

KEN THOMPSON'S 6-MAN TABLES

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ABSTRACT

Ken Thompson recently communicated some results mined from his set of 64 6-man endgame tables. These list some positions of interest, namely, mutual zugzwangs and those of maximum depth. The results have been analysed by the authors and found to be identical or compatible with the available or published findings of Karrer, Nalimov, Stiller and Wirth.

1. INTRODUCTION

Thompson has recently created 64 pawnless 6-man endgame tables (EGTs) of btm positions, computed as usual to the Depth to Conversion (DTC) metric and published on the web (Thompson, 2000). Exceptionally, he also computed a KRKNKN EGT to Depth to Mate (DTM) which holds the record for the deepest available EGT.

Each EGT was mined for its list of maximal depth and mutual zugzwang³ positions; these results were generously communicated to the authors to be analysed further. The second author's manual efforts were duplicated and completed by the first author's programs which also referred to Nalimov's EGTs.

Table 1 lists known data for the endgames and *Bishop-signature sub-endgames*⁴ (indicated by a *b*):

- notation: *o* – obtrusive force⁵, *s* – also computed by Stiller (1991, 1996), *n* – Nalimov EGT available,
- the maxDTC figure and the number of distinct maxDTC positions, wtm and/or btm, and
- the number of distinct mzug, the maxDTC of an mzug, and the number at maxDTC

As is customary, the table is based on a set of positions which exclude only those illegal positions with the side not to move in check. Some unreachable positions remain: any affected data can be decremented to correspond to purely legal positions. Where a set of btm positions has not been identified, upper-bounds, anticipating possible duplicates, for the number at maxDTC have been derived from provided distribution data. The maximal and mzug data, including complete sets of positions for each endgame, is available on the web's evolving endgame site (Tamplin, 2001) with DTM figures from Nalimov EGTs where available.

No *full point mzug* – Black winning with wtm – has been found. Other early observations about the endgames:

- KBBNKR: the two btm maxDTC positions are unreachable (Conrady, 2001),
- KQQKRB: two of the four maxDTC positions (bR a2/4) are unreachable (Conrady, 2001),
- KQRKQR: Stiller (1996) remarks on the “surprising” maxDTC of 92,
- KRBKBN: the won wKe2Bh7Rg2/bKa6Ng5Be7+121w was drawn, DEEP FRITZ – DEEP JUNIOR⁶,
- KRNNKQ: maxDTC wKc7Rh2Na2b3/bKa6Qd1+w identified as a deep study (Elkies, 2000),
- KRRRQK: DTC-minimaxing, Bl. loses wKd8Rb1g1h4/bKf7Qb3+b after 59 checks (Conrady, 2001).

The isolation of information for Bishop-signature sub-endgames is an innovation. For Bishop-signature sub-endgames which do not contain a maxDTC position for the complete endgame, the number of maxDTC wtm positions is not known. In eleven cases, the maxDTC for wtm positions is also not known. Thompson also confirms results by Karrer and Wirth (Tamplin, 2001) for some 11 4- and 5-man EGTs.

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³ also *mzug*: here, as Ken records only “White wins or does not”, a position where White wins with btm but not with wtm.

⁴ e.g. KBBNKB-efgh has e/g (f/h) White/Black Bishops on one (the other) colour of square; $e \geq f$ but if $e = f$, $g \geq h$.

⁵ force beyond that initially present on the board, e.g. a second Queen or white-square Bishop, or a third R/B/N.

⁶ Match in 2001 to determine the chess engine to challenge Kramnik later this year: game 13, move 121w.

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2. REFERENCES

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| Endgame | | | | maxDTC | | # @ maxDTC | | | mzugs | | |
|-------------|--------------|-----|---------|--------|-----|------------|-----|----|-------|-----|--------|
| Title | GBR code | w-b | o b s n | wtm | btm | wtm | btm | | # of | max | # @ |
| | | | | | | = | = | ≤ | mzugs | DTC | maxDTC |
| KQKBBB | 1090/03 | 2-4 | o s | 51 | 51 | | 1 | | 463 | 38 | 1 |
| KQKBBB-0021 | 1090/03-0021 | 2-4 | o b s | | 39 | | 14 | | 392 | 35 | 1 |
| KQKBBB-0030 | 1090/03-0030 | 2-4 | o b s | 51 | 51 | | 1 | | 71 | 38 | 1 |
| KQKBBN | 1063 | 2-4 | s | 63 | 62 | 1 | | 17 | 3290 | 59 | 1 |
| KQKBBN-0011 | 1063-0011 | 2-4 | b s | | 51 | | 7 | | 1305 | 46 | 1 |
| KQKBBN-0020 | 1063-0020 | 2-4 | o b s | 63 | 62 | 1 | | 17 | 1985 | 59 | 1 |
| KQKBNN | 1036 | 2-4 | | 49 | 49 | | 1 | | 3779 | 37 | 4 |
| KQKNNN | 1009/03 | 2-4 | o s | 35 | 35 | | 6 | | 2886 | 25 | 1 |
| KBBKNN | 0026 | 3-3 | n | 38 | 38 | | 1 | | 817 | 25 | 1 |
| KBBKNN-1100 | 0026-1100 | 3-3 | b s n | 38 | 38 | | 1 | | 817 | 25 | 1 |
| KBNKNN | 0017 | 3-3 | n | 13 | 12 | 1 | 1 | | 402 | 8 | 8 |
| KNNKNN | 0008 | 3-3 | n | 7 | 6 | 44 | | 8 | 32 | 1 | 32 |
| KQBKQB | 4040 | 3-3 | s | 46 | 45 | 2 | | 3 | 21 | 7 | 1 |
| KQBKQB-1001 | 4040-1001 | 3-3 | b s | 30 | 29 | | | ? | 13 | 7 | 1 |
| KQBKQB-1010 | 4040-1010 | 3-3 | b s | 46 | 45 | 2 | | 3 | 8 | 4 | 1 |
| KQBKQN | 4013 | 3-3 | s | 36 | 36 | | 1 | | 76 | 10 | 1 |
| KQBKQR | 4310 | 3-3 | s | 32 | 31 | 3 | | 5 | 6 | 4 | 1 |
| KQBKRb | 1340 | 3-3 | | 42 | 41 | 2 | | 10 | 16 | 12 | 3 |
| KQBKRb-1001 | 1340-1001 | 3-3 | b | 42 | 41 | 2 | | 10 | 7 | 12 | 3 |
| KQBKRb-1010 | 1340-1010 | 3-3 | b | | 22 | | | 83 | 9 | 10 | 1 |
| KQBKRn | 1313 | 3-3 | | 27 | 27 | | 6 | | 15 | 15 | 2 |
| KQBKRr | 1610 | 3-3 | s n | 85 | 84 | 1 | | 79 | 158 | 70 | 1 |
| KQNKQB | 4031 | 3-3 | s | 32 | 32 | | 3 | | 34 | 15 | 1 |
| KQNKQN | 4004 | 3-3 | s | 29 | 29 | | 3 | | 149 | 11 | 2 |
| KQNKQR | 4301 | 3-3 | s | 27 | 26 | 6 | | 2 | 3 | 3 | 1 |
| KQNKRb | 1331 | 3-3 | | 26 | 26 | | 19 | | 88 | 18 | 1 |
| KQNKRn | 1304 | 3-3 | | 40 | 40 | | 1 | | 123 | 20 | 1 |
| KQNKRr | 1601 | 3-3 | s n | 153 | 153 | | 6 | | 905 | 137 | 2 |
| KQQKQQ | 8000 | 3-3 | o s n | 44 | 44 | | 1 | | 8 | 14 | 1 |
| KQQKQR | 5300 | 3-3 | o s n | 48 | 47 | 3 | 1 | | 15 | 15 | 1 |
| KQQKRb | 2330 | 3-3 | o n | 14 | 13 | 4 | | 28 | 0 | --- | 0 |
| KQRKQB | 4130 | 3-3 | s | 73 | 73 | | 12 | | 1359 | 56 | 1 |
| KQRKQN | 4103 | 3-3 | s | 71 | 71 | | 4 | | 1722 | 48 | 1 |
| KQRKQR | 4400 | 3-3 | s | 92 | 92 | | 1 | | 236 | 40 | 1 |
| KQRKRb | 1430 | 3-3 | | 21 | 21 | | 10 | | 1 | 1 | 1 |
| KQRKRr | 1700 | 3-3 | n | 34 | 34 | | 4 | | 5 | 11 | 1 |
| KRBKBB | 0170 | 3-3 | n | 83 | 83 | | 3 | | 376 | 73 | 1 |
| KRBKBB-1002 | 0170-1002 | 3-3 | o b n | 83 | 83 | | 3 | | 120 | 73 | 1 |
| KRBKBB-1011 | 0170-1011 | 3-3 | b s n | 75 | 74 | | 2 | | 90 | 68 | 1 |
| KRBKBB-1020 | 0170-1020 | 3-3 | o b n | 49 | 48 | | 4 | | 166 | 36 | 1 |

Table 1a. Data on Thompson's 6-man EGTs, Part 1.

| Endgame | | | | maxDTC | | # @ maxDTC | | | mzugs | | |
|-------------|--------------|-----|---------|--------|-----|------------|-----|----|-------|-----|--------|
| Title | GBR code | w-b | o b s n | wtm | btm | wtm | btm | | # of | max | # @ |
| | | | | | | = | = | ≤ | mzugs | DTC | maxDTC |
| KRBKBN | 0143 | 3-3 | s | 98 | 98 | | 6 | | 1456 | 79 | 1 |
| KRBKBN-1001 | 0143-1001 | 3-3 | b | 98 | 98 | | 6 | | 23 | 79 | 1 |
| KRBKBN-1010 | 0143-1010 | 3-3 | b | | 64 | | 4 | | 1433 | 50 | 1 |
| KRBKNN | 0116 | 3-3 | s n | 223 | 222 | 1 | | 2 | 203 | 213 | 1 |
| KRBKRB | 0440 | 3-3 | | 17 | 16 | 4 | 1 | | 11 | 7 | 1 |
| KRBKRB-1001 | 0440-1001 | 3-3 | b | 17 | 16 | 4 | 1 | | 4 | 5 | 1 |
| KRBKRB-1010 | 0440-1010 | 3-3 | b | 12 | 11 | | 9 | | 7 | 7 | 1 |
| KRBKRN | 0413 | 3-3 | | 21 | 20 | 62 | | 26 | 96 | 13 | 1 |
| KRNKBB | 0161 | 3-3 | s n | 140 | 140 | | 9 | | 801 | 133 | 1 |
| KRNKBB-0011 | 0161-0011 | 3-3 | b s n | | 52 | | 8 | | 253 | 42 | 1 |
| KRNKBB-0020 | 0161-0020 | 3-3 | o b s n | 140 | 140 | | 9 | | 548 | 133 | 1 |
| KRNKBN | 0134 | 3-3 | s | 190 | 189 | 1 | | 7 | 7933 | 180 | 1 |
| KRNKNN | 0107 | 3-3 | s n | 243 | 242 | 1 | | 7 | 8997 | 226 | 2 |
| KRNKRB | 0431 | 3-3 | | 14 | 13 | 25 | 2 | | 7 | 5 | 2 |
| KRNKRN | 0404 | 3-3 | | 21 | 20 | 5 | | 2 | 69 | 11 | 1 |
| KRRKBB | 0260 | 3-3 | n | 37 | 37 | | 16 | | 15 | 21 | 1 |
| KRRKBB-0011 | 0260-0011 | 3-3 | b s n | 37 | 37 | | 16 | | 13 | 18 | 1 |
| KRRKBB-0020 | 0260-0020 | 3-3 | o b n | | 26 | | 92 | | 2 | 21 | 1 |
| KRRKBN | 0233 | 3-3 | n | 26 | 25 | 3 | | 42 | 57 | 17 | 2 |
| KRRKNN | 0206 | 3-3 | n | 33 | 33 | | 3 | | 41 | 22 | 1 |
| KRRKRB | 0530 | 3-3 | s n | 54 | 54 | | 13 | | 499 | 41 | 2 |
| KRRKRN | 0503 | 3-3 | s n | 73 | 73 | | 3 | | 697 | 50 | 1 |
| KRRKRR | 0800 | 3-3 | s n | 18 | 17 | 2 | | 3 | 4 | 6 | 2 |
| KBBBKB | 0090/31 | 4-2 | o | 20 | 20 | | 4 | | 0 | --- | 0 |
| KBBBKN | 0093/30 | 4-2 | o | 12 | 12 | | 8 | | 0 | --- | 0 |
| KBBBKR | 0390/30 | 4-2 | o s | 69 | 68 | 1 | | 23 | 8 | 61 | 1 |
| KBBBKR-2100 | 0390/30-2100 | 4-2 | o b s | 69 | 68 | 1 | | 23 | 8 | 61 | 1 |
| KBBNKB | 0051 | 4-2 | | 36 | 36 | | 4 | | 23 | 24 | 1 |
