Classification Credibility based on Rank-Ordered Z Statistic

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General Question

- How should **observed** P&C claim experience be reflected to differentiate between types (classes) of exposure?
- Context - Highly skewed distributions, picture easily clouded by individual observations (or lack of them).

Differing Approaches

- Traditional approaches by P&C actuaries in ratemaking
- “Predictive Modeling”, regression techniques, GLM

Traditional Actuarial Approach

- Assign credibility based on general concept of **amount**.
  - Claim Count
  - Amount of Exposure
- Same amount -> Same credibility, regardless of consistency of results

Regression Techniques

- Standard errors of regression coefficients provide useful context for observed impacts
- Assumption of normality generality requires transformation for our problems
- Other assumptions sometimes overlooked

Simple Regression Example

- Let's assume an X variable that takes one of three categorical values, A, B, or C.
- Let's assume that a Y variable is dependent on the value of the X variable as follows:

$$\begin{Bmatrix} Y \sim N(\mu = 1, \sigma = 1) & X = A \\ Y \sim N(\mu = 1.5, \sigma = 1) & X = B \\ Y \sim N(\mu = 1.5, \sigma = .5) & X = C \end{Bmatrix}$$

Simple Regression Example

- Simulated 1000 observations with roughly equal number of A, B, and C values for X.

X	Y
A	2.822577
B	0.996076
B	2.389125
B	0.462811
A	1.007083
C	1.736555
C	1.298622
B	0.503695
B	1.777454
B	0.866742
B	1.914832

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B	0.503695
B	1.777454
B	0.866742
B	1.914832

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.
.

X matrix:

constant	B	C
1	0	0
1	1	0
1	1	0
1	1	0
1	0	0
1	0	1
1	0	1
1	1	0
1	1	0
1	1	0
1	1	0

.
.
.

Simple Regression Example

- Regression Results:

	Coefficient	s.e.	t
constant	0.9350	0.0466	20.054
B	0.5732	0.0666	8.612
C	0.5353	0.0650	8.231

s=.85

Simple Regression Example

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- Implication:

$$\begin{Bmatrix} Y \sim N(\mu = .94, \sigma = .85) & X = A \\ Y \sim N(\mu = 1.51, \sigma = .85) & X = B \\ Y \sim N(\mu = 1.47, \sigma = .85) & X = C \end{Bmatrix}$$

Simple Regression Example

- Standard errors of the coefficients are determined by multiplying 's' by the square roots of the diagonal elements of the $(\mathbf{X}^T\mathbf{X})^{-1}$ matrix.

$\mathbf{X}^T\mathbf{X}$

1000	319	350
319	319	0
350	0	350

$(\mathbf{X}^T\mathbf{X})^{-1}$

0.003021	-0.00302	-0.00302
-0.00302	**0.006156**	0.003021
-0.00302	0.003021	**0.005878**

- The errors *only* factor in through the value of 's', which is calculated in common.

Simple Regression Example

- Now, assume that our variable of interest is actually e^Y (more similar to our typical problem).
- If we correctly include the variance component into our estimate of the variable – $\exp(\mu+.5\sigma^2)$ – either analytically, or through simulation, but incorrectly *ignore* the heteroskedasticity, we will get misleading results.

Simple Regression Example

	Regression	True Mean	Sample Average
A	3.650	4.482	4.055
B	6.475	7.389	7.955
C	6.234	5.078	4.884

General Approach

- Assign Z-scores from a standard normal distribution based on the rank order of the observations, across classes.
- Calculate average values of Z and Z^2 for the classes.
- From these calculate a t-statistic and assign credibility based on the strength of this statistic.

Observation
5,906
8,390
17,059
19,439
20,638
20,810
33,787
37,816
50,943
54,650
227,680
238,145

Observation	Rank
5,906	1
8,390	2
17,059	3
19,439	4
20,638	5
20,810	6
33,787	7
37,816	8
50,943	9
54,650	10
227,680	11
238,145	12

Observation	Rank	$\bar{Z}$
5,906	1	-1.840
8,390	2	-1.158
17,059	3	-0.815
19,439	4	-0.550
20,638	5	-0.319
20,810	6	-0.105
33,787	7	0.105
37,816	8	0.319
50,943	9	0.550
54,650	10	0.815
227,680	11	1.158
238,145	12	1.840

Observation	Rank	$\bar{Z}$	$\overline{Z^2}$
5,906	1	-1.840	3.544
8,390	2	-1.158	1.356
17,059	3	-0.815	0.672
19,439	4	-0.550	0.307
20,638	5	-0.319	0.106
20,810	6	-0.105	0.015
33,787	7	0.105	0.015
37,816	8	0.319	0.106
50,943	9	0.550	0.307
54,650	10	0.815	0.672
227,680	11	1.158	1.356
238,145	12	1.840	3.544

Observation	Rank	$\bar{Z}$	$\overline{Z^2}$	Class
5,906	1	-1.840	3.544	A
8,390	2	-1.158	1.356	B
17,059	3	-0.815	0.672	A
19,439	4	-0.550	0.307	B
20,638	5	-0.319	0.106	B
20,810	6	-0.105	0.015	A
33,787	7	0.105	0.015	B
37,816	8	0.319	0.106	A
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227,680	11	1.158	1.356	A
238,145	12	1.840	3.544	B

A	B	
-0.07781	0.077807	$\bar{Z}$
1.060701	0.939299	$\overline{Z^2}$

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-0.07781	0.077807	$\bar{Z}$
1.060701	0.939299	$\overline{Z^2}$
1.02696	0.966046	SD(Z)

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1.02696	0.966046	SD(Z)
0.419255	0.394387	s.e.(Z)

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A	B	
-0.07781	0.077807	$\bar{Z}$
1.060701	0.939299	$\overline{Z^2}$
1.02696	0.966046	SD(Z)
0.419255	0.394387	s.e.(Z)
-0.18558	0.197285	t

Complications for Determining Z

- Exposure that is not necessarily uniform across the population.
- Values in common – which gets ranked higher?
  - Important case for many of our problems: **Zero**

Instead of thinking of each observation as a point, think of each observation (or group of observations) as a *range* along the standard normal curve. Integration can then give average values of Z and Z^2.

For a given *partition* ‘i’ of the data, Let

$$Z_i = \Phi^{-1}\left(\frac{\sum_{j=1}^{i} E_j}{\sum_{j=1}^{n} E_j}\right),$$ where Φ represents the CDF of the standard normal distribution.

The average Z score for partition i can be found by integration over the standard normal CDF, and is equal to:

$$\bar{Z}_i = \frac{\left(\sum_{j=1}^{n} E_j\right)\left(e^{-.5Z_{i-1}^2} - e^{-.5Z_i^2}\right)}{E_i\sqrt{2\pi}}$$

The average value of Z^2 for partition i is equal to:

$$\overline{Z_i^2} = 1 + \frac{\left(\sum_{j=1}^{n} E_j\right)\left(Z_{i-1}e^{-.5Z_{i-1}^2} - Z_i e^{-.5Z_i^2}\right)}{E_i\sqrt{2\pi}}$$

Observation	Rank	Z	$\bar{Z}$	$\overline{Z^2}$
5,906	1	-1.383	-1.840	3.544
8,390	2	-0.967	-1.158	1.356
17,059	3	-0.674	-0.815	0.672
19,439	4	-0.431	-0.550	0.307
20,638	5	-0.210	-0.319	0.106
20,810	6	0.000	-0.105	0.015
33,787	7	0.210	0.105	0.015
37,816	8	0.431	0.319	0.106
50,943	9	0.674	0.550	0.307
54,650	10	0.967	0.815	0.672
227,680	11	1.383	1.158	1.356
238,145	12		1.840	3.544

Assigning Credibility

- Typically in hypothesis testing, a threshold is established for determining **whether or not** an observation is statistically significant compared to a null hypothesis.
- If we move away from this binary view of acceptance, together with our measured t statistic, we can **generalize** to a concept of **credibility** calculated as:

  $(t - t_0)/t$ where t_0 is based on the established threshold.
- Also, may wish to set credibility to zero when the z score is in the opposite direction of the raw relationship.

