![American Academy of Actuaries logo — Objective. Independent. Effective.™]

Report to the
National Association of Insurance Commissioners
Property and Casualty Risk-Based Capital (E) Working Group

Update to
Property and Casualty Risk-Based Capital
Underwriting Factors
Experience Through December 31, 2017

Presented by the American Academy of Actuaries[1]
Property and Casualty Risk-Based Capital Committee

March 2021
(Revised April 21, 2021)

American Academy of Actuaries

Property and Casualty Risk-Based Capital Committee

Committee Chairperson   **(2017 – 2020)**: Lauren Cavanaugh, MAAA, FCAS
                                          (2020-current): David Traugott

Committee Members
 Michael Angelina, MAAA, ACAS, CERA
 Marios Argyrou, MAAA, ASA, FCAS
 Natalie Atkinson, MAAA, FIA
 Wayne Blackburn, MAAA, FCAS
 Lesley Bosniack, MAAA, FCAS, CERA
 Sandra Callanan, MAAA, FCAS
 Wanchin Chou, MAAA, FCAS, CPCU, CSPA
 Joseph Cofield, MAAA, FCAS
 Smitesh Davé, MAAA, FCAS
 Dennis Franciskovich, MAAA, FCAS
 Dennis Guenthner, MAAA, FCAS, CERA
 Qing He, MAAA, FCAS
 Allan Kaufman, MAAA, FCAS
 Judy Mottar, MAAA, ACAS
 David Shleifer, MAAA, ACAS
 David Traugott, MAAA, FCAS
 Ron Wilkins, MAAA, FCAS
 Jianhui Yu, MAAA, FCAS

Key Contributors: Wayne Blackburn, Lesley Bosniack, Sandra Callanan, Joseph Cofield, Dennis Franciskovich, Qing He, Allan Kaufman, Judy Mottar, David Traugott, Jianhui Yu, SakMan Luk

 NAIC support provided by SakMan Luk, Eva Yeung and Jane Barr

Contents

1. INTRODUCTION

The American Academy of Actuaries Property and Casualty Risk-Based Capital Committee ("Committee" or "We") prepared this Report ("Report") at the request of the National Association of Insurance Commissioners' ("NAIC") Property and Casualty (P&C) Risk-Based Capital (RBC) Working Group ("NAIC Working Group" or "Working Group").

In this Report, we present indicated Line of Business ("LOB") Underwriting ("UW") Risk Factors for the P&C RBC Formula ("RBC Formula" or "Formula"), specifically, RBC Line 4 on pages PR017 and PR018 for the Formula. We refer to these LOB UW Risk Factors as the "Reserve Risk Factor" ("RRF") and the "Premium Risk Factor" ("PRF"), respectively, or "Risk Factors," generically.

This is the first in a series of three reports. The results of this review will be input to subsequent Reports 2 and 3 that will address the following:

- Report 2—Investment Income Adjustment ("IIA")—RBC Line 8 on page PR017 (R4 UW Risk - Reserves) and Line 7 on page PR018 (R5 – UW Risk – Net Written Premium), by LOB.
- Report 3—Loss Concentration Factor ("LCF") and Premium Concentration Factor ("PCF")—RBC Line 14 on PR017 and PR018 respectively.

We describe the full scope of this three-part project in a letter to the NAIC Working Group dated May 9, 2019, that is attached as Appendix 15 in this Report. We plan to issue Reports 2 and 3 later this year.

We provide these indicated Risk Factors for the information of the NAIC Working Group. Report 2—Investment Income Adjustment, to be provided later this year, may also be useful in informing NAIC Working Group action related to the indicated UW Risk Factors in this Report.[2]

This work by the Committee builds on prior American Academy of Actuaries reports on UW Risk Factors, most recently in 2010 and 2016, which we refer to as the 2010 Report and the 2016 Report, respectively. We also use Casualty Actuarial Society (CAS) RBC research prepared by the CAS Dependency and Calibration Working Party (DCWP). We list this American Academy of Actuaries and CAS material in the Reference Section, Appendix 14.

The analysis presented in this Report is based on data evaluated through December 31, 2017. The analysis in the 2016 report was based on data evaluated through December 31, 2014.

---

[2] The IIA Report will address the fact that the current IIA's are based on a 5% interest rate, even though current interest rates are much lower. It is likely that the effect of reflecting lower interest rates will increase the overall risk charges.

2. FINDINGS

Indicated Risk Factors

Using the data and methodology described in this Report, we calculate the indicated Risk Factors. We compare the indicated factors to (a) indicated Risk Factors from the 2016 Report and (b) the Risk Factors in the 2020 RBC Formula in tables below:

- In Tables 1a and 1b we compare the Risk Factors indicated by the current analysis to the Risk Factors indicated in the 2016 Report. This comparison shows us the effects of changes in methodology and additional data for this Report compared to the 2016 Report.

- In Tables 1c-1e we show the effect on RBC values of moving from the Risk Factors in the 2020 RBC Formula to the Risk Factors indicated by this analysis. Appendix 13 provides further details on the effect of that change, and also the effects of "capping" the changes, using the capping rules the NAIC Working Group considered in evaluating the 2016 Report.[3]

Table 1a shows the following information:

- Columns 2 and 5—The factors in the "2020 RBC Formula" column are those used in the 2020 RBC Formula, except that, for catastrophe exposed LOBs, we increase the 2020 Risk Factors to their values before the NAIC catastrophe risk adjustments.[4,5]

- Columns 3 and 6—The Risk Factors in the "Indicated (2014 Data)" columns are the indicated factors presented in the 2016 Committee Report (2016 report),[6] using data evaluated through December 31, 2014.

- Columns 4 and 7—The Risk Factors in the "Indicated (2017 Data)"[7] columns are the indicated Risk Factors from this study, using data evaluated through December 31, 2017.

The all-lines average indicated Risk Factors in the analysis are relatively close to the all-lines average indicated Risk Factors from the 2016 analysis. Nonetheless, there are some notable changes in Risk Factors by LOB.

---

[3] While we provide this detailed information, as noted in the Introduction, the results of our IAA Report may provide more context for any changes in Line 4 Risk Factors.

[4] Beginning in 2016, the RBC Formula includes a new risk component, RCat, covering earthquake and hurricane components of the total premium risk. The indicated PRFs in this Report and in the 2016 Report have been calibrated with data that included earthquake and hurricane losses. Therefore, to avoid double counting of catastrophe risk, the NAIC developed a procedure to reduce the otherwise applicable Risk Factors for the affected LOBs. The factors that reduce the indicated PRFs to an ex-cat basis by LOB are as follows: Homeowners (0.971), CMP (0.980), Special Liability (0.983), Special Property (0.982), and Reinsurance: Nonproportional Assumed Property and Reinsurance: Nonproportional Assumed Financial, collectively called ("Reinsurance Property") (0.944).

[5] The indicated Risk Factors do not reflect the transition rules, often referred to as 'capping', that the NAIC requested.

[6] The NAIC has adopted a portion of the indicated Risk Factors from the 2016 Report in several steps from 2016 to 2019. The remaining differences between the 2019 Risk Factors and the indicated Risk Factors contained in the 2016 Report are due to NAIC capping for those LOBs that has not yet been removed.

[7] These indicated Risk Factors do not reflect any transition rules, often referred to as "capping," that the NAIC might request.

If the NAIC Working Group decides to update the current factors based on this research, we can provide "capping" alternatives if so requested.

Table 1a
Comparison of Risk Factors
2020 RBC Formula/ 2014 Data / 2017 data

(1)	(2)	(3)	(4)	(5)	(6)	(7)
	PRFs			RRFs		
Line	2020 RBC Formula	Indicated (2014 Data)	Indicated (2017 Data)	2020 RBC Formula	Indicated (2014 Data)	Indicated (2017 Data)
(1) H/F	0.964	0.964	0.960	0.213	0.213	0.223
(2) PPA	0.969	0.969	0.975	0.179	0.179	0.201
(3) CA	1.010	1.010	1.022	0.276	0.348	0.361
(4) WC	1.044	1.044	1.030	0.344	0.344	0.335
(5) CMP	0.901	0.901	0.897	0.494	0.494	0.499
(6) MPL Occ.	1.668	1.490	1.480	0.383	0.296	0.265
(7) MPL C-M	1.130	1.176	1.149	0.276	0.089	0.094
(8) SL	0.938	0.949	0.952	0.304	0.431	0.415
(9) OL	1.013	1.013	1.014	0.531	0.531	0.527
(11) Spec. Prop.	0.879	0.831	0.831	0.246	0.428	0.278
(12) APD	0.836	0.836	0.837	0.155	0.155	0.132
(10) Fidelity / Surety	0.854	0.680	0.666	0.371	0.917	0.600
(13) Other	0.935	0.935	0.933	0.220	0.375	0.225
(15) International	1.234	1.638	1.712	0.359	0.695	1.044
(16) Reins. Prop. / Fin.	1.239	1.240	1.240	0.415	0.415	0.343
(17) Reins. Liab.	1.323	1.322	1.252	0.656	0.656	0.636
(18) PL	1.263	1.285	1.270	0.802	1.345	1.472
(14) Financial / Mortgage	1.598	2.513	2.588	0.179	0.060	0.001
(19) Warranty	0.854	1.028	0.975	0.371	0.316	0.312
Average Risk Factor- all Lines	0.964	0.968	0.967	0.362	0.383	0.376
Average Risk Factor- 10-Yr Lines	0.996	0.996	0.995	0.375	0.387	0.390
Average Risk Factor- 2-Yr Lines	0.880	0.895	0.897	0.226	0.344	0.218

Note 1: Average Risk Factors are based on 2017 industry total net written premium and net unpaid loss and loss adjustment expense reserves, by LOB, for PRFs and RRFs, respectively.

Note 2: The company risk charge depends on not only the Risk Factors, above, but also depends on adjustments for company experience, investment income, loss sensitive contracts, company expenses (for premium risk) and a concentration adjustment. The change in Risk Factor is not representative of the change in RBC value for any particular company, as the Risk Factor does not include all elements of the RBC Formula and as distribution of premium/reserves by LOB differs widely among companies. Tables 1c-1e provide further details on the effect of the indicted Risk Factors on overall RBC values.

Note 3: Our indications are based on data from 1989[8]–2017 Annual Statements, Schedule P Parts 1, 2 and 3 for "Ten-Year LOBs" and from 1997–2017 confidential RBC Filings for Two-Year LOBs. [9] The NAIC compiled the data from the RBC Filings so that the available experience reflected 10 years for all LOBs.

Note 4: The shaded lines represent factors which are based on a limited amount of data.[10]

As our data sources and methods somewhat different between Two-Year LOBs and Ten-Year LOBs, the table shows the average indicated Risk Factors for all-lines combined and, also, separately for Two-Year LOBs and Ten-Year LOBs. Ten-Year LOBs are the LOBs for which Schedule P shows 10 accident years (AYs) of data. Two-Year LOBs are those for which Schedule P shows only two AYs of data.

Table 1b, below, supplements Table 1a, showing the premium risk charges assuming industry average expenses and showing the percentage change in Premium Risk Charge percentage (PRC%) and Reserve Risk Charge percentage (RRC%).[11] Note that the percentage change in RBC charge is higher than the change in Risk Factor as a percentage of premium or reserves.

---

[8] Electronic data for Part 1 is available for some earlier years, but, for the earlier annual statement years, the LOB definitions in Schedule P were not the same as the current LOB definitions.
[9] The Two-Year LOBs include Special Property, Automobile Physical Damage, Fidelity/Surety, Other (Including Credit, Accident and Health), Financial/Mortgage Guaranty, and Warranty.
[10] The analysis uses less than $50 billion in 2017 NEP or less than $50 billion in 2017 reserves after filtering, using Annual Statement data for all LOBs.
[11] PRC% = PRF + 2017 industry average expense ratio by LOB -100%. RRC% = RRF. Column (4) = column (3)/column (2). Column (7) = column (6)/column (5).

Table 1b
Comparison of Risk Factors
2020 RBC Formula/ 201 Data / 2017 data

(1)	(2)	(3)	(4)	(5)	(6)	(7)
	PRC%s			RRC%s		
Line	Indicated (2014 Data)	Indicated (2017 Data)	% Change	Indicated (2014 Data)	Indicated (2017 Data)	% Change
(1) H/F	25.4%	24.9%	-1.7%	21.3%	22.3%	4.5%
(2) PPA	19.7%	20.4%	3.2%	17.9%	20.1%	12.3%
(3) CA	29.6%	30.8%	4.1%	34.8%	36.1%	3.9%
(4) WC	30.6%	29.1%	-4.8%	34.4%	33.5%	-2.5%
(5) CMP	25.7%	25.3%	-1.5%	49.4%	49.9%	1.0%
(6) MPL Occ.	74.4%	73.5%	-1.3%	29.6%	26.5%	-10.3%
(7) MPL C-M	43.1%	40.4%	-6.3%	8.9%	9.4%	5.5%
(8) SL	28.7%	29.1%	1.2%	43.1%	41.5%	-3.8%
(9) OL	31.6%	31.8%	0.4%	53.1%	52.7%	-0.8%
(11) Spec. Prop.	13.2%	13.2%	0.1%	42.8%	27.8%	-35.2%
(12) APD	6.8%	6.9%	2.1%	15.5%	13.2%	-14.7%
(10) Fidelity / Surety	18.0%	16.6%	-8.0%	91.7%	60.0%	-34.5%
(13) Other	19.1%	18.9%	-0.9%	37.5%	22.5%	-40.0%
(15) International	107.7%	115.1%	6.9%	69.5%	104.4%	50.2%
(16) Reins. Prop. / Fin.	50.7%	50.7%	0.0%	41.5%	34.3%	-17.3%
(17) Reins. Liab.	59.0%	52.0%	-11.9%	65.6%	63.6%	-2.9%
(18) PL	61.4%	60.0%	-2.4%	134.5%	147.2%	9.5%
(14) Financial / Mortgage	185.4%	192.9%	4.0%	6.0%	0.1%	-98.2%
(19) Warranty	28.6%	23.3%	-18.6%	31.6%	31.2%	-1.3%
Average Risk Factor- all Lines	23.8%	23.8%	-0.1%	38.3%	37.6%	-1.9%
Average Risk Factor- 10-Yr Lines	26.9%	26.7%	-0.5%	38.7%	39.0%	0.9%
Average Risk Factor- 2-Yr Lines	16.0%	16.3%	1.6%	34.4%	21.8%	-36.6%

See Notes 1-4 on Table 1a

Effect of Indicated Risk Factors on RBC by Company

The NAIC has provided the information in Appendix 13, which summarizes the company-by-company changes in RBC values implied by the indicated RBC factors, for all companies with RBC Filings in 2019. These calculations include the effect of all elements of the RBC Formula.

Tables 1c – 1e, below, compare the RBC values based on the indicated Risk Factors with the 2017 data, in this Report, to the RBC values based on the indicated Risk Factors with the 2014 data, in the 2016 Report.

Table 1c shows that, overall, the 2017 indicated Risk Factors produce very little change in UW RBC Values for reserve risk, premium risk, or total Authorized Control Level (ACL) RBC. The average effect is a change of -0.6% for ACL.

Table 1c
Change in RBC Values
Indicated Risk Factors with 2017 Data Compared to Indications with 2014 Data

Risk Element	Indicated: 2017 Data vs 2014 Data
Change in Reserve Risk RBC	-1.9%
Change in Premium Risk RBC	-0.4%
Change in ACL	-0.7%

Table 1d shows that the changes, by company, are largely confined to the ±5% range.

Table 1d
Distribution of Change in ACL Values

(1)	(2)
% Change in ACL RBC	Indicated: 2017 Data vs 2014 Data
Less Than -50%	0
-50% to -25%	26
-25% to -15%	26
-15% to -5%	173
-5% to 5%	1,525
5% to 15%	85
15% to 25%	2
25% to 50%	0
Over 50%	0
Total	1,837

Table 1e shows the effect on RBC value by Type of Company.[12]

The largest change is for the Type of Company "NOC". The LOBs that predominate for that Type of Company are Fidelity/Surety, Special Liability,[13] and Other Liability. The variation in changes by Type of Company are larger for reserve risk than for premium risk. Appendix 13 contains more details on Type of Company and the distribution of LOBs within each Type of Company.

In the next section, we discuss the changes in data and methodology that influence those observations.

---

[12] Each LOB is categorized as being typical of a particular Type of Company, e.g., Private Passenger Automobile Liability is typical of Personal Lines companies. For each company, the category with the largest amount of premium determines the Type for that company. For example, a company with more of its premium in Private Passenger Automobile Liability, Homeowners, or Automobile Physical Damage than in any of the other groups of LOBs is categorized as Personal. Appendix 13, Part 4 provides the complete definition.
[13] For example, Boiler and Machinery and Ocean Marine LOBs.

Table 1e
Change in ACL Values by Type of Company
Indicated Risk Factors with 2017 Data Compared to Indications with 2014 Data

Type of Company	ACL Value with 2020 Risk Charges ($Billions)	Indicated 2017 vs. Indicated 2014		
		Reserve Risk Charge	Premium Risk Charge	ACL
Commercial	64.9	-3.3%	-0.7%	-1.7%
Med Prof Liab	2.4	-14.9%	-6.9%	-3.0%
NOC	0.9	-26.9%	-1.7%	-12.5%
Personal	84.3	4.8%	0.9%	0.5%
Reinsurance	8.2	-5.1%	-3.4%	-0.5%
Workers Comp	10.1	-3.2%	-4.3%	-2.1%
Total	170.6	-1.9%	-0.4%	-0.7%

NOC = Not otherwise classified.

