

**Together, Individuals Make a Difference****Summary**

Here is the abstract of your paper.

Firstly, that is ...

Secondly, that is ...

Finally, that is ...

$$F(\omega) = \int_{-\infty}^{\infty} f(t) e^{-i\omega t} dt$$

$$f(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} F(\omega) e^{i\omega t} d\omega$$

**PCA**

%

**Keywords:** A, B, C,

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# 1 Introduction

## 1.1 Problem Background

## 1.2 Restatement of Problem

A literature[1] say something about this problem ... There is a conception named "momentum" in tennis, which has a great impact on players' performance. It is a generalization of the influence in manifold aspects like mental stress and residual energy. So the fluctuation of momentum is the most probable factor that reveals the trend of match. However, the momentum is not easy to be quantified for it includes many subjective indicators, and there are few models that can be directly used, so we decide to cut in the following questions from statistical analysis and data procession:

- Develop a model that captures the flow of play as points occur and apply it to one or more of the matches. Your model should identify which player is performing better at a given time in the match, as well as how much better they are performing. Provide a visualization based on your model to depict the match flow. *Note: in tennis, the player serving has a much higher probability of winning the point/game. You may wish to factor this into your model in some way.*
- A tennis coach is skeptical that "momentum" plays any role in the match. Instead, he postulates that swings in play and runs of success by one player are random. Use your model/metric to assess this claim.
- Coaches would love to know if there are indicators that can help determine when the flow of play is about to change from favoring one player to the other.
  - 1) Using the data provided for at least one match, develop a model that predicts these swings in the match. What factors seem most related (if any)?
  - 2) Given the differential in past match "momentum" swings how do you advise a player going into a new match against a different player?
- Test the model you developed on one or more of the other matches. How well do you predict the swings in the match? If the model performs poorly at times, can you identify any factors that might need to be included in future models? How generalizable is your model to other matches (such as Women's matches), tournaments, court surfaces, and other sports such as table tennis.
- Produce a report of no more than 25 pages with your findings and include a one- to two-page memo summarizing your results with advice for coaches on the role of "momentum", and how to prepare players to respond to events that impact the flow of play during a tennis match.

## 1.3 Our work

We do such things ...

1. We do ...
2. We do ...
3. We do ...

## 2 Question Preparation

### 2.1 Assumptions

### 2.2 Notations

The primary notations used in this paper are listed in Table 1.

Table 1: Notations

Symbol	Definition
$C_i$	the first one
$S_i$	the second one
$G$	the second one
$V$	the second one
$B$	the second one
$M$	the second one
$A$	the second one
$D$	the second one
$E$	the second one
$\gamma$	Sport Advantagen Coefficient
$m_{c_i}$	the second one
$m_{c_i s_j}$	the second one
$g_i$	the second one
$\xi$	The Probability of First Medal

## 3 Data Preprocessing

### 3.1 Basic Data Preprocessing

$$G_i \cap G_j = \emptyset, \bigcup_{i=1}^5 G_i = X$$

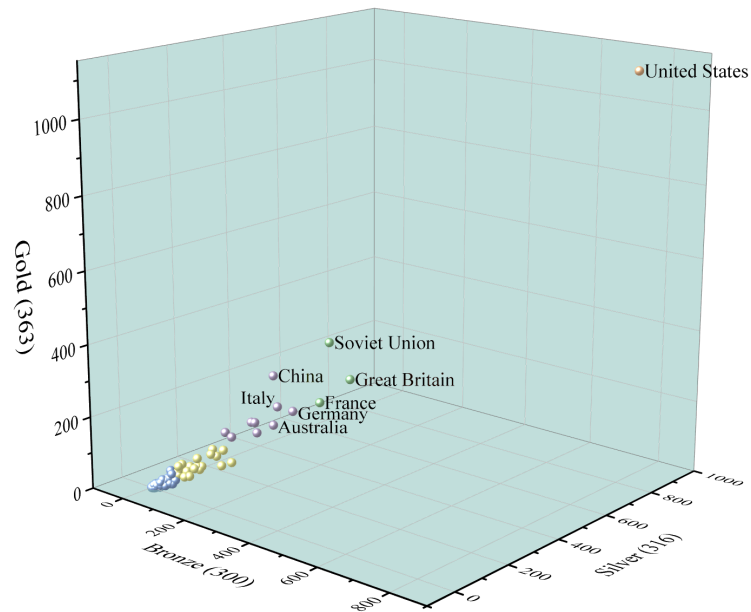


Figure 1: Scatter plot of national level classification (based on Kmeans++clustering algorithm)

