WORKSHOP
BDSports: BIG DATA ANALYTICS IN SPORTS

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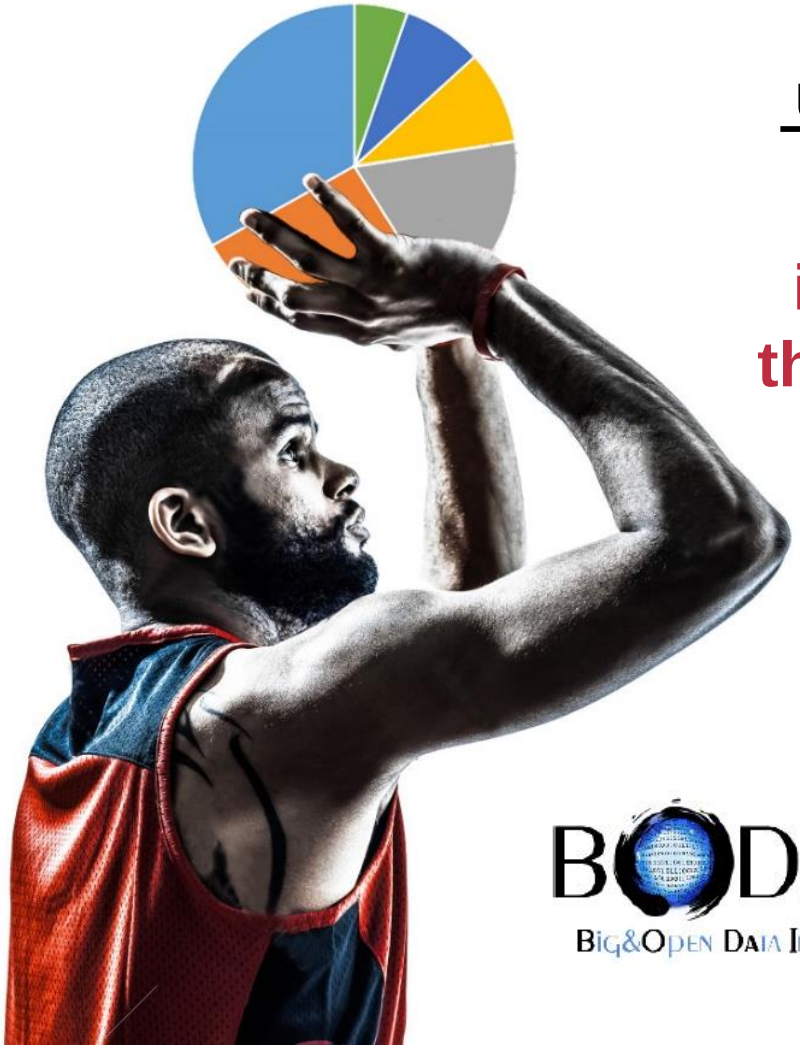
Università degli studi di Brescia



Teaching Statistics in Upper Secondary School: the positive experience of PLS (Piano Lauree Scientifche)

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BODAI – LAB
BIG&OPEN DATA INNOVATION LABORATORY

Aims of the presentation

- Teaching statistics at the high school in Italy
- Some good practices on how to teach statistics for increasing synergies between University and high school
- The “Piano Lauree Scienifiche” project
- The last year experience: laboratories on Statistics and Sports

Introduction

In an increasingly data-driven world, **statistical literacy** is becoming an essential competency, not only for researchers who conduct formal statistical analyses, but also for informed citizens that everyday make decisions based on data.

STATISTICAL LITERACY

(a) people's ability to *interpret and critically evaluate* statistical information, data-related arguments, or stochastic phenomena, that they may encounter in different contexts,

(b) people ability to *discuss and communicate* their reactions to such statistical information, such as their understanding of the meaning of the information, or their concerns regarding the appropriateness of given conclusions. (I. Gal, 2002)

The Teaching of Statistics and Probability in Italian Schools

- Statistical abilities must be learned at school with the objectives of preparing students for college, work and everyday life

- In 2010 the Italian Ministry of Education introduced statistics and probability contents into the new mathematics curriculum under the domain named “Uncertainty and data”, a fundamental topic at all school levels.

- Consequently, students are expected to be adequately trained in statistics in preparation for academic programs, professional careers and every day life

Critical issues and improving actions

Teaching: critical issues

In the Italian school system, few mathematics school teachers have been trained in or are familiar with statistical concepts and methods. They are not competent in selecting relevant, useful, and meaningful real examples.

➡ training actions to increase statistical competences focusing on real data analysis

Learning: critical issues

The teaching environment affects students attitudes towards statistics. Difficult discipline, too much theoretical aspects and sometimes boring

➡ actions to stimulate their awareness of the importance of statistical thinking in further education as well as in their professional life

A more recent kind of action

- Trying to enhance both teachers knowledge of statistics and students awareness of the importance of statistical thinking several Italian statisticians are actively taking part in the “Piano Lauree Scientifiche (PLS)”, a national scientific high school degree project.

