

Using Intramuscular Fat % to Predict Marbling

Applications for the Australian beef industry

Sarah Stewart, Graham Gardner, Garth Tarr



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Session 32: The role of marbling in beef quality – development, importance, measurement and harmonisation

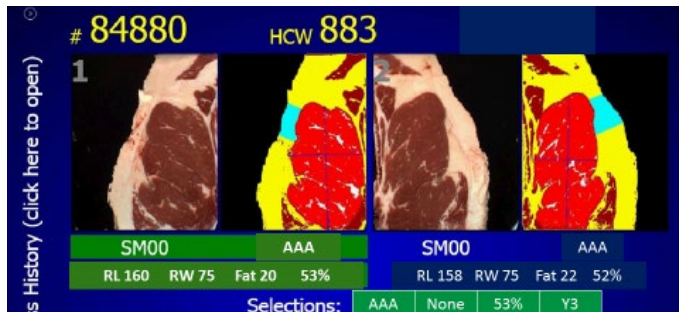
Outline

- \$AUD34 million to accelerate the development of objective carcass technologies
- Challenges with using marbling to calibrate devices
- Chemical IMF% as an alternative trait
- Hypothesis
- Model development
- Validation performance
- Industry application



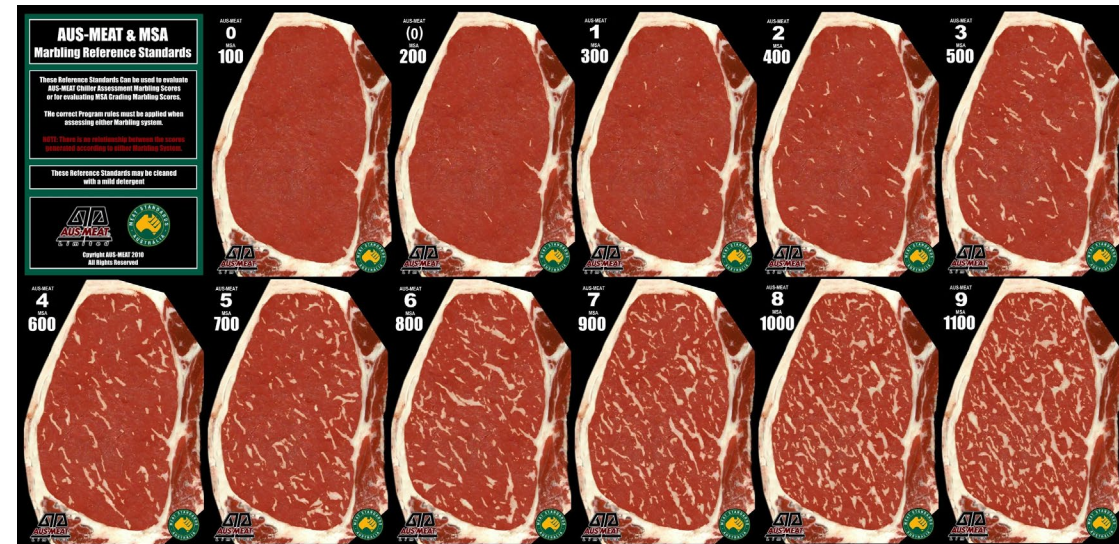
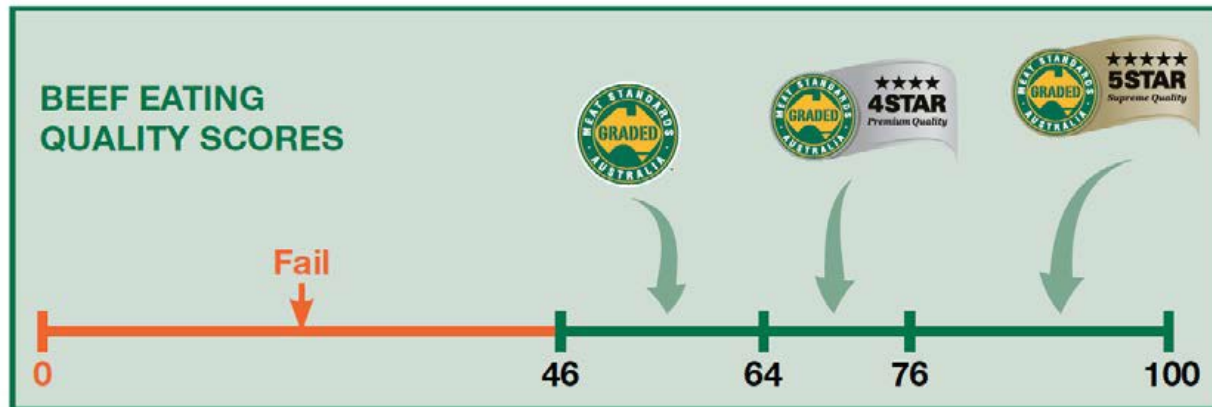
Objective carcass grading

- Develop and commercialise technologies
- Opportunity to grade carcasses using objective traits
- Chemical Intramuscular fat %
- New technologies that do not require a cut surface



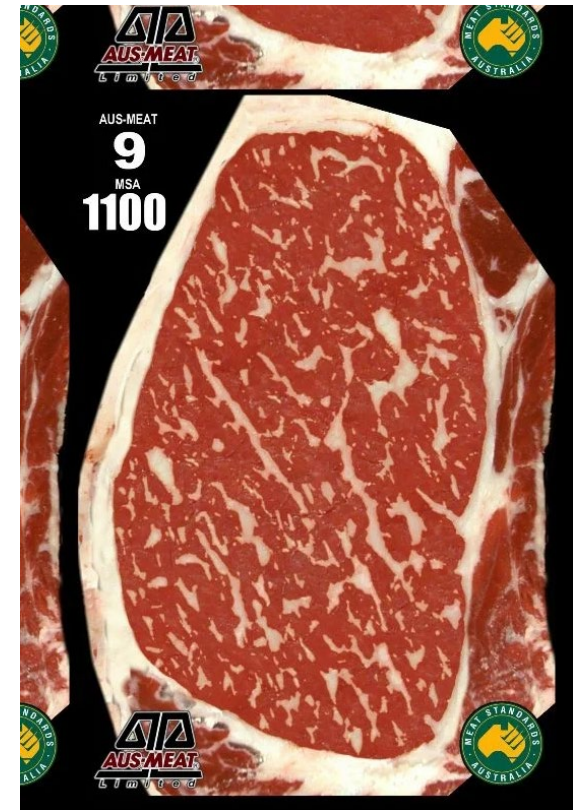
But current industry standard is visual marbling

- Human based assessment of visible IMF%
- AUS-MEAT marbling
- MSA marbling score
- MSA eating quality model
- Key profit driver for beef brands



Several issues

- Subjective human based assessment = biased
- Affected by day, grader, time
- Multiple technologies require calibration and accreditation
 - Subjective traits = shifting target
 - Cannot directly compare technologies if tested separately
- Marbling score limit
 - Prevents accurate feedback to producers
 - Inconsistencies in brand segregation
 - Softens price signals



An alternative standard - Chemical IMF%

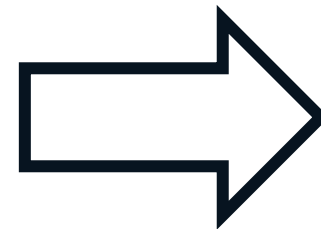
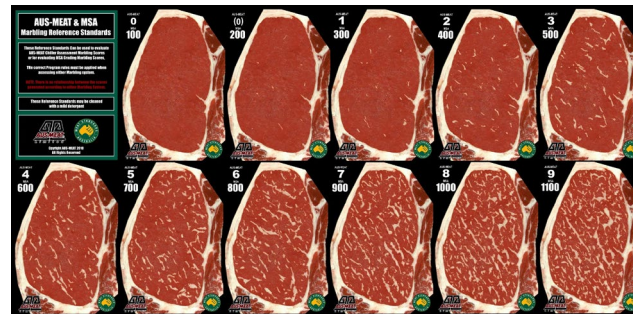
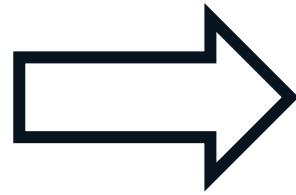
- Objective and repeatable trait
- Positively influences tenderness, juiciness, flavour
- Comparable precision to MSA marbling in MSA model
- Standardized and AUS-MEAT accredited method of determining fat%
- Displace visual marbling scores?



Significant disruption to the beef industry!!!

