Department of Agriculture and Food

Using NeuralTools to generate a pricing model for wool

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Australian Wool Industry

- 70% of world trade in apparel wool is Australian wool
- Unlike other commodities
  - Each farm lot is fully measured
  - Each farm lot has an individual price
- About 450,000 farm lots sold each year in Australia
- Raw wool value of AUD3 billion annually

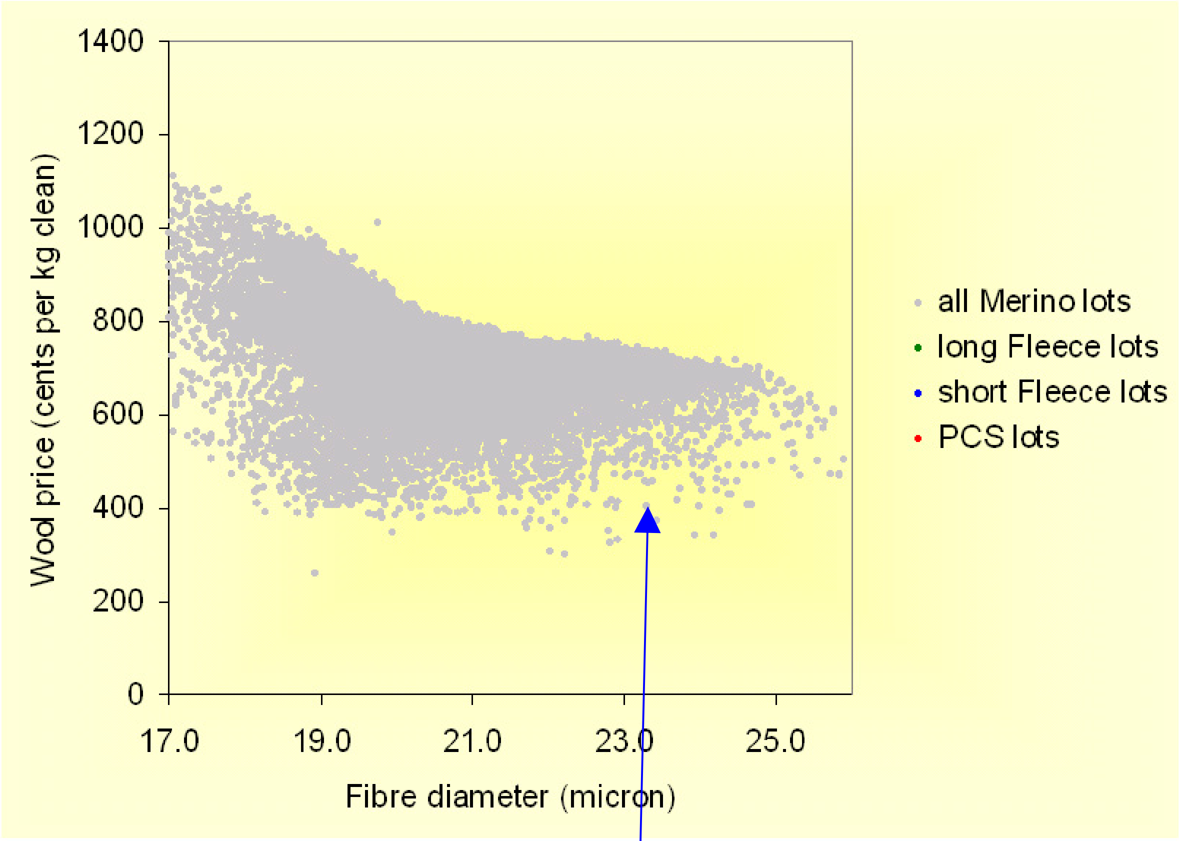
Wool prices & market reporting

- Estimates of auction price on individual lots needed by sellers (farmers)
- Forecast auction price on individual lots required by buyers for contracts
- Market reporting of price paid for different wool types

Neural nets & wool prices

- Neural nets attractive because
  - Number of records is large
  - Prices are dynamic
  - Price/attribute relationships are non-linear and interactive
  - Price/attribute relationships are dynamic over time
  - The data set is incomplete and imprecise

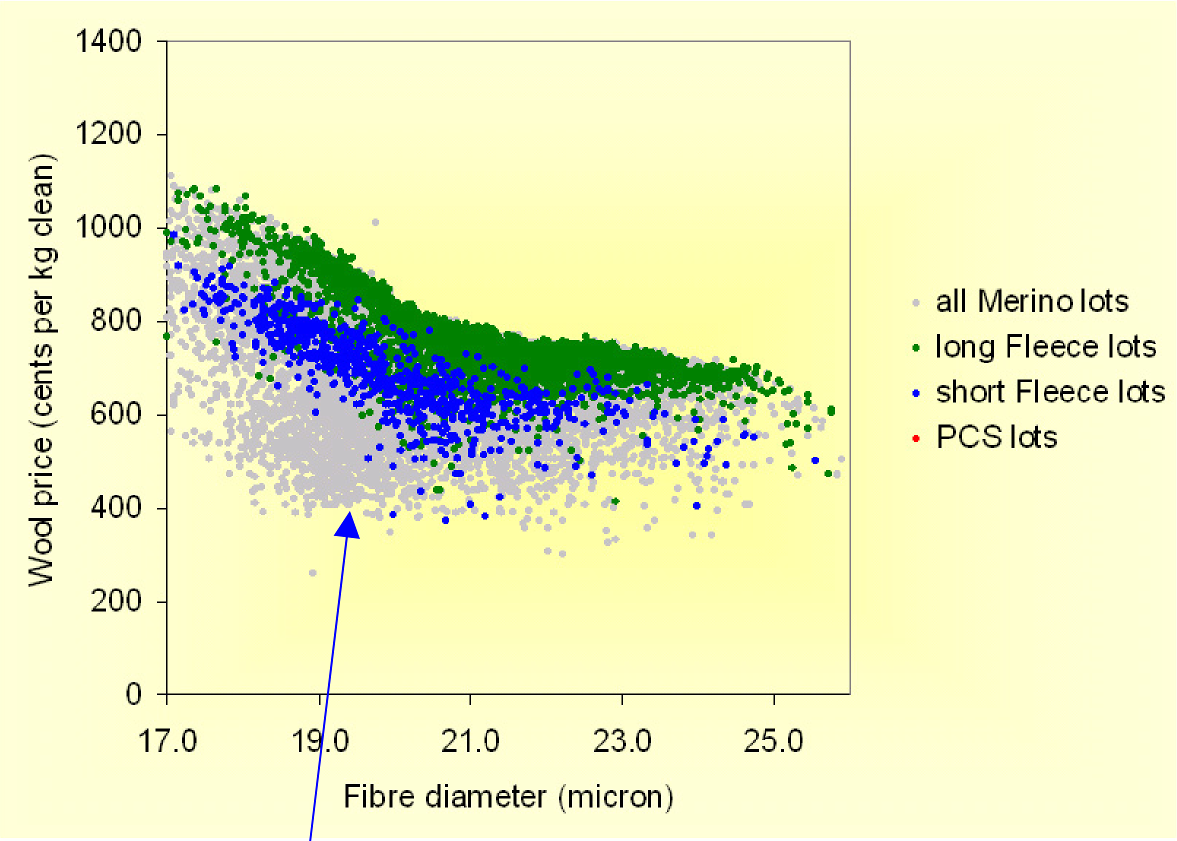
All Merino fleece lots



(Fremantle Jan-Mar 2006)

Each grey dot represents a parcel of wool sold at auction i.e. a 'case'

