ISSN 1313 - 8820
Volume 7, Number 2
June 2015

AGRICULTURAL SCIENCE AND TECHNOLOGY

2015

An International Journal Published by Faculty of Agriculture,
Trakia University, Stara Zagora, Bulgaria

Scope and policy of the journal

Agricultural Science and Technology /AST/ – an International Scientific Journal of Agricultural and Technology Sciences is published in English in one volume of 4 issues per year, as a printed journal and in electronic form. The policy of the journal is to publish original papers, reviews and short communications covering the aspects of agriculture related with life sciences and modern technologies. It will offer opportunities to address the global needs relating to food and environment, health, exploit the technology to provide innovative products and sustainable development. Papers will be considered in aspects of both fundamental and applied science in the areas of Genetics and Breeding, Nutrition and Physiology, Production Systems, Agriculture and Environment and Product Quality and Safety. Other categories closely related to the above topics could be considered by the editors. The detailed information of the journal is available at the website. Proceedings of scientific meetings and conference reports will be considered for special issues.

Submission of Manuscripts

All manuscripts written in English should be submitted as MS-Word file attachments via e-mail to <u>editoffice@agriscitech.eu</u>. Manuscripts must be prepared strictly in accordance with the detailed instructions for authors at the website <u>www.agriscitech.eu</u> and the instructions on the last page of the journal. For each manuscript the signatures of all authors are needed confirming their consent to publish it and to nominate on author for correspondence.

They have to be presented by a submission letter signed by all authors. The form of the submission letter is available upon from request from the Technical Assistance or could be downloaded from the website of the journal. Manuscripts submitted to this journal are considered if they have submitted only to it, they have not been published already, nor are they under consideration for publication in press elsewhere. All manuscripts are subject to editorial review and the editors reserve the right to improve style and return the paper for rewriting to the authors, if necessary. The editorial board reserves rights to reject manuscripts based on priorities and space availability in the journal.

The journal is committed to respect high standards of ethics in the editing and reviewing process and malpractice statement. Commitments of authors related to authorship are also very important for a high standard of ethics and publishing. We follow closely the Committee on Publication Ethics (COPE), <u>http://publicationethics.org/resources/guidelines</u>

The articles appearing in this journal are indexed and abstracted in: EBSCO Publishing, Inc. and AGRIS (FAO).

The journal is accepted to be indexed with the support of a project № BG051PO001-3.3.05-0001 "Science and business" financed by Operational Programme "Human Resources Development" of EU. The title has been suggested to be included in SCOPUS (Elsevier) and Electronic Journals Submission Form (Thomson Reuters).

Address of Editorial office:
Agricultural Science and Technology
Faculty of Agriculture, Trakia University
Student's campus, 6000 Stara Zagora
Bulgaria
Telephone.: +359 42 699330
+359 42 699446
<u>www.agriscitech.eu</u>

Technical Assistance:
Nely Tsvetanova
Telephone.: +359 42 699446
E-mail: <u>editoffice@agriscitech.eu</u>

ISSN 1313 - 8820

Volume 7, Number 2
June 2015

AGRICULTURAL SCIENCE AND TECHNOLOGY

2015

An International Journal Published by Faculty of Agriculture,
Trakia University, Stara Zagora, Bulgaria

Classification and regression tree analysis in modeling the milk yield and conformation traits for Holstein cows in Bulgaria

A.Yordanova[1]*, S. Gocheva-Ilieva[1], H. Kulina[1], L. Yordanova[2], I. Marinov[3]

[1]Department of Applied Mathematics and Modeling, Faculty of Mathematics and Informatics, Plovdiv University Paisii Hilendarski, 24 Tzar Asen, 4000 Plovdiv, Bulgaria
[2]Department of Mathematics and Informatics, Faculty of Economics, Trakia University, 6000 Stara Zagora, Bulgaria
[3]Department of Animal Science – Ruminants and Dairy Farming, Faculty of Agriculture, Trakia University, 6000 Stara Zagora, Bulgaria

