Martin-Luther-University Halle-Wittenberg
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Animal Breeding

Health traits and lactation survival in relation to conformation traits in German Holstein Cows

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Session 4 "Innovative dairy research and extension (Young Train)", Aug 26th 2019, 08:30

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Introduction

- conformation is a well recorded trait
    - it is still important to many breeders and breeding organizations
    - it corresponds to longevity
- health traits become more and more important
    - but health recording is a challenge within farms

The objectives:
1. analyze relationships between health traits and conformation traits
2. analyze differences in conformation traits comparing cows culled within the first lactation to cows reaching four or more lactations

Material and methods

- data originated from large contract herds in North-Eastern Germany
  - all cows are scored for conformation during first lactation (19 traits recorded on a 1 to 9 scale, except for stature, measured in cm)
  - health traits for all sorts of diseases were recorded under a supervised scheme

- **data set I**: 56,273 first lactation records with information on health and conformation,
  - years of first calving from 2008 to 2015

- **data set II**: 8,272 cows culled within the first lactation and 24,933 cows that finished at least three lactations
  - years of first calving from 2008 to 2013

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Material and methods – Health traits and longevity traits

- **two different health trait definitions:**
    1) number of new cases over all main groups (from 0 to n)
    2) number of different groups of disease cases during lactation (from 0 to 4)

    ➢ **main groups of diseases are:** mastitis, claw disorders, reproductive disorders, metabolic disorders

- **definition for longevity:**
    - culled within first lactation (LS1) or survived third lactation (LS4+)

Material and methods – Data set I

- linear mixed models were used for data analysis in SAS 9.4 :

$$y_{ijklmno} = \mu + HYSC_i + RANK_j + AFC_k + HT_l + \beta LL_m + s_n + e_{ijklmno}$$

$y_{ijklmno}$	conformation trait
μ	overall mean
$HYSC_i$	herd*year*season*classifier (i=1,2,…,2025)
$RANK_j$	rank for milk yield (j=1,2,3)
AFC_k	age at first calving (k=1,2,…,5)
HT_l	health trait (l=0,1,…,5)
βLL_m	regression coefficient for lactation length
s_n	random sire effect
$e_{ijklmno}$	random residual effect

Health traits:

1. *number of new cases*
   - from 0 (=healthy) to 5+ across diseases
2. *number of different groups of disease cases*
   - from 0 to 3 or 4 different groups of diseases

Material and methods – Data set II

- linear mixed models were used for data analysis in SAS 9.4 :

$$y_{ijklmn} = \mu + HYC_i + RANK_j + AFC_k + LS_l + s_m + e_{ijklmn}$$

y_{ijklmn}	conformation trait
μ	overall mean
HYC_i	herd*year*classifier (i=1,2,…611)
$RANK_j$	rank for milk yield (j=1,2,3)
AFC_k	age at first calving (k=1,2,…,5)
LS_l	lactation survival (l=1,2)
s_m	random sire effect
e_{ijklmn}	random residual effect

Longevity:
- ➤ defined as *lactation survival* two categories/classes:
  - culled during first lactation (LS1)
  - survived at least three lactations (LS4+)

Results – Data set I – Frequency within health traits

Number of new disease cases
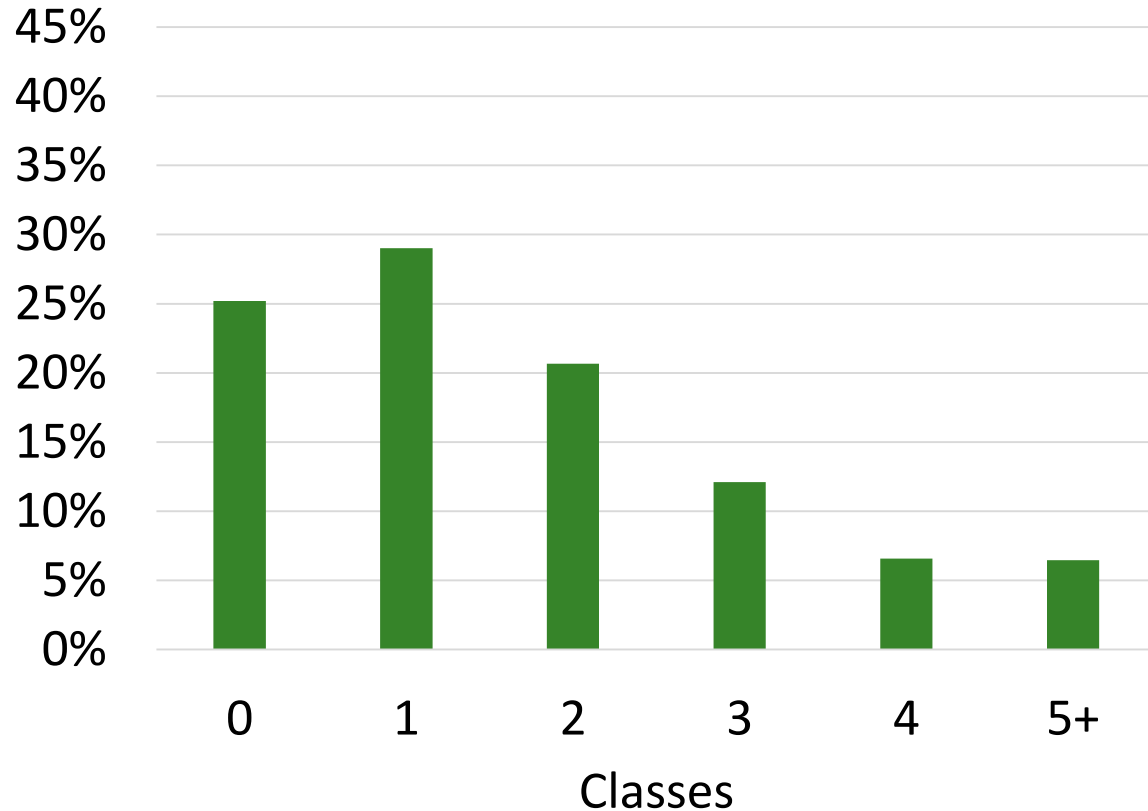
Number of different groups of disease cases

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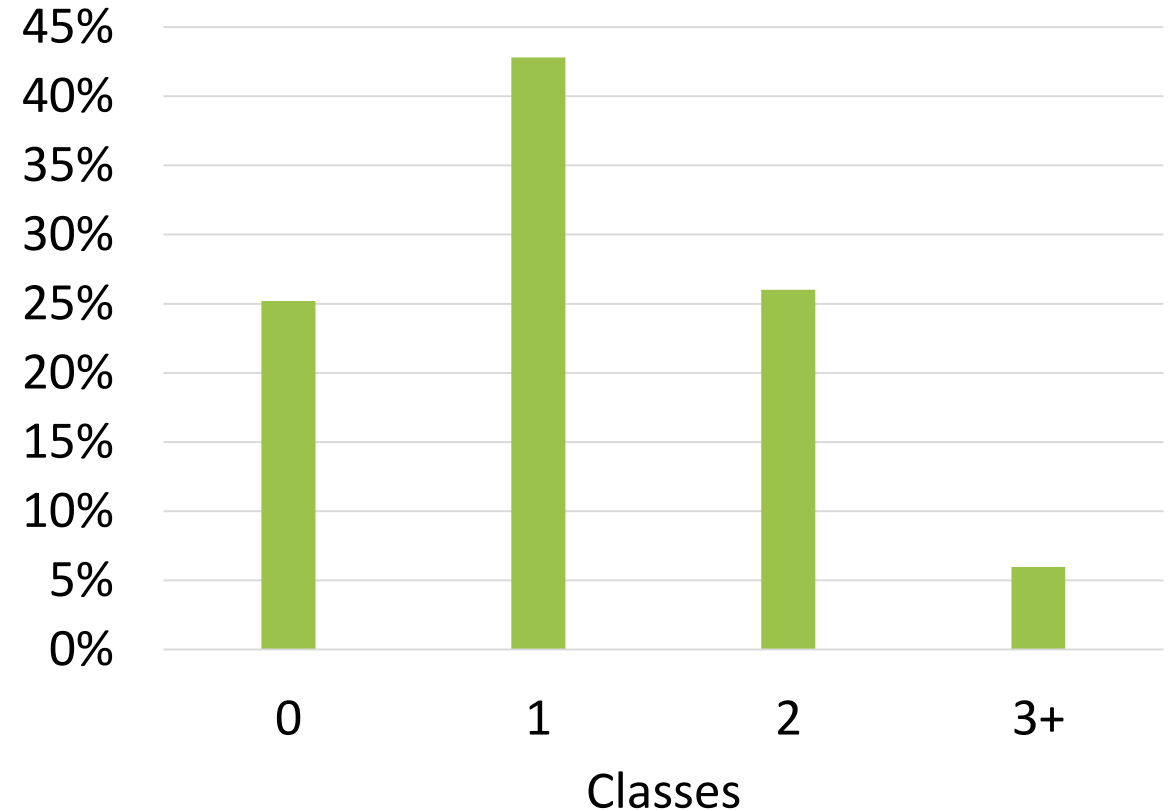
Table 1 LSMEANS for conformation traits with a highly significant (p<0.0001 and F-value>10) effect of *number of new disease cases*

Class	Dairy form	Rump width	Rear leg set	Hock quality	Foot angle	Loco-motion	Fore udder attachment	Udder depth	Body condition
0	5.38	5.23	5.17	5.17	5.00	5.16	5.48	5.64	5.07
1	5.46	5.25	5.22	5.12	4.97	5.05	5.40	5.57	5.00
2	5.52	5.27	5.26	5.10	4.94	4.98	5.30	5.50	4.92
3	5.59	5.32	5.30	5.05	4.91	4.85	5.24	5.45	4.84
4	5.64	5.32	5.36	5.03	4.87	4.75	5.14	5.40	4.78
5+	5.75	5.41	5.45	4.94	4.83	4.55	5.07	5.37	4.63
Diff	-0.37	-0.17	-0.28	+0.23	+0.17	+0.61	+0.41	+0.27	+0.44

SE ranged from 0.02 to 0.03

- **further important traits**: stature, chest width, rump angle, rear leg rear view, rear udder height, central ligament

Results – Data set I – *Number of different groups of diseases*

Table 2 LSMEANS for conformation traits with a highly significant (p<0.0001 and F-value>10) effect of *number of different groups of diseases*

Class	Dairy form	Rump width	Rear leg set	Hock quality	Rear leg rear view	Foot angle	Loco-motion	Rear udder height	Central liga-ment	Fore udder attach-ment	Udder depth	Body con-dition
0	5.38	5.23	5.18	5.17	5.03	4.99	5.15	5.31	5.51	5.48	5.64	5.06
1	5.49	5.26	5.24	5.11	4.98	4.95	5.01	5.26	5.45	5.38	5.55	4.96
2	5.57	5.31	5.31	5.04	4.93	4.91	4.85	5.23	5.43	5.21	5.44	4.85
3+	5.72	5.40	5.39	5.04	4.82	4.87	4.70	5.17	5.36	5.08	5.32	4.70
Diff	**-0.34**	**-0.17**	**-0.21**	**+0.13**	**+0.21**	**+0.12**	**+0.45**	**+0.14**	**+0.15**	**+0.40**	**+0.32**	**+0.36**

