The Effect of the Abattoir on Beef Carcass Classification Results

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Summary

The aim of the present study was to test a possible way of monitoring cattle carcass classification using a statistical approach. For that purpose the analysis of covariance (ANCOVA by SAS) was used with the fixed effect of the abattoir, carcass weight (as a covariate) and their interaction. The analysis was based on the relationship between carcass weight and conformation or fatness grades. We tested if the regression lines of individual abattoirs differ from the average. The analysis comprised data for young bulls of Simmental breed slaughtered in Slovenia in the period from 2007 to 2010 (52,624 records). Results showed that in many abattoirs the assessment of conformation and fatness deviates significantly from the average, i.e. regression lines for several abattoirs differ significantly from the average (population) line. Differences were more important for the conformation than fatness. The statistical process control using the analysis of covariance can be used for additional monitoring of cattle carcass classification.

Key words

cattle, carcass classification, uncertainty, abattoir effect, statistical control

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Received: May 13, 2011 | Accepted: July 6, 2011

ACKNOWLEDGEMENTS
The authors acknowledge the financial support from the Slovenian Research Agency (programme P4-0072 and P1-0164).

Aim

Various measurements or assessments are always subjected to the instrument and/or evaluator's error(s), which could have smaller or greater consequences for the final results of the control. Legal acts (Commission Regulation, 2008; UL RS 2/2010) concerning the classification EUROP lay down an obligation to monitor/check the work of the evaluators in cattle carcasses classification. In Slovenia, the regular monitoring of cattle carcass classification is performed with on-spot checks (every three months); the control can also be done upon the reclamation from the parties involved. It is performed, in both cases, by the official government inspectors. A recent study of Diez et al. (2003) showed that the performance of the classifiers can be affected by carcass weight (different for standard or light carcasses). To our knowledge there is no literature available dealing with the accuracy of the EUROP classification in beef cattle. In the present study, we tested a possible statistical approach of continuous monitoring, based on the data that are gathered daily on the slaughter line. Unfortunately, in the Slovenian situation, the evaluator performing carcass grading is not recorded by the classification body. It is therefore difficult to evaluate the exact evaluator's contribution to the classification uncertainty. We can only assume, by knowing that within the same abattoir the majority of measurements are taken by one person, that the main factor of abattoir effect is the evaluator. Under the given circumstances, it was the aim of our study to evaluate the differences between the abattoirs in the EUROP classification performance in Slovenia.

Material and methods

Data for the analysis was gathered from official classification body for a period of four years (2007 to 2010). In order to minimize possible effects of breed or crossing and age category, only the data for the Simmental young bulls (age of 12 to 24 months) were included in the analysis which represents the most numerous age category and breed in Slovenia. Thus the analysis was performed on 52,624 records (Table 1). The analysis was based on the association between warm carcass weight (as independent variable) and conformation or fatness (as dependent variables). We calculated regression lines for individual abattoir and compared them to the average (population) line. Prior to the statistical analysis, warm carcass weight was rounded to 5 kg. A condition of at least five records per each carcass weight class, abattoir and year had to be fulfilled, i.e. providing at least 20 data (conformation and fatness grades) for each value of carcass weight class. That way all abattoirs were equally represented in the estimation of the average (population) line, used as the basis for the comparison. Altogether, the analysis comprised nine abattoirs with warm carcass weight ranging from 210 to 518 kg. Data was analyzed using the analysis of covariance (ANCOVA procedure) of statistical package SAS 9.1 (2002). A model included the effect of the abattoir, warm carcass weight (as covariate) and their interaction. Pair-wise comparisons of different abattoirs were of no practical importance; instead we were more interested in comparison of individual abattoir to the average (population) line. Statistically significant effect of the interaction between the abattoir and warm carcass weight (differences in the regression coefficient or slope) indicated statistically significant deviation of an individual abattoir from the average, indicating significantly different assessment in this abattoir. On the other hand when significant differences occurred only in the intercepts we supposed certain systematic deviation.

Table 1. Basic statistics of the data (young bulls of Simmental breed) included in the analysis

	N	Carcass weight, kg (Mean ± SD)	Conformation (Mean ± SD)	Fatness (Mean ± SD)
Abattoir A	4545	362 ± 60	8.54 ± 1.84	6.79 ± 1.77
Abattoir B	1527	366 ± 58	8.34 ± 1.75	6.10 ± 1.66
Abattoir C	7127	352 ± 56	7.87 ± 1.55	6.69 ± 1.54
Abattoir D	13458	370 ± 55	8.98 ± 1.69	6.67 ± 1.52
Abattoir E	1853	336 ± 58	7.80 ± 2.04	5.46 ± 2.48
Abattoir F	10341	374 ± 57	9.07 ± 1.96	7.09 ± 1.69
Abattoir G	10069	367 ± 54	8.56 ± 1.63	6.53 ± 1.60
Abattoir H	2075	352 ± 57	7.88 ± 1.84	6.45 ± 1.75
Abattoir I	1629	364 ± 50	8.38 ± 1.63	5.85 ± 1.13

Results and discussion

Analysis of covariance (Table 2) showed a significant effect of the interaction carcass weight × abattoir on both, the conformation and fatness. This result indicates that grading in different abattoirs varied from that observed in average. In general, differences in the regression lines were more important for the conformation than for the fatness (Table 3). In five out of nine abattoirs the slopes of regression lines differed from the population average, and in seven out of nine abattoirs in the case of the intercepts. Conformation assessment was the closest to the population average in abattoirs B, F and H. On the other hand the most important deviations were observed for abattoirs A, C and E. In the case of fatness, the slopes of regression lines differed significantly from the population average in three (D, G, I) out of nine abattoirs, whereas the intercepts were significantly different in four (A, D G, I) out of nine abattoirs. There are many possible factors that could contribute to the uncertainty in cattle carcass classification. On the whole they could be divided into the factors associated with the assessor and factors associated with the abattoir. Factors related to the abattoir concern different working conditions (slow or fast slaughter line, differences in lightning, size of working space, *etc.*), differences in animals (different breeds/crossings, different breeding intensity, *etc.*). Factors related to the assessor are mainly his/her ability to repeat/reproduce the results, which is related to the experience and regular training. Although the major part of the grading within an abattoir is usually made by one evaluator, it is likely that in some abattoirs the shares of the main and replacing classifier(s) are more or less important. An additional factors that could contribute to the classification uncertainty could arise from the changing of the scale (from 5-point to 15-point scale) and unequal speed of adaptation. The results could also be affected by the number of classified animals in a certain abattoir. In the present study all these factors cannot be distinguished and are comprised within the abattoir effect.

Present analysis demonstrates one possible way of monitoring the uncertainty in cattle classification using a statistical approach. It is important to emphasize that the results indicate

Table 2. Analysis of covariance

	Conformation		Fatness	
Average ± SD	8.4±0.21		6.4 ±0.18	
R^2	0.98		0.97	
Effect				
Abattoir	<0.0001		<0.0001	
Carcass weight	<0.0001		<0.0001	
Abattoir × Carcass weight	<0.0001		<0.0001	
Regression lines	Equation	R^2	Equation	R^2
Average	C=0.024×CW−0.13	0.99	F=0.017×CW+0.33	0.99
Abattoir A	C=0.018×CW+1.95	0.98	F=0.015×CW+1.35	0.97
Abattoir B	C=0.025×CW−0.66	0.98	F=0.018×CW−0.49	0.93
Abattoir C	C=0.019×CW+1.36	0.94	F=0.017×CW+0.72	0.99
Abattoir D	C=0.021×CW+1.10	0.99	F=0.014×CW+1.49	0.98
Abattoir E	C=0.033×CW−3.36	0.98	F=0.018×CW−0.31	0.85
Abattoir F	C=0.025×CW−0.57	0.98	F=0.018×CW+0.44	0.99
Abattoir G	C=0.020×CW+1.23	0.99	F=0.014×CW+1.29	0.97
Abattoir H	C=0.026×CW−1.43	0.97	F=0.020×CW−0.60	0.90
Abattoir I	C=0.019×CW+1.51	0.94	F=0.009×CW+2.51	0.89

SD – standard deviation; R^2 – coefficient of determination; C – conformation; F – fatness; CW – carcass weight.