A more flexible approach is required to reduce disruption

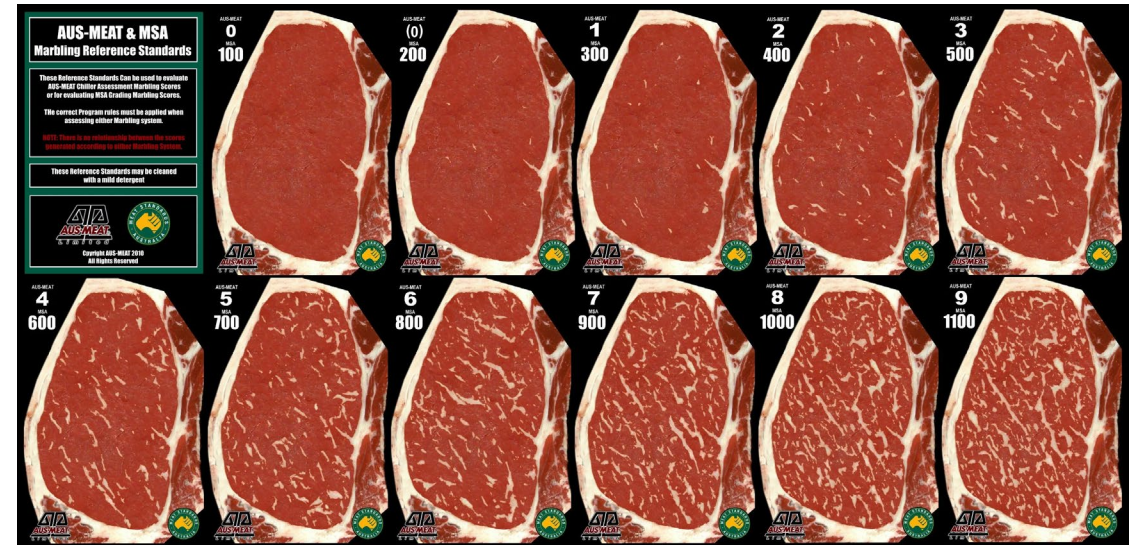
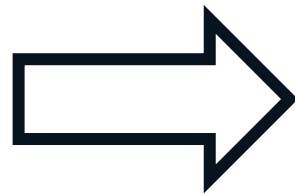
Develop industry models that convert IMF% into marbling



Industry
application

Hypothesis

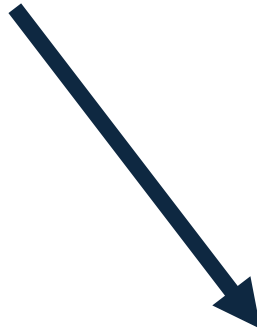
Conversion models will precisely and accurately predict marbling when independently validated



Experimental design

Pooled industry datasets (n = 5513)

- Beef Information nucleus herd
- AUS-MEAT accreditation trials
- Multiple carcass categories



Experimental design

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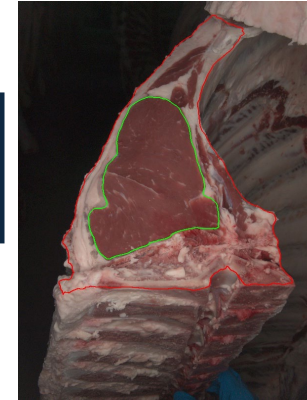
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Carcass grading

24 hours post-slaughter

- 10-13th rib
- 1 hour bloom



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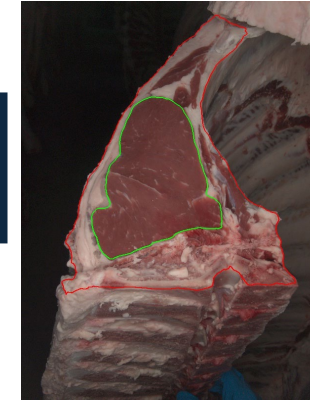
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Chemical IMF%



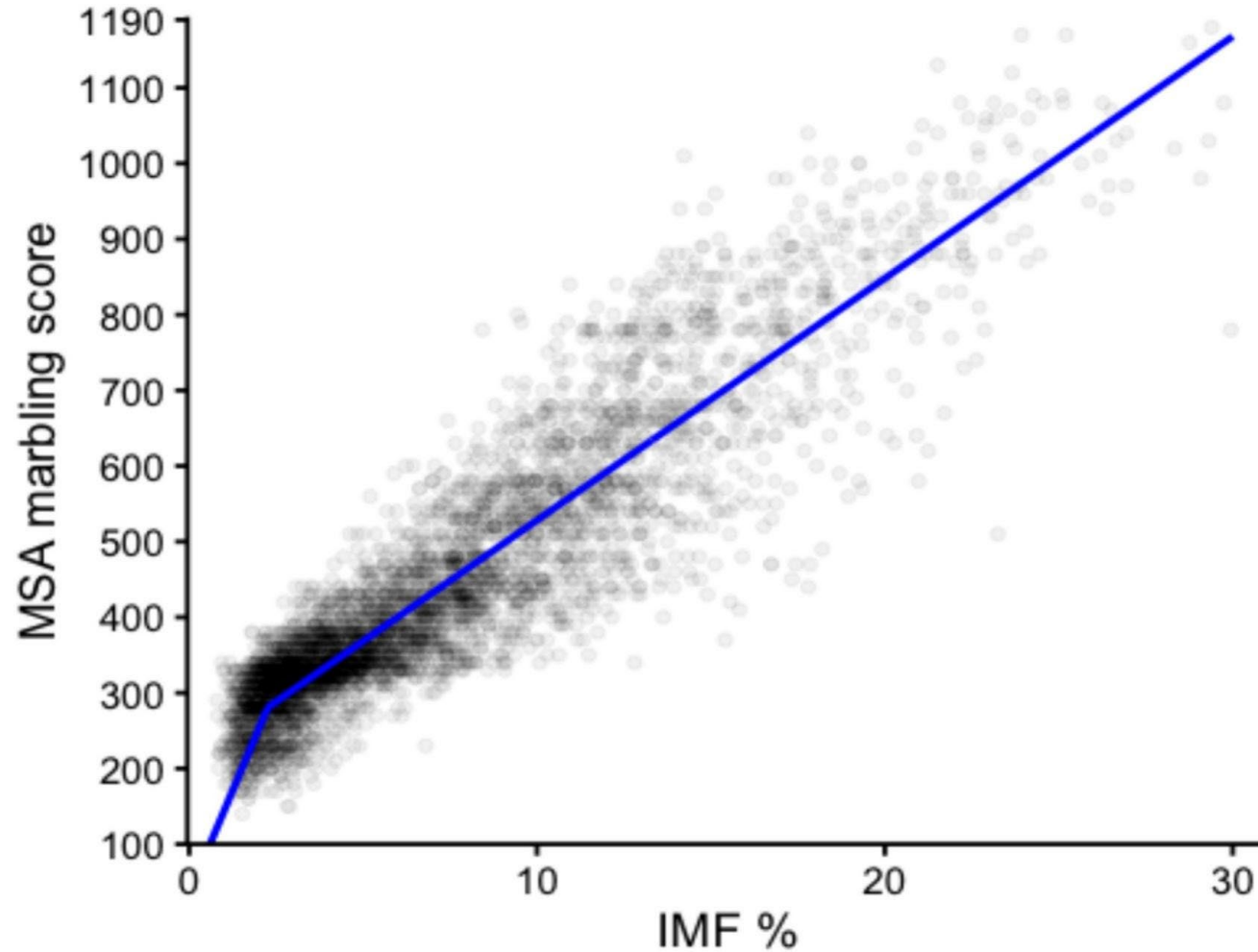
Lab based Near Infrared Spectroscopy

- Calibrated by chloroform Soxhlet extraction

	Overall (<i>N</i> = 4850)	Validation (<i>N</i> = 663)
MSA marbling score		
Mean ± SD	436 ± 174	466 ± 209
Range	140 – 1180	140 – 1140
AUS-MEAT marbling		
Median ± SD	1.0 ± 1.74	1.0 ± 2.07
Range	0 – 9	0 – 9
Chemical IMF%		
Mean ± SD	7.06 ± 5.01	7.86 ± 6.29
Range	0.808 – 30.0	0.43 – 32.25

