

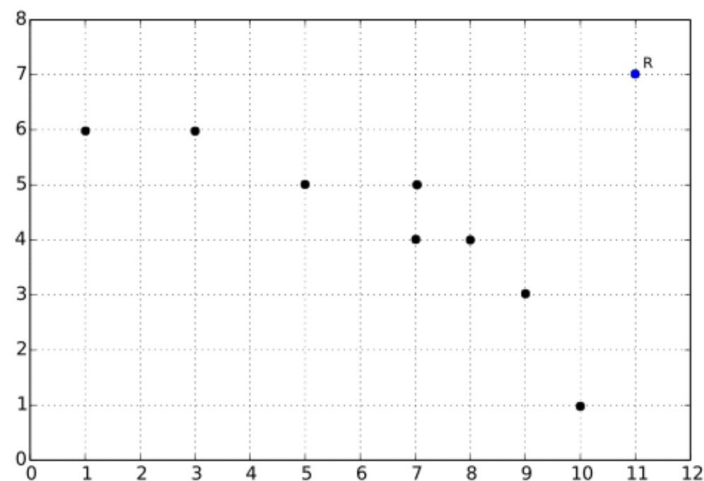
Assignment 34 (Hypervolume)

Take a look at the Hypervolume (HV) metric from the lecture and answer the following questions.

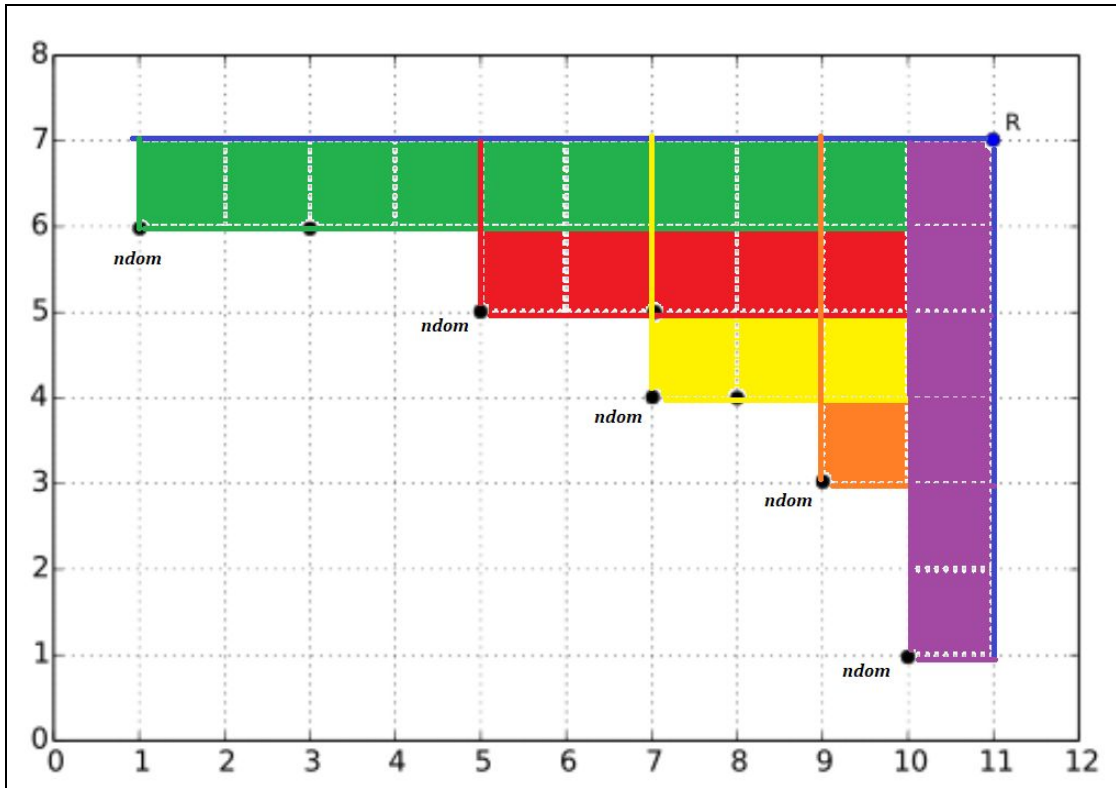
- Please explain how this metric works, and what you need to compute it.
- HV is a combined approach to **convergence** and **diversity** metrics.
- In the **objective space**, it calculates the volume covered by the non-dominated member solutions(S).
- For each $i \in S$, an HV (v_i) is constructed wrt ref. pt which is found by constructing a vector of **worst** objective function values (ex. Nadir point).

- Computation: **Union of all HV**: $HV(s) = \bigcup_{i=1}^{|S|} v_i$

- Given the following set of solutions (black points) in a multi-objective optimization problem, where both objectives should be **minimized**, compute the HV of these points using the reference point R (in blue).

