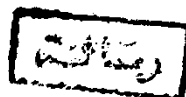


**MODELING TO DETERMINE POSSIBLE PROBLEMS
IN APPLICATION OF THE ANIMAL MODEL
IN DAIRY CATTLE**

By



MANAL MOHAMAD AHMED SAYED

B.Sc. Agric. Sci. (Animal Production),

Ain Shams University, 1985

M.Sc. (Animal Breeding)

Ain Shams University, 1989

A thesis submitted in partial fulfillment
of
the requirement for the degree of

55680

636.082

4 4

DOCTOR OF PHILOSOPHY

in

Agricultural Science

(Animal Breeding)



Department of Animal Production

Faculty of Agriculture

Ain Shams University

1997

APPROVAL SHEET

MODELING TO DETERMINE POSSIBLE PROBLEMS
IN APPLICATION OF THE ANIMAL MODEL
IN DAIRY CATTLE

By

MANAL MOHAMAD AHMED SAYED

B.Sc. Agric. Sci. (Animal Production),

Ain Shams University, 1985

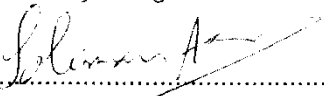
M.Sc. (Animal Breeding)

Ain Shams University, 1989

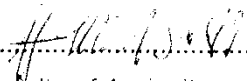
This thesis for Ph.D. degree has been approved by:

Prof. Dr. Ali A. Nigm 

Prof. of Animal Breeding, Faculty of Agriculture
Cairo University.

Prof. Dr. Ashraf M. Soliman 

Prof. of Animal Breeding, Faculty of Agriculture
Al-Zagazig University.

Prof. Dr. Hussein M. Mansour 

Prof. of Animal Breeding, Faculty of Agriculture
Ain Shams University.

Date of examination: 27/9 / 1997



ACKNOWLEDGEMENTS

First and foremost, all praises are due to Allah, who blessed me with good advisors and friends.

I owe my advisor, Dr. Hussein Mansour, Professor of Animal Breeding, Ain Shams University a great deal. Through his sincere efforts, it has been possible to obtain the programs, used in this study. Dr. Mansour proposed the work plan and guided the study. Special word of thankfulness is due to him for his constructive criticism and his everyday readiness to help in overcoming problems during the analysis and writing this thesis. Through his endless ability to give and his patience and the friendly atmosphere he secures for his students I learned a lot.

Appreciation and special thanks is extended to Prof. Dr. Esam El-Tawel, Professor of Animal Breeding, Ain Shams University for his aid, optimism and understanding through my study.

My deepest gratitude are deserved to Dr. E. Salah E. Galal, Professor of Animal Breeding, Ain Shams University. He taught me a lot through my study and extended my understanding of my scientific career. Dr. Galal proposed the topic of this study.

Special thanks are to my mother and my father, who teach me the worth of science, give encouragement and in their eyes I can read my success. All my love to my brothers and my sisters and their sons who provide me with confidence, encouragement, support and patience at time needed. I like to express my sincere thanks to my brother Dr. Hamdy Elsayed, who always encouraged me and deposited the confidence in me to reach this point in my life.

This thesis would have never been accomplished without the kindly help of my close friend, Miss Reda Elsaid a member of the Scientific computation unit. I like to express my special thanks to her.

I like to express my sincere appreciation to scientific computation unit members. My friend Nafisa Abdel-Karim who ever stands by me and miss Zeinab Abou Benaia for their great help

This thesis is dedicated with all my love to the only person in the world that I wish to see him better than me, my kid Abd El-Rahman. Nothing could satisfy my feeling toward his lovely smile which stand by me at time needed.

**MODELING TO DETERMINE POSSIBLE PROBLEMS
IN APPLICATION OF THE ANIMAL MODEL
IN DAIRY CATTLE**

By

MANAL MOHAMAD AHMED SAYED

B.Sc. Agric. Sci. (Animal Production),

Ain Shams University, 1985

M.Sc. (Animal Breeding)

Ain Shams University, 1989

Under the supervision of:

Prof. Dr. H. M. Mansour

Prof. of Animal Breeding, Fac. of Agric., Ain Shams Univ.

Prof. Dr. E. A. El-Tawil

Prof. of Animal Breeding, Fac. of Agric., Ain Shams Univ.

ABSTRACT

MANAL MOHAMMAD AHMAD SAYED. Modeling to determine possible problems in application of the animal model in dairy cattle. Unpublished Ph.D., University of Ain Shams, Faculty of Agriculture, Department of Animal Production, 1997.

This thesis was directed to study three problems arise when analyzing animal breeding data for estimating variance components and / or predicting breeding values.

In chapter 1, the effect of different degrees of disconnectedness (50 levels) on estimating variance components was investigated by generating three populations depending on the value of heritability (0.1, 0.25 and 0.4). It was noticed that mean squared errors did not change noticeably by changing the degree of connectedness. Whereas there was a slight decrease in bias by increasing the degree of connectedness.

In chapter 2, the relevance of predicting the breeding value of a trait analyzed as multiple traits versus the prediction using a single trait analysis specially in case of missing values was studied. Results of this chapter indicated that bias was lower when the trait was analyzed by multiple traits analysis than when analyzed using a single trait analysis for the estimation of variance component and for the prediction of breeding values.

Chapter 3, concerned with studying the effect of correction for fixed effect on estimating variance components by four different models. Results indicated that mixed model is the best model to yield constants for correcting fixed effects whereas cow model is the best model for estimating variance components.

Key words: simulation, dairy cattle, disconnectedness, single trait, multiple traits, environmental adjustments, variance components, breeding values, modeling and animal model.

TABLE OF CONTENTS

	PAGE
1.Introduction	1
2. Review of Literature	3
2.1.The history and importance of simulation procedures	3
2.1.1. The simulation of random number generators	3
2.2. The mean squared error	4
2.3. Disconnectedness	4
2.4. The Importance of Using Multitrait Analysis	7
2.5. Correction for fixed effects	10
2.5.1. Correction for age	12
2.5.2. Correction for parity and year of calving	14
2.6. The best model to be used for estimating variance components	15
3- Material and Methods.....	17
3.1. Disconnectedness	17
3.1.1. Simulation Procedure	17
3.1.2. The Structure of Complete Disconnected Data	17
3.1.3. The structure of connected data	18
3.1.4. Statistical Analysis	20
3.2. Single and Multiple Traits	22
3.2.1. Simulation Procedure	22
3.2.2. Statistical Analysis	23
3.3. Correction for fixed effects	25
3.3.1.Simulation Procedure	25
3.3.2. Statistical Analysis	26
3.3.2.1. Correction for fixed effects	26
3.3.2.2. Computing Variance Components	28
4. Results and Discussion	31
4.1. Disconnectedness	31

	Page
4.1.1. Heritability, Genetic and Environmental Variances	31
4.1.2. Bias, variance and mean Squared Errors (MSE) of Heritability, Genetic and Environmental Variances	31
4.2. Type of analysis	57
4.2.1. Bias, variance and mean squared errors of breeding values	57
4.2.2. Bias, variance and Mean Squared Errors of Heritability, Genetic and Environmental Variances	59
4.3. Correction for Fixed Effects	63
4.3.1. Bias, Variance and Mean Squared Errors of Age Constants	63
4.3.2. Bias, Variance and Mean Squared Errors for the First Three Parities	66
4.3.3. Bias, Variance and Mean Squared Errors of Years ...	69
4.3.4. Bias, Variance and Mean Squared Errors for Genetic, Environmental Variances and Heritability	79
5- Summary and Conclusions	86
6- References	92
7- Arabic Summary	

LIST OF TABLES

Tables	PAGE
1. The assumed parametric values for phenotypic, genetic, residual variances and heritabilities values for the three studied populations	20
2. Average values of the ten samples for the estimates of genetic and environmental variances and heritability	32
3. Bias of genetic variances (σ_a^2) for the three simulated populations	34
4. Bias of environmental variances (σ_e^2) for the three simulated populations	36
5. Bias of heritability (h^2) for the three simulated populations ..	38
6. Variances of genetic variance estimates for the three simulated populations	40
7. Variances of environmental variance estimates for the three simulated populations	42
8. Variances of heritability estimates for the three simulated populations	44
9. Mean squared errors for genetic variances for the three simulated populations	46
10. Mean squared errors of environmental variances for the three simulated populations	48
11. Mean squared errors of heritability for the three simulated populations	50
12. Analysis of variance of bias for genetic (Bias of σ_a^2), environmental (Bias of σ_e^2) variances and heritability (Bias of h^2)	52
13. Analysis of variance of mean squared errors for genetic (σ_a^2), environmental (σ_e^2) variances and heritability (h^2)	53
14. Analysis of variance for genetic (σ_a^2), environmental (σ_e^2) variances and heritability (h^2) variances	53

