IMPARTIALITY IN DIVING

EVIDENCE FROM THE EUROPEAN CHAMPIONSHIPS

By

Botond Döme

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Economics Department

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Supervisor:

Gábor Kézdi

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III. Abstract

Judging at sport contests give an excellent opportunity to empirically test for impartiality of the judges. Quite naturally, one would expect a judge to give higher score to his fellow countryman on average.

This hypothesis motivates to empirically test for the presence of impartiality. The methodology used in this paper involves basic econometric models, such as ordinary least squares and ordered probit estimation.

The empirical findings support the initial expectation of imperfect impartiality.

IV. Motivation

Scoring sports performances, i.e. evaluation of sports that involve judging not only refereeing are subject to bias. This research focuses on experience from international diving competitions. The data set consists of dive points of individual dives from main international diving – euro and world - championships over the last three years.

The crucial question is whether nationality matters when it comes about scoring. Are the scores given by a compatriot judge usually higher than scores given from any other judge?

More specifically I estimate the following equation:

$$\tilde{d}_{ik} - j_{ik}^{l} = \alpha + \beta D_{cp} + \gamma\, dd_{ik} + \boldsymbol{\delta}\mathbf{Z} + \varepsilon_{ik}$$

where $\tilde{d}_{ik}$ is a well-chosen measure of the quality of dive k of individual i, j_{ik}^{l} is the score of judge l for the dive k of individual i, D_{cp} is the dummy variable that takes one for fellow-countryman judges, dd stands for the difficulty of the dive and the matrix $\mathbf{Z}$ may contain other explanatory variables.

If the dummy variable is significant then we conclude scoring is subject to bias, judges are partial toward fellow-countrymen/women divers. A positive significant value for beta would clearly indicate that nationality matters. In the latter case, a possible extension would be to evaluate the current diving regulations, whether they take care of the /may be present or not/ impartiality.

V. Overview of related literature

Although there is no paper available that empirically evaluates impartiality of judging at sports contests according to my knowledge, decisions made at sports championships involve quite a number of fields of studies. Since impartiality is a crucial question in ethics, the philosophical and psychological aspects will also be discussed. The precence of judges in the competition can also be related to the law: judicial independence is a central motive in many articles in law, politics and economics. A more recent phenomenon is to use proxy variables for culture and quantitative methods used in linguistics to analyze judgement in cultural contests. Therefore the following paragraphs naturally cover the related literature in sports economics, ethics, philosophy, law, linguistics and culture.

1. Sports and economics

Economic analysis of sport events is a very popular research area nowadays. Articles are published quite frequently. In North America one can read papers about the National Football League (NFL), National Hockey League (NHL), National Basketball Association (NBA), Major League Baseball (MLB). One of the first authors is Simon Rottenberg who analysed the *labor market* of baseball players in Rottenberg (1956). Since then a large number of analysis followed his initial contribution, to extend economic analysis to the field of sports. An example is Staw and Hoang (1995) who tested whether draft order in professional basketball effects playing time and survival in NBA. Lewis (2003) shows how analytics can be used for player selection in professional football, this is done in practice at the Oakland A's. Davenport, Cohen and Jacobson (2005) and Davenport (2006) list further examples how analytics transformed human resources management in professional sports. He gives an example in baseball is The Boston Red Sox, and soccer as well, namely the Italian club A.C. Milan.

The analysis more often covers the Football Association (FA) in Europe since soccer is the farmost popular sport on the contintent, millions of people follow the Premier League in the United Kingdom or the Bundesliga in Germany. Articles deal with managerial efficiency, team, coach and club performance as discussed in Kern and Süssmuth (2005), Koning (2000) and Barros and Leach (2006).

Sports attendance can be also modeled using econometric theory, examples are Garcia and Rodriguez (2002) and Owen and Weatherston (2004) who analyse Spanish soccer and rugby attendance, respectively. Another line of research tests social sciences hypothesis using sports competitions data. Szymanski (2000) tests for racial discrimination using wages in English league soccer. Levitt (2002) tests the economic model of crime using NHL data.

A large number of sports economic studies apply *financial theory* on sport contest outcomes, e.g. Mallios (1999) applies gambling & financial markets models to predict NBA, NFL and MLB outcomes. The efficienct markets hypothesis is another frequently analysed financial theory in the sports context, Lo, Hausch and Ziemba (1994) and Brown and Abraham (2002) evaluate the effeciency of betting markets. A detailed literature review about papers analyzing outcome uncertainty in sport contests is available in Szymanski (2003, 1157-8).

Although a huge library could be easily filled with the studies analyzing sports economics, the majority of the papers do not deal with sport contest design, rules and regulation. Surprisingly the only paper that deals explicitly with the design of sporting contests is Szymanski (2003), to my knowledge. There are a couple of papers who estimate partial effects of changes in the rules and regulations on the incentive structure of the players and the competition itself. Abrevaya (2004) carries out such estimations in the hockey context.

The lack of empirical research conducted to evaluate contest design, rules and regulations of sports championships is a relevant issue. As Stefan Szymanski puts it:

> *"While there been a good deal of research that has direct implications for the design of individualistic contests, empirical testing remains limited despite widespread agreement that this would be a very fruitful area in which to conduct testing."*
>
> Szymanski (2003)

This essay is contributes to the current sports economics literature mostly because of two reasons. On one hand, analysis of diving competition data for economic reasoning is unprecedented before, to my knowledge. More importantly, empirical evaluation of championships rules and regulation via analyzing the decision making process of professional judges has not been done before, according to my experience.

2. Ethics & moral philosophy

The concept of impartiality can be defined in many different ways. The philosophical approach, that relates impartiality to traditional moral theories, defines impartialism the following way:

> *"Many philosophers are imparitalists: they maintain that morality requires us to allocate our time and resources without according special preference to our own goals and interests and without displaying favouritism or partiality towards those to whom we happen to be in some way specially related."*

Cottingham (1986)

The concept of impartiality, however, is practically not feasible, as shown by several philosophical articles e.g. Cottingham (1986), Friedman (1991) and Stark (1997).

As Cynthia A. Stark argues, empirical feasibility of impartialism is in doubt since it does

> *"require agents to perform … psychological feats that are beyond human capability, such as ignoring all knowledge of one's values and traits"*
>
> Stark (1997, 478)

The approach of this research is highly practical, hence my evaluation focuses on the decision making procedure, keeping the desire of equality and fairness of rules and decision procedures in mind. In the modeling chapter I further define efficiency of the diving contest, that briefly describes the the measurement of (im)partiality using simple econometric methods.

3. Law & judicial independence

In the law literature there is an ongoing debate on the independence of courts. The main question is what guarantees independence. A number of authors argue that the constitution and institutional rules protect judicial indepence. However, Rosenn (1987) showed empirical evidence that constitutional protections themselves cannot guarantee a proper level of independence. In case of highdiving, the regulation is very detailed and there are several strict rules set by the Ligue Européenne de Natation (LEN)[1], Fédération Internationale de Natation (FINA)[2] and the International Olympic Comittee[3]

An even more relevant line of research from the sporting contests point of view puts the interest of the government in the centre of the picture. Landes and Posner (1975) argues that the interest of the administration in having an independent judiciary is clear since independence makes legislative bargains more durable.

Ramseyer (1994) develops the theory that political competition makes judicial independence more likely. Furthermore Stephenson (2003) creates the corresponding formal model and empirically tests the hypothesis. When applying this theory to international diving competitions, one can substitute the parties with nations and the organizing country with the government and the same theory applies. The rules and regulations are executed by the referees delegated by international aquatics organizations such as LEN or FINA[4].

The design of Internation Criminal Tribunals gives an interesting opportunity for comparison. According to Meron (2005) the composition of international courts includes judges not only with previous judging experience but also with academic, legal or diplomatic experience without judging experience. Therefore the maintenance of impartial judgement at international courts requires the potential bias to be filtered out or at least to be corrected. Thus multipanel judging was introduced at international courts and it is an essential element of the design of court's decision making procedure. The judgement becomes final after the majority of the judges agreed on the outcome.

In diving, multijudge panels are present because of the very same impartiality argument. The usual procedure is to filter out the highest and lowest scores given for a specific dive.

