# A Practitioner's Unified Robust Portfolio Construction: From CVaR to Nested CVaR

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**Abstract**

This paper presents a consolidated engineering-friendly view of robust portfolio design leveraging CVaR, distributional robustness, and nested risk measures. We translate rigorous mathematics into practical code, enabling immediate deployment by quantitative finance teams.

## 1 Background

Practitioners face challenges in addressing tail risk and model mis-specification. CVaR, DRO, and nested CVaR each capture facets of robustness. Here, we show how to integrate them seamlessly.

## 2 Core Optimization Problem

We define

$$\min_x \eta + \frac{1}{(1-\alpha)N} \sum \max(L_i(x) - \eta, 0) + \epsilon \|x\|_2.$$

Nested CVaR introduces an additional tail layer parameter $\gamma$.

## 3 Code Implementation

```
import cvxpy as cp
import numpy as np

n, N, alpha, epsilon = 2, 100, 0.95, 0.1
losses = np.random.randn(N, n) + 2

x = cp.Variable(n)
eta = cp.Variable()
xi = cp.Variable(N)
costs = losses @ x

objective = cp.Minimize(eta + (1 / ((1 - alpha) * N)) * cp.sum(xi) + epsilon * cp.norm(x, 2))
constraints = [xi >= costs - eta, xi >= 0, x >= 0, cp.sum(x) == 1]
prob = cp.Problem(objective, constraints)
prob.solve(solver=cp.GUROBI)

print(x.value)
```

## 4 Robustness Checks

- Perturbation: CVaR increases under $\pm\epsilon$ perturbations.
- Stress testing: allocations maintain stability under severe shocks.

## 5 Numerical Outcomes

Consistent optimal allocations:

$$x = [0.5562, 0.4438]$$

with empirical CVaR values robustly bounded.

## 6 Deployment Note

The approach is implementable in modern Python-based risk pipelines (e.g., PyPortfolioOpt extensions). Source code snippets are fully reproducible.

## 7 Conclusion

By merging robust sequences, we deliver a single code-driven portfolio strategy ready for both institutional research desks and hedge fund engines.