C ontinuous Rating
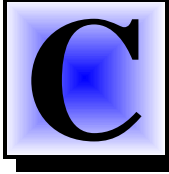
Premium Rate Calculations for the Continuous Rating Model
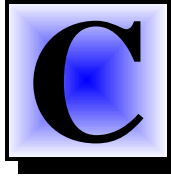
April 10, 2000

C ontinuous Rating

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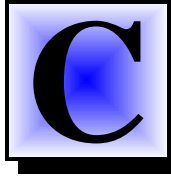# **C** ontinuous Rating

I ntroduction

This document establishes the procedure for calculating Actual Production History (APH) yield based premium rates using the Continuous Rating model. This procedure is effective beginning with the 2001 crop year and applies to all crops insured under insurance plan codes 25, 44, and 90. All other crops and insurance plans will continue to use existing rating models for the 2001 crop year. However, the Risk Management Agency (RMA) may add additional crops and insurance plans to this rating model in future crop years.

Continuous Rating uses four basic components: Reference Yield, Reference Rate, Exponent and Fixed Rate Load. These are adjusted by additional coverage rates and high-risk surcharges. As required by federal statute, the computed Base Premium Rate must be capped at 120% of the prior year's applicable Base Premium Rate. The applicable capping procedures are outlined within this procedure.

Continuous Rating is a different method of rate presentation, which allows rates to be calculated for any producer's APH Yield. Prior to the introduction of the Continuous Rating model, RMA published Base Premium Rates for APH yield based crops using a fixed rate for a span of yields, which was typically nine rate spans (R-span) per crop. The Continuous Rating model develops a rate for each yield rather than for ranges of yields. The rates change only incrementally for a small difference in yield. Since the Continuous Rating method would result in too many rates to publish in a small document, RMA will publish a single Base Premium Rate (the Reference Rate) at the 75% coverage level for the established county average yield (the Reference Yield) for each type and practice combination. Rates for all other possible yields are computed from this single published rate using the Continuous Rating computations outlined in this procedure.

A worksheet is provided within this procedure to assist in the computation of a Base Premium Rate for a given yield. The worksheet requires the current and previous year's Actuarial Table showing the Continuous Rating components, as applicable, and the corresponding 2000 crop year Actuarial Table, if any.

The following definitions and calculation instructions should be consulted for an explanation of the necessary components within each step of the calculations. Rounding rules for final and intermediate values are described in each step of the calculations.
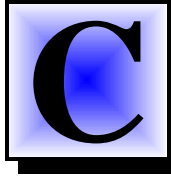
Continuous Rating

Automated rate calculation and premium quoting software must follow the rate calculation instructions as described here. The Actuarial Table information required for rating can be obtained from the Actuarial Data Master (ADM) for the current crop year. See the applicable RO Server Bulletin for the ADM record layouts. See the Data Acceptance System Handbook (FCIC-M13) for Base Premium Rate reporting and validation instructions.

Conflicts between this procedure and FCIC-M13 will be governed by this procedure. Conflicts between this procedure and the FCIC 18010 Crop Insurance Handbook (CIH), such as the determination of the appropriate APH Yield from which to compute a Base Premium Rate, will be governed by the CIH.

Any questions regarding this procedure should be addressed to:

> Office of the Assistant Manager for Research and Development, Actuarial Division
> Rates and Prices Branch
> P.O. Box 419293
> Kansas City, MO 64141
> Email ContRate@rm.fcic.usda.gov
> Fax (816) 926-3170

Continuous Rating

Definitions

Actuarial Table
The FCI-35 Coverage And Rates document for the state / county / crop / insurance plan / type / practice for the appropriate year.

Additional Coverage Rate
One or more rates that are added to the Preliminary Base Rate to account for the risk of certain specified elected options and any high-risk surcharge. This is the sum of the applicable items annotated with an "A" in the "Additional Coverage and High-Risk Rates" section of the Actuarial Table.

Adjusted Base Rate
The Preliminary Base Rate with adjustments made for additional coverage options/endorsements and/or high-risk land.

Approved APH Yield
In summary, this is the amount of production per acre computed and approved by the verifier (based on up to ten years of history), including any applicable adjustments, as defined in the Crop Insurance Handbook.

Average APH Yield
The simple average of the per-acre yields in the APH database (before any yield adjustment), as defined in the Crop Insurance Handbook.

