Assessing heterogeneity (and predictability ??) of runners' performance in Switzerland

Gianrocco Lazzari[1,*], Stefano Savaré[2], Antonio Iubatti[2], Maxime Peschard[2], Ondine Chanon[2], Michele Catasta[3], and Marcel Salathé[1]

[1]Global Health Institute, School of Life Sciences, Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland.
[2]School of Computer Science, Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland.
[3]Department of Computer Science, Stanford University, Stanford, USA.
[*]gianrocco.lazzari@epfl.ch

ABSTRACT

keywords: Aging, Distance running, Endurance performance, Sex difference

Introduction

as show in[1] blabalblab

Results

Demographics

In fig. 1(a) and 1(b) we show respectively how the number of runners increased in the last 15 years, by distances and gender. This raise was steeper for man than for women (fig. 1(b)), and steeper in the shorter distance (10 Km) than in the longer ones (fig. 1(a) - participants in full marathons seems to have decreased though) [1].

For a significant analysis of runners' performance, it is important to check the amount of data present in the various events, and therefore first assess the heterogeneity of events popularity. In fig. 2(a) we show the distribution of number of editions each event was hosted, across all history. Counting all editions of all races as independent, we recorded 222 events. More interestingly in fig. 2(b) one can see the broad distribution of number of participants in the different events. In particular, a power-law fit ($f(x) \sim x^{-\alpha}$) provides an exponent of $\alpha = 1.69 \pm 0.05$[2].

Inversely, one can measure how participative runners have been across Switzerland. In fig. 3(a) we show the distribution[3] of the number of events to which each runners participated. We collected data from a total number of 531426 runners.

The case of Lausanne Marathon

nice plots here :)

Overall performance analysis

Age-performance relation

We wanted to check whether the previously found[1–4] U-relation between age and performance holds as well in the case of swiss races. In fig. 4 (**plot to be improved!**) we show the dependence of runners' performance on age, for four of the most popular swiss marathons. The above-mentioned U-shaped although still slightly appearing in the longest distance (42Km), it does emerge more clearly in the half-marathons, as shown indeed in fig. 5 (**plot to be improved!**)

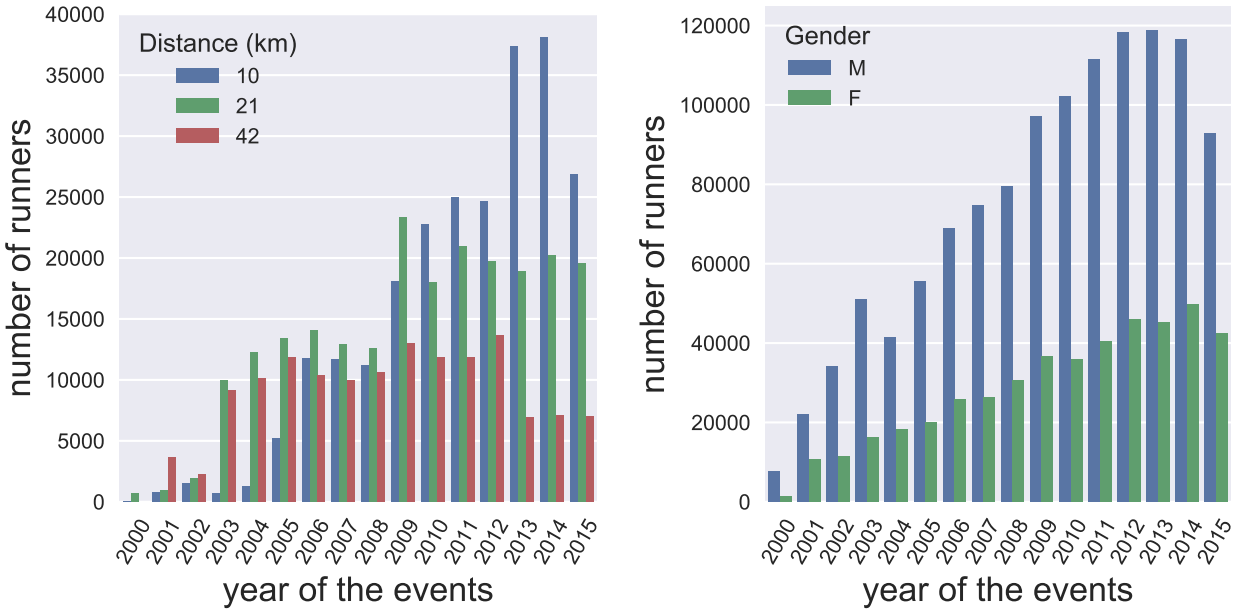
Temperature-performance relation

we don't have enough data (can be re-checked)...

