PROBLEM

$$w_h\boldsymbol{hx} + w_e G(\boldsymbol{u_1 x}, \boldsymbol{u_2 x}) + w_d H(\boldsymbol{s_1 x}, \boldsymbol{s_2 x}, \boldsymbol{s_3 x})$$

subject to:

$$\boldsymbol{cx} \leq B$$

$$(\boldsymbol{I} - \boldsymbol{D}')\boldsymbol{x} \leq 1 - \boldsymbol{di}$$

- $\boldsymbol{x}$ is the nx1 control vector where n is the number of barriers and $x_i \in \{0, 1\}$
- $\boldsymbol{D}$ is a nxn matrix where d_{ij} = 1 if barrier j is directly downstream from barrier i
- $\boldsymbol{h}$ is the 1xn vector with elements h_i which are the habitat between barrier i and the next upstream barrier(s)
- $\boldsymbol{u}_u$ are 1xn indicator vectors assigning a user group to each barrier where $u \in \{1, 2\}$
- $\boldsymbol{s}_s$ are 1xn indicator vectors assigning a salmon stock to each barrier where $s \in \{1, 2, 3\}$
- G is the non-linear function for the Gini coefficient
- H is the non-linear function for the Herfindahl-Hirschman index
- $\boldsymbol{c}$ is the 1xn vector with elements c_i that are the cost of removing barrier i
- B is the budget
- $\boldsymbol{I}$ is a nxn identity matrix
- $\boldsymbol{d}$ is a nx1 vector with elements d_i that count the number of barriers directly downstream from barrier i