Journal of Animal and Veterinary Advances 3 (12): 824-827, 2004

The Analysis of Binomial Data for Reproductive Performance by a Generalized Linear Mixed Model (GENMOD) in Karakas (Local Ewes) in Turkey

Kadir Karaku, Firat Cengiz, [1]Hamit Mirtagioğlu, Selçuk Seçkin Tuncer [1]Serhat Arslan
Yüzüncü Yil Üniversitesi Ziraat Fakultesi, Zootekni Bölümü Hayvan Yetiştirme ve Islahi Ana Bilim Dali, 65080, Van; [1]Yüzüncü Yil Üniversitesi Ziraat Fakultesi, Zootekni Bölümü Biyometri ve Genetik Ana Bilim Dali, 65080, Van

Abstract: The objective of this study is to analyze by generalized linear mixed modeling technique with binomial structure for reproductive characteristics in Karaka° local ewes in Turkey. The data were collected from Yuzuncu Yil University, Animal Science Breeding Farms in Turkey. A total of 83 ewes and their 94 lambs at born 2004 season were included in the analysis born over a period of one year. A log linear relationship between the mean and the factors such as age, sire (rams), type of birth and sex of lambs by the log link function and distributed as poisson. According to analysis result for GEE, effecting of ram, birth type and sex of lamb have been statistically significant ($P<0.01$) on the birth weight. On the other hand, effect of age of the dam has not been significantly on the birth weight. There is only investigating to effect of ram and age dam on the non-return rate. No significance effects were determined for these factors on the non-return rate. Ram produced medium (3 or 4 mass activity score) quality of the sperm have been higher birth weight than others. Male and single born lambs have been also highest birth weight. There are no differences for age of dam. However, lambs born from 2 or 3 ageing dams have slightly more born weights than others. In present study, there are no available indicator factors for non-return rate and pregnant status for investigating factors.

Key words: reproduction trait, ewe, ram effect, GENMOD, Binomial data

Introduction

Fertility traits in livestock are economically most importance and are well established. Good fertility in animals is important for keeping the productive performance within acceptable limits, reducing the number of culling owing to reproductive failure (Van Arendonk *et al.*, 1989; Fogarty *et al.*, 1994; Van Arendonk *et al.*, 1996). Animal breeders use mixed models to separate fixed effects, for example age, breed or sex, from random genetic effects and other sources of variation. The random effects in the model typically represent genetically different animals, for example sires. The variance of the random effects relative to the total variation is used to estimate heritability which is needed to assess the potential for genetic improvement. Predicted values of the random effects are needed for selecting animals for use in breeding programs (Simianer and Schaeffer, 1989).

Binomial traits are sometimes regarded as resulting from classifying an underlying normal variable into two classes relative to some threshold. Methods for predicting, from threshold data, random effects on the underlying scale are presented by Gianola *et al.* (1990) and Harville (1990) following the suggestion of Thompson (1990). These methods maximize the likelihood jointly for both fixed and random effects using Bayesian arguments. The alternative general method proposed here maximizes the likelihood with respect to the fixed effects; taking expectations over the random effects arise naturally from the equations that are solved. Those will be referred to as the joint maximization and expectation methods respectively. They produce identical results when used with normally distributed data (Foulley *et al.*, 1990).

The Karakas is a breed of native sheep that is a variety of Akkaraman sheep in Turkey. The breed consists of about 6 million sheep that are raised in an area of East Anatolian in Turkey. The husbandry is typically extensive; sheep are feed natural conditional and crops. Feeding systems are not nutritionally balanced to stage of lactation as well all breeding stages such as lambing, lactation period or pregnant periods. Despite this low level of management conditions, the mean milk yield for a lactation length of 185 d is about 85 kg. Because of these productivity levels and the remarkable ability of ewes were raised about per 30% in the total sheep of Turkey (Akcapinar & Kadak, 1982.; Akcapinar & Aydýn, 1984; Odabasioðlu ***et al***, 1996). Reproductive characteristics for Akkaraman and their varieties were not widely investigated in literature. The objective of this study is to analyze by generalized linear mixed modeling technique with binomial structure for reproductive characteristics in Karaka° local ewes in Turkey.

Material and Methods

The data were collected from Yuzuncu Yil University, Animal Science Breeding Farms in Turkey. A total of 83 ewes and their 94 lambs at born 2004 season were included in the analysis born over a period of one year. Three Kakara° rams were analyzed for sperm characteristics before artificial insemination (AI). AI is applied according to sperm

performance of rams. Reproductive characteristics were included in birth weight (BW), pregnant status (PS), birth type, sex and return or non-returning (SNR) performance for two successive estrus cycles of ewes and age of dam (2, 3, 4, and 5).

