



A cuts-based Meat Standards Australia grading system for sheepmeat

L. PANNIER, T. PLEASANTS, G. GARDNER, G. TARR, A. BALL, P. MCGILCHRIST, D.W. PETHICK



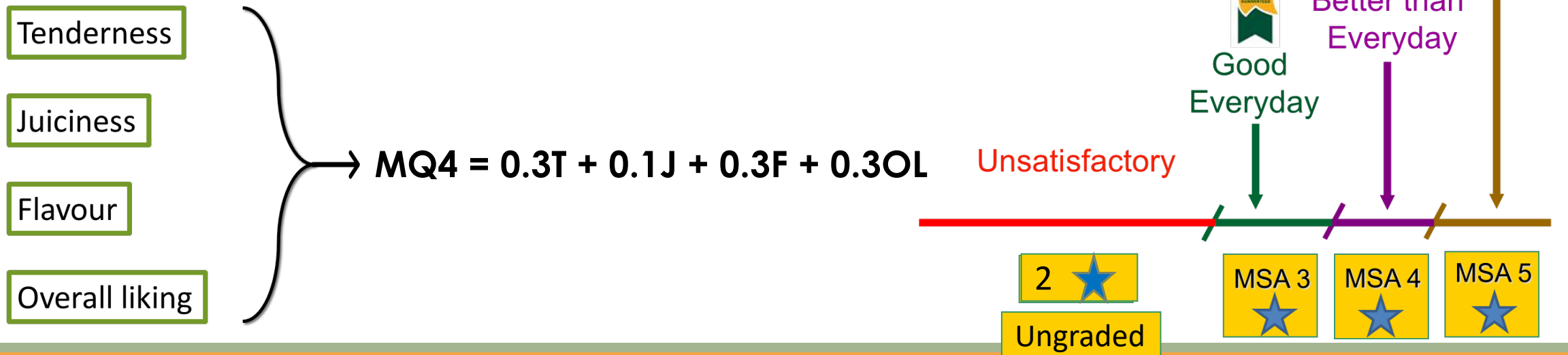
Outline

- Predicting eating quality – beef Meat Standard Australia
- Current Meat Standard Australia sheepmeat system
- Approach to develop a cuts-based eating quality prediction system for sheep
- Brand and product differentiation

Predicting eating quality - Beef



- Grading system to predict the final eating quality of a cooked product
- Guidelines, predictors, compliance thresholds
- Consumer focused model



Predicting eating quality - Beef



- Grading system to predict the final eating quality of a cooked

• Guide

• Consumer

Does not commercially exist
for lamb

Tenderness

Juiciness

Flavour

Overall liking

$$MQ4 = 0.3T + 0.1J + 0.3F + 0.3OL$$

Unsatisfactory

Good
Everyday

Better than
Everyday

Premium

2 ★

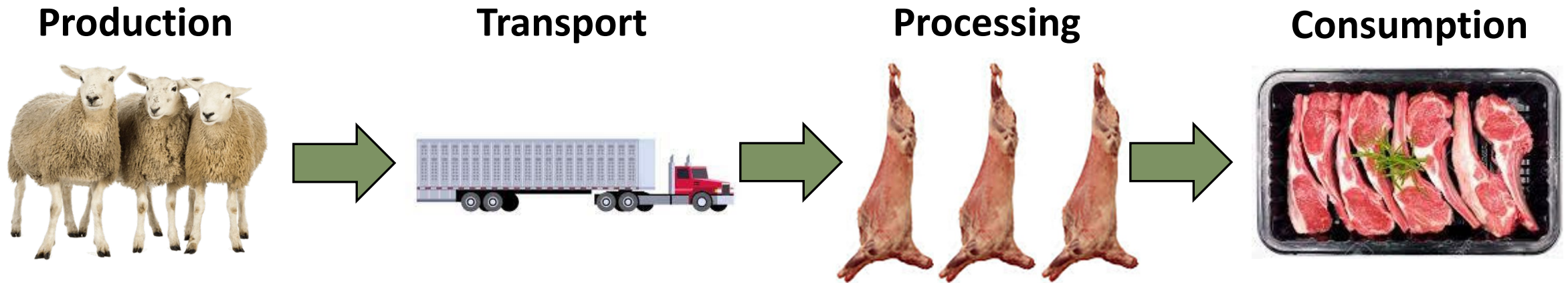
Ungraded

MSA 3 ★

MSA 4 ★

MSA 5 ★

Current MSA sheepmeat pathways model



It is a simple 'in/out' system with guidelines for
Producers
Processors
Retailers

