

Tables 17 represent the Brier, PF, and F1 values of DeMuVGN and other models in the project environment, respectively. The best results on each measure of each version have been marked in bold format.

Tables 17. The Supplementary results for RQ2 and RQ3.

| Project | Brier [↓] | | | | | | | | | |
|--------------------------|--------------------|--------------|--------------|-------|--------|-------|-------|-------|-------|--------------|
| | DeMuVGN | BiGGNN | CGCN | DBN | DP-CNN | LR+ | NB+ | RF+ | SVM+ | Xgboost+ |
| ActiveMQ_5.0.0->5.1.0 | 0.008 | 0.008 | 0.029 | 0.052 | 0.036 | 0.137 | 0.166 | 0.279 | 0.166 | 0.029 |
| ActiveMQ_5.1.0->5.2.0 | 0.011 | 0.046 | 0.017 | 0.154 | 0.077 | 0.133 | 0.140 | 0.075 | 0.169 | 0.088 |
| ActiveMQ_5.2.0->5.3.0 | 0.009 | 0.029 | 0.021 | 0.119 | 0.252 | 0.170 | 0.587 | 0.094 | 0.218 | 0.138 |
| ActiveMQ_5.3.0->5.8.0 | 0.001 | 0.002 | 0.062 | 0.088 | 0.231 | 0.282 | 0.273 | 0.091 | 0.232 | 0.116 |
| Camel_1.4.0->2.9.0 | 0.004 | 0.038 | 0.023 | 0.079 | 0.251 | 0.170 | 0.099 | 0.116 | 0.248 | 0.051 |
| Camel_2.9.0->2.10.0 | 0.001 | 0.007 | 0.009 | 0.050 | 0.246 | 0.137 | 0.074 | 0.025 | 0.178 | 0.114 |
| Camel_2.10.0->2.11.0 | 0.001 | 0.062 | 0.015 | 0.060 | 0.297 | 0.134 | 0.091 | 0.028 | 0.229 | 0.121 |
| HBase_0.95.0->0.95.2 | 0.027 | 0.130 | 0.187 | 0.168 | 0.342 | 0.247 | 0.336 | 0.103 | 0.253 | 0.618 |
| JRuby_1.4.0->1.5.0 | 0.067 | 0.081 | 0.122 | 0.116 | 0.209 | 0.185 | 0.176 | 0.118 | 0.247 | 0.240 |
| JRuby_1.1->1.4.0 | 0.029 | 0.063 | 0.131 | 0.201 | 0.126 | 0.192 | 0.151 | 0.122 | 0.252 | 0.086 |
| Lucene_2.3.0->2.9.0 | 0.090 | 0.137 | 0.194 | 0.272 | 0.157 | 0.247 | 0.212 | 0.161 | 0.254 | 0.026 |
| Wicket_1.3.0beta2->1.5.3 | 0.003 | 0.010 | 0.032 | 0.088 | 0.297 | 0.065 | 0.099 | 0.098 | 0.088 | 0.194 |
| Average | 0.021 | 0.051 | 0.070 | 0.121 | 0.210 | 0.175 | 0.200 | 0.109 | 0.211 | 0.152 |
| Project | PF [↓] | | | | | | | | | |
| | DeMuVGN | BiGGNN | CGCN | DBN | DP-CNN | LR+ | NB+ | RF+ | SVM+ | Xgboost+ |
| ActiveMQ_5.0.0->5.1.0 | 0.001 | 0.007 | 0.021 | 0.052 | 0.144 | 0.146 | 0.143 | 0.652 | 0.118 | 0.013 |
| ActiveMQ_5.1.0->5.2.0 | 0.000 | 0.003 | 0.007 | 0.109 | 0.370 | 0.152 | 0.099 | 0.020 | 0.113 | 0.022 |
| ActiveMQ_5.2.0->5.3.0 | 0.001 | 0.004 | 0.003 | 0.054 | 0.039 | 0.187 | 0.636 | 0.084 | 0.631 | 0.026 |
| ActiveMQ_5.3.0->5.8.0 | 0.002 | 0.002 | 0.051 | 0.054 | 0.183 | 0.406 | 0.278 | 0.071 | 0.178 | 0.142 |