SE ranged from 0.02 to 0.03

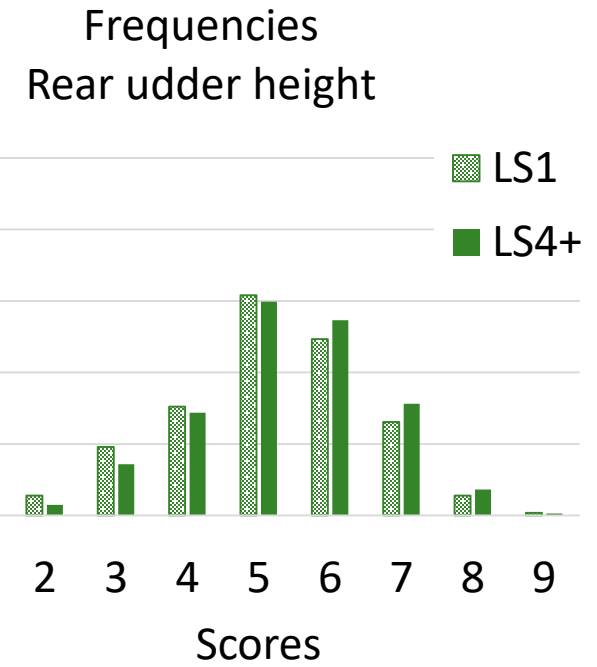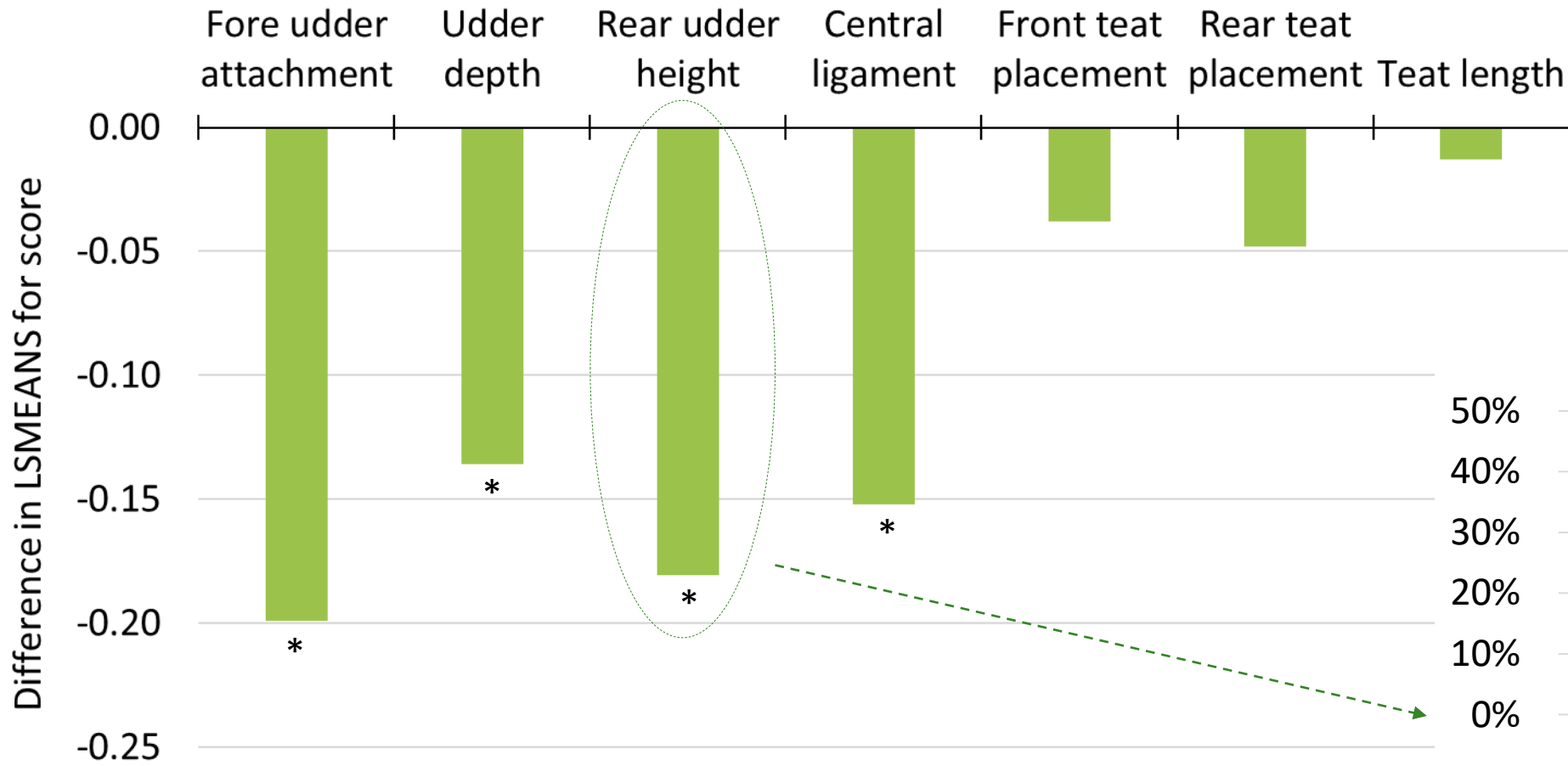- **further important traits**: stature, rump angle
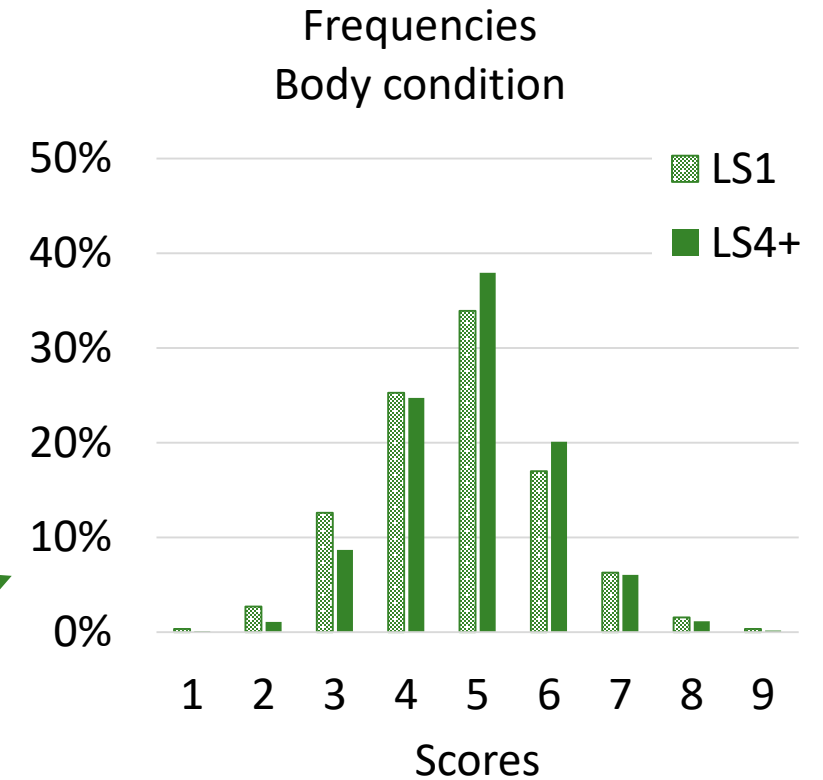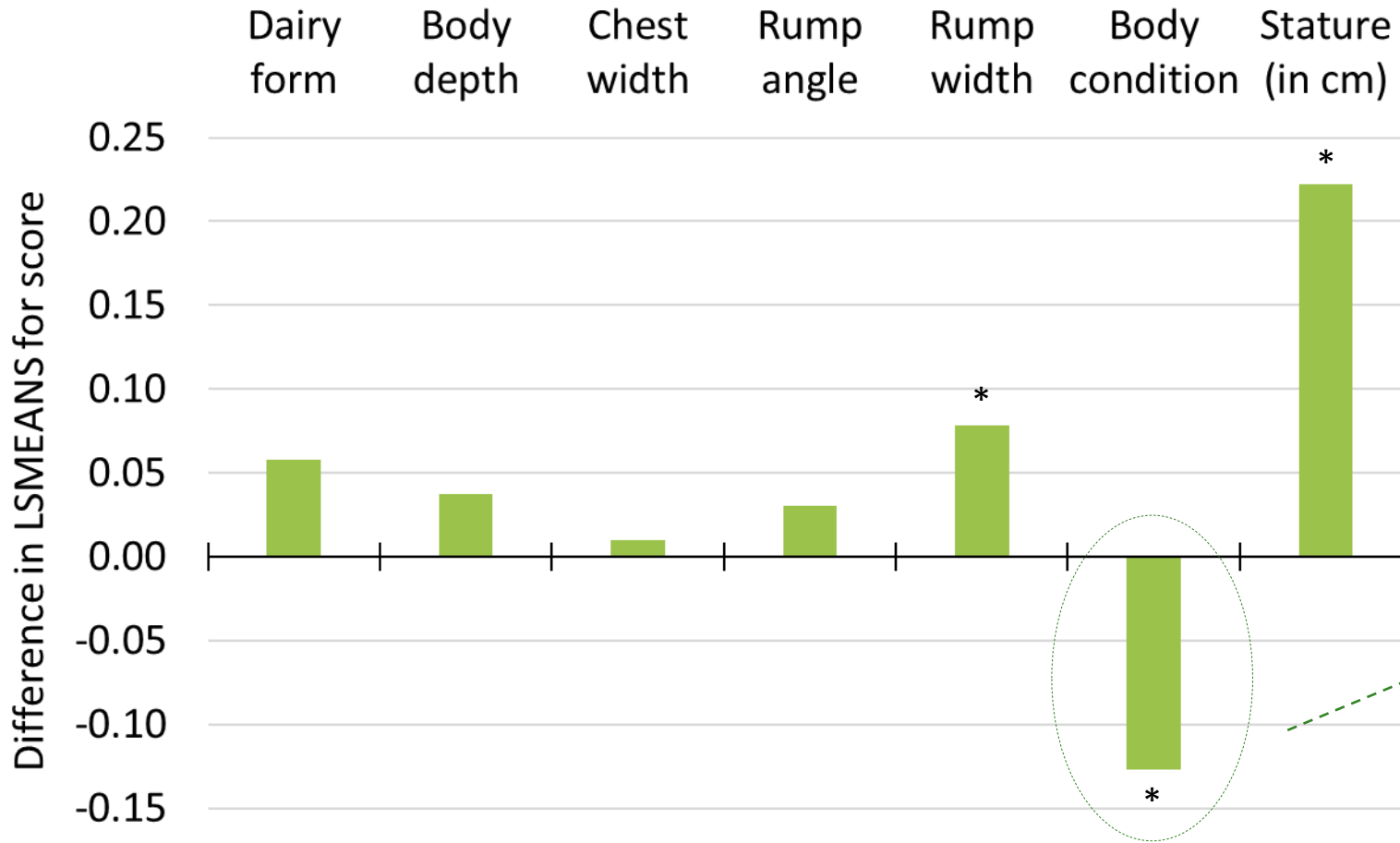
* p<0.0001