	Exposure	Loss	Loss/Exp
A	1	0	0
A	1	0	0
A	1	0	0
A	1	0	0
A	1	0	0
A	1	0	0
A	1	0	0
B	1	0	0
B	1	0	0
B	1	0	0
A	1	100	100
A	1	100	100
B	1	100	100
B	1	200	200
B	1	200	200
B	1	1000	1000
B	1	10000	10000
B	1	15000	15000
A	1	30000	30000
B	1	60000	60000

Partition	Exposure	Loss	Loss/Exp
1	10	0	0
2	3	300	100
3	2	400	200
4	1	1000	1000
5	1	10000	10000
6	1	15000	15000
7	1	30000	30000
8	1	60000	60000

Partition	Exposure	Loss	Loss/Exp	Z_i
1	10	0	0	0.000
2	3	300	100	0.385
3	2	400	200	0.674
4	1	1000	1000	0.842
5	1	10000	10000	1.036
6	1	15000	15000	1.282
7	1	30000	30000	1.645
8	1	60000	60000	infinity

Partition	Exposure	Loss	Loss/Exp	Z_i	$\bar{Z}$	$\overline{Z^2}$
1	10	0	0	0.000	-0.798	1.000
2	3	300	100	0.385	0.190	0.049
3	2	400	200	0.674	0.526	0.284
4	1	1000	1000	0.842	0.756	0.574
5	1	10000	10000	1.036	0.936	0.879
6	1	15000	15000	1.282	1.153	1.335
7	1	30000	30000	1.645	1.447	2.105
8	1	60000	60000	infinity	2.063	4.393

	Exposure	Loss	Loss/Exp	$\bar{Z}$	$\overline{Z^2}$
A	1	0	0	-0.798	1.000
A	1	0	0	-0.798	1.000
A	1	0	0	-0.798	1.000
A	1	0	0	-0.798	1.000
A	1	0	0	-0.798	1.000
A	1	0	0	-0.798	1.000
A	1	0	0	-0.798	1.000
B	1	0	0	-0.798	1.000
B	1	0	0	-0.798	1.000
B	1	0	0	-0.798	1.000
A	1	100	100	0.190	0.049
A	1	100	100	0.190	0.049
B	1	100	100	0.190	0.049
B	1	200	200	0.526	0.284
B	1	200	200	0.526	0.284
B	1	1000	1000	0.756	0.574
B	1	10000	10000	0.936	0.879
B	1	15000	15000	1.153	1.335
A	1	30000	30000	1.447	2.105
B	1	60000	60000	2.063	4.393

	Exposure	Loss	Loss/Exp	$\bar{Z}$	$\overline{Z^2}$	s.e.	t	percentile	threshhold	credibility
A	10	30200	3,020	-0.376	0.920	0.291	-1.291	0.114	0.883	0.316
B	10	86500	8,650	0.376	1.080	0.341	1.100	0.850	0.883	0.197
	20	116700	5,835							

	Measured Relativity	Credibility Adjusted Relativity
A	**0.517566**	0.847642
B	**1.482434**	1.095138

0.8 Confidence Level

Real World Example

- National Practitioner Data Bank – Medical malpractice claim data.
- 185K claim amounts were analyzed in a multiplicative factor model using the following fields:
  - Year original report processed
  - Practitioner's work state
  - Practitioner's state of license (first listed)
  - Practitioners' field of license
  - Age group of practitioner
  - Malpractice allegation group
  - Payment a result of…
  - Age group of patient
  - Gender of patient
  - Patient type (inpatient, outpatient)
- Average severity across all claims is $215K.
- An 80% confidence threshold was used with resulting t-statistics to establish credibility
- The results shown here are only for purposes of illustrating the method. This is not to be taken as a thorough analysis of the NPDB.

Practioner’s field of license

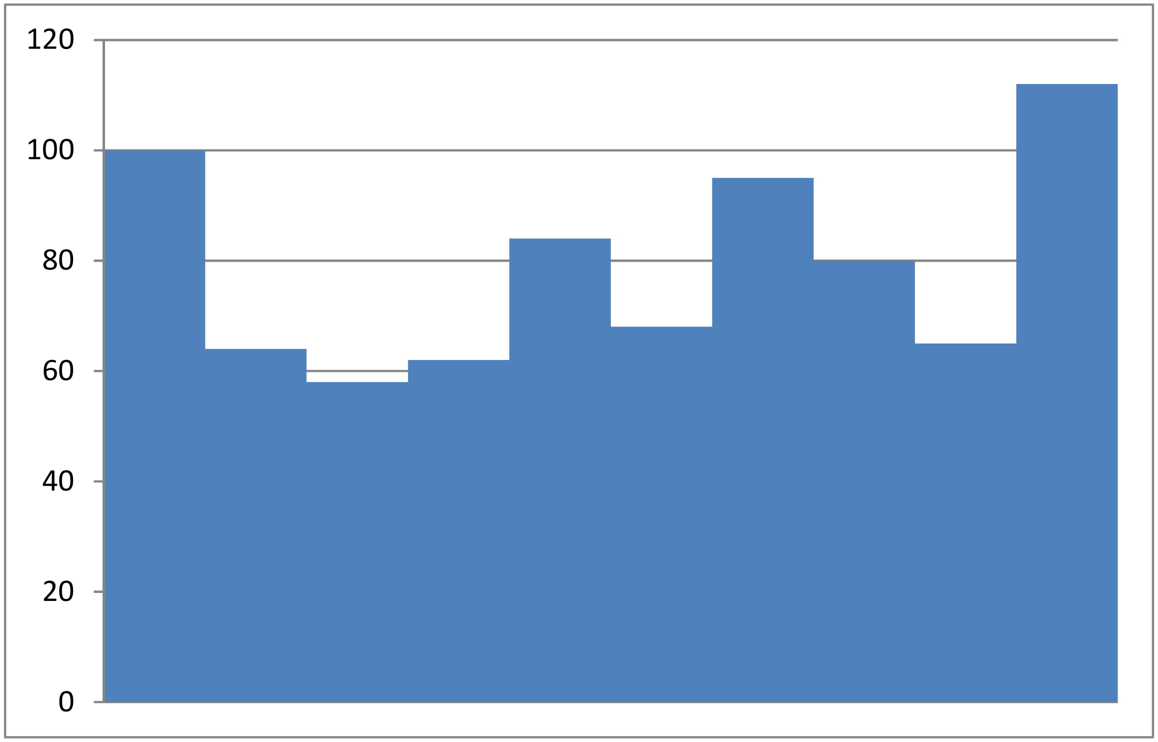
value Licnfeld	target	xFactor Licnfeld	Factor	Rank	Z
10	18,500,000	129,874	142.4461	1	4.549043
100	22,500,000	248,120	90.68196	2	4.312155
10	7,350,000	106,810	68.81392	3	4.197858
30	14,500,000	214,002	67.75636	4	4.120999
10	14,500,000	215,647	67.23937	5	4.062734
10	16,500,000	247,475	66.67332	6	4.015661
10	6,050,000	101,838	59.40803	7	3.976091
10	7,950,000	138,398	57.44304	8	3.941909
10	13,500,000	241,556	55.88777	9	3.911793
100	7,950,000	143,411	55.43523	10	3.884853
20	3,950,000	71,717	55.07734	11	3.860469
10	16,500,000	338,567	48.73485	12	3.838184
10	7,450,000	156,480	47.60995	13	3.817656
10	6,750,000	144,835	46.60476	14	3.79862
130	6,950,000	156,152	44.50789	15	3.780869
10	6,950,000	156,152	44.50789	16	3.764234
10	4,950,000	118,751	41.68374	17	3.748581
10	3,350,000	85,144	39.34505	18	3.733795
120	18,500,000	471,425	39.24274	19	3.719783
10	5,950,000	152,476	39.02249	20	3.706465
10	3,550,000	91,283	38.89003	21	3.693774
50	4,950,000	129,589	38.19762	22	3.681651
10	12,500,000	328,102	38.09794	23	3.670046