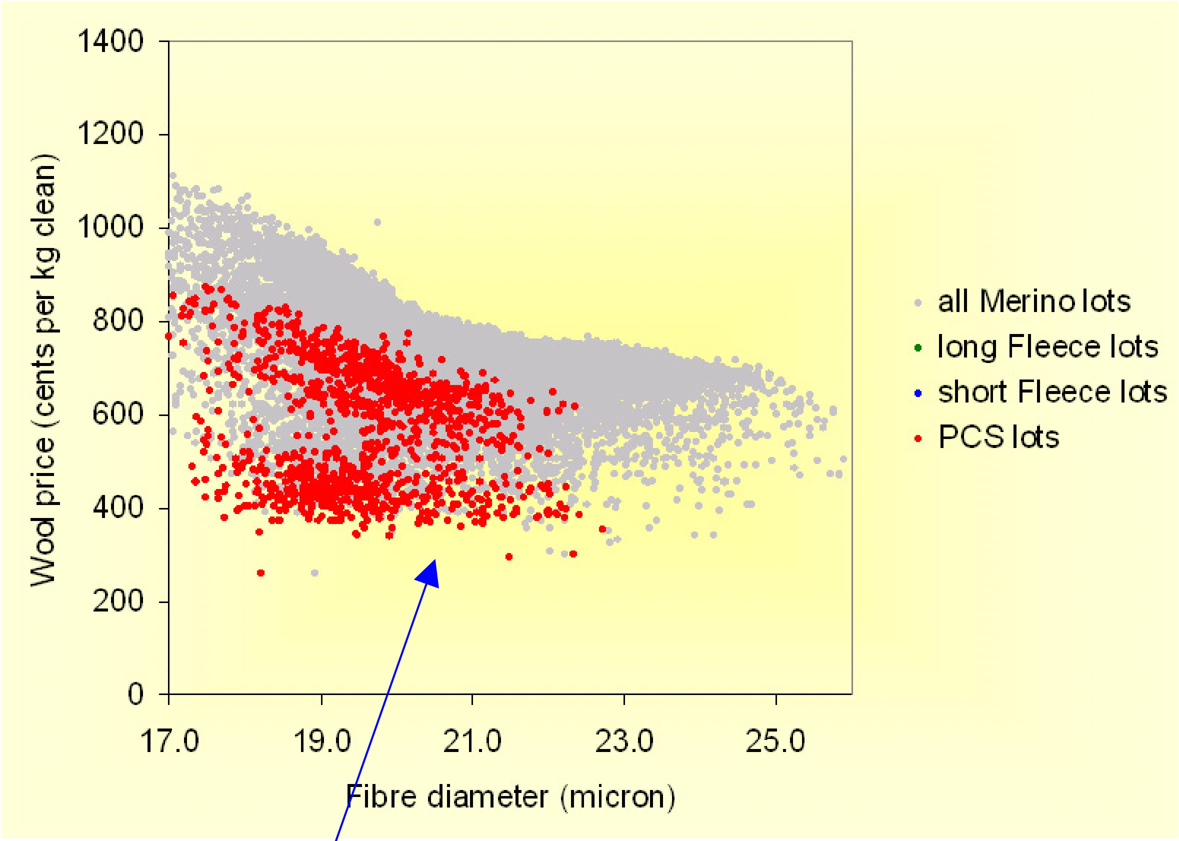
Long & short fleece lots



(Fremantle Jan-Mar 2006)

Long and short wool differentiated on price

Merino pieces lots

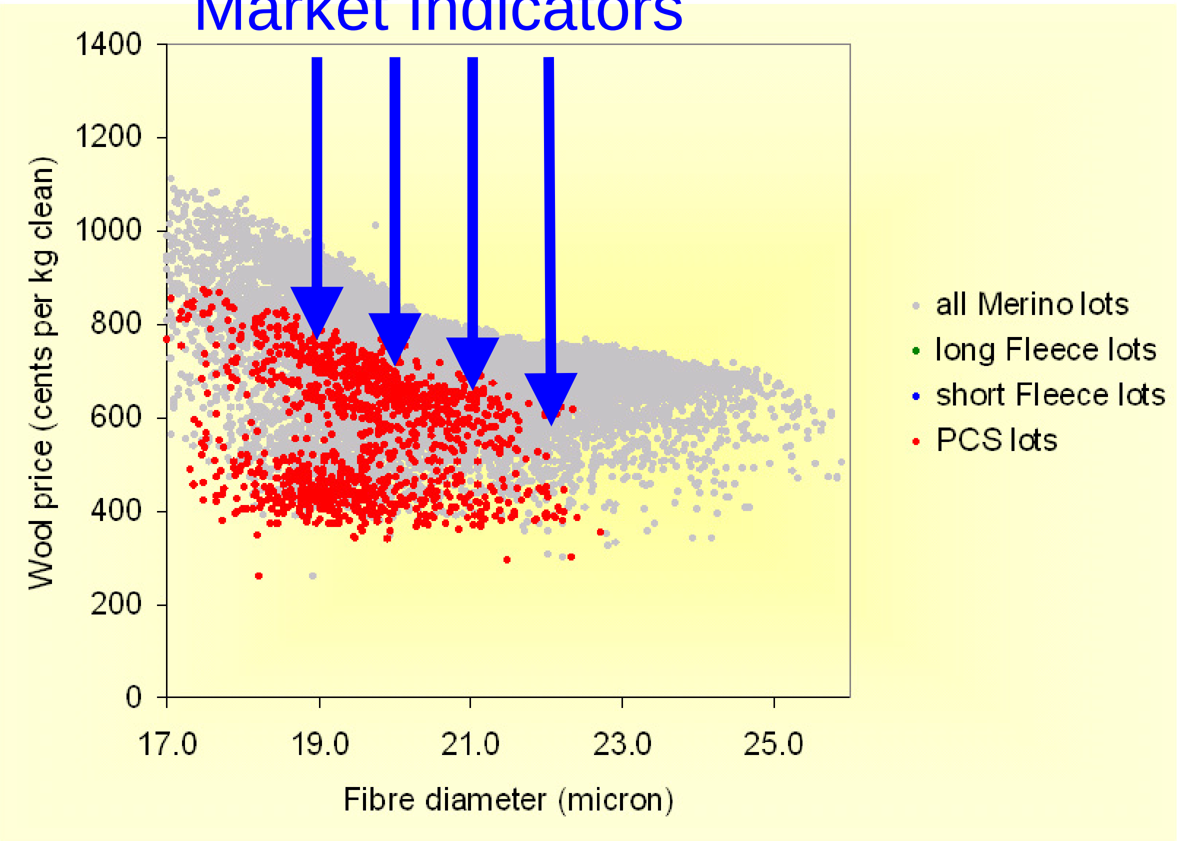


(Fremantle Jan-Mar 2006)

Pieces wool
(a subset of the wool clip)

The Challenge !