Abstract. *In the field of livestock breeding the investigation of the factors that influence to the highest degree the efficiency (e.g. milk yield) is essential for determining the conditions for the improvement of the overall production results. To extract relevant information from the data the appropriate mathematical methods are very useful. The aim of this work is to demonstrate the capabilities of the method of Classification and regression trees (CART) for statistical data processing including data of ordinal and nominal type. For a sample of 97 observations of cattle from 4 farms in Bulgaria, two decision trees are built for studying dependence of the 305 days milk yield for Holshte in cows with respect to 13 independent variables – 12 conformation traits and farm. The model with 12 independent variables for conformation traits describes 48% of the data and identifies the main factors for quantities of milk – udder width, locomotion, stature and chest width with normalized importance 100%, 48.1%, 41.2% and 39%, respectively. The second model includes the farm where the cattle are reared as 13th independent variable and this expanded model accounts for 70% of the data. Following the obtained rules for both models, predictions for new data could be made before end of lactations.*

Keywords: CART method, decision tree, Holstein cows, conformation traits, milk yield

Introduction

The increasing of farm animal productivity in quality and quantity is a main goal of the selection researches and breeding programs. Scientific studies and practical results show that one-sided selection of productive qualities negatively affects the animal health status and their longevity(Pryce et al., 1998; Roxström et al.,2001; Berry et al., 2003; Krupa et al., 2005; Bouška et al., 2006).Contemporary breeding programs regard as important the conformation trait status, their changes and the constitution of the animals. This is endorsed by the EU Member States and reflects the specific qualities of the reared breeds and specifies the information that must be obtained and used for making selection decisions. Numerous statistical and mathematical methods are included in this process to define the relationship and interactions between productive and reproductive traits with conformation ones relevant to a more precise evaluation of the animals (Berry et al., 2004).

The World Holstein Frisian federation (WHFF, 2015) is responsible for the organization and control of the breeding value evaluation of this breed. It has reached the greatest level of standardization in the evaluation of farm animals by the conformation traits in cattle. The established system is recommended for linear type traits as each of them is transformed to an ordinal type by a 9-point scale. Genetic and phenotype breeding value evaluation of farmed animals is based on the implementation of different multivariate techniques, mixed linear or other type statistical methods. Pantelic et al. (2010) and Nemcova et al. (2011) present such kinds of models that include conformation traits for Holstein breed. There are studies which rely on factor analysis to determine the relations between productive and conformation traits (Kern et al., 2014). The most commonly used method for determining the interactions between the observed traits is based on the Least Square method where the object of investigation is the change of a dependent variable with respect to one or more independent variables.

The main assumption of the above methods is the dependent variable to have normal distribution which is not always respected. In this case an appropriate one is the method of Classification and regression Trees (CART). In the field of animal science this method is not popular enough despite its advantages in studies of interactions for variables from continuous, nominal and ordinal type (Topal et al., 2010).

The advantages of CART could be summarized as follows (Breiman et al., 1984):

- The method is non parametric and it makes no assumption about the type of distribution of the dependent variable. In fact, the tree itself can be considered as a kind of multi-dimensional distribution of the data;
- It is successful in case of missing data of important predicators;
- The method performs well with both small and large data sets;
- The retrieved results are easy to interpret.

The aim of this study is to demonstrate the capabilities of the CART method for statistical data processing for Holstein cows in Bulgaria. The study includes processing of data of ordinal and nominal type presenting conformation and productive traits for a sample of the breed and farms of livestock.

Material and methods

Data description

Data from lactations of 97 Holstein cows, collected in the period

* e-mail: tonyjordanoff@gmail.com

2013 – 2014 from 4 farms situated in different regions in Bulgaria is used in the study. The number of the cows by farms is the following: farm 1 has 38 cows, farm 2 – 16, farm 3 – 18 and farm 5 – 25. 12 linear type traits are measured and evaluated according to ICAR International Agreement of Recording Practices for conformation traits from 2013. The data includes also a productive trait – 305 days milk yield, which we will regard as dependent on conformation traits. Animals are covered from first to third lactation. Linear type traits are characteristics of separate parts of the body of dairy cows. The form and development of these traits have impact on cows' productivity, their health status as well as their longevity. They are described individually and as a degree or level of their manifestation. For the linear traits description a nine degrees scale is applied and for them 1 and 9 scores stay for the biological extremes of a cow. The traits are divided in two groups according to the way of their presenting – traits, which are described through degree of developing and traits which have two opposite disadvantages. For the first group minimum degree of development is given by 1 and maximum by 9. The second group has the ideal form with degrees around 5 scores, 1 and 9 scores represent two extreme variants which are not desired for the practice. In the analysis these data are transformed to a 1 – 5 scale. For the end evaluation of an individual animal (cow) for conformation traits four groups of linear type traits are formed. The groups follow the functional features: general view, milk characteristics, legs and foots, and udder. This means that an analysis of the relationships between linear type traits inside the groups and between groups can determine the optimal set of linear type traits for conformation evaluation. The description of the variables used in the study is given in Table 1.