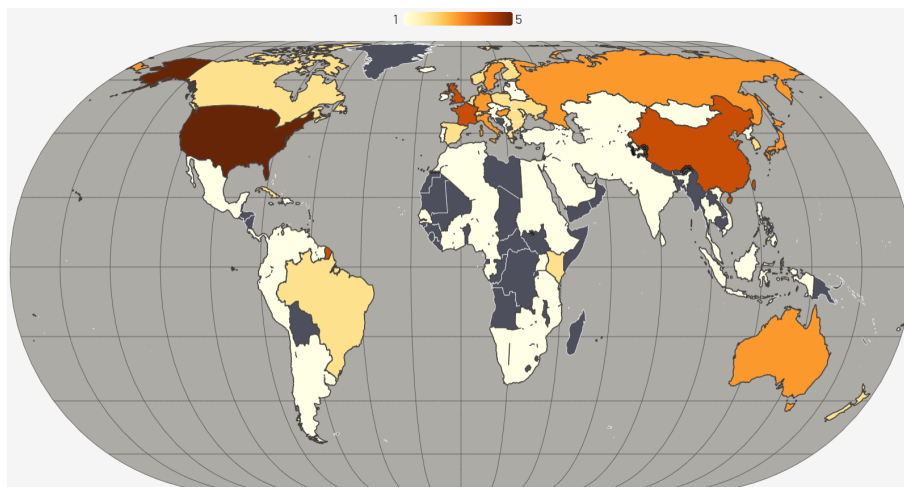


Figure 2: aa

## 3.2 Data Mining

### 3.2.1 Athlete Service Status

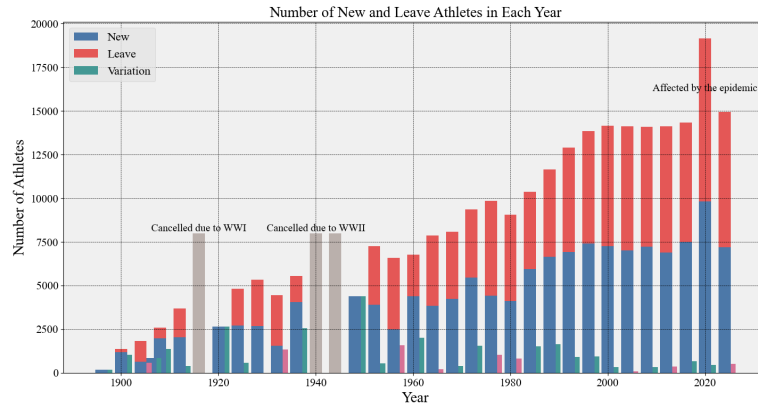
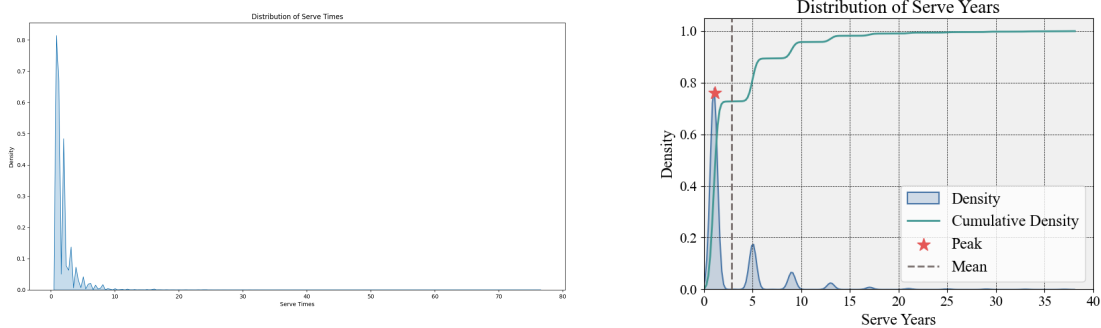