Nurse Anesthetist

Population Factors		Nurse Anesthetist			
Percentile	Value	Count	Exposure	Loss	
10%	0.041805	100	18,288,621	303,300	
20%	0.099083	64	12,754,972	910,750	
30%	0.18414	58	12,150,885	1,736,250	
40%	0.300609	62	13,262,408	3,287,500	
50%	0.468677	84	17,716,832	6,840,000	
60%	0.695223	68	15,702,604	8,982,500	
70%	0.990848	95	20,414,142	17,490,000	
80%	1.441739	80	16,667,073	19,940,000	
90%	2.37696	65	13,195,099	24,635,000	
100%	142.4461	112	22,489,339	112,625,000	
		788	162,641,975	196,750,300	
				1.210	Average Factor
				249,683	Avg Loss

Avg Z	0.068
Avg Z^2	1.337
SD(Z)	1.154
s.e.(Z)	0.041
t	1.66
Cred	0.49
Final Factor	1.103

Nurse Anesthetist

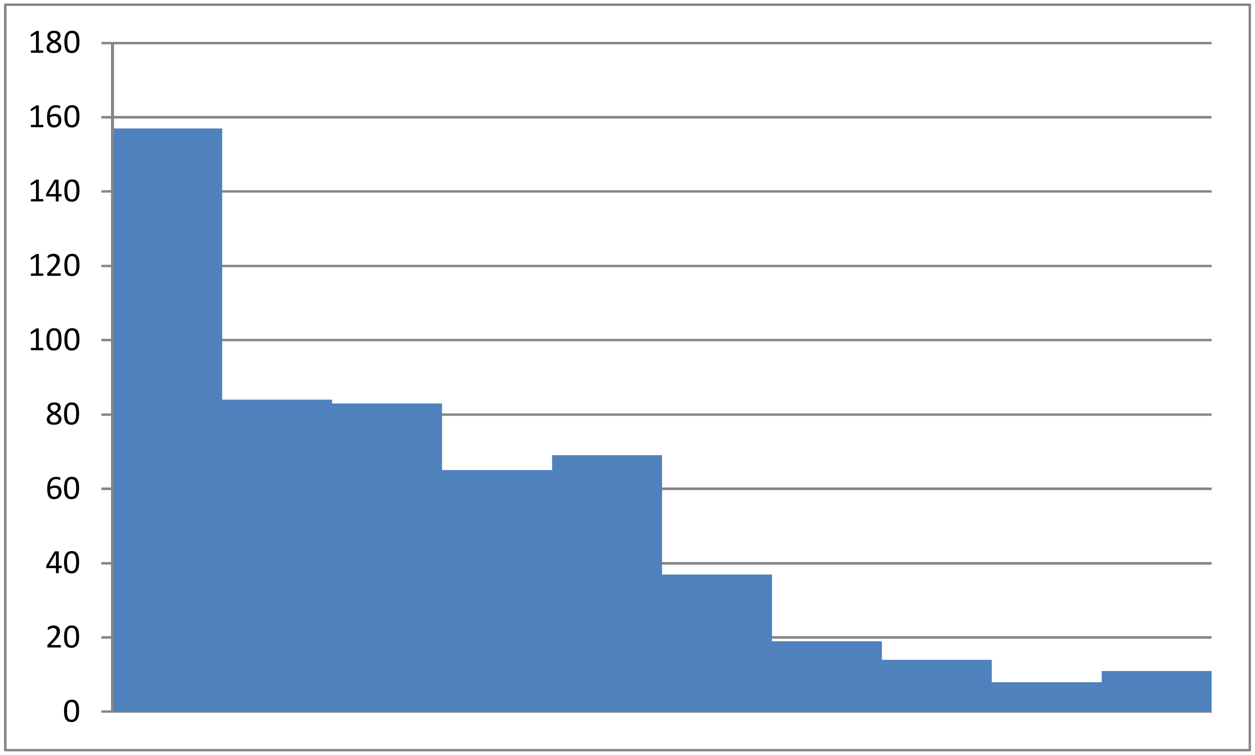


Physical Therapist

Population Factors		Physical Therapist		
Percentile	Value	Count	Exposure	Loss
10%	0.041805	157	28,695,827	553,750
20%	0.099083	84	15,180,634	1,035,250
30%	0.18414	83	14,948,442	2,028,750
40%	0.300609	65	11,913,877	2,833,750
50%	0.468677	69	11,330,755	4,360,000
60%	0.695223	37	7,202,447	4,057,500
70%	0.990848	19	3,492,262	2,942,500
80%	1.441739	14	2,804,117	3,330,000
90%	2.37696	8	1,291,352	2,450,000
100%	142.4461	11	1,824,268	7,360,000
		547	98,683,981	30,951,500
				0.314 Average Factor
				56,584 Avg Loss

Avg Z	-0.755
Avg Z^2	1.363
SD(Z)	0.891
s.e.(Z)	0.038
t	-19.82
Cred	0.96
Final Factor	0.341