Method of CART

CART is a powerful non parametric modeling technique, first proposed by Breimen et al. (1984). It finds large application in many areas, including agricultural and veterinary sciences (Cak et al., 2013; Eyduran et al., 2013 and the references provided). CART method is capable to classify and predict values of a given dependent variable Y by identifying the main patterns into the set of independent variables. For binary classification problems, the dependent variable is binary-valued, whereas for regression problems it is of continuous or interval type. The independent variables could be of nominal, ordinal or continuous type. The CART is based on a recursive partitioning algorithm, a step-by-step procedure to construct a decision binary tree by either splitting or not splitting each node on the tree into two child nodes. In a regression problem, a predicted value is simply the mean value of the cases in every terminal node (leaf) of the decision tree. At each step, one independent variable, say X_k and its appropriate threshold value e.g. θ_k are determined, which minimizes the mean squared error from all variables and all threshold values. The splitting rule has the form $x_{ki}<\theta_k$ for all cases of with two possible answers "yes" or "no". This way, the input space of the independent variables is partitioned into non-overlapping 2D rectangular or hyper cuboid (multi-dimensional) regions. A decision tree is a flow chart representing a classification and regression predictive model for the dependent variable. All initial cases are distributed in this partition, i.e. into terminal nodes of the decision tree. IBM SPSS statistical software was used for building the models and other computations.

Results and discussion

Building the decision tree for the conformation evaluation of Holstein cows

The CART technique was applied for some initially given specifications. They were selected to stabilize the model patterns and to avoid the model complexity. The model summary of the constructed CART model is shown in Table 2.

The resulting decision tree is shown in Figure 1. In the beginning, all the initial 97 cases (observations) are placed in a root node 0 of the tree. Their mean value is 7583 kg per 305 day period. These cases are first splitted for variable UdderW (udder width) into two groups: those with values of UdderW smaller or equal to 7.5, and those with values for UdderW bigger than 7.5. In the left splitting node 1 there are 75 cases with a predicted (i.e. mean) value for MilkY305 of 6968 kg. In the right node 2 are classified 22 cases with the UdderW values greater than 7.5 and their predicted value for MilkY305 is 9680 kg. Node 2 is a terminal node. It is no more split into child nodes because of the selected limiting specifications (Table 2). For each splitting variable in the decision tree the improvement part

Table 1. Description of the variables used in the analysis

Variable	Variable name	Type	Measure
305 days milk yield	MilkY305	Scale	kg
Stature	Stature	Ordinal	1-9 scale
Chest width	ChestW	Ordinal	1-9
Rump width	RumpW	Ordinal	1-9
Rear legs rear view	RLRV	Ordinal	1-9
Rear leg set (side view)	RLSW	Ordinal	1-5, transformed
Hock development	HockD	Ordinal	1-9
Bone structure	Bone	Ordinal	1-9
Foot angle	FootA	Ordinal	1-5, transformed
Foot depth	FootD	Ordinal	1-9
Udder width	UdderW	Ordinal	1-9
Locomotion	Locomotion	Ordinal	1-9
Lameness	Lameness	Ordinal	1-9
Location	FarmN	Nominal	Farm number: 1, 2, 3 and 5

Table 2. Model summary for the dependence of 305 days milk yield of Holstein cows with respect to 12 conformation traits

Specifications	Growing Method	CART
	Dependent Variable	MilkY305
	Independent Variables	Stature, ChestW, RumpW, RLRV, RLSW, HockD, Bone, FootA, FootD, UdderW, Locomotion, Lameness
	Validation	None
	Maximum Tree Depth	5
	Minimum Cases in Parent Node	20
	Minimum Cases in Child Node	10
	Independent Variables Included	UdderW, Stature, HockD, ChestW, Locomotion, RLRV, Bone, Lameness, RumpW, FootD, RLSW
Results	Number of Nodes	9
	Number of Terminal Nodes	5
	Depth	3

