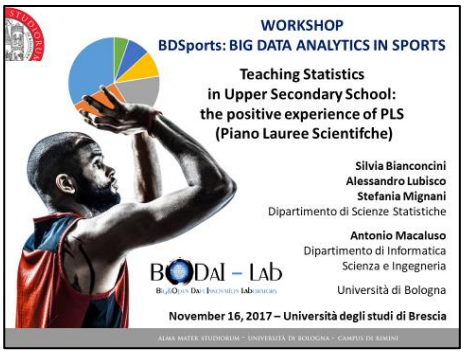
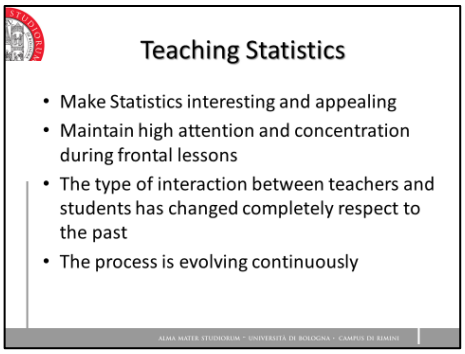
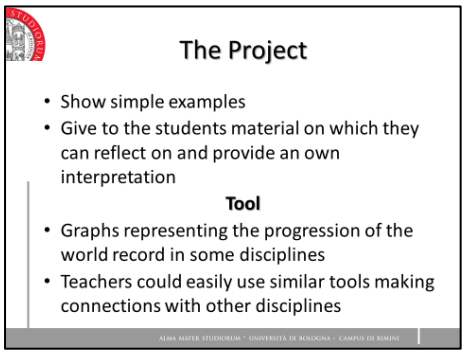
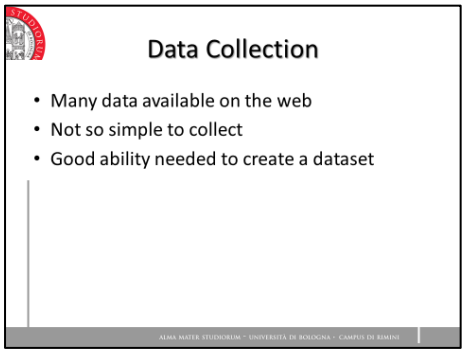




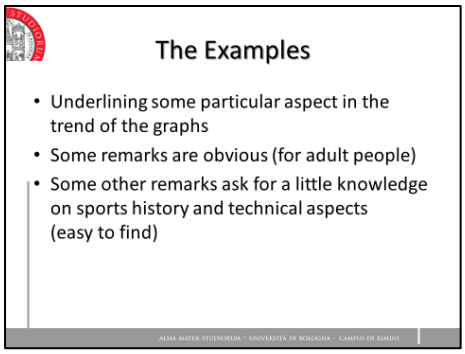
One of the problems in teaching statistics, as for many other subjects, is to make it interesting and appealing.
Students are used to get information and stimuli from every kind of media in a very fast way.
This is one of the reasons why it is difficult to maintain high levels of attention and concentration, especially during a classical frontal lesson.
This is true at any level, from elementary school up to university. The type of interaction between teachers and students has changed completely respect to the past and the process is evolving continuously.



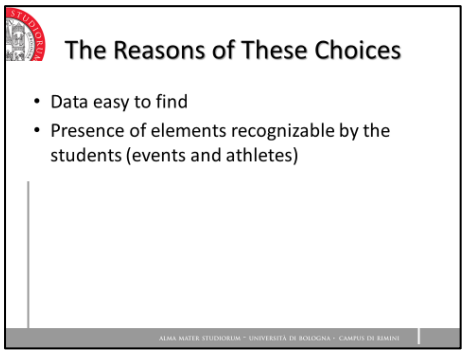
My role in this project was to show simple examples, in order to give to the students material on which they can reflect on and provide an own interpretation. In particular, I showed some graphs representing the progression of world record in some disciplines, such as athletics and swimming.
One of the most interesting aspects is that teachers, not necessarily with expertise in statistics, can use similar tools, and, as I will show, make also connections with other disciplines.



