) Since the amount is material it should be disclosed in the opinion paragraph of a qualified opinion.

d) The impact of the change (25m) and the reason for the change should be included in the relevant comments section.
a) 1 → company's booked reserves → Balance sheet

2 → unsecured receivables → schedule F

b) 1) AOS compares actuary's reserve esti. to company's booked esti. This isn't in the SAD, so it provides additional insight to regulators + the board on the loss reserve adequacy

2) SAD doesn't consider the adverse development over the history. AOS shows adverse development for past 5 yrs if 3 or more of those years have developed poorly by 5% or more of surplus. Shows a historical review of reserve adequacy, not just prospective.
a) 1: 10-10 rule: if there is more than a 10% chance the reinsurer will realize a 10% loss or greater.

b) If the tail amounts are very sporadic and the ERP test doesn't result in a reliable answer.

c) % of a loss - to identify tail values
   disc. rate - to get severity values to a NPV amount
   severity - to determine if out of loss is significant.

d) Whether there is timing risk involved; w/o timing risk, the contract doesn't qualify, even if there is U/W risk.
   10-10 rule is rather arbitrary and some users may not understand its significance.

e) Could still present timing + U/W risk, but just not enough to pass a test.
Exam 7

Spring 2014

Candidate #1152

Score 47.00
a. Bayesian credibility using VHM and EVPV weights.

\[ Z = \frac{VHM}{VHM \times EVPV} \]

where \( \alpha \) is % increase, \( \gamma \) is ultimate loss.

\[ EVPV = 0.08 \left[ 3^2 + 22.5^2 \right] = 3.2876 \]

\[ VHM = 75 \times 3^2 = 602.5 \]

\[ ULT = VHM \times Z \times ( \text{Chem Ladder} - \text{VHM}) + (1 - Z) \times \text{Approx VHM} \]

\[ ULT = 602.5 \times Z \times (18 + 16 + 20 + 18) + (1 - Z) \times 1.5 \text{CDF} \]

\[ (12 + 0 + 14 + 12) \]

\[ ULT = 7842 \times Z \left( \text{Chem Ladder} - \text{VHM} \right) + (1 - Z) \left( \text{Approx VHM} \right) \]

\[ Z = \frac{VHM}{EVPV} \]

\[ \Rightarrow 0.6056 \times (1.5 \times 22.5) + (1 - 0.6056) \times 22.5 = [27.95] \]

b. It is not appropriate because least squares assume things/assumptions are constant from one year to the next, that is, similar expenditure rates to levels, mix of businesses. This problem shows that the policy, coverage was expanded so thus the LS method is not appropriate for this situation.
Looking at the 1st graph, the losses seem to develop linearly. That is, there aren't many plots consequently above or below the line. Thus, it seems to follow linearly like one of Mack's CL assumptions, the first one. The next incremental values are proportional to the losses to date times a factor which implies linearity.

Looking at the 2nd graph, the residuals seem to be close to 0 at lower amounts, but further out as you move further along the losses. This is similar to Mack's CL assumption the third one. The variance of the past losses are proportional to the cumulative losses to date. Also, it seems to be that there aren't subsequent residuals negative or positive, which implies linearity.

Thus because it seems that the plots match 2 of Mack's assumptions for the CL, assuming the third is gone (Independence of AV), I would say using CL is appropriate for estimating ultimate loss.
Process Variance = $\frac{1}{n-1} \sum (x_i - \bar{x})^2$

$n = 6$, # of points in the triangle

$\sigma^2$, times one for the distribution (w/p) and n for the ECR.

$\sigma^2 = \frac{1}{3} \left[ \frac{100 - 80)^2 + (255 - 300)^2 + (150 - 200)^2 + (170 - 80)^2 + (180 - 300)^2 + (120 - 100)^2}{3} \right]

= 14.25 = \sigma^2$

Total SD = $\sqrt{\text{Perimeter Variance} + \text{Process Variance}}$

$= \sqrt{\frac{350,000}{3} + 1.500,000(14.25)}$

$\sigma = \sqrt{350,030}$
a. Check 12 to 36. Age 0 to 3 years. Use Pemix 3 c.

So-bane on 12-24, LDEs compared to 36-48

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<th>36-48</th>
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<td>10</td>
<td>1.75</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>1.00</td>
</tr>
</tbody>
</table>

\( \frac{1,500}{4,000} = 1.25 \)

Calc: \( x = 12-24 \), \( y = 36-48 \)

\[
\hat{x} = \frac{5 \times 2 + 1.75 \times 1}{3} = \frac{2.95}{3} = 0.983
\]

\[
\hat{y} = \frac{1.2 \times 2 + 1.1 \times 1}{3} = \frac{4.5}{3} = 1.5
\]

\[
x = (x - \hat{x})
\]

\[
x^2 = (5 - 0.983)^2 + (2 - 0.983)^2 + (1.75 - 0.983)^2 = 6.26
\]

\[
y^2 = (1.2 - 1.5)^2 + (2 - 1.5)^2 = 0.87
\]

\[
exy = (5 - 0.983)(2 - 0.983) + (2 - 0.983)(1.75 - 0.983) + (1.75 - 0.983)(1.5 - 0.983) = -0.17967 = 0.35
\]

\[
r = \frac{exy}{x^2y^2} = \frac{-0.17967}{6.26 \times 0.87} = -0.243 = r
\]

\( n = 3 \), for that... \( T = r \sqrt{\frac{n-2}{1-r^2}} = -0.243 \sqrt{\frac{1}{1 - 0.243^2}} = -1.251 \)

\( p = 0.05 \), thus we reject the null that there is no correlation. So there is no correlation in adjacent factors.

b. 1. That the variance of the losses are proportional to the losses to date.

2. That the next incremental loss is proportional to the losses to date.

(Rem to from Mack)
a. \(6(x) = 6(36) = \frac{36^{.75}}{26^{.25} + 24^{.25}} = .734\)

Notice we are using 36 months, because the question asked for 36.

We didn't specify age before 3, because in that case, \(x\) is the average age would have been 30, but it asked for 36, so we will use 36.

\(= \) (Expense) (Cost per Exposure) (Development %)
\(= \) (1000)(800)(1.734) = 1,387,200

b. Ult Case: \(C(x) = \text{Pd. loss} + (1 - 6(x))\) (Expense) (Cost per Exposure)
\(C(12) = .94\). This is close enough to 1, we will assume no truncation necessary in the act of the problem.

\(= \) 650,000 + (1 - .734)(1000)(800) = 862,800

2. If we disregard the apriori, then this becomes a Chain Ladder.
\(U \text{lt} = \text{Paid to Date} / (6(x))\)
\(= \) 650,000 / .734
\(= \) 885,559

3. Banker's Method: Paid loss + (1 - \(\frac{1}{6(x)}\)) (BF Ult).

The BF Ult = CC \(\text{Ult} in this case due to the apriori, Thus we have the BF Ult in part b.

Though it doesn't need to be a BF or CC, just any apriori estimate will do.

\(= \) 650,000 + (1 - .734)(862,800) = 1,879,805

Notice this is same as \((.734)(885,559 - 650,000) + (1 - .734)(862,800 - 650,000) = U \text{lt} - 650,000\)

where we weight the \(C \text{ ultkeep with}.734 \text{ (2)}\) and \(ul \text{ BF ult keep with}.734 \text{ (1- 2)}\).
a. \( x = 2 \), \( x = LDF_{x=2} \)

\[
LDF_{x=2} = \frac{LDF_{x=2}}{1 - (R_x^t)} \cdot \left[ 1.125 \times 0.962 - \frac{11.46}{.944} \right]
\]

\[
LDF_{t=36} = LDF_{t=36} \cdot (R_t^t) + xSLDF_{t=36} (1-R_t^t)
\]

\[1.146 = 1.125 \times 0.962 + xSLDF_{t=36} (1-0.962) \]

\[1.678 = xSLDF_{t=36} \]
1. One of the issues is that $A$ cannot take negative values. One adjustment to this could be changing the negative values to 0, then running the model again. There are many workarounds for this, this is just one of them. Making them 0 allows for $A$ to at least flow through the model.

2. Another issue is missing values. To adjust for these, because we usually want data in the form of the triangle, one can interpolate and predict what the missing value would be, like assume linear development between 2 years.

3. We can estimate data. When the data is not all uniform, for example, the 1st period is only 9 months whereas the rest are 12 or the last calendar year is 9 months while the rest are 12, one can round 9 to interpolate and estimate those values, such as multiplying them by $(9/12)$ for 9 months to be 12.

4. No Standardized Residuals: If the data has non-standardized residuals, then we can make them standardized. One way is using the stratified sampling method where we would put the residuals into buckets by their residual amount, then run different analyses/diagnosing on each individual bucket. (Buckets determined by a range of residual amounts).
1. Specification Error: Where the model doesn't correctly capture the nature of the losses.
2. Parameter Selection Error: When in selecting parameters, one selected one that wasn't accurate.
3. Data Error: Anything wrong with the data used in using, whether it's not accurate, has typos, etc.

b. H0: The automated process may fail to capture anything that may require a manual change, such as a legal change that the process could not fully capture. This is Specification Error, and why we need more models.

C: Claim information is received from a third party, thus there is inside the data that the data may not be appropriate for this business, e.g., if a catastrophe was included in the third-party data that wasn't in our data. Thus, Data Error.

c. H1: It should receive less if a favorable score he causes. Are only using one model, it is not testing or looking at other scenarios or other variables, this too reliant on one model.