Physical Therapist



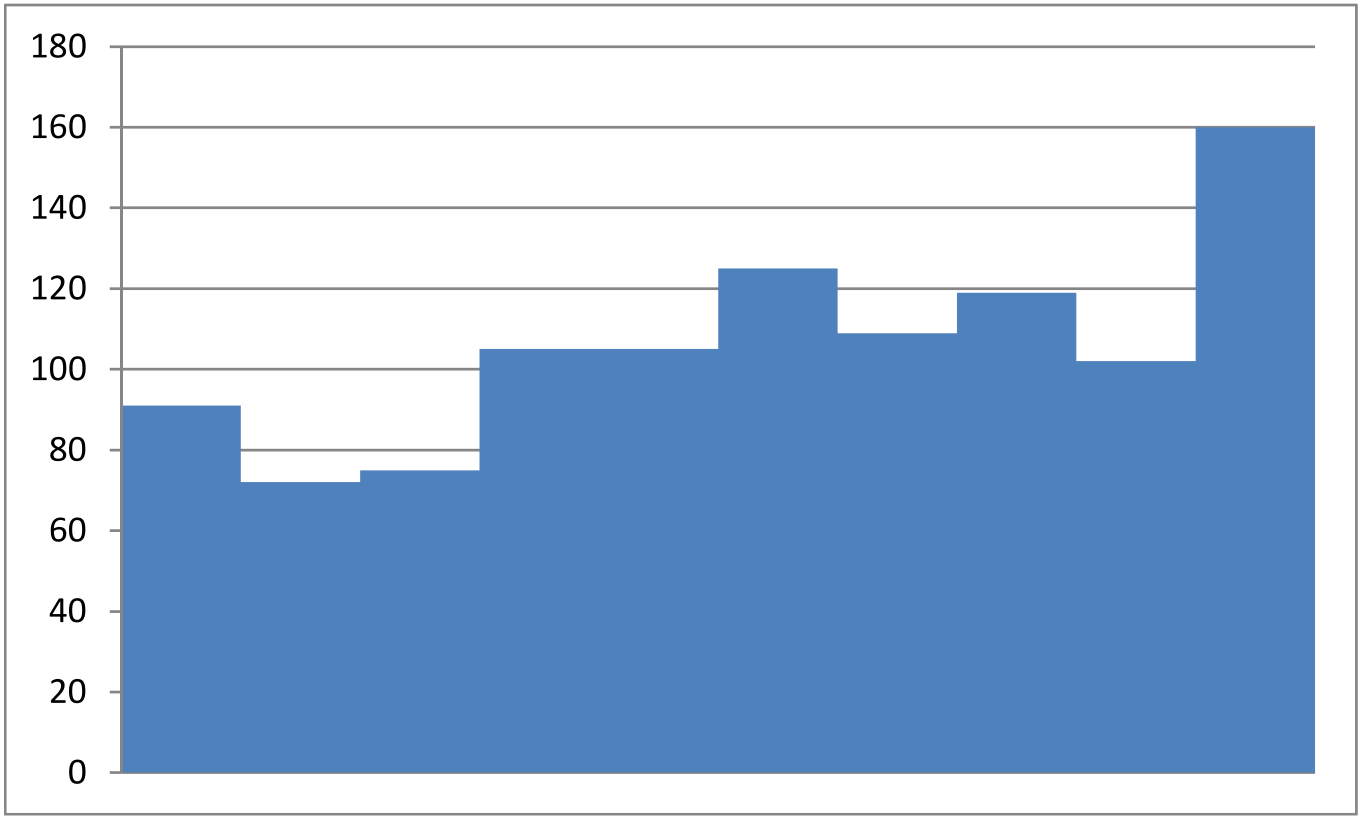
Phys. Intern/Resident

Population Factors		**Phys. Intern/Resident**		
Percentile	Value	Count	Exposure	Loss
10%	0.041805	91	17,640,771	308,000
20%	0.099083	72	17,649,370	1,212,000
30%	0.18414	75	17,822,005	2,536,500
40%	0.300609	105	26,196,004	6,240,000
50%	0.468677	105	26,827,287	10,257,500
60%	0.695223	125	34,503,260	19,817,500
70%	0.990848	109	28,137,490	23,255,000
80%	1.441739	119	26,471,600	31,320,000
90%	2.37696	102	27,220,966	49,950,000
100%	142.4461	160	40,383,922	217,965,000
		1,063	262,852,675	362,861,500

1.380	Average Factor
341,356	Avg Loss

Avg Z	0.181
Avg Z^2	1.310
SD(Z)	1.130
s.e.(Z)	0.035
t	5.21
Cred	0.84
Final Factor	1.320

Phys. Intern/Resident



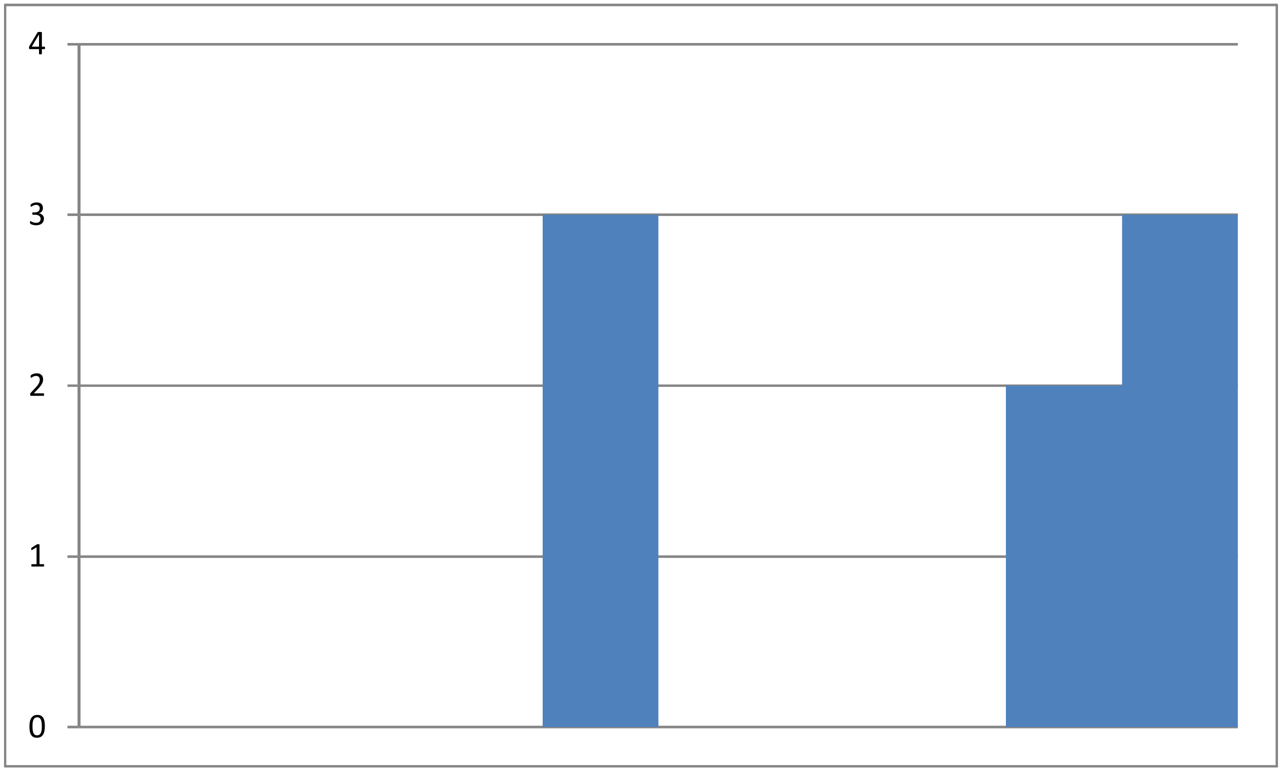
Rad. Therapy Technologist

Population Factors	
Percentile	Value
10%	0.041805
20%	0.099083
30%	0.18414
40%	0.300609
50%	0.468677
60%	0.695223
70%	0.990848
80%	1.441739
90%	2.37696
100%	142.4461

Rad. Therapy Technologist				
	Exposure	Loss		
0	-	-		
0	-	-		
0	-	-		
0	-	-		
3	515,760	167,500		
0	-	-		
0	-	-		
0	-	-		
2	471,293	840,000		
3	497,133	1,445,000		
8	1,484,186	2,452,500		
		1.652	Average Factor	
		306,563	Avg Loss	

Avg Z	0.738
Avg Z^2	1.124
SD(Z)	0.761
s.e.(Z)	0.269
t	2.74
Cred	0.65
Final Factor	1.424

