Experiment results log.

Planned order of scenarios

Scenarios	Parameters	Week
A1	N	March 23 - March 29
A2	B	March 30 - April 5
A3	Datasets	March 30 - April 5
B1	Chain Strength	April 6 - April 12
B2	Embedding	April 13 - April 19
B3	Shots	April 20 - April 26
B4	Annealing	April 27 - May 3

Actual order of scenarios

Scenarios	Parameters	Week
A1	**N**	**March 23 - March 29**
B1	Chain Strength	March 30 - April 5
A2	B	March 30 - April 5
A3	Datasets	April 6 - April 12
B2	Embedding	April 13 - April 19
B3	Shots	April 20 - April 26
B4	Annealing	April 27 - May 3

Sidenotes to research about

- Scenario A1 epsilon values appear to follow a linear trend: y = (x-8) * 0.0142227624 + 1
- Find what is the maximum N value that is supported by dwave

Scenario A1

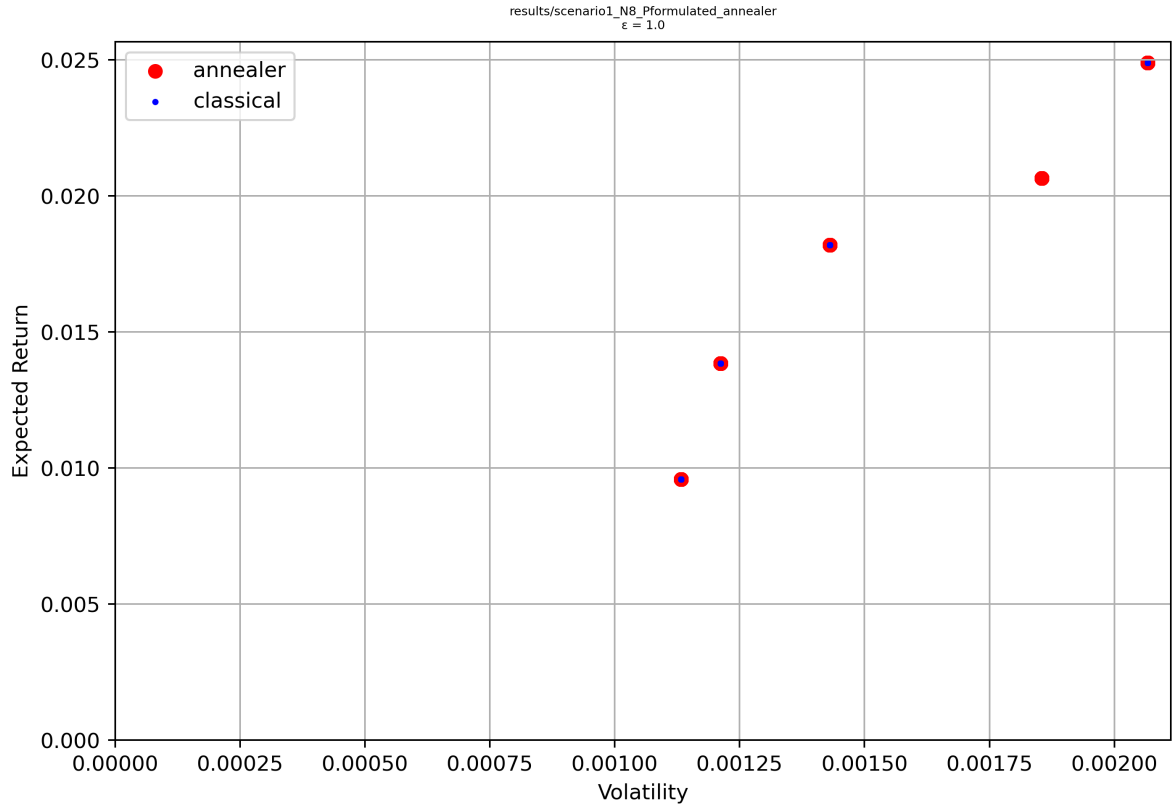
We started by experimenting several values of N, in order to find the maximum possible value of N that could be solved in a reasonable time by the classical solver.

