Results for instances from collection
`Dispersion-QKP with strategy expo`

# File dispersion-qkp-expo_0100_005.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 100 |
| Density ($\Delta$) | 5.0 % |
| Edges ($m$) | 259 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 751.6 | 3.58 | 17.49 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.0 | 0.2 | 0.1 | 0.0 | **0.0** |
| 5.0 | 1,290.4 | **0.00** | 7.64 | 6.17 | **0.00** | **0.00** | **0.00** | **0.00** | 0.1 | 0.2 | 0.1 | 0.0 | 1.0 |
| 10.0 | 2,187.7 | 3.08 | 3.71 | 1.75 | **0.00** | **0.00** | **0.00** | **0.00** | 0.1 | 0.2 | 0.2 | 0.1 | **0.0** |
| 25.0 | 4,424.7 | 0.80 | 4.29 | 2.77 | 0.01 | **0.00** | **0.00** | **0.00** | 0.1 | 0.3 | 0.4 | 0.1 | 2.0 |
| 50.0 | 7,820.2 | 0.23 | 3.15 | 0.28 | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.5 | 0.2 | 0.1 | 1.0 |
| 75.0 | 10,582.9 | 0.17 | 1.00 | 0.05 | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.2 | 0.0 | **0.0** |
| 90.0 | 11,692.9 | 0.04 | 0.04 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.1 | 0.0 | **0.0** |
| 95.0 | 11,920.9 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.1 | 0.0 | **0.0** |
| Avg | | 0.99 | 4.66 | 1.38 | 0.00 | **0.00** | **0.00** | **0.00** | 0.2 | 0.4 | 0.2 | 0.1 | 0.5 |
| Min | | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.0 | 0.2 | 0.1 | 0.0 | **0.0** |
| Max | | 3.58 | 17.49 | 6.17 | 0.01 | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.4 | 0.1 | 2.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 31 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 0.3 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.1 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0100_010.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 100 |
| Density ($\Delta$) | 10.0 % |
| Edges ($m$) | 514 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 1,326.6 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.0 | 0.2 | 0.1 | 0.1 | 1.0 |
| 5.0 | 2,185.3 | 0.18 | 0.18 | 0.18 | **0.00** | **0.00** | **0.00** | **0.00** | 0.1 | 0.2 | 0.1 | 0.1 | 1.0 |
| 10.0 | 3,827.4 | 2.16 | 1.83 | 2.08 | **0.00** | **0.00** | **0.00** | **0.00** | 0.1 | 0.2 | 0.2 | 0.0 | 1.0 |
| 25.0 | 8,300.6 | 1.46 | 0.60 | 1.28 | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.4 | 0.4 | 0.5 | 2.0 |
| 50.0 | 15,685.6 | 0.16 | 0.47 | 0.16 | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.5 | 0.2 | 0.1 | 2.0 |
| 75.0 | 21,604.1 | 0.43 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.2 | 0.0 | 1.0 |
| 90.0 | 24,615.5 | 0.10 | 0.10 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.2 | 0.0 | **0.0** |
| 95.0 | 25,510.4 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.2 | 0.0 | 1.0 |
| Avg | | 0.56 | 0.40 | 0.46 | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.4 | 0.2 | 0.1 | 1.1 |
| Min | | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.0 | 0.2 | 0.1 | 0.0 | **0.0** |
| Max | | 2.16 | 1.83 | 2.08 | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.4 | 0.5 | 2.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 23 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 0.3 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.1 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0100_025.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 100 |
| Density ($\Delta$) | 25.0 % |
| Edges ($m$) | 1,258 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 2,258.5 | 0.76 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.0 | 0.2 | 0.2 | 0.2 | 2.0 |
| 5.0 | 4,075.5 | 1.02 | 0.55 | 0.21 | **0.00** | **0.00** | **0.00** | **0.00** | 0.1 | 0.2 | 0.2 | 0.6 | 2.0 |
| 10.0 | 7,356.1 | 0.77 | **0.00** | 0.76 | **0.00** | **0.00** | **0.00** | **0.00** | 0.1 | 0.2 | 0.4 | 1.6 | 6.0 |
| 25.0 | 18,405.9 | 0.16 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.4 | 0.2 | 0.4 | 6.0 |
| 50.0 | 34,513.4 | 0.17 | **0.00** | 0.10 | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.5 | 0.3 | 0.7 | 3.0 |
| 75.0 | 49,786.3 | 1.02 | 0.41 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.5 | 0.2 | 0.1 | 2.0 |
| 90.0 | 57,787.8 | 0.20 | 0.20 | 0.05 | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.2 | 0.3 | 4.0 |
| 95.0 | 60,443.0 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.2 | 0.1 | 1.0 |
| Avg | | 0.51 | 0.15 | 0.14 | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.4 | 0.2 | 0.5 | 3.2 |
| Min | | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.0 | 0.2 | 0.2 | 0.1 | 1.0 |
| Max | | 1.02 | 0.55 | 0.76 | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.4 | 1.6 | 6.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 16 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 0.3 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.1 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0100_050.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 100 |
| Density ($\Delta$) | 50.0 % |
| Edges ($m$) | 2,499 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 4,176.8 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.0 | 0.2 | 0.2 | 0.5 | 1.0 |
| 5.0 | 7,757.6 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.1 | 0.2 | 0.2 | 0.2 | 2.0 |
| 10.0 | 14,833.5 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.1 | 0.2 | 0.2 | 0.4 | 3.0 |
| 25.0 | 34,728.7 | 0.48 | **0.00** | 0.05 | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.3 | 0.2 | 1.4 | 8.0 |
| 50.0 | 65,610.7 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.4 | 0.4 | 2.3 | 18.0 |
| 75.0 | 97,476.7 | 0.29 | 0.06 | 0.01 | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.5 | 0.2 | 12.4 | 72.0 |
| 90.0 | 114,757.1 | 0.90 | 0.61 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.2 | 19.4 | 120.0 |
| 95.0 | 120,953.7 | 0.41 | 0.40 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.4 | 0.6 | 0.2 | 2.7 | 11.0 |
| Avg | | 0.26 | 0.13 | 0.01 | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.4 | 0.2 | 4.9 | 29.4 |
| Min | | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.0 | 0.2 | 0.2 | 0.2 | 1.0 |
| Max | | 0.90 | 0.61 | 0.05 | **0.00** | **0.00** | **0.00** | **0.00** | 0.4 | 0.6 | 0.4 | 19.4 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 13 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 0.3 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.1 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0100_075.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 100 |
| Density ($\Delta$) | 75.0 % |
| Edges ($m$) | 3,750 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 5,579.2 | 1.95 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.0 | 0.2 | 0.2 | 1.1 | 2.0 |
| 5.0 | 11,109.6 | 5.32 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.1 | 0.2 | 0.2 | 0.3 | 3.0 |
| 10.0 | 20,369.8 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.1 | 0.3 | 0.2 | 0.6 | 5.0 |
| 25.0 | 49,361.2 | 2.53 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.4 | 0.2 | 1.9 | 7.0 |
| 50.0 | 95,465.2 | 1.61 | 0.04 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.5 | 0.3 | 6.0 | 39.0 |
| 75.0 | 141,078.9 | 1.24 | 0.75 | 0.01 | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.2 | 14.8 | 120.0 |
| 90.0 | 167,111.5 | 0.93 | 0.58 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.4 | 0.6 | 0.2 | 97.6 | 120.0 |
| 95.0 | 176,304.4 | 0.19 | 0.19 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.2 | 10.4 | 27.0 |
