**FISH 507/SOE 592 – Introduction to Structured Decision Making**

Homework #3

Due to Sarah via email ([sconver@uw.edu](mailto:sconver@uw.edu)) by 5pm on Friday, 2/10/2023

A multi-agency group of managers are working to improve habitat in one of the breeding tributaries of the federally endangered Wenatchee River Chinook salmon population. There is uncertainty over what habitat management actions are most effective. Due to some recent research, though, we have estimated probabilities of population outcomes in terms of the expected number of returning breeders per year under each of five habitat management strategies, which are collections of habitat management actions. We have discretized the possible outcomes to intervals of 100 breeding fish – we can take the median of the interval as the value for that outcome (e.g., for the 0-100 breeding fish interval, we can use a value of 50 fish for our calculations).

Your assignment is to solve the following decision problem for a variety of decision makers representing different agencies, each of whom has a slightly different risk tolerance. A decision analyst worked with these decision makers to better understand their risk tolerance, producing the information we have below.

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| --- | --- | --- | --- | --- | --- |
|  | Action 1: Habitat Strategy 1 | Action 2: Habitat Strategy 2 | Action 3: Habitat Strategy 3 | Action 4: Habitat Strategy 4 | Action 5: Habitat Strategy 5 |
|  | Probabilities of seven outcomes (value for the outcome is given on left) under each of the strategies | | | | |
| N = 0-100  **Value = 50** | 0.10 | 0.25 | 0.00 | 0.10 | 0.14 |
| N = 100-200 **Value = 150** | 0.15 | 0.10 | 0.00 | 0.10 | 0.14 |
| N = 200-300 **Value = 250** | 0.20 | 0.05 | 0.25 | 0.10 | 0.14 |
| N = 300-400 **Value = 350** | 0.20 | 0.05 | 0.25 | 0.10 | 0.15 |
| N = 400-500 **Value = 450** | 0.15 | 0.10 | 0.25 | 0.20 | 0.15 |
| N = 500-600 **Value = 550** | 0.10 | 0.20 | 0.25 | 0.20 | 0.14 |
| N = 600-700  **Value = 650** | 0.10 | 0.25 | 0.00 | 0.20 | 0.14 |

1. The first decision maker is interested in maximizing the expected number of returning breeders. Which habitat strategy maximizes the expected number of breeders, and how many breeders are expected under that strategy?
2. The second decision maker has articulated a desire to maximize the probability that the population does not decline below its current value (current value = 250). Which habitat management strategy maximizes the probability that we get at least 250 breeders, and what is the probability that we get at least 250 breeders under that strategy?
3. The third decision maker has articulated a desire to maximize the probability of hitting the population target for this breeding tributary that is identified in recovery planning documents, which is 450 breeders. Which habitat management strategy maximizes the probability that we get at least 450 breeders, and what is the probability that we get at least 450 breeders under that strategy?
4. The fourth decision maker has identified a desire to maximize the minimum outcome. Which habitat management strategy maximizes the minimum number of breeders that might be obtained under that strategy, and what is the minimum number of breeders that might be obtained under that strategy?
5. The fifth decision maker has developed their own utility function:

Note that this is essentially a utility of ln(x+0.1) but where we have standardized it to the

* 1. scale.
* Provide a plot of the utility function (i.e., value on x-axis, utility on y-axis).
* Is this decision maker risk-averse or risk-seeking? Explain.
* Which habitat management strategy is preferred by this decision maker, and what is the expected utility under that strategy?

1. Explain the collective preferences of these five decision makers. Are there some alternatives that we can eliminate? Are there some alternatives that are still in play? Can we identify a single alternative that is preferred by all? If not, what would you recommend next, if you were the decision analyst working with this group?