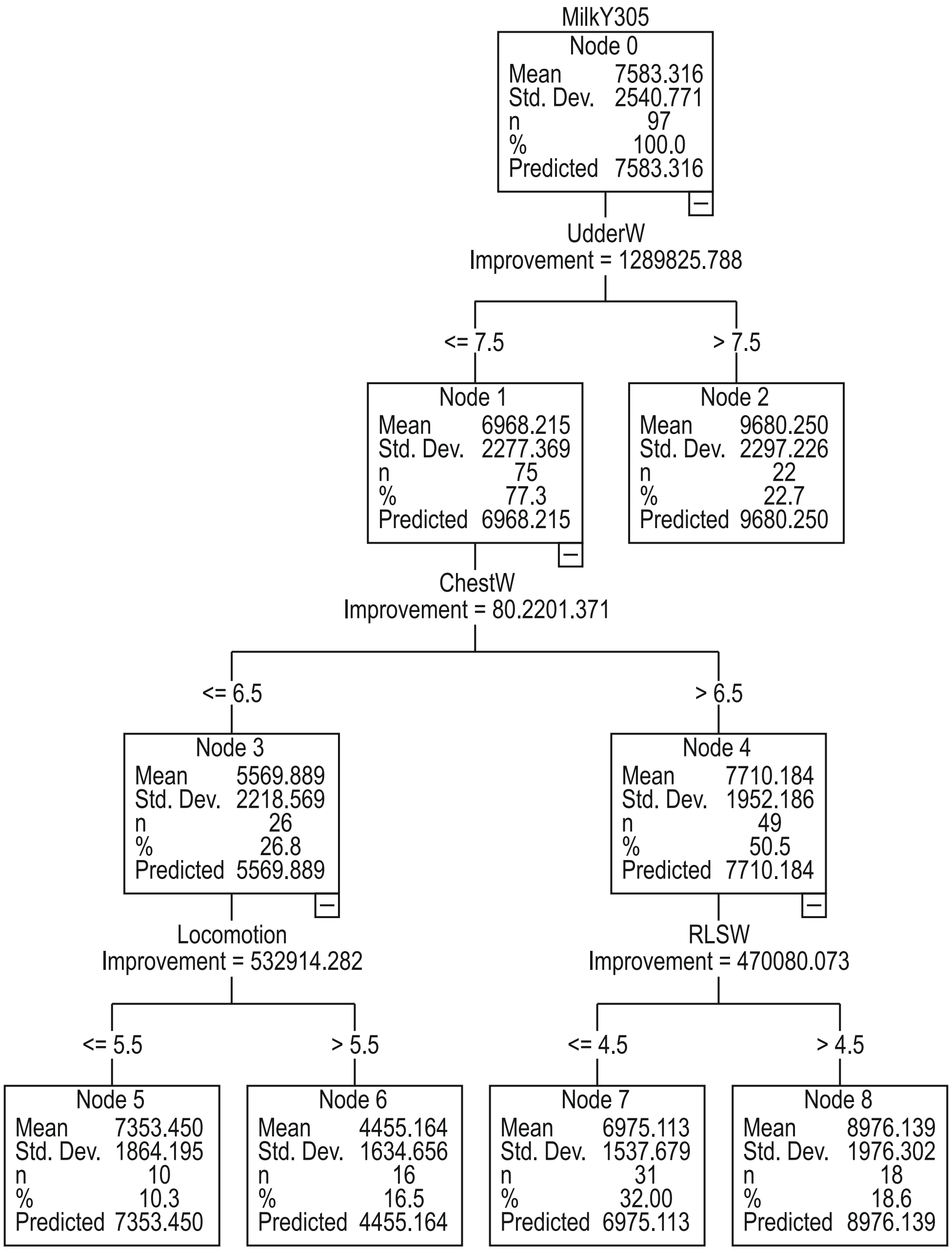

Figure 1. CART decision tree built for target variable MilkY305 and 12 variables of conformation traits.

of the contribution of this variable to the model is also calculated.

