2.4.4 → Determining trend periods Cont...

→ Two-step trending

→ Up to this point, we have applied a one-step trending approach. However, this method becomes less accurate when historical trend rates are expected to differ significantly from future trends. For instance, this may occur if all insureds are shifted to a higher deductible starting w/ renewals as of a specific date. In that case, we can use two-step trending to take into account that the future trend rate is expected to differ from the historical trend rate.

→ The first step, known as the current trend step, adjusts each year's historical data to the average level of the most recent time period in the trend data. The second step, called the projected trend step, further adjusts this data from the average date of the latest time period to the average date of the future policy period.

→ There are two approaches for performing the current trend step. Similar to estimating a trend, the choice of method depends on the stability of the data & the type of trend being measured:

→ For loss trends, where loss data often exhibits volatility, we use approach 1, which adjusts historical data by applying an annual trend factor

→ For premium trends, where changes in average premium are relatively stable, we use approach 2, which adjusts historical data to match the current trend level.

→ Lets discuss the two approaches:

→ Approach 1 → Historical data is adjusted by applying an annual trend factor from the average historical date to the average date of the latest available period.

→ For example, assume the historical data is AY 2016 losses, & the annual trend is 3%. If the latest data is AQ 2018 Q4 losses, the current trend period will be from 7/1/2016 to 11/15/2018, which is 28.5 months or 2.375 years. So,

$$\text{Current trend factor} = (1+0.03)^{2.375} = 1.0727$$

→ Approach 2 → Historical data is adjusted to align w/ the most recent known average, based on the assumption that this average serves as a credible reference point for estimating future trends.

→ For example, assume the average EP for CY 2016 is \$520, & the average written premium for the latest available quarter, CQ 2017 Q4, is \$535. The current trend factor, assuming WP trends are used to forecast EP is,

$$\boxed{\text{Current trend factor} = \frac{\text{Latest Avg WP at CRL}}{\text{Historical Avg EP at CRL}}}$$

$$= \frac{535}{520} = 1.0288$$

→ No matter which approach is used for the current trend step, the projected trend step is performed like a one-step trending. A projected annual trend rate is selected & applied over the interval between the average date of the latest time period & the average date in the forecast period.

→ For example, if the future trend period spans from 7/1/2018 to 7/1/2020, i.e. a duration of 2 years, & an annual trend of −2% is selected, the projected trend factor is calculated as:

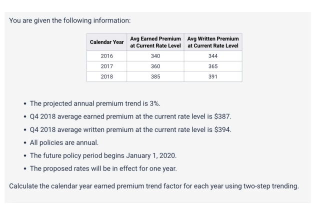
$$\text{Projected trend factor} = (1-0.02)^{2} = 0.9604$$

→ Finally, the total trend factor to adjust historical data to the future time period is:

$$\boxed{\text{Total trend factor} = \text{Current trend factor} \times \text{Projected trend factor}}$$

→ Examples

→



You are given the following information:

Calendar Year	Avg Earned Premium at Current Rate Level	Avg Written Premium at Current Rate Level
2016	340	344
2017	360	365
2018	385	391

- The projected annual premium trend is 3%.
- Q4 2018 average earned premium at the current rate level is \$387.
- Q4 2018 average written premium at the current rate level is \$394.
- All policies are annual.
- The future policy period begins January 1, 2020.
- The proposed rates will be in effect for one year.

Calculate the calendar year earned premium trend factor for each year using two-step trending.

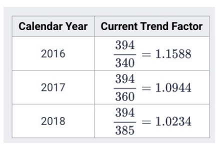
→ Original Solution

→ Since we are trending EP using two-step trending, there are 4 possible approaches. For the first step, we can either adjust each historical period level to be equal to the latest level, or we can determine an average trend to apply to each historical period. In addition, we can either use the EP trend or the WP trend to forecast EP.

→ B/c the Q4 2018 average premium amounts are given, it makes sense to adjust each historical period level to be equal to the latest level. In addition, it is generally recommended to forecast EP using WP data when it is given on the exam. So, we'll start by solving w/ this approach.

