Summary of Review by John Pierce Consulting Actuary of
BPA #AG-645S-B-09-0029   BPA Call AG-645S-K-11-0063   Due October 14, 2011
"Methodology Analysis for Weighting Historical Experience"
Funded by the RMA and produced by Coble, Miller, Rejesus, Boyles, Knight and Goodwin
Page 1

This submission by Coble, Miller, Rejesus, Boyles, Knight and Goodwin proposed to revise the current RMA methodology for updating rates. It is my understanding that approval of the submission will impact rates for all crops in the FCIC programs.

Section 5 of the Implementation Report lists the following changes recommended to the RMA ratemaking methodology:

1. An adjustment to pre-1995 loss costs (reducing these pre-1995 loss costs to bring them to current levels)
2. Weather weighting (using weather indices to place loss costs by country by crop in statistical "bins", and also using these weather indices to temper the impact of extreme years in the excess loss procedure)
3. Net acre weighting within probability bins
4. The use of a 20 year moving average of loss data (instead of the current procedure's 31 years)
5. Use of a 90th percentile cutoff for catastrophe loading (instead of the current 80th percentile cutoff) and distributing the catastrophe loading across each climate division (instead of the current procedure's distribution of the catastrophe loading across each state)

I believe the arguments made in the submission for these changes are convincing. However, in our review we do identify a number of potential problem areas in the submission. These include:

1. There is no mention of global warming in the submission. Because of the possibility that global warming – or some other long-term trend in weather -- does exist, it would appear necessary for the submission to consider the possible impact of this phenomenon on its calculation of weather indices.
2. The fractional logit regression procedure is used in the submission. I believe the information provided in the submission leaves a significant part of this procedure as a "black box" for the reviewers.
3. Various aspects of the pre-1995 adjustment are unclear. The Technical Report uses ordinary least squares to calculate three methods for calculating this adjustment. However, the technical report does not provide sufficient information for us to actually calculate this adjustment.
   In addition, the Implementation Report suggests using the fractional logit regression method for calculating this adjustment, even though the Technical Report used ordinary least squares regression. Finally, the Implementation Report does not reach a conclusion as to whether this adjustment should be on the state, regional or national level.
4. The Climate Division Data is available yearly from 1895 to present. However, some data from the pre-1931 years was not available, and had been estimated using regression techniques. The submission does not investigate whether using data from only 1931 to present would be an improvement over their approach of using 1895 to present data.
5. The RMA premium and loss experience by year and by crop provides some

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Page 2

evidence that breaking the experience period between pre-2003 years and 2004 and subsequent years might be preferable to the submission's breaking of the experience into pre-1995 years and 1995 and subsequent years.

1. Actuarial soundness.

A. Is adequate, credible, and reliable rate-making data available? Is it likely that the data will continue to be available? Is the data vulnerable to tampering if the proposed policy is approved?
Answer 2A: The submission uses the RMA's Statplan database. This database includes experience from the various FCIC insurance products and covers approximately 35 years of history. The Statplan database is credible and reliable. Because the database is under control of the RMA, it would not be vulnerable to tampering.

The submission also uses historical weather data from "the National Climatic Data Center's Time Bias Corrected Divisional Temperature-Precipitation-Drought Index data, also called the Climate Division Data. Climate Division data provide monthly, serially complete information on temperature, precipitation, relative severity of dry and wet periods using drought indexes, and degree day metrics of heat and cold accumulation since 1895 for the continental United States, grouped into 344 divisions. Updates are operationally provided each month by NOAA's National Climatic Data Center." (pages 23-24 of the Implementation Report.)

This Climate Division Data appears to be credible and reliable. Because the data is under control of a government agency, it would not be vulnerable to tampering.

B. Are the explicit and implicit assumptions used in the rating process reasonable?
Answer 2B: One implicit assumption in the submission involves the Climate Division Data. The submission does not mention global warming. More broadly, the submission does not mention the possibility of any trend in the Climate Division Data.

Global warming is a topic which is the subject of ongoing debate. Nevertheless, I believe it would have been appropriate for the submission to consider – if only in broad-brush terms – the impact on their conclusions from any trend towards more extreme weather in recent years.

