Reading: Werner 09: Risk Classification
Model: Univariabe Methods for Rating Variable Differentials
Problem Type: Pure Premium Method - Adjusted

Find Propose rating factors for rating variable 2, adjusting for distributional bias.

Given

Exposure Distribution

	variable 2		
variable 1	2A	2B	2C
1A	195	84	6
1B	92	91	106
1C	13	109	143

Current Relativities for Rating Variable 1

variable 1	relativity
1A	1.60
1B	1.00
1C	0.72

variable 1 has rating levels: 1A, 1B, 1C
variable 2 has rating levels: 2A, 2B, 2C

base level for variable 2 is 2B

Loss Distribution

	variable 2		
variable 1	2A	2B	2C
1A	70,785	37,128	3,060
1B	42,964	47,502	57,664
1C	6,409	60,059	92,521

Step 1 calculate variable 2 relativites as a weighted average of variable 1 relativities

==> *you can do these calculations all in 1 table - I broke it up to (hopefully?) make it easier to see what's going on*

(2A exposures)

var 1	var 1 rels	weights
1A	1.6000	195
1B	1.0000	92
1C	0.7200	13
total	1.3779	**300**
	(wtd avg)	

(2B exposures)

var 1	var 1 rels	weights
1A	1.6000	84
1B	1.0000	91
1C	0.7200	109
total	1.0700	**284**
	(wtd avg)	

(2C exposures)

var 1	var 1 rels	weights
1A	1.6000	6
1B	1.0000	106
1C	0.7200	143
total	0.8571	**255**
	(wtd avg)	

Step 2 use step 1 to calculate <u>adjusted exposures</u> for rating variable 2

total adjusted exposures = *(wtd avg relativity) x (total unadjusted exposures)*

level of var 2	wtd avg relativity	total unadj. expos.	total adjusted expos.	
2A	1.3779	**300**	413.36	= 1.3779 x 300
2B	1.0700	**284**	303.88	= 1.07 x 284
2C	0.8571	**255**	218.56	= 0.8571 x 255

Step 3 now just apply the "regular" pure premium method but use the adjusted exposures

(1)	(2)	(3)	(4)	(5)	(6)	
level of var 2	adjusted expos.	reported L + ALAE	pure premium	indicated relativity	rebased indicated relativity	
2A	413.36	120,158	290.7	0.6506	0.6105	
2B	303.88	144,689	476.1	1.0657	1.0000	<== base level
2C	218.56	153,245	701.2	1.5694	1.4726	
Total	935.80	418,092	446.8	1.0000	0.938	

(final answers in green)

(4) = (3) / (2)
(5) = (4) / (Tot4)
(6) = (5) / (Base5) where Base5 = 1.066

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Find Propose rating factors for rating variable 2, adjusting for distributional bias.

Given

Exposure Distribution

	variable 2		
variable 1	2A	2B	2C
1A	176	92	5
1B	94	91	96
1C	19	104	131

Current Relativities for Rating Variable 1

variable 1	relativity
1A	1.00
1B	0.51
1C	1.52

variable 1 has rating levels: 1A, 1B, 1C
variable 2 has rating levels: 2A, 2B, 2C

base level for variable 2 is 2A

Loss Distribution

	variable 2		
variable 1	2A	2B	2C
1A	61,776	41,400	2,505
1B	42,300	46,592	53,760
1C	9,367	58,136	82,530

Step 1 calculate variable 2 relativites as a weighted average of variable 1 relativities

==> *you can do these calculations all in 1 table - I broke it up to (hopefully?) make it easier to see what's going on*

(2A exposures)

var 1	var 1 rels	weights
1A	1.0000	176
1B	0.5100	94
1C	1.5200	19
total	0.8748	**289**
	(wtd avg)	

(2B exposures)

var 1	var 1 rels	weights
1A	1.0000	92
1B	0.5100	91
1C	1.5200	104
total	1.0331	**287**
	(wtd avg)	

(2C exposures)

var 1	var 1 rels	weights
1A	1.0000	5
1B	0.5100	96
1C	1.5200	131
total	1.0909	**232**
	(wtd avg)	

Step 2 use step 1 to calculate adjusted exposures for rating variable 2

total adjusted exposures = *(wtd avg relativity) x (total unadjusted exposures)*

level of var 2	wtd avg relativity	total unadj. expos.	total adjusted expos.	
2A	0.8748	**289**	252.82	= 0.8748 x 289
2B	1.0331	**287**	296.49	= 1.0331 x 287
2C	1.0909	**232**	253.08	= 1.0909 x 232

Step 3 now just apply the "regular" pure premium method but use the adjusted exposures

(1)	(2)	(3)	(4)	(5)	(6)	
level of var 2	adjusted expos.	reported L + ALAE	pure premium	indicated relativity	rebased indicated relativity	
2A	252.82	113,443	448.7	0.9038	1.0000	<== base level
2B	296.49	146,128	492.9	0.9927	1.0984	
2C	253.08	138,795	548.4	1.1046	1.2222	
Total	802.39	398,366	496.5	1.0000	1.106	

(final answers in green)

(4) = (3) / (2)
(5) = (4) / (Tot4)
(6) = (5) / (Base5) where Base5 = 0.904

Reading: Werner 09: Risk Classification
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Problem Type: Pure Premium Method - Adjusted

Find Propose rating factors for rating variable 2, adjusting for distributional bias.

