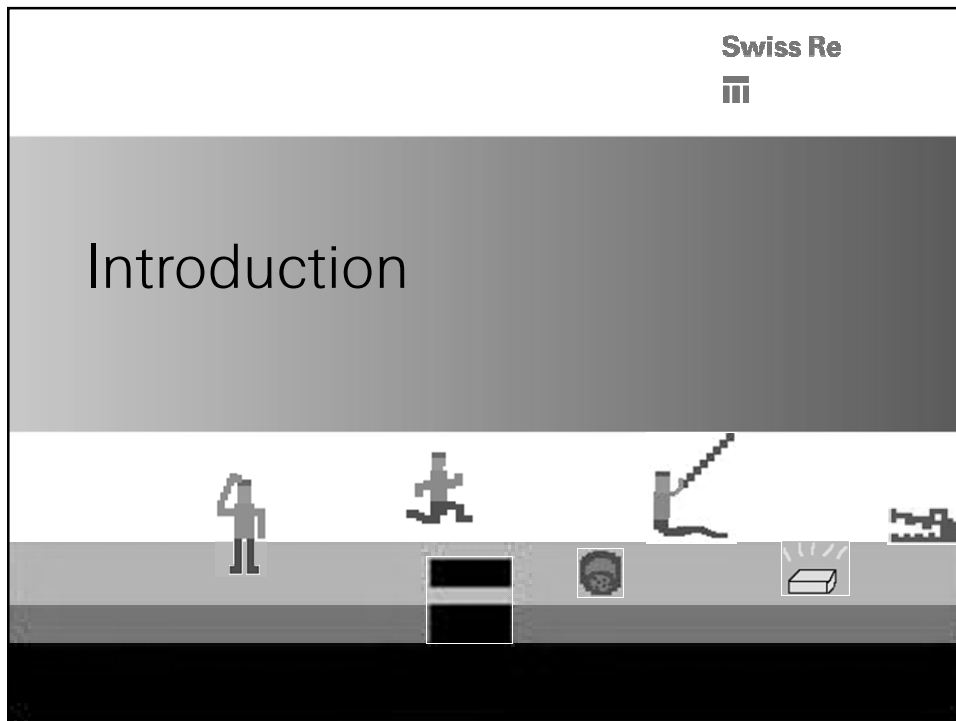


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Avoiding Pitfalls in Lapse and Mortality Studies

Steve Ekblad, FSA, MAAA
ACSW Spring Meeting
June 23, 2011



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Introduction



Agenda

- Exposure records
- Lapse study setup
- Mortality study setup
- Experience analysis
- Summary

Exposure records



Example of exposure record setup

- Split policy into multiple exposure records
- Policy issued 8/10/2006

Record #	Exposure Segments		Exposure Years (#)	Duration	Calendar	Anniversary
	Expo Start	Expo End			Year	Year
1	8/10/06	12/31/06	0.39	1	2006	2006
2	1/1/07	8/10/07	0.61	1	2007	2006
3	8/11/07	12/31/07	0.39	2	2007	2007
4	1/1/08	8/10/08	0.61	2	2008	2007
5	8/11/08	12/31/08	0.39	3	2008	2008
6	1/1/09	8/10/09	0.61	3	2009	2008
7	8/11/09	12/31/09	0.39	4	2009	2009
8	1/1/10	8/10/10	0.61	4	2010	2009
9	8/11/10	12/31/10	0.39	5	2010	2010

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Reflect the study's exposure period

- Suppose we have terminations from 1/1/2008 through 12/31/2010
- Remove the shaded records

Record #	Exposure Segments		Exposure Years (#)	Duration	Calendar	Anniversary
	Expo Start	Expo End			Year	Year
1	8/10/06	12/31/06	0.39	1	2006	2006
2	1/1/07	8/10/07	0.61	1	2007	2006
3	8/11/07	12/31/07	0.39	2	2007	2007
4	1/1/08	8/10/08	0.61	2	2008	2007
5	8/11/08	12/31/08	0.39	3	2008	2008
6	1/1/09	8/10/09	0.61	3	2009	2008
7	8/11/09	12/31/09	0.39	4	2009	2009
8	1/1/10	8/10/10	0.61	4	2010	2009
9	8/11/10	12/31/10	0.39	5	2010	2010

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Lapse study setup


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Lapse study exposures

- Can we use these same exposures for a lapse study?
- Watch out! 

