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*Research article*

# Survival prediction model for right-censored data based on improved composite quantile regression neural network

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## Supplementary

**Table S1.** Parametric results of the integer encoding GS optimization model for the NKI70 dataset.

| layer | method | node | dropout | n_epoch | bsize | optimizer | activation |
|---|---|---|---|---|---|---|---|
| layer = 1 | GS-rcICQRNN-5 | 120 | 0.5 | 100 | 128 | nadam | sigmoid |
| | GS-rcICQRNN-10 | 150 | 0.5 | 100 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-15 | 80 | 0.4 | 100 | 64 | adam | sigmoid |
| | GS-rcICQRNN-19 | 80 | 0.2 | 200 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-30 | 80 | 0.3 | 200 | 128 | adam | sigmoid |
| | GS-rcICQRNN-50 | 120 | 0.3 | 100 | 128 | adam | sigmoid |
| | GS-QRNN | 300 | 0.4 | 50 | 128 | adam | sigmoid |
| layer = 2 | GS-rcICQRNN-5 | 150 | 0.4 | 200 | 64 | adam | sigmoid |
| | GS-rcICQRNN-10 | 80 | 0.2 | 200 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-15 | 120 | 0.4 | 200 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-19 | 200 | 0.5 | 200 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-30 | 300 | 0.5 | 200 | 128 | adam | sigmoid |
| | GS-rcICQRNN-50 | 150 | 0.4 | 200 | 128 | nadam | sigmoid |
| | GS-QRNN | 150 | 0.4 | 50 | 64 | adam | sigmoid |
| layer = 3 | GS-rcICQRNN-5 | 80 | 0.2 | 200 | 64 | adam | sigmoid |
| | GS-rcICQRNN-10 | 150 | 0.2 | 100 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-15 | 300 | 0.3 | 100 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-19 | 200 | 0.2 | 200 | 128 | adam | sigmoid |
| | GS-rcICQRNN-30 | 100 | 0.3 | 200 | 128 | adam | sigmoid |
| | GS-CQRNN-50 | 300 | 0.2 | 100 | 64 | adam | sigmoid |
| | GS-QRNN | 200 | 0.3 | 200 | 128 | nadam | sigmoid |