- This initiative started in 2005 promoted by the Ministry of Education in order to increase enrolments to scientific University degrees by promoting joint initiatives between high schools and Universities.

- The disciplines involved are

Biology, Biotechnology, Earth Sciences, Chemistry, Mathematics, Material Sciences, Physics, Statistics

PLS-years 2015-2018

Four actions

1) Laboratories for students
2) Assess competencies necessary to enter University
3) Training teachers
4) Activity to analyse and reduce University drop-out

PLS-years 2015-2018
University sites

The Bologna University project

- Specifically, at Bologna University, a team of Professors of the Statistical Sciences Department supports both activities for teacher training and laboratories for high-school students emphasizing a data-oriented approach to enhance statistical thinking and reasoning.
- The project is structured in several steps in order to give methods and tools to realize a statistical investigation:

1) At the University - Training meetings to discuss a case study with professors and school teachers involved through an open call to all high schools (Emilia-Romagna and Marche)
2) At the school - Laboratory activity with school teachers, students and University tutors to realize a project on the case study previously illustrated
3) In a Statistic Public event - Meeting and activities to present the results of the best project realized by students

First step: Teacher training

✓ *Generally in Italian schools the approaches to teaching statistics focus on procedures and computations and do not generally lead students to reason or think statistically*

➡ *The PLS project moves from theoretical approach to a more empirical one*

- During the meeting at the University the professors illustrate a real problem and present the methods and tools to conduct a statistical investigation
- The methodological instruments are discussed even with possible links to mathematical concepts more familiar to school teachers
- The illustrated case study allows possible synergy among others disciplines taught at school (chemistry, physics, psychology, economics, …)
- Experts of the investigated phenomenon are invited at the meeting to stimulate the discussion

Second step: students activities

- The case study discussed during the University meetings is illustrated to the students by their teachers
- The students under the supervision of the teacher and University tutors realize the case study following the main steps of a statistical investigation:

1) Discuss the goals of the study
2) Choose the type of survey
3) Identify the tools for collecting data:
   - National/International sources
   - ad hoc questionnaire
4) Collect the data
5) Analyze data with adequate tools
6) Interpret and discuss the results
7) Arrange a report

Second step: students activities

- *The project is arranged in an cooperative learning environment*
- *Cooperative learning:* a methodology involving students who work together as a team to solve an assigned task or to reach a common goal.

Main advantages:

- ❖ Increase teacher satisfaction and the sense of partnership between students and instructors
- ❖ Students and teachers are encouraged to analyze and discuss the proposed issues and to send solutions, suggestions and remarks.
- ❖ a learning community is created where individuals and groups can exchange ideas and find tools to solve problems.

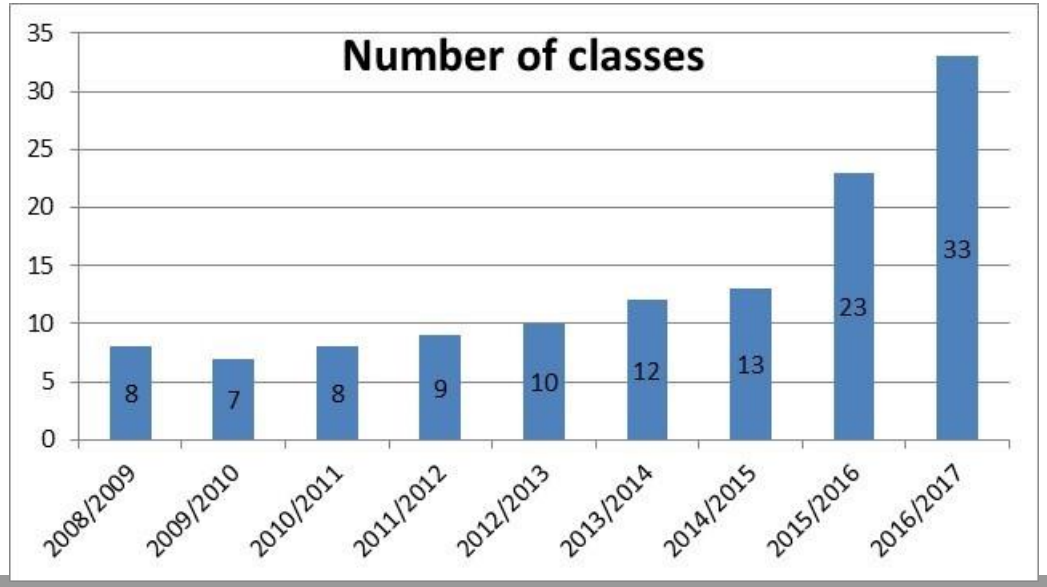
Third step: dissemination of the project results