Current MSA sheepmeat pathways model

Production



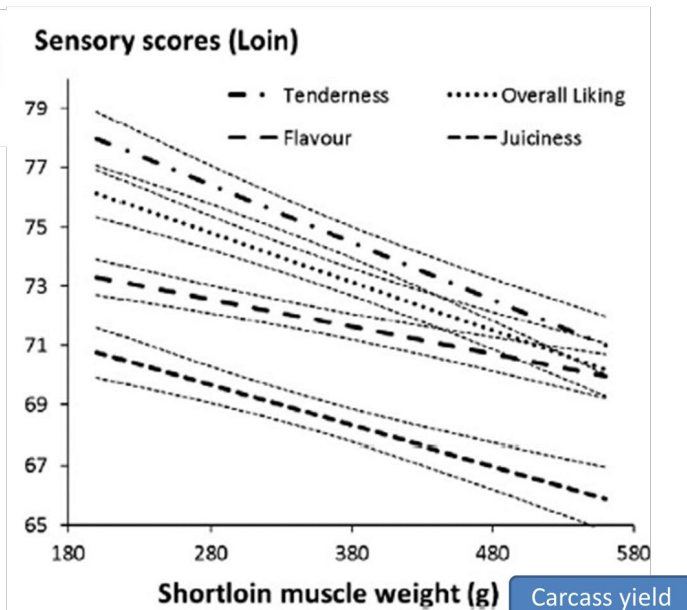
Consumption



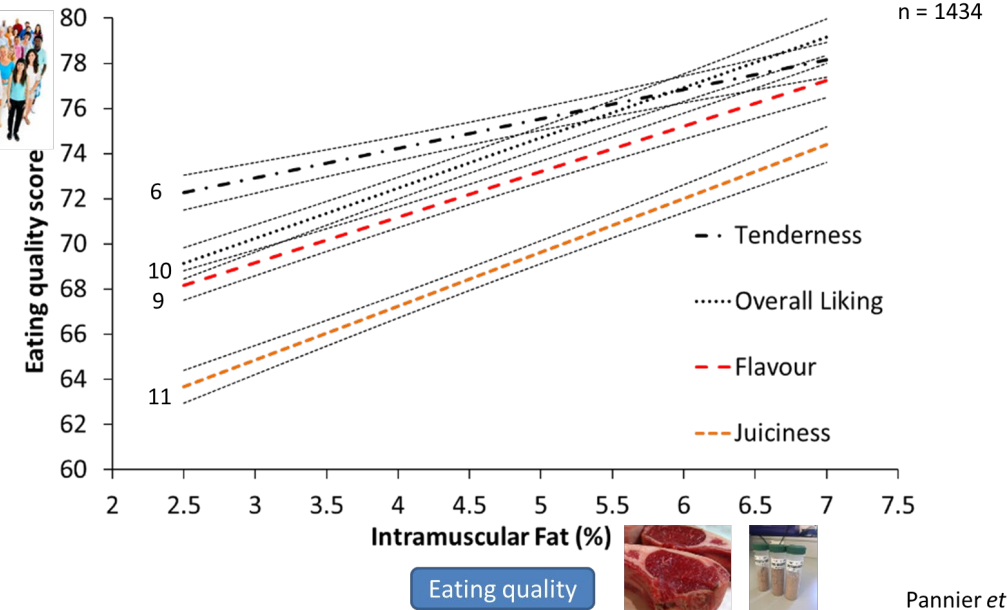
Lack of objective measures &
Individual grading

Carcass variables to predict consumer scores

Increasing muscle weight reduces eating quality Eating quality increases when IMF% increases