Figure 3: Number of New and Leave Athletes in Each Year



(a) Distribution of Serve Times

(b) Distribution of Serve Years

Figure 4: Two images

### 3.2.2 Distribution of Countries' Strength Sports

## 4 Task1:Medal Prediction Model Based on LightGBM

### 4.1 Medal Standings

The detail can be described by equation (1):Equation 1:

$$\alpha + \beta = \gamma \quad (1)$$

$$\alpha + \beta = \gamma$$

$$\alpha$$

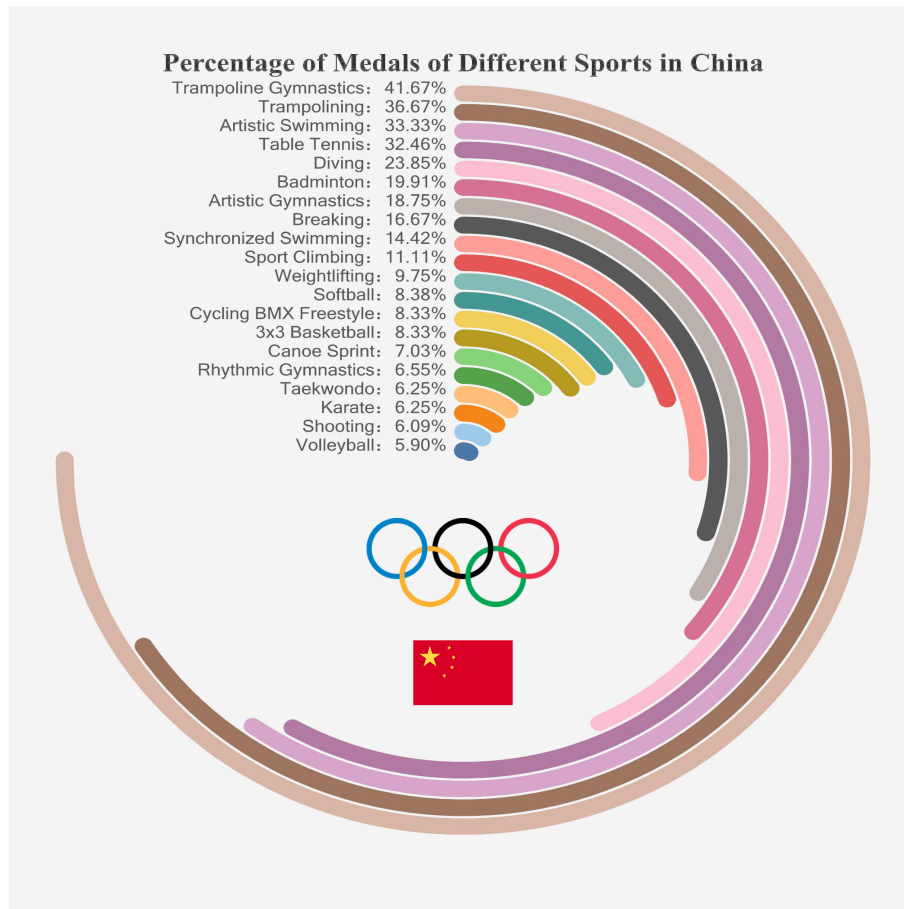


Figure 5: Percentage of Medals of Different Sports in China

$$\gamma = \frac{m_{c_i s_j}}{\sum m_{c_i s_j}}$$

$$\begin{aligned} A + B + C + D + E + F \\ = G + Q + W + E + R + T + Y \\ = A + S + D + F + G + H + J \end{aligned} \quad (2)$$

$$F(x) = \begin{cases} 0 & , \text{if } x < 0 \\ x + 1 & , \text{if } x > 0 \\ 1 & , \text{otherwise} \end{cases} \quad (3)$$

Table 2: Variable Name

Variable Name	Code	Definition
Whether Host Country	<i>is host</i>	Whether the country is the host(1 for host,0 for non-host)

Continued on next page

Table 2: Variable Name (Continued)

