In ricordo di Bruno

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1   Bruno my roommate

Bruno and I shared an office at the Department of Statistics and Probabaility, Univeristy "La Sapienza" for almost 10 years between 1982 and 1992 when we were both in our 30's as assistant professors. We both won the "concorso" for associate professor in 1990 and started our commuting; Bruno went to Milan and I went to Trento. He was a wonderful roommate, he always had a joke to crack, a play on words and whenever I had a hard probability problem to solve, I could always turn to Bruno. He could explain a problem by associating it to a simple realworld situation. Bruno and I together with other friends and collaborators would often eat our "panino" on the lawn and chat about university issues and other common interests. We both liked classical music and went to quite a few concerts together. We also liked mountain hiking. We had a few holidays together in Trentino and went on mountain walks together with my daughter who was about 6 years old at the time. Bruno had a way with children and was great in getting her to do long walks, he would sing songs, play word games and tell jokes, till we got to the top of the mountain. I miss him. He gave me a small "albero della felicità" which is thriving and now is about 2 meters high...so I have a memory of Bruno with me every time I water the plants.

2   Forensic statistics and probability

Some things connected to my work in forensic statistics I think Bruno would like.

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2.1 Forensic Identification in the Talmud

In the law of inheritance the Talmud evaluates the probability that a pregnant woman whose husband dies will bear a live male child. This probability must be less than one-half; as given in *Yevamoth 119a*: *A minority [of pregnant women] miscarry and of all the live births half are male and half female. Add the minority of those who miscarry to the half who bear females and the males are in a minority.*

A ruling of the 2nd century that states: *(Yevamoth 64b)*: *[A mother] had one child circumcised and he died; a second one and he died; one must not circumcise the third*, shows that the independence assumption of certain events cannot be assumed, unlike how the independence assumption was erroneously made in the year 2000 in the Sally Clarke case (a young woman wrongfully accused of murdering her two babies, based on flawed probabilistic reasoning presented in court by a pediatrician Professor Sir Roy Meadow).

2.2 L'Affaire Dreyfus

In 1894, while an artillery captain for the General Staff of France, Alfred Dreyfus was suspected of providing secret military information to the German government and was condemned to life imprisonment for espionage on Devil's Island.

Alphonse Bertillon was a witness for the prosecution in the Dreyfus affair in 1894 and again in 1899. He testified as a handwriting expert and claimed that the incriminating document (known as the "bordereau") contained strong evidence pointing to Dreyfus's handrwriting, and where it differed the discrepencies were deliberate. However, he was not a handwriting expert, and his convoluted and flawed evidence was a significant contributing factor to one of the most infamous miscarriages of justice. Using a complex system of measurements (based on geometric transformations, probability calculus and military cryptography), he attempted to prove that Dreyfus had disguised his handwriting and forged an imitation of his own handwriting. Both courts martial accepted Bertillon's analysis, and Dreyfus was convicted. The verdict of the second court martial caused a huge scandal, and it was eventually overturned.

Bertillon used the notion from military cryptography that coded messages are often written using a "key" (here using the word *intérêt*) repeated many times. He overlaid the bordereau on the "key" and saw that many letters matched, but many did not. So he made a second almost identical key except for vertical lines the same distance apart as those of the bordereau.

He computed the expected values of the most frequent letters in French

writing, according to the frequency of their occurrence in the key. Now, the bordereau contained about 800 letters and, for example, 60 were r's, so one would expect to find $1/7$ (there being 1 r in the 7 letters of intérêt) of the r's in the bordereau lying over an r in the key, *i.e.* between 8 or 9 r's. Whereas, Bertillon found 17.

In 1906, Dreyfus appealed his case again, to obtain the annulment of his guilty verdict. The fallacy in Bertillon's reasoning was revealed only then in the Court of Appeal by three mathematicians, Poincaré, Appell and Darboux. They stated "If one takes certain coincidences as evidence, and one shows that there had been a priori few chances for those to happen, have we the right to conclude that they cannot be the effect of chance?" Furthermore, they showed that by using two keys, Bertillon was basically doubling the probability of coincidence of certain letters being overlaid. The verdict was overturned and Dreyfus was also awarded the Cross of the *Légion d'Honneur*, which stated, "a soldier who has endured an unparallelled martyrdom."

Grazie Bruno