Let me make a brief preface on data collection. There are many data available on the web, but it's not always so simple to collect them. You should have good skills, as for example with Excel, to create a dataset. But I didn't talk about this with the students, because this was not the goal.

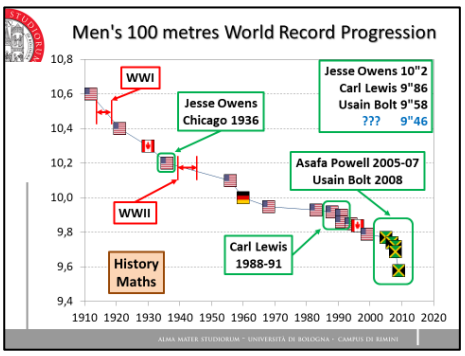


Let have a look now to the examples I proposed to the students, with the aim of underlining some particular aspects in the trends displayed in the graphs. Some remarks are obvious for adults like us, but they could be not so simple for students. Some other remarks, instead, require a little knowledge on sports history and technical aspects that, however, are easy to find.



The examples, as I said, refers to athletics and swimming for a couple of reasons:

- Data are easy to find
- Presence of elements recognizable by the students (events and athletes)

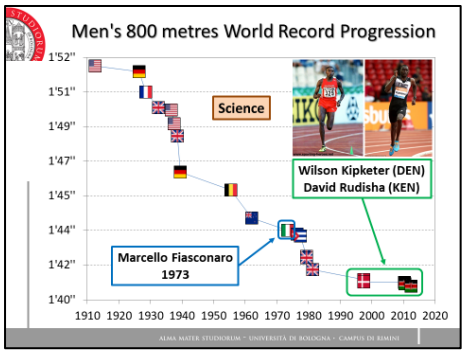


Let we start from the athletics with the 100 meters world record progression.

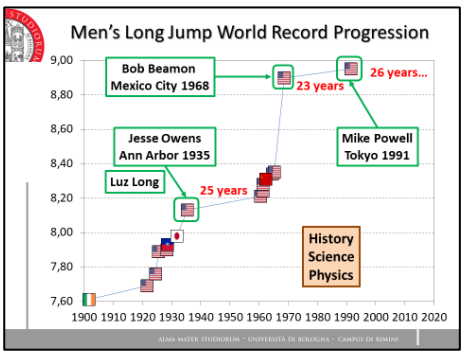
Each flag represents a world record and, of course, the flag corresponds to the nationality of the athlete. In this graph you can easily see that there are no world record in the two periods corresponding to world war one and two. An easy connection to history, that you can also develop looking at the athletes involved. It's very well known the adventure of Jesse Owens during the Olympic games in Berlin in 1936. Young students know him through the movie "Race" produced in 2016. Owens obtained the world record in Chicago with 10.2, while in Berlin he beat "only" the Olympic record with 10.3.

Carl Lewis, an idol for people like me, appears to be a total stranger to the students, while, of course, Usain Bolt is very well known.

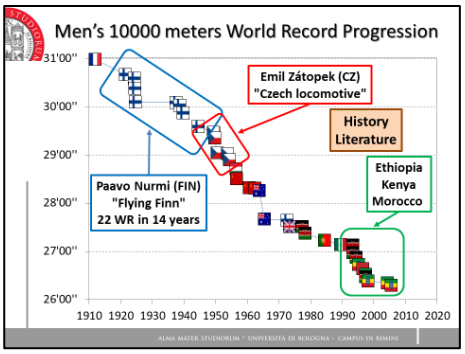
Some studies tried to calculate the theoretical limit in this discipline, identifying it in 9.46. It is sure that Bolt is a sort of outlier, because he reached 9.58 too much early. However, it could happen that another prodigy of nature beats his record, but it will take a long time to see more than one athlete able to reach that performance.