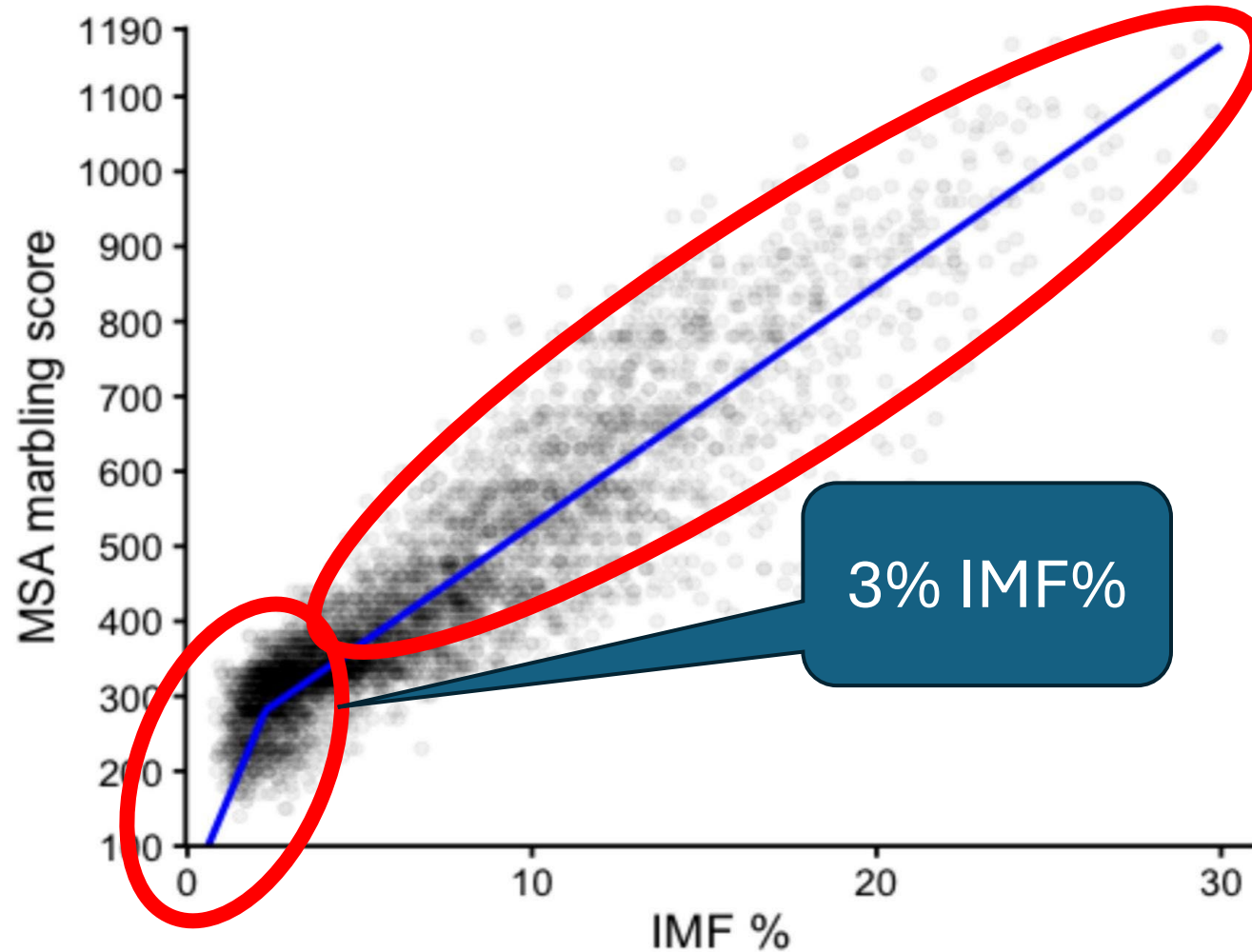
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Analysis – MSA marbling



- Segmented relationship
- “Low” and “High”

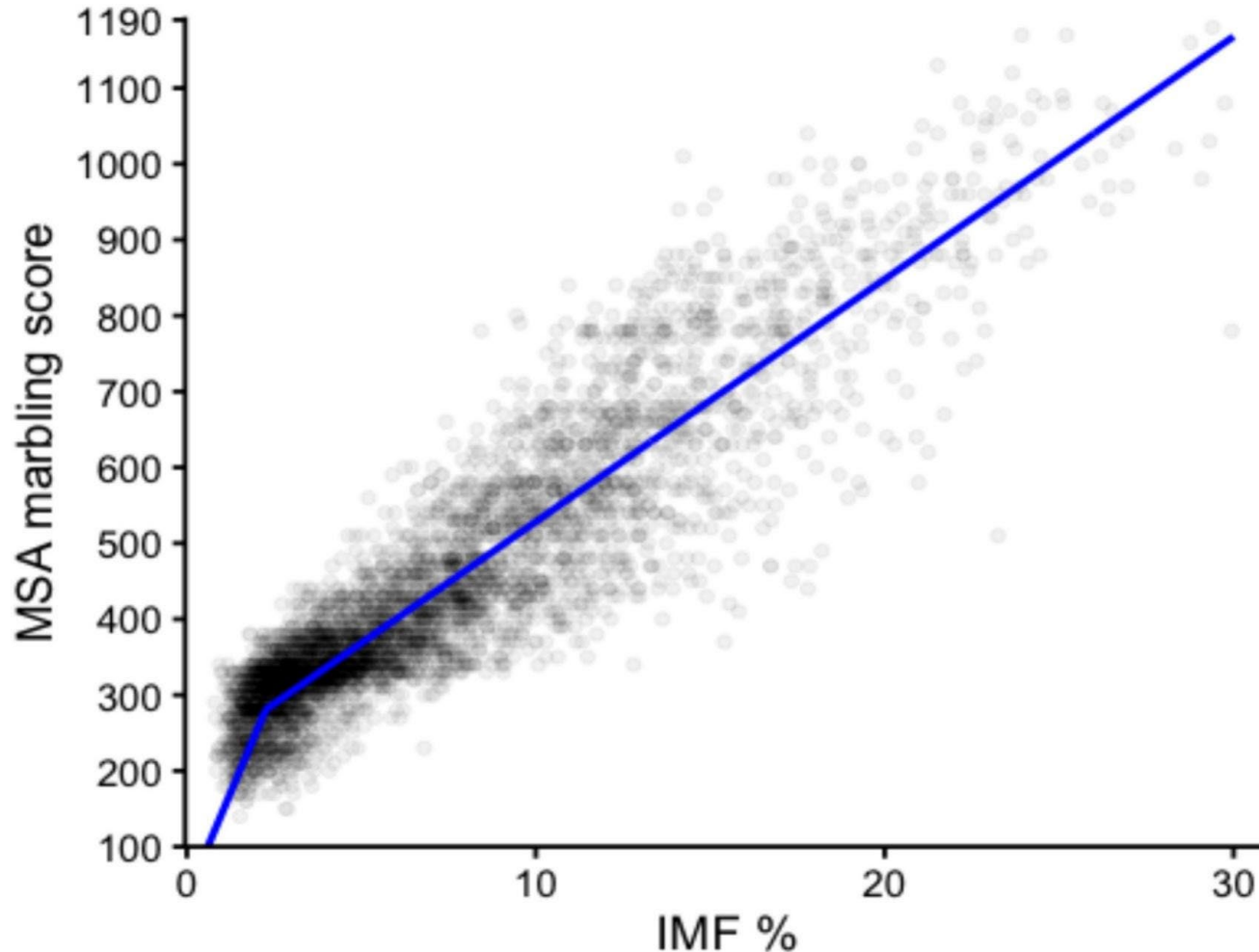
Analysis – MSA marbling



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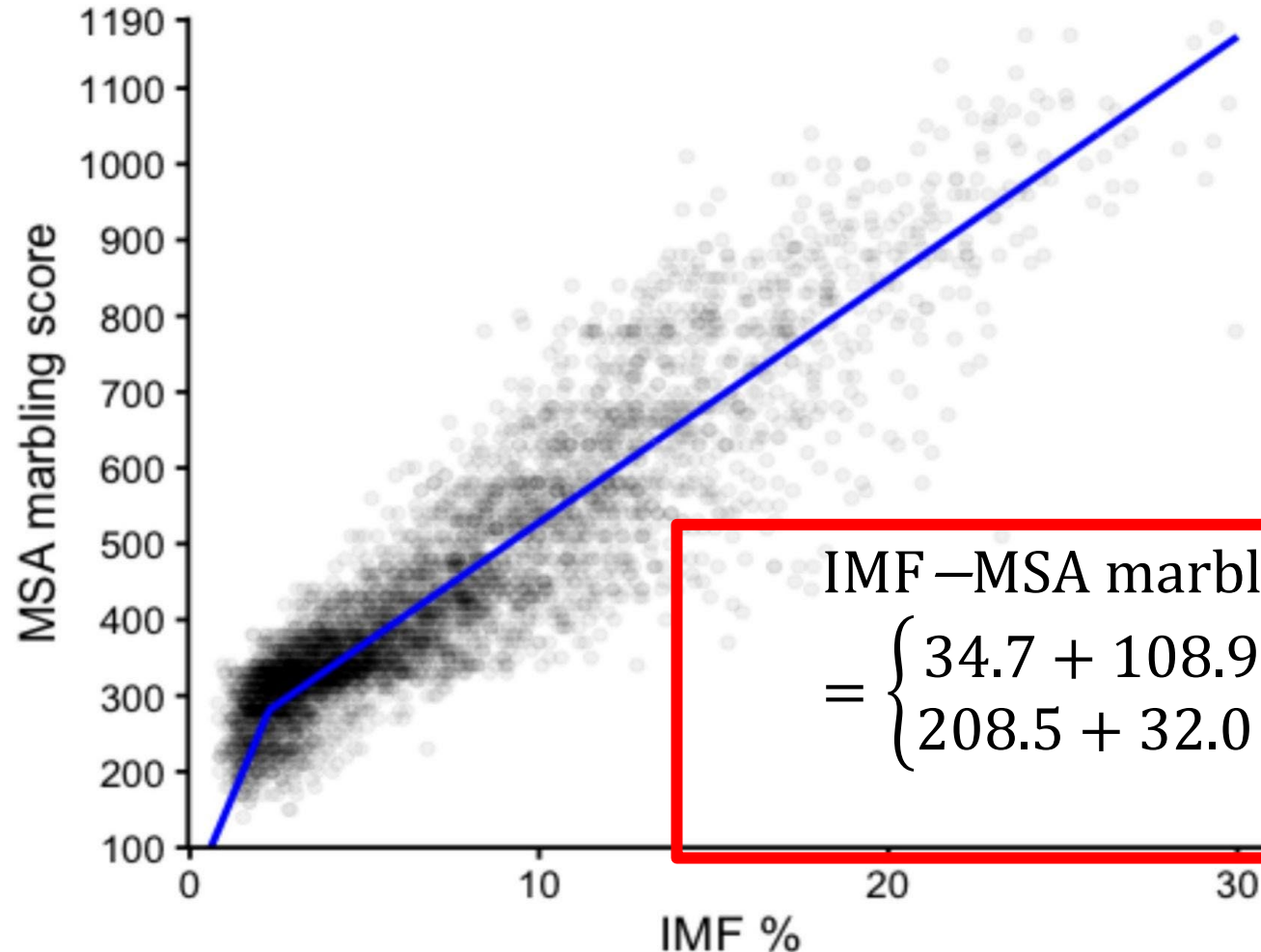
3% IMF%

