Tropical and Subtropical Agroecosystems, 11 (2009): 91 - 94

Tropical and Subtropical Agroecosystems

NOTA CORTA [SHORT NOTE]

QUALITATIVE ANALYSIS OF OFFICIAL MILK CONTROL IN VALENCIA COMMUNITY (SPAIN) BY SELF ORGANIZING MAPS

[ANÁLISIS CUALITATIVO DEL CONTROL LECHERO EN LA COMUNIDAD VALENCIANA (ESPAÑA) MEDIANTE MAPAS AUTO-ORGANIZADOS]

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SUMMARY

Breeding programs in dairy goats are mainly based on milk production and composition. Murciano-Granadina goats are located principally in the central and southern regions of Spain. This study is focused in Valencia Community (Spain) and the objective is to study the Murciano-Granadina livestock based on the database from Murciano-Granadina Goat Breeders Association of Valencia (AMURVAL). The aim of this study is to analyze the relationship among different variables related with milk production; milk yield, fat, protein, lactose, SCC, the number of births, lactation number and season. This analysis is carried out by using the Self Organizing Map. This tool allows mapping high-dimensional input spaces into much lower-dimensional spaces, thus making much more straightforward to understand any representation of data. These representations enable to visually extract qualitative relationships among variables (*Visual Data Mining*). A total of 3221 Murciano-Granadina dairy goats from AMURVAL were chosen. Self Organizing Maps (SOM) were used to analyze data with the system identification toolbox of MATLAB v7. Data were obtained from Official Milk Control during 2006 campaign. SOM considered in this study is formed by 21×14 neurons (294 neurons); the chosen architecture is given by the range of the input variables used. The map shown that more than 70% of the goats has milk yield greater than 300 kg per lactation and goat, indicating good performance of farms. Besides, the SOM obtained indicate a group of neurons that included goats with high SSC (2%). The use of Self Organizing Maps in the descriptive analysis of this kind of data sets has proven to be highly valuable in extracting qualitative conclusions and guiding in improving the performance of farms.

Keywords: dairy goats, milk control, self organizing maps

INTRODUCTION

Goat production is located principally in the central and southern regions in Spain. According to Falagán et al. (1995) approximately 20% of the national goat livestock consists of Murciano-Granadina goats. Murciano-Granadina goats are well adapted to the Mediterranean climate characterised by semiarid conditions with low rainfall and high temperatures. Breeding programs are based primarily on milk yield and milk composition (Analla et al. 1996). Most Murciano-Granadina goats are machine milked once a day and official milk records for the Herd Book are obtained during lactation. Farmers' income comes from milk production and composition, and the accurate measurement or prediction of milk yield (MY) is essential to their economy (Oregui and Falagán, 2005). Moreover, not only accurate prediction is desired. It is interesting to determine and to evaluate the most important factors that can affect the flock and their relationships. In this study we are going to focus on the variables obtained by the Official Milk Control.

Artificial Neural networks (ANNs) have been applied to a huge amount of fields during last year's (Arbib, 2003; Hu, 2003). However, there are some fields in which the use of ANNs is still scarce; animal science is one of these fields. Self-Organizing Map (SOM) (Kohonen, 1997), a neural network that allows qualitative information extraction, was used in order to obtain a straight forward and visual representation of the relationships among different variables of study.

MATERIAL AND METHODS

Data base. This study is focused in Valencia Community (Spain) and the objective is to study the Murciano-Granadina livestock based on the database from Murciano-Granadina Goat Breeders Association of Valencia (AMURVAL). The aim of this study is to

analyze the relationship among different variables related with milk production; milk yield, fat, protein, lactose, SCC, the number of births, lactation number and parity season. A total of 3221 Murciano-Granadina dairy goats from AMURVAL were chosen. Data were obtained from Official Milk Control during 2006 campaign.

Self Organizing Maps. Artificial Neural Networks (ANN) are mathematical models which can find non-linear relationships between two data sets (Ripley, 1996). Grzesiak *et al.* (2003) used ANN to predict 305 days Milk Yield (MY) based on MY of the first 4 test days; Fernández *et al.*, (2005; 2006) used ANN to study dairy management practices in dairy goat farms.
Data were analyzed using a neural network, the so-called Self-Organizing Map, SOM (Kohonen, 1997). This network is formed by elementary units, neurons, in a bi-dimensional network. In our study, these neurons represent different goats after the training process is carried out. The goal of this neural network is to find out intrinsic relationships among data; these relationships enable to cluster data in similar groups. It allows a visual representation of the relationships among the discriminating variables of the study. In order to achieve this visual representation, input data is mapped into a two-dimensional representation, in which relationships are clearly shown. Mapping preserves topological relationships among data, that is, if two goats show a similar behavior (in terms of availability of MY or fat percentage, for instance), then they will appear close each other in the two-dimensional map. Finally, a distance criterion is used in order to obtain the clusters within the two-dimensional map.