Independence & impartiality causes a certain level of predictability. As Theodor Meron puts it:

> *"… actors need to believe that an impartial arbiter will adjudicate their differences, and that their reliance on the existing laws and regulations will be honored. In resolving disputes, judges explain and clarify those laws and regulations. When judges are independent and act in accordance with the law, their decisions have a certain predictability."*
>
> Meron (2005, 359)

The predictability mentioned by Meron is the central focus of this essay, an empirical model will be formulated in a subsequent chapter.

4. Linguistics & culture

Ginsburg and Noury (2004) analyses the political and cultural aspects of voting at the Eurovision Song Contest. They find that coalition formation is not so much based on political reasons but cultural. The cliques that support each other's competitor are based on cultural similarities that can be proxied by linguistic characteristics.

However, the Eurovision does not allow nations to vote for their own competitor. Still, linguistic and cultural characteristics of the performer influence voting behavior. The same holds for the semi-final and final sessions in diving. The preliminary sessions give a chance to evaluate the voting for your fellow countryman or countrywoman competitor.

Dyen, Kruskal and Black (1992) computed linguistic distances among 84 indoeuropean languages using the lexicostatistical method. The lexicostatistical method is an invention of Morris Swadesh. Swadesh (1952) examined indoeuropean languages based on the most common 200 words from each language. The output of the method gives the linguistic distances of the indoeuropean languages e.g. on a 1 to 1000 scale. Measuring how close different cultures are to one another using linguistic distances is further discussed in Greenberg (1956) and Johnson (2007).

VI. The Data set

The data set used to analyze judging behavior in this paper is taken from the 28th LEN European Swimming Championships. The events took place in Budapest, Hungary 26. July – 6. August 2006. The data is taken from Omega Timing[5] who have the data set in Adobe Acrobat pdf format on their website. Therefore it was a prerequisite for the data set to be transformed into any database format that is friendly with statistical software. The post transformation work, the data steps and the modeling has been mainly performed in Statistical Analysis Software (SAS) and some of the codes and macro programs are included in Appendix C. Emphasis on programming is relevant since it makes the inclusion of the data of other past international competitions much easier and therefore future research and extension of the paper a reasonable goal.

5. History of Diving

Although most sources[6] trace the development of diving back to the seventienth century, the sport has a far longer past. The diver of Paestum discussed in Rubin (1999) appears on a classical Greek painting discovered in Italy in 1968. The painting dates back to between 470 and 480 A.C. The 'Tomba del Tuffatore' (the Tomb of the Diver) is the earliest evidence of the sport diving. The ancient painting shows a young man diving from a platform into the sea capturing the person in the air, as seen below.

Figure 1 La Tomba del Tuffatore[7]

Source: Mussapi (2007)

The sport started to develop at a greater pace when European gymnasts practiced over water. The close relation of diving and gymnastics is shown by the very fact that most transition toward professional diving is from gymnastics even nowadays.

Diving competitions take place at least since the ninetienth century. As Sullivan (1905) documents 'fancy diving' entered the swimming program of the 1904 Olympic Games organized in St. Louis. The number of events started to grow with the addition of platform dives in London in 1908 – see British Olympic Council (1908). There was no real change in the Programme till the Olympics in Sydney in 2000 when the syncrhonised events were first introduced. Nowadays there is a 3 meter springboard and a 10 meter platform event in the program of the Olympic Games, both for men and women, in individual and synchronised category. Other international competitions such as European and World Championships also include the 1-meter individual diving event.

The number and difficulty level of dives has been increased dramatically.

6. European Championships

European Championships (EC) in diving, together with swimming, synchronized swimming and open water swimming are held every even year. The LEN Technical Committee for Diving (TDC) is the responsible body for applying the LEN Rules and Regulations[8]. There are both individual and team contests. At the EC the following individual diving events take place

- 1m springboard
- 3m springboard
- 10m platform

Synchronised diving events are only on the 3m springboard and the 10m platform. All the events are organized for men and women, separately. There are two or three phases of each contest: the preliminary, semi-final and final phases, with the semi-final being optional[9]. The types of dives performed and the nationalities represented at the European Championships are shown in the following tables by frequency counts.

Table 1 Dives by nationality and contest type

Nationality	n
AUT	32
AZE	6
BLR	52
CRO	32
ESP	55
FIN	30
FRA	20
GBR	59
GER	79
GRE	44
HUN	42
ITA	82
NOR	12
POL	24
ROM	15
RUS	86
SCG	25
SUI	28
SWE	50
UKR	82
	855

ctype	n
m1	144
m10	72
m10synchro	36
m3	130
m3synchro	66
w1	110
w10	105
w10synchro	35
w3	107
w3synchro	50
	855

Types of dives

This section discusses the international coding of dives and the most usual types since explanatory variables are created using the diving codes for modeling purposes. The international coding of the dives consists of three or four consecutive numbers depending on the type of dive plus an additional letter[10].

The first digit determines the starting and or the flying position of the dive, it may take the value of 1 to 6 and means front, back, reverse, inward, twisting and armstand starting or flying position, respectively.

The second digit has a different meaning depending on the value of the first digit. If the first digit is between 1 and 4 so that the dive is front, back, reverse or inward, the second digit indicates the presence of flying action (value of 1). Most often it takes the zero value (no flying action). In case of an armstand dive (first digit takes the value of 6) or a twisting dive (first digit takes the value of 5) the second digit indicates the direction of the dive that may be front, back and reverse denoted by 1 to 3 respectively.

The third digit describes the number of somersaults performed in the dive. The unit is a half somersault denoted by 1, e.g. one-and-a-half somersaults are denoted by three.

There exists a fourth digit in case of an armstand or twisting dive. This digit indicates the number of half twists performed in the dive.

After leaving the springboard (1 and 3 meter events) or the platform (10 meter events) the diver can take the following positions: straight (no flexion), pike (flexion at hips), tuck (flexion at hips and knees) and free (combination of the previous three positions restricted to twisting dives), denoted by the letter at the end of the dive code, from A to D, respectively.

Using these coding rules it is easy to see that the dive 107B means a forward three and a half somersault, performed in pike position.

The difficulty of the dives is measured according starting, flying positions, number of twists and somersaults performed. Based on the diving codes, each dive is assigned a degree of difficulty (DD). The variable DD takes the value from 1.9 to 3.8 in the 2006 European Championships sample.

Judging

Individual diving events are judged by a panel of seven judges, all of them scoring the execution of the dive. Synchro diving events are judged by a panel of nine judges. Out of the nine judges five judge the synchronisation, the remaining four judges the execution of the dive. The two divers' execution is judged by two of the execution judges, each.

Judges award points on a 0 to 10 scale for the dives. The approach to the board or platform must be disregarded just like the underwater movements.

As the FINA rules and regulations state

"When judging a dive, the judge must not be influenced by any factor other than the technique and execution of the dive."

FINA (2005, D 8.1.2)

The technique and the execution covers the initial position, the approach, the take-off, the flight and the entry to the water. In synchronised diving, coordination in timing, height of the take-off, coordinated movements during the flight and coordinated timing and distance of the entry matters mainly.

The dive points are awarded according to the following categories[11]

- Completely failed 0 points
- Unsatisfactory ½ to 2 points

- Deficient 2½ to 4½ points
- Satisfactory 5 to 6 points
- Good 6½ to 8 points
- Very good 8½ to 10 points

It is important to note that the referee, and optionally the assistant referee, observes the diver and may decide to deduct points if any rule is broken. This way the judge is able to focus on the quality of the dive and award the points accordingly.

In individual diving the highest two and the lowest two scores are dropped so that only the three scores in the middle matter. In synchronised events the lowest and highest dive points are neglected for execution and synchronisation, leaving five scores taking into account.

The two most important variables that allows for statistical inference in case of judges is the dive point awarded for the dive and the nationality of the judge. The judges – all together with the referees – are summerized by the frequency counts below.

