F3: Linear Function with Harmonic Weights

The F3 plot displays a problem where the global optimum is equal to the maximum weighted sum of variables. This problem involves each bit contributing additively to the solution with a fixed weight. Consequently, algorithms that can reliably identify and preserve improvements tend to converge rapidly.

As expected, RS performs poorly on this problem. While RS achieves some early improvement through chance, its lack of memory and refinement means its trajectory only slowly climbs, finishing with a best-so-far value of between 3500-4000. This underlines the inefficiency of independent sampling when systematic progress is required.

By contrast, RLS and (1+1) EA demonstrate far superior performance. After a short initial phase, both algorithms rapidly climb to the global optimum (~5000). However, RLS consistently reaches the optimum faster, while (1+1) EA takes slightly more evaluations before plateauing at the same level. This indicates that while both are effective, RLS is marginally more efficient on this problem.

The standard deviation patterns reinforce these findings. RS maintains high variability throughout, as independent random samples vary significantly across runs. RLS and (1+1) EA both show higher variability in the very early evaluations, but this quickly collapses once high-weight bits are fixed. By the time they reach the plateau, both are highly consistent across runs.

In summary, F3 confirms expectations that for linear problems both RLS and (1+1) EA reliably reach the global optimum, far outperforming RS. Between the two, RLS shows a small efficiency advantage, as it requires fewer evaluations to reach optimality.