Pannier *et al.* 2014

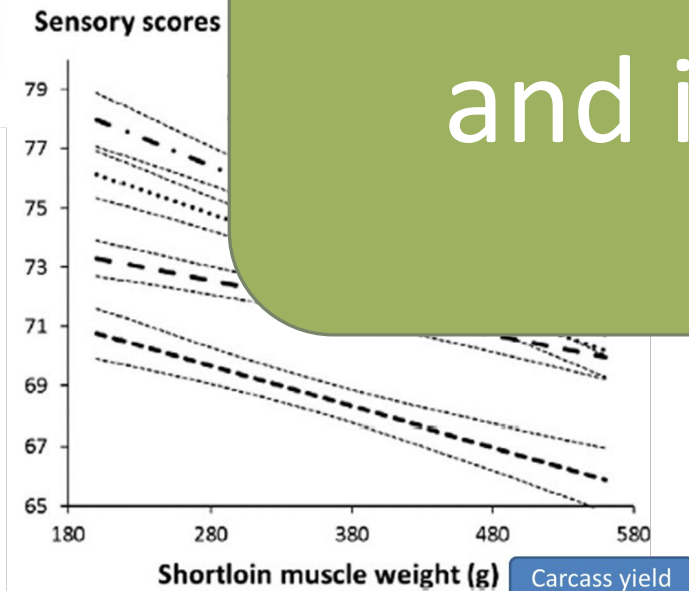


Pannier *et al.* 2014

Carcass variables to predict consumer scores

Balance for lean meat yield
and intramuscular fat%

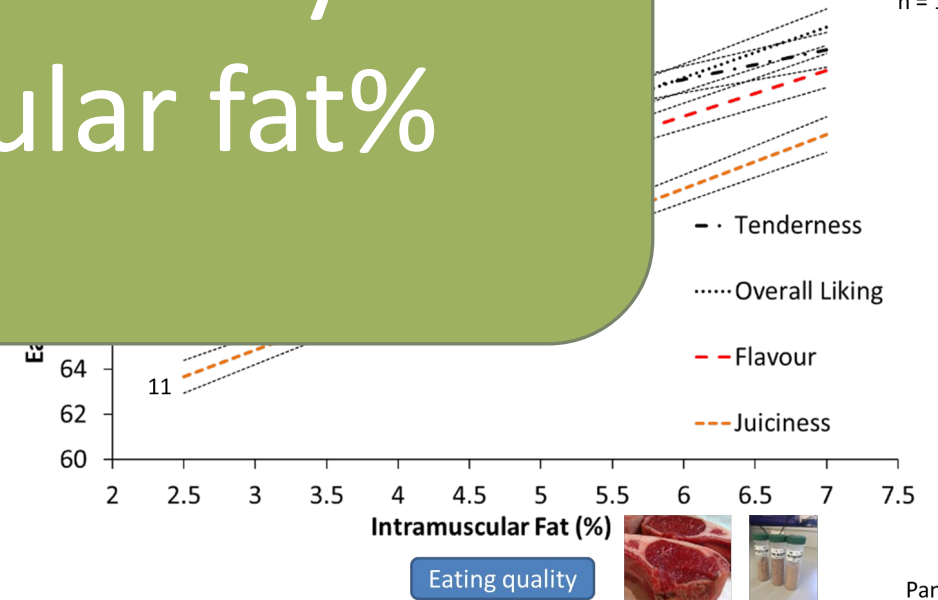
Increasing muscle



Pannier *et al.* 2014

IMF% increases

n = 1434



Pannier *et al.* 2014

Recent advances in technology



DEXA



hyperspectral camera

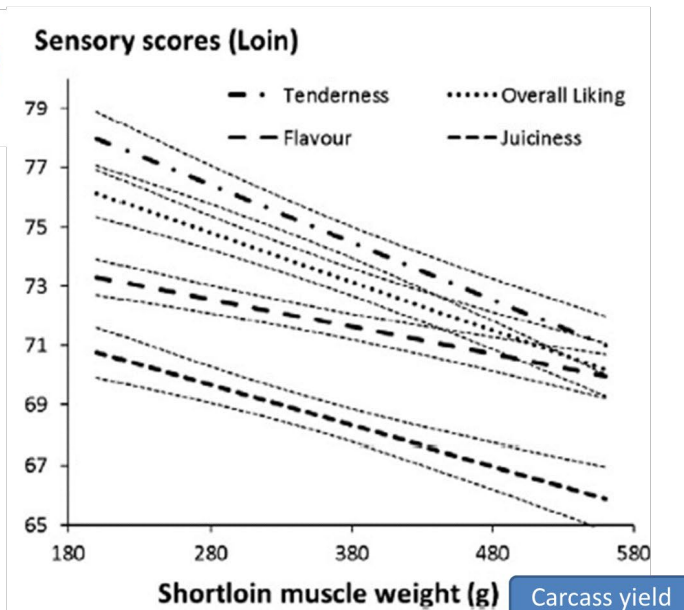


NiR Probe

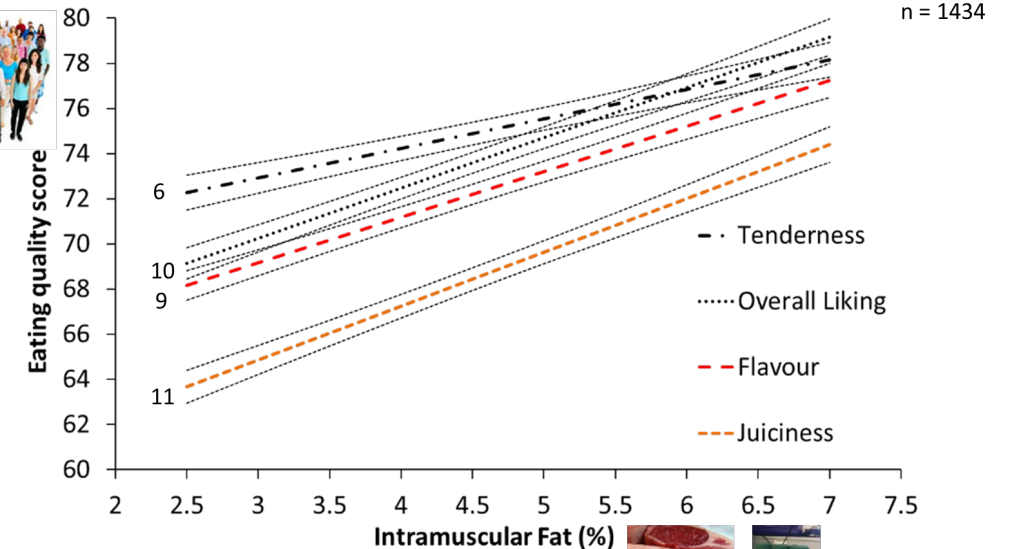


Meat Eating
Quality probe

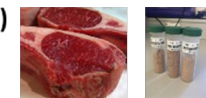
Increasing muscle weight reduces eating quality Eating quality increases when IMF% increases



Pannier *et al.* 2014



Pannier *et al.* 2014



How do we build a prediction model
inclusive of lean meat yield and
intramuscular fat%?