The next splitting procedure continues from node 1. Now the more important variable is found to be ChestW (chest width) with the corresponding threshold value of 6.5. The information for the two child nodes 3 and 4 is given as in the first step of the algorithm. By repeating the steps we obtain the decision tree, shown in Figure 1. The decision tree could be considered as a sequence of rules, defined by the splitting inequalities. The full rule description of the obtained terminal nodes of the tree is given in Table 3. The decision tree could be used for classification and prediction of new data by following the rules until classifying the new data case into some of the terminal nodes of the tree.If a group of cows has average Udder width bigger than 7.5 (UdderW> 7.5) we can expect a value of 305 days milk yield close to 9680 kg even if the 305 days lactations have not finished yet. Node 5 determines predicted value of 305 days milk yield 7353 kg when Udder width is less than or equal to 7.5 (UdderW≤7.5), Chest width is less than or equal to 6.5 (ChestW ≤ 6.5) and Locomotion is less than or equal to 5.5. The results for Nodes 6, 7 and 8 are interpreted in a similar way.

We have to point out that in the CART algorithm some additional procedures for pruning the tree, model validation and others could be used for refinement of the model. It is also recommended to avoid building large trees. It is known that this provides poor results when the model is applied to new data sets and it becomes difficult to interpret (Steinberg and Colla, 1995).

The model summary from Table 2 indicates 11 variables included in the model. Detailed contribution of these factors on the 305 days milk yield is given in Table 4. The biggest importance has udder width (considered as 100%), and others are normalized relatively to it. The second factor affecting the milk yield of cattle in