I wanted to use the 800 meters world record progression for two reasons:
The first is a curiosity. It's known that, at the present time, the best mid-distance (and also long-distance) runners comes from Africa. In particular from Kenya, Ethiopia and Morocco. There are some reasons connected to the size and the shape of the athletes. Compared, for example, to European athletes, they have a higher skin surface in relation to the weight, and this allows a better heat dissipation. Furthermore, they have longer legs in relation to the body, so they can run faster and easily than the others.
So, why we have Danish flags here? This athlete is Wilson Kipketer, Danish but Kenyan-born.
The second reason is a little tribute to the Italian flag, not so easy to see in athletics. Someone of us probably remembers Marcello Fiasconaro that in 1973 beat the world record.



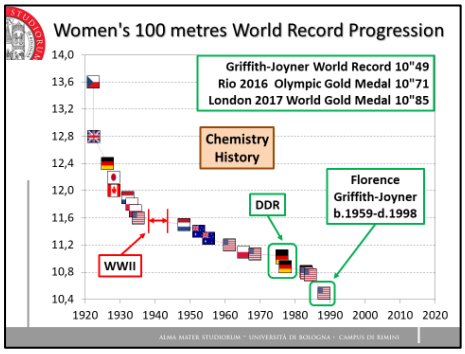
In this slide we can see again Jesse Owens. Also in this case he didn't beat the world record during the Olympic games.
No one probably remember that also the German athlete Luz Long beat the Olympic record and he did it three times in the same competition. And surely, no one knows that Long died as a soldier in 1943 at the age of 30 in the so called "massacro di Biscari", a crime war of the US army in Italy.
The record of Jesse Owens is important because it has taken 25 years to beat it (and 20 for the 100 meters one). Like Bolt, Jesse Owens was an outlier. And also Bob Beamon was. Mexico City is located at the elevation of over 22 hundred meters. This means lower level of oxygen, but also thinner air. So, after a high-altitude period of adjustment, the athletes can obtain high performances. In 1968 the jump of Bob Beamon was 55 centimetres longer than the previous record. Only 23 years after, Mike Powell was able to beat that measure.
Here you can find a connection to physiology and how red blood cells work with a low level of oxygen. In physics you can study the penetration of a body in thinner air.



10000 meters. Paavo Nurmi was a hero for Finnish people, nicknamed the "Flying Finn". He set 22 world record at distances between 1500 meters and 20 kilometers, unbeaten in most of the races he did in 14 years. After him, another phenomenon: the Czechoslovak runner Emil Zatopek, nicknamed the "Czech Locomotive". Beyond the performance, it must be said that Zatopek lived during the soviet domination. He supported the party's democratic wing, and after the 1968 Prague Spring, he was stripped of his rank and expelled from the army and the party, removed from all important positions and forced to work in a string of inferior and dangerous positions, such as a uranium mine.

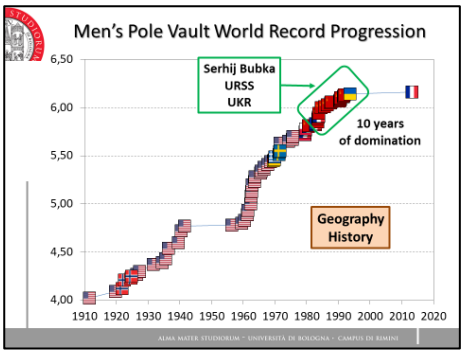
A beautiful book whose title is "Correre", tells his history. So here we have a connection with literature.

I already told something about African athletes in the last slide and here you can see how they dominate this speciality from the Nineties.