| | | | | | | | | | | |
|--------------------------|-----------------|--------|-------|-------|--------|-------|-------|-------|-------|----------|
| Camel_1.4.0->2.9.0 | 0.002 | 0.046 | 0.025 | 0.065 | 0.172 | 0.219 | 0.088 | 0.120 | 0.084 | 0.030 |
| Camel_2.9.0->2.10.0 | 0.000 | 0.035 | 0.009 | 0.029 | 0.205 | 0.137 | 0.062 | 0.011 | 0.021 | 0.081 |
| Camel_2.10.0->2.11.0 | 0.000 | 0.012 | 0.016 | 0.046 | 0.060 | 0.133 | 0.078 | 0.013 | 0.123 | 0.084 |
| HBase_0.95.0->0.95.2 | 0.027 | 0.001 | 0.174 | 0.083 | 0.141 | 0.440 | 0.160 | 0.089 | 0.002 | 0.776 |
| JRuby_1.4.0->1.5.0 | 0.067 | 0.003 | 0.125 | 0.116 | 0.092 | 0.142 | 0.008 | 0.016 | 0.000 | 0.157 |
| JRuby_1.1->1.4.0 | 0.029 | 0.017 | 0.052 | 0.102 | 0.195 | 0.252 | 0.002 | 0.083 | 0.323 | 0.078 |
| Lucene_2.3.0->2.9.0 | 0.090 | 0.090 | 0.172 | 0.011 | 0.195 | 0.414 | 0.020 | 0.000 | 0.301 | 0.013 |
| Wicket_1.3.0beta2->1.5.3 | 0.003 | 0.053 | 0.003 | 0.055 | 0.004 | 0.040 | 0.078 | 0.098 | 0.015 | 0.002 |
| Average | 0.018 | 0.023 | 0.055 | 0.065 | 0.150 | 0.222 | 0.138 | 0.105 | 0.159 | 0.119 |
| Project | F1 [†] | | | | | | | | | |
| | DeMuVGN | BiGGNN | CGCN | DBN | DP-CNN | LR+ | NB+ | RF+ | SVM+ | Xgboost+ |
| ActiveMQ_5.0.0->5.1.0 | 0.905 | 0.940 | 0.847 | 0.602 | 0.467 | 0.293 | 0.332 | 0.126 | 0.353 | 0.330 |
| ActiveMQ_5.1.0->5.2.0 | 0.901 | 0.606 | 0.908 | 0.597 | 0.532 | 0.410 | 0.437 | 0.305 | 0.389 | 0.355 |
| ActiveMQ_5.2.0->5.3.0 | 0.936 | 0.814 | 0.866 | 0.584 | 0.385 | 0.391 | 0.279 | 0.421 | 0.268 | 0.427 |
| ActiveMQ_5.3.0->5.8.0 | 0.988 | 0.987 | 0.509 | 0.537 | 0.590 | 0.192 | 0.257 | 0.336 | 0.280 | 0.126 |
| Camel_1.4.0->2.9.0 | 0.919 | 0.831 | 0.685 | 0.546 | 0.486 | 0.487 | 0.224 | 0.131 | 0.463 | 0.201 |
| Camel_2.9.0->2.10.0 | 0.945 | 0.809 | 0.856 | 0.549 | 0.450 | 0.134 | 0.183 | 0.163 | 0.144 | 0.397 |
| Camel_2.10.0->2.11.0 | 0.993 | 0.841 | 0.762 | 0.595 | 0.559 | 0.201 | 0.260 | 0.376 | 0.365 | 0.464 |
| HBase_0.95.0->0.95.2 | 0.960 | 0.562 | 0.598 | 0.505 | 0.562 | 0.465 | 0.111 | 0.423 | 0.326 | 0.117 |
| JRuby_1.4.0->1.5.0 | 0.741 | 0.681 | 0.581 | 0.678 | 0.327 | 0.398 | 0.147 | 0.429 | 0.355 | 0.424 |
| JRuby_1.1->1.4.0 | 0.869 | 0.701 | 0.521 | 0.567 | 0.472 | 0.381 | 0.312 | 0.470 | 0.345 | 0.322 |
| Lucene_2.3.0->2.9.0 | 0.740 | 0.500 | 0.566 | 0.522 | 0.484 | 0.289 | 0.307 | 0.000 | 0.100 | 0.176 |
| Wicket_1.3.0beta2->1.5.3 | 0.956 | 0.791 | 0.355 | 0.522 | 0.561 | 0.305 | 0.255 | 0.413 | 0.118 | 0.011 |
| Average | 0.905 | 0.755 | 0.671 | 0.567 | 0.490 | 0.329 | 0.259 | 0.299 | 0.292 | 0.279 |