Medal Expectation Increment *Personnel Expectation Increment	<i>medal_increment * personnel_increment</i>	Product of medal expectation increment and personnel expectation increment
Sport Advantage Coefficient	<i>sport_adv</i>	Advantage coefficient of a specific sport
Country Level	<i>country_lvl</i>	The level of the country in the competition (ordered by rank)
Project Medal Expectation /Project Personnel Expection	<i>sport_medal _per_ person</i>	Ratio of sport medals to projected personnel for a specific sport
Gold Medal Probability	<i>gold_prob</i>	Probability of an athlete winning a gold medal
Silver Medal Probability	<i>silver_prob</i>	Probability of an athlete winning a silver medal
Bronze Medal Probability	<i>silver_prob</i>	Probability of an athlete winning a bronze medal
No Medal Probability	<i>no_medal_probe</i>	Probability of an athlete winning no medal

Figure 6: Medal count prediction

## 4.2 Countries that Win Their First Medal

## 4.3 Events and Medal Counts by Countries

## 5 Task2:

The results are shown in Figure 9, where  $t$  denotes the time in seconds, and  $c$  refers to the concentration of water in the boiler.



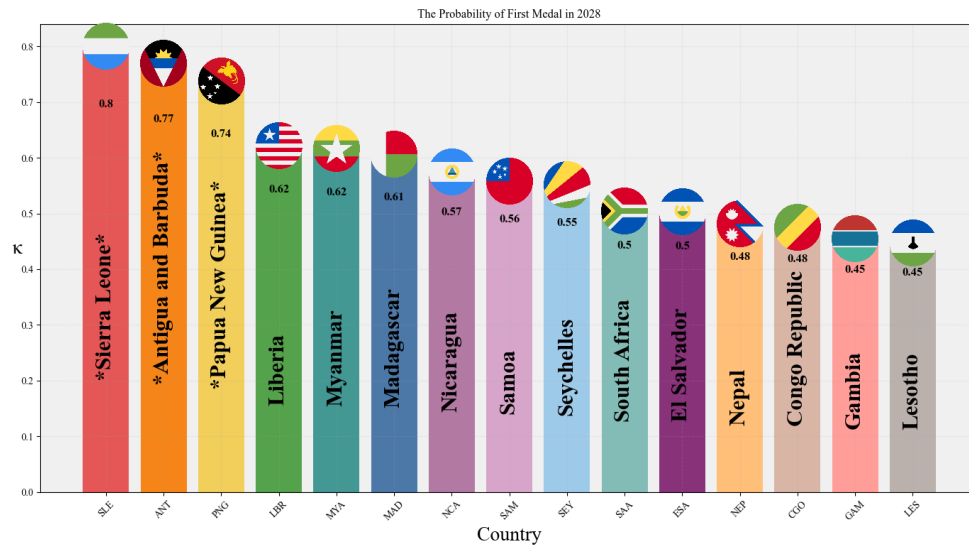
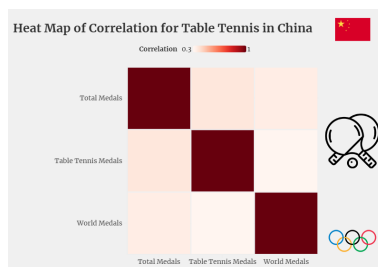
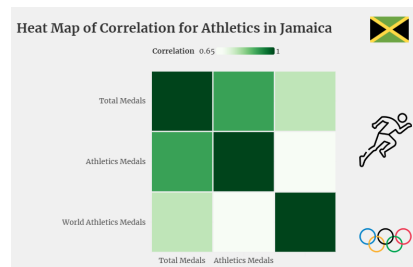


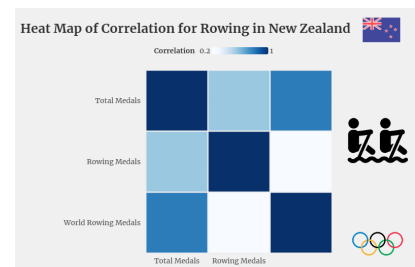
Figure 7: The Probability of First Medal in 2028