C: favorably due to having information that is not reliable, and using it in each of their models, so if an error occurred, all of them would be off/incorrect.
1. We could check the residuals. We could then check for heteroscedasticity, which is a residuals plot by the chart would be good. We could then see whether our assumption for constant variance is accurate or not. Judging from the chart, it does not have residuals, it looks reasonable.

2. We could do a test for linearity, if we had more data. This would suggest whether a GLC is accurate enough or not. Also, it would show whether or not the model delivers linearity or not. We don't have enough data, but assuming no changes in business, and such, the mean payments appear to be reasonable.

3. We can look at reasonableness at the Chart. They should be decreasing as we become more recent, because due to the law of large numbers, any divergence could be affected by another divergence. Judging from the model, this doesn't exactly hold, as 2012 is much different since it covers instead of falls. Thus, I would lean towards not too unreasonable at least for 2017.

4. I would check the volatility on the CDF, because past CDFs are usually highly volatile, and if that's the case, I would not reject this model and go for a different method that is more stable, such as a BF. Judging from this, the last year looks too volatile, probably due to a highly increased CDF; thus, this would make me say as it seems unstable.
1. Selection of a different set of DFs. For example, choosing an N-year weighted average as opposed to all year weighted average.

2. For age wage factor, say 24-36, have different DFs for each age. 

3. We can change the B value to be higher or lower to change the variance of our posterior distribution. If B is too high, it implies larger variance, thus less confidence/weight on our posterior distribution (the BF).

\[
\frac{\text{B}}{\text{V}} = \frac{\text{E}(X)}{\text{Var}(X)}
\]

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\[Z = \frac{\text{BF}}{\text{BF} + 1}\] From the credibility formula, you can see that the less the B value, the higher the variance of the prior is, and the less weight we give to the BF, since the CL weight is Z and the BF weight is $(1-Z)$, and $Z$ gets larger as $B$ decreases.
a. Workers' Comp: It is important because WC is highly regulated and there were changes such as an increase in cases, then we would need to adjust our models to account for this as we could be underestimating A (in this example). Thus legislative risk is important to WC.

b. (0-1) Event risk is important to the policies because in the case of a catastrophic event, there will be a lot of WC claims filed, more than usual. Thus when considering WC, we would have to also consider catastrophic event risk that would come with it to avoid underestimating the risk (in this example).

c. Asbestos? Not sure if this is a line of business, but I'm assuming it is. This risk is one that no one can escape for, but (0-1) hard to gauge the full depth potential for this cause, there are claims that occur for it that are unexpected from the cost of the policy. Thus only latent claim risk, risk not known prior is very important to asbestos risk, thus it is important to capture or try to model.
a. The cap period contains other factors on it as well, namely the basic premium, thus it is not unusual for the cap period to have more premium than losses.

b. The incremental losses on adjustment 3 could have been all above the cap and because it is over the max loss on the policy. It would have no impact on the premium. Then a adjustment 4, a smaller claim under the cap could have developed, causing the change in premium once the claim was under the cap.

c. There could have been losses that increased in the excess of the cap, which would have no impact on premium but increase the losses along with losses that may have decreased within the cap, that would have lowered the premium. In this case the amount excess of the cap increased more than the amounts within the cap decreased.
1. Reporting (log) - The remunerator has a reporting log in receiving the claims because the claims must filter through the primary insurer or remunerator before it gets sent/invoice to the remunerator.

2. Lack of industry data - Industry data of remunerares contain many lines of businesses and many types of contracts, etc. Thus the data is not homogeneous and may not be productive at all.

3. Lack of claims information - The remunerator receives less information on claims than the primary insurer would, thus they have less to go on when processing for them. They are reliant on what the primary insurer sends them to know about their specific claims.

4. Social Trends (Indicators) - There is a lot of upward trends in remunerares, especially for an XEL remunerator, trend predicts them at the excess (and more than it would a primary insurer at a basic trust level).
### Casualty Actuarial Society

**Only One Question Per Page**

**Do Not Write On The Back Of This Sheet**

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<td>1,500</td>
<td>2.5</td>
<td>2,600</td>
<td>.577</td>
<td></td>
<td>2,842</td>
</tr>
</tbody>
</table>

\[
\text{UH LR for AV 2011: } \frac{(\text{Losses} + \text{IBNR})}{(\text{AdPrem})} = \frac{(2,800 + 1,503)}{(4,500)} = \frac{4,303}{4,500} = 0.9578 \%
\]

If we wanted the actual loss ratio pre-to any change in rates, UW, or exposure then we would use the Earned Risk Premium, but I'm assuming the question asks for only one LR, not both of these.

\[
\text{UH LR for AV 2011: } \frac{(\text{UH} + \text{CC})}{(\text{Earned Risk PP})} = \frac{4,303}{4,500} = 0.9578
\]
\[ P/E = \frac{(1-p)}{k-p\times POE} \]

\[ P/BV = \frac{1 + POE - k}{k-g} \]

Use Transaction Multiples. Since these Pure Premiums are nonlinear, I will use an average of their ratios, for each of their respective lines of business.

**WC:** \[ \frac{21.9 + 18.5 + 18.6}{3} = 20 = P/E \]

\[ P/E = \text{Earnings} \times 20 \rightarrow 636 \times 20 = 12,720. \]

\[ P/BV = 12,720 / 5,750 = 1.523 \]

**Papo:** \[ \frac{16.4 + 19.7 + 17.9}{3} = 18 = P/E \]

\[ P/E = \text{Earnings} \times 18 \rightarrow 318 \times 18 = 5,724. \]

\[ P/BV = 5,724 / 3,860 = 1.477. \]

(This looks odd)

**Auto:** \[ \frac{15.9 + 17.2 + 14.8}{3} = 15.3 = P/E \]

\[ P/E = \text{Earnings} \times 15.3 \rightarrow 297 \times 15.3 = 4,544.1 \]

\[ P/BV = 4,544.1 / 7210 = 2.056 \]

This using transaction multiples and assuming the average of the three peers for each line was indicative, we have:

<table>
<thead>
<tr>
<th>P/BV Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>WC: 1.523</td>
</tr>
<tr>
<td>Papo: 1.477</td>
</tr>
<tr>
<td>Auto: 2.056</td>
</tr>
</tbody>
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</tr>
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</tr>
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</tr>
</tbody>
</table>
rc = 0.025  \ E[r_a] = 0.06  \ P = 1.25

\text{CAPM} = k = r_c + \beta \cdot (r_a - r_c) = 0.025 + 1.25(0.06 - 0.025) = 0.0875625%

Use DDM, q = 5\% after 2016, per what was given.

\text{DDM3: } PV(D_0) = \frac{D_0}{1 + k} + \frac{D_1}{(1 + k)^2} + \frac{D_2}{(1 + k)^3} + \frac{D_3(1 + g)}{(k - g)(1 + k)^3}

= \frac{450,000}{1.06875} + \frac{500,000}{1.06875^2} + \frac{675,000}{1.06875^3} + \frac{675,800(1.05)}{1.06875^3 - 0.05}

= 32576184
<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity (ES)</td>
<td>3,000,000</td>
<td>3,150,000</td>
<td>3,307,500</td>
<td>3,472,515</td>
</tr>
<tr>
<td>NE</td>
<td>470,000</td>
<td>500,000</td>
<td>550,000</td>
<td></td>
</tr>
<tr>
<td>Capital</td>
<td>150,000</td>
<td>157,500</td>
<td>163,325</td>
<td></td>
</tr>
<tr>
<td>NI-NE</td>
<td>270,000</td>
<td>342,500</td>
<td>384,025</td>
<td></td>
</tr>
<tr>
<td>(FCFE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For 2016 (Because they asked only for 2016): $384,025$

Note this is not PV'd, they didn't give a rate.

b. Because they actually just negate each other in the FCFE formula. The FCFE approach only looks at what could have been grown out, without any considerations for reserves/etc. They would all under reserves and non-cash changes, cancelling each other out. In FCFE, we are only looking for what the company could have paid out, by assuming that's everything that's not what you accumulated within the firm.
a. Market risk: The risk that our investments in things like equity will change in value, and the volatility in that change.

Credit risk: The risk that another party will default on its obligations, such as repayment of a loan.

b. Interest rate risk: That the interest rate that was expected on our equity/property is different than what we expected.

2. Equity/Risk: That the value of our equity has changed from what we expected it to be, like the value of an office.

3. Currency risk: That our investments in foreign markets may be lowered due to shifts in the value of currency, that is, the exchange rate fluctuating.

c. Market risk affects assets/liabilities because it relates to their relative value, whether for example a property is worth as much as it was expected to be. Credit risk relates to assets/liabilities because if you are expecting payment from someone who is renting out one of your locations, they have a chance of defaulting on the lease. Here is an example: how they relate, if the price of the property drops, it could encourage the loan payer of the plane to default.
Assume non-negative correlations.

Assume 75% correlation between assets.

Assume 75% correlation between markets.

Assume there is 75% correlation between banks.

Assume non-negative, correlated assets.

Assuming they are all from the same firms:

\[ 100 + 40 + 40 + 10 = 190 \text{ million} \]

The range would be from 0 – 190.

Assume the banks:

Market: \[ 100 + 40 = 140 \]

Credit: \[ 40 + 10 = 50 \]

Total: \[ 40 \]

Thus, the range of total risk is \[ (0, 190) \]

This is assuming non-negative correlations, that is 0-100% positive correlations.
1. Duration: The length of time it takes for the bond to mature is a key driver of how risky it is. The longer the duration, the higher the chance that it is to default. One is 5 years, and the other is much longer at 10 years, thus it is probably more risky in terms of duration.

