

# CAS Seminar on Ratemaking

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**General Ratemaking Concepts**

**Session GEN-1 – Data and Overall Indication**

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## General Concept

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- Set rate levels so that rates are “adequate, reasonable, and not unfairly discriminatory”
  - Adequate: Not too low
  - Reasonable: Not too high
  - Not unfairly discriminatory: Allocation of overall rate to individuals is based on cost justification
  
- Rates are set at an overall (usually state-wide) level
  
- Overall rates are then allocated to:
  - Territory (location of insured)
  - Classification (type of insured)

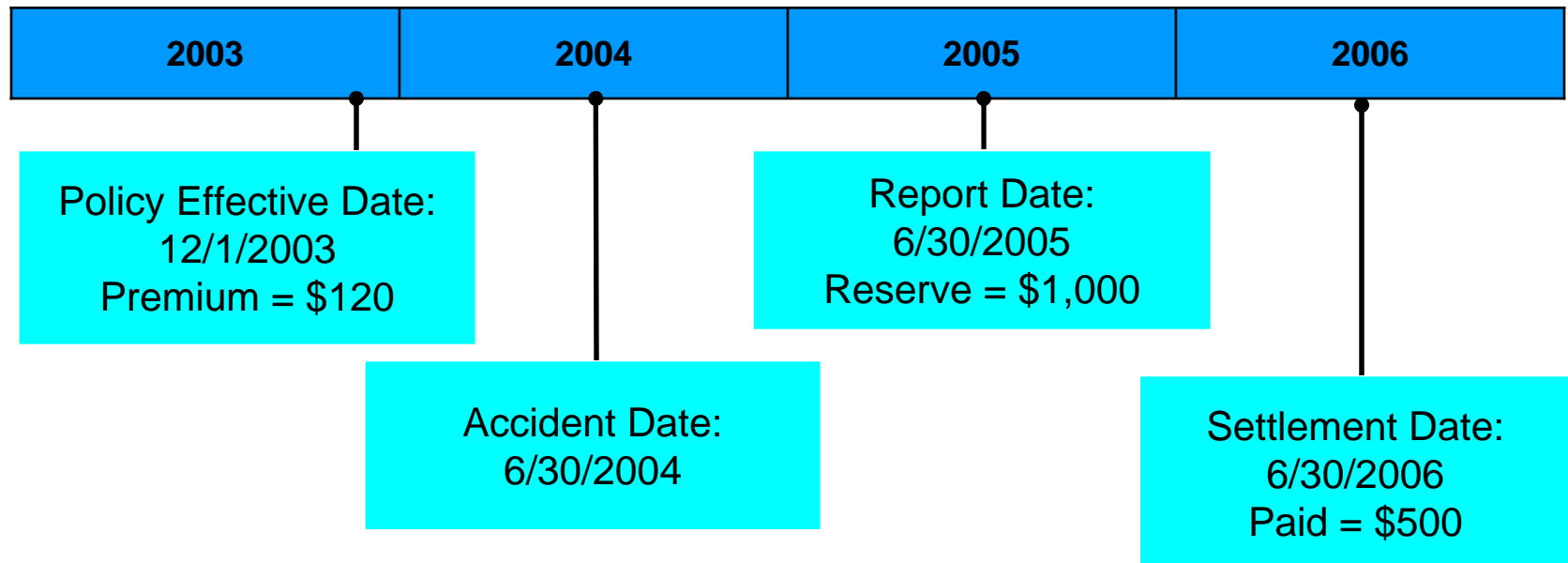
## Considerations for Ratemaking

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- Historical premiums
  - Changes in historical rate levels
  
