

**Reading:** Werner 09: Risk Classification  
**Model:** Univariate Methods for Rating Variable Differentials  
**Problem Type:** Pure Premium Method - With Credibility

W-09 (022) - (2017.Spring #7 Problem)

**Find** Calculate the indicated rate change for each class that results in a revenue-neutral overall change.

**Given**

| level<br>of<br>variable | EE     | reported<br>L + ALAE | current<br>relativity |
|-------------------------|--------|----------------------|-----------------------|
| 1                       | 10,500 | 512,000              | 1.00                  |
| 2                       | 5,200  | 740,000              | 1.50                  |
| 3                       | 13,100 | 632,000              | 1.30                  |

\* EE = Earned Exposures

Full credibility: 13,260 exposures

*Use the square-root rule for credibility.*

*Complement of credibility is no change.*

**Step 1** complete the following table and note the key columns:

(Col 5) = indicated relative

(Col 8) = current relative (**normalized** so that the exposure-weighted average equals 1.000)

(Col 9) = weighted average of (Col 5) and (Col 8) using (Col 6) as the weight for (Col 5)

| (1)               | (2)         | (3)       | (4)          | (5)                | (6)                   | (7)              | (8)                                | (9)                         |
|-------------------|-------------|-----------|--------------|--------------------|-----------------------|------------------|------------------------------------|-----------------------------|
| level of variable | reported EE | L + ALAE  | pure premium | indicated relative | credibility (weights) | current relative | <b>normalized</b> current relative | cred-wtd indicated relative |
| A                 | 10,500      | 512,000   | 48.762       | 0.745              | 0.890                 | 1.00             | 0.815                              | 0.753                       |
| B                 | 5,200       | 740,000   | 142.308      | 2.175              | 0.626                 | 1.50             | 1.223                              | 1.819                       |
| C                 | 13,100      | 632,000   | 48.244       | 0.737              | 0.994                 | 1.30             | 1.060                              | 0.739                       |
| Total             | 28,800      | 1,884,000 | 65.417       | 1.000              | --                    | 1.227            | 1.000                              | 0.939                       |

(4) = (3) / (2)

(5) = (4) / (Tot4)

(6) =  $\sqrt[4]{(2) / 13260}$  (maximum value is 1.0)

(7) given information

**(Tot7) = exposure-weighted average of (6)**

(8) = (7) / (Tot7)

(9) =  $[(6) \times (5) + (1.0 - (6)) \times (8)]$

**Step 2** calculate the % change in relative from current to credibility-weighted indicated, but note:

==> you must first normalize the cred-wtd indicated relative as shown in (Col 10)

==> you must then "off-balance" the change in (Col 11) so that the **total change is 0.0%** in (Col 12)

| (1)               | (10)                                 | (11)   | (12)                        | (12) = (10)/(8) <== alternate formula for (12) |
|-------------------|--------------------------------------|--------|-----------------------------|------------------------------------------------|
| level of variable | <b>normalized</b> cred-wtd ind. rel. | change | <b>change with off-bal.</b> | <b>change with off-bal.</b>                    |
| A                 | 0.802                                | -19.8% | -1.7%                       | -1.7%                                          |
| B                 | 1.937                                | 29.1%  | 58.4%                       | 58.4%                                          |
| C                 | 0.787                                | -39.5% | -25.7%                      | -25.7%                                         |
| Total             | 1.000                                | -18.5% | 0.0%                        | 0.0%                                           |

\* This way of calculating column (12) seems simpler than the method given in the examiner's report.

(final answers in green)

(10) = (9) / (Tot9)

(11) = (10) / (7) - 1.0

**(12) =  $(1.0 + (11)) / (1.0 + (Tot11)) - 1.0$**