| Avg | | 1.72 | 0.20 | 0.00 | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.4 | 0.2 | 16.6 | 40.4 |
| Min | | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.0 | 0.2 | 0.2 | 0.3 | 2.0 |
| Max | | 5.32 | 0.75 | 0.01 | **0.00** | **0.00** | **0.00** | **0.00** | 0.4 | 0.6 | 0.3 | 97.6 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 7 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 0.3 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.1 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0100_100.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 100 |
| Density ($\Delta$) | 100.0 % |
| Edges ($m$) | 4,950 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 8,702.8 | 0.86 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.1 | 0.2 | 0.2 | 1.2 | 7.0 |
| 5.0 | 15,368.6 | 2.28 | 1.35 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.1 | 0.2 | 0.2 | 2.6 | 18.0 |
| 10.0 | 28,970.9 | 0.37 | 0.37 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.1 | 0.3 | 0.2 | 1.6 | 16.0 |
| 25.0 | 69,707.9 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.4 | 0.2 | 0.6 | 7.0 |
| 50.0 | 128,603.1 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.5 | 0.2 | 1.4 | 12.0 |
| 75.0 | 187,856.2 | 0.91 | 0.62 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.2 | 20.9 | 120.0 |
| 90.0 | 222,894.8 | 0.65 | 0.65 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.6 | 0.3 | 120.2 | 120.0 |
| 95.0 | 235,892.2 | 0.29 | 0.25 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.7 | 0.2 | 37.5 | 67.0 |
| Avg | | 0.67 | 0.41 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 0.4 | 0.2 | 23.2 | 45.9 |
| Min | | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.1 | 0.2 | 0.2 | 0.6 | 7.0 |
| Max | | 2.28 | 1.35 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 0.7 | 0.3 | 120.2 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 8 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 0.3 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.1 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0200_005.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 200 |
| Density ($\Delta$) | 5.0 % |
| Edges ($m$) | 1,046 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 2,301.0 | 4.12 | 1.01 | 2.47 | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 1.2 | 0.6 | 0.6 | 2.0 |
| 5.0 | 4,084.7 | 0.54 | 1.35 | 4.33 | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 1.4 | 0.9 | 0.4 | 5.0 |
| 10.0 | 7,549.6 | 0.96 | 2.18 | 4.13 | **0.00** | **0.00** | **0.00** | **0.00** | 0.4 | 2.2 | 1.1 | 0.2 | 1.0 |
| 25.0 | 17,241.7 | 0.64 | 1.27 | 0.35 | **0.00** | **0.00** | **0.00** | **0.00** | 0.7 | 3.2 | 4.2 | 0.6 | 10.0 |
| 50.0 | 32,222.0 | 0.19 | 0.19 | 0.07 | **0.00** | **0.00** | **0.00** | **0.00** | 1.0 | 4.1 | 1.9 | 0.3 | 10.0 |
| 75.0 | 44,599.6 | 0.06 | **0.00** | 0.02 | **0.00** | **0.00** | **0.00** | **0.00** | 1.3 | 4.4 | 1.1 | 0.2 | 14.0 |
| 90.0 | 50,399.1 | 0.02 | 0.02 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 1.3 | 4.8 | 0.6 | 0.1 | 13.0 |
| 95.0 | 52,056.2 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 1.4 | 4.5 | 0.5 | 0.0 | 2.0 |
| Avg | | 0.82 | 0.75 | 1.42 | **0.00** | **0.00** | **0.00** | **0.00** | 0.8 | 3.2 | 1.4 | 0.3 | 7.1 |
| Min | | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 1.2 | 0.5 | 0.0 | 1.0 |
| Max | | 4.12 | 2.18 | 4.33 | **0.00** | **0.00** | **0.00** | **0.00** | 1.4 | 4.8 | 4.2 | 0.6 | 14.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 31 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 0.6 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.1 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0200_010.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 200 |
| Density ($\Delta$) | 10.0 % |
| Edges ($m$) | 2,057 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 3,125.2 | **0.00** | 1.77 | 1.53 | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 1.3 | 0.7 | 0.2 | 1.0 |
| 5.0 | 6,133.1 | 1.16 | 1.12 | 0.75 | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 1.6 | 0.7 | 0.4 | 3.0 |
| 10.0 | 11,686.9 | 0.80 | 0.23 | 0.62 | **0.00** | **0.00** | **0.00** | **0.00** | 0.4 | 2.3 | 1.9 | 0.4 | 11.0 |
| 25.0 | 27,312.6 | 1.09 | 0.35 | 0.24 | — | **0.00** | **0.00** | **0.00** | 0.7 | 3.2 | 120.0 | 0.7 | 6.0 |
| 50.0 | 53,821.8 | **0.00** | 0.48 | 0.24 | **0.00** | **0.00** | **0.00** | **0.01** | 1.1 | 4.2 | 9.9 | 0.4 | 3.0 |
| 75.0 | 79,466.4 | 0.24 | 0.08 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 1.3 | 4.4 | 1.1 | 1.1 | 55.0 |
| 90.0 | 93,619.0 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 1.4 | 5.1 | 0.8 | 0.2 | 5.0 |
| 95.0 | 97,509.9 | 0.29 | 0.09 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 1.5 | 4.6 | 0.5 | 0.2 | 4.0 |
| Avg | | 0.45 | 0.52 | 0.42 | — | **0.00** | **0.00** | **0.00** | 0.9 | 3.3 | 17.0 | 0.4 | 11.0 |
| Min | | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 1.3 | 0.5 | 0.2 | 1.0 |
| Max | | 1.16 | 1.77 | 1.53 | — | **0.00** | **0.00** | **0.01** | 1.5 | 5.1 | 120.0 | 1.1 | 55.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 16 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 0.7 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.1 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0200_025.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 200 |
| Density ($\Delta$) | 25.0 % |
| Edges ($m$) | 4,968 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 7,062.2 | 1.99 | 0.07 | 1.56 | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 1.2 | 1.0 | 1.0 | 7.0 |
| 5.0 | 14,141.9 | 1.52 | 0.98 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 1.8 | 1.6 | 0.8 | 7.0 |
| 10.0 | 28,211.1 | 0.44 | **0.00** | 0.36 | **0.00** | **0.00** | **0.00** | **0.00** | 0.5 | 2.3 | 2.0 | 1.2 | 11.0 |
| 25.0 | 69,094.4 | 0.11 | 0.13 | 0.30 | **0.00** | **0.00** | **0.00** | **0.00** | 0.8 | 3.4 | 1.5 | 1.5 | 9.0 |
| 50.0 | 130,892.3 | 0.06 | 0.06 | 0.03 | **0.00** | **0.00** | **0.00** | **0.00** | 1.1 | 3.9 | 2.8 | 6.0 | 69.0 |
| 75.0 | 192,356.8 | **0.00** | 0.09 | 0.01 | **0.00** | **0.00** | **0.00** | **0.00** | 1.3 | 5.0 | 1.1 | 3.3 | 22.0 |
| 90.0 | 229,079.5 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 1.5 | 4.4 | 0.9 | 0.6 | 5.0 |
| 95.0 | 240,286.3 | 0.23 | 0.22 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 1.5 | 5.8 | 0.6 | 10.6 | 49.0 |
| Avg | | 0.54 | 0.19 | 0.28 | **0.00** | **0.00** | **0.00** | **0.00** | 0.9 | 3.5 | 1.4 | 3.1 | 22.4 |
| Min | | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 1.2 | 0.6 | 0.6 | 5.0 |
| Max | | 1.99 | 0.98 | 1.56 | **0.00** | **0.00** | **0.00** | **0.00** | 1.5 | 5.8 | 2.8 | 10.6 | 69.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 13 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 0.7 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.1 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0200_050.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 200 |
| Density ($\Delta$) | 50.0 % |
| Edges ($m$) | 9,903 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 13,859.7 | 1.31 | 0.09 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 1.3 | 0.6 | 5.4 | 43.0 |
| 5.0 | 27,103.2 | **0.00** | 0.72 | 0.02 | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 1.8 | 1.0 | 4.5 | 21.0 |