(a) Heatmap of Correlation for Table Tennis in China



(b) Heatmap of Correlation for Athletics in Jamaica



(c) Heatmap of Correlation for Rowing in New Zealand

Figure 8: Three images

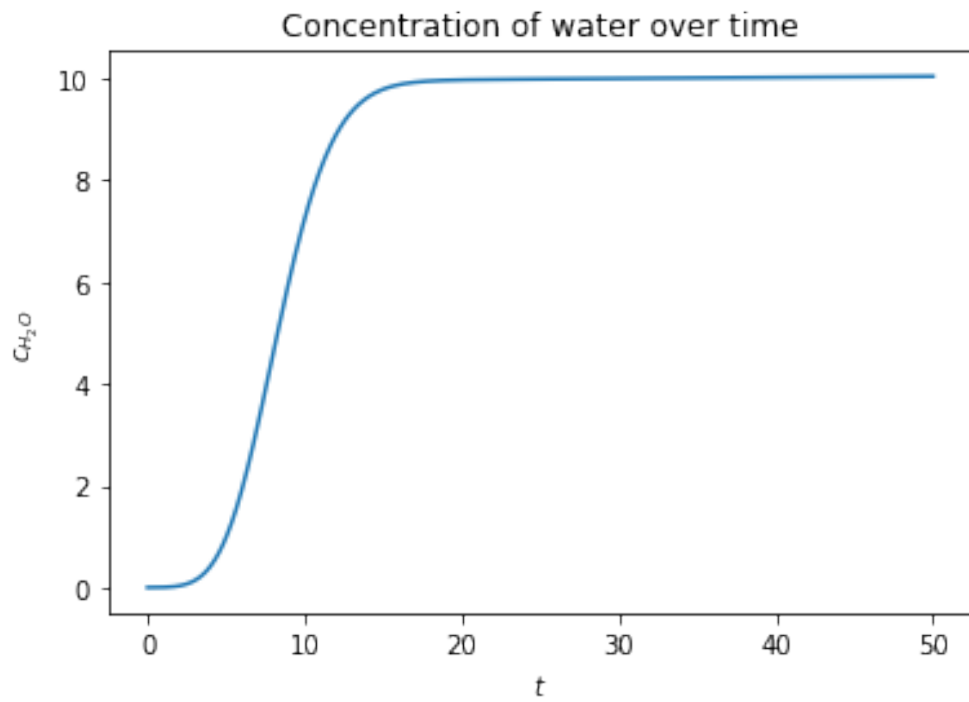


Figure 9: The result of Model 2

## **6 Task3**

## **7 Task4**

## **8 Sensitivity Analysis**

## **9 Model Evaluation**

### **9.1 Strengths**

- First one...
- Second one ...

### **9.2 Weaknesses**

- Only one ...

## **10 Conclusion**

## Memorandum

**To:** Heishan Yan

**From:** Team 1234567

**Date:** October 1st, 2019

**Subject:** A better choice than MS Word:  $\text{\LaTeX}$

In the memo, we want to introduce you an alternate typesetting program to the prevailing MS Word:  $\text{\LaTeX}$ . In fact, the history of  $\text{\LaTeX}$  is even longer than that of MS Word. In 1970s, the famous computer scientist Donald Knuth first came out with a typesetting program, which named  $\text{\TeX}$ ...

Firstly, ...

Secondly, ...

Lastly, ...

According to all those mentioned above, it is really worth to have a try on  $\text{\LaTeX}$ !

## References

- [1] Einstein, A., Podolsky, B., & Rosen, N. (1935). Can quantum-mechanical description of physical reality be considered complete?. *Physical review*, 47(10), 777.
- [2] *A simple, easy  $\text{\LaTeX}$  template for MCM/ICM: EasyMCM*. (2018). Retrieved December 1, 2019, from <https://www.cnblogs.com/xjtu-blacksmith/p/easymcm.html>

## Appendix A: Further on L<sup>A</sup>T<sub>E</sub>X

To clarify the importance of using L<sup>A</sup>T<sub>E</sub>X in MCM or ICM, several points need to be covered, which are ...

To be more specific, ...

All in all, ...

Anyway, nobody **really** needs such appendix ...

## Appendix B: Program Codes

Here are the program codes we used in our research.

**test.py**

```
# Python code example
for i in range(10):
    print('Hello, world!')
```

**test.m**

```
% MATLAB code example
for i = 1:10
    disp("hello, world!");
end
```

**test.cpp**

```
// C++ code example
#include <iostream>
using namespace std;

int main() {
    for (int i = 0; i < 10; i++)
        cout << "hello, world" << endl;
    return 0;
}
```