C. Are the technical analyses (e.g. stochastic and other simulations) technically correct? Do they provide credible, relevant results?
Answer 2C: The submission relies on a fractional logit regression procedure in an important portion of the proposed methodology – the assignment of weather indices to individual years by crop and by climate division.

These weather indices are in turn used in the assignment of years to weather "bins". For example, Tables 4.15 and 4.16 of the Implementation Report show how each of the 20 years from 1991 to 2010 for corn in Illinois Climate Division 5 are assigned to 11 "bins" based on the weather indices for that crop-state combination.

Additionally, the weather indices are used in the excess loss procedure. Based on the weather indices for excess years, the amount of excess loss which is added back to the climate division is adjusted to reflect years where the excess event is less likely than average.

This fractional logit regression procedure is described in general terms in the submission. In addition, the procedure is described in a paper by Papke and Wooldridge "Econometric Methods for Fractional Response Variables with An Application to 401(K) Plan Participation Rates". This paper is extremely technical and detailed, and did not provide us with understandable information.

Table 4.4 in the Implementation Report provides an example of the output of a fractional logit

regression. Based on additional data and information provided by Thomas Worth of the RMA, we were able to use the information in Table 4.4 to produce weather indices for corn for Illinois Climate Division 5 as follows:

Pre-Adjust Weather Index = -17.6357 + 0.0101*Total CDD + 0.0055*jaj CDD
For 2010 the data from Thomas Worth shows: Total CDD = 1134   jaj CDD = 616
Pre-Adjust Weather Index (2010) = -17.6357 + .0.0101*1134 + 0.0055*616
Pre-Adjust Weather Index (2010) = -2.7943

Adjusted Weather Index = exp(Pre-Adjust Weather Index) / (1+exp(Pre-Adjust Weather Index))
where exp(x) = raise e to the power (x)
For 2010, this value is:
Adjusted Weather Index (2010) = 0.061158 / (1+0.061158) = 0.057633

Having worked through this example, we understood some of the calculations associated with the fractional logit regression procedure. However, we still do not have an explanation of how the procedure fits the weather data and produces the pre-adjusted regression coefficients. While the explanation in the submission provides some background, I feel that the fractional logit regression procedure remains for the most part a "black box" to us.

Another part of the technical analysis which merits discussion is the calculation of the pre-1995 adjustment. Based on changes in the RMA insurance program beginning in 1995, the submission includes an adjustment to loss cost ratios from 1995 and prior years. As shown in Table 4.18 of the Implementation Report, this adjustment involves multiplying the pre-1995 loss costs by an adjustment factor -- to reduce those loss costs to the current (1995 and subsequent) level.

The Technical Report includes extensive analysis of possible methods for determining this pre-1995 adjustment (on pages 47-70). The methods all use ordinary least squares projections, and produce results on a by-crop by-state level, as well as on a regional by-crop level and a countrywide by-crop level. However, the submission does not include all of the detailed coefficients which would allow us to actually calculate the various pre-1995 adjustment factors.

The Implementation Report discusses the pre-1995 adjustment factor as well, and states "We suggest estimation with the fractional logit procedure" (page 45). The Implementation Report therefore suggests using the fractional logit regression procedure, even though the Technical Report has done extensive testing using ordinary least squares regression. Furthermore, the Implementation Report states "Our previous analysis evaluated state, regional and national level estimates of the pre-1995 effect. … we do not make a specific recommendation as to what level of aggregation should be used." (page 45)

Section 5 of the Implementation Report provides estimates of the impact of the submission's new methodology on base rates for corn and for soybeans. Because the submission does not recommend either the state, regional or national adjustment factors, it is not clear which pre-1995 adjustments are used in the Section 5 impacts.

It therefore appears that the technical analysis of the pre-1995 adjustment is not finalized, with a variety of approaches still being considered.

D. Is the data used for the analyses appropriate, reliable, and the best available?
Answer 2D: The RMA Statplan data is by definition the best available source for experience on the FCIC insurance programs.

The Climate Division Data is discussed in the submission and is also described in more detail in a paper by Guttman and Quayle "A Historical Perspective of U.S. Climate Divisions". These two authors discuss the Climate Division Data, and point out that – while the data is available for each year in the period from 1895 to present – the data from prior to 1931 is sometimes incomplete. In this early period missing data for some states is estimated based on regression analysis using available data from neighboring states.