Record #	Exposure Start	Exposure Segments Expo End	Exposure Years (#)	Duration	Calendar Year	Anniversary Year
4	1/1/08	8/10/08	0.61	2	2008	2007
5	8/11/08	12/31/08	0.39	3	2008	2008
6	1/1/09	8/10/09	0.61	3	2009	2008
7	8/11/09	12/31/09	0.39	4	2009	2009
8	1/1/10	8/10/10	0.61	4	2010	2009
9	8/11/10	12/31/10	0.39	5	2010	2010

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Biased lapse study records

- Lapses more likely at end of duration (anniversary date)



➔ Duration 2 lapse rate biased upward, duration 5 downward

Record #	Exposure Segments Expo Start	Exposure Segments Expo End	Exposure Years (#)	Exposure Duration	Calendar Year	Anniversary Year
4	1/1/08	8/10/08	0.61	2	2008	2007
5	8/11/08	12/31/08	0.39	3	2008	2008
6	1/1/09	8/10/09	0.61	3	2009	2008
7	8/11/09	12/31/09	0.39	4	2009	2009
8	1/1/10	8/10/10	0.61	4	2010	2009
9	8/11/10	12/31/10	0.39	5	2010	2010

Exposure methods

- Exact Method
 - Exposure counted for each day a policy is inforce
 - Stops exposure at death, lapse, or end of study
- Actuarial Method
 - Assumes a full year of exposure for all policies inforce at the start of the year (i.e., that all terminations occur at the end of the year)
- Generalized Exposure Technique (GET)
 - Exposure units consistent with premium payment mode (problem is we often don't know the mode)



Exposure method comparison

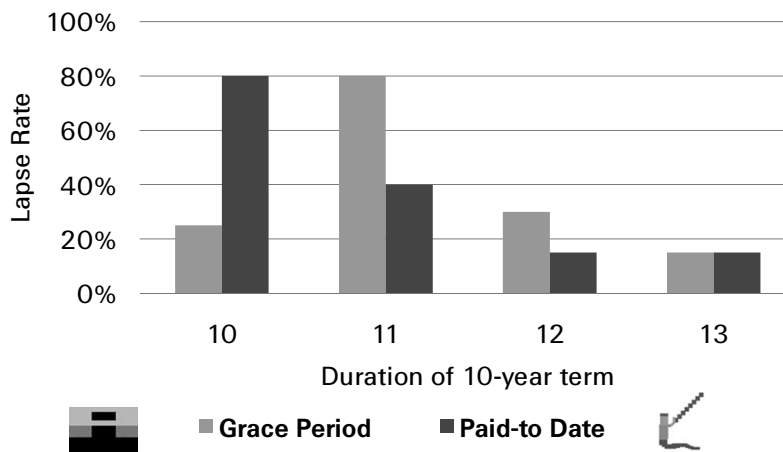
- 1000 policies with **quarterly premiums** in duration 4
- **100 lapsed 9 months** into duration 4

Record #	Exposure Segments		Dur	Exposure Years			Lapse Count
	Expo Start	Expo End		Exact Method	Actuarial Method	Gen. Expo Technique	
107	8/11/09	12/31/09	4	0.39	1.00	1.00	0
108	1/1/10	8/10/10	4	0.61	1.00	1.00	0
207	8/11/09	12/31/09	4	0.39	1.00	0.75	0
208	1/1/10	5/10/10	4	0.36	1.00	0.75	1
900 policies like records 107-108:				900	900	900	0
100 policies like records 207-208:				75	100	75	100
Totals:				975	1000	975	100
Lapse Rates:				*9.75%	10.00%	10.26%	

* Exact Method measures in days, so annualize using $1 - (1 - \text{lapses} / \text{exposure} / 365)^{365}$






Watch grace period in lapse studies!