The N values are: 8, 16, 32, and 64. P was calculated as P = -q * min_sigma + max_mu

For this scenario, we used the "diversified" dataset and 1000 shots per execution. The q values are listed in the following table:

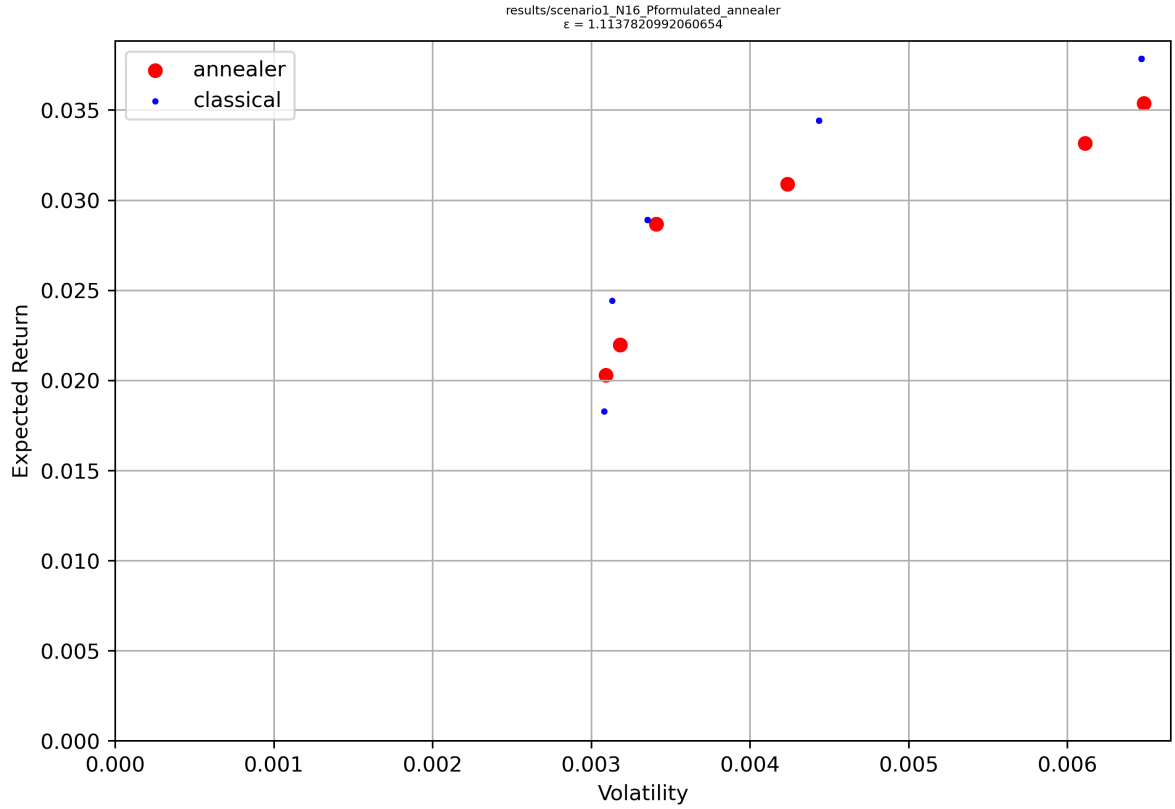
N	q values	Epsilon Indicator
8	0, 11, 20, 54	1.0
16	0, 2, 6, 100, 500	1.114
32	0, 0.4, 0.9, 2, 3, 9, 100	1.340
64	0, 0.2, 0.4, 0.6, 1.1, 1.3, 1.5, 2, 5, 6, 7, 8, 10, 100, 500	1.755

