Applied Risk Analytics

Evaluating RI-PRF Strategies with the MTRA Tool

Jim Housing* is the manager of BB Ranch in Platte County and is in the process of evaluating Pasture Rangeland, Forage-Rainfall Index (RI-PRF) insurance options. He is looking for a strategy to better manage production risk on their native pastures. It is fall and has been extremely dry throughout the past summer. Jim is worried about continuing drought conditions. RI-PRF seems like a reasonable tool that could allow the ranch to manage some of this risk. He is interested to examine the policy further. He is most concerned about rainfall and the corresponding grass production in the April-May and June-July timeframes.

RI-PRF policies are based upon a 17x17 mile grid area and utilize a rainfall index to measure precipitation at numerous sites in the grid areas determined by NOAA (National Oceanic and Atmospheric Administration). Coverage is established by a base index value and is divided into eleven, two-month index intervals. Producers select coverage intervals with no more than 70 percent of total coverage assigned to any one interval (intervals must be non-consecutive). Coverage can vary from 70-90 percent of the index base value and producers may choose a productivity factor of up to 150 percent of the index base value. Indemnities are paid if the insured value falls below the actual index base value determined by the rainfall index.

RightRisk Analytics
Tools and guides are available at no cost at the website https://RightRisk.org

Using the Decision Support Tool

Using the decision support tool available online at prodwebnlb.rma.usda.gov/apps/prf# is a quick and simple way to estimate RI-PRF

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Table 1. Example RI-PRF Coverage Levels and Premiums.

Coverage Option	Coverage Level (%)	Productivity Factor (%)	Coverage (Total $)	Estimated Premium (Total $)	Per Acre ($)	Estimated Indemnity (Total $)	Per Acre ($)
Max: April-May	90	150	$ 5,020	$ 390	$ 0.61	$ 3,631	$ 5.67
June-July	90	150	$ 2,151	$ 157	$ 0.25	$ 1,563	$ 2.44
Mid: April-May	85	100	$ 3,161	$195	$ 0.30	$ 2,235	$ 3.49
June-July	85	100	$ 1,355	$ 78	$ 0.12	$ 963	$ 1.50
Min: April-May	60	60	$ 1,562	$ 51	$ 0.08	$ 1,006	$ 1.57
June-July	60	60	$ 669	$ 20	$ 0.03	$ 434	$ 0.68

coverage. The tool allows the user to determine coverage options and compare to historical estimates back to 1948. The BB Ranch is in Platte County, Wyoming (Grid #26500). The base index value is $8.30/acre. Jim selects 70 percent coverage in the April-May interval and the remaining 30 percent in the June-July interval; he also enters 640 acres. These intervals represent the critical forage production periods. He can use the historical data provided by the tool to estimate potential indemnity payments.

The interval value was 24.9 for April-May in 1966 and in 1980 it was 24.6 for June-July. It is important to note that, while these data points represent the historical low, it is possible that the index could result in an even lower index value. For the purpose of our analysis, we will assume these are the low index values. We will use the data generated by the support tool to examine three coverage options for the BB Ranch: 1. The maximum coverage available (90 percent coverage, 150 percent productivity factor), 2. A mid-range level (85 percent coverage, and 100 percent productivity factor), and 3. The minimum coverage available (70 percent coverage, and 60 percent productivity factor). Entering each of these options, along with the corresponding data for 1966 and 1980, the tool generates the total coverage, potential indemnity, and premium data found in Table 1.

Selecting the maximum amount of coverage may be an acceptable risk management strategy, given the premium price and fit with the BB Ranch cost structure. Jim would like to evaluate the different strategies on a long-term basis. Using a simple, partial budget approach may not be adequate to compare the strategies, as it is difficult to estimate how effective the policy would be over the long term. Simply comparing coverage with the long term data may not provide an accurate picture, let alone determine if RI-PRF coverage could be expected to generate a positive net return over a long period of time.