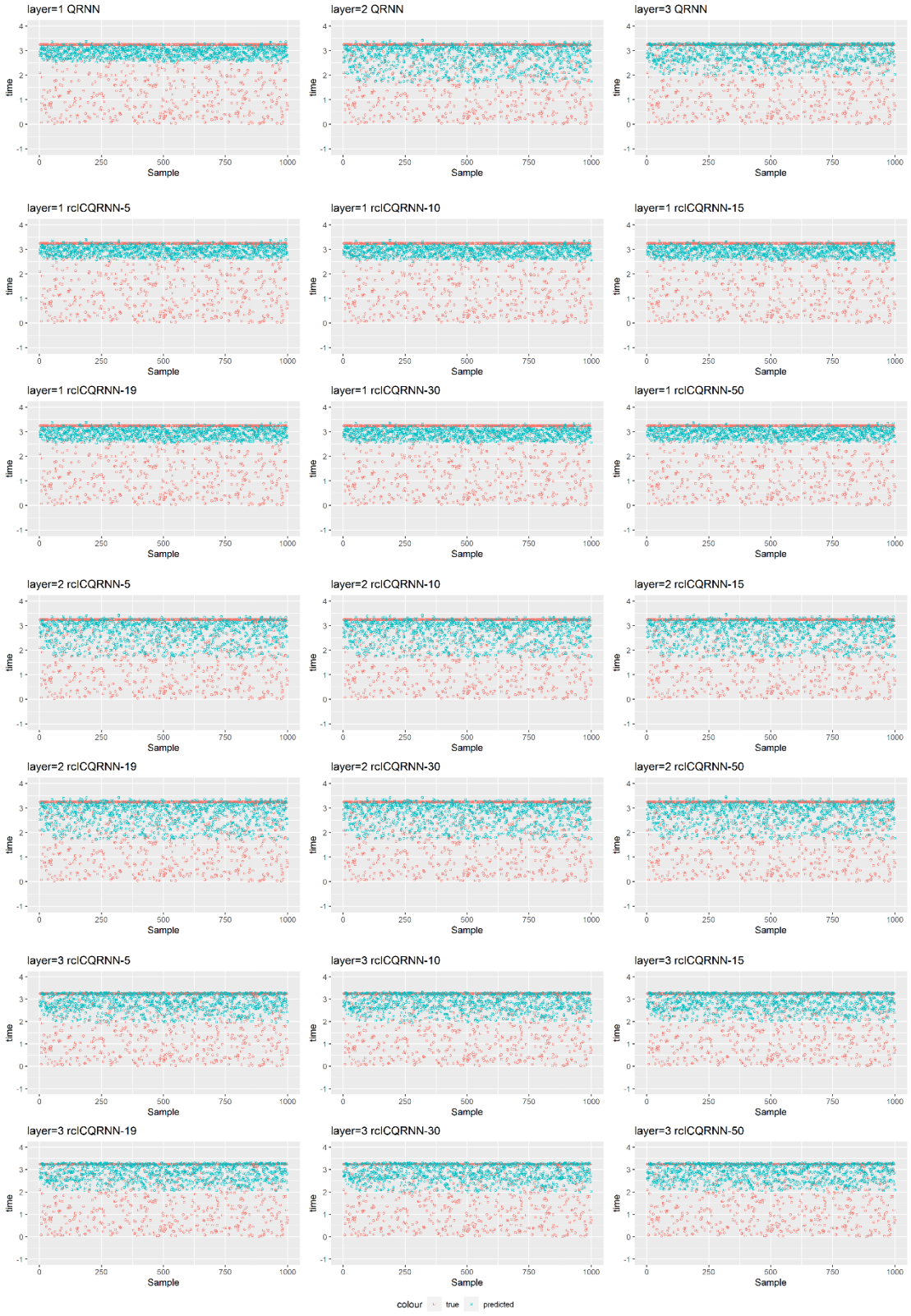


**Figure S1.** Scatter plots of actual versus predicted survival times.

**Table S2.** Parameter results of the integer encoding WOA-optimized model for the NKI70 dataset.

| layer | method | node | dropout | n_epoch | bsize |
|---|---|---|---|---|---|
| layer = 1 | WOA-rcICQRNN-5 | 51 | 0.3 | 102 | 102 |
| | WOA-rcICQRNN-10 | 50 | 0.4 | 136 | 94 |
| | WOA-rcICQRNN-15 | 92 | 0.2 | 64 | 89 |
| | WOA-rcICQRNN-19 | 61 | 0.2 | 69 | 72 |
| | WOA-rcICQRNN-30 | 136 | 0.3 | 208 | 105 |
| | WOA-rcICQRNN-50 | 102 | 0.4 | 315 | 107 |
| | WOA-QRNN | 20 | 0.2 | 192 | 118 |
| layer = 2 | WOA-rcICQRNN-5 | 91 | 0.4 | 83 | 104 |
| | WOA-rcICQRNN-10 | 134 | 0.2 | 88 | 100 |
| | WOA-rcICQRNN-15 | 130 | 0.3 | 50 | 93 |
| | WOA-rcICQRNN-19 | 82 | 0.3 | 142 | 107 |
| | WOA-rcICQRNN-30 | 40 | 0.4 | 142 | 96 |
| | WOA-rcICQRNN-50 | 188 | 0.4 | 178 | 100 |
| | WOA-QRNN | 65 | 0.3 | 159 | 104 |
| layer = 3 | WOA-rcICQRNN-5 | 66 | 0.2 | 129 | 104 |
| | WOA-rcICQRNN-10 | 263 | 0.4 | 377 | 106 |
| | WOA-rcICQRNN-15 | 71 | 0.2 | 110 | 96 |
| | WOA-rcICQRNN-19 | 44 | 0.2 | 109 | 101 |
| | WOA-rcICQRNN-30 | 188 | 0.3 | 198 | 107 |
| | WOA-rcICQRNN-50 | 30 | 0.4 | 167 | 106 |
| | WOA-QRNN | 178 | 0.2 | 113 | 104 |