Results – Data set II – Differences in feet and legs scores contrasting (LS1 - LS4+)
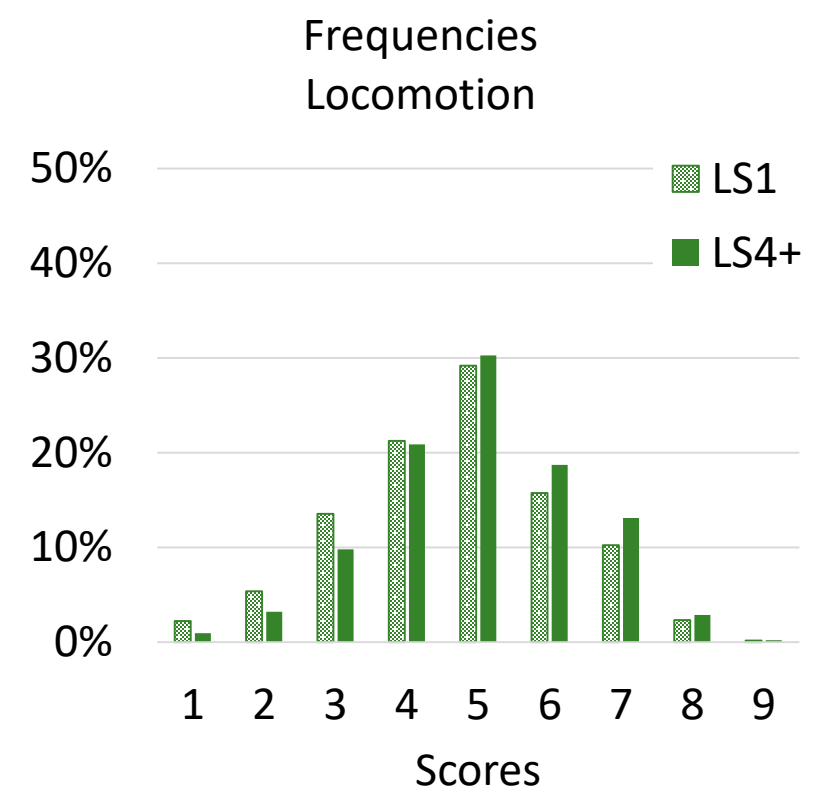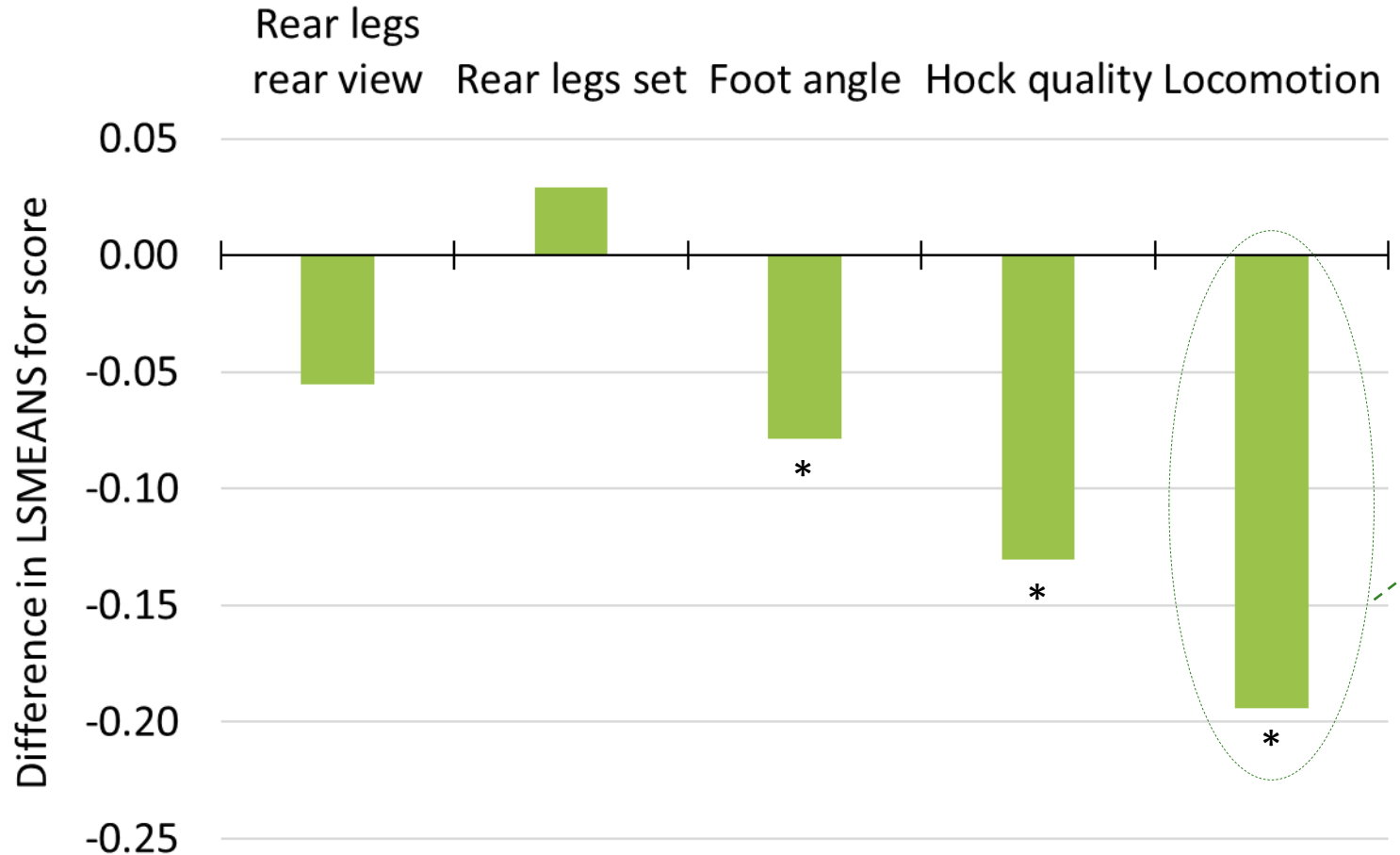
* p<0.0001

Results – Data set II – Differences in udder scores contrasting (LS1 - LS4+)

* p<0.0001

Conclusion

Data set I

Healthier cows have...

Data set II

Older cows have...

higher scores for

rear leg rear view

fore udder attachment, central ligament, udder depth, rear udder height

hock quality, foot angle, locomotion

and body condition

lower scores for

dairy form
and rear leg set

rump width

... and are less tall

Overall conclusion

- there are conformation traits which are valuable indicators of health and longevity in dairy cattle

- important traits differ hardly between the two data sets and should be the focus of breeding for improved conformation

- it could be discussed if other conformation traits are really needed

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Example: mastitis with determined healing period of 14 days:

1. diagnosis on day 20
2. diagnosis on day 21
3. diagnosis on day 23
4. diagnosis on day 24
5. diagnosis on day 30
6. diagnosis on day 50
7. diagnosis on day 55 (Digital dermatitis)

Figure legend

— first diagnosis/new disease case
— repeated diagnosis (R)/treatment (T)
— R or T extend disease period
— first diagnosis of other disease
LD   lactation day

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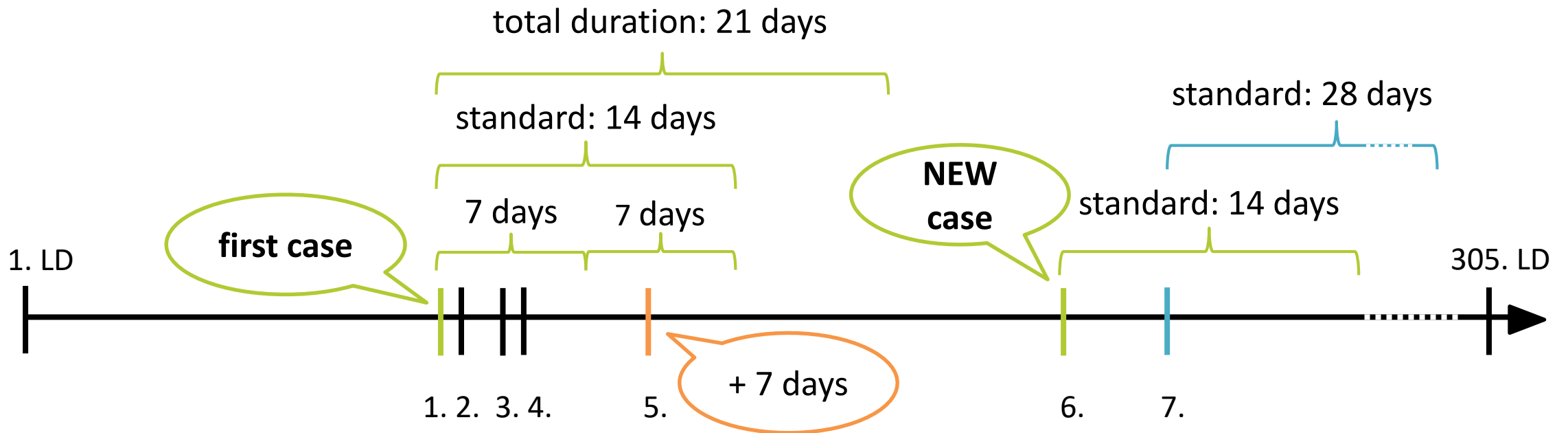
Results – Data set I – *Number of new disease cases*

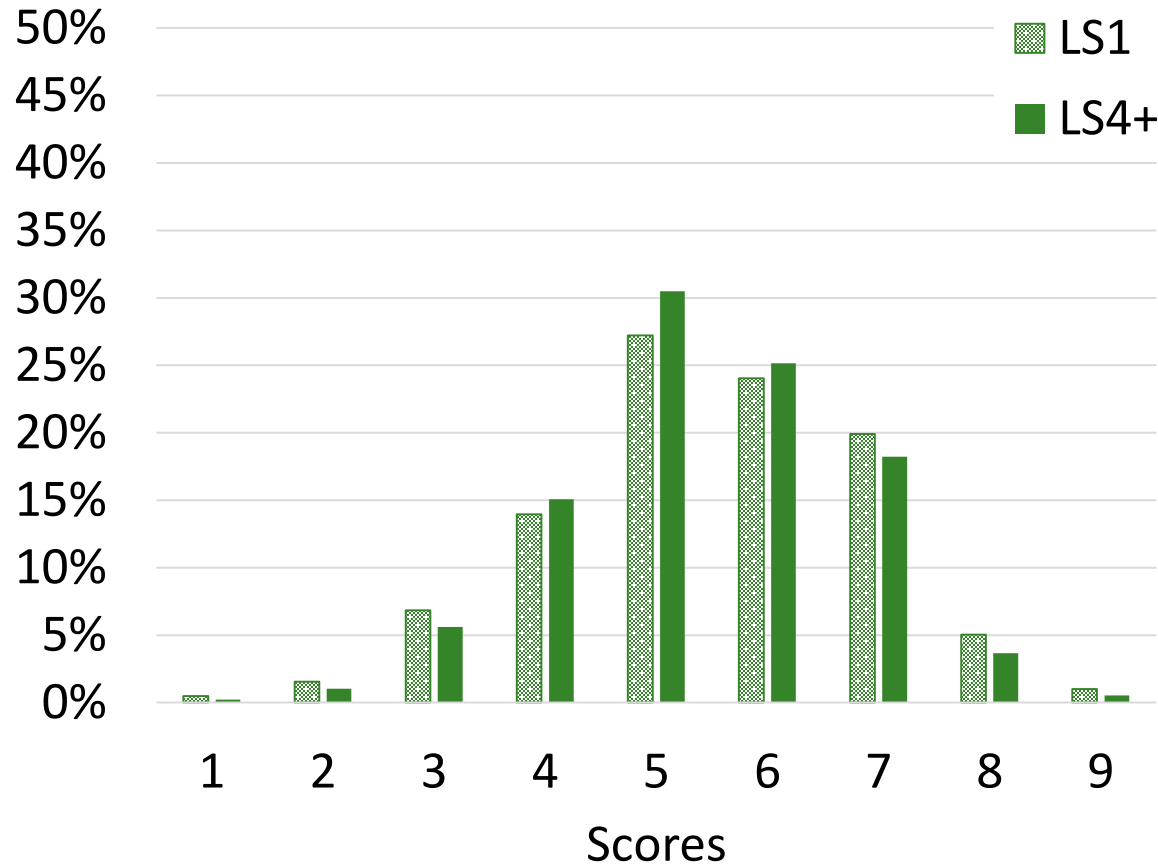**Figure 1** LSMEANS for conformation traits with a highly significant (p<0.0001) effect of *number of new disease cases*