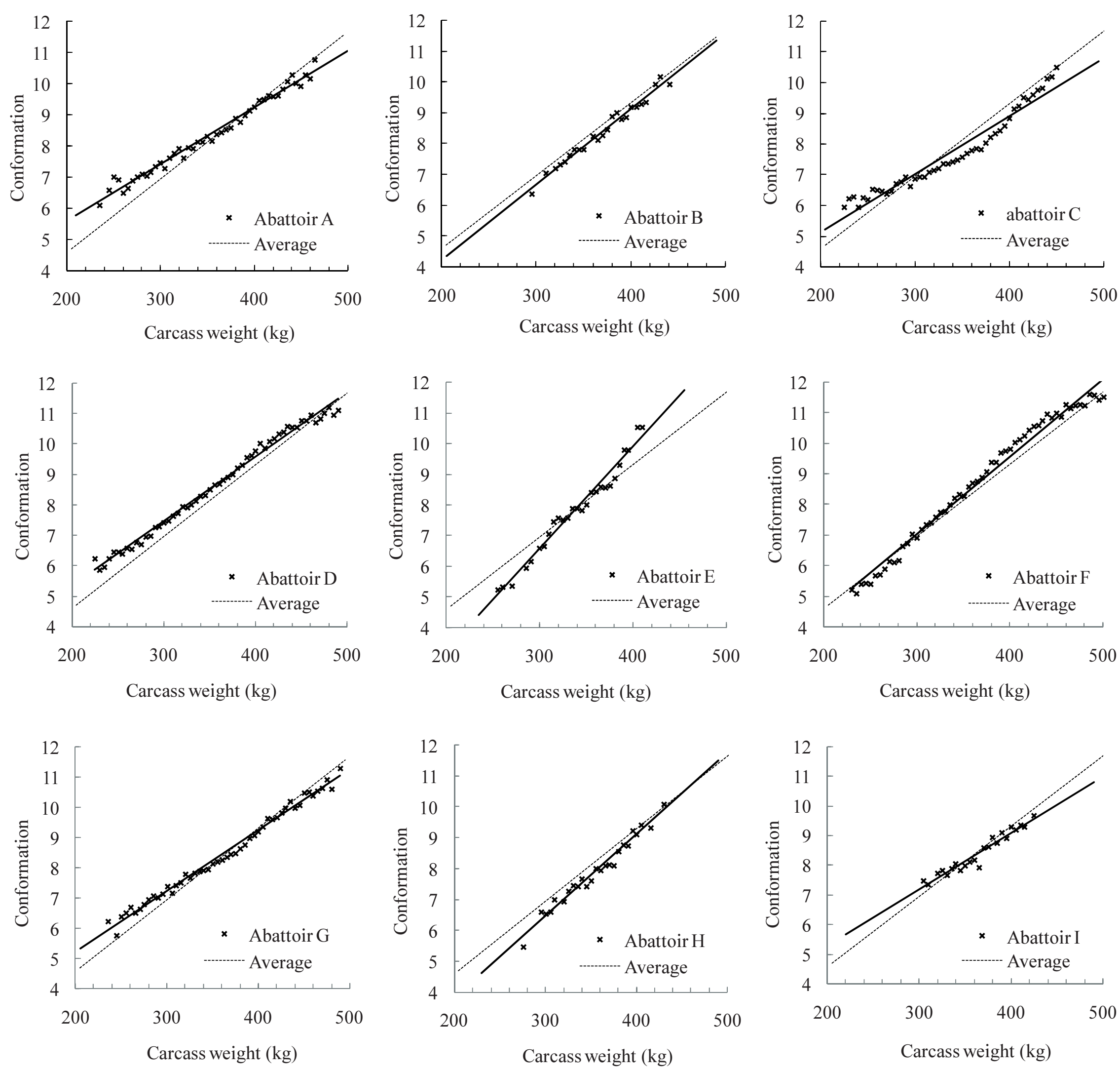

Figure 1. Deviations of individual abattoirs from the population average in conformation grading

Table 3. The comparison of individual abattoirs with population average (differences in slopes and intercepts)

	Conformation	Fatness
Differences in slopes		
Abattoir A *vs.* average	−0.0054 (p=0.0003)	−0.0018 (p=0.1536)
Abattoir B *vs.* average	0.0009 (p=0.6096)	0.0010 (p=0.5220)
Abattoir C *vs.* average	−0.0048 (p=0.0013)	0.0002 (p=0.8985)
Abattoir D *vs.* average	−0.0024 (p=0.0980)	−0.0028 (p=0.0243)
Abattoir E *vs.* average	0.0095 (p<0.0001)	0.0007 (p=0.0683)
Abattoir F *vs.* average	0.0017 (p=0.2268)	0.0008 (p=0.4943)
Abattoir G *vs.* average	−0.0035 (p=0.0164)	−0.0026 (p=0.0381)
Abattoir H *vs.* average	0.0028 (p=0.1151)	0.0028 (p=0.0641)
Abattoir I *vs.* average	−0.0046 (p=0.0163)	−0.0078 (p<0.0001)
Differences in intercepts		
Abattoir A *vs.* average	2.0823 (p=0.0001)	1.0126 (p=0.0277)
Abattoir B *vs.* average	−0.5302 (p=0.4198)	−0.8283 (p=0.1394)
Abattoir C *vs.* average	1.4845 (p=0.0059)	0.3825 (p=0.4026)
Abattoir D *vs.* average	1.2305 (p=0.0204)	1.1531 (p=0.0108)
Abattoir E *vs.* average	−3.2330 (p<0.0001)	−0.6454 (p=0.2106)
Abattoir F *vs.* average	−0.4423 (p=0.4022)	0.1038 (p=0.8174)
Abattoir G *vs.* average	1.3554 (p=0.0114)	0.9600 (p=0.0352)
Abattoir H *vs.* average	−1.3051 (p=0.0413)	−0.9378 (p=0.0849)
Abattoir I *vs.* average	1.6387 (p=0.0195)	2.1763 (p=0.0003)

statistically important differences in the classification results for many abattoirs, but that this does not necessarily denote consequences from the practical point of view, i.e. affecting the payment. Nevertheless, regular statistical monitoring of the classification enables a detection of the abattoirs/assessors with important deviations and thus the basis for the necessary correction steps for the improvement of the accuracy. Carcass classification results are a delicate issue since they are the basis for the payment to the farmer. Thus, a constant monitoring and improvement of the accuracy of the classification is important for preserving the farmer's trust in the system.

