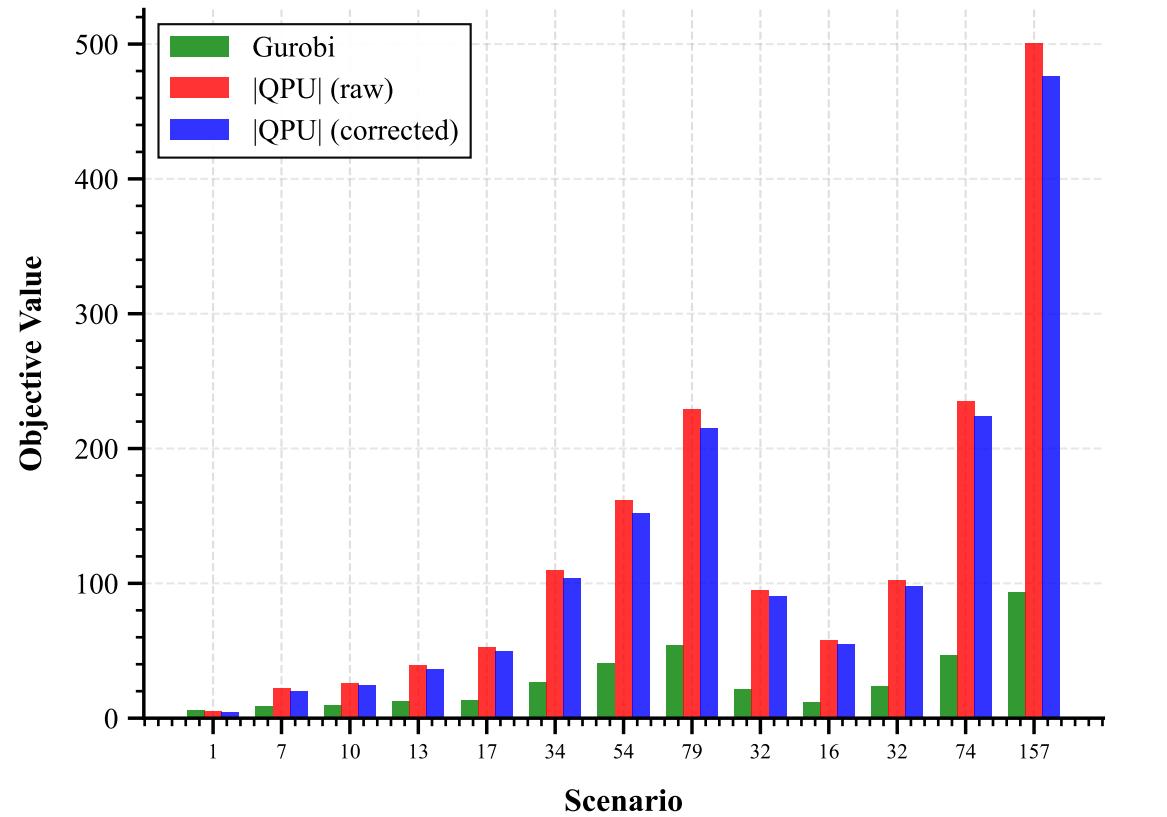
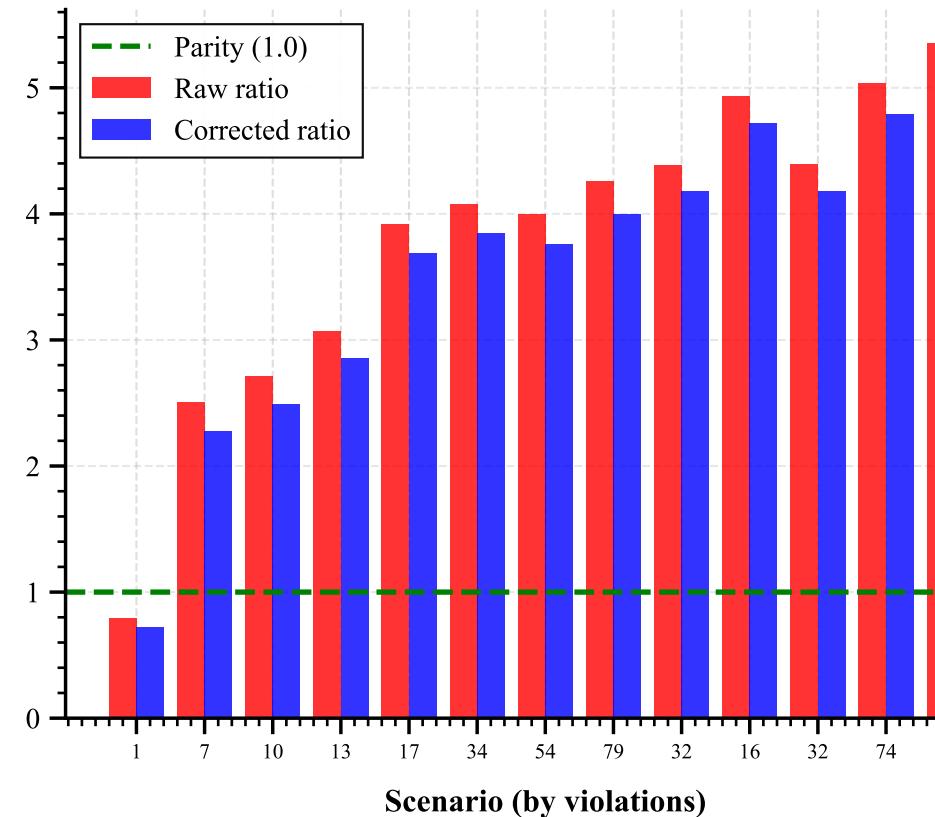


