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Marathon pacing and elevation change

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An analysis of marathon pacing and elevation change is presented. It is based on an empirical observation of how the pace of elite and non-elite marathon runners change over the course of the marathon and a simple approximation of the energy cost of ascent and decent. It was observed that the pace of the runners slowed in a regular manner that could be broken up into four regions. That observation can be used to project target paces for a desired marathon finish time. However, that estimate fails to take in to account the energetic costs of elevation changes (hills) along the marathon course. Several approximations are made to give a coarse estimate of target paces for marathon run on courses with significant elevation changes, i.e. a hilly course. The 2012 Oakland Marathon course is used as and example of a hilly course and the times of 23 finishers are examined.

Comments:	Six pages, seven figures Updated on 1-Oct-12 with better approximation for Eq. (2) and a reference to work supporting that formula
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