Class	Stature	Dairy form	Chest width	Rump angle	Rump width	Rear leg set	Hock quality	Rear leg rear view	Rear udder height	Central ligament	Fore udder attachment	Udder depth	Foot angle	Body condition	Loco-motion
0	147.42	5.38	5.34	4.95	5.23	5.17	5.17	5.04	5.31	5.51	5.48	5.64	5.00	5.07	5.15
1	147.49	5.46	5.35	4.96	5.25	5.22	5.12	4.99	5.27	5.44	5.40	5.57	4.97	5.00	5.05
2	147.52	5.52	5.31	4.96	5.27	5.26	5.10	4.98	5.24	5.44	5.30	5.50	4.94	4.92	4.98
3	147.53	5.59	5.30	4.98	5.32	5.30	5.05	4.91	5.25	5.43	5.24	5.45	4.91	4.84	4.85
4	147.60	5.64	5.25	5.02	5.32	5.36	5.03	4.88	5.23	5.41	5.14	5.40	4.87	4.78	4.75
5+	147.77	5.75	5.25	5.08	5.41	5.45	4.94	4.80	5.16	5.39	5.07	5.37	4.83	4.63	4.55
Diff	**-0.35**	**-0.37**	**+0.09**	**-0.13**	**-0.17**	**-0.28**	**+0.23**	**+0.24**	**+0.15**	**+0.21**	**+0.41**	**+0.27**	**+0.17**	**+0.44**	**+0.60**

SE ranged from 0.02 to 0.03 (0.05-0.07 for stature)

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Results – Data set I – *Number of different groups of disease cases*

Figure 2 LSMEANS for conformation traits with a highly significant (p<0.0001) effect of *number of different groups of diseases*

Class	Stature	Dairy form	Rump angle	Rump width	Rear leg set	Hock quality	Rear leg rear view	Rear udder height	Central liga-ment	Fore udder attach-ment	Udder depth	Foot angle	Body con-dition	Loco-motion
0	147.42	5.38	4.95	5.23	5.18	5.17	5.03	5.31	5.51	5.48	5.64	4.99	5.06	5.15
1	147.49	5.49	4.96	5.26	5.24	5.11	4.98	5.26	5.45	5.38	5.55	4.95	4.96	5.01
2	147.56	5.57	4.99	5.31	5.31	5.04	4.93	5.23	5.43	5.21	5.44	4.91	4.85	4.85
3+	147.74	5.72	5.06	5.40	5.39	5.04	4.82	5.17	5.36	5.08	5.32	4.87	4.70	4.70
Diff	**+0.32**	**-0.34**	**-0.11**	**-0.17**	**-0.21**	**+0.13**	**+0.21**	**+0.27**	**+0.34**	**+0.40**	**+0.32**	**+0.12**	**+0.36**	**+0.45**

SE ranged from 0.02 to 0.03 (0.05-0.07 for stature)

Dairy form

Stature
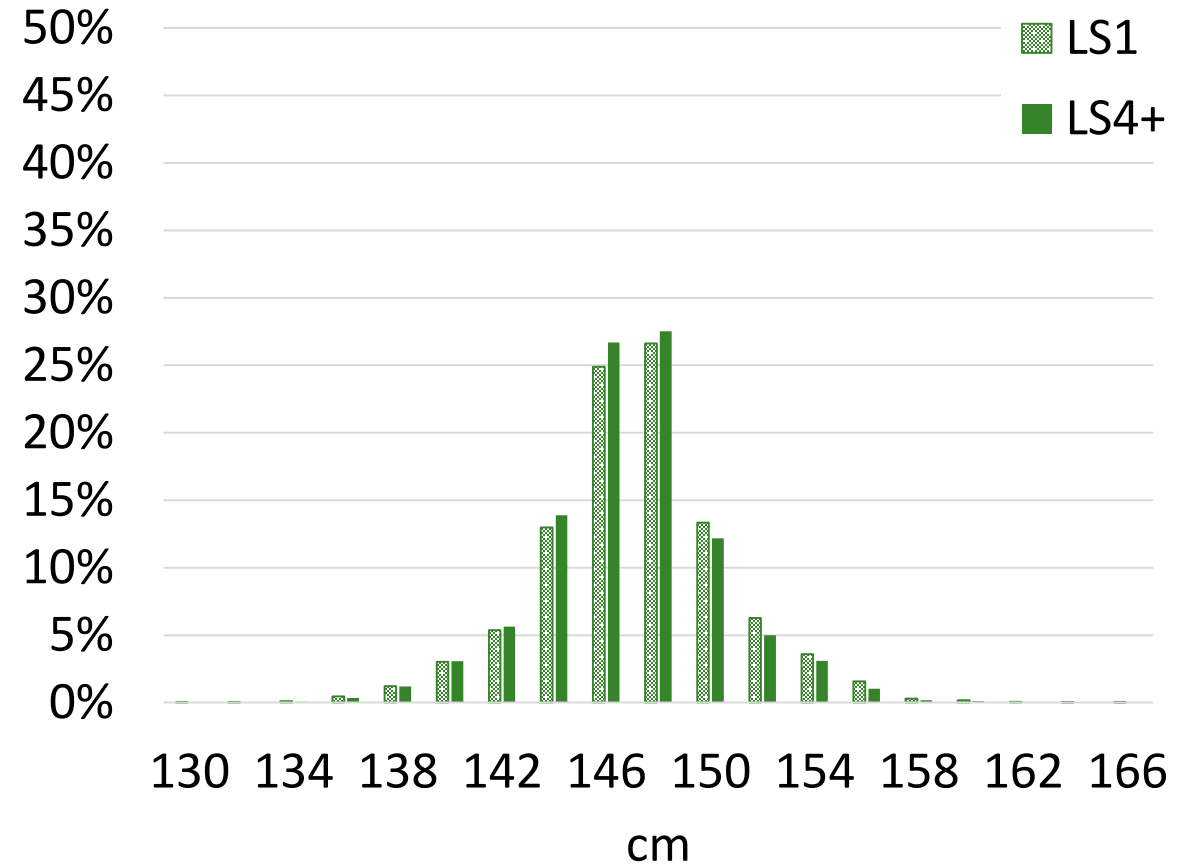
Results – Data set II – Frequency of scores

Body depth
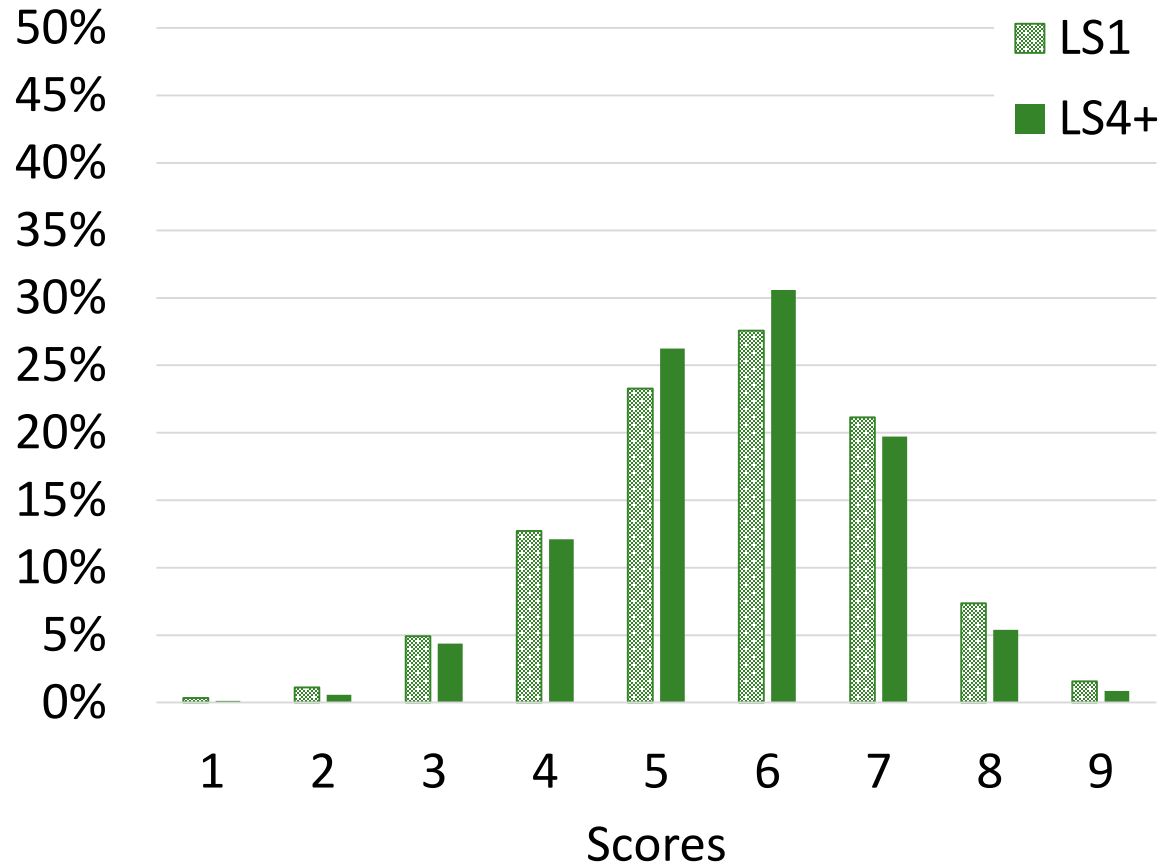
Chest width
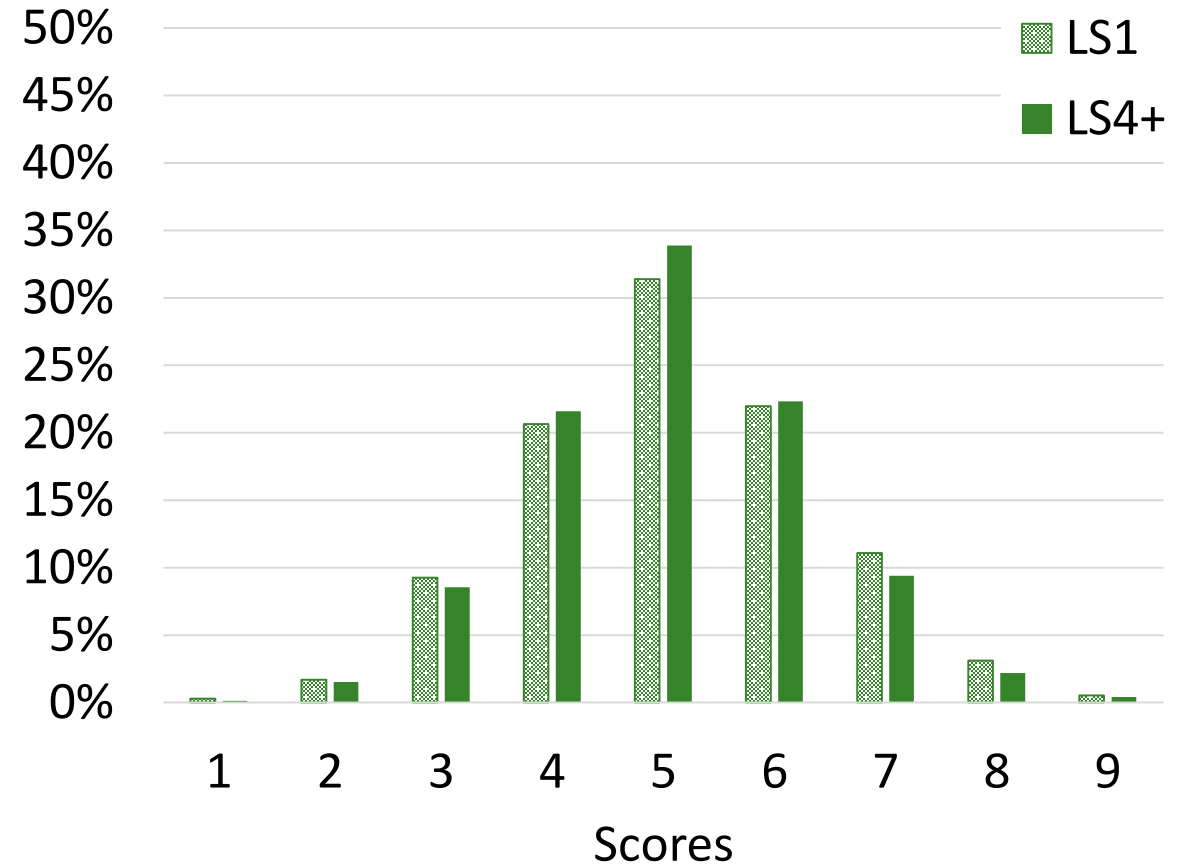
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Rump width