Market Indicators



(Fremantle Jan-Mar 2006)

Market indicators, like a stock market index, used to price wool

Model development (1)

- Assemble 6 month data set
  - Independent category and numeric variables
  - Dependent numeric variable (price)
  - Training, testing and prediction data

Excel Demo

- Use *Best Net Search*
- Evaluate predictive capability
- Refine model

Model development (2)

- Assemble a 6 month data set
- Use *Best Net Search*
  - GRN – proved best in most cases (generalised regression neural net)
  - MLFN – also tried with up to 5 nodes (multi layer feed-forward neural net)
- Evaluate predictive capability
- Refine model

Configuration summary

Net Information

Name	Net Trained on Pieces wool sales, weeks 33 - 38, 2006 (3)
Configurations Included in Search	GRNN, MLFN 2 to 3 nodes
Best Configuration	GRNN Numeric Predictor
Location	Palisade Conf Curtis v6 BNS 6hrs.xls
Independent Category Variables	8 (Sale centre, Sale week, Sale outcome, Style, Med Hard Cotts, Unscourable Colour, Jowls, Dark Stain)
Independent Numeric Variables	8 (Staple Length, Staple Strength, Vegetable Matter, Diameter, CV Diameter, Mid Breaks, Yield, Hauteur)
Dependent Variable	Numeric Var. (Clean price)

Model development (3)

- Assemble a 6 month data set
- Use *Best Net Search*
- Evaluate predictive capability
- Refine model

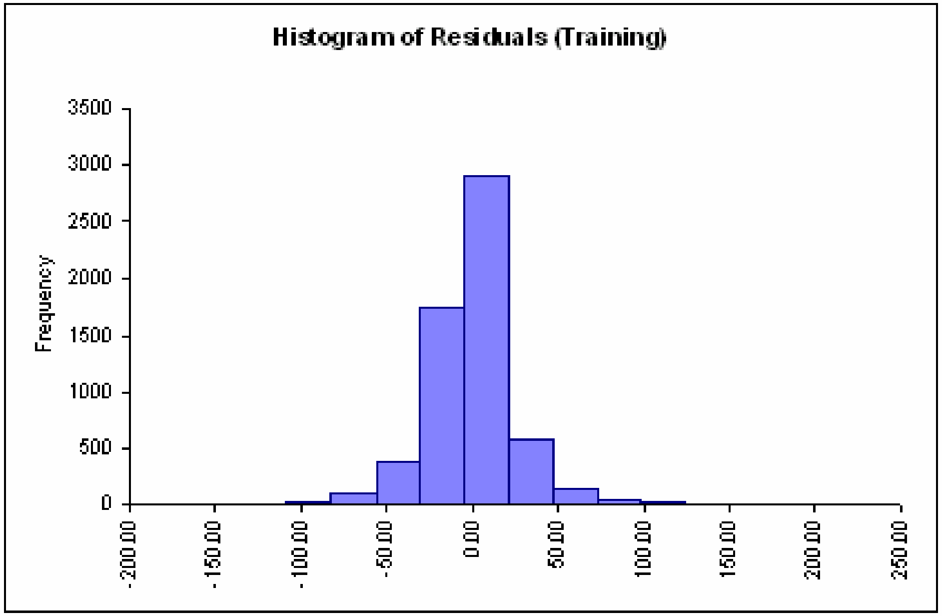
Model evaluation (1)

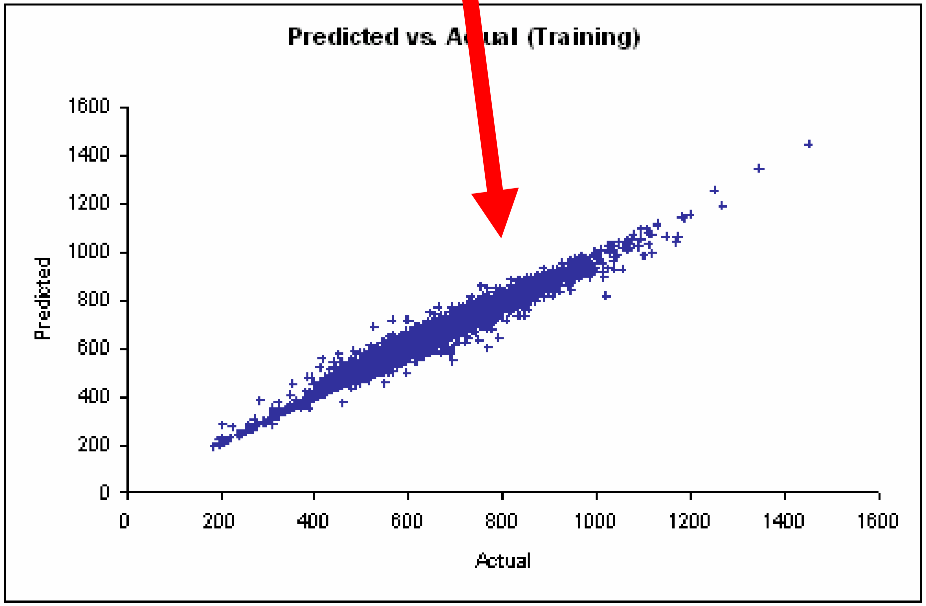
- NeuralTools outputs
  - Error measures
  - Actual versus Predicted, Residuals
  - Variable Impact Analysis
- Live Prediction
- Relationships between variables
- Compare to published market indicators

Model evaluation (1)
Training and Testing summary

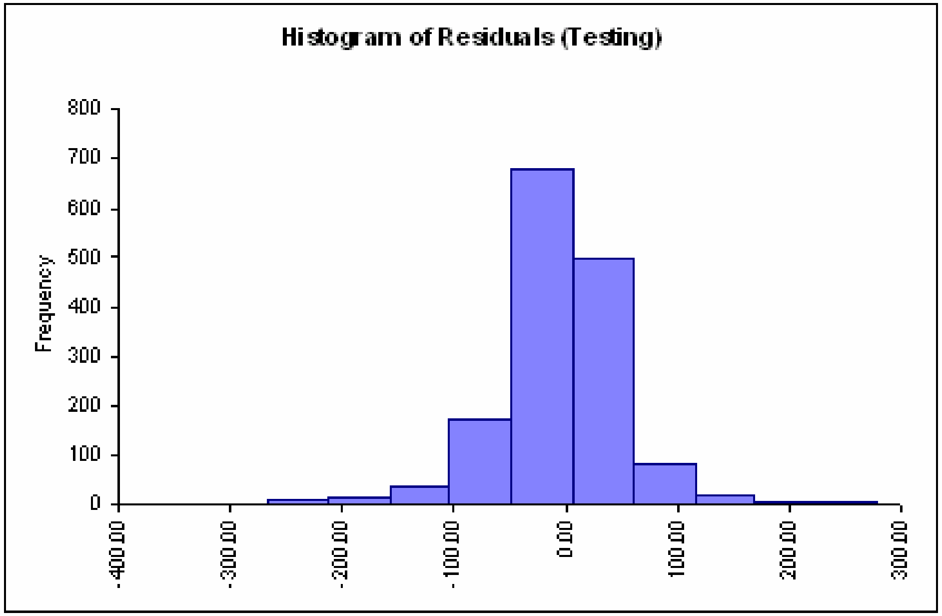
Training	
Number of Cases	5910
Training Time (h:min:sec)	0:39:43
Number of Trials	104
Reason Stopped	Auto-Stopped
% Bad Predictions (5% Tolerance)	14.7377%
Root Mean Square Error	24.72
Mean Absolute Error	$\boxed{16.42}$
Std. Deviation of Abs. Error	18.48
Testing	
Number of Cases	1507
% Bad Predictions (5% Tolerance)	43.3975%
Root Mean Square Error	53.18
Mean Absolute Error	$\boxed{36.99}$
Std. Deviation of Abs. Error	38.21

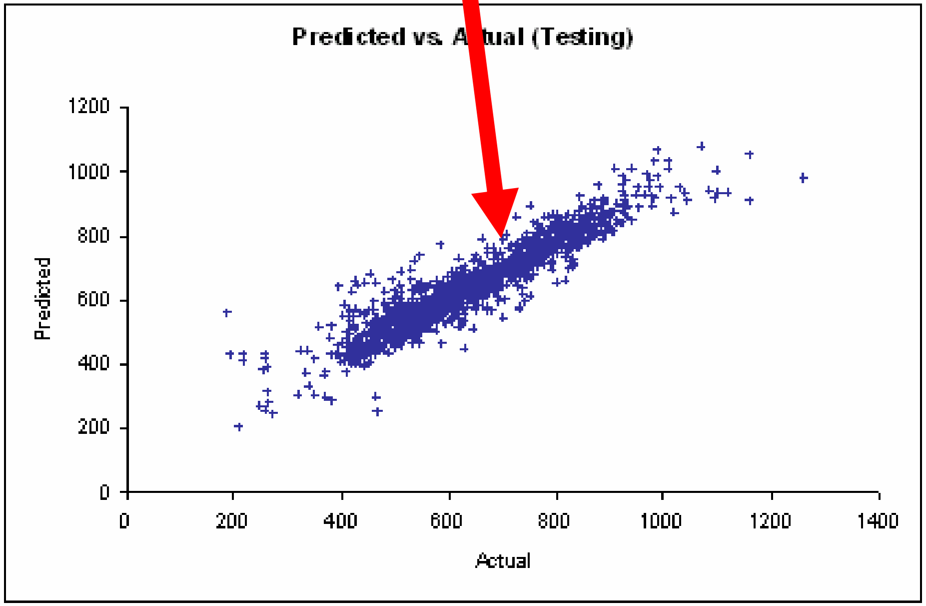
Model evaluation - Training data (mean absolute error 16 cents)