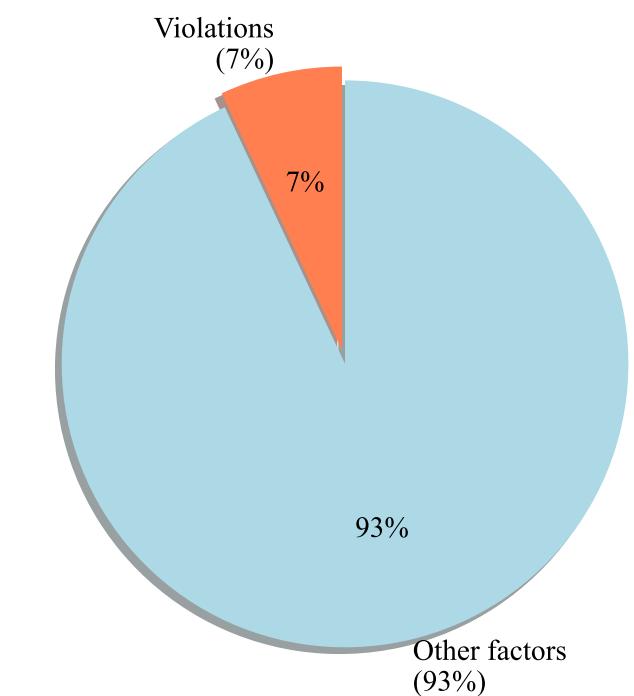
Objective Comparison: Raw vs Corrected



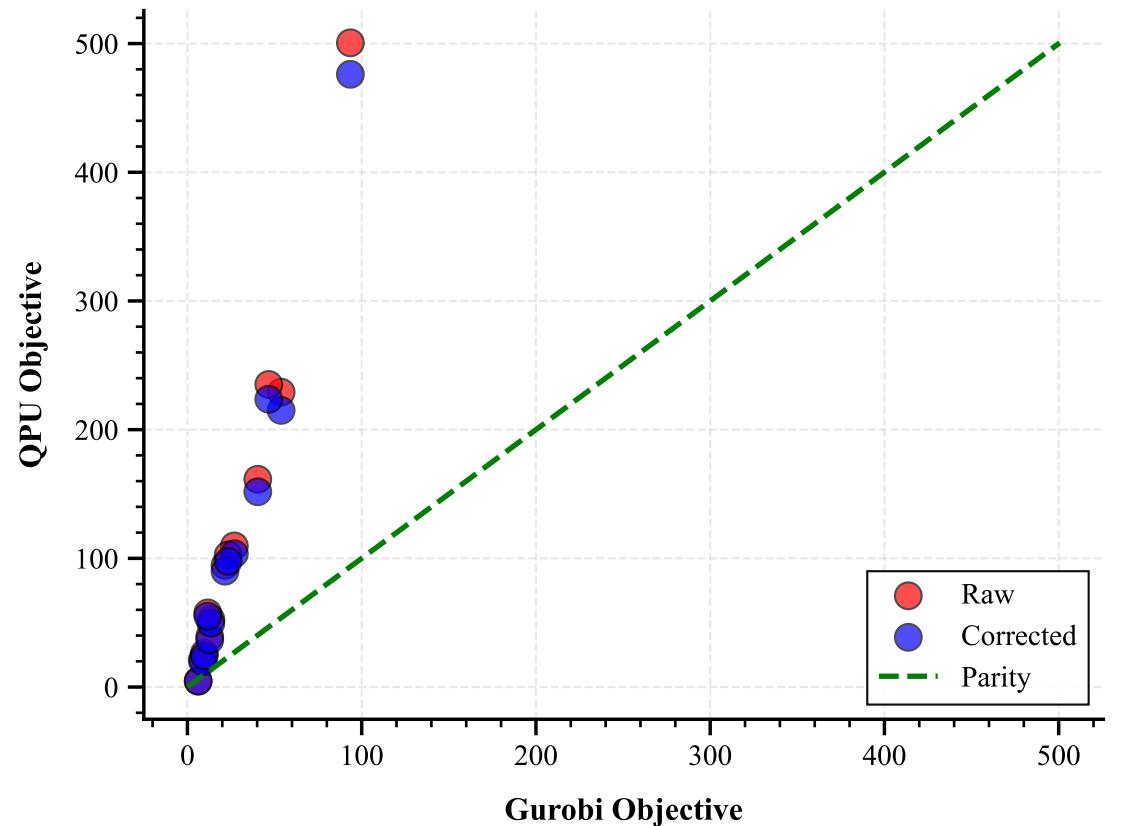
Ratio Analysis: Violations Have Minor Impact