- Historical losses
  - Data organized in several ways
  
- Historical loss adjustment expenses
  
- Historical and/or budgeted expenses
  
- Other Considerations

## Background — Hypothetical Policy Timeline

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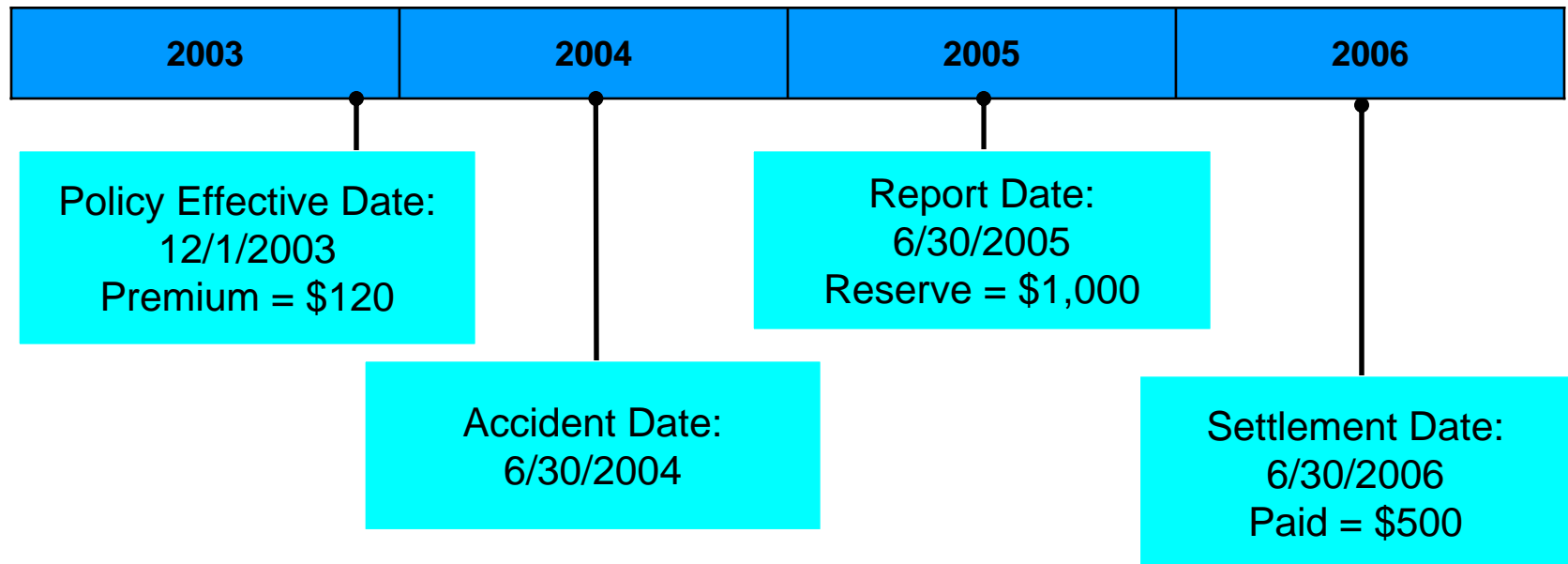


## Insurance Financial Data

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- The delays between when the policy is written and when claims are eventually paid causes issues in compiling ratemaking data
- Insurers produce data in several formats:
  - Calendar year data
    - Premium and loss transactions are recorded during the year processed
    - Matches most of the information in the P/C Annual Statement
    - Data does not change over time
    - However, premiums and losses do not match
  - Policy year data
  - Accident year data

## Background — Hypothetical Policy Timeline - Calendar Year



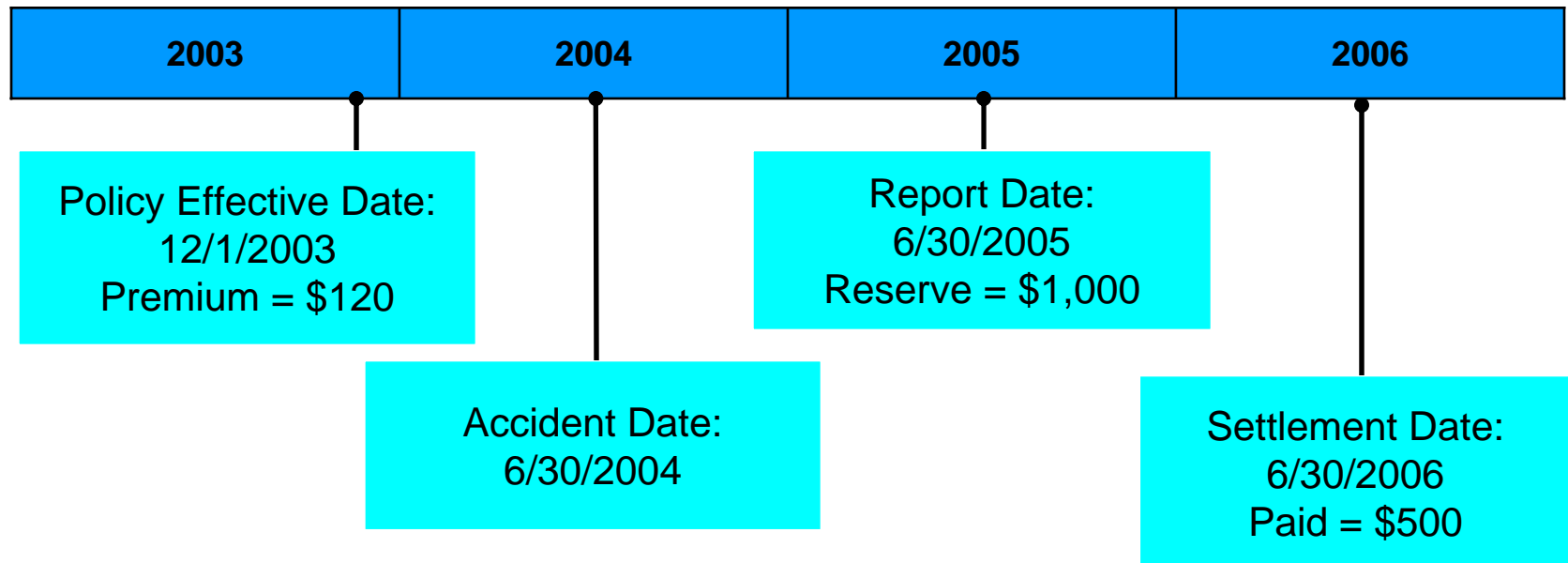
	Calendar Year Data			
	2003	2004	2005	2006
Written Premium	\$120	\$0	\$0	\$0
Earned Premium	\$10	\$110	\$0	\$0
Losses	\$0	\$0	\$1,000	(\$500)