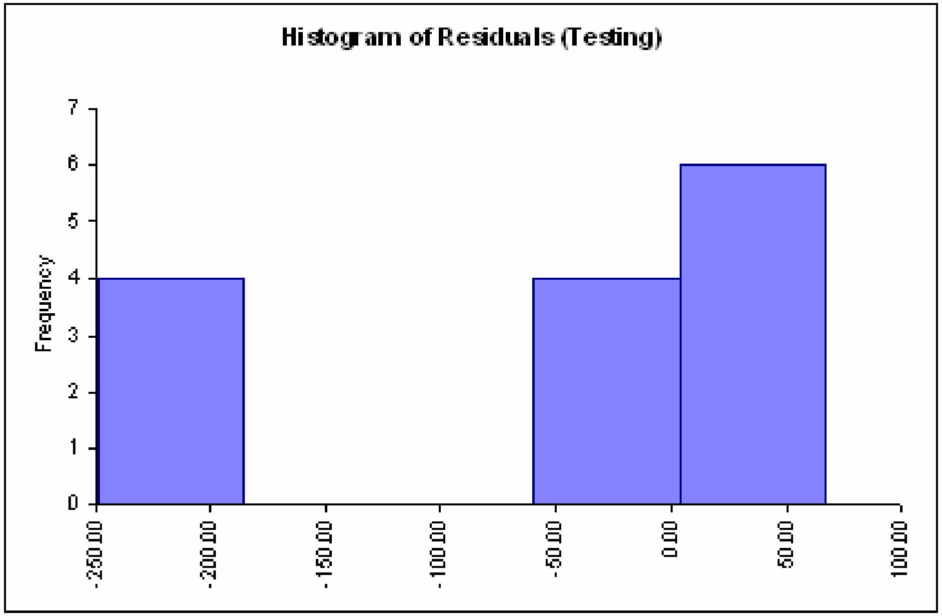
Model evaluation - Testing data (mean absolute error 37 cents)

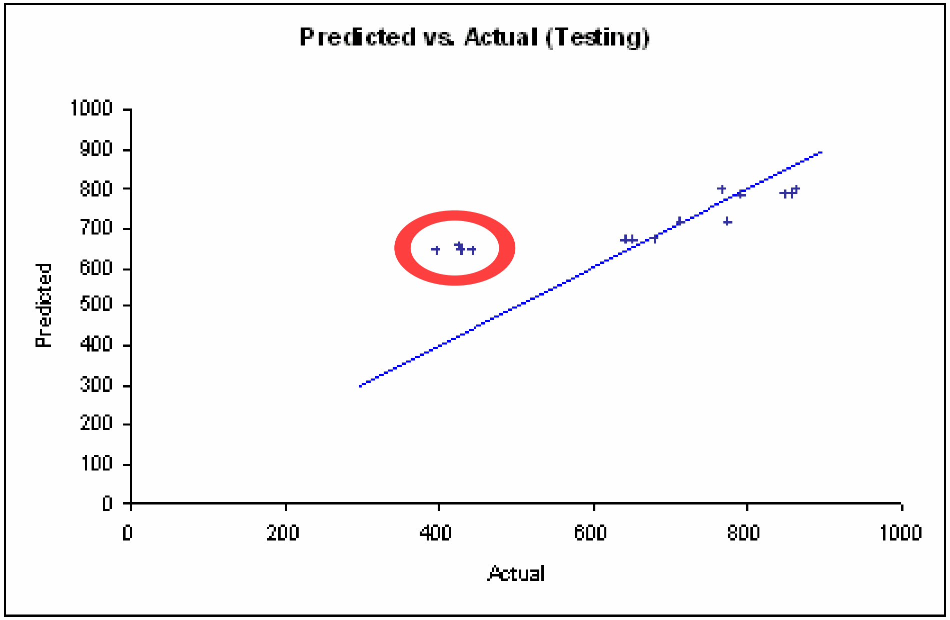




Model evaluation (1)
Testing data (indicators)

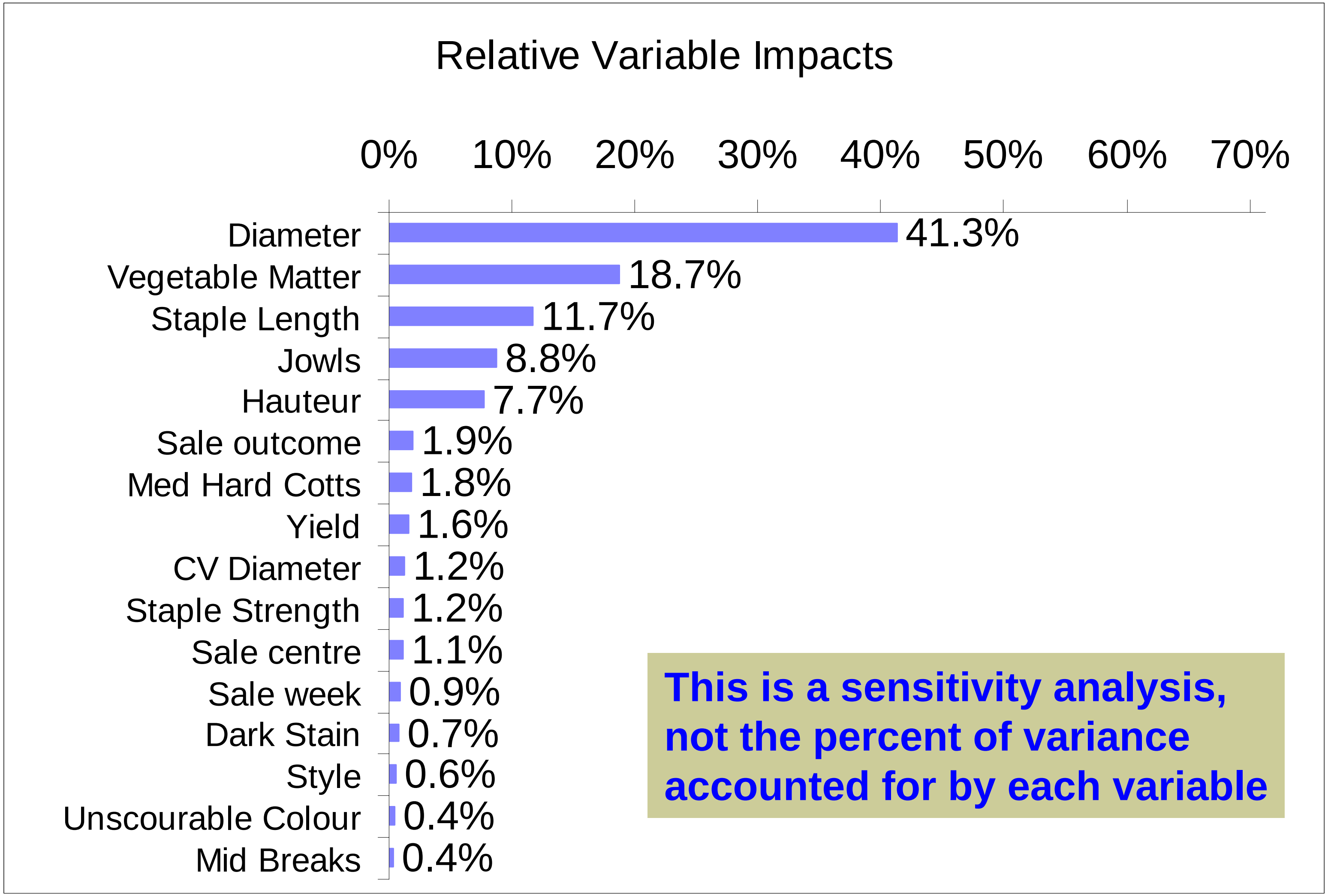
Observed versus predicted for the published Pieces Market indicators