| 10.0 | 53,472.7 | 0.57 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.5 | 2.3 | 1.1 | 6.4 | 44.0 |
| 25.0 | 131,247.9 | 0.80 | 0.09 | 0.05 | **0.00** | **0.00** | 0.04 | **0.00** | 0.7 | 3.2 | 1.4 | 61.1 | 120.0 |
| 50.0 | 255,893.4 | 0.09 | 0.02 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 1.0 | 3.9 | 2.0 | 5.0 | 91.0 |
| 75.0 | 377,699.5 | 0.03 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 1.2 | 4.6 | 2.4 | 12.5 | 79.0 |
| 90.0 | 450,903.4 | 0.22 | 0.20 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 1.4 | 4.3 | 0.9 | 120.7 | 120.0 |
| 95.0 | 473,890.1 | 0.27 | 0.27 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 1.7 | 5.4 | 0.8 | 120.3 | 120.0 |
| Avg | | 0.41 | 0.17 | 0.01 | **0.00** | **0.00** | 0.01 | **0.00** | 0.9 | 3.4 | 1.3 | 42.0 | 79.8 |
| Min | | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 1.3 | 0.6 | 4.5 | 21.0 |
| Max | | 1.31 | 0.72 | 0.05 | **0.00** | **0.00** | 0.04 | **0.00** | 1.7 | 5.4 | 2.4 | 120.7 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 10 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 0.7 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.1 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0200_075.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 200 |
| Density ($\Delta$) | 75.0 % |
| Edges ($m$) | 14,958 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 21,573.4 | 3.54 | 1.15 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 1.3 | 0.6 | 8.1 | 120.0 |
| 5.0 | 41,499.0 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.4 | 1.8 | 0.6 | 3.6 | 38.0 |
| 10.0 | 80,118.2 | 1.08 | 0.91 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.5 | 2.3 | 0.9 | 47.3 | 120.0 |
| 25.0 | 196,352.9 | 0.14 | 0.01 | **0.00** | **0.00** | **0.00** | **0.00** | **0.01** | 0.8 | 3.2 | 0.8 | 3.4 | 120.0 |
| 50.0 | 385,824.0 | 1.02 | 0.03 | 0.04 | **0.00** | **0.00** | **0.00** | **0.00** | 1.1 | 3.9 | 1.7 | 53.7 | 120.0 |
| 75.0 | 572,488.0 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 1.4 | 4.6 | 1.2 | 12.3 | 120.0 |
| 90.0 | 681,756.7 | 0.37 | 0.31 | 0.03 | **0.00** | **0.00** | **0.00** | **0.00** | 1.5 | 4.4 | 0.9 | 120.5 | 120.0 |
| 95.0 | 715,769.6 | 0.32 | 0.32 | **0.00** | **0.00** | 0.05 | **0.00** | **0.00** | 1.5 | 5.5 | 1.0 | 120.1 | 120.0 |
| Avg | | 0.81 | 0.34 | 0.01 | **0.00** | 0.01 | **0.00** | **0.00** | 0.9 | 3.4 | 1.0 | 46.1 | 109.8 |
| Min | | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 1.3 | 0.6 | 3.4 | 38.0 |
| Max | | 3.54 | 1.15 | 0.04 | **0.00** | 0.05 | **0.00** | **0.01** | 1.5 | 5.5 | 1.7 | 120.5 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 8 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 0.7 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.1 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0200_100.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 200 |
| Density ($\Delta$) | 100.0 % |
| Edges ($m$) | 19,900 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 26,044.1 | 2.44 | 1.28 | 0.63 | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 1.4 | 0.6 | 27.2 | 120.0 |
| 5.0 | 51,194.1 | 0.82 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.3 | 1.7 | 0.6 | 41.4 | 120.0 |
| 10.0 | 102,614.3 | 0.29 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.5 | 2.5 | 0.7 | 24.0 | 94.0 |
| 25.0 | 257,461.6 | 0.47 | 0.25 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.8 | 3.2 | 0.8 | 120.5 | 120.0 |
| 50.0 | 510,102.2 | 0.28 | 0.13 | **0.00** | **0.00** | **0.00** | 0.91 | **0.00** | 1.1 | 4.2 | 0.8 | 51.7 | 120.0 |
| 75.0 | 750,317.1 | 0.38 | 0.27 | **0.00** | **0.00** | 0.03 | **0.00** | **0.00** | 1.3 | 4.3 | 1.0 | 120.5 | 120.0 |
| 90.0 | 892,842.6 | 0.39 | 0.34 | 0.01 | **0.00** | 0.02 | **0.00** | **0.00** | 1.4 | 5.0 | 2.1 | 120.1 | 120.0 |
| 95.0 | 938,260.7 | 0.22 | 0.19 | 0.01 | **0.00** | 0.07 | **0.00** | **0.00** | 1.5 | 4.5 | 3.6 | 120.3 | 120.0 |
| Avg | | 0.66 | 0.31 | 0.08 | **0.00** | 0.02 | 0.11 | **0.00** | 0.9 | 3.4 | 1.3 | 78.2 | 116.8 |
| Min | | 0.22 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.2 | 1.4 | 0.6 | 24.0 | 94.0 |
| Max | | 2.44 | 1.28 | 0.63 | **0.00** | 0.07 | 0.91 | **0.00** | 1.5 | 5.0 | 3.6 | 120.5 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 6 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 0.8 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.2 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0300_005.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 300 |
| Density ($\Delta$) | 5.0 % |
| Edges ($m$) | 2,253 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 3,599.6 | 1.70 | 2.43 | 6.08 | **0.00** | **0.00** | **0.00** | **0.00** | 0.4 | 6.1 | 11.1 | 0.8 | 6.0 |
| 5.0 | 6,856.3 | 0.68 | 1.31 | 3.15 | — | **0.00** | **0.00** | **0.00** | 0.7 | 7.4 | 120.0 | 1.2 | 20.0 |
| 10.0 | 13,398.9 | 0.31 | 0.68 | 0.98 | **0.00** | **0.00** | **0.00** | **0.00** | 1.1 | 10.8 | 40.9 | 1.1 | 11.0 |
| 25.0 | 32,503.8 | 0.67 | 0.47 | 1.03 | — | **0.00** | **0.00** | **0.00** | 1.8 | 14.1 | 120.0 | 0.6 | 34.0 |
| 50.0 | 62,143.3 | 0.18 | 0.16 | 0.15 | — | **0.00** | **0.00** | **0.00** | 2.6 | 19.1 | 120.0 | 0.4 | 7.0 |
| 75.0 | 88,655.0 | 0.04 | 0.11 | 0.03 | **0.00** | **0.00** | **0.00** | **0.00** | 3.2 | 16.4 | 63.6 | 0.4 | 16.0 |
| 90.0 | 102,995.7 | 0.03 | 0.07 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 3.5 | 19.1 | 5.1 | 0.3 | 11.0 |
| 95.0 | 107,414.2 | 0.14 | 0.14 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 3.6 | 15.5 | 1.7 | 0.5 | 66.0 |
| Avg | | 0.47 | 0.67 | 1.43 | — | **0.00** | **0.00** | **0.00** | 2.1 | 13.5 | 60.3 | 0.7 | 21.4 |
| Min | | 0.03 | 0.07 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.4 | 6.1 | 1.7 | 0.3 | 6.0 |
| Max | | 1.70 | 2.43 | 6.08 | — | **0.00** | **0.00** | **0.00** | 3.6 | 19.1 | 120.0 | 1.2 | 66.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 27 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 1.0 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.2 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0300_010.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 300 |
| Density ($\Delta$) | 10.0 % |
| Edges ($m$) | 4,393 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 8,208.3 | 1.31 | 1.29 | 1.56 | **0.00** | **0.00** | **0.00** | **0.00** | 0.5 | 6.0 | 1.4 | 0.3 | 1.0 |
| 5.0 | 15,165.9 | 0.11 | 0.08 | 0.80 | 0.01 | **0.00** | **0.00** | **0.00** | 0.8 | 7.8 | 2.0 | 0.7 | 58.0 |
| 10.0 | 27,912.6 | 0.36 | 0.32 | 0.84 | **0.00** | **0.00** | **0.00** | **0.00** | 1.1 | 10.6 | 5.3 | 0.6 | 11.0 |
| 25.0 | 64,157.0 | 0.22 | 0.01 | 0.02 | **0.00** | **0.00** | **0.00** | **0.00** | 1.8 | 14.1 | 5.9 | 0.8 | 44.0 |
| 50.0 | 118,937.7 | 0.21 | 0.01 | 0.14 | — | **0.00** | **0.00** | **0.01** | 2.5 | 16.1 | 120.0 | 4.3 | 120.0 |
| 75.0 | 172,726.1 | **0.00** | 0.08 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 3.1 | 17.3 | 6.9 | 1.3 | 120.0 |
| 90.0 | 202,396.4 | 0.09 | 0.09 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 3.4 | 15.6 | 2.3 | 0.5 | 11.0 |
| 95.0 | 210,731.6 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 3.4 | 16.7 | 1.3 | 0.7 | 34.0 |
| Avg | | 0.29 | 0.24 | 0.42 | — | **0.00** | **0.00** | **0.00** | 2.1 | 13.0 | 18.1 | 1.2 | 49.9 |
| Min | | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.5 | 6.0 | 1.3 | 0.3 | 1.0 |