Given

Exposure Distribution

	variable 2		
variable 1	2A	2B	2C
1A	191	113	7
1B	96	93	96
1C	25	108	135

Current Relativities for Rating Variable 1

variable 1	relativity
1A	1.35
1B	0.71
1C	1.00

variable 1 has rating levels: 1A, 1B, 1C
variable 2 has rating levels: 2A, 2B, 2C

base level for variable 2 is 2C

Loss Distribution

	variable 2		
variable 1	2A	2B	2C
1A	72,389	49,720	3,493
1B	43,584	48,081	52,800
1C	12,250	58,644	87,210

Step 1 calculate variable 2 relativites as a weighted average of variable 1 relativities

==> *you can do these calculations all in 1 table - I broke it up to (hopefully?) make it easier to see what's going on*

(2A exposures)

var 1	var 1 rels	weights
1A	1.3500	191
1B	0.7100	96
1C	1.0000	25
total	1.1250	**312**
	(wtd avg)	

(2B exposures)

var 1	var 1 rels	weights
1A	1.3500	113
1B	0.7100	93
1C	1.0000	108
total	1.0401	**314**
	(wtd avg)	

(2C exposures)

var 1	var 1 rels	weights
1A	1.3500	7
1B	0.7100	96
1C	1.0000	135
total	0.8933	**238**
	(wtd avg)	

Step 2 use step 1 to calculate adjusted exposures for rating variable 2

total adjusted exposures = (wtd avg relativity) x (total unadjusted exposures)

level of var 2	wtd avg relativity	total unadj. expos.	total adjusted expos.	
2A	1.1250	**312**	351.01	= 1.125 x 312
2B	1.0401	**314**	326.58	= 1.0401 x 314
2C	0.8933	**238**	212.61	= 0.8933 x 238

Step 3 now just apply the "regular" pure premium method but use the adjusted exposures

(1) level of var 2	(2) adjusted expos.	(3) reported L + ALAE	(4) pure premium	(5) indicated relativity	(6) rebased indicated relativity	
2A	351.01	128,223	365.3	0.7595	0.5412	
2B	326.58	156,445	479.0	0.9960	0.7097	
2C	212.61	143,503	675.0	1.4033	1.0000	<== base level
Total	890.20	428,171	481.0	1.0000	0.713	

(final answers in green)

(4) = (3) / (2)
(5) = (4) / (Tot4)
(6) = (5) / (Base5) where Base5 = 1.403

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Problem Type: Pure Premium Method - Adjusted

Find Propose rating factors for rating variable 2, adjusting for distributional bias.

Given

Exposure Distribution

	variable 2		
variable 1	2A	2B	2C
1A	183	104	6
1B	90	100	92
1C	13	100	126

Current Relativities for Rating Variable 1

variable 1	relativity
1A	1.00
1B	0.44
1C	1.41

variable 1 has rating levels: 1A, 1B, 1C
variable 2 has rating levels: 2A, 2B, 2C

base level for variable 2 is 2A

Loss Distribution

	variable 2		
variable 1	2A	2B	2C
1A	65,331	48,256	2,952
1B	41,490	53,000	49,772
1C	6,461	54,100	78,372

Step 1 calculate variable 2 relativites as a weighted average of variable 1 relativities

==> *you can do these calculations all in 1 table - I broke it up to (hopefully?) make it easier to see what's going on*

(2A exposures)

var 1	var 1 rels	weights
1A	1.0000	183
1B	0.4400	90
1C	1.4100	13
total	0.8424	**286**
	(wtd avg)	

(2B exposures)

var 1	var 1 rels	weights
1A	1.0000	104
1B	0.4400	100
1C	1.4100	100
total	0.9507	**304**
	(wtd avg)	

(2C exposures)

var 1	var 1 rels	weights
1A	1.0000	6
1B	0.4400	92
1C	1.4100	126
total	1.0006	**224**
	(wtd avg)	

Step 2 use step 1 to calculate adjusted exposures for rating variable 2

total adjusted exposures	=	*(wtd avg relativity) x (total unadjusted exposures)*

level of var 2	wtd avg relativity	total unadj. expos.	total adjusted expos.	
2A	0.8424	**286**	240.93	= 0.8424 x 286
2B	0.9507	**304**	289.00	= 0.9507 x 304
2C	1.0006	**224**	224.14	= 1.0006 x 224

Step 3 now just apply the "regular" pure premium method but use the adjusted exposures

(1)	(2)	(3)	(4)	(5)	(6)	
level of var 2	adjusted expos.	reported L + ALAE	pure premium	indicated relativity	rebased indicated relativity	
2A	240.93	113,282	470.2	0.8870	1.0000	<== base level
2B	289.00	155,356	537.6	1.0141	1.1433	
2C	224.14	131,096	584.9	1.1033	1.2439	
Total	754.07	399,734	530.1	1.0000	1.127	

(final answers in green)

(4) = (3) / (2)
(5) = (4) / (Tot4)
(6) = (5) / (Base5) where Base5 = 0.887