2.3.2 → Developing Premiums

→ Any need to develop premiums for when 1) an incomplete year of data is used or 2) LOB w/ audits

2.3.3 → Developing losses

→ Summary → Chain ladder method (development technique) steps

1) Compile claims data
2) Calculate age-to-age factors
3) Calculate averages
4) Select claim development factors
5) Select tail factor
6) Calculate cumulative claim development factors
7) Project ultimate claims

a) straight average
b) medial average (Britway) → X, 2, 3, X = $\frac{2+3}{2}$ = 2.5)
c) geometric average → n^{th} root of product
d) volume-weighted → remember to have same # of #s in num + denom

→ If using a straight average for a selection, write "XXX has remained stable across Ays. Assuming this will remain consistent in the future, I will take a straight average"

ideas to keep in mind when selecting: smooth progression, stability, credibility of experience, change in patterns, applicability of the historical period, shock losses / cat losses

⇒ Note on selecting factors ⇒ JUSTIFY EVERY SELECTION

> You can select anything that seems reasonable, whether that's an average, a particular age-to-age factor, or anything else. Use your actuarial judgement when selecting factors. And remember, you don't have to make the same type of selection at each maturity either. If the age-to-age factors look unstable at 12 months but fairly stable for other maturities, it might be reasonable to select the medial average at 12 months and the straight average for other maturities.
>
> On the exam in general, there are no strict rules for what factor to select as long as you make a reasonable choice. The default selection would be the straight average, but if there's a reason to not do that, make a different selection and explain your reasoning for doing so.

→ If given selections for LDFs, choose from only them ⇒ don't freestyle

2.4 → Trending

2.4.1 → Actuarial standard of practice No. 13

→ ★ read this before exam

→ Definitions →

- *Experience period*: the time period in which the historical data occurs.
- *Forecast period*: the future time period to which historical data is projected.
- *Social influences*: the impact on insurance costs of changes in claim consciousness, court practices, legal precedents, and other non-economic factors.
- *Trending period*: the time over which the trend is applied when projecting from the experience period to the forecast period.
- *Trending procedure*: a process that involves estimating future values by analyzing changes between exposure periods that can impact claim costs and frequencies, exposures, premiums, expenses, retention rates, marketing/solicitation response rates, and economic indices.

2.4.2 → Selecting data for trending

→ Exposure data → some LOBs rely on exposure measures, such as payroll or sales revenue, which can be influenced by time-related factors like inflation. Any need to account for this w/ exposure trends

→ Premium data → The average premium level can change over time due to inflationary pressure as well. Another type of change over time to the premium level is a distributional change, which is a change in the characteristics of the policies written. The resulting change to the premium level is known as premium trend.

→ e.g.) some characteristic such as amount of insurance for a homeowners policy increases w/ inflation ⇒ avg premium increases
shift in deductibles at renewal causes premium shift (e.g. ↑ded)

→ Loss data → changes over time in the expected levels of claim frequency + severity are known as loss trends. Loss trends can be driven by many different factors, such as: inflation, increasing medical costs, advancements in safety tech, distributional changes (like a growing population of risky policies)

→ Can be estimated by analyzing pure premium directly or freq/sev separately (as they may have different drivers)

→ order of operations ★ → Trending is typically performed after adjusting the data for anomalies like catastrophes + rate or benefit changes, ensuring any distortions + the true trend are eliminated.

→ Additionally, trending can be applied either before or after the data is developed to ultimate values

2.4.3 → Estimating a trend

→ Methods for determining trends

→ There are multiple methods for calculating trends. The choice of method depends on the stability of the data + the type of trend being measured.

→ 1) Simple average of percent changes → This can be for premium trends that are stable

→ 2) Linear + exponential trend fitting → – – – – loss trends – – – volatile

→ (1 + pure premium trend) = (1 + frequency trend) * (1 + severity trend)
↳ aka loss cost trend

⇒ if estimating PP trend, est ult claims like usual, then divide by exposures at end ⇒ calculate Δ% to find trend

→ Example → To identify the rate of change, calculate quarterly percentage changes + annual percentage changes in average WP
↳ % Δ one quarter to the next quarter
↳ % Δ one quarter to the following year's same quarter (e.g. $\frac{2025\ Q1}{2024\ Q1} - 1$)