**Table S3.** Parametric results of the One-Hot encoding GS optimization model for the NKI70 dataset.

| layer | method | node | dropout | n_epoch | bsize | optimizer | activation |
|---|---|---|---|---|---|---|---|
| layer = 1 | GS-rcICQRNN-5 | 300 | 0.2 | 50 | 128 | nadam | sigmoid |
| | GS-rcICQRNN-10 | 150 | 0.5 | 100 | 128 | nadam | sigmoid |
| | GS-rcICQRNN-15 | 150 | 0.3 | 50 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-19 | 150 | 0.2 | 50 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-30 | 300 | 0.5 | 50 | 64 | adam | sigmoid |
| | GS-rcICQRNN-50 | 150 | 0.4 | 50 | 64 | adam | sigmoid |
| | GS-QRNN | 150 | 0.5 | 50 | 64 | nadam | sigmoid |
| layer = 2 | GS-rcICQRNN-5 | 200 | 0.2 | 100 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-10 | 300 | 0.5 | 200 | 128 | nadam | sigmoid |
| | GS-rcICQRNN-15 | 200 | 0.4 | 200 | 64 | adam | sigmoid |
| | GS-rcICQRNN-19 | 120 | 0.2 | 200 | 128 | adam | sigmoid |
| | GS-rcICQRNN-30 | 200 | 0.3 | 200 | 128 | nadam | sigmoid |
| | GS-rcICQRNN-50 | 200 | 0.3 | 100 | 64 | nadam | sigmoid |
| | GS-QRNN | 200 | 0.4 | 200 | 128 | adam | sigmoid |
| layer = 3 | GS-rcICQRNN-5 | 100 | 0.2 | 200 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-10 | 200 | 0.2 | 200 | 128 | adam | sigmoid |
| | GS-rcICQRNN-15 | 200 | 0.2 | 100 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-19 | 200 | 0.2 | 100 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-30 | 200 | 0.4 | 200 | 64 | nadam | sigmoid |
| | GS-CQRNN-50 | 150 | 0.2 | 200 | 128 | adam | sigmoid |
| | GS-QRNN | 120 | 0.2 | 200 | 64 | adam | sigmoid |

**Table S4.** Parameter results of the One-Hot encoding WOA-optimized model for the NKI70 dataset.

| layer | method | node | dropout | n_epoch | bsize |
|---|---|---|---|---|---|
| layer = 1 | WOA-rcICQRNN-5 | 55 | 0.2 | 65 | 75 |
| | WOA-rcICQRNN-10 | 121 | 0.3 | 117 | 98 |
| | WOA-rcICQRNN-15 | 50 | 0.3 | 81 | 96 |
| | WOA-rcICQRNN-19 | 35 | 0.2 | 154 | 99 |
| | WOA-rcICQRNN-30 | 103 | 0.3 | 138 | 109 |
| | WOA-rcICQRNN-50 | 122 | 0.3 | 73 | 81 |
| | WOA-QRNN | 34 | 0.3 | 125 | 73 |
| layer = 2 | WOA-rcICQRNN-5 | 24 | 0.2 | 106 | 64 |
| | WOA-rcICQRNN-10 | 36 | 0.2 | 117 | 127 |
| | WOA-rcICQRNN-15 | 69 | 0.3 | 119 | 88 |
| | WOA-rcICQRNN-19 | 60 | 0.3 | 157 | 97 |
| | WOA-rcICQRNN-30 | 63 | 0.4 | 121 | 72 |
| | WOA-rcICQRNN-50 | 142 | 0.4 | 69 | 98 |
| | WOA-QRNN | 50 | 0.3 | 112 | 113 |
| layer = 3 | WOA-rcICQRNN-5 | 62 | 0.2 | 87 | 72 |
| | WOA-rcICQRNN-10 | 63 | 0.3 | 284 | 104 |
| | WOA-rcICQRNN-15 | 179 | 0.2 | 90 | 91 |
| | WOA-rcICQRNN-19 | 43 | 0.3 | 184 | 76 |
| | WOA-rcICQRNN-30 | 157 | 0.4 | 193 | 117 |
| | WOA-rcICQRNN-50 | 36 | 0.2 | 113 | 71 |
| | WOA-QRNN | 158 | 0.2 | 176 | 106 |

**Table S5.** Parametric results of the integer encoding GS optimization model for the METABRIC dataset.

| layer | method | node | dropout | n_epoch | bsize | optimizer | activation |
|---|---|---|---|---|---|---|---|
| layer = 1 | GS-rcICQRNN-5 | 200 | 0.5 | 50 | 128 | adam | sigmoid |
| | GS-rcICQRNN-10 | 200 | 0.5 | 50 | 128 | adam | sigmoid |
| | GS-rcICQRNN-15 | 200 | 0.5 | 100 | 64 | adam | sigmoid |
| | GS-rcICQRNN-19 | 200 | 0.5 | 100 | 64 | adam | sigmoid |
| | GS-rcICQRNN-30 | 200 | 0.5 | 50 | 64 | adam | sigmoid |
| | GS-rcICQRNN-50 | 150 | 0.5 | 100 | 64 | adam | sigmoid |
| | GS-QRNN | 200 | 0.5 | 100 | 64 | adam | sigmoid |
| layer = 2 | GS-rcICQRNN-5 | 150 | 0.5 | 50 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-10 | 200 | 0.4 | 50 | 128 | adam | sigmoid |
| | GS-rcICQRNN-15 | 200 | 0.5 | 50 | 64 | adam | sigmoid |
| | GS-rcICQRNN-19 | 200 | 0.5 | 100 | 128 | adam | sigmoid |
| | GS-rcICQRNN-30 | 200 | 0.5 | 50 | 128 | nadam | sigmoid |
| | GS-rcICQRNN-50 | 200 | 0.5 | 50 | 64 | adam | sigmoid |
| | GS-QRNN | 120 | 0.5 | 100 | 128 | nadam | sigmoid |
| layer = 3 | GS-rcICQRNN-5 | 120 | 0.2 | 200 | 64 | adam | sigmoid |
| | GS-rcICQRNN-10 | 200 | 0.2 | 200 | 128 | adam | sigmoid |
| | GS-rcICQRNN-15 | 120 | 0.2 | 200 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-19 | 200 | 0.3 | 100 | 64 | adam | sigmoid |
| | GS-rcICQRNN-30 | 120 | 0.2 | 200 | 64 | nadam | sigmoid |
| | GS-CQRNN-50 | 150 | 0.5 | 100 | 128 | nadam | sigmoid |
| | GS-QRNN | 150 | 0.2 | 100 | 64 | nadam | sigmoid |

**Table S6.** Parameter results of the integer encoding WOA-optimized model for the METABRIC dataset.

| layer | method | node | dropout | n_epoch | bsize |
|---|---|---|---|---|---|
| layer=1 | WOA-rcICQRNN-5 | 245 | 0.4 | 164 | 102 |
| | WOA-rcICQRNN-10 | 183 | 0.4 | 71 | 72 |
| | WOA-rcICQRNN-15 | 212 | 0.4 | 120 | 111 |
| | WOA-rcICQRNN-19 | 202 | 0.3 | 62 | 68 |
| | WOA-rcICQRNN-30 | 204 | 0.4 | 73 | 115 |
| | WOA-rcICQRNN-50 | 51 | 0.4 | 128 | 79 |
| | WOA-QRNN | 63 | 0.3 | 69 | 108 |
| layer=2 | WOA-rcICQRNN-5 | 68 | 0.4 | 87 | 81 |
| | WOA-rcICQRNN-10 | 107 | 0.3 | 135 | 102 |
| | WOA-rcICQRNN-15 | 139 | 0.4 | 80 | 102 |
| | WOA-rcICQRNN-19 | 107 | 0.4 | 99 | 102 |
| | WOA-rcICQRNN-30 | 180 | 0.4 | 62 | 101 |
| | WOA-rcICQRNN-50 | 100 | 0.4 | 203 | 116 |
| | WOA-QRNN | 84 | 0.4 | 65 | 102 |
| layer=3 | WOA-rcICQRNN-5 | 47 | 0.4 | 82 | 72 |
| | WOA-rcICQRNN-10 | 136 | 0.4 | 59 | 74 |
| | WOA-rcICQRNN-15 | 253 | 0.4 | 100 | 102 |
| | WOA-rcICQRNN-19 | 109 | 0.4 | 148 | 102 |
| | WOA-rcICQRNN-30 | 62 | 0.4 | 100 | 116 |
| | WOA-rcICQRNN-50 | 233 | 0.4 | 59 | 81 |
| | WOA-QRNN | 20 | 0.4 | 464 | 102 |