Multi-Temporal Risk Analyzer (MTRA) Tool

The Multi-Temporal Risk Analyzer tool (MTRA) from RightRisk.org is a budgeting tool designed to provide users the means to examine the long-term outcome of management decisions, often evaluated with partial budgeting. The MTRA tool is a spreadsheet-based, partial budget tool that allows users to enter inflows from added returns and reduced costs, along with outflows due to reduced returns and added costs. For each of these costs and return categories, users enter a most likely, minimum, and maximum value to account for uncertainty. In addition, the user may select from 1 to 20 years in which each cost or return factor is expected to occur.

Table 2. MTRA Entries for BB Ranch Pasture Rangeland, Forage (RI-PRF) Coverage Example.

Proposed Change:	Interest Rate:	5.00%		~ Check the boxes belo					
RI-PRF Long Term Strategy	Most Likely VALUE	Expected Low/High Value			Year 1	Year 2	Year 3	Year 4	Year 5
Added Returns									
Indemnity payment (April-May interval)	$ 390	$ - Low	All		☑	☑	☑	☑	☑
		$ 3,631 High	None						
Indemnity payment (June-July interval)	$ 157	Low	All		☑	☑	☑	☑	☑
		$ 1,563 High	None						
	$ -	$ - Low	All		☐	☐	☐	☐	☐
		$ - High	None						
	$ -	$ - Low	All		☐	☐	☐	☐	☐
		$ - High	None						
Reduced Costs									
	$ -	$ - Low	All		☐	☐	☐	☐	☐
		$ - High	None						
	$ -	$ - Low	All		☐	☐	☐	☐	☐
		$ - High	None						
		Low	All		☐	☐	☐	☐	☐
		High	None						
	$ -	$ - Low	All		☐	☐	☐	☐	☐
		$ - High	None						
Added Costs									
Premium Cost	$ 547	$ 547 Low	All		☑	☑	☑	☑	☑
		$ 547 High	None						
	$ -	$ - Low	All		☐	☐	☐	☐	☐

We begin by first entering the maximum coverage strategy in the MTRA input page. We enter the potential indemnity payments of $3,631 for April-May and $1,563 for June-July under Added Returns. These totals will serve as the maximum values for the indemnity payment. Zero is entered for the minimum, as in some years there will be no indemnity. Finally, we set the most likely values for each interval as the proportional premium cost given by the RMA Decision Support tool ($390 for April-May, and $157 for June-July). For this first simulation run, we select 20 years for each entry, Table 2.

MTRA evaluates risk scenarios for single- and multi-year periods using a set of random draws to

simulate the possible actual cost and returns to account for uncertainty. Results include annual and cumulative net returns on a cash- and net present value-basis via the output screen after clicking RUN.

The maximum coverage strategy results in a positive net return over 20 years on a cash basis for a total of $12,721 or an average of $636/year for this first draw (Table 3). When we factor in a 5 percent interest rate (time value of money), the strategy results in a positive, cumulative net return of $8,350 or an average of $418/year. Clicking RUN again generates another single draw of randomized results.

Table 3. Max Coverage Option MTRA Simulation Results.

Proposed Change: RI-PRF Long Term Strategy

Interest Rate: 0.00%

	CASH-basis analysis				
YEAR	*Projected* Total Added Returns	*Projected* Total Reduced Costs	*Projected* Total Added Costs	*Projected* Total Reduced Returns	*Projected* NET ANNUAL Return
1	1,561	-	547	-	1,014
2	511	-	547	-	-36
3	1,066	-	547	-	519
4	1,626	-	547	-	1,079
5	1,405	-	547	-	858
6	1,733	-	547	-	1,186
7	960	-	547	-	413
8	116	-	547	-	-431
9	1,602	-	547	-	1,055
10	1,002	-	547	-	455
11	2,253	-	547	-	1,706
12	1,252	-	547	-	705
13	706	-	547	-	159
14	167	-	547	-	-380
15	1,005	-	547	-	458
16	762	-	547	-	215
17	2,320	-	547	-	1,773
18	1,246	-	547	-	699
19	1,591	-	547	-	1,044
20	777	-	547	-	230