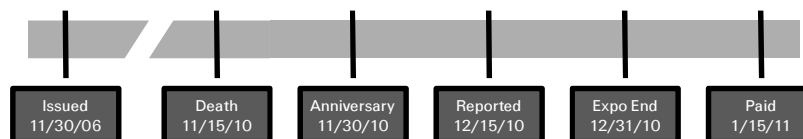


Mortality study setup



Count your claims

- Exposure period: 1/1/2008 to 12/31/2010
- Policy issued 11/30/2006
- Death on 11/15/2010, reported 12/15/2010, paid 1/15/2011
- Termination date based on...
 - Date of death: Included in study in duration 4 
 - Reported date: Included in study in duration 5 
 - Paid date: **Not included in study** 





Claim reporting lag

Month	Dates of death		
	Year		
	2008	2009	2010
1	22	31	34
2	29	24	25
3	26	32	38
4	22	29	31
5	25	25	37
6	28	32	32
7	19	22	28
8	28	23	39
9	36	25	33
10	22	26	37
11	29	32	19
12	23	30	7

■ Avg # claims for first 10 months of 2010 = 33

➔ Likely missing ~40 claims (14 from November, 26 from December)

➔ 2010 mortality could be off by 10%, entire study by 4%

■ Handle incurred but not reported (IBNR) claims

- Apply factors to adjust expected claims by month
- Or, add late-reported claims 2+ months later
- Or, back up exposure end date



Ensure fair comparisons

Calendar Year	A/E Ratios	
	Study A	Study B
2005	102.5%	
2006	98.5%	
2007	103.5%	
2008	97.5%	98.5%
2009		101.5%
2010		97.0%
Total	100.5%	99.0%

■ Study A covers 2005-2008

■ Study B covers 2008-2010

■ Actual-to-expected (A/Es) ratios in both studies are relative to a 2011 pricing table without any adjustments

■ Study B appears to have lower mortality

■ Need to adjust for mortality improvement!

Account for improvement

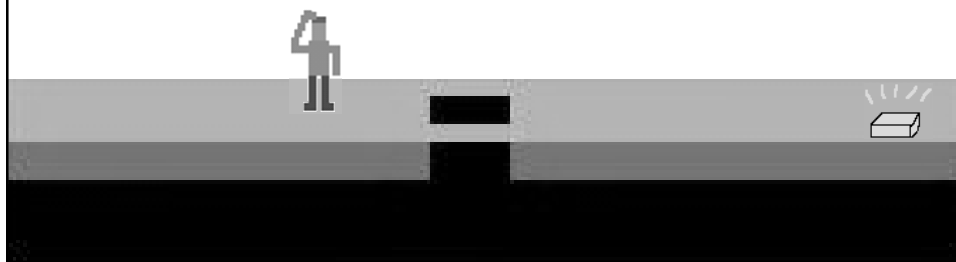
Calendar Year	A/E Ratios			
	Study A	Study B	Adjusted* Study A	Adjusted* Study B
2005	102.5%		96.6%	
2006	98.5%		93.7%	
2007	103.5%		99.5%	
2008	97.5%	98.5%	94.6%	95.6%
2009		101.5%		99.5%
2010		97.0%		96.0%
Total	100.5%	99.0%	96.1%	97.0%

- * Expected mortality "disimproved" from 2011 by 1% per year
- Older study A/E is lower due to more years of disimprovement