Analysis – MSA marbling



- Segmented relationship
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- Model fitted through each data sub-set
- Sensitivity analysis

Analysis – MSA marbling

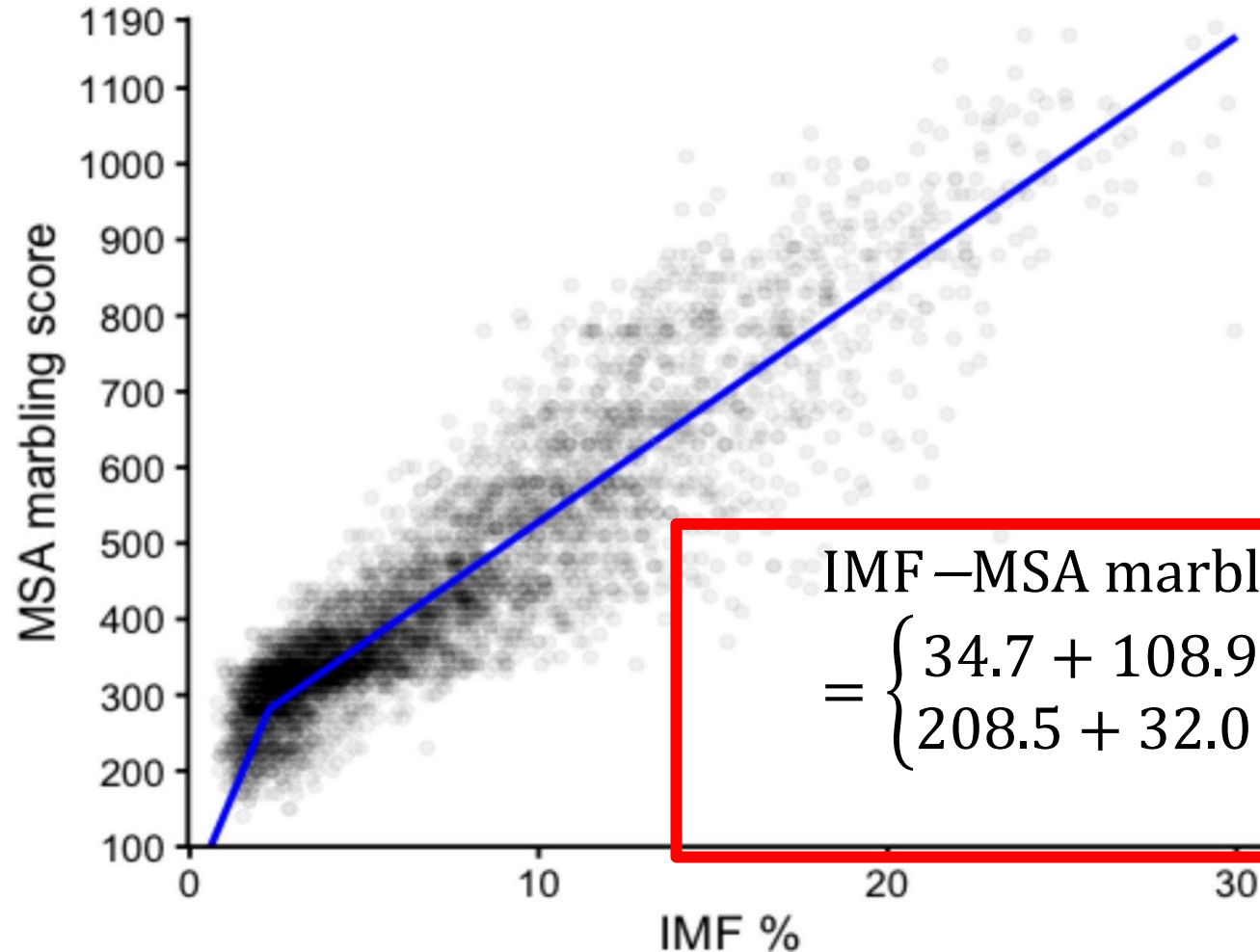


- Segmented relationship
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- Model fitted through each data sub-set
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IMF –MSA marbling

$$= \begin{cases} 34.7 + 108.9 \times \text{IMF} & \text{when } 0.6 \leq \text{IMF} < 2.3 \text{ and} \\ 208.5 + 32.0 \times \text{IMF} & \text{when } \text{IMF} \geq 2.3 \end{cases}$$