APH Yield
The APH yield for the current year that is used to determine the applicable rate, as defined in the Crop Insurance Handbook. Generally this is the Approved APH Yield, unless the yield floor applies, in which case this is the Average APH Yield.

Base Premium Rate
The Adjusted Base Rate multiplied by the Coverage Level Rate Differential.

Continuous Rating

Continuous Rating Base Rate   The base rate calculated from the APH Yield and appropriate year's set of rate variables: Reference Yield, Reference Rate, Exponent and Fixed Rate Load.

Exponent   A rate component used in calculating the Continuous Rating Base Rate. The Exponent is listed on the Actuarial Table for the appropriate year.

Fixed Rate Load   A rate component used in calculating the Continuous Rating Base Rate. The Fixed Rate Load is listed on the Actuarial Table for the appropriate year.

Designated Rate   A fixed rate that is used in the calculation of the Adjusted Base Rate. The Designated Rate is annotated with an "F" in the "Additional Coverage and High-Risk Rates" section of the Actuarial Table.

Multiplicative Factor   One or more factors that are multiplied against the Preliminary Base Rate (after the Additional Coverage Rate is applied) to account for the risk of certain specified elected options and any high-risk surcharge. This is the product of the applicable items annotated with an "M" in the "Additional Coverage and High-Risk Rates" section of the Actuarial Table.

Preliminary Base Rate   The lowest of: (1) the current year's Continuous Rating Base Rate, (2) 120% of the Yield Span Base Rate, and (3) 120% of the prior year's Continuous Rating Base Rate.

Reference Rate   A rate component used in calculating the Continuous Rating Base Rate. The Reference Rate is listed on the Actuarial Table for the appropriate year.

Reference Yield   A rate component used in calculating the Continuous Rating Base Rate. The Reference Yield is listed on the Actuarial Table for the appropriate year.

Yield Ratio   The ratio of the APH Yield to the Reference Yield.
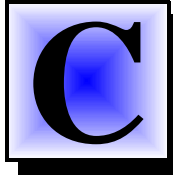
Continuous Rating

Yield Span Base Rate

Initially, the R-span rate at the 75% coverage level the insured would have paid for the same APH yield in crop year 2000. In future years, these yield spans and associated base rates will be determined by RMA and the values will be found on the applicable ADM record.
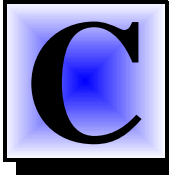
Continuous Rating

Sample Actuarial Table Document

Examples throughout this document refer to the following sample Actuarial Table. All examples use the following assumptions:

