# *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(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 2σ, 97% probability, confidence levels.

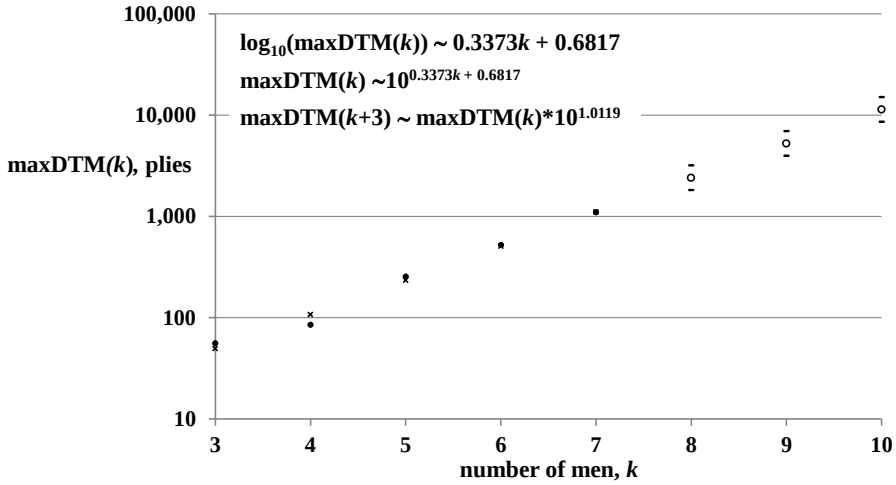


**Figure 1.** The maxDTM(*k*) trend: actuals, best linear fit, predictions and 2σ confidence intervals.

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* ≡ *WmBm*, endgame *E* with man *m* added to both sides,
maxDTM(*E*) ≡ the maximum DTM in plies of the White wins in *E* ('0' if there are no wins), and
maxDTM(*k*) ≡ max{maxDTM(*E*) | *E* is a *k*-man endgame}

1) if $k \geq 3$, maxDTM($k$+1) > 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 maxDTM($Em$) ≥ maxDTM($E$),
4) the linear trend above will continue for some time, i.e., 'Three more men: maxDTM times ten!"

With Moore's Law in mind, the last conjecture was dubbed *Haworth's Law*, as it were, *en passant* by a visiting Thomine 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 $2400^{+}$/ $5220^{+}$/$11340^{+}$ plies and 2σ-predictions of results in $1810^{+}$/$3940^{+}$/$8570^{+}$ plies. It gives a 90% probability of an 8m result in $2000^{+}$ plies and an 80% probability of a 10m result in $10000^{+}$ plies. The model at least challenges us to consider why this might be and how long the trend will continue.

## References

Haworth, G. M$^{c}$C. (2013). Chess Endgame Records. Dataset at http://centaur.reading.ac.uk/34268/.

Zakharov, V. (2013). Private communication of 'MVL' Lomonosov 7-man DTM EGT statistics.

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[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.