Most points are on the 1:1 line, but a small group hover above i.e. they have higher predicted values than reported

Model evaluation (1)
Variable impact analysis



This is a sensitivity analysis, not the percent of variance accounted for by each variable

Model evaluation (2)

- NeuralTools outputs
  - Error measures
  - Actual versus Predicted, Residuals
  - Variable Impact Analysis
- Live Prediction
- Relationships between variables
- Compare to published market indicators

Model evaluation (2)
Live prediction

Simple spreadsheet pricing tool.

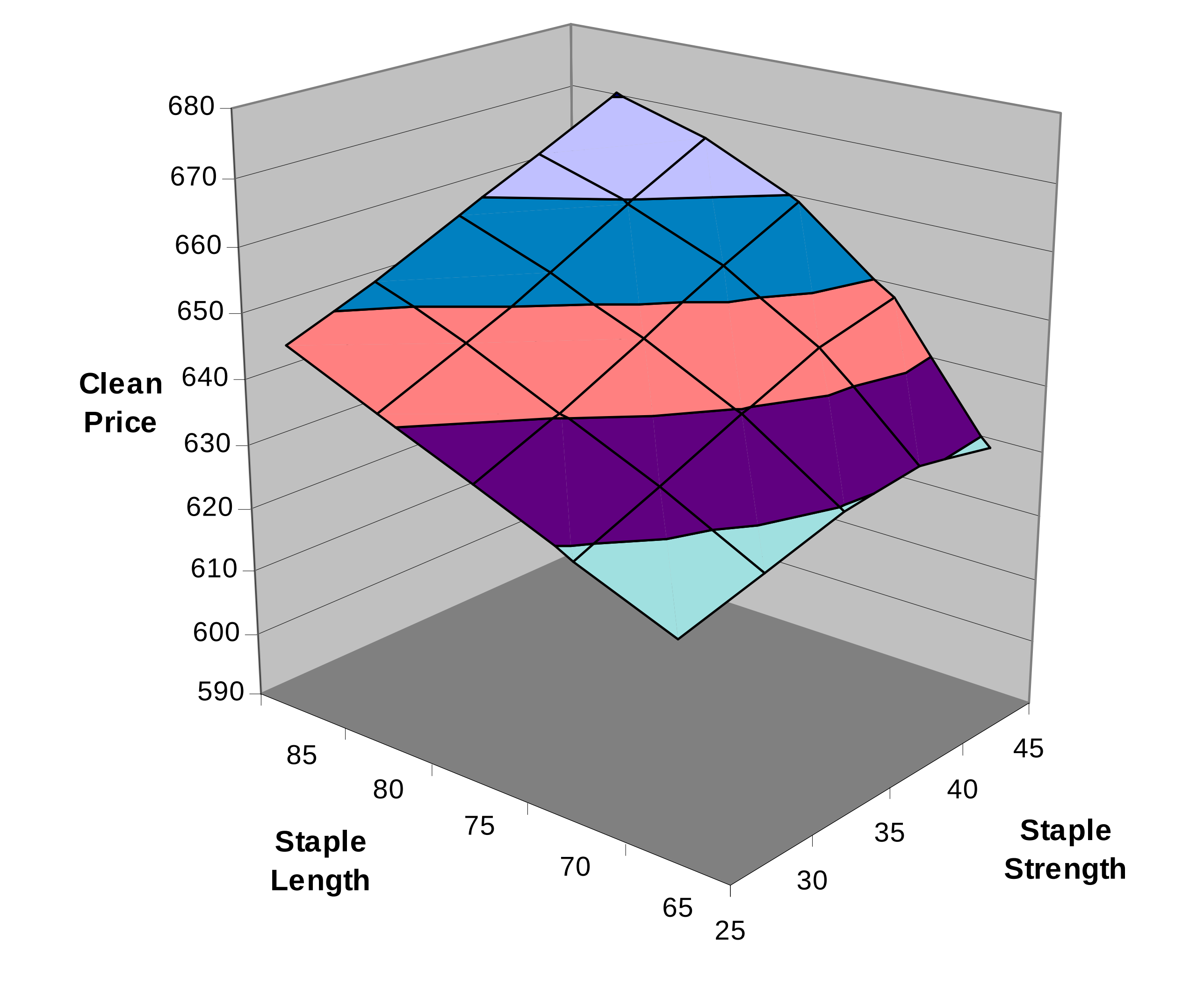
Change any of the values in the yellow cells, and '*Live prediction*' updates the clean price

Sale centre	Fremantle
Sale week	W38
Style	Average
Med Hard Cotts	C0
Unscourable Colour	H0
Jowls	J0
Dark Stain	S0
Diameter	20.0
Yield	50.0
Vegetable Matter	2.5
Staple Length	80
Staple Strength	35
Mid Breaks	55
Hauteur	62
Clean price	**664**

Model evaluation (3)

- NeuralTools outputs
  - Error measures
  - Actual versus Predicted, Residuals
  - Variable Impact Analysis
- Live Prediction
- Relationships between variables
- Compare to published market indicators

Model evaluation (3) relationships between variables

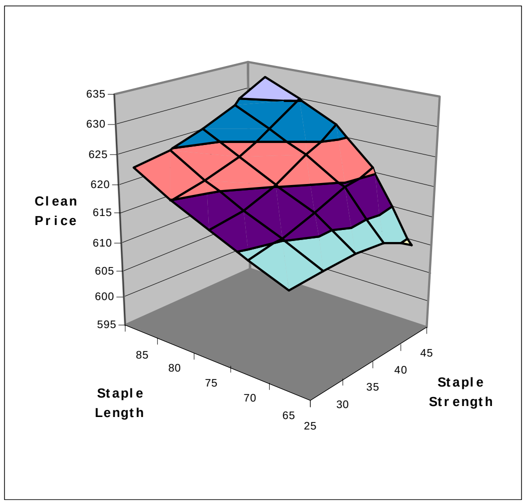


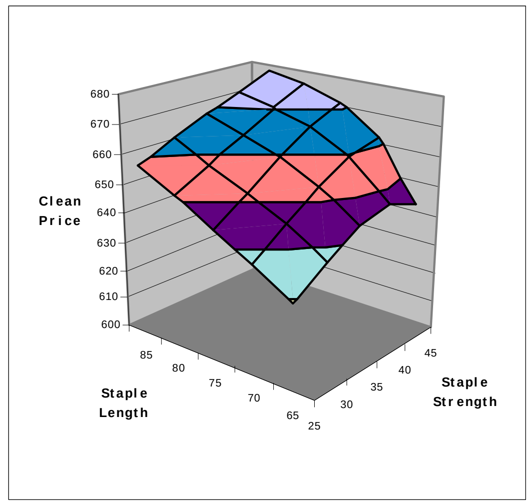
Sydney
Week 38
21 micron
2% VM

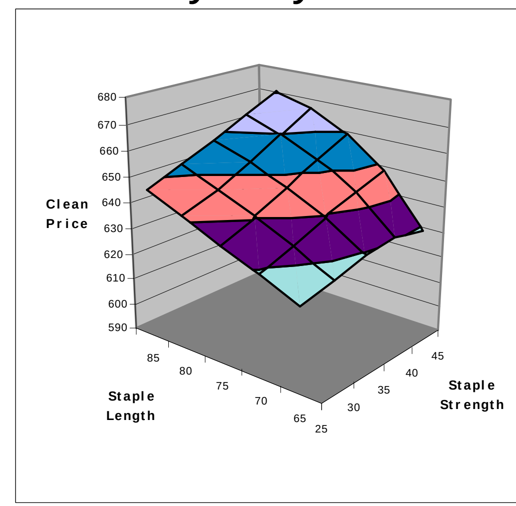
Model evaluation (3) relationships between variables