Given this background, it may have been appropriate for the submission to consider the impact of an alternate approach – of using the Climate Division Data only for the period from 1931 to present.

E. *Does experience from prior years and relevant crops and areas support the validity of the proposed rates?*
Answer 2F: We obtained premium and loss experience from the RMA website for a) all crops, for years 1989-2010 and b) apples, corn, and soybeans, for years 2004-2010. We viewed this experience from a few different perspectives:
Does the experience support the generally lower rates for FCIC products which are expected to result from this submission?
Does the experience on apples, corn and soybeans support the higher rates which are expected to result for apples, and the lower rates which are expected to result for corn and soybeans?
Does the experience support the position that FCIC experience (loss ratios, and loss cost ratios) changed dramatically for the better beginning in 1995?

The table below shows experience for all crops from 1989 to 2010.

Summary of RMA Loss Ratio Reports for 1989-2010										
All Crops -- Buy-Up Coverage Only (CAT excluded)										
Premium and Indemnity Shown in $1,000's										
	1989	1990	1991	1992	1993	1994				Total 89-94
Premium	814,302	836,468	737,049	758,789	755,739	949,395				4,851,742
Indemnity	1,212,235	973,032	955,289	918,215	1,655,479	601,146				6,315,396
Loss Ratio	149%	116%	130%	121%	219%	63%				130%
	1995	1996	1997	1998	1999	2000	2001	2002	2003	Total 95-03
Premium	1,090,508	1,408,699	1,426,100	1,517,775	2,014,351	2,275,324	2,715,809	2,684,649	3,205,475	18,338,690
Indemnity	1,400,140	1,342,663	949,744	1,561,395	2,352,764	2,528,993	2,909,972	3,988,368	3,216,222	20,250,261
Loss Ratio	128%	95%	67%	103%	117%	111%	107%	149%	100%	110%
	2004	2005	2006	2007	2008	2009	2010			Total 04-10
Premium	3,944,251	3,712,434	4,365,131	6,288,533	9,515,121	8,641,236	7,325,320			43,792,026
Indemnity	3,155,235	2,266,515	3,434,704	3,487,972	8,602,971	5,154,052	4,196,167			30,297,616
Loss Ratio	80%	61%	79%	55%	90%	60%	57%			69%

The extremely low loss ratios – averaging 69% across all crops during the 2004-2010 period – do provide additional support for the generally lower rates which are expected to result from this submission.

Not all rates will decline if the methodology in this submission is adopted. For example, rates for corn and soybeans are expected to decline, but rates for apples are expected to increase. The following table shows recent experience for these three crops during the 2004-2010 period. Loss ratios for corn and soybeans are quite low (54% for corn and 59% for soybeans) but loss ratios are relatively high at 123% for apples. The actual RMA experience therefore supports the expected direction of the changes in rates for these three crops.

				Summary of RMA Loss Ratio Reports for 2004-2010						
				Apples, Corn and Soybeans -- All Coverages						
				Premium and Indemnity						
			Apples							
	2004	2005	2006	2007	2008	2009	2010			Total 04-10
Premium	27,406,946	36,946,661	35,907,329	39,535,807	46,585,341	60,053,652	63,129,800			309,565,536
Indemnity	18,653,731	39,482,775	48,086,791	50,572,586	69,774,956	72,025,833	83,024,122			381,620,794
Loss Ratio	68%	107%	134%	128%	150%	120%	132%			123%
			Corn							
	2004	2005	2006	2007	2008	2009	2010			Total 04-10
Premium	1,406,769,772	1,265,847,493	1,561,050,566	3,109,900,085	3,804,344,456	3,396,415,492	2,855,200,988			17,399,528,852
Indemnity	814,200,896	697,946,532	807,625,823	1,095,466,475	3,063,515,648	1,178,868,553	1,720,466,628			9,378,090,555
Loss Ratio	58%	55%	52%	35%	81%	35%	60%			54%
			Soybeans							
	2004	2005	2006	2007	2008	2009	2010			Total 04-10
Premium	943,561,418	873,155,931	1,042,784,150	1,066,163,554	2,609,708,811	1,981,984,102	1,747,061,964			10,264,419,930
Indemnity	739,813,485	260,245,246	305,780,701	602,745,032	2,873,849,415	555,899,236	739,945,264			6,078,278,379
Loss Ratio	78%	30%	29%	57%	110%	28%	42%			59%

Finally, we also considered the insurance premiums per unit of exposure during the 1989-2010 period. These values can be derived from the RMA's loss ratio reports, as shown in the table below.

