2009 FCIC 11010 Rate Methodology Handbook Actual Production History (APH) Summary of Changes

Listed below are the changes to the Rate Methodology Handbook that have the most significant impact. Minor changes and correction are not included in this listing. Refer to the actual 2008 Rate Methodology Handbook to identify clarifications/changes that have been made effective for 2009.

Reference	**Description of additions, changes or clarifications:**
Cover Page	Changed 2008 Crop Year to 2009 Reinsurance Year
Sec. 2(B)(2)(a)(i)	Added the APDD Director to the oversight and approval process used for the annual rating cycle.
Sec. 2(B)(2)(a)(ii)	Added the APDD Director to the oversight and approval process used for the implementation of actuarial rate studies.
Sec. 2(B)(2)(a)(iii)	Added the APDD Director to the oversight and approval process used for the reference yield updates.
Sec. 2(B)(2)(a)(iv)	Added the APDD Director to the oversight and approval process used for the Rate Methodology Memorandum.
Sec. 3(B)(3)	Changed the range of updated target reference yields, for crops with a target rate review, to be within a lower and upper boundary of the t-yield.
Sec. 3(B)(4)	Updated section on coverage level rate differentials for all remaining continuously rated crops to say that AB expects to incorporate the recommendations beginning with the 2009 crop year. Because the change to the coverage level rate differentials may move premium rates up or down, they will be updated in conjunction with a full review of base rates and reference yields.
Sec. 3(B)(5)(IV)	Changed the minimum State Cat Load from 0.010 to 0.0065.
Sec. 3(B)(5)(V)	Changed the minimum State Cat Load from 1% to 0.65%.
Sec. 3(B)(5)(VIII)	Added that RMA suspended the implemention the variable optional unit discount indefinitely with RMA's eWA system redesign). Clarified that the optional unit surcharge factor is 11.1% and the multiplicative discount factor is 10%.
Sec. 3(B)(7)	Added the Actuarial and Product Design Division Director to the list of personnel in the APH Business Process and Critical Control Points.
Sec. 4 (Exhibit 2)	Added APDD Director to the business process and critical control points.

United States
Department of
Agriculture

RATE METHODOLOGY HANDBOOK

Federal Crop
Insurance
Corporation

ACTUAL PRODUCTION HISTORY (APH)

Risk Management Agency

Actuarial Branch

FCIC-11010 (RMH-APH)

2009 and Subsequent Reinsurance Years

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UNITED STATES DEPARTMENT OF AGRICULTURE
WASHINGTON, D.C. 20250

FEDERAL CROP INSURANCE HANDBOOK	NUMBER: FCIC-11010 (RMH-APH)
SUBJECT: **RATE METHODOLOGY HANDBOOK ACTUAL PRODUCTION HISTORY (APH) 2009 AND SUBSEQUENT CROP YEARS**	**OPI: Actuarial Branch** **APPROVED: DATE:10/02/2008** **/s/ Thomas Worth 10/02/08** **Senior Actuary, DAPM** **/s/ Mary Alonzo 10/02/08** **Director, Actuarial and Product Design Division**

THIS HANDBOOK CONTAINS THE APPROVED RISK MANAGEMENT AGENCY RATE METHODOLOGY FOR APH RATING COMPONENTS FOR 2009 AND SUBSEQUENT CROP YEARS.

SUMMARY OF CHANGES/CONTROL CHART

Major Changes: See changes or additions in text that have been highlighted.

RATE METHODOLOGY HANDBOOK
ACTUAL PRODUCTION HISTORY (APH)

SUMMARY OF CHANGES/CONTROL CHART

Control Chart For: Rate Methodology - APH Handbook						
	SC Page(s)	TC Page(s)	Text Page(s)	Reference Material	Date	Directive Number
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ACTUAL PRODUCTION HISTORY (APH)

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RATE METHODOLOGY HANDBOOK
ACTUAL PRODUCTION HISTORY (APH)

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1. INTRODUCTION & PURPOSE

This handbook provides general instructions, guidelines, and a comprehensive framework for the procedures used to determine base premium rates for crops whose insurance guarantee is based on a producer's actual production history (APH). These rates are applicable to policies insured through or reinsured by the Federal Crop Insurance Corporation (FCIC) and administered by the Risk Management Agency (RMA). This handbook encompasses APH rate making of both permanent (regulatory) and pilot crop insurance programs. In addition to procedures, this handbook provides history, background, guidance, and understanding with regard to establishing premium rates for crop insurance programs and the calculations underlying premium rates. The data used in each of the tables in this handbook is for illustration purposes only. The handbook is not intended to be either exhaustive or exclusive.

For crops whose premium rates are based on the producer's actual production history (APH), this handbook:

(1) Identifies RMA's role in setting premium rates including the business process and critical control points during the process.
(2) Outlines and details the framework of processes and procedures utilized in calculating and establishing actuarially sound premium rates.
(3) Provides general instructions and guidelines that RMA uses to develop, update, and maintain premium rates for insurance programs.
(4) Identifies and assigns authorities and responsibilities.

In general, the steps or procedures for rate making covered in this handbook are:
(1) To focus on the data (insurance experience) used in the rate making process. The logic and decisions made with regard to the treatment of the raw data are documented;
(2) To establish target rates in accordance with the approved process with emphasis on long-term rate adequacy and sufficiency;
(3) To demonstrate how a producer's approved yield directly affects the individual's premium rate while achieving overall program actuarial soundness;
(4) To identify and discuss implementation of recent studies and recommendations including, but not limited to determination of rate relativities;
(5) To discuss implementation of the capping process and revision of rate components toward targets;
(6) To identify and describe internal control policies and procedures, critical control points used in establishing an APH rate, and supervisory/management oversight as required; and
(7) To provide supporting documentation for the ratemaking process, including, but not limited to the periodic review of established rates, ratemaking formulas and calculations, and management decisions.

2. SPECIAL INSTRUCTIONS

This handbook is written and maintained by:

Office of the Deputy Administrator for Product Management,
Actuarial Branch
6501 Beacon Drive, Mail Stop 0811
Kansas City, Missouri 64131
Telephone: (816)-926-7216 FAX: (816)-926-1307

If an error is found, notify us in writing at the address given. Outline the error and indicate the proposed correction. Errors may be corrected for the current crop year. Proposed changes should be submitted in writing through the proper organizational channels to Actuarial Branch for consideration.

This handbook remains in effect until superseded by reissuance of **either** the entire handbook **or** selected portions (through slipsheets or bulletins). If slipsheets have been issued for a handbook, the original handbook as amended by slipsheet pages shall constitute the handbook. A bulletin can supersede either the original handbook or subsequent slipsheets.

A. ABBREVIATIONS AND DEFINITIONS

(1) ABBREVIATIONS:

AD	Actuarial Division
AB	Actuarial Branch
ADM	Actuarial Data Master
AFS	Actuarial Filing System
APH	Actual Production History
CAS	Casualty Actuarial Society
CAT	Catastrophic Risk Protection
CIH	Crop Insurance Handbook
CRC	Crop Revenue Coverage
CSH	Classification Standards Handbook
DAPM	RMA Deputy Administrator for Product Management
FCIC	Federal Crop Insurance Corporation
FIPS	Federal Information Processing Standards
GRIP	Group Risk Income Protection
GRP	Group Risk Protection
IIP	Indexed Income Protection
IP	Income Protection
LASH	Loss Adjustment Standards Handbook
MPCI	Multiple Peril Crop Insurance
NASS	National Agricultural Statistics Service
RA	Revenue Assurance
RMA	Risk Management Agency
RO	RMA Regional Office
SOW	Statement of Work
TO	Task Order
USDA	United States Department of Agriculture

(2) DEFINITIONS:

Act	The Federal Crop Insurance Act (7 U.S.C. 1501-1524), as amended.
Actual Production History	APH. Coverage based on an insured's farm production capability and history, as demonstrated by acceptable documentation.
Actuarial Documents	The material for the crop year that is posted on RMA's website at the http://www.rma.usda.gov. These documents show the amounts of insurance or production guarantees, coverage levels, premium rates, insurable crop production practices, insurable acreage, and other related information regarding crop insurance for a crop in a county.
Actuarially Sound	A situation in which the premium rates charged to insured persons are sufficient to cover the present value of anticipated losses and to build a reasonable reserve.
Additional Coverage	All levels of insurance coverage greater than Catastrophic coverage.
Add-On-Rate	The rate associated with the risk of insuring a specific crop endorsement that is not included in the base rate of a policy for a given coverage level.
Base Rate	The rate associated with the risk of insuring the basic policy provisions for a given crop, type and practice, in a given location, for a given coverage level.
Basic Provisions	The basic (common) policy insurance information.
Basic Unit	All insurable acreage of the insured crop in the county on the date coverage begins for the crop year.
Board	The Board of Directors of FCIC.
Catastrophic Coverage	CAT. The minimum level of risk protection coverage offered by FCIC (for APH, 50% of the approved yield indemnified at 55% of the expected market price).
Capping	Calculations that ensure cumulative changes in premium rating components fall within a specified range (e.g. -5% to +15% in the Rate Methodology Memorandum) or within the legislatively mandated 20% maximum rate change.
CAT Load	A premium amount assigned to account for anomalous insurance loss experience.

Classification Standards Handbook	CSH. A document denoted by RMA as the Classification Standards Handbook, located at http://www.rma.usda.gov which provides operating standards for coverage and rate classification determinations.
Code of Federal Regulations	CFR. Proposed and final regulations published in the Federal Register also are considered to be part of the CFR.
Continuous Rating	RMA formula-driven rating procedure that generates rates as a function of the relationship between APH yield and the multi-peril risk. A unique premium rate for each pre-determined yield within a crop, state, county, type, practice program is developed through a continuous function for each unique yield and the generated rate function is relatively without interruption rather than being based on pooled yields for a single rate or an interrupted rating function.
County Summary Tables	Statplan database tables that contain detailed insurance experience at the insurance plan/crop/state/county level. The data would differ from the historical databases (policy or polsum databases) since the data has been scrubbed and purged of certain information (e.g. extreme outliers, etc.).
Coverage	The insurance provided by the policy against loss of a crop due to an insured peril.
Coverage Level Relativities	Calculated factor applied to premium rates in consideration of differences in expected losses between coverage levels.
Credibility	The measure of the predictive value of the loss experience. For RMA rate making, the number of indemnified units over time in a defined group or area is used to measure credibility.
Crop	An agricultural commodity insured under authority of the Act.
Crop Insurance Handbook	CIH. A document denoted by RMA as the Crop Insurance Handbook, located at http://www.rma.usda.gov. The CIH provides underwriting instructions for crop insurance policies.
Crop Insurance Procedures	Methods approved by RMA to administer approved crop programs. The term includes the Underwriting Guides, the CIH, the Loss Adjustment Standards Handbook (LASH), Manager's and PM Bulletins, or other documents that may be issued by RMA, refer to http://www.rma.usda.gov.
Crop Policy	The legal documents needed to establish a contract between the insured person and the insurance provider, including but not limited to the Common Crop Insurance Policy Basic Provisions, the Crop Provisions, as published in the CFR or

	by RMA on its website, the Special Provisions, as applicable, and the actuarial documents.
Crop Program	The insurance plan or plans whereby the insurable interests of a producer of a crop are protected.
Crop Provisions	Any specific crop information that may attach to the common policy.
Crop Revenue Coverage	CRC. A plan of insurance that guarantees a stated amount of revenue. This plan covers revenue shortfalls due to low price, yield or combination of the two. (NOTE: Plans offering gross revenue coverage include Crop Revenue Coverage (CRC), Income Protection (IP), and Revenue Assurance (RA).
Crop Year	The period of time defined by the applicable crop insurance policy. For APH, purposes, the term does not include any year the crop was not planted, or was prevented from planting due to an insurable cause, or was not produced for insurable purposes.
Disaster Reserve Factor	A factor used to increase calculated rates by an amount intended to meet the Congressional requirement that rates be adequate to cover anticipated losses and a reasonable reserve.
Endogenous Risk Factor	A factor used to account for differences between actual loss costs for a coverage level and the loss cost implied by policies from other coverage levels.
Endorsement	An option offered under a Federal crop insurance policy that provides additional coverage or benefits to the insured.
Enterprise Unit	A unit that includes all insurable acreage of the insured crop in the county in which the insured has a share on the date coverage begins for the crop year.
Exponent	A factor used to distribute the rate relativity across yields.
Filing Year	Consists of the 4/30, 6/30, 8/31, 9/30, 10/31, 11/30, 12/31, 1/31 & 3/15 crop insurance filings. The 4/30 filing includes the prior year Raisins; the 8/31 filing includes the following year Arizona/California/Texas Citrus, Macadamia Nuts and Revenue Coverage Avocados; the 1/31 filing consists of the following year Nursery and Florida Fruit Trees; the 3/15 filing consists of the following year Florida Citrus.
Fixed Rate Load	A rate component used in calculating the fixed rate portion of the total rate published.

Group Risk Income Protection	GRIP. A plan of insurance that adds a revenue component to the Group Risk Plan. A base price and harvest price are established based on specified futures contracts. These components are used in tandem with the expected and actual yield components established under GRP coverage to determine if an area-wide revenue shortfall has occurred.
Group Risk Plan	GRP. A plan of insurance that provides protection based on an area index. A plan of insurance that bases coverage for all insureds in an area (e.g., county) on the area's actual average yield during the given crop year relative to its trend-adjusted historical average yield.
Harvest Price Option	HPO is a coverage under the Revenue Assurance plan of insurance. It allows the insured to use the greater of the projected harvest price or the Fall harvest price to determine the per-acre revenue guarantee.
High Risk Land	Acreage with identifiable physical limitations to crop production that may increase the potential frequency and/or severity of loss; or expose a planted or intended crop to perils not generally encountered by most insureds.
Historical Databases	(Also referred to as either Policy Database or Polsum Database) Databases containing historical crop insurance sales and loss information that reflect no adjustments and actual amounts received or paid.
Income Protection	IP. A plan of insurance that guarantees a stated amount of revenue. The plan covers revenue shortfalls due to low price, yield, or combination of the two (NOTE: Plans offering gross revenue coverage include Crop Revenue Coverage (CRC), Income Protection (IP), and Revenue Assurance (RA).
Indemnity	The amount of money that the approved insurance provider owes the insured based on the determination of loss.
Indexed Income Protection	IIP. See Income Protection (IP). A plan of insurance that emulates most features of the Income Protection (IP) insurance plan with one exception: IIP is based on an indexed yield rather than the standard APH yield.
Informational Memorandum	A document issued by RMA to convey supplemental information regarding the Federal Crop Insurance program to insured producers, reinsured companies, and other interested parties. Refer to http://www.rma.usda.gov.

Insurance Experience	Tables that contain the number of policies earning premium, policies indemnified, units earning premium, units indemnified, net insured acres, liability, total premium, producer premium, subsidy, indemnity, loss ratio, earned premium rate, and loss cost ratio.
Insurance Provider	A company reinsured by FCIC that provides crop insurance coverage to producers participating in any Federal crop insurance program administered under the Federal Crop Insurance Reform Act of 1994.
Late Planted	The acreage initially planted to the insured crop after the final planting date designated in the Special Provisions for the insured crop in the county.
Liability	The total amount that the insurance provider would be obligated to pay to the insured if there was a total loss.
Loss Cost Ratio	LCR. The ratio of total indemnity divided by total liability.
Loss Ratio	LR. The ratio of total indemnity divided by total premium.
Manager's Bulletin	A document issued by RMA's Administrator to convey information that supplements the crop insurance procedures. Located at http://www.rma.usda.gov.
Moral Hazard	A situation wherein the insured fails to exercise proper management of the insured crop, thereby increasing the likelihood of an indemnity payment under the terms and conditions of the insurance policy.
NASS	The National Agricultural Statistics Service, an agency of the U.S. Department of Agriculture, or a successor agency.
Option	A policy provision chosen by the insured that offers additional coverage and benefits beyond those provided by the standard insurance policy.
Optional Unit	A unit elected that is on a basis greater than the unit structure on which the insurance is based. Land that would otherwise be one basic unit may be divided into optional units according to the optional unit definition contained in the Crop's Basic Provisions, Crop Provisions and/or Special Provisions. Optional units may be available for acreage located in separate, legally identifiable sections, section equivalents, or Farm Service Agency Farm Serial Number's (whichever applies). Some perennial crops allow optional units for acreage of the crop grown on non-contiguous land and/or for different types/varieties. Most crops allow optional units for irrigated and non-irrigated practices.

Optional Unit Factor	A factor to reflect the fact that indemnity is not computed for an entire farm, but rather for each division of a farm.
Plan of Insurance	A general structure of insurance that may be extended to one or more crops (e.g., actual production history and revenue coverage).
Policy or Polsum Databases	**See "Historical Databases".**
Prevented Planting	Due to a covered cause of loss, failure to plant the insured crop with the proper equipment by the final planting date designated in the Special Provisions for the insured crop in the county.
Price Election	The amount that is the value per pound, bushel, ton, carton, or other applicable unit of measure for the purposes of determining premium and indemnity under the policy.
Producer Premium	The amount of premium paid by the insured.
Production Guarantee	The number of pounds, bushels, tons, cartons, or other applicable units of measure determined by multiplying the approved yield per acre by the coverage level percentage elected by the insured.
Production to Count	Harvested and unharvested production in the insured field or area.
Production Ratio	PR. The unit's production to count divided by the unit's average historic production.
Production Ratio Table	Tables that contain summarized experience from units with liability.
Program Materials	Basic Provisions, Catastrophic Risk Protection Endorsement, crop provisions, Special Provisions of Insurance, loss adjustment handbook, loss adjustment manual, all applicable actuarial documents, Appendix III, Crop Insurance Handbook, underwriting requirements, and other forms necessary to deliver the program.
Quality Adjustment	Damage which lowers the quality of the crop due to insurable causes.
Rate Relativity	The ratio of the rate at a given coverage level to the rate at the 65% coverage level.

Record Types

a) Type 9 – Used to identify which reinsurance fund into which a policy has been designated and thus the amount of loss or gain borne by RMA or by a reinsured company on a policy.
b. Type 10 - Used to establish a policy and provide information regarding the policyholder and entities with a significant business interest. A Type 10 record requires at least one Type 14 record to be submitted with it.
c) Type 11 - Used to establish premium and liability for each acreage line. The record also identifies the land location and allows reporting of common USDA information.
d) Type 14 – Used to establish the crop, county, plan code and reports the contract data determined at Sales Closing.
e) Type 15 - Used to record/report APH yield information for designated crops.
f) Type 20-22 - The Type 21 and 22 Records are used to establish the loss amounts for a given policy and the Type 20 Records are used to identify the application or disbursement of loss payments. Type 20 records are linked by Claim Number to corresponding Type 21/22 records. Therefore, all Type 20 and 21/22 records for a policy from the transaction file replace all Type 20 and 21/22 records for the policy on the policy database.

Reference Rate

A rate component used in calculating the continuous base rate that is intended to estimate the unloaded base rate at the county average yield.

Reference Yield

Average yield of a group of growers often reflected at the crop-county level and calculated from NASS data. The relationships between unit APH yields and the reference yield are used to assign premium rates, with higher premium rates assigned to units with APH yields that fall below the reference yield and lower premium rates assigned to units with APH yields above the reference yield.

Reinsurance Year

RY. Year designation defined in the Standard Reinsurance Agreement (SRA) to include **3** crop years: the current crop year (equal to the RY), the prior crop year (RY minus 1), or the upcoming crop year (RY plus 1). The prior year includes raisins and the upcoming year includes Macadamia Nuts, Arizona/California/Texas Citrus, Nursery, Florida Fruit Trees, and Revenue Coverage Avocados.

Replanting

Performing the cultural practices necessary to prepare the land to replace the seed or plants of the damaged or destroyed insured crop and then replanting the seed or plants of the same crop in the insured acreage with the expectation of producing at least the yield used to determine the production guarantee.

Replanted Crop	The same agricultural commodity replanted on the same acreage as the first insured crop for harvest in the same crop year (if replanting is specifically made optional by the policy).
Product Management Bulletins	PM Memoranda is issued by the DAPM to convey information that supplements the crop insurance procedures. Refer to http://www.rma.usda.gov.
Revenue Assurance	RA. Protects a producer's crop revenue whenever low prices or low yields, or combination of both, causes the crop revenue to fall below the guaranteed revenue level. (NOTE: Plans offering gross revenue coverage include Crop Revenue Coverage (CRC), Income Protection (IP), and Revenue Assurance (RA).
R-Span	A set yield interval published in the actuarial documents and often established at a county-crop level. Each r-span interval corresponded to a premium rate. The r-spans were used to assign premium rates based on insureds' individual APH yields. Insureds with individual APH yields that fell in a low r-span interval were assigned a high premium rate while insureds with individual APH yields that fell in a high r-span interval were assigned a low premium rate. Use of r-spans was discontinued after the continuous rating process was implemented.
Small Grains Crop Provisions	Crop provisions established specifically for Barley, Oats, Rye, Wheat, Flax, and Buckwheat (insurable crops when planted for harvest as grain.)
Statement of Work	SOW. Statement of Work, a traditional Government-prepared work statement that describes the work in terms of "what" is to be the required output, in addition to "how" the work is to be accomplished.
Special Provisions Of Insurance	SPOI. The part of the policy that contains specific provisions of insurance that may vary by geographic location. Dates listed include the sales closing, initial and final planting, acreage reporting, and premium billing dates. This document also displays statements pertaining to insurance coverage, price elections, premium discounts, adjustments, and insurance availability.
Stage Code	Used to identify the average stage of growth and variability of potential production and plant damage for prevented planted and replanted acreage
StatPlan	Statistical Database Planning system developed to provide a standardized, normalized, and reliable actuarial database.

Subject Matter Experts	Individuals and entities used to obtain specialized technical information or feedback on the crop program including, but not limited to, the following: CSREES personnel; university personnel; FSA office personnel; growers association representatives; state, regional, and national crop association representatives; insured and non-insured producers (including limited resource farmers); insurance provider representatives; agents; and loss adjusters.
Subsidy	The amount of total premium paid by the FCIC on behalf of the insured.
Target Rate	The rate calculated assuming that a unit yield is equal to the reference yield.
Target Reference Yield	The "expected" yield for a given crop, type, and practice within a county/State location from which all producer individual yields are measured.
Total Premium	The total amount of premium for an insured's coverage that is determined by multiplying liability by the unsubsidized premium rate.
Transitional Yield	T-Yield. An estimated yield provided in the Actuarial Table used in calculating average/approved yields when less than four years of actual, temporary and/or assigned yields are available on a crop by county basis.
Type-Practice Factor	A rating factor used to approximate the appropriate rating relationships between types/practices for a given crop on a regional or statewide basis.
Unit	The insurable acreage of the insured crop in the county used when determining the approved APH yield.
Unit Division Load	A factor to reflect the fact that indemnity is not computed for an entire farm, but rather for each division of a farm.
Unloaded Base Rate	The premium rate exclusive of any additional charges related to extra coverage, such as quality protection, or special reserves, such as catastrophic loads.
Whole Farm Unit	All insurable acreage of 2 or more insured crops planted in the county in which the insured has a share on the date coverage begins for each crop for the crop year.
Written Agreement	A document that alters designated terms of a crop policy as authorized under the basic provisions, the crop provisions, or the special provisions for the insured crop.

Written Agreement Handbook	WAH. A document denoted by RMA as the Written Agreement Handbook which provides specific information regarding written agreements, refer to http://www.rma.usda.gov.

B. BUSINESS PROCESS AND CRITICAL CONTROL POINTS

(1) BUSINESS PROCESS:

a. Actuarial Branch Staff Structure

i. The Actuarial Branch (AB) is located in RMA's Kansas City office under the direction of the Deputy Administrator for Product Management (PM). The AB Chief reports to the Director of the Actuarial Product Design Division (APDD). The AB is organized into three work teams: 1) Rates Team; 2) Prices Team, and 3) Filing Team. Each team is composed of Specialists in their respective areas and is led by a Senior position. The Rates Team Senior Statistician (RT Leader), the Prices Team Senior Economist (PT Leader), and the Filing Team Senior Risk Management Specialist (FT Leader) report to the AB Chief (AB Chief). The RT Leader coordinates the efforts of statisticians and actuaries within AB for all aspects of rate maintenance, development, and updates. Statisticians and actuaries within AB are assigned specific crops for which they are responsible to ensure that rates are: 1) established in an actuarially sound manner; 2) properly determined and calculated based on agency direction, policies, and protocol; and 3) distributed to the crop insurance industry for the calculation of premium for crop insurance policies.

b. In an effort to maximize federal efficiency and reduce the federal work force, support for all automated systems has been contracted out to the private sector for several years.

i. Under the private sector contract for automation services, federal employees in AB provide contractors with specifications (for changes requiring system modifications) and specific direction for any ongoing operations related to the rate development and maintenance functions. In some cases, statisticians and actuaries will directly provide necessary technical guidance for contractors; in other cases, such direction will come from the RT Leader or the AB Chief.

ii. Federal employees in AB provide necessary technical guidance, review, and approve/disapprove the work performed by the contractors. In the past, direction to contractors has taken on two forms: 1) formal, and 2) informal. Formal refers to written directions ranging from detailed written specifications to emails directing actions to be taken. Informal refers to non-written directions such as phone calls providing direction to the contractors as to specific actions to be taken. For 2005 and succeeding years, RMA initiated and fully implemented standardized configuration management protocols such that all requests for change and actions are tracked and documented through the use of the approved Configuration Management software. In accordance with the established Configuration Management Policy, RMA has established Configuration Control Boards (CCBs) that approve all action(s) that impact the automated systems, databases, and applications. The mandatory implementation of this process has formalized all direction to contractors by AB staff.

iii. When system changes, enhancements, or replacements have been programmed by contractors according to RMA specifications, contractors conduct unit testing (use of small amounts of developed test data or actual historical data to confirm the success of intended change) and make any required changes. When these changes have been implemented, the

modified code is ready for Quality Assurance (QA) testing. The purpose of QA testing is two-fold: 1) confirm the correction/implementation of specific scenarios as authorized in specifications; 2) apply new programming code to a larger volume of data and scenarios to ensure no negative or unintended impact has resulted. Contractors may do some QA testing and provide the results to AB Rate Specialists for review and approval; however, generally, AB Rate Specialists directly conduct QA testing. After review and analysis of QA testing, AB Rate Specialists confirm test results and recommend approval or disapproval of the proposed program/system change(s) to RT Leader. AB Rate Specialists and RT Leader apprise the AB Chief of the results and their recommendation(s). If no concerns or issues are raised by these individuals, the RT Leader will approve test results and notify the RMA Production Support Team that the change can be moved to the production environment; consequently, the move is conducted by the RMA Production Support Team. In the event of disapproval, the configuration management process would start over again. These actions are captured through the use of approved configuration management software and through the actions of the CCB.

c. Regional Office involvement
    i. Although AB is ultimately responsible for (and the final approving official of) all rates, Regional Office staff are directly involved in the rate development process. In cases where data sources have high levels of longevity and credibility, direct reliance on data-driven rates almost always occurs. In cases where data sources are limited and lack either longevity or credibility, greater reliance on judgment rating is necessary and may be utilized. Regional Office staff play a significant role in facilitating judgmental rating determinations since they are closer to the impacted area, have specific knowledge about the area and related information, and may have sources for additional objective or subjective data sources.
    ii. Regional Office staff are also directly involved in the final rate review and approval process. For all premium rates, regardless of credibility, Regional Offices review every target rate generated and work directly with AB staff to arrive at the final target rate. In addition, Regional Office staff also review the final rate documents to ensure that the final published rate components are consistent with the agreed-to target rate components.
    iii. Regional Offices play a substantial role in rate development and oversight. To facilitate communication between AB and each Regional Office, the Rates Work Group (comprised of AB rates personnel, two Regional Office Directors, and representatives from each of the ten regional offices) hold regular conference calls and meetings to review rating protocol, to improve rating procedures and applications, to generate overall process improvement, and to provide updated information/training.