Net Return:	**12,721**
MIN Rtn:	-431
AVG. Rtn:	636
MAX Rtn:	1773

Interest Rate: 5.00%

	PRESENT VALUE-basis analysis				
YEAR	*Projected* PV-Total Added Returns	*Projected* PV-Total Reduced Costs	*Projected* PV-Total Added Costs	*Projected* PV-Total Reduced Returns	*Projected* PV-NET ANNUAL Return
1	1,561	-	547	-	1,014
2	487	-	521	-	-34
3	967	-	496	-	471
4	1,405	-	473	-	932
5	1,156	-	450	-	705
6	1,358	-	429	-	929
7	716	-	408	-	308
8	82	-	389	-	-306
9	1,084	-	370	-	714
10	646	-	353	-	293
11	1,383	-	336	-	1,048
12	732	-	320	-	412
13	393	-	305	-	88
14	89	-	290	-	-201
15	508	-	276	-	232
16	367	-	263	-	103
17	1,063	-	251	-	812
18	544	-	239	-	305
19	661	-	227	-	434
20	307	-	216	-	91

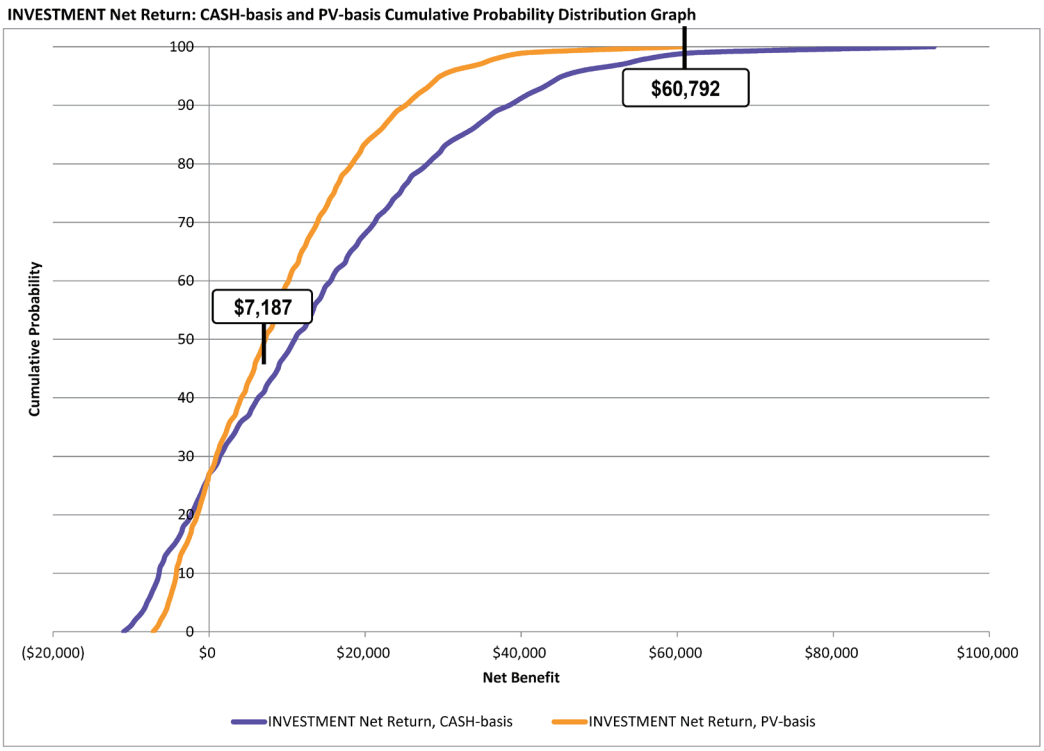
Net Return:	**8,350**
MIN Rtn:	-306
AVG. Rtn:	418
MAX Rtn:	1048

MTRA Analytics

The multi-draw and probability analytics are among the more important outputs provided by MTRA; viewing outcomes for just a single 20-year draw does not provide a complete picture of the range of all possible outcomes. The multi-draw analysis reveals the expected net returns for 1,000 draws, better describing the overall range of possibilities, the expected probabilities, as well as showing the effect of the time value of money (interest rate) on estimated net returns.