Table 2 Judges by nationality and contest type

Nationality	n
AUT	7
BLR	7
ESP	8
FIN	8
FRA	5
GBR	9
GER	10
GRE	7
HUN	6
ITA	10
LEN	20
NED	6
NOR	6
RUS	10
SUI	8
SWE	4
UKR	9
	140

ctype	n
m1	16
m10	16
m10synchro	11
m3	16
m3synchro	11
w1	16
w10	16
w10synchro	11
w3	16
w3synchro	11
	140

Note that the table is created on an event basis, so that a person judging men one-meter springboard and woman ten-meter platform will be counted twice. The row 'LEN' among the nationalities refers to the referee, nominated by the European Swimming Federation.

Construction of the samples

The sample used in the empirical evaluation matches the divers and the judges. Therefore the total number of events contains all the individual dives and awards, plus the synchronisation awards from the synchro dives. In case of the execution dives there are two observations per diver. The lack of further awards does not allow the estimation of biased judgement so that it is excluded from the sample.

Alltogether there are 5611 awards to be analyzed in the most extensive sample, denoted by sample one. Which is the number of dives performed at the Championships times the number of judges giving awards (excluded the execution judges in the synchro case).

Table 3 Observations by contest type, sample 1

ctype	n
m1	1008
m10	504
m10synchro	180
m3	910
m3synchro	330
w1	770
w10	735
w10synchro	175
w3	749
w3synchro	250
	5611

Table 4 Observations by nationality, sample 1

Divers' nationality			Judges' nationality	
Nat	n		NatJ	n
AUT	224		AUT	245
AZE	42		AZE	
BLR	340		BLR	240
CRO	214		CRO	
ESP	353		ESP	396
FIN	198		FIN	391
FRA	140		FRA	281
GBR	381		GBR	401
GER	509		GER	444
GRE	286		GRE	354
HUN	284		HUN	314
ITA	530		ITA	436
NED			NED	367
NOR	84		NOR	321
POL	156		POL	
ROM	95		ROM	
RUS	558		RUS	573
SCG	165		SCG	
SUI	184		SUI	376
SWE	338		SWE	201
UKR	530		UKR	271
	5611			5611

7. Linguistic data in the model

To approximate the cultural distance of the participating nations the Dyen matrix of the linguistic distances is used. Dyen, Kruskal & Black (1992) reports a quantitative method to compute the linguistic distances between eighty-four Indoeuropean languages by counting the shared cognates among the most common words.

This paper uses the electronic version of the Dyen matrix that is available in the appendix of Johnson (2007)[12]. The filtered Dyen matrix with the data set of the nations participating in the European Championships is available in Appendix A.

Using the information about linguistic characteristics provided by Dyen I create four categories describing cultural distance. The 'distant' group takes the values between 157-265 on Dyen's scale, having the German-French pair the most distant with the value 157 and the Italian-

German relationship with 265. The ‘medium’ group takes values between 548-695 where 548 denotes the British-Norwegian and 695 the Swedish-German pair. The ‘close’ group is between 707-842 with Croatioan-Ukranian having the value of 707 and Swedish-Norwegian the closest with 842. The fourth group consists of pairs formed with the same nationality, that translates to 1000 on Dyen’s scale.

Sample 2 is the restricted version of sample 1: it includes those observations from sample 1 that have a valid value in Dyen’s matrix. The frequency list of observations by contest type and nationality is available in Appendix A. The adjustment in sample 2 means dropping Azeri, Finnish, Hungarian and Swiss data.

VII. Empirical analysis

This section briefly discusses the empirical model, the predictability of awards and redefines impartiality from a highly empirical point of view, motivated by the financial literature.

The crucial question is whether nationality matters when it comes about scoring. Are the scores given by a compatriot judge usually higher than scores given from any other judge?

More specifically I estimate the following equation:

$$\tilde{d}_{ik} - j_{ik}^{l} = \alpha + \beta D_{cp} + \gamma\, dd_{ik} + \boldsymbol{\delta}\mathbf{Z} + \varepsilon_{ik}$$

where $\tilde{d}_{ik}$ is a well-chosen measure of the quality of dive *k* of individual *i*, j_{ik}^{l} is the score of judge *l* for the dive *k* of individual *i*, D_{cp} is the dummy variable that takes one for fellow-countryman judges, dd stands for the difficulty of the dive and the matrix $\mathbf{Z}$ may contain other explanatory variables.

8. Predictability of scores and impartiality

The predictability quoted from Theodor Meron (2004) can be empirically tested in the diving contest setting, unlike in case of the examination of judicial independence in general.

The predictability of scores and impartiality in diving has many roots: unwritten conventions, experience in training and judging at national championships, traditions of the sport all have a great effect.

Choosing diving for testing imparitality of judgments in sports contests is also reasonable. It has more subjective elements than e.g. swimming where only time matters. On the other hand, more artistic sports, like synchonised swimming or figure skating, are not balanced and it seems that the subjective element of the sport represents too much weight at scoring. Diving luckily lies somewhere in between swimming and synchronised swimming, so the objective elements are heavily represented in judging. Of course even in case of the heavy presence of objective elements in the evaluation of competitors' performance, it is not as easy to measure performance as it is in case of swimming in a quantitative way.

Impartiality redefined

Impartiality and market efficiency are paralell concepts from an empirical point of view. Hence I briefly review the classical version of the Efficient Markets Hypothesis (EMH) then I redefine impartiality from an empirical point of view, motivated by the EMH.

Eugene Fama created the earliest definition of the and the Efficient Markets Hypothesis giving the following example, *"A market in which prices always « fully reflect » all available information is called « efficient »"* see Fama (1970). Burton Malkiel defines efficiency very similarly, but explains it in more detail: "*A capital market is said to be efficient if it fully and correctly reflects all relevant information in determining security prices… Moreover, efficiency with respect to an information set … implies that it is impossible to make economic profits by trading on the basis of [that info set]"* see Malkiel (1999). Another milestone in efficiency theory was Harry Roberts' paper. He was the first to introduce the distinction between weak and strong form efficiency - see Roberts (1967) or Fama (1970).

Motivated by the approach of Roberts (1967) and Fama (1970) this essay distinguishes between three different levels of imparitality. Weak form of impartiality of judging holds if the divers and dives characteristics do not make it possible to predict bias in the judgement. To put it different way, it states that divers cannot arbitrage on the choice of dive and judges do not distinguish among the divers according to their characteristics.

Semi-strong form of impartiality holds if there is no possibility to predict biased judgement using the characteristics of judges. In other words, competitors are evaluated similarly independent of the person of the judge, i.e. there is no judge who would systematically undervalue of overvalue the awards given for the dives performed.

Strong form of impartiality is present if the two previous definitions and even their combination do hold. That is common characteristics of judges and divers, such as nationality or cultural closeness, do not influence the probability of biased judgement.

9. Econometric challenges

Since the data available for the current research, especially considering the quantitative measures of dive quality and diver performance is limited, the essay has to deal with certain econometric challenges.

Presence of measurement error

Measurement error is present on the right-hand side since the theoretical bias is constructed as the difference between the expected value of dive award outcome and the award given by a specific judge. Unfortunately this is a noisy measure, especially if we consider that the average dive award is computed from five and seven separate judgments, in case of synchro and individual events, respectively.

Low explanatory power

Since the econometric problem is to estimate models where there should not be any explanatory power or space for prediction low explanatory power is a property of all the models estimated below, just as it is in case of the return prediction literature in finance.

Heteroscedasticity robust standard errors are used in all the models estimated below according to the rejection of the null hypothesis in the corresponding heteroscedasticity tests. White standard errors in case of Ordinary Least Squares and Huber-White standard errors in the Ordered Probit case.

The left-hand side variable of the ordered probit model is constructed as a rounded integer number of the scores*2, since the unit of the awards is one-half.

Weak form impartiality tests are not reported in the current paper, all the variables available in the dataset showed insignificance, thus the competition satisfies the weak form of impartiality.

The semi-strong form of impartiality is rejected, since several significant variables are present in the model: the gender of the judge and the synchro dive dummy is significant at 10 percent in the OLS case, the synchro dive dummy is significant at 5 percent in the probit case, and a couple of judge nationality dummies are significant in all the specifications.[13] The following table summarizes the empirical results.