(2) CRITICAL CONTROL POINTS:

a. Throughout the rate calculation process, several critical control points occur. At each critical control point, decisions must be made and RMA employee(s) are responsible for making rate-related decisions and for ensuring successful completion of rate-related activities. Critical control points, oversight, and approval are detailed in Exhibit 2 in flowchart diagrams and are also discussed below in narrative form. The process outlined is indicative of the oversight and approval process used throughout the rating process.

i. Annual Rating Cycle

1. As the first step in the rating process, the RT Leader loads the most recent years' information into the StatPlan Database.
2. After verifying that the most up-to-date data has been loaded, RT Leader directs the process to run the normalization process that yields an adjusted data file used exclusively for rating purposes.
3. After reviewing output from the normalization process, the RT Leader initiates the annual rating cycle routine yielding a list of county/crop programs recommended for rate review for the upcoming year.
4. AB Rate Specialists review the output from the annual rating cycle routine for completeness and accuracy. They also analyze the recommended results for reasonableness and analyze outliers and unexpected results as a means of validation.
5. AB Rate Specialists combine the results from the annual rating cycle routine with their own knowledge of the crop and areas to determine whether additional crops or areas should be added to the generated list for review in the upcoming year. A crop or area could be added based on a number of actuarial considerations, regional office recommendations, or management recommendations.
6. AB Rate Specialists provide final recommendations for rate review for each crop to the RT Leader who summarizes all recommendations, approves recommendations for the upcoming year, and presents to the AB Chief. Results from the annual rating cycle review may be modified to reflect resource constraints and other actuarial priorities.
7. AB Chief reviews and approves recommendations and presents to the APDD Director.
8. The APDD Director reviews and concurs on recommendations and presents to the Senior Actuary.
9. Senior Actuary reviews and approves recommendations and presents to Deputy Administrator for PM.
10. Final approved list of recommendations for rate reviews for the upcoming year will be included in the Rate Methodology Memorandum submitted to the Agency Administrator for signature.
    a. Additional rate reviews could be conducted (if requested) for documented cause subsequent to approval of the Rate Methodology Memorandum.
11. Following approval of the Rate Methodology Memorandum, AB moves forward with implementation efforts.

ii. Implementation of Actuarial Rate Studies

1. When the final deliverables from the contract for an actuarial rate study has been received by AB, it is evaluated by AB Rate Specialists for soundness, implementation impacts and considerations, and an assessment of time required for implementation.
    a. Regional Office staff may be consulted and provide feedback to AB.
2. Based on recommendations from the AB Rate Specialists, the RT Leader will review and approve/disapprove recommendations and apprise the AB Chief.
3. The AB Chief will review and approve/disapprove recommendations and apprise the APDD Director.
4. The APDD Director will review and concur/nonconcur on recommendations and apprise the Senior Actuary.
5. The Senior Actuary will review and approve/disapprove recommendations and apprise Deputy Administrator for PM. The DAPM has the discretion to apprise the Administrator and/or the FCIC Board.
6. Final approved list of recommendations for actuarial studies to be implemented in the upcoming year will be included in the Rate Methodology Memorandum submitted to the Agency Administrator for signature.
7. Following approval of the Rate Methodology Memorandum, AB moves forward with implementation efforts.

iii. Reference Yields

1. Based on the final approved list of recommendations for target rate reviews for the upcoming year that resulted from the Annual Rating Cycle, reference yields will be updated in all cases that target rates are reviewed.
    a. Reference yields can be updated more frequently (if requested) and for documented cause.
2. AB Staff update reference yields based on updated T-yields
    a. Regional Office staff may be consulted and provide feedback to AB.
3. RT Leader will review and approve/disapprove the recommended list of reference yields to be updated and apprise the AB Chief.
4. The AB Chief will review and approve/disapprove recommendations and apprise the APDD Director, Senior Actuary and Deputy Administrator for PM.
5. The list of reference yields recommended to be updated is included in the Rate Methodology Memorandum submitted to the Agency Administrator for signature.
6. Following approval of the Rate Methodology Memorandum, AB moves forward with implementation efforts.

iv. Rate Methodology Memo

1. Recommendations (for the upcoming year) for crops and areas to be rated (from annual rating cycle process), actuarial studies to be implemented, reference yields to be updated, and other rate loads (e.g. Prevented Planting, etc.) to be reviewed/updated are

incorporated into a document called the Rate Methodology Memorandum.

a. Other rate loads are reviewed/updated on a periodic basis and are often included in the Rate Methodology Memorandum. The frequency of review for other rate loads varies.

2. The RT Leader will draft the Rate Methodology Memorandum in the form of a decision memorandum to be ultimately approved by the Agency Administrator.
    a. Regional Office staff (through the Rates Work Group) review portions of or the entire draft and may provide feedback to AB.
3. The AB Chief will review and approve/disapprove the Rate Methodology Memorandum and apprise the APDD Director.
4. The APDD Director will review and approve/disapprove the Rate Methodology Memorandum and apprise the Senior Actuary.
5. The Senior Actuary will review and approve/disapprove the Rate Methodology Memorandum and apprise the Deputy Administrator for PM for approval.
6. The Deputy Administrator for PM will sign the final Rate Methodology Memorandum and forward to the Agency Administrator for signature
7. Once signed by the Agency Administrator, the Rate Methodology Memorandum becomes the actuarial work plan for the coming year.
8. Following approval of the Rate Methodology Memorandum, AB moves forward with implementation efforts.

v. Target Rates

1. Once the StatPlan Database has been loaded with up-to-date data, the RT Leader directs the contractors to run the target rate calculation routine.
2. AB Rate Specialists review the system-generated target rates for completeness and overall reasonableness. Then RT Leader notifies Regional Office staff that target rates are available for their review.
3. Regional Office staff review the system-generated target rates. If they agree with the target rates, they are approved and move forward in the system. If they disagree with the system-generated target rates, they can recommend rates derived through an alternative rating methodology and provide supporting documentation. If AB Rate Specialists agree with the alternative rates, they move forward in the system.
4. If AB Rate Specialists and the RO Staff can not agree on rates, even after considerable consultation and collaboration, then the issue is raised to the AB Chief and the Regional Office Director. If agreement at that level can not be reached, the issue is raised to the Deputy Administrator for PM and the Deputy Administrator for Insurance Services (IS) for final resolution.
5. Once all rates have been agreed to in the system, the RT Leader notifies the AB Chief that target rates have been established and ready to move to the next stage of the rate development/publication process.

vi. Publication of Rates

1. Rating Components

a. Target Rates

i. For crops undergoing a current year target rate review, the target rates have been agreed to by AB Rate Specialists and RO Staff. These rates are ready for use in the Capping Process (See Below).

ii. For crops **not** undergoing a current year target rate review:

1. If their target rates have been reached, the target rates are ready for use in the Capping Process (See Below).
2. If their target rates have **not** been reached, the published rates will be revised by moving toward the target rate during the Capping Process (See Below).

b. Target Reference Yields

i. Crops undergoing a current year target rate review will also undergo a reference yield review and target reference yields will be updated accordingly for use in the Capping Process (See Below).

1. Target Reference Yields are reviewed/updated when Target Rates are reviewed/updated, but can be reviewed/updated more frequently, if needed.

ii. For crops **not** undergoing a current year target rate review:

1. If the target reference yield has been reached, the target reference yields are ready for use in the Capping Process (See Below).
2. If the target reference yield has **not** been reached, the published reference yields will be revised by moving toward the target reference yield during the Capping Process (See Below).

c. Target Coverage Level Relativities

i. Crops undergoing a current year coverage level relativity review will have coverage level relativity targets updated for use in Capping Process (See Below).

1. Target Coverage Level Relativities are reviewed/updated when Target Rates are reviewed/updated, but can be reviewed/updated more frequently, if needed.

ii. For crops **not** undergoing a current year coverage level relativity review:

1. If target coverage level relativities have been reached, the target coverage level relativities are ready for use in Capping Process (See Below).

2. If target coverage level relativities have **not** been reached, the published coverage level relativities will be moved toward the target coverage level relativities during the Capping Process (See Below).

d. Target Rate Exponents
   i. Crops undergoing a current year rate exponent review will have rate exponent targets updated accordingly for use in the Capping Process (See Below).
      1. Target Rate Exponents will generally be reviewed/updated when Target Rates are reviewed/updated, but can be reviewed/updated more frequently, if needed.
   ii. For crops **not** undergoing a current year rate exponent review:
      1. If target rating exponents have been reached, the target rating exponents are ready for use in the Capping Process (See Below).
      2. If target rating exponents have **not** been reached, the published rating exponents will be revised by moving toward the target rating exponents during the Capping Process (See Below).

e. Other Rate Loads
   i. Other rate loads (e.g. Prevented Planting, etc.) are reviewed/updated on a periodic basis. The frequency of review for other rate loads varies.

2. Capping Process
   a. When the four rating components (target rates, target reference yields, target coverage level relativities, and target rate exponents) are ready for use in the Capping Process, the RT Leader initiates the Capping Process program.
3. Loading AFS Database
   a. Following the Capping Process, RT Leader initiates the loading of final rating components to the Actuarial Filing System (AFS) Database.
4. Generation of Documents
   a. RT Leader notifies the FT Leader that rates are loaded into the system and rate documents can now be generated.
   b. FT Leader initiates the generation of rate documents and notifies Regional Office staff that documents are available online for their review.
   c. Regional Office staff and AB staff review documents, validate calculations, and make any necessary corrections/updates.
      i. Regional Offices concur on final documents.
      ii. Any and all changes to rating components must be approved by the RT Leader and the AB Chief.
5. Publication of Documents

a. When all final rate documents have been concurred upon by AB Rate Specialists and by RO staff, the AB Chief authorizes publication of all documents and notifies all customers via RO Server Release memorandum.

3. RATING METHODOLOGY - APH

The accuracy of an established rate is one of the benchmarks used to determine whether a regulatory (approved existing crop) program should be modified or whether a pilot crop program should be modified, terminated, or converted to a permanent program.

The Act contains the following provisions pertinent to rate making.

(1) Sec. 508(i) (2) states "Review of rating methodologies. To maximize participation in the Federal crop insurance program and to ensure equity for producers, the Corporation shall periodically review the methodologies employed for rating plans of insurance under this chapter consistent with section 507(c)(2) of this title."[1]

(2) Sec. 508(i) (3) states "Analysis of rating and loss history. The Corporation shall analyze the rating and loss history of approved policies and plans of insurance for agricultural commodities by area."

(3) Sec. 508(d) (2) states "the amount of the premium shall be sufficient to cover anticipated losses and a reasonable reserve."

The following instructions specify activities leading to the final published county rates by crop program.

A. RATING GOALS - APH

Rate Methodology Memorandum: Annually, a decision memorandum (memo) is written by AB (located in the RMA Deputy Administrator for Product Management (DAPM) office) identifying the planned rate and coverage objectives for the upcoming year. Issues outlined in the memo may be the direct result of legislative initiatives, policy changes, implementation of actuarial studies, or routine reviews based on updated experience. This memo must be approved by the Administrator before AB will make rate changes.

The rate and coverage strategies outlined in this memorandum remain generally consistent with the rate and coverage strategies employed by the Risk Management Agency (RMA) for the past several years. RMA maintains underlying data records in its databases to support its rating calculations and statistical analysis related to rate determination and decision support for the Rate Methodology Memorandum. The strategies are a normal and accepted standard practice used in the insurance industry to achieve certain ratemaking objectives, principally to promote stability while remaining sufficiently responsive to reflect changes in the underlying risk insured. Any ratemaking process attempts to capture potential future costs, but may not be a perfect prediction of the future costs that

will be incurred. Rate and coverage strategies reflecting these considerations are a normal and accepted part of the regulatory environment in which insurance operates.

As indicated by the model adopted from the *Analysis of Rating Cycle for Multiple Peril Crop Insurance* report, RMA will conduct county level rate reviews by crop/state combination as listed in the annual memorandum. For these crop/state combinations undergoing county level rate reviews, RMA will update transitional yields and establish new targets for reference rate, fixed rate, and reference yields for the county/crop/type/practice.

Changes in premium rates for all crops will generally range from –5% to +15%. In accordance with legislative mandate, in the extreme cases, premium rate increases will be capped at 20% compared to what the insured would have paid the previous year for the same coverage. Beginning in the 2007 crop year a premium rate decrease of more than 20% was allowed if the target rate could not be reached in three years or if the rate change was due to a change in the program (i.e. a new practice was offered). This is accomplished through reinsured company premium quoting software and validated through RMA acceptance/validation systems.

B. RATING METHODOLOGY - APH COMPONENTS

The Rating Methodology for APH includes eight (8) primary components. Each component will be examined and explained below in this Handbook.

(1) INSURANCE EXPERIENCE COMPONENT

STATPLAN DATABASE/DATA RETRIEVAL and COMPILATION

(A) STATPLAN

Objectives: (1) Standardize the multiple policy databases into a single database with multiple years of data under a single standard format, (2) Filter the data to include only data that is relevant to the risk analysis, (3) Stabilize the database so multiple analysts will be evaluating identical historic data, and (4) Summarize the producer experience whereby it is user friendly and provides quicker data access.

Statplan was developed to provide a reliable database from which sound actuarial decisions could be made. Prior to its development, historic records were retained in multiple databases where key fields did not abide by a single standard. The first step in the development of the Statplan database was to merge all historic records, dating back to 1948, to create a single database with common key fields between years. The development of a common database simplified the analysis of data while eliminating large amounts of detailed information unnecessary for making actuarial decisions.

The second step in the development of the Statplan database was to selectively eliminate historic records whose premium rates were based on alternative methods other than the actual production history rating methodology, such as group insurance policies. Additionally, there are historic records that require pre-identified loss information be segregated from losses that are directly related to crop yield production risks. In the following components, each of these scenarios will be reviewed and analyzed in detail.

The third step in the development of Statplan was to create a stable environment from which to operate. The policy databases are constantly being updated with transactions. This prevented

statistical figures derived prior to an update from being accurately compared with statistical figures completed after an update. An automated reconciliation report (referred to internally as the Audit Report) compares pre-load data with data loaded into Statplan to ensure that all appropriate data has been loaded. The output report serves as reference documentation and is reviewed by AB Rate Specialists for reasonableness and appropriateness and any issues/concerns are raised to the RT Leader and AB Chief. Statplan data loads are periodic (twice a year) and updates are only applied to the past two or three years (depending on the completeness of the prior years' data). Static data will shorten the timeframe needed to update the historic data in Statplan.

The fourth step in the development of Statplan was to summarize selected detail information and store it into tables that could be easily utilized for premium rate analysis. Given that RMA develops county rates and not individual insured rates, most Statplan users would find summarized crop unit data suitable for their needs. They would not require the individual insured's experience; therefore, it would not be necessary to track individual data between crop years to develop summarized data. The Statplan database consists of a number of tables that serve as a depository of policy unit experience. The two main tables that will be referred to often in this document are the production ratio tables and the county summary tables. These two tables are currently the two primary components used in RMA's rate programs.

The production ratio tables can be defined as tables that contain summarized experience from units with liability and excluding those units as outlined in Sections III through VI in this chapter. (Note: Section II, VII-IX modifies the liability but do not eliminate it from the table). The production ratio is the units' production to count divided by the units' average historic production.

For example, if a unit is expected to produce 100 bushels of grain but the production to count was 53 bushels then the production ratio is simply .53. More details surrounding the production ratio table will be discussed toward the end of this component.

The first major table is the production ratio table which is the foundation from which RMA's base rates are determined. These tables provide data which may be used: to normalize past experience into a common coverage level; to identify which insurance plans are utilized; and to determine which county/crop programs are reviewed. This chapter will outline the process used to partition the policy data into individual tables for further rate analysis, and to filter the data so that only experience relevant to the establishment of a base rate remains.

The second major table is the county sum table. This table becomes a depository for all data that is summarized to a county level risk. Independent analysis and ad-hoc studies of county level data fields can be used for calculating specific risks, such as replant or prevented planting, which are not directly related to a production ratio.

This document contains detailed logic flows, examples, and detail reports of how Statplan adjusts and eliminates data from selected tables. It explains data appearance as received from the Policy Database, adjustments made, and final Statplan appearance after loaded. The data in this component flows in the following order:

I. Data Extract
II. Winter Kill Experience
III. High Risk Experience
IV. Whole Farm Units
V. Prevented Planting

VI. Written Agreements
VII. Late Planted/Planting
VIII. Replants
IX. Revenue Adjustments
X. Additional Revenue Adjustment Issues
XI. Production Ratio Calculations
XII. Database Tables

I. *Data Extract*

Data in Statplan is based on crop insurance experience extracted from yearly policy databases. Each re-insurance year's policy data is stored in this database, so extractions are completed on an annual basis. The data is extracted from the acreage record (CU_LINE_ITEM) table and the loss record (CLAIM_LINE_ITEM) table of each policy year database.

The initial selection is on a crop code basis in order to control the amount of data being extracted from each year's policy database. Only data fields pertinent for rate making or decision making processes are extracted.

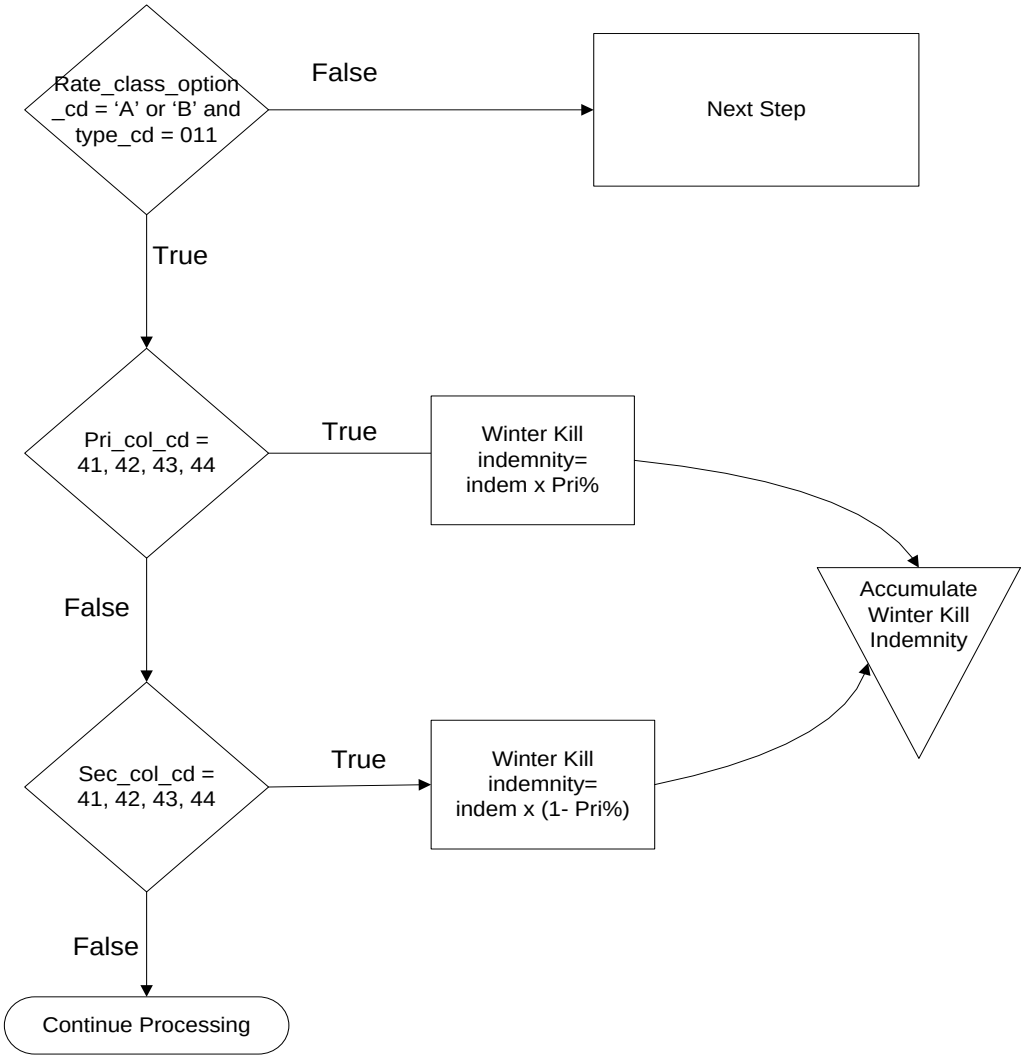
As a general rule, only plans of insurance whose experience can support the rate making process of the APH plan of insurance are utilized in Statplan. For example, the Group Risk Plan (GRP) of insurance experience is not utilized to establish rates for the Actual Production History (APH) program, so the data is not captured in Statplan. The insurance plans (and their respective codes) included are as follows: Peanuts (10), Revenue Assurance-RA (25), Tobacco Guaranteed Production (30), Crop Revenue Coverage-CRC (44), Yield Based Dollar Amount of Insurance (55), Tobacco Quota (70), Grower Yield Certification Span-GYC Span (84), Grower Yield Certification-GYC (86), and Actual Production History-APH (90).

II. *Winter Kill Experience*

Optional Winter wheat and barley coverage is offered in selected counties where BOTH a Fall final planting date and a Spring final planting date are provided. The endorsement, Option A or Option B attaches to the Small Grains Crop Provisions and provides coverage for Fall-seeded wheat or barley between the Fall final planting date and the Spring planting date. If Option A or B coverage is elected an additional rate is added to the base rate paid by the insured.

Statplan separates insurance losses covered under the base policy verses those covered under the optional coverage. The Option A and Option B experience is aggregated in the county sum table and is excluded from the experience data deposited in the production ratio tables. An automated file containing excluded Option A and Option B records is produced and retained for validation purposes. For additional validation, the information is available via query against the historical databases.

Identifying losses that occurred during the Fall and Spring planting dates is difficult. The primary and secondary causes of loss reported on the loss record are used to identify the Option A and Option B losses or Winter kill losses. All records with a cause of loss (primary and secondary) code of frost (41), freeze (42), cold Winter (43), and cold wet weather (44) are identified as Winter kill causes of loss. Counties with Fall final planting dates only and Winter kill cause of loss codes will be unaffected because Winter kill is a covered peril under the basic provisions.



III. *High Risk Experience*

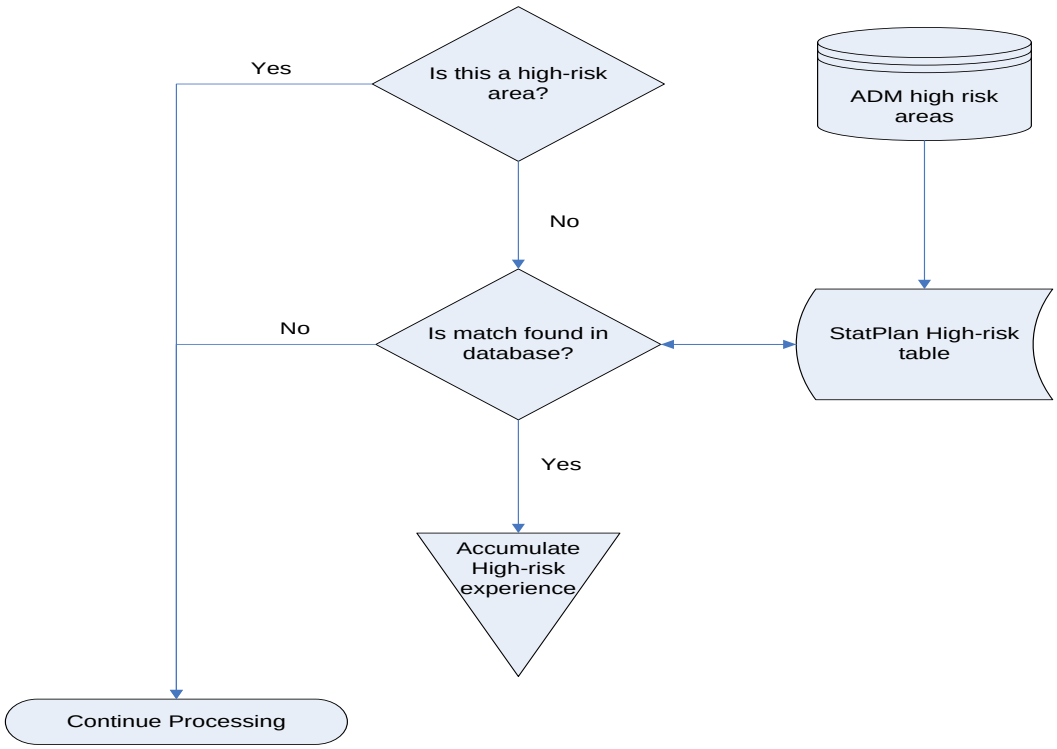
High-risk land is described as "acreage with identifiable physical limitations to crop production that may increase the potential frequency and/or severity of loss; or expose a planted or intended crop to perils not generally encountered by most insureds". Such acreage may consist of flood plains, poorly drained areas, high sand content soils, high aluminum toxicity soils, high sodium content soils, high alkali soils, peat soils, soils with high or low pH, soils that are highly erodible, etc.

High-risk land is identified or classified with the use of legal descriptor documents or listings. This classification code is then utilized on the actuarial documents to publish adjustments to transitional yields and/or base rates. High-risk rate adjustments may be an add-on rate, a multiplicative rate factor, or a fixed rate to cover the additional risk.

Given that high-risk land does not represent the basic production risk of the county, all high-risk experience is **excluded** from the production ratio tables. An automated file containing excluded high risk records is produced and retained for validation purposes. For additional validation, the information is also available via query against the historical databases. The exclusion is accomplished in the loading of the policy data into Statplan by matching the classification code on

the policy records against a table in Statplan that contains all high-risk classifications.

Additional information on the insurability of high-risk land can be found in the ***Classification Standards Handbook*** and the ***Crop Insurance Handbook.***



IV. *Whole Farm Units*

Whole farm units are defined as "all insurable acreage of 2 or more insured crops planted in the county in which the insured has a share on the date coverage begins for each crop for the crop year".

Whole farm units are excluded from all Statplan tables. Currently, whole farm units are only sold under insurance plan 25, revenue assurance. The experience recorded under a whole farm unit can not be partitioned into individual crops on the loss record; therefore, all experience is excluded from all tables in Statplan. An automated file containing excluded whole farm unit records is produced and retained for validation purposes. For additional validation, the information is also available via query against the historical databases.

