HOW TO NORMALIZE THE METHODS FOR GRADING PIG CARCASES IN THE COMMUNITY ?

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SUMMARY

Putting into practice the conclusions of the present research concerning the harmonisation of methods for grading pig carcases in the Community would not noticeably improve accuracy. The average lean proportion accuracy in the national pig populations estimated by EC authorised methods is assessed around 2 %.

Therefore, the question about a normalization, i.e. accuracy between 0.5 % and 1.0 %, of these methods is to be raised. In order to normalize it is necessary to thoroughly study all the methodological problems. These questions deal with four subjects : lean proportion, grading instrument, prediction equation and experimental design. Normalization could use the following means : a common experimental design, an EC dissection method combined with a clearly defined lean proportion calculation, the use of common regressors, one single equation by Member State from tissue depths measured by the same instrument (called reference instrument) for each State, a common calibration procedure for grading probes in comparison to reference instrument, a common statistical methodology for modelisation and associated parameters estimation, a standard scheme for the required document to gain authorisation from Brussels for the use of grading methods.

Such a program, which needs additional dissections in EC, could lead to put into practice within three or four years normalized grading methods.

INTRODUCTION

Although the pig carcases grading in the E.E.C. is objective, its setting-up introduces divergences, due to gaps in regulation but also to technologies evolution and increasing complexity of statistical methods. Consequently important biases can be found between lean proportions estimated by each Member State. As biases could generate competition distortions, it is important to reduce these as much as possible : an aim between 0.5 and 1 % of lean appears to be reasonable and attainable. That is what we call a normalization.

We present here a way to achieve grading methods normalization, after having dealt with the origin of actual divergences. We end with proposals to reach a maximal harmonisation as part of present E.E.C. project.

1. ORIGINS OF PRESENT DIFFERENCES BETWEEN GRADING METHODS

1.1. Present regulation and its gaps

A regulation dated 1984 (CEE n°3220/84) defines the E.E.C. scheme for pig carcases grading. Later the way to apply this scheme was established (CEE n°2967/85).

Five constraints are imposed :

- a representative sample of pig population,
- at least 120 carcases,
- full dissection or dissection with the same effect,
- a determination coefficient $R^2 > 0.64$,
- a residual standard deviation $Se < 2.5$.

No statement describes which criteria are essential for the sample to be representative. Furthermore, a representative sample corresponds to a randomized protocol. Yet a planned protocol, stratified on regressors or at least on a linear combination of regressors, gives better parameters estimations in linear regression.

The lean proportion calculation must be clearly defined and single. Without any accurate statistical constraints, the use of a national dissection method instead of full dissection could only produce biases between equations. Furthermore, dissection and lean proportion are two different things ; from a same dissection method it is possible to calculate the lean proportion in many ways.

There are no particular problem with the three other constraints, even if we can regret that the only two statistical parameters selected are not enough to appreciate the model accuracy.

1.2. Enforcement of the regulation

The objective grading according to lean proportion have been made compulsory since 1st January 1989. All Member States, except Portugal, have one or more authorised methods. But some Member States do not use objective grading in their slaughterhouses.

For the Member States which use objective grading in their slaughterhouses, the used proportion of authorised methods is unknown. All have not the same accuracy.

Finally, the population evolution is not known since the last equation calculation.

2. NORMALIZATION SCHEME

2.1. One single and accurate lean proportion reference

The lean proportion reference must be clearly defined. The right way for calculation has to be written and any interpretation must be possible. The variables included in the calculation must be measured during the dissection. This dissection method have to be carried out exactly in a same way by all Member States. Repeatability has to be easy and cost has to be low.

2.2. Regressors

By now, the best regressors used for lean proportion are lateral backfat and eye muscle depths. The site the most used within the E.E.C. is located between the 3rd and 4th last ribs 6 cm beside the split line ; few differences exist between rib sites ; this one has the advantage not to perforate through tenderloin. So, in a normalized scheme one lateral rib fat depth and one lateral rib muscle depth could be chosen as compulsory regressors. Member States could add a fat depth (and muscle depth) in another site.

Finally, measurements have to be taken with a same grading probe. This point is absolutely essential. Indeed, probes are only measurement instruments and therefore they can produce errors. A likely assumption is that measurement error is independent of predicted variable, i.e. lean proportion. So, it is necessary to choose a reference instrument, the most accurate of existing instruments, because it allows the highest reliability for equation computation. However, equation parameters estimation has to take measurement error into account (DAUMAS, DHORNE, 1992).

If slaughterhouses would like to use another probe, it should be tested against the reference instrument. It has to be unbiased (if need be after correction), and its mean square error has to be included in the calculation of statistical parameters linked to the prediction equation. To be unbiased is very important so that every carcase is identically reckoned by different probes, i.e. any systematic advantage of being graded by a given probe is avoided.

At the moment, only two Member States have put this strategy into practice : Germany and France, with respectively Ultrasonic Scanner SSD 256 (BRANSCHEID et al., 1991) and Endoscope 5 000 (DAUMAS, 1991) as reference instrument. Though accuracy of these instruments is a bit higher than this of the probes used under industrial circumstances, it seems possible to find a better reference to be used in the whole E.E.C. Search of this instrument (or method) should be one of the aims assigned by the Commission.

The method applied by numerous Member States, which consist in taking measurements with many grading probes on the dissected sample, has to be argued on the basis of an appropriate protocol (randomization). Indeed, it not only adds a supplementary error (deviation, overstitching...) in comparison to a single probe, but moreover it seems that the theoritical prediction equation (i.e. without error measurement) should always be the same for all probes. Consequently a better solution would be to dissociate the probes test from the equation computation.

2.3. Modelization

When the reference probe is chosen, error measurement has to be estimated. If this one is consistent, model has to be elaborated using regression with error measurement. If not, classical regression (i.e. under assumption there is no measurement error on regressors) has to be used. Until now, all Member States have always used classical regression, but with no prior proof that measurement error made with the probe used was insignificant.

Then, the question is : should the model used be linear or non linear in the parameters ? It could be interesting to try models linked with the biological knowledge of differentiation of tissues. These deterministic and often differential models are non linear in the parameters to be estimated. These models could be used as theoritical reference and then approached by linear models, because of the difficulty or the impossibility to gain the estimators properties.

Then, it has to be chosen between a linear or non linear model on regressors. Linear model on regressors could have the disadvantage of global or local estimation biases. So, more complicated models, which give a better idea of the reality and especially at the extremes of the study interval, could be interesting, like quadratic models for instance. To visually choose the most fitted models, it is important in practice to study the response curves.

When the model is chosen, adjustement criteria have to be explained ; statistical efficiency contraints

and regulated constraints can lead this choice. Such criteria as Cp of MALLOWS, residual standard deviation and prediction error at interval extremes, can be accepted.

The most important point in adjustement strategy choice concerns how to take observations into account. As the proportion of outliers is rather high, it is better to make an interactive data analysis or a robust parameters estimation, in order to avoid that some observations have a too high contribution level in the prediction model.

Parameters have to be estimated using the most adjusted statistical method, i.e. the maximum of likelyhood or the unbiased estimator with the minimal mean square, which are equal for most models used.

As there are biases between subpopulations, it could be a best solution to have a model for each factors class. The qualitative variables, which highly contribute in the variability, are sex, breed and feeding types. On line, breed and feeding types are unknown and difficult to know. On the other hand, it is very easy to know the sex ; for instance, sex is recorded for most of French carcases. So, it is logical to offer to carry out one equation for each of the three sexes (gilt, castrated male, entire male) in the E.E.C.

2.4. EXPERIMENTAL DESIGN

2.4.1. For dissected sample

A planned design, stratified on regressors (for instance, one fat depth and one muscle depth), or in the worst case on estimated lean proportion when difficult in practice. A regular stratification could be proposed, such as 1/3, 1/3, 1/3, with internal boundaries at ± 1 standard deviation and external boundaries at ± 2 standard deviations, to avoid outliers.

Furthermore, local variability has to be estimated by several measurements, included at the same site.

2.4.2. For probes test samples

The aims of this test are to verify the unbias in comparison to the reference instrument assumed unbiased in comparison to the real value, and to estimate measurement error of the probe to be tested.