Rump angle

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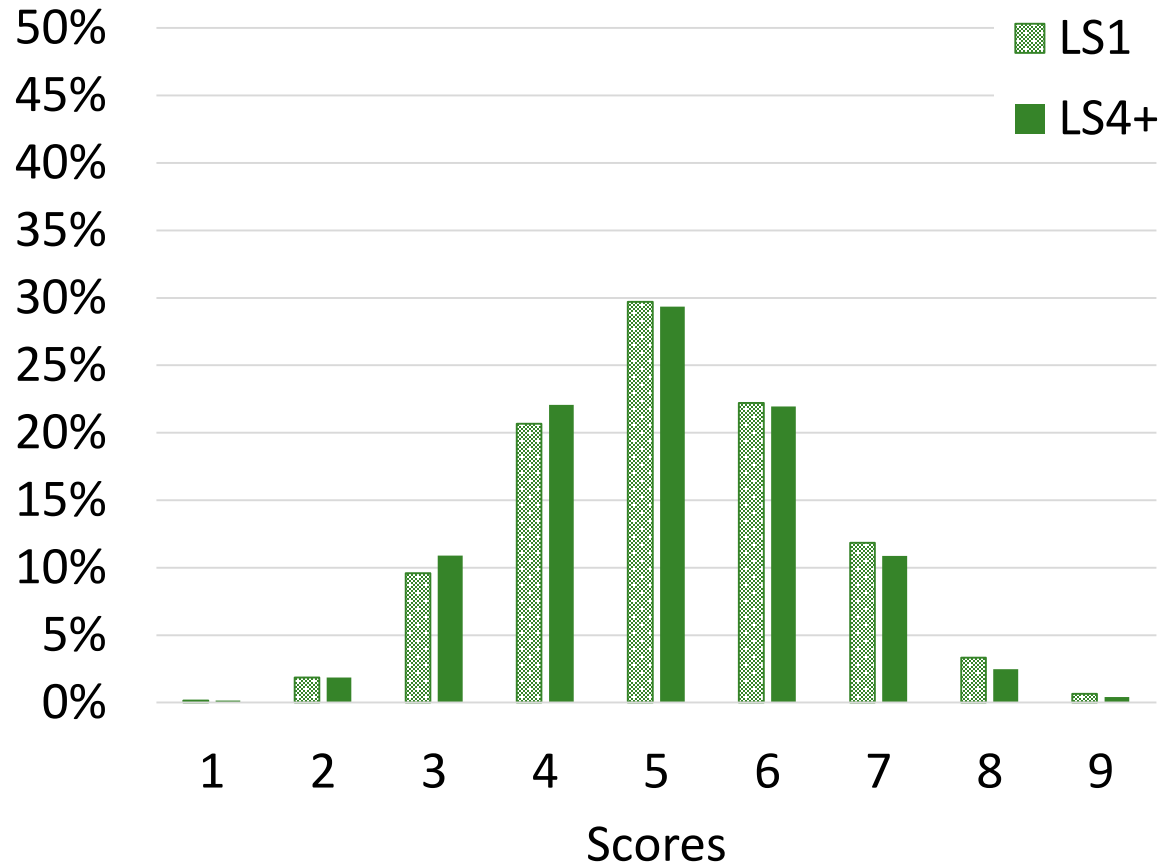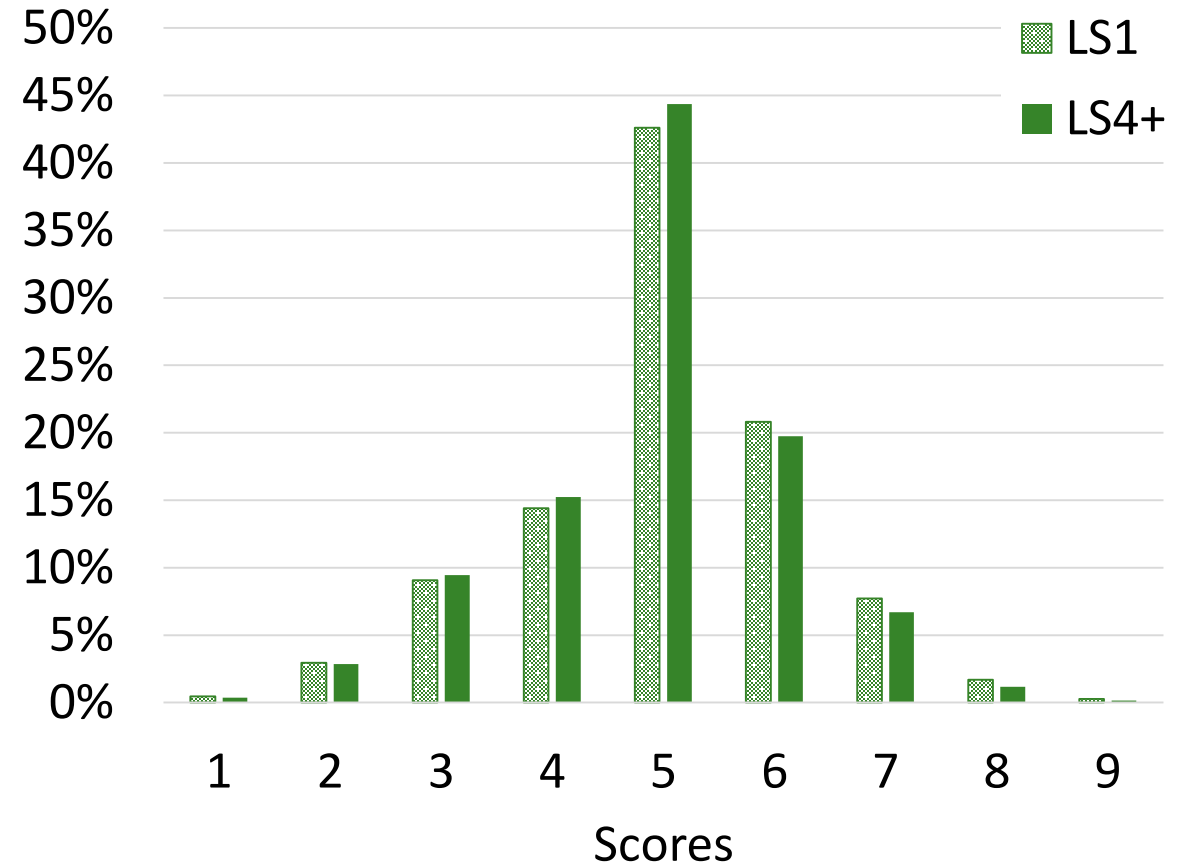
Results – Data set II – Frequency of scores for body condition and stature

Body condition
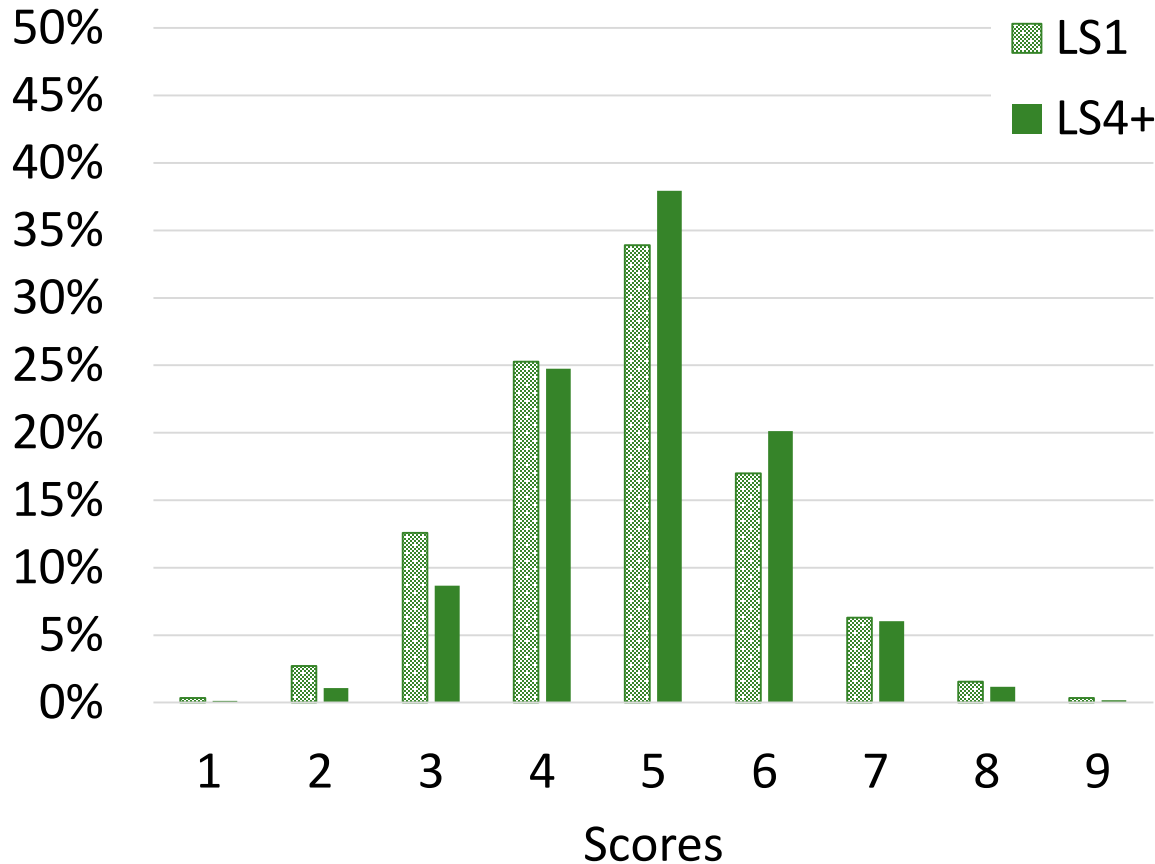
Locomotion
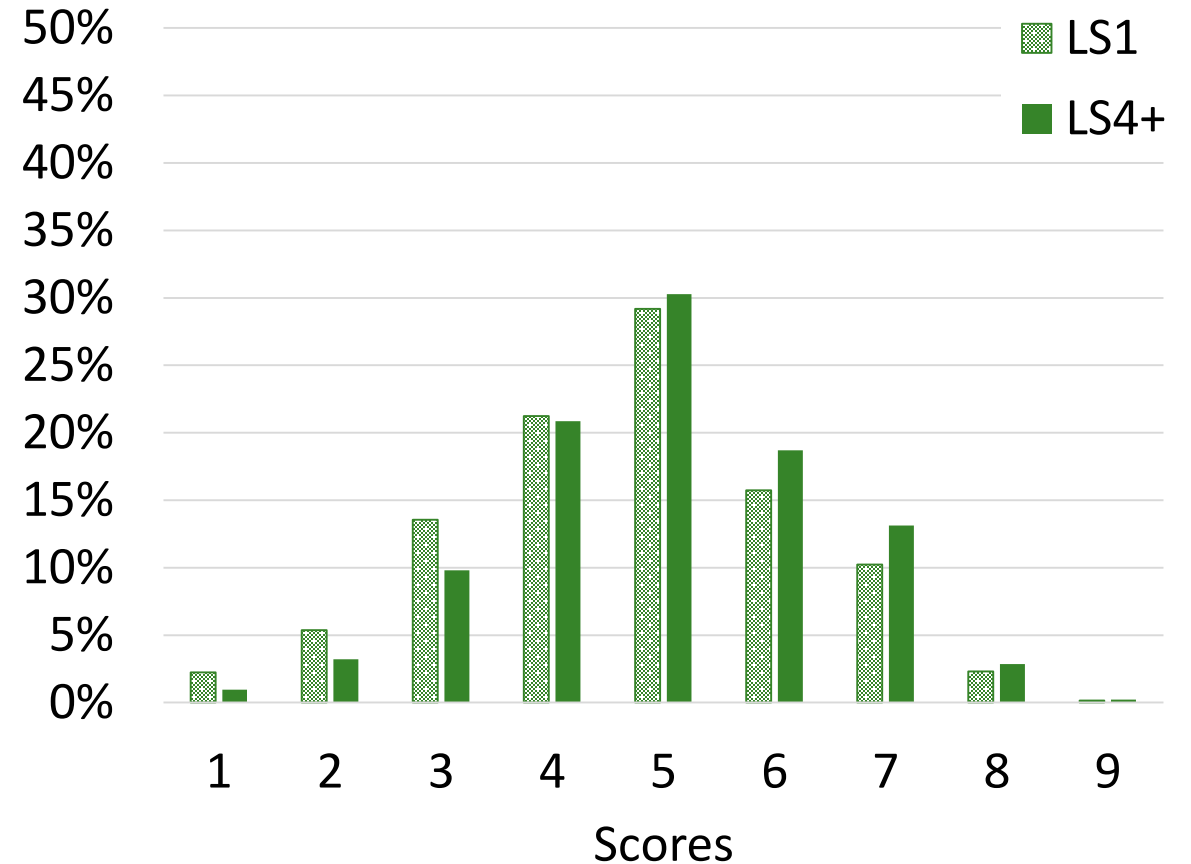
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Hock quality