**Table S7.** Optimized parameter results of GS algorithm and WOA algorithm for One-Hot encoding of METABRIC dataset.

| layer | method | node | dropout | n_epoch | bsize | optimizer | activation |
|---|---|---|---|---|---|---|---|
| layer = 1 | GS-rcICQRNN-5 | 150 | 0.5 | 50 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-10 | 150 | 0.5 | 50 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-15 | 150 | 0.5 | 100 | 128 | adam | sigmoid |
| | GS-rcICQRNN-19 | 200 | 0.5 | 50 | 64 | adam | sigmoid |
| | GS-rcICQRNN-30 | 150 | 0.5 | 50 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-50 | 150 | 0.5 | 100 | 128 | adam | sigmoid |
| | GS-QRNN | 200 | 0.5 | 50 | 64 | adam | sigmoid |
| | WOA-rcICQRNN-5 | 270 | 0.3 | 92 | 114 | - | - |
| | WOA-rcICQRNN-10 | 280 | 0.4 | 292 | 102 | - | - |
| | WOA-rcICQRNN-15 | 168 | 0.4 | 270 | 108 | - | - |
| | WOA-rcICQRNN-19 | 232 | 0.3 | 122 | 111 | - | - |
| | WOA-rcICQRNN-30 | 217 | 0.4 | 93 | 78 | - | - |
| | WOA-rcICQRNN-50 | 279 | 0.4 | 117 | 74 | - | - |
| | WOA-QRNN | 184 | 0.4 | 160 | 99 | - | - |
| layer = 2 | GS-rcICQRNN-5 | 200 | 0.5 | 50 | 64 | adam | sigmoid |
| | GS-rcICQRNN-10 | 200 | 0.4 | 100 | 128 | adam | sigmoid |
| | GS-rcICQRNN-15 | 100 | 0.3 | 100 | 64 | adam | sigmoid |
| | GS-rcICQRNN-19 | 100 | 0.5 | 100 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-30 | 120 | 0.4 | 100 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-50 | 200 | 0.5 | 100 | 128 | nadam | sigmoid |
| | GS-QRNN | 200 | 0.3 | 50 | 64 | adam | sigmoid |
| | WOA-rcICQRNN-5 | 102 | 0.3 | 124 | 84 | - | - |
| | WOA-rcICQRNN-10 | 195 | 0.4 | 99 | 74 | - | - |
| | WOA-rcICQRNN-15 | 248 | 0.3 | 62 | 74 | - | - |
| | WOA-rcICQRNN-19 | 245 | 0.4 | 97 | 102 | - | - |
| | WOA-rcICQRNN-30 | 176 | 0.3 | 123 | 102 | - | - |
| | WOA-rcICQRNN-50 | 170 | 0.4 | 92 | 80 | - | - |
| | WOA-QRNN | 59 | 0.2 | 98 | 74 | - | - |
| layer = 3 | GS-rcICQRNN-5 | 150 | 0.5 | 100 | 64 | adam | sigmoid |
| | GS-rcICQRNN-10 | 200 | 0.5 | 100 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-15 | 120 | 0.3 | 100 | 64 | nadam | sigmoid |
| | GS-rcICQRNN-19 | 150 | 0.5 | 100 | 64 | adam | sigmoid |
| | GS-rcICQRNN-30 | 200 | 0.3 | 100 | 128 | nadam | sigmoid |
| | GS-rcICQRNN-50 | 120 | 0.4 | 200 | 128 | adam | sigmoid |
| | GS-QRNN | 200 | 0.5 | 100 | 64 | adam | sigmoid |
| | WOA-rcICQRNN-5 | 164 | 0.4 | 120 | 74 | - | - |
| | WOA-rcICQRNN-10 | 154 | 0.3 | 76 | 74 | - | - |
| | WOA-rcICQRNN-15 | 186 | 0.4 | 78 | 93 | - | - |
| | WOA-rcICQRNN-19 | 255 | 0.4 | 205 | 102 | - | - |
| | WOA-rcICQRNN-30 | 95 | 0.2 | 147 | 102 | - | - |
| | WOA-rcICQRNN-50 | 102 | 0.4 | 180 | 116 | - | - |
| | WOA-QRNN | 147 | 0.4 | 115 | 102 | - | - |