Stratification could be made taking into account factors which can influence measurement error, such as fat depth, muscle depth, P.S.E. status. In order to reduce the number of pigs, it could be useful to stitch at several sites. At each point it could be interesting to stitch four times, two times with reference instrument and two times with the probe to be tested, in order to know which probe gives a different value from the others. As tissues could be deformed after an overstitching, the stitching order of probes has to be randomized and at the same time the operator effect has to be monitored.

After this test under experimental circumstances, a test under industrial circumstances can be carried out, in order to appreciate the behaviour of the probe in the normal environment.

3. THE PRESENT HARMONISATION TRIAL

In 1989 the decision of starting research concerning the harmonisation of methods for grading pig carcases in the Community was taken. In 1990 a concerted trial was carried out by Member States, Germany and Luxembourg excluded. In 1991, Mr COOK from M.L.C. in Great Britain collected data and began computation, as part of an agreement with the Commission. During the first half year of 1992 Mr COOK gave a first report and discussions have begun. Putting into practice the conclusions in slaughterhouses could be achieved in 1992 or 1993.

3.1. Purposes and means of this trial

There are two main purposes :

- to replace the too expensive full dissection by a cheaper and rather accurate dissection method ;
- to assess the biases and the accuracy of the present authorised methods and maybe to change equations if they are not fitted.

The means consist in the Kulmbach simplified dissection of at least 120 sides. Among these 120 , at least 30 are fully dissected.

A stratification on lean proportion (S)EUROP grades was imposed according to the following scheme :

- on the complete sample : 40 % in both extremes and 20 % in the middle.
- on the full dissections subsample : 50 % in both extremes.

3.2. Methodological lacks

Before the beginning of the trial, the French delegation explained its important disagreements about the EC protocol (DAUMAS, DHORNE, 1990). Two years later, we have to state the lack of rigour of the protocol and the absence of a debate about the way of a data statistical computation. Consequently, row data are

unusable. From now on, a first step must consist in listing the differences which occured in the methodology implementation in each Member State. According to the importance of these differences, corrections could be applied or not. A second step must be the definition of a statistical methodology to choose equations.

Some problems have staid out of the scope of the trial, such as the estimation of probe measurement error, the precise definition of regressors, the characteristics of a good sampling and the characteristics allowing to differenciate two probes.

3.3. Hopes for a minimum level of harmonisation

The implementation of the present conclusions of the harmonisation draft (COOK, YATES, 1992) should not much reduce the biases between Member States in grading methods. In our opinion, these biases could furthermore reach 2 or 3 % lean.

The only hope to reach a minimum level of harmonisation at the end of trial is to rapidly and entirely solve all the methodological problems. Then, it is essential to define a new lean proportion reference. Three possibilities can be considered : from full dissection using double regression (ENGEL, WALSTRA, 1991), from Kulmbach simplified dissection (BRANSCHEID et al, 1990) or from a supersimplified dissection. Afterwards, a statistical methodology for data computing has to be elaborated on a general agreement basis. Only from these conclusions each Member State should propose the authorisation of new grading methods in the utmost transparency.

CONCLUSION

The E.E.C. regulation about pig carcases grading is no more adjusted to the actual practice conditions. Its gaps have produced divergences between the lean proportion estimations of the different Member States.

The harmonisation process started by the european Commission gives evidence of a sudden awareness and wish to put it right. Unfortunately, because of a lack of rigour the coordinated trial, which took part in 1990, will be only a little step for harmonisation.

We hope it will be only a stage towards a normalisation, i.e. a reduction of biases between Member States at a level inferior at 1 % muscle. This normalisation make necessary new E.E.C. dissections. This trial could use the following means : a common adequate experimental design, a common dissection method and a single and clearly defined lean proportion calculation, the use of common regressors, one single equation by Member State from tissues depths measured by the same instrument (called reference instrument) for every State, a common calibration procedure for grading probes in comparison to reference instrument, a common statistical methodology for modelization and associated parameters estimation, a standard scheme for the required document to gain authorisation from Brussels for the use of grading methods.

Such a programm could need three or four years between the decision and the use of these normalized grading methods in slaughterhouses.

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