Table 5 Semi-strong form of impartiality: OLS and ordered Probit results

variable	OLS (1)		OLS (2)		Ordered Probit (1)		Ordered Probit (2)	
	parameter	std	parameter	std	parameter	std	parameter	std
female judge	1.109	1.725	**-1.247***	3.384	3.089	4.923	-0.288	9.747
variance of awards	-2.802	7.702	-2.565	7.554	-1.171	18.085	-0.119	17.862
degree of difficulty	0.366	1.552	-0.315	1.569	5.054	4.344	3.255	4.429
synchro dive	1.232	1.607	**3.125***	1.654	5.530	4.498	**10.494****	4.665
judge BLR			3.225	4.964			2.362	14.308
judge ESP			**-8.269*****	3.127			**-22.159****	9.096
judge FRA			-0.402	3.572			-3.416	10.080
judge GBR			4.832	3.273			10.725	9.293
judge GER			-3.839	3.183			-11.971	9.164
judge GRE			3.272	3.355			6.164	9.587
judge ITA			**-10.949*****	3.164			**-32.171*****	9.114
judge NED			-0.029	3.218			-3.978	9.238
judge NOR			4.889	3.362			10.914	9.803
judge RUS			0.314	3.706			-2.888	10.695
judge SWE			**7.532***	4.026			**21.823***	11.682
judge UKR			1.218	3.587			2.153	10.468
R-squared	0.03%		1.75%		0.03%		0.03%	
P-value of partial F/ or LR	85.80%		0.00%		62.77%		0.00%	

Strong form of impartiality is also rejected, since many explanatory variables are significant at the one-percent level. The fact that both the judge and the diver are female, has a positive effect on the bias. The following table show several OLS specification results testing the strong form of imparitality.

Table 6 OLS estimation results: testing the strong form of impartiality

variable	specification (1)		specification (2)		specification (3)		specification (4)	
	parameter	std	parameter	std	parameter	std	parameter	std
female	**5.704****	2.837	**7.937****	3.659	**5.991****	2.841	**8.175****	3.670
opposite sex	-1.858	1.251	-0.65	1.341	-1.843	1.250	-0.586	1.342
cultural distance	**0.008*****	0.002	**0.010*****	0.002				
distant language					**-2.985****	1.444	**-2.453***	1.459
same nationality					**6.931*****	2.496	**8.395*****	2.534
judge BLR			-2.432	4.043			-2.505	4.040
judge ESP			**-6.626****	3.066			**-7.088****	3.068
judge FRA			0.747	3.574			0.45	3.577
judge GBR			5.096	3.308			4.484	3.307
judge GER			-2.705	3.103			-3.292	3.105
judge GRE			5.518	3.375			4.148	3.359
judge ITA			**-10.08*****	3.126			**-10.645*****	3.128
judge NED			0.41	3.225			0.627	3.235
judge NOR			5.376	3.390			5.216	3.391
judge RUS			-1.06	2.963			-1.427	2.968
judge SWE			**8.516****	3.970			**8.143****	3.980
judge UKR			0.465	3.586			0.286	3.600
R-squared	0.58%		2.23%		0.75%		2.38%	

It is clear from the various specifications that nationality and culture have a significant influence on the bias. The cultural distance variable shows that the closer the culture of the judge and the diver is, the greater the expected value of the bias is.

Similarly, the categorical specifications denoted by (3) and (4) show significance and the expected signs. Culturally distant nations bias each others scores downwards while in case of same nationality upward bias is present.

The following table summarizes the same results in case of ordered probit models.

Table 7 Ordered probit estimation results: testing the strong form of impartiality

variable	specification (1)		specification (2)		specification (3)		specification (4)	
	parameter	std	parameter	std	parameter	std	parameter	std
female	**14.342***	8.086	**21.903****	10.530	**15.188***	8.104	**22.645****	10.561
opposite sex	-4.704	3.518	-1.463	3.795	-4.667	3.518	-1.274	3.799
cultural distance	**0.023*****	0.006	**0.026*****	0.006				
distant language					**-7.670***	4.127	-6.283	4.213
same nationality					**19.834*****	7.115	**23.846*****	7.275
judge BLR			-9.932	11.697			-10.175	11.684
judge ESP			**-17.172***	8.916			**-18.4893****	8.937
judge FRA			0.185	10.096			-0.623	10.122
judge GBR			12.420	9.403			10.774	9.410
judge GER			-8.122	9.000			-9.797	9.019
judge GRE			12.648	9.656			8.877	9.640
judge ITA			**-29.014*****	9.031			**-30.6558*****	9.059
judge NED			-1.994	9.290			-1.333	9.323
judge NOR			13.487	9.909			13.123	9.915
judge RUS			-3.847	8.669			-4.890	8.697
judge SWE			**25.634****	11.585			**24.646****	11.621
judge UKR			0.797	10.478			0.280	10.525
R-squared	0.209%		0.848%		0.284%		0.920%	

The findings from the ordered probit are in line with the OLS specification, signs and significance of the variables is as expected.

VIII. Further Research

Future research would use previous international championships data such as EC, WC, Olympic Games. The broader data base would allow to measure the date of first international appeareance (called bleeding) and also the number of years spent competing internationally, which could be relevant variables in the model.

Similarly, international ranking of the divers, and the knowledge of the order of the dives performed at the competition would be relevant information, since it could be estimated via panel data methods.

Improving the current essay into policy paper would be necessary, by comparing the outcomes of the models with and without applying the current FINA rule (ie. Dropping the lowest and highest scores from the sample).

IX. Concluding remarks

This article examined the hypothesis of impartiality. Redefinition of impartiality from an empirical point of view – motivated by financial theory – proved to be a useful idea.

The ordinary least squares and the ordered probit estimation results show evidence that semi-strong form and strong form of impartiality do not hold in case of international highdiving competitions.

Further research is needed to assess the policy implications and recommendations of the empirical findings of weak impartiality.

X. Appendix A – Tables

Table 8 Dyen matrix for European languages

	AUT	BLR	ESP	FRA	GBR	GER	GRE	ITA	NED	NOR	POL	ROM	RUS	SCG	SWE	UKR
AUT	1000	247	253	244	578	1000	188	265	838	633	246	249	245	236	695	241
BLR	247	1000	230	221	235	247	174	237	237	240	751	212	732	673	254	839
ESP	253	230	1000	734	240	253	167	788	258	239	228	594	231	232	253	218
FRA	244	221	734	1000	236	244	157	803	244	230	219	579	222	228	244	219
GBR	578	235	240	236	1000	578	162	247	608	548	239	227	242	234	589	223
GER	1000	247	253	244	578	1000	188	265	838	633	246	249	245	236	695	241
GRE	188	174	167	157	162	188	1000	178	188	179	163	157	168	179	184	158
ITA	265	237	788	803	247	265	178	1000	260	246	236	660	239	245	259	226
NED	838	237	258	244	608	838	188	260	1000	650	231	254	224	221	692	215
NOR	633	240	239	230	548	633	179	246	650	1000	238	214	242	228	842	228
POL	246	751	228	219	239	246	163	236	231	238	1000	216	734	680	237	802
ROM	249	212	594	579	227	249	157	660	254	214	216	1000	219	222	239	201
RUS	245	732	231	222	242	245	168	239	224	242	734	219	1000	675	246	779
SCG	236	673	232	228	234	236	179	245	221	228	680	222	675	1000	237	707
SWE	695	254	253	244	589	695	184	259	692	842	237	239	246	237	1000	242
UKR	241	839	218	219	223	241	158	226	215	228	802	201	779	707	242	1000

Table 9 Observations by contest type, sample 2

ctype	n
m1	660
m10	330
m10synchro	144
m3	636
m3synchro	216
w1	513
w10	600
w10synchro	140
w3	495
w3synchro	225
	3959

Table 10 Observations by nationality, sample 2

Divers' nationality		Judges' nationality	
Nat	n	NatJ	n
AUT	183	AUT	215
AZE		AZE	
BLR	264	BLR	210
CRO	175	CRO	
ESP	291	ESP	349
FIN		FIN	
FRA	114	FRA	255
GBR	309	GBR	345
GER	405	GER	392
GRE	235	GRE	305
HUN		HUN	
ITA	429	ITA	380
NED		NED	319
NOR	69	NOR	277
POL	126	POL	
ROM	80	ROM	
RUS	447	RUS	499
SCG	136	SCG	
SUI		SUI	
SWE	273	SWE	174
UKR	423	UKR	239
	3959		3959

