

The R-Z Weight System (EOWEP) for FPA-PM

(An Abstract)

Douglas B. Rideout, Ph.D.
and
Pamela Sue Ziesler

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Fire Economics Laboratory
Department of Forest, Rangeland, and Watershed Stewardship
Colorado State University, Fort Collins, CO 80523

Why Weights?

The original economic design for FPA (Rideout and Kirsch 2002) called for a system of non-monetized weights to guide resource allocation decisions. Previous and current fire management analysis systems use dollar values to weight the importance or value of different alternatives. FPA-PM is the first major system designed as a non-monetized application that conforms to the expectations that federal fire agencies use cost effectiveness analysis for program management planning. Cost effectiveness analysis requires a physical measure of effectiveness such as acres protected or acres improved. Because some acres are more important to protect than others, a weighting system is required to reflect this importance in the optimal deployment model (integer program - IP). Weights are applied at the FPU level because each FPU is composed of several administrative units that will share a common IP run.

This is Not a Training Document

This is an abstract of the EOWEP weighting system and it is not intended as a training document. Much more training materials are (or have been) separately prepared. The process for elicitation of fire protection attributes and their implicit prices is a central feature of EOWEP. Important information on the elicitation process is not addressed in this paper but will be (is) addressed in subsequent educational materials associated with “training.”

What is a Weight?

In initial attack, a weight defines how much more important it is to protect one kind of acre from wildfire than it is to protect another kind of acre (at a given intensity level and sensitivity period). For example, if it is twice as important to protect acres containing sensitive habitat than it is to protect acres of rangeland, then protecting acres of sensitive habitat would count twice as much toward the effectiveness calculation. Thus, weights are *not* priorities or ranks. Instead, they empirically reflect the relative importance of fire protection by fire intensity level and sensitivity period.

The integrity of the weight system requires that weights only reflect the relative importance of protecting different kinds of acres from wildfire during initial attack. They are not a means for manipulating the outcome of the FPA-PM process to arrive at a desired outcome. Similarly, using weights as political statements or as bargaining leverage to encourage/discourage participation in FPU membership is inappropriate. Any use of weights other than for expressing the relative importance of protecting different kinds of acres from wildfire effects invalidates the FPA-PM economic analysis as performed by the integer program.

The R-Z System (EOWEP) in FPA-PM

Credible construction of weights relies upon an understanding of the economics involved. Before elicitation, the planning team must grasp the meaning of the comparisons and how these comparisons are used in the system.

Expert Elicitation

Elicitation of attributes and their implicit prices from the expert is required. The expert is defined as the collection of fire managers, planners and resource managers necessary to provide information on initial attack and fire effects for assessing the relative importance of protecting different kinds of acres from wildfire.

Elicitation and Definition of Protection Attributes

Our system requires elicitation of a list of wildfire protection attributes reflecting the reasons that protection is important. Protection attributes are elicited from and defined by interdisciplinary experts on the planning unit and may reflect planning goals or objectives. Each attribute has a defined unit of measure in acres that needs to be commonly understood by each member of the planning team. Teams should develop a short paragraph for each attribute to document its meaning. Principles of attributes will be defined in another paper and in educational materials associated with the training process.

Elicitation of Relative Values of Protection Attributes

Developing a common understanding of the protection attributes requires time and effort by the planning team. Each protection attribute is assessed relative to the other attributes by eliciting, for example, how important it is to protect acres of sensitive habitat relative to protecting acres containing structures such as homes¹. The process and rules for elicitation are central to the integrity of the weight system and they will be (are) separately addressed in papers and in educational materials.

Acres Inventory of Protection Attributes

After elicitation of the attribute prices, the planning team must take their list of attributes and estimate how many acres of each attribute reside in each FMU. If an acre contains two protection attributes it is necessary to count it twice; once for each attribute. If an acre contains no protection attribute, the acre is not counted. An example of the acre inventory by FMU and attribute is listed in Table 1.

¹ Such acreage is often known as the wildland urban interface or (WUI). Because definitions of the WUI have been politicized and greatly vary, we encourage direct physical definition of the attribute in terms of a description of the resource and to avoid use of the term WUI.

Computation of FMU weights

In an FMU, the acres for each protection attribute are multiplied by their attribute price (IAP) to yield the value of protecting that attribute in the FMU. These individual contributions to value are summed for each FMU to produce the Fire Protection Value (FPV) for the FMU. This FPV is divided by the number of acres in the FMU where fires could occur to provide a per acre weight for the FMU. This is the weight for the FMU that is applied to the integer program. This weight only has meaning when compared to the weight calculated for another FMU. For example, if the weight calculated for FMU 1 was 1.2 and the weight for FMU 2 was 0.8 then we would interpret this as saying that it is $(1.2/0.8)$ 1.5 times more important, or 50 percent more important, to protect acres in FMU 1. An empirical example of FMU weight computations, based on the Southern Sierra Prototype, is shown in the following table.

Protection Attribute	FMU			IAP
	FMU 12	FMU 13	FMU 14	
Wilderness	28,893	5,344	47,930	0.200
Sequoia Groves	0	1,099	0	0.750
WUI	41,949	41,683	61,766	1.000
Forest Structure	154	51,762	560	0.400
Commercial Timber	0	5,000	0	0.600
Natural Areas of SC		5,000	160	0.570
Social Areas of SC		10,000		0.700
Cultural Areas of SC		5,000		0.750
Rangeland	10,000	3,000		0.300
General Protection				0.100
Fire Protection Value	50789	81781	71667	
Total Acres in FMU	55501	74799	82167	
Final FMU Weight	0.92	1.09	0.87	

Table 1: Draft FMU Weight Calculation for Southern Sierra Prototype

This draft table shows the list of elicited attributes in the first column followed by the number of acres of each attribute by FMU. The elicited IAPs are in the last column and their “currency” is acres of WUI—high structure density; the highest IAP in this example. Computations are as described above.

Discussion

The R-Z Expert Opinion Weight Elicitation Process (EOWEP) relies on establishing, documenting and evaluating the reasons why it is important to protect acres from wildfire. The strengths of this method are that when properly conducted it should be defensible and based on a sound application of economic theory. Elicitation of the attributes and their prices is the crux of the process. This requires a clear understanding of the elicitation process, attribute definitions and comparisons by the planning team. There are many implications that are not addressed in this abstract, but one that should be mentioned is the concept of the FPU family. In the sense that a family shares the family income, the FPU shares the cost analysis and budget allocation (even though it may be broken out by agency). The construct of the FPU requires that the integer program and the budget allocation be performed across the entire FPU. **Any weight system** would require an evaluation of each FMU relative to the other FMUs for initial attack. The method presented in this abstract makes the weighting process explicit, objective and, we think, defensible. Entities that cannot agree upon a common set of attributes and IAPs likely do not belong in the same FPU. This is the nature of the FPU “sharing” a budget analysis and

integer program run, and it is not a function of the weighting system. An advantage of a credible weight system is that it can identify members of the FPU that cannot contribute as part of the family.

Selected References

Champ, Patricia, A. et al., Editors, 2004. A Primer on Nonmarket Valuation. Kluwer Academic Publishers. Dordrecht, The Netherlands.

Osborne, David and Peter Plastrik. 2000. The Reinventor's Fieldbook: Tools for transforming government. Jossey-Bass. San Francisco. 689pp.

Rideout, Douglas B. and Andrew G. Kirsch. 2002. The Economic Theory Guiding Fire Program Analysis System: Response to Questions Submitted by Howard Roose. Working Paper, Department of Forest Sciences, Colorado State University. Fort Collins, CO 28pp.