Reproductive characteristics e.g., RNR were analyzed by generalized linear model (GENMOD) using with linking function log scale and distributed as poisson. BW was also investigated by GENMOD with using normal distributions and linking for identity function. Using model parameters for μ is poisson mean parameter. Model is $log(\mu) = X_i^1\beta$, where, β is unknown parameters to be estimated by the poisson model procedure (Park *et al.*, 1998). The logarithm of N is used as an data set, that is, regression variables with a constant coefficient of 1 for each observations for example return for first estrus. A log linear relationship between the mean and the factors such as age, sire (rams), type of birth and sex of lambs by the log link function and distributed as poisson. The log link function ensures that mean number of lams for each ram and age group for ewes predicted from the fitted model will be positively defined.

GEE analyses were executed by SAS (1998).

Results and Discussion

An important aspect of GENMOD is the selection of explanatory variables in the model. Goodness of fitting statistics is illustrated in Table 1 for BW, SNR and PS.

In the Table 1 was summarized to Criteria for Assessing Goodness of Fit" for BW, SNR and PS. The values of the deviance divided by its degrees of freedom is less then 1. A P value is not computed for the deviance; however, a deviance that is small relative to its degrees of freedom is a possible indication of a good model fit. Asymptotic distribution theory applies to binomial data as the number of binomial trials parameter N becomes large for each combination of explanatory variables. McCullagh and Nelder (1989) caution against the use of the deviance alone to asses' model fit. Model fit for each observation should be assessed by examination of residuals. In the "Analysis of Parameter Estimates", Chi Square values for the explanatory variables indicated that the parameter values other than the intercept term are all significant. The scale parameter was set to 1 for binomial distribution.

Type 3 analyzing results for BW and SNR were summarized in Table 2.

According to analysis result for GEE, effecting of ram, birth type and sex of lamb have been statistically significant ($P<0.01$) on the BW. On the other hand, effect of age of the dam has not been significantly on the BW. There is only investigating to effect of ram and age dam on the SNR. No significance effects were determined for these factors on the SNR.

Table 1: Criteria for assessing Goodness of fitting statistics for models

Tratis	Birth weight (BW)			Return or non-return for AI service (SNR)			Pregnant status (PS)		
	Df	Value	Value/Df	DF	Value	Value/DF	DF	Value	Value/DF
Deviance	84	23.89	0.28	85	6.16	0.07	88	1.85	0.021
Pearson Chi-square	84	23.89	0.28	85	6.94	0.08	88	0.99	0.011
Log-Likelihood	-	-68.53	-	-	-91.83	-	-	-93.93	-

Table 2: Logistic regression Type 3 analysis in birth weight, return or non-return for AI service in Karakas ewes

Factors	Birth Weight (BW)			Return or non-return for AI service (SNR)		
	DF	χ^2 value	Pr> Chi	DF	χ^2 value	Pr> Chi
Ram Effect	2	17.89	0.0001	2	0.367	0.832
Age of Dam	3	2.741	0.4334	3	0.796	0.850
Birth Type	1	26.602	0.0001	-	-	-
Sex	1	9.485	0.0021	-	-	-

Table 3: Logistic regression type 2 analysis for pregnant status in Karakas ewes

Factor	Pregnant Status (PS)		
	DF	χ^2 value	Pr> Chi
Time of AI	1	0.059	0.807
Age of Dam	3	0.003	0.999
Returning	1	0.074	0.785

Table 4: Estimating parameters and confidence intervals for birth weight, return or non-return for AI service and pregnant status in Karakas ewes

Traits	Birth Weight (BW)			Return or non-return for AI service (SNR)			Pregnant Status (PS)		
	Lower	estimate	Upper	Lower	estimate	Upper	Lower	estimate	Upper
Ram Effect (3-4)*	-0.303	0.186	0.677	-0.90	0.055	1.01	-	-	-
Birth Type (single)	0.381	0.604	0.827	-	-	-	-	-	-
Sex (male)	0.135	0.356	0.576	-	-	-	-	-	-
Time of AI (2)	-	-	-	-	-	-	-0.596	0.271	0.466
Age of Dam (2-3)	-0.524	0.358	0.104	-0.37	0.305	0.83	-0.658	0.335	0.658
Returning (1)	-	-	-	-	-	-	-0.573	0.092	0.756

*Sperm quality for rams was assessed and classified as 0-5 categories according to the their mas activity

Type 3 analyzing results for PS was also summarized in Table 3.
According to analysis results, effecting of age of dam, effect of applying time of artificial insemination and returning number have not been significantly on the PS.
Estimating parameters and confidence intervals for effect of the investigating factors on BW, SNR and PS were summarized in Table 4.
According to the Table 4, lambs' Ram produced medium (3 or 4 mass activity score) quality of the sperm have been higher BW than others. Male and single born lambs have been also highest BW. There are no differences for age of dam. However, lambs born from 2 or 3 ageing dams have slightly more born weights than others. In present study, there are no available indicator factors for SNR and PS for investigating factors. However, good fertility in dams is important for keeping the lambing within acceptable limits (for herds level) reducing the number of inseminations and reducing culling owing to reproductive failure (Van Arendonk *et al.*, 1989).