| Max | | 1.31 | 1.29 | 1.56 | — | **0.00** | **0.00** | **0.01** | 3.4 | 17.3 | 120.0 | 4.3 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 35 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 0.9 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.2 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0300_025.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 300 |
| Density ($\Delta$) | 25.0 % |
| Edges ($m$) | 11,217 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 17,134.5 | 0.83 | 0.20 | 0.07 | **0.00** | **0.00** | **0.00** | **0.00** | 0.6 | 6.7 | 2.3 | 5.6 | 39.0 |
| 5.0 | 33,162.7 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.9 | 8.2 | 2.1 | 3.2 | 30.0 |
| 10.0 | 62,845.2 | 0.35 | 0.09 | 0.06 | **0.00** | **0.00** | **0.00** | **0.00** | 1.2 | 11.1 | 10.6 | 14.4 | 74.0 |
| 25.0 | 152,832.8 | 0.12 | 0.05 | 0.09 | **0.00** | **0.00** | **0.00** | **0.00** | 1.9 | 14.0 | 10.0 | 7.8 | 120.0 |
| 50.0 | 296,155.6 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.01** | 2.7 | 18.7 | 7.3 | 5.0 | 120.0 |
| 75.0 | 432,718.0 | 0.01 | 0.01 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 3.2 | 15.9 | 4.4 | 17.8 | 120.0 |
| 90.0 | 513,762.5 | 0.15 | 0.05 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 3.5 | 18.6 | 4.1 | 10.5 | 120.0 |
| 95.0 | 540,249.4 | 0.12 | 0.09 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 3.6 | 15.4 | 2.0 | 6.4 | 66.0 |
| Avg | | 0.20 | 0.06 | 0.03 | **0.00** | **0.00** | **0.00** | **0.00** | 2.2 | 13.6 | 5.3 | 8.8 | 86.1 |
| Min | | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.6 | 6.7 | 2.0 | 3.2 | 30.0 |
| Max | | 0.83 | 0.20 | 0.09 | **0.00** | **0.00** | **0.00** | **0.01** | 3.6 | 18.7 | 10.6 | 17.8 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 18 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 1.0 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.2 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0300_050.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 300 |
| Density ($\Delta$) | 50.0 % |
| Edges ($m$) | 22,452 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 32,710.3 | 0.71 | 0.53 | 0.06 | **0.00** | **0.00** | 0.06 | **0.00** | 0.6 | 6.2 | 1.9 | 13.2 | 120.0 |
| 5.0 | 63,512.7 | 0.89 | 0.36 | **0.00** | **0.00** | **0.00** | 0.09 | **0.00** | 0.9 | 8.5 | 2.0 | 30.1 | 120.0 |
| 10.0 | 123,545.8 | 0.47 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 1.2 | 10.6 | 5.1 | 27.4 | 120.0 |
| 25.0 | 303,435.0 | 0.59 | 0.14 | **0.00** | **0.00** | **0.00** | 0.96 | **0.00** | 2.0 | 14.7 | 3.0 | 21.2 | 120.0 |
| 50.0 | 582,308.5 | 0.52 | 0.01 | **0.00** | **0.00** | **0.00** | 0.63 | **0.01** | 2.8 | 15.9 | 8.8 | 120.8 | 120.0 |
| 75.0 | 861,851.1 | 0.14 | 0.11 | **0.00** | **0.00** | **0.00** | 0.81 | **0.00** | 3.3 | 17.3 | 3.8 | 120.6 | 120.0 |
| 90.0 | 1,021,862.4 | 0.18 | 0.17 | **0.00** | **0.00** | 0.07 | **0.00** | **0.00** | 3.6 | 15.8 | 3.1 | 120.1 | 120.0 |
| 95.0 | 1,074,505.6 | 0.04 | 0.04 | **0.00** | **0.00** | 0.03 | **0.00** | **0.00** | 3.6 | 16.9 | 1.7 | 120.2 | 120.0 |
| Avg | | 0.44 | 0.17 | 0.01 | **0.00** | 0.01 | 0.32 | **0.00** | 2.2 | 13.2 | 3.7 | 71.7 | 120.0 |
| Min | | 0.04 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.6 | 6.2 | 1.7 | 13.2 | 120.0 |
| Max | | 0.89 | 0.53 | 0.06 | **0.00** | 0.07 | 0.96 | **0.01** | 3.6 | 17.3 | 8.8 | 120.8 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 12 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 1.1 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.2 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0300_075.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 300 |
| Density ($\Delta$) | 75.0 % |
| Edges ($m$) | 33,699 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 48,498.2 | 1.68 | 0.44 | 0.04 | **0.00** | **0.00** | **0.00** | **0.00** | 0.7 | 6.6 | 1.5 | 14.8 | 120.0 |
| 5.0 | 93,699.7 | 1.02 | 0.22 | 0.22 | **0.00** | **0.00** | **0.00** | **0.00** | 1.0 | 8.3 | 1.7 | 36.5 | 120.0 |
| 10.0 | 180,778.4 | 1.08 | 0.57 | 0.05 | **0.00** | **0.00** | **0.00** | **0.01** | 1.3 | 11.3 | 2.3 | 120.8 | 120.0 |
| 25.0 | 444,553.4 | 0.95 | 0.81 | **0.00** | **0.00** | **0.00** | 1.06 | **0.01** | 2.0 | 14.0 | 6.0 | 120.5 | 120.0 |
| 50.0 | 862,831.5 | 0.36 | 0.19 | 0.03 | **0.00** | 0.01 | 1.58 | **0.01** | 2.8 | 18.6 | 7.5 | 120.2 | 120.0 |
| 75.0 | 1,272,782.8 | 0.28 | 0.16 | 0.01 | **0.00** | 0.01 | 1.34 | **0.00** | 3.7 | 15.7 | 6.0 | 120.6 | 120.0 |
| 90.0 | 1,516,600.7 | 0.35 | 0.23 | **0.00** | **0.00** | 0.14 | 0.46 | **0.00** | 3.5 | 18.6 | 30.7 | 120.1 | 120.0 |
| 95.0 | 1,599,479.4 | 0.14 | 0.14 | **0.00** | **0.00** | 0.06 | **0.00** | **0.00** | 3.6 | 15.3 | 2.4 | 120.1 | 120.0 |
| Avg | | 0.73 | 0.34 | 0.04 | **0.00** | 0.03 | 0.55 | **0.00** | 2.3 | 13.5 | 7.3 | 96.7 | 120.0 |
| Min | | 0.14 | 0.14 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.7 | 6.6 | 1.5 | 14.8 | 120.0 |
| Max | | 1.68 | 0.81 | 0.22 | **0.00** | 0.14 | 1.58 | **0.01** | 3.7 | 18.6 | 30.7 | 120.8 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 9 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 1.2 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.2 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0300_100.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 300 |
| Density ($\Delta$) | 100.0 % |
| Edges ($m$) | 44,850 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 64,826.2 | 0.02 | **0.00** | **0.00** | **0.00** | **0.00** | 1.41 | **0.00** | 0.6 | 6.4 | 1.5 | 20.1 | 120.0 |
| 5.0 | 126,524.0 | 0.90 | 0.62 | 0.02 | **0.00** | **0.00** | **0.00** | **0.00** | 0.9 | 8.9 | 1.6 | 120.3 | 120.0 |
| 10.0 | 242,237.3 | 1.11 | 0.85 | **0.00** | **0.00** | 0.12 | 1.36 | **0.00** | 1.2 | 10.6 | 2.0 | 121.5 | 120.0 |
| 25.0 | 594,796.2 | 0.81 | 0.56 | **0.00** | **0.00** | **0.00** | 0.99 | **0.01** | 1.9 | 15.0 | 2.4 | 120.3 | 120.0 |
| 50.0 | 1,158,456.9 | 0.42 | 0.32 | 0.01 | **0.00** | 0.13 | 1.34 | **0.01** | 2.6 | 15.9 | 17.9 | 120.3 | 120.0 |
| 75.0 | 1,708,410.9 | 0.62 | 0.54 | **0.00** | **0.00** | **0.00** | 1.43 | **0.00** | 3.1 | 17.6 | 2.5 | 120.6 | 120.0 |
| 90.0 | 2,028,387.3 | 0.26 | 0.26 | 0.01 | — | 0.28 | **0.00** | **0.00** | 3.3 | 15.7 | 120.0 | 120.1 | 120.0 |
| 95.0 | 2,140,021.7 | 0.08 | 0.08 | **0.00** | **0.00** | 0.09 | **0.00** | **0.00** | 3.4 | 17.3 | 3.1 | 120.1 | 120.0 |
| Avg | | 0.53 | 0.40 | **0.01** | — | 0.08 | 0.82 | **0.00** | 2.1 | 13.4 | 18.9 | 107.9 | 120.0 |
| Min | | 0.02 | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | 0.6 | 6.4 | 1.5 | 20.1 | 120.0 |
| Max | | 1.11 | 0.85 | **0.02** | — | 0.28 | 1.43 | **0.01** | 3.4 | 17.6 | 120.0 | 121.5 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 8 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 1.3 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.2 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0500_005.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 500 |
| Density ($\Delta$) | 5.0 % |
| Edges ($m$) | 6,170 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 10,159.9 | 0.63 | 1.39 | 3.44 | — | **0.00** | **0.00** | **0.00** | 1.4 | 41.1 | 120.0 | 0.7 | 25.0 |
| 5.0 | 18,914.5 | 0.40 | 0.82 | 1.39 | — | **0.00** | **0.00** | **0.00** | 2.2 | 54.8 | 120.0 | 1.2 | 66.0 |