Analysis – MSA marbling



$$R^2 = 0.80$$

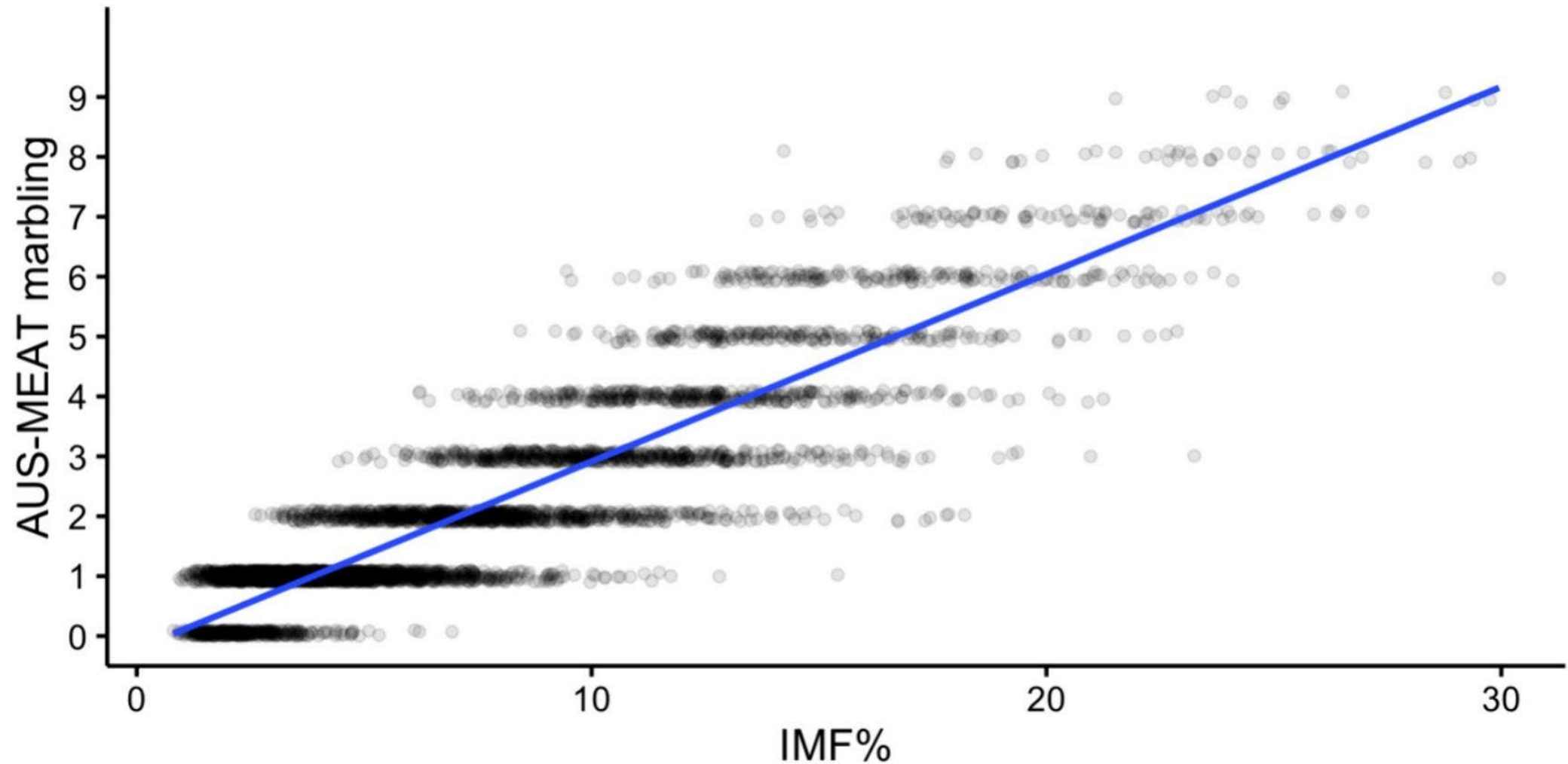
$$RSE = 78.04$$

IMF – MSA marbling

$$= \begin{cases} 34.7 + 108.9 \times \text{IMF} \\ 208.5 + 32.0 \times \text{IMF} \end{cases}$$

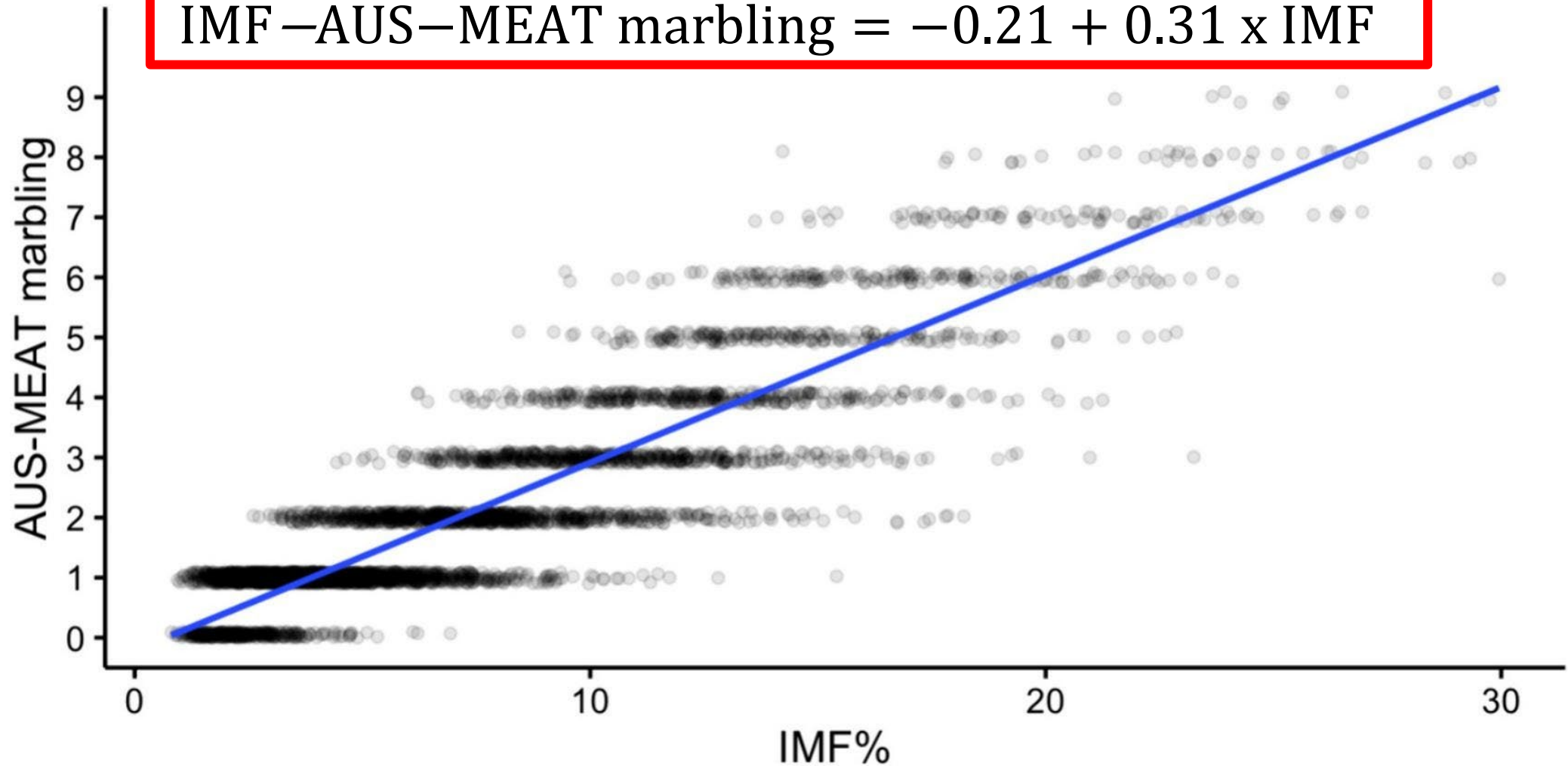
when $0.6 \leq \text{IMF} < 2.3$ and
when $\text{IMF} \geq 2.3$