## Insurance Financial Data

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    - However, premiums and losses do not match
  - Policy year data
    - Premium and loss transactions are recorded on all policies with effective dates (new and renewal) during the year
    - Premiums and losses do match
    - Significant time delay until finalized data is available
  - Accident year data

## Background — Hypothetical Policy Timeline - Policy Year



	Policy Year Data			
	2003 at 12/03	2003 at 12/04	2003 at 12/05	2003 at 12/06
Written Premium	\$120	\$120	\$120	\$120
Earned Premium	\$10	\$120	\$120	\$120
Losses	\$0	\$0	\$1,000	\$500

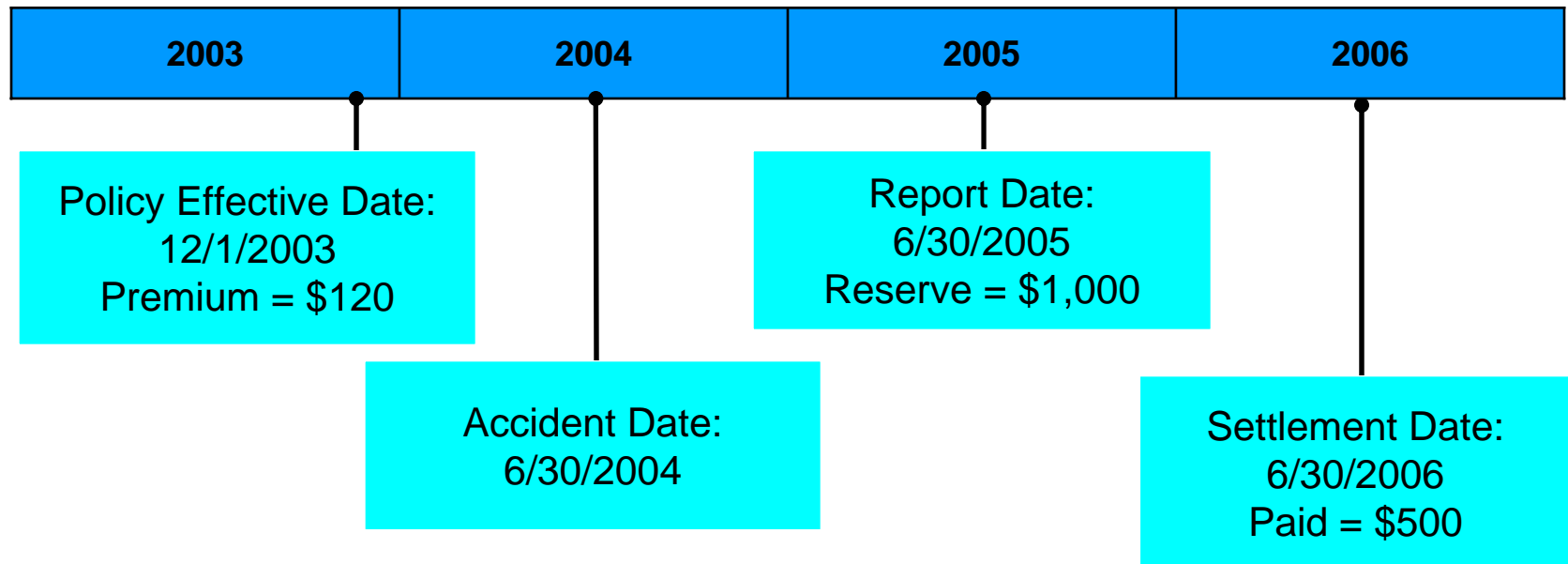


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    - However, premiums and losses do not match
  - Policy year data
    - Premium and loss transactions are recorded on all policies with effective dates (new and renewal) during the year
    - Premiums and losses do match
    - Significant time delay until finalized data is available
  - Accident year data
    - Loss transactions are recorded on all accidents occurring during the year
    - Premiums (calendar year earned) and losses generally match
    - Shorter delay until finalized data is available

Example —  
Hypothetical Policy Timeline – Calendar-Accident Year



	Accident Year Data			
	2004 at 12/03	2004 at 12/04	2004 at 12/05	2004 at 12/06
Written Premium	NA	\$0	\$0	\$0
Earned Premium	NA	\$110	\$110	\$110
Losses	NA	\$0	\$1,000	\$500

## General Ratemaking Equation

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- Future premiums =
  - + Future losses
  - + Future expenses
  - + Underwriting profit and contingencies

While taking into consideration other external issues

## General Ratemaking Methods

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- Loss ratio (LR) method
  - Develops indicated rate change
  - Percent change – two methods depending on expense ratio (ER)
    - $[\text{Experience LR}] / [\text{Target LR}]$ , or
    - $[\text{Experience LR} + \text{Fixed ER}] / [\text{Target LR} + \text{Fixed ER}]$
  
