The expected number of olympic medals: a case study of team Portugal at Tokyo 2020

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The 2020 Summer Olympic Games reached to an end in Tokyo, Japan. Even though all the hiccups, constraints, and challenges imposed by the COVID-19 pandemic, the Games were successfully held in August 2021. For the first time in history, Team Portugal won four medals (one gold, one silver, and two bronzes). In 2018 the Portuguese Olympic Committee signed a contract with the Portuguese Institute of Sport and Youth (i.e., Portuguese government) listing the deliverables of the mission Tokyo 2020 against a funding scheme of 18.5 million euros (Contrato n.º 33-A/2018; Contrato — Programa de Desenvolvimento Desportivo n.º CP/1/DDF/2018). The document sets, among other goals and deliverables, that no less than two medals would be won at Tokyo 2020 (section IV.1. of the contract).

On the road to Tokyo, Portugal got more than two medallists at World Championships in several Olympic sports. Indeed, there were six to eight potential medallists at the 2020 Olympic Games (O Jogo, 2021). There is evidence that just one-third to one-fourth of the Olympic athletes are able to excel and outperform at the Olympic Games. In the sport of competitive swimming, just 29.82% of all male Olympians and 53.84% of the finalists at Rio 2016 improved their entry times (Barbosa, 2016a). On average, only 30% of the swimmers were able to improve their entry time at the 2012 and 2016 Olympic Games (Barbosa, 2016b). At Rio 2016, Team Portugal was expected to win two medals out of nine potential medallists, i.e., almost 25% of effectiveness (Garcia, 2016). Thus, one can wonder if the Portuguese Olympic Committee was sensible, assuming that two athletes would reach the podium spot out of six to eight potential medallists. Also, it begs the question if the four medals won were an outstanding achievement, deemed as a substantial improvement of the Portuguese sports system or, if alternatively, the Portuguese Olympic Committee underestimated the number of medals that the country could win.

To address these questions, two Monte Carlo simulations were run. One using a normal distribution and another a triangular distribution. In each case, it was run 10,000 simulations, for a confidence interval of 99.5%, expecting two medals out of eight potential medallists.

Figure 1 depicts the histograms of normal and triangular distributions of the simulations predicting the number of medals to be won by Team Portugal at Tokyo 2020. In the case of the normal distribution, the mean and median number of medals are 1.97 and 1.98, respectively (Table 1). Conversely, for a triangular distribution, the mean is 3.31, and the median is 3.07. I.e., a normal distribution suggests that two medals could be won; whereas, the triangular distribution three. Thus, under these assumptions, the simulations suggest that Team Portugal can win two to three medals at the Olympic Games.

The follow-up question is what the probability is of Team Portugal overachieve, winning two to four medals. If a normal distribution is considered, the probability is 29% (Table 1). However, if a triangular distribution is taken into consideration, such probability increases to 40% (Table 1). Winning four medals corresponds to percentile 80 in the normal distribution and 65 in the triangular distribution (Table 2).

In the previous two Olympiads (London 2012 and Rio 2016), Team Portugal brought home one single medal in each edition. Fast forward to this year, the tally raised to four medals at Tokyo 2020. Therefore, the number of medals won in the past three Olympiads seems to be more due to chance for a sports system that is designed and set to bag 2-3 medals. Notwithstanding, Team Portugal competed at 12 Olympic Games since 1976 (under the democratic political