2. Concentration Risk: Both bonds are issued in the US, or at least were formed in the US. If something happens to the US market, both of these bonds may be at danger due to being in the same country/concentration, geographically near. Thus a countrywide impact would affect both.

3. Credit Rating: The credit rating of a bond tells how likely the issuer is to default or meet their obligations. The lower the rating, the riskier the bond is (the more likely to default). In this example, the AA company is clear, as it is not as risky, but the one with the credit rating of BBB is a little more risky; has a higher chance of defaulting.
a. HO and Auto.

Homeowner and Auto usually are independent; that is, a co-accident usually does not imply that something from the home is stolen or broken. However, during times of catastrophe, such as a hurricane, both homes and cars can be damaged, thus they are correlated in extreme events.

b. One may use a copula to capture correlation. One example is the Heavy Right Tail copula. It has little to no correlation on the left side (favorable side), but has correlation on the right tail, where extreme events and the correlations are. Thus, it could account for correlation for risks that usually aren't correlated.
a. Frequency = x, Score = y

\[ x = (2 + 0.5 + 4 + 125 + 1) / 5 = 2.2 \]
\[ y = (15,000 + 25,000 + 5,000 + 3,000 + 12,000) / 5 = 12,400 \]
\[ \sum (x - \bar{x})^2 = (2 - 2.2)^2 + (0.5 - 2.2)^2 + (4 - 2.2)^2 + (125 - 2.2)^2 + (1 - 2.2)^2 = 107.5 \]
\[ \sum (y - \bar{y})^2 = (15,000 - 12,400)^2 + (25,000 - 12,400)^2 + (5,000 - 12,400)^2 + (3,000 - 12,400)^2 + (12,000 - 12,400)^2 = 708,000,000 \]
\[ \sum xy = (2 \times x)y = (2 \times 15,000) + (0.5 \times 25,000) + (4 \times 5,000) + (125 \times 12,000) + (1 \times 12,000) \]
\[ = 2(30,000 + 12,000) + 1(12,000 - 12,400) = -3,800 \]

\[ p \approx \frac{-3.800}{\sqrt{107.5 \times 708,000,000}} = -0.7911 \]

b. Use 1 as the highest.

\[ 4 \text{ Sums} + 2 \text{ Sums} + 2 \text{ Sums} = 8 \text{ Sums} \]

<table>
<thead>
<tr>
<th>Freq</th>
<th>Score</th>
<th>Freq</th>
<th>Score</th>
<th>Freq</th>
<th>Score</th>
<th>Freq</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
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<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>4</td>
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<tr>
<td>4</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

\[ \text{Mode Freq} 15, \text{then reordering four scores} \]

Thus, I was 1, which was the third entry in.

\[ \chi^2 = 1 - 2(0.7911) = -1.5711 \]

\[ \text{with} 1 , 1 \]

\[ \frac{8(0.7911)^2}{1 \times 1} \]

\[ n = 5 \]
C. 1. It describes the dependency of the two categories on one member, which may not be good because dependency may change depending on whom the distribution you are at.

2. It uses dollar amounts, so it requires more information. But when using dollar amounts, it gives more weight to those amounts further from the mean, which we may not want, because an outlier may skew the correlation number a lot.

a. It describes more between as just one number as well, so it would not solve the issue. However, it does solve issue 2, because it only uses ranks and not pure dollar amounts. Thus, it would not be as affected by an outlier as the Pearson's correlation would.

b. Advantage: One can see the dependency across the entire distribution, so they can see ranges where there is correlation and ranges where there aren't, as opposed to just having one number.

Disadvantage: Trying to pick out correlations are tough because it requires human judgment. We could see a correlation, but in fact, it could just be how the multivariate distributions are naturally, so it is hard to get an accurate judgment here.
a. Risk Measure: VaR\textsubscript{99%} (Millions)

\[ \text{Line A: } 3 = \frac{3}{2} \times 2 \Rightarrow 3.5 \times 2 = 7 \Rightarrow 150 = 0 \times \] Profit/\text{VaR}_{99%} \]

\[ \Rightarrow \mu + 2.326 \times 50 + 1.65(2.326) = 388.9 \]

\[ 50 \times 388.9 = 12,530 \%
\]

\[ \text{Line B: } 2.5 = \frac{2.5}{2.5} \times 22.5 = 0 \times \] Profit/\text{VaR}_{99%} \]

\[ \Rightarrow \mu + 2.326 \times 9 + 7.25(2.326) = 61.335 \]

\[ \times 61.335 = 14.67\% \]

Using a 99\% VaR, it looks like Line B provides a better return on risk-adjusted capital because we expect to earn a higher return.

b. Assume independence, thus we can add them together.

Risk Capital for the firm: 388.9 + 61.335 = 460,235 (Risk Capital for Firm [both lines])

Risk-Adjusted Performance = Profit / Capital x Risk Measure = (50 + 9) / (460,235)

\[ = 17.82\% \text{ for risk-adjusted performance of whole} \]

c. \( r(X_E) = p(X_E) \)

\[ \text{Line A: } 398.9 \]

\[ 460,235 \]

\[ \sqrt{398.9} \]

\[ \text{Line B: } 61.335 \]

\[ 61.335 \]

\[ 460,235 \]

They would be the same because we assumed independence, so there is no demonstration benefit here.

d. The advantage of the incremental marginal approach over the proportional allocation method is that the sum of the allocations equals the sum of the whole firm.

\[ \text{Line A: } p(X_E) = p(Y) - p(Y - D_X) \]

\[ r(4) = p(Y) - p(Y - 0.1(X_E)) = 460,235 - 0.1(388.9) \]

\[ = 45,624.6 \text{ through 2} \]

\[ \text{Line B: } r(5) = p(X_E) - p(Y - 0.1(X_E)) = 460,235 - 0.1(61.335) \]

\[ = 45,916.7 \]
a.1 The shareholders decisions do directly affect the debtholders and the debtholders decisions adversely affect the shareholders. If the shareholders do not

b.1 Debtholders in non-insurance firms are just waiting for payment on bonds they invested

2. Both debtholders and shareholders do not want the firm to become mad or distressed, because they are not indemnified or make profit respectively. Thus it works in both their best interests to minimize risk whenever possible.

2. Similar to the explanation I gave on 1a, they have somewhat of a direct and indirect relationship, so they have to balance risky endeavors with

3. Because the debtholders in non-insurance firm need to be paid back
to continue their everyday lines, they would want more of the amount of

risk to be held by the firm and their near investors so they are reimbursed.

There is a non-insurance firm or less concerned with others, so they

would pay (most likely) they should hold as much retained and

invested firm ahead.
a. Without reinsurance:

\[ \text{UW Profit: } (\text{Premium} - \text{Exp. losses} - \text{Aq. Expenses}) \]
\[ = 1000 - 700 - 150 \]
\[ = 150 \text{ million} \]

With reinsurance:

\[ \text{UW Profit: } (\text{Premium} - \text{Prem. Bm} - \text{Exp. losses} + \text{Expected recovery} - \text{Aq. Exp.} - \text{Commision}) \]
\[ = (1000 - 450 - 700 + 110 - 150 - 67.5) \]
\[ = 242.5 \text{ million} \]

b. Without reinsurance:

\[ V = E \times \left( \frac{1}{1 + \delta - i} \right) \]
\[ = \left( \frac{650 + \left( 2000 + 1000 - 150 \right) \times 0.05}{1 + 0.03 - 0.02} \right) \]
\[ = \frac{879.125}{1.08} \]
\[ = 813.874 \text{ million} \]

With reinsurance:

\[ V = E \times \left( \frac{1 + \delta - i}{1 + \delta} \right) \]
\[ = \left( \frac{242.5 + \left( 2000 + 1000 - 450 - 150 - 67.5 \right) \times 0.05}{1 + 0.03 - 0.02} \right) \]
\[ = \frac{359.125}{1.08} \]
\[ = 330.294 \text{ million} \]
\[ = 2785 \text{ million} \]

It seems as though purchased A. Their firm value would go down by 2785 million.
2. The bridging model is when we look at previous loss rates to select a loss ratio for our current year of business. This could be erroneous because some of those loss ratios could have been favorable years or not fully matured yet. Thus, it is an operational risk in our model that it may not be an accurate selection. The point being, based off historical loss ratios, they may not be indicative of future loss ratios, especially if we have a just off that.

1. Maintaining talent. During soft cycles, make sure the top talent is not from our bag a year and that we continue to invest in developing them so they stay and help improve the firm. Once the cycle is over.