- The best projects are selected by University professors and are presented in a public event at the University usually related to the dissemination of statistical literacy initiatives

- Example: Italian Statistics Day

Bologna University projects

1) Statistics at school: evaluating students' satisfaction; (2008,2009)
2) Statistics and happiness: evaluating the well-being of youth generation; (2010, 2011, 2012)
3) Statistics and social media; (2013)
4) Statistics and taste: judging the quality of food; (2014)
5) Statistics and risk assessment; (2015)
6) **Statistics and sports (2016)**



PLS Project 2016/2017

Liceo scientifico Copernico

Teachers: Silvia Bacchelli, Silvia Focardi, Angela Rambaldi, Elisa Targa

Students: Lisa Negrini, Aurora Ponti, Giulia Fantoni, Jiahao Xu, Chiara Zappi, Leonardo Bellini, Chadli Khalid, Ernesto Suresh

Tutors: Antonio Macaluso, Matteo Masotti

Supervisors: Stefania Mignani, Silvia Bianconcini

Main features of the project

Big&OpenData InnovationLaboratory

Aims of the laboratory:

- Motivate students to learn statistical concept through a data-driven approach in a stimulating field
- Provide University guidance activities

Main features of the project

Scheduling for each class

- Lessons (6 hours) dedicated to statistics background by owner teachers
- Practical activities (6 hours) carried out by an university tutor in the laboratory

Students will complete data analyses and several group activities. The corresponding results have been presented to tutors and classmates

Data Set

- Statistical units: players of basketball teams
- Variables: Free throw, 2-points Made, 2-points Attempt , 3-points Made, 3-points Attempt, Personal Foul, Rebounds, Assist, Game played, Minute played, Total point Made

PLAYERS	Pts	GP	Min	Fouls		2-points			3-points			Free throw			Rebounds			Stop		Ass
				C	S	R	T	%	R	T	%	R	T	%	O	D	T	D	S	
Justin Knox	368	26	727	64	73	149	264	56	5	17	29	55	69	80	53	133	186	17	11	16
Matteo Montano	289	26	553	59	54	45	94	48	48	128	38	55	64	86	10	48	58	0	5	43
Stefano Mancinelli	252	24	643	43	54	77	164	47	18	64	28	44	61	72	19	105	124	14	5	59
Leonardo Candi	241	24	682	69	94	50	111	45	22	87	25	75	83	90	13	45	58	5	9	64
Nazzareno Italiano	193	25	425	81	57	32	77	42	29	55	53	42	60	70	22	61	83	2	5	28
Alex Legion	145	8	244	24	21	34	61	56	20	49	41	17	18	94	7	30	37	0	4	16
Michele Ruzzier	145	23	571	60	55	42	79	53	12	49	24	25	36	69	9	27	36	1	6	95
Davide Raucci	89	26	404	58	21	18	46	39	13	38	34	14	20	70	22	39	61	2	8	26
Mitja Nikolic	77	10	245	19	16	20	31	65	10	35	29	7	13	54	6	42	48	4	1	15

Dream Team Analysis

- Create a Basket Dream Team by choosing the best players among the Italian Serie A2 teams
- Use basic statistics (mean, median, variance, etc.) to describe the group
- First step: compare the percentage and absolute values regarding to different players of the team, accounting their roles (Point guard, Shooting guard, Small forward, Power forward, Center)
- Second step: variability charts and concentration index (or Gini index)

THE STUDY OF VARIABILITY

Real Team Analysis

- Real team, description of the roles in the team (Point guard, Shooting guard, Small forward, Power forward, Center)
- Analysis of all variables
  - Free throw, 2-points Made, 2-points Attempt , 3-points Made, 3-points Attempt, Personal Foul, Rebounds, Assist, Game played, Minute played, Total point Made
  - Use basic statistics (mean, median, variance etc.) to describe the group
  - First step: compare the percentage and absolute values regarding to different players of the team, accounting for their roles (bar graphs, Kiviat diagrams)
- Second step: variability graphs and global performance

COMPOSITE INDICATOR

Performance index

- Through the performance index, one can get a single number that lets him to synthesize all the other variables
- Total Basketball Proficiency Score (TBPS)

DIFFERENT APPROACHES

REASONING ON THE TOOLS FOR REDUCE VARIABILITY

The project outcomes

- The project allows school students:
  - ✓to be exposed to statistical idea and thinking in a correct way
  - ✓to communicate the results in a proper way

- All of this could help school students to identify statistics among other scientific disciplines and, if interested in it, to enroll into university statistics degrees.

"The best thing about being a statistician is that you get to play in everyone else's backyard."

(John Tukey, Bell Labs, Princeton University)