Elements Driving Differences Between 2017 Indicated Risk Factors and 2014 Indicated Risk Factors

The changes in indicated Risk Factors from the 2016 Report to the current Report result from additional data and from some refinements in methodology. The sections below discuss the factors driving the major changes by Type of Company.

1. Zero Interior Anomaly—RRFs

We find that in the RBC Filings, there are companies that do not complete the interior of loss triangles, perhaps because these values are not required in the RBC calculation. For these companies, in the incurred and paid development triangle of the RBC Filing, all points are zero or blank, other than (a) initial evaluations by AY on the diagonal of the triangle, and (b) current evaluations of each AY, on the last column. We refer to these as "Zero Interior" triangles. Appendix 4, Table A-5b, contains an illustration of a zero interior triangle.

For Two-Year LOBs, in this Report, we remove Zero Interior triangle data from our analysis. That is a change compared to the 2016 Report, and that is the largest source of change in indicated RRFs for Two-Year LOBs. Four of those Two-Year LOBs are typical lines for the Type of Company "NOC" which shows the largest change in reserve risk RBC value as follows: Fidelity/Surety, "Other," Financial/Mortgage Guaranty, and Warranty.

In the 2016 Report we addressed the potential for zero interior data by excluding Reserve Runoff Ratios (RRR) with absolute value greater than 5. In this report we applied the zero interior filter in addition to excluding RRRs with absolute value greater than 5. Appendix 11, Table A-8a shows the effect of zero interior filter, by LOB.

2. Refined Minor Lines Definition—RRFs

We exclude risk data points where the premium for the LOB represents a small portion of a company's all lines premium as defined below. We call these data points "Minor Lines."

For Reserve Risk, the Minor Lines filter compares the NEP for the LOB for a period of years to the corresponding all-lines premium. To the extent the appropriate data are available, we use a rolling Ten-Year period for this calculation. As there are variations in the data available from year-to-year, the "window" varies by LOB. Appendix 5 provides further details on this approach.

The use of Ten-Year "windows" differs from the approach in 2016 Report, where the reserve risk Minor Lines definition was based on all-years premium. With the increase in the number of years of premium in our data set, we determined that a change in procedure should be considered, and we adopted this approach.

This change in methodology reduces RRFs by about 1% overall, but by larger amounts for the reinsurance LOBs, for Financial/Mortgage Guaranty, for Other, and for Special Property LOBs. The change drives much of the change for the reserve risk RBC values for the Reinsurance Type of Company. Appendix 11, Table A-8a shows the effect of the revised minor lines definition, by LOB.

3. Absolute (RRR)>5—RRFs—Two-Year LOBs Based on RBC Data

In the 2016 Report, we excluded RRR values greater than 5 for both Ten-Year LOBs and Two-Year LOBs from Annual Statement and RBC data, respectively, because we were concerned that the ratios reflected data quality issues.

We have reviewed this issue, and for the Two-Year LOBs from confidential RBC data, we continue to exclude data if the absolute value of RRR is greater than 5, as many such values appear to be due to data anomalies. For the Ten-Year LOBs, however, in this review, we use RRR values, regardless of size.

If large RRR values were data errors, then we might expect an impact across all LOBs. However, for Ten-Year LOBs, to the contrary, we find a wide range of impacts, as a percentage of reserves, from a low 0.000 to a high of 0.195. There are nine of thirteen Ten-Year LOBs affected by less than 1% of reserves and only two affected by more than 5% of reserves. As such, we see no need for an all-lines exclusion.

Table A-5a, in Appendix 4, below, shows the effect of removing this filter by LOB. It shows that the weighted average effect on the RRFs for Ten-Year LOBs is an increase of 0.9% of reserves. It shows the Ten-Year LOBs most affected by removing the exclusion are as follows: Products Liability (19% of reserves) and International (20% of reserves). The LOB effects are not apparent in the Type of Company summary because Products Liability is usually a small part of business for a Commercial Type of Company and International is a relatively small LOB.

The change tends to increase the indicated RRF for reinsurance liability, which mitigates the effect of other changes in RRF for that LOB, e.g., the change in the Minor Lines procedure.

4. Other Changes

We describe the nature of the changes in more detail in the remainder of the Report, and we show all the components of change in the following Appendices:

- PRFs (Ten-Year LOBs): Appendix 10, Table A-7
- RRFs (all LOBs): Appendix 11, Table A-8

Issues Related to Certain LOBs

Various considerations that might affect the selection of Risk Factors for certain LOBs are as follows:

- Low Credibility LOBs—The International, Financial/Mortgage Guaranty, and Warranty LOBs have relatively few data points for our analysis—900, 200, and 100 respectively—after filtering for reserve risk and similar amounts for premium risk. That compares to over 10,000 data points for the Private Passenger Liability, Homeowners, and Workers' Compensation LOBs. As such, indicated Risk Factors are more subject to variation from year-to-year because of even small changes in methodology and because of random variations in emerging data, than is the case for other LOBs.

- Financial/Mortgage Guaranty—There are many single state/monoline companies that provide data in the Annual Statements, but that are exempt from RBC requirement. The data for the single state/monoline mortgage/financial guaranty companies are <u>not</u> included in the data used to develop the indicated Risk Factors in Table 1.[14]

- Warranty—This LOB was separated from the Fidelity/Surety LOB in 2008. Some companies provided a complete history for Accident Year ("AY") including prior AYs. Other companies provided the separate data only for AYs 2008 and subsequent. As such, RBC data for the Warranty LOB in Annual Statements prior to 2017 is very limited.

- International—As noted in the first bullet, the volume of data in this LOB is relatively low. Moreover, proportionally more of the historical experience for this LOB arises from earlier Annual Statements than from more recent Annual Statements. As such, the relevance of indicated Risks Factors for current LOB M business is less certain than for other LOBs.

- Products—Asbestos and Environmental claim emergence affects reserve development from each of the over 30 years of Annual Statements in our analysis. It is possible that this ongoing emergence results in over-stated indicated RRFs.[15,16]

- Minimum Risk Charges—For some LOBs, the indicated risk charges will be negative, after the investment income adjustment, for a company with industry average expenses and with average loss ratio/reserve development experience (Medical Professional Claims Made and Financial/Mortgage Guaranty RRFs). Also, for one LOB, the indicated risk charge will be zero or above, but below 5%, (Automobile Physical Damage-PRF). The NAIC Working Group may want to consider the use minimum risk factors.

---

[14] This RBC Risk Factor analysis does not consider the solvency risk aspects of Statutory Contingency Reserves that might be provided for Financial/Mortgage Guaranty LOBs or the implications of large unearned premium reserves (viewed as a percentage of written premium) for longer duration policies in Warranty, Financial/Mortgage, and health (included in "Other") LOBs.

[15] It is less obvious in the PRF indicated Risk Factors, but asbestos and environmental claim emergence might also affect Reinsurance Liability, Other Liability, and (to a lesser degree) Commercial Multiperil LOBs.

[16] To the extent that the NAIC Working Group implements changes in risk factors with caps, as it has done in the past, this risk of over-stated Product Liability RRFs is mitigated.

Effect of 2017 Risk Factors Compared to Risk Factors in 2020 RBC Formula

If the NAIC Working Group were to implement Risk Factor changes based on the indicated Risk Factors, Table 1f, below, shows the percentage change in reserve Risk Charge, premium Risk Charge and ACL that would result, using capped and uncapped scenarios shown.

Table 1f
Change in RBC Values
2020 RBC Formula Risk Factors vs. Alternative Capped and Uncapped Indicated risk Factors

(1)	(2)	(3)	(4)	(5)
		% Change From 2020 Formula		
Row	**Risk Factors/Cappping**	**Reserve Risk Charge**	**Premium Risk Charge**	**ACL**
1	**2020 RBC Fomula**	Base	Base	Base
2	**2014 Indicated -Uncapped**	9.3%	-1.9%	2.8%
3	**2017 Indicated -Uncapped**	7.2%	-2.3%	2.1%
4	**2017 Indicated - 5% Min. - Uncapped**	7.9%	-2.3%	2.2%
5	**2017 Indicated - 5% Min. - ±10% Max**	0.5%	-0.6%	0.0%
6	**2017 Indicated - 5% Min. - ±20% Max**	2.1%	-1.5%	0.4%
7	**2017 Indicated - 5% Min. - ±35% Max**	3.4%	-2.5%	0.7%

Table 1f shows the following:

- Row 2—The change in risk charges that would result from implementing the 2014 indicated Risk Factors in the 2016 Report is not zero, because those factors have been partially, but not fully implemented.

- Row 3—The change in Risk Factors that would result from implementing the 2017 indicated Risk Factors are lower than from implementing the 2014 indicted Risk Factors, because, as shown in Table 1c, the 2017 indicated Risk Factors are lower than the 2014 indicted Risk Factors.

- Row 4—If we apply a minimum risk charge, after investment income adjustments, of 5%, the change in risk charges is slightly higher than if that were not applied, i.e., 2.2% of ACL rather than 2.1% of ACL.

- Rows 5-7—If we apply the 2017 indicted Risk Factors, but capped to produce a maximum change in risk charge by LOB, after investment income adjustment, the changes in ACL are 0.0%, 0.4%, and 0.7% for caps of 10%, 20%, and 35% respectively. The caps are applied to the absolute value of the risk charge change, i.e., no more than 10% upward or 10% downward. The 5% minimum is applied in each of the examples.

3. METHODOLOGY

We determine the indicated Risk Factors as outlined below in Appendices 1-9. In Appendices 10 and 11, we analyze the movement in indicated Risk Factors from the values in the 2016 Report to the values in in this Report.

Risk Factor Overview

We describe the basis for the PRF and RRF indications below.

PRF Indications

The PRF for a LOB is a component of the premium risk charge, which reflects the risk that a subsequent year of company premium, net of reinsurance, will produce an adverse UW result.

The indicated PRF for each LOB is derived from loss and loss adjustment expense ("LAE") ratios, for each LOB/company/year in the selected experience period. We refer to the net earned premium ("NEP") and the loss ratio ("LR") for an AY/company/LOB as a premium risk data point.

The indicated PRF is the 87.5[th] percentile of the LRs after the filtering described in the Data Selection section below.

RRF Indications

The RRF for a LOB is a component of the reserve risk charge, which reflects the risk that currently reported reserves for loss and all loss adjustment expense, net of reinsurance, will develop adversely from the initial reserve date to ultimate.[17, 18]

The indicated RRF for each LOB is derived from RRRs by company/year in the selected experience period. The denominator of that ratio is the company carried loss reserve, for all AYs combined, at the initial reserve date.[19] The numerator of the ratio is the increase/decrease in the company estimated incurred losses for all AYs combined from that initial reserve date to the latest available evaluation date. Appendix 12—Examples 1, 2, and 3 illustrate the RRR calculation. We refer to the initial reserve amount and the RRR for an initial reserve date/company/LOB as a reserve risk data point. We refer to premium and reserve risk data points, generically, as risk data points.

The indicated RRF is the 87.5[th] percentile of the RRRs after the filtering described below.

---

[17] The development to ultimate is often referred to as a "runoff" time horizon, in contrast to a "one year" time horizon that considers adverse development over a one-year period. This is intended to be the development to ultimate, but implementation of that intention is limited by the available data.

[18] The RRF does not measure the adequacy of a company's carried reserves. The company experience adjustment, not part of this analysis, partially reflects company historical reserve adequacy, relative to the industry.

[19] The amounts in this calculation are gross of nontabular discount.

<u>Data</u>

We obtain our data from:

- Annual Statements, Schedule P, Parts 1, 2, and 3, for all LOBs, for years 1989[20]–2017, and
- Confidential RBC Filings,[21] for Two-Year LOBs, for years 1994–2017.[22]

Compared to the 2016 Report, the data available for this Report include three "new" Annual Statement and RBC Filings (2015–2017), and eight "older" Annual Statements (1989–1996). These additional data are desirable because they include more data points, contain more developed data for recent years, reflect a wider range of UW and economic conditions, include more recent data, and provide some data for AY 1988 and subsequent that were not available in the data used for the 2016 Report.[23]

<u>Data Filtering</u>

Consistent with the 2016 Report methodology, our indicated Risk Factors use the data described above and filtering rules itemized below. The filtering rules address the following features of the data:

1. Experience period

2. Pooling

3. Anomalous data, including Zero Interior filter

4. Minor lines

5. Age

6. Size

7. Maturity

In this analysis we refine the use of filters compared to the 2016 Report, as follows:

For both Premium and Reserve Risk:
- Enhanced the size threshold calculation (Appendix 7)
- Age based on "pool" age rather than "oldest company" age (Appendix 6)
- In the 2016 Report we selected the most mature LR and RRR after we consolidated company data into pools, as appropriate, ("Pooling First"). In this Report, we select the most mature LRs and RRRs by company, before consolidation into pools, as appropriate ("Maturity First"). (Appendix 3).

---

[20] Electronic data for Part 1 is available for some earlier years, but, for the earlier annual statement years, the LOB definitions in Schedule P were not the same as the current LOB definitions.
[21] RBC Forms PC111-114 and 121-122 for premium and RBC Forms 211-214, 221-222, and 301-304, for reserves.
[22] RBC Filing data compiled by regulators who provide summary results to this Committee.
[23] For example, there are companies with 1996 Annual Statements that include data on AY 1988, or reserve year ending December 31, 1988, that did not file Annual Statements after 1996. In this case, the 1988 experience of these companies are not part of the 2016 Report analysis, because data from 1996 and prior Annual Statements were not available.

For Reserve Risk Factors:

- Revise the treatment of RRRs with absolute value greater than 5 for Ten-Year LOBs (Appendix 4)
- Revised definition of "Minor Lines" (Appendix 5)
- Zero Interior filter for reserve risk data for confidential RBC Filings, used for Two-Year LOBs, and from Annual Statement, for all LOBs (Appendix 4)
- Minor lines categorization and LOB-age for RBC RRRs based on Annual Statement data (Appendix 5—Minor Lines and Appendix 6—LOB-age)

We identify the changes with the largest effects, by Type of Company, in the Findings section above.

We outline the nature of these filters, and the impact of the changes, in the sections immediately below, and we further describe them in Appendices 1-9. Except as noted, we applied the same methods in our analysis of Annual Statement data and confidential RBC data.

1. Experience Period (Appendix 2)

In this Report, we use LRs for AYs 1988–2017 and RRRs for initial reserve years ending 1988–2016.[24] For Ten-Year LOBs, we obtain this data from Annual Statements. For Two-Year LOBs, we obtain the data from confidential RBC Filings. For the 2016 Report, the data covered LRs and RRRs from AY 1988–2014 and initial reserve years ending December 31, 1988–2013.

Exclude AYs and Initial Reserve Years Prior to 1988

For this Report, we have experience for AYs/Reserve Years 1980 to 1987 that was not available for the 2016 Report. Looking at indicated Risk Factors by decade, we find that for nearly all the liability LOBs, this oldest block of years shows the highest indicated PRFs and RRFs.

This pattern may be due to factors that might not be applicable to current conditions. For example, the 1993 Report on Reserve and Underwriting Risk Factors by the American Academy of Actuaries Property/Casualty Risk-Based Capital Task Force (page 4)[25] identified four reasons why the experience of the 1980's might not be suitable for projection of the future. These are:

- *The tort liability explosion, particularly in respect to asbestos and environmental liabilities.*

- *A great deal of naïve capacity, focused especially on general liability and reinsurance lines.*

- *High interest rates, creating intense pressures to engage in cash flow underwriting*

- *High inflation rates*

---

[24] Note that the most recent AY is 2017, but the most recent initial reserve date is December 2016. The most recent initial reserve year is always one year older than the most recent AY, as for the latest year, the reserve development is zero and not useful for our analysis.

[25] American Academy of Actuaries Property/Casualty Risk-Based Capital Task Force, Report on Reserve and Underwriting Risk Factors, May 1993, https://www.casact.org/pubs/forum/93sforum/93sf105.pdf.

Other considerations include:

- Company loss reserving practices may have improved because of required actuarial opinions and increased regulatory, rating agency and management attention to reserving.

- The adverse experience in these years triggered expansion in the use of claims-made policies, pollution exclusions, asbestos exclusions, and other policy changes.

- Company pricing discipline and pricing methodology may have improved since the 1980's.

Therefore, in this Report, we do not use the experience prior to 1988, because these early years may not be sufficiently relevant to the present conditions.

2. Pooling (Appendix 3)

We combine risk data points from intercompany pool participants into a single pool-wide risk data point. Two features of the pooling process are new in this Report.

- First, in the 2016 Report we selected the most mature LR and RRR after we consolidated company data into pools, as appropriate, ("Pooling First"). In this Report, we select the most mature LRs and RRRs by company, before consolidation into pools, as appropriate ("Maturity First"). We example the reasons for this change in Appendix 3.