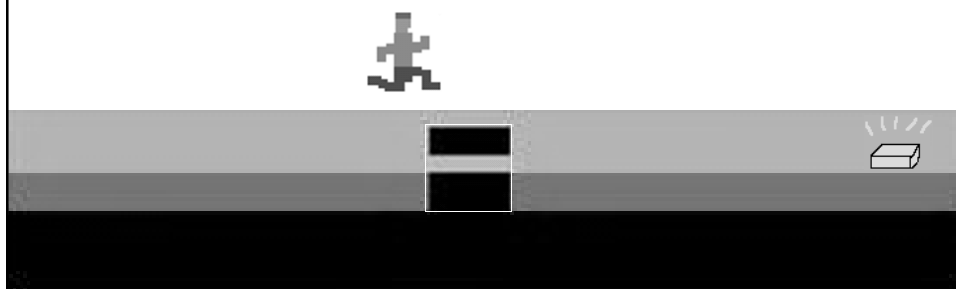
Experience analysis

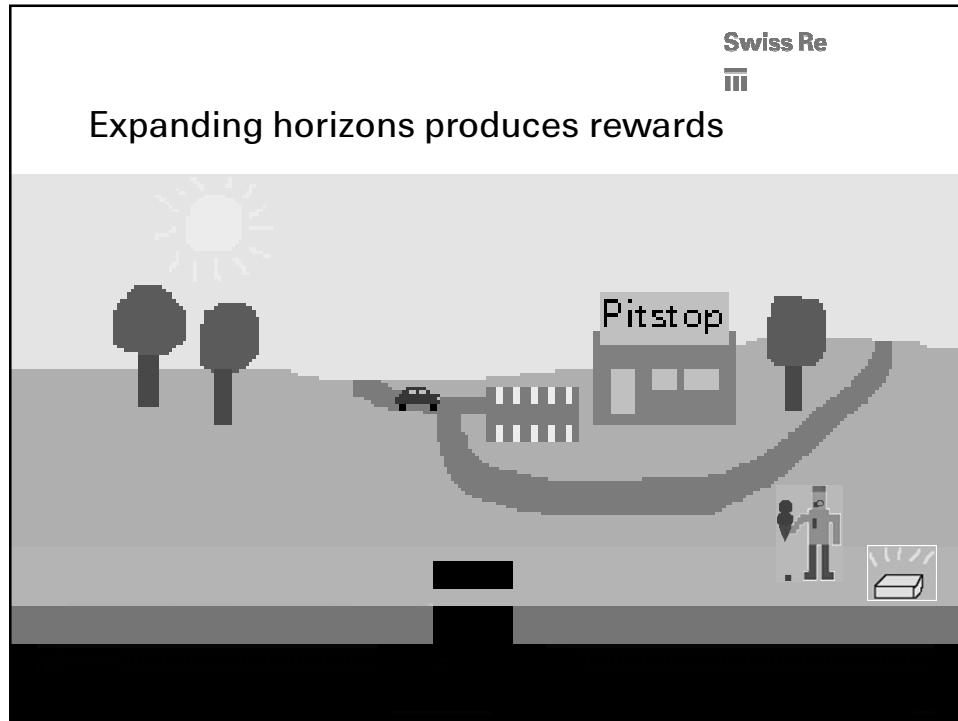
Univariate vs. multivariate analysis


- Analyzing one variable at a time doesn't reveal the whole picture
- Consider further analyses in more dimensions
 - Univariate breakdowns within specific subsets
 - Pivot tables
 - Multivariate analysis (e.g. Cox proportional hazards models)
 - Predictive modeling



Consider alternatives to jumping






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Univariate-only analysis is dangerous!

Issue Era	A/E
2001-04	110%
2005-07	95%
2008-10	90%

Duration	A/E
1-2	90%
3-5	105%
6-10	110%

Calendar	Year	A/E
	2008	103%
	2009	100%
	2010	97%

Conclusions from these results: 

- Changes in underwriting in both 2005 and 2008 are yielding some good results
- Selection effect is stronger than when table was first developed
 - Durational slope needs to be steepened
- Nice improvement by year of exposure
 - Expect this to continue as good recent issues get more exposure in study

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Further analysis reveals more clues

Duration	Issue Era	A/E
1-2	2001-04	N/A*
	2005-07	85%
	2008-10	90%
3-5	2001-04	110%
	2005-07	100%
	2008-10	N/A*
6-10	2001-04	110%
	2005-07	N/A*
	2008-10	N/A*

* No data or low credibility

Revised conclusions:

- 2005 U/W changes were effective
- 2008 U/W changes were **not** effective
- Low duration 1-2 A/E is real
- Slope between durs 3-5 and 6-10 due to issue era mix
- Improving exposure year trend caused by issue era mix

Issue Era	A/E	Duration	A/E	Calendar	
				Year	A/E
2001-04	110%	1-2	90%	2008	103%
2005-07	95%	3-5	105%	2009	100%
2008-10	90%	6-10	110%	2010	97%


Summary


Key learnings

- Only include exposure records from time period where termination records are available
- Be aware of biases due to timing of terminations
- Select an exposure method to match the use of the study results
- Understand how termination dates are defined
- Account for mortality improvement
- Expand your analysis into more dimensions
- And one more thing before deciding we're done...

Document it so you can repeat it

Example: Preparation of this presentation

1. Think up a catchy title
2. List subtopics to cover
3. Develop examples to support key messages
4. Expand on key messages using bullet points
5. Incorporate cute little illustrations drawn using MS Paint 
6. Add sound effects as a last-ditch effort to keep people awake



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