2. Information Management. As long as management understands the effects of the cycle, they will not make any rash decisions during them (i.e., operational risk), thus keeping them informed of your expectations during soft cycles are key.
a. The amount of capital to keep the firm from going into bankruptcy, risk.

b. The amount of capital required to maintain a certain rating by a rating agency.

c. They may want to see how much they would need to maintain solvency, which could be more important to them than restraining their rating agency capital level. This could be out-of-date management views or may be even a regulation request.

c(i): The amount of capital gain that the firm is earning profit at a lower level, or that would improve operations.

d. The amount of capital required to maintain franchise value, for example, public opinion of the firm.

d(i): The firm may want to see how they operate under stressed profit rather than by their public image or perceived market value. This could just be due to management's request or out of curiosity or because they would like to prepare for this scenario.
a. Benefits: If they are probability density functions, then it is simple enough to calculate value at risk, other risk measures for Solvency II. For example, VaR$_{99%}$ would be a requirement for the 1-year loss, and one had a distribution that captured the loss correctly, this would be easily computable.

b. Drawback: There are some risks that cannot be quantitatively modeled and require judgment due to their complexities. One example of this is liquidity risk, and the fact that it is a Pillar II risk of Pillar I because it requires expert opinion.

b. Any sort of judgment approach. For example, all experts can write what they think a reserve should be, the votes should be tallied and scored. Then they should discuss the results and rewrite to avoid any bias. This is a disadvantage because there are risks that are too hard/complex to be quantified by a probability density function and require judgment.
Exam 7

Spring 2014

Candidate #115

Score 47.25 (Passing Score)
CASUALTY ACTUARIAL SOCIETY

ONLY ONE QUESTION PER PAGE

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EXAM 7  QUESTION #: 1  CANDIDATE #: 00115

a) \[ Z = \frac{VHM}{VWM + ZUPV} \]

Let union loss = y

\[ VHM = d^2 \frac{t^2}{y^2} = (0.75)^2 \cdot 3^2 = 5.063 \]

\[ ZUPV = \frac{d^2}{a} \left( \frac{t^2}{y^2} \right) = (0.08)^2 \left( \frac{3^2}{32.5^2} \right) = 0.0398 \]

\[ LDF = \frac{12+10+14+14}{12+10+14+14} = 1.5 \]

\[ Vc = 21 \times 1.5 = 31.5 \]

\[ E(Y) = (0.25)(12) + (0.25)(10) + (0.25)(14) \times 1.25 = 22.5 \]

\[ Z = \frac{5.063}{5.063 + 0.0398} = 0.606 \]

Bayes Law:

\[ ZVc + (1 - Z)Vc \]

\[ = 0.606 \times 31.5 + (1 - 0.606) \times 22.5 \]

\[ = 27.954 \text{ (M) \#} \]

b) LS method is not appropriate because AY 2012 time system shift (policy coverage is expanded).
Why C_{i+1} v.s. C_i chart, we all know \( C_{i+1} = b C_i \), \( b \) is constant (incremental)

and \( a = 0 \) (if we assume \( C_{i+1} = a + b C_i \)).

The expected claims are proportional with the losses paid to date \( a \) (the assumption of CL method).

\( C_{i+1} \) by weighted residual v.s. \( C_i \), residual increase with \( C_i \) increase.

\( C_{i+1} \) the variance of losses are proportional with the losses paid to date \( (the \ assumption \ of \ CL \ method) \).
\[ \sum = \frac{1}{n-1} \sum \frac{\text{expected value}^2}{\text{variance}} \]

\[ = \frac{1}{6-3} \left( \frac{150^2}{50} + \frac{200^2}{100} + \frac{(100-200)^2}{200} + \frac{300^2}{300} + \frac{(300-200)^2}{300} + \frac{(500-200)^2}{100} \right) \]

\[ = 14.25 \]

process SD = \((14.25 \times 1500000)^{0.5}\)

\[ = 4623.3 \]

total SD = \((4623.3^2 + 350000)^{0.5}\)

\[ = 350030.5 \]
<table>
<thead>
<tr>
<th></th>
<th>12-24</th>
<th>2436</th>
<th>2.364</th>
<th>0.205</th>
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<tr>
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<td>1.25</td>
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<td>-0.045</td>
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<td></td>
<td>7.51</td>
<td>0.083</td>
<td>0.513</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \bar{X} = 2.691 \]
\[ \bar{Y} = 1.295 \]

\[ r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2} \sqrt{\sum (y_i - \bar{y})^2}} = \frac{0.15}{\sqrt{7.51 - 0.083}} = 0.65 \]

\[ n = 4, D7 = n - 2 = 2 \]

\[ T = 0.65 \cdot \frac{(4-2)}{2} = 1.209 < 1.89 (D7 = 2) \]

\[ \text{not reject separate age independent assumption} \]

Return to page 2 of 2.
CASUALTY ACTUARIAL SOCIETY

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EXAM 7

QUESTION #: 4

CANDIDATE #: 00115

\[ z = \frac{x - \bar{x}}{s_x}, \quad y = \frac{y - \bar{y}}{s_y} \]

<p>| | | |</p>
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<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
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<td>1000</td>
</tr>
<tr>
<td>700</td>
<td>5000</td>
<td>2450</td>
</tr>
</tbody>
</table>

Total

\[ x = 650, \quad y = 575 \]

\[ x = \frac{650}{9000} = 0.07222 \]

\[ y = \frac{575}{9000} = 0.06444 \]

\[ f = 0.818 \left( n-2 \right) \left( 1-0.818 \right) \left( 1-0.818 \right)^2 \]

\[ DF = n-2 = 2 \]

\[ \chi^2 = 2.010 > 1.89 (DF = 2) \]

Reject the assumption of independence.

b) The expected losses are proportional with the losses that have paid to date.

c) The variance of losses are proportional with the losses that have paid to date.
a) expected incurred loss = $1,000 \times 0.00 = 80,000$

\[ g_{26}(X) = \frac{36^2}{36^2 + 24^2} = 0.734 \]

\[ 0.734 \times 80,000 = 58,678 \]$

b) unpaid ratio = \[ 1 - 0.734 = 0.266 \]

unpaid loss = 0.266 \times 80,000 = 21,280$

\[ V_{ce} = 650,000 + 21,280 = 671,280 \]$

c) \[ V_{ce} = \frac{671,280}{0.734} = 914,759 \]$

d) \[ V_{GB} = p_k V_{ce} + \hat{q}_k V_{be} \]

\[ = 0.734 \times 914,759 + 0.266 \times 671,280 \] (here, I use 0 as a round of $V_{be}$)

\[ = 879,505 \]
a) \[
\frac{LD^+ - \bar{R}^L}{LD^+} = \frac{R^L}{R_{x+1}^L}
\]

\[
\frac{1.125}{X} = 0.944/0.962
\]

\[
X = 1.146
\]

b) \[
LD^+ = \bar{R}^L \cdot LD^+ + (1 - \bar{R}^L) \cdot XLD^+\]

\[
1.146 = 0.944 \cdot 1.125 + (1 - 0.944) \cdot XLD^+
\]

\[
XLD^+ = 1.5
\]
1. Negative niremental loss: GLM can't work \( \Rightarrow \) Use Chain-Ladder Model

2. Negative mean on Gamma distribution \( \Rightarrow \) Use Gamma \((-\mu_m, 1\mu_m)\) + \(2\mu_m\)

3. Outliers: outside box-whiskers \( (2\sigma \approx 75\% - 25\%); \) if data out of \(3\sigma\) then check.

4. Sum of residual don't equal zero \( \Rightarrow \) Subtract average difference between zero and sum of residual. The sum of adjusted residual = zero.
a) specification error: incorrect of actuarial valuation process
   parameter selection error: model or parameter are not appropriate
   data error: lack data or too deep understanding of portfolio

b) specification error: Ho: number of model
    WC: data process.
   parameter selection error: Ho: number of model
    WC: stability of estimator
   data error: Ho: understand the business
    WC: data input quality

c) specification error: Ho: less sure, because only use one model
    WC: less sure, parameter data on claim, may be large portion of claims can't be know (ZBNV)
   parameter selection error: Ho: less sure, because only use one model
    WC: less sure, because estimator are volatile between models
   data error: Ho: more score, because company write Ho many year.
    WC: less score, because use third party, data input error may more.
1. Mean unpaid should decrease as mature, this data has decrease mean, it's reasonable.

2. Standard error should decrease as mature, this data has decrease SD, it's reasonable.

3. CV should decrease but last year may increase ("high standard error"). This data is reasonable.

4. Total mean should be greater than sum of each year's variance because it represents years' ultimate loss. This data has a trend, it's not reasonable.

\[ 4074^2 = 16,172,598 > 35^2 + 60^2 + 45^2 + 126^2 + 402^2 = 10,060,556 \]
a) 1. Column variance: If we have two stages, column variance, we can split in column variance among groups. (e.g., claims process change) and let some years use our prior variance.

2. Row variance: If we have very volatile row variance (e.g., portfolio shift) we can use historical data as prior row parameter, (assume row variance are gamma distribution) and put small variance with prior variance.

b) 

\[ Z_j = \frac{P_j^2}{ \theta_j + \theta_1} \]

\[ Z \propto \theta \]

If other constant, \( \theta \) increase then \( Z \) decrease and less weight on CL, and more weight on BF.

\( \theta \) decrease \( Z \) increase \( \Rightarrow \) more weight on CL and less weight on BF.
A) Workers compensation: because WC have longer tail and legislation change can affect benefit (may include ZBVR claim, not only future claim).

b) Homeowners: Catastrophe (ex. 2004, 7/7/1) event could affect large number of claims in one event.

C) CGL: Include some very long tail risk (ex: asbestos) and maybe don't consider when pricing.
a) \(\text{PDLD}_1 = \frac{BP}{50} \cdot \frac{\text{LM}}{1200} + \frac{\text{LM}}{1200} \cdot \text{LCF} \cdot 7X\)

Because first adjustment include basic premium (not only loss portion) so its maybe large that incremental loss.

b) 3rd adjustment: If all losses are less than limit and will no incremental premium.

4th adjustment: If losses arent large than limit and will have positive incremental premium.

c) If some loss larger than limit and will no premium deduction.

And some loss are decrease that prior adjustment and will produce negative premium.
1. Report lag: pipeline is longer because primary may through claims system, accountancy system, reinsurance system, then report to reinsurer.

2. Upward development: for excess of loss reinsurer may know claim after few years, whereas claims develop into large loss (maybe half of attachment point).