Rad. Therapy Technologist

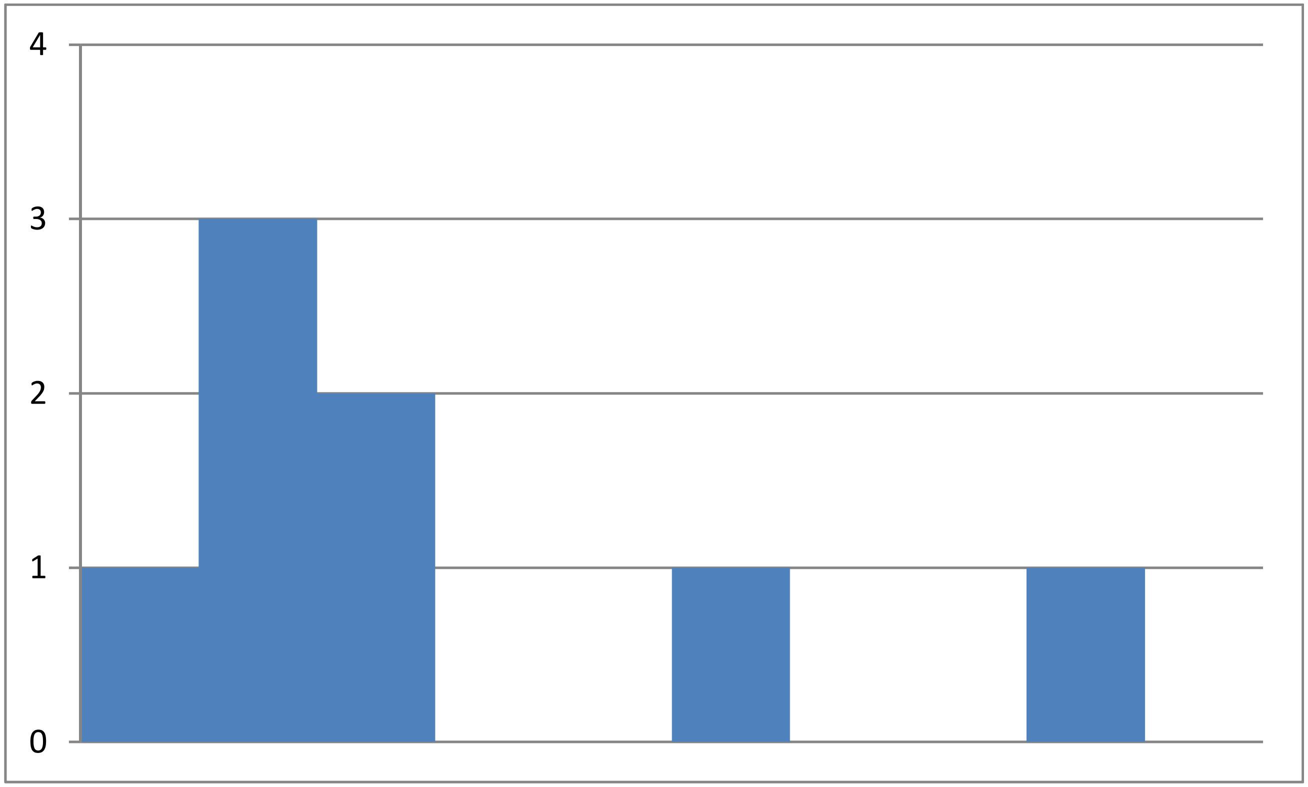


Denturist

Population Factors		Denturist		
Percentile	Value	Count	Exposure	Loss
10%	0.041805	1	225,268	2,500
20%	0.099083	3	576,570	47,500
30%	0.18414	2	335,849	35,000
40%	0.300609	0	-	-
50%	0.468677	0	-	-
60%	0.695223	1	212,745	145,000
70%	0.990848	0	-	-
80%	1.441739	0	-	-
90%	2.37696	1	82,274	135,000
100%	142.4461	0	-	-
		8	1,432,707	365,000
				0.255 Average Factor
				45,625 Avg Loss

Avg Z	-0.653
Avg Z^2	1.102
SD(Z)	0.822
s.e.(Z)	0.291
t	-2.25
Cred	0.57
Final Factor	0.575

Denturist



Malpractice Allegation Group

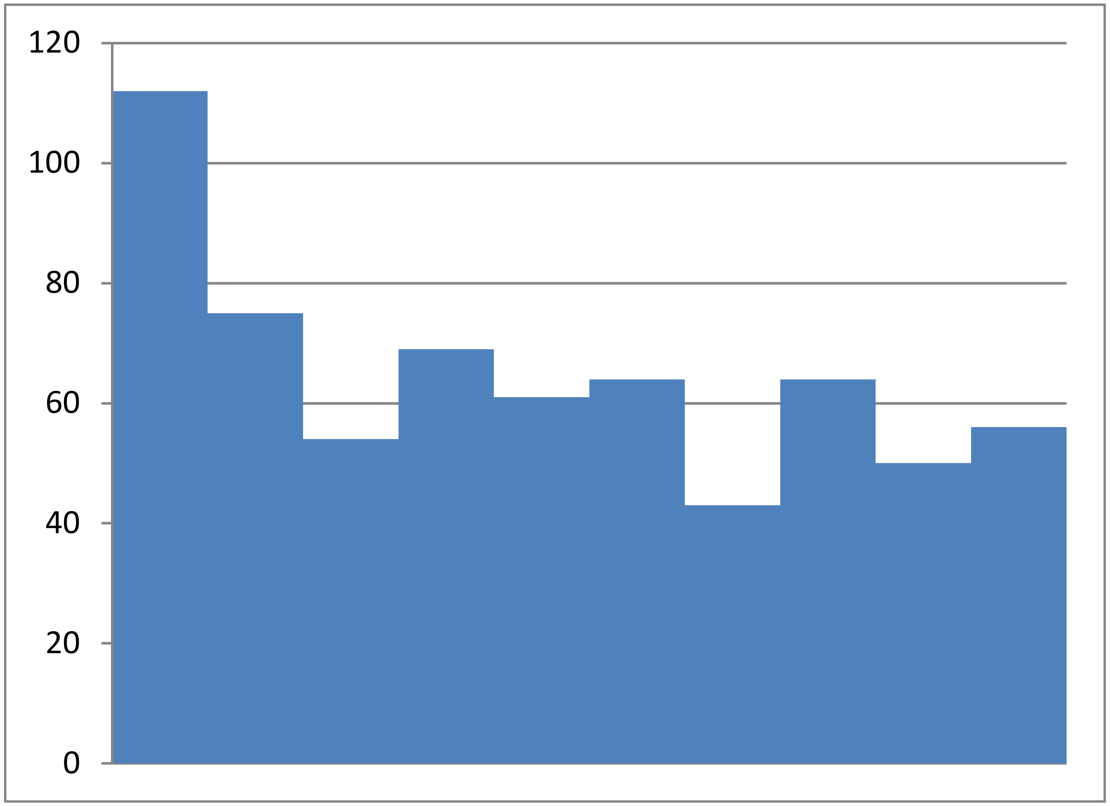
value ALGNNATR	target	xFactor ALGNNATR	Factor	Rank	Z
20	14,500,000	60,234	240.7274944	1	4.549043342
30	18,500,000	175,085	105.6628924	2	4.312154996
70	22,500,000	238,535	94.32564102	3	4.197857809
30	4,950,000	68,812	71.93532649	4	4.1209994
1	16,500,000	251,158	65.695802	5	4.062733895
20	5,950,000	91,356	65.13009151	6	4.015661142
10	14,500,000	241,678	59.99729166	7	3.97609059
50	18,500,000	326,572	56.6490697	8	3.941909391
10	3,950,000	73,057	54.06710229	9	3.911792569
50	12,500,000	234,879	53.21881766	10	3.884853401
60	7,350,000	140,861	52.17897235	11	3.860468733
50	22,500,000	437,025	51.48442013	12	3.838183604
50	8,950,000	177,253	50.49288099	13	3.817655521
10	13,500,000	270,713	49.86832219	14	3.798620083
50	6,450,000	133,999	48.13479438	15	3.78086884
20	7,950,000	169,877	46.79864343	16	3.764234488
50	8,150,000	177,253	45.97955085	17	3.748580674
20	6,050,000	135,538	44.63683319	18	3.733794776
50	5,950,000	133,999	44.40341497	19	3.719782677
10	715,000	16,125	44.34151972	20	3.706464909
20	1,950,000	44,031	44.28728517	21	3.693773747
20	7,950,000	184,197	43.1604148	22	3.681651
30	395,000	9,512	41.52854774	23	3.670046292
30	2,950,000	72,551	40.66082473	24	3.658915717
60	2,250,000	55,394	40.61797867	25	3.648220773
1	1,750,000	44,811	39.05296464	26	3.637927507
60	1,250,000	32,348	38.64188571	27	3.628005821
1	3,550,000	92,641	38.31985223	28	3.618428909
60	1,450,000	39,047	37.13455387	29	3.609172792