Tables	PAGE
15. Bias, variance and mean squared errors for breeding values of fat yield under single and multiple traits analysis	58
16. Analysis of variance of bias, mean squared errors and variances for breeding values of fat yield	59
17. Bias for estimates of genetic (σ_a^2), environmental (σ_e^2) variances and heritability (h^2) of fat yield under single and multiple traits analysis	60
18. Variances for estimates of genetic (σ_a^2), environmental (σ_e^2) variances and heritability (h^2) of fat yield under single and multiple traits analysis	60
19. Mean squared errors for estimates of genetic (σ_a^2), environmental (σ_e^2) variances and heritability (h^2) of fat yield under single and multiple traits analysis	61
20. Analysis of variance of bias, variance and mean squared errors for heritability (h^2)	62
21. Analysis of variance of bias, variance and mean squared errors for genetic variance (σ_a^2)	62
22. Analysis of variance of bias, variance and mean squared errors for environmental variances (σ_e^2)	63
23. Bias for age at calving in different models for the first three parities	64
24. Variance for age at calving in different models for the first three parities	64
25. Mean squared errors for age at calving in different models for the first three parities	65
26. Bias for the first three parities at four different models	66
27. Variance for the first three parities at four different models	67
28. Mean squared errors for the first three parities at four different models	67
29. Bias for twenty years at four different models	70

Tables	PAGE
30. Variance for twenty years at four different models	71
31. Mean squared errors for twenty years at four different models	72
32. Analysis of variance of bias, variance and mean squared errors for age constants	77
33. Analysis of variance of bias, variance and mean squared errors for parity constants	78
34. Analysis of variance of bias, variance and mean squared errors for years constants	79
35. Bias for genetic variance (σ^2_a), environmental variance (σ^2_e) and heritability (h^2) at four different models	80
36. Variance for estimates of genetic variance (σ^2_a), environmental variance (σ^2_e) and heritability (h^2) at four different models	80
37. Mean squared errors (MSE) for genetic variance (σ^2_a), environmental variance (σ^2_e) and heritability (h^2) at four different models	80
38. Analysis of variance of bias, variance and mean squared errors for genetic variance (σ^2_a)	85
39. Analysis of variance of bias, variance and mean squared errors for environmental variance (σ^2_e)	85
40. Analysis of variance of bias, variance and mean squared errors for heritability (h^2)	85

LIST OF FIGURES

Figure	PAGE
1- Example for a complete disconnected structure of data consists of two connected sub sets	18
2- Example for a completely connected data set	19
3- The relationship between the degree of connectedness and bias at $h^2 = 0.1$ for heritability, genetic variance and residual, respectively	54
4- The relationship between the degree of connectedness and bias at $h^2 = 0.25$ for heritability, genetic variance and residual, respectively	55
5- The relationship between the degree of connectedness and bias at $h^2 = 0.4$ for heritability, genetic variance and residual, respectively	56
6- Bias of age at the first three parities at four different models ...	65
7- Bias of the first three parities at four different models	68
8- Bias of the year 1 to year 5 at four different models	73
9- Bias of the year 6 to year 10 at four different models	74
10- Bias of the year 11 to year 15 at four different models	75
11- Bias of the year 16 to year 20 at four different models	76
12- Bias of the genetic variance at four different models	81
13- Bias of the environmental variance at four different models	82
14- Bias of the heritability at four different models	83

List of Abbreviations

GLM	general linear model
VAR. COMP.	variance component
SAS	statistical analysis system
PEV	predicted error variance
BV's	breeding values
BLUP	best linear unbiased predictors
yr	year
R^2	coefficient of determination
h^2	heritability
σ_a^2	genetic variance
σ_e^2	environmental variance
σ_p^2	phenotypic variance
MSE	mean squared errors
DC	degree of connectedness
LSMLMW	least square maximum likelihood mean weighted
MTDFREML	multiple traits derivative free restricted maximum likelihood
kg	kilogram