**Table S8.** Survival prediction results after feature selection for the METABRIC dataset.

| layer | method | Cindex | MMSE | QL |
|---|---|---|---|---|
| layer = 1 | Integer-FS-CQRNN-5 | 0.761(0.0103) | 0.6524(0.0355) | 0.3119(0.0047) |
| | Integer-FS-CQRNN-10 | 0.7617(0.0081) | 0.657(0.0321) | 0.3122(0.0051) |
| | Integer-FS-CQRNN-15 | 0.761(0.0107) | 0.66(0.0356) | 0.3117(0.0058) |
| | Integer-FS-CQRNN-19 | 0.762(0.0093) | 0.6599(0.0335) | 0.3105(0.0057) |
| | Integer-FS-CQRNN-30 | 0.7636(0.0092) | 0.6448(0.0289) | 0.3108(0.0053) |
| | Integer-FS-CQRNN-50 | 0.7639(0.0094) | 0.6525(0.029) | 0.3096(0.0054) |
| | Integer-FS-QRNN | 0.7617(0.0115) | 0.6509(0.0243) | 0.3123(0.0054) |
| | One-Hot-FS-CQRNN-5 | 0.8356(0.0077) | 0.5135(0.0241) | 0.2818(0.0038) |
| | One-Hot-FS-CQRNN-10 | 0.8357(0.0099) | 0.5119(0.0259) | 0.2828(0.0051) |
| | One-Hot-FS-CQRNN-15 | 0.8338(0.0078) | 0.5174(0.0266) | 0.2827(0.0036) |
| | One-Hot-FS-CQRNN-19 | 0.8362(0.0092) | 0.5174(0.0255) | 0.2833(0.0046) |
| | One-Hot-FS-CQRNN-30 | 0.8341(0.0085) | 0.5186(0.027) | 0.2841(0.0045) |
| | One-Hot-FS-CQRNN-50 | 0.8338(0.0078) | 0.5174(0.0266) | 0.2827(0.0036) |
| | One-Hot-FS-QRNN | 0.8368(0.0092) | 0.5156(0.0241) | 0.2823(0.0048) |
| layer = 2 | Integer-FS-CQRNN-5 | 0.7666(0.0072) | 0.7388(0.034) | 0.2952(0.0033) |
| | Integer-FS-CQRNN-10 | 0.7649(0.0079) | 0.7489(0.0397) | 0.2966(0.004) |
| | Integer-FS-CQRNN-15 | 0.7647(0.0066) | 0.7491(0.0323) | 0.2967(0.0035) |
| | Integer-FS-CQRNN-19 | 0.7657(0.0062) | 0.7494(0.0269) | 0.2956(0.0035) |
| | Integer-FS-CQRNN-30 | 0.765(0.0066) | 0.7489(0.0328) | 0.2968(0.0036) |
| | Integer-FS-CQRNN-50 | 0.7677(0.0078) | 0.7408(0.0364) | 0.2953(0.0043) |
| | Integer-FS-QRNN | 0.7681(0.0064) | 0.7342(0.0315) | 0.2955(0.0037) |
| | One-Hot-FS-CQRNN-5 | 0.8263(0.0057) | 0.6714(0.0289) | 0.2763(0.0037) |
| | One-Hot-FS-CQRNN-10 | 0.8272(0.0069) | 0.6747(0.0323) | 0.2759(0.0038) |
| | One-Hot-FS-CQRNN-15 | 0.8289(0.0064) | 0.6676(0.0306) | 0.2759(0.0038) |
| | One-Hot-FS-CQRNN-19 | 0.8283(0.0059) | 0.6604(0.0287) | 0.2758(0.0036) |
| | One-Hot-FS-CQRNN-30 | 0.8284(0.0065) | 0.6741(0.0365) | 0.2757(0.0034) |
| | One-Hot-FS-CQRNN-50 | 0.8287(0.0059) | 0.6635(0.0243) | 0.2761(0.0034) |
| | One-Hot-FS-QRNN | 0.8282(0.0074) | 0.6659(0.0315) | 0.2767(0.0037) |
| layer = 3 | Integer-FS-CQRNN-5 | 0.7608(0.0083) | 0.7716(0.0548) | 0.2957(0.0049) |
| | Integer-FS-CQRNN-10 | 0.7617(0.0067) | 0.7688(0.04) | 0.2957(0.0039) |
| | Integer-FS-CQRNN-15 | 0.7589(0.0089) | 0.7784(0.0428) | 0.296(0.0042) |
| | Integer-FS-CQRNN-19 | 0.759(0.0075) | 0.7754(0.0423) | 0.296(0.0039) |
| | Integer-FS-CQRNN-30 | 0.7591(0.0067) | 0.7687(0.0446) | 0.2951(0.0043) |
| | Integer-FS-CQRNN-50 | 0.7597(0.0067) | 0.7774(0.0405) | 0.2954(0.0042) |
| | Integer-FS-QRNN | 0.7579(0.0073) | 0.7676(0.0451) | 0.2948(0.0044) |
| | One-Hot-FS-CQRNN-5 | 0.8148(0.0072) | 0.7153(0.0382) | 0.2814(0.0047) |
| | One-Hot-FS-CQRNN-10 | 0.8122(0.007) | 0.7353(0.0338) | 0.2841(0.0038) |
| | One-Hot-FS-CQRNN-15 | 0.8127(0.0086) | 0.7275(0.0432) | 0.2821(0.0046) |
| | One-Hot-FS-CQRNN-19 | 0.8106(0.0081) | 0.7216(0.0439) | 0.2827(0.0042) |
| | One-Hot-FS-CQRNN-30 | 0.8127(0.0078) | 0.7251(0.0353) | 0.2828(0.0049) |
| | One-Hot-FS-CQRNN-50 | 0.8119(0.0091) | 0.7221(0.0378) | 0.2823(0.0045) |
| | One-Hot-FS-QRNN | 0.8126(0.0069) | 0.721(0.0417) | 0.2811(0.0053) |