- Pure premium (PP) method
  - Develops indicated rate per unit of exposure
  - Pure premium = losses per exposure unit
  - Rate =  
$$(\text{Experience Loss PP} + \text{Fixed Exp PP}) / (1.0 - \text{Variable Exp Ratio})$$
  
- Note: With identical data and assumptions, these two methods produce identical results

## General Ratemaking Methods – Data for Example

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- Rates are needed for policies effective July 1, 2008 through June 30, 2009
- Rates are for annual policies
- Overall rates will be based off of:
  - Two years of loss experience (2006 and 2007)
  - Three years of expense experience (2005 through 2007)
  - Current cost of capital
  - Competitive environment
- Rate relativities will be reviewed
- Example shown here is based on personal automobile liability data

## General Ratemaking Methods – Data for Example

Calendar/ Accident Year	Cal Year Earned Premium	State X Accident Year Reported Losses & DCC excluding Catastrophes					
		At 12 Months	At 24 Months	At 36 Months	At 48 Months	At 60 Months	At 72 Months
2000	\$68,458	\$38,946	\$46,032	\$48,861	\$50,198	\$50,704	\$50,902
2001	68,837	41,163	49,373	52,356	53,778	54,299	54,577
2002	72,477	42,395	50,578	53,695	55,137	55,877	56,137
2003	79,165	44,768	52,982	56,104	57,696	58,354	
2004	86,536	45,159	52,476	55,430	56,974		
2005	91,578	45,416	52,585	55,490			
2006	93,999	46,274	53,679				
2007	95,202	46,616					

## General Ratemaking Methods – Data for Example

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- Expenses
  - Loss adjustment expenses
    - Defense and Cost Containment or DCC (included in losses)
    - Adjusting and Other Expense or AOE
  - Underwriting expenses
    - Commissions
    - Other acquisition
    - General (company overhead)
    - Taxes, licenses, fees
- Profit & contingencies
- Other
  - Catastrophe loads
- Rate level history
- Trends / inflationary data

## General Ratemaking Methods – Outline

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- Losses – Step 1
  - Estimate ultimate losses for historical periods (excluding catastrophes)
  - Adjust to reflect inflation to proposed rate effective period
  - Adjust to include loss adjustment expenses
  - Adjust to include catastrophes
- Premiums – Step 2
  - Adjust for past rate changes
  - Adjust for inflation-sensitive rating
- Expenses – Step 3
  - Review historical ratios and future budget
  - Review profit and contingencies
  - Split between fixed and variable expenses
- Combine Losses, Premiums, and Expenses to Determine Overall Rate Level Indications – Step 4



## Step 1A - Estimate Historical Ultimate Losses

Calendar/ Accident Year	State X Accident Year Reported Losses & DCC excluding Catastrophes						
	At 12 Months	At 24 Months	At 36 Months	At 48 Months	At 60 Months	At 72 Months	At Ultimate
2000	\$38,946	\$46,032	\$48,861	\$50,198	\$50,704	\$50,902	???
2001	41,163	49,373	52,356	53,778	54,299	54,577	???
2002	42,395	50,578	53,695	55,137	55,877	56,137	???
2003	44,768	52,982	56,104	57,696	58,354		???
2004	45,159	52,476	55,430	56,974			???
2005	45,416	52,585	55,490				???
2006	46,274	53,679					???
2007	46,616						???

Estimate ultimate value of each accident year's losses – based on data “triangle” – loss development method

## Step 1A - Estimate Historical Ultimate Losses (cont'd)

Calendar/ Accident Year	State X Accident Year Reported Losses & DCC excluding Catastrophes					
	12-24 Months	24-36 Months	36-48 Months	48-60 Months	60-72 Months	After 72 Months
2000	1.182	1.061	1.027	1.010	1.004	NA
2001	1.199	1.060	1.027	1.010	1.005	NA
2002	1.193	1.062	1.027	1.013	1.005	NA
2003	1.183	1.059	1.028	1.011	NA	
2004	1.162	1.056	1.028	NA		
2005	1.158	1.055	NA			
2006	1.160	NA				
2007	NA					
Selected	1.160	1.057	1.028	1.012	1.005	1.005
Cumulative	1.288	1.111	1.051	1.022	1.010	1.005

Typical “loss development method” estimates the change from evaluation to evaluation – for example, losses tend to increase on average by 15% to 20% between 12 and 24 months

## Step 1A - Estimate Historical Ultimate Losses

- Product of latest evaluation of losses and appropriate “loss development factor” produces estimate of ultimate losses by accident year
  - There are many other ways to estimate ultimate losses by accident year
  - Loss development method is one of the most standard

Calendar/ Accident Year	State X Accident Year Ultimate Losses & DCC excluding Catastrophes		
	Reported Losses at Dec 2007	Development Factor to Ultimate	Estimated Ultimate Losses
2000	\$50,902	1.005	\$51,157
2001	54,577	1.005	54,850
2002	56,137	1.005	56,418
2003	58,354	1.010	58,939
2004	56,974	1.022	58,236
2005	55,490	1.051	58,307
2006	53,679	1.111	59,619
2007	46,616	1.288	60,058