XI. Appendix B – Graphs

Table 11 Histogram of cultural distance variable, sample 2 (cDist)

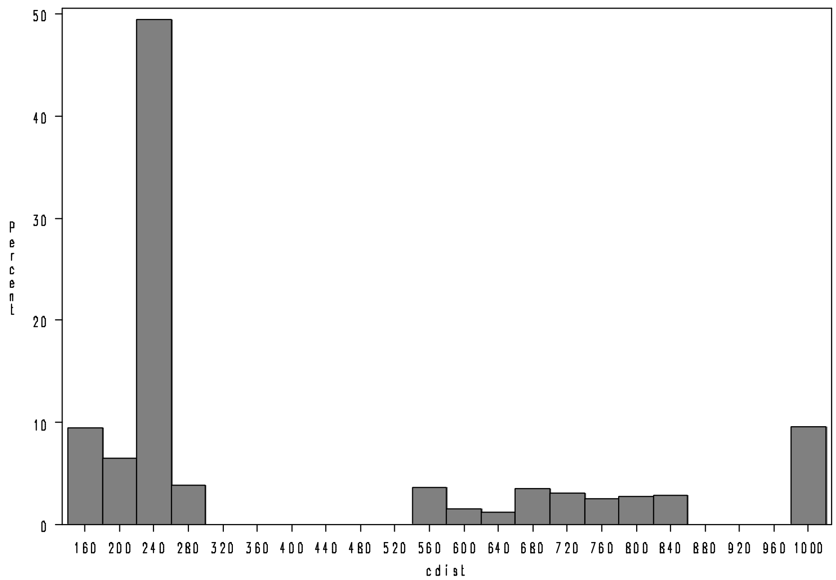


Table 12 Histogram of bias, sample 1

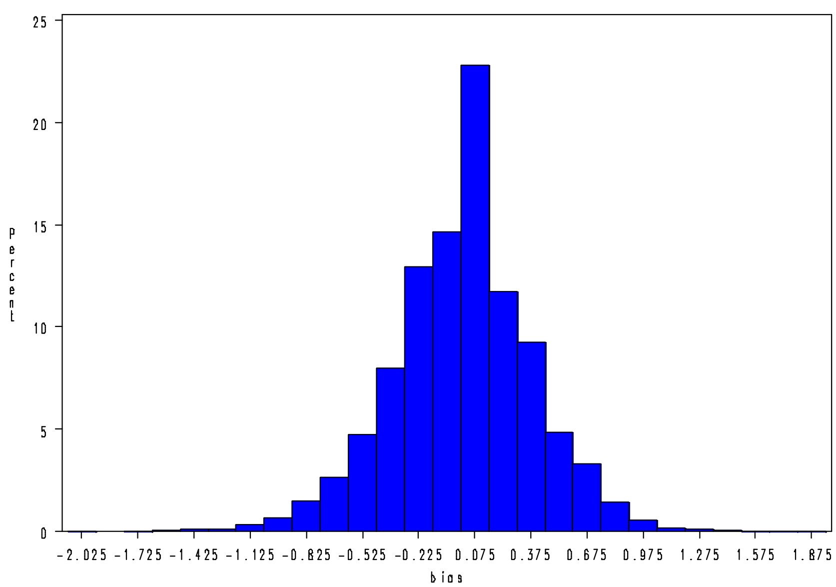


Table 13 Histogram of bias, sample 2

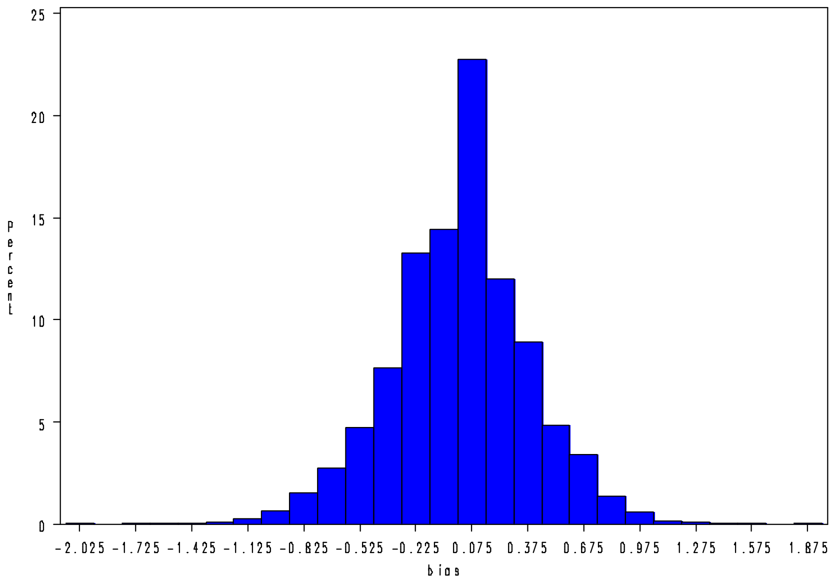


Table 14 Scatter plots: bias, sample 1

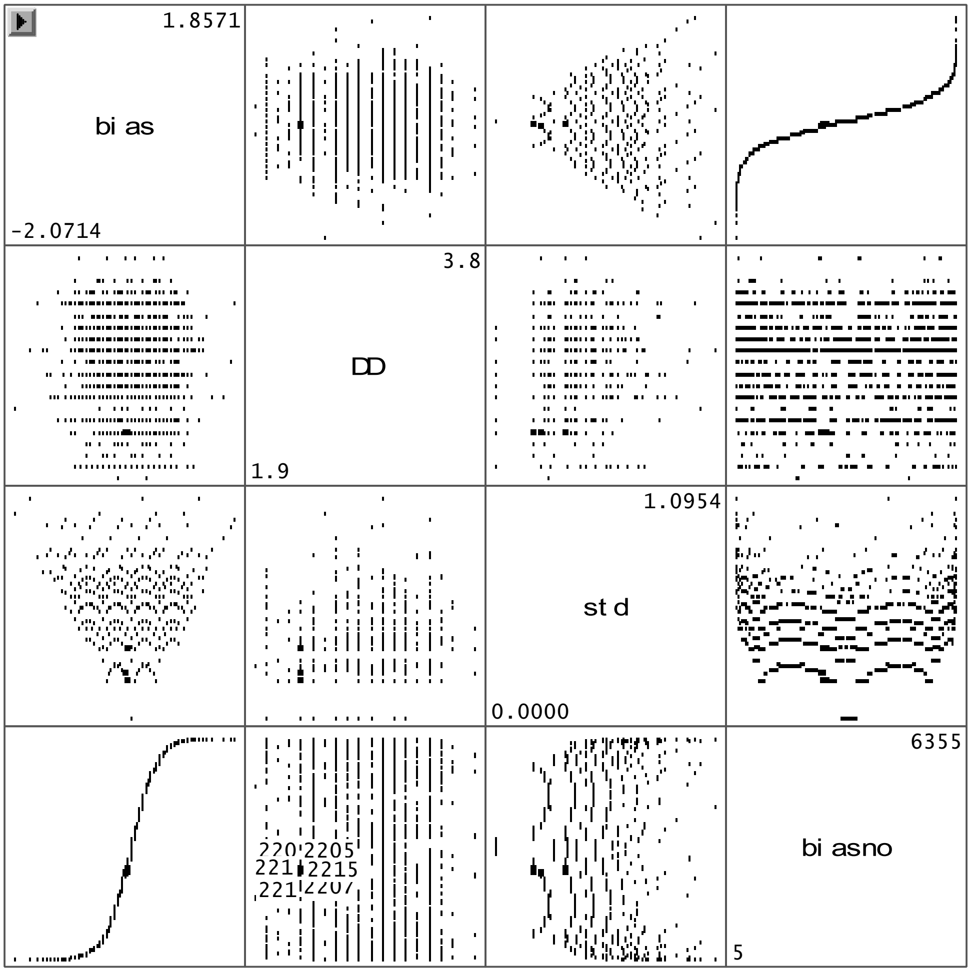
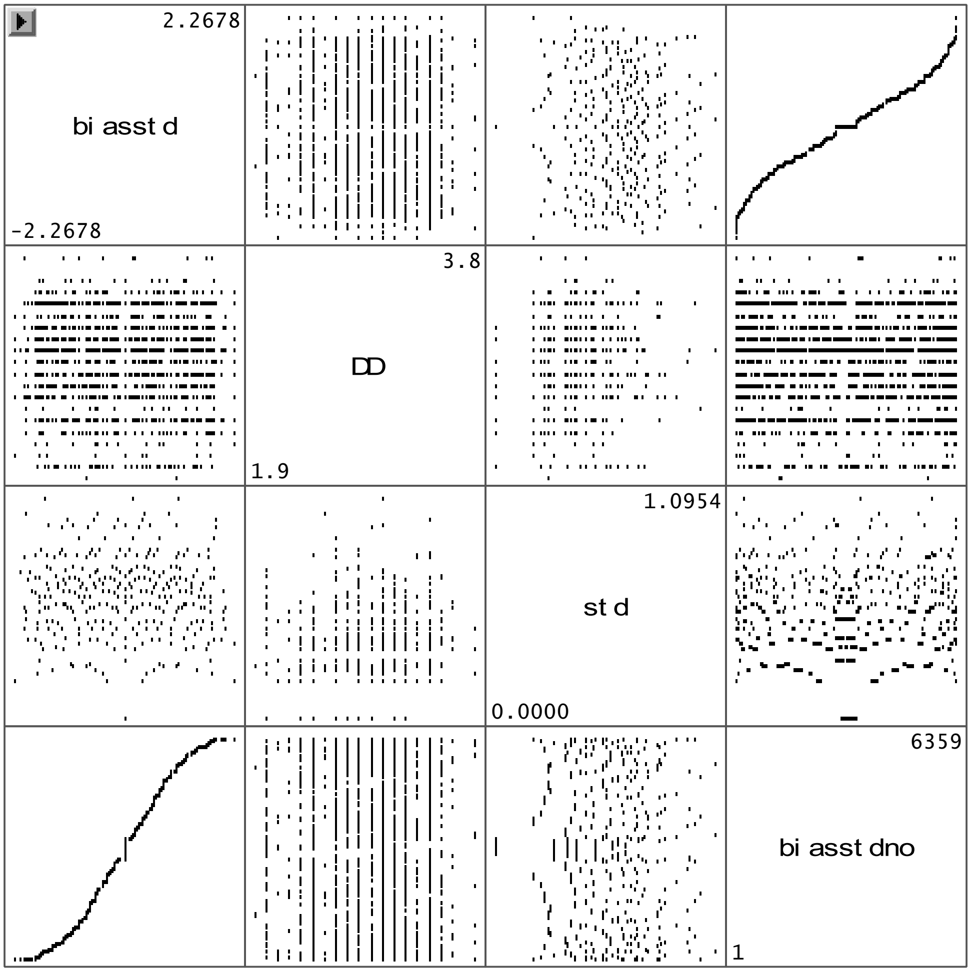


Table 15 Scatter plots: biasstd, sample 1



XII. Appendix C - SAS code

Table 16 SAS macro generating the LHS variable

```
%macro biasgen;
	%let i = 1;
		%do %while (&i <= 9);
			options firstobs=1 obs=max;
				proc sql noprint;
					update full
						set bias = j&i-avg
						where jno = %eval(&i);
				quit;
			%let i = %eval(&i + 1);
		%end;
		options firstobs=1 obs=max;
%mend;
%biasgen;
```

Table 17 SAS macro generating the nationality dummies

```
%macro dummify(var2dum, indata, outdata);
%put ********************************************;
%put *** generating numeric vars from strings ***;
%put *** numeric variables ordered by freq    ***;
%put ********************************************;
%put *** &var2dum 2 dummify ***;

%put *** backup copy of original data set ***;
options firstobs=1 obs=max;
proc sql noprint;
	create table &outdata as
		select * from &indata;
quit;

%put *** frequency count ***;
proc sort data=&outdata;
	by &var2dum;
run;
proc summary data=&outdata nway;
	class &var2dum;
	output out=temp;
run;
proc sort data=temp;
	by descending _freq_;
run;

proc sql;
	alter table &outdata
		add d&var2dum num;
quit;
proc sql noprint;
	select count(*) into :numvars
		from temp;
quit;
%put &numvars;

%let i = 1;
%do %while (&i <= &numvars);
	options firstobs=&i obs=&i;
		proc sql noprint;
			select &var2dum into :val&i
```

```
                                        from temp;
                    quit;
          %put &&val&i;
          %put d&&val&i;
          options firstobs=1 obs=max;
                    proc sql;
                              alter table &outdata
                                        add d&&val&i num;
                    quit;
                    proc sql noprint;
                              update &outdata
                                        set d&var2dum = %eval(&i-1)
                                        where &var2dum = "&&val&i";
                    quit;
                    proc sql noprint;
                              update &outdata
                                        set d&&val&i = 0;
                              update &outdata
                                        set d&&val&i = 1
                                        where &var2dum = "&&val&i";
                    quit;
          %let i = %eval(&i + 1);
%end;

options firstobs=1 obs=max;

%mend;
```

