Haworth's Law

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HAWORTH’S LAW

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The latest ‘Depth to Mate’ results from the Lomonosov team (Zakharov, 2013) find a maxDTM 7-man wtm win in KQPKRBN of 1,097 plies, i.e., of 549 winner’s moves. They therefore add one data point to an already suggestive trend of \( \log(\text{maxDTM}) \) against \( k \), the number of men on the board. Figure 1 is a plot of the data (Haworth, 2013) showing the actuals for 3- to 7-man chess, the best least-squares linear fit\(^2\) to these points, and the extrapolation of that ‘fit’ to 10-man chess with 2\(\sigma\), 97% probability, confidence levels.

![Figure 1](image)

**Figure 1.** The maxDTM\((k)\) trend: actuals, best linear fit, predictions and 2\(\sigma\) confidence intervals.

Here are some of the conjectures which may be made, using the following notation:

- \( E = WB \) an endgame with White force \( W \) and Black force \( B \),
- \( Em = WinBm \) endgame \( E \) with man \( m \) added to both sides,
- \( \text{maxDTM}(E) = \) the maximum DTM in plies of the White wins in \( E \) (‘0’ if there are no wins), and
- \( \text{maxDTM}(E|k) = \max\{\text{maxDTM}(Em) \mid E \text{ is a } k \text{-man endgame}\} \)

1) if \( k \geq 3 \), \( \text{maxDTM}(k+1) > \text{maxDTM}(k) \),
2) if \( k \geq 3 \), a maxDTM \( k \)-man position \( p_k \) may be modified to a position \( p_{k+1} \) with greater DTM depth:
   the side which does not have the move may often be imagined to have just captured a man,
3) if \( k \geq 3 \), there is a \( k \)-man endgame \( E \) and man \( m \) such that \( \text{maxDTM}(Em) \geq \text{maxDTM}(E) \),
4) the linear trend above will continue for some time, i.e., ‘Three more men: maxDTM times ten!’\(^3\)

With Moore’s Law in mind, the last conjecture was dubbed *Haworth’s Law*, as it were, *en passant* by a visiting Thominie Stolberg-Rohr WFM. It is certainly a prediction like Moore’s Law rather than a provable, physical law. However, it is not a self-fulfilling prophecy as many argue Moore’s Law is. The rules of the game have determined those deep wins and losses already. For 8/9/10-man chess, the model gives a 50% probability of decisive results in 2400\(^\circ\)/5220\(^\circ\)/11340\(^\circ\) plies and 2\(\sigma\)-predictions of results in 1810\(^\circ\)/3940\(^\circ\)/8570\(^\circ\) plies. It gives a 90% probability of an 8m result in 2000\(^\circ\) plies and an 80% probability of a 10m result in 10000\(^\circ\) plies. The model at least challenges us to consider why this might be and how long the trend will continue.

**References**


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\(^1\) The University of Reading, Berkshire, UK, RG6 6AH, email: guy.haworth@bnc.oxon.org.

\(^2\) The best-fit quadratic polynomial reduces the ‘linear’ residual error by only 6% and gives even higher predictions for the 8/9/10-man maxDTM. The best cubic and quartic fits clearly give overfitted models which are not credible.