Reported losses from Page 17, development factors from Page 18

## Step 1B – Adjust Historical Ultimate Losses for Inflation

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- Adjust to reflect inflation to proposed rate effective period
  - Also known as “Trend”
  - Review historical data: frequency, severity, pure premium
    - Frequency = Average number of claims / exposure
    - Severity = Average size of claim = losses / number of claims
    - Pure premium = Average losses / exposure = frequency x severity
  - Data available for
    - Company State X
    - Company region
    - Company countrywide
    - Insurance industry State X
    - Insurance industry region
    - Insurance industry countrywide
    - External to insurance (e.g., Consumer Price Index)

## Step 1B - Adjust Historical Ultimate Losses for Inflation

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- Historical data used to derive trend rate can be
  - Reported or paid
  - Accident period or calendar period
    - Monthly, quarterly, annual
    - Length of period: More periods gives more information, but old data may not be reflective of future
- Trending procedure can be based on
  - Exponential fits
  - Linear fits
  - Time series
  - Econometric models

## Step 1B – Adjust Historical Ultimate Losses for Inflation

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- Determine average “trend to” date
  - The date when the average accident is expected to occur under the proposed rates
  - Proposed rates will be effective between July 1, 2008 and June 30, 2009
  - Average policy will be written on January 1, 2009
  - That average policy will be in effect 12 months
  - The average accident date for the average policy is assumed to be in the middle of the average policy, or July 1, 2009

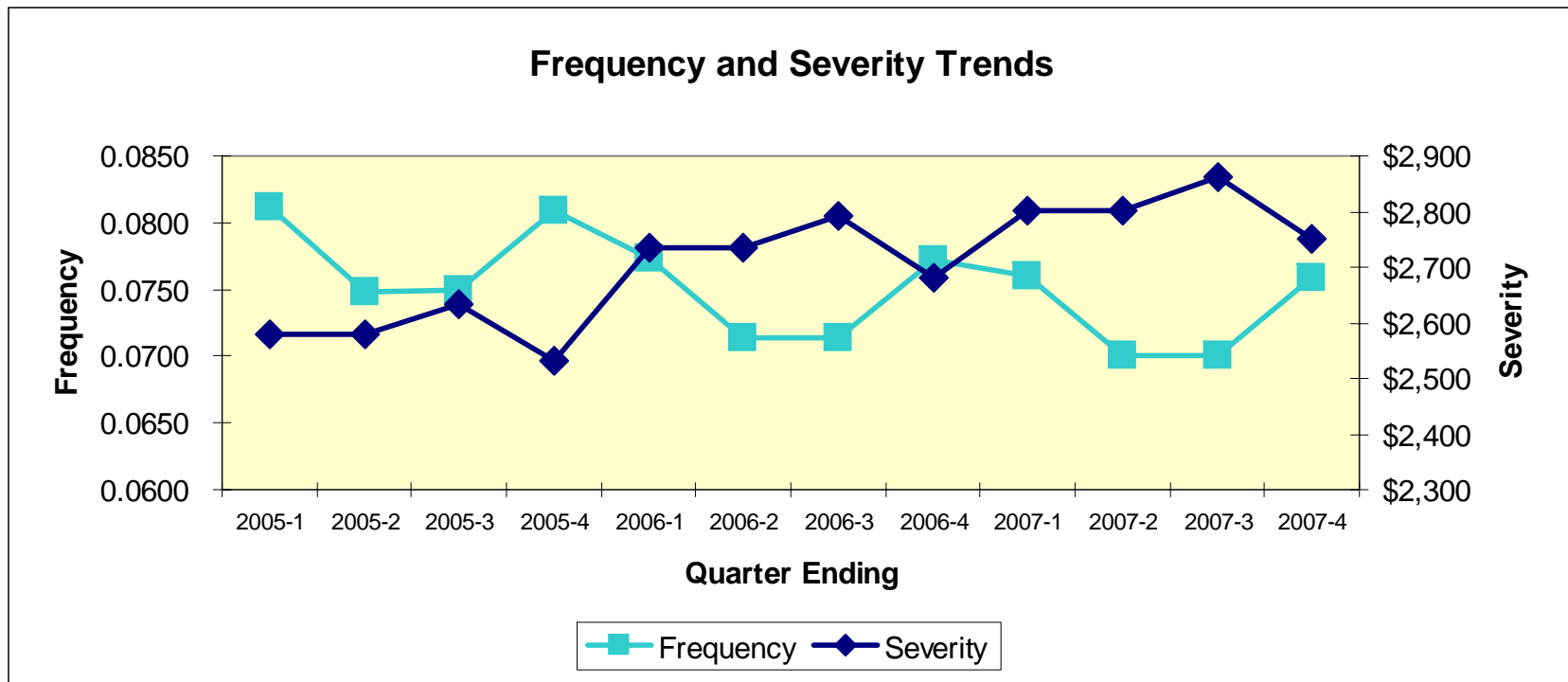
## Step 1B - Adjust Historical Ultimate Losses for Inflation