3. Claims pattern: different between UOB, type of coverage, type of primary, attachment point.

4. Lack of important information: reinsurer usually only have CY data, and does not have AY data.
\[
E_L R = \frac{9500}{6000 \times \frac{1}{15} + 6000 \times \frac{1}{3} + 5500 \times \frac{1}{6} + 5000 \times \frac{1}{0.5}}
\]

\[
= 0.729
\]

\[
E_L = 0.729 \times 5500 = 4008
\]

\[
P_{SB} = 2500 + 4008 \times (1 - \frac{1}{6}) = 4003
\]

SB Ultimate Loss Ratio for 2011

\[
= \frac{4003}{5500} \quad (I \text{ assume ultimate } \text{ is based on adjusted premium})
\]

\[
= 72.7\%
\]
P/0 ratio: I use average

WC = \((21.9 + 18.8 + 47.6)/3\) = 20

CP = \((16.4 + 17.9 + 15.9)/3\) = 18

CA = \((13.9 + 17.2 + 148)/3\) = 15.3

Price: WC = 636 × 20 = 12,720

CP = 318 × 18 = 5724

CA = 299 × 15.3 = 4511.7

P/0 ratio = \( (12920 + 5724 + 4511.7)/(1830 + 15860 + 2210)\) = 1.398
\[ Y = 0.005 + 0.05 \times 0.06 = 0.1 \]

\[
TV = \frac{(6110000 \times 0.05)}{0.1 - 0.05} = 14,178,000
\]

\[
\frac{[3 \times 0.427]}{1 - 0.427}
\]

\[ PV \ TV = 14,178,000 \times 1.1^2 = 10,649,887 \]

\[
450000 / (1.1) + 500000 / (1.1^2) + 675000 / (1.1^3) = 1,329,451
\]

\[ v = 1329451 + 10649887 = 11,979,338 \]
\[ \begin{array}{ccc}
\text{Year} & 2014 & 2015 & 2016 \\
\text{Beginning Equity} & 3,200,000 & 3,110,000 & 3,307,500 \\
\text{Ending Equity} & 3,150,000 & 3,307,500 & 3,472,250 \\
\text{Net Income} & 420,000 & 500,000 & 550,000 \\
\text{TCFE} = \text{NI} - \Delta \text{Equity} \\
= 550,000 - (3,472,250 - 3,307,500) \\
= 384,625 \\
\end{array} \]

b) TCFE only considers equity. Equity is after debt & reserve. So TCFE unaffected by loan reserve.
a) Market risk: The market down or change affect value of asset and liability.

credit risk: The risk that company default or credit quality down then can't receive.

b) Asset-Liability mismatch risk: interest rate change affect different impact on asset and liability.

2. Current risk: If invest in different currency, balance inventory's current change rate may decrease and some may increase.


c) Market risk: If stock market downside, price of insurance stock down.
If interest rate decrease, the discount rate will down, the present value of liability increase.

credit risk: If counterparty default, the ceding loss reserve can't record the whole asset down, And new insurer must pay does full, then that liability increase.

d) upward: \( 100 + 40 + 40 - 70 = 190 \) = fully positive correlation

downward: \( (100 + 40^2 + 40^2 + 10)^{1/2} = 115.3 \) = independent

range: \((115.3, 190)\)
1. Credit quality: the counterparty's credit quality (rating) affects default rate and recovery rate.

2. Concentration by country: same country may affect by similar factors or events.

3. Maturity: longer maturity faces large credit risk.

Comment: A credit quality, because  technology company's rating is BBB and just large portion (30%), the company face major risk is BBB company default. maybe it decrease BBB company portion.

2 Concentration: because all investment is US so face large risk when US economic down. Recommend invest to other country.

3. Maturity: because BBB company bond have long maturity (10 years), so face large interest rate risk. maybe change invest short maturity.
a) Homeowners & Auto: They typically uncorrelated, but catastrophe event happen (e.g., flood, fire) could change number of claim on both pLOB.

b) Use copulas.

We can use HFT copulas to make high correlation in tail and low correlation in other part.
a) \[ Y = \frac{\sum (T-t)(S-S)}{\sum (T-t)(S-S)^2} \]

<table>
<thead>
<tr>
<th>( T-t )</th>
<th>( S-S )</th>
<th>((T-t)(S-S))</th>
<th>((S-S)^2)</th>
<th>( (T-t)(S-S)^2 )</th>
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<tr>
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<td>0</td>
<td>0</td>
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<td>13000</td>
<td>0.0175</td>
<td>2210000</td>
</tr>
<tr>
<td>3</td>
<td>0.2</td>
<td>-9000</td>
<td>0.04</td>
<td>360000</td>
</tr>
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<td>0.0025</td>
<td>81000</td>
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<td>0</td>
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</tr>
<tr>
<td>Total</td>
<td>0.075</td>
<td>30700000</td>
<td>338000000</td>
<td></td>
</tr>
</tbody>
</table>

\[ Y = \frac{30700000}{338000000} = 0.079 \]

b) class | C | D
|--------|---|---
| 1      | T | F |
| 2      | T |   |
| 3      |   |   |
| 4      |   |   |
| 5      | 2 | 8 |

\[ Z = \frac{28}{28} = 0.6 \]

c) 1. Use value, not rank
2. Use square, so put more weight on few extreme values.
d) 1. Kendall τ use rank instead of value
   2. use rank and dont use square, then put less weight on extreme value (then Fisher).

e) adv: we can show full picture or correlation, not only one number
   disadv: sometimes hard to find correlation because no number.
CASUALTY ACTUARIAL SOCIETY

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EXAM 7

QUESTION #: 27

CANDIDATE #: 00115

capital required = \text{profit} \times \text{Std} \times CV

1) capital: \[ A = 50 \times 2.326 \times 300\% = 348.9 \]
\[ B = 9 \times 2.326 \times 250\% = 52.3 \]

return: \[ \frac{A}{B} \times 100\% = 14.3\% \]
\[ \frac{B}{A} \times 100\% = 19.2\% \]

line B better.

b) AD B independence

\[ \text{capital required} = \sqrt{A^2 + B^2} = 352.8 \]

return: \[ \frac{352.8}{352.8} = 100\% \]

C) capital: \[ A = 352.8 \times 3.489 \times \left( \frac{352.8 + 32.37}{352.8 + 32.37} \right) = 306.8 \]
\[ B = 352.8 \times 32.37 \times \left( \frac{352.8 + 32.37}{352.8 + 32.37} \right) = 46 \]

d) capital: \[ A = 352.8 - 3.3 = 305.8 \]
\[ B = 352.8 - 348.9 = 3.9 \]

adv: some numerical marginal are suitable allocation, make decide
right.
a) Their different on retain risk, debholder want safe, but shareholder want make profit, profit increase $\Rightarrow$ shareholder make more money. But, debholder

b) Insurance: debholder are policyholder, different than non-insurance firm.

2. Mutual insurance: shareholders are policyholder different than non-insurance firm.

b) By b, because policyholder want insurance have more capital and now capital level company's premium must provide a discount. So insurance company may them

c) because policyholder want insurance safer (mutual insurance more) so will retain less risk.
a) without reinsurance:

\[ \text{Profit} = EP - \text{Loss} - \text{Expense} \]
\[ = 100 - 200 - 150 = -650 \]

b) with reinsurance:

\[ \text{Profit} = EP - \text{Loss} - \text{Expense} - \text{Reinsurance Premium} \]
\[ = 100 - 200 - 150 - 450 + 67.5 + 110 \]
\[ = 377.5 \]

b) without reinsurance:

\[ D = \frac{1 - \delta}{1 + \delta} = 0.942 \]
\[ V = 650 \cdot \frac{0.942}{1 - 0.942} = 1055.7 \]

b) with reinsurance:

\[ D = \frac{1 - \delta_{re}}{1 + \delta_{re}} = 0.967 \]
\[ V = 377.5 \cdot \frac{0.967}{1 - 0.967} = 1106.2 \]
\[ V_2 - V_1 = 505 \]
a) Problem 1: Model maybe not appropriate.  
   Model possibly appropriate, but selection may be improper.  
   Selection and model often appropriate, but result not popular.  
   So ignore it.

b) Market overreaction: Price in soft market often too low and in hard market often too high. So we can use these chances to make profit.

Owners: Company's manager must know some index in soft market, cost, health, overhead, expense ratio will increase, rate decrease, and premium = rate - expense. Company can't focus on market share.
a) Economic capital level: the amount of capital that a specify confident level and a specify time period (about solvency)

Rating agency capital: the amount of capital that require by retain a specify credit rating.

b) Rating agency capital calculate by rating agency (ex: S&P, Moody’s) may be appropriate every insurer. Economic capital level calculate by each company internal model. So could reflect each insurer portfolio and risk.

c) Economic impairment earning: the amount of losses that matter fixed economic impairment.