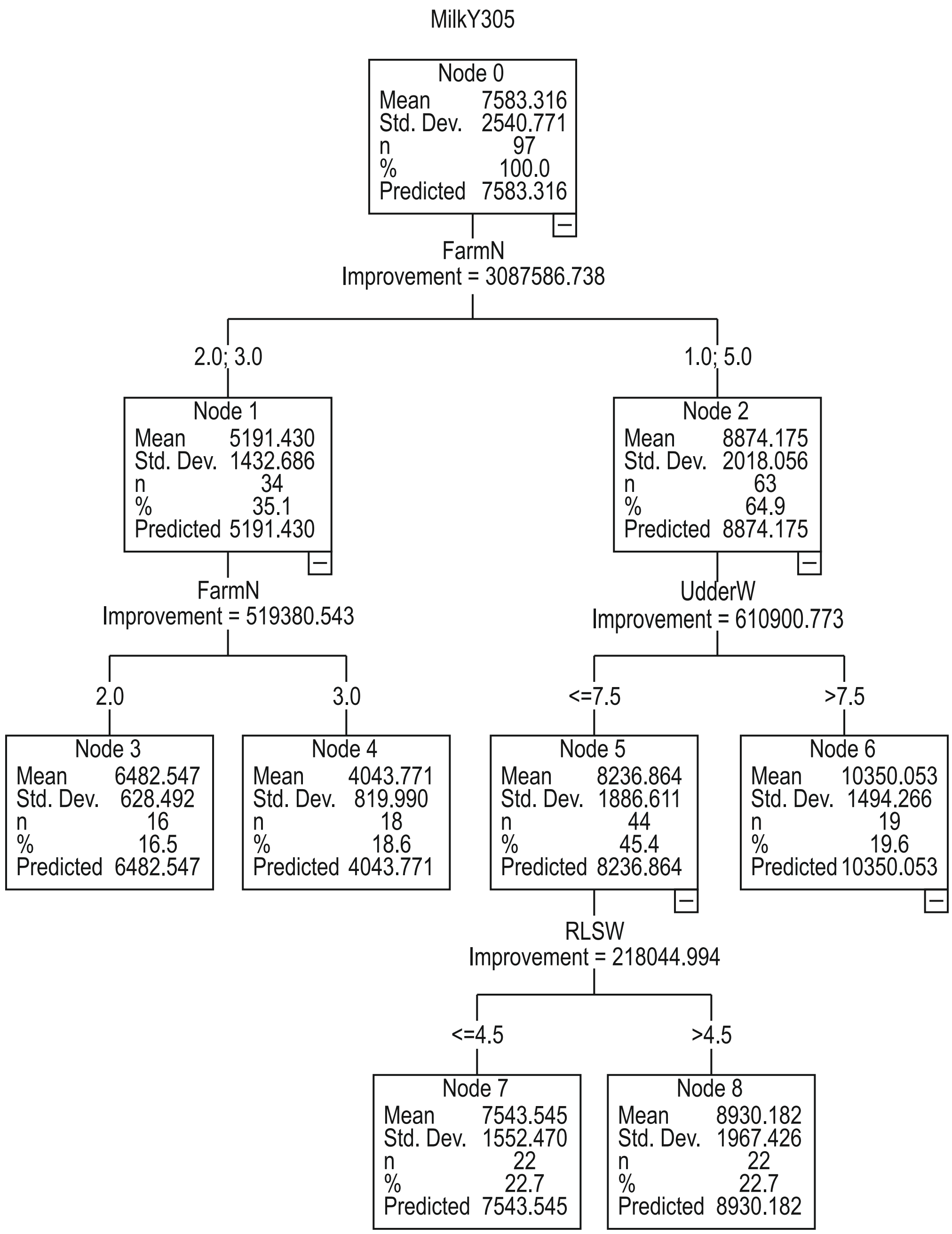

Figure 2. CART decision tree built for target variable MilkY305, 12 variables of conformation traits and farm number

Table 3. Description of the rules and predicted values for the five terminal nodes of the decision tree from the first model

Terminal Node	Number of cases	Rules	Predicted value for MilkY305-d, kg
Node 2	22	UdderW > 7.5	9680
Node 5	10	UdderW ≤ 7.5, ChestW ≤ 6.5, Locomotion ≤ 5.5	7353
Node 6	16	UdderW ≤ 7.5, ChestW ≤ 6.5, Locomotion > 5.5	4455
Node 7	31	UdderW > 7.5, ChestW > 6.5, RLSW ≤ 4.5	6975
Node 8	18	UdderW > 7.5, ChestW > 6.5, RLSW > 4.5	8976

Table 4. Relative importance of the factors affecting the 305 days milk yield of the investigated sample for Holstein cows in Bulgaria

Independent Variable	Importance	Normalized Importance (%)
UdderW	2055849	100.0
Locomotion	989260	48.1
Stature	846301	41.2
ChestW	802201	39.0
Lameness	568127	27.6
RLSW	470080	22.9
HockD	380497	18.5
RumpW	270580	13.2
Bone	216727	10.5
RLRV	216179	10.5
FootD	95787	4.7

Growing Method: CART
Dependent Variable: MilkY30

the sample is locomotion with about 48%, followed by stature (41%) and chest width (39%). To note only variable FootA does not influence the model. The constructed model has coefficient of determination $R^2 = 0.484$ at significance level 0.001. This describes about 48% of the examined data set.

Building the decision tree for the conformation traits and farms of Holstein cows

To analyze the importance of the farms the CART procedure was applied again at the same specifications by including also the variable FarmN. The obtained decision tree is shown in Figure 2. When observing the results with respect to the distribution of cases in the five terminal nodes, we observe that the dominant observations, classified in nodes 2 and 8 with the highest values of the 305 days milk yield (Figure 2) are from farm number one. It is seen from Figure 2 that the terminal nodes 6 and 8 classify the cases with the biggest mean values of MilkY305 (10350 and 8930 kg, respectively) and these results are for farm 1 and farm 5. All the cases in terminal node 6 and a half from node 8 are from farm 1. The two other farms show lower results. This analysis reveals the importance of the farm, i.e. the conditions for the feeding and breeding of cattle. The constructed model has coefficient of determination $R^2 = 0.701$ and describes 70% of the data.

Conclusion

The paper demonstrates the possibility for investigation of the basic relations, classification and prediction in the multivariate data using the CART methodology. For a sample of 97 observations of cattle from 4 farms in Bulgaria, two decision trees are built for studying dependence of the 305 days milk yield for Holshtein cows with respect to the changes in 13 independent variables. Taking into account the 12 independent variables for conformation traits a model is constructed, which describes 48% of the data and identifies the main factors for quantities of milk, namely udder width, locomotion, stature and chest width with normalized importance of 100%, 48.1%, 41.2% and 39%, respectively. The output data are classified into five main groups. The second model takesfurther into account the influence of the farm where the cattle are reared. The expanded model explains 70% of the data and classifies them into 5 groups. It was found that a major factor in milk production is the farm, i.e. the terms of feeding and breeding of the livestock.

The last instructions of ICAR for evaluation of the exterior include 24 linear attributes, which in itself makes it difficult to assess their impact on the productive, reproductive or other characteristics of cattle. Implementation of the CART method clarifies the guidelines for selection in individual linear traits and can help for possible development of selection indices depending on their importance.

Acknowledgement

This study was partially supported by the NPD of Plovdiv University grant NI15-FMI-004.