Multi-draw results are highlighted in Figure 1 in the form of a probability distribution for the expected net returns from the strategy on a cash- and net present value-basis. The orange line represents the strategy's net return on a present value basis, while the purple line represents the cash basis returns. Net present value-basis results for the maximum coverage option, assuming a 5 percent interest rate, suggest that if the RI-PRF policy were purchased consistently every year over a 20-year period at the max coverage level, the most likely total net return would result in around $7,187 or $359/year (50/50 chance), around $0.56/acre/year. In addition, we can see there is essentially a 100 percent probability that returns will not exceed $60,792 or $3,040/year ($4.75/acre).

Figure 1. Maximum Coverage Example Probability Distribution, Cash- and Net Present Value-Basis.



We can easily re-run the simulation for the two other coverage options. The mid-range coverage is approximately half the premium cost per acre at $0.42. We enter the expected indemnity values and premium cost from Table 1, along with $2,235 and $963 for the expected interval indemnity maximums, leaving the interest rate the

same (5 percent). Clicking RUN causes MTRA to calculate a 50/50 probability of generating a total net return over a 20-year span of $4,566 ($228 per year) and a 100 percent probability that returns will not exceed $58,488 ($2,924 per year).

The minimum coverage option includes $1,006 and $434 for the expected interval indemnity maximum values from Table 1 and $71 for the premium cost. Clicking RUN results in a MTRA probability curve similar to the other two options, with an expected lower overall set of possible returns. The most likely net return over twenty years of purchasing the minimum coverage option (50/50 probability) would be $2,151 or $108 per year. Total net returns would not be expected to exceed $27,377 or $1,369 per year (100 percent probability).

Table 4. RI-PRF Coverage MTRA Results Comparison, Net Present Value-Basis, 640 Acres.

	Maximum Coverage	Mid-Range Coverage	Minimum Coverage
Total Premium, 20 years	$ 10,940	$ 5,460	$ 1,420
Annual Premium	$ 547	$ 273	$ 71
Per Acre Premium	$ 0.85	$ 0.43	$ 0.11
- Highest Possible - Estimated Net Return, 20 years			
Total Net Return	$ 60,792	$ 58,488	$ 27,377
Annual Net Return	$ 3,040	$ 2,924	$ 1,369
Per Acre Annual Net Return	$ 4.75	$ 4.57	$ 2.14
- Most Likely - Estimated Net Return, 20 years			
Total Net Return (50/50)	$ 7,187	$ 4,566	$ 2,151
Annual Net Return	$ 359	$ 228	$ 108
Per Acre Annual Net Return	$ 0.56	$ 0.36	$ 0.17

The Decision

The main challenge outlined earlier for Jim was how to examine and compare different levels of RI-PRF coverage. Without the MTRA results, it would be difficult to estimate the long-term returns of purchasing coverage on a net present value basis. The results from the MTRA simulations under all three coverage options examined for the BB Ranch example are outlined in Table 4. One interesting aspect is that the expected high return for the mid-range option is not much lower, $2,304 lower in total or $115 per year, than estimated under maximum coverage, even though purchased at half the premium cost. This is mirrored by the most likely net returns; the mid-range coverage generates an average yearly net return of $131 less than the maximum coverage.

It may be a good idea for Jim to purchase the mid-range option, if his goal is to keep expenses down on the ranch. On the other hand, if the higher coverage premium is acceptable from a cost standpoint, Jim could expect a positive net return over twenty years using the maximum coverage strategy. The net return results generated by the MTRA analytics offer the BB Ranch a better understanding of the tradeoffs between the alternatives. As a result, Jim is better equipped to decide which level of coverage fits their long-term risk management needs.

** The Jim Housing operation is a case study example created to demonstrate RightRisk tools and their applications. No identification with actual persons living or deceased, places, or agricultural operation is intended nor should be inferred.*