APPENDIX E: UNIVARIATE CLASSIFICATION EXAMPLE

The following two exhibits show examples of traditional (univariate) classification analysis using a pure premium and loss ratio analysis. Though not explicitly stated, each analysis uses multiple years of exposure, premium, and loss data.

PURE PREMIUM APPROACH

Column 1 displays the earned exposures by class. As discussed in earlier chapters, earned exposures are normally used as the best match to the reported losses.

Column 2 displays the calendar accident year reported loss and ALAE. In this example, loss development and trend are assumed to have a negligible effect on the pure premium relativities and therefore have been ignored. Column 3 displays the pure premium, or average loss and ALAE per exposure. Column 4 converts the pure premiums into pure premium relativities by dividing the pure premium for each class by the total pure premium. Expressing the class experience relative to the total is important for comparing these indicated pure premium relativities to those currently used by the company or used by competitors (assuming those are expressed relative to the total, also). Column 5 shows the current class relativities as specified in the rating manual. The base class is Class J, as evidenced by its relativity of 1.00. Column 6 displays the current class relativities normalized so that the total exposure-weighted average relativity is 1.00. (It is preferable to weight the relativities using premium adjusted to the base class, but exposures are used as a proxy.) By normalizing these relativities, the actuary can compare them on an apples-to-apples basis to the indicated relativities in Column 4.

Column 7 contains the credibility measure for each class. The full credibility standard is 11,050 exposures, and partial credibility is calculated using the square root rule. The 11,050 figure is derived based on the 663 claim standard[57] and an expected frequency of 6%. Column 8 shows the credibility-weighted indicated relativity, which is determined by credibility-weighting the indicated relativities with the normalized current relativities. Another commonly used complement of credibility is the all class pure premium, but that was ruled out due to the significant variation between the classes. Column 9 shows the credibility-weighted indicated relativities after they are adjusted to the base class.

Column 10 displays the selected relativities. Column 11 shows the expected change in premium for each class due to the change between the current and selected manual relativities. The fact that the total exposure-weighted average relativity changed by -0.2% (= 1.2776 / 1.2802 - 1.0) means that if the selected class relativities are implemented without any other changes, the overall premium will change by -0.2%. The base rate needs to be increased, or "offset," by the reciprocal of that change factor (1.0 / (1.0 + -0.2%)) if no overall premium change is desired (i.e., to make the rate change revenue neutral). Column 12 displays the percent change by class assuming the selected relativities and the base rate offset.

[57] As discussed in Chapter 12, the 663 standard assumes no variation in the size of loss and that there is a 99% chance that the observed value will be within 10% of the true value.

LOSS RATIO APPROACH

Column 1 shows the earned premium at current rate level. Chapter 5 discusses several methods for adjusting premium to present rate level. For the purposes of the relativity analysis, it is critical that the premium be adjusted at the granular level rather than at the aggregate level. In other words, it is not sufficient to use the parallelogram method at the aggregate level if the rate changes varied by the classes being examined.

Column 2 displays the reported loss and ALAE. The same comments about trend and development made in the pure premium approach apply.

Column 3 is the loss ratio for each class and for all classes combined. Column 4 converts the loss ratios to indicated changes by dividing the loss ratio for each class by the loss ratio of all classes combined and subtracting one. The indicated change is the percentage the current class relativities (displayed in Column 8) need to be increased or decreased so that the expected loss ratio will be the same for every class.

Columns 5 through 7 derive the credibility-weighted indicated change. Column 6 shows the calculation of the credibility assigned to each class based on the claim counts shown in Column 5. The full credibility standard is 663 claims, and partial credibility is calculated using the square root rule. Column 7 is the credibility-weighted indicated change where the complement of credibility is no change (i.e., 0%).

The current relativities in Column 8 are adjusted by the credibility-weighted indicated change to determine the credibility-weighted indicated relativities in Column 9. The relativities in Column 9 are adjusted to the base class level in Column 10.

Column 11 contains the selected relativities, and Column 12 is the calculation of the relativity change for each class. The total change in Column 12 is the weighted average of the class changes using premium at current rate level as the weight. This represents the expected change in premium due to the selected class relativity changes, and is the amount the base rate needs to be offset if these relativity changes are to be implemented on a revenue-neutral basis. Column 13 is the change for each class if the selected relativities are implemented and the base rate is offset.