V. *Prevented Planting*

Prevented planting is defined as "a failure to plant the insured crop with proper equipment by the final planting date designated in the Special Provisions for the insured crop in the county". The insured may also be eligible for a prevented planting payment if he/she failed to plant the insured crop with the proper equipment within the late planting period. The insured must have been prevented from planting the insured crop due to an insured cause of loss that is general in the surrounding area and that prevents other producers from planting acreage with similar characteristics.

Prevented planting was first added to the basic crop policy provisions in 1994 for 11 crops. In 2005, there are 29 crops with prevented planting coverage. Base coverage for prevented planting is not consistent across crops and has also increased since its inception in 1994. Beginning with Spring crops of 1998, insureds were also allowed to purchase additional prevented planting coverage above the basic coverage for an optional premium. Refer to Target Rate Development to see the crops with prevented planting coverage and the percentage coverage amount by year.

For those crops with prevented planting provisions, indemnities are based on the policy provisions of a crop and are expressed as a percent of the initial liability. Most major crops are indemnified at 60%; however some crops have a basic coverage as low as 25% (ref. M13 Exhibit 21-6). Both prevented Planting Option with 5% buy-up option (PF) and Prevented Planting Option with 10% buy-up option (PT) increase the coverage provided by the basic provisions by the respective amounts.

Prevented planting indemnities are not considered production losses since the crop is not planted and the expected production is zero. Therefore, all experience related to prevented planting is excluded from the production ratio tables, but experience is included in the county sum tables.

Statplan will: 1) exclude the prevented planting indemnities and associated liability from the production ratio tables; 2) capture the prevented planting indemnities and associated liability and acreage for prevented rate reviews; 3) store the basic, PF and PT information in separate fields for option factor review; and 4) re-determine the initial liability at the time of sale using the guarantee reduction percent. If only part of the unit acreage was prevented from being planted, the remaining acreage is included in the production ratio tables.

Step #1: Prevented planting indemnities are identified by stage code on the claim record. A matching acreage record will provide the reduced liability, premium and acreage for the portion of acreage that was prevented. Stage codes for prevented planted acres have changed considerably since payments began in 1994.

Therefore, adjustments may be needed depending on the year:

'PT' 1998 --	(Basic coverage plus 10%)
'PF' 1998 --	(Basic coverage plus 5%)
'P2' 1994 --	(Basic coverage)
'P1' 1996 –1998	(black dirt – treat same as basic coverage)
'U3' 1996 –1998	(substitute crop, partial pmt. – exclude from all tables
'H3' 1996 –1998	(substitute crop, partial pmt. – exclude from all tables
'P3' 1994 --1995	
'P4' 1994 --1995	

Step #2: **For 1998 and subsequent crop years, p**revented planting liability, indemnities and acreage are segregated based on type of coverage. Basic coverage is accumulated under field names of PP, while prevented planting losses coded as PF or PT are divided into the portion that was paid for basic and the portion that was paid for the add-on option. To illustrate, a PT stage loss would be calculated as follows:

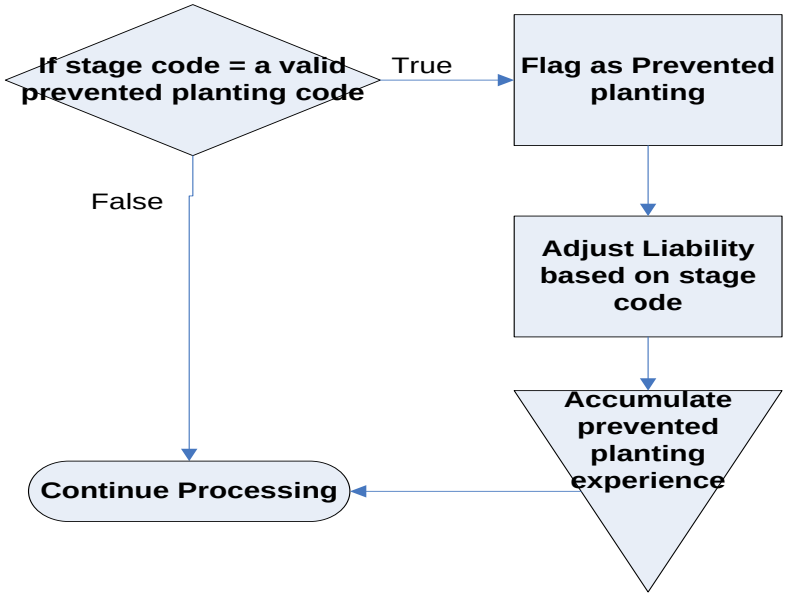
PT Liability = Liability * .10 / Guarantee Reduction Percentage
PP Liability = (Liability / Guarantee Reduction Percentage) – PT Liability

PT Indemnity = Indemnity * .10 / Guarantee Reduction Percentage
PP Indemnity = Indemnity – PT Indemnity.

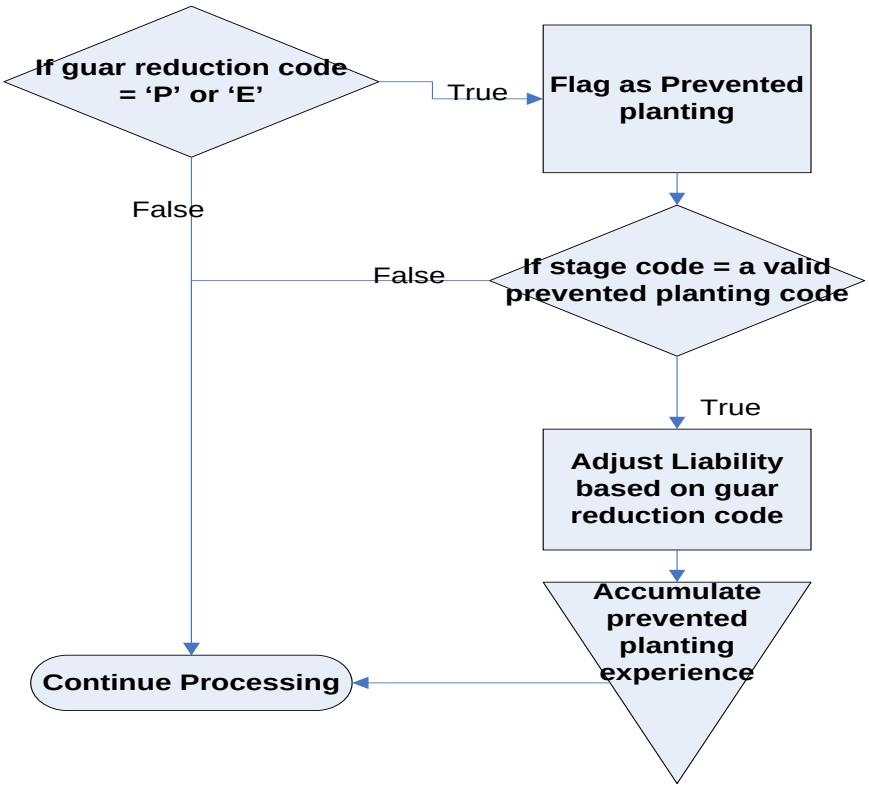
It should be noted that the Liability is divided by the Guar. Reduction Pct. because the recorded liability in the policy database has been reduced to the indemnity value, and is no longer the liability from which it was originally rated.

An automated file containing excluded adjustments (through Steps #1 and #2) is produced and retained for validation purposes. For additional validation, the information is also available via query against the historical databases.

Prevented Planting processing logic prior to 2001



Prevented Planting processing logic since 2001



VI. *Written Agreements*

Written Agreements are defined as: "a document that alters designated terms of a crop policy as authorized under the basic provisions, the crop provisions, or the special provisions for the insured crop". In addition, the written agreement is used to provide insurance for insurable crops when coverage and/or rates are not available.

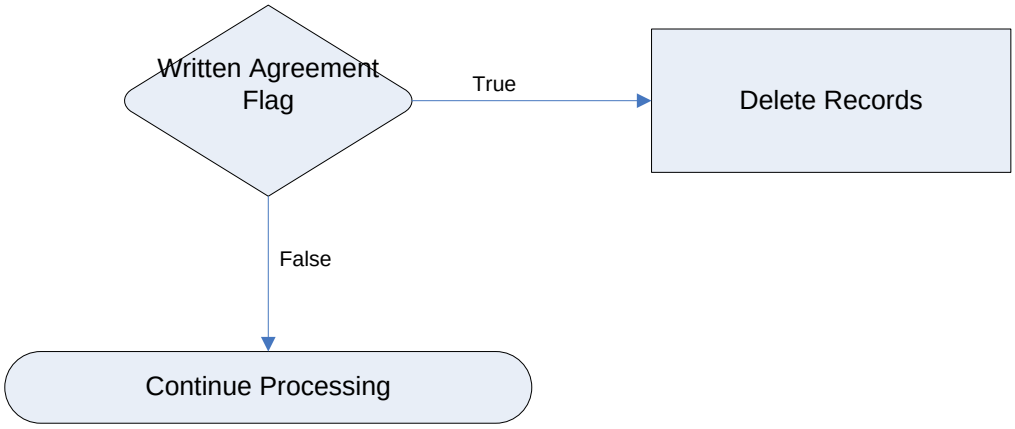
The written agreement acreage on the policy database is identified by reviewing the written agreement processing flag field (writn_agmt_flg). If the written agreement processing flag is positive, then the acreage is designated as a written agreement.

For the purpose of ratemaking, all written agreements are eliminated from Statplan because the individual rating methods used to evaluate the risks that underscore most written agreements are not consistent with the rating methods used to set county rates. An automated file containing excluded written agreement records is produced and retained for validation purposes. For additional validation, the information is also available via query against the historical databases.

For additional information, see Section 4 of the ***Crop Insurance Handbook*** or the ***Written Agreement Handbook*** at the following website:

www.rma.usda.gov/FTP/Publications/directives/24000/pdf/01_24020.pdf

Written agreement records are excluded from Statplan with the following logic:



VII. *Late Planted/Planting Adjustments*

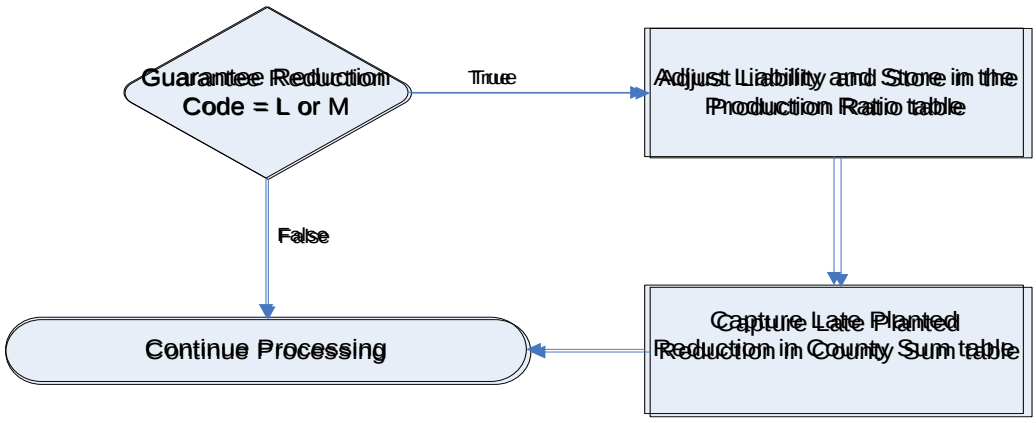
Late planted acreage is defined as "acreage initially planted to the insured crop after the final planting date designated in the Special Provisions for the insured crop in the county".

Late planting provisions provide reduced coverage for insurable acreage planted during any applicable late planting period, and for insurable acreage that was prevented from being timely planted but was planted to the insured crop during the late planting period for crops with prevented planting coverage. The premium for the late planted coverage is the same as for the acreage that was planted timely.

Late planted coverage is provided by the basic provisions and may be altered by the crop provisions or special provisions. For most of the major crops, the production guarantee is reduced 1% per day for each day planted after the final planting date, up to a maximum of 25 days. The applicable production guarantee reductions by crop and additional information can be found in Section 4 of the ***Crop Insurance Handbook***.

The key to identifying late planted acreage on the policy database is reviewing the guarantee reduction code field (guar_red_cd). If the reduction code is equal to L (late) or M (maximum late) then the acreage was planted late. For all late planted acreage, the guarantee reduction percentage field (guar_red_pct) also needs to be captured.

For the purpose of ratemaking, all late planted acreage utilized in Statplan will need the liability restored to the pre-production guarantee reduction (Liability / guar_red_pct). The reduction in liability or the difference between the production guarantee and the guarantee based on the approved APH yield is also captured for future analysis of appropriate guarantee reductions in the county sum tables. Possible examples of future analysis could include, but not be limited to: 1) Late Planting direct impact on loss ratios, overall losses, or premium rates; 2) Accuracy of late-filed penalty charges vs. associated risk; etc.)



VIII. *Replants*

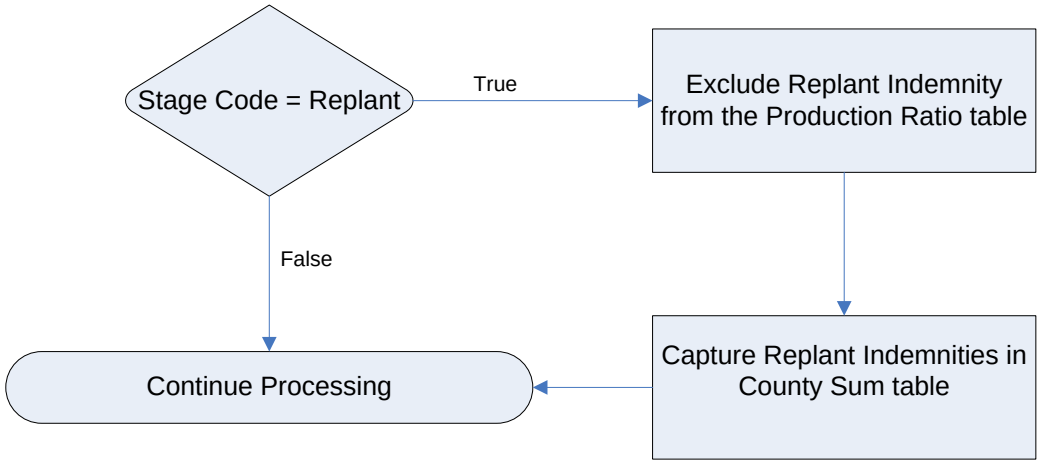
Replanted is defined as: "performing the cultural practices necessary to prepare the land to replace the seed or plants of the damaged or destroyed insured crop and then replanting the seed or plants of the same crop in the insured acreage with the expectation of producing at least the yield used to determine the production guarantee".

Any acreage of the insured crop that was damaged prior to the final planting date, to the extent that a majority of the growers in the area would not normally further care for the crop, must be replanted (unless the Insurance Provider agrees that replanting is not practical) for coverage to continue. When it is practical to replant and the crop is not replanted, insurance does not attach (no premium or indemnity is due on such acreage).

For additional information, see Section 4 of the ***Crop Insurance Handbook*** and Part 3, Section 1 of the ***Loss Adjustment Manual***.

The key to identifying replanted acreage in the policy database is reviewing the stage code field (stage_cd). If the stage code is equal to 'R', 'OR', 'RT' or 'RS', then the loss line is a replant indemnity.

For the purpose of ratemaking, the risk of replant will be analyzed separate from yield production losses. Therefore all replant indemnities are subtracted from the unit indemnity and stored in the county sum tables. All remaining unit indemnity that is associated with production either from additional acreage within the unit or from the replanted acreage is utilized in the production ratio tables of Statplan.



IX. *Revenue Adjustments*

The Federal Crop Insurance Reform Act of 1994 directed the Federal Crop Insurance Corporation (FCIC) to develop a pilot crop insurance program that provides coverage against reduced gross income as a result of a reduction in yield or price. Two plans were privately developed: Crop Revenue Coverage (CRC) and Revenue Assurance (RA); and a third plan Income Protection (IP) was developed by FCIC. These three plans of insurance were approved by the Board of Directors and sales began on a limited basis beginning with the 1996 crop year.

The three plans are very similar but have some distinctive features. All plans guarantee revenue by combining yield and price variability. Indemnities are paid when any combination of yield and price result in revenue that is less than the revenue guarantee. CRC, RA, and IP plans are similar in that they use the policy terms and conditions of the Actual Production History (APH) plan as the basic coverage.

Revenue protection for all three products is provided by extending traditional APH protection to include price variability. The price component common to CRC, RA, and IP uses the commodity futures market for price discovery. Price discovery occurs twice; first, before the insurance period to establish the revenue guarantee (base price) and second, at harvest time (harvest price). All revenue insurance plans pay the insured producer an indemnity when the revenue production to count is less than the revenue guarantee.

While the plans are similar there are differences that are coverage related. CRC includes coverage for the harvest price being greater than the base price (increasing the guarantee) while RA offers this coverage as an option. IP coverage is for a single enterprise unit per crop per county, while CRC and RA allow for optional and basic units. IP does not allow for an increase in guarantee.

Initially, revenue insurance was offered for limited crops and in a limited number of counties and states; but over time, it was expanded to 9 crops and into most areas where APH is offered. In addition, it has grown in popularity and garnered a significant proportion of RMA's total book of business.

After data has been extracted from the historical databases, Statplan utilizes virtually all CRC and RA records. Revenue adjustments must occur and are accomplished in an automated routine by converting these records into equivalent APH records for use in APH rate evaluations. An automated file containing adjusted revenue records is produced and retained for validation purposes. For additional validation, the information is also available via query against the historical databases.

Statplan does not capture IP and IIP records because these data are on an enterprise basis and not compatible with establishing APH rates on an optional unit basis; however, this does not represent a significant omission since IP and IIP sales represent a negligible share of insurance sales volume. The resulting equivalent APH records from CRC or RA are stored by their original insurance plan code.

The primary data fields needed in the conversion process are the discovery prices for the revenue products and the APH price election. Statplan will query the yearly Actuarial Data Master (ADM) for the revenue and APH price data fields prior to adjusting the policy data being evaluated. The adjustment process for all revenue policy records is as follows:

$$\text{StatPlan Liability} = \text{Revenue Liability} \times \frac{\text{APH Price Election}}{\text{Revenue Base Price}}$$

The revenue base price, which is embedded in the revenue liability, is replaced by the APH price election to give a recalculated policy liability based on the APH price election.

The indemnity conversion is more complicated than exchanging prices to those that would have occurred under an APH policy. First, it should be determined if the policy has upside price protection (CRC or RA-HPO). That is, if the harvest price is greater than the base price, the lost production is paid at the harvest price. Under that scenario the loss guarantee is based on the harvest price and not the original liability. All CRC polices cover upside price protection, while RA policy holders may or may not have the coverage depending on their election of the harvest price option.

If the RA harvest price option is NOT elected, (no upside price protection) then the loss guarantee is equal to the revenue liability.

Step 1A:

$$\text{Loss Guarantee} = \text{Revenue Liability}$$

If the RA harvest price option is elected or the policy is a CRC policy, then the loss guarantee is equal to the revenue liability adjusted to the higher of the base price or the harvest price.

Step 1B:

$$\text{Loss Guarantee} = \text{Rev.Liability} \times \frac{\text{Max (Base Price, HarvestPrice)}}{\text{Base Price}}$$

The revenue production to count on the unit is then calculated by simply subtracting the revenue indemnity from the determined revenue loss guarantee (Step 1A or 1B). The production to count will never be less than zero.

Step 2:

$$\text{Production To Count (PTC)} = \text{Loss Guarantee} - \text{Rev. Indemnity}$$

The Statplan Indemnity (APH equivalent) is calculated by adjusting the production to count from the revenue unit by the revenue harvest price and the APH price election and subtracting that quantity from the unit liability (APH equivalent).

Step 3:

$$\text{Indemnity} = \text{StatPlan Liability} - \left[\text{PTC} \times \frac{\text{APH Price Election}}{\text{Revenue Harvest Price}} \right]$$

This resulting calculation has the potential to be negative when all or part of the loss is due to price declines. If the result is negative, the Statplan indemnity is set to 0 (zero) since no indemnity would have been paid under APH.

Step 4:

$$\text{StatPlan Indemnity} = \text{Max}\left(\text{Indemnity}, 0\right)$$

In summary, the liability and indemnity fields stored in Statplan under the revenue insurance plans (25 or 44) represent the liability and indemnity that would have occurred under an APH program. No adjustments are made to the revenue acreage fields.

X. *Additional Revenue Adjustment Issues*

All revenue adjustments take place after procedures in Sections II through Section VIII are completed. This order is important for the following reasons: 1) Revenue replants are based on the base price and not on a harvest price; and 2) units with multiple types of losses, (for example, prevented and harvested) should be dealt with before the revenue adjustment is completed.

Replant losses on revenue products are handled like all other replant losses as described in Section VIII. However, because these are revenue policies they will be converted to an equivalent APH product. The liability conversion for replant losses is analogous to that described in Section IX.

Since the acreage was replanted, the liability will remain in the production ratio tables. The conversion of the indemnity on the revenue replant is slightly different than described in Section IX. For replants, the indemnities are based on the base price and not on a harvest price; therefore, the calculation is as follows:

$$\text{StatPlan Rplt Indemnity} = \text{Revenue Rplt Indemnity} \times \frac{\text{APH Price Election}}{\text{Revenue Base Price}}$$

When there are multiple types of losses within a unit, the general rule of thumb is as follows: if the unit indemnity cannot be partitioned and assigned to the proper acreage and liability then the attribution should be based on the part of the unit with the highest acreage. The following are two such scenarios where this could occur:

Scenario #1: Part of the acreage in the unit is identified as high risk and part of the insured acreage is "normal". As a result, it is not known for certain if any loss is on the high risk acreage. The majority of the acreage will determine whether the unit is treated as "normal" or high risk.

Scenario #2: Part of the acreage is replanted, for which payments are based on the base price, and part not replanted within a unit. Enough information should be given to help distinguish the two acreages to make the proper adjustments.

XI. *Production Ratio Calculations*

Following the data clean-up process used in the prior sections, all acreage, liability and indemnity are summarized to a policy unit level. Unit production to count is determined by subtracting the unit indemnity from the unit liability.

$$\text{Production to Count (PTC)} = \text{Liability} - \text{Indemnity}$$

The production ratio is defined as the unit's production to count divided by the expected production. It is known that the true production to count is unknown in cases where there is zero indemnity. That is, the production to count is at least as large as or larger than the liability or unit guarantee. It is for that reason that there are separate production ratio tables by coverage level. The subject of adjusting data when the production to count is unknown will be covered in greater detail later in this component.

Since,

$$\text{Liability} = \text{Expected Production} \times \text{Coverage Level}$$

or

$$\text{Expected Production} = \text{Liability} \Big/ \text{Coverage Level}$$

Then it follows that:

$$\text{Production Ratio (PR)} = \frac{\text{Production to Count}}{\text{Expected Production}}$$

or

$$\text{Production Ratio (PR)} = \frac{\text{PTC}}{\text{Liability}} \times \text{Coverage Level}$$

XII. *Database Tables*

The key to establishing actuarially sound county base rates depends on the data populated in the production ratio tables of Statplan. An automated reconciliation report (referred to internally as the Audit Report) compares pre-load data with data loaded into Statplan to ensure that all appropriate data has been loaded. The output report serves as reference documentation and is reviewed by AB Rate Specialists for reasonableness, appropriateness, and to ensure that calculated production ratios accurately reflect programmed calculations and any issues/concerns are raised to the RT Leader and AB Chief. The following is an example taken from the production ratio summary table for Adams County, Iowa. The key fields and data fields utilized in the rate making process are defined below the following table.

Table 1

crop	st	co	yr	ip	cg	cvl	pr	d ind	d liab	d ac	d ut	d ui	c ind	c liab	c ac	c ut	c ui
0041	19	3	2001	90	A	0.65	0	1621	1628	13	2	1	1621	1628	13	2	1
0041	19	3	2001	90	A	0.65	0.11	3867	4664	35	2	1	5488	6292	48	4	2
0041	19	3	2001	90	A	0.65	0.12	942	1154	8	2	1	6430	7446	56	6	3
0041	19	3	2001	90	A	0.65	0.14	4331	5543	47	2	1	10761	12989	103	8	4
0041	19	3	2001	90	A	0.65	0.45	1006	3330	23	2	1	11767	16319	125	10	5
0041	19	3	2001	90	A	0.65	0.46	1023	3553	24	2	1	12790	19872	149	12	6
0041	19	3	2001	90	A	0.65	0.48	700	2620	18	2	1	13490	22492	167	14	7
0041	19	3	2001	90	A	0.65	0.62	292	7176	48	3	3	13782	29668	215	17	8
0041	19	3	2001	90	A	0.65	0.65	0	454190	2752	125	2	13782	483858	2967	142	8

Title, Statplan field name, Definition, Selection criteria used above

crop,	(crop_cd),	Crop code,	“0041” (Corn)
st,	(state_cd),	FIPS State Code,	19 (Iowa)
co,	(county_cd),	FIPS County Code,	3, (Adams County)
yr,	(crop_year_id),	Crop year,	“2001”
ip,	(ins_plan_id),	Insurance Plan,	90
cg,	(coverage_cat_cd),	Coverage Category	
cvl,	(cov_lvl_pct),	Coverage Level Percent,	.65
pr,	(prod_ratio),	Production Ratio	

Production ratios are limited to those that are observed and will range from 0 to the coverage level percent. In this example, only 9 production ratios were observed in crop year 2001 based on the

listed data keys.

Data fields are of two types; discrete and cumulative. In this case, discrete production ratio values represent total values for that unique production ratio value while the cumulative values for that production ratio represent the totals for that production ratio as well as all production ratios less than that value. There are a number of data fields populated in the production ratio tables. The following fields are utilized in the county rate worksheets:

Discrete indemnity (cps_d_indem_amt) and **cumulative indemnity** (cps_c_indem_amt) contain the discrete and cumulative indemnities of the associated production ratio. For example, production ratio .14 in the above example contains discrete and cumulative indemnity totals from all units with the established key fields (crop, state, county, etc.) of $4,331 and $10,761, respectively. The discrete indemnity of $4,331 represents all units in the identified group with production ratios between .135+ and .145 inclusively while the cumulative indemnity of $10,761 represents all units in the identified group with production ratios between 0 and .145 inclusively.

Discrete liability (cps_d_liab_amt) and **cumulative liability** (cps_c_liab_amt) contain the discrete and cumulative liabilities of the associated production ratio. For example, production ratio .14 in the above example contains discrete and cumulative liability totals from all units with the established key fields (crop, state, county, etc.) of $5,543 and $12,989, respectively.

The production ratio can be verified using the formulas given is Section XI in the above example:

PTC = $5543-$4331 or $1212 and PR = ($1212 / $5543) x .65 or .142125 or .14

Discrete net acres (cps_d_n_ac_qty) and **cumulative net acres** (cps_c_n_ac_qty) contain the discrete and cumulative net acres of the associated production ratio. For example, production ratio .14 in the above example contains discrete and cumulative net acreage totals from all units of 47 acres and 103 acres, respectively.

Discrete unit count (cps_d_unit_ct) and **cumulative unit count** (cps_c_unit_ct) contain the discrete and cumulative unit counts of the associated production ratio. For example, production ratio .14 in the above example contains discrete and cumulative unit counts of 2 and 8, respectively.