Crop	**Wheat**
Insurance Plan	**90**
State	**Nebraska**
County	**Box Butte**
Type	**NTS (997)**
Practice	**Summerfallow (005)**
APH Yield	**35 bushels**
Elected coverage level	**60%**
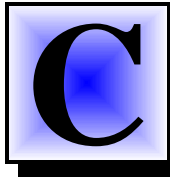
Continuous Rating

```
                        COUNTY ACTUARIAL TABLE                      PAGE    1
                       FCI-35 COVERAGE AND RATES
                      xxxx AND SUCCEEDING CROP YEARS

ST: NEBRASKA (31)                                       CROP: WHEAT (0011)
CO: Box Butte (013)                                     PLAN: APH (90)
-------------------------------------------------------------------------------

-------------------------------------------------------------------------------
TYPE                                                               PRACTICE
(997)NTS -- No Type Specified                      Irrigated -- I (002)
(997)NTS -- No Type Specified            Continuous Cropping -- CC (004)
(997)NTS -- No Type Specified                 Summerfallow -- SF (005)
-------------------------------------------------------------------------------
          TYPE             | (997) NTS  | (997) NTS  | (997) NTS  |
          PRACTICE         | (002) I    | (004) CC   | (005) SF   |
-------------------------------------------------------------------------------
REFERENCE YIELD(BU)        |    51.5    |    24.5    |    31.5    |
REFERENCE RATE             |    0.073   |    0.289   |    0.128   |
EXPONENT                   |   -1.955   |   -1.867   |   -1.924   |
FIXED RATE LOAD            |    0.023   |    0.023   |    0.023   |
-------------------------------------------------------------------------------
              ADDITIONAL COVERAGE AND HIGH-RISK RATES
-------------------------------------------------------------------------------
(AAA) HIGH-RISK AREA     |A|    0.098   |    0.300   |    0.151   |
-------------------------------------------------------------------------------
                 COVERAGE LEVEL RATE DIFFERENTIALS
-------------------------------------------------------------------------------
          CAT              |    0.47    |    0.47    |    0.47    |
          50%              |    0.47    |    0.47    |    0.47    |
          55%              |    0.51    |    0.51    |    0.51    |
          60%              |    0.57    |    0.57    |    0.57    |
          65%              |    0.65    |    0.65    |    0.65    |
          70%              |    0.79    |    0.79    |    0.79    |
          75%              |    1.00    |    1.00    |    1.00    |
-------------------------------------------------------------------------------
                            UNIT FACTORS
-------------------------------------------------------------------------------
(BU) BASIC UNIT            |    0.90    |    0.90    |    0.90    |
(OU) OPTIONAL UNITS        |    1.00    |    1.00    |    1.00    |
-------------------------------------------------------------------------------
                    OPTIONAL COVERAGE FACTORS
-------------------------------------------------------------------------------
(HF) HAIL & FIRE EXCLUSION |    0.52    |    0.52    |    0.52    |
(PF) PREVENTED PLANTING +5%|    1.01    |    1.01    |    1.01    |
(PT) PREVENTED PLANTING +10%|   1.02    |    1.02    |    1.02    |
(SR) SHORT RATE ADJUSTMENT |    0.35    |    0.35    |    0.35    |
-------------------------------------------------------------------------------
                     TRANSITIONAL YIELDS (BU)
-------------------------------------------------------------------------------
                           |    57.0    |    27.0    |    31.0    |
-------------------------------------------------------------------------------
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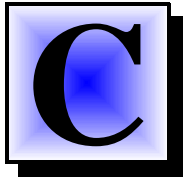
C ontinuous Rating

C ontinuous Rating Worksheet

1. Calculate the current year's *Yield Ratio*:
    APH Yield / Current Year Reference Yield.

    _____ / _____ = _____
    <div style="text-align:center">(1)</div>

2. Calculate the current year's *Continuous Rating Base Rate*:
    (Current Year Yield Ratio ** Current Year Exponent) x Current Year Reference Rate + Current Year Fixed Rate
    Load

    [_____ ** _____] x _____ + _____ = _____
    <div style="text-align:center">(2)</div>

3. Calculate 120% of the *Yield Span Base Rate*:
    Yield Span Base Rate x 1.20

    _____ x 1.20 = _____
    <div style="text-align:center">(2)</div>

4. Calculate the prior year's *Yield Ratio:*
    APH Yield / Prior Year Reference Yield

    _____ / _____ = _____
    <div style="text-align:center">(1)</div>