- Second, while we generally apply the filter to the pooled data points, we apply the new zero interior filter before pooling.

3. Anomalous values (Appendix 4)

Premium Risk

For PRFs, we exclude risk data points with anomalous values, i.e., negative values for premiums, incurred losses. We exclude zero incurred losses, as these can represent unusual financial transactions or other data anomalies.

Reserve Risk

For RRFs, we exclude the entire company/LOB/statement year data triangle, before pooling, if:

- Any calendar year[26] has negative cumulative incurred losses, all AYs combined

- Any calendar year has negative total cumulative paid losses, all AYs combined

- Any calendar year has a negative total reserve, all AYs combined

- The interior of the development triangle is entirely zero values

Also, for both Annual Statement and RBC data, we exclude risk data points where the initial reserve is zero. In the Pooling First approach, this can have has the effect of excluding the entire company/LOB/statement year. In the Maturity First approach, even if there is a zero initial reserve at one valuation date, we might construct RRR values from data points in the statement year for other maturities that have non-zero initial reserves.

---

[26] A calendar year in the Annual Statement or RBC development triangle is the sum of values for all AYs within a column of the data triangle. The test means examining the sum of the incurred losses over all AYs plus the prior year row, for a development column in Schedule P, Part 2, or the corresponding amounts for RBC incurred loss schedules, and similarly for paid losses in Schedule P Part 3.

Absolute (RRR)>5

As discussed in the Findings section, we exclude RBC risk data with absolute values of RRR>5 for Two-Year LOBs. In the 2016 Report, we excluded RRR values greater than 5 for both Ten-Year LOBs and Two-Year LOBs because we were concerned that the ratios reflected data quality issues.

4. Minor Lines (Appendix 5)

We exclude risk data points where the premium for the LOB represents a small portion of a company's all lines premium as defined below. ("Minor Lines")

For premium risk, the Minor Lines filter compares the LOB premium to the all-lines NEP for each AY separately. This is the same method that was used in the 2016 Report. As described in the Findings section above, for Reserve Risk, the Minor Lines filter compares the NEP for the LOB for a period of years—10 years where practical—to the corresponding all-lines premium.

For both reserve risk and premium risk, the threshold boundary for Minor Lines is as follows:

Table 2
Minor Lines Thresholds -PRFs and RRFs

LOBs (NAIC Code)	Minor Lines Threshold
All lines other than those listed below	5.0%
Other Liability and Products Liability combined	5.0%
Special Liability, Fidelity/Surety, Warranty	2.5%
International, Financial/Mortgage Guaranty	No Filter

These thresholds in Table 2 are the same as in the 2016 Report.

We determine the Minor Line status of each reserve risk data point using Annual Statement data. We apply that status to the corresponding RBC reserve risk data point.[27]

5. Age—Years of LOB NEP > 0 (Appendix 6)

We exclude premium and reserve risk data points where, for a particular company/LOB, there are less than five years[28] of NEP greater than zero.

This is the same filter that we used in the 2016 Report, although (1) with additional years of experience, there are some "young" LOBs excluded by this age filter in the 2016 Report that are not excluded in this Report, and (2) in this Report we determined age by pool while in the 2016 Report pool age equaled the age of the oldest company within the pool. This change may have excluded some data points that had been included in the 2016 Report.

6. LOB Size (Appendix 7)

We exclude risk data points where, for a LOB, NEP (or initial reserve) is less than the 15th percentile for the AY or initial reserve year. We smooth the 15th percentile size threshold in one of several ways that we discuss in Appendix 7.

---

[27] This simplifies the calculation effort required of the regulatory working with the confidential RBC data.
[28] Consecutive or non-consecutive years.

7. Maturity (Appendix 8)

We exclude the least mature risk data points, as we did in the 2016 Report. We exclude risk data points with maturity less than the number of years shown in Table 3 below.

Table 3—Maturity Filtering
"na" means there is no filter, i.e., use all years regardless of maturity

Line	PRF	RRF
(1) H/F	na	3
(2) PPA	na	3
(3) CA	na	3
(4) WC	na	4
(5) CMP	na	5
(6) MPL Occ.	5	4
(7) MPL C-M	na	5
(8) SL	na	3
(9) OL	na	4
(11) Spec. Prop.	na	na
(12) APD	na	na
(10) Fidelity / Surety	na	na
(13) Other	na	na
(15) International	4	na
(16) Reins. Prop. / Fin.	na	3
(17) Reins. Liab.	4	4
(18) PL	5	4
(14) Financial / Mortgage	4	na
(19) Warranty	5	na

8. Overall Effect of Filtering

Table 4 below shows the volume of NEP/reserve used in the filtered data set compared to the total volume. This table shows that the proposed filtered data set uses most of the NEP and reserve volume available in the data, after removing anomalous data.

Table 4—Data Used in Filtered Data Set[29]
1988–2017 AYs and Initial Reserve Years

Item	PRF			RRF		
	All Lines	10 Yr Lines	2-Yr Lines	All Lines	10 Yr Lines	2-Yr Lines
% Premium/Reserves	92%	93%	90%	82%	82%	72%
% Risk Data Points	52%	52%	52%	46%	45%	47%

---

[29] Data from 1988–2017, reflecting the effect of all filtering (items 1-7).

In the 2016 Report, these ratios had similar values. For premium and reserve amounts, the all-lines ratios were 93% and 80% for premium and reserves, respectively. For number of data points, the ratios were 53% and 43% for premium and reserves, respectively.

9. Safety Level

Consistent with prior Committee reports and NAIC Working Group, decisions, the indicated Risk Factors are based on an 87.5th percentile of reserve risk data points and premium risk data points for Reserve Risk and Premium Risk, respectively, subject to the filtering discussed previously.[30]

4. OTHER CONSIDERATIONS AND FUTURE RESEARCH

This Report does not address the following issues:

1. Catastrophe Loss Adjustment—The indicated PRFs shown in this Report reflect the inclusion of earthquake and hurricane catastrophe losses. We have not separated the Risk Factors into the non-catastrophe and catastrophe components used in the RBC Formula.

2. Workers' Compensation Discount—Our scope does not include estimating the effect that unwinding Workers' Compensation tabular reserves might have on the indicated Risk Factors.

3. Line 3 Company Experience Adjustment—The RBC formula includes an adjustment for the company loss ratio for premium risk (or runoff ratio for reserve risk) in relation to the corresponding industry ratios in pages PR0017 and PR0018, lines 1, 2, and 3.

   Consistent with the proposed calibration of PRFs and RRFs, the NAIC P&C RBC Working Group should consider changes to the calculation of the industry loss ratio and/or reserve ratio (Line 1 on PR0017 and PR0018) to reflect the filtering of the Risk Factor calibration discussed above. This could include:[31]

   - Excluding risk data points when premiums (reserves) are below the 15th percentile for that AY/LOB ("Size").
   - Combining risk data points from intercompany pool participants into a single pool-wide risk data point ("Pooling").
   - Excluding risk data points where the NEP for the LOB represents a small portion of a company's total NEP ("Minor Lines").
   - Excluding LOB/company risk data points if there are less than five years of NEP for that LOB ("Age").
   - Assess the need for change to reflect that calibration data exclude certain immature risk data points.[32]

4. The current RBC formula structure—Our indicated Risk Factors assume the current structure of the RBC Formula. For example,[33] while indicated UW Risk Factors vary by line of business volume, the Committee provides a single factor for each LOB.

---

[30] In the next report, we plan to further discuss the safety level reflecting both Line 4 safety level and the effect of the investment income offset.

[31] We believe the NAIC method of developing the factors excludes anomalous data, i.e., unexpected zero or negative values.

[32] Adjustment possibilities include (a) revising own-company calculation to use only the more mature risk data points, or (b) making no adjustment because the company data and industry data are at the same maturity.

[33] This is one example. There are other variations in the RBC Formula.

5. As discussed earlier in the report, in the Findings section, for several LOBs, there are particular issues that might affect selected Risk Factors and/or might be the subject of future analysis.

6. The zero interior aspect of the RBC Filing data[34] that we use for our calibration indicates that additional data quality assessment for past data, and/or clarification of RBC Filing requirements, might be useful. Assessment of data quality is problematic because the RBC data is confidential, and not available in detail to this Committee.

7. As we were completing this analysis, we realized that it is possible to obtain two data points from the loss triangles provided for two-year lines of business in the Annual Statement. Because it contains a reserve valued one year prior to two individual accident years provided in the triangle, it is possible to calculate a reserve risk ratio from solely the prior year row and this would provide one additional year of development.

5. APPENDIX 1—DATA

We obtain our data from 1989[35]–2017 Annual Statements, Parts 1, 2, and 3 for all LOBs, and from 1994–2017 confidential RBC Filings for Two-Year LOBs.

Compared to the 2016 Report, the following additional data is available for this Report:

- The 2015–2017 Annual Statements and RBC Filings add three additional AYs and three initial reserve dates: AYs 2015, 2016, and 2017, and initial reserve dates December 31, 2014, 2015, and 2016. These Filings also increase the maturity of data for AYs and reserve runoff on initial reserves for 2007–2014.[36]

- The eight older Annual Statements (1989–1996) provide data for additional older AYs, and initial reserve dates, i.e.:

    o AYs 1980-1987 and December 31, 1980–1987 initial reserve dates for Ten-Year LOBs, and

    o AY 1988 and December 31, 1987, initial reserve dates for Two-Year LOBs, from Annual Statements.

These additional data are desirable, because they include more data points, contain more developed data for recent years, and reflect the effects of a wider range of UW and economic conditions. Moreover, the Annual Statement Filings for years prior to 1997 provide additional data for initial

---

[34] This issue does not relate to the quality of RBC Filing data used for RBC calculations. Rather, because our calibrations use RBC Filing data that is not used for RBC Filing calculations, some data submission

[35] Electronic data for Part 1 is available for some earlier years, but, for the earlier annual statement years, the LOB definitions in Schedule P were not the same as the current LOB definitions.

[36] LRs for AYs 2006–2014 in the 2016 Report were valued at ages 9, 8, …, 1, respectively. In the current report, LRs for AYs 2006–2008 are valued as of 10 years, and LRs for AYs 2009–2014 are valued at ages 9, 8, …, 4, respectively. Reserve development data are similarly more mature.

reserve years ending 1988 and subsequent, for those companies with 1988 and subsequent experience that did not file Annual Statements after 1996.[37]

Lines of Business
Schedule P currently contains information on 22 LOBs.

For the RBC Formula, and in our analysis, those 22 LOBs are combined into 19 LOBs.[38] Other Liability Claims-Made is combined with Other Liability: Occurrence, (collectively "Other Liability") Products Liability: Claims Made is combined with Products Liability: Occurrence, (collectively "Products Liability") and Reinsurance: Nonproportional Assumed Property is combined with Reinsurance Nonproportional Assumed Financial (collectively "Reinsurance Property").

Two-Year and Ten-Year LOBs
For six of the 19 LOB combinations, Schedule P contains premium and claim information on the most recent two AYs and reserve development information on prior years combined. We refer to these as "Two-Year LOBs." These six lines are Special Property, Automobile Physical Damage, Fidelity/Surety, Other (Including Credit, Accident and Health), Financial/Mortgage Guaranty, and Warranty.

For the remaining LOBs, Schedule P contains information on the most recent 10 AYs and reserve development on prior years. We refer to these as "Ten-Year LOBs."

Thus, in our Annual Statement data, for Ten-Year LOBs, we have AY LRs and RRRs evaluated at maturities up to 10 years, and for Two-Year LOBs, we have AY LRs and RRRs evaluated at maturities up to two years. The RRRs from Two-Year LOBs cover the development of only the most recent two calendar years, for all accident years, including those prior to the most recent two accident years.

Premium and Reserve Risk Data
For the analysis of premium risk, for each LOB, we obtain (a) earned premium net of reinsurance, (b) incurred loss and loss adjustment expenses net of reinsurance, and (c) the related LR, for each LOB, AY, company, and annual statement year.

For the analysis of reserve risk, we obtain (a) loss and defense and cost containment expense ("DCCE") reserves at each year end, for all AYs combined, net of reinsurance (b) the increase/decrease in reserve estimate to the latest available maturity, for all AYs combined, net of reinsurance, and (c) the ratio of (a) and (b) that we call the RRR.[39]

---

[37] For example, there are companies with 1996 Annual Statements that include data on AY 1988, or reserve year ending December 31, 1988, that did not file Annual Statements after 1996. In this case, the 1988 experience of these companies are not part of the 2016 Report analysis, because data from 1996 and prior Annual Statements were not available.

[38] The LOB definitions had a major revision in the 1989 Annual Statement. There have been some changes in LOB definitions in the years from 1989 to present. As needed, in the section below, we note those that affect analysis.

[39] All values gross of non-tabular discount. Reserves and payments are net of salvage and subrogation, as reported in the Annual Statement.

Note that the calibration is based on runoff of loss + DCCE, but the resulting Risk Factor is applied to loss + all LAE. This assumes that development for adjusting and other expenses follows the same pattern as loss + DCCE.

Appendix 12, Examples 1, 2, and 3 below illustrate how we calculate RRRs for Ten-Year LOBs and Two-Year LOBs, from Annual Statement data and RRRs for Two-Year LOBs from RBC Filings.

Confidential Information in RBC Filings

The RBC Filings[40] provide incurred loss and DCCE development draw from Schedule P Part 2, for all LOBs, and paid loss and DCCE development drawn from Schedule P Part 3, for Two-Year LOBs.

The differences between Annual Statement data and confidential RBC Filing data for reserve risk, for Two-Year LOBs, include the following:

- Annual Statement Schedule P Parts 2 and 3 contains the latest two calendar years of development data. For example, the 2017 Annual Statement shows the incurred and paid values for the following:

    - AY 2017 evaluated at December 31, 2017,

    - AY 2016 evaluated at December 31, 2016, and December 31, 2016, and

    - The reserve at December 31, 2015, for accident years 2015 and prior and the change in incurred and paid values for AYs 2015 and prior (combined) in calendar year 2016 and in calendar year 2017.

- RBC data includes up to 10 individual AYs of development, over 10 calendar years, but it does not include any development information on AYs prior to those 10.

    Because RBC data does not include development information on AYs prior to year 10, the most mature runoff ratio from RBC data includes only one AY, i.e., the most mature AY, which provides maturities from one to 10.

Thus, for the most mature RRRs from Annual Statement data we have two calendar years of development for all AYs, while for RBC data we have up to 10 calendar years of development, but for only one AY. Neither type of data is as complete as the development history available for Ten-Year LOBs from the Annual Statement, which provides ten calendar years of development for all AYs.

AY Indicated Risk Factors—Annual Statement Data Compared to RBC Data

For Two-Year LOBs, we have data from Annual Statements and from RBC Filings. We calculate indicated PRFs and RRFs from each source.

---

[40] RBC Forms PC111-114 and 121-122 for premium and RBC Forms 211-214, 221-222, and 301-304, for reserves.

Table A-1 below shows the differences between PRF indications using Annual Statement data and PRFs indications using RBC Filing data, and the differences between RRF indications using Annual Statement data and RRF indications using RBC Filing data.

Table A-1
Two-Year LOBs—Indicated Risk Factors
Annual Statement Data vs. RBC Data

LOB	Indicated PRFs					
	RBC	A/S	A/S - RBC	RBC No. Pts	A/S No. Pts	% increase in No Pts [(5)-(4)]/(4)
	(1)	(2)	(3)	(4)	(5)	(6)
(11) Spec. Prop.	0.831	0.836	0.005	13,073	14,941	14%
(12) APD	0.837	0.847	0.010	13,847	15,121	9%
(10) Fidelity / Surety	0.666	0.704	0.038	2,830	3,389	20%
(13) Other	0.933	0.953	0.020	2,698	3,083	14%
(14) Financial / Mortgage	2.588	1.929	(0.659)	339	1,042	207%
(19) Warranty	0.975	0.902	(0.073)	134	182	36%

LOB	Indicated RRFs					
	RBC	A/S	A/S - RBC	RBC No. Pts	A/S No. Pts	% increase in No Pts [(5)-(4)]/(4)
	(1)	(2)	(3)	(4)	(5)	(6)
(11) Spec. Prop.	0.278	0.238	(0.040)	8,903	11,767	32%
(12) APD	0.132	0.163	0.030	7,508	11,161	49%
(10) Fidelity / Surety	0.600	0.311	(0.290)	1,941	2,636	36%
(13) Other	0.225	0.175	(0.050)	1,886	2,434	29%
(14) Financial / Mortgage	0.001	0.274	0.273	226	957	323%
(19) Warranty	0.312	0.349	0.037	76	144	89%

In interpreting the differences indicated Risk Factors between the Annual Statement data and RBC data, we note the following, with respect to both PRFs and RRFs:

- Warranty—This LOB was separated from the Fidelity/Surety LOB in 2008. Some companies provided a complete history for all AYs, including AYs prior to 2008. Other companies provided the separate data only for AYs 2008 and subsequent. As such, only Annual Statement 2017 and RBC Filing 2017 contains complete development and reserve runoff data, and, overall, there are too few points, i.e., under 100, to provide reliable indicated Risk Factors. Hence, variations between Annual Statement and RBC indicated Risk Factors are not surprising.

