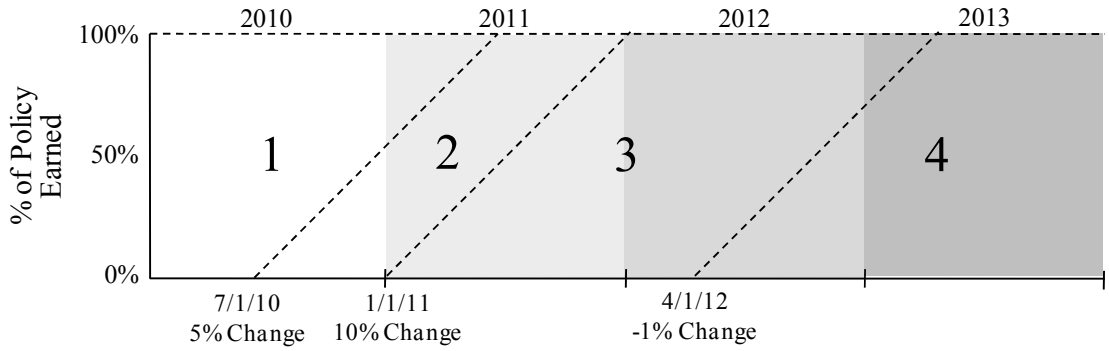
5.17 Rate Changes assuming CY EP with Annual Policies

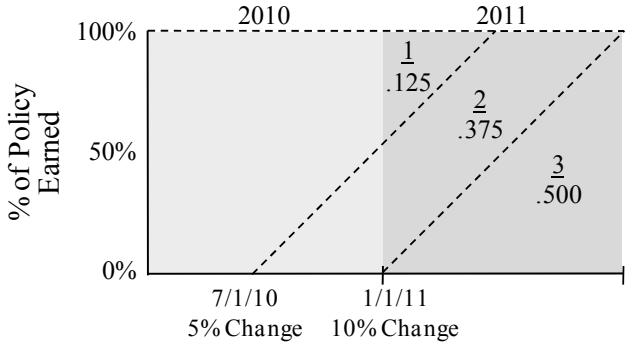


Once the picture is drawn, the next step is to calculate the portion of each calendar year's earned premium (the area within the square) that corresponds to each unique rate level group. Considering Calendar Year 2011, there are three areas: the area representing earned premium on policies written after January 1, 2010 and prior to the July 1, 2010 rate change (area of rate level group 1 in Calendar Year 2011), the area representing earned premium on policies written on or after July 1, 2010 and before January 1, 2011 (area of rate level group 2 in Calendar Year 2011), and the area representing earned premium on policies written on or after January 1, 2011 and before January 1, 2012 (area of rate level group 3 in Calendar Year 2011). Simple geometry,[14] as well as the assumption that the distribution of policies written is uniform over time, is used to calculate the portion of the square represented by each rate level area. For example, area 1 in Calendar Year 2011 is a triangle with area equal to ½ x base x height. The base and height are both six months (January 1, 2011 to June 30, 2011) so the area (in months) is 18 (= ½ x 6 x 6). This area's portion of the entire calendar year square is 0.125 (=18 / (12 x 12)). The math is simplified if restating the base and height as portions of a year (0.125 = ½ x ½ x ½). Also, some areas (e.g., area 2 in Calendar Year 2011) are easier to calculate as one minus the sum of the remaining areas. The areas of the three rate levels in Calendar Year 2011 are summarized below:

- Area 1 in CY 2011: 0.125 = 0.50 x 0.50 x 0.50
- Area 2 in CY 2011: 0.375 = 1.00 - (0.125 + 0.500)
- Area 3 in CY 2011: 0.500 = 0.50 x 1.00 x 1.00

[14] The following geometric formulae may be used in the parallelogram method:
Area of a triangle: ½ x base x height
Area of a parallelogram: base x height
Area of a trapezoid: ½ x ($base_1$ + $base_2$) x height

5.18 Areas in 2011 assuming CY EP with Annual Policies)



Step 3 of the procedure involves determining the cumulative rate level index for each distinct rate level group. The first rate level group is assigned the rate level of 1.00. The cumulative rate level index of each subsequent group is the prior group's cumulative rate level index multiplied by the rate level for that group. For example, the cumulative rate level index for the second rate level group is 1.05 (= 1.00 x 1.05). The third rate level group's cumulative rate level index is 1.155 (= 1.05 x 1.10). The following table shows the cumulative rate level indices for each group in our example.