Rear leg set
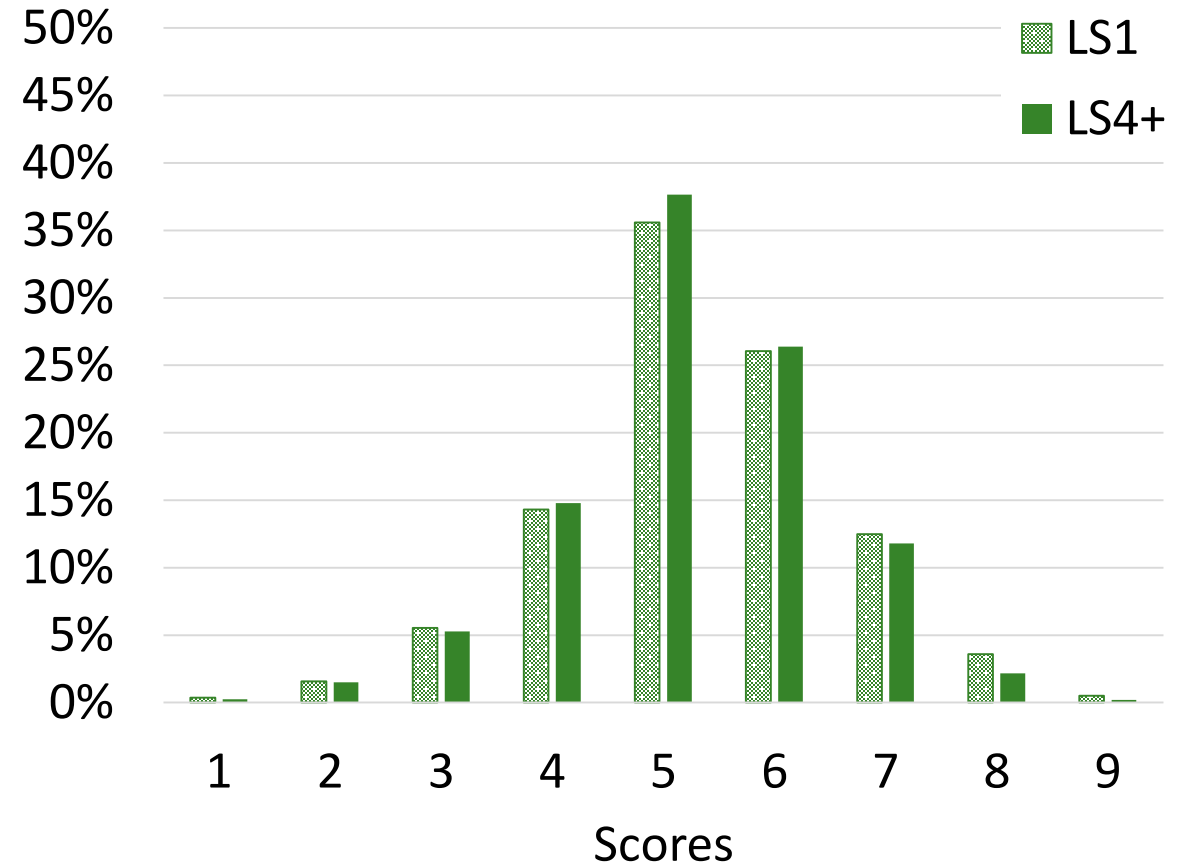
Rear leg rear view
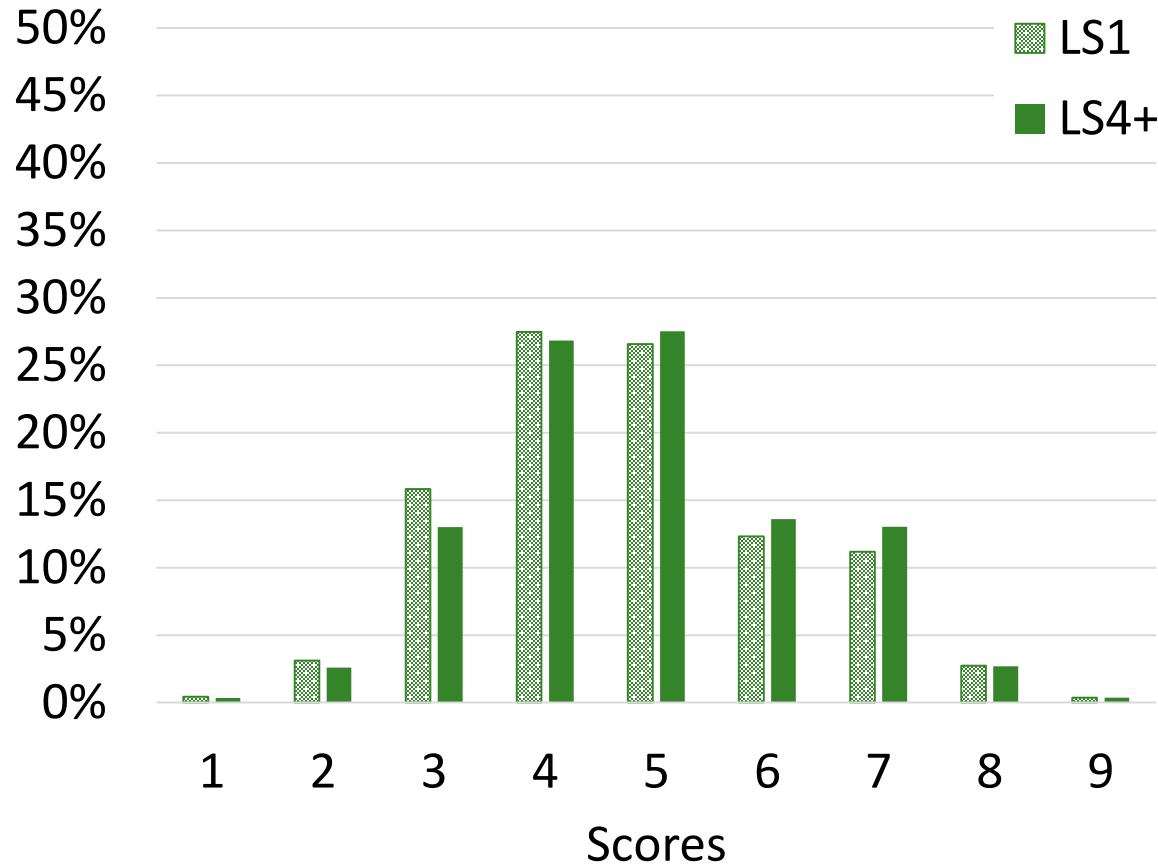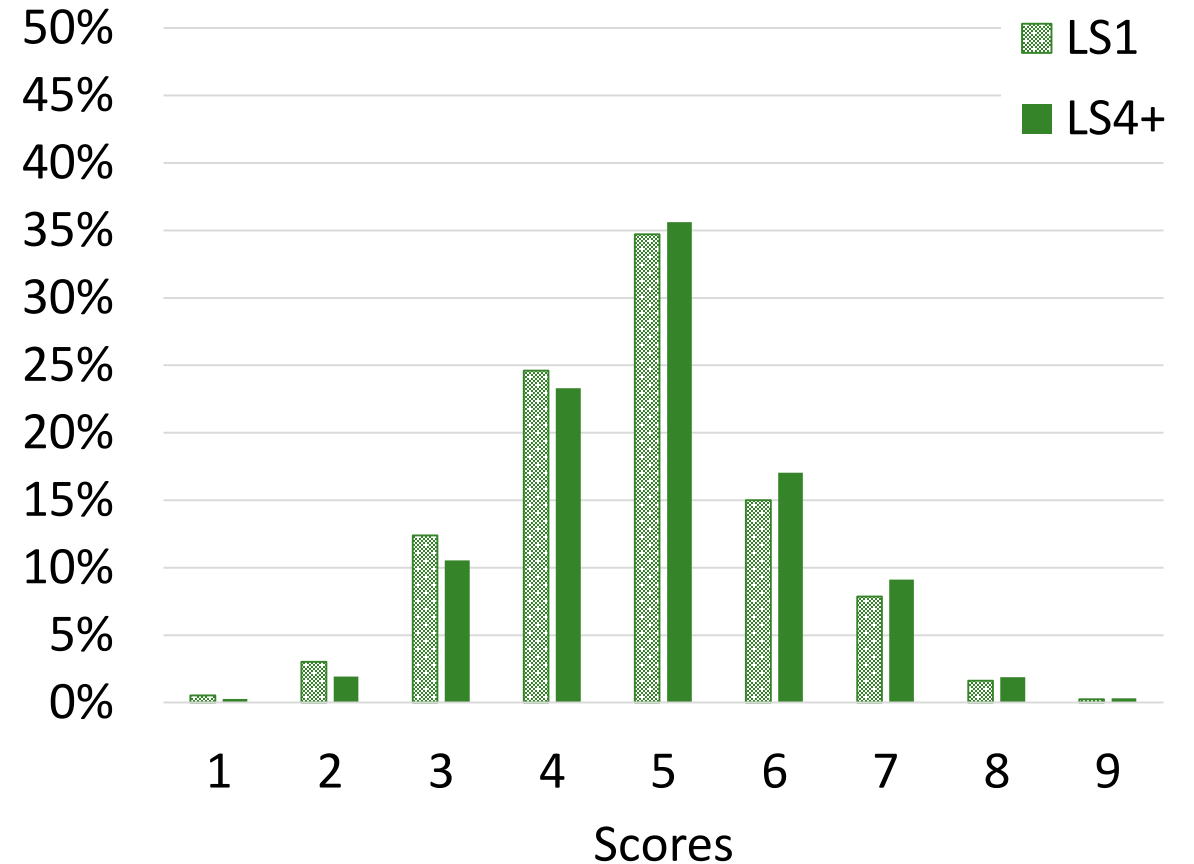
Foot angle