| 10.0 | 35,470.9 | 0.25 | 0.25 | 1.00 | — | **0.00** | 0.02 | **0.01** | 3.4 | 72.9 | 120.0 | 1.4 | 120.0 |
| 25.0 | 84,045.8 | 0.31 | 0.33 | 0.24 | — | **0.00** | **0.00** | **0.01** | 5.6 | 104.0 | 120.0 | 8.9 | 120.0 |
| 50.0 | 164,879.9 | 0.06 | 0.02 | 0.01 | — | **0.00** | 0.02 | **0.01** | 8.0 | 116.0 | 120.0 | 1.7 | 120.0 |
| 75.0 | 243,131.0 | 0.02 | 0.04 | 0.01 | — | **0.00** | **0.00** | **0.00** | 10.3 | 108.4 | 120.0 | 0.9 | 31.0 |
| 90.0 | 286,772.7 | 0.08 | **0.00** | **0.00** | — | **0.00** | **0.00** | **0.00** | 10.8 | 103.6 | 120.0 | 0.9 | 61.0 |
| 95.0 | 300,030.2 | 0.16 | **0.00** | **0.00** | — | **0.00** | **0.00** | **0.00** | 10.9 | 89.5 | 120.0 | 0.8 | 70.0 |
| Avg | | 0.24 | 0.36 | 0.76 | — | **0.00** | 0.01 | **0.01** | 6.6 | 86.3 | 120.0 | 2.1 | 76.6 |
| Min | | 0.02 | **0.00** | **0.00** | — | **0.00** | **0.00** | **0.00** | 1.4 | 41.1 | 120.0 | 0.7 | 25.0 |
| Max | | 0.63 | 1.39 | 3.44 | — | **0.00** | 0.02 | **0.01** | 10.9 | 116.0 | 120.0 | 8.9 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 23 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 1.5 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.2 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0500_010.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 500 |
| Density ($\Delta$) | 10.0 % |
| Edges ($m$) | 12,674 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 18,278.8 | 0.30 | **0.00** | 0.17 | — | **0.00** | **0.00** | **0.00** | 1.8 | 43.7 | 120.0 | 1.6 | 59.0 |
| 5.0 | 34,763.8 | 0.34 | 0.13 | 1.13 | — | **0.00** | **0.00** | **0.01** | 2.6 | 56.5 | 120.0 | 3.2 | 78.0 |
| 10.0 | 67,528.0 | 0.71 | 0.15 | 0.28 | — | **0.00** | 0.02 | **0.01** | 3.8 | 78.7 | 120.0 | 7.4 | 120.0 |
| 25.0 | 163,212.9 | 0.10 | 0.08 | 0.17 | — | **0.00** | 0.04 | **0.01** | 6.2 | 110.8 | 120.0 | 30.3 | 120.0 |
| 50.0 | 322,049.6 | 0.15 | 0.10 | 0.12 | — | **0.00** | 0.12 | **0.01** | 8.8 | 113.9 | 120.0 | 113.9 | 120.0 |
| 75.0 | 484,446.9 | 0.06 | 0.01 | 0.02 | — | **0.00** | 0.01 | **0.01** | 10.7 | 105.8 | 120.0 | 18.6 | 120.0 |
| 90.0 | 579,466.7 | 0.03 | **0.00** | **0.00** | — | **0.00** | **0.00** | **0.00** | 11.3 | 96.6 | 120.0 | 3.5 | 120.0 |
| 95.0 | 608,724.9 | 0.15 | 0.13 | **0.00** | — | **0.00** | 0.03 | **0.00** | 11.7 | 90.5 | 120.0 | 90.7 | 120.0 |
| Avg | | 0.23 | 0.07 | 0.24 | — | **0.00** | 0.03 | **0.01** | 7.1 | 87.1 | 120.0 | 33.6 | 107.1 |
| Min | | 0.03 | **0.00** | **0.00** | — | **0.00** | **0.00** | **0.00** | 1.8 | 43.7 | 120.0 | 1.6 | 59.0 |
| Max | | 0.71 | 0.15 | 1.13 | — | **0.00** | 0.12 | **0.01** | 11.7 | 113.9 | 120.0 | 113.9 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 18 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 1.7 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.2 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0500_025.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 500 |
| Density ($\Delta$) | 25.0 % |
| Edges ($m$) | 31,231 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 38,857.9 | **0.00** | **0.00** | **0.00** | — | **0.00** | **0.00** | **0.01** | 1.7 | 42.3 | 120.0 | 84.2 | 120.0 |
| 5.0 | 77,845.3 | 0.05 | 0.05 | 0.04 | — | **0.00** | 0.06 | **0.01** | 2.5 | 57.5 | 120.0 | 120.2 | 120.0 |
| 10.0 | 157,256.5 | 0.20 | **0.00** | 0.04 | — | 2.68 | 0.47 | **0.01** | 3.6 | 74.6 | 120.0 | 121.3 | 120.0 |
| 25.0 | 397,599.5 | 0.03 | 0.03 | **0.00** | — | 2.37 | 0.54 | **0.01** | 5.9 | 106.0 | 120.0 | 120.1 | 120.0 |
| 50.0 | 802,459.4 | 0.18 | 0.05 | **0.00** | — | 0.07 | 0.44 | **0.01** | 8.1 | 104.5 | 120.0 | 120.1 | 120.0 |
| 75.0 | 1,200,332.5 | 0.26 | 0.18 | **0.00** | — | **0.00** | 0.70 | **0.01** | 9.7 | 104.9 | 120.0 | 120.8 | 120.0 |
| 90.0 | 1,431,524.4 | 0.31 | 0.28 | **0.00** | — | **0.00** | 0.35 | **0.00** | 10.8 | 98.0 | 120.0 | 9.0 | 120.0 |
| 95.0 | 1,504,604.8 | 0.02 | 0.01 | **0.00** | — | **0.00** | 0.21 | **0.00** | 11.8 | 87.8 | 120.0 | 9.6 | 120.0 |
| Avg | | 0.13 | 0.07 | **0.01** | — | 0.64 | 0.35 | **0.01** | 6.8 | 84.5 | 120.0 | 88.2 | 120.0 |
| Min | | **0.00** | **0.00** | **0.00** | — | **0.00** | **0.00** | **0.00** | 1.7 | 42.3 | 120.0 | 9.0 | 120.0 |
| Max | | 0.31 | 0.28 | **0.04** | — | 2.68 | 0.70 | **0.01** | 11.8 | 106.0 | 120.0 | 121.3 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 10 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 1.8 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.3 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0500_050.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 500 |
| Density ($\Delta$) | 50.0 % |
| Edges ($m$) | 62,315 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 75,360.7 | 0.01 | 0.01 | **0.00** | — | 1,923.32 | **0.00** | **0.01** | 1.8 | 46.5 | 120.0 | 120.2 | 120.0 |
| 5.0 | 152,070.8 | 1.00 | 0.28 | **0.00** | — | 3.83 | 0.79 | **0.01** | 2.7 | 58.2 | 120.0 | 120.1 | 120.0 |
| 10.0 | 305,947.5 | 0.44 | 0.11 | **0.00** | — | 0.97 | 0.69 | **0.01** | 3.9 | 79.7 | 120.0 | 120.1 | 120.0 |
| 25.0 | 779,904.6 | **0.00** | **0.00** | **0.00** | — | 0.95 | 1.63 | **0.01** | 6.2 | 111.1 | 120.0 | 120.1 | 120.0 |
| 50.0 | 1,556,736.3 | 0.28 | 0.11 | **0.00** | — | 0.86 | 1.46 | **0.01** | 8.6 | 104.6 | 120.0 | 120.1 | 120.0 |
| 75.0 | 2,347,281.2 | 0.17 | 0.12 | **0.00** | — | 4.30 | 1.18 | **0.01** | 10.4 | 112.7 | 120.0 | 120.2 | 120.0 |
| 90.0 | 2,814,236.9 | 0.02 | 0.02 | **0.00** | — | 0.01 | 0.48 | **0.01** | 11.3 | 95.7 | 120.0 | 120.1 | 120.0 |
| 95.0 | 2,965,983.7 | 0.07 | 0.04 | **0.00** | — | **0.00** | 0.24 | **0.00** | 11.6 | 95.1 | 120.0 | 77.1 | 120.0 |
| Avg | | 0.25 | 0.09 | **0.00** | — | 241.78 | 0.81 | **0.01** | 7.0 | 88.0 | 120.0 | 114.7 | 120.0 |
| Min | | **0.00** | **0.00** | **0.00** | — | **0.00** | **0.00** | **0.00** | 1.8 | 46.5 | 120.0 | 77.1 | 120.0 |
| Max | | 1.00 | 0.28 | **0.00** | — | 1,923.32 | 1.63 | **0.01** | 11.6 | 112.7 | 120.0 | 120.2 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 5 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 2.1 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.3 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0500_075.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 500 |
| Density ($\Delta$) | 75.0 % |
| Edges ($m$) | 93,522 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 113,413.7 | **0.00** | **0.00** | **0.00** | — | 1,566.87 | 0.99 | **0.01** | 1.7 | 43.4 | 120.0 | 120.1 | 120.0 |
| 5.0 | 227,644.1 | 0.66 | 0.18 | **0.00** | — | 1,125.70 | 1.05 | **0.01** | 2.5 | 58.0 | 120.0 | 120.1 | 120.0 |
| 10.0 | 457,198.8 | 0.48 | 0.31 | **0.00** | — | 625.61 | 1.33 | **0.01** | 3.6 | 75.8 | 120.0 | 120.1 | 120.0 |
| 25.0 | 1,171,167.5 | 0.13 | **0.00** | **0.00** | — | 296.69 | 1.61 | **0.01** | 5.8 | 103.3 | 120.0 | 120.1 | 120.0 |
| 50.0 | 2,341,380.7 | 0.39 | **0.00** | **0.00** | — | 86.59 | 1.70 | **0.01** | 8.2 | 104.2 | 120.0 | 120.1 | 120.0 |
| 75.0 | 3,524,336.7 | 0.09 | 0.02 | **0.00** | — | 34.55 | 1.34 | **0.01** | 9.9 | 104.2 | 120.0 | 120.1 | 120.0 |
| 90.0 | 4,217,052.8 | 0.08 | 0.05 | **0.00** | — | 10.16 | 0.88 | **0.00** | 10.6 | 96.2 | 120.0 | 120.1 | 120.0 |
| 95.0 | 4,445,627.8 | 0.07 | 0.07 | **0.00** | — | 4.00 | 0.28 | **0.00** | 10.9 | 88.0 | 120.0 | 120.1 | 120.0 |
| Avg | | 0.24 | 0.08 | **0.00** | — | 468.77 | 1.15 | **0.01** | 6.7 | 84.1 | 120.0 | 120.1 | 120.0 |