Projection of franchise value: the amount of capital require in a specify confidence level make franchise value exceed specify amount.

d) Franchise value is future business, so is harder to estimate.
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EXAM 7 QUESTION #: 27 CANDIDATE #: 00115

a) Benefit: Only use one number, so could disclose less information about company.

b) Drawback: Too simple, doesn't fit day-to-day action in whole
company.

b) Use day-to-day management process.

adv: consistent with operation of company.
Exam 7

Spring 2014

Candidate #648

Score 47.50
a) \[ VHM = E\left(\frac{Y}{\bar{Y}}\right)^2 \text{var}(Y) \]
\[ E\left(\frac{Y}{\bar{Y}}\right) = 0.75 \]
\[ \text{var}\left(\frac{Y}{\bar{Y}}\right) = 0.08^2 = 0.0064 \]
\[ \text{var}(Y) = 3^2 = 9 \]
\[ E(Y) = 1.25(21) = 26.25 \]
\[ VHM = 0.75^2 \times 9 = 5.0625 \]
\[ EPV = 0.0064[9 + 26.25^2] = 4.4676 \]
\[ Y = \text{ultimate loss} \]
\[ Z = \frac{VHM}{VHM + EPV} = \frac{5.0625}{9.5301} = 0.5312 \]
\[ x_0 = \text{reported loss} \]
\[ z_t = Z \times x_0 + (1-Z) E(Y) \]
\[ \text{Ultimate loss} = \frac{0.5312(21)}{0.75} + (1-0.5312)(26.25) = 27.18 \]

b) There are systematic distortions in the data due to the change in policy coverage. Least-squares is not appropriate when systematic distortions are present; only if random fluctuations or changes in inflation or exposures occur that can be corrected for, is least squares appropriate.
Based on the first chart (C_{ia} vs C_{ii}), chain ladder would appear to be appropriate. It shows a linear relationship between incremental losses at time 1 (C_{ii}) and incremental losses at time 2 (C_{i2}). There is no intercept suggested, which is consistent with the chain ladder formula \( y = bx \). It also follows Mack's first assumption that incremental losses are proportional to losses reported to date. The second chart, however, shows more spread in the residuals than is ideal. We want residuals randomly scattered around the zero line, but these are increasing at higher loss amounts. The LDFs for the larger loss amounts may not be correct. The actuary should investigate this before using this chain ladder model output.
\[ \theta^2 = \text{variance} = \frac{1}{\text{mean}} \sum_{n-p}^{(c-\mu)^2} \mu \]

\[ c = \text{actual incremental loss} \]

\[ \mu = \text{expected incr. loss} \]

\[ n = 10 = \# \text{of predicted pts} \]

\[ p = 3 = \text{capeCod: } \omega, \theta, EFR \text{ parameters} \]

\[ \frac{(c-\mu)^2}{\mu} \]

\[
\begin{array}{cccc}
10 & 12 & 5 & 3.6 \\
11 & 10.75 & 2 & = \frac{(180-200)}{500} \\
12 & 20 & 4 & \\
\end{array}
\]

\[ \frac{1}{6-3} \times \sum \left( \sqrt{5+20+4+\cdots+2} \right) \]

\[ \theta^2 = \frac{1}{3} (42.75) = 14.25 \times 1000 = 14250 \]

\[ \text{(given)} \]

\[ \text{process variance} = \theta^2 \times \sum \text{reserves} \]

\[ \approx 1,500,000 = 21,375,000,000 \]

\[ = 14,350 \]

\[ \text{parameter variance} = \theta^2 \]

\[ \approx 350,000^2 \]

\[ \text{total variance} = \text{process + parameter} = 14,350 + 350,000^2 \]

\[ \text{standard deviation} = \sqrt{\text{total variance}} = \sqrt{379,308,600} = 379,308.6 \]
**CASUALTY ACTUARIAL SOCIETY**

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**EXAM** 7  
**QUESTION #:** 4  
**CANDIDATE #:** 00648

\[ \text{page 1 of 2} \]

\[ a) \]

| 08 | 5.0 = \( \frac{100}{500} \) | 1.5 = \( \frac{100}{1000} \) |
| 09 | 2.0 | 1.250 |
| 10 | 1.875 | 1.333 |
| 11 | 1.067 | 1.100 = \( \frac{2000}{2000} \) |

\[ \bar{X} = \frac{\sum X}{n} = \frac{4.0 \cdot 0.500 + 1.0 \cdot 0.250 + 0.875 \cdot 0.333 + 1.067 \cdot 1.00}{4} = 1.8136 | \bar{Y} = \frac{\sum Y}{n} = \frac{0.500 + 0.250 + 0.333 + 1.00}{4} = 0.296 \]

\[ \bar{X} = 1.8136 \quad \bar{Y} = 0.296 \]

\[ \Sigma X = 6.512 \quad \Sigma Y = 1.183 \]

\[ r = \frac{\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{\Sigma X^2 - (\Sigma X)^2} \sqrt{\Sigma Y^2 - (\Sigma Y)^2}} = \frac{6.73279}{\sqrt{7.511074} \cdot 0.083517} = 0.5333 \]

\[ T = r \left[ \frac{n-2}{1-r^2} \right]^{\frac{1}{2}} = 0.5333 \left[ \frac{4-2}{1-0.5333^2} \right]^{\frac{1}{2}} = 0.8916 \]

\[ n=4 \quad 2 \text{ degrees of freedom} \]

\[ \text{# pairs being compared} = 0.8916 < 1.89 \quad \text{not significant} \]

\[ \text{so factors are independent} \]
a) (cont.) ATA factors are independent from 2 to 36 months, since T statistic

of $0.89116 < 1.89$.  

b) 1) losses in different accident years are

independent of losses in other accident years

2) variance of incremental losses is proportional
to losses reported to date multiplied by

a factor based on age.
a) \( G(x) = \frac{x^{2.5}}{x^{2.5} + 0^{2.5}} \) \( t = 36 \)  
\[ \text{avg age} = 0^{+} 30 \]  
\[ G(30) = 0.636 \]  
\[ \text{lag} = \frac{1}{\text{LDF}} \]  
\[ 1000 \text{ expo.} \times 800 = \$800,000 \text{ loss} \]  
\[ 800,000 \times 0.636 = \$508,800 \]  
\[ \text{expected to be paid} \]  

b) \( \text{actual loss} = 1,500,000 = C_{x} \)  
\[ \text{actual + expected incremental} \]  
\[ 1,500,000 + 508,800 = 1,958,800 \]  

c) \[ \frac{800,000}{0.636} = 1,257,316 \]  
\[ \text{expected x LDF} \]  

d) \( \text{RAA+PRC} \) \( \text{Uab} = 0.636(1257861.64) + 0.364(158800) \)  
\[ \text{Pr} = 0.636 \]  
\[ \text{Pr} = 1.686 + 0.314 \]  
\[ \text{q} = 0.314 \]  
\[ \text{Uab} = \text{Pr} \text{ Uac} + (1-\text{Pr}) \text{ Ucc} \]  
\[ 1571,803 \]  
\[ \text{reserve} \]
a) \[ \frac{LDF_t}{R_t} = \frac{LDF_t}{R_t} \]

\[ \frac{1.125}{(0.962 \times 0.944 \times 0.920)} = 0.962 \]

\[ LDF_{36-48} = 1.0296 = X \]

b) \[ LDF_t = LDF_t (R_t) + XSLDF_t (1-R_t) \]

\[ 1.0295 = 1.0125 (0.962) + x (1-0.962) \]

(from(a)) \[ \frac{1.0295}{(1-0.962)} = 0.0125 \]

\[ 0.21275 = XSLDF(1-0.962) \]

\[ 5.100 = XSLDF_{36-48} \]
- Overdispersed Poisson cannot handle negative incremental loss data (or losses that decrease from one development period to next).
  - To adjust for this, use normal approximation to the Negative Binomial.

- If there is negative incremental data, add that value to all cells in the triangle (or subtract negative value) then apply log-link. After running model, subtract value from cells.

- Need dispersion factor \( \phi \), which may be hard to calculate.

- Residual values will be zero in corners → use other residual values when modeling these spaces.
a) Specification error - reflects the fact that it is not possible to precisely model the insurance process.

Parameter selection error - reflects the fact that it is not possible to perfectly estimate linear predictors or, in general, that model parameters are incorrect.

Data error - risk that there is an inadequate amount of data to build a model and/or that there is a lack of knowledge regarding pricing and underwriting practices.

b) Spec 1) Number of models 4) Number of models run

Parameter selection (history) 3) Claim system automation 6) Claim information source

Number of runs

Data

Claim system

Automation

Source
C) 1) **unfavorable** - prefer to run more than one for homeowners to capture event/cat risk as well as provide check on first model validity

2) favorable since meeting regularly to share insights - beneficial to both parties

3) middle - probably favorable going forward for standard data process, but may be unfavorable as all parties adjust to new system

4) favorable - multiple models provide balance and checks on one another

5) less favorable - new line for this company - may be some lacking knowledge, thus far - good to use 4 models to balance this

6) less favorable - good that data is received quarterly, but third party introduces risks with handoffs and quality
1) $\sum$ individual AY std error = 5026

$5026 < 4024$ total $\rightarrow$ this is what we expect

sum of independent acc yr standard error is

less than total standard error for model

*reasonable

2) $\sum$ ind AY cov $\times$ mean $\approx 5026$

$63 \times 556 + \ldots + 403 \times 7011 < 14557 \times 0.276$

sum of ind. AY cov is $<$ total cov for model

* reasonable

3) unpaid claims increase in newer accident years - expected behavior in chain ladder model
   - more claims have already been paid in older years

4) standard error increases in newer accident years - expected behavior in chain ladder model
   - more unpaid claims in newer years (3), and more corresponding uncertainty in those claims, so
   std error is increasing as age closer to current.
a) 1) Expert opinion regarding a given LDF (loss development factor). Due to a change in claims handling, perhaps, an actuary may override a calculated LDF in favor of something higher based on his/her knowledge of expected changes that aren't yet in the data.