				Summary of RMA Loss Ratio Reports for 1989-2010						
				All Crops -- Buy-Up Coverage Only (CAT excluded)						
				Premium and Liability Shown in $1,000's						
	1989	1990	1991	1992	1993	1994				Total 89-94
Premium	814,302	836,468	737,049	758,789	755,739	949,395				4,851,742
Liability	13,535,807	12,828,368	11,215,994	11,334,059	11,353,421	13,608,387				73,876,036
Prem/Liability	$ 0.060	$ 0.065	$ 0.066	$ 0.067	$ 0.067	$ 0.070				$ 0.066
	1995	1996	1997	1998	1999	2000	2001	2002	2003	Total 95-03
Premium	1,090,508	1,408,699	1,426,100	1,517,775	2,014,351	2,275,324	2,715,809	2,684,649	3,205,475	18,338,690
Liability	15,346,421	19,303,090	19,165,190	20,841,481	23,608,659	27,302,555	29,877,548	30,481,149	33,917,882	219,843,975
Prem/Liability	$ 0.071	$ 0.073	$ 0.074	$ 0.073	$ 0.085	$ 0.083	$ 0.091	$ 0.088	$ 0.095	$ 0.083
	2004	2005	2006	2007	2008	2009	2010			Total 04-10
Premium	3,944,251	3,712,434	4,365,131	6,288,533	9,515,121	8,641,236	7,325,320			43,792,026
Liability	39,469,474	37,185,449	43,232,303	59,894,869	81,439,377	71,641,824	71,007,193			403,870,489
Prem/Liability	$ 0.100	$ 0.100	$ 0.101	$ 0.105	$ 0.117	$ 0.121	$ 0.103			$ 0.108

Premiums per dollar of Liability increased from an average of $0.066 in 1989-1994 to an average of $0.083 in 1995-2003 to an average of $0.108 in 2004-2010. These premium increases could explain much of the loss ratio decline from 1989-1994 to 1995-2003. However, the loss ratio decline from 1995-2003 to 2004-2010 is somewhat larger than would be expected from the premium increases alone.

(The premium increase from 1995-2003 to 2004-2010 averages 30.1%. A rate increase of this magnitude would be expected to decrease the 1995-2003 loss ratio of 110% to about 85%, where 110% / 1.301 = 85%. However, the actual all-crops loss ratio for 2004-2010 is 69%.)

An explicit assumption in the submission is that there is a change in the FCIC insurance program in 1995, so an adjustment to the pre-1995 loss costs is appropriate. Based on discussions with Thomas Worth of the RMA, some of the factors relating to this 1995 change are:
1. Disaster assistance was linked to buying FCIC insurance. That link has subsequently been loosened, but many of the producers who entered the program at that time have remained in the program.
2. The RMA was given authority to track taxpayer ID's. This additional tool reduced fraud.
3. The policy wording was tightened.
4. Rates were increased.
5. In addition, in recent years farming methods have improved. For example, genetically

engineered corn and soybeans are now quite common. These crops are more robust. Also, improved combines and tractors make it easier for producers to plant and harvest in poor weather conditions.

The submission provides information on the increase in FCIC premium volume beginning in 1995. That increase in volume, combined with the background information in the previous paragraph, does support a difference in loss costs in pre-1995 years versus 1995 and subsequent years. However, the RMA loss ratio information – with the extremely low loss ratios in the 2004-2010 period – might suggest an alternate break point. The loss ratio information might suggest a break point into pre-2003 years versus 2004 and subsequent years.

> *F. Are the proposed premium rates likely to cover anticipated losses and a reasonable reserve?*

Answer 2I: When dealing with weather events, relatively short periods of historical experience may not provide completely credible results. Nevertheless, the extremely low loss ratios for FCIC insurance observed during the 2004-2010 period provide some additional support for the overall decrease in rates which is expected to result from this submission.

Based on the submission itself and our additional review of the RMA loss ratio experience, I believe it is likely that the rates resulting from the proposed new methodology will cover anticipated losses and a reasonable reserve.