Epsilon Indicator - scenario1Y2021M03D31h18m52s49



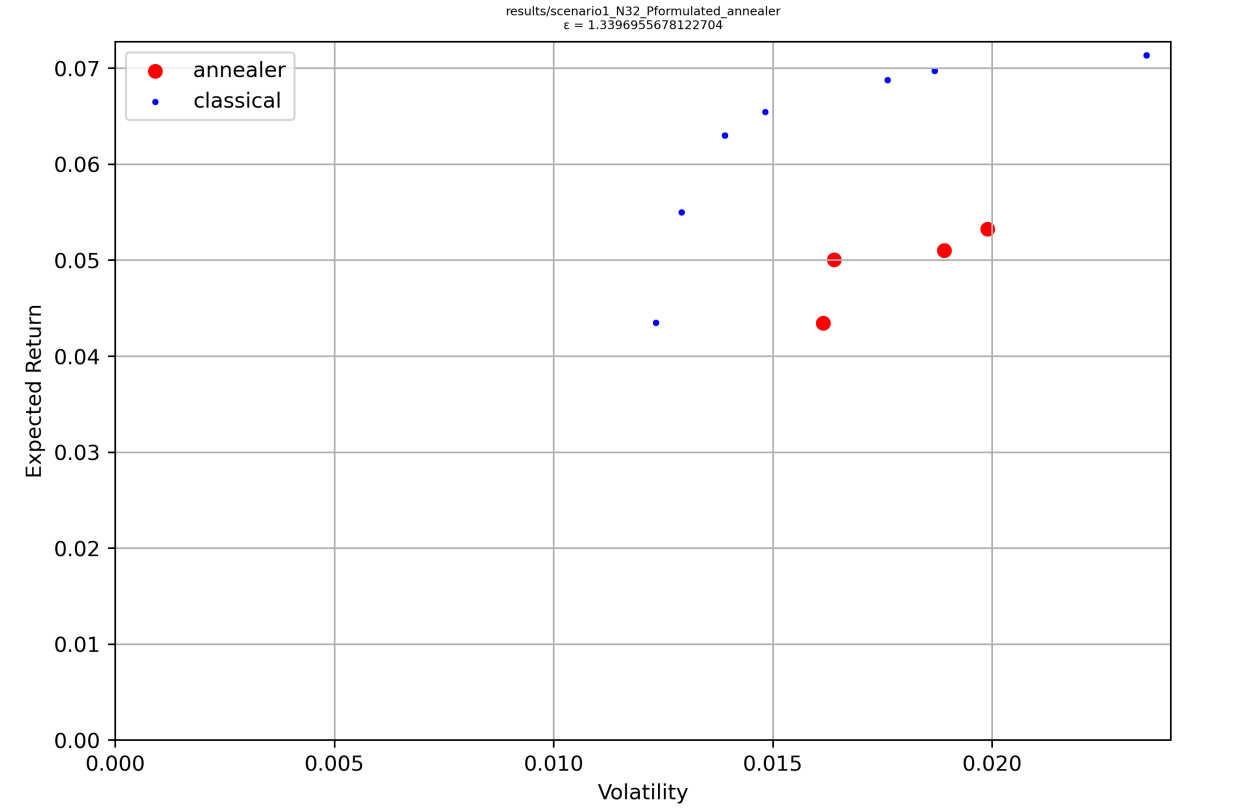
How to interpret: Blue markers are part of the efficient frontier. The epsilon indicator is the minimum factor by which the red set has to be multiplied in the objective so as to weakly dominate the blue set. Hence, the closer to 1 is the epsilon indicator, the better the red set.

Epsilon Indicator - scenario1Y2021M03D31h18m53s02



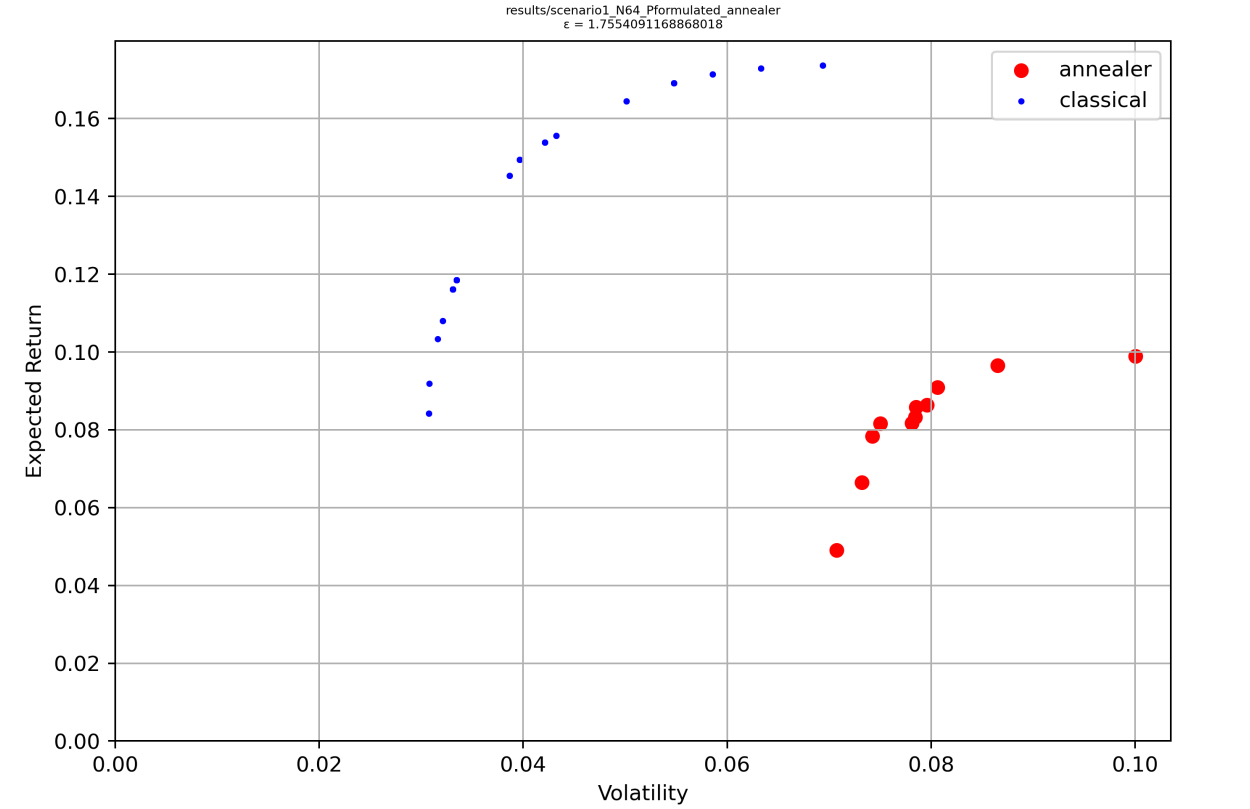
How to interpret: Blue markers are part of the efficient frontier. The epsilon indicator is the minimum factor by which the red set has to be multiplied in the objective so as to weakly dominate the blue set. Hence, the closer to 1 is the epsilon indicator, the better the red set.