- Financial/Mortgage Guaranty—There are many single state/monoline companies that provide data in the Annual Statements, but who are exempt from RBC requirement. As they do not make RBC Filings, the experience for the single state/monoline mortgage/financial guaranty companies is not included in the data used to develop the indicated Risk Factors in Table 1. Hence there is substantially more data in the Annual Statement data than the RBC data, and differences between Annual Statement and RBC indicated Risk Factors are not surprising.

With respect to PRFs, for the other four Two-Year LOBs, the RBC data produces lower indicated Risk Factors. We interpret this to be the effect of favorable AY LR development that is reflected in the 10-year development in the RBC Filing data but is not reflected in the two-year development in the Annual Statement data.

With respect to RRFs, the direction of the differences between the RRFs based on Annual Statement data and RRFs based on RBC data vary by LOB, and we note the following:

- The RBC data includes both favorable and unfavorable reserve development that may not reflected in the two-calendar year window reflected in the Annual Statement data.

  o For Automobile Physical Damage, it appears that the balance of favorable and unfavorable produces a lower RRF from the RBC data than from the Annual Statement data.

  o For Fidelity and Surety, it appears that adverse economic environments in the 1999–2002 period and the 2008–2009 period generate adverse development on initial reserves established at year-ends prior to those dates, but not reflected for several years after those periods.

- RBC reserve risk data includes fewer data points for all the Two-Year LOBs, and the differences are proportionally larger for some LOBs than for others. As the company-by-company RBC data is confidential, and not available to us, we have not explored that in detail.

6. APPENDIX 2—EXPERIENCE PERIOD

We have Annual Statements premium risk data for AYs 1980–2017, for most Ten-Year LOBs and 1985–2017 from RBC Filings for most Two-Year LOBs.

We have RRRs for the same starting dates, but ending in 2016.[41] Because Annual Statement LOB definitions change over time, there are fewer years of experience for the Medical Professional Liability, Warranty, and Financial/Mortgage Guaranty LOBs. Table A-2, below, shows the LRs and RRRs available to us by year.

---

[41] The most recent initial reserve year is always one year older than the most recent AY, as, for the latest year, we only have an initial estimate and no information on subsequent development.

Table A-2
LR and RRR Years From Available Data

Source	Net Earned Premium and Loss Ratio Years:	Initial Reserve and Reserve Runoff Ratios for Years Ending Dec. 31:
Annual Statements (Statement Years 1989-2017)		
Most Ten-Year LOBs	1980-2017	1980-2016
Most Two-Year LOBs	1988-2017	1988-2016
Annual Statements Exceptions		
MPL Claims Made, MPL Occurrence (Note 1)	1984-2017	1984-2016
Financial/Mortgage (Note 2)	1993-2017	1993-2016
Warranty (Note 3)	2007-2017	2007-2016
Confidential RBC Filings (Filing Years 1994-2017)		
Most Two-Year LOBs (Note 4)	1985-2017	1988-2016
Warranty (Note 3)	2007-2017	2007-2017

Note 1: Earliest Annual Statement or RBC Filing for the MPL LOBs – 1993
Note 2: Earliest Annual Statement for the Financial/ Mortgage LOB– 1994
Note 3: Earliest Annual Statement or RBC Filing for Warranty LOB – 2008, when the Warranty LOB was separated from the Fidelity/Surety LOB. RBC Filings for some companies show the new Warranty LOB for AYs 2008 and subsequent only, while some companies show RBC data for prior AYs as well.
Note 4: We did not use data from RBC filing years 1994-1996, as data for those years was collected for information purposes only, and might be subject to learning-curve errors.

Treatment of 1980–1987 AYs/RRRs

The current data set includes 1980–1987 AYs and RRRs that were not available for prior Committee reports, nor for the DCWP for its work.

Table A-3 below shows the indicated Risk Factors by decade, 1980–1989, 1990–1999, 2000–2009, and 2010–2017. We see that, for nearly all the liability LOBs, the oldest block of years, 1980–1989, shows the highest indicated PRFs and RRFs.

Table A-4, below, shows that including the oldest years (1980–1987) in the indicated Risk Factors produces significantly higher indicated RRFs and a somewhat higher PRFs, compared to the indicated Risk Factors excluding the oldest years. RRFs increase by more than 20% for many of the larger volume lines.

Therefore, for the reasons we discuss above, in the "1. Experience Period" subsection in the Methodology section, we believe the experience prior to 1988 may not be applicable to current conditions, and we do not include it in our indicated Risk Factors.

We plan to revisit this assumption when we review Investment Income Adjustments in our next report, where we will consider the effect of interest rate changes on risk charges over the entire period.

Table A-3
Comparison of Risk Factors—
Current Indicated (2017 Data) AY/RRF 10-Year Experience Ranges

Line	PRF				RRF			
	80-89	90-99	00-09	10-17 (2)	80-89	90-99	00-09	10-16 (2)
(1) H/F	0.918	0.999	0.946	0.909	0.398	0.195	0.272	0.200
(2) PPA	1.074	0.969	0.955	0.959	0.396	0.165	0.195	0.246
(3) CA	1.193	1.069	0.958	1.017	0.589	0.349	0.359	0.423
(4) WC	1.198	1.041	1.042	0.928	0.536	0.293	0.382	0.134
(5) CMP	1.020	0.951	0.848	0.857	0.973	0.553	0.456	0.366
(6) MPL Occ.	1.777	1.634	1.379	1.254	0.981	0.246	0.361	0.138
(7) MPL C-M	1.035	1.368	1.084	1.023	0.242	0.133	0.081	0.116
(8) SL	1.145	0.996	0.892	0.882	0.651	0.680	0.277	0.102
(9) OL	1.634	1.076	1.016	0.930	1.612	0.619	0.521	0.261
(11) Spec. Prop.	0.722	0.858	0.797	0.840	0.252	0.305	0.246	0.282
(12) APD	0.773	0.847	0.817	0.857	0.045	0.119	0.164	0.146
(10) Fidelity / Surety	0.673	0.666	0.760	0.543	0.373	0.915	0.560	0.264
(13) Other	0.905	0.947	0.932	0.903	0.132	0.239	0.272	0.119
(15) International	1.708	1.623	1.675	1.630	2.489	2.141	0.460	0.273
(16) Reins. Prop. / Fin.	1.363	1.235	1.268	1.127	0.732	0.416	0.314	0.000
(17) Reins. Liab.	1.785	1.328	1.359	0.903	1.023	0.658	0.729	0.060
(18) PL	1.496	1.378	1.290	1.067	2.490	1.532	1.701	0.701
(14) Financial / Mortgage	2.726	2.530	2.506	2.000		0.059	0.000	0.006
(19) Warranty		0.663	0.937	0.900			0.113	0.508
Average Risk Factor- all Lines	1.056	0.991	0.950	0.925	0.780	0.389	0.392	0.223
Average Risk Factor- 10-Yr Lines	1.143	1.023	0.979	0.941	0.835	0.400	0.409	0.227
Average Risk Factor- 2-Yr Lines	0.834	0.907	0.877	0.884	0.163	0.267	0.212	0.182

Notes:

(1) For Medical Professional Liability LOBs, the 1980–1989 year-band includes only 1984–1989. For Two-Year LOBs, the 1980–1989 year-band includes only 1988–1989. For Financial/Mortgage, the 1990–1999 band includes only 1993–1999. For Warranty, data for AYs prior to 2008 is limited, in that many companies did not report any data for AYs prior to 2008.

(2) For PRFs and RRFs the 2010–2016/2017 have limited credibility because the maturity filter excludes up to five of the latest 10 years, and because the remaining data points are less mature than the data points for any other decade.

(3) Average risk factors weighted with Annual Statement premium for all LOBs, including LOBs calibrated with RBC data.

(4) The treatment of salvage and subrogation in statutory accounting has changed over time. That might contribute to the differences between 1980–1989 indicated Risk Factors and subsequent decade Risk Factors for Special Property and Automobile Physical Damage LOBs.

Table A-4
Comparison of Risk Factors by Experience Period
Including/Excluding 1980–1987

Line	PRF		RRF	
	88-17	80-17	88-16	80-16
(1) H/F	0.960	0.951	0.223	0.273
(2) PPA	0.975	1.001	0.201	0.244
(3) CA	1.022	1.073	0.361	0.417
(4) WC	1.030	1.067	0.335	0.376
(5) CMP	0.897	0.928	0.499	0.627
(6) MPL Occ.	1.480	1.556	0.265	0.350
(7) MPL C-M	1.149	1.150	0.094	0.109
(8) SL	0.952	1.006	0.415	0.477
(9) OL	1.014	1.137	0.527	0.821
(11) Spec. Prop.	0.831	0.822	0.278	0.278
(12) APD	0.837	0.834	0.132	0.132
(10) Fidelity / Surety	0.666	0.676	0.600	0.600
(13) Other	0.933	0.933	0.225	0.225
(15) International	1.712	1.679	1.044	1.479
(16) Reins. Prop. / Fin.	1.240	1.240	0.343	0.348
(17) Reins. Liab.	1.252	1.493	0.636	0.636
(18) PL	1.270	1.360	1.472	1.691
(14) Financial / Mortgage	2.588	2.588	0.001	0.001
(19) Warranty	0.975	0.975	0.312	0.312
Average Risk Factor- all Lines	0.967	0.992	0.376	0.471
Average Risk Factor- 10-Yr Lines	0.995	1.030	0.390	0.494
Average Risk Factor- 2-Yr Lines	0.897	0.894	0.218	0.218

See notes to Table A-3.

7. APPENDIX 3—POOLING METHODOLOGY

Pool Mapping

In determining the indicated UW Risk Factors, we combine the data from intercompany pool participants into a single pool-wide risk data point. Alternatively, if we were to treat these interrelated risk data points as independent, the same loss ratio value (or reserve runoff ratio) would appear multiple times, reducing the apparent variability in the LR (or RRR) across companies, and distorting the indicated 87.5[th] percentile LR/RRR value.[42]

---

[42] See DCWP Report 6 pages 10-12, 16, and 77-80 for more details.
https://www.casact.org/pubs/forum/13fforum/01-Report-6-RBC.pdf

We identify intercompany pools by annual statement year using the following information, to the extent available, for each company and annual statement year:[43]

- NAIC group code from 2010, 2014, and 2017 analyses to identify member companies,
- Schedule P Intercompany Pooling Participation Percentage (Schedule P Part 1 Column 34),
- Schedule F Part 9 Note, and
- Notes to Financial Statements, Note 26[44] (on Intercompany Pooling Arrangements).

Our current analysis includes 1984–1996 and 2015–2017 Annual Statements, which were not part of prior Academy or DCWP analysis. For the early years, 1984–1996, as we do not have the NAIC group assignments by company, we identify pool members as companies with identical or similar loss ratios across companies in combination with the oldest known NAIC group code. For the most recent years, 2015–2017, we had the 2017 NAIC group code to guide us. For 1997–2014 we make a few changes to the pool mapping based on an improved perspective on pooling, arising from the longer history of Annual Statements available to us.

Note that due to the limitations of the data and information available, our methodology is approximate, and might not necessarily identify all intercompany pooling arrangements and/or may combine some companies that are not actually pooled.[45] Group identification becomes more approximate for older annual statement years. However, we believe that the elimination of multiple identical records from the data set through this adjustment, even with the approximations, improves the quality of the Risk Factor analysis.

Selection of Most Mature Data Point—Maturity First vis-à-vis Pooling First

We have multiple evaluations of each initial reserve date-RRR and AY-LR for a given LOB/company. We remove data triangles that we classify as anomalous (see Appendix 4). Then, for each LOB, for each AY/Initial reserve year, before pooling, we determine the Annual Statement that had the most mature evaluation of the AY/initial reserve year. We calculate the LR/RRR from that Annual Statement. We pooled the resulting LRs/RRRs, using the pool associated with the annual statement year from which we calculated the LR/RRR. We refer to this approach as "Maturity First."

In prior reviews, after removing company data triangles that we classified as anomalous, we then pooled Annual Statements, where appropriate, based on the annual statement year from which the data was derived.[46] After pooling, for each LOB, we determined the most recent annual statement

---

[43] The pool is defined separately for each statement year. For example, if two companies are in an intercompany pool for annual statement year 2013, then all data points from that annual statement year will be pooled. If the same two companies are no longer subject to intercompany pooling in 2014, the data points will not be pooled.

[44] Currently Note 26. This information was in different Notes at different years in the past.

[45] The pooling structure can also affect "LOB age" as we measure age based on number of years of NEP>0 for the pooled data.

[46] This change is the latest in a series of refinements to the pooling calculation in the course of studies over the past 10 years, as described below.

year for each company or pool. We obtained up to 10 LRs or RRRs from that Annual Statement. We used earlier Annual Statements to obtained one LR/RRR using the most mature AY for LR and both the most mature AY and prior AYs for RRRs. We refer to this approach as "Pooling First."

In the normal course, the Maturity First and Pooling First methods are the same. However, we find that there are companies where the most mature reading for an LR/RRR for a LOB does not appear in the expected Annual Statement. That might be because of new pool assignments, perhaps because the company was sold, the company ceased filing Annual Statements, reinsurance transactions reduced the LR/RRR data to zero, or for other reasons.

For a company subject to pooling, with the Pooling First approach, changes in pool assignment during the experience period can result in using of the same company data multiple times. Consider two companies, A and B, each with two statements (2016 and 2017) with data for each of the 10 AYs and for the prior years combined. Also suppose that A and B became part of Pool X in 2017. In the Pooling First approach, the 2017 statements for A and B are combined into a single statement for Pool X. We calculate 30 LRs (27 RRRs) for each LOB: 10 LRs (9 RRRs) for each of A, plus 10 LRs (9 RRRs) for B from statement year 2016, plus 10 LRs (9 RRRs) for Pool X from statement year 2017.

In the Maturity First approach, prior to pooling, we calculate 10 LRs (9 RRRs) for each of Companies A and B (for AYs 2008–2017, and for initial reserve years 2008–2016) from the 2017 Annual Statement and one LR/RRR from the 2016 Annual Statement (for LR/RRR 2007). These values are then pooled, resulting in 12AY LRs (11 RRRs). The 20 LRs (18 RRRs) from the 2017 Annual Statement from Company A and Company B are pooled into Pool X and the remaining two LRs/RRRs from the 2016 Annual Statement remain unpooled. Hence, the total number of data points in the final dataset is reduced from 30/27 in the Pooling First Approach to 12/11 in the current Maturity First Approach.

The difference arises because, in the Pooling First approach, Pool X is considered a new company which results in some duplication of LR/RRRs. Hence, as expected, using the Maturity First approach somewhat reduces the number of data points.

8. APPENDIX 4—ANOMALOUS DATA

We describe the anomalous data treatment in the Methodology Section. In this Appendix we show Tables supporting the discussion of Absolute (RRR)>5 and Zero Interior anomalous data filters.

Prior to 2010, the pooling issue was identified, but there was no adjustment. DCWP introduced a pooling adjustment. The pooling adjustment assumed the pooling status was constant over the 1997–2010 Annual Statements available for its work. Based on that assumption, Pooling First or Maturity First were equivalent. The 2016 Report, with a longer Annual Statement history, examined the pooling history in more detail and reflected the changes in pooling from annual statement year to annual statement year. However, that analysis continued to calculate based on Pooling First approach. In this Report, with a still longer history of Annual Statements, we revised the Pooling First approach and modified the calculation as described.

Absolute (RRR)>5

Table A-5a, below, shows the effect, by LOB, of removing the Absolute (RRR)>5 filter. Table A-5a shows that the weighted average effect on the RRFs for Ten-Year LOBs is an increase of 2.4% of reserves, in RRFs, and there are important variations by LOB within the Ten-Year LOBs. The effect on indicated RRRs is most apparent in International (23% of reserves) and Products Liability (15% of reserves).

Table A-5a
Effect of 500% Filter/ Ten-Year LOBs

Line	RRR - Exclude if over 500%		Difference	
	Yes	No	%	value
(1) H/F	0.221	0.223	1%	0.002
(2) PPA	0.200	0.201	1%	0.001
(3) CA	0.361	0.361	0%	0.000
(4) WC	0.334	0.335	0%	0.001
(5) CMP	0.494	0.499	1%	0.005
(6) MPL Occ.	0.259	0.265	2%	0.006
(7) MPL C-M	0.090	0.094	4%	0.004
(8) SL	0.386	0.415	7%	0.029
(9) OL	0.520	0.527	1%	0.007
(15) International	0.850	1.044	23%	0.195
(16) Reins. Prop. / Fin.	0.342	0.343	0%	0.002
(17) Reins. Liab.	0.598	0.636	6%	0.038
(18) PL	1.280	1.472	15%	0.192
Average Risk Factor- 10-Yr Lines	0.381	0.390	2.4%	0.009

"Zero Interior" Reserve Risk Data Anomalies

As noted in the Methodology section, in our current review we exclude a LOB/Statement year if the interior of the development triangle is zero. Table A-5b below is an illustration of such data. We also observe some cases where some of, but not the entire interior of the data triangle has unexpected zero values.

Table A-5b
Zero Interior Example

		1	2	3	4	5	6	7	8	9	10
		INCURRED NET LOSSES AND DEFENSE AND COST CONTAINMENT EXPENSES REPORTED AT YEAR END ($000 OMITTED)									
Years in Which											
Losses Were Incurred		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Prior	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	2008	1,875									1,231
3	2009		1,926								1,267
4	2010			3,378							2,943
5	2011				7,774						7,393
6	2012					8,010					9,423
7	2013						9,751				9,927
8	2014							11,581			18,535
9	2015								14,533		18,086
10	2016									23,314	24,070
11	2017										

With data of this type, we can calculate RRRs for individual AYs, for example, the 10-year development, for AY 2008. However, we cannot calculate RRRs for any full initial reserve year.

In the 2016 Report, we addressed this data anomaly in two ways. First, wherever possible we used the RRR based on development of the single most mature AY, row 2 that is not affected by the zero interior values. Second, we limited the impact of zero values by excluding data points where the absolute value of the RRR was greater than 500%.

In this Report, we exclude any data point where the entire interior is blank, which partly address the need for the Absolute (RRR)>500% limitation. However, we continue to exclude any data point with RRR >500%. We believe our current process has improved the identification of valid RBC data. However, there may be further steps we and/or NAIC could take to improve the data further, in future reviews.[47]

The Zero Interior issue predominately relates to RBC data for Two-Year LOBs, which are discussed above. There are also a small number of companies with Ten-Year LOB Annual Statement data that present zero interiors, typically showing non-zero values in the latest diagonal but having zero/blank data for all other values, including zero/blank in the latest evaluation column. We exclude that Ten-Year LOB data.

9. APPENDIX 5—MINOR LINES

We exclude risk data points where the volume for a LOB represents a small portion of a company's volume as defined below ("Minor Lines"). The DWCP research[48] reported, and the 2016 Report agreed, that "For certain [specialty] LOBs failure to exclude the Minor Lines risk data points

---

[47] As the detailed data is confidential, there are limits on the extent to which this Committee can address this issue alone.
[48] DCWP Reports 6 and 7.

appears to result in PRFs that are not representative of the risks for companies writing the bulk of the industry LOB premium."[49]

For premium risk, similar to the 2016 Report, the Minor Lines filter calculation compares the LOB NEP to the all-lines NEP for each AY separately.

For reserve risk, the Minor Lines filter compares the LOB NEP to the all-lines NEP for a range of years, usually 10 years ending at the initial reserve date.[50] Because the Annual Statement LOB definitions vary over time, a 10-year range is not possible for all LOBs for all initial reserve data. Hence, our approach varies somewhat by LOB. Table A-6 shows our approach for all years.

Table A-6
Reserve Risk Minor Lines Definition: Net Earned Premium Year-Ranges

Line	Initial Reserve Years Ending:	Net Earned Premium from the following AYs
Most Lines	1998-2016	Rolling 10-year window ending at the initial reserve date
	1988-1997	Ten years, 1988-1997
	1980-1987	Fifteen years, 1980-1994 (Notes 1, 2) Data unavailable for Two-Year LOBs.
MPL Occ and CM	1984-1987	Eleven years 1984-1994 (Note 2)
	1988-1997	See Most LOBs
	1998-2016	See Most LOBs
Financial/Mortgage	1993-2002	Ten years, 1993-2002
	2003-2016	Rolling 10-year window ending at the initial reserve date
Warranty	2007-2016	Ten Years, 2007-2016 (Note 3)

Note 1: We use a relatively long period because, in the early part of this time period, the all-lines total does not include Two-Year LOBs and overstates the ratio of LOB premium to all-lines premium.
Note 2: This table shows the methods we would apply to initial reserve years 1980-1987, but for the reasons discussed previously, we do not use those initial reserve dates in our indicated Risk Factors.
Note 3: These are the only years of available data for the Warranty LOB.

This Minor Lines approach differs from the approach in the 2016 Report, where the reserve risk Minor Lines definition was based on all-years premium. With the increase in the number of years of premium in our data set, we adopt the approach described above.

The thresholds for the LOB Minor Lines filters for both PRFs and RRFs are the same as those we used in the 2016 Report, and are as follows:

- Apply 5.0% filter for most lines with exceptions described below.

- Apply no Minor Lines exclusion for the International and Financial/Mortgage Guaranty lines of business due to the low volume in these lines.

---

[49] DCWP Report 6, Page 5.

[50] This is determined after pooling, so changes in pooling can affect Minor Line status.

- Apply 2.5% filter for the Special Liability, Fidelity/Surety, and Warranty lines of business, because a 5% filter for either PRFs or RRFs would exclude most premiums or initial reserves.[51]
- Exclude risk data points where the combined Other Liability and Products Liability NEP is less than 5.0% of total NEP to avoid exclusion of too much Products Liability volume.[52]

For RRFs, which require multiple years of premium data, we determine Minor Line status using Annual Statement data, and we apply that categorization to the RBC data. To the extent that the LOB/Company/Initial Reserve Date in the RBC data do not have a corresponding data point in the Annual Statement data,[53] the data point is treated as a Minor Line. For PRFs, which require a single year of data, we determine Minor Line by comparing the RBC NEP by LOB/company/year to the all-lines total NEP from the Annual Statement data.

We find that the change in Minor Lines definition, from the all-year basis to the 10-year basis, decreases the indicated RRFs for nearly all LOBs. That result is consistent with (a) Minor Lines tend to have higher RRRs than non-Minor Lines, and (b) the new method better distinguishes between Minor Lines data and non-Minor Lines data.

10. APPENDIX 6—YEARS OF LOB NEP > 0 ("LOB Age" or "Age")

The 2016 Report[54] concluded that for most LOBs, PRFs and RRFs are smallest for companies with the longest experience period for a particular LOB. The 2016 Report presented an analysis of Risk Factors, by LOB by Age. The analysis in the 2016 report shows that the differential in Risk Factors by Age is most pronounced when comparing Risk Factors with a filter of Age equal to 5+ years[55] when compared to companies with age less than 5 years. In addition, few risk data points are removed with a filter that removes Ages less than 5.

In this Report we calculate the age of the pool as the number of years of NEP>0 for the pool. In the 2016 Report, we calculated age as the maximum of the number of years of NEP>0 for any of the companies in the pool. This change somewhat reduces the number of data points after filtering.

11. APPENDIX 7—LOB-SIZE THRESHOLDS

Our indicated Risk Factors exclude risk data points with small premium/reserve LOB size, defined as the 15th percentile of size. We exclude the risk data points with small size because the experience

---

[51] In addition to the other considerations, for Warranty, a 2.5% filter was chosen due limited volume of warranty experience.

[52] Correlation between NEP for PL and OL lines, for baseline PRF data with no Minor Lines exclusion, was 0.66.

[53] Such mismatches can occur because, there are pooling changes by Annual Statement year and the data point might derive from one Annual Statement year in the RBC data and a different Annual Statement year in the Two-Year Annual Statement data.

[54] This conclusion is consistent with the conclusion in DCWP, in Report 6, Section 7 and DCWP Report 7, Section 7.

[55] Consecutive or nonconsecutive years.

of these companies/pools is not representative of the experience derived from the majority of risk data points.[56] We apply the size threshold analysis to the data after filtering for Minor Lines and Age, as described in the earlier Appendices.

We consider four smoothing approaches to calculating the 15th percentile, as follows: (1) 15th percentile by year without adjustment, (2) smoothed 15th percentile by year, (3) detrended 15th percentile by year, and (4) all-year 15th percentile.

Raw and Smoothed 15th Percentile by Year
In method 1, we select the 15th percentile by each LOB and accident/reserve year, for each company/pool as appropriate.

In method 2, to remove large discontinuities by year, we limit each point to be within 10% of the prior and subsequent years. For the first accident/reserve year (1988), we limit each point to be within 10% of the three-year average (1989–1991) and the subsequent year (1989). For the last accident/reserve year (2017/2016), we limit each point to be within 10% of the three-year average (2014–2016/2013–2015) and the prior year (2016/2015).

Detrended 15th Percentile by Year
We developed the third approach listed above in response to a suggestion for future research in the 2016 Report. For some LOBs, the 15th percentile size varies randomly up and down so much that even the smoothed 15th percentile had large variations in size threshold from year to year. To address that feature, we use regression to calculate the annual trend in the 15th percentile company size by year. We use this trend to adjust the LOB premium for each company for each year to a common date, 1999 for premium and 1998 for reserves. We call the result of that calculation the "Adjusted LOB Size."

We then determine the all-year LOB 15th percentile of the Adjusted LOB Size values across all data points. We use the regression trend rate to detrend the all-year LOB 15th percentile to the historical level for each year to determine the smoothed LOB 15th percentile by year.

Selected LOB Size Approaches
For all RRF calculations and for PRF calculations with Annual Statement data, we select the smoothed 15th percentile method for Homeowners, Private Passenger Auto Liability, Workers' Compensation, Special Property, and Auto Physical Damage. For Warranty, we select the all-year overall 15th percentile. For the other 13 LOBs, we select the detrended 15th percentile method.

For PRF calculations with RBC data we select the smoothed 15th percentile method for five of the six Two-Year LOBs, and for Warranty, we select the all-year overall 15th percentile.

---

[56] DCWP Reports 6 and 7 shows the extent to which indicated Risk Factors vary by LOB-size.

12. APPENDIX 8—MATURITY

The 2016 Report found that Risk Factors based on data grouped by age of development can increase as the age of development increases; the effect varies by LOB but is especially pronounced for LOBs such as WC and MPL-Occurrence.

The 2016 Report considered: (a) ways to adjust risk data points so that they reflected a 10 years maturity; and (b) the alternative of excluding risk data points that are not sufficiently mature. The 2016 Report used method (b). Our indicated Risk Factors are based on the same approach that was used in the 2016 Report.

Table 3, in the Methodology section, shows the maturity filters we use.

13. APPENDIX 9—ORDER OF POOLING, ANOMALIES, AND OTHER FILTERS

In this section we summarize the order in which we apply the filtering rules discussed above.

PRF Analysis from Annual Statement Data

1. Exclude AY/LOB/Company data points with negative premium or with zero or negative incurred loss amounts

2. Calculate LRs for each AY/company/LOB remaining in the data

3. Identify the data point with greatest maturity for each AY/company/LOB

4. Apply Pooling rules to combine AY/company/LOB data points, where appropriate

5. For each AY/company-pool/LOB data point we determine, and apply filters, for the following, on a pool basis:

   a. Minor Line status

   b. LOB Age

6. With the pool data, after the prior filtering, calculate size threshold by LOB/AY and identify whether the company size exceeds that threshold.

7. Apply Maturity filter.

RRF Analysis from Annual Statement or RBC Data

1. Exclude all company Annual Statement triangles with negative calendar year values or zero interior values. Also exclude potential data points with zero calendar reserves prior to the current valuation year of each Annual Statement.

2. Calculate RRRs for each initial reserve year/company/LOB from the remaining data.

3. Identify the RRR with the greatest maturity for each initial reserve year/company/LOB.

4. Apply pooling rules to company initial reserve year/company/LOB data points, where appropriate.

5. For each RRR/company-pool/LOB data point, we determine and apply filters, for the following, on pool basis:

   a. Minor Line status

   b. LOB Age

6. With the pool data, after the prior filtering, calculate size threshold by LOB/ initial reserve year and identify whether the company size exceeds that threshold.

7. Apply Maturity filter.

For Two-Year LOBs, for indicated PRFs from RBC data, we determine age, maturity, and size thresholds from RBC data. We determine Minor Line status using RBC data by LOB combined with Annual Statement for all lines combined.

For Two-Year LOBs, for indicated RRFs from RBC data, we determine size thresholds from RBC data. We determine age and Minor Line status, which require matching premium information, from Annual Statement premium data. There is no maturity filter applicable to RRFs for Two-Year LOBs.

For pooled data risk data points, for both Two-Year and Ten-Year LOBs, we determine age and maturity on a pooled basis, rather than using maximum or average values by company. We also determine Minor Lines status on a pooled basis.

14. APPENDIX 10—ANALYSIS OF CHANGE IN PRFs 2014 TO 2017 FOR TEN-YEAR LOBs

In this section we show our analysis of the change in PRFs, from the results of the 2016 Report to the results in this Report, for Ten-Year LOBs. In this analysis of change, for each LOB, we begin with the results in the 2016 Report. We then calculate a series of indicated PRFs, each step applies additional changes in methodology/data from the 2016 Report to this Report. The change in indicated PRFs between steps constitutes our measure of the effect of the methodology/data change.

We believe this provides useful information on the relative effects of each change. However, the effects interact, so that if we calculate effects in a different order, then we might measure a different effect for each change. Hence, the changes should be interpreted as informative, but not definitive.

For Two-Year LOBs, developed from confidential RBC data, we did not have the detail data from the 2016 Report needed to perform a change analysis.[57]

---

[57] We note that changes are small for the larger LOBs and that when the number of data points is small—e.g., Financial/Mortgage and Warranty—the movements from year to year are not unexpected.

In the subsections below we identify which of the methodology/data changes, each of which was discussed earlier in the report, is placed in each of the categories.

Data and Maturity First

This category covers the following:

- As we now have older Annual Statements, we have data points for AYs and initial reserve years 1988 and subsequent that were not included in our 2016 Report.

- As we discussed in the Appendix 3—Pooling Methodology, we now select the most mature data points and then combine individual companies into pools, rather than performing the calculation in the reverse order.

- Finally, with respect to data, in the normal course of an analysis update, there are changes in the NAIC database, which contains company reports as of the date that the information was extracted.[58] In our current work, we use data extracted from the NAIC database as of the first quarter of 2019, which updates our entire data set. The 2016 Report used data extracted in 2015–2016.

Filters

This category covers the following:

- We implemented some changes in the way we calculate the Size filtering (Appendix 7).

- While we apply the same five-year age filter, as we have added older and newer AYs to our database, some companies that were "new" (age under five years) in the 2016 Report are not "new" in this Report.

- We based age on the pool age. In the 2016 Report age equaled the maximum age of any company in the pool. As a result, we may have excluded some data points that were included in the 2016 Report.

Development and Recent Years

As in every re-evaluation, there are changes due to increasing maturity of data for AYs and initial reserve years that have not yet reached maximum maturity available in our data and the addition of new AYs and initial reserve years.

Effect of Changes

Table A-7a—PRFs, below, shows the effect of these factors, by LOB. Table A-7b, below, shows the changes in the number of data points after each step of the analysis.

---

[58] For example, we see more data from Annual Statement years and RBC years 2013 and 2014, in the 2017 data than in the 2014 data. We understand this to be because Annual Statements and RBC Filings for some companies were not included in the NAIC data when the 2014 data was downloaded.

Table A-7a—PRFs—Analysis of Change
Indicated Risk Factors based on 2014 data to indications based on 2017 data

| Line | 2014 Indicated PRF | Change as a Percentage of Premium, Due to: | | | | | 2017 Indicated PRF |
		Data, Maturity First	Filter	Development	Recent Years	Total Change	
(1) H/F	0.964	0.2%	0.1%	0.0%	-0.7%	-0.4%	0.960
(2) PPA	0.969	0.7%	0.0%	0.2%	-0.2%	0.6%	0.975
(3) CA	1.010	0.6%	0.1%	0.9%	-0.4%	1.2%	1.022
(4) WC	1.044	0.3%	0.1%	-0.4%	-1.4%	-1.5%	1.030
(5) CMP	0.901	0.2%	0.0%	0.2%	-0.8%	-0.4%	0.897
(6) MPL Occ.	1.490	2.6%	-3.2%	-0.3%	0.0%	-0.9%	1.480
(7) MPL C-M	1.176	-0.1%	-0.2%	-0.6%	-1.8%	-2.7%	1.149
(8) SL	0.949	0.3%	-0.1%	0.1%	0.0%	0.4%	0.952
(9) OL	1.013	0.5%	0.1%	0.3%	-0.7%	0.1%	1.014
(11) Spec. Prop.	0.831	N/A	N/A	N/A	N/A	0.0%	0.831
(12) APD	0.836	N/A	N/A	N/A	N/A	0.1%	0.837
(10) Fidelity / Surety	0.680	N/A	N/A	N/A	N/A	-1.4%	0.666
(13) Other	0.935	N/A	N/A	N/A	N/A	-0.2%	0.933
(15) International	1.638	7.4%	0.0%	0.0%	0.0%	7.4%	1.712
(16) Reins. Prop. / Fin.	1.240	-1.2%	1.3%	-0.1%	0.0%	0.0%	1.240
(17) Reins. Liab.	1.322	-3.7%	-3.5%	0.2%	0.0%	-7.0%	1.252
(18) PL	1.285	-0.3%	-2.0%	0.9%	0.0%	-1.5%	1.270
(14) Financial / Mortgage	2.513	N/A	N/A	N/A	N/A	7.5%	2.588
(19) Warranty	1.028	N/A	N/A	N/A	N/A	-5.3%	0.975
Average Risk Factor - All Lines	0.968	N/A	N/A	N/A	N/A	0.0%	0.967
Average Risk Factor - 10-Yr Lines	0.996	0.3%	0.0%	0.1%	-0.6%	-0.1%	0.995
Average Risk Factor - 2-Yr Lines	0.895	N/A	N/A	N/A	N/A	0.3%	0.897

Table A-7b—PRFs—Analysis of Change
Number of Filtered Data Points

Line	2014 Indicated PRF	Change in Number of Filtered Data Points Resulting From:					2017 Indicated PRF
		Data, Maturity First	Filter	Development	Recent Years [1]	Total Change	
(1) H/F	11,256	563	9	-	1,070	1,642	12,898
(2) PPA	10,904	556	(35)	-	835	1,356	12,260
(3) CA	7,589	472	(20)	-	631	1,083	8,672
(4) WC	7,931	416	(45)	-	677	1,048	8,979
(5) CMP	8,791	652	(109)	-	731	1,274	10,065
(6) MPL Occ.	1,112	31	135	-	-	166	1,278
(7) MPL C-M	3,281	121	86	-	446	653	3,934
(8) SL	2,145	138	(34)	-	126	230	2,375
(9) OL	10,951	585	(65)	-	991	1,511	12,462
(11) Spec. Prop.	10,908	N/A	N/A	N/A	N/A	2,165	13,073
(12) APD	12,040	N/A	N/A	N/A	N/A	1,807	13,847
(10) Fidelity / Surety	2,370	N/A	N/A	N/A	N/A	460	2,830
(13) Other	2,268	N/A	N/A	N/A	N/A	430	2,698
(15) International	410	47	61	-	-	108	518
(16) Reins. Prop. / Fin.	1,182	89	(2)	-	88	175	1,357
(17) Reins. Liab.	1,189	137	87	-	-	224	1,413
(18) PL	3,341	165	254	-	-	419	3,760
(14) Financial / Mortgage	245	N/A	N/A	N/A	N/A	94	339
(19) Warranty	83	N/A	N/A	N/A	N/A	51	134
Data Points - All Lines	97,996	N/A	N/A	N/A	N/A	14,896	112,892
Data Points - 10-Yr Lines	70,082	3,972	322	-	5,595	9,889	79,971
Data Points - 2-Yr Lines	27,914	N/A	N/A	N/A	N/A	5,007	32,921

Notes: Recent Years for MPL Occ., International, Reins. Liab., and PL are zero because the maturity filter excludes accident years 2015-2017 in the analysis of change.

