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Binary Logistic Regression of the Gulf of Cadiz Fishing Fleet

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1. Introduction and Objectives

Small scale coastal fleet, namely artisanal fleet, plays an important role in the social fabric and the cultural identity of many of Europe's coastal regions[1]. Therefore it is important to define a classification criteria based upon technical, socio-economic and cultural indicators in order to identify the vessels included in this fleet against European industrial fleet. Moreover, it is important the availability of scientific tools that allow classifying a vessel into artisanal or industrial ones scientific experts have agreed a matrix of criteria indicators which European Union's fleets are artisanal.

The aims of this paper is building a multivariate relation of the dependence between the classification of the fleet attained through a scores-based classification system and the criteria indicators proposed for classification purposes by scientific expertise in the Gulf of Cadiz area. The multivariate analysis technique that is used for this aim is binary logistic regression analysis.

This paper begins describing the materials and methods used in order to get the aforementioned aim. A concise description of the data used together with the main characteristics of binary logistic regression will be done at this point. Then the results attained from the binary logistic regression are shown in the Results section and finally, the main conclusions reached are summarized.

2. Material and Methods

This paper covers data on the whole fleet of the South Atlantic Spanish fishing area (Figure 1). The data used in this paper were provided by IFAPA and consists of the technical characteristics of vessels attained from the Spanish Census of Fishing Fleet, its crew size attained from the Spanish labor authorities, and its capture in 2009 from ID@PES data base.

[1] EC (2009): Green Paper. Reform of Common Fisheries Policy. COM(2009)163 final.

Figure 1. Gulf of Cádiz

The aforementioned data are completed with PRESPO expertise classification of the fleet into artisanal and industrial vessels provided by IFAPA based upon a score based system described in Castilla & García (2010). Table 1 summarized the main characteristics of the vessels distinguishing between artisanal and industrial vessels.

Table 1. Descriptive Statistics of Gulf of Cádiz Fishing Fleet

	GT		Overall length		Engine power		CPUE	
	Mean	variance	Mean	variance	Mean	variance	Mean	variance
Artisanal	3.83	6.31	8.34	6.13	37.04	582.85	117.28	57982.6
Industrial	24.67	260.14	16.87	12.56	182.47	8915.15	676.58	1366095

This paper used limited dependent regression models, specifically Binary Logistic Regression in order to get its aims (Agresti, 2002; Hosmer & Lemeshow, 2000; Silva & Barroso, 2004). This method is a multivariate analysis technique that studies the dependence of non-metric variables form a set of independent metric and/or non-metric variables in order to handle responses that are dichotomous. Specifically, the dependent variables will represent the classification of a vessel into artisanal and industrial; while the independent variable is a matrix of criteria indicators used to classify the fleet.

3. Results

An automatic estimation procedure based upon the change of the loglikelihood ratio criteria was applied in order to choose the Binary Logistic Regression that identifies the set of criteria indicators that explains better the classification of vessels attained through the PRESPO score based

classification system. The output variable of the aforementioned model was a dichotomous response variable that takes 0 value for artisanal vessels and 1 value for industrial vessels, while the input variables were three score non-metric variables related to number of licenses hold (licenses), the crew size and the fishing gear of the vessels (Table 2) and four metric variables related to the capital and the targeted stock (Table 3).

Table 2. Score non-metric variables of the model

Criteria indicator	Score				
	1	2	3	4	5
Licenses	<2	[2,4[	[4,6[	[6,8[	>8
Crew	Static		seines		Towed
Gear	≥5	[4,5[	[3,4[	[2,3[	<2

Table 3. Metric variables of the model

Item	Variable	Indicator
Capital	Length	Overall length (m)
	Engine power	Main engine power (Kw)
	Tonnage	Gross tonnage (GT)
Stocks	CPUE	Mean capture/landing (Kg)

The final model chosen following this procedure includes in the independent variables set the following for the Gulf of Cadiz fishing fleet: Gear, Tonnage, Engine power and CPUE. These are the variables that explain better, more than the 98.5% of the variance according Nagelkerke, the PRESPO score based classification system of the fishing fleet. Table 4 show the estimation output of the chosen model where all the variables but Gear in the case of Seines as expected are significant at 5% level according Wald test.

Table 4. Estimation output of the Binary Logistic Regression

	B	E.T.	Wald	gl	Sig.	Exp(B)
Intercept	-11,08	2,89	14,74	1,00	0,00	0,00
Towed			17,27	2,00	0,00	
Static	-11,26	2,71	17,27	1,00	0,00	0,00
Seines	38,58	138188307,60	0,00	1,00	1,00	57047204606760872,00
Tonnage	1,07	0,32	11,43	1,00	0,00	2,92
Engine power	0,05	0,02	6,52	1,00	0,01	1,06
CPUE	0,01	0,00	11,24	1,00	0,00	1,01

4. Conclusions

A Binary Logistic Regression has been estimated in order to provide a scientific method to classify vessels into artisanal and industrial according PRESPO score based classification system of the European Fishing Fleet. The matrix of indicators that explains better PRESPO classification of Gulf of Cadiz fleet are the type of gear, the tonnage, the engine power and CPUE. The forecast classification attained by this model coincides with the score based classification system in more than the 99% of the cases (Table 5).

Table 5. Classification table

Observed	Forecast		
	Classification		Right percentage
	Artisanal	Industrial	
Artisanal	300	1	99.7
Industrial	3	326	99.1
Global percentage			99.4

Further research attempts can be done in order to accommodate polytomous responses using multinomial logistic regression models in order to allow the classification of the fleet into small scale, coastal and industrial vessels.

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