- Review changes over time in frequency and severity, by quarter

Calendar/ Accident Quarter	State X Accident Year Reported Frequencies and Severities excluding Catastrophes		
	Reported Frequency	Reported Severity	Reported Pure Premium
2005-1	0.0812	\$2,579	\$209
2005-2	0.0748	2,579	193
2005-3	0.0749	2,632	197
2005-4	0.0809	2,532	205
2006-1	0.0774	2,733	211
2006-2	0.0714	2,733	195
2006-3	0.0713	2,791	199
2006-4	0.0772	2,682	207
2007-1	0.0760	2,802	213
2007-2	0.0701	2,802	196
2007-3	0.0701	2,861	200
2007-4	0.0758	2,750	209

## Step 1B - Adjust Historical Ultimate Losses for Inflation

- Seasonality distorts quarterly results





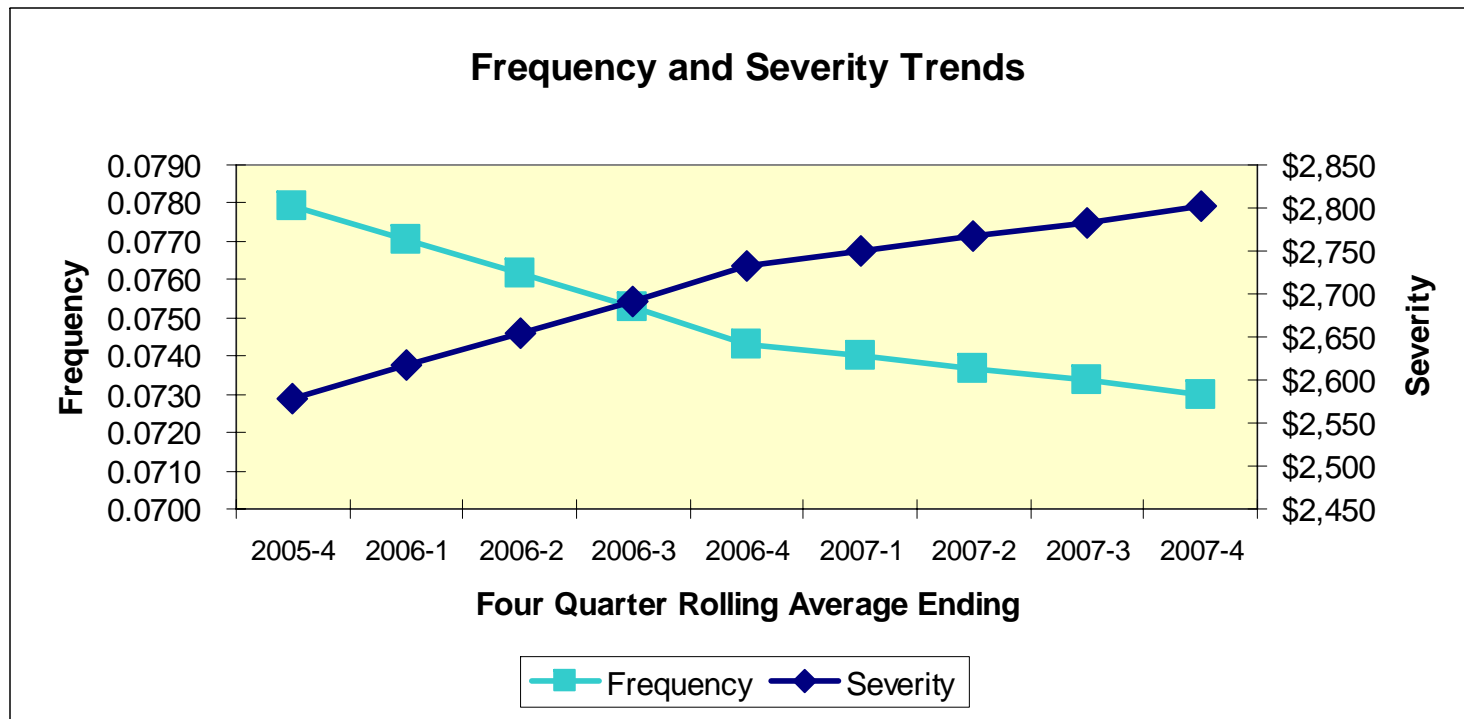
## Step 1B - Adjust Historical Ultimate Losses for Inflation

- Smooth seasonality distortions by reviewing data on a four-quarters rolling average basis

Four Quarter Rolling Average Ending	State X Accident Year Reported Frequencies and Severities excluding Catastrophes		
	Reported Frequency	Reported Severity	Reported Pure Premium
2005-4	0.0779	\$2,579	\$201
2006-1	0.0770	2,617	202
2006-2	0.0762	2,653	202
2006-3	0.0753	2,691	203
2006-4	0.0743	2,733	203
2007-1	0.0740	2,751	204
2007-2	0.0737	2,767	204
2007-3	0.0734	2,784	204
2007-4	0.0730	2,802	205

## Step 1B - Adjust Historical Ultimate Losses for Inflation

- Seasonality distortions are eliminated



Based on above results, and various fits, select frequency and severity trends at -1% and 3% respectively