IV and Blood Products Related

Population Factors		**IV and Blood Products Related**		
Percentile	Value	Count	Exposure	Loss
10%	0.05462	112	24,775,971	562,600
20%	0.120586	75	17,096,573	1,396,750
30%	0.207375	54	11,357,346	1,817,500
40%	0.328603	69	15,118,425	4,020,000
50%	0.49206	61	13,916,420	5,692,500
60%	0.702418	64	14,623,417	8,740,000
70%	0.966734	43	10,898,318	9,172,500
80%	1.400657	64	14,058,479	16,072,500
90%	2.311856	50	12,836,477	22,645,000
100%	240.7275	56	12,208,921	57,385,000
		648	146,890,347	127,504,350
				0.868 Average Factor
				196,766 Avg Loss

Avg Z	-0.230
Avg Z^2	1.388
SD(Z)	1.156
s.e.(Z)	0.045
t	-5.08
Cred	0.83
Final Factor	0.890

IV and Blood Products Related



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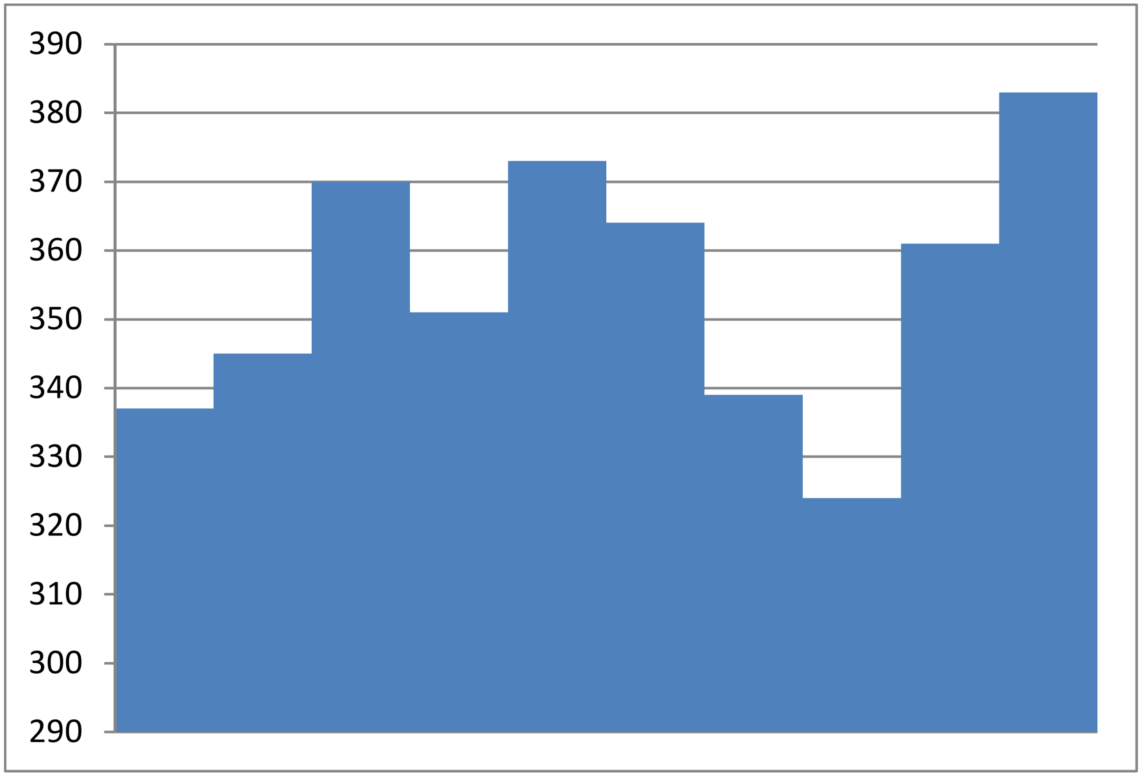
Monitoring Related

Population Factors		**Monitoring Related**		
Percentile	Value	Count	Exposure	Loss
10%	0.05462	337	73,584,132	2,110,100
20%	0.120586	345	75,721,162	6,539,250
30%	0.207375	370	87,325,606	13,959,500
40%	0.328603	351	86,242,360	22,601,250
50%	0.49206	373	98,894,853	40,063,750
60%	0.702418	364	90,781,054	54,225,000
70%	0.966734	339	88,352,143	72,765,000
80%	1.400657	324	83,894,637	98,377,500
90%	2.311856	361	92,584,699	163,367,500
100%	240.7275	383	97,405,946	484,920,000
		3,547	874,786,592	958,928,850
				1.096 Average Factor
				270,349 Avg Loss

Avg Z	0.023
Avg Z^2	1.034
SD(Z)	1.017
s.e.(Z)	0.017
t	1.33
Cred	0.37
Final Factor	1.036

Monitoring Related



Obstetrics Related

Population Factors		**Obstetrics Related**			
Percentile	Value	Count	Exposure	Loss	
10%	0.05462	521	131,273,682	3,635,250	
20%	0.120586	622	165,129,684	14,516,500	
30%	0.207375	761	197,032,446	32,512,500	
40%	0.328603	921	249,717,119	66,455,000	
50%	0.49206	1186	330,216,907	135,222,500	
60%	0.702418	1352	379,839,309	225,745,000	
70%	0.966734	1491	412,124,985	341,502,500	
80%	1.400657	1717	484,599,405	563,565,000	
90%	2.311856	1898	567,536,790	1,028,370,000	
100%	240.7275	2635	699,404,287	3,294,460,000	
		13,104	3,616,874,614	5,705,984,250	
				1.578	Average Factor
				435,438	Avg Loss

Avg Z	0.469
Avg Z^2	1.172
SD(Z)	0.976
s.e.(Z)	0.009
t	55.09
Cred	0.98
Final Factor	1.566

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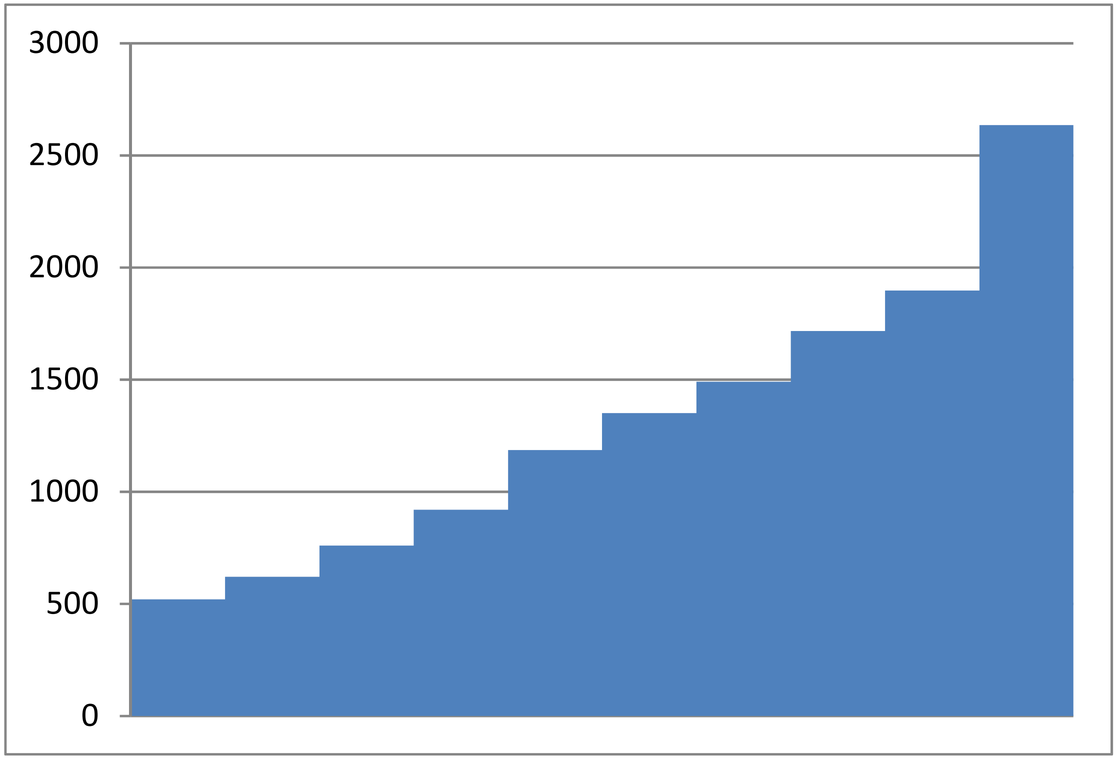
Obstetrics Related