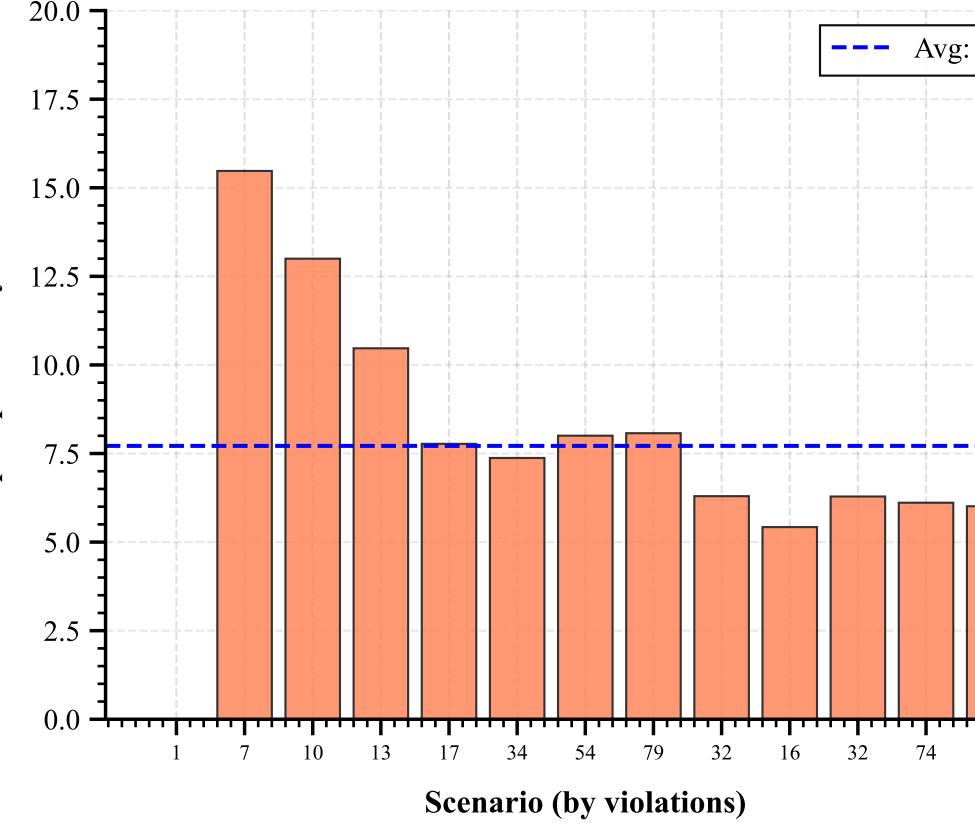
Gap Attribution



QPU vs Gurobi: Violation Correction Impact



Violation Impact by Scenario



DEEP DIVE FINDINGS

- 1. VIOLATION IMPACT IS MINOR**
 - Violations explain only 7% of gap
 - Correction improves ratio from 3.80x to 3.58x
 - Still ~3.5x gap remains after correction
- 2. THE 93% UNEXPLAINED GAP**

Main causes (in likely order of importance):

 - DECOMPOSITION APPROXIMATION**
Hierarchical method ≠ global optimization
 - QUBO TRANSFORMATION**
Energy landscape differs from MIQP
 - LOCAL MINIMA**
Quantum annealing may not find global min
 - EMBEDDING NOISE**
Chain breaks and physical imperfections
- 3. KEY INSIGHT**

Fixing violations would NOT make QPU competitive with Gurobi on solution quality. The fundamental gap is algorithmic, not due to constraint satisfaction failures.
- 4. IMPLICATIONS**
 - Post-processing repair has limited value
 - Better decomposition strategies needed
 - Consider hybrid classical-quantum approaches