Calendar Quarter	WP at Current Rate Level	Written Exposures	Avg WP at Current Rate Level	Quarterly % Change	Annual % Change
2016Q1	68,409.73	132	518.26		
2016Q2	69,933.21	134	521.89	0.7%	
2016Q3	70,910.48	135	525.26	0.6%	
2016Q4	72,977.61	138	528.82	0.7%	
2017Q1	74,634.01	140	533.10	0.8%	2.9%
2017Q2	75,774.76	141	537.41	0.8%	3.0%
2017Q3	77,435.68	143	541.51	0.8%	3.1%
2017Q4	78,323.20	144	543.91	0.4%	2.9%
2018Q1	80,263.03	146	549.75	1.1%	3.1%
2018Q2	81,959.37	148	553.78	0.7%	3.0%
2018Q3	83,634.55	150	557.56	0.7%	3.0%
2018Q4	84,526.43	151	559.78	0.4%	2.9%

↳ Use these #s to get the trend of X% that we apply later

→ Example →

You are given the following information:

- The annual premium exponential trend fit based on data for the 12 months ending each quarter evaluated through December 31, 2017 is:

Year Ending Calendar Quarter	Avg Earned Premium at Current Rate Level
2015Q1	497.30
2015Q2	499.70
2015Q3	487.00
2015Q4	476.80
2016Q1	469.00
2016Q2	461.20
2016Q3	465.60
2016Q4	469.50
2017Q1	474.80
2017Q2	480.20
2017Q3	483.60
2017Q4	489.50

Renewals begin to ↑ deductible (2015Q3)
All policies have ↑ deductible (2016Q3)
B/c CY data, includes policies w/ old deductible
not affected by old deductible
12, 8, 6, 4

Number of Points	Annual Exponential Trend Fit
12 point	-0.8%
8 point	3.1%
6 point	4.1%
4 point	4.0%

- All policies are annual.
- Proposed rates will be in effect from January 1, 2019 to January 1, 2020.
- Starting with July 1, 2015 renewals, the minimum deductible was increased from $500 to $1,000.

Select the trend to be applied to CY2017 earned premium. Include justification of the premium trend selection.

→ when given selections for linear / exponential fits, can be more creative + select values in between the fits if appropriate

→ If chose to trend freq + sev separately, compare result w/ given pure premium trends to see if it's supported

→ Since the deductible change was implemented starting w/ policies renewing on July 1, 2015, the last possible date a policy could be written w/ the old deductible is June 30, 2016. So, there could be policies w/ the old deductible earning premium as late as June 30, 2017.

→ The trend will be applied to CY2017 EP, so we want to select a trend that is not as affected by the deductible change. However, we also want to include as much data as possible.

→ B/c the 6-point trend avoids most of the influence of the deductible change, + the data point stabilizes at this point, select a trend of 4.1%

⇒ Since all of the trends use at least 4 data points, all will still be impacted by the old deductible. So, we want to choose a value where the impact is minimal + the data has stabilized

→ Effects of limits on trend

→ In general, for a positive severity trend,
Basic limits trend ≤ Total limits trend ≤ Excess loss trend

→ On the other hand, if the severity trend is negative, the relationship becomes
Excess loss trend ≤ Total limits trend ≤ Basic limits trend

Loss cost trend = Pure premium trend
⇒ Estimate ult claims like usual
⇒ divide by exposures at end
⇒ calculate Δ% to find trend

→ Basic limits + XS loss trend

	(a) Total limits loss	(b) Trended total limits loss	(c) Restated losses @ basic limits	(d) Restated trended losses @ basic limits	(e) XS untrended loss	(f) XS trended loss
			= min((a), thresh)	= min((b), thresh)	= max(0, (a) − thresh)	= max(0, (b) − thresh)
Total:	Σ	Σ	Σ	Σ	Σ	Σ
Trend:	$\frac{\Sigma(b)}{\Sigma(a)} - 1$ = Total limits trend			$\frac{\Sigma(d)}{\Sigma(c)} - 1$ = Basic limits trend		$\frac{\Sigma(f)}{\Sigma(e)} - 1$ = XS loss trend

(Check) — more drastic impact than basic limits loss trend (in the direction of the total limits loss trend)

2.4.4 → Determining trend periods

→ Overview → After selecting trend amounts, the next step is to determine the length of time the trend should be applied

→ The experience + forecast periods depend on several factors, such as:
→ The type of data (e.g. EP or WP or losses)
→ The length of the policy term (e.g. 6 or 12 months)
→ The type of data aggregation (e.g. calendar/accident year or policy year)
→ The length of time rates are expected to be in effect

→ w/ these assumptions, the trend period is the length of time from the midpoint of the experience period to the midpoint of the forecast period.