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Fore udder attachment

Udder depth

Rear udder height — LS1, LS4+

Central ligament — LS1, LS4+

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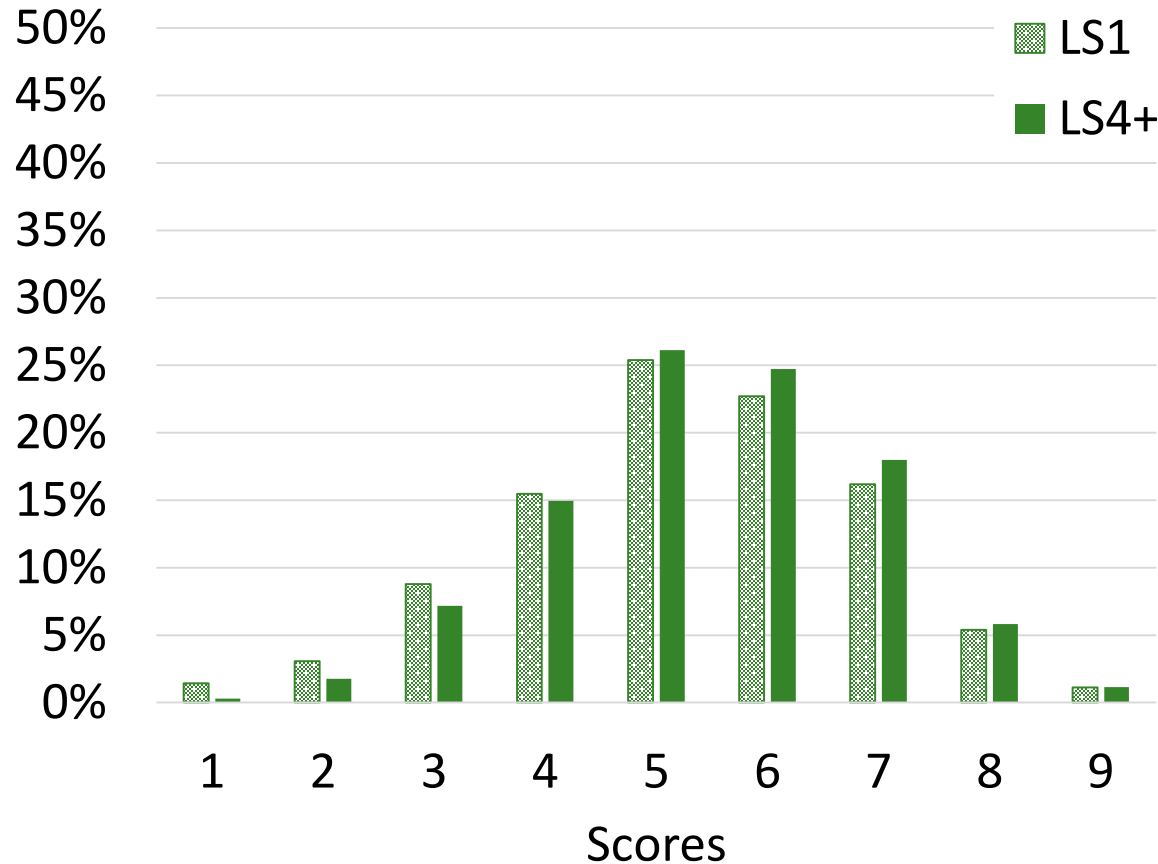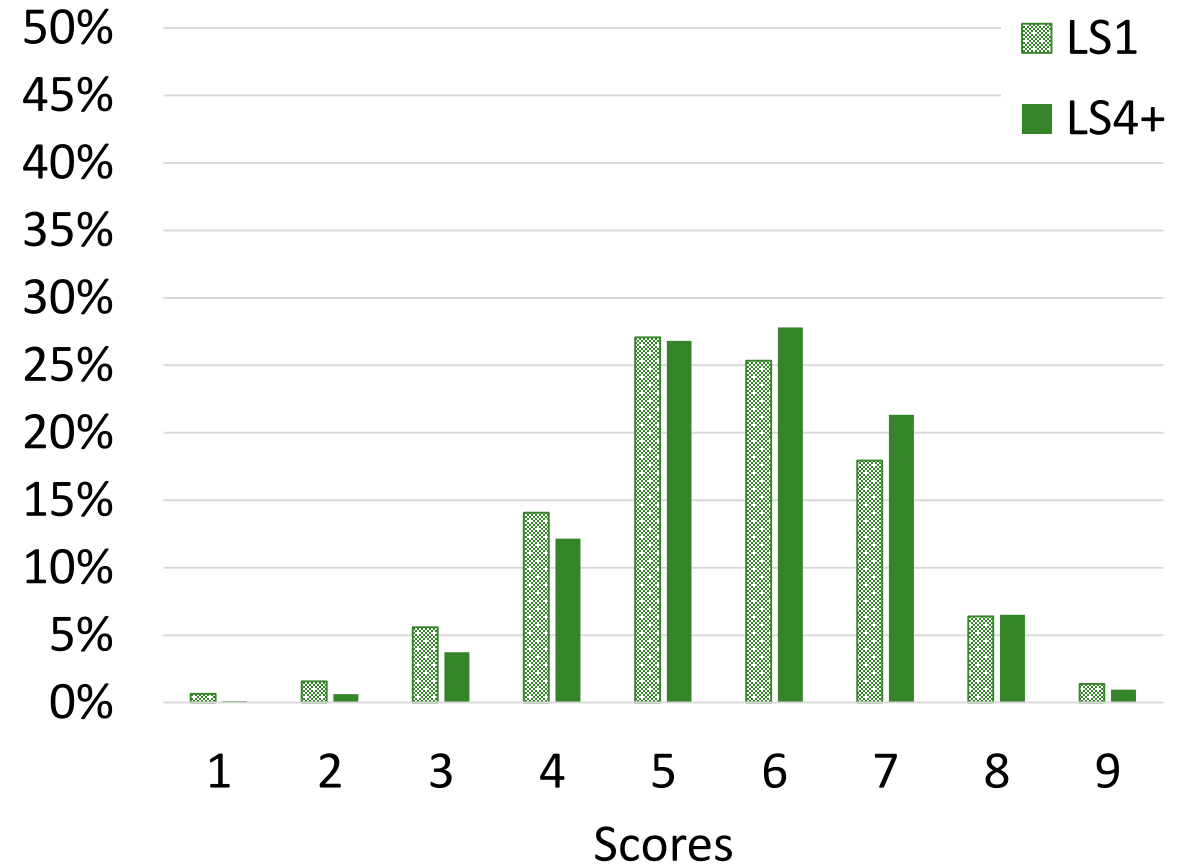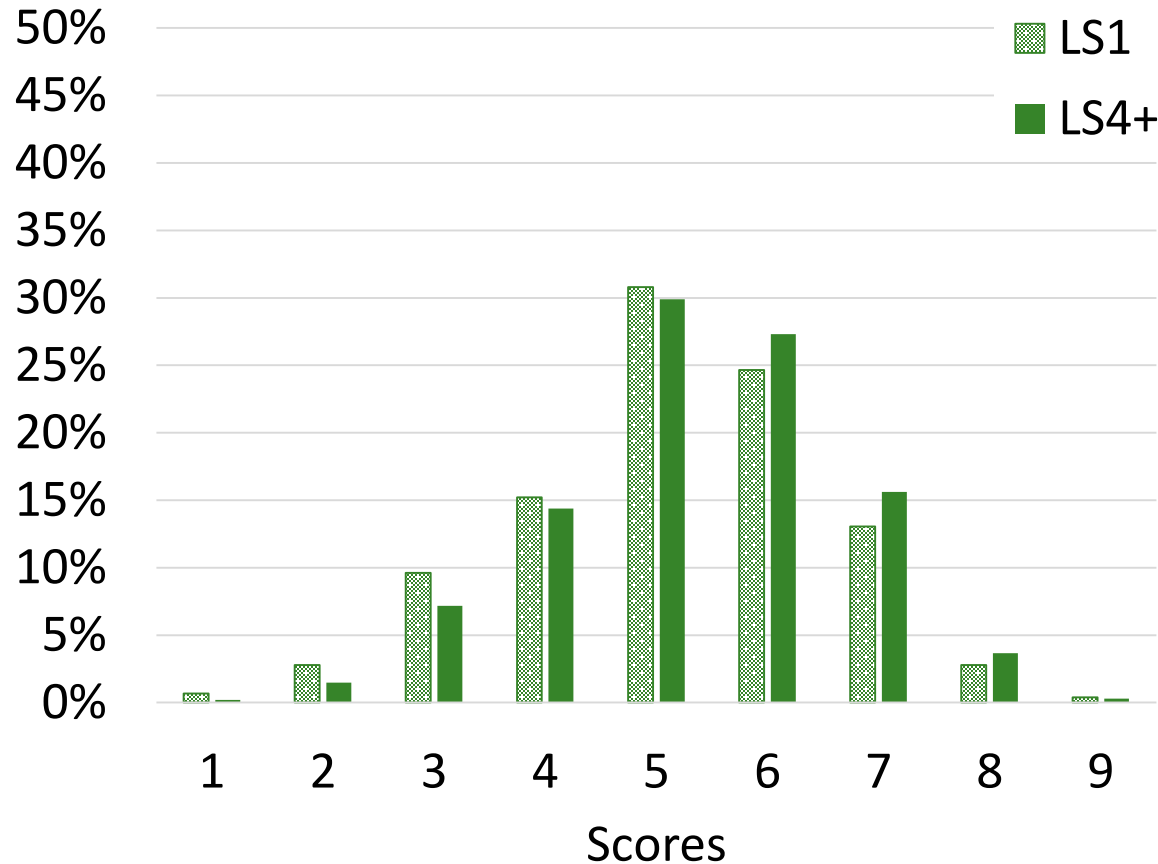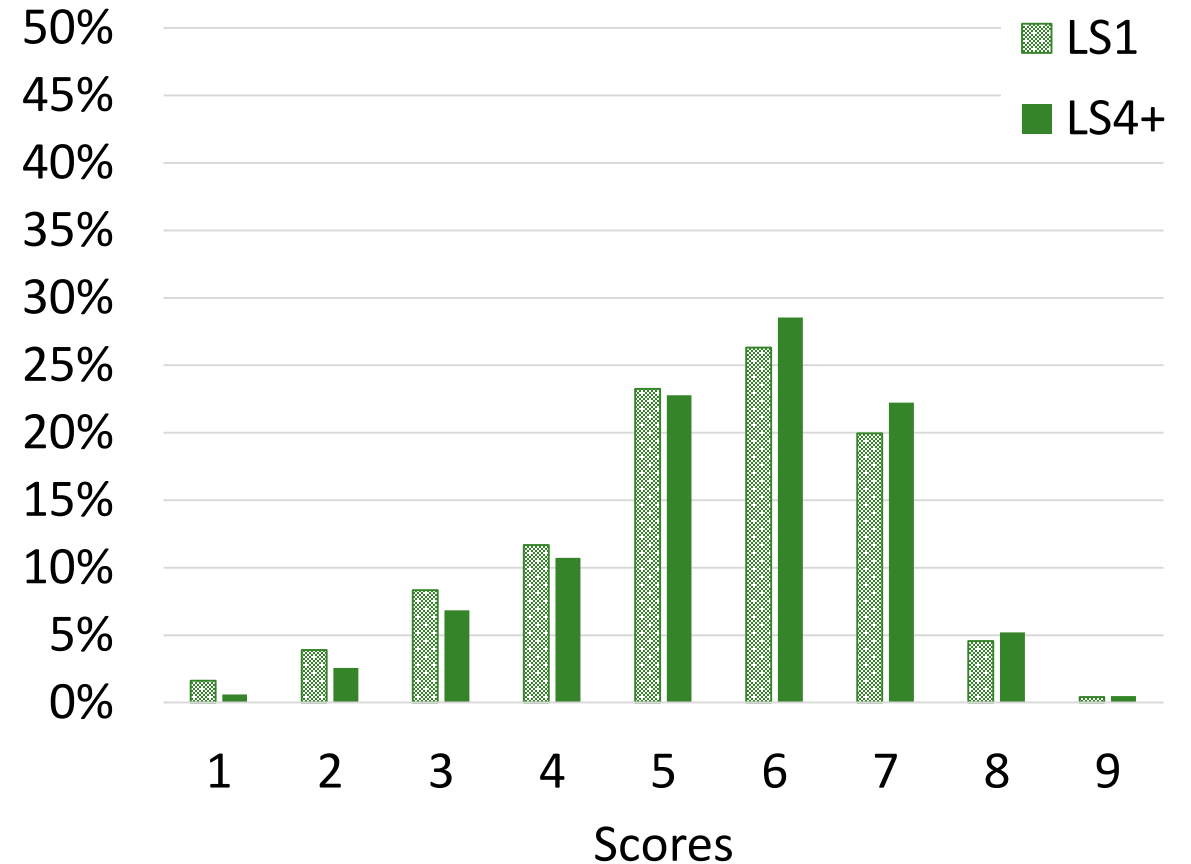
Results – Data set II – Frequency of scores