Discrete units indemnified count (cps_d_unit_indem_ct) and **cumulative units indemnified count** (cps_c_unit_indem_ct) contain the discrete and cumulative indemnified units of the associated production ratio. For example, production ratio .14 in the above example contains discrete and cumulative unit indemnified totals of 1 and 4, respectively.

If the table includes a row where the production ratio is equal to the coverage level, then (in most cases) this row would represent all units which did not sustain a loss and the production to count is assumed to be greater than or equal to the liability. On a rare occasion when a unit has a very minor indemnity, the calculated production to count will be less than the liability and the production ratio will round up to the coverage level. Therefore, it is possible to have discrete indemnity present in the row where the production ratio is equal to the coverage level.

The summarized row data in the production ratio tables of Statplan can now be utilized in the rating models. From these tables, data can easily be summarized further to include multiple insurance plans, multiple years, multiple counties and, most importantly to the analysts, the ability to combine the table data into a common coverage level. The common coverage level adjustment process will

be discussed in the Rate Making Concepts Component.

(B) DATA RETRIEVAL AND COMPILATION

Objective: to extract historic insurance experience from the Statplan database; to compile the raw experience; and to adjust all experience to a common coverage level.

The extraction/retrieval step in the rate generation process begins with; 1) the identification of which insurance programs are to be reviewed, and 2) the identification of data elements that are necessary to complete the rate review process. In the identification of which programs to review, the decisions made within the yearly rating methodology memorandum are incorporated. Historically, the rating structures within RMA have been developed on a crop/county basis. This will be discussed further in a later component. The identification of which crops and which state/county programs to be reviewed are key elements in both the identification process and its inclusion in the actuarial rate structure of AFS.

I. *Data Identification*

Key Elements (Key Data Fields):

Crops:
Based on the direction given in the Rate Methodology memo and the output from the Annual Rating Cycle (to be discussed under another component), specific crops/states are identified for rate review and are included as an attachment (Attachment H) to the Rate Methodology memo. Additional crop/states may be subjectively added to the list for review if documented evidence can be generated that would justify the additional reviews. Automated load files created through the Statplan load routine are date-stamped and serve as a record of the most recent data loaded for rate review and evaluation. In addition, when rates are reviewed/updated, the rate application assigns a run identification number denoting the date and time it was run.

State/County:
Generally, this level of selection is based on output from the Annual Rating Cycle; however, additional crop/states may be subjectively added to the list for review if documented evidence can be generated that would justify the additional reviews. Given that the catastrophic fixed rate load will be determined at the State level, it is unlikely that an independent rate review would be selected for an individual county (but it would not prevent a review).

Insurance Plans*:*
The Statplan database is used primarily to aide in the development of APH rates. Other insurance plans such as revenue plans of insurance can be converted to an APH basis as discussed earlier. However, specific insurance plans may be excluded if justified in the Rate Methodology Memorandum. The default in the data extract would include all insurance plans in the Statplan database in a crop review.

Types/Practices:
The default in the data extract would include all types and practices in the rate review. Currently systems would require that all types and practices be run concurrently even if only one type or practice was being reviewed.

In addition to the key data fields (listed above), three sub-key data fields are established in the selection of data. These three sub-key data fields are listed below:

Sub-Key Elements (Sub-Key Data Fields):

Coverage Categories
The default in the data extract would include all coverage categories except for Catastrophic Risk Protection "CAT" policies.

Coverage Level
The 65% coverage level has widely been used as the coverage level of choice to which all other coverage levels are adjusted. For ad hoc analysis, there is the option of selecting an alternate coverage level to adjust the raw experience; however, care must be exhibited in the selection of the common coverage level. If the adjustment is to a lower coverage level, some essential information may be lost while an adjustment to a higher coverage level requires some estimation of unknown observations.

Crop Years:
The default in the data extract would include all insurance experience beginning with and including crop year 1975. Historically crop year 1975 has been the benchmark year used for the compilation of insurance experience. There is the option to select an alternative starting crop year for analysis purposes if it is reasonable and the decision can be justified. The crop years of insurance utilized in the rate making for a given crop/county program begins with crop year 1975 and ends with the most recent year of complete experience (generally one lag year from crop year whose target rate is being established).

II. *Rate Worksheets*

Objective: To compile data elements stored in the Statplan database that will be used in the rate review worksheets for the identified rate unit (state/county/crop).

The RMA rate review process begins with the generation of rate review worksheets. These worksheets serve as reference documentation and are reviewed by AB Rate Specialists for reasonableness, appropriateness, and to ensure that calculated values accurately reflect programmed calculations and any issues/concerns are raised to the RT Leader and AB Chief. These worksheets are generated based on Key Elements and Sub-Key Elements established above, including crop, state, county. Several other data elements reside in the Statplan database that are used in the development of rates. The two most important data elements are liability and indemnity (to be discussed in more detail) which are used to derive the Loss Cost Ratio (LCR).

The following table is an example of the data that is compiled from the Statplan database. Specific line items shown in this table are explained in detail in upcoming sections related to target rate development. These are actual observations from Table A: Bond County, Illinois for Corn from 1975 to 2002. References will be made throughout this chapter to this worksheet as each cell of data is reviewed. The basis of years being 1975 through 2002 is for illustration purposes. The actual years used in the rate calculations are dependent upon the crop year in which the target rate is set.

Table 2: County Report - CORN (0041), ILLINOIS (17), Bond (005), APH (90)

Year	Indemnity	Liability	LCR	Avg Cov Level	Adj Indem	Adj Liab	Adj LCR	LCR After 80th Pct	Cat Indem	Net Acres	Units Indem	Cat Units Indem
1975	$0.00	$35,196.00	0.000	0.650	$0.00	$35,196.00	0.000	0.000	$0.00	593.0	0	0
1976	$14,135.00	$55,918.00	0.253	0.620	$16,094.69	$58,623.71	0.275	0.129	$8,541.47	744.0	2	3
1977	$899.00	$53,111.00	0.017	0.620	$1,023.64	$55,680.89	0.018	0.018	$0.00	699.0	1	0
1978	$1,125.00	$28,589.00	0.039	0.620	$1,280.97	$29,972.34	0.043	0.043	$0.00	405.0	1	0
1979	$0.00	$38,029.00	0.000	0.620	$0.00	$39,869.11	0.000	0.000	$0.00	465.0	0	0
1980	$9,021.00	$56,726.00	0.159	0.699	$7,330.33	$52,452.67	0.140	0.129	$576.98	625.2	4	0
1981	$4,543.00	$153,273.00	0.030	0.739	$3,542.47	$134,544.07	0.026	0.026	$0.00	1193.1	2	0
1982	$1,521.00	$70,525.00	0.022	0.712	$1,272.60	$64,271.27	0.020	0.020	$0.00	640.1	2	0
1983	$12,705.00	$31,511.00	0.403	0.724	$11,600.73	$28,394.33	0.409	0.129	$7,944.73	297.2	2	5
1984	$69,670.00	$541,248.00	0.129	0.668	$69,020.03	$526,103.00	0.131	0.129	$1,262.65	3767.1	42	1
1985	$36,946.00	$1,328,642.00	0.028	0.654	$37,290.33	$1,319,407.07	0.028	0.028	$0.00	8592.8	18	0
1986	$19,628.00	$1,696,428.00	0.012	0.655	$18,968.00	$1,682,306.80	0.011	0.011	$0.00	12910.1	18	0
1987	$19,437.00	$1,320,109.00	0.015	0.653	$19,437.00	$1,313,927.00	0.015	0.015	$0.00	11668.8	15	0
1988	$393,646.00	$1,481,032.00	0.266	0.650	$390,692.53	$1,481,117.20	0.264	0.129	$199,950.82	12667.1	117	122
1989	$11,560.00	$2,199,835.00	0.005	0.649	$11,560.00	$2,197,549.53	0.005	0.005	$0.00	15424.8	16	0
1990	$51,228.00	$1,242,892.00	0.041	0.652	$51,144.39	$1,239,387.50	0.041	0.041	$0.00	9342.8	42	0
1991	$30,714.00	$2,013,155.00	0.015	0.649	$30,714.00	$2,015,168.87	0.015	0.015	$0.00	14799.8	26	0
1992	$4,241.00	$1,819,433.00	0.002	0.649	$4,241.00	$1,821,071.23	0.002	0.002	$0.00	13138.1	9	0
1993	$15,046.00	$1,472,578.00	0.010	0.649	$14,727.47	$1,475,610.50	0.010	0.010	$0.00	10037.8	6	0
1994	$41,608.00	$3,210,935.00	0.013	0.647	$41,608.00	$3,224,592.33	0.013	0.013	$0.00	18954.9	30	0
1995	$509,876.00	$2,639,252.00	0.193	0.649	$508,440.27	$2,645,601.00	0.192	0.129	$167,731.10	18564.5	131	64
1996	$83,975.00	$5,270,138.00	0.016	0.651	$83,328.00	$5,259,563.72	0.016	0.016	$0.00	25675.6	26	0
1997	$62,808.00	$5,122,012.00	0.012	0.648	$62,808.00	$5,136,881.24	0.012	0.012	$0.00	27010.9	36	0
1998	$326,618.00	$5,218,469.00	0.063	0.650	$330,108.72	$5,216,581.57	0.063	0.063	$0.00	25891.9	64	0
1999	$104,620.00	$5,464,923.00	0.019	0.663	$91,660.96	$5,358,164.73	0.017	0.017	$0.00	32056.4	84	0
2000	$43,583.00	$6,353,656.00	0.007	0.671	$44,023.66	$6,149,585.44	0.007	0.007	$0.00	40201.7	21	0
2001	$115,581.00	$8,136,318.00	0.014	0.688	$94,041.47	$7,655,440.11	0.012	0.012	$0.00	63266.5	57	0
2002	$1,145,296.00	$7,877,382.00	0.145	0.696	$933,308.22	$7,339,766.69	0.127	0.127	$0.00	60227.5	367	0
Summary	$3,130,030.00	$64,931,315.00	0.069	0.660	$2,879,267.47	$63,556,829.92	0.068	0.046	$386,007.76	15352.2	1139	195

III. *Data Compilation*

Objective: to compile data elements stored in the Statplan database that will be used in the rate review worksheets for the identified rate unit (state/county/crop).

Before discussing the worksheet further it is important that the structure of the data stored in Statplan is understood. Table 3 is an example of how liability is stored in the Statplan database for a specific insurance plan (CRC), for a specific year (2002) and for a specific coverage level (65%). For Bond County, Illinois there may exist up to 22 corn tables just for year 2002, covering 3 insurance plans, 8 coverage levels (5 for RA), plus one table for catastrophic policy data. The latter table may be just a small part of the total picture. In addition, each crop year will vary depending on the availability of insurance plans, coverage levels, type of insurance plans and producer participation.

TABLE 3

Production Ratio	Discrete Liability	Cumulative Liability
	Coverage Level 65%	
....		
0.45	7,548	434,677
0.46	13,082	447,759
0.47	5,635	453,395
0.48	18,078	471,473
0.49	20,562	492,035
0.50	13,376	505,411
0.51	0	505,411
0.52	0	505,411
0.53	1,613	507,024
0.54	19,827	526,851
0.55	0	526,851
0.56	25,840	552,690
0.57	42,613	595,303
0.58	27,263	622,566
0.59	7,830	630,396
0.60	5,894	636,291
0.61	20,887	657,177
0.62	7,924	665,101
0.63	19,467	684,569
0.64	16,336	700,905
0.65	436,718	1,137,623

There are a number of properties about Table 3 that need to be fully understood before the compilation process is addressed.

First, the above table contains both discrete and cumulative liability totals. In short, the discrete values are the sum of all observations that have a unique production ratio value as listed. For example, all units in the 2002 CRC Corn at the 65% coverage level with a production ratio of .57 have a combined liability of $42,613.

For the purpose of combining similar units into a single discrete value, the production ratio of .57 would include all observations with a calculated production ratio between .5650 and .574999.

Second, the cumulative totals are the summation of all production ratios less than or equal to the given production ratio. For example, the cumulative liability at production ratio .57 is $595,303 which is the summation of all units with production ratios from 0 to .574999.

Third, the Statplan database contains only production ratio values that were observed. For example, the production ratios of .51 and .52 would have the implied values as shown, but they do not in fact exist in the table.

Fourth, the values found in the discrete column may not add up to the cumulative column for all production ratios for CRC and RA due to rounding. This is only the case for CRC and RA where the original liability, in whole dollars, has been converted to a resulting APH liability in dollars and cents. No intermediate level rounding was done when calculating the cumulative totals.

RMA offers various coverage levels of insurance (to be discussed in a later component). Generally, these coverage levels range from 50% to 85% in 5% increments. In addition, several crops have multiple insurance plans from which one can extract the yield risk independent of the price risk. Combining the data into a common coverage level and a simulated APH product gives the analyst the maximum amount of insurance exposure possible.

The following is a subset of the 2002 Corn data from Bond County, Illinois. Insurance plans (APH, CRC, RA) have been combined into a common coverage level in the table.

TABLE 4

	Coverage Level							
	65 Percent				70 Percent			
Production Ratio	Discrete Indem	Discrete Liability	Cumulative Indem	Cumulative Liability	Discrete Indem	Discrete Liability	Cumulative Indem	Cumulative Liability
0.47	1529	5635	266580	527564	4380	13344	427618	813626
0.48	5199	19733	271779	547297	4977	15743	432595	829369
0.49	11534	47659	283313	594956	19443	65185	452038	894554
0.50	3583	15291	286896	610247	7433	25962	459471	920516
0.51			286896	610247	9894	36699	469365	957215
0.52			286896	610247	4984	19722	474349	976937
0.53	288	1613	287184	611860	4985	20273	479334	997210
0.54	3395	19827	290579	631687	6642	28578	485976	1025788
0.55			290579	631687	12514	57870	498490	1083658
0.56	3515	25840	294094	657527	8986	45661	507476	1129319
0.57	5304	42613	299398	700140	9939	53329	517415	1182648
0.58	2979	27941	302377	728081	17901	103413	535316	1286061
0.59	1815	19155	304192	747236	11219	69944	546535	1356005
0.60	600	8100	304792	755336	6146	41951	552681	1397956
0.61	1285	20887	306077	776223	10089	77318	562770	1475274
0.62	370	7924	306447	784147	4540	40076	567310	1515350
0.63	709	19467	307156	803614	630	6584	567940	1521934
0.64	330	16336	307486	819950	2465	30436	570405	1552370
0.65	0	802661	**307486**	**1622611**	481	6320	570886	1558690
0.66					188	3641	571074	1562331
0.67					1061	27527	572135	1589858
0.68					1144	37072	573279	1626930
0.69					875	46935	574154	1673865
0.70					49	3007937	**574203**	**4681802**

The above information will be utilized to further understand the basis of the rate worksheet, similar to Table A of this chapter.

Indemnity and **Liability**, the second and third columns on the rate worksheet, are simply the total of the maximum cumulative values for each coverage level. Using the above data and assuming that only coverage levels 65% and 70% were sold, then the total indemnity for 2002 would be recorded as **$307,486** + **$574,203** or **$881,689** and the total liability for 2002 would be recorded as **$1,622,611** + **$4,681,802** or **$6,304,413**. (The total is less than what is recorded for 2002 on the worksheet, which suggests that other coverage levels were also sold in addition to 65% and 70%).

LCR, the fourth column on the rate worksheet, represents the Loss Cost Ratio which is derived from dividing column 2 by column 3 or the total indemnity by the total liability. In this example, divide **$881,689** by **$6,304,413** for a LCR of .13985 or **.140**.

Avg. Cov. Level, the fifth column on the rate worksheet, is the average of all coverage levels weighted by the net acres insured. The information in this column serves two purposes; 1) to aid in the adjustment process for data prior to 1980, and 2) to provide information regarding the average insured in a county.

Adj. Liability, the seventh column on the rate workbook, represents total liability (column three) after the data has been adjusted to a common coverage level. That is, the total liability if re-stated at a single or common coverage level. The general formula used for calculating the adjusted liability is as follows:

$$\text{Adjusted Liability} = \sum_{a}\left(\text{Maximum Cumulative Liability} \times \left[\frac{\text{common coverage level}}{\text{observed coverage level}}\right]\right)$$

The summary sign represents instances where there are multiple coverage levels sold. For example if the data from Table 2, shown previously in this chapter, were used and RMA adjusted the data to a 65% common coverage level, then the following would be observed:

Adjusted Liability = (Max Cumulative Liability at 65% cov. lev. x .65 /.65) +
(Max Cumulative Liability at 70% cov. lev. x .65 /.70)

OR

Adjusted Liability = (**$1,622,611** x .65/.65) + (**$4,681,802** x .65/.70)

= $5,969,999

In short, the total liability of $6,304,413, when re-stated at the common coverage level of 65% equates to $5,969,999. The same process could be used to adjust the liability to another common coverage level. For example, adjusting to a 75% coverage level would produce an adjusted liability of $6,888,460 ($1,622,611 x 75/65 + $4,681,802 x 75/70).

Adj. Indemnity, the sixth column on the rate workbook, represents total indemnity (column two) after the data has been adjusted to a common coverage level, i.e., the total indemnity if re-stated to a single or common coverage level. Unlike the liability adjustments, the indemnity adjustment process is dependent on the crop year from which the data is retrieved.

Prior to 1980

For years prior to 1980, crop insurance was sold at a single coverage level by county/ type/practice. It was not uncommon to have multiple types or practices within a county where each type or practice had a different coverage level. In addition, the coverage levels were not standardized to 5% coverage level increments. For example, it would not be uncommon to find a county with one practice with a coverage level of 67% and another practice with a coverage level of 62%. For this reason a simple quadratic equation is used to estimate the losses that would have occurred at the chosen common coverage level. The quadratic equation was derived from the coverage level rate relatives for 50%, 65% and 75% that were used when crop insurance was made available at multiple coverage levels beginning in 1980. For corn and a number of other major commodities the quadratic equation for adjusting to a common coverage level of 65% is:

$$\mathbf{0.00141\ x^2 + (-0.1439)\ x + 4.38}$$

where **x** equals the average coverage level expressed as a percentage, such as 62% or 67%.

The above equation yields the relative adjustment needed to equate the indemnities to a common coverage level. Therefore, if the recorded indemnity is divided by the adjustment factor the result is the expected indemnity at 65% coverage level.

For example, the rate worksheet for Bond County, Illinois (Table A) indicates there were indemnities of $14,135.00 in 1976 and the average coverage level was 62.0%. Using the quadratic equation with an average coverage level of 62.0%, the following adjustment factor is determined:

$$= 0.00141\ (62)^2 + (-0.1439) * (62) + 4.38$$

$$= 5.42004 - 8.9218 + 4.38$$

$$= \mathbf{.87824} \quad \textit{therefore,}$$

Adjusted Indemnity = $14,135.00 / .87824 = $16,094.69

The increase in indemnities of $1,959.69 ($16,094.69-$14,135.00) is partially due to the difference in the liability, the adjusted liability and the LCR. In 1976 the LCR was rather significant at the 62% coverage level so one would expect that the losses would be more significant at a higher coverage level.

It is possible, in extreme cases, to over-estimate or under-estimate the indemnities using the quadratic equation, therefore two limits are also utilized in the calculation.

1) The minimum value for the adjusted indemnity is $0
2) The maximum value for the adjusted indemnity can not exceed the increase in the estimated change in liability.

For example, in 1976 the liability was $55,918 (column 3) and the adjusted liability is $58,623.71 ($55918 x 65/62) or an increase of $2,705.71. Thus, a maximum increase in adjusted indemnity is established at $2,705.71.

$1,959.69 < $2,705.71 ✓

Crop Years Since 1980

Beginning in 1980, RMA began offering crop insurance at three standard coverage levels of 50%, 65% and 75%. Coverage levels were further expanded in 1996 to include all 5% increments between 50% and 75% and further expanded, on a limited basis, to 80% and 85% in 1998.

Adjusting indemnities to a common coverage level involves: 1) adjusting higher coverage levels down to the common coverage level, and 2) adjusting lower coverage levels up to the common coverage level. This will be discussed further in the Rate Making Concepts Component.

Case 1 – Adjusting higher coverage levels down to the common coverage level

The production ratio is defined as the ratio of the actual value of production to the liability. Thus an indemnity is paid only when the production ratio is less than the coverage level. Therefore, when adjusting a higher coverage level to a common (lower) coverage level the only concern is with indemnities related to production ratios less than the common coverage level.

In Table 5, the data for the 70% coverage level was provided. By definition, indemnity payments would not be made if the production ratio exceeded the common coverage level (assume 65%).

Therefore, to make the adjustments, first identify the maximum production ratio that is less than or equal to the common coverage level. Once identified, obtain the cumulative indemnity and the cumulative liability.

Table 5

Coverage Level
70 Percent

	Production Ratio	Discrete Indem	Discrete Liability	Cumulative Indem	Cumulative Liability
	0.60	6146	41951	552681	1397956
	0.61	10089	77318	562770	1475274
	0.62	4540	40076	567310	1515350
	0.63	630	6584	567940	1521934
	0.64	2465	30436	570405	1552370
➔	**0.65**	481	6320	➔ **570886**	➔ **1558690**
	0.66	188	3641	571074	1562331
	0.67	1061	27527	572135	1589858
	0.68	1144	37072	573279	1626930
	0.69	875	46935	574154	1673865
	0.70	49	3007937	574203	4681802

Adjusting the 70% coverage level data found in the above table to the equivalent 65% coverage level requires the following steps;

Step 1: Cumulative Indemnity ($I_{@65}$) = \$570,886

Step 2: Cumulative Liability ($L_{@65}$) = \$1,558,690

Step 3: Cumulative Liability re-stated at 65% (L_{65}) = $L_{@65} \times {}^{65}/_{70}$

= \$1,447,355

Step 4: Reduction in Liability = $L_{@65} - L_{65}$ = \$1,558,690 - \$1,447,355

= \$111,335

Step 5: Adjusted Indemnity (I_{65}) = $I_{@65}$ – Reduction in Liability

= $570,886 - $111,335

= $459,551

A similar adjustment process would be used on all other coverage levels when adjusting the indemnities from a higher coverage level to a lower coverage level.

Case 2 – Adjusting the lower coverage levels up to the common coverage level

Under this scenario, the process used to estimate losses at a higher coverage level will be reviewed. The issue is more difficult given that no information on production ratios greater than the coverage level is readily available. This will be discussed further in the Rate Making Concepts Component.

The following example utilizing Statplan data from Table A: 2002 Corn crop in Bond County, Illinois will illustrate the adjustment process to a higher coverage level.

Table 6

Coverage Level
60 Percent

Production Ratio	Discrete Indem	Discrete Liability	Cumulative Indem	Cumulative Liability
0.04	2330	2516	2330	2516
0.25	5083	8812	7413	11328
0.37	1530	4069	8943	15397
0.47	854	3978	9797	19375
0.58	174	4293	9971	23668
0.60	0	17750	9971	41418

Based on the above information, a minimum and a maximum indemnification can be determined at all higher coverage levels. To obtain a minimum estimate, one assumes that no additional policy units will be indemnified as the coverage level increases. To obtain a maximum estimate, one assumes that all additional policy units will be indemnified as the coverage level increases. Realistically, neither estimate has a high probability of occurrence and therefore, neither is a good estimate of the expected losses at a higher coverage level, but they do serve as bounds to a loss cost estimator below.

Lower bound

Let $L_{<60}$ equal the liability of all policy units at the **maximum** production ratio **less than** the coverage level. In the example above, that line would be for production ratio .58 for the 60% coverage level. Since how much loss has already been paid out is known, the only adjustment is to those same policy units in order to account for greater losses due to higher coverage.

Min I_{65} = [$L_{<60}$ × $^{65}/_{60}$] – $L_{<60}$ + I_{60}

Min I_{65} = [$23,668 × $^{65}/_{60}$] - $23,668 + $9,971

Min I_{65} = $1,972.33 + $9,971

Min I_{65} = $11,943

Upper bound

Let L_{60} equal the liability of all policy units at the **maximum** production ratio **less than or equal** to the coverage level. In short, it is assumed that all policy units have production ratios less than the common coverage level. Since the amount of loss that has already been paid out is known, the only adjustment is to add all remaining policy units to the loss pool due to higher coverage.

Max I_{65} = [L_{60} × $^{65}/_{60}$] – L_{60} + I_{60}

Max I_{65} = [$41,418 × $^{65}/_{60}$] - $41,418 + $9,971

Max I_{65} = $3,451.50 + $9,971

Max I_{65} = $13,423

Adjusted Indemnity Estimate

Let L_{60} equal the liability of all policy units at the **maximum** production ratio **less than or equal** to the coverage level and Let $L_{<60}$ equal the liability of all policy units at the **maximum** production ratio **less than** the coverage level. The difference between these two observations will be the discrete liability where the production ratio is equal to the coverage level if one such observation exists. Additional losses can be estimated based on the loss cost ratio of the population.

$$I_{65} = MinI_{65} + [(L_{60} - L_{<60}) \times (65/60) - (L_{60} - L_{<60})] \times (I_{60} / L_{60})$$

I_{65} = $11,943 + [(($41,418 - $23,668)x(65/60)) – ($41,418 - $23,668)]x($9,971/$41,418)

I_{65} = $11,943 + [$1,479 x 0.24074]

I_{65} = $11,943 + $356

I_{65} = $12,299

Adjusted Indemnity = Min I_{65} < I_{65} < Max I_{65}

= $11,943 < $12,299 < $13,423

= $12,299

Adj. LCR, the eighth column on the rate worksheet, represents the Adjusted Loss Cost Ratio which is derived from dividing column 6 by column 7 or the total adjusted indemnity by the total adjusted liability. Using the policy and adjusted data in the calculations from above for 60%, 65%, and 70% coverage levels, the following is produced:

Table 7

	Policy Indemnity	Policy Liability	Adjusted Indemnity	Adjusted Liability
L_{60}	$9,971	$41,418	$13,423	$44,870
L_{65}	$307,486	$1,622,601	$307,486	$1,622,601
L_{70}	$574,203	$4,681,802	$459,551	$4,347,388
Total	$891,660	$6,345,821	$780,460	$6,014,858
LCR		0.141		0.130

This same routine is completed for each year, each coverage level and each insurance plan that is being evaluated on the worksheet for which data is available. For a specific crop, Statplan is loaded no more frequently than on an annual basis and is reconciled via automated reconciliation routines. AB Rate Specialists review the automated reconciliation output reports in comparison to the rate application data for reasonableness, appropriateness, and to ensure that values have been calculated properly.

The following data fields and field names are then written to the rates database into the adjusted county data table (adj_cnty_data);

crop code	crop_cd
experience year	exper_yr_id
insurance plan	ins_plan_id
coverage level percent	cov_lvl_pct
state code	state_cd
county code	county_cd
unadjusted indemnity amount	unadj_indm_amt
unadjusted liability amount	unadj_liab_amt
adjusted indemnity amount	adj_indm_amt
adjusted liability amount	adj_liab_amt
net acres	net_acres
units indemnified	units_indm

(2) RATE MAKING CONCEPTS COMPONENT

The purpose of the rate making concepts portion of this handbook is to identify structural components for the APH crop programs. Although rate making concepts do vary to some degree between various APH crop programs, most concepts are quite similar. The sources for much of the content for this section will be (1) annual rating; (2) crop production and utilization data; and (3)

subject matter experts knowledgeable about the industry.