2) The second type of expert opinion would be in the confidence level. In the example above, the actuary is making a prediction without data to validate it. S/he should use a large variance around the prior so that this opinion gets some weight, but most of the estimate comes from actual data due to the large variance.

b) The $\beta$ value is used in the Bayesian model to calculate the variance of the prior distribution, which is gamma. The variance is $\frac{1}{\beta^2}$, so as $\beta$ is larger, the variance is smaller, and when $\beta$ is smaller, the variance grows larger. In a Bayesian model, there is a weighing of the chain ladder (CL) and Bornheuter Ferguson (BF) estimates. The larger variance (smaller $\beta$) gives more value in the actual data, providing an estimate closer to CL. As small variance puts high confidence in the prior distribution and gives an estimate closer to BF. In the example given, the variance increases down the column, so the first would be closest to BF, and the bottom would be closest to CL.

<table>
<thead>
<tr>
<th>$\alpha$</th>
<th>$\beta$</th>
<th>mean</th>
<th>var</th>
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<tr>
<td>30000</td>
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<td>2500</td>
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<td>3000</td>
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</tr>
<tr>
<td>300</td>
<td>12</td>
<td>2500</td>
<td>2083</td>
</tr>
</tbody>
</table>
a) Workers compensation - this is a long-tail line of business with claims that stay open for many years, a legislative ruling could affect all open claims at once, significantly increasing reserve need - a company would need to be prepared in order to be able to handle the reserve/increase in payment change to stay in business.

b) Homeowners - this is a fairly short-tail line of business but it is greatly affected by event risk - large losses, catastrophes, weather events - these all tend to be tail risk, low frequency but very high severity - a company needs to be prepared for such risks in order to keep the promise of insurance to indemnify their customers upon making claims.
c) Workers compensation - long-tail line of business and due to the nature of risks like asbestos, an insurer may not know until 20-30 years after the fact that it will be paying claims for this risk. Since risks like this are possible, a WC company would need to always hold a cushion of capital to be prepared for this type of latent claim risk.
a) The first adjustment for premium includes basic premium that covers things like premium taxes. Thus, the PDLD, measure will normally be > 1.00.

b) If the losses deteriorated between age 3 and 4, which happened here (15000 @ 3 -> 20000 @ 4), the insurer would need to charge premium accordingly.

c) Due to good loss experience, the insured may receive premium back at the fifth adjustment. This is one of the advantages of a retro rated policy.
1) There are long lags in reporting of losses from the primary insurer to the reinsurer. This is caused by a long reporting pipeline (primary claims → primary accounting → intermediary → reinsurer), a tendency to reserve at modal values so the insurer (primary) doesn’t know which claims will pierce the reinsurance layer, and the late emergence of tort claims.

2) There is persistent upward development in claim amounts for reinsurers. This may be caused by serious undervaluation of ALAE costs as well as economic and social inflation.

3) There is heterogeneity in reporting patterns due to variations in types of underlying business by line, type of contract, type of reinsurance cover, and differing attachment points. This makes it difficult to group claims into similar buckets for standard loss reserving procedures.

4) The information the reinsurer receives is often lacking data, such as exposures. Also, the data may be on a calendar year rather than accident year basis, making it more challenging for the reinsurer to organize data into triangles for reserving.
**CASUALTY ACTUARIAL SOCIETY**

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**EXAM 7**

**QUESTION #: 14**

**CANDIDATE #: 006048**

<table>
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<th>CY/A</th>
<th>Adj. prem</th>
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<th>used-up premium</th>
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<tr>
<td>10</td>
<td>5000</td>
<td>.80</td>
<td>= 4000</td>
</tr>
<tr>
<td>11</td>
<td>5500</td>
<td>.625</td>
<td>3437.5</td>
</tr>
<tr>
<td>12</td>
<td>6000</td>
<td>.50</td>
<td>3000</td>
</tr>
<tr>
<td>13</td>
<td>6500</td>
<td>.40=2.5=1.25</td>
<td>2400</td>
</tr>
<tr>
<td></td>
<td>23000</td>
<td></td>
<td>13037.5</td>
</tr>
</tbody>
</table>

\[
\text{Cape Cod expected loss} = 9500 \times .7287 = 6907.15
\]

\[
\text{Loss ratio} = \frac{6907.15}{13037.5} = .537
\]

\[
\text{adj-u-u:} (1)-(3)
\]

<table>
<thead>
<tr>
<th>CY/A</th>
<th>unused premium \times ELR + rpt. loss = ultimate loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1000 \times .7287 + 3000 = 3728.7</td>
</tr>
<tr>
<td>11</td>
<td>2002.5</td>
</tr>
<tr>
<td>12</td>
<td>3000</td>
</tr>
<tr>
<td>13</td>
<td>3900</td>
</tr>
</tbody>
</table>

\[
\text{Cape Cod reserve + reported loss to date} = \text{ultimate loss estimate}
\]

\[
\text{ELR 2011} = \frac{\text{ultimate loss}}{\text{ERPP}} = \frac{4000.9}{4500} = .8895
\]

\[
\text{Ultimate ERPP} = 4500 \times .8895 = 3992.67
\]
WC
\[ \text{peer avg} = \frac{21.9 + 18.5 + 19.6}{3} = 20 \]

WC: PE 20 \times \text{Earnings} 6.36 = 12,720 = \text{price peer}

\[ \text{Price} = \frac{12,720}{8,350} = 1.523 \]

**Commercial Property**
\[ \text{peer avg} = \frac{16.4 + 19.7 + 17.9}{3} = 18 \]

CP: PE 18 \times \text{earn.} 318 = 5,724 = \text{price peer}

\[ \frac{P}{BV} = \frac{5,724}{5,860} = 0.9768 \]

**Commercial Auto**
\[ \text{peer avg} = \frac{13.9 + 17.2 + 14.8}{3} = 15.3 \]

CA: PE 15.3 \times \text{earn.} 297 = 4,544.1 = \text{price peer}

\[ \frac{P}{BV} = \frac{4,544.1}{22.10} = 2.056 \]

Overall
\[ \frac{P}{BV} = \frac{12,720 + 5,724 + 4,544.1}{8,350 + 5,860 + 22.10} = 1.40 \]
CAPM: \[ k = r_f + \beta (E(r_m) - r_f) \]
\[ = 0.025 + 1.35(0.06) \]
\[ = 10\% \]

\[ DDM = \frac{E(div_1)}{1+k} + \frac{E(div_2)}{1+k} + \ldots + \frac{E(div_n)(1+g)}{k-g} \]

Terminal value: \[ \frac{675,000 \cdot 1.05}{1.10} = 14,175,000 \]

\[ DDM = \frac{450,000}{1.10} + \frac{500,000}{1.10^2} + \frac{675,000}{1.10^3} + \frac{14,175,000}{1.10^3} = 11,979,338.84 \text{ value of corporation} \]
### a)

<table>
<thead>
<tr>
<th>Year</th>
<th>Equity</th>
<th>Income</th>
<th>End Equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>3,000,000</td>
<td>420,000</td>
<td>3,150,000</td>
</tr>
<tr>
<td>2015</td>
<td>3,150,000</td>
<td>500,000</td>
<td>3,307,500</td>
</tr>
<tr>
<td>2016</td>
<td>3,307,500</td>
<td>550,000</td>
<td>3,472,875</td>
</tr>
</tbody>
</table>

- Required capital increase:
- Net income: $550,000
- End equity: $3,472,875 = $3,307,500 x 1.05

### b)

FCFE is free cash flow to equity only, so it does not include debt items like loss or loss adjustment expense reserves. FCFE is preferred for insurers over FCF, or free cash flow to the firm, as FCFE includes debt and it is difficult to delineate what is actually debt in an insurance company due to the unique financial situation of policyholder liabilities.
a) Market risk is the risk of loss due to changes in the market resulting from interest rate changes or asset-liability mismatches.

Credit risk is due to decreases in value of places a company invests its money - risk of getting money back. Examples include counterparty concentration, default, and downgraderisk.

b) Interest rate drops may affect an insurer by decreasing the value of its investments.
Asset liability mismatch - the timing and value of assets does not match the timing of liabilities.

C) Credit risk greatly affects invested assets and insurance liabilities due to investment companies defaulting or being downgraded - this in turn hurts the insurer's ability to pay insurance liabilities.
Market risk can decrease value of invested assets through drops in interest rate.

d) \[ \sqrt{(100-40)^2 + (40-10)^2} = 67.08 \]
\[ (0, 67.08) \]
Concentration risk - risk that bonds or investments are focused in too few companies - if one or two companies go under, company holding bonds could fail as well.

Related to this scenario, this insurer has $35 million of bonds in only two companies. The bank is probably stable with its AA rating, but the BBB rated tech company seems like it could be riskier - the insurer may want to diversify into more bonds with different issuers.

Default risk - the risk that a company will default on its liabilities - i.e., not be able to pay back money to investors when it comes due.

Related to the example here, the higher default risk is with the tech company since it already has a poorer rating of BBB, and the maturity of the bonds is longer, allowing more time for the performance of this company to decline. Also, technology is a field that can be 'hot and cold' - if something new comes along, this company may lose business - not as stable as a bank.

Downgrade risk - the risk that the credit rating of a company will decrease, signifying less strength and a higher probability of default.