5. Calculate 120% of the prior year's *Continuous Rating Base Rate:*
    ((Prior Year Yield Ratio ** Prior Year Exponent) x Prior Year Reference Rate + Prior Year Fixed Rate Load) x
    1.20

    [[_____ ** _____] x _____ + _____] x 1.20 = _____
    <div style="text-align:center">(2)</div>

6. Determine the *Preliminary Base Rate:*
    Enter the lowest result of steps 2, 3 and 5.
    _____

7. Determine the *Adjusted Base Rate:*
    Greater of:
    [Preliminary Base Rate + Additional Coverage Rate] x Multiplicative Factor   OR   Designated Rate

    [_____ + _____] x _____ = _____   OR _____
    <div style="text-align:center">(2)   (2)</div>

8. Calculate the *Base Premium Rate:*
    Adjusted Base Rate x Coverage Level Rate Differential

    _____ x _____ = _____
    <div style="text-align:center">(2) (3)</div>

(1) Round to nearest hundredth, minimum value = .50, maximum value = 1.50
(2) Round to 8 decimal places including each interim step
(3) Maximum value .999

Continuous Rating

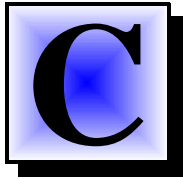# **C**ONTINUOUS RATING CALCULATION

Step 1:   Calculate Current Year's Yield Ratio:

Calculate the current year's Yield Ratio based on the APH Yield and the current year's Reference Yield.

$$Current\ Year's\ Yield\ Ratio\ =\ \frac{APH\ Yield}{Current\ Year's\ Reference\ Yield}$$

- Round the Yield Ratio to the nearest hundredth
- Minimum Yield Ratio equal to .50
- Maximum Yield Ratio equal to 1.50

For example, we are given the APH Yield of 35 bushels per acre and we find that the Reference Yield on the Actuarial Table for Summerfallow Wheat is 31.5 bushels; therefore, the Yield Ratio is: 1.11 (35.0 / 31.5 = 1.1111111 ...).

C ontinuous Rating

Step 2:   Calculate Current Year's Continuous Rating Base Rate:

Calculate the current year's Continuous Rating Base Rate based on the current year's Yield Ratio, Exponent, Reference Rate and Fixed Rate Load.

{(Current Year Yield Ratio) $^{Current\ Year\ Exponent}$ *} x Current Year Reference Rate +*

Current Year Fixed Rate Load

- Round to 8 decimal places, including each interim step

The first calculation is to raise the result of step 1 (Yield Ratio) by the power function (Exponent). For example, we determined the Yield Ratio to be 1.11 in step 1 and the Exponent for Summerfallow Wheat on the Actuarial Table is -1.924. This results in a factor of .81808530 (.818085299...).   The second calculation is to take that result .81808530 and multiply it by the Reference Rate for Summerfallow Wheat (.128) from the Actuarial Table, which results in a value of .10471492 (.104714918....). The third calculation is to take that result (.10471492) and add the Fixed Rate Load for Summerfallow Wheat (.023) from the Actuarial Table. This results in a Continuous Rating Base Rate of .12771492.
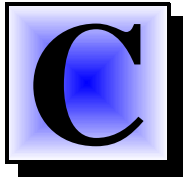
Continuous Rating

Step 3:   Calculate 120% of Yield Span Base Rate:

Calculate 120% of the Yield Span Base Rate based on the APH Yield. If the applicable state / county / crop / insurance plan / type / practice did not exist in the prior crop year, the yield and rate elements used in determining the Yield Span Base Rate of this calculation will be blank. If blank, the Yield Span Base Rate should be considered to be equal to 0.999 for processing purposes.

> *Yield Span Base Rate x 1.20*

- Round to 8 decimal places

For example, the 75% coverage level Yield Span Base Rate for APH Yields of 35 through 38, Summerfallow Wheat in Box Butte County for crop year 2000 was .122 (R06).

 This Yield Span Base Rate of .122 is multiplied by 1.20 for a result of .1464.

Note: In certain circumstances, the Yield Span Base Rate used in the rating formula may need to be modified (lowered) in order to ensure that no rate increase exceeds 20%. This situation can arise in the year or years following a revision to the components of the Continuous Rating formula.

For example, in the event that a revision to the components of the Continuous Rating formula for cropyear 2004 results in a rate increase in excess of 20% for some APH Yield, the Preliminary Base Rate will be less than the current year's Continuous Rating Base Rate. This creates the possibility that some producer may receive a rate increase of more than 20% the following year unless the Yield Span Base Rate is modified the following year. To address this problem, RMA will identify the restrained yields and selectively override values for the Yield Span Base Rates to ensure that the rate increase will not exceed 20%.
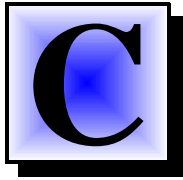
C ontinuous Rating

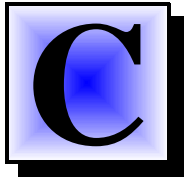## Step 4:   Calculate Prior Year's Yield Ratio:

NOTE: Whenever the applicable state / county / crop / insurance plan / type / practice did not exist in the prior crop year, the prior year's Continuous Rating Base Rate components will be the same as the current year's components.

For the 2001 crop year, the computation of the prior year's Continuous Rating Base Rate is not applicable, as continuous rating did not exist in 2000. However, to ensure uniformity of the calculations in future years, the 2000 crop year Continuous Rating Base Rate components (Reference Yield, Reference Rate, Exponent, Fixed Rate Load) will be the same as the 2001 crop year components.

Calculate the prior year's Yield Ratio based on the APH Yield and the prior year's Reference Yield.

$$\textbf{\textit{Prior Year's Yield Ratio}} \ = \ \frac{\textbf{\textit{APH Yield}}}{\textbf{\textit{Prior Year's Reference Yield}}}$$

- Round the Yield Ratio to the nearest hundredth
- Minimum Yield Ratio equal to .50
- Maximum Yield Ratio equal to 1.50

C ontinuous Rating

Step 5: **Calculate 120% of Prior Year's Continuous Rating Base Rate:**

Calculate 120% of the prior year's Continuous Rating Base Rate determined from the prior year's Yield Ratio, Exponent, Reference Rate, and Fixed Rate Load.

{{(Prior Year Yield Ratio) $^{Prior\ Year\ Exponent}$ *} x Prior Year Reference Rate +*

Prior Year Fixed Rate Load} x 1.20

- Round to 8 decimal places, including each interim step

For example, in 2001 the prior year's Continuous Rating Base Rate components will be identical to the current year values. The prior year's Yield Ratio is the APH Yield of 35 bushels divided by the prior year's Reference Yield of 31 bushels, for a result of 1.11. The prior year's Continuous Rating Base Rate is:

$1.11^{-1.924}$ x .128 + .023 = .12771492

This is multiplied by 1.20, for a result of .15325790.
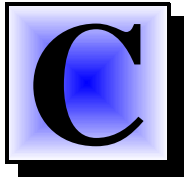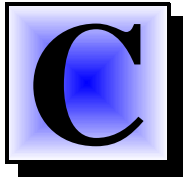
C ontinuous Rating

Step 6:   Determine Preliminary Base Rate:

The Preliminary Base Rate is the lowest result of Step 2, Step 3 and Step 5.

Preliminary Base Rate = Lowest result of Steps 2, 3, and 5

The purpose of this step is to limit the annual rate increase to no more than 20%, in accordance with federal statute.

For example, the result in Step 2 was .12771492; in Step 3 was .14640000; and Step 5 was .15325790. The lowest of the three results is .12771492 from Step 2.

Continuous Rating

Step 7: Determine Adjusted Base Rate:

The Adjusted Base Rate is the greater of: (1) the Preliminary Base Rate (Step 6) plus any Additional Coverage Rate, with the sum multiplied by the Multiplicative Factor; or (2) the Designated Rate.

Adjusted Base Rate = Greater of:

> *[Preliminary Base Rate + Additional Coverage Rate] x Multiplicative Factor*

>   *OR*

> *Designated Rate*
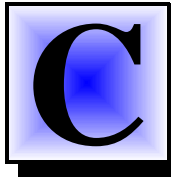
- Round to 8 decimal places

For example, if the insured acreage is in map area AAA, there is an additive rate of .151 shown on the Actuarial Table for Summerfallow Wheat. The Adjusted Base Rate in this example would equal .27871492 (.12771492 + .151).

The above adjustments to the Preliminary Base Rate are intended to reflect the added risk of high-risk areas and certain coverage endorsements. The default for the Additional Coverage Rate is 0.000, the default for the Multiplicative Factor is 1.000 and the default for the Designated Rate is 0.000.

Current additive endorsements are:

MA	Malting Barley Price and Quality Endorsement - Option A
MB	Malting Barley Price and Quality Endorsement - Option B
WA	Wheat: Winter Coverage Endorsement - Option A
WB	Wheat: Winter Coverage Endorsement - Option B

If multiple adjustments are needed, they must be combined before being entered into the formula. For example, an add-on high-risk rate surcharge would need to be combined with the winter coverage endorsement rate before being added to the Preliminary Base Rate.

C ontinuous Rating

Step 8:   Calculate Base Premium Rate:

Calculate the Base Premium Rate by multiplying the Adjusted Base Rate (Step 7) by the elected Coverage Level Rate Differential found on the Actuarial Table.

> ***Base Premium Rate = Adjusted Base Rate x Coverage Level Rate Differential***

- Round to 8 decimal places
- Cap rate at 0.999

For example, if the insured elected the 60% coverage level, the Adjusted Base Rate of .27871492 from step 7 would be multiplied by the 60% Coverage Level Rate Differential of .57 as shown on the Actuarial Table, which equals .15886750.

The Base Premium Rate calculated in this step is subsequently utilized to calculate the total premium cost for insurance plan codes 25, 44 and 90.