Data analysis. Once the map training is finished, the visualization of the two-dimensional map provides qualitative information about how the input variables are interrelated each other for the data set used to train the map. SOM is a visualization tool that were developed in MATLAB environment (Matlab 7.0, Mathworks, Inc. 2003).

RESULTS AND DISCUSSION

SOM considered in this study is formed by 21×14 neurons (294 neurons); the chosen architecture is given by the range of the input variables used. Each neuron is represented by a vector, which consists of a number of components fixed by the number of variables taken to each goat. The different components or variables are shown in Figure 1, each component or variable has 294 neurons. Each neuron could include zero, one, two or more goats and those neurons which include one or more goats are called "winner neurons", that means that these neurons are prototypes and represent the characteristics of a goat or group of goats.
Each goat is allocated in a certain place of the two-dimensional map (Figure 1). Since this mapping preserves topological relationships, goats that appear close to each other in the SOM, are indeed similar in the original input space. This visual representation allows determining main groups of goats with similar characteristics.

Figure 1 represents the map SOM for the 10 variables or components taken into account in this study. By using a grey-scale, light or dark zones on the map correspond with high or low values or situation respectively. First component studied is the *Number of Lactation*, the average value is 2±1.63 and the range goes between 1 and 11, only 5% of the goats have a parity number between 8 and 11 (this area is shown in the center of the map with light color). The *Litter Size* average is 2±0.63 and is showed in most of the map with light color, right and down of this variable locate goats with litter size 1 (dark color). The *Standard Milk Yield* has an average value of 411±163.46 kg per goat and lactation. The minimum value obtained was 75 kg per lactation and goat (upper and dark area of the map) and a 20% of goats have MY higher than 500 kg (light zone in the center-down area of the map). Next components expressed in percentage were *Fat* (5±0.77), *Protein* (3±0.37), *Dry Matter* (14±7.49) and *Lactose* (5±0.29), and all of them are into the Murciano-Granadina standard (Oregui and Falagán, 2005). Only was observed a 7-10% of the goats with higher values for fat and protein (upper-right area of the map), and these extreme values were associated with less MY. *SCC* was other component studied and the average value was of 897 x 10^3 cells/mL, although SOM detected a 2% of goat with values greater than 4600 (small light area down-left). *Parity Season* were distributed around the year, more numbers of birth were obtained in spring and autumn versus winter and summer.

Daza (2004) calculated the break event point in Murciano-Granadina farms under different Spanish livestock scenarios, assuming different fixed and variable cost. The average *Break event Point* obtained was 315 kg of standard milk per lactation and goat. In our AMURVAL database was observed that more of 70% of the goats has higher values (light shade of the map) than the Daza study's, indicating that level of performance at Valencia Community Murciano-Granadina livestock are according with the sustainability productivity based on Daza (2004) study. Similar tendency was observed by Castel et al. (2003) and Mena et al. (2005) in the South East of Spain (Andalusia) with Malagueña breed, and with Murciano-Granadina breed in Murcia Region by Fernández et al. (2007)

CONCLUSION

The use of Self Organizing Maps in the descriptive analysis of this kind of data sets has proven to be highly valuable in extracting qualitative conclusions and guiding in improving the performance of goats.

ACKNOWLEDGMENTS

This work was funded by Generalitat Valenciana in cooperation with Murciano-Granadina Goat Breeders Association of Valencia (AMURVAL).

REFERENCES

Analla, M., Jiménez-Gamero, I., Muñoz-Serrano, A., Serradilla, J. M., Falagán., A., 1996. Estimation of genetic parameters for milk yield and fat and protein contents of milk from Murciano-Granadina goats. J. Dairy Sci 79, 1895-1998.

Arbib, M. (2003). The Handbook of Brain Theory and Neural Networks, MIT Press.

Castel, J.M., Mena, Y., Delgado-Pertiñez, M., Carmuñez, J., Basalto, J., Caravaca, F., Guzmán Guerrero, J.L., Alcalde, M.J.2003. Charactarization of semi-extensive goat production systems in southern Spain. Small Rum. Res. 47, 133-143.

Daza, 2004. Gestión técnico económica. In: Ganado Caprino: Producción, Nutrición y Sanidad. Capitulo 15. Ed. Agricola Española. 293-312.

Falagán A., Guerrero, J. E., Serrano, A., 1995. Systèmes d'elevage caprin dans le sud de l'Espagne. Pages 38-50 in Proc. Goat production systems in the Mediterranean. EAAP Publication Nº 71. Wageningen, The Netherlands: Wageningen Pers.

Hu, Y.H., Hwang, J.N., Hwang, J.N. (2003) Handbook of Neural Network Signal Processing. Academic Press.

Ripley, B.D. (1996) Pattern Recognition and Neural Networks, Cambridge University Press.