Related to this portfolio, the bank has an AA rating and therefore is a solid company. Even if
It were downgraded, it would still probably be A, which is solid. The tech company, however, has a much poorer 'BBB' rating. There would be more lost if this company was downgraded, and likely, it would be closer to defaulting on some of its liabilities. Again, it probably is in the insurer's best interest to diversify further into more bond issuers to balance this risk.
a) Property and workers' compensation insurance are generally uncorrelated due to the different natures of the exposures written and short tail (prop) vs long tail (wc) development. However, if an earthquake occurred in California during business hours, this extreme event would cause correlation in the two lines. There would be extensive property damage and inevitably personal injuries that would be claimed as work comp due to it being during business hours.

b) The use of a copula to model correlation in the tails of the loss distribution is a method to account for the type of issue referenced in (a). I would recommend using an HRT (Heavy Right Tail) copula for modeling heavy tail correlation, as it
b) (cont.) shows strong dependencies in the far right tail.
a) class \( x = \text{freq} \quad y = \text{sev} \)

<table>
<thead>
<tr>
<th>class</th>
<th>( x )</th>
<th>( y )</th>
<th>( x \times y )</th>
<th>( x^2 )</th>
<th>( y^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.20</td>
<td>15000</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>.05</td>
<td>35000</td>
<td>-15</td>
<td>-0.25</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>.40</td>
<td>5000</td>
<td>.20</td>
<td>-0.80</td>
<td>2500</td>
</tr>
<tr>
<td>4</td>
<td>.25</td>
<td>3000</td>
<td>.05</td>
<td>-0.06</td>
<td>900</td>
</tr>
<tr>
<td>5</td>
<td>.10</td>
<td>12000</td>
<td>-10</td>
<td>-1.0</td>
<td>14400</td>
</tr>
</tbody>
</table>

Average \( \bar{x} = \frac{\sum x \times y}{\sum y} = \frac{12000}{5} = 2400 \)

Pearson \( \rho = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2 \times \sum (y - \bar{y})^2}} \)

\( \rho = \frac{-3800}{\sqrt{0.075 \times 3000 \times 6000}} = -0.7906 \)

b) rank small\( \rightarrow \) large

<table>
<thead>
<tr>
<th>rank</th>
<th>corresponding severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12000 ( \rightarrow )</td>
</tr>
<tr>
<td>2</td>
<td>15000 ( \rightarrow )</td>
</tr>
<tr>
<td>3</td>
<td>5000 ( \rightarrow )</td>
</tr>
<tr>
<td>4</td>
<td>3000 ( \rightarrow )</td>
</tr>
<tr>
<td>5</td>
<td>5000 ( \rightarrow )</td>
</tr>
</tbody>
</table>

Reorder severity to get into rank (small to large) order

\( n = 5 \) = number of pairs to rank

\( Q = \) number of swaps to reorder

\( T = 1 - \frac{4Q}{n(n-1)} = 1 - \frac{4(8)}{5(4)} = 1 - 32 = -0.60 \)
c) 1) Pearson measures correlation as a cardinal (value) measure. This puts a significant amount of weight on outlying data points, especially because the distance to the mean is squared in the denominator of the $r$ calculation.
2) Pearson correlation measure is just one number, so it does not give much information for an entire loss distribution—not ideal to have all correlation measure in one number.

d) Kendall $T$ does address issue (1) above. It is an ordinal, or rank, measure, so it simply evaluates the ranks of one data set relative to the other. It does not get inflated by outliers. However, Kendall $T$ is also just one number, as Pearson $r$ is, so in this they are similar—would need a scatterplot to show correlation across entire distribution.

e) The advantage of a scatterplot is that it shows correlations or dependencies across an entire distribution and how they can vary, versus summarizing in one point. The disadvantage of a scatterplot is that the observer/analyst may have their eyes play tricks and see patterns on the scatterplot that don't really exist.
C ASUALTY ACTUARIAL SOCIETY

ONLY ONE QUESTION PER PAGE

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EXAM 7  QUESTION #: 22  CANDIDATE #: 00648

page 1 of 2

a) \( z \times \text{CoV} = \frac{\theta}{\mu} \)

\( A: 2.326 \times 3 = 6.978 \quad \frac{600}{\mu} \)

\( B: 2.326 \times 2.5 = 5.815 \quad \frac{250}{\mu} \)

b)

\( \sigma \)

\( c) \frac{\text{proportional allocation}}{\sum \rho(X_j)} = \frac{\rho(Y) \rho(X_j)}{\sum \rho(X_j)} \)

Assume risk cap \( A = 10,000 \)

Risk cap \( B = 20,000 \)

Total = 25,000

\( A: \frac{10000(25000)}{30000} = 8333 \frac{1}{3} \)

\( B: \frac{20000(25000)}{30000} = 11666 \frac{2}{3} \)
d) incremental marginal allocation = \[ \rho(y) - \rho(y - eX_j) \]

- The allocation to the parts sum up to the total risk measure is the advantage over the proportional allocation method.
a) Financial distress is expensive - if a firm doesn't diversify risk, may end up selling high-yield bonds or stocks at a discount to try to build back up the capital base. This firm may have to put off upgrading systems and sell assets at a discount to stay above water. Shareholders and debtholders have differing views of risk appetite - based on investment in company, shareholders will take more risk if company value decreases, as they have less to lose than debtholders. Debtholders would take less risky moves.

b) In an insurance firm, shareholders are the debtholders who are the customers. As such, they are more invested in having a high-rated, well-capitalized insurance firm making responsible decisions. It isn't just an investment in the insurance on their cars, homes, and other assets. In a non-insurance firm, shareholders and debtholders have differing interests. If the firm value declines, shareholders lose value in investments but will be willing to take risky moves to rebuild the firm capital, while the debtholders do not want the additional risk taken, as they do not want the entire firm to go under.

c) Because insurance customers/debtholders want a solid, positively-rated firm that can pay its liabilities when they come due, it behooves insurance firms to protect their capital base with risk management. In addition, it is difficult for insurance firms, especially small and mutual companies,
to get capital in the market. A non-insurance firm has more freedom to access capital markets and offer bonds, though they will be at a high yield if distressed. Insurance firms should keep less risk relative to non-insurance firms.
a) u/w profit
   with reinsurance  without reinsurance

   retained premium (1000 - 450) = 550  EP  1,000
   - loss  200  loss  - 200
   - expense 150  expense = 150
   + recovery 110
   + commission .675
   $377.50

b) 800
   with reinsurance  without reinsurance

   D' = 1 - d' = 1 - .004 = .996039
   1 + r
   D = 1 - d = 1 - .03 = .97
   1 + r
   M' = $29.294
   1 - D
   D = 1 - .03 = .97
   M = D = 116.11181

   inv. assets = .05 (2000 + 550
   = = 2,550 + 150 + 67.5
   expenses comm.
   = 123.375
   inv. assets = .05 (2000 + 1000 - 150)
   = 142.5

   E = 800 650 + 142.5 = 792.5
   u/w income
   inv. assets
   E' = 123.375 + 377.50
   inv. assets u/w income(a)
   = 500.875
   V = E x M
   = 500.875 x .97
   = 487.201

   difference: $1,840.52
   with - without reins
   1,862.93 - 1,281.41
a) A bridging model uses a Bornhuetter-Ferguson type model, with older loss ratios bridged forward and used as 'plan' loss ratios for newer years. The problem with essentially linking all loss ratios or correlating the plan with the older years, is that if the older years begin to deteriorate, this will "bridge" forward to the newer years via the BF model. At this point, a company will have a large reserve deficiency and must decide what to do. A likely outcome is that the company books the deficiency and takes a significant ratings downgrade, hurting current business and basically alienating new business. The current business may try to leave in droves due to the credit downgrade, leading to credit and liquidity risks for the company.

b) One aspect is intellectual property. During soft markets, a company needs to drop its requirements for expected premium volume. However, even though fewer dollars are on the books (temporarily, until cycle goes back to hard market), management needs to maintain intellectual property to be strong when market turns. Examples are key employees such as actuaries and strong IT professionals, maintaining a presence in core market channels, and keeping systems up-to-date with current technology. A second aspect is owner education. The owners need to understand how financials will look during effective cycle management of a soft market. Premiums will decrease, as the company
is not just dropping rates to maintain market share. This means underwriters' incentives need to be flexible to reflect different (lower) amounts of written premium and rather focus on following the cycle plan. The owners need to recognize that ratios to premium such as loss and expense ratios will look out of line during the soft market. The owners need to know this is acceptable and not make knee-jerk reactions so that the company can go back into the hard market in a much more preferred position than companies who adopted the 'maintain market share' approach.
a) i) Economic capital - the capital level that keeps a company's probability of ruin below a certain percentage ($\alpha$) - also above insolvency - measured based on a company's internal model.

ii) Rating agency capital - the amount of capital required to maintain a certain agency financial rating - usually based on a standard, factor-based model from the rating agency - measured at a different level of confidence/sufficiency than (i).

b) Economic capital is an internal model-based measure specific to that firm. Rating agency capital is usually based on a factor approach used for many firms. For a particular company, economic capital can incorporate the firm's strengths and weaknesses and measure it relative to itself in past years.

c) i) Econ impairment earnings - the level of capital that will keep a firm from reaching impairment - usually measured at a lower confidence level than the measures in (a).

ii) Protection of franchise value - the level of capital that will keep franchise value (market - book value) of a company above a certain level.

d) Economic impairment, like econ. capital, is measured using an internal model. This is preferable to models that apply across various firms, like that to calculate prot. of franchise value.
a) A benefit of a probability density function is that it measures the probability of events over the entire distribution for capital needs. The drawback is that the largest need for capital comes from extreme tail events, and a standard probability distribution does not give enough weight to these tail events to have sufficient capital to support them.

b) An alternative would be a transformed probability distribution, or distortion measure such as the Wang Transform. It measures probability across the entire distribution, like in (a), but it transforms the distribution to add weight in the tail, more appropriately valuing extreme events in the calculation of capital needs.