→ First, find the current trend factor for each year using:

$$\text{Current trend factor} = \frac{\text{Latest Avg WP at CRL}}{\text{Historical Avg WP at CRL}} \rightarrow \text{Constant numerator}$$



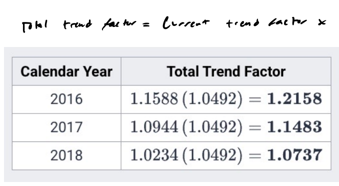
Calendar Year	Current Trend Factor
2016	$\frac{394}{340} = 1.1588$
2017	$\frac{394}{360} = 1.0944$
2018	$\frac{394}{385} = 1.0234$

→ Then, the projected trend period is from the midpoint of Q4 2018 (the latest time period) to the midpoint of the future policy period when premium is written. So, the trend period is from 11/15/2018 to 7/1/2020, which is 1.625 years. The projected trend factor for each year is

$$(1+0.03)^{1.625} = 1.0492$$

→ Finally, calculate each year's total trend factor using:

$$\text{Total trend factor} = \text{Current trend factor} \times \text{Projected trend factor}$$

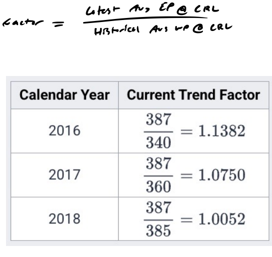


Calendar Year	Total Trend Factor
2016	$1.1588\,(1.0492) = \mathbf{1.2158}$
2017	$1.0944\,(1.0492) = \mathbf{1.1483}$
2018	$1.0234\,(1.0492) = \mathbf{1.0737}$

→ Alternative Solution 1

→ Now, use the EP data, & again adjust each historical period level to be equal to the latest level. The current trend factor for each year is

$$\text{Current trend factor} = \frac{\text{Latest Avg EP @ CRL}}{\text{Historical Avg WP @ CRL}}$$

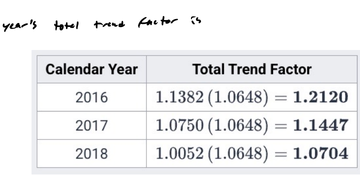


Calendar Year	Current Trend Factor
2016	$\frac{387}{340} = 1.1382$
2017	$\frac{387}{360} = 1.0750$
2018	$\frac{387}{385} = 1.0052$

→ The projected trend period is from the midpoint of Q4 2018 to the midpoint of the future policy period when premium is earned. Since the future policy period is from 1/1/2020 to 12/31/2020, premium will be earned from 1/1/2020 to 12/31/2021. So, the trend period is from 11/15/2018 to 1/1/2021, which is 2.125 years. The projected trend factor for each year is

$$(1+0.03)^{2.125} = 1.0648$$

→ Finally, each year's total trend factor is



Calendar Year	Total Trend Factor
2016	$1.1382\,(1.0648) = \mathbf{1.2120}$
2017	$1.0750\,(1.0648) = \mathbf{1.1447}$
2018	$1.0052\,(1.0648) = \mathbf{1.0704}$

→ Alternate Solution 2

→ Now, for the first step, find the WP trend as a simple average of each year's trend:

Calendar Year	Annual % Change
2017	$\frac{365}{344} - 1 = 6.10\%$
2018	$\frac{391}{365} - 1 = 7.12\%$

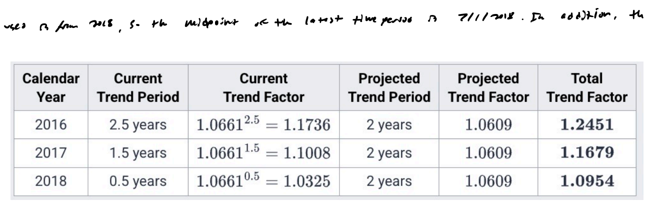
$$\text{Current trend} = \frac{0.0610 + 0.0712}{2} = 6.61\%$$

→ Since we are using WP data to trend EP, we trend from the average written dates of the historical EP to the latest average written date, & then again to the future average written date.