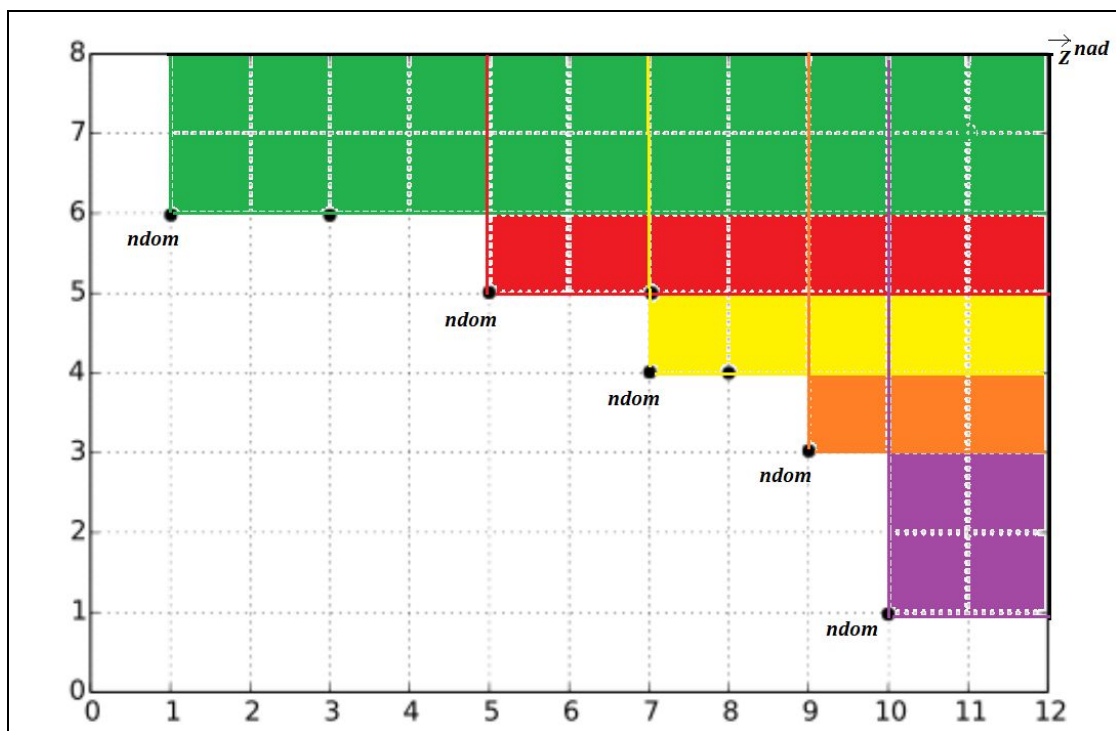


- Now try computing the HV of these points using the vector of worst objective function values (nadir point) as reference point. What differences do you notice when using different reference points? Which of these two points is better for reflecting the actual quality of the solution set?



Using given ref. pt 'R'

HV (S) = count of coloured boxes = 24

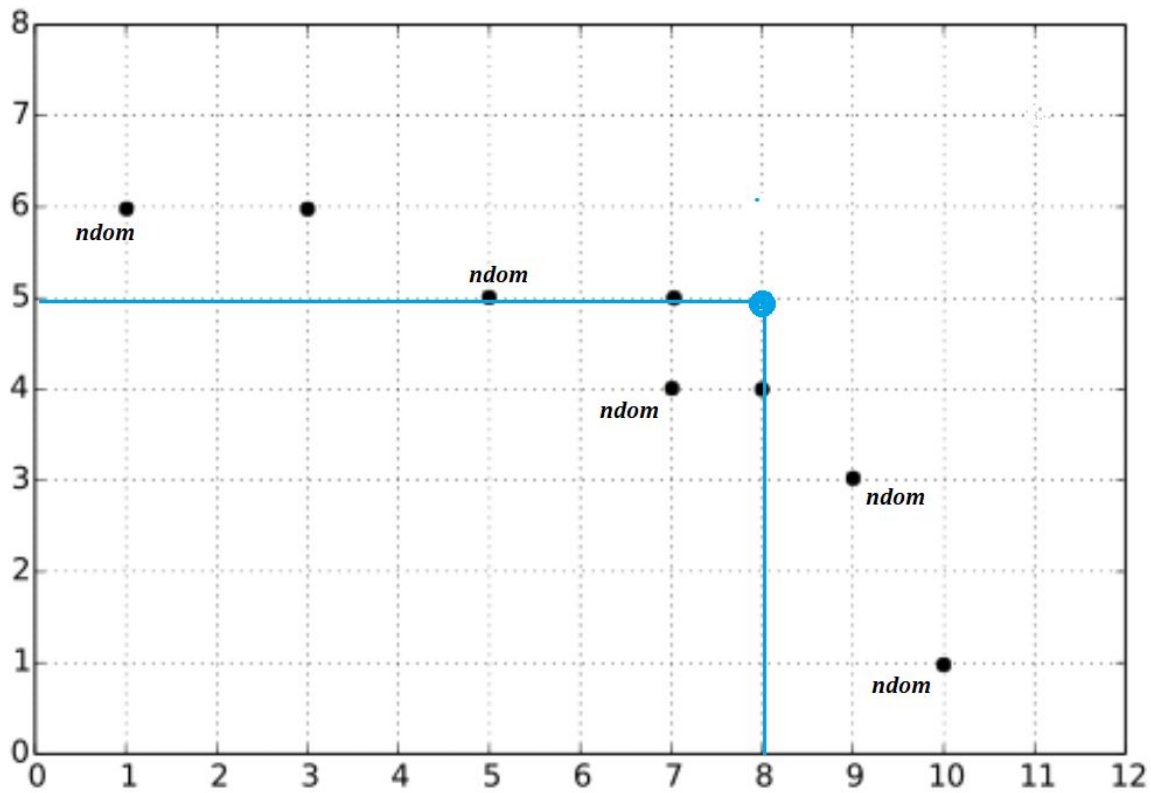


Using nadir point

HV (S) = count of coloured boxes = 41

The nadir point gives a good estimation of the actual quality of solution set.

- What would happen if the reference point is too close to the solution set, i.e. the reference point is dominating the nadir point?



Some non-dominated solutions may not be covered \Rightarrow lesser HV.