Wicked Good Auto Insurance Company
Classification Relativities

Class	(1) Earned Exposures	(2) Reported Loss & ALAE	(3) Pure Premium	(4) Indicated Relativity	(5) Current Relativity	(6) Normalized Current Relativity	(7) Credibility	(8) Credibility-Weighted Indicated Relativity	(9) Credibility-Weighted Indicated Relativity @ Base Class	(10) Selected Relativity	(11) Relativity Change	(12) Percent Change with Off-Balance
J	16,520	$ 878,200	$ 53.16	0.7831	1.00	0.7811	1.00	0.7831	1.0000	1.00	0.0%	0.2%
K	11,328	$ 740,940	$ 65.41	0.9636	1.15	0.8983	1.00	0.9636	1.2305	1.23	7.0%	7.2%
L	1,266	$ 136,830	$ 108.08	1.5922	1.95	1.5232	0.34	1.5467	1.9751	1.98	1.5%	1.7%
M	12,836	$ 888,582	$ 69.23	1.0199	1.35	1.0545	1.00	1.0199	1.3024	1.30	-3.7%	-3.5%
N	4,200	$ 753,156	$ 179.32	2.6417	3.50	2.7339	0.62	2.6767	3.4181	3.42	-2.3%	-2.1%
P	11,538	$ 518,146	$ 44.91	0.6616	0.85	0.6640	1.00	0.6616	0.8448	0.84	-1.2%	-1.0%
TOTAL	57,688	$ 3,915,854	$ 67.88	1.0000	1.2802	1.0000		1.0016		1.2776	-0.2%	0.0%

(3) = (2) / (1)
(4) = (3) / (Tot3)
(Tot5) = (5) weighted by (1)
(6) = (5) / (Tot5)
(7) = [(1) / 11,050] ^ 0.5 limited to 1.0
(8) = (4) x (7) + [1.0 - (7)] x (6)
(Tot8) = (8) weighted by (1)
(9) = (8) / (Base8)
(Tot10) = (10) weighted by (1)
(11) = (10) / (5) - 1.0
(12) = [1.0 + (11)] / [1.0 + (Tot11)] - 1.0

Wicked Good Auto Insurance Company
Classification Relativities

Class	(1) Premium at Current Rate Level	(2) Reported Loss and ALAE	(3) Loss Ratio	(4) Indicated Change	(5) Number of Claims	(6) Credibility	(7) Credibility-Weighted Indicated Change	(8) Current Relativity	(9) Credibility-Weighted Indicated Relativity	(10) Credibility-Weighted Indicated Relativity @ Base Class	(11) Selected Relativity @ Base Class	(12) Relativity Change	(13) Percent Change with Off-Balance
J	$ 1,114,932	$ 878,200	78.8%	2.3%	826	1.00	2.3%	1.00	1.0230	1.0000	1.00	0.0%	2.4%
K	$ 917,284	$ 740,940	80.8%	4.9%	652	0.99	4.9%	1.15	1.2064	1.1793	1.18	2.6%	5.0%
L	$ 166,314	$ 136,830	82.3%	6.9%	124	0.43	3.0%	1.95	2.0085	1.9633	1.96	0.5%	2.9%
M	$ 1,162,236	$ 888,582	76.5%	-0.6%	866	1.00	-0.6%	1.35	1.3419	1.3117	1.31	-3.0%	-0.7%
N	$ 1,056,318	$ 753,156	71.3%	-7.4%	736	1.00	-7.4%	3.50	3.2410	3.1681	3.17	-9.4%	-7.3%
P	$ 666,978	$ 518,146	77.7%	0.9%	490	0.86	0.8%	0.85	0.8568	0.8375	0.84	-1.2%	1.1%
TOTAL	$ 5,084,062	$ 3,915,854	77.0%	0.0%	3,694							-2.3%	0.0%

(3) = (2) / (1)
(4) = (3) / (Tot3) - 1.0
(6) = [(5) / 663] ^ 0.5 limited to 1.0
(7) = (4) x (6) + 0.0% x [1.0-(6)]
(9) = [1.0 + (7)] x (8)
(10) = (9) / (Base9)
(12) = (11) / (8) - 1.0
(Tot12) = (12) weighted by (1)
(13) = [1.0 + (12)] / [1.0 + (Tot12)] - 1.0