Fremantle | Melbourne | Sydney

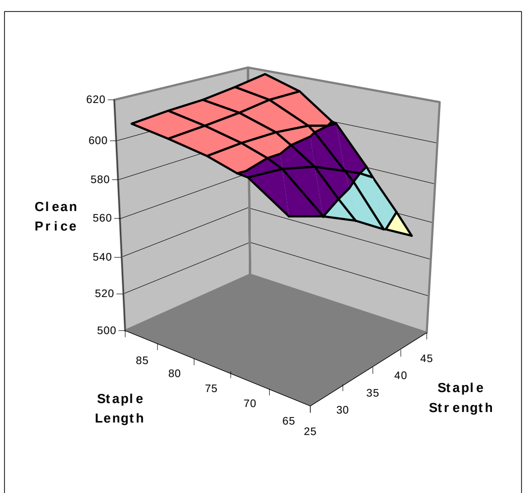
21 micron

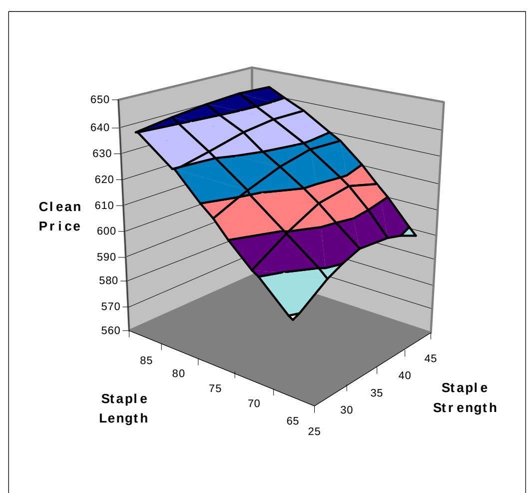


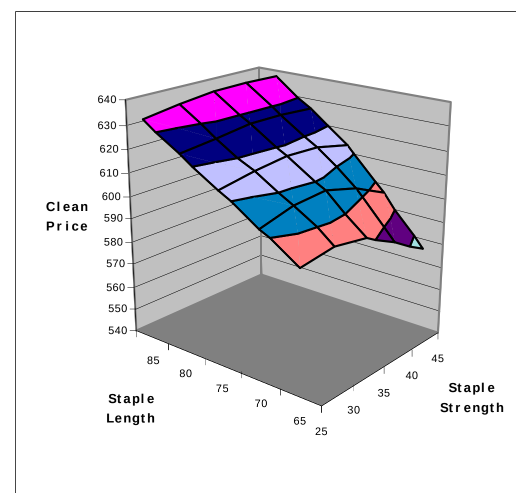




22 micron







Model evaluation (3) relationships between variables

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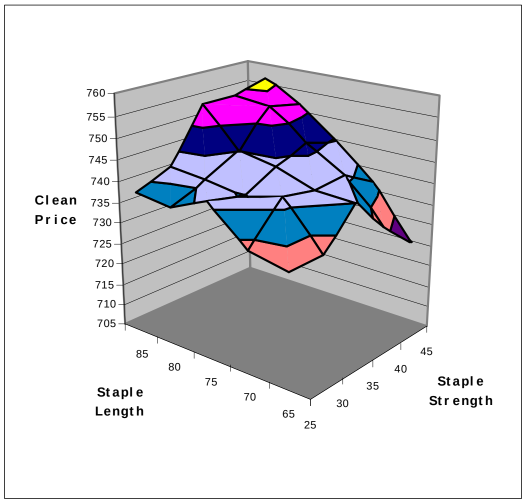
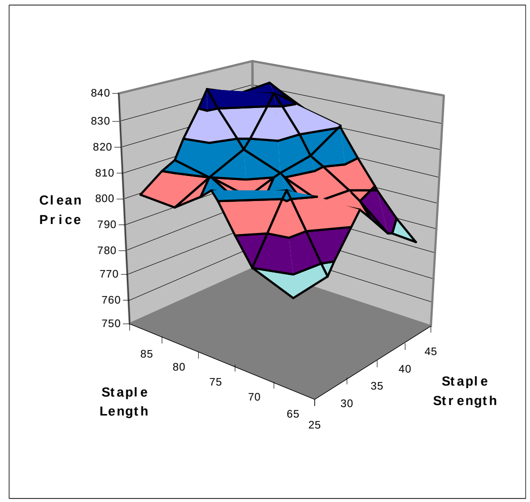
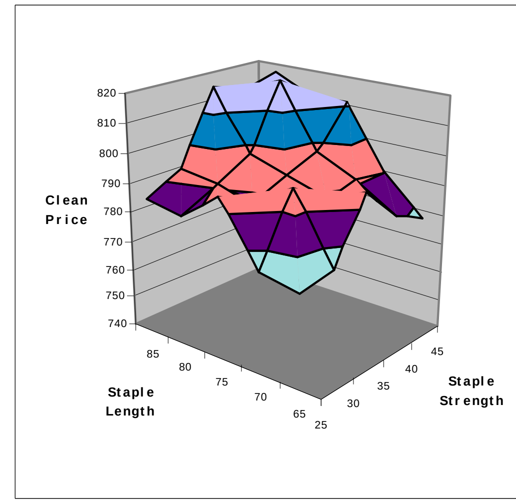
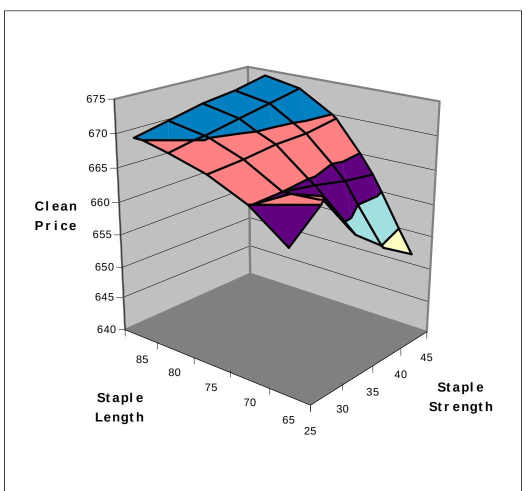
19 micron