| Min | | **0.00** | **0.00** | **0.00** | — | 4.00 | 0.28 | **0.00** | 1.7 | 43.4 | 120.0 | 120.1 | 120.0 |
| Max | | 0.66 | 0.31 | **0.00** | — | 1,566.87 | 1.70 | **0.01** | 10.9 | 104.2 | 120.0 | 120.1 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 3 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 2.2 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.3 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_0500_100.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 500 |
| Density ($\Delta$) | 100.0 % |
| Edges ($m$) | 124,750 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 148,569.4 | 0.96 | 0.63 | **0.00** | — | 2,577.40 | 1.28 | **0.01** | 1.8 | 43.7 | 120.0 | 120.1 | 120.0 |
| 5.0 | 301,221.4 | 0.51 | 0.09 | **0.00** | — | 1,321.50 | 2.19 | **0.01** | 2.6 | 57.8 | 120.0 | 120.1 | 120.0 |
| 10.0 | 608,617.1 | 0.91 | **0.00** | **0.00** | — | 609.82 | 1.97 | **0.01** | 3.7 | 75.0 | 120.0 | 120.1 | 120.0 |
| 25.0 | 1,548,169.7 | 0.25 | 0.13 | **0.00** | — | 264.01 | 3.27 | **0.01** | 6.0 | 106.0 | 120.0 | 120.1 | 120.0 |
| 50.0 | 3,118,862.2 | 0.11 | 0.01 | **0.00** | — | 99.80 | 1.52 | **0.01** | 8.4 | 109.0 | 120.0 | 120.1 | 120.0 |
| 75.0 | 4,693,962.0 | 0.13 | 0.08 | **0.00** | — | 28.64 | 1.65 | **0.01** | 10.2 | 107.8 | 120.0 | 120.1 | 120.0 |
| 90.0 | 5,621,223.4 | 0.07 | 0.05 | **0.00** | — | 9.02 | 0.97 | **0.01** | 10.7 | 98.7 | 120.0 | 120.1 | 120.0 |
| 95.0 | 5,929,249.8 | 0.07 | 0.06 | **0.00** | — | 5.45 | 0.30 | **0.00** | 10.9 | 90.5 | 120.0 | 120.1 | 120.0 |
| Avg | | 0.38 | 0.13 | **0.00** | — | 614.46 | 1.64 | **0.01** | 6.8 | 86.1 | 120.0 | 120.1 | 120.0 |
| Min | | 0.07 | **0.00** | **0.00** | — | 5.45 | 0.30 | **0.00** | 1.8 | 43.7 | 120.0 | 120.1 | 120.0 |
| Max | | 0.96 | 0.63 | **0.00** | — | 2,577.40 | 3.27 | **0.01** | 10.9 | 109.0 | 120.0 | 120.1 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 3 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 2.5 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.4 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_1000_005.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 1,000 |
| Density ($\Delta$) | 5.0 % |
| Edges ($m$) | 24,843 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 34,451.6 | 0.32 | 0.17 | — | — | **0.00** | 0.19 | **0.01** | 10.2 | 120.0 | 120.0 | 9.9 | 120.0 |
| 5.0 | 67,534.9 | 0.13 | 0.13 | — | — | **0.00** | 0.07 | **0.01** | 15.4 | 120.0 | 120.0 | 23.4 | 120.0 |
| 10.0 | 134,033.9 | 0.37 | 0.18 | — | — | **0.00** | 0.25 | **0.02** | 22.8 | 120.0 | 120.0 | 11.2 | 120.0 |
| 25.0 | 328,732.9 | 0.04 | 0.10 | — | — | **0.00** | 0.10 | **0.01** | 38.6 | 120.0 | 120.0 | 8.3 | 120.0 |
| 50.0 | 648,119.5 | 0.04 | 0.05 | — | — | **0.00** | 0.19 | **0.03** | 54.3 | 120.0 | 120.0 | 14.2 | 120.0 |
| 75.0 | 963,603.7 | 0.03 | 0.01 | — | — | **0.00** | 0.17 | **0.02** | 63.6 | 120.0 | 120.0 | 6.2 | 120.0 |
| 90.0 | 1,144,258.5 | 0.09 | 0.06 | — | — | **0.00** | 0.16 | **0.01** | 67.8 | 120.0 | 120.0 | 7.8 | 120.0 |
| 95.0 | 1,200,556.5 | 0.06 | 0.06 | — | — | **0.00** | 0.07 | **0.01** | 70.1 | 120.0 | 120.0 | 9.3 | 120.0 |
| Avg | | 0.14 | 0.10 | — | — | **0.00** | 0.15 | **0.02** | 42.8 | 120.0 | 120.0 | 11.3 | 120.0 |
| Min | | 0.03 | 0.01 | — | — | **0.00** | 0.07 | **0.01** | 10.2 | 120.0 | 120.0 | 6.2 | 120.0 |
| Max | | 0.37 | 0.18 | — | — | **0.00** | 0.25 | **0.03** | 70.1 | 120.0 | 120.0 | 23.4 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 20 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 3.1 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.4 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_1000_010.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 1,000 |
| Density ($\Delta$) | 10.0 % |
| Edges ($m$) | 49,946 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 62,045.7 | 0.31 | 0.20 | — | — | **0.00** | 0.14 | **0.02** | 10.7 | 120.0 | 120.0 | 120.1 | 120.0 |
| 5.0 | 126,277.1 | 0.22 | 0.20 | — | — | **0.00** | 0.18 | **0.01** | 16.2 | 120.0 | 120.0 | 115.3 | 120.0 |
| 10.0 | 251,084.4 | 0.09 | **0.00** | — | — | 0.07 | 0.29 | **0.02** | 23.1 | 120.0 | 120.0 | 120.9 | 120.0 |
| 25.0 | 636,814.2 | 0.05 | 0.01 | — | — | **0.00** | 0.39 | **0.03** | 37.3 | 120.0 | 120.0 | 91.6 | 120.0 |
| 50.0 | 1,267,913.2 | 0.19 | **0.00** | — | — | 0.24 | 0.46 | **0.03** | 52.0 | 120.0 | 120.0 | 120.3 | 120.0 |
| 75.0 | 1,901,791.8 | 0.05 | **0.00** | — | — | **0.00** | 0.53 | **0.02** | 60.7 | 120.0 | 120.0 | 46.8 | 120.0 |
| 90.0 | 2,276,091.1 | 0.05 | 0.05 | — | — | **0.00** | 0.27 | **0.01** | 65.9 | 120.0 | 120.0 | 46.1 | 120.0 |
| 95.0 | 2,392,820.3 | 0.09 | 0.01 | — | — | **0.00** | 0.05 | **0.01** | 71.3 | 120.0 | 120.0 | 19.2 | 120.0 |
| Avg | | 0.13 | 0.06 | — | — | **0.04** | 0.29 | **0.02** | 42.2 | 120.0 | 120.0 | 85.0 | 120.0 |
| Min | | 0.05 | **0.00** | — | — | **0.00** | 0.05 | **0.01** | 10.7 | 120.0 | 120.0 | 19.2 | 120.0 |
| Max | | 0.31 | **0.20** | — | — | 0.24 | 0.53 | **0.03** | 71.3 | 120.0 | 120.0 | 120.9 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 12 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 3.3 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.5 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_1000_025.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 1,000 |
| Density ($\Delta$) | 25.0 % |
| Edges ($m$) | 124,788 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 155,296.9 | **0.00** | **0.00** | — | — | 0.77 | 0.12 | **0.02** | 10.8 | 120.0 | 120.0 | 120.3 | 120.0 |
| 5.0 | 312,811.1 | 0.37 | **0.00** | — | — | 0.09 | 0.44 | **0.01** | 15.6 | 120.0 | 120.0 | 120.3 | 120.0 |
| 10.0 | 630,664.7 | 0.23 | **0.00** | — | — | 1.85 | 0.58 | **0.02** | 23.0 | 120.0 | 120.0 | 120.3 | 120.0 |
| 25.0 | 1,581,746.6 | **0.00** | 0.01 | — | — | **0.00** | 1.01 | **0.03** | 37.5 | 120.0 | 120.0 | 41.8 | 120.0 |
| 50.0 | 3,133,492.4 | 0.21 | **0.00** | — | — | 0.93 | 1.59 | **0.03** | 52.4 | 120.0 | 120.0 | 120.3 | 120.0 |
| 75.0 | 4,706,281.0 | **0.00** | **0.00** | — | — | 4.30 | 1.17 | **0.02** | 62.7 | 120.0 | 120.0 | 120.5 | 120.0 |
| 90.0 | 5,636,165.5 | 0.09 | 0.07 | — | — | **0.00** | 0.40 | **0.01** | 66.4 | 120.0 | 120.0 | 120.6 | 120.0 |
| 95.0 | 5,939,893.3 | 0.01 | **0.00** | — | — | **0.00** | 0.19 | **0.01** | 67.0 | 120.0 | 120.0 | 25.1 | 120.0 |
| Avg | | 0.11 | **0.01** | — | — | 0.99 | 0.69 | **0.02** | 41.9 | 120.0 | 120.0 | 98.6 | 120.0 |
| Min | | **0.00** | **0.00** | — | — | **0.00** | 0.12 | **0.01** | 10.8 | 120.0 | 120.0 | 25.1 | 120.0 |
| Max | | 0.37 | **0.07** | — | — | 4.30 | 1.59 | **0.03** | 67.0 | 120.0 | 120.0 | 120.6 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 6 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 3.9 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.5 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_1000_050.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 1,000 |
| Density ($\Delta$) | 50.0 % |
| Edges ($m$) | 249,853 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 297,259.3 | 0.19 | **0.00** | — | — | 1,540.45 | 2.04 | **0.03** | 10.9 | 120.0 | 120.0 | 120.5 | 120.0 |
| 5.0 | 601,837.6 | 0.08 | **0.00** | — | — | 1,092.04 | 1.91 | **0.01** | 16.1 | 120.0 | 120.0 | 120.4 | 120.0 |
| 10.0 | 1,224,737.5 | 0.04 | **0.00** | — | — | 714.56 | 2.40 | **0.02** | 23.6 | 120.0 | 120.0 | 120.3 | 120.0 |