The following section includes the RMA approved ratemaking concept/methodology/process. It is based on input from the actuarial firm of **MILLIMAN & ROBERTSON, INC.** (aka **MILLIMAN USA**) and the paper *Actuarial Documentation of Multiple Peril Crop Insurance Ratemaking Procedures*, which was presented in November 2000. The entire paper can be found at the following website: www.rma.usda.gov/-/media/RMA/Publications/MPCI_Ratemaking.pdf

RATEMAKING – ACTUARIAL CONCEPTS

The development of rates for property and casualty insurance companies has long been the province of Casualty Actuaries. There is a vast body of literature that has been developed on ratemaking topics; much of it is incorporated into publications of the Casualty Actuarial Society ("CAS"). In this report, two documents will be referred to when addressing actuarial ratemaking concepts. The first document is the *Statement of Principles Regarding Property and Casualty Insurance Ratemaking ("Statement of Principles")*. The purpose of this document (which was developed by the CAS Committee on Principles of Ratemaking and adopted by the CAS Board of Directors in 1988) is to "identify and describe principles applicable to the determination and review of property and casualty insurance rates". The second document is a textbook, developed by the CAS Textbook Steering Committee in 1989, titled *Foundations of Casualty Actuarial Science (Foundations)*. The text "is intended as an introduction to casualty actuarial concepts and practices". *Foundations* has one chapter dedicated to ratemaking. For many of the steps in the MPCI ratemaking process, these two documents will be referred to in order to identify the actuarial basis for the calculation.

It is important to understand that there is no single ratemaking approach that will apply to all insurance coverages. *Foundations* states that "...manual rates are estimates of average costs based upon a combination of statistical methods and professional judgment". For MPCI, as is the case for most insurance coverages, the ratemaking process has evolved over time as information and research have become available. For each of the steps in the process, there may be alternative approaches that could be used and which could produce reasonable results. It is not the intent to try to identify all possible alternatives to the current approach. However, in many cases alternatives are discussed that may be appropriate. RMA's rationale for choosing an alternative approach over the primary approach would be documented either within the automated system or via hardcopy documentation maintained in AB or in the regional office. Alternative or subjective rating is an accepted insurance practice.

A third reference, which provides additional background and discussion of MPCI ratemaking procedures, is the paper *"Ratemaking Procedures for Multiple Peril Crop Insurance"*, which was published in the Winter 2000 edition of the CAS Forum. (This paper can be downloaded from the CAS website, www.casact.org.)

DETERMINATION OF EXPOSURE, LOSS, AND PREMIUM

Before discussing the ratemaking process, two important values are introduced that are used in the MPCI rate development. These values are liability and indemnity.

Liability is a measure of the insurer's exposure to loss for a given producer or group of producers.

Liability represents the total insured value of the crop, calculated as:

Liability = Acres planted x Expected Yield (called APH Yield) x Selected Coverage Level x Base Price x Price Election Percentage.

Indemnity is the amount paid under MPCI coverage for a producer suffering a covered loss. Indemnity is paid when the value of production is less than the liability purchased.
In this case, the amount of indemnity paid is equal to the liability minus the value of the production where the latter is calculated as:

Value of Production = Acres Planted x Actual Yield x Base Price x Price Election Percentage.

The premium paid by a producer is derived as follows:

Premium = Liability x Rate x Adjustment Factor.

The ultimate objective of the ratemaking process is to derive the premium rate used in the above formula. Derivation is discussed further in the next section.

MPCI RATEMAKING OVERVIEW

The *Statement of Principles* identifies a fundamental principle of insurance ratemaking as: "A rate is an estimate of the expected value of future costs." Typically, the largest component of the rate is the provision for losses. While there are other, non-trivial considerations in rate development, most of the actuarial foundations of ratemaking are intended to provide a framework for estimating the expected loss component of the rate.

For MPCI rates, other expenses and capital costs are provided for in separate agreements. Therefore, the ratemaking procedure deals strictly with deriving the expected loss component. This component is represented by the Loss Cost Ratio (LCR), which is derived by dividing indemnity by liability. The LCR is a measure of loss per unit of exposure. Thus, one of the objectives of MPCI ratemaking is to derive LCRs that are representative of the expected losses for a given unit of exposure.

Because different crops are subject to different perils and, therefore, varying loss costs, the MPCI procedure establishes rates for each crop separately. It is rare that a single insured, for any insurance coverage, will be sufficiently large such that expected losses can be derived solely from the insured's own loss history. Thus, it is common and appropriate to consider the aggregate experience of a group of similar risks in developing rates. For MPCI the aggregation is done geographically. Rates are developed by geographic area, usually county. Thus, for each crop, the MPCI ratemaking process typically derives LCRs (and consequently rates) by county. There are other determinants used to tailor the rate to an individual producer, depending on utilization of certain farming practices. These will be discussed further in later components.

The MPCI ratemaking procedure can be broken into five steps:

1. Adjusting the Loss (Indemnity) and Exposure (Liability) to a common coverage level;
2. Derivation of County Unloaded Base Rates;
3. Base Rate Loading;
4. Capping Rate Changes; and
5. Updating the Type/Practice and Group factors.

COUNTY RATING – DISCUSSION

As noted above, MPCI rates are most commonly developed by county. County rating is an historical element of the MPCI ratemaking process; federal crop insurance evolved as a county based program. As will be discussed later in this report, county loss costs are often unstable with high levels of variability; consequently, the ratemaking process includes several steps intended to smooth some of the fluctuation. This instability and variability could suggest that an alternative geographical rating unit, larger than county, might be considered in such cases.

However, in addition to its historical basis there are other reasons for maintaining the county as the basic ratemaking unit. In the ***Foundations*** text, chapter 5 discusses risk classification and identifies several criteria for selecting rating variables. These include (pages 235-244) Actuarial Criteria, Operational Criteria, Social Criteria and Legal Criteria which support the use of county loss costs to satisfy actuarial criteria except in situations that are highly unstable and highly variable.

County rating addresses certain operational criteria that must be considered for the successful delivery of the crop insurance program. The ***Foundations*** text identifies operational criteria such as objectivity, ease of administration, and exclusive and exhaustive, all of which are met by the use of county. In addition, social criteria would also support county rating. In addition to being historically accepted, the county is a benchmark for many other agricultural activities. For example, farm programs are often administered by county and crop yields are generally reported by county (and used in MPCI rating for producers without an actual production history).

It should be noted that while the classification unit is the county information, as will be illustrated in later chapters, information from broader units may be used in deriving the county rates. It is the opinion of AB that there are other areas of the ratemaking process that may lend themselves to more fruitful research than alternatives to county rating.

ADJUSTING LOSS AND EXPOSURE TO A COMMON COVERAGE LEVEL

MPCI is offered at various coverage levels, generally ranging from 50% to 75%. In order to make the greatest use of the historical data; one of the first steps in the ratemaking process is to adjust the data to a common coverage level. With this adjustment, liability and indemnity data of producers with different coverage levels can be combined to develop the rates. For most crops, data is adjusted to the most commonly purchased coverage level of 65%.

For coverage levels other than 65%, indemnity and liability are adjusted to reflect the values that would have been reported had the coverage been purchased at the 65% level. (As will be discussed below, the rates for the other coverage levels are derived from the rates developed at the 65% level).

Adjusting the liability is fairly simple. For any specific coverage level, the aggregate liability at that coverage level is multiplied by the ratio of the common coverage level to that specific coverage level. For example, to adjust the liability from a 75% coverage level to a common coverage level of 65%, multiply all liability at the 75% coverage level by the ratio 0.65/0.75. Sub-Exhibit 1 indicates that this produces the correct value.

Two separate cases of adjusting indemnity need to be considered; adjusting the higher coverage levels down to the 65% coverage level (Case 1), or adjusting the lower coverage levels up to the 65% coverage level (Case 2). Indemnity amounts obtained at the 65% coverage level need no adjustment.

Case 1 – Adjusting indemnity from a higher coverage level down to the 65% coverage level

As described above, indemnity is paid when the value of production is less than the liability. RMA defines production ratio as the ratio of the actual value of production to the liability. Thus, indemnity is paid only when the production ratio is less than the coverage level. Due to adjusting to the 65% coverage level, there will be no indemnity at this coverage level when production ratios are greater than 65%. Therefore, for Case 1 only consideration for the indemnity related to production ratios less than 65% is needed.

For production ratios less than the common coverage level of 65%, every dollar decrease in coverage (liability) would have reduced the amount indemnified by one dollar. For example, suppose a producer had purchased a 75% coverage level that implied $100 of liability. If this producer's actual production was $60, the indemnification would be $40. If that producer had purchased a coverage level of 65%, the liability would have been $87 = $100 * (0.65/0.75) and the indemnification would be $27 = $87 - $60. In going from the 75% coverage level to the 65% coverage level, both the liability and indemnity went down by the same dollar amount, $13.

Sub-Exhibit 2 presents a hypothetical example which illustrates that, for all production ratios less than 65%, the adjusted indemnity (in going from 75% coverage to 65% coverage) is equal to the unadjusted indemnity minus the reduction in liability. For production ratios exceeding 65%, the adjusted indemnity will be $0. The RMA adjustment process is based on the above relationships.

Case 2 – Adjusting from a lower coverage level up to the common coverage level

Case 2 is more difficult since the indemnity is being increased to the amount that would have applied had a higher coverage level been chosen. Case 2 has two components. The first is for indemnity related to production ratios up to the lower (50%) coverage level. This adjustment is relatively straightforward, and analogous to the Case 1 example above. Specifically, for production ratios up to 50%, the adjusted indemnity is equal to the unadjusted indemnity plus the increase in liability. This is illustrated in Sub-Exhibit 3.

Sub-Exhibit 3 also displays the adjusted indemnity for production ratios above 50%. However, since no indemnification is made for these production ratios at the 50% coverage levels, RMA does not actually capture the production value information required to make this adjustment. In actual RMA data, the production value column of Sub-Exhibit 3 would be blank for production ratios above 50%. Therefore, these indemnity adjustments need to be approximated.

RMA's current approach to handling this problem is to develop minimum and maximum bounds to the adjusted indemnity and interpolating between the two. The minimum adjustment assumes that

there are no production ratios between 50% and 65%. The minimum is then derived by adding the liability adjustment calculated based only on the liability related to production ratios less than 50% to the unadjusted indemnity. It is known that at least this much indemnity at the higher common coverage level would have been obtained, the question is how much more would result from production ratios of 50% to 65% (for which no indemnification was paid and therefore no yield information collected). For these production ratios, the maximum adjustment would occur if all non-indemnified production ratios were at 50%. Thus, to derive the maximum adjustment it is necessary to calculate the total liability adjustment regardless of production ratio (since it is assumed that all production ratios between 50% and 65% are at 50%). This adjustment would then be added to the unadjusted indemnity to get the maximum adjusted indemnity.

In order to interpolate between the maximum and minimum indemnity, the indemnity is totaled over all production ratios less than or equal to the specific coverage level that is being adjusted from. The liability is totaled in the same way and the LCR is calculated. This ratio is applied to the liability that was not subject to a loss under the lower coverage level (i.e., liability related to production ratios greater than 50%) to determine the related additional indemnity at the higher coverage level. Adding this amount to the minimum indemnity approximates the adjusted liability. This approximation of the adjusted indemnity is then subject to the maximum bound as determined above. Sub-Exhibit 4 illustrates the indemnity adjustment using this approximation technique.

The concept of adjusting exposures and losses to a common coverage level is valid and appropriate. Without adjustment, combining the data for different coverage levels would produce rates non-representative of any single coverage level. Rates would reflect the past mixture of various coverage levels and would not be appropriate in the future if the distribution of coverage levels changes.

An alternative would be to treat each coverage level separately and develop rates for each. This may be appropriate if there are differences in loss experience for producers who select different coverage levels. For example, if producers who have better experience insure with lower coverage levels in order to save on premiums, and producers with poor experience insure to higher levels of coverage in order to protect against persistent losses, loss cost ratios may vary by coverage level. On the other hand, segregating the data by coverage level can result in less stability and predictability of expected losses due to the greater statistical variation. In addition, the consideration of differences in expected losses between coverage levels is considered in the coverage level relativities, which are discussed later.

There are two actuarial concepts involved here: homogeneity and credibility. Homogeneity refers to the degree to which data has been segregated into similar groupings. The *Statement of Principles* discusses homogeneity as follows: “Ratemaking accuracy often is improved by subdividing experience into groups exhibiting similar characteristics... subdividing or combining the data so as to minimize the distorting effects of operational or procedural changes should be fully explored”.

Credibility is defined as follows: “Credibility is a measure of the predictive value that the actuary attaches to a particular body of data. Credibility is increased by making groupings more homogeneous or by increasing the size of the group analyzed.”

The two criteria for increasing credibility often conflict. The data can be refined into increasingly homogeneous groups; as it is refined there is less data in each separate group, resulting in greater statistical variation and a lesser degree of confidence in the predictive value of the data.

Adjusting the data to a common coverage level allows RMA to utilize as large a base as possible while also maintaining the homogeneity of the data. It is the opinion of AB that the concept utilized by RMA is actuarially sound.

The Indemnity Coverage Level Adjustment was discussed in the Milliman & Robertson, Inc. report titled "Federal Crop Insurance Corporation Ratemaking Overview" dated June 14, 1996. In that report, possible alternatives to that adjustment approach were discussed. The current RMA approach differs from that used at the time of the earlier study. However, it still requires a fairly significant approximation in going from a lower to higher coverage level. Although it is believed this approximation to be reasonable given the current availability of data, additional analysis is recommended on a continual basis to determine feasible alternatives. As stated in the June 14, 1996 report, two possible approaches would be to convert all data to a 50% coverage level or to examine a distribution of yield data to evaluate an approximation approach. The "Federal Crop Insurance Corporation Ratemaking Overview" dated June 14, 1996 is available upon request to AB.

Sub-Exhibit 1

ADJUSTING LIABILITY TO COMMON COVERAGE LEVEL

1) Liability (L) = Acres x APH x Price x Coverage Level

2) Define : Value = Acres x APH x Price

3) Then : L = Value x Coverage Level

4) At 75% Coverage Level : L_{75} = Value x .75

5) At 65% Coverage Level : L_{65} = Value x .65

6) Therefore : L_{65} = Value x .75 x (.65/.75)

$$L_{65} = L_{75} \times (.65/.75)$$

ADJUSTING INDEMNITY FROM A HIGHER TO A LOWER COVERAGE LEVEL

Coverage Level	**75%**	**65%**	**Difference**
Liability*	$9,000	$7,800	$1,200

Yield per Acre	**Production Ratio**	**Production Value**	**Indemnity* Coverage Level**		
			75%	**65%**	**Difference**
0 0.	0%	$0	$9,000	$7,800	$1,200
15	12.5	1,500	7,500	6,300	1,200
30	25.0	3,000	6,000	4,800	1,200
45	37.5	4,500	4,500	3,300	1,200
60	50.0	6,000	3,000	1,800	1,200
75	62.5	7,500	1,500	300	1,200
78	65.0	7,800	1,200	-	1,200
85	70.8	8,500	500	-	-
90	75.0	9,000	-	-	-
105	87.5	10,500	-	-	-

* Acres = 100
APH = 120
Price = $1.00

ADJUSTING INDEMNITY FROM A HIGHER TO A LOWER COVERAGE LEVEL

Coverage Level	**50%**	**65%**	**Difference**
Liability*	$6,000	$7,800	$1,800

			Indemnity*		
Yield per Acre	**Production Ratio**	**Production Value**	**Coverage Level**		
			50%	**65%**	**Difference**
0	0.0%	$0	$6,000	$7,800	$1,800
15	12.5	1,500	4,500	6,300	1,800
30	25.0	3,000	3,000	4,800	1,800
45	37.5	4,500	1,500	3,300	1,800
50	41.7	5,000	1,000	2,800	1,800
55	45.8	5,500	500	2,300	1,800
60	50.0	6,000	-	1,800	1,800
65	54.2	6,500	-	1,300	1,300
70	58.3	7,000	-	800	800
75	62.5	7,500	-	300	300
78	65.0	7,800	-	-	-
85	70.8	8,500	-	-	-
90	75.0	9,000	-	-	-
105	87.5	10,500	-	-	-

* Acres = 100
APH = 120
Price = $1.00

ADJUSTING INDEMNITY FROM A HIGHER TO A LOWER COVERAGE LEVEL (APPROXIMATION TECHNIQUE)[1]

Adjusting Indemnity to Higher Coverage Level (50% to 65%)			
Production Ratios	**Liability**	**Indemnity**	**Adjusted Liability[2]**
<50%	$150,000	$30,000	$195,000
>=50%	400,000	0	520,000

1) The above values are created to illustrate the calculation. They are not true RMA data.
2) Liability x (.65/.50)

Adjusted Indemnity Calculation

The minimum adjusted indemnity is equal to the unadjusted indemnity plus the liability adjustment for production ratios less than 50%.

Minimum Adjusted Indemnity = $30,000 + ($195,000 - $150,000) = $75,000

The maximum adjusted indemnity is equal to the unadjusted indemnity plus the liability adjustment for all production ratios.

Maximum Adjusted Indemnity =
$30,000 + ($195,000 - $150,000) + ($520,000 - $400,000) = $195,000

The loss cost ratio used in the interpolation is based on the liability and indemnity for production ratios less than 50%.

Loss Cost Ratio = $30,000 / $150,000 = 20%

The interpolated adjusted indemnity is then the minimum indemnity plus 20% of the liability adjustment for production ratios greater than or equal to 50%.

Interpolated Adjusted Indemnity = $75,000 + .20 * ($520,000 – $400,000) = $99,000

If necessary, the interpolated adjusted indemnity would be subject to the maximum adjusted indemnity.

ANNUAL RATING CYCLE

Crop year 2005 marked the initial year for implementing the annual rating cycle study. Prior to 2005, generally all crops were reviewed annually. The rating cycle study titled: "Analysis of Rating Cycle for Multiple Peril Crop Insurance" completed by Milliman USA (A.K.A Milliman and Robertson, Inc.) introduced an objective selection process and provided a decision tree for determining which crop and state combinations should have county level rate reviews. After receiving the study, RMA began implementing the recommended rating cycle beginning with the 2005 crop year as authorized in the Rate Methodology Memorandum. NOTE: This report is documented and maintained by AB on-file for examination.

The study recommended that RMA establish a maximum number of years that a crop/state combination can go without a full review. Initially, they suggested a maximum of 5 years between reviews of crop/states with credible historic experience and a maximum of 3 years between reviews for crop/states with less than credible experience. Credibility for this purpose was determined to be 20 or more years of experience at the crop/state level. For 2005, an abbreviated version of the decision tree in the study was applied: All crop/states with 20 or more years of data with no rate review in the past 5 years and all crop/states with less than 20 years of data with no rate review in the past 3 years would have a full county rate review. Based on those criteria a list of crop/states was identified by AB for a full county rate review.

In addition, Regional Offices can recommend additional crop/county/state programs to be added to the list of crops recommended for a complete rate review. Regional Office recommendations will be in writing and will include supporting justification and documentation.

(3) REFERENCE YIELDS COMPONENT

A study completed by the actuarial firm of Milliman and Robertson, Inc. in 1983, brought about several significant changes to how rates were quoted. Implementation of these changes began with the introduction of the APH insurance plan in 1985. Corn, grain sorghum, peanuts and tobacco were the first crops to be converted followed by wheat, oats, and barley in 1986. There are two critical components of the APH plan of insurance; 1) the growers guarantee was based on their actual production history (APH), 2) the growers premium rate was based on their actual production history (APH yield) relative to other growers in the same geographic area.

The distribution of rates under the APH program is based on the assumption that each grower's APH can be rated relative to their peers or a homogenous group of growers. The formula for comparison was:

$$\frac{y_i}{\bar{y}}$$

Where $\mathbf{y_i}$ represents the growers yield and **y bar** represents the homogenous group or the center point of the range.

The NASS crop reporting district was chosen to be the basis of y bar, or reference yield, as the measuring stick from which all growers in the defined group would be evaluated. It was felt that the crop reporting district represented a broader group of growers and the NASS history for the prior ten years was summarized by crop reporting district and a simple average planted yield was calculated across the ten years. In areas where types and practices were considerably different, a relational factor was applied to the data to determine reference yield values by type and practice.

The reference yields remained at the levels determined when converted to APH until 1990 or 1991, depending on the crop, when the reference yields were updated using the most current ten years of NASS data. Rates were also adjusted to remove the affects of a yield adjustment on rates (a rate neutral adjustment).

The reference yield remained unchanged for most areas until 2001, when the APH plans were converted to the continuous rating system. At that time reference yields were established by calculating the center point of the high and low yields of the center r-span. It should be noted that this calculated reference yield should be similar to the calculated district yield determined in the early 1990's but may not be exact.

The 2005 rate methodology memo outlined efforts to update the reference yields. These efforts were prompted by yield trends that suggested the reference yields were too low. In addition, if counties within a NASS crop reporting district were not considered to be homogeneous, the district yield could be a poor representative of the county reference yield.

Target reference yields are established as needed as outlined in the rate methodology memorandum or subsequent informational memorandum. For crops whose target rates are being reviewed, beginning in 2008 and subsequent years, the reference yields are updated by establishing target reference yields using the following steps:

1. The transitional yield (t-yield) is multiplied by two factors to create limits of movement.

2. If the reference yield was within the boundaries calculated in step 1, no change was made to the reference yield.

3. If the reference yield was outside the boundaries calculated in step 1, the reference yield was updated to equal the t-yield boundary.

In short, all target reference yields, for crops with a target rate review, are updated to be within a lower and upper boundary of the t-yield.

(4) COVERAGE LEVEL RATE RELATIVITIES COMPONENT

Prior to 1980, only one coverage level was available to insureds. The coverage level did vary over time and by region, crop, and even types and practices; however, the insured had no choice of multiple coverage levels.

The Federal Crop Insurance Corporation (FCIC) Act of 1980 created a significant change in this system by specifying that three levels of coverage may be elected by the insured based on appraised or recorded yields. The coverage levels of level 1 - 50%, level 2 – 65% and level 3 – 75% were standardized across all crops and regions. Initially, FCIC had no empirical data with which to evaluate the loss costs between coverage levels. Therefore, the pricing for level 3, in particular, was based on a theoretical model that was largely untested and whose results were tempered significantly due to marketing considerations. As a result, the rate "spread" between the three coverage levels was substantially increased by FCIC for crop year 1983.

In the Fall of 1983, the actuarial firm of Milliman and Robertson, Inc. was contracted with to review the coverage level experience of 1981 and 1982 and make recommendations. A number of changes were made to the rate models as a result on these studies beginning in crop year 1985.

Among the many changes was the creation of constant coverage level relativities across most APH crops. These coverage level relativities were:

Coverage Level	Rate Relativity
75%	1.00
65%	.65
50%	.47

Milliman and Robertson, Inc. was retained by the Economic Research Service to evaluate the coverage level relativities for the Federal Crop Insurance Corporation in 1995. The scope of the initial study was to produce one set of relativities for the major crops. Later studies attempted to recognize differences between regions, crop types, and cropping practices.

The 1996 Federal Agricultural Improvement and Reform Act (FAIR) brought about sweeping changes to U.S. agricultural policy. Among those changes was the addition of three new coverage levels in 5% increments, resulting in six coverage levels: 50%, 55%, 60%, 65%, 70% and 75%.

The quadratic equation based on the best fit of the previously-existing three coverage levels was determined as shown below:

$$2.86 - [C \times 0.0938] + [C^2 \times 0.00092]$$ Where C equals the coverage level.

From this equation the rate relativities were derived for the three new coverage levels (55%, 60% and 70%) as follows:

Coverage Level	Rate Relativity
75%	1.00
70%	.79
65%	.65
60%	.57
55%	.51
50%	.47

In 1998, for selected areas and crops, coverage levels 80% and 85% were offered. Coverage level relativities for these new levels of insurance were primarily based on an extension of the quadratic equation.

Coverage Level	Rate Relativity
85%	1.60
80%	1.22
75%	1.00
70%	.79
65%	.65
60%	.57
55%	.51
50%	.47

Two revenue plans of insurance were introduced in 1996 and 1997; one based on the fixed rate relativities from the APH product, and one based on a simulated probability model. The exposure and overlap was limited to selected crops but the difference in rates quoted at different coverage levels was quite apparent. RMA sub-contracted with Coble, Goodwin, Ker, and Knight in 2002, to review the rate relativities for three major crops (Corn, Soybeans, and Wheat) which were common to both insurance plans. The empirical data suggested that the rate relativities should be different than the current relativities for each of the three crops. RMA began incorporating the new relativities into the CRC plan of insurance beginning with the Spring 2003 crop year.

New rate relativities were also incorporated into the APH plan of insurance beginning with crop year 2004. It should be noted that some rate relativity changes were not fully implemented into the APH plan in a single year because they resulted in rates that exceeded the mandated 20% rate increase (discussed further in a later component). In such cases, multiple years are used to incorporate the rate relativities. NOTE: The report is on-file with AB.

In addition, the study determined that behavior characteristics of insureds exist that are influential in determining the coverage level purchased. RMA incorporated an endogenous risk factor into the rate process to overcome this temperament. The endogenous risk component in the premium rate reflects the changes in producer behavior from changes in their coverage level.

A contract was let to review the rate relativities of the remaining revenue crops in 2004. This group of six crops (barley, canola, cotton, grain sorghum, rice, and sunflowers) included the remaining crops that were covered by at least one of the revenue plans of insurance. The results of the study were very similar to the results found in the previous study. NOTE: The entire report is on-file and available by request to AB.

Target coverage level rate differentials (including endogenous risk factors) were updated for the APH and CRC plans of insurance for 2004 corn, soybeans, and wheat, consistent with the first contract and the Expert Reviews for this report conducted for the FCIC Board of Directors. The 2004 actuarial document reflected movement toward the target coverage level rate differentials. The 2005 and subsequent years' actuarial documents reflect additional movement toward the target coverage level rate differentials if not completely captured in 2004 and subsequent years.

For 2005, target coverage level rate differentials (including endogenous risk factors) were updated for the APH and CRC plans of insurance for barley, canola, cotton, grain sorghum, rice, and sunflowers consistent with the second contract (Coble, Goodwin, Ker, and Knight, *Implied Rate Relativities).* The 2006 and subsequent crop years' actuarial documents for these crops will reflect movement toward the target coverage level rate differentials. RMA contracted for the review of coverage level rate differentials for all remaining continuously rated crops. The final recommendations were recently completed and differentials were recommended for all remaining continuously rated crops. AB expects to incorporate these recommendations beginning with the 2009 crop year. Because the change to the coverage level rate differentials may move premium rates up or down, they will be updated in conjunction with a full review of base rates and reference yields. Annual movement toward target levels is documented within rate application runs that are date-stamped and serve as a record of application runs through automated assignment of run identification numbers. When rates are reviewed/updated, the rate application assigns a run identification number denoting the date and time it was run. Capping of the target values for final publication is covered in both the Critical Control Points and the upcoming Mandated Capping sections of this handbook.