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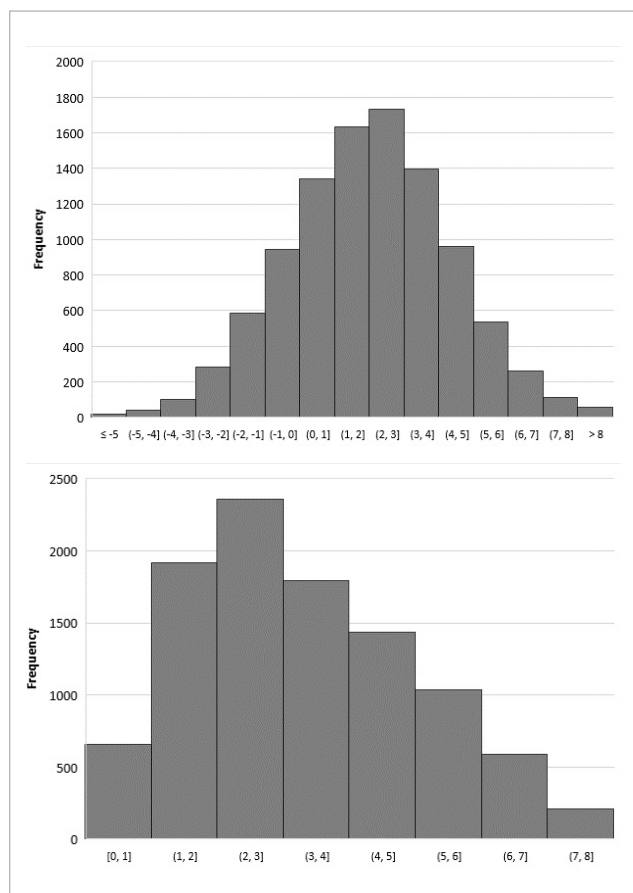
Figure 1. Histogram for normal distribution (top panel) and triangular distribution (bottom panel) of the Monte Carlo simulations predicting the number of medals to be won by Team Portugal at Tokyo 2020.

Table 1. Statistics of the Monte Carlo simulations predicting the number of medals to be won by Team Portugal at Tokyo 2020.

	Normal distribution	Triangular distribution
N	10,000	10,000
Mean	1.98	3.31
Median	1.97	3.07
Standard-deviation	2.36	1.70
Variance	5.57	2.88
Minimum	-7.653	0.048
Maximum	11.170	7.928
Skewness	0.014	0.455
Kurtosis	0.149	-0.543
Probability of winning 2-4 medals	29%	40%

Table 2. Percentiles of the Monte Carlo simulations predicting the number of medals to be won by Team Portugal at Tokyo 2020.

Percentile	Normal distribution	Triangular distribution
5	-1.9	0.9
10	-1.0	1.3
15	-0.4	1.5
20	0.0	1.8
25	0.4	2.0
30	0.8	2.2
35	1.1	2.4
40	1.4	2.6
45	1.7	2.9
50	2.0	3.1
55	2.2	3.3
60	2.6	3.6
65	2.9	3.9
70	3.2	4.2
75	3.6	4.5
80	4.0	4.9
85	4.4	5.3
90	5.0	5.8
95	5.9	6.5

system). The country won two or three medals in six editions (Montreal 1976, Los Angeles 1984, Atlanta 1996, Sydney 2000, Athens 2004, Beijing 2008).

Hence, the likelihood of Team Portugal winning more than two to three medals is rather small. Any results where Team Portugal wins less than two medals or more than three medals seems to be more due to randomness of the sports phenomena than changes in any underlying key-factor. To climb up the medal tally tables from 2-3 medals (not considering the randomness abovementioned) requires a meaningful change in the Portuguese sports and educational systems from grassroots to elite performance, underpinned by a reviewed funding scheme.

If climbing the medal tally table is indeed a mid- to long-term goal, a conversation should begin as soon as possible, and a few questions addressed: (1) what is the role of the sports system in Portugal? I.e., why does Portugal want to win more medals? (2) What is the vision of the sports landscape by 2036-2040? (3) what is the strategic plan to reach the Vision 2040? I.e., how to reach the vision? (4) what are the international best practices to be included in the plan and help us achieve the vision? (5) what is the funding scheme underpinning the strategic plan?

In such cases, analytics and other evidence-based tools can aid to make informed decisions on public policies, deliverables, and outputs. For instance, comprehensive simulations

can be run to forecast the medal tally based on inputs such as Team Portugal demographics (e.g., number of athletes, number of athletes by competitive level, number of participating sports, number of potential medallists, number of athletes engaged full-time in the Olympic preparation, number of dual-careers athletes), econometrics (e.g., country GPD, GDP per capita, percentage of GDP invested, absolute and partial contribution from public and private funding sources), key-performance indicators from the sports system (e.g., number of people actively engaged in sports and physical exercise, percentage of youngsters participating in youth sports, number of high-performance centres country-wide, number of part-time and full-time multi-disciplinary support staff, level of education and life-long learning of coaching staff), and educational system (e.g., physical education teaching hours, participation in extra and co-curricular sports activities in school, weight of physical education grade to GPA).

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