5.19 Step 3

Rate Level Group	(1) Effective Date	(2) Overall Average Rate Change	(3) Rate Level Index	(4) Cumulative Rate Level Index
1	Initial	--	1.00	1.0000
2	7/1/10	5.0%	1.05	1.0500
3	1/1/11	10.0%	1.10	1.1550
4	4/1/12	-1.0%	0.99	1.1435

(4)= (Previous Row4) x (3)

Step 4, the calculation of the average rate level index for each year, is the weighted average of the cumulative rate level indices in Step 3, using the areas calculated in Step 2 as weights. For example, the average rate level index for Calendar Year 2011 is:

$$1.0963 = 1.000 \text{ x } 0.125 + 1.0500 \text{ x } 0.375 + 1.1550 \text{ x } 0.500.$$

Step 5 is the calculation of the on-level factor, defined as follows:

$$\text{On - Level Factor for Historical Period} = \frac{\text{Current Cumulative Rate Level Index}}{\text{Average Rate Level Index for Historical Period}}.$$

The numerator considers the most recent cumulative rate level index (i.e., not just the most recent within the historical experience period) from Step 3. The denominator is the result of Step 4.

For the simple example, the following is the on-level factor for Calendar Year 2011 earned premium, assuming annual policies:

$$1.0431 = \frac{1.1435}{1.0963}.$$

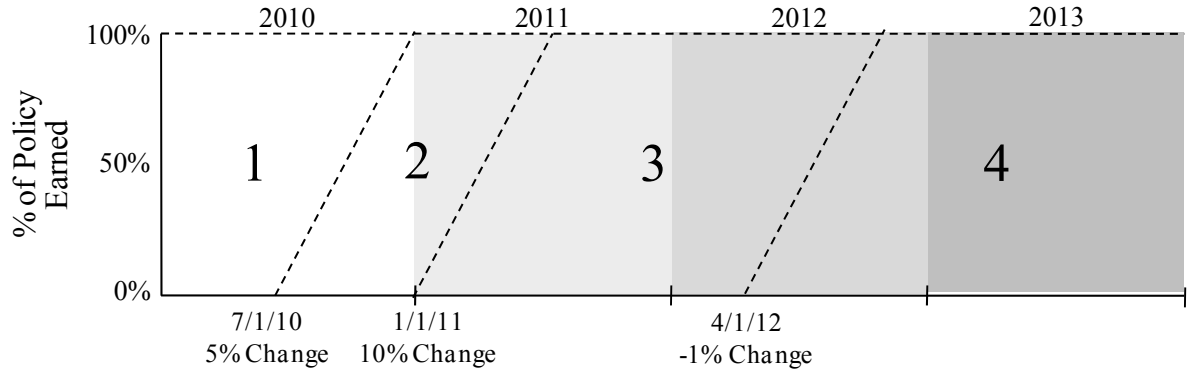
In Step 6, this on-level factor is applied to the Calendar Year 2011 earned premium in order to bring it to current rate level.

$$\text{CY11EP at current rate level} = \text{CY11EP x } 1.0431.$$

Standard Calendar Year Calculations for Six-Month Policies

If the policy term in the example is six months rather than annual (as is common in personal automobile coverage), then the pictorial representation of the rate level groups is as follows:

5.20 Rate Changes assuming CY EP with 6-Month Policies



In this case, the areas (Step 2) for Calendar Year 2011 are as follows:

- Area 1 in CY 2011: N/A
- Area 2 in CY 2011: 0.250 = 0.50 x 0.50 x 1.00
- Area 3 in CY 2011: 0.750 = 1.00 - 0.250

The cumulative rate level indices (Step 3) are the same as those used for the annual policies.

The following is the average rate level index (Step 4) for Calendar Year 2011 assuming semi-annual policies:

$$1.1288 = 1.0500 \times 0.250 + 1.1550 \times 0.750$$

The on-level factor (Step 5) to adjust Calendar Year 2011 earned premium to current rate level assuming semi-annual policies is:

$$1.0130 = \frac{1.1435}{1.1288}.$$

The on-level adjustment for semi-annual policies is smaller than for annual policies because the semi-annual rate changes earn more quickly.