**Table S9.** Survival prediction results after integer encoding optimization for METABRIC dataset.

| layer | method | Cindex | MMSE | QL |
|---|---|---|---|---|
| layer = 1 | Integer-FS-GS-CQRNN-5 | 0.7969(0.0105) | 0.5388(0.0318) | 0.2918(0.0049) |
| | Integer-FS-GS-CQRNN-10 | 0.7984(0.0098) | 0.5379(0.0255) | 0.2907(0.0043) |
| | Integer-FS-GS-CQRNN-15 | 0.7937(0.0086) | 0.5418(0.0263) | 0.2945(0.0036) |
| | Integer-FS-GS-CQRNN-19 | 0.7932(0.0069) | 0.5482(0.0258) | 0.2946(0.0031) |
| | Integer-FS-GS-CQRNN-30 | 0.7958(0.0112) | 0.5422(0.0387) | 0.2917(0.0043) |
| | Integer-FS-GS-CQRNN-50 | 0.791(0.0102) | 0.5506(0.0239) | 0.2968(0.0043) |
| | Integer-FS-GS-QRNN | 0.7913(0.0094) | 0.5504(0.0322) | 0.2953(0.0035) |
| | Integer-FS-WOA-CQRNN-5 | 0.7886(0.0106) | 0.5698(0.0348) | 0.2969(0.0054) |
| | Integer-FS-WOA-CQRNN-10 | 0.7933(0.0092) | 0.5458(0.0279) | 0.2939(0.0043) |
| | Integer-FS-WOA-CQRNN-15 | 0.7911(0.008) | 0.5603(0.0257) | 0.2975(0.0039) |
| | Integer-FS-WOA-CQRNN-19 | 0.7912(0.0115) | 0.5493(0.0362) | 0.2948(0.0055) |
| | Integer-FS-WOA-CQRNN-30 | 0.7946(0.0107) | 0.5409(0.031) | 0.2952(0.0051) |
| | Integer-FS-WOA-CQRNN-50 | 0.78(0.0124) | 0.5793(0.032) | 0.307(0.0051) |
| | Integer-FS-WOA-QRNN | 0.7679(0.0134) | 0.5931(0.0417) | 0.3101(0.0058) |
| layer = 2 | Integer-FS-GS-CQRNN-5 | 0.8108(0.0082) | 0.5519(0.0315) | 0.2706(0.0032) |
| | Integer-FS-GS-CQRNN-10 | 0.8002(0.0077) | 0.5951(0.0369) | 0.2795(0.0033) |
| | Integer-FS-GS-CQRNN-15 | 0.8077(0.0076) | 0.5609(0.036) | 0.2728(0.0035) |
| | Integer-FS-GS-CQRNN-19 | 0.7977(0.0068) | 0.5912(0.0342) | 0.2783(0.0027) |
| | Integer-FS-GS-CQRNN-30 | 0.8083(0.0072) | 0.5535(0.0353) | 0.2726(0.0038) |
| | Integer-FS-GS-CQRNN-50 | 0.808(0.0081) | 0.5579(0.039) | 0.2732(0.0036) |