Table 18 SAS datasteps

```
libname ustemp 'e:/data/diving/ustemp';

proc setinit;
run;

proc sort
      data = ustemp.dives;
      by dd;
run;

proc sql noprint;
      alter table ustemp.dives
            drop dtype;
      alter table ustemp.dives
            add dtype char(1);
      update ustemp.dives
            set dtype = dive;
quit;



      %let dataset = total;
      %let outdata = dives;
      %let data2sum1 = ustemp.dives;
      %let data2sum2 = ustemp.judges;
      %let libname = e:/data/diving/ustemp/;
      proc sql noprint;
                  create table ustemp.&outdata as
                        select *
                        from ustemp.dives;
      quit;
```

```
* merging tables;
%put * merging tables;


      proc sql noprint;
                  create table ustemp.full as
                        select coalesce(s.id, d.id)
                        as id, s.ctype, s.nat, d.NatJ, diveno, divemin,
divemax, dno, s.Last,   s.First,
                        Dive, dtype,      DD,    J1,    J2,    J3,    J4,    J5,
      J6,    J7, J8, J9,
                        jno, jfemale, LastJ, FirstJ, coalesce(s.panel,
d.panel) as panel
                        from ustemp.dives s full join ustemp.judges d
                        on s.ctype = d.ctype and s.session = d.session and
s.panel = d.panel;
      quit;
      proc sql noprint;
                  create table ustemp.full as
                        select *
                        from ustemp.full
                        where panel eq "A" or panel eq "B" and diveno and
jno and Nat and NatJ and jno > 0;
      quit;





      proc sql noprint;
            create table full as
                  select id, ctype, nat, NatJ, diveno, divemin, divemax,
dno, Last,  First,
                        Dive, dtype, DD,  J1,    J2,    J3,    J4,    J5,    J6,
      J7, J8, J9,
                        jno, jfemale, LastJ, FirstJ, panel
                  from ustemp.full;
      quit;
      proc sql noprint;
                  alter table full
                        add avg_sexec num, avg_ssync num, avg_indi num,
avg9 num, avg num, std_sexec num, std_ssync num, std_indi num, std9 num,
std num, var num, ddsq num, bias num, biasstd num, biasstdt num;;
      quit;
      proc sql noprint;
                  update full
                        set avg_sexec = mean(j1, j2, j3, j4);
                  update full
                        set avg_ssync = mean(j5, j6, j7, j8, j9);
                  update full
                        set avg_indi = mean(j1, j2, j3, j4, j5, j6, j7);
                  update full
                        set avg9 = mean(j1, j2, j3, j4, j5, j6, j7, j8,
j9);
                  update full
                        set std_sexec = std(j1, j2, j3, j4);
```

```
                update full
                      set std_ssync = std(j5, j6, j7, j8, j9);
                update full
                      set std_indi = std(j1, j2, j3, j4, j5, j6, j7);
                update full
                      set std9 = std(j1, j2, j3, j4, j5, j6, j7, j8, j9);
    quit;


    proc sql noprint;
          update full
                set avg = avg_indi
                      where j8 eq 0 and j9 = 0;
          update full
                set std = std_indi
                      where j8 eq 0 and j9 = 0;
          update full
                set avg = avg_sexec
                      where j8 <> 0 and j9 <> 0 and jno le 4;
          update full
                set std = std_sexec
                      where j8 <> 0 and j9 <> 0 and jno le 4;
          update full
                set avg = avg_ssync
                      where j8 <> 0 and j9 <> 0 and jno ge 5;
          update full
                set std = std_ssync
                      where j8 <> 0 and j9 <> 0 and jno ge 5;
    quit;
    proc sql noprint;
          update full
                set var = std*std;
          update full
                set ddsq = dd*dd;
    quit;
    proc sort data = full;
          by j8 j9 ctype diveno jno;
    run;



    proc sql noprint;
                alter table full
                      add d_nat num;
                update full
                      set d_nat = 0;
                update full
                      set d_nat = 1
                      where nat = natJ;
    quit;
    proc sql noprint;
          select count(*) into : numall
                from full;
    quit;

    proc sql noprint;
          alter table full
                add dfemale num, individual num, synchro num, sexecution
num, ssynchro num, d1m num, d3m num, d10m num;
          update full
                set dfemale = index(ctype,"w");
```

```
            update full
                  set synchro = index(ctype,"synch");
            update full
                  set synchro = 1
                  where synchro > 0;
            update full
                  set individual = 0;
            update full
                  set individual = 1
                  where j8 = 0 and j9 = 0;
            update full
                  set sexecution = 0;
            update full
                  set sexecution = 1
                  where synchro = 1 and jno le 4;
            update full
                  set ssynchro = 0;
            update full
                  set ssynchro = 1
                  where synchro = 1 and jno ge 5;
            update full
                  set d10m = index(ctype,"10");
            update full
                  set d10m = 1
                  where d10m > 0;
            update full
                  set d3m = index(ctype,"3");
            update full
                  set d3m = 1
                  where d3m > 0;
            update full
                  set d1m = 0;
            update full
                  set d1m = 1
                  where d3m = 0 and d10m = 0;
      quit;


proc sql noprint;
      alter table full
            add male num, female num, opposite num;
      update full
            set female = dfemale*jfemale;
      update full
            set male = (1-dfemale)*(1-jfemale);
      update full
            set opposite = 0;
      update full
            set opposite = 1
                  where male = 0 and female = 0;
quit;


      %macro biasgen;
      %let i = 1;
            %do %while (&i <= 9);
                  options firstobs=1 obs=max;
                        proc sql noprint;
                              update full
                                    set bias = j&i-avg
                                    where jno = %eval(&i);
```

```
                    quit;
                %let i = %eval(&i + 1);
            %end;
            options firstobs=1 obs=max;
        %mend;
        %biasgen;

        proc sql noprint;
            update full
                set biasstd = bias/std;
            update full
                set biasstd = 0
                where bias = 0 or std = 0;
            update full
                set biasstdt = biasstd*sqrt(7)
                where individual = 1;
            update full
                set biasstdt = biasstd*sqrt(4)
                where sexecution = 1;
            update full
                set biasstdt = biasstd*sqrt(5)
                where ssynchro = 1;
        quit;


        proc sort data = full;
            by j8 j9 ctype diveno jno;
        run;
        proc sql noprint;
            create table ustemp.full
                as select *
                from full
                where nat and natj;
        quit;


%macro dummifyJ(var2dum, indata, outdata);
%put ********************************************;
%put *** generating numeric vars from strings ***;
%put *** numeric variables ordered by freq    ***;
%put ********************************************;
%put *** &var2dum 2 dummify ***;

%put *** backup copy of original data set ***;
options firstobs=1 obs=max;
proc sql noprint;
    create table &outdata as
        select * from &indata;
quit;

%put *** frequency count ***;
proc sort data=&outdata;
    by &var2dum;
run;
proc summary data=&outdata nway;
    class &var2dum;
    output out=temp;
run;
proc sort data=temp;
    by descending _freq_;
run;
```

```
proc sql;
      alter table &outdata
            add d&var2dum num;
quit;
proc sql noprint;
      select count(*) into :numvars
            from temp;
quit;
%put &numvars;

%let i = 1;
%do %while (&i <= &numvars);
      options firstobs=&i obs=&i;
            proc sql noprint;
                  select &var2dum into :val&i
                        from temp;
            quit;
      %put &&val&i;
      %put d&&val&i;
      options firstobs=1 obs=max;
            proc sql;
                  alter table &outdata
                        add dJ&&val&i num;
            quit;
            proc sql noprint;
                  update &outdata
                        set d&var2dum = %eval(&i-1)
                        where &var2dum = "&&val&i";
            quit;
            proc sql noprint;
                  update &outdata
                        set dJ&&val&i = 0;
                  update &outdata
                        set dJ&&val&i = 1
                        where &var2dum = "&&val&i";
            quit;
      %let i = %eval(&i + 1);
%end;

options firstobs=1 obs=max;

%mend;