Epsilon Indicator - scenario1Y2021M03D31h18m53s15



How to interpret: Blue markers are part of the efficient frontier. The epsilon indicator is the minimum factor by which the red set has to be multiplied in the objective so as to weakly dominate the blue set. Hence, the closer to 1 is the epsilon indicator, the better the red set.

Epsilon Indicator - scenario1Y2021M03D31h18m53s26



How to interpret: Blue markers are part of the efficient frontier. The epsilon indicator is the minimum factor by which the red set has to be multiplied in the objective so as to weakly dominate the blue set. Hence, the closer to 1 is the epsilon indicator, the better the red set.

Key Takeaways:

As expected, the epsilon indicator increases with the N value. However, during those executions, dwave's problem inspector warned that the chains were too weak, and that, in the case of N=64, all samples had

broken chains. Based on this warning, we decided to immediately execute scenario B1, changing the original order of scenarios.

Scenario B1

Looking at the percent of chain breaks in scenario A1, we have the following boxplots:

We have three tables, one for the epsilon indicator, one for the percentages of valid solutions, and one for the percentages of chain breaks.

Starting with the percent of chain breaks:

Chain strength	**N8**	**N16**	**N32**	**N64**
default value				
0.125 * maxAbs				
0.250 * maxAbs				
0.375 * maxAbs				
0.500 * maxAbs				
0.625 * maxAbs				
0.750 * maxAbs				
0.875 * maxAbs				
1.000 * maxAbs				
1.125 * maxAbs				
1.250 * maxAbs				
1.375 * maxAbs				
1.500 * maxAbs				

Then, we obtained the following epsilon indicators:

Chain strength	**N8**	**N16**	**N32**	**N64**
default value	1.000	**1.114**	1.340	1.755
0.125 * maxAbs	1.368	6.672	1.426	1.640
0.250 * maxAbs	1.000	1.167	**1.245**	1.504
0.375 * maxAbs	1.000	1.176*	1.275	1.429
0.500 * maxAbs	1.000	1.177	1.284	1.524
0.625 * maxAbs	1.000	1.208	1.325	**1.388**
0.750 * maxAbs	1.000	1.164	1.364	1.423

Chain strength	N8	N16	N32	N64
0.875 * maxAbs	1.000	1.208	1.372	1.358
1.000 * maxAbs	1.000	1.140	1.567	1.520
1.125 * maxAbs	1.000	1.182	1.350	1.421
1.250 * maxAbs	1.000	1.218	1.457	1.518
1.375 * maxAbs	1.000	1.130	1.462	1.488
1.500 * maxAbs	1.000	1.182	1.445	1.583

- Interestingly, this iteration got 3 of the 5 optimal solutions.

Finally, we obtained the following percentages of valid solutions:

Chain strength	N8	N16	N32	N64
default value	0.877	**0.688**	0.121	0.094
0.125 * maxAbs	0.001	0.002	0.076	0.205
0.250 * maxAbs	**0.934**	0.622	**0.395**	**0.243**
0.375 * maxAbs	0.848	0.543	0.325	0.220
0.500 * maxAbs	0.781	0.485	0.299	0.186
0.625 * maxAbs	0.703	0.444	0.261	0.172
0.750 * maxAbs	0.665	0.388	0.252	0.170
0.875 * maxAbs	0.630	0.406	0.242	0.163
1.000 * maxAbs	0.598	0.366	0.235	0.151
1.125 * maxAbs	0.594	0.370	0.219	0.148
1.250 * maxAbs	0.556	0.342	0.223	0.129
1.375 * maxAbs	0.540	0.330	0.212	0.136
1.500 * maxAbs	0.512	0.310	0.198	0.138

Key Takeaways: