Supplementary Material

Multi-objective Optimization to Derive an SPI target

To set up the optimisation task, we first need to express the parameter space and any constraints. Since our goal is to identify an optimised soundscape target distribution, the parameters we will search over are:

- $\xi = (\xi_x, \xi_y)$, $-1 \leq \xi \leq 1$

- $\Omega = \begin{pmatrix} var(x) & cov(x,y) \\ cov(y,x) & var(y) \end{pmatrix}$

  - $0 \leq var() \leq 1$
  - $-1 \leq cov() \leq 1$
  - Ω must be symmetric and positive definite

- $\alpha = (\alpha_x, \alpha_y)$, $-5 \leq \alpha \leq 5$

- $-1 \leq x, y \leq 1$ In `pymoo`, each objective function is supposed to be minimized. Therefore, we need to convert both SPI and r() to minimize problems.

- $\min -r(ranks_{quality}, ranks_{target})$

- $\min -mean(SPI_{target}(X_i))$

The final objective function is:

- $f_1 = -r(ranks_{quality}, ranks_{target})$
- $f_2 = -mean(SPI_{target}(X_i))$

So our variables to optimize are:

- $-1 \leq \xi_x \leq 1$
- $-1 \leq \xi_y \leq 1$
- $0 \leq var(x) \leq 1$
- $0 \leq var(y) \leq 1$
- $-1 \leq cov(x,y) \leq 1$