For all Ten-Year LOBs combined, the change in indicated PRFs from 2014 to 2017 is relatively small, -0.1% of premium.

However, there some LOBs with larger changes in indicated Risk Factors. The two Ten-Year LOBs with indicated PRF changes greater than ±5% of premium are the following:

- International PRF is increased due to the data changes.

- Reinsurance Liability PRF is reduced due to both data changes and the filter changes.

- Financial/Mortgage and Warranty LOB PRFs change by more than 5% of premium, but these are lines with limited data and the therefore more subject to variation in indicated Risk Factors due to random effects of new information and/or even small changes in methodology.

15.APPENDIX 11—ANALYSIS OF CHANGE IN RRFs 2014 TO 2017

In this section we show our analysis of the change in RRFs, for Ten-Year LOBs and Two-Year[59] LOBs, comparing from the results of the 2016 Report to the results in this Report. We described the approach in Appendix 10, above.

We categorize the changes in indicated RRFs, from those in the 2016 Report to those in this Report, as follows:

1. New Minor Lines approach for reserves described in Appendix 5 ("Minor Line Filter").

2. Other Filters including Age, LOB Size, and Maturity ("Other Filters").

3. Updates in NAIC database[60] ("New data") and increased maturity of initial reserve years 1998-2013 ("New Data (< 2014), Development").

4. New AYs – 2014-2016 ("Recent Years (2014-17)").

5. New quality control test to remove triangles whose entire interior is blank, Zero Interior filter.

6. Calculate RRR values by company, and select the most mature company data point, before pooling ("Maturity First").

7. Allow |RRRs|>500% for Ten-Year LOBs ("Allow |RRR| >500%").

Table A-8a—RRFs shows the effects of each of these factors, by LOB. Table A-8b, below, shows the changes in the number of data points after each step of the analysis.

---

[59] We were able to analyze the drivers of change in RRFs from RBC data, as the regulator working with our committee recreated, under our direction, the 2016 analysis, which enabled us to analyze the drivers of change for both Ten-Year and Two-Year LOBs.

[60] As expected, we see additional data for Annual Statement Years 2013 and 2014. Also, for LOB "Other," in addition to the expected changes due to updates, we observed a significant reduction in the number of data points in the 2001 Annual Statement Year. That might have been an error in the prior analysis.

Table A-8a—RRFs—Analysis of Change
Indicated Risk Factors based on 2014 data to indications based on 2017 data

Line	2014 Indicated RRF	Change as a Percentage of Reserves, Due to:								2017 Indicated RRF
		Minor Line Filter	Other Filters	New Data (< 2014), Development	Recent Years (2014-17)	Zero Interior	Maturity First	Allow |RRF| >500%	Total Change	
(1) H/F	0.213	-0.4%	-0.9%	1.4%	0.0%	0.6%	0.1%	0.2%	1.0%	0.223
(2) PPA	0.179	0.3%	-0.2%	1.2%	0.3%	0.3%	0.2%	0.1%	2.2%	0.201
(3) CA	0.348	-1.1%	-0.1%	1.7%	0.5%	0.4%	0.0%	0.0%	1.4%	0.361
(4) WC	0.344	-0.5%	0.3%	-0.6%	-0.3%	0.2%	0.0%	0.1%	-0.9%	0.335
(5) CMP	0.494	-1.1%	-0.1%	0.2%	0.0%	0.7%	0.2%	0.5%	0.5%	0.499
(6) MPL Occ.	0.296	-1.0%	0.0%	-3.0%	-0.4%	0.4%	0.3%	0.6%	-3.1%	0.265
(7) MPL C-M	0.089	0.0%	0.0%	0.5%	0.0%	0.3%	-0.6%	0.4%	0.5%	0.094
(8) SL	0.431	-0.5%	0.0%	-3.2%	-1.4%	1.3%	-0.7%	2.9%	-1.6%	0.415
(9) OL	0.531	-1.3%	0.3%	-0.5%	-1.0%	1.0%	0.3%	0.7%	-0.4%	0.527
(11) Spec. Prop.	0.428	-4.1%	1.2%	-1.9%	0.0%	-10.9%	0.7%	0.0%	-15.1%	0.278
(12) APD	0.155	0.9%	0.4%	0.9%	0.3%	-3.0%	-1.9%	0.0%	-2.3%	0.132
(10) Fidelity / Surety	0.917	-1.7%	5.7%	4.4%	7.2%	-46.3%	-1.1%	0.0%	-31.6%	0.600
(13) Other	0.375	-5.7%	5.4%	-0.1%	0.6%	-15.8%	0.6%	0.0%	-15.0%	0.225
(15) International	0.695	-0.6%	26.7%	-2.1%	-6.9%	0.4%	-1.9%	19.5%	34.9%	1.044
(16) Reins. Prop. / Fin.	0.415	-6.6%	0.2%	0.7%	-1.6%	0.9%	-0.9%	0.2%	-7.2%	0.343
(17) Reins. Liab.	0.656	-4.7%	0.6%	-3.1%	-1.0%	0.5%	2.0%	3.8%	-1.9%	0.636
(18) PL	1.345	-3.9%	2.8%	-4.5%	-1.1%	0.5%	-0.3%	19.2%	12.8%	1.472
(14) Financial / Mortgage	0.060	-3.7%	-2.3%	0.7%	5.5%	-4.2%	-2.0%	0.0%	-5.9%	0.001
(19) Warranty	0.316	33.2%	-4.7%	8.1%	17.5%	-47.0%	-7.5%	0.0%	-0.4%	0.312
Average Risk Factor - All Lines	0.383	-1.1%	0.3%	-0.1%	-0.2%	-0.5%	0.1%	0.9%	-0.7%	0.376
Average Risk Factor - 10-Yr Lines	0.387	-1.0%	0.2%	-0.1%	-0.3%	0.5%	0.2%	0.9%	0.4%	0.390
Average Risk Factor - 2-Yr Lines	0.344	-3.2%	1.3%	-0.2%	1.9%	-12.0%	-0.4%	0.0%	-12.6%	0.218

Table A-8b—RRFs—Analysis of Change
Number of Filtered Data Points

Line	2014 Indicated RRF	Minor Line Filter	Other Filters	New Data (< 2014), Development	Recent Years (2014-17) [1]	Zero Interior [2]	Maturity First	Allow |RRR| >500%	Total Change	2017 Indicated RRF
		Change in Number of Filtered Data Points Resulting From:								
(1) H/F	11,258	51	(516)	660	748	21	(380)	20	604	11,862
(2) PPA	11,620	105	(709)	619	637	(3)	(456)	13	206	11,826
(3) CA	8,232	(115)	(548)	503	431	9	(254)	4	30	8,262
(4) WC	8,087	60	(586)	682	224	18	(225)	2	175	8,262
(5) CMP	8,322	(91)	(496)	956	-	12	(212)	16	185	8,507
(6) MPL Occ.	1,271	(94)	(30)	136	60	-	35	4	111	1,382
(7) MPL C-M	2,493	(26)	(39)	525	-	-	11	7	478	2,971
(8) SL	2,215	155	(77)	128	106	(3)	(28)	22	303	2,518
(9) OL	10,568	(295)	(395)	956	336	(2)	(16)	20	604	11,172
(11) Spec. Prop.	8,499	(477)	(250)	469	607	137	(82)	-	404	8,903
(12) APD	6,620	(15)	(366)	403	358	278	230	-	888	7,508
(10) Fidelity / Surety	1,971	172	(362)	31	172	(20)	(23)	-	(30)	1,941
(13) Other	1,756	122	(307)	133	124	1	57	-	130	1,886
(15) International	580	(21)	137	76	43	(1)	77	40	351	931
(16) Reins. Prop. / Fin.	1,222	105	(70)	18	65	-	32	7	157	1,379
(17) Reins. Liab.	1,348	65	(20)	74	35	1	52	11	218	1,566
(18) PL	4,196	(57)	(156)	328	116	(4)	(62)	106	271	4,467
(14) Financial / Mortgage	258	(33)	(37)	(5)	19	2	22	-	(32)	226
(19) Warranty	69	(7)	12	(3)	19	9	(23)	-	7	76
Average Risk Factor - All Lines	90,585	(396)	(4,815)	6,689	4,100	455	(1,245)	272	5,060	95,645
Average Risk Factor - 10-Yr Lines	71,412	(158)	(3,505)	5,661	2,801	48	(1,426)	272	3,693	75,105
Average Risk Factor - 2-Yr Lines	19,173	(238)	(1,310)	1,028	1,299	407	181	-	1,367	20,540

Notes:

(1) Recent Years for CMP and MPL C-M are zero due because the maturity filter excludes initial reserve years 2014–2016 in the analysis of change.

(2) The effect shown in this column is the net result of several filters. First, prior to the impact of other filters, applying the zero interior filter caused data points to reduce in all lines. However, some number of RRRs from RBC triangles with zero interiors, have already been removed due to RRR> 5 filter, so the net decrease in number of RRRs is less than the decrease due to the zero interior filter alone. Moreover, when we remove the RBC triangles with zero interior values, then to the extent that there are RBC triangles from later, less mature, valuations, unaffected by zero interior values, we use those triangles. The combined effect of those factors can produce an increase in RRRs.

For all Ten-Year LOBs combined, the change in indicated RRFs from 2014 to 2017 is 0.4% of reserves. However, there some Ten-Year LOBs with larger changes in indicated Risk Factors. The three LOBs with indicated RRF changes greater than ±5% of reserves are the following:

- The International indicated RRF increased by 34.9% overall due to Other Filters (company age) and allowing RRRs greater than 500%. International is one of the three smallest lines of business both in terms of company data points included in the analysis and reserve volume. Its sensitivity to the changes is not surprising.

- The Reinsurance Prop./Fin. indicated RRF decreased 7.2% of reserves, due primarily to changes in the Minor Line filter and the addition of recent years.

- The Products Liability indicated RRF increased 12.8% of reserves due primarily to the impact of allowing RRRs greater than 500%.

For all Two-Year LOBs combined, the change in indicated RRFs from 2014 to 2017 is more significant than the Ten-Year LOBs, at -12.6%. This was driven by the new zero interior filter. With the exception of automobile physical damage, all of the Two-Year LOBs had changes greater than ±5% of reserves.

16. APPENDIX 12—EXAMPLES

Example 1: Reserve Runoff Ratio—Ten-Year LOBs—Annual Statement Data

In this section, we show how the RRRs are calculated from Annual Statement data for Ten-Year LOBs.

To illustrate the runoff ratio calculation based on Annual Statement data, consider the following simulated example, Company XYZ's Schedule P, Part 2 and 3 for a particular LOB for Annual Statement Year 2017.

Table A-9a
Simulated Company XYZ Schedule P—Part 2

		1	2	3	4	5	6	7	8	9	10	11	12
		INCURRED NET LOSSES AND DEFENSE AND COST CONTAINMENT EXPENSES REPORTED AT YEAR END ($000 OMITTED)										DEVELOPMENT	
Years in Which												One	Two
Losses Were Incurred		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Year	Year
1	Prior	730	510	470	450	450	450	440	440	440	440	0	0
2	2008	4,890	3,750	3,700	3,620	3,620	3,620	3,620	3,620	3,620	3,620	0	0
3	2009	XXX	5,010	4,110	3,680	3,730	3,660	3,650	3,650	3,660	3,660	0	10
4	2010	XXX	XXX	3,720	2,850	2,810	2,670	2,640	2,620	2,620	2,620	0	0
5	2011	XXX	XXX	XXX	3,150	2,500	2,490	2,480	2,480	2,480	2,470	-10	-10
6	2012	XXX	XXX	XXX	XXX	2,900	2,230	2,190	2,170	2,170	2,150	-20	-20
7	2013	XXX	XXX	XXX	XXX	XXX	2,700	1,960	1,970	1,960	2,050	90	80
8	2014	XXX	XXX	XXX	XXX	XXX	XXX	3,770	3,580	3,530	3,370	-160	-210
9	2015	XXX	XXX	XXX	XXX	XXX	XXX	XXX	270	310	300	-10	30
10	2016	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	0	0	0	XXX
11	2017	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	0	XXX	XXX
12	Total											-110	-120

We calculate nine RRRs from these data. The most mature is the RRR for the 2008 initial reserve year. The numerator of the Reserve Runoff Ratio is the incurred development for 2008 and prior AYs, combined, from the 2008 evaluation year to the 2017 evaluation year. These data come from Schedule P, Part 2 and we calculate this from the numbers in bold above as follows:

$(440 + 3,620) – (730 + 4,890) = -1,560$

		1	2	3	4	5	6	7	8	9	10	11	12
		CUMULATIVE PAID NET LOSSES AND DEFENSE AND COST CONTAINMENT EXPENSES REPORTED AT YEAR END ($000 OMITTED)										Number of Claims Closed With Loss	Number of Claims Closed Without Loss
Years in Which Losses Were Incurred		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017		
1	Prior	0	390	450	440	440	440	440	440	440	430	1,110	170
2	2008	2,100	3,360	3,580	3,620	3,620	3,620	3,620	3,620	3,620	3,620	860	150
3	2009	XXX	1,540	2,770	3,350	3,620	3,640	3,650	3,650	3,660	3,650	610	100
4	2010	XXX	XXX	1,410	2,180	2,380	2,570	2,600	2,600	2,600	2,600	490	90
5	2011	XXX	XXX	XXX	1,280	2,120	2,310	2,430	2,440	2,440	2,470	420	50
6	2012	XXX	XXX	XXX	XXX	980	1,630	1,880	2,010	2,080	2,100	410	40
7	2013	XXX	XXX	XXX	XXX	XXX	1,150	1,780	1,830	1,890	2,000	460	50
8	2014	XXX	XXX	XXX	XXX	XXX	XXX	1,560	2,590	3,200	3,300	530	70
9	2015	XXX	XXX	XXX	XXX	XXX	XXX	XXX	140	150	160	40	0
10	2016	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	0	0	0	0
11	2017	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	0	0	0

The denominator of this ratio is the carried loss reserves at the 2008 evaluation date. We calculate this for all AYs combined using Schedule P, Parts 2 and 3, from the cells that are shaded above as follows:

(730 + 4,890) – (0 + 2,100) = 3,520

The value for Prior AYs in calendar year 2008 is zero because the Prior rows in Parts 2 and 3 of Schedule P are the amounts excluding the amounts paid through December 31, 2008, on AYs 2008 and prior.

The reserve runoff ratio is then simply the numerator divided by the denominator:
-1,560 ÷ 3,520 = -44.3%

The reserve runoff ratios for reserve years 2009 through 2016 are calculated in the same manner. For initial reserve year 2009, the numerator of the RRR, Part 2, columns 2 and 12, is (440+3,620+3,660) - (510+3,750+5,010) = -1,550.

The denominator of the RRR, from Parts 2 and 3, column 2, is (510+3,750+5,010) - (390+3,360+1,540) = 3,980. The RRR is -38.9%.

Example 2: Reserve Runoff Ratio—Two-Year LOBs—Annual Statement Data
While our indicated RRFs for Two-Years LOBs is based on data from confidential RBC Filings, for comparison purposes, we also calculate indicated RRFs based on Annual Statement data.