| 25.0 | 3,115,598.4 | 0.13 | **0.00** | — | — | 276.08 | 2.47 | **0.05** | 39.4 | 120.0 | 120.0 | 120.3 | 120.0 |
| 50.0 | 6,256,745.9 | **0.00** | **0.00** | — | — | 98.96 | 2.25 | **0.03** | 52.2 | 120.0 | 120.0 | 120.3 | 120.0 |
| 75.0 | 9,398,856.3 | 0.04 | **0.00** | — | — | 31.36 | 1.81 | **0.02** | 61.5 | 120.0 | 120.0 | 120.3 | 120.0 |
| 90.0 | 11,274,908.2 | 0.09 | 0.06 | — | — | **0.00** | 0.81 | **0.01** | 65.5 | 120.0 | 120.0 | 120.3 | 120.0 |
| 95.0 | 11,885,465.6 | 0.01 | **0.00** | — | — | 0.01 | 0.19 | **0.01** | 67.5 | 120.0 | 120.0 | 120.3 | 120.0 |
| Avg | | 0.07 | **0.01** | — | — | 469.18 | 1.74 | **0.02** | 42.1 | 120.0 | 120.0 | 120.3 | 120.0 |
| Min | | **0.00** | **0.00** | — | — | **0.00** | 0.19 | **0.01** | 10.9 | 120.0 | 120.0 | 120.3 | 120.0 |
| Max | | 0.19 | **0.06** | — | — | 1,540.45 | 2.47 | **0.05** | 67.5 | 120.0 | 120.0 | 120.5 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 3 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 4.8 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.7 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_1000_075.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 1,000 |
| Density ($\Delta$) | 75.0 % |
| Edges ($m$) | 374,291 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 440,613.8 | 0.11 | **0.00** | — | — | 2,167.41 | 2.86 | **0.03** | 10.6 | 120.0 | 120.0 | 120.3 | 120.0 |
| 5.0 | 903,642.5 | **0.00** | **0.00** | — | — | 1,390.41 | 2.70 | **0.01** | 16.5 | 120.0 | 120.0 | 120.4 | 120.0 |
| 10.0 | 1,838,710.0 | 0.05 | **0.00** | — | — | 747.67 | 3.87 | **0.02** | 25.0 | 120.0 | 120.0 | 120.4 | 120.0 |
| 25.0 | 4,695,997.2 | **0.00** | **0.00** | — | — | 267.88 | 3.77 | **0.03** | 40.2 | 120.0 | 120.0 | 120.4 | 120.0 |
| 50.0 | 9,347,994.6 | 0.01 | **0.00** | — | — | 93.69 | 3.59 | **0.03** | 56.4 | 120.0 | 120.0 | 120.4 | 120.0 |
| 75.0 | 14,068,954.5 | **0.00** | **0.00** | — | — | 29.58 | 2.01 | **0.02** | 66.4 | 120.0 | 120.0 | 120.3 | 120.0 |
| 90.0 | 16,897,141.5 | 0.01 | **0.00** | — | — | 0.04 | 0.73 | **0.01** | 70.9 | 120.0 | 120.0 | 120.4 | 120.0 |
| 95.0 | 17,799,789.4 | 0.01 | **0.00** | — | — | 0.10 | 0.13 | **0.01** | 72.3 | 120.0 | 120.0 | 120.4 | 120.0 |
| Avg | | 0.02 | **0.00** | — | — | 587.10 | 2.46 | **0.02** | 44.8 | 120.0 | 120.0 | 120.4 | 120.0 |
| Min | | **0.00** | **0.00** | — | — | 0.04 | 0.13 | **0.01** | 10.6 | 120.0 | 120.0 | 120.3 | 120.0 |
| Max | | 0.11 | **0.00** | — | — | 2,167.41 | 3.87 | **0.03** | 72.3 | 120.0 | 120.0 | 120.4 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 3 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 5.8 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.8 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_1000_100.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 1,000 |
| Density ($\Delta$) | 100.0 % |
| Edges ($m$) | 499,500 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 592,191.9 | **0.00** | **0.00** | — | — | 2,148.68 | 3.22 | **0.03** | 11.4 | 120.0 | 120.0 | 120.6 | 121.0 |
| 5.0 | 1,204,218.9 | **0.00** | **0.00** | — | — | 1,371.08 | 3.74 | **0.01** | 17.5 | 120.0 | 120.0 | 120.7 | 120.0 |
| 10.0 | 2,453,846.7 | 0.53 | **0.00** | — | — | 841.60 | 4.21 | **0.02** | 24.3 | 120.0 | 120.0 | 120.8 | 120.0 |
| 25.0 | 6,261,060.4 | 0.05 | **0.00** | — | — | 295.81 | 3.81 | **0.03** | 39.4 | 120.0 | 120.0 | 120.5 | 120.0 |
| 50.0 | 12,481,235.4 | 0.02 | **0.00** | — | — | 99.97 | 4.24 | **0.03** | 53.9 | 120.0 | 120.0 | 122.9 | 121.0 |
| 75.0 | 18,775,329.3 | 0.01 | **0.00** | — | — | 36.21 | 3.11 | **0.02** | 64.1 | 120.0 | 120.0 | 123.2 | 120.0 |
| 90.0 | 22,540,787.0 | 0.01 | **0.00** | — | — | 13.38 | 0.81 | **0.01** | 68.8 | 120.0 | 120.0 | 120.5 | 120.0 |
| 95.0 | 23,742,260.7 | 0.01 | **0.00** | — | — | 5.71 | 0.30 | **0.01** | 70.6 | 120.0 | 120.0 | 120.5 | 121.0 |
| Avg | | 0.08 | **0.00** | — | — | 601.56 | 2.93 | **0.02** | 43.8 | 120.0 | 120.0 | 121.2 | 120.4 |
| Min | | **0.00** | **0.00** | — | — | 5.71 | 0.30 | **0.01** | 11.4 | 120.0 | 120.0 | 120.5 | 120.0 |
| Max | | 0.53 | **0.00** | — | — | 2,148.68 | 4.24 | **0.03** | 70.6 | 120.0 | 120.0 | 123.2 | 121.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 3 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 7.2 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 1.0 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_2000_005.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 2,000 |
| Density ($\Delta$) | 5.0 % |
| Edges ($m$) | 99,532 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 132,260.1 | 0.11 | **0.00** | — | — | 2,381.11 | 0.18 | **0.06** | 71.3 | 120.0 | 120.0 | 120.1 | 120.0 |
| 5.0 | 263,179.2 | 0.05 | **0.00** | — | — | 1,520.97 | 0.26 | **0.03** | 106.2 | 120.0 | 120.0 | 120.3 | 120.0 |
| 10.0 | 524,482.4 | 0.03 | 0.03 | — | — | **0.00** | 0.16 | **0.03** | 120.1 | 120.0 | 120.0 | 91.8 | 120.0 |
| 25.0 | 1,278,179.7 | 0.02 | **0.00** | — | — | 2.76 | 0.43 | **0.13** | 120.1 | 120.0 | 120.0 | 120.1 | 120.0 |
| 50.0 | 2,528,664.3 | 0.01 | **0.00** | — | — | 13.60 | 0.74 | **0.13** | 120.1 | 120.0 | 120.0 | 120.1 | 120.0 |
| 75.0 | 3,785,052.3 | 0.03 | **0.00** | — | — | 0.52 | 0.56 | **0.09** | 120.0 | 120.0 | 120.0 | 120.1 | 120.0 |
| 90.0 | 4,526,909.6 | 0.02 | 0.01 | — | — | **0.00** | 0.26 | **0.08** | 120.1 | 120.0 | 120.0 | 44.4 | 120.0 |
| 95.0 | 4,762,737.3 | **0.00** | **0.00** | — | — | **0.00** | 0.14 | **0.07** | 120.1 | 120.0 | 120.0 | 53.1 | 120.0 |
| Avg | | 0.03 | **0.01** | — | — | 489.87 | 0.34 | **0.08** | 112.2 | 120.0 | 120.0 | 98.8 | 120.0 |
| Min | | **0.00** | **0.00** | — | — | **0.00** | 0.14 | **0.03** | 71.3 | 120.0 | 120.0 | 44.4 | 120.0 |
| Max | | 0.11 | **0.03** | — | — | 2,381.11 | 0.74 | **0.13** | 120.1 | 120.0 | 120.0 | 120.3 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 10 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 7.1 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 0.8 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_2000_010.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 2,000 |
| Density ($\Delta$) | 10.0 % |
| Edges ($m$) | 200,204 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 248,175.8 | 0.13 | **0.00** | — | — | 2,765.71 | 0.61 | **0.07** | 70.9 | 120.0 | 120.0 | 120.8 | 120.0 |
| 5.0 | 500,091.8 | 0.09 | **0.00** | — | — | 1,501.29 | 0.51 | **0.03** | 105.6 | 120.0 | 120.0 | 120.7 | 120.0 |
| 10.0 | 1,002,794.9 | 0.01 | **0.00** | — | — | 725.82 | 0.70 | **0.06** | 120.0 | 120.0 | 120.0 | 120.7 | 120.0 |
| 25.0 | 2,508,917.4 | 0.02 | **0.00** | — | — | 269.51 | 1.41 | **0.11** | 120.1 | 120.0 | 120.0 | 120.8 | 120.0 |
| 50.0 | 5,038,504.5 | 0.02 | **0.00** | — | — | 99.75 | 1.18 | **0.12** | 120.2 | 120.0 | 120.0 | 120.5 | 120.0 |
| 75.0 | 7,555,731.6 | 0.01 | **0.00** | — | — | 32.61 | 0.98 | **0.09** | 120.2 | 120.0 | 120.0 | 120.9 | 120.0 |
| 90.0 | 9,059,927.2 | 0.01 | **0.00** | — | — | 10.50 | 0.53 | **0.08** | 120.1 | 120.0 | 120.0 | 120.4 | 120.0 |
| 95.0 | 9,546,454.7 | **0.00** | **0.00** | — | — | 4.95 | 0.26 | **0.07** | 120.1 | 120.0 | 120.0 | 120.6 | 120.0 |
| Avg | | 0.04 | **0.00** | — | — | 676.27 | 0.77 | **0.08** | 112.2 | 120.0 | 120.0 | 120.7 | 120.0 |
| Min | | **0.00** | **0.00** | — | — | 4.95 | 0.26 | **0.03** | 70.9 | 120.0 | 120.0 | 120.4 | 120.0 |
