**Supplementary File 5**

**Table :** *A table showing the BIC scores of the models testing during the extended model selection on the final dataset***.**

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| --- | --- | --- |
| **Model rank** | **Model** | **BIC** |
| 1 | HIVw+R7 | 207691.5 |
| 2 | HIVw+R8 | 207670.3 |
| 3 | HIVw+R9 | 207647.3 |
| 4 | mtMAM+R7 | 202894.7 |
| 5 | mtMAM+R8 | 202776.2 |
| 6 | mtMAM+R9 | 202755.6 |
| 7 | LG | 200741 |
| 8 | mtVer+R7 | 200466.8 |
| 9 | mtVer+R8 | 200359.7 |
| 10 | mtVer+R9 | 200334.2 |
| 11 | HIVw+F+R7 | 199629.2 |
| 12 | HIVw+F+R8 | 199575.9 |
| 13 | HIVw+F+R9 | 199565.9 |
| 14 | mtREV+R7 | 199366 |
| 15 | mtREV+R8 | 199324.8 |
| 16 | mtREV+R9 | 199322.4 |
| 17 | FLU+R7 | 199248.7 |
| 18 | FLU+R8 | 199248.7 |
| 19 | FLU+R9 | 199233.2 |
| 20 | mtMAM+F+R7 | 198362.2 |
| 21 | mtMAM+F+R8 | 198335.5 |
| 22 | mtMAM+F+R9 | 198335.2 |
| 23 | DCMut+R9 | 198035.3 |
| 24 | DCMut+R7 | 198034.2 |
| 25 | DCMut+R8 | 198031 |
| 26 | Dayhoff+R9 | 198028.7 |
| 27 | Dayhoff+R7 | 198028 |
| 28 | Dayhoff+R8 | 198025.1 |
| 29 | HIVb+R7 | 197849 |
| 30 | HIVb+R8 | 197821.4 |
| 31 | HIVb+R9 | 197818.4 |
| 32 | rtREV+R8 | 197022.2 |
| 33 | rtREV+R7 | 197021.1 |
| 34 | mtART+R7 | 196889.6 |
| 35 | mtART+R8 | 196764.5 |
| 36 | mtART+R9 | 196761.2 |
| 37 | Q.bird+R7 | 196324.1 |
| 38 | Q.bird+R8 | 196320.1 |
| 39 | Q.bird+R9 | 196303 |
| 40 | FLU+F+R7 | 195954.1 |
| 41 | FLU+F+R8 | 195933.8 |
| 42 | FLU+F+R9 | 195922 |
| 43 | mtInv+R7 | 195892 |
| 44 | mtInv+R8 | 195822.6 |
| 45 | mtInv+R9 | 195805.2 |
| 46 | mtMet+R7 | 195792.1 |
| 47 | Blosum62+R7 | 195758.4 |
| 48 | Blosum62+R8 | 195740.3 |
| 49 | mtMet+R8 | 195727.2 |
| 50 | mtMet+R9 | 195692.9 |
| 51 | Q.mammal+R8 | 195594.2 |
| 52 | Q.mammal+R7 | 195593.5 |
| 53 | Blosum62+R9 | 195590.9 |
| 54 | mtVer+F+R7 | 195467.3 |
| 55 | PMB+R7 | 195429.3 |
| 56 | mtVer+F+R8 | 195376.4 |
| 57 | mtVer+F+R9 | 195366.2 |
| 58 | WAG+R7 | 195309.1 |
| 59 | WAG+R8 | 195306.4 |
| 60 | WAG+R9 | 195281.4 |
| 61 | PMB+R9 | 195249.8 |
| 62 | PMB+R8 | 195240.7 |
| 63 | LG+R2 | 195209.9 |
| 64 | VT+R8 | 195194.9 |
| 65 | VT+R7 | 195192.6 |
| 66 | HIVb+F+R7 | 195167.8 |
| 67 | HIVb+F+R8 | 195139.7 |
| 68 | HIVb+F+R9 | 195124.8 |
| 69 | JTTDCMut+R7 | 194955.6 |
| 70 | JTTDCMut+R9 | 194953.7 |
| 71 | JTTDCMut+R8 | 194950.4 |
| 72 | mtART+F+R7 | 194944.8 |
| 73 | JTT+R7 | 194866.1 |
| 74 | JTT+R8 | 194861.8 |
| 75 | JTT+R9 | 194843 |
| 76 | mtART+F+R8 | 194841.1 |
| 77 | mtART+F+R9 | 194823.3 |
| 78 | cpREV+R7 | 194725.6 |
| 79 | cpREV+R8 | 194716.9 |
| 80 | cpREV+R9 | 194716 |
| 81 | mtREV+F+R7 | 194673.8 |