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Age Group of Practitioner

value PRACTAGE	Target	xFactor PRACTAGE	Factor	Rank	Z
50	14,500,000	50,727	285.8449	1	4.549043
40	18,500,000	144,140	128.3478	2	4.312155
50	22,500,000	247,520	90.90192	3	4.197858
30	4,950,000	57,209	86.52487	4	4.120999
50	5,950,000	76,936	77.33684	5	4.062734
50	7,350,000	119,718	61.39446	6	4.015661
40	14,500,000	239,335	60.5845	7	3.976091
40	16,500,000	274,659	60.07448	8	3.941909
40	7,950,000	141,659	56.12069	9	3.911793
50	3,950,000	73,067	54.06024	10	3.884853
40	6,050,000	113,024	53.52826	11	3.860469
30	1,950,000	37,079	52.5898	12	3.838184
50	7,950,000	155,123	51.24958	13	3.817656
40	395,000	7,830	50.44438	14	3.79862
40	13,500,000	268,089	50.3564	15	3.780869
30	2,950,000	60,318	48.90744	16	3.764234
40	2,250,000	46,617	48.26552	17	3.748581
30	595,000	12,519	47.52629	18	3.733795
20	1,250,000	27,498	45.45843	19	3.719783
30	6,950,000	155,771	44.61677	20	3.706465
40	16,500,000	375,756	43.91143	21	3.693774
30	1,450,000	33,185	43.69478	22	3.681651
50	7,450,000	175,390	42.47669	23	3.670046
60	715,000	17,000	42.05932	24	3.658916
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

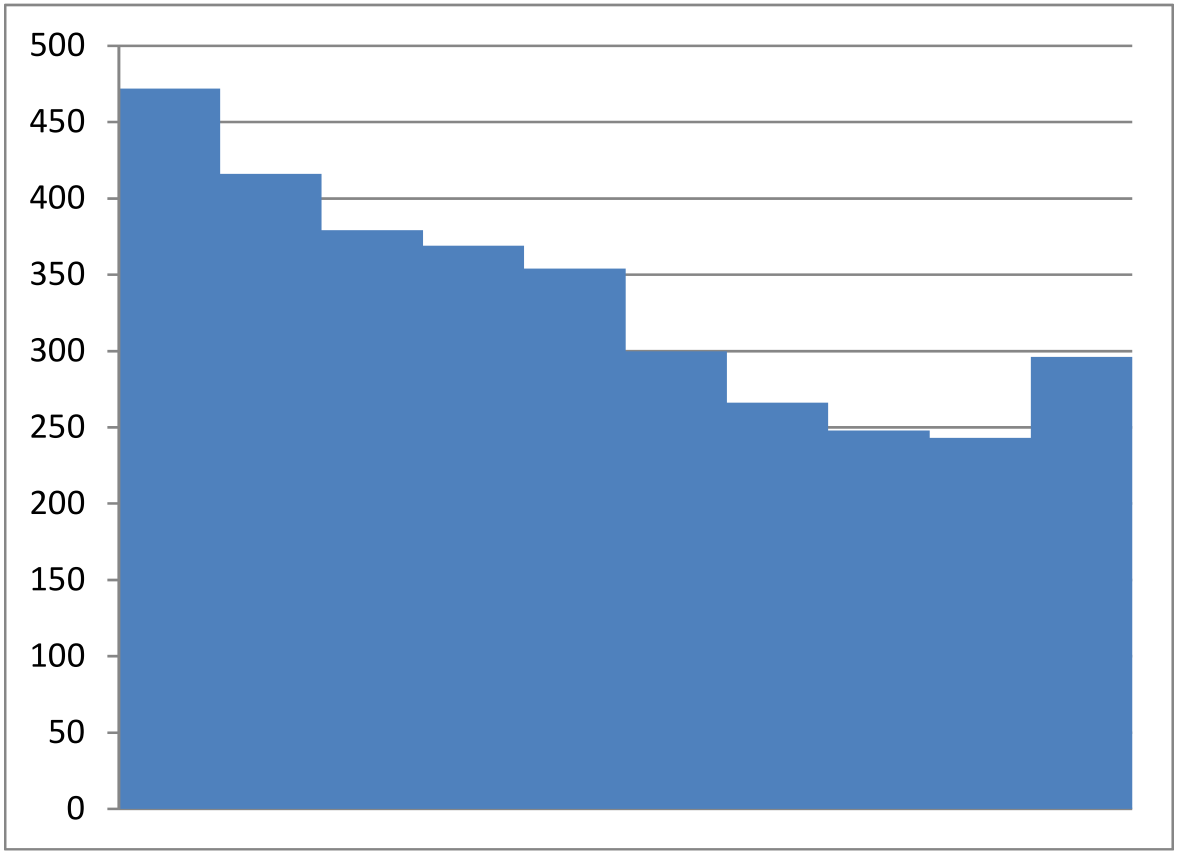
20-29 Years Old

Population Factors		**20-29 Years Old**		
Percentile	Value	Count	Exposure	Loss
10%	0.059593	472	62,366,984	1,854,200
20%	0.130032	416	60,222,231	5,587,500
30%	0.220899	379	56,804,544	9,778,250
40%	0.343411	369	61,951,421	17,397,500
50%	0.509496	354	61,342,270	25,841,250
60%	0.716369	300	49,956,736	30,230,000
70%	0.995321	266	51,060,153	42,797,500
80%	1.428828	248	44,690,562	53,832,500
90%	2.324493	243	44,846,331	81,060,000
100%	285.8449	296	61,390,703	310,515,000
		3,343	554,631,935	578,893,700
				1.044 Average Factor
				173,166 Avg Loss

Avg Z	-0.185
Avg Z^2	1.159
SD(Z)	1.061
s.e.(Z)	0.018
t	-10.06
Cred	0
Final Factor	1.000