→ Policies are annual, so premium earned in a year will be from policies written in that year & the prior year. For instance, premium earned in 2016 is from policies written between 1/1/2015 & 12/31/2016. Therefore, the midpoint of each historical period is January 1 of that year.

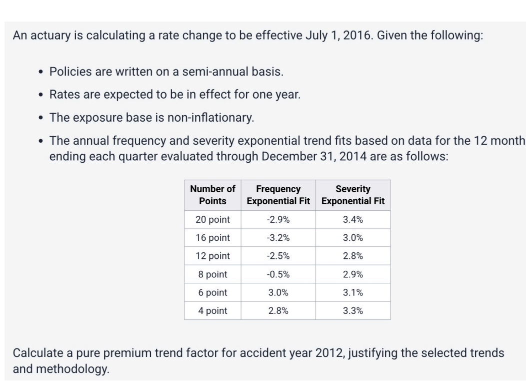
→ The latest data used is from 2018, so the midpoint of the latest time period is 7/1/2018. In addition, the future average written date is 7/1/2020.

Therefore,



Calendar Year	Current Trend Period	Current Trend Factor	Projected Trend Period	Projected Trend Factor	Total Trend Factor
2016	2.5 years	$1.0661^{2.5} = 1.1736$	2 years	1.0609	**1.2451**
2017	1.5 years	$1.0661^{1.5} = 1.1008$	2 years	1.0609	**1.1679**
2018	0.5 years	$1.0661^{0.5} = 1.0325$	2 years	1.0609	**1.0954**

→



An actuary is calculating a rate change to be effective July 1, 2016. Given the following:

- Policies are written on a semi-annual basis.
- Rates are expected to be in effect for one year.
- The exposure base is non-inflationary.
- The annual frequency and severity exponential trend fits based on data for the 12 months ending each quarter evaluated through December 31, 2014 are as follows:

Number of Points	Frequency Exponential Fit	Severity Exponential Fit
20 point	-2.9%	3.4%
16 point	-3.2%	3.0%
12 point	-2.5%	2.8%
8 point	-0.5%	2.9%
6 point	3.0%	3.1%
4 point	2.8%	3.3%

Calculate a pure premium trend factor for accident year 2012, justifying the selected trends and methodology.

→ The frequency trend has changed significantly, while the severity trend is fairly stable. So, use a two-step trend for frequency & a one-step trend for severity

→ For frequency, use the 20 pt trend of −2.9% to go from 2012 to 2014, as this value is in the middle of the 12, 16, & 20 point trends. Then, to trend from the latest date to the future policy period, use the 6 point trend since the trend looks stable from then on.

→ The average accident date of AY 2012 is the midpoint of the year, or 7/1/2012. The latest date is the midpoint of 2014, or 7/1/2014. Since rates are in effect from 7/1/2016 to 7/1/2017, & policies have 6-month terms, accidents can occur between 7/1/2016 & 12/31/2017. So, the average accident date of the future policy period is 4/1/2017. Therefore, the total frequency trend factor is

$$(1-0.029)^{2}(1+0.030)^{2.75} = 1.0222$$

→ Since the severity trend is stable, select an average of all values, which is

$$\frac{0.034 + 0.030 + \cdots + 0.033}{6} = 3.1\%$$

→ The trend period for severity is from 7/1/2012 to 4/1/2017, which is 4.75 years. So, the total severity trend factor is

$$(1+0.031)^{4.75} = 1.1552$$

→ Finally, the pure premium trend factor is

$$\frac{\text{Freq}}{\text{trend}} \times \frac{\text{Sev}}{\text{Trend}} = 1.0222\,(1.1552) = 1.1809$$

→ NOTES → There are many possible ways to solve this problem. B/c the frequency trend changes significantly, it is preferred to select a two-step trend, but one-step may also be valid if appropriate justification is provided.