| | Integer-FS-GS-QRNN | 0.8002(0.0068) | 0.5683(0.0295) | 0.2754(0.0031) |
| | Integer-FS-WOA-CQRNN-5 | 0.8047(0.0093) | 0.5302(0.0311) | 0.2756(0.0042) |
| | Integer-FS-WOA-CQRNN-10 | 0.7979(0.0111) | 0.6094(0.0455) | 0.2807(0.0045) |
| | Integer-FS-WOA-CQRNN-15 | 0.8052(0.0117) | 0.5457(0.0535) | 0.272(0.0047) |
| | Integer-FS-WOA-CQRNN-19 | 0.8067(0.0106) | 0.5533(0.0427) | 0.2728(0.0047) |
| | Integer-FS-WOA-CQRNN-30 | 0.805(0.0101) | 0.5681(0.0393) | 0.2737(0.0028) |
| | Integer-FS-WOA-CQRNN-50 | 0.7991(0.0066) | 0.6066(0.0314) | 0.281(0.0037) |
| | Integer-FS-WOA-QRNN | 0.8002(0.0152) | 0.5352(0.0479) | 0.271(0.005) |
| layer = 3 | Integer-FS-GS-CQRNN-5 | 0.7681(0.0053) | 0.7166(0.0313) | 0.2945(0.0036) |
| | Integer-FS-GS-CQRNN-10 | 0.7704(0.0056) | 0.7179(0.0373) | 0.2968(0.0042) |
| | Integer-FS-GS-CQRNN-15 | 0.7675(0.0065) | 0.7255(0.0309) | 0.2942(0.0041) |
| | Integer-FS-GS-CQRNN-19 | 0.7593(0.0074) | 0.7508(0.0386) | 0.3(0.0039) |
| | Integer-FS-GS-CQRNN-30 | 0.7674(0.0071) | 0.7301(0.0411) | 0.2944(0.0038) |
| | Integer-FS-GS-CQRNN-50 | 0.7833(0.0069) | 0.6726(0.0366) | 0.2888(0.0039) |
| | Integer-FS-GS-QRNN | 0.7628(0.0079) | 0.7519(0.0437) | 0.2979(0.0039) |
| | Integer-FS-WOA-CQRNN-5 | 0.8032(0.0073) | 0.5121(0.0258) | 0.2713(0.0036) |
| | Integer-FS-WOA-CQRNN-10 | 0.807(0.0097) | 0.549(0.0399) | 0.2757(0.0038) |
| | Integer-FS-WOA-CQRNN-15 | 0.8068(0.0102) | 0.5734(0.0478) | 0.2767(0.0058) |
| | Integer-FS-WOA-CQRNN-19 | 0.7968(0.0121) | 0.6126(0.0384) | 0.2833(0.0051) |
| | Integer-FS-WOA-CQRNN-30 | 0.8035(0.0098) | 0.5301(0.0402) | 0.2703(0.0032) |
| | Integer-FS-WOA-CQRNN-50 | 0.8039(0.0081) | 0.5848(0.046) | 0.2796(0.0061) |
| | Integer-FS-WOA-QRNN | 0.8022(0.007) | 0.5009(0.0228) | 0.2739(0.0038) |