[1]For simplicity we only include the most popular distances. There are many events that include shorter distances, like 3 Km, 5 Km, usually attended by a small fraction of young runners.

[2]The power-law starts from a lower-bound, whose value results as well from the fitting procedure: $x_{min} = 688$ runners/race

[3] One can see that a log-normal would fit better in this case than a power-law model. In particular the fitted parameters are $\mu = -0.70, \sigma = 1.55$



(a) (b)

Figure 1. Number of participants in running competition in Switzerland, across time, by distance (a) and gender (b).

some reviews on the topic:
http://runningstrong.com/temperature.html
http://believeperform.com/performance/the-effects-of-heat-on-sport-performance/

Geographical analysis
(to be included ??) (by Antonio)

Network of runners
(to be included ??) (by Gr)

Forecast of career advancement (??)
(not done yet)
nice article on fivethertyeight, pointing to one of the best/latest model[5]

Discussion

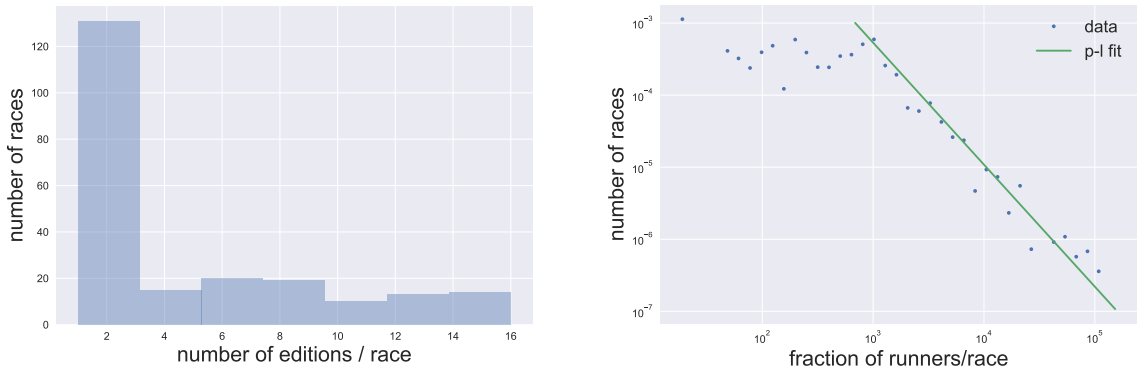
Methods

Data parsing
@stefano (remember to add the *definition of runner*)

Data analysis
All analysis were performed on python notebooks (available on the related repository), using standard python packages for data analysis and plotting, such as `pandas`, `seaborn`, `scipy`, `powerlaw`[4] and `networkx`.

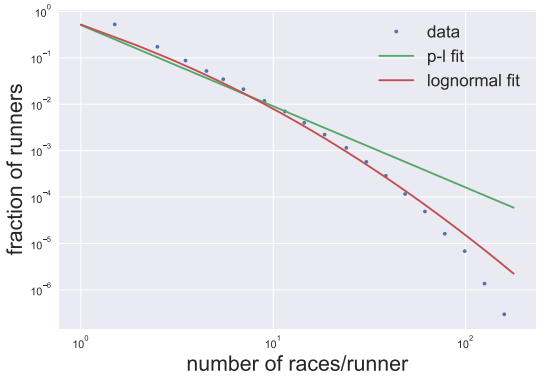
Data visualization
We implemented interactive visualizations of some of our results and collected them in the Hop Suisse[5] website. After exporting the data needed for the plot in `.json` dumps, we used C3.js for the interactive plotting. More details on how datasets queries

[4] https://pypi.python.org/pypi/powerlaw
[5] https://hopsuisse.github.io



(a) (b)

Figure 2. Assess popularity of running competitions, in Switzerland.