(5) TARGET RATE DEVELOPMENT COMPONENT

Objective: to develop actuarially sound County Target Rates based on historic experience.

As previously noted, the Statplan insurance experience was gathered and adjusted to a common coverage level for each year of exposure for each crop / state / county report entity. In this component, target rates will be developed and the actuarial concepts and theory behind the process of ratemaking will be discussed.

The following data table developed from Statplan and produced from a typical county program will be used as the summary data adjusted to a common coverage level (in this example 65%).

Table 8
WHEAT (0011), KANSAS (20), Allen (001)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Crop Year	**Net Acres**	**Indemnity**	**Liability**	**LCR**	**Average Coverage Level**	**Adjusted Indemnity**	**Adjusted Liability**	**Adjusted LCR**	**Capped Adjusted Indemnity**	**LCR After 80th Pct**	**CAT Indemnity**
1975	1,323.0	$77	$40,995	0.002	0.6	$94	$44,411	0.002	$94	0.002	$0
1976	1,475.0	$3,002	$50,575	0.059	0.6	$3,652	$54,790	0.067	$3,652	0.067	$0
1977	981.0	$4,516	$34,060	0.133	0.6	$5,494	$36,898	0.149	$5,494	0.149	$0
1978	130.0	$0	$5,148	0.000	0.6	$0	$5,577	0.000	$0	0.000	$0
1979	839.0	$0	$33,111	0.000	0.6	$0	$35,870	0.000	$0	0.000	$0
1980	634.8	$0	$30,178	0.000	0.654	$0	$29,948	0.000	$0	0.000	$0
1981	2,605.1	$15,828	$163,318	0.097	0.706	$11,693	$148,861	0.079	$11,693	0.079	$0
1982	6,949.7	$124,426	$556,393	0.224	0.714	$101,360	$504,210	0.201	$100,699	0.200	$669
1983	5,039.8	$26,371	$391,155	0.067	0.717	$20,415	$353,563	0.058	$20,415	0.058	$0
1984	2,953.6	$12,043	$232,965	0.052	0.699	$8,601	$216,417	0.040	$8,601	0.040	$0
1985	3,603.4	$71,931	$246,108	0.292	0.669	$66,934	$239,126	0.280	$47,758	0.200	$19,181
1986	1,249.1	$46,553	$78,287	0.595	0.686	$42,563	$74,297	0.573	$14,838	0.200	$27,726
1987	4,521.2	$76,203	$260,520	0.293	0.65	$75,759	$260,076	0.291	$51,942	0.200	$23,822
1988	7,431.6	$26,377	$405,715	0.065	0.655	$25,580	$402,832	0.064	$25,580	0.064	$0
1989	9,419.0	$7,645	$585,152	0.013	0.656	$7,645	$581,233	0.013	$7,645	0.013	$0
1990	11,285.6	$54,647	$830,520	0.066	0.653	$51,942	$826,597	0.063	$51,942	0.063	$0
1991	8,550.6	$19,353	$538,090	0.036	0.655	$17,942	$534,655	0.034	$17,942	0.034	$0
1992	7,697.5	$3,591	$483,767	0.007	0.654	$3,487	$481,409	0.007	$3,487	0.007	$0
1993	6,785.0	$144,081	$446,303	0.323	0.652	$142,997	$445,135	0.321	$88,901	0.200	$54,104
1994	9,327.6	$5,561	$577,999	0.010	0.639	$5,638	$584,322	0.010	$5,638	0.010	$0
1995	7,812.7	$117,191	$431,491	0.272	0.648	$118,263	$432,273	0.274	$86,332	0.200	$31,938
1996	10,192.7	$143,628	$730,932	0.196	0.647	$145,750	$732,989	0.199	$145,750	0.199	$0
1997	8,674.3	$38,911	$529,712	0.073	0.649	$38,911	$530,427	0.073	$38,911	0.073	$0
1998	7,024.9	$24,730	$527,928	0.047	0.648	$24,661	$528,801	0.047	$24,661	0.047	$0
1999	5,509.0	$67,209	$386,478	0.174	0.661	$64,076	$379,485	0.169	$64,076	0.169	$0
2000	11,886.1	$1,670	$783,987	0.002	0.657	$1,670	$774,296	0.002	$1,670	0.002	$0
2001	13,870.2	$44,284	$864,049	0.051	0.668	$44,049	$839,345	0.052	$44,049	0.052	$0
2002	15,958.5	$38,665	$1,180,738	0.033	0.664	$36,064	$1,152,809	0.031	$36,064	0.031	$0
Summary	173,730.0	$1,118,493	$11,425,674	0.114	0.654	$1,065,240	$11,230,652	0.111	$907,834	0.084	$157,439

I. Capped Loss Costs

Catastrophic loading is an actuarial technique used to account for the fact that insurance rates are generally derived from a limited sample of past experience that is subject to sampling error. For example, a one-in-100 year event may be included in the history and be weighted, in a short time series, with much greater weight than appropriate. Unfortunately, rarely does RMA have knowledge of the true underlying probability distribution from which the data are drawn. Catastrophic loading is then an applied technique used to deal with this lack of knowledge. It does not add information or overcome the sampling problem; rather, it is a decision rule to help mitigate the problem. Thus catastrophic loading is intended to remove anomalies from the data but not redistribute "normal" loss experience and create unintended subsidies.

Capped loss costs are reviewed by AB Rate Specialists for reasonableness, appropriateness, and to ensure that calculated values accurately reflect programmed calculation specifications and any issues/concerns are raised to the RT Leader and AB Chief.

The adverse affect of a single year, or several years, is not uncommon for property coverage, in particular one in which weather can affect loss experience. The *Statement of Principles* states, "Consideration should be given to the impact of catastrophes on the experience and procedures should be developed to include an allowance for the catastrophe exposure in the rate". This step removes those losses that are identified as excess from the county experience and builds back into the rates the excess losses by spreading them over a broader base.

The catastrophic procedure used by RMA involves truncation of the loss experience at a point and treating any losses above that point as outliers, not representative of the county, with the intended result of reducing the impact that a single year will have on the average loss cost of each county. The losses above the truncation point will then be distributed across all counties in the state.

Currently, the RMA procedure truncates the county loss experience at the 80^{th} percentile. This is done non-parametrically; that is, no distributional assumptions are made and the percentiles are found by ranking the observed loss costs. For example, if 20 years of data are available, then the 80^{th} percentile of the loss cost is the 16^{th} highest observed loss cost ratio. When the percentile does not fall on a discrete observation, such as is the case in Allen County, Kansas where there are 28 observed loss costs, the 80^{th} percentile falls at 22.4 and linear interpolation between the 22^{nd} and the 23^{rd} observations is used.

All observations above the truncation point or calculated truncation point are established at that point. The indemnity associated with loss cost ratios below the truncation point remain in the county pool and the indemnities associated with loss cost ratios above the truncation are placed in a catastrophic pool.

While the long-term average (shown in the ninth column in the table above) is 0.111, the average is adversely affected by a few years with much higher than average LCRs, such as 1986 (.573) and 1993 (.321). Under this procedure, the adjusted average LCR for any single year is capped at the 80_{th} percentile LCR of all years.

In Table 8, the Capped LCR (Column 11) is calculated by linear interpolation to the 80th percentile point of the Adjusted LCRs (column 9). In this case with 28 years of data, the 22nd and 23rd highest Adjusted LCRs are interpolated. The 22nd Adjusted LCR, if ranked in order, is crop year 1996 when the loss cost ratio was .1988 and the 23rd Adjusted LCR is crop year 1982 when the loss cost ratio was .2010. The interpolated value (80th percentile) or truncation point is 0.1997 (0.200). For each year, the Capped LCR is the minimum of the Adjusted LCR and the truncation point of .1997.

Column 12, identified as Cat Indemnity, is the amount of indemnity that is excluded from the counties capped LCR. That is the excess indemnity over and above the capped LCR as determined above. The cat indemnity is calculated using the following formula:

$$Cat\ Indemnity = \left[\frac{Adjusted\ Indemnity}{Adjusted\ Liability} - Capped\ LCR \right] \times Adjusted\ Liability$$

For Example, Crop Year 1995 Cat Indemnity = [($118,263 / $432,273)–0.1997] x $432,273.00 = $31,938.

The total indemnity identified as Cat Indemnity for Allen County is $157,439, which can be found on the summary line and will be used later in the ratemaking process.

II. *Net Acres Insured*

The number of acres insured will aid in the determination of credibility in the ratemaking process. The worksheet for Wheat in Allen County, Kansas will again be used to help illustrate how the number of acres are captured and determined for further use in the ratemaking process.

The net acres insured (column 2 in Table 8) represents the count of acres insured by year. These counts are tabulated and stored in StatPlan within the production ratio tables and are then summarized for inclusion on the worksheet. The number of insured net acres is used in the decision tree for establishing credibility and with the credibility weight calculation for a given county.

III. *County Unloaded Rate Determination*

Background:

The target rate calculation is represented by the following equation:

$$\text{target} = \left(\frac{\left(\frac{\text{unlrate} + \text{cntycat}}{0.88} \right)}{0.9} \right) \text{tpfactor} + \frac{\text{pp} + \text{replant} + \text{qa} + \text{statecat}}{0.9}$$

Historically, the unloaded rate (unlrate) = (county LCR x 0.6) + (circle LCR x 0.4). Historically, the circle LCR comprised the data from the target county's concentric circle, which didn't include the target county itself. RMA contracted with Milliman USA to review RMA's credibility procedures and recommend any refinements to the rating process.

Based on the recommendations from Milliman USA in the report "*An Independent Actuarial*

Review of Credibility Theory in Rate Determination, April 2002", beginning in crop year 2006, RMA shifted away from the historical weighting procedure, which establishes credibility based on units indemnified. The new procedure for weighting the experience in determining credibility weights for the target county and circle is a function of the acres underlying the target county's data and the circle's data. From this point forward, RMA will now refer to the circle as the county group or credibility complement. The only calculation in the equation above that will be changing due to this shift in credibility theory will be the calculation of the unloaded rate. The following is a summation of the procedural modifications:

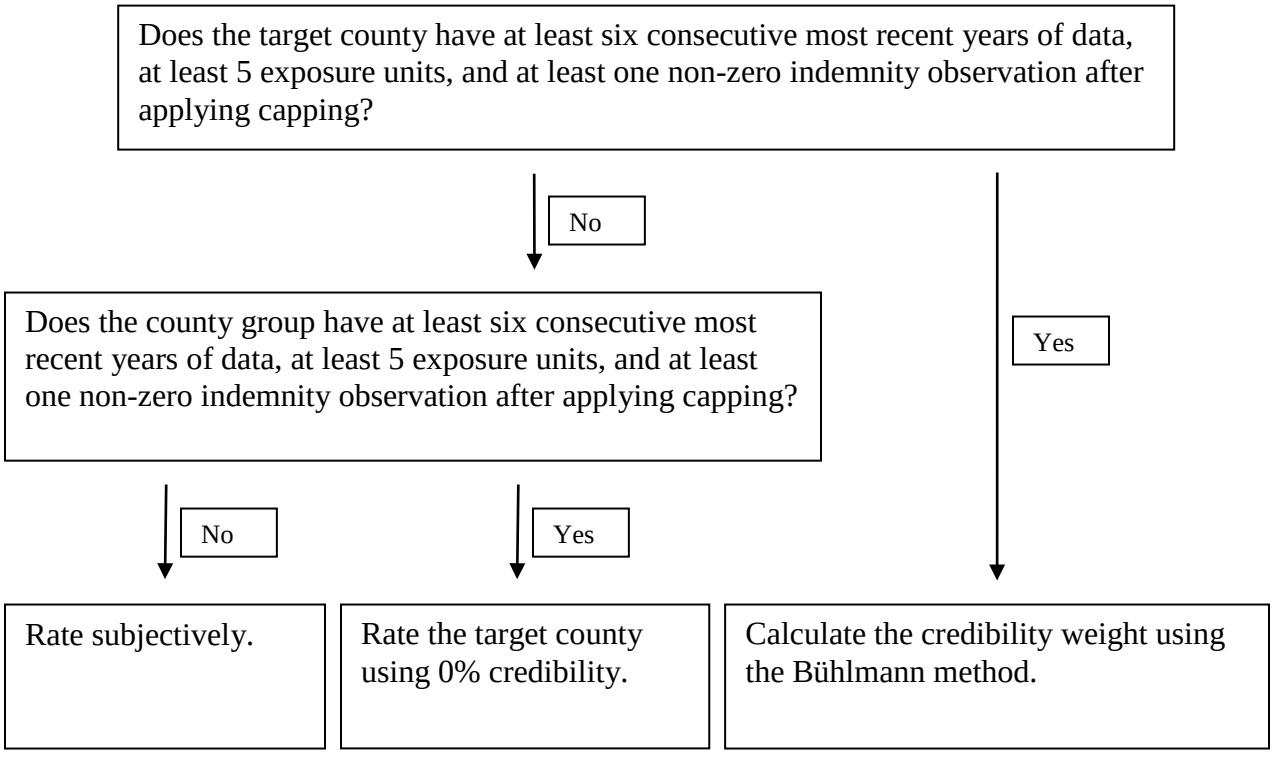
1. The credibility weight to be assigned an individual county be based on the formula *P/(P+K)*, where P is a measure of exposure and K is a measure of the historical variability of county losses;

2. The credibility complement (county group) be defined as the overall loss cost ratio of the combined experience of the target county and surrounding counties.

Procedure:

The following will outline step-by-step the procedure used to calculate the unloaded rate for a target county under the continuous rating model:

1) Work through a decision tree for determining if the county is to be rated empirically or subjectively. The decision tree is as follows:



2) The following outlines the procedure for calculating the target rate using the Bühlmann weight:

$$R = Z\overline{X} + (1 - Z)\mu$$

$$Z = \frac{P}{P + K}$$

where:

R = County Unloaded Target Rate

Z = Bühlmann credibility factor, ranging from 0 to 1

$\overline{X}$ = The sample mean of an individual county to which credibility is applied (average of the adjusted capped LCRs for all available years of data for the county)

μ = The underlying mean (average of the adjusted capped LCRs for all available years of data for the entire *county group*)

P = Exposure units (Total number of net acres for a given crop in the target county summed over all available crop years divided by the appropriate α)

K = v/a

v = Sample variance of the adjusted capped LCRs for all available years of data for the target county

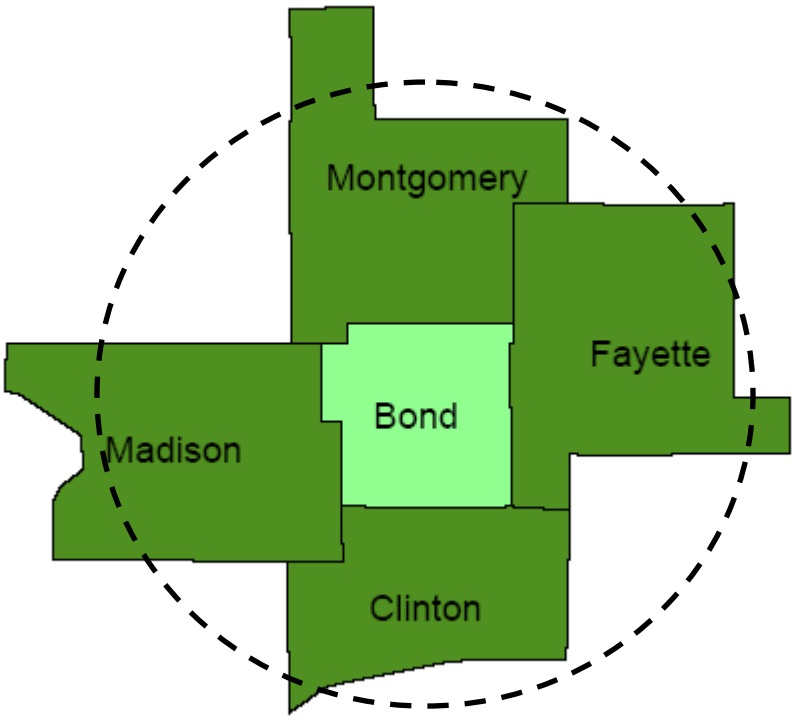
a = Sample variance of the $\overline{X}s$ from the county group

Credibility is one of the most complex actuarial concepts. It is sufficiently important to command a full chapter in the <u>*Foundations*</u> text. The Casualty Actuarial Society's *Statement of Principles Regarding Property and Casualty Insurance Ratemaking* defines "credibility" in an actuarial context as:

> *"Credibility is the measure of the predictive value that the actuary attaches to a particular body of data. Credibility is increased by making groupings more homogenous or by increasing the size of the group analyzed. A group should be large enough to be statistically reliable. Obtaining homogenous groupings requires refinement and partitioning of the data. There is a point at which partitioning divides data into groups too small to provide credible patterns. Each situation requires balancing homogeneity and the volume of data."*

The groupings applied by the RMA ratemaking process are county-level. The volume of data is currently measured by the number of acres insured. This Bayesian credibility approach develops a credibility weight as a function of the exposure underlying a county's experience and the variance of the historical data using the ratio P / (P+K), where P is the exposure measure, and K is the ratio of the process variance to the variance of the hypothetical means. This new procedure allows for a more accurate predictor of future experience as well as allowing counties with a greater amount of experience, but relatively few losses, a rate that more accurately reflects their experience.

The unloaded rate calculation uses a "concentric circle" smoothing process applied to the county unloaded target rates to smooth rates across neighboring counties. In this process neighboring counties are defined as any county that shares a common border. A look-up file is used to define each county's neighbors. For example, for Bond County, Illinois the file would include FIPS (Federal Information Processing Standards) codes for Clinton, Fayette, Madison and Montgomery counties, IL. There are a few exceptions to the bordering county rule. These exceptions generally occur when two counties or more are divided by a large body of water, such as Lake Michigan, or the counties include a mountain range, such as the Sierra Nevada Mountains. Some judgment goes into determining if a county should be excluded from the pool of surrounding counties. This judgment should be largely driven by agricultural similarities or dissimilarities between counties. Recommendations for exceptions are prepared by AB Rate Specialists. The AB Rate Specialists and RT Leader apprise the AB Chief of the rationale and their recommendation(s). Provided that no concerns or issues are raised by these individuals, the RT Leader approves the exception and authorizes implementation.



The Simple Group LCR is a weighted average of surrounding counties' Simple Group LCRs (weighted by each county's Total Adjusted Liability), which includes the target county itself. In other words, it is the sum of the product of Total Adjusted Liability and Simple County LCR divided by the sum of Total Adjusted Liability.

First the Adjusted Liability and the Adjusted Indemnity minus the Cat Indemnity is established for each of the surrounding counties by year. The surrounding county data along with the target county is then summarized by year, which results in a group county Adjusted Liability and Adjusted Indemnity minus Cat Indemnity totals. These totals are then used to calculate a yearly loss cost ratio (LCR) for the group counties. The last step is to determine a simple LCR by summing all the yearly LCRs and dividing by the number of years with observations. The automated system assigns a run identification number denoting the date and time it was run that can be utilized for future review and reference.

Table 9

Historical Information for County Group - Wheat

Crop	Crop Year	Net Acres	Units Indemnified	Capped Adjusted Indemnity	Adjusted Liability	Capped Adjusted LCR
0011	1975	10006.0	51	27,392	391,753	0.06992161
0011	1976	13654.0	69	41,244	552,075	0.07470724
0011	1977	11513.0	72	50,636	476,670	0.10622863
0011	1978	2091.0	19	5,409	90,082	0.06004529
0011	1979	9183.0	14	6,409	427,993	0.01497454
0011	1980	10323.3	16	6,028	549,325	0.01097347
0011	1981	33601.3	158	139,806	1,948,080	0.07176605
0011	1982	63037.9	629	698,143	4,678,061	0.14923769
0011	1983	41291.6	173	107,424	2,926,619	0.03670584
0011	1984	32024.1	185	123,160	2,337,183	0.05269592
0011	1985	32093.9	373	321,827	2,075,130	0.15508763
0011	1986	17629.5	116	161,598	1,047,131	0.15432453
0011	1987	16346.1	117	137,549	824,616	0.16680370
0011	1988	40928.9	81	56,679	1,963,970	0.02885940
0011	1989	56436.4	78	57,297	3,106,543	0.01844397
0011	1990	62548.7	441	283,584	4,137,445	0.06854085
0011	1991	50013.4	187	105,916	2,821,689	0.03753638
0011	1992	42075.6	48	46,130	2,360,327	0.01954390
0011	1993	37460.1	380	289,910	2,195,774	0.13203089
0011	1994	57118.9	175	197,701	3,277,813	0.06031491
0011	1995	47403.6	452	351,487	2,505,000	0.14031417
0011	1996	65108.4	344	462,276	4,382,367	0.10548546
0011	1997	45346.7	126	82,764	3,107,632	0.02663250
0011	1998	40581.6	76	76,808	3,008,414	0.02553106
0011	1999	32278.8	198	333,607	2,332,382	0.14303275
0011	2000	71577.9	25	28,713	4,776,765	0.00601097
0011	2001	84552.0	51	72,670	5,212,208	0.01394227
0011	2002	99398.3	198	240,365	7,339,575	0.03274917
	Summary	1125624.0	4,852	4,512,532	70,852,622	0.0708
					(Within) Variance*:	0.0028

Notes:
1. (*) Sample variance of "Capped LCR" for all available crop years.

In this example, the Group County made up of the seven counties that surround Allen County, Kansas has a simple LCR of 0.0708 for wheat. This information can now be added to the worksheet summary table in the row called Cnty Group LCR (includes target).

The final step needed to determine the county unloaded rate is calculating the Z value to apply to the county's insurance experience. This process determines how much weight should be assigned to the target county's experience and the county group's experience. The following is an example from Allen County, Kansas for wheat.

Table 10

Credibility Weighted Calculation for Capped Loss Cost Ratio - Wheat

State	County	ID	Average Capped LCR	Net Acres	Alpha	P (Net Acres/Alpha)
Kansas	**Allen**	**Target County**	**0.0841**	173730	10000	17.373
Kansas	Anderson	Surr County 1	0.0575			
Kansas	Bourbon	Surr County 2	0.0648			
Kansas	Coffey	Surr County 3	0.0629			
Kansas	Linn	Surr County 4	0.0631			
Kansas	Neosho	Surr County 5	0.0786			
Kansas	Wilson	Surr County 6	0.0685			
Kansas	Woodson	Surr County 7	0.0741			
			Cnty Group Exposure Units:			112.5624

Cnty Group LCR (includes target):	0.0708	*
Variance of Capped LCR (target county only):	0.0062	
Variance of County Group (includes target):	0.0001	**

K = Var[Target County]/Var[County Group] =	62	
Z = P/(P+K) =	0.2189	
Capped LCR: 0.2189 x 0.084 + [1 - 0.2189] x 0.071 =	**0.074**	**= Unloaded Rate**

Notes:

1. (*) Calculated by taking the sum of all county's experience each year, calculating a LCR for the group for each year, then averaging the LCRs acr
2. (**) Sample variance of "Average Capped LCR" from Column (4) including the target county.
3. "LCR" is loss cost ratio.

This represents the Unloaded Rate for the county target rate and is entered in the county summary worksheet. Unloaded Rates are reviewed by AB Rate Specialists for reasonableness, appropriateness, and to ensure that calculated values accurately reflect programmed calculation specifications and any issues/concerns are raised to the Rate Team Leader (Rates TL) and AB Chief.

The credibility procedure addresses the concern of representativeness of events in a county's loss history and the variability of county rates over time and space. Incorporating loss history from neighboring counties into the target county's rate determination increases the possibility that all possible events are a part of the county pool of events. One should also recognize that events in nearby counties are often correlated to events of the target county.

The credibility procedure in effect results in losses being redistributed from higher historical loss areas to lower historical loss years. Such reallocations are valid to the degree that: 1) events that occurred in surrounding counties are similar to events that could have occurred in the target county; 2) such events are under-represented or over-represented in the target county's loss history.

IV. *State Catastrophic Load.*

In Section I of this chapter, the amount of county indemnity that was capped was identified, but nothing further was explained on how the capped indemnity would be utilized in the rate making process. The State Cat Load or State Excess Load adds a provision for the Excess Indemnity excluded from the loss cost in the unloaded rate calculation. The following table is a part of the summary of the state excess calculation for Kansas wheat.

Table 11

Crop	State	County	Adjusted Liability	Cat Indemnity
		Allen	$11,230,652	$157,439
		Anderson	$10,830,185	$238,407
		Atchison	$4,184,325	$139,254
		Barber	$75,958,064	$2,203,898
		Barton	$133,922,920	$6,194,010
		…	…	…
WHEAT	KANSAS	ALL COUNTIES	**$6,669,467,278**	**$247,858,656**

Adjusted liability and Cat indemnity amounts are totaled by state by summing across all counties (e.g., the adjusted liability for KS includes $11,230,652 from Allen county; the CAT indemnity includes $157,439 from Allen County). For Kansas wheat, the following State Cat Load was calculated:

$$State\ Cat\ Load = \frac{\sum Cat\ Indemnities\ \ from\ all\ counties}{\sum Liability\ \ from\ all\ counties} \qquad \textit{or}$$

State Cat Load = $247,858,656 / $6,669,467,278 = **0.037163**

The State Cat Load is limited to a maximum of .0325 and a minimum of .0065. As a result, the state cat load will be capped at **.0325** for Allen County, Kansas wheat, with the remaining distributed to the County Cat Load. The maximum of .0325 was subjectively determined by FCIC senior management. Initially, the maximum was set at .05 based on the 75% coverage level. More recently, it was modified to .0325 based on the 65% coverage level (i.e. .05 x .65 = .0325). Beginning with the 11/30/2007 and subsequent filings, the cup amount changed from 0.010 to 0.0065 in order to keep the cup on a consistent basis with rates re-stated to the 65% coverage level.

The Excess Indemnity for each county is essentially pooled for the entire state and then spread back evenly to each county. As noted earlier, the actuarial justification for the capping process is that extreme LCRs are generally due to catastrophic events and as such are infrequent, lack statistical credibility, and may not be reflective of the county's expected value. Since they have been removed from the county experience, it is appropriate to add them in at a broader level. The State Cat Load calculation accomplishes this.

The automated system assigns a run identification number denoting the date and time the State Cat

Load routine was run that can be utilized for future review and reference. State Catastrophic Load output files are reviewed by AB Rate Specialists for reasonableness, appropriateness, and to ensure that calculated values accurately reflect programmed calculation specifications and any issues/concerns are raised to the Rate Team Leader (Rates TL) and AB Chief.

V. *County Catastrophic Load.*

The State Cat Load is calculated as excess indemnity divided by the total adjusted liability. The State Cat load is then limited to a maximum of 3.25% (5% at 75% coverage) and a minimum of 0.65%. Any state excess above the 3.25% cap is distributed back to each county proportional to each county's adjusted liability. The purpose for the caps is to limit the amount of rate being shared across all counties when the counties may or may not be homogenous.

If the state cat load is greater than 3.25%, as is the case with Allen County, Kansas wheat, the following calculations are performed to establish the target county's County Cat Load. This is done by the calculating the excess indemnity that would then be prorated back to each county based on its amount of indemnity contributed to the state pool relative to its liability.