Analysis – AUS-MEAT marbling

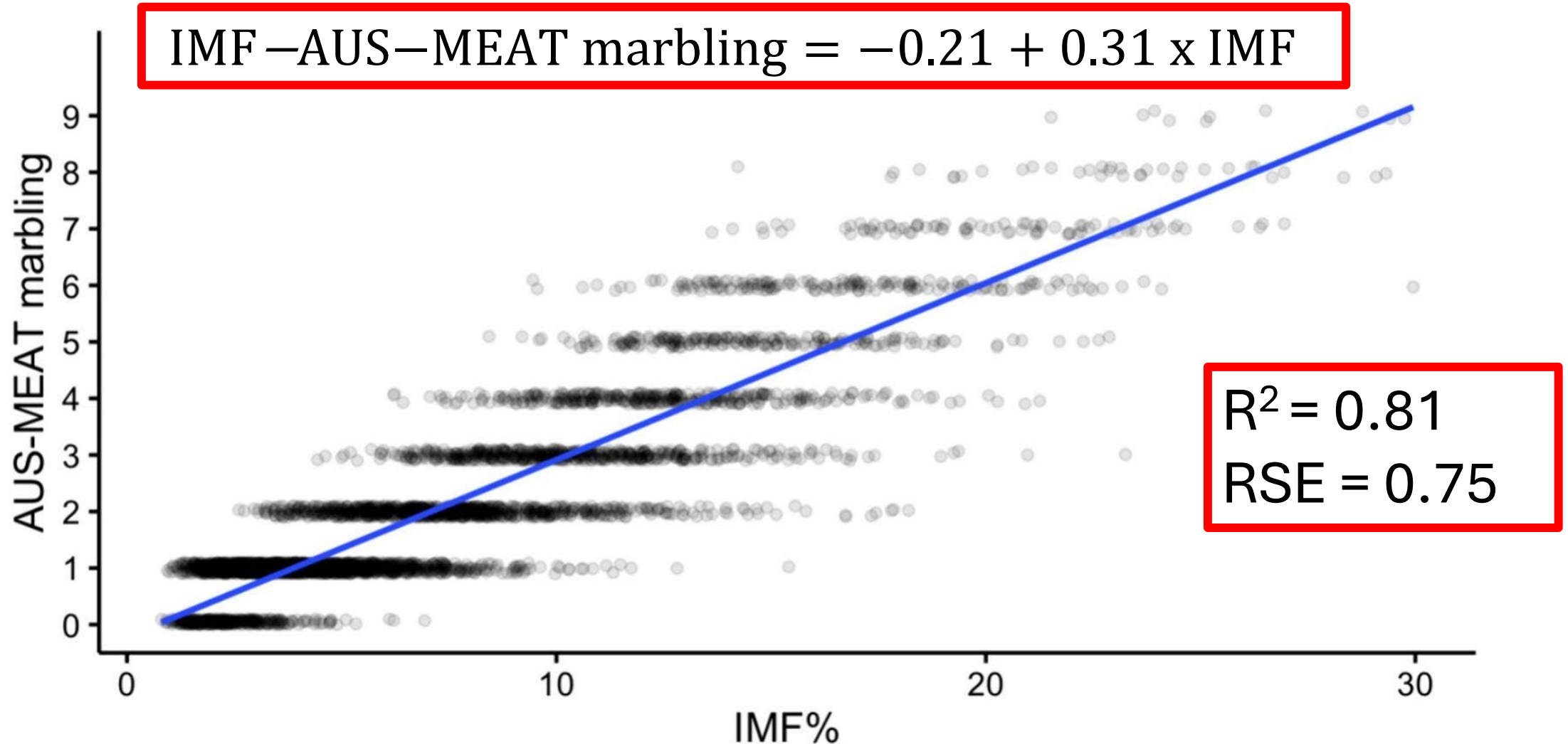


Analysis – AUS-MEAT marbling

$$\text{IMF – AUS – MEAT marbling} = -0.21 + 0.31 \times \text{IMF}$$

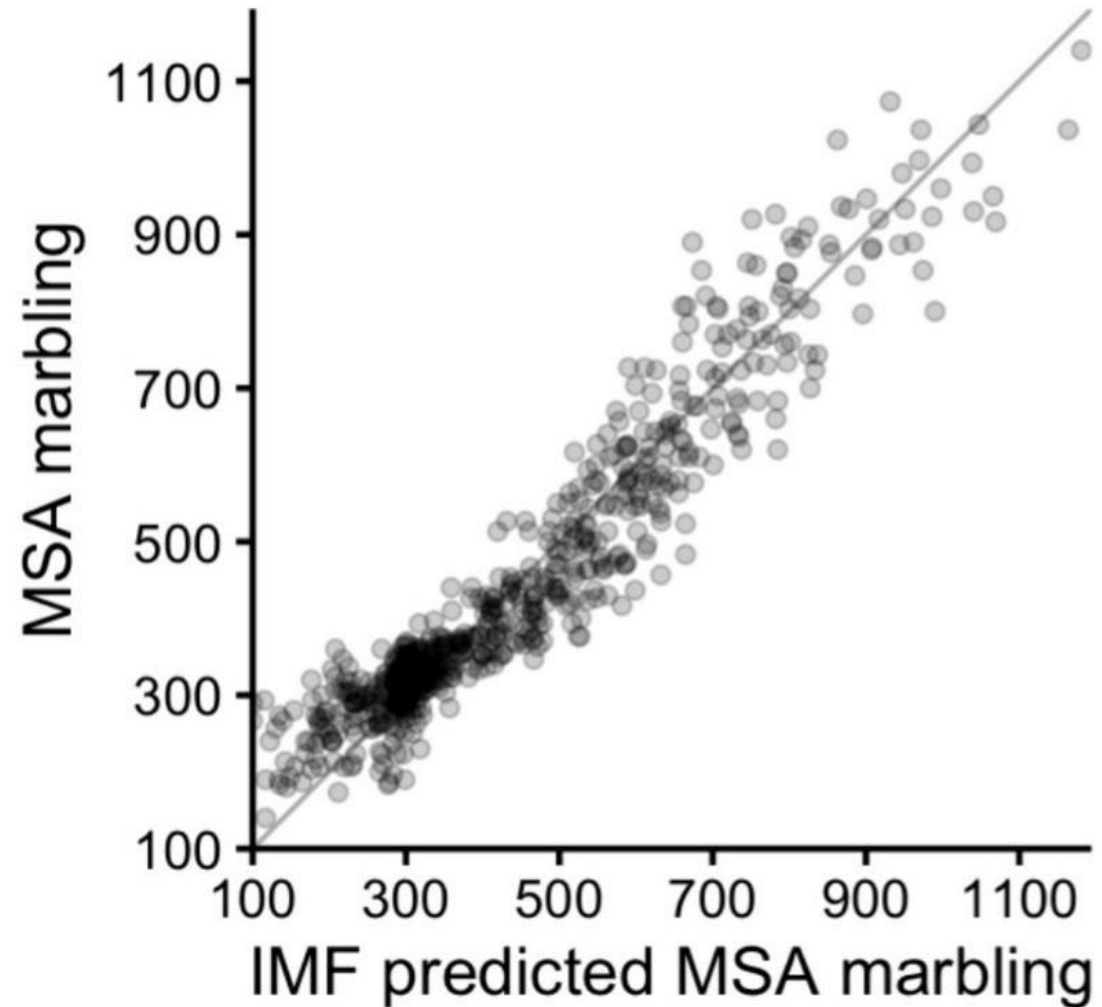


Analysis – AUS-MEAT marbling

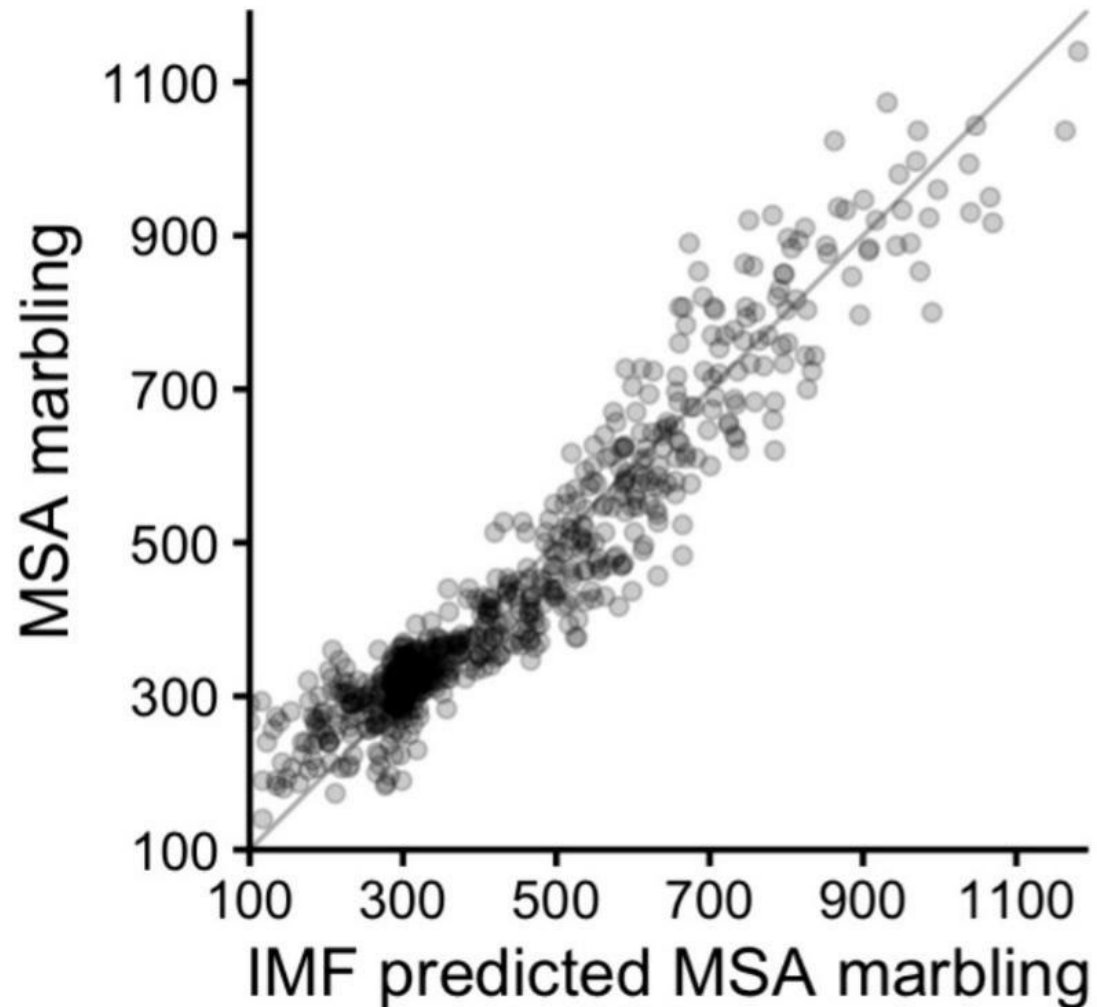


Independent validation

Analysis - Validation