## Step 1B - Adjust Historical Ultimate Losses for Inflation

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- Estimated ultimate losses, adjusted for annual trend of 2% (combination of frequency and severity trends), results in the following:

Calendar/ Accident Year	State X Accident Year Ultimate Losses & DCC excluding		
	Estimated Ultimate Losses	Trend Factor to July 1, 2009	Est Ult Losses on July 2009 Level
2006	\$59,619	1.060	\$63,212
2007	60,058	1.040	62,448

Estimated ultimate losses from Page 19, annual trend factor from Page 26

## Step 1C – Include Loss Adjustment Expenses

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- Losses included in prior steps can be losses alone, or losses plus some loss adjustment expenses
  - Loss adjustment expenses are split into two components
    - Defense and Cost Containment (DCC)
    - Adjusting and Other Expense (AOE)
  - Often, DCC is included with losses in Step 1A (as in this example)
  - AOE is incorporated through factor

## Step 1C - Include Loss Adjustment Expenses

- Adjusting and Other Expense (AOE) loading as a percent of loss and defense and cost containment (DCC) expenses

Calendar Year	Calendar Year			
	2005	2006	2007	Average
AOE / Loss & DCC	15.5%	14.9%	15.1%	15.2%

Calendar/ Accident Year	State X Accident Year Ultimate Losses & DCC excluding		
	Est Ult Losses on July 2009 Level	AOE Factor	Est Ult Losses on July 2009 Level
2006	\$63,212	1.152	\$72,795
2007	62,448	1.152	71,914

Estimated ultimate losses on July 2009 level from Page 27

## Step 1D - Include Catastrophe Loading

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- Historically, a long term average catastrophe / non-catastrophe was loaded into the rates
  - For example, for homeowners, 50 years of hurricane data for a given state was included in rates
- Over the last 15 years (post-Hurricane Andrew)
  - Models of catastrophes, applied to a book of business in a state, provides an estimate of expected annual losses
  - Models are commonly used for hurricanes, earthquake
  - Non-modeled losses may still be loaded into rates based on long-term average ratios
- Since the example here is personal automobile liability, no such loading is required

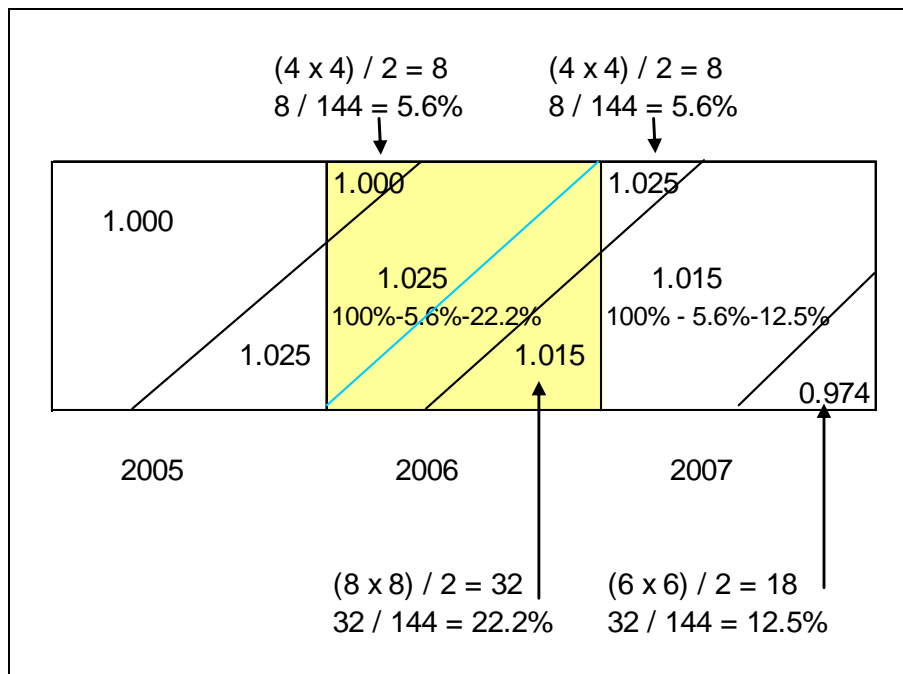
## Step 2A - Premiums Adjusted to Current Rates

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- Latest two years of historical premiums (2006 and 2007)
- Adjust to current rates, reflecting what the 7/1/2008-6/30/2009 premiums would be with no future rate changes
- Two methods
  - Extension of exposures
    - Re-rate each exposure/policy using current rates
    - Most accurate
    - Difficult and time-consuming
  - Parallelogram method
    - Estimate average rate level for historical periods relative to current rates
    - Significantly easier
    - Assumes policies written evenly through the year

## Step 2A - Premiums Adjusted to Current Rates

- Estimate the average rate index in each of the historical periods, and compare to the current rate level