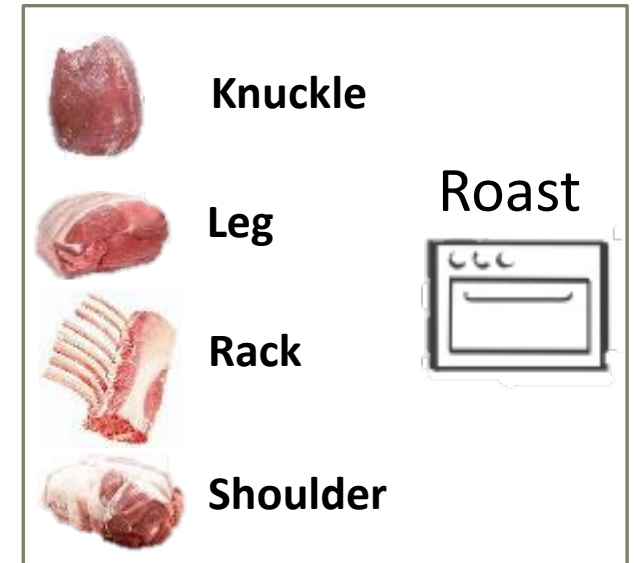
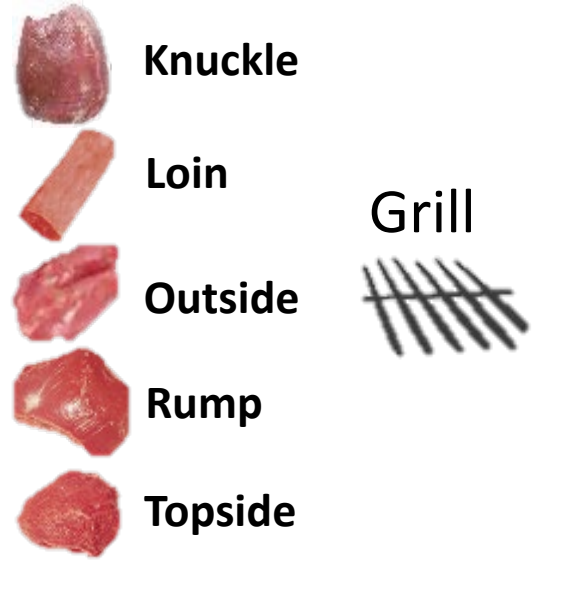
Construction of prediction model

Data Structure

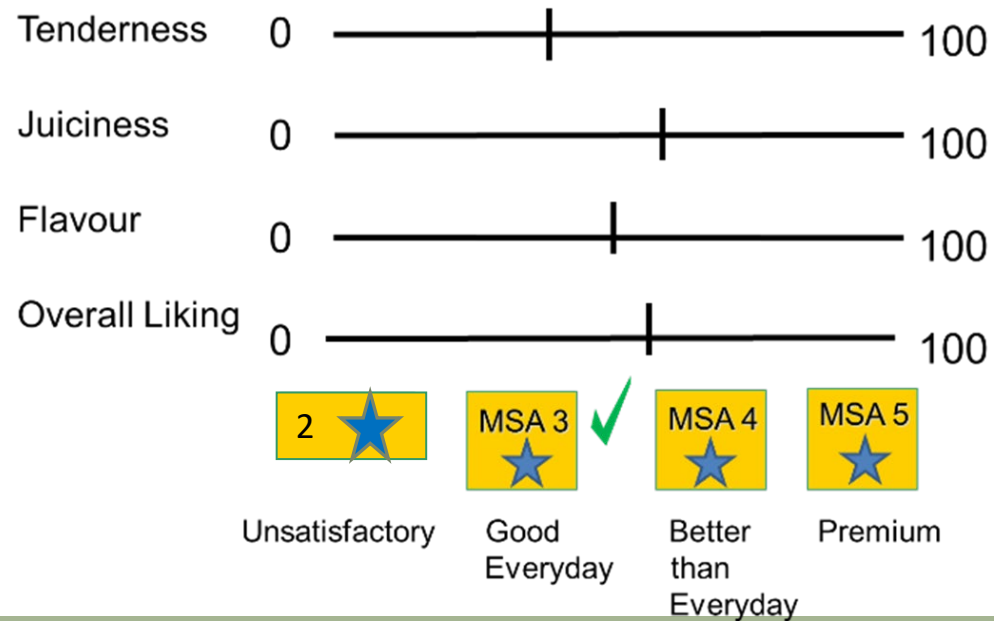
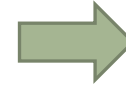
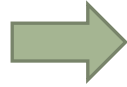
- 9 cut x cook options



