2.1.3 → Catastrophe data

→ overview → loss data used in the ratemaking process should also be adjusted for losses from catastrophes, similar to shock losses. While shock losses come from individual claims of high severity, catastrophe losses come from unusually severe disasters, both natural & man-made, that result in a large # of claims.

→ Examples of some natural catastrophes include hurricanes, earthquakes, tornadoes, floods, wildfires, & hail storms. Examples of man-made catastrophes include explosions, oil spills, & some terrorist activities.

→ There isn't a set definition for what counts as a catastrophe. However, to be considered a catastrophe by the Property Claims Services (PCS) unit of the Insurance Service Office (ISO), an event needs to meet two requirements. The event must:

1) result in at least $25 million in direct insured losses to property, &
2) affect a significant # of policyholders & insureds

→ For the ratemaking process though, insurers may choose to use their own definitions of catastrophe.

→ The reasoning for adjusting shock losses can also be applied to catastrophe data. Loss projections are typically based on a shorter experience period, like 3-5 years. However, that period of time may not include enough data to accurately estimate future catastrophe losses. For instance, if there was an unusually high # of cats in the data, this would cause indicated rates to increase. Similarly if there were few or no cats, this would cause indicated rates to decrease. Estimating cat losses based on a longer experience period helps improve stability in the rates.

→ Adjusting for catastrophes

→ To adjust for catastrophes when projecting future losses for ratemaking, actual catastrophe losses can be replaced by the average expected cat loss.

→ The method for determining the expected cat loss can vary by the type of insurance & the type of cat loss. Cat losses are typically broken down into the following two types:

1) Non-modeled cat losses
2) Modelled cat losses

→ Non-modeled cat analysis is used for events that occur somewhat regularly over a period of many years. One example of this type of event is hail storms for personal auto coverage, as these storms happen fairly regularly, but a longer experience period (like 10-30 years) is likely needed for estimating them.

→ In contrast, modeled catastrophe analysis is used for events that occur very infrequently but that result in high severity claims, like hurricanes or earthquakes. Even if many years of data are considered, this may not correctly account for the expected damage from these events. In that case, a stochastic model can be used to estimate the likelihood of those types of cat events, along w/ the damages that would likely result given the insured properties. The model takes into account the insurer's exposure & estimates the expected annual modeled cat loss.

→ Determining non-modeled cat loss provision

→ Method 1: cat loss loading factor

→ One method for setting the non-modeled cat loss provision is to follow the same process used for the shock loss provision.

1) Sum the cat losses
2) Sum the non-cat losses
3) Calculate the ratio of cat losses to non-cat losses
4) Calculate the cat loss loading factor as 1 plus the ratio found above

Then, multiply non-cat losses used in the ratemaking analysis by the factor above to incorporate the long-term average expected non-modeled cat loss.

→ Similar to shock losses, it is important to consider the length of the experience period. The selected length of time should balance both stability & responsiveness. As mentioned above, a longer experience period, such as 10-30 years, will likely be needed for estimating non-modeled cat losses.

→ Method 2: Cat loss pure premium

→ A different method for incorporating non-modeled cat losses is to develop a pure premium or loss ratio just for the non-modeled cat exposure.

→ For instance, assume we need the non-modeled cat loss pure premium for a homeowners' book of business. Using the amount of insurance years (AIY), which is the total amount of insurance for all policies inforce during the calendar year, the process for determining the pure premium is:

1) Calculate the ratio of non-modeled cat losses to AIY for each year in the experience
2) Average the cat-to-AIY ratio for all years
3) Apply the non-modeled cat provision per AIY to the average AIY per exposure expected in the future to get the non-modeled cat pure premium

While a typical exposure base for homeowners' insurance is house-years, using the amount of insurance years in the denominator of the ratio is a simple way to adjust the ratio for inflation.

→ Total cat loss provision

→ We won't cover how to project the modeled cat losses, but they should still be incorporated into losses if they are given. For instance, if the modeled cat pure premium is given, it can be added to the non-modeled cat pure premium to find the total cat pure premium. Then, the total cat pure premium can be added to the non-cat pure premium to get the total pure premium.

→ Other considerations

→ Keep in mind that most years, the actual cat losses will be lower than the expected annual provision for cat losses. However, in years when a major catastrophe (or catastrophes) occurs, the actual cat losses will be significantly higher than the estimated provision.