→ Other considerations

→ Now that we have thoroughly discussed trending on its own, lets revisit it alongside the other topics we've previously covered: anomalies, rate & benefit changes, & development. Up to this point, we've examined each of these topics individually & in isolation from trending. Now, we'll explore how trending interacts w/ each of them & consider their combined effect.

→ Anomalies → Before trending loss data, any extraordinary losses should be removed or adjusted, or the loss trends should be selected based on basic limits loss data.

→ Catastrophe losses will result in a significant increase in frequency & severity, while large losses will typically only impact severity since they tend to be individual claims. If catastrophe or large losses cannot be identified, trends should not be determined using 12-month rolling averages, as one anomaly would then affect multiple data points.

→ Once a trend is determined, that trend should also be applied to data where extraordinary losses are removed or adjusted.

→ Rate & benefit changes → It is also helpful to adjust data for rate or benefit changes before determining trends. For instance, assume that a court ruling results in an increase of 4% for all expected loss payments after a specific date. In that case, the data will show a positive severity trend until all claims paid out are under the court ruling.

→ If adjustments for rate or benefit changes are not made, the impact of these changes should be considered when selecting the trend. In addition, when selecting a trend to apply to historical data that has been adjusted for rate or benefit changes, make sure to select a trend that is not impacted by those same changes. Otherwise, the effects of the changes will be taken into account twice.

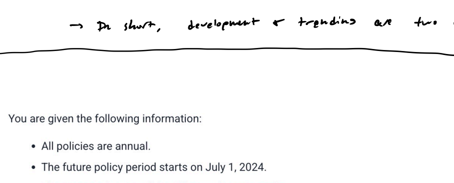
→ Development → There is a well known misconception called the overlap fallacy, which states that developing & trending will double count the effect of inflation & other possible changes

→ This is not true b/c the development factors are used to bring immature values to their expected ultimate values, while trending factors are used to adjust the ultimate values from the historical experience period to the period the rates will be in effect. Loss development does incorporate inflation that results in increased payments for reported claims in time after reporting, but it does not include inflation from the experience period to the forecast period.

→ In short, development & trending are two independent steps, both of which are important in ratemaking.

→ Assignment

→ Q1 →



You are given the following information:

- All policies are annual.
- The future policy period starts on July 1, 2024.
- The proposed rates will be effective for 15 months.

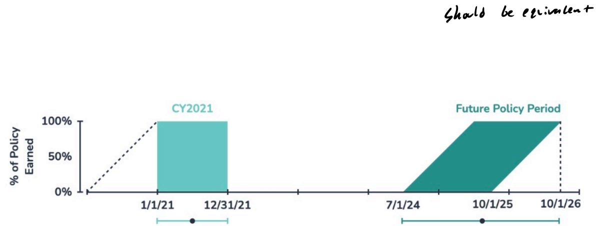
Determine the trend period for CY2021 earned premium under the following assumptions:

(a) The trend is applied to earned premium.

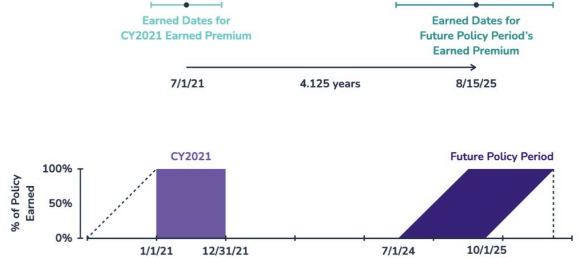
(b) The trend is applied to written premium.