Effective Date	Rate Level
5/1/2005	2.5%
5/1/2006	-1.0%
6/1/2007	-4.0%

Average Rate Level Calculation:		
Year	Weight	Index
2006	5.6%	1.000
	72.2%	1.025
	22.2%	1.015
Average		1.021
Current		0.974
Factor		0.954
2007	5.6%	1.025
	81.9%	1.025
	12.5%	0.974
Average		1.019
Current		0.974
Factor		0.956



## Step 2B - On-Level Premiums

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- Premiums for 2006 and 2007, had the underlying policies been written at the current level, are estimated as follows:

Calendar/ Accident Year	State X Calendar Year Earned Premium		
	Earned Premium	On-Level Factor	On-Level Earned Premium
2006	\$93,999	0.954	\$89,658
2007	95,202	0.956	91,044

Earned premium from Page 14, on-level factors from Page 32

## Step 2B – On-Level Premiums Adjusted for Inflation

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- Some insurance rates are based on an inflation-sensitive exposure
  - Homeowners with the value of the property
  - Auto with the value of the car
  - Workers compensation with wages
- Premiums may also increase (or decrease) if the distribution of business by territory or class has changed over the historical experience period
- Even with no changes to a rate manual, insurers can see increasing premiums over time
- Determine average “trend to” date
  - The date when the average policy is expected to be written under the proposed rates
  - Proposed rates will be effective between July 1, 2008 and June 30, 2009
  - Average policy will be written on January 1, 2009
- Since this example is for personal automobile liability, and exposure is measured as one car-year, no such premium trend is needed

## Step 3A – Underwriting Expenses

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- Underwriting expenses are based on three years of historical expenses

Calendar Year	Calendar Year			
	2005	2006	2007	Average
Commissions & Brokerage	14.2%	14.5%	14.3%	14.3%
Other Acquisition	4.0%	3.4%	3.6%	3.7%
General Expenses	5.8%	5.5%	5.7%	5.7%
Taxes, Licenses, Fees	1.9%	2.1%	2.0%	2.0%
Total	25.9%	25.5%	25.6%	25.7%

## Step 3B – Fixed versus Variable Underwriting Expenses

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- Some expenses vary directly with premiums
  - Premium taxes
  - Commissions
- Some expenses vary with inflation, but are not directly proportional to premiums
  - Other acquisition
  - General expenses
  - Miscellaneous taxes/licenses/fees
- May also consider dividends, reinsurance costs, assessments
- Fixed expense ratio may be analyzed based on
  - Trending/inflation from CPI-type data
  - Premiums trended and on current level
  - Or may simply use
    - Historical ratios if premium changes and expense trends are similar
    - Budgeted expenses if available

## Step 3B – Fixed versus Variable Underwriting Expenses

- Selected expenses are split between fixed and variable:

Expense Category	Item	Percent
Variable	Commissions	14.3%
	Taxes	2.0%
	Profit & Cont *	3.0%
	Total Variable	19.3%
Fixed	Other Acq	3.7%
	General	5.7%
	Total Fixed	9.3%
Expected Loss Ratio		71.3%

Note: derivation of appropriate profit and contingencies loading is beyond the scope of this session – other expenses from Page 35

## Step 4 – Overall Rate Indications – Overall Expenses

- Combining the losses, premiums, and expenses, we have indications as follows

Calendar/ Accident Year	State X Calendar / Accident Year		
	Est Ult Losses on July 2009 Level	On-Level Earned Premium	On-Level Trended Loss Ratio
2006	\$72,795	\$89,658	81.2%
2007	71,914	91,044	79.0%
Total	144,709	180,703	80.1%

Fixed Expense Ratio	9.3%
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Variable Expense Ratio	19.3%
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Indicated Rate Change	10.8%
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$$= [80.1\% + 9.3\%] / [100\% - 19.3\%] - 1.0$$

Losses from Page 29, premiums from page 33, expenses from page 37

## Step 4 – Alternative – Pure Premium Method

The pure premium method focuses on the cost per exposure:

Calendar/ Accident Year	State X Calendar / Accident Year		
	Est Ult Losses on July 2009 Level	Earned Exposures	Trended Pure Premium
2006	\$72,795	293,453	\$248.06
2007	71,914	293,602	\$244.94
Total	144,709	587,055	\$246.50

Fixed Expense Ratio	9.3%
Average On-Level Premium	\$307.81
Fixed Expense Pure Premium	\$29.44
Variable Expense Ratio	19.3%
Indicated Average Rate = $[\$246.50 + \$29.4] / [100\% - 19.3\%]$	\$341.07
Indicated Average Rate Change = $\$341.07 / \$307.81 - 1.0$	10.8%

Losses from Page 29, expenses from page 37, fixed expense pure premium reflects trend

## Beyond Step 4 – Overall Rate Indications

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- Refine overall indications
  - Incorporate “credibility” (GEN-4)
  - Refine profit and contingencies provision (RCM Track)
  
- Allocate overall rates to territory and classification (GEN-2)
  
- Derive indicated increased limits factors (GEN-3)
  
- Incorporate external information
  - Personal automobile rates in general have been dropping or stable
  - Why is our indicated rate change so different than the industry?
  - Is there a territory or classification that is causing the adverse experience?