Fernández C., Soria E., Magdalena R., Martín J.D., Navarro M.J., Sánchez-Seiquer P. 2005. Mapas autoorganizados en el manejo de explotaciones de Pequeños Rumiantes. Ganadería. 35, 48-52

Fernández C., Soria E., Martín J.D., Serrano A.J. 2006. Neural network for animal science applications; two case studies. Expert Sys. Applications. 31, 444-450.

Fernández C., Soria E., Magdalena R., Martin J.D., Mata C. 2007. Qualitative analysis of feed management prectice on goat herds by self organizing maps in Murcia Region of Spain. J. Appl. Anim. Res. 32, 41-47.

Grzesiak W., Lacroix R., Wojcik J., Blaszcyk P. 2003. A comparison of neural network and multiple regression predictions for 305-day lactation yield using partial lactation records. Can. J. Anim. Sci. 83, 307-310.

Kohonen T. 1997. Self-Organizing Maps. Springer Verlag. 521pp

MATLAB v7. The Mathworks Incorporation. 2003. .SOM Toolbox for Matlab 5.

Mena Y., Castel J.M., Caravaca F.P., Guzmán J.L., González P. 2005. Situación actual, evolución y diagnóstico de los sistemas semiextensivos de producción caprina en Andalucía Centro-Occidental. Junta de Andalucia. Consejería de Agricultura y Pesca. 222pp.

Oregui L.M., Falagán A. 2005. Specfite et diversite des systemes de productions ovine et caprine dans le basin mediterraneenne. 5th Seminar : Technico-Economic analysis of the sheep and goat production system : methodology and appraisal for development and prospects. FAO-CIHEAM network for sheep and goats. Sevilla. Spain

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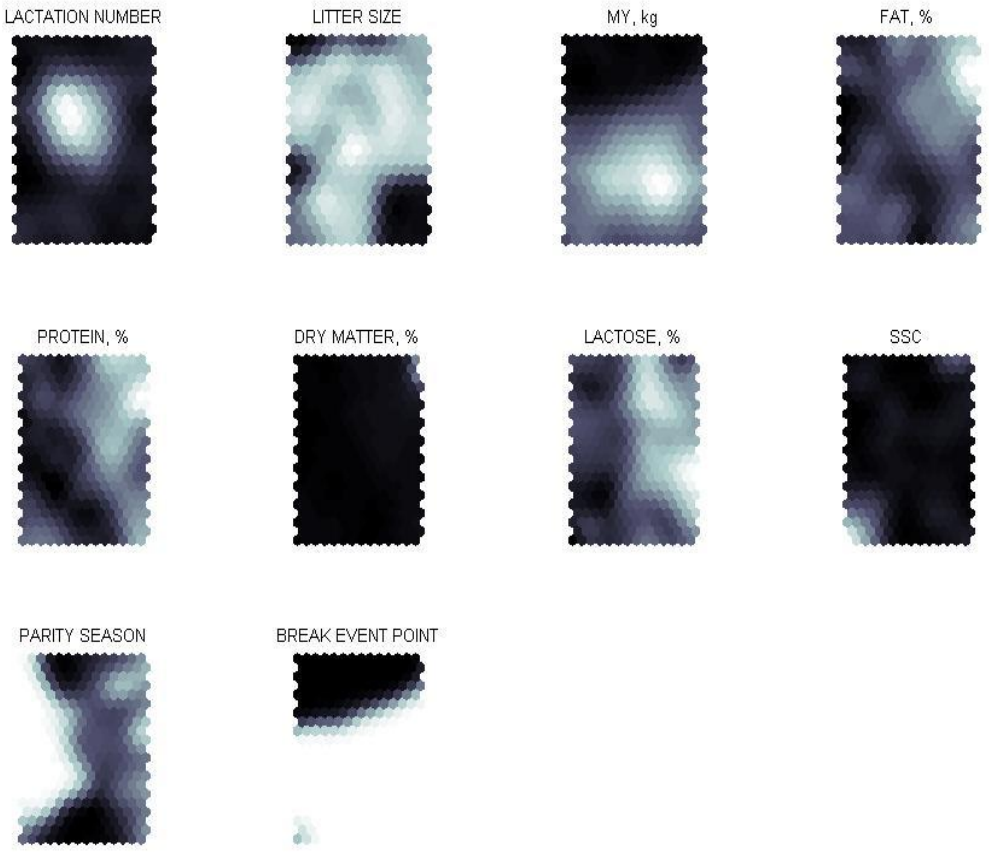

Figure 1. Self Organizing Map (SOM) representation for the 10 variables considered. Light/dark zones correspond with high/low values. Each hexagon represent a neuron and the number of neurons (294) is located in the same position independent of the variable or component studied

Submitted June 30, 2008 – Accepted May 08, 2009