$n > 3100$



Consumer sensory sessions



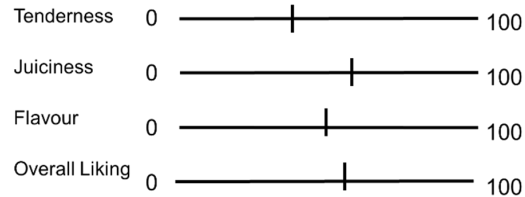
- 312 sessions
- 18 720 consumers
- 10 responses per cut
- 112 320 consumer responses

Statistical approach for constructing prediction model

Linear discriminant analysis

Defines MQ4 score

overall liking
tenderness
juiciness
flavour



Statistical approach for constructing prediction model

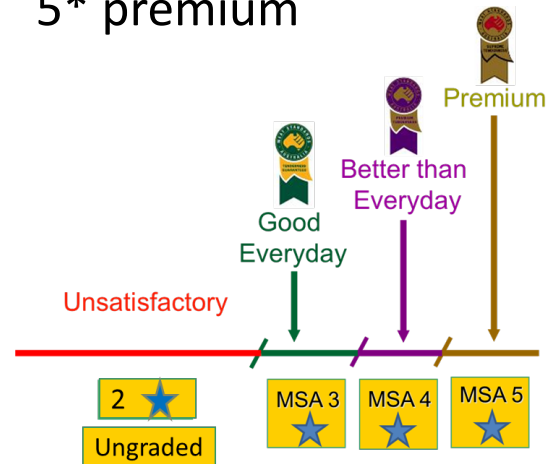
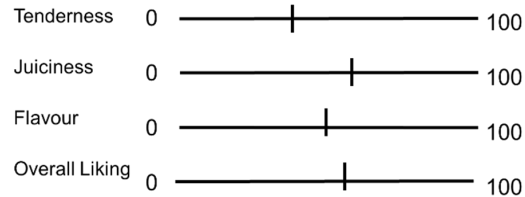
Linear discriminant analysis

Defines MQ4 score

overall liking
tenderness
juiciness
flavour

Defines quality grade thresholds

2* ungraded/unsatisfactory
3* good every day
4* better than every day
5* premium

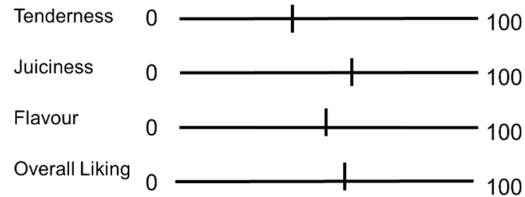


Statistical approach for constructing prediction model

Linear discriminant analysis

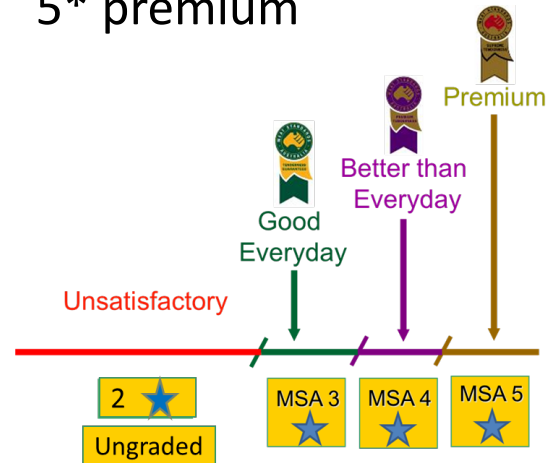
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Regression model with carcass variables

Predict MQ4 with Carcass variable

Cut by cooking
Lean meat yield
Hot carcass weight
IMF%

Prediction model outcome

Linear discriminant analysis

Defines MQ4 score



Defines quality grade thresholds

Regression model with carcass
variables

Predict MQ4 with Carcass variable

$$\text{MQ4} = 0.3\text{T} + 0.1\text{J} + 0.3\text{F} + 0.3\text{OL}$$

Prediction model outcome

Linear discriminant analysis

Defines MQ4 score



$$\text{MQ4} = 0.3T + 0.1J + 0.3F + 0.3OL$$

Defines quality grade thresholds



MQ4 thresholds	
2/3 star	41.4
3/4 star	63.8
4/5 star	80.5

Regression model with carcass variables

Predict MQ4 with Carcass variable

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Linear discriminant analysis

Defines MQ4 score



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Regression model with carcass variables

Predict MQ4 with Carcass variable

Cut/cook (20)