Teat length
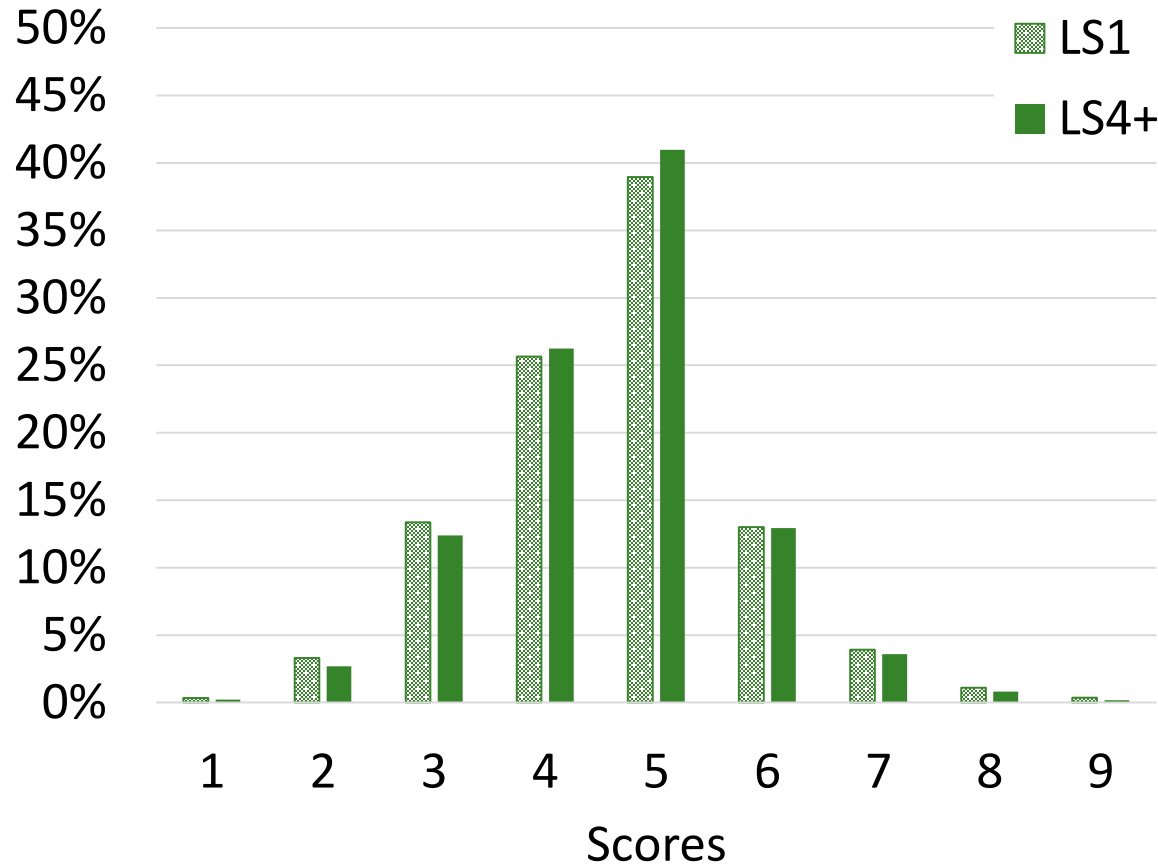
Fore teat position

Rear teat position

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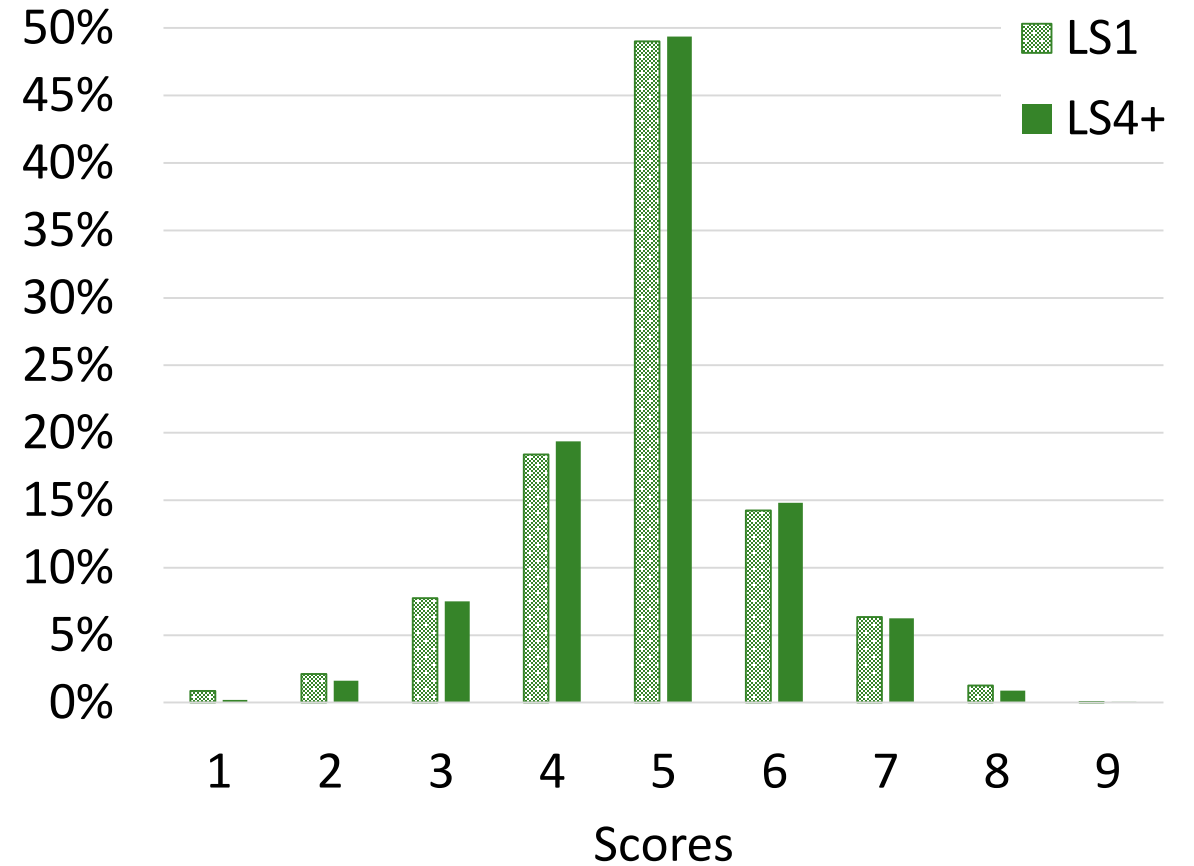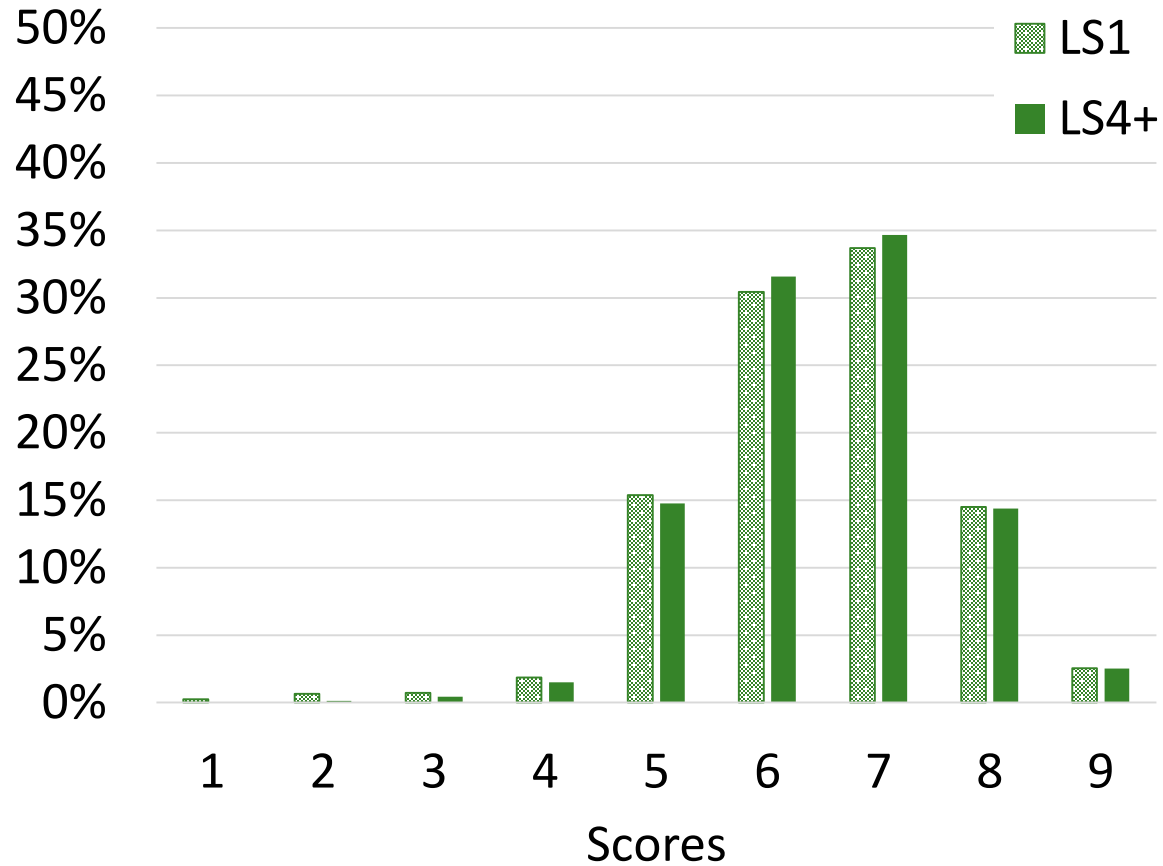
Frequencies of number of new disease cases

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