Conclusions

A statistical approach using analysis of covariance has been shown to be a suitable tool for supplementary control in cattle carcass classification. Our results show significant deviations from the population average in the conformation and fatness grading for several abattoirs. Overall, the deviations were more important for the conformation than fatness grading. Although these deviations do not necessarily have a practical consequence

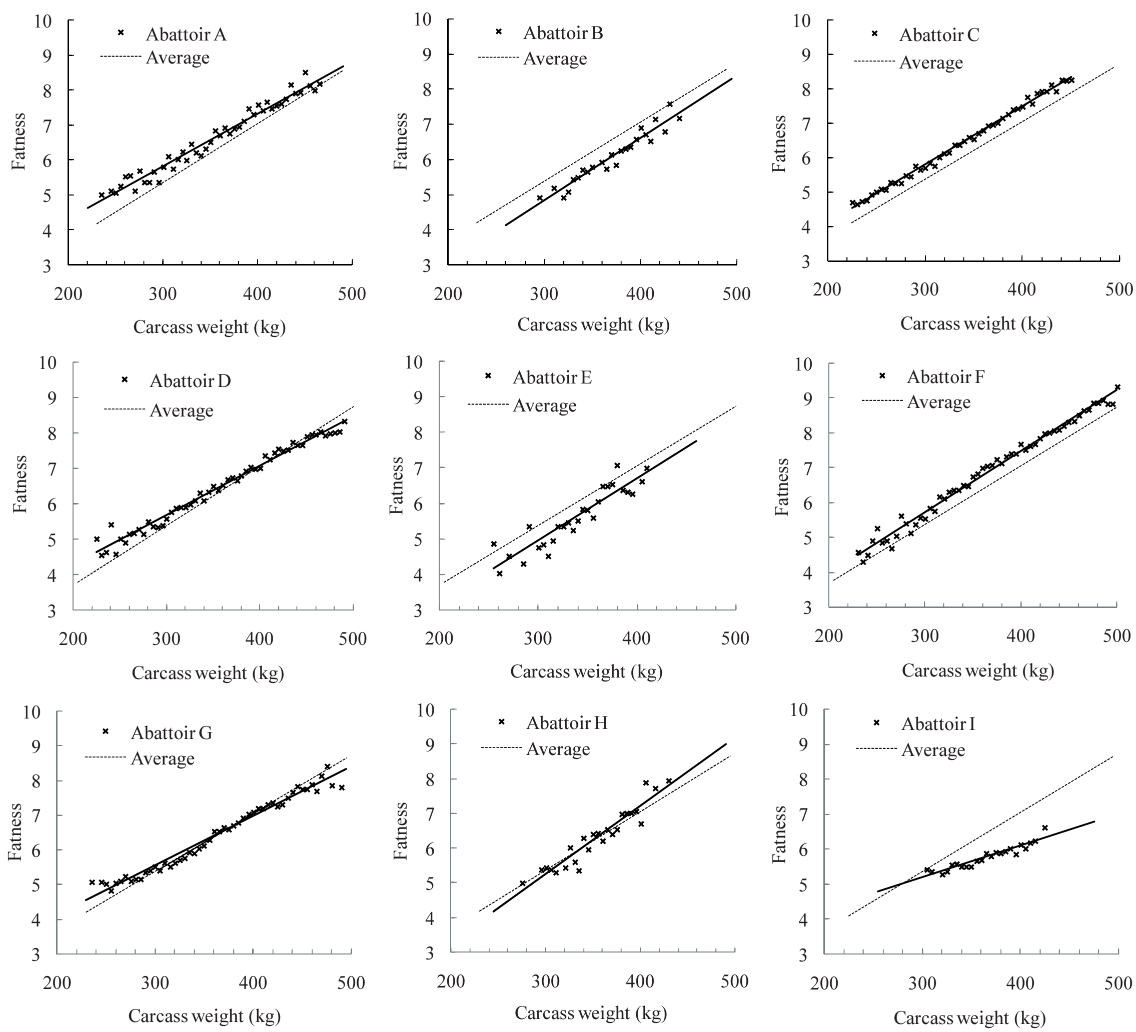

Figure 2. Deviations of individual abattoirs from the population average in fatness grading

in the payment, care for the accurate classification is important for the farmer's trust in the system.

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