Analysis - Validation



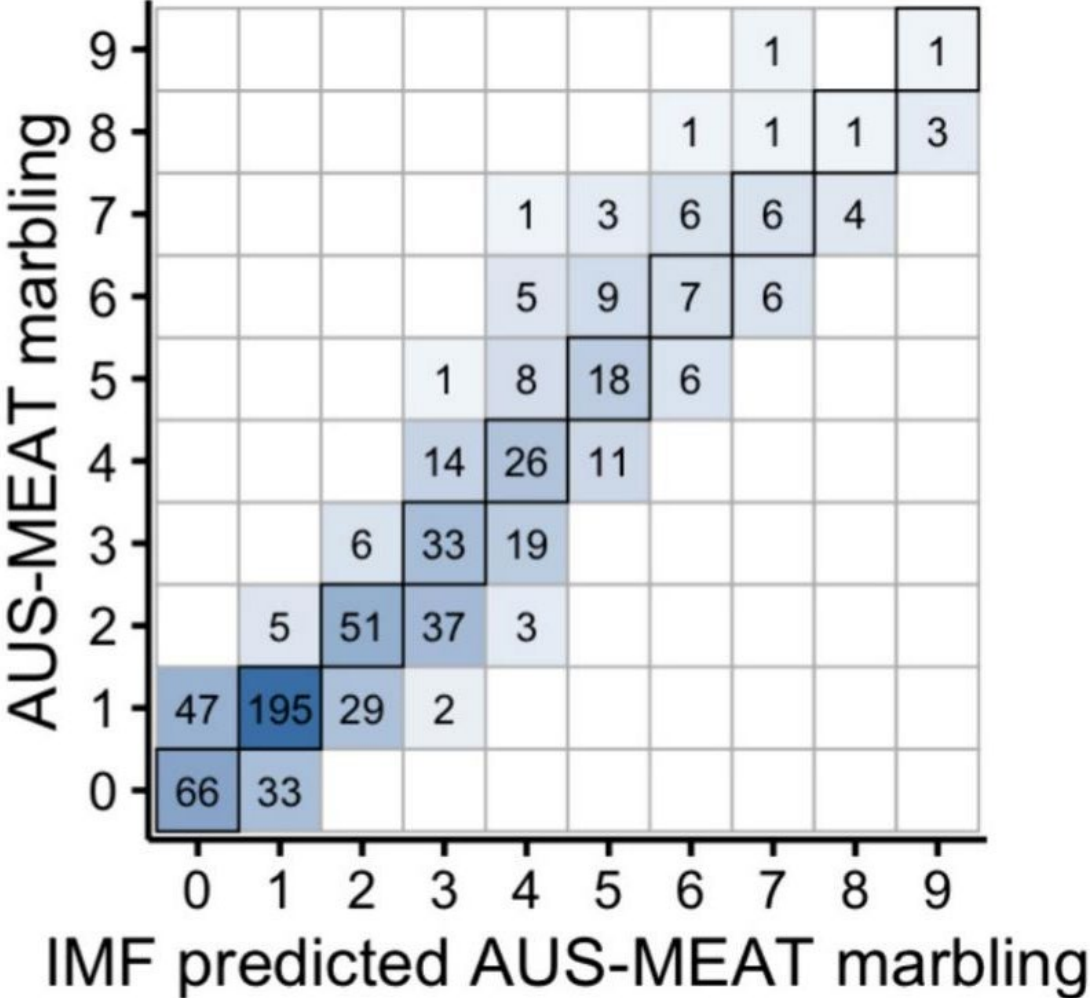
$$R^2 = 0.91$$

$$RSE = 57.9$$

$$\text{Bias} = -0.54$$

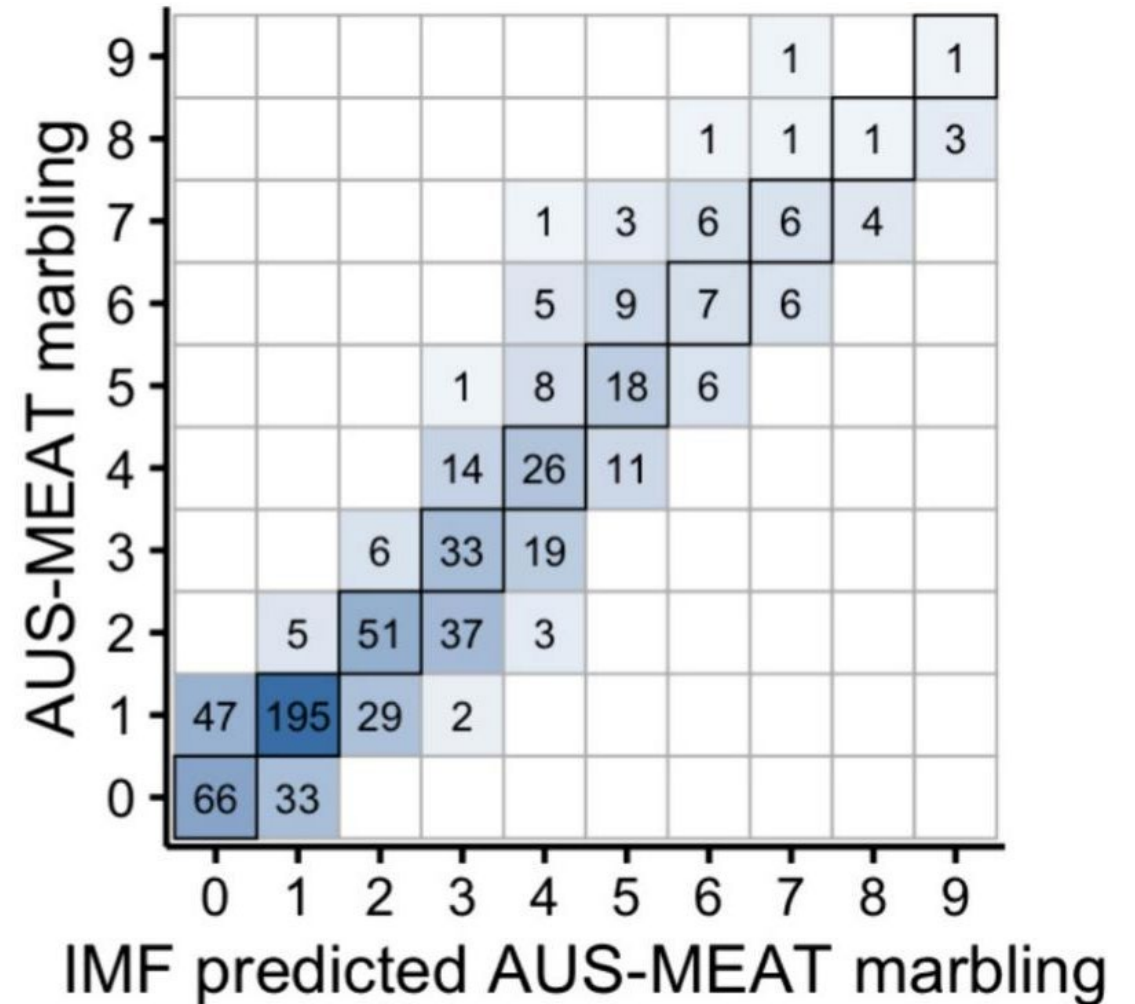
$$\text{Slope} = 0.90$$

Analysis - Validation



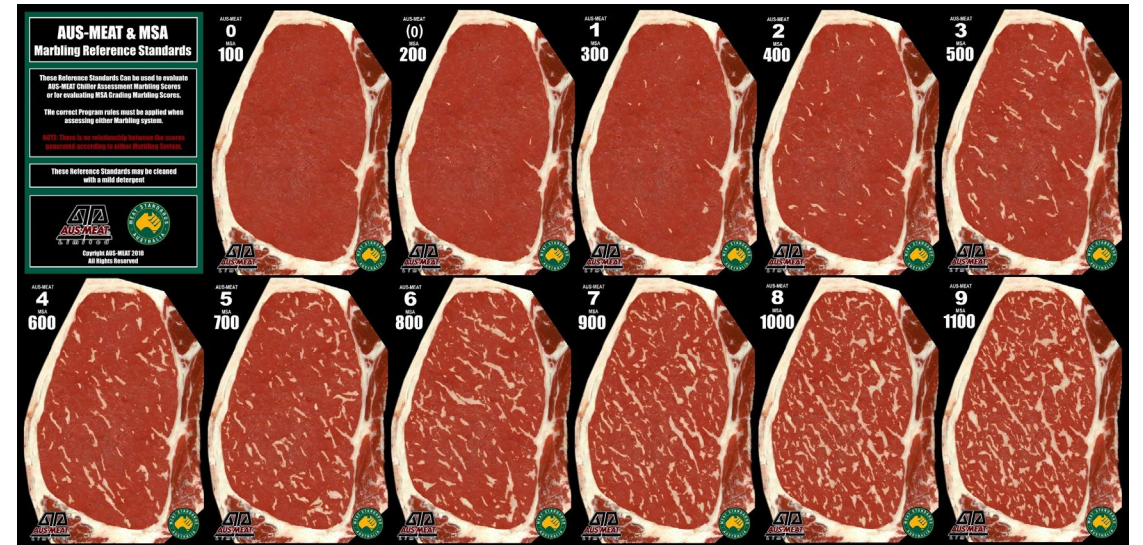
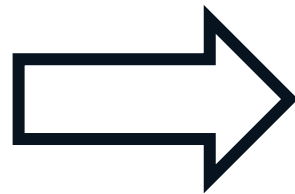
Analysis - Validation