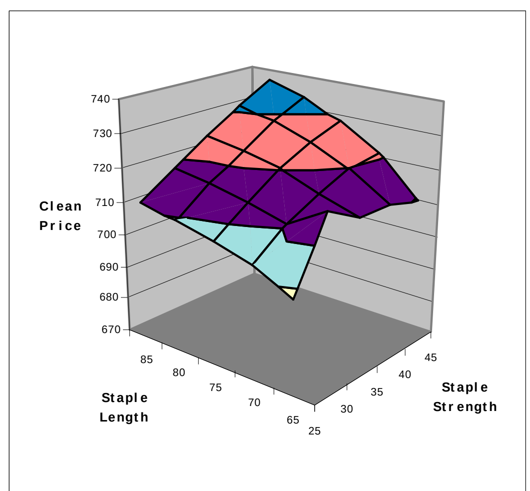


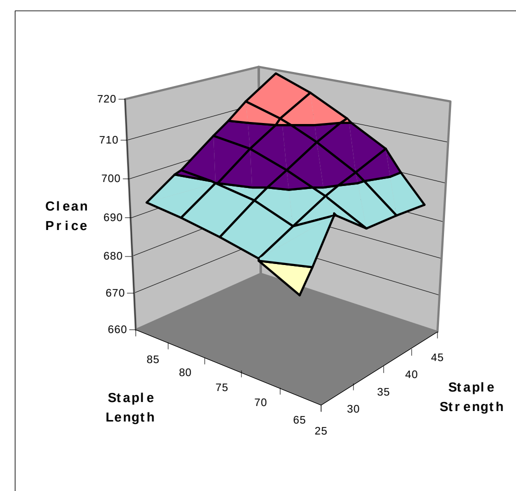




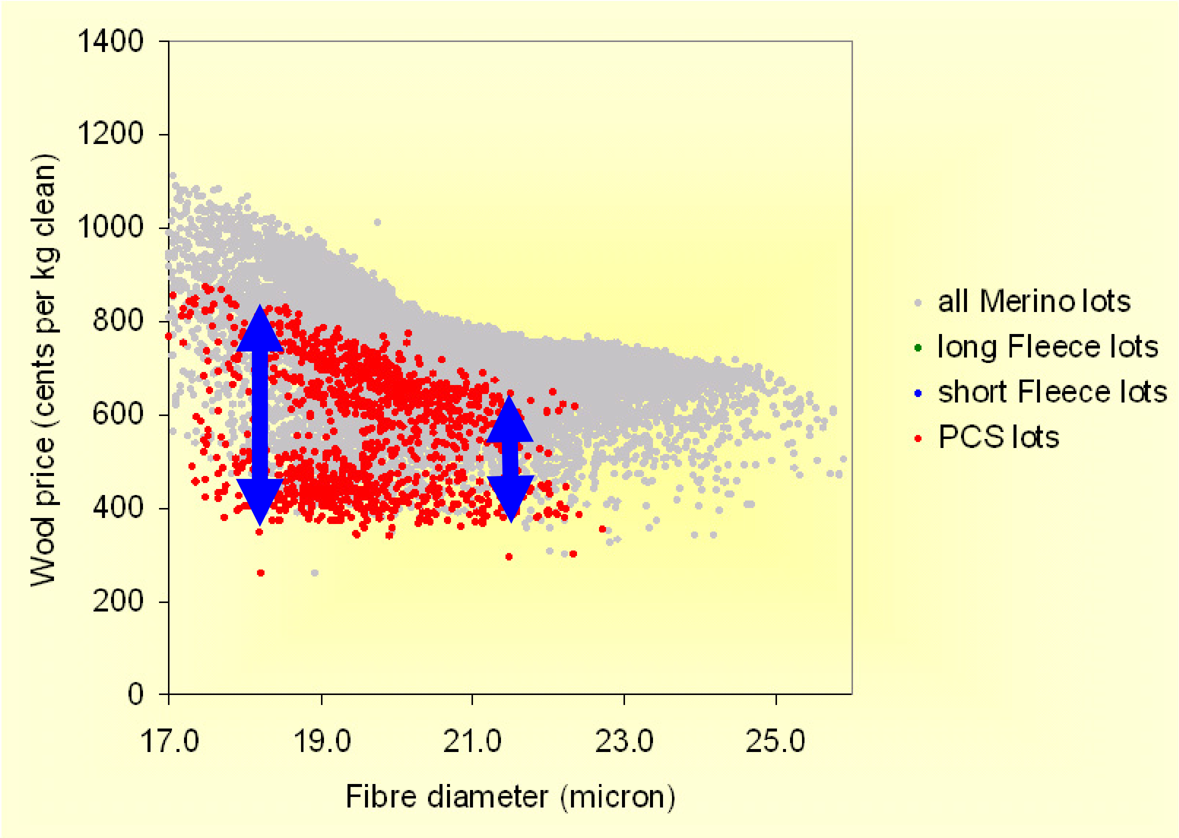
20 micron







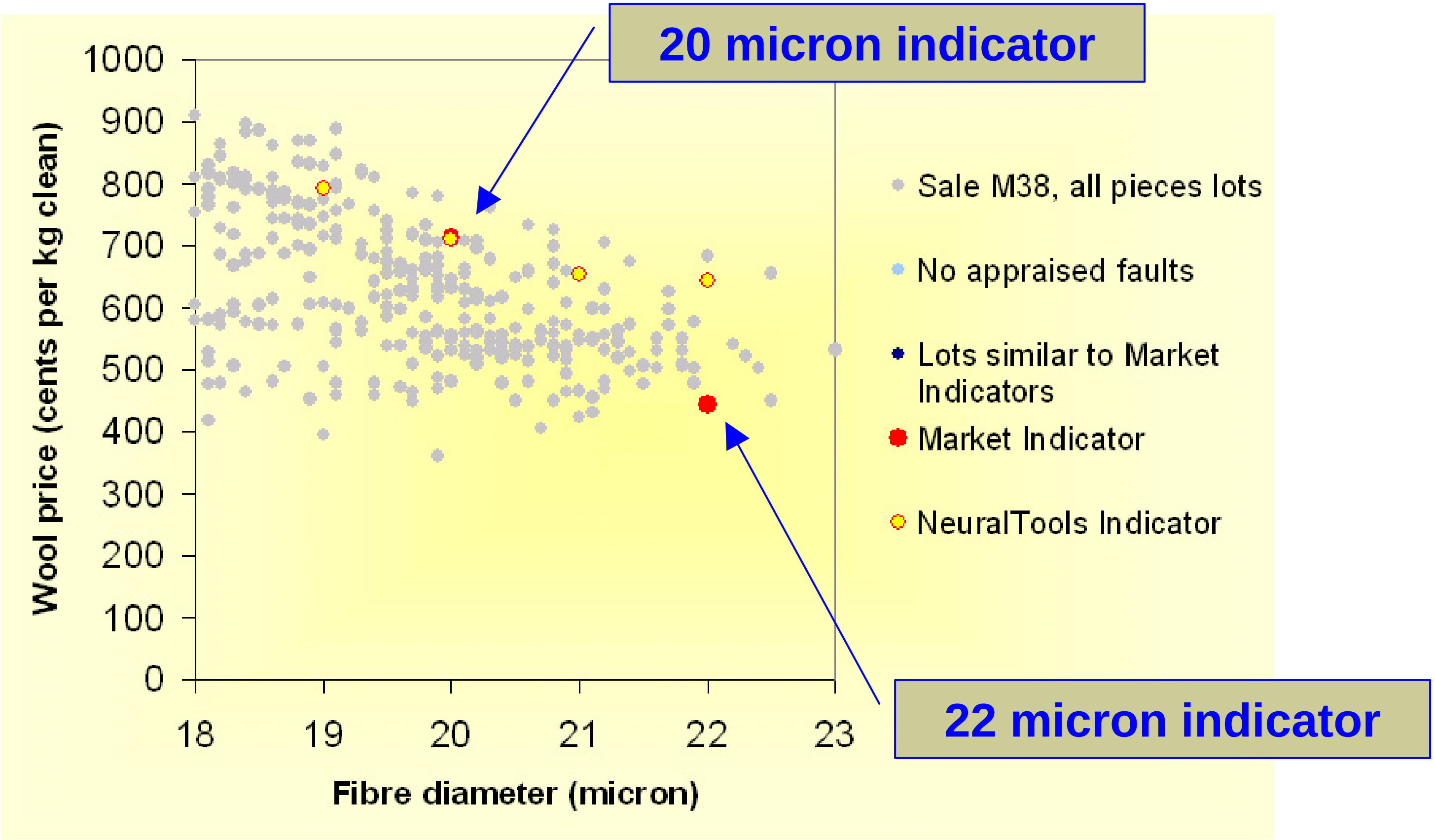
Price spread variation



Model evaluation (4)