Conclusion

In the analysis a GENMOD procedure for an unequal design was used in order to account for the effect of some reproduction traits. This procedure accounts for the effect of these traits on the estimates of parameters, if all information upon which the culling decisions were made in included in the data. Using these values the correlated response in fertility reduced the profit of selection on the other economic yields such as milk production. Artificial insemination determining the optimum breeding strategy and female fertility, the relation ship between fertility at different ages and cost of collecting fertility data should be accounted for. Herd management has a big influence on fertility and should therefore be taken into account in deciding how much emphasis to put on fertility in a breeding program.

References

Akçapinar, H. and I. Aydin, 1984. Morkaraman Kuzularýnýn Erzurum'da Ozel bir Iþletmede Yari Entansif Sartlarda Büyüme ve Yaþama Gücü (with English Abstract). A.U. Vet. Fak. Derg, 31: 128-136.

Akçapinar, H.and R. Kadak, 1982. Morkaraman ve Kangal-Akkaraman Kuzularinin Büyüme ve Yaşama Kabiliyeti Uzerinde Karşilaştirmali Araştirmalar (with English Abstract). Firat Üniv. Vet. Fak. Derg., Cilt. 1-2: 203-212.

Fogarty, N. M., L. D. Brash and A. R. Gilmour, 1994. Genetic Parameters for Reproduction and Lamb Production and Their Components and Liveweight, Fat Dept and Wool Production in Hyfer Sheep. Aust. J. Agric. Res., 443-457.

Foulley, J. L., D. Gianola and S. Im., 1990. Genetic Evaluation for Discrete Polygenic Traits in Animal Breeding. In: Gianola, D. and Hammond, K. (Ed.) Advances in Statistical Methods for Genetic Improvement of Livestock. Ed:, Springer-Verlag, Berlin Heidelberg, Germany, pp: 361-409.

Foulley, J. L., D., Gianola, M. S., Cristobal and S. Im, 1990. A Method for Assessing Extent and Sources of Heterogeneity of Residual Variances in Mixed Linear Models. J. Dairy Sci., 73: 1612-1624.

Harville, D. A., 1990. BLUP (Best Linear Unbiased Prediction) and Beyond. In: Gianola, D. and Hammond, K. (Ed.) Advances in Statistical Methods for Genetic Improvement of Livestock. Ed:, Springer-Verlag, Berlin Heidelberg, Germany, pp: 239-276.

Odabaþioğlu, F., M. Küçük and M. Arslan, 1996. Saf ve melez (Dorset Down x Morkaraman) Morkaraman kuzularinda buyume ve yasama gucu ozellikleri (with English Abstract). Hayv. Araş. Derg., 6: 87-90.

Park, T., D. W. Shin and C. G. Park, 1998. A Generalized Estimating Equations Approach for Testing Ordered Group Effects with Repeated Measurements. Biometrics, 54: 1645-1653.

SAS, 1998, SAS/SATAT Software: Changes and Enhancements. SAS Inst., Cary, NC.

Simianer, H. and L. R. Schaeffer, 1989. Estimation of Covariance Components between One Continuous and One Binary Trait. Genet. Sel. Eval., 303-315.

Thompson, R., 1990. Generalized Linear Models and Applications to Animal Breeding. In: Gianola, D. and Hammond, K. (Ed.) Advances in Statistical Methods for Genetic Improvement of Livestock. Ed:, Springer-Verlag, Berlin Heidelberg, Germany, pp: 312-328.

Van Arendonk, J. A. M., C. V., Rosmeulen, L. L. G. Janss and E. F., Knol, 1996. Estimation of Direct and Maternal Genetic (Co)variances for Survival within Litters of Piglets. Liv. Prod. Sci., 46: 163-171.

Van Arendonk, J. A. M., R. Hovenier and W. De Boer, 1989. Phenotypic and Genetic Association between Fertility and Production in Dairy Cows. Livest. Prod. Sci., 21: 1-12.