(a)

Figure 3. Assess how participative runners are across competitions, in Switzerland.

and plots were built can be found on the dedicated GitHub repository[6]. We also build an animated infographics[7], inspired by Hans Rosling's work. With such video we wanted to show in a more powerful and clear way the relations among runners' mean pace, experience and age, providing as well information on gender and race length (the python code used to construct the video frames can be found in the related folder[8] of our GitHub repository).

Author contributions statement

G.L. and A.I. performed the data analysis. S.S., O.C. and M.P. performed the data parsing. G.L. and S.S. wrote the manuscript. M.C. and M.S. review the manuscript.

Additional information

All the code used to parse the data from `https://www.datasport.com/en/`, for data analysis and visualization can be found in our open GitHub repository: `https://github.com/ggrrll/hop_suisse_ada_project_public`.

Competing financial interests

The authors declare no conflict of interests.

[6] `https://github.com/hopsuisse/hopsuisse.github.io`
[7] `https://www.youtube.com/watch?v=MyvbnOXHShw`
[8] `https://github.com/ggrrll/hop_suisse_ada_project_public/tree/master/8-video`

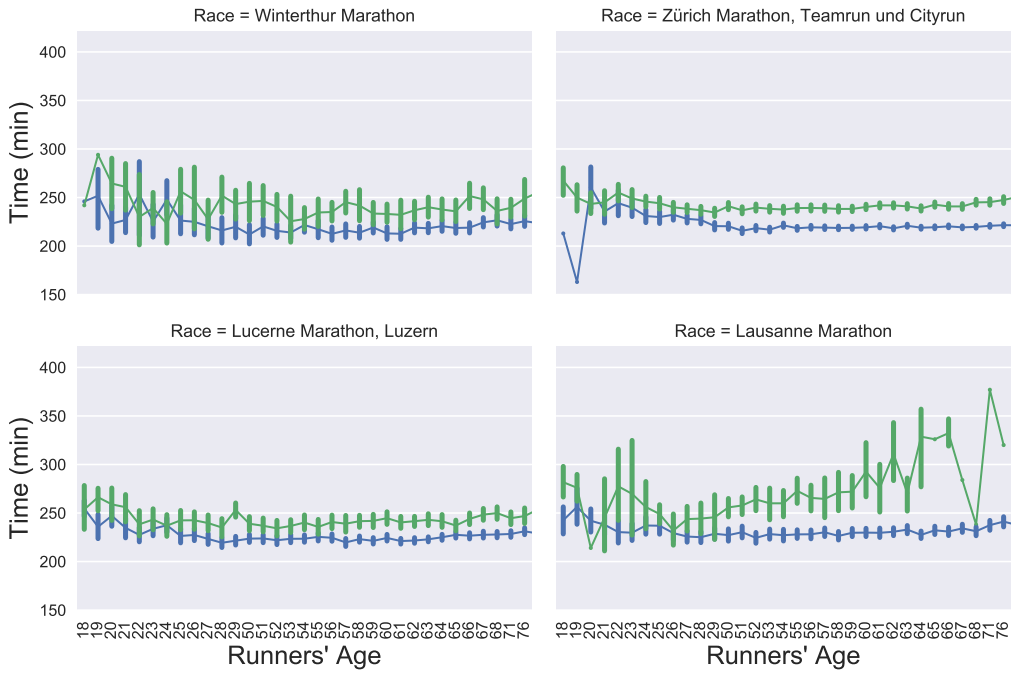


Figure 4. Relation between runners' performance (time in minutes to complete the race) and age, for the most popular marathons, color coded by gender.

References

1. Connick, M. J., Beckman, E. M. & Tweedy, S. M. Relative age affects marathon performance in male and female athletes. *J. sports science & medicine* **14**, 669 (2015).
2. Knechtle, B., Assadi, H., Lepers, R., Rosemann, T. & Rüst, C. A. Relationship between age and elite marathon race time in world single age records from 5 to 93 years. *BMC sports science, medicine rehabilitation* **6**, 31 (2014).
3. Lara, B., Salinero, J. J. & Del Coso, J. The relationship between age and running time in elite marathoners is u-shaped. *Age* **36**, 1003–1008 (2014).
4. Lehto, N. Effects of age on marathon finishing time among male amateur runners in stockholm marathon 1979–2014. *J. Sport Heal. Sci.* **5**, 349–354 (2016).
5. Vickers, A. J. & Vertosick, E. A. An empirical study of race times in recreational endurance runners. *BMC Sports Sci. Medicine Rehabil.* **8**, 26 (2016).