References

Berry DP, Buckley F, Dillon P, Evans RD, Rath M and Veerkamp RF, 2003.Genetic Relationships among body condition score, body weight, milk yield, and fertility in dairy cows. Journal of Dairy Sciences, 86, 2193-2204.

Berry DP, Buckley F, Dillon P, Evans RD and Veerkamp RF, 2004. Genetic relationships among linear type traits, milk yield, bodyweight, fertility and somatic cell count in primiparous dairy cows. Irish Journal of Agricultural and Food Research, 43, 161-176.

Bouška J, Vacek M, Stipkova M, Nemcova E and Pytloun P, 2006.The relationship between conformations of dams and daughters in Czech Holsteins. Czech Journal of Animal Sciences, 51, 236-240.

Breiman L, Friedman JH, Olshen RA and Stone CJ, 1984.Classification and regression trees.Wadsworth and Brooks, Monterey, CA, US.

Cak B, Keskin S and Yilmaz O,2013.Regression tree analysis for determining of affecting factors to lactation milk yield in brown Swiss cattle. Asian Journal of Animal and Veterinary Advances, 8, 677-682.

Eyduran E, Yilmaz I, Tariq MM and Kaygisiz A,2013.Estimation of 305-D milk yield using regression tree method in brown Swiss cattle. The Journal of Animal and Plant Sciences, 23, 731-735.

ICAR International Agreement of Recording Practices,

2012.Conformation recording of dairy cattle.
Kern EL, Cobuci JA, Costa CN and Pimentel CM, 2014. Factor analysis of linear type traits and their relation with longevity in Brazilian Holstein cattle.Asian Australasian Journal of Animal Sciences, 27, 784-790.
Krupa E, Wolfová M, Peškovičová D, Huba J and Krupová Z, 2005. Economic values of traits for Slovakian Pied cattle under different marketing strategies. Czech Journal of Animal Science, 50, 483-492.
Nemcova E, Stipkova M and Zavadilova L, 2011. Genetic parameters for linear type traitsin Czech Holstein cattle. Czech Journal of Animal Science, 56, 157-162.
Pantelic V,Samolovac L, Aleksic S, Trivunovic S, Petrovic MM, Ostojic-Andric D and Novakovic Z, 2010. Heritability of type traits in first calving Black and White cows. ArchivTierzucht, 53, 545-554.
Pryce JE, Esslemont RJ, Thompson R, Veerkamp RF, Kossaibati MA and Simm G,1998. Estimation of genetic parameters using health, fertility and production data from a management recording system for dairy cattle. Animal Science, 66, 577-584.
Roxström A, Strandberg E, Berglund B, Emanuelson U and Philipsson J, 2001.Genetic and environmental correlations among the female fertility traits, and between the ability to show oestrus and milk production in dairy cattle. Acta Agriculturae Scandinavica, Section A - Animal Science, 51, 192-199.
Steinberg D and Colla PL, 1995. CART: tree-structured non parametric data analysis. Salford Systems,San Diego, US.
Topal M, Aksakal V, Bayram B and Yaganoglu AM, 2010. An analysis of the factors affecting birth weight and actual milk yield in Swedish red cattle using regression tree analysis. The Journal of Animal and Plant Sciences, 20, 63-69.
World Holstein Friesian Federation, April 2015. http://www.whff.info/index.php

CONTENTS

Review

Genetics and Breeding

Nutrition and Physiology

CONTENTS

Production Systems

Agriculture and Environment

Product Quality and Safety

Instruction for authors

Preparation of papers

Papers shall be submitted at the editorial office typed on standard typing pages (A4, 30 lines per page, 62 characters per line). The editors recommend up to 15 pages for full research paper (including abstract references, tables, figures and other appendices)

The manuscript should be structured as follows: Title, Names of authors and affiliation address, Abstract, List of keywords, Introduction, Material and methods,Results, Discussion, Conclusion, Acknowledgements (if any), References, Tables, Figures.

The title needs to be as concise and informative about the nature of research. It should be written with small letter /bold, 14/ without any abbreviations.

Names and affiliation of authors The names of the authors should be presented from the initials of first names followed by the family names. The complete address and name of the institution should be stated next. The affiliation of authors are designated by different signs. For the author who is going to be corresponding by the editorial board and readers, an E-mail address and telephone number should be presented as footnote on the first page. Corresponding author is indicated with *.