$R^2_v = 0.88$
 $RSE_v = 0.68$
Bias = 0.06
Slope = 0.94



Hypothesis

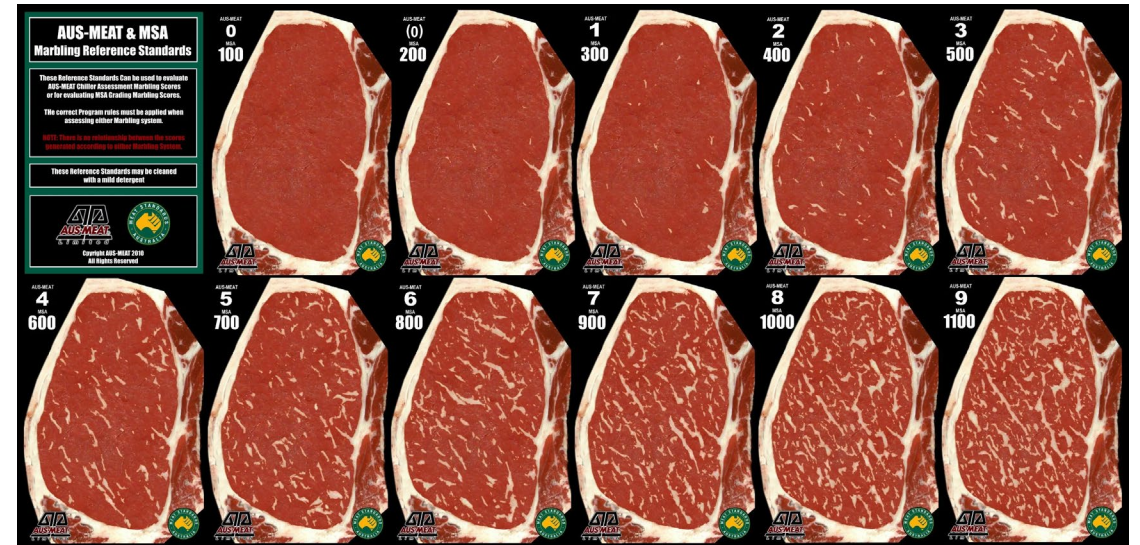
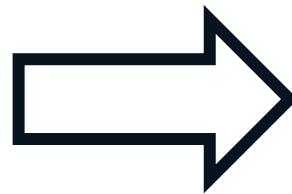
Conversion models will precisely and accurately predict marbling when independently validated



Hypothesis



Conversion models will precisely and accurately predict marbling when independently validated

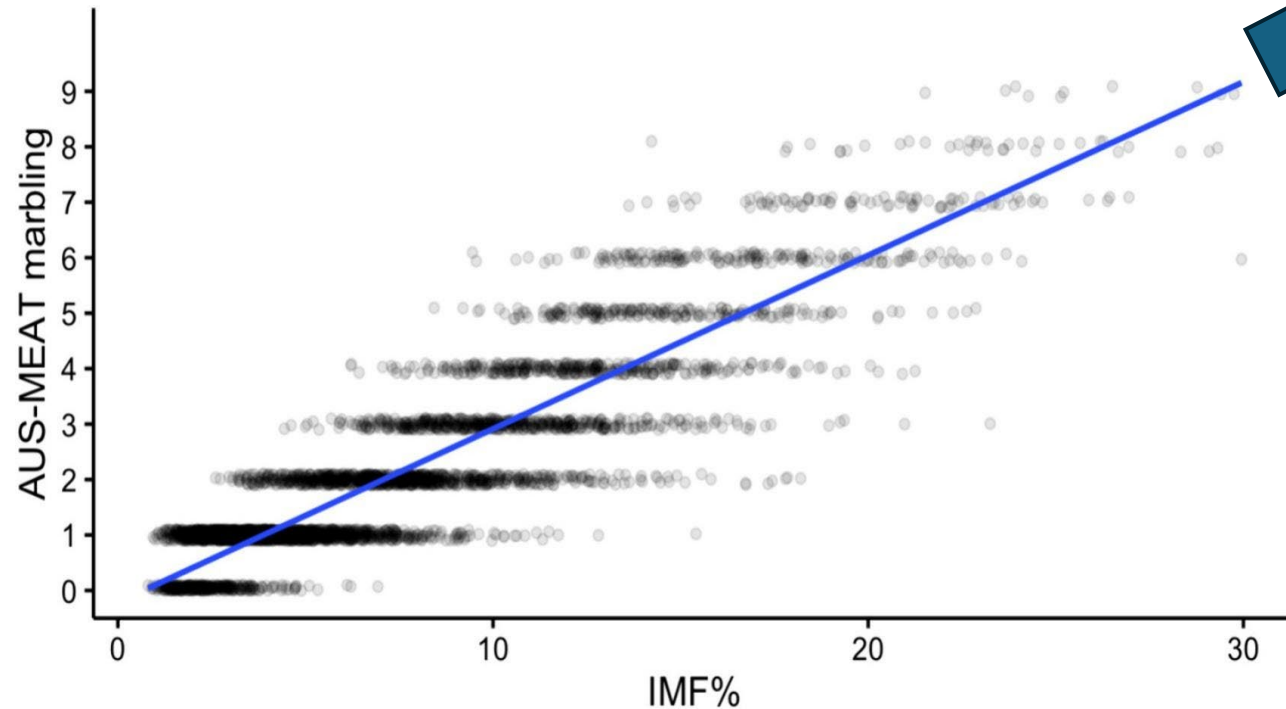


Industry application

- Simple models can convert IMF% into MSA and AUS-MEAT marbling scores
- Objective grading technologies can be calibrated against chemical IMF%
- IMF%-derived values can be used as inputs into MSA grading
 - Minimal disruption as trading language unchanged
 - Increase precision of eating quality prediction

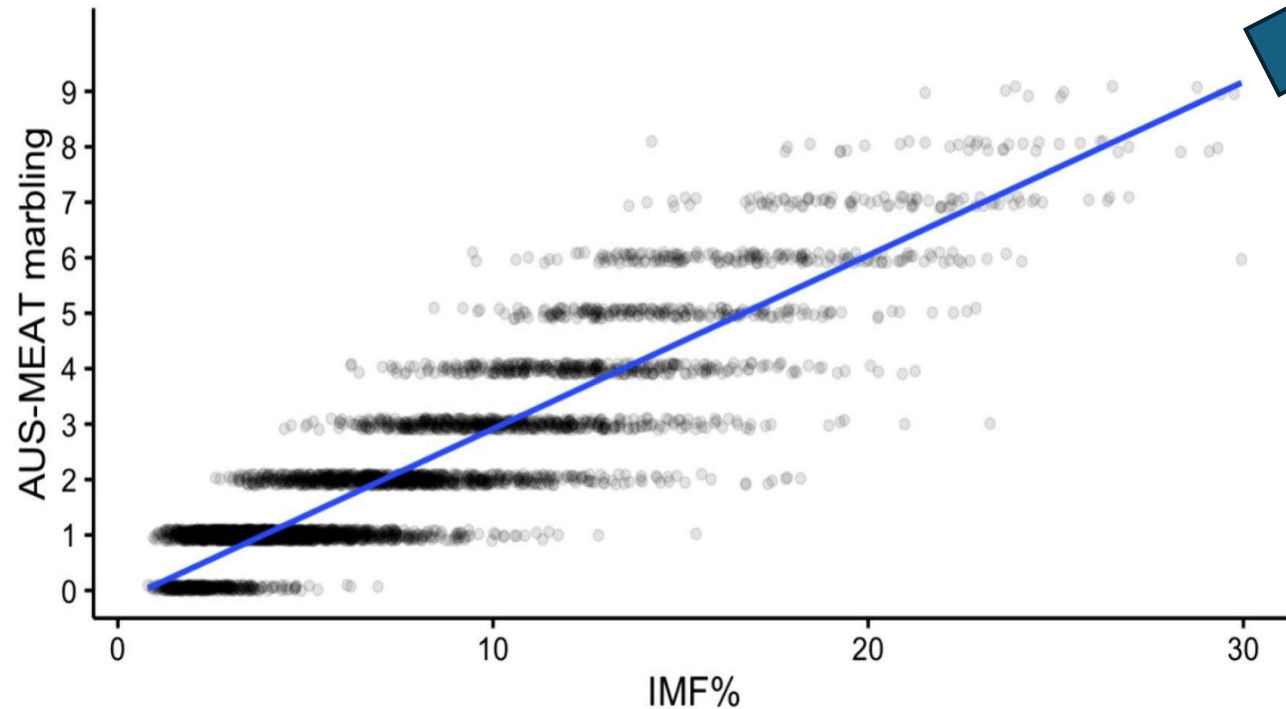
Industry application

- Industry defined models could extend AUS-MEAT and MSA marbling scores



Industry application

- Industry defined models could extend AUS-MEAT and MSA marbling scores



Huge value for the
beef industry

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Thank you



Using chemical intramuscular fat percentage to predict visual marbling scores in Australian beef carcasses

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