The correlation between inbreeding and performance in the Hanoverian Sport Horse.

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Abstract

The aim of this thesis was to examine the relationship between inbreeding and performance in the Hanoverian Sport Horse.

A total of 84,724 hanoverian horses born between the years 1990 and 2009 were used for the study, of which 78,907 had their own performance records. Pedigree records were traced back as far as possible, with a maximum of 37 generations used. There was 100% completeness of pedigree up to the grandparent generation for all horses. The majority of horses (80%) had completeness of pedigree past the sixth generation.

Inbreeding were calculated using two methods; the Meuwissen method and the van Raden Method. Both methods gave identical results (100% fit). As aquantitative measure of performance, the Integrated Estimated Breeding Value (iEBV), using both breed and competition results was used. The Evaluation was carried out using the BLUP (Best Linear Unbiased Prediction) Multitrait Repeatability Animal Model. Two different GLM were run with the inbreeding coefficient (IBC) modelled as either a continuous variable or as a fixed class of five differing levels of inbreeding ($IBC=0.00$; $0 < IBC \leq 0.01$: $0.01 < IBC \leq 0.02$; $0.02 < IBC \leq 0.05$; $0.05 < IBC$). Age and Sex were included as fixed effects within the model.

All subgroups in both dressage and jumping data, with either fixed effect or linear covariate for the IBC, generated a similar result. Due to the large sample size there was a significant ($p < 0.001$) relationship between inbreeding (IBC) and performance (iEBV). In dressage horses there was a significant positive relationship in all categories while in jumping horses there was a significant negative relationship in all catagories. However, the effect of inbreeding on iEBV explained only ±1% of the variance in the models. The models were simultaneously adjusted for the bias of the confounding factor of sex which also accounted for ±1% of the variance. The majority of variance in iEBV is due to the year cohort effect which accounts for ± 95%. The low level of inbreeding (±1.5%) and lack of biological effect on iEBV indicate that inbreeding is not a problem in the Hannoverian horse.

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Table of Contents

List of abbreviations and terms

APB	(Aufbauprüfung) Sport events – show jumping and dressage of Young Horses' competitions,
ATSE	Accumulated, transformed and standardized earnings
BLUP	Best Linear Unbiased Predictor Multi-trait–Repeatability–Animal Model
$BYEAR_k$	fixed effect of birth year class (k=1-10; 1990-1991, 1992-1993, ..., 2008- 2009)
CPT	Central performance tests
DF	Degrees of freedom
DKB-Bundeschampionate	The German Championships of Young German Horses and Ponies
Dressage horses	Refers to the dressage data of the relevant horse subgroup
DWB	Dutch Warmblood horse
eijkl	Random residual
F	Coefficient of inbreeding as defined by Sewall Wright
F_A	Inbreeding Coefficient of the common ancestor
F_x	Inbreeding Coefficient of individual horse
FE	Fixed effect
FEI	Federation Equestre Internationale
FN	Fédération Equestre Nationale (Germany)
GLM	General Linear Model
H^2	Heritability
HLP	(Hengstleistungsprüfung) Stallion performance test.
i	Intensity of selection of genetic gain

IBC	Inbreeding coefficient
IBCi	Inbreeding coefficient of $horse_i$
$IBCC_i$	Fixed effect of inbreeding coefficient class (i=1-5; IBC=0.00, 0.00 < IBC ≤ 0.01, 0.01 < IBC ≤ 0.02, 0.02 < IBC ≤ 0.05, IBC > 0.05)
iEBV	Integrated Estimated Breeding Value
IGE	Integrated Genetic Evaluation
IHB	Irish Horse Board
Jumping Horses	Refers to the jumping data of the relevant horse subgroup
KWPN	Royal Dutch Sport Horse
LC	linear covariate
Meuw.f	The Meuwissen method for computation of inbreeding coefficients
MPT	iEBV for mare performance test
MPTD	iEBV for dressage in mare performance test
MPTJ	iEBV for jumping in mare performance test
N	Number of horses in relevant subgroup
n_1	Number of generations from the sire to the common ancestor
n_2	Number of generations from the dam to the common ancestor
p	P-value
Pr	"The probability of"
PEDIG	Fortran 77 software package used for computation of inbreeding coefficients
r	Accuracy of selection of genetic gain
R^2	R-squared
RF	Rasmussen Factor
rg	Genetic Correlation
SEXj	Fixed effect of sex

S.D.	Standard Deviation
SF	Selle Français horse
SPT	iEBV for stallion performance test.
SPTD	iEBV for dressage in stallion performance test.
SPTJ	iEBV for jumping in stallion performance test.
SS	Sum of Squares
SWB	Swedish Warmblood horse
T	Generation interval
TC	iEBV for Tournament competitions
TCD	iEBV for tournament competitions dressage
TCJ	iEBV for Tournament competitions jumping
TI	Total Index
TID	Total Index Dressage
TIJ	Total Index Jumping
TIMEFORM	Relates to Timeform Publications and is a publishing company in Halifax, West Yorkshire, England as used by the racing industry to produce information and statistics on individual racehorses.
TORIS	Turnier ORganisations und Informations System
TSP	(Turniersportprüfung) Sport events - show jumping and dressage competitions.
V_P	Phenotypic variation
V_G	Variation in genetic values
VA	(Veranlagungsprüfung) ability test of young stallions,
vanrad.f	The van Raden method for the computation of inbreeding coefficients
YC	iEBV for Young Horse competitions

YCD	iEBV for Young Horse competitions dressage
YCJ	iEBV for Young Horse competitions jumping
yijkl	Breeding value (iEBV)
ZSP	(Zuchtstutenprüfung) Own performance test of mares,
μ	Model constant

List of Figures

List of Tables

List of Equations

List of Models

$y_{ijkl} = \mu + b\ IBC_i + SEX_j + BYEAR_k + e_{ijkl}$

y_{ijkl} = breeding value (iEBV)

μ = model constant

IBC_i = inbreeding coefficient of $horse_i$

SEX_j = fixed effect of sex

$BYEAR_k$ = fixed effect of birth year class (k=1-10; 1990-1991, 1992-1993, ..., 2008-2009)

e_{ijkl} = random residual

$y_{ijkl} = \mu + IBCC_i + SEX_j + BYEAR_k + e_{ijkl}$

y_{ijkl} = breeding value (iEBV)

μ = model constant

$IBCC_i$ = fixed effect of inbreeding coefficient class (i=1-5; IBC=0.00, $0.00 < IBC \leq 0.01$, $0.01 < IBC \leq 0.02$, $0.02 < IBC \leq 0.05$, $IBC > 0.05$)

SEX_j = fixed effect of sex (j=1-2; stallions, mares)

$BYEAR_k$ = fixed effect of birth year class (k=1-10; 1990-1991, 1992-1993, ..., 2008-2009)

e_{ijkl} = random residual