→ Note that each historical period (e.g. each historical CY) is trended separately, but to the same future date. For example, assume data from CYs 2016, 2017 + 2018 is used to estimate rates that will be in effect during CY 2020. The forecast period will be the same for each year's data, but CY2016, CY2017, + CY2018 data will each have different experience periods

→ one step trending

→ The one-step trending approach involves applying a single trend to historical data to adjust it to the forecast period. Consider the following examples of how to determine the trend period for one-step trending

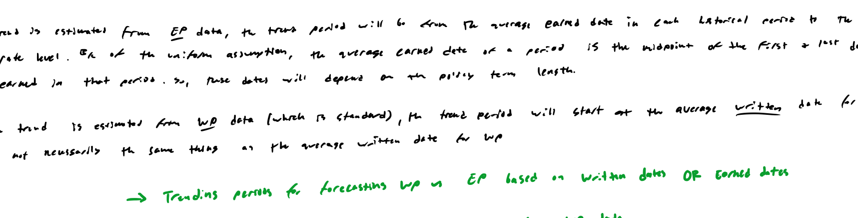
→ Forecasting WP

→ When forecasting WP using an estimated WP trend, the trend period will be from the average written date in each historical period to the average written date at the new rate level.

→ B/c we assume policies are written uniformly over time, the average written date is:

→ For the experience period: the midpoint of the first + last dates that policies were written in the historical period

→ For the forecast period: the midpoint of the first + last dates that policies were written at the new rates



→ Forecasting EP

→ For a ratemaking analysis, it is more common to forecast EP, rather than WP. However, the trend percentage used for forecasting EP can be estimated from EP data or WP data.

→ If the trend is estimated from EP data, the trend period will be from the average earned date in each historical period to the average earned date at the new rate level. B/c of the uniform assumption, the average earned date of a period is the midpoint of the first + last dates that premium could be earned in that period. So, these dates will depend on the policy term length.

→ If the trend is estimated from WP data (which is standard), the trend period will start at the average written date for a time period of EP. This is not necessarily the same thing as the average written date for WP

→ Trending periods for forecasting WP vs EP based on written dates OR earned dates

→ forecasting WP → will only have WP data
⇒ Avg written dates for both historical + forecast period

→ forecasting EP → can be from EP or WP

⇒ both approaches should result in same length of trend period, but the trend period when using WP will start + end one half a policy period sooner than if use EP

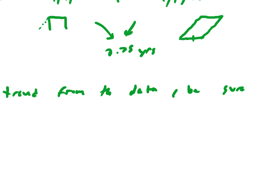
⇒ avg earned date for both historical period + forecast period

⇒ avg written date for the time period of EP + for future policy period

Said a better way

→ Determining trend periods!!!
↳ when forecasting EP, can use written dates OR earned dates
⇒ Both should result in SAME length of trend period, just a shifted interval by ½ a policy period
⇒ Calculate + using both methods as a CHECK!!!

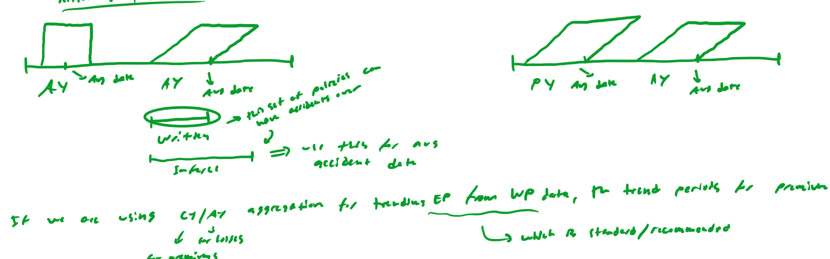
Earned: 7/1/2017 to 4/1/2020
Written: 4/1/2017 to 1/1/2020 ⇒ ½ policy period sooner



→ when calculating a trend from the data, be sure to do it on an annual basis

→ Forecasting losses

→ Trend period is from avg accident date in each historical period to the average accident date when the new rates will be in effect. W/ the uniform assumption, the average accident date is the midpoint of the periods.



→ If we are using CY/AY aggregation for trending EP (for premiums) + (for losses) from WP data, the trend periods for premium + loss will match exactly
↳ which is standard/recommended

→ Applying a trend

→ Simple, just need to do: Trended Premium (or losses) = untrended Premium (or losses) * (1 + trend %)$^{\text{length of trend period (in years)}}$

→ If there is a new law when adjusting losses or premiums, need to apply it historically to all periods that don't have the law
⇒ can just do w/ trending step

→ If freq + sev trends are clearly changing, do two-step trending
⇒ e.g.) can do one-step for freq + two-step for sev