The RRR calculation for Two-Year LOBs from Annual Statement data is similar to the calculation for Ten-Year LOBs, but the calculation includes only two AY and the prior year data. The

following example from a 2017 Annual Statement illustrates the runoff ratio calculation based on Annual Statement data for sample Company XYZ Schedule P, Part 2 and 3.

Table A10a
Simulated Company XYZ Schedule P—Part 2—Two-Year LOBs

		1	2	3	4	5	6	7	8	9	10	11	12
		INCURRED NET LOSSES AND DEFENSE AND COST CONTAINMENT EXPENSES REPORTED AT YEAR END ($000 OMITTED)										Development	
Years in Which Losses Were Incurred		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	One Year	Two Year
1	Prior	XXX	XXX	XXX	XXX	XXX	XXX	XXX	15,498	17,703	18,326	624	2,829
2	2016	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	23,314	24,070	756	XXX
3	2017	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	25,274	XXX	XXX
4	Total											1,379	2,829

Table A10b
Simulated Company XYZ Schedule P—Part 3—Two-Year LOBs

		1	2	3	4	5	6	7	8	9	10
		CUMULATIVE PAID NET LOSSES AND DEFENSE AND COST CONTAINMENT EXPENSES REPORTED AT YEAR END ($000 OMITTED)									
Years in Which Losses Were Incurred		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Prior	XXX	XXX	XXX	XXX	XXX	XXX	XXX	0	9,253	15,544
2	2016	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	4,060	12,442
3	2017	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	4,263

We calculate only one runoff ratio from these data, the runoff ratio for the 2016 reserve year. For this ratio, the numerator of the Reserve Runoff Ratio is the incurred development for 2016 and prior AYs, combined, from 2016 evaluation year to the 2017 evaluation year. These data come from Schedule P, Part 2 and we calculate this as follows:

$(18,326 + 24,070) – (17,703 + 23,314) = 1,379$

The denominator is the carried loss reserves at the 2016 evaluation date. We calculate this for all AYs combined using Schedule P, Parts 2 and 3, as follows:

$(17,703+23,314) – (9,253 + 4,060) = 27,704$

The reserve runoff ratio is then simply the numerator divided by the denominator:
$1,379 ÷ 27,704 = 5.0\%$.

Example 3: Reserve Runoff Ratio—Two-Year LOBs—RBC Data
The tables below shows an example of RBC data. This data is the RBC data that is consistent with the Two-Year Annual Statement data shown in Example 2, above.

Table A11a
Simulated Company XYZ RBC Equivalent of Schedule P—Part 2—Two-Year LOBs

		1	2	3	4	5	6	7	8	9	10
		INCURRED NET LOSSES AND DEFENSE AND COST CONTAINMENT EXPENSES REPORTED AT YEAR END ($000 OMITTED)									
	Years in Which Losses Were Incurred	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Prior	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	2008	1,875	1,808	1,678	1,496	1,463	1,338	1,179	1,182	1,216	1,231
3	2009		1,926	1,827	1,481	1,388	1,446	1,276	1,290	1,304	1,267
4	2010			3,378	3,567	3,100	3,048	3,042	2,947	2,965	2,943
5	2011				7,774	8,902	8,128	7,351	7,949	7,855	7,393
6	2012					8,010	9,881	9,571	9,435	9,428	9,423
7	2013						9,751	10,222	9,959	9,944	9,927
8	2014							11,581	12,426	18,731	18,535
9	2015								14,533	16,738	18,086
10	2016									23,314	24,070
11	2017										

Table A11b
Simulated Company XYZ RBC Equivalent of Schedule P—Part 3—Two-Year LOBs

		1	2	3	4	5	6	7	8	9	10
	Years in Which Losses Were Incurred	CUMULATIVE PAID NET LOSSES AND DEFENSE AND COST CONTAINMENT EXPENSES REPORTED AT YEAR END ($000 OMITTED)									
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Prior	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	2008	92	573	835	960	997	1,039	1,106	1,158	1,202	1,233
3	2009		111	488	779	997	1,090	1,156	1,197	1,201	1,203
4	2010			99	815	1,937	2,238	2,451	2,614	2,811	2,802
5	2011				557	3,939	5,020	5,447	6,165	6,242	6,316
6	2012					2,332	4,315	5,024	7,900	8,656	8,848
7	2013						3,497	8,841	9,374	9,535	9,660
8	2014							3,112	8,533	12,387	14,464
9	2015								1,888	6,049	9,848
10	2016									4,060	12,442
11	2017										XXX

The RBC data differs from the Annual Statement data in that there is no data in the Prior row.

We calculate RRRs using the most mature runoff data available. Often that was age 10, corresponding to 2008 and prior. One feature of that calculation is that the runoff contains only one AY.

For example, the runoff for initial reserve year 2008 would be calculated as follows:

Incurred Movement = 1,231 – 1,875 = -645, using the "2008 row".
The initial reserve = 1,875 – 92 = 1,783
The runoff ratio equals -645 ÷ 1,783 = -36.1%

Because there is no prior row, this constitutes the development of 2008 only.

17.APPENDIX 13—IMPACT OF ALTERNATVE RISK FACTORS

Part 1: Change in P&C RBC Charges by Type of Company: R4 Alone, R5 Alone, and Total ACL

R4 charge - Reserve Risk							
Total R4 Charge \ Company Category	Commercial	Med Mal	NOC	Personal	Reinsurer	Vorkers Com	Total
2020 RBC Formula	78.3	2.3	0.6	26.8	3.1	12.3	123.4
Indicated (2014 Uncapped)	89.0	0.7	1.1	27.6	3.3	13.2	134.9
Percentage change	13.7%	-70.1%	85.3%	3.1%	6.0%	7.7%	9.3%
Indicated (2017 Uncapped)	86.0	0.6	0.8	29.0	3.1	12.8	132.3
Percentage change	9.9%	-74.5%	35.5%	8.0%	0.6%	4.2%	7.2%
Indicated (2017 Min 5%)	86.2	1.1	0.8	29.1	3.1	12.8	133.1
Percentage change	10.1%	-51.5%	35.6%	8.4%	0.5%	4.1%	7.9%
Indicated (2017 Max chg 10%)	78.7	2.1	0.6	27.6	3.0	11.9	124.1
Percentage change	0.6%	-8.9%	5.0%	3.1%	-3.7%	-2.9%	0.5%
Indicated (2017 Max chg 20%)	79.9	1.9	0.6	28.5	3.0	12.1	126.0
Percentage change	2.1%	-17.9%	10.0%	6.2%	-4.5%	-1.8%	2.1%
Indicated (2017 Max chg 35%)	81.4	1.6	0.7	28.7	3.0	12.2	127.6
Percentage change	4.0%	-31.0%	17.6%	7.0%	-4.4%	-0.3%	3.4%

R5 charge - Premium Risk							
Total R5 Charge \ Company Category	Commercial	Med Mal	NOC	Personal	Reinsurer	Vorkers Com	Total
2020 RBC Formula	33.9	1.5	0.7	32.1	0.7	5.5	74.4
Indicated (2014 Uncapped)	32.6	1.5	0.6	31.9	0.8	5.5	72.9
Percentage change	-3.7%	2.7%	-16.6%	-0.5%	7.3%	0.1%	-1.9%
Indicated (2017 Uncapped)	32.4	1.4	0.6	32.2	0.8	5.2	72.6
Percentage change	-4.4%	-4.4%	-18.0%	0.5%	3.6%	-4.2%	-2.3%
Indicated (2017 Min 5%)	32.4	1.4	0.6	32.2	0.8	5.2	72.6
Percentage change	-4.4%	-4.4%	-18.0%	0.5%	3.6%	-4.2%	-2.3%
Indicated (2017 Max chg 10%)	33.4	1.5	0.7	32.4	0.7	5.2	73.9
Percentage change	-1.4%	1.0%	-1.9%	0.9%	-2.0%	-4.2%	-0.6%
Indicated (2017 Max chg 20%)	32.9	1.5	0.7	32.3	0.7	5.2	73.3
Percentage change	-2.9%	-2.3%	-5.1%	0.6%	-3.5%	-4.4%	-1.5%
Indicated (2017 Max chg 35%)	32.3	1.4	0.6	32.2	0.7	5.2	72.5
Percentage change	-4.6%	-4.4%	-10.0%	0.4%	-2.1%	-4.6%	-2.5%

Total Authorized Control Level (ACL) - RBC							
ACL RBC \ Company Category	Commercial	Med Mal	NOC	Personal	Reinsurer	Vorkers Com	Total
2020 RBC Formula	64.9	2.4	0.9	84.3	8.2	10.1	170.6
Indicated (2014 Uncapped)	69.2	2.0	1.0	84.5	8.2	10.5	175.4
Percentage change	6.6%	-17.1%	20.7%	0.3%	0.6%	3.9%	2.8%
Indicated (2017 Uncapped)	68.0	1.9	0.9	84.9	8.2	10.3	174.2
Percentage change	4.8%	-19.5%	5.7%	0.8%	0.1%	1.7%	2.1%
Indicated (2017 Min 5%)	68.0	2.0	0.9	84.9	8.2	10.3	174.3
Percentage change	4.9%	-15.8%	5.6%	0.8%	0.1%	1.7%	2.2%
Indicated (2017 Max chg 10%)	64.9	2.3	0.9	84.5	8.1	10.0	170.7
Percentage change	0.1%	-2.9%	0.8%	0.3%	-0.4%	-1.8%	0.0%
Indicated (2017 Max chg 20%)	65.4	2.2	0.9	84.7	8.1	10.0	171.3
Percentage change	0.8%	-6.3%	1.2%	0.5%	-0.4%	-1.3%	0.4%
Indicated (2017 Max chg 35%)	65.9	2.1	0.9	84.8	8.1	10.1	171.8
Percentage change	1.6%	-10.6%	2.0%	0.6%	-0.4%	-0.6%	0.7%

Notes

Amounts in Billions. Excluding Zero and Negative Size Companies

"NOC," standing for Not Otherwise Classified, means companies whose major line is one of the following: Special Liability, Fidelity/Surety, "Other," International, Financial/Mortgage Guaranty, Warranty.

Risk factors for "2014 Data" and "2017 Data" for catastrophe exposed LOBs, are reduced to reflect the fact that catastrophe risk is incorporated separately in the RBC Formula. We apply the multiplicative adjustment used by the NAIC. See footnote 4.

Part 2: Change in P&C RBC Charges by % Size in Change in RBC Value: R4 Alone, R5 Alone, and Total ACL

% Change in Risk Charge	2020 to 2017 Uncapped	2020 to 2017 Min 5%	2020 to 2017 Max Chg 10%	2020 to 2017 Max Chg 20%	2020 to 2017 Max Chg 35%
P&C RBC - Distribution of Companies by Change of R4 Charges					
% Changes in R4					
Less Than -50%	168	133	1	1	7
-50% to -25%	19	49	1	10	144
-25% to -15%	6	10	2	140	36
-15% to -5%	139	144	312	184	148
-5% to 5%	536	523	987	772	643
5% to 15%	506	520	531	527	527
15% to 25%	245	242	0	199	236
25% to 50%	151	149	0	0	91
Over 50%	67	67	3	4	5
Total	1837	1837	1837	1837	1837
R5 - P&C RBC - Distribution of Companies by Change of R5 Charges					
% Changes in R5					
Less Than -50%	19	19	2	3	12
-50% to -25%	68	68	7	30	52
-25% to -15%	54	54	21	41	63
-15% to -5%	275	275	183	240	285
-5% to 5%	1273	1273	1481	1386	1288
5% to 15%	117	117	118	112	112
15% to 25%	9	9	6	6	6
25% to 50%	12	12	12	11	11
Over 50%	10	10	7	8	8
Total	1837	1837	1837	1837	1837
ACL - P&C RBC - Distribution of Companies by Change of ACL RBC					
% Changes in ACL RBC					
Less Than -50%	26	12	0	0	0
-50% to -25%	78	78	0	3	38
-25% to -15%	55	55	1	36	69
-15% to -5%	138	149	157	204	172
-5% to 5%	1161	1164	1586	1416	1319
5% to 15%	242	244	93	166	185
15% to 25%	70	68	0	12	43
25% to 50%	58	58	0	0	11
Over 50%	9	9	0	0	0
Total	1837	1837	1837	1837	1837

Part 3: Change in P&C RBC Charges by Size of Company: R4 Alone, R5 Alone, and Total ACL

P&C RBC - Comparison of R4 by Company Size (L&LAE + NWP)												
R4 \ Company Size	zero or less	0%-10%	10%-20%	20%-30%	30%-40%	40%-50%	50%-60%	60%-70%	70%-80%	80%-90%	90%-100%	Total
2020 RBC Formula	156.0	19.3	74.3	189.0	355.5	712.7	1,119.9	2,430.2	4,566.6	12,271.0	101,666.8	123,561.5
Indicated (2014 Uncapped)	174.1	21.1	72.4	184.1	404.3	755.0	1,152.4	2,625.6	4,914.1	13,564.6	111,212.9	135,080.6
Percentage change	11.6%	9.1%	-2.6%	-2.5%	13.7%	5.9%	2.9%	8.0%	7.6%	10.5%	9.4%	9.3%
Indicated (2017 Uncapped)	179.8	19.5	67.3	170.2	369.9	721.6	1,125.1	2,509.5	4,833.0	13,268.7	109,222.2	132,486.7
Percentage change	15.3%	0.9%	-9.5%	-9.9%	4.0%	1.2%	0.5%	3.3%	5.8%	8.1%	7.4%	7.2%
Indicated (2017 Min 5%)	179.6	20.0	70.8	179.6	377.9	745.0	1,144.0	2,553.7	4,884.9	13,375.8	109,767.0	133,298.3
Percentage change	15.1%	3.8%	-4.8%	-4.9%	6.3%	4.5%	2.1%	5.1%	7.0%	9.0%	8.0%	7.9%
Indicated (2017 Max Chg 10%)	164.1	19.2	73.8	187.1	359.3	713.7	1,124.5	2,440.3	4,595.5	12,312.1	102,237.1	124,226.9
Percentage change	5.2%	-0.5%	-0.7%	-1.0%	1.1%	0.1%	0.4%	0.4%	0.6%	0.3%	0.6%	0.5%
Indicated (2017 Max Chg 20%)	171.5	19.4	72.9	186.0	363.2	719.8	1,133.1	2,464.4	4,652.4	12,499.2	103,895.3	126,177.1
Percentage change	9.9%	0.3%	-2.0%	-1.6%	2.2%	1.0%	1.2%	1.4%	1.9%	1.9%	2.2%	2.1%
Indicated (2017 Max Chg 35%)	176.2	19.5	72.0	183.6	367.2	724.8	1,136.0	2,482.5	4,696.6	12,700.1	105,236.3	127,794.8
Percentage change	12.9%	0.9%	-3.1%	-2.8%	3.3%	1.7%	1.4%	2.2%	2.8%	3.5%	3.5%	3.4%

P&C RBC - Comparison of R5 by Company Size (L&LAE + NWP)												
R5 \ Company Size	zero or less	0%-10%	10%-20%	20%-30%	30%-40%	40%-50%	50%-60%	60%-70%	70%-80%	80%-90%	90%-100%	Total
2020 RBC Formula	368.8	107.0	143.6	246.2	472.2	698.0	1,096.9	1,962.0	3,717.3	8,526.7	57,392.3	74,731.1
Indicated (2014 Uncapped)	367.6	106.5	137.3	235.8	456.7	686.5	1,049.7	1,893.3	3,607.5	8,293.0	56,476.0	73,309.9
Percentage change	-0.3%	-0.5%	-4.4%	-4.2%	-3.3%	-1.6%	-4.3%	-3.5%	-3.0%	-2.7%	-1.6%	-1.9%
Indicated (2017 Uncapped)	371.8	106.3	136.0	232.5	451.9	677.9	1,037.8	1,870.1	3,577.7	8,195.4	56,347.9	73,005.5
Percentage change	0.8%	-0.7%	-5.3%	-5.6%	-4.3%	-2.9%	-5.4%	-4.7%	-3.8%	-3.9%	-1.8%	-2.3%
Indicated (2017 Min 5%)	371.8	106.3	136.0	232.5	451.9	677.9	1,037.8	1,870.1	3,577.7	8,195.4	56,347.9	73,005.5
Percentage change	0.8%	-0.7%	-5.3%	-5.6%	-4.3%	-2.9%	-5.4%	-4.7%	-3.8%	-3.9%	-1.8%	-2.3%
Indicated (2017 Max Chg 10%)	372.7	107.0	142.1	243.6	466.8	693.0	1,080.2	1,940.2	3,678.3	8,414.1	57,165.8	74,303.9
Percentage change	1.1%	0.0%	-1.0%	-1.0%	-1.1%	-0.7%	-1.5%	-1.1%	-1.1%	-1.3%	-0.4%	-0.6%
Indicated (2017 Max Chg 20%)	372.4	106.8	140.3	240.6	462.2	688.1	1,065.4	1,918.2	3,636.4	8,320.1	56,674.4	73,624.8
Percentage change	1.0%	-0.2%	-2.3%	-2.3%	-2.1%	-1.4%	-2.9%	-2.2%	-2.2%	-2.4%	-1.3%	-1.5%
Indicated (2017 Max Chg 35%)	371.9	106.5	137.8	236.5	455.9	681.5	1,047.7	1,888.8	3,579.8	8,206.3	56,163.8	72,876.5
Percentage change	0.9%	-0.5%	-4.0%	-3.9%	-3.4%	-2.4%	-4.5%	-3.7%	-3.7%	-3.8%	-2.1%	-2.5%