%dummifyJ(natJ, ustemp.full, ustemp.full);



      %let filename = ustemp.full;
      data &filename;
            set &filename;
                  obsno + 1;
            do time=1 to &numall;
            end;
      run;
      data &filename;
            set &filename;
            drop time;
      run;

      proc sort
            data = &filename;
```

```
		by bias ctype synchro;
	run;
	data &filename;
		set &filename;
			biasno + 1;
		do time=1 to &numall;
		end;
	run;
	data &filename;
		set &filename;
		drop time;
	run;

	proc sort
		data = &filename;
		by biasstd ctype synchro;
	run;
	data &filename;
		set &filename;
			biasstdno + 1;
		do time=1 to &numall;
		end;
	run;
	data &filename;
		set &filename;
		drop time;
	run;


	proc sort
		data = &filename;
		by biasstdt ctype synchro;
	run;
	data &filename;
		set &filename;
			biasstdtno + 1;
		do time=1 to &numall;
		end;
	run;
	data &filename;
		set &filename;
		drop time;
	run;


	%put * excel output of data set;
	%let outdata = ustemp.full;
	%let sample = sample_nat;
	proc sql noprint;
		create table ustemp.&sample as
			select *
			from &outdata;
	quit;



proc sql noprint;
		create table sample_nat as select
			coalesce(s.Nat, d.Nat) as Nat, coalesce(s.NatJ, d.NatJ)
as NatJ, d.cDist,
```

```
                s.DD,       s.Dive,     dtype, s.First,   s.FirstJ,
        s.J1,       s.J2,
                s.J3,       s.J4,       s.J5,       s.J6,       s.J7,
        s.J8,       s.J9,       s.Last,     s.LastJ,
                s.avg,      s.avg9,     s.avg_indi,       s.avg_sexec,
        s.avg_ssync,
                s.bias,     s.biasno,   s.biasstd,  s.biasstdno,
        s.biasstdt,       s.ctype,    s.d10m,
                s.d1m,      s.d3m,      s.dJAUT,    s.dJBLR,    s.dJESP,
        s.dJFIN,    s.dJFRA,    s.dJGBR,
                s.dJGER,    s.dJGRE,    s.dJHUN,    s.dJITA,    s.dJNED,
        s.dJNOR,    s.dJRUS,
                s.dJSUI,    s.dJSWE,    s.dJUKR,    s.ddsq,     s.dfemale,
        s.divemax,  s.divemin,
                s.diveno,   s.dNat,     s.dnatJ,    s.dno,      s.female,
        s.id,       s.individual,
                s.jfemale,  s.jno,      s.male,     s.obsno,
        s.opposite,       s.panel,    s.sexecution,
                s.ssynchro,       s.std,      s.std9,     s.std_indi,
        s.std_sexec,      s.std_ssync,
                s.synchro,  s.var
            from ustemp.sample_nat s full join ustemp.cDist d
                on s.Nat = d.Nat and s.NatJ = d.NatJ;
quit;


proc sql noprint;
            create table ustemp.sample_nat as
                select *
                from sample_nat
                where dd and sexecution = 0;
quit;
%let dummy = 'e:\codes\diving\var2dum.sas';
%include &dummy;
%dummify(nat, ustemp.sample_nat, ustemp.sample_nat );

proc sql noprint;
      alter table ustemp.sample_nat
            add dnat_ordered num, dnatj_ordered num;
      update ustemp.sample_nat
            set dnat_ordered = dnat;
      update ustemp.sample_nat
            set dnatj_ordered = dnatj;
      update ustemp.sample_nat
            set dnat = 0;
      update ustemp.sample_nat
            set dnat = 1 where nat = natj;
quit;


proc sort
      data = ustemp.sample_nat;
      by cdist;
run;



proc sql noprint;
      alter table ustemp.sample_nat
            add ddistant num, dmedium num, dclose num, dcdistNA num;
      update ustemp.sample_nat set ddistant = 0;
```

```
	update ustemp.sample_nat set ddistant = 1
		where cdist le 500 and cdist ge 1;
	update ustemp.sample_nat set dmedium = 0;
	update ustemp.sample_nat set dmedium = 1
		where cdist le 700 and cdist ge 501;
	update ustemp.sample_nat set dclose = 0;
	update ustemp.sample_nat set dclose = 1
		where cdist le 999 and cdist ge 701;
	update ustemp.sample_nat set dcdistNA = 1;
	update ustemp.sample_nat set dcdistNA = 0
		where cdist;
quit;



%let sample = sample_nat;
proc sql noprint;
	alter table ustemp.&sample
		add divetype char;
	update ustemp.&sample
		set divetype = "front"
		where dtype like '1%';
	update ustemp.&sample
		set divetype = "back"
		where dtype like '2%';
	update ustemp.&sample
		set divetype = "reverse"
		where dtype like '3%';
	update ustemp.&sample
		set divetype = "inward"
		where dtype like '4%';
	update ustemp.&sample
		set divetype = "twisting"
		where dtype like '5%';
	update ustemp.&sample
		set divetype = "armstand"
		where dtype like '6%';
quit;
%dummify(divetype, ustemp.&sample, ustemp.&sample);



proc sql noprint;
	alter table ustemp.&sample
		add d1 num, d2 num, d3 num, d4 num, d5 num, d6 num;
	update ustemp.&sample set d1 = 0;
	update ustemp.&sample set d1 = 1 where dno = 1;
	update ustemp.&sample set d2 = 0;
	update ustemp.&sample set d2 = 1 where dno = 2;
	update ustemp.&sample set d3 = 0;
	update ustemp.&sample set d3 = 1 where dno = 3;
	update ustemp.&sample set d4 = 0;
	update ustemp.&sample set d4 = 1 where dno = 4;
	update ustemp.&sample set d5 = 0;
	update ustemp.&sample set d5 = 1 where dno = 5;
	update ustemp.&sample set d6 = 0;
	update ustemp.&sample set d6 = 1 where dno = 6;
quit;


	%let filename = ustemp.sample_nat;
```

```
      proc sql noprint;
            alter table &filename
                  add ordered num;
            update &filename
                  set ordered = 0;
            update &filename
                  set ordered = -1
                  where biasstdt le -2.365 and individual = 1;
            update &filename
                  set ordered = 1
                  where biasstdt ge 2.365 and individual = 1;
            update &filename
                  set ordered = -1
                  where biasstdt le -2.571 and ssynchro = 1;
            update &filename
                  set ordered = 1
                  where biasstdt ge 2.571 and ssynchro = 1;
            update &filename
                  set ordered = -1
                  where biasstdt le -2.776 and sexecution = 1;
            update &filename
                  set ordered = 1
                  where biasstdt ge 2.776 and sexecution = 1;
      quit;


proc sql noprint;
      alter table &filename
            drop somersault;
quit;
proc sql noprint;
            alter table &filename
                  add bias_integer num, bias_round num, somersault char;
            update &filename
                  set bias_integer = int(2*bias);
            update &filename
                  set bias_round = round(2*bias, 1);
            update &filename set somersault = '0';
            update &filename set somersault = substr(dive, 3, 1);
quit;


proc sql noprint;
      alter table  ustemp.sample_nat
            add natjnat char(6);
      update  ustemp.sample_nat
            set natjnat = compress(natJ||nat);
quit;
*%dummify(natjnat, ustemp.sample_nat, ustemp.sample_nat );



      %let sample = sample_nat;
      %let dataset = sample_nat;
      %let outdata = &sample;
      %let data2sum1 = ustemp.&sample;
      %let data2sum2 = ustemp.&sample;
      %let libname = e:/data/diving/ustemp/;

      %put * report about the full data set;
```

```
%include 'e:/codes/diving/summary.sas';
%include 'e:/codes/diving/output.sas';


      proc contents
            data = ustemp.&sample
            out = ustemp.toc_&sample;
      run;
      %let xlname = toc_&sample;
      proc export data = ustemp.toc_&sample
            outfile = "&libname&xlname..xls"
            dbms = tab replace;
      run;



      * excel output of data set;
      %put * excel output of data set;
      %let libname = e:/data/diving/ustemp/;
      %let sample = sample_nat;
      %let filename = ustemp.sample_nat;
      proc export data = &filename
            outfile = "&libname&sample..xls"
            dbms = excel replace;
      run;



proc sql noprint;
            create table ustemp.sample_cdist as
                  select      *
                  from ustemp.sample_nat
                  where cdist;
quit;





      %let filename = ustemp.sample_cdist;
      proc sort
            data = &filename;
            by cdist ctype synchro;
      run;
      data &filename;
            set &filename;
                  cdistno + 1;
            do time=1 to &numall;
            end;
      run;
      data &filename;
            set &filename;
            drop time;
      run;






      * excel output of data set;
```

```
      %put * excel output of data set;
      %let libname = e:/data/diving/ustemp/;
      %let sample = sample_cdist;
      %let filename = ustemp.sample_cdist;
      proc export data = &filename
            outfile = "&libname&sample..xls"
            dbms = excel replace;
      run;



%put * report about the full data set;
      %let dataset = sample_cdist;
      %let outdata = &sample;
      %let data2sum1 = ustemp.&sample;
      %let data2sum2 = ustemp.&sample;
      %let libname = e:/data/diving/ustemp/;


%include 'e:/codes/diving/summary.sas';
%include 'e:/codes/diving/output.sas';


      proc contents
            data = ustemp.&sample
            out = ustemp.toc_&sample;
      run;
      %let xlname = toc_&sample;
      proc export data = ustemp.toc_&sample
            outfile = "&libname&xlname..xls"
            dbms = excel replace;
      run;
```