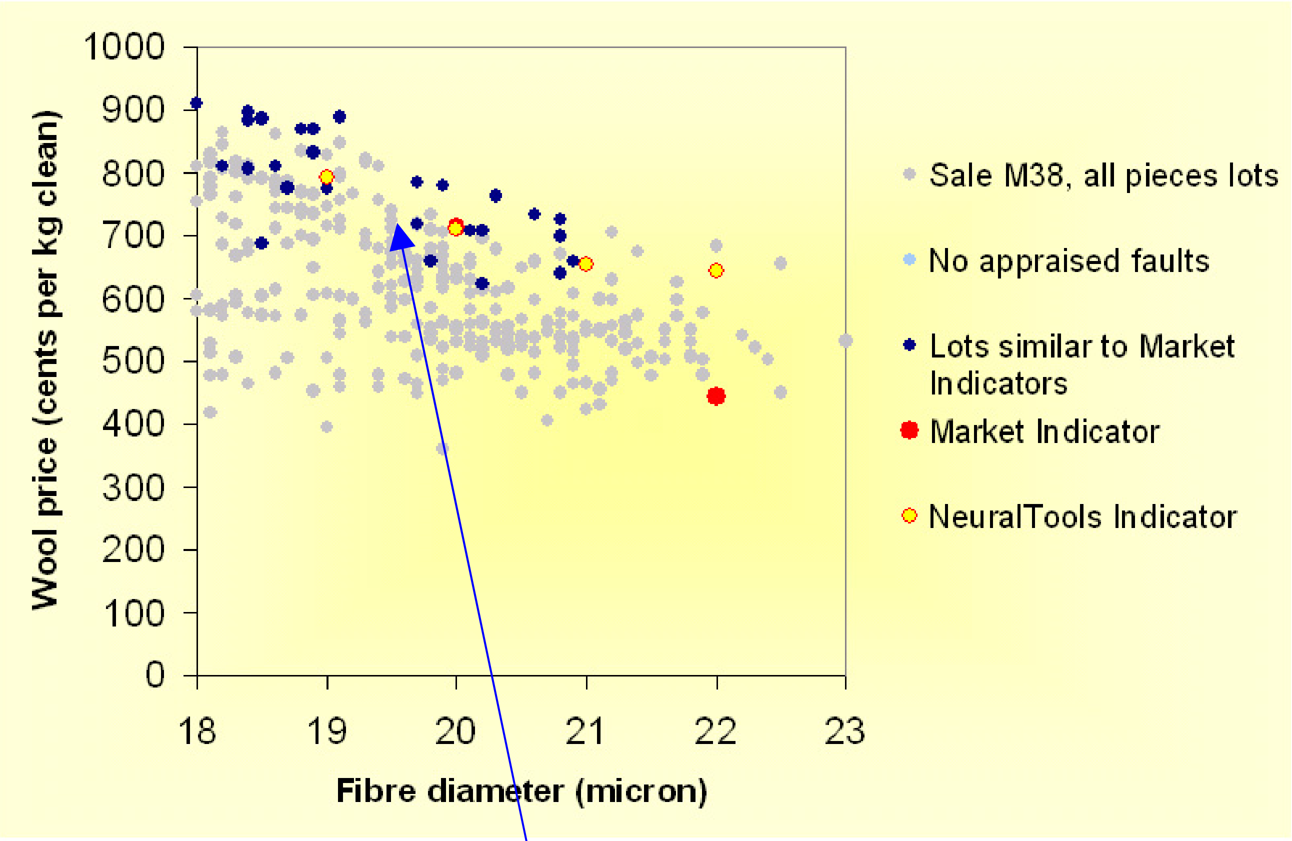
- NeuralTools outputs
  - Error measures
  - Actual versus Predicted, Residuals
  - Variable Impact Analysis
- Live Prediction
- Relationships between variables
- Compare to published market indicators

Model evaluation (4) predictive capability



Melbourne Week 38

Model evaluation (4) predictive capability



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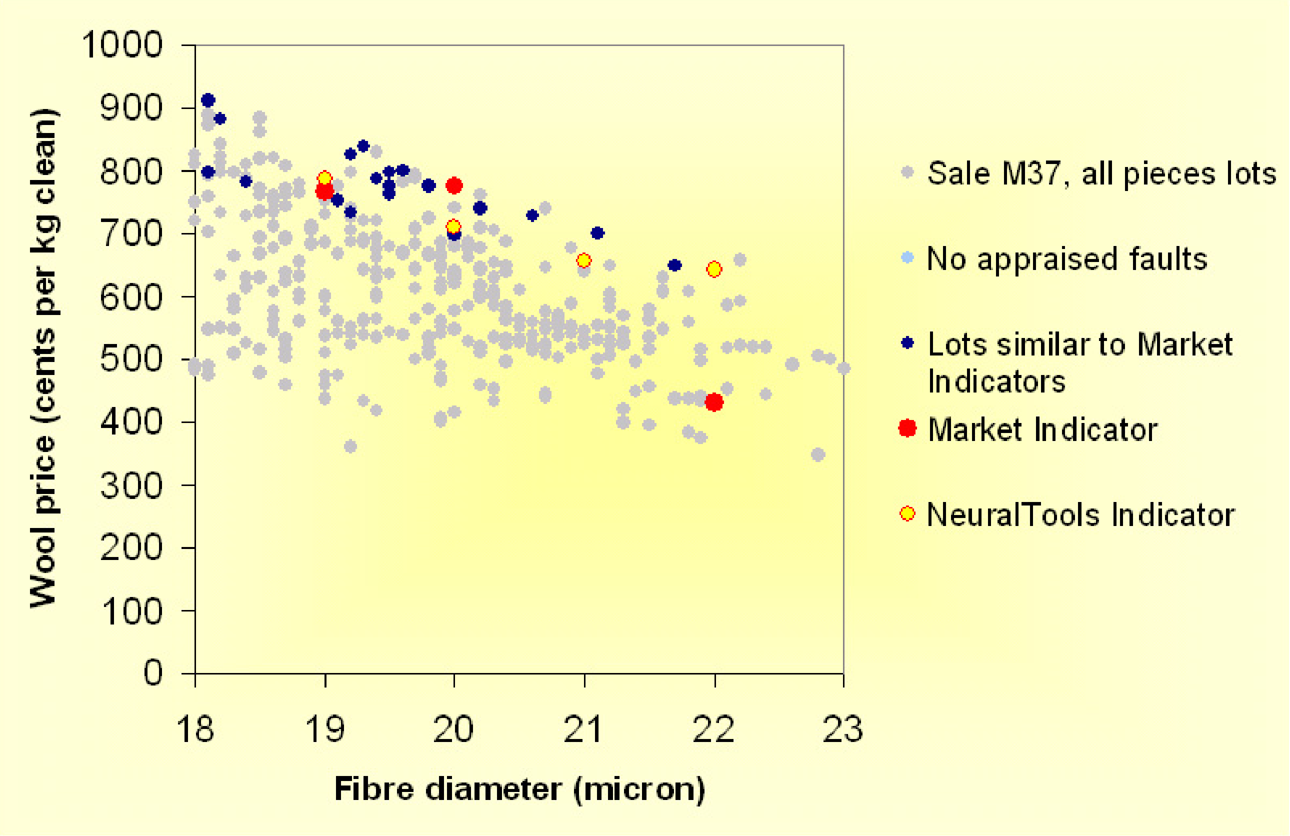
Dark blue lots have SL, SS and VM "similar" to market indicator definition

Model evaluation (4) predictive capability



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