| 82 | mtREV+F+R9 | 194631.5 |
| 83 | mtREV+F+R8 | 194628.8 |
| 84 | Q.bird+F+R7 | 194334.3 |
| 85 | Q.bird+F+R8 | 194312.1 |
| 86 | Q.bird+F+R9 | 194299.2 |
| 87 | LG+R3 | 194030.1 |
| 88 | DCMut+F+R7 | 193919.1 |
| 89 | DCMut+F+R8 | 193913.8 |
| 90 | Dayhoff+F+R7 | 193913 |
| 91 | Dayhoff+F+R8 | 193907.8 |
| 92 | DCMut+F+R9 | 193896.7 |
| 93 | Dayhoff+F+R9 | 193890.5 |
| 94 | rtREV+F+R7 | 193836.3 |
| 95 | rtREV+F+R8 | 193817.2 |
| 96 | rtREV+F+R9 | 193808.4 |
| 97 | PMB+F+R7 | 193705.3 |
| 98 | PMB+F+R8 | 193702.3 |
| 99 | PMB+F+R9 | 193699.6 |
| 100 | LG+R4 | 193662.4 |
| 101 | Q.yeast+R7 | 193624.4 |
| 102 | LG+G4 | 193623.6 |
| 103 | Q.yeast+R8 | 193622.2 |
| 104 | Q.yeast+R9 | 193613.7 |
| 105 | Q.mammal+F+R7 | 193563.6 |
| 106 | Blosum62+F+R8 | 193544.7 |
| 107 | Blosum62+F+R7 | 193544.6 |
| 108 | Q.mammal+F+R8 | 193527.9 |
| 109 | Q.mammal+F+R9 | 193522.7 |
| 110 | Q.insect+R7 | 193511.8 |
| 111 | Q.insect+R8 | 193508.7 |
| 112 | Q.insect+R9 | 193491.4 |
| 113 | mtZOA+R7 | 193425.9 |
| 114 | LG+R5 | 193414.8 |
| 115 | mtZOA+R8 | 193321.5 |
| 116 | LG+R6 | 193313.6 |
| 117 | mtZOA+R9 | 193299.2 |
| 118 | LG+R7 | 193278.5 |
| 119 | LG+R9 | 193273.1 |
| 120 | LG+R8 | 193272.7 |
| 121 | Q.plant+R7 | 193191.4 |
| 122 | Q.plant+R8 | 193181.5 |
| 123 | Q.plant+R9 | 193174.6 |
| 124 | Q.pfam+R8 | 193091.9 |
| 125 | Q.pfam+R7 | 193089.8 |
| 126 | cpREV+F+R7 | 192785.7 |
| 127 | cpREV+F+R8 | 192776.5 |
| 128 | cpREV+F+R9 | 192772.1 |
| 129 | mtMet+F+R7 | 192749.3 |
| 130 | mtMet+F+R8 | 192665.6 |
| 131 | mtMet+F+R9 | 192643.5 |
| 132 | mtZOA+F+R7 | 192626.5 |
| 133 | mtZOA+F+R8 | 192607.6 |
| 134 | WAG+F+R7 | 192532.1 |
| 135 | WAG+F+R9 | 192523.9 |
| 136 | WAG+F+R8 | 192519.8 |
| 137 | mtZOA+F+R9 | 192503.9 |
| 138 | Q.plant+F+R7 | 192381.5 |
| 139 | Q.plant+F+R8 | 192342.9 |
| 140 | Q.plant+F+R9 | 192340.3 |
| 141 | VT+F+R7 | 192284.4 |
| 142 | VT+F+R9 | 192283.8 |
| 143 | VT+F+R8 | 192278.7 |
| 144 | JTTDCMut+F+R7 | 192204.8 |
| 145 | JTTDCMut+F+R8 | 192196.7 |
| 146 | JTTDCMut+F+R9 | 192188.3 |
| 147 | JTT+F+R7 | 192150.4 |
| 148 | JTT+F+R8 | 192140.6 |
| 149 | JTT+F+R9 | 192132 |
| 150 | Q.pfam+F+R7 | 192051.9 |
| 151 | Q.pfam+F+R9 | 192006.7 |
| 152 | Q.pfam+F+R8 | 192005.5 |
| 153 | Q.insect+F+R7 | 191985.4 |
| 154 | Q.insect+F+R9 | 191937.9 |
| 155 | Q.insect+F+R8 | 191935.3 |
| 156 | LG+F+R7 | 191823.2 |
| 157 | LG+F+R9 | 191782.7 |
| 158 | LG+F+R8 | 191775.8 |
| 159 | Q.yeast+F+R7 | 191749.7 |
| 160 | Q.yeast+F+R8 | 191703.1 |
| 161 | Q.yeast+F+R9 | 191694.4 |
| 162 | mtInv+F+R7 | 191564.9 |
| 163 | mtInv+F+R8 | 191484.7 |
| 164 | mtInv+F+R9 | 191477.8 |