| Max | | 0.13 | **0.00** | — | — | 2,765.71 | 1.41 | **0.12** | 120.2 | 120.0 | 120.0 | 120.9 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 6 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 7.4 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 1.0 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_2000_025.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 2,000 |
| Density ($\Delta$) | 25.0 % |
| Edges ($m$) | 500,018 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 612,257.2 | 0.06 | **0.00** | — | — | 2,474.71 | 2.99 | **0.13** | 71.9 | 120.0 | 120.0 | 124.3 | 121.0 |
| 5.0 | 1,234,357.4 | 0.13 | **0.00** | — | — | 1,561.34 | 2.43 | **0.03** | 105.3 | 120.0 | 120.0 | 121.1 | 121.0 |
| 10.0 | 2,492,561.7 | 0.01 | **0.00** | — | — | 873.35 | 2.66 | **0.06** | 120.1 | 120.0 | 120.0 | 125.5 | 121.0 |
| 25.0 | 6,239,405.4 | 0.05 | **0.00** | — | — | 294.02 | 3.49 | **0.10** | 120.0 | 120.0 | 120.0 | 121.5 | 121.0 |
| 50.0 | 12,475,438.6 | 0.01 | **0.00** | — | — | 95.32 | 3.97 | **0.12** | 120.1 | 120.0 | 120.0 | 121.1 | 121.0 |
| 75.0 | 18,778,993.5 | 0.02 | **0.00** | — | — | 34.78 | 2.12 | **0.10** | 120.2 | 120.0 | 120.0 | 124.1 | 121.0 |
| 90.0 | 22,575,818.9 | 0.09 | **0.00** | — | — | 12.02 | 0.63 | **0.08** | 120.0 | 120.0 | 120.0 | 121.1 | 121.0 |
| 95.0 | 23,803,549.8 | 0.01 | **0.00** | — | — | 4.75 | 0.22 | **0.07** | 120.2 | 120.0 | 120.0 | 120.4 | 121.0 |
| Avg | | 0.05 | **0.00** | — | — | 668.79 | 2.31 | **0.09** | 112.2 | 120.0 | 120.0 | 122.4 | 121.0 |
| Min | | 0.01 | **0.00** | — | — | 4.75 | 0.22 | **0.03** | 71.9 | 120.0 | 120.0 | 120.4 | 121.0 |
| Max | | 0.13 | **0.00** | — | — | 2,474.71 | 3.97 | **0.13** | 120.2 | 120.0 | 120.0 | 125.5 | 121.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 4 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 10.2 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 1.4 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_2000_050.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 2,000 |
| Density ($\Delta$) | 50.0 % |
| Edges ($m$) | 999,583 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 1,204,589.6 | 0.36 | **0.00** | — | — | 3,407.54 | 4.93 | **0.13** | 73.4 | 120.0 | 120.0 | 120.6 | 122.0 |
| 5.0 | 2,452,727.0 | 0.04 | **0.00** | — | — | 1,562.03 | 4.43 | **0.03** | 106.9 | 120.0 | 120.0 | 121.2 | 122.0 |
| 10.0 | 4,970,628.0 | 0.06 | **0.00** | — | — | 835.66 | 4.66 | **0.06** | 120.0 | 120.0 | 120.0 | 120.7 | 122.0 |
| 25.0 | 12,443,217.7 | 0.04 | **0.00** | — | — | 275.07 | 6.27 | **0.10** | 120.1 | 120.0 | 120.0 | 126.4 | 122.0 |
| 50.0 | 24,942,677.7 | **0.00** | **0.00** | — | — | 96.52 | 6.14 | **0.12** | 120.0 | 120.0 | 120.0 | 123.7 | 122.0 |
| 75.0 | 37,492,874.7 | **0.00** | **0.00** | — | — | 32.56 | 2.85 | **0.10** | 120.2 | 120.0 | 120.0 | 122.1 | 122.0 |
| 90.0 | 44,998,502.8 | 0.01 | **0.00** | — | — | 10.28 | 1.10 | **0.08** | 120.2 | 120.0 | 120.0 | 122.1 | 122.0 |
| 95.0 | 47,477,239.0 | **0.00** | **0.00** | — | — | 4.60 | 0.35 | **0.07** | 120.1 | 120.0 | 120.0 | 122.2 | 122.0 |
| Avg | | 0.06 | **0.00** | — | — | 778.03 | 3.84 | **0.09** | 112.6 | 120.0 | 120.0 | 122.4 | 122.0 |
| Min | | **0.00** | **0.00** | — | — | 4.60 | 0.35 | **0.03** | 73.4 | 120.0 | 120.0 | 120.6 | 122.0 |
| Max | | 0.36 | **0.00** | — | — | 3,407.54 | 6.27 | **0.13** | 120.2 | 120.0 | 120.0 | 126.4 | 122.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 3 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 14.1 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 1.9 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_2000_075.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 2,000 |
| Density ($\Delta$) | 75.0 % |
| Edges ($m$) | 1,499,290 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 1,808,508.8 | 0.03 | **0.00** | — | — | 2,758.29 | 6.26 | **0.13** | 72.3 | 120.0 | 120.0 | 121.9 | 120.0 |
| 5.0 | 3,654,303.2 | 0.09 | **0.00** | — | — | 1,490.68 | 6.47 | **0.03** | 107.9 | 120.0 | 120.0 | 121.6 | 120.0 |
| 10.0 | 7,405,266.7 | 0.04 | **0.00** | — | — | 818.11 | 7.39 | **0.06** | 120.1 | 120.0 | 120.0 | 122.8 | 120.0 |
| 25.0 | 18,581,985.4 | 0.02 | **0.00** | — | — | 294.30 | 8.14 | **0.10** | 120.1 | 120.0 | 120.0 | 121.8 | 120.0 |
| 50.0 | 37,368,063.9 | 0.01 | **0.00** | — | — | 96.21 | 7.17 | **0.12** | 120.1 | 120.0 | 120.0 | 122.9 | 120.0 |
| 75.0 | 56,191,297.7 | 0.01 | **0.00** | — | — | 30.04 | 3.50 | **0.10** | 120.2 | 120.0 | 120.0 | 121.7 | 120.0 |
| 90.0 | 67,538,078.7 | 0.01 | **0.00** | — | — | 10.69 | 1.20 | **0.08** | 120.2 | 120.0 | 120.0 | 122.7 | 120.0 |
| 95.0 | 71,274,315.0 | **0.00** | **0.00** | — | — | 5.30 | 0.48 | **0.07** | 120.1 | 120.0 | 120.0 | 121.5 | 120.0 |
| Avg | | 0.03 | **0.00** | — | — | 687.95 | 5.08 | **0.09** | 112.6 | 120.0 | 120.0 | 122.1 | 120.0 |
| Min | | **0.00** | **0.00** | — | — | 5.30 | 0.48 | **0.03** | 72.3 | 120.0 | 120.0 | 121.5 | 120.0 |
| Max | | 0.09 | **0.00** | — | — | 2,758.29 | 8.14 | **0.13** | 120.2 | 120.0 | 120.0 | 122.9 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 3 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 18.0 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 2.5 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |

# File dispersion-qkp-expo_2000_100.txt

| Property of graph | Value |
|---|---|
| Nodes ($n$) | 2,000 |
| Density ($\Delta$) | 100.0 % |
| Edges ($m$) | 1,999,000 |

| | | Deviation from best OFV (%) | | | | | | Running time (s) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\gamma$ | Best OFV | QKBP* | RG | DP | QK | Gurobi | Hexaly | QKBP* | RG | DP | QK | Gurobi | Hexaly |
| 2.5 | 2,397,736.1 | 0.07 | **0.00** | — | — | 2,872.04 | 8.95 | **0.12** | 72.5 | 120.0 | 120.0 | 121.8 | 120.0 |
| 5.0 | 4,857,547.4 | 0.06 | **0.00** | — | — | 1,864.69 | 5.83 | **0.03** | 106.0 | 120.0 | 120.0 | 122.2 | 120.0 |
| 10.0 | 9,849,244.9 | 0.02 | **0.00** | — | — | 864.46 | 9.46 | **0.06** | 120.0 | 120.0 | 120.0 | 122.5 | 120.0 |
| 25.0 | 24,802,222.7 | **0.00** | **0.00** | — | — | 297.74 | 8.42 | **0.10** | 120.0 | 120.0 | 120.0 | 122.9 | 120.0 |
| 50.0 | 49,784,658.9 | 0.01 | **0.00** | — | — | 95.66 | 7.86 | **0.11** | 120.2 | 120.0 | 120.0 | 122.0 | 120.0 |
| 75.0 | 74,831,588.1 | 0.01 | **0.00** | — | — | 31.51 | 4.23 | **0.10** | 120.1 | 120.0 | 120.0 | 122.8 | 120.0 |
| 90.0 | 89,970,984.0 | **0.00** | **0.00** | — | — | 10.27 | 1.49 | **0.08** | 120.2 | 120.0 | 120.0 | 121.2 | 120.0 |
| 95.0 | 94,964,809.9 | **0.00** | **0.00** | — | — | 4.93 | 0.71 | **0.07** | 120.2 | 120.0 | 120.0 | 121.1 | 120.0 |
| Avg | | 0.02 | **0.00** | — | — | 755.16 | 5.87 | **0.09** | 112.4 | 120.0 | 120.0 | 122.1 | 120.0 |
| Min | | **0.00** | **0.00** | — | — | 4.93 | 0.71 | **0.03** | 72.5 | 120.0 | 120.0 | 121.1 | 120.0 |
| Max | | 0.07 | **0.00** | — | — | 2,872.04 | 9.46 | **0.12** | 120.2 | 120.0 | 120.0 | 122.9 | 120.0 |

*The contribution in this paper

| QKBP-specific information | Value |
|---|---|
| Number of breakpoints | 2 |
| Running time in seconds for writing input file ($t^{\text{write}}$) | 22.1 |
| Running time in seconds for executing parametric cut procedure ($t^{\text{cut}}$) | 3.1 |
| Running time in seconds for reading result file ($t^{\text{read}}$) | 0.0 |