P&C RBC - Comparison of ACL RBC by Company Size (L&LAE + NWP)												
ACL RBC \ Company Size	zero or less	0%-10%	10%-20%	20%-30%	30%-40%	40%-50%	50%-60%	60%-70%	70%-80%	80%-90%	90%-100%	Total
2020 RBC Formula	897.2	188.3	204.5	442.4	718.3	1,003.2	1,409.5	2,990.9	4,824.2	12,841.7	146,023.6	171,543.8
Indicated (2014 Uncapped)	901.3	189.0	202.6	439.4	731.6	1,020.6	1,407.4	3,032.7	4,951.8	13,367.4	150,037.4	176,281.3
Percentage change	0.5%	0.4%	-0.9%	-0.7%	1.9%	1.7%	-0.1%	1.4%	2.6%	4.1%	2.7%	2.8%
Indicated (2017 Uncapped)	903.2	188.4	200.6	434.2	718.6	1,007.0	1,395.3	3,002.6	4,917.3	13,221.9	149,099.7	175,088.9
Percentage change	0.7%	0.1%	-1.9%	-1.9%	0.0%	0.4%	-1.0%	0.4%	1.9%	3.0%	2.1%	2.1%
Indicated (2017 Min 5%)	903.2	188.5	201.1	435.6	720.0	1,011.6	1,398.7	3,012.4	4,925.3	13,239.6	149,200.0	175,235.9
Percentage change	0.7%	0.1%	-1.7%	-1.6%	0.2%	0.8%	-0.8%	0.7%	2.1%	3.1%	2.2%	2.2%
Indicated (2017 Max Chg 10%)	900.6	188.3	203.5	440.6	716.4	1,000.7	1,403.1	2,985.1	4,816.0	12,821.2	146,143.0	171,618.3
Percentage change	0.4%	0.0%	-0.4%	-0.4%	-0.3%	-0.2%	-0.5%	-0.2%	-0.2%	-0.2%	0.1%	0.0%
Indicated (2017 Max Chg 20%)	901.9	188.2	202.7	439.1	716.2	1,001.0	1,400.6	2,986.0	4,824.2	12,869.1	146,648.4	172,177.3
Percentage change	0.5%	0.0%	-0.9%	-0.7%	-0.3%	-0.2%	-0.6%	-0.2%	0.0%	0.2%	0.4%	0.4%
Indicated (2017 Max Chg 35%)	902.6	188.2	201.6	437.2	715.8	1,001.1	1,395.9	2,983.5	4,827.7	12,926.5	147,158.3	172,738.3
Percentage change	0.6%	0.0%	-1.4%	-1.2%	-0.3%	-0.2%	-1.0%	-0.2%	0.1%	0.7%	0.8%	0.7%

Part 4: Type of Company Definition

For each company, the company is assigned to one of six categories—Personal Lines, Commercial Lines, Medical Professional Liability, Reinsurance, Workers' Compensation, or Other—by determining the amount of premium plus reserves (net written premium, plus net loss and LAE unpaid) for each of the six categories (using the table shown below), and then determining the category with the highest amount of premium plus reserves.

Schedule P Line	Category		Schedule P Line	Category
(1) H/F	Personal Lines		(12) APD	Personal Lines
(2) PPA	Personal Lines		(10) Fidelity / Surety	Other
(3) CA	Commercial Lines		(13) Other	Other
(4) WC	Workers Compensation		(15) International	Other
(5) CMP	Commercial Lines		(16) Reins. Prop. / Fin.	Reinsurance
(6) MPL Occ.	Medical Malpractice		(17) Reins. Liab.	Reinsurance
(7) MPL C-M	Medical Malpractice		(18) Product Liab.	Commercial Lines
(8) SL	Other		(14) Financial / Mortgage	Other
(9) OL	Commercial Lines		(19) Warranty	Other
(11) Spec. Prop.	Commercial Lines			

Part 5: LOB Share With Each Type of Company

The table below shows the proportion of NWP+Loss and LAE reserve by LOB within each of the type of company categories.

LOB\Category	Commercial	Med Mal	NOC	Personal	Reinsurer	Workers Comp	Total
HF	6%	0%	0%	17%	2%	2%	10%
PPA	6%	0%	0%	45%	2%	4%	22%
CA	8%	0%	0%	3%	2%	4%	5%
WC	16%	1%	0%	2%	2%	73%	15%
CMP	10%	0%	0%	3%	1%	6%	6%
MM Occ	0%	24%	0%	1%	0%	0%	1%
MM CM	1%	72%	0%	1%	0%	0%	2%
SL	2%	0%	20%	0%	2%	0%	1%
OL	30%	2%	22%	3%	8%	6%	16%
FID/SUR	1%	0%	38%	0%	0%	1%	1%
SP	9%	0%	2%	2%	6%	1%	5%
APD	4%	0%	0%	18%	1%	2%	9%
Other	1%	0%	13%	0%	0%	0%	1%
Fin/Mortgage	0%	0%	0%	0%	0%	0%	0%
INTL	0%	0%	0%	0%	3%	0%	0%
Rein (Prop and	1%	0%	0%	2%	21%	0%	2%
Rein (LiAl)	3%	1%	0%	2%	49%	1%	3%
PL	2%	0%	0%	0%	0%	1%	1%
WAR	0%	0%	4%	0%	0%	0%	0%
Total %	100%	100%	100%	100%	100%	100%	100%
Total - $	612,343,230	21,289,449	7,851,892	524,169,525	14,841,788	119,683,083	1,300,178,967

We see that the main LOBs within the category NOC are Fidelity/Surety, Other Liability and Special Liability, and we see that the Medical Professional Type of Company is predominantly Medical Professional Liability Claims Made.

18. APPENDIX 14—REFERENCES

 [1] American Academy of Actuaries, 2010, 2010 Update to P/C Risk-Based Capital Underwriting Factors Presented to the National Association of Insurance Commissioners' Property Risk-Based Capital Working Group March 2010, American Academy of Actuaries' P/C Risk-Based Capital Committee.
https://www.actuary.org/sites/default/files/pdf/casualty/rbc_update_mar10.pdf

[2] American Academy of Actuaries, 2016, A report dated October 2016 presenting an update to the Risk Factors indicated based on data with evaluation dates through December 2014 and with multiple, significant, refinements to the methodology used in the prior reports.
https://www.actuary.org/sites/default/files/files/publications/PC_RBC_UWFactors_10282016.pdf

[3] Casualty Actuarial Society EForum, 2013-2014,

    Premium Risk Charges—Improvements to Current Calibration Method (**Report 6**)
    http://www.casact.org/pubs/forum/13fforum/01-Report-6-RBC.pdf
    Reserve Risk Charges—Improvements to Current Calibration Method (**Report 7**)
    http://www.casact.org/pubs/forum/14wforum/Report-7-RBC.pdf

[4] American Academy of Actuaries Property/Casualty Risk-Based Capital Task Force, Report on Reserve and Underwriting Risk Factors, May 1993, https://www.casact.org/pubs/forum/93sforum/93sf105.pdf

19.APPENDIX 15—May 2019 Letter to NAIC

American Academy *of* Actuaries

Objective. Independent. Effective.™

May 8, 2019

Tom Botsko, Chair
Property and Casualty Risk-Based Capital Working Group
National Association of Insurance Commissioners
(via email to Eva Yeung)

Dear Tom:

The American Academy of Actuaries[1] Property and Casualty Risk-Based Capital (RBC)
Committee plans to support the National Association of Insurance Commissioners'
efforts to update the calibration of factors used to calculate underwriting (UW) risk. This
letter describes our plans. We appreciate this opportunity to describe those plans and
solicit input from the NAIC Property and Casualty RBC Working Group.

1. Overview

We plan to analyze the following:

- Investment Income Adjustment (IIA)—RBC Line 8 on page PR017 (R4 Reserve
  risk) and Line 7 on page PR018 (R5 Premium risk), by Line of Business (LOB);

- Loss Concentration Factor (LCF) and Premium Concentration Factor (PCF)—
  RBC Line 14 on PR017 and PR018 respectively, which are used to calculate
  diversification credit in the RBC Formula; and

- LOB UW risk factors—RBC Line 4 on PR017 and PR018. We will use the results
  of this review as a starting point for the IIA and LCF/PCF analysis. This review
  will include the use of data not available to this Academy committee at the time
  the 2016 Academy Report[2] was provided.

---

[1] The American Academy of Actuaries is a 19,500-member professional association whose mission is to
serve the public and the U.S. actuarial profession. For more than 50 years, the Academy has assisted
public policy makers on all levels by providing leadership, objective expertise, and actuarial advice on risk
and financial security issues. The Academy also sets qualification, practice, and professionalism standards
for actuaries in the United States.

[2] Report to National Association of Insurance Commissioners Property andCasualty Risk-Based Capital
(E) Working Group: 2016 Update to Property and Casualty Risk-Based Capital Underwriting Factors,
American Academy of Actuaries Property and Casualty Risk-Based Capital Committee, October 2016.

The remainder of this letter provides more details regarding our proposed analyses.

2. IIA Analysis (Line 8/7)

The IIA reduces the amount of UW risk charge to recognize that future investment income will be available to offset the cost of adverse UW (premium risk) or reserve development (reserve risk).

Evaluation approach

The IIAs are based on a 5% per annum interest rate assumption, which is not consistent with recent experience.

We will consider two ways to update the IIAs. First, the Line 4 risk factor and the IIA on Lines 8/7 are currently calibrated as independent parameters. We use the term Nominal Value Approach (NVA) to describe an approach that does not consider possible interactions between interest rates underlying the IIA and loss experience underlying the Line 4 risk factors.

Implementing NVA requires changing the IIAs to reflect changing interest rates over time. We will consider how that might be done in a manner that provides reasonable stability but remains responsive to current conditions.

Second, we note that there are reasons to expect that loss ratios (LRs) and reserve runoff ratios (RRRs) are higher when interest rates are higher.[3] An alternative to NVA, which considers a possible interaction between UW risk and interest rates, is to calibrate UW risk factors (Line 4) using data discounted to present value based on historical interest rates. Risk factors and IIAs can be developed from that analysis. We refer to that alternative as the Present Value Approach (PVA).

With PVA, we would establish the combined effect of the underwriting risk factors (Line 4) and the IIA (Line 8/7). We would produce a single indicated risk factor that reflects both UW risk, Line 4, and IIA, Lines 8/7. If desired, for consistency with the current format of the RBC Formula, that combined risk factor can be split into its two components. However, future changes in interest rates will not necessarily require changes in the IIA values.

We plan to prepare indicated risk factors for IIAs based on both NVA and PVA.

Interaction with UW risk safety level

Consistent with prior calibrations, UW risk factor Line 4 calibrations prepared for the NAIC in the 2016 Report are based on an 87.5[th] percentile safety level. We understand

---

[3] An observation in the 1993 Report on Reserve and Underwriting Risk Factors by the American Academy of Actuaries Property/Casualty Risk-Based Capital Task Force, and more recently, Casualty Actuarial Society Dependency and Calibration Working Party Report 15. Publication in CAS EForum is pending.

the 87.5th percentile is used because it appeared to be consistent with the UW risk safety level selected when the RBC Formula was first calibrated in the early 1990s.

The 5% interest rate was also selected in the initial RBC calibration in the early 1990s. At that time actual interest rates were higher than 5%. Therefore, the initial IIA calibration can be viewed as including an implicit interest rate safety margin—that being the difference between actual interest rates at the time and the 5% interest rate selected.

In the IIA analysis, we will use interest rates with and without the kind of implicit safety margin that was part of the RBC calibration in the early 1990s. In using interest rates with no implicit safety margin, we will consider the extent to which the UW risk safety level should be increased to a value above 87.5%, to reflect the combination of the current 87.5th percentile on UW risk and any implicit interest rate safety margin. We will provide the NAIC with alternative treatments on this issue.

3. LCF/PCF Analysis (Line 14)

The LCF/PCF uses the ratio of the reserve/premium amount for the company's largest RBC LOB to the company's all-lines total reserve/premium amount. This ratio is used to measure the spread of business by LOB, commonly called diversification. We refer to that ratio as the Company Line of Business Maximum% (CoMaxLine%).

The LCF/PCF equals CoMaxLine% times 0.3 plus 0.7. This produces a discount for diversification, up to a maximum somewhat less than 30%.[4]

Evaluation of 30% Maximum Diversification Credit

The proposed work will review the extent to which the 30% maximum should be revised based on experience.

---

[4] The maximum credit would be 30% if the number of LOBs were infinite. If premium/reserves were divided equally among the 19 LOBs, CoMaxLine% is 1/19, 5.26%, and the maximum credit is 28.4%.

Evaluation of other approaches

There are alternatives to the CoMaxLine% Approach in the RBC formula. One alternative approach is to use the largest LOB risk amount, rather than the largest reserve/premium amount. We refer to this as the CoMaxLine%-Risk approach. [5,6]

Another alternative approach to evaluating diversification could be based on the Herfendahl-Hirschman Index (HHI). HHI is widely used by economists to measure concentration. The HHI index considers the relative proportions of all LOBs (largest, second-largest, third-largest, etc.) [7], whereas the CoMaxLine% approach only considers the relative proportion of the largest LOB.

We will evaluate these alternatives.

4. Update to UW factors

The UW factors presented in the 2016 Report are based on data for Annual Statement years 1997–2014. For this work, the NAIC has provided data for Annual Statement years 1984[8]–2017. We plan to update UW factors to include the additional new years (2015–2017), and we will potentially use data from Annual Statement years prior to 1997 for specific LOBs.

Our indicated risk factors will include the effect of catastrophe events, net of reinsurance. We expect that the NAIC will continue to apply its current catastrophe adjustment

---

[5] As an example of the difference between the risk maximum and the premium/reserve (volume) maximum, consider a hypothetical company that had $1 million of private passenger liability premium and $1 million of occurrence medical malpractice premium.

The private passenger automobile risk premium charge is about 15% and malpractice occurrence premium risk charge is about 60%, producing $150,000 of automobile premium risk, $600,000 of medical malpractice premium risk, and $750,000 in total premium risk (before diversification).

Using the CoMaxLine% approach in the RBC Formula, the CoMaxLine% is 0.50, and the credit for spread of business is 15%, half of the 30% maximum credit.

Based on risk, the maximum risk is the $600,000 for occurrence medical malpractice and the CoMaxLine%-Risk is 0.80 (600,000/750,000). The CoMaxLine%-Risk is much higher than CoMaxLine% because from the risk perspective the company is much less diversified. Measured this way, the credit for spread of business is reduced to 6%.

[6] Using risk by LOB suggests the use of expenses by LOB. Expenses by LOB for the current year are in the Insurance Expense Exhibit, which is not filed until a month after the Annual Statement is filed. We will test options that use data that is available when the Annual Statement is filed, e.g., current year total expenses allocated by LOB based on prior year expenses by LOB, prior year expense by LOB with no adjustment to the current year, and current year company-wide expenses that does not vary by LOB.

[7] HHI equals the sum of the squares of the relative proportions of each LOB compared to the total.

For example, if there is only one LOB, HHI is 1.0, as is the case for the CoMaxLine%. With two lines split 50% and 50% HHI and the CoMaxLine% are still the same, both 0.5.

With two lines split 25% and 75% HHI is 0.25^2 plus 0.75^2 or 0.625 compared to the CoMaxLine% of 0.750, i.e., HHI shows more diversification. With three lines split 50%, 25% and 25% HHI is 0.50^2 plus 0.25^2 plus 0.25^2 or 0.375, more diversification than the CoMaxLine% of 0.5.

The HHI is sometimes applied to only the n-th largest segments, e.g., the degree of diversification among the top five or 10 LOBs.

[8] Annual Statements 1989 and subsequent for reserve risk data.

process to any updated UW risk factors it may choose to implement based on the results of our analysis.[9]

5. Timeline

NAIC staff have provided us with much of the necessary data. We greatly appreciate that assistance, without which this project would not be possible.

We are currently reviewing the data and organizing it for our analyses.

We will provide a timeline and milestones at future meetings and calls.

6. Directional Impacts of These Analyses on RBC Formula Values

While we currently have no results, based on the nature of the changes, we expect that:

- The IIA revision will indicate an increase in amount of UW risk charges for all companies; and

- The LCF/PCF analysis will generally indicate a decrease in amount of UW risk charges for diversified companies.

We expect to provide possible transition rules for implementation, consistent with past practice and/or if such rules appear warranted by features in the data.

Also, as we have in the past, we will ask NAIC to do an impact review of indicated changes.

<div align="center">*   *   *   *</div>

We appreciate this opportunity to assist the NAIC.

Regards,

Lauren Cavanaugh
Chairperson
Academy Property & Casualty
Risk-Based Capital Committee

---

[9] The Academy P&C RBC Committee would be happy to discuss how we might assist the NAIC in calibration of the risk factors on a net-of-catastrophe basis, but we believe that should be a separate project, after we complete the projects we describe in this letter.