XIII. Reference List

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XIV. Endnotes

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[1] See the webpage of LEN at http://www.lenweb.org/

[2] See http://www.fina.org/rules/english/diving.php

[3] International Olympic Comittee, Official website of the Olympic Movement. http://www.olympic.org

[4] The diving rules are discussed in details on the following websites: Ligue Européenne de Natation (LEN) http://www.lenweb.org/ Fédération Internationale de Natation (FINA) http://www.fina.org/rules/ and International Olympic Comittee, Official website of the Olympic Movement http://www.olympic.org

[5] Omega Timing http://omegatiming.com/diving/

[6] E.g. the International Olympic Comittee at http://www.olympic.org, the Australian Olympic Comittee at http://www.olympics.com.au etc. Basically all relevant international aquatics organizations assume this date. An exception is the paper written by Benjamin D. Rubin in 1999. See referenc list for details.

[7] Roberto Mussapi's article 'Inferni, mari, isole' is available in Italian at http://www.griseldaonline.it/percorsi/archivio/mussapi.htm

[8] The details of the rules and regulations are available at http://www.lenweb.org

[9] No semi-final session takes place in the synchro events and in the 10 meter platform events in the European Championships.

[10] For further details see regulations of the Fédération Internationale de Natation

[11] Categories are taken from FINA (2005, D 8.1.1)

[12] http://linguistics.berkeley.edu/~kjohnson/quantitative/CD/

[13] All specifications contain a constant. One, two and three stars denote the significance at 10 percent, 5 percent and 1 percent levels, respectively.