→ In addition to incorporating the estimated long-term average cat losses, insurance companies may also track & even limit the # of policies they issue in areas that are prone to cats. This can help minimize the effect that a cat can have on the company's profitability

→ If the insurer would rather take on the risk associated w/ issuing policies in cat-prone areas, they can do this by increasing the underwriting profit provision so that it reflects the increased cost of capital needed for taking on the extraordinary risk. This can be accomplished in other ways as well, such as by purchasing reinsurance or by requiring higher deductibles for cat-related losses.

→ Example →

You are given the following information for a homeowners book of business:

Calendar Year	Amount of Insurance Years ($000s)	Reported Non-Modeled Cat Losses ($000s)
	x	y
2006	2,927,233	245,287
2007	2,973,561	233,587
2008	2,957,807	958,313
2009	3,115,471	43,719
2010	3,542,699	2,882,314
2011	3,259,448	105,709
2012	3,420,296	310,671
2013	3,085,130	60,310
2014	3,385,704	556,363
2015	3,237,248	1,304
2016	2,865,198	80,844
2017	2,855,069	538,382
2018	3,171,067	31,202
2019	3,237,948	71,964
2020	3,368,559	196,020

- Modeled catastrophe pure premium: $30
- Future average AIY per exposure: $275

Calculate the total catastrophe pure premium using all years of non-modeled catastrophe data.

→ Step 1 → Take y_i/x_i for each year
Step 2 → Average all y_i/x_i = z
Step 3 → Take Future Avg AIY per exposure * z

→ (in excel) z = AVERAGE(Y/X) = 0.12857 → Non-modeled cat provision per AIY

275 * z = 35.36 → non-modeled cat pp

⇒ Total cat pp = Modeled cat pp + non-modeled cat pp
= 30 + 35.36
= 65.36

Alternative Solution

→ weighted avg → Step 1 + Step 2 ⇒ $z = \frac{\sum y_i}{\sum x_i} = 0.13324$

→ Step 3 as above ⇒ Non modeled cat PP = $\times$ 275 = 36.64

⇒ Total cat PP = + 30 = 66.64

in general

$$\frac{\text{CAT loss}}{\text{AIY}} \times \frac{\text{AIY}}{\text{Exposures}} = \frac{\text{CAT loss}}{\text{Exposures}} = \text{CAT PP}$$

≈ similar to

$$\frac{\text{Claim count}}{\text{Exposure}} \times \frac{\text{losses}}{\text{claim count}} = \frac{\text{losses}}{\text{Exposure}} = \text{PP}$$

< Freq * Sev >

→ Assignment

→ Q1)

You are given the following information for a homeowners book of business:

Calendar Year	Amount of Insurance Years ($000s)	Reported Non-Modeled Cat Losses ($000s)
	x	y
2011	3,600,000	205,700
2012	3,557,000	218,800
2013	3,802,000	139,000
2014	3,676,000	556,363
2015	3,482,000	381,200
2016	3,612,000	198,400
2017	3,777,000	246,000
2018	3,927,000	296,300
2019	4,036,000	343,000
2020	3,892,000	196,020

- Modeled catastrophy Pure premium = $42
- Future average AIY per Exposure = $400

(a) Calculate the total catastrophe pure premium using all years of non-modeled catastrophe data.

(b) Explain why catastrophe pure premium tends to be split into modeled and non-modeled components.

→ a) Step 1 → in Excel y_i/x_i
Step 2 → z = AVERAGE(↓) = 0.07469
Step 3 → $\frac{\text{AIY}}{\text{exposure}} * \frac{\text{CAT loss}}{\text{AIY}}$ = 400 * z = 29.87598
\+ Modeled cat PP = 42

$71.88 = Total cat PP

→ b) Non-modeled cat analysis is used for events that occur somewhat regularly, such as hail storms. A longer experience period (10+ years) is typically needed for impact of this component.

Modeled cat analysis is used for events that occur very infrequently but result in high-severity claims, like hurricanes or earthquakes. Even a longer experience period is unlikely to accurately account for the expected damages from modeled cat events. Instead, a stochastic model can be used to estimate an insurer's expected annual modeled cat loss.