Gross Consulting

20-29 Years Old

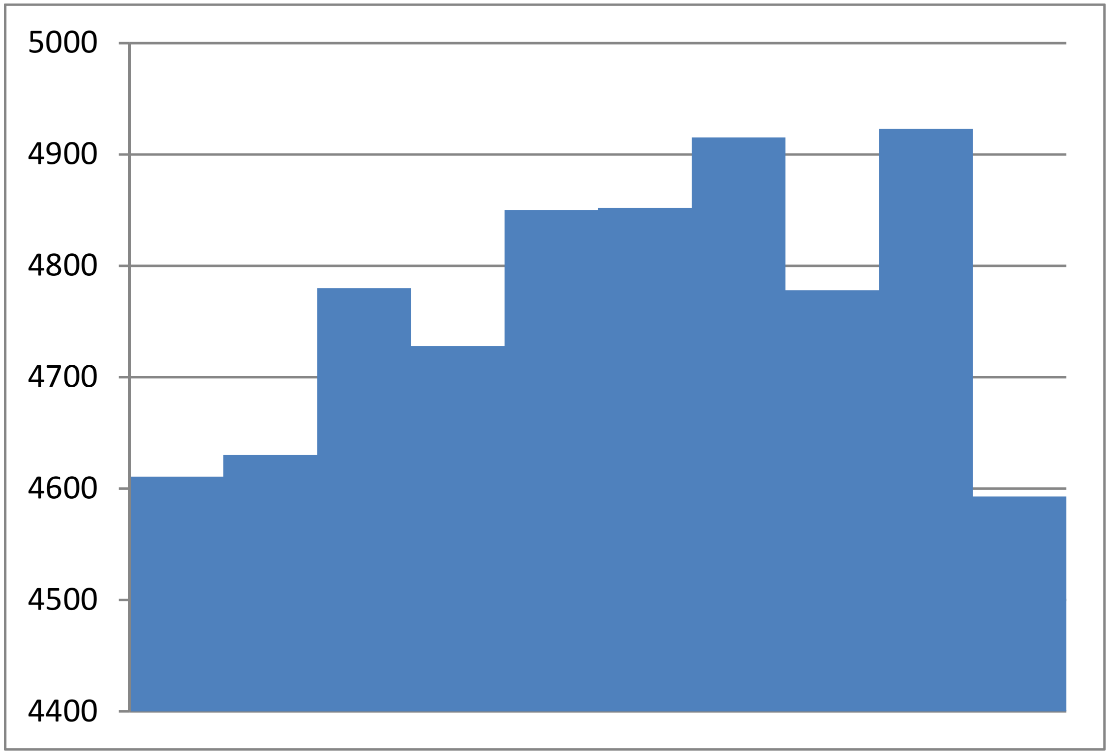


50-59 Years Old

Population Factors		**50-59 Years Old**		
Percentile	Value	Count	Exposure	Loss
10%	0.059593	4611	907,308,046	27,954,850
20%	0.130032	4630	903,670,630	84,731,250
30%	0.220899	4780	950,994,674	165,112,000
40%	0.343411	4728	1,010,451,947	283,003,750
50%	0.509496	4850	1,096,305,390	464,975,500
60%	0.716369	4852	1,138,897,435	695,573,750
70%	0.995321	4915	1,171,863,167	989,665,000
80%	1.428828	4778	1,157,859,115	1,384,010,000
90%	2.324493	4923	1,196,630,849	2,169,140,000
100%	285.8449	4593	1,021,798,236	4,143,510,000
		47,660	10,555,779,490	10,407,676,100
				0.986 Average Factor
				218,373 Avg Loss

Avg Z	0.007
Avg Z^2	0.967
SD(Z)	0.983
s.e.(Z)	0.005
t	1.62
Cred	0
Final Factor	1.000

50-59 Years Old



60-69 Years Old

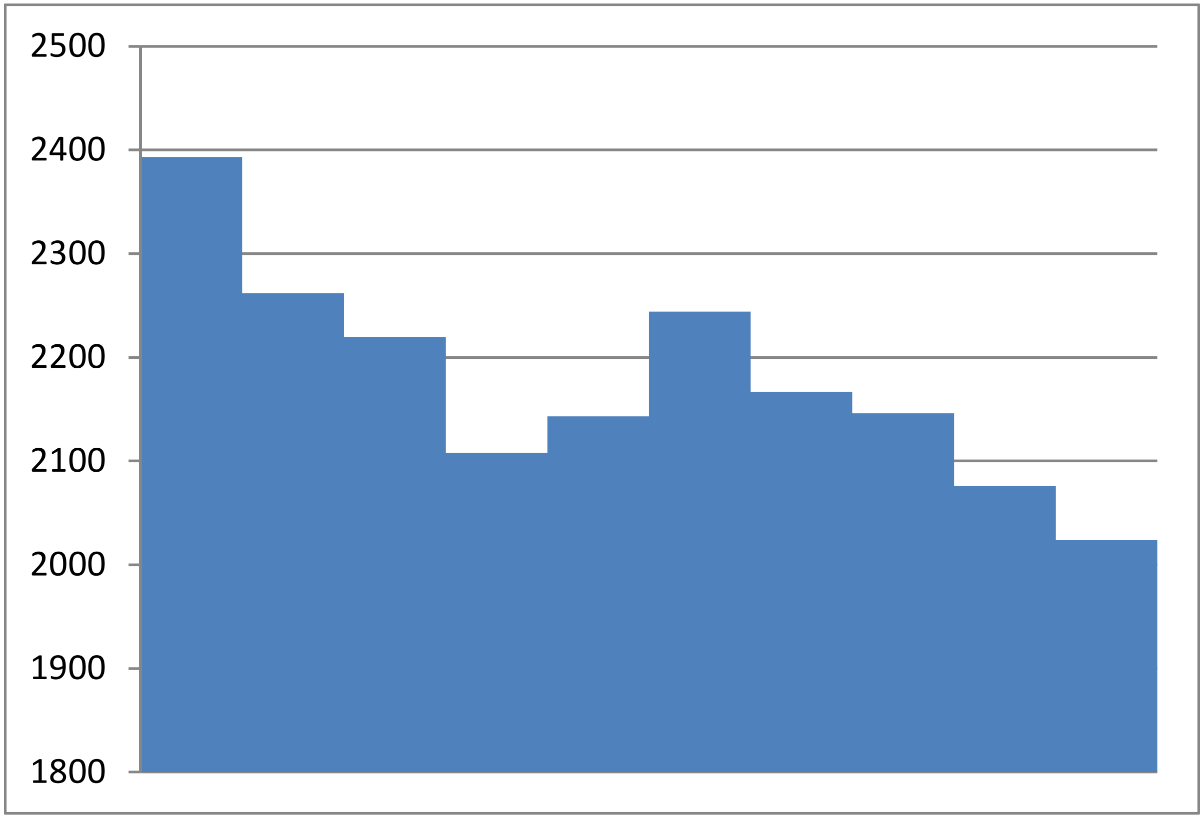
Population Factors		**60-69 Years Old**		
Percentile	Value	Count	Exposure	Loss
10%	0.059593	2393	452,176,013	13,717,750
20%	0.130032	2262	420,911,530	39,201,250
30%	0.220899	2220	436,823,872	75,761,250
40%	0.343411	2108	440,410,893	123,074,250
50%	0.509496	2143	465,707,966	196,943,750
60%	0.716369	2244	518,531,759	315,815,000
70%	0.995321	2167	489,033,927	415,962,500
80%	1.428828	2146	493,774,468	587,470,000
90%	2.324493	2076	485,195,837	878,180,000
100%	285.8449	2024	441,267,647	1,731,950,000
		21,783	4,643,833,913	4,378,075,750

0.943 Average Factor

200,986 Avg Loss

Avg Z	-0.042
Avg Z^2	1.000
SD(Z)	0.999
s.e.(Z)	0.007
t	-6.19
Cred	0.86
Final Factor	0.951

60-69 Years Old



Summary of those Illustrated

Characteristic	Value	Exposure	Observed Factor	t-stat	Cred
Practitioner Age	50-59 Years Old	47660	0.986	1.62	0
Practitioner Age	60-69 Years Old	21783	0.943	-6.19	0.86
Malpractice Allegation Group	Obstetrics Related	13104	1.578	55.09	0.98
Malpractice Allegation Group	Monitoring Related	3547	1.096	1.33	0.37
Practitioner Age	20-29 Years Old	3343	1.044	-10.06	0
Practitioner's Field of License	Phys. Intern/Resident	1063	1.380	5.21	0.84
Practitioner's Field of License	Nurse Anesthetist	788	1.210	1.66	0.49
Malpractice Allegation Group	IV and Blood Products	648	0.868	-5.08	0.83
Practitioner's Field of License	Physical Therapist	547	0.314	-19.82	0.96
Practitioner's Field of License	Rad. Therapy Technolo	8	1.652	2.74	0.65
Practitioner's Field of License	Denturist	8	0.255	-2.25	0.57

Summary

- Assigning a standard-normal Z score to individual observations, based on population rank-order, can be a useful way of considering the credibility of classifications, without making assumptions about the underlying distributional form of the observations.
- Credibility based on such an approach can result in giving more credibility to smaller amounts of exposure, when observations are consistent.