Abstract should be not more than 350 words. It should be clearly stated what new findings have been made in the course of research. Abbreviations and references to authors are inadmissible in the summary. It should be understandable without having read the paper and should be in one paragraph.

Keywords: Up to maximum of 5 keywords should be selected not repeating the title but giving the essence of study.

The introduction must answer the following questions: What is known and what is new on the studied issue? What necessitated the research problem, described in the paper? What is your hypothesis and goal ?

Material and methods: The objects of research, organization of experiments, chemical analyses, statistical and other methods and conditions applied for the experiments should be described in detail. A criterion of sufficient information is to be possible for others to repeat the experiment in order to verify results.

Results are presented in understandable tables and figures, accompanied by the statistical parameters needed for the evaluation. Data from tables and figures should not be repeated in the text.

Tables should be as simple and as few as possible. Each table should have its own explanatory title and to be typed on a separate page. They should be outside the main body of the text and an indication should be given where it should be inserted.

Figures should be sharp with good contrast and rendition. Graphic materials should be preferred. Photographs to be appropriate for printing. Illustrations are supplied in colour as an exception after special agreement with the editorial board and possible payment of extra costs. The figures are to be each in a single file and their location should be given within the text.

Discussion: The objective of this section is to indicate the scientific significance of the study. By comparing the results and conclusions of other scientists the contribution of the study for expanding or modifying existing knowledge is pointed out clearly and convincingly to the reader.

Conclusion: The most important consequences for the science and practice resulting from the conducted research should be summarized in a few sentences. The conclusions shouldn't be numbered and no new paragraphs be used. Contributions are the core of conclusions.

References:

In the text, references should be cited as follows: single author: Sandberg (2002); two authors: Andersson and Georges (2004); more than two authors: Andersson et al.(2003). When several references are cited simultaneously, they should be ranked by chronological order e.g.: (Sandberg, 2002; Andersson et al., 2003; Andersson and Georges, 2004).

References are arranged alphabetically by the name of the first author. If an author is cited more than once, first his individual publications are given ranked by year, then come publications with one co-author, two co-authors, etc. The names of authors, article and journal titles in the Cyrillic or alphabet different from Latin, should be transliterated into Latin and article titles should be translated into English. The original language of articles and books translated into English is indicated in parenthesis after the bibliographic reference (Bulgarian = Bg, Russian = Ru, Serbian = Sr, if in the Cyrillic, Mongolian = Mo, Greek = Gr, Georgian = Geor., Japanese = Ja, Chinese = Ch, Arabic = Ar, etc.)

The following order in the reference list is recommended:

Journal articles: Author(s) surname and initials, year. Title. Full title of the journal, volume, pages. Example:

Simm G, Lewis RM, Grundy B and Dingwall WS, 2002. Responses to selection for lean growth in sheep. Animal Science, 74, 39-50

Books: Author(s) surname and initials, year. Title. Edition, name of publisher, place of publication. Example:

Oldenbroek JK, 1999. Genebanks and the conservation of farm animal genetic resources, Second edition. DLO Institute for Animal Science and Health, Netherlands.

Book chapter or conference proceedings: Author(s) surname and initials, year. Title. In: Title of the book or of the proceedings followed by the editor(s), volume, pages. Name of publisher, place of publication. Example:

Mauff G, Pulverer G, Operkuch W, Hummel K and Hidden C, 1995. C3-variants and diverse phenotypes of unconverted and converted C3. In: Provides of the Biological Fluids (ed. H. Peters), vol. 22, 143-165, Pergamon Press. Oxford, UK.

Todorov N and Mitev J, 1995. Effect of level of feeding during dry period, and body condition score on reproductive performance in dairy cows,IXth International Conference on Production Diseases in Farm Animals, September 11–14, Berlin, Germany.

Thesis:

Hristova D, 2013. Investigation on genetic diversity in local sheep breeds using DNA markers. Thesis for PhD, Trakia University, Stara Zagora, Bulgaria, (Bg).

The Editorial Board of the Journal is not responsible for incorrect quotes of reference sources and the relevant violations of copyrights.

Animal welfare

Studies performed on experimental animals should be carried out according to internationally recognized guidelines for animal welfare. That should be clearly described in the respective section "Material and methods".

AGRICULTURAL SCIENCE AND TECHNOLOGY

Volume 7, Number 2
June 2015

Journal web site:
www.agriscitech.eu

Publisher:
www.alfamarket.biz