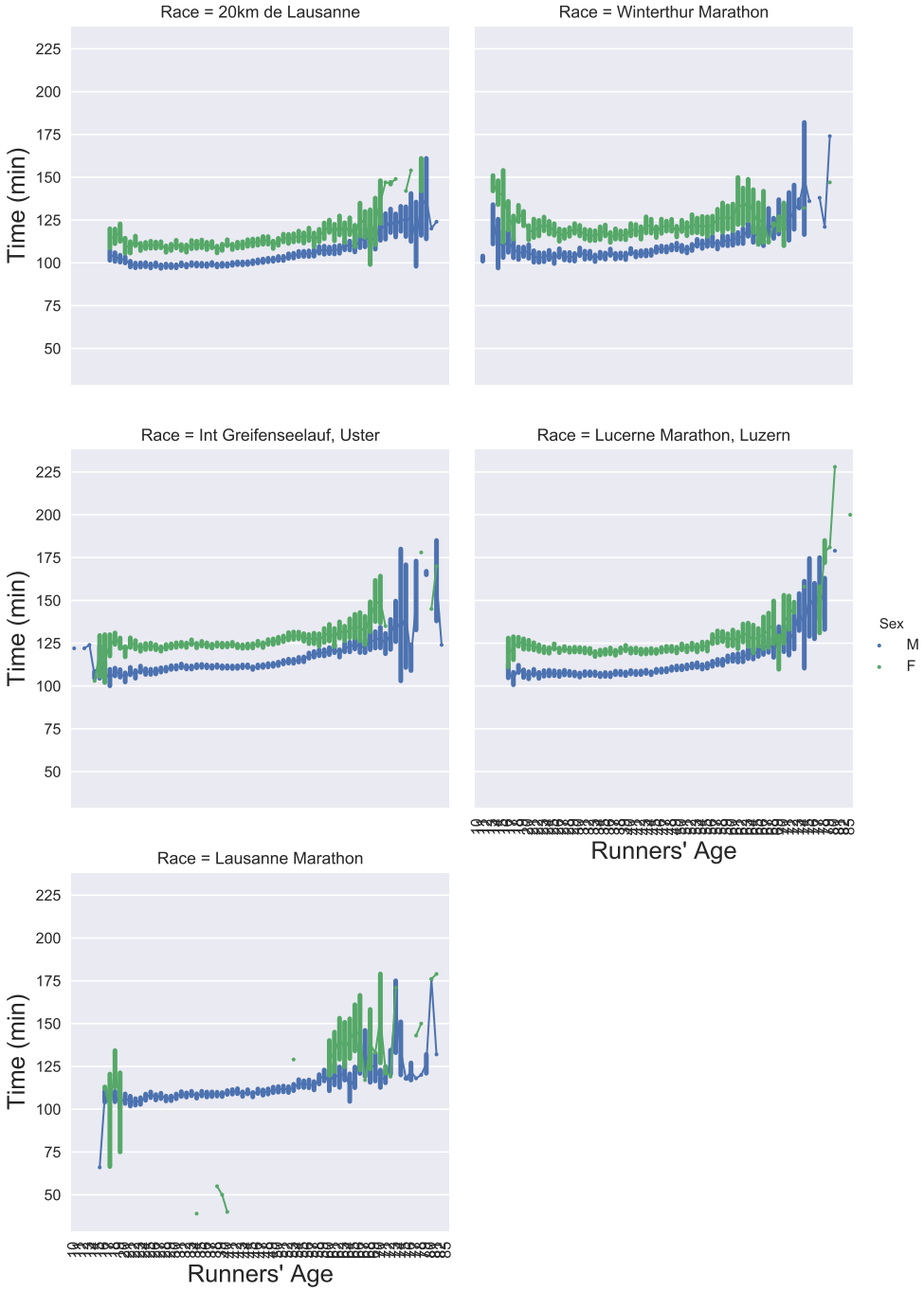


Figure 5. Relation between runners' performance (time in minutes to complete the race) and age, for the most popular half-marathons (20 Km and 21 Km), color coded by gender.