> *G. Is the actuarial method appropriate for the proposed policy?*

Answer 2J: The proposed new actuarial methods described in the submission appear to be reasonable and appropriate. These new methods are discussed and analyzed in detail in the submission, and for the most part the submission's recommendations are well-documented. We have listed a number of potential problem areas with the proposed methods in our answers to Questions 2A to 2F above.

Conclusion: The purpose of the submission is to revise and refine the RMA's methodology for updating rates. It is my understanding that approval of the submission will impact rates for all crops in the FCIC programs.

Section 5 of the Implementation Report lists the following recommended changes to the RMA ratemaking methodology:
1. An adjustment to pre-1995 loss costs (reducing these pre-1995 loss costs to bring them to current levels)
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1. There is no mention of global warming in the submission. Because of the possibility that

global warming – or some other long-term trend in weather -- does exist, it would appear necessary for the submission to consider the possible impact of this phenomenon on its calculation of weather indices.

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5. The RMA premium and loss experience by year and by crop provides some evidence that breaking the experience period between pre-2003 years and 2004 and subsequent years might be preferable to the submission's breaking of the experience into pre-1995 years and 1995 and subsequent years.

Background of John Pierce

<u>Education and Credentials</u>

B.S.	University of Chicago	1971
M.B.A.	University of Chicago	1983
F.C.A.S.	Fellow of the Casualty Actuarial Society	
M.A.A.A.	Member of the American Academy of Actuaries	

<u>Consulting Experience</u>
Consulting practice established May of 1983. Examples of completed projects include:

Annual Statement work for property-casualty insurers and reinsurers -- review of year-end loss and LAE reserves, provide actuarial opinion letters and actuarial reports, all per statutory requirements.

Rate analyses and rate filings for a variety of product lines (e.g. Private Passenger automobile, Real Estate E&O, Group AD&D, Crop Insurance)

Analysis of funding requirements for Hospital Professional Liability self-insurance trust funds. Analysis of funding requirements for Workers Compensation self-insurers.

Analysis of company and bureau rate filings for South Dakota, Michigan and Oklahoma state Insurance Departments. Analysis of Crop Insurance submissions to RMA.

Design of system to calculate Worker's Compensation Indemnity and Medical reserves on a claim-by-claim basis. Used by a leading Illinois self-insurer.

<u>Experience Prior to Consulting</u>
Insurance Services Office (ISO) Chicago, IL June 1979 to May 1983
Midwest Regional Actuary -- responsible for presentation of rate filings to all midwestern state insurance departments. Involved in filings for all ISO lines of business (e.g. Private Passenger, Homeowners, Medical Malpractice, Increased Limits factors.)

Kemper Insurance Long Grove, IL. October 1977 to June 1979
Group health actuary -- responsible for pricing and profitability studies of all group health products (e.g. Group Major Medical and Dental, multi-employer trust plans, group LTD.)

Zurich Insurance Chicago, IL. August 1973 to October 1977
Annual Statement loss reserves for personal and commercial property-casualty lines. Loss reserve calculations for Group Health Insurance. Ratemaking for Private Passenger and Homeowners.

CNA Insurance Chicago, IL. May 1971 to August 1973
Pricing and loss reserve calculations for Group Health insurance.

JOHN PIERCE Consulting Actuary

Background of Maureen Boyle

Education and Credentials

B.S.	University of Illinois 1993	
M.S.	University of Illinois 1994	
A.C.A.S.	Associate of the Casualty Actuarial Society	
M.A.A.A.	Member of the American Academy of Actuaries	

Experience at John Pierce Consulting Actuary
Prepare Workers Compensation rate filings; work on GAP and Collateral Protection Insurance (CPI) rate filings; loss reserve projections for Automobile, Title Insurance, Accident & Health, and other lines

Experience Prior to John Pierce Consulting Actuary
The Warranty Group 2003 to 2007
Review external books of business for potential acquisition; prepare and defend rate filings for Specialty and Warranty products; work with data center to improve data capture for GAP contracts

Fireman's Fund Insurance Company   2001-2002
Supervised pricing of personal lines, financial institution and warranty insurance

CNA Insurance 1996-2001
Estimated ultimate loss and LAE for CNA's medical professional liability products; performed reserve reviews of retrospectively rated and excess property business

Coopers & Lybrand LLP 1994-1996
Actuarial associate