Excess Cat Load = State Cat Load – 0.0325

then

(1)

$$\text{Target County Cat Indem portion} = \left[\sum \text{Target County Cat Indem}\right] / \sum \text{State Cat Indem}$$

then

(2)

$$\text{Excess Indemnity} = \text{Excess Cat Load } x \sum \text{State Adjusted Liability}$$

then

(3)

$$\text{Target County Liability} = \sum \text{target county adjusted liability}$$

then

(4)

Target County Cat Load = [(1) * (2)] / (3)

For Allen County, Kansas wheat, the state catastrophic load was greater than the cap of .0325; therefore, an excess indemnity would need to be distributed amongst the counties. The following table illustrates the County Cat Load calculation for Allen County, Kansas wheat.

Table 12

Allen County, Kansas Wheat			
Excess Cat Load:	0.03716319 - 0.0325 =	0.00466319	
Target County Cat Indemnity:	$15,7951 / $247,858,656 =	0.00063726	
Excess Indemnity:	0.004663 x $6,669,467,278 =	31100993	
Target County Liability:		11145547	
Target County Cat Load:	(0.000637 x $31,100,993) / $11,230,652 =	**0.00176404**	**(0.0018)**

VI. *Miscellaneous Rate Loads*

Policy provisions are subject to change and changes may have an effect on the risk of insurance. Therefore, it is essential that each change be reviewed for rate impact. Currently, there are three other rate loads that are included in the ratemaking process: 1) Prevented Planting rate load; 2) Replant rate load; and 3) Quality Adjustment rate load. Not all crop policies contain coverage provisions for prevented planting, replanting or quality standards. Therefore, individual crop policy provisions are utilized to determine if a rate load is greater than zero (0.000). Exhibit 1 lists which crops currently have coverage for prevented planting, replanting, and quality adjustment.

These three rate loads are calculated outside of the "normal" rate determination because they are considered external factors "which are not directly related to yield loss." The rate loads for prevented planting, replant, and quality adjustment are generally based on internal RMA evaluations and reviews. The supporting information and documentation for these internal evaluations and reviews is maintained in AB for future review and verification. Prevented planting coverage was first added to a limited number of crops beginning in 1994; replant coverage, while being a part of the basic provisions for a longer time, has had limited losses; and quality adjustment language was added to a number of crop policies beginning with Spring crops of crop year 2000.

The prevented planting and replant loss data was removed from the loss experience in Statplan and is therefore not included in the data underlying the rates. Nevertheless, since prevented planting and replant are an identifiable event, the rates should include a provision for this type of loss, so the concept of the adjustment is appropriate.

Although captured in the loss data, quality adjustments are not isolated on the loss records, making it nearly impossible to capture the impact of quality adjustments on the recorded indemnities. While it is believed to be a very small amount of additional indemnity that occurs due to quality adjustment, the ideal scenario would be to extract the amount of quality loss from the loss experience similar to the method used for prevented planting or replant. Since this segregated data is not currently available and until it is available, judgment on the part of the analyst is utilized during quality adjustment rate load reviews, weighting the amount of quality losses contained in the loss experience verses the current rate load. All data utilized during the subjective judgment process will be maintained either in the Regional Office or in AB for future review and reference.

VII. *Disaster Reserve Factor*

The disaster reserve factor is used to increase calculated rates by an amount that is intended to meet the Congressional requirement that rates be adequate to cover anticipated losses and a reasonable reserve. This factor is applied to all crops and insurance plans.

RMA's current disaster reserve factor is 0.88 and is based on calculations done in 1991. Analysts used 41 years (1948-1988) of data for all crops and figured the probability for breaking even 85% of the time over any 10 year period, which resulted in a target loss ratio of 0.88. That means that 1/0.88 or 13.6% is currently added into the rate for reserve. Prior to 1991 the disaster reserve load was set at .90. It is unknown when the disaster reserve load was first added to the rate determination process but was probably instituted in the mid 80's when APH (Actual Production History) first began. RMA contracted with a non-governmental entity to conduct a study to review and evaluate the disaster reserve factor load. The contracted review was recently completed and confirmed that RMA's current Disaster Reserve Load was appropriate, thus no changes to this load will be made.

Actuarial procedures often incorporate a risk load or contingency load in order to build in an additional margin of protection against future adverse experience. The *Statement of Principles* states, "The rate should include a charge for the risk of random variation from the expected costs." In Table 8, it can be seen that even after removing the extreme portions of the historical loss cost ratios, the annual LCRs may vary significantly from the long-term average of 0.084. There is no single approach that will produce an appropriate risk margin in all circumstances. Factors that need to be considered include: variability in loss costs from year to year, accumulated funds that have been earmarked to pay claims if indemnified losses exceed premium revenues, and availability of funds from other sources to pay claims should the accumulated funds be depleted.

VIII. *Optional Unit Factor*

The Unit Division Load or Optional Unit Factor takes into account the fact that indemnity is not computed for an entire farm, but rather for each division of a farm. For example, if a farm is divided into four equal segments where one segment had 0% production and the other three had 100% production, the producer would receive indemnity for the unproductive segment at a 75% coverage level, whereas, if the farm was insured as a whole, there would be no indemnity at the 75% coverage level.

To incorporate the unit structure into the premium rates, the main actuarial procedure used is premium rate discounts. This means that once the base premium rate has been set, it will then be adjusted depending on the choice of unit format. The actuarial logic for incorporating unit format discounts in premium rate setting is to ensure that premium rates reflect any difference in loss experience among the different unit formats.

The basic unit structure is typically the "base" unit format in historical experience. Since the optional unit format is the lowest level of presentation of the actuarial structures, the historical experience is loaded up by how much discount is warranted for a producer that selects basic units over optional units. This means that discounts are given only when an insured producer chooses to insure at the basic, enterprise, or whole-farm unit level. For example, if a corn producer chooses to insure his acreage as a basic unit, a multiplicative discount factor is used to adjust his base premium rate to reflect this unit format.

This multiplicative discount factor for basic units has been set at 10% for many years as a

reasonable discount for the coverage that is given up from having basic units instead of optional units. This equates to an optional unit surcharge factor in establishing target rates of 11.1% (1.0 / 0.90). This assumes that the historic loss cost ratios for a basic unit would be 10% less than that of optional units. The 11.1% optional unit factor is currently a universal factor used for all crops and geographic areas where the policy allows for optional units. Internal data analysis and evaluation have tended to support the amount of this load. RMA has contracted with a non-governmental entity to conduct a study to review and evaluate the appropriate factors for each of the unit structures. The study concluded that the current unit structure does not need to be changed. However, the current basic unit discount of 10%, while actuarially appropriate for the book of business as a whole, should be tailored to vary across crops, regions, and unit structures (including enterprise units). The Board has approved adoption of the study recommendations. RMA planned to implement the variable unit discount (but this implementation has been suspended indefinitely with RMA's eWA system redesign).

Maintaining the indemnity data separately by unit or field, as would be necessary to avoid the Unit Division Load correction factor, would probably be more accurate but also more cumbersome and less cost efficient. It is often necessary to balance the benefits of more accurate results and the costs of obtaining those results. The procedure of deriving rate indications based on data at the field level instead of the field unit level is a reasonable simplification as long as the adequacy of the Unit Division load is monitored.

IX. *County Target Rate*

The county target rates are developed using the following formula and the variables defined in earlier sections of this chapter. The target rate is generally considered to consist of two parts, a variable portion and a fixed portion. However, an individual's rate (not covered in this manual) may vary based upon his approved yield. The basis for different rates for different approved yields is driven by the variable portion of the rate while the fixed portion of the rate remains constant across all approved yields.

Target Rate = Variable Rate + Fixed Rate

$$\text{Target Rate} = \left(\frac{\left(\frac{\text{ULR} + \text{CntyCAT}}{\text{ResFac}} \right)}{\text{UnitFac}} \right) + \left(\frac{\text{PP} + \text{RP} + \text{QA} + \text{StCAT}}{\text{UnitFac}} \right)$$

Where

ULR =	County Unloaded Rate	Section III
CntyCAT =	County Catastrophic Rate Load	Section V
ResFac =	Disaster Reserve Factor	Section VII
PP =	Prevented Planting Rate Load	Section VI
RP =	Replant Rate Load	Section VI
QA =	Quality Adjustment Rate Load	Section VI
StCAT =	State Catastrophic Rate Load	Section IV
UnitFac =	Optional Unit Factor	Section VIII

Substituting the values found in previous sections of this chapter, plus assumed values for PP, RP, and QA, a target rate can be determined for wheat in Allen County, Kansas of:

$$\text{Target Rate} = \left(\frac{\left(\frac{0.074 + 0.0018}{.88} \right)}{.90} \right) + \left(\frac{0.006 + 0 + 0.001 + 0.0325}{.90} \right)$$

Target Rate = 0.0957 (variable) + 0.0439 (fixed)

= 0.140

The automated system assigns a run identification number denoting the date and time the County Rates routine was run that can be utilized for future review and reference. County Rates are reviewed by AB Rate Specialists for reasonableness, appropriateness, and to ensure that calculated values accurately reflect programmed calculation specifications and any issues/concerns are raised to the Rate Team Leader (Rates TL) and AB Chief.

X. *Judgment Target Rate*

The focus in the first nine sections of this chapter has been on the development of a mechanical process for determining the rate. However, there will be situations where human intervention will be a necessity in determining the county target rate. Situations where counties experience is limited or the county experience does not represent the expectation of future events.

As discussed previously, the credibility measurement is an indicator of predictability of future events and is based on the number of acres insured. The weight of the experience is a factor of the amount of acres and variability of a county's experience with its county group.

All county target rates that are not credibile undergo a mandatory review by the AB and Regional Underwriting Office. For these counties, each crop rate specialist review the adjusted insurance experience and provide a target rate with justification for acceptance for the county target rate.

The county target rates and justification documents submitted by the regional offices are then reviewed by AB for completeness and to resolve any differences. Once accepted by AB the county target rates are posted to a file within the rates database as county target rates for the current year and subsequent years or until another rate review is completed.

XI. *Type/ Practice Factors*

The rates developed to this point have used data aggregated for all crop types and cultural farming practices. Each type or practice can affect a producer's expected indemnification and, consequently, needs to be reflected in the individual producer's rates.

Type/Practice factors reflect the fact that different crop types and farming practices increase or reduce the risk of loss. For example, an irrigation practice reduces the risk of loss due to inadequate moisture. For each practice, the rate is multiplied by a factor representing the relative risk. Type/Practice factors are derived from MPCI data that is aggregated at a level greater than the county level. This is appropriate, since the county data would likely lack sufficient credibility.

In addition, one should not expect that the relative impact of specific practices would vary

significantly from one county to the next (although the impact could vary across broader regions). It should be noted that subdividing data, and aggregating at a broader level, is commonly used in insurance ratemaking.

Currently the type/practice factors are applied to the variable portion of the rate only. The fixed rate portion of the rate is generally considered to be rate loads that are uniform across a broad range of types, practices, crops, counties, and policies.

$$\text{Target Rate} = \left(\frac{\left(\frac{\text{ULR} + \text{CntyCAT}}{\text{ResFac}} \right)}{\text{UnitFac}} \times (PF) \right) + \left(\frac{\text{PP} + \text{RP} + \text{QA} + \text{StCAT}}{\text{UnitFac}} \right)$$, **where**

ULR = County Unloaded Rate

CntyCAT =	County Catastrophic Rate Load	Section V
ResFac =	Disaster Reserve Factor	Section VII
PF =	Practice Factor	Section XI
PP =	Prevented Planting Rate Load	Section VI
RP =	Replant Rate Load	Section VI
QA =	Quality Adjustment Rate Load	Section VI
StCAT =	State Catastrophic Rate Load	Section IV
UnitFac =	Optional Unit Factor	Section VIII

Milliman & Robertson, Inc. wrote in 2000, the type/practice factors are derived by dividing the practice specific LCR by the combined LCR where the combined LCR is calculated over all practices in the rating area. This is a reasonable approach. RMA should monitor the type/practice factors over time to determine whether there are any trends emerging in the factors.

AB Rate Specialists review updates and modifications to type/practice factors for reasonableness, appropriateness, and uniform application across regions. Problems or differences discovered would be presented to the RT Leader and to the AB Chief for resolution. Documentation, in these cases, would be maintained by the AB Rate Specialist in either hardcopy or automated media.

(6) MANDATED CAPPING REQUIREMENTS COMPONENT

Objective: to determine a process such that changes in target rate, reference yield and coverage level rate relativities are maximized to the extent that they do not exceed the 20% increase in base premium rate that is legislatively imposed on RMA.

Changes in premium for all crops will generally range from –5% to +15%. In accordance with legislative mandate, in the extreme cases premium increases will be capped at 20% compared to what the insured would have paid last year for the same coverage. However, premium decreases can exceed 20% so that the target base premium rate can be reached in three years. The premium rate for the first year is decreased so that in the following two years the premium rate will only have to decrease by no more than 20% to reach its target rate at the end of three years. The capping calculations are performed in a stand-alone SAS program with output generated in spreadsheet format that serves as input used to load final published rates to AFS. Edit and validation reports are a by-product of this process. These reports are reviewed by AB Rate Specialists who approve the final output. The reports are reviewed for reasonableness, appropriateness, and to ensure that

calculated values accurately reflect programmed calculation specifications and any issues/concerns are raised to the Rate Team Leader (Rates TL) and AB Chief. When all problems have been analyzed and final output has been approved, the data is loaded to AFS.

The Base Premium Rate is defined as:

$$(1) \quad \boldsymbol{BPR} = \left(\left(\frac{\boldsymbol{APH\_yield}}{\boldsymbol{reference\_yield}} \right)^{\text{exponent}} \cdot \boldsymbol{reference\_rate} + \boldsymbol{fixed\_load} \right) \cdot \boldsymbol{differential}$$

For capping purposes, assume that the t-yield represents the county average. Therefore, the base premium rate for capping is defined as:

$$(2) \quad \boldsymbol{BPR} = \left(\left(\frac{\boldsymbol{t\_yield}}{\boldsymbol{reference\_yield}} \right)^{\text{exponent}} \cdot \boldsymbol{reference\_rate} + \boldsymbol{fixed\_load} \right) \cdot \boldsymbol{differential}$$

Where the yield ratio is bound:

$$(3) \quad .5 \le \left(\frac{\boldsymbol{t\_yield}}{\boldsymbol{reference\_yield}} \right) \le 1.5$$

The t-yield and exponents are assumed to be fixed. The other four components can change and move towards their target values.

The goal of the capping routine is to change the four components so as to keep the change in the *BPR* within policy bounds.

So, start off with the initial *BPR*

$$(4) \quad \boldsymbol{BPR}_{\boldsymbol{initial}} = \left(\left(\frac{\overline{\boldsymbol{ty}}}{\boldsymbol{y}_{\boldsymbol{initial}}} \right)^{\overline{\boldsymbol{exp}}} \cdot \boldsymbol{r}_{\boldsymbol{initial}} + \boldsymbol{f}_{\boldsymbol{initial}} \right) \cdot \boldsymbol{d}_{\boldsymbol{initial}}$$

And the target *BPR*

$$(5) \quad \boldsymbol{BPR}_{\text{target}} = \left(\left(\frac{\overline{\boldsymbol{ty}}}{\boldsymbol{y}_{\text{target}}} \right)^{\overline{\boldsymbol{exp}}} \cdot \boldsymbol{r}_{\text{target}} + \boldsymbol{f}_{\text{target}} \right) \cdot \boldsymbol{d}_{\text{target}}$$

Where ***ty*** is the target yield, ***y*** is the reference yield, ***r*** is the reference rate, ***f*** is the fixed load, and ***d*** is the differential.

However, there are caps placed on the movement of the *BPR*.

If $\boldsymbol{BPR}_{\boldsymbol{target}} > \boldsymbol{BPR}_{\boldsymbol{initial}}$ then:

$$(6) \quad BPR_{capped} = \min\left(BPR_{target}, \min\left[\left(1.09 + .06 \cdot \Delta BPR_{65}\right) \cdot BPR_{initial}, 1.2 \cdot BPR_{initial}\right]\right)$$

Where ΔBRP_{65} is the percent change in the base premium rate at the 65% coverage level.

If $\boldsymbol{BPR_{target} < BPR_{initial}}$ and BPR_{target} will be reached in three years then:

(7) $BPR_{capped} = \left(BPR_{initial} * \max\left[.91 - .06 * (BPR_{initial} / BPR_{target} - 1), .8, BPR_{target}/BPR_{initial}\right]\right)$

If $\boldsymbol{BPR_{target} < BPR_{initial}}$ and BPR_{target} will **not** be reached in three years then for year one:

(8) $BPR_{capped} = 1.23 * BPR_{target}$

Then use formula (7) for the following two years.

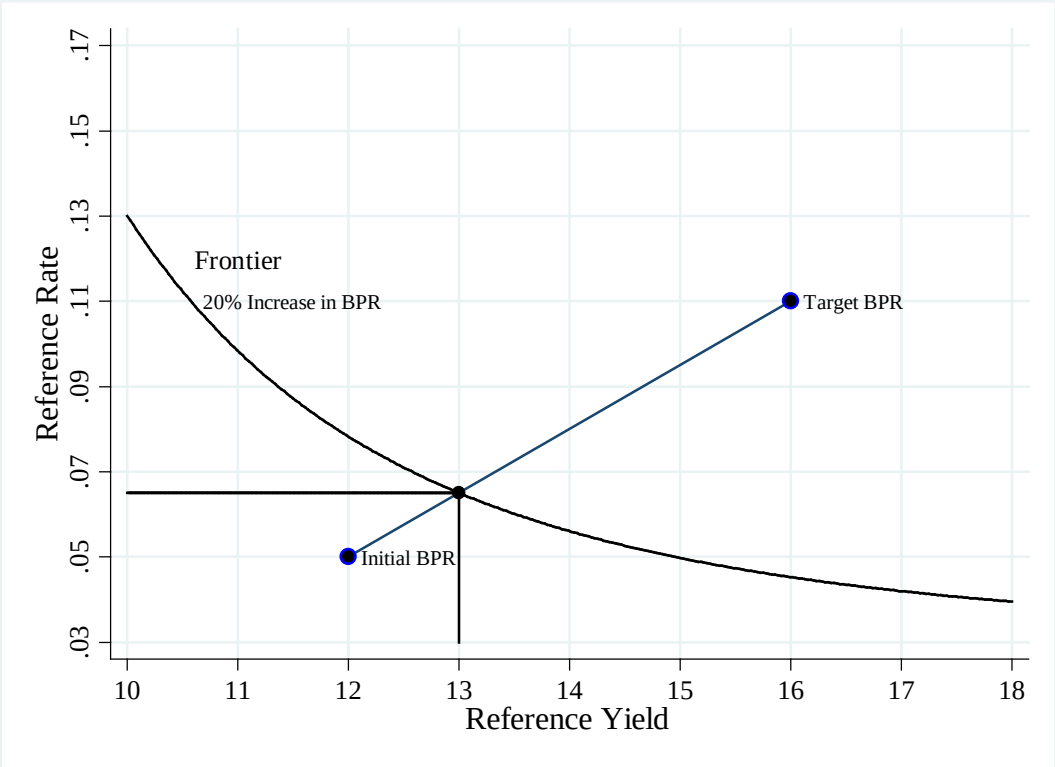
The capped base premium rate (BPR_{capped}) can be used to define an iso-rate frontier: all combinations of the reference yield, reference rate, fixed load, and differential that give the same rate.

(9) $$\boldsymbol{BPR_{capped}} = \left(\left(\frac{\overline{ty}}{y}\right)^{\overline{exp}} \cdot \boldsymbol{r} + \boldsymbol{f}\right) \cdot \boldsymbol{d}$$

Suppose the maximum change in the *BPR* is 20%. The rate frontier would be all combinations of reference yield (*y*), reference rate (*r*), fixed load (*f*), and the differential (*d*) that results in a 20% increase in the *BPR*. Then, the capping routine finds the intersection point of the line defined by the initial and target *BPR*s and the rate frontier. The point of intersection will determine the values of the rating components.

Example 1

Assume the fixed load and differential are constant. Given the initial reference yield of 12 and rate .05, the target values for the yield (16) and rate (.11) results in the new target *BPR* to exceed the maximum allowable increase defined by the frontier. The capping routine will find the intersection point which will give the derived values for the reference rate and yield (.065 and 13).



Point of Intersection of a Line and Plane

Because it is necessary to work in $\mathbb{R}^3$ space (reference rate, reference yield and fixed load space), use of the typical equation of a line in a plane, $y = mx + b$, is not appropriate. It is necessary to use the parametric form of the equation of the line. Below is an example of how to find the intersection point of a plane and line.

Given points $P_1 = (X_1, Y_1, Z_1)$ and $P_2 = (X_2, Y_2, Z_2)$ the parametric form for the line is:

$$\boldsymbol{x} = \boldsymbol{x}_1 + \boldsymbol{t}(\boldsymbol{x}_2 - \boldsymbol{x}_1)$$
$$\boldsymbol{y} = \boldsymbol{y}_1 + \boldsymbol{t}(\boldsymbol{y}_2 - \boldsymbol{y}_1)$$
$$\boldsymbol{z} = \boldsymbol{z}_1 + \boldsymbol{t}(\boldsymbol{z}_2 - \boldsymbol{z}_1)$$
$$0 \le \boldsymbol{t} \le 1$$

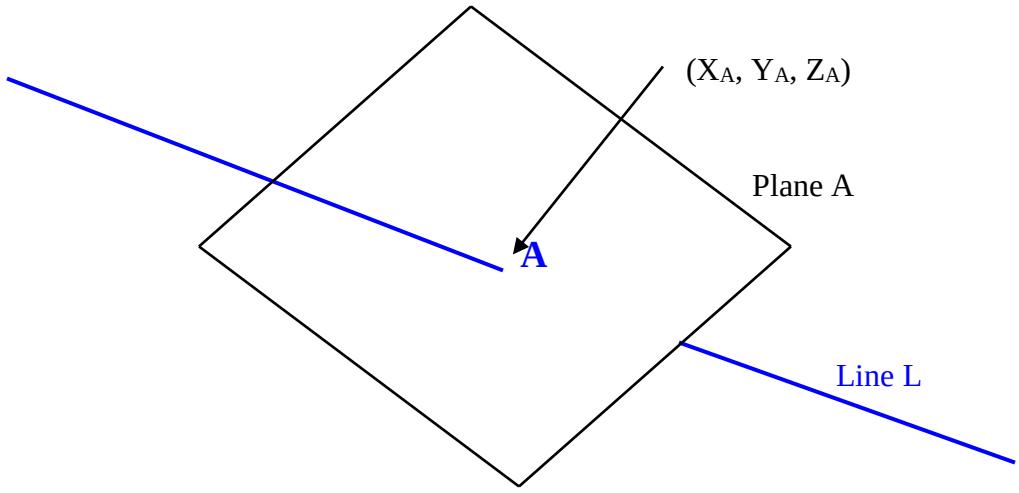
To find the point of intersection, **A**, of the line ***L***:

$$\boldsymbol{x} = 2 - 3\boldsymbol{t}$$
$$\boldsymbol{y} = -3 + \boldsymbol{t}$$
$$\boldsymbol{z} = 1 - 2\boldsymbol{t}$$

With the plane ***P***:

$$4\boldsymbol{x} - 2\boldsymbol{y} + 2\boldsymbol{z} = 5$$

one must find the coordinates that satisfy both the equation of the line and the equation of the plane.



For the line at A, **HAVE**

$$x_A = 2 - 3t_A$$
$$y_A = -3 + t_A$$
$$z_A = 1 - 2t_A$$

For the plane at A, **HAVE**

$$4x_A - 2y_A + 2z_A = 5$$

Now combine these to find t_A:

$$4(2 - 3t_A) - 2(-3 + t_A) + 2(1 - 2t_A) = 5$$
$$t_A = \frac{11}{18}$$

Now use this value to find the coordinates of A:

$$x_A = 2 - 3\left(\frac{11}{18}\right) = \frac{1}{6}$$
$$y_A = -3 + \left(\frac{11}{18}\right) = -\frac{43}{18}$$
$$z_A = 1 - 2\left(\frac{11}{18}\right) = -\frac{2}{9}$$

Example 2

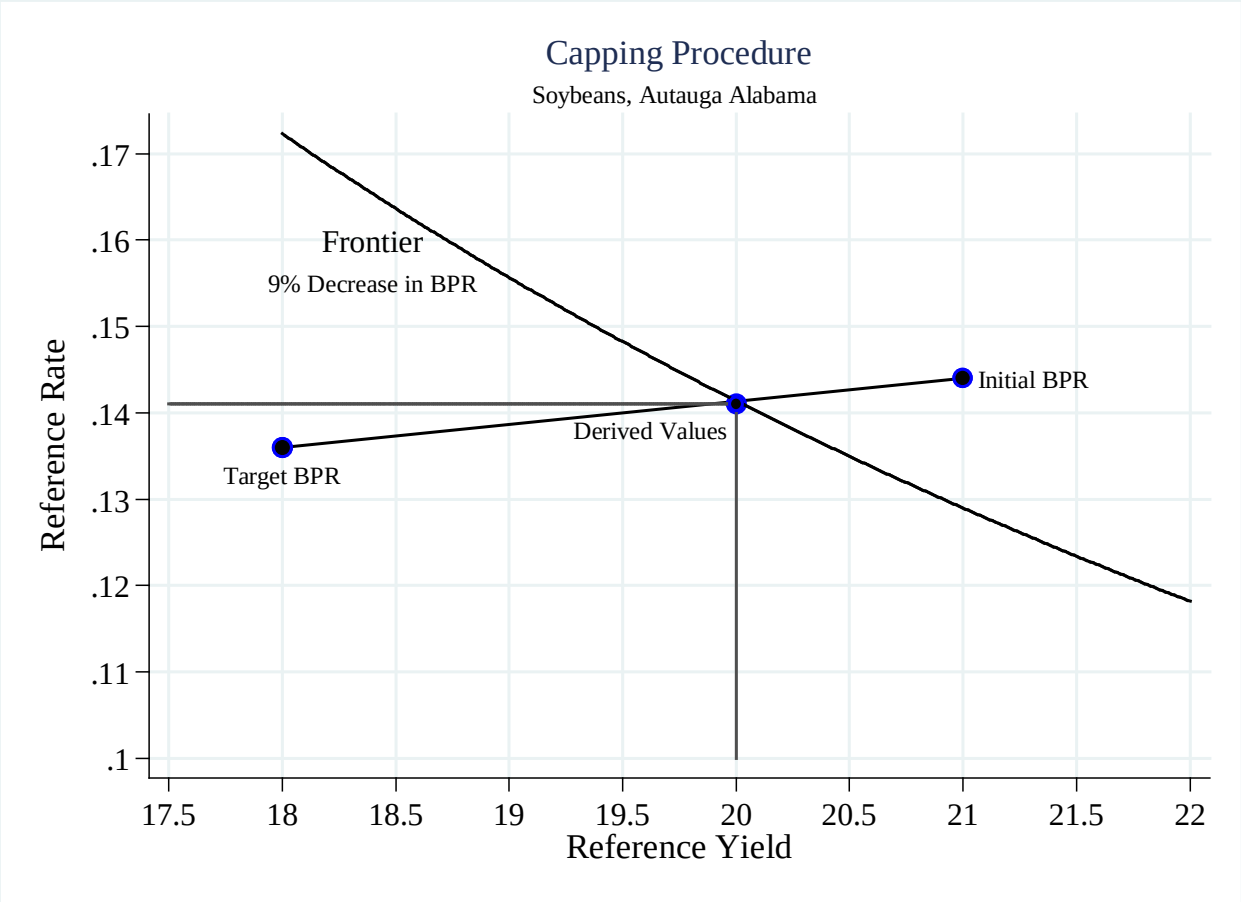
In Bibb county Alabama the current base premium rate for soybeans is .27. The target values would lower the rate to .20, a 26% decrease. The resulting allowed change would be capped at

10% with the derived reference yield rounded to the nearest whole number.