Grill: knuckle = loin = rump > outside > topside

Roast: rack > shoulder > knuckle > leg

Prediction model outcome

Linear discriminant analysis

Defines MQ4 score



$$\text{MQ4} = 0.3T + 0.1J + 0.3F + 0.3OL$$

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Regression model with carcass variables

Predict MQ4 with Carcass variable

Cut/cook (20)

Grill: knuckle = loin = rump > outside > topside

Roast: rack > shoulder > knuckle > leg

Lean meat yield (-3)

Hot carcass weight

Lean meat yield: 45-65%

Prediction model outcome

Linear discriminant analysis

Defines MQ4 score



$$MQ4 = 0.3T + 0.1J + 0.3F + 0.3OL$$

Defines quality grade thresholds



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2/3 star	41.4
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Regression model with carcass variables

Predict MQ4 with Carcass variable

Cut/cook (20)

Grill: knuckle = loin = rump > outside > topside

Roast: rack > shoulder > knuckle > leg

Lean meat yield (-3)

Hot carcass weight

Lean meat yield: 45-65%

IMF% (+18)

Grill: loin > topside > outside > knuckle

Roast: rack > leg > shoulder

IMF%: 2-10%

Accuracy of prediction model

Grill

Actual consumer assigned quality grade

Predicted
quality
grade

	2 star	3 star	4 star	5 star
2 star	61			
3 star		52		
4 star			39	
5 star				53

Roast

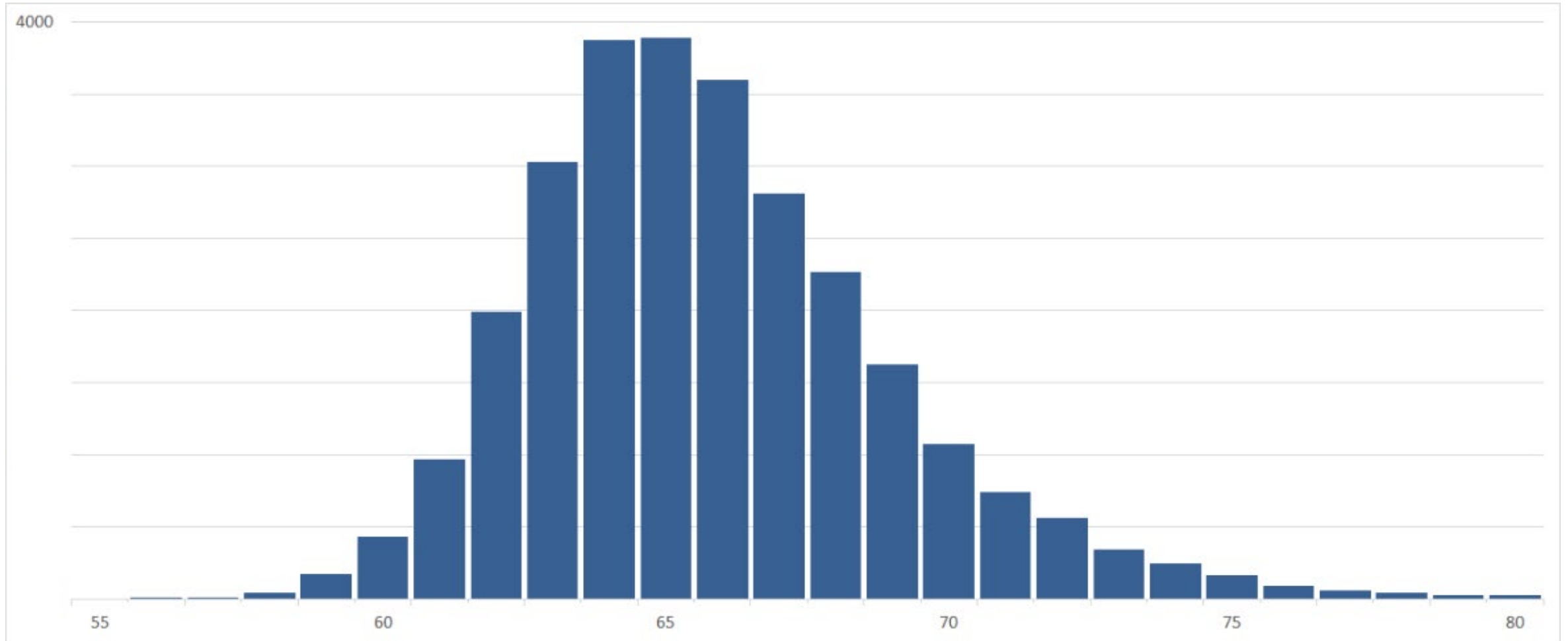
Actual consumer assigned quality grade

Predicted
quality
grade

	2 star	3 star	4 star	5 star
2 star	58			
3 star		51		
4 star			39	
5 star				54

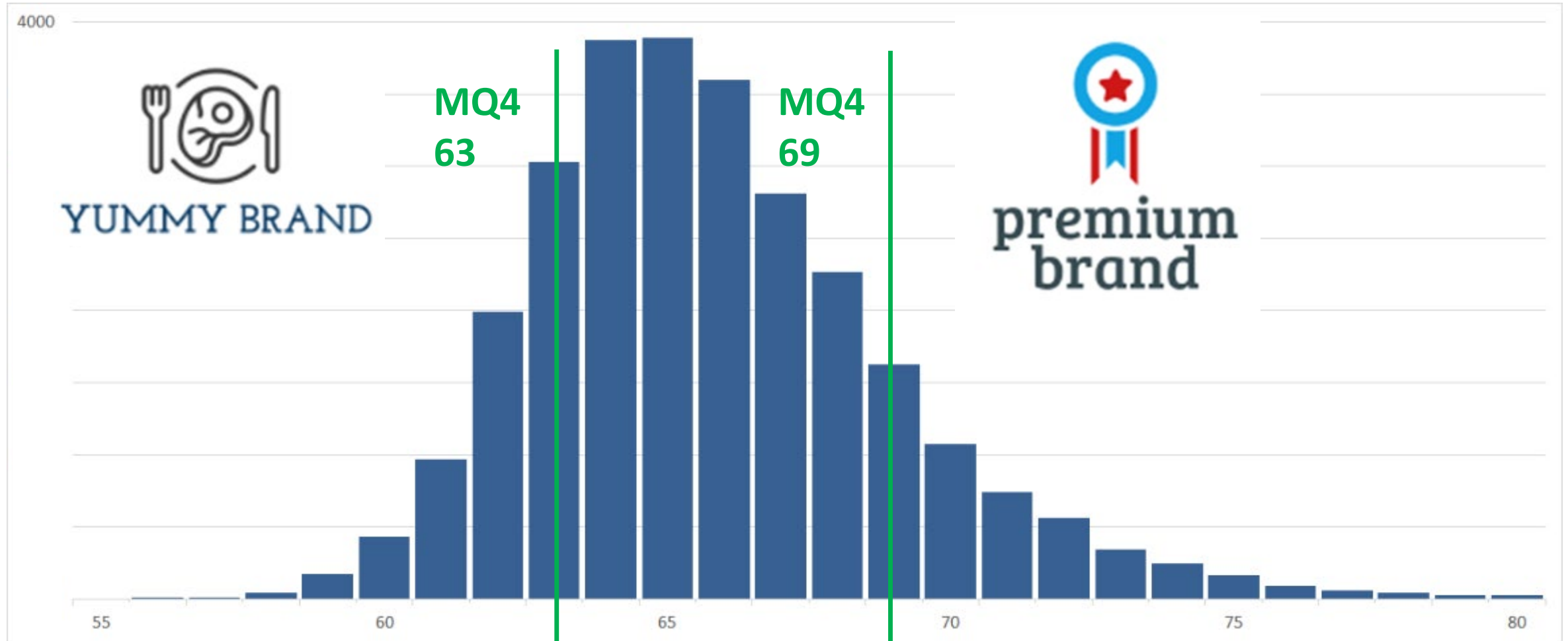
Correctly allocated product to
quality grade