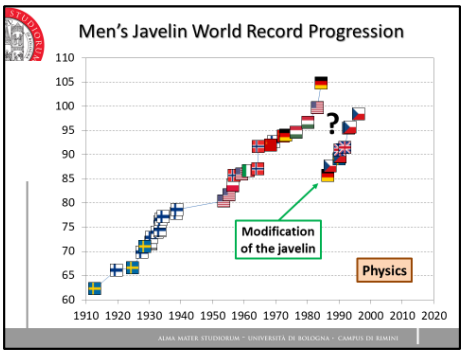
Here one example with women record. You can see the effect of the sport policy in East Germany. Athletes were systematically doped with anabolic steroids and other drugs. DDR was not the only country that adopted this policy. Russia and China, for example did something similar.

The actual record belongs to Florence Griffith. In 1988 (it means 29 years ago) she ran the 100 meters in 10.49 seconds, improving the previous record of 25 cents. She was never found positive and she died at 38 in her bed suffocating during an epileptic crisis. To understand the value of her performance, consider that in the last Olympic games and World championship the gold medals were won respectively with 10.71 and 10.85.



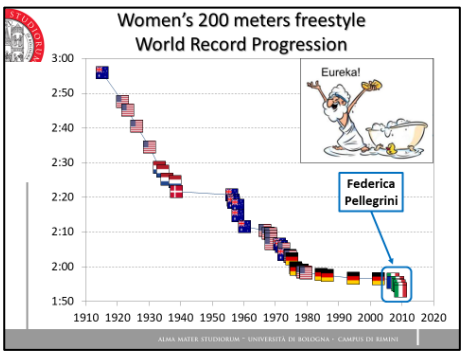
Pole vault. Serhji Bubka dominated for ten years breaking the world record 35 times (17 outdoor and 18 indoor). He competed for the Soviet Union team until its dissolution in 1991 and then for Ukraine, when that country declared its independency in 1993. The Ukrainian flag represents his last record. During his carrer, only the French athlete Thierry Vigneron, the last record man before him, interrupted his series: during the Golden Gala in Rome in 1984 he set the record with the measure of 5.91, but in the same competition Bubka broke it with 5.94.

In 1985 he reached the measure of 6 meters, increasing the previous record of 6 centimeters. He knew that for each record he received a prize. For this reason he increased the following record of only one centimetre at a time. His last record of 6.14, obtained in Italy in 1994, lasted almost 21 years. It's curious that Renaud Lavillenie, a French athlete, beat that record in Ukraine, in the same meet in the same arena.



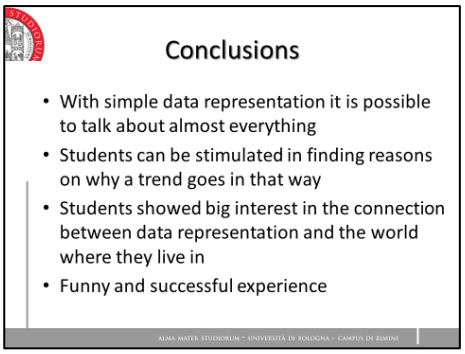
Very curious is the graph of the javelin. In 1985 the record reached 105 meters. This kind of distance created a problem: the stadiums were not big enough. The javelin was redesigned so that the centre of gravity was moved 4 cm forward and the distance reduced of 10%.

Experts in physics could explain why this happens.



There are so many other examples, but I choose this last one. We are now in a swimming pool. The women's 200 meters freestyle. Why this? Because we have finally an Italian outlier: Federica Pellegrini. Only a couple of things: she's one of the best swimmers we've ever seen. But the last record date back to 2009. In 2008 it was introduced a new kind of swimsuit made of polyurethane, very helpful for floating. 2009 was the last year where

that material was allowed. In a couple of years, almost 250 world record were broken and many still resist. The performance of Federica Pellegrini is one of them. We all thank the Archimedes' principle.



In conclusion, I wanted to show how it is possible, with simple data representation, to talk about almost everything, for the same reasons for which statistics apply everywhere, and how students can be stimulated in finding reasons on why a trend goes in that way.

They showed big interest in this connection between data representation and the world where they live in. The experience with the students was very funny and successful.