| KBBNKB-1110 | 0051-1110 | 4-2 | b | | 29 | | 106 | | 1 | 18 | 1 |
| KBBNKB-2001 | 0051-2001 | 4-2 | o b | 21 | 20 | | 22 | | 9 | 6 | 1 |
| KBBNKB-2010 | 0051-2010 | 4-2 | o b | 36 | 36 | | 4 | | 13 | 24 | 1 |
| KBBNKN | 0024 | 4-2 | s | 31 | 31 | | 54 | | 29 | 26 | 1 |
| KBBNKN-1100 | 0024-1100 | 4-2 | b s | | 13 | | 70 | | 0 | -- | 0 |
| KBBNKN-2000 | 0024-2000 | 4-2 | o b s | 31 | 31 | | 54 | | 29 | 26 | 1 |
| KBBNKQ | 3021 | 4-2 | | 12 | 11 | 109 | | 15 | 17 | 4 | 5 |
| KBBNKQ-1100 | 3021-1100 | 4-2 | b s | 12 | 11 | 109 | | 15 | 17 | 4 | 5 |
| KBBNKQ-2000 | 3021-2000 | 4-2 | o b | 7 | 6 | | 12 | | 0 | -- | 0 |
| KBBNKR | 0321 | 4-2 | | 68 | 68 | | 2 | | 337 | 54 | 2 |
| KBBNKR-1100 | 0321-1100 | 4-2 | b s | 68 | 68 | | 2 | | 80 | 54 | 1 |
| KBBNKR-2000 | 0321-2000 | 4-2 | o b | 66 | 65 | | 8 | | 257 | 54 | 1 |
| KBNNKB | 0042 | 4-2 | | 38 | 38 | | 2 | | 124 | 27 | 1 |
| KBNNKB-1001 | 0042-1001 | 4-2 | b | | 32 | | 8 | | 15 | 25 | 1 |
| KBNNKB-1010 | 0042-1010 | 4-2 | b | 38 | 38 | | 2 | | 109 | 27 | 1 |
| KBNNKN | 0015 | 4-2 | | 27 | 27 | | 54 | | 91 | 22 | 1 |
| KBNNKR | 0312 | 4-2 | s | 49 | 48 | 12 | | 4 | 628 | 37 | 1 |
| KNNNKB | 0039/30 | 4-2 | o s | 92 | 91 | 1 | | 2 | 1009 | 66 | 1 |
| KNNNKN | 0009/31 | 4-2 | o s | 86 | 86 | | 2 | | 2115 | 78 | 2 |
| KNNNKR | 0309/30 | 4-2 | o | 12 | 11 | 2 | | 2 | 82 | 5 | 1 |
| KQNNKQ | 4002 | 4-2 | s | 72 | 72 | | 2 | | 1082 | 57 | 1 |
| KRBBKQ | 3120 | 4-2 | | 44 | 44 | | 1 | | 222 | 36 | 2 |
| KRBBKQ-1100 | 3120-1100 | 4-2 | b s | 44 | 44 | | 1 | | 192 | 36 | 2 |
| KRBBKQ-2000 | 3120-2000 | 4-2 | o b | | 15 | | 2 | | 30 | 7 | 2 |
| KRBBKR | 0420 | 4-2 | | 36 | 35 | 1 | | 20 | 10 | 18 | 1 |
| KRBBKR-1100 | 0420-1100 | 4-2 | b | | 27 | | 75 | | 5 | 15 | 1 |
| KRBBKR-2000 | 0420-2000 | 4-2 | o b | 36 | 35 | 1 | | 20 | 5 | 18 | 1 |
| KRBNKQ | 3111 | 4-2 | s | 99 | 98 | 4 | | 3 | 983 | 92 | 1 |
| KRNNKQ | 3102 | 4-2 | | 28 | 27 | 2 | 1 | | 198 | 14 | 1 |
| KRRBKQ | 3210 | 4-2 | s | 82 | 82 | | 4 | | 191 | 56 | 1 |
| KRRNKQ | 3201 | 4-2 | s | 101 | 101 | | 2 | | 739 | 86 | 1 |
| KRRRKQ | 3900/30 | 4-2 | o s | 65 | 65 | | 5 | | 1 | 17 | 1 |

Table 1b. Data on Thompson's 6-man EGTs, Part 2.