→

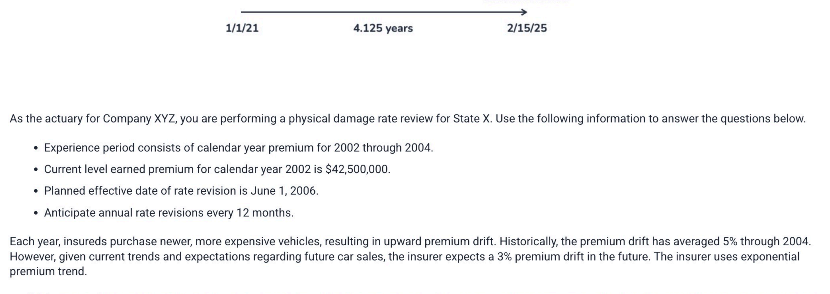
a)



b)



→ Q2 →



As the actuary for Company XYZ, you are performing a physical damage rate review for State X. Use the following information to answer the questions below.

- Experience period consists of calendar year premium for 2002 through 2004.
- Current level earned premium for calendar year 2002 is \$42,500,000.
- Planned effective date of rate revision is June 1, 2006.
- Anticipate annual rate revisions every 12 months.

Each year, insureds purchase newer, more expensive vehicles, resulting in upward premium drift. Historically, the premium drift has averaged 5% through 2004. However, given current trends and expectations regarding future car sales, the insurer expects a 3% premium drift in the future. The insurer uses exponential premium trend.

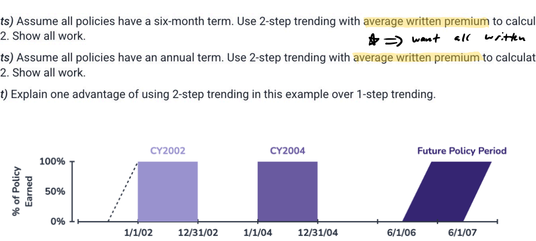
(a) *(1.5 points)* Assume all policies have a six-month term. Use 2-step trending with average written premium to calculate the trended premium for calendar year 2002. Show all work.

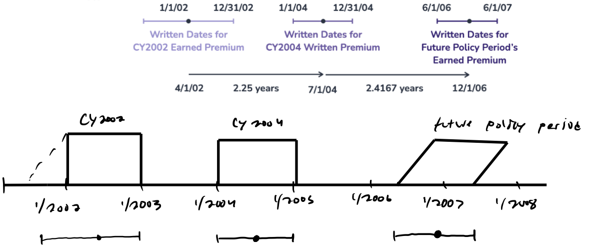
★ ⇒ want all written dates

(b) *(1.5 points)* Assume all policies have an annual term. Use 2-step trending with average written premium to calculate the trended premium for calendar year 2002. Show all work.

(c) *(0.5 point)* Explain one advantage of using 2-step trending in this example over 1-step trending.

→ a)

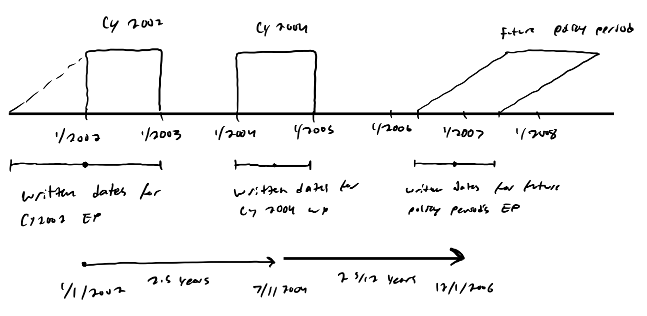




$$\Rightarrow \text{CY 2002 trended EP} = (1+0.05)^{2.25}(1+0.03)^{2.4167} \times 42.5\text{M} = \$50,993,426$$

★ changing the policy term only affects the historical written dates ⇒ written dates for most recent time period & the future policy period are unaffected

→ b)



$$\Rightarrow \text{CY 2002 trended EP} = (1+0.05)^{2.5}(1+0.03)^{2.4167} \times 42.5\text{M} = \$51,568,615$$

→ c) Two-step trending allows us to account for changes in the way premium trends over time. If premium has historically trended at one rate during the experience period, but is not expected to continue trending at that rate in the future, we can split the premium trend into a current trend step & a projected trend step rather than assuming premium trends at a constant rate.