Soybeans
Alabama, Bibb County

	Reference Yield	Fixed Load	Reference Rate	t-yield	Exponent	Residual	Differential	BPR
Initial	21.0	.03	.1440	16	-1.879	1	1	.270
Target	18.0	.03	.1360	16	-1.879	1	1	.200
Derived	20.0	.03	.1410	16	-1.879	1	1	.244

No Type Specified / Irrigated, Coverage Level 65%



(7) APH BUSINESS PROCESS AND CRITICAL CONTROL COMPONENT

RMA establishes an annual filing schedule that includes final dates for county expansion, policy provision changes, actuarial document changes including rate and coverage changes, price establishment dates, and document preparation dates. These dates establish a reasonable timeframe from which all rate work can be processed.

APH rate reviews are a part of the overall business process as has been discussed in the prior

chapters. Generally, each step of the process involves AB.

In addition to a strict filing schedule that dates must be held too, critical control points are also established to assume proper quality control within each step of the rate determination process. These critical control points are outlined earlier in Section 2 of this handbook under Business Process and Critical Control Points and also in the APH Business Process and Critical Control Points Exhibit 2. Section 2 and Exhibit 2 both denote that approval or disapproval of recommendations is required before the processes can continue and supervisory oversight is required where noted.

Documentation is generally maintained in AB; however, additional documentation is also maintained in Regional Offices. Contracted studies, internal evaluations and analysis, and authorizing memoranda, etc. are maintained in AB for future review and reference. AB also maintains automated (and hardcopy, if applicable) documentation of rate determination, rate review, and rate approval as denoted in Section 2 and Exhibit 2.

RMA's AB periodically reviews and updates documented support for all factors in the rate determination process. The frequency for review of some factors will vary, but will generally be reviewed every 3 years unless the underlying study suggests a longer interval for review.

Keys to the APH Business Process and Critical Control Points Exhibit 2:

RO Staff	Regional Office Staff
RO Director	Regional Office Director
AB Staff	Actuarial Branch Staff Members
RT Leader	AB Rates Team Senior Statistician
FT Leader	AB Filing Team Senior Risk Management Specialist
AB Chief	Actuarial Branch Chief
APDD Director	Actuarial and Product Design Division Director
Senior Actuary	RMA Senior Actuary
Deputy Admin for PM	RMA Deputy Administrator for Product Management
Admin	RMA Administrator

4. REFERENCE MATERIAL

EXHIBIT 1 – Crops with PP/RP/QA Provisions

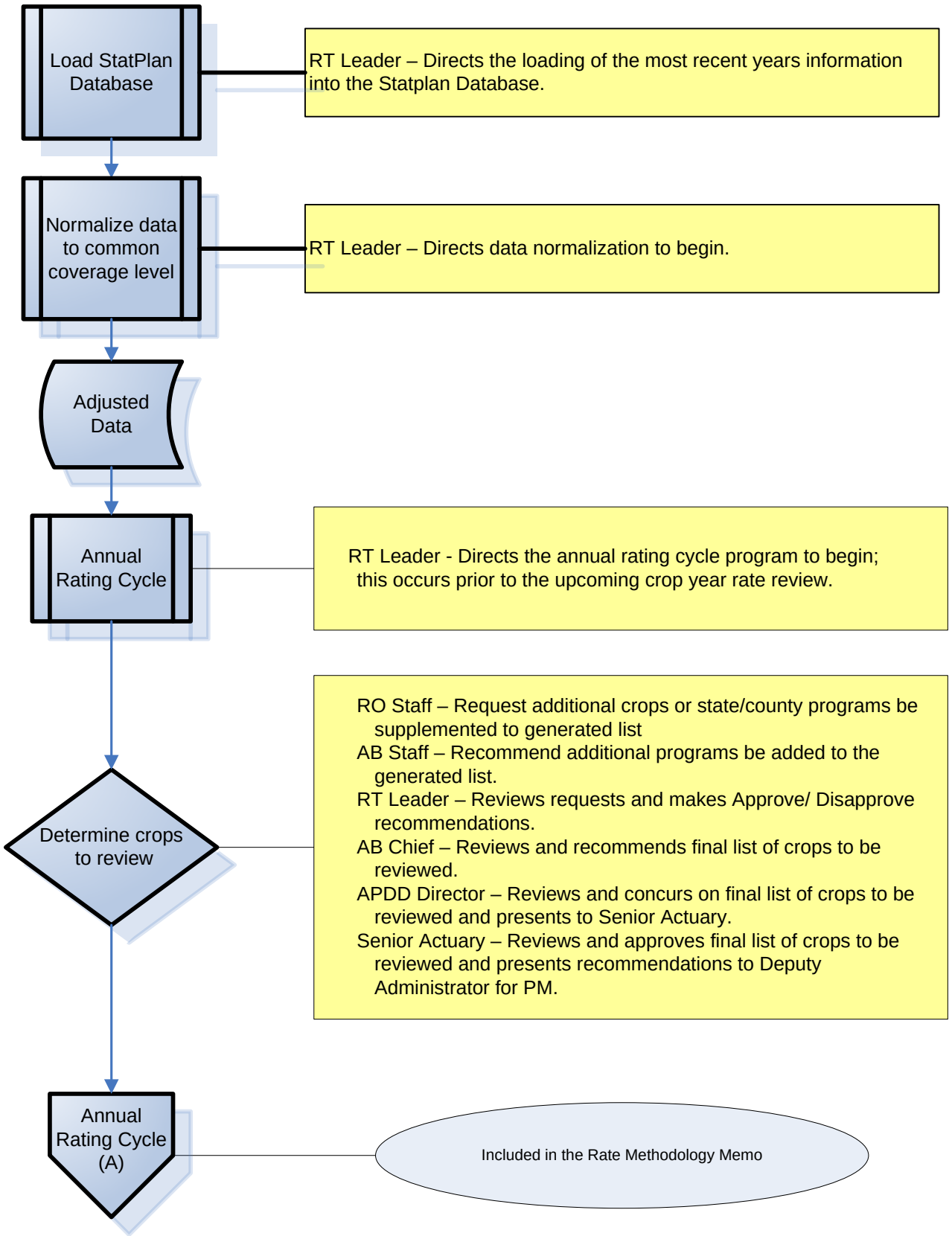
APH Crop	Crop Code	Prevented Planting / Coverage			Replant Payment Prov.	Quality Adjustment	***Enterprise (E) ** Optional (O) Basic (B) Unit
Almonds	0028						B/O
Apples	0054						B/O
Avocados (Pilot - Florida Only)	0019						B/O
Beans (Processing)	0046	Yes	1998	40%			B/O/O by type
Blueberries	0012						B/O by type 2/
Cabbage (Pilot)	0072				Yes		B/O
Canola/Rapeseed	0015	Yes	1995	60%	Yes		B/O
Citrus (AZ & CA) Grapefruit Lemons Mandarin Minneola Tangelos Navel Oranges Sweet Oranges Valencia Oranges Orlando Tangelos Kinnow Mandarins	 0201 0202 0205 0206 0215 0216 0217 0237 0239						B by Crop/O
Citrus Fruit (Texas) Early & Midseason Oranges Late Oranges All Other Grapefruit Ruby Red Grapefruit Rio Red & Star Ruby Grapefruit	 0224 0225 0226 0228 0238						B/O
Corn	0041	Yes	1994	60%	Yes		B/O/E
Grain Sorghum	0051	Yes	1994	60%	Yes		B/O/E
Soybeans	0081	Yes	1994	60%	Yes		B/O/E
Cotton	0021	Yes	1994	50%			B/O
Cotton (ELS)	0022	Yes	1994	50%			B/O
Cranberries	0058						B/O
Dry Beans	0047	Yes	1997	60%	Yes		B/O/O by type
Figs	0060						B by type/O
Forage Production	0033						B/O
Grapes	0053						B/O Variety3/
Grapes, Table	0052						B/O Variety3/
Hybrid Corn Seed	0062	Yes	1994	60%			B/O
Hybrid Sorghum Seed	0050	Yes	1994	60%			B/O
Macadamia Nuts	0023						B/O
Millet	0017	Yes	2004	60%			B/O
Mint (Pilot)	0074						B/O
Mustard (Pilot)	0069	Yes	1999	60%	Yes		B/O
Onions	0013	Yes	1998	45%	Yes		B/O/O by type
Peaches	0034						B/O
Peanuts	0075	Yes	1999	50%	Yes		B/O by FSN

APH Crop	Crop Code	Prevented Planting / Coverage			Replant Payment Prov.	Quality Adjustment	***Enterprise (E) ** Optional (O) Basic (B) Unit
Pears	0089						B/O
Peas, Dry	0067	Yes	1998	60%			B/O/O by Type
Peas, Green	0064	Yes	1998	40%			B/O/O by Type
Plums	0092						B/O
Popcorn	0043	Yes	1999	60%	Yes		B/O
Potatoes	0084	Yes	1998	25%			B/O
Prunes	0036						B/O 3/
Rice	**0018**	**Yes**	**1994**	**45%**	**Yes**		**B/O**
Safflower	**0049**	**Yes**	**1998**	**60%**	**Yes**		**B/O**
Silage Sorghum Pilot	**0059**	**Yes**	**2005**	**60%**	**Yes**		**B/O/E**
Barley	**0091**	**Yes**	**1994**	**60%**	**Yes**		**B/O/E**
Flax	**0031**	**Yes**	**1995**	**60%**	**Yes**		**B/O/E**
Oats	**0016**	**Yes**	**1994**	**60%**	**Yes**		**B/O/E**
Rye	**0094**	**Yes**	**1995**	**60%**	**Yes**		**B/O/E**
Wheat	**0011**	**Yes**	**1994**	**60%**	**Yes**		**B/O/E**
Stonefruit **Fresh Apricots** **Processing Apricots** **Fresh Nectarine** **Processing Cling Peaches** **Processing Freestone Peaches** **Fresh Freestone Peaches**	 **0218** **0219** **0220** **0221** **0222** **0223**						**B/O by type**
Sugar Beets	**0039**	**Yes**	**1997**	**45%**	**Yes**		**B/O**
Sugarcane	**0038**						**B/O**
Sunflower Seed	**0078**	**Yes**	**1998**	**60%**	**Yes**		**B/O**
Sweet Corn (Processing)	**0042**	**Yes**	**1998**	**60%**			**B/O**
Sweet Potatoes (Pilot)	**0085**						**B*** **
Tobacco, Guaranteed Production **Flue Cured** **Fire Cured** **Maryland** **Dark Air** **Cigar Filler** **Cigar Binder** **Cigar Wrapper**	 **0229** **0230** **0232** **0233** **0234** **0235** **0236**						**B by/share/ type/ O by FSN 3/**
Tobacco (Quota) **Burley**	 **0231**						**B by FSN**
Tomatoes (Fresh Mkt Guar. Prod.)	**0086**				**Yes**		**B/O**
Tomatoes (Processing)	**0087**				**Yes**		
Wild Rice (Pilot)	**0055**						**B/O**

EXHIBIT 2 – APH Business Process and Critical Control Points

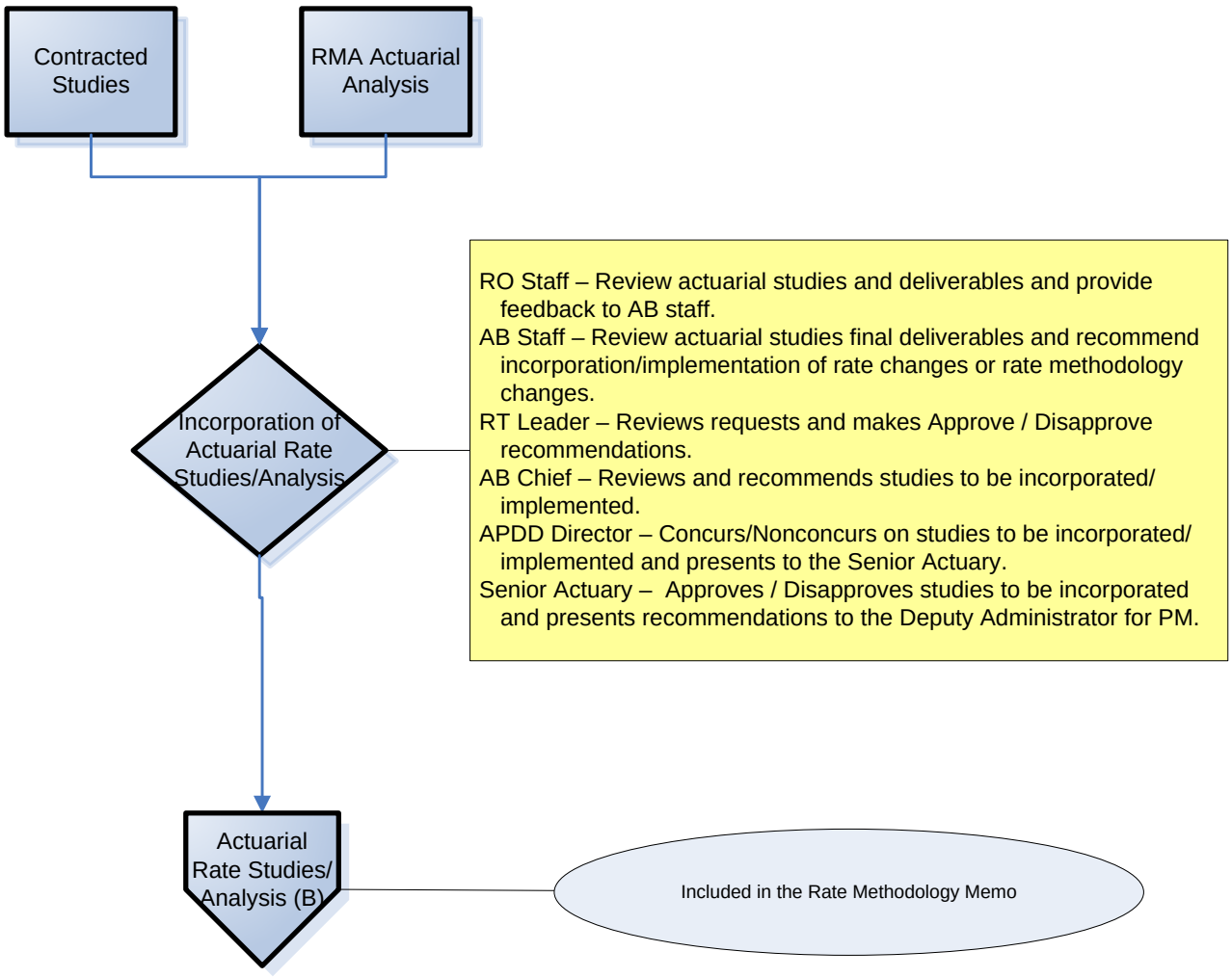
APH Business Process and Critical Control Points

Annual Rating Cycle



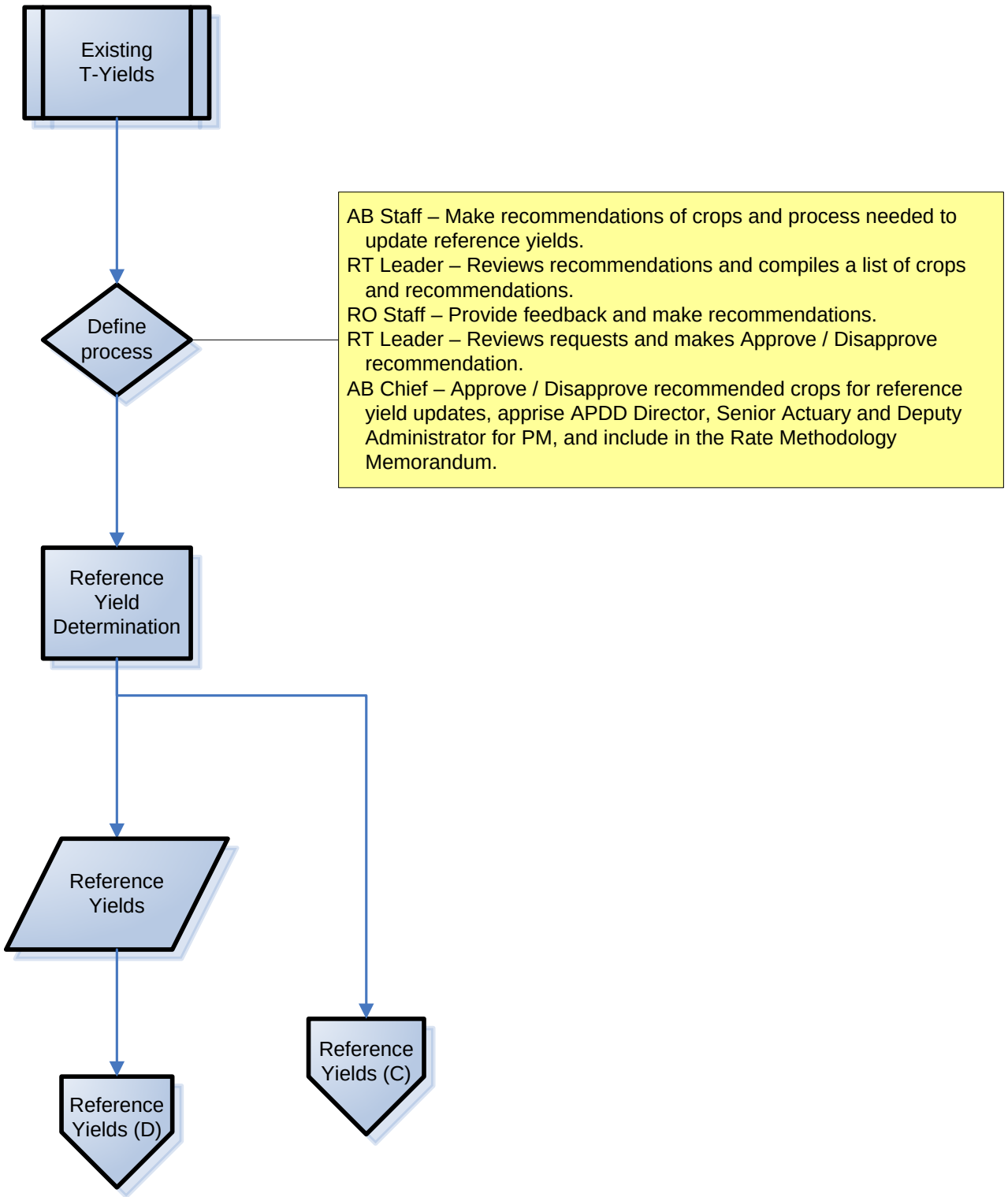
APH Business Process and Critical Control Points

Implementation of Actuarial Rate Studies



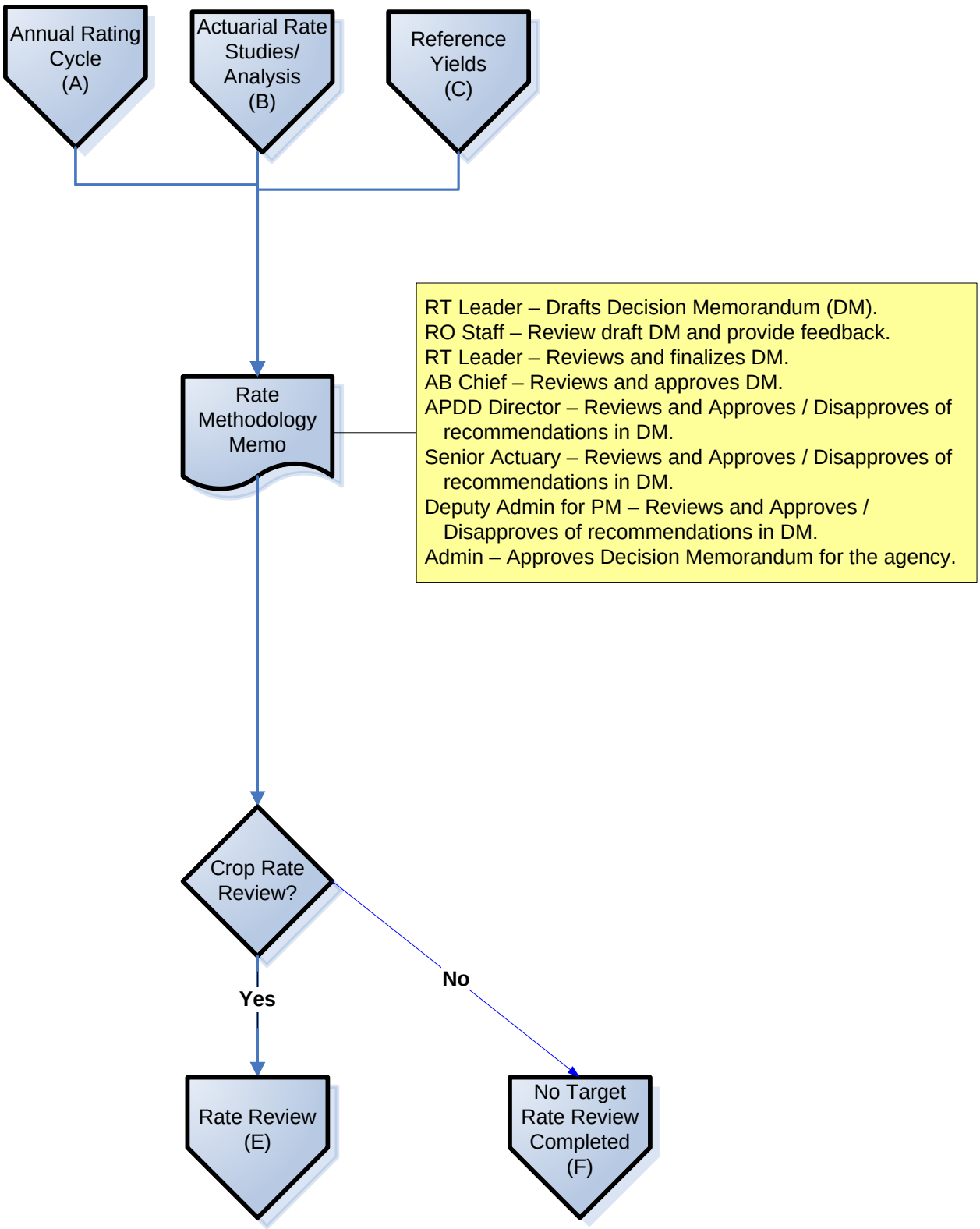
APH Business Process and Critical Control Points

Reference Yields



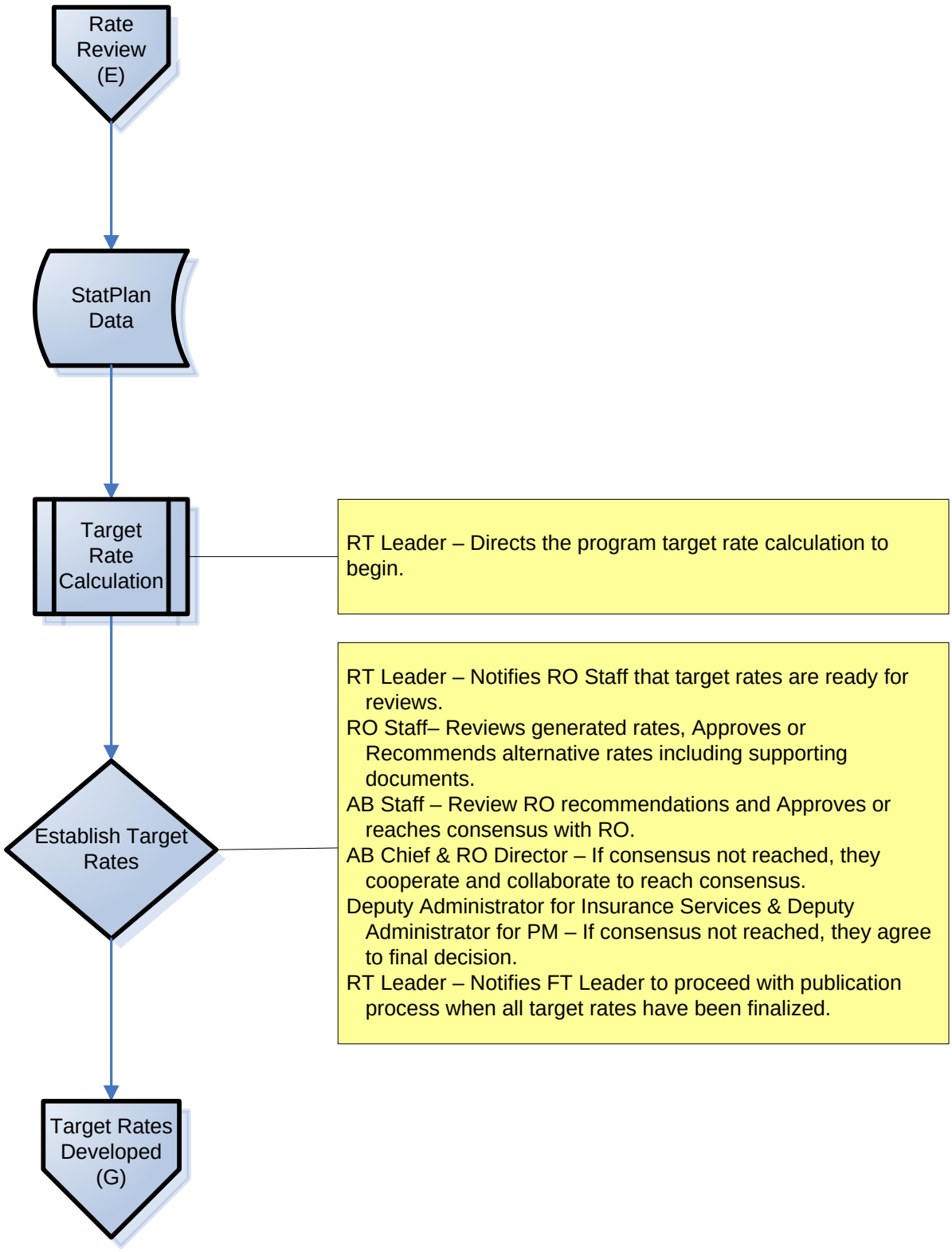
APH Business Process and Critical Control Points

Rate Methodology Memo



APH Business Process and Critical Control Points

Target Rates



APH Business Process and Critical Control Points

Publication of Rates