Loin MQ4 Score Distribution



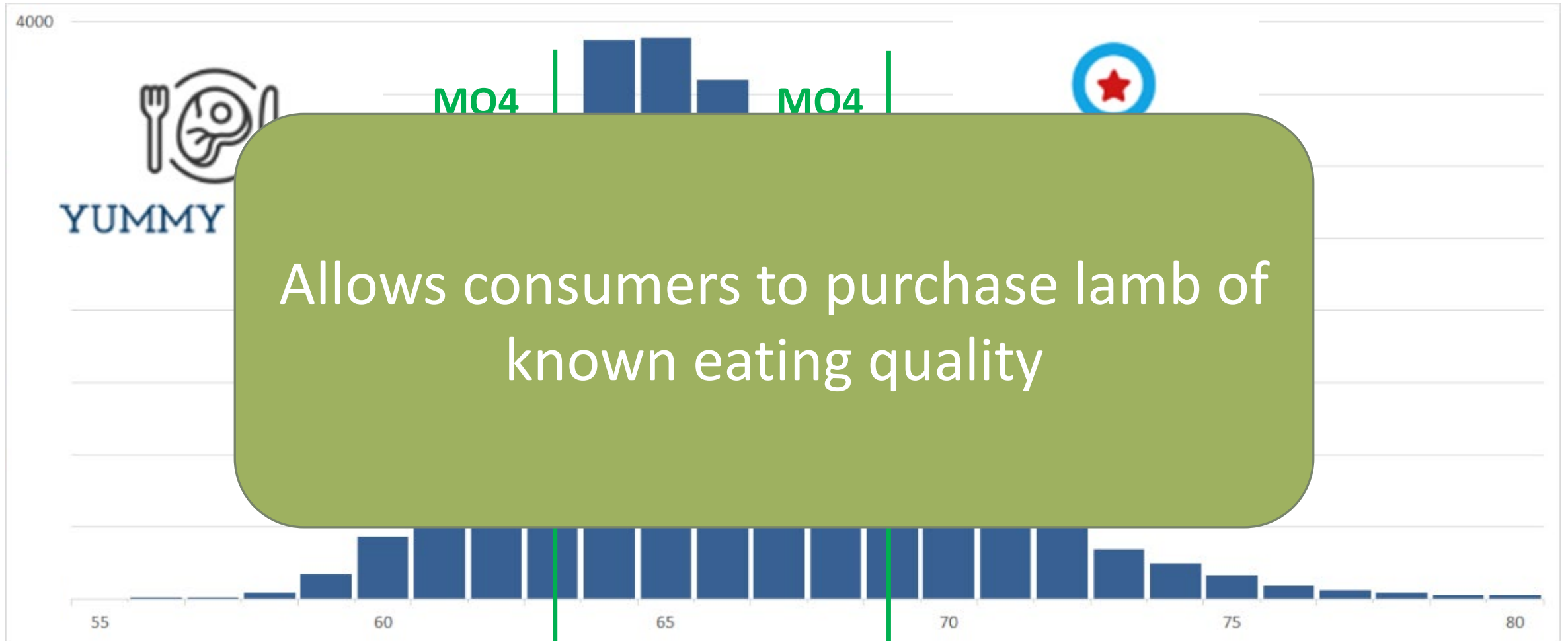
Meat Quality (MQ4) Score

Customised brand segregation



Meat Quality (MQ4) Score

Customised brand segregation



Meat Quality (MQ4) Score

Future work for this model



Predictors

Cut/cook

Lean meat yield

Carcass weight

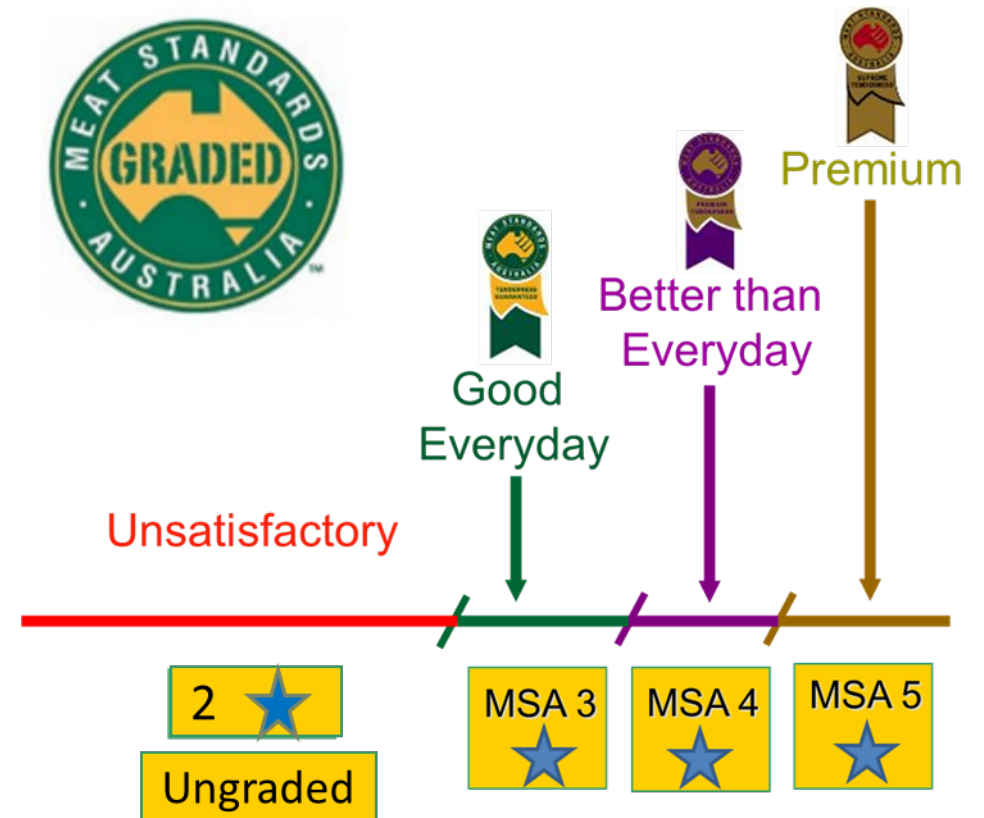
Intramuscular fat%

Animal age

Ageing time



Consumer Score
& Quality Grade



Conclusions and industry outcomes

- Don't forget about consumer eating quality
- New cuts-based MSA model for sheepmeat is ready to go
- Balance for lean meat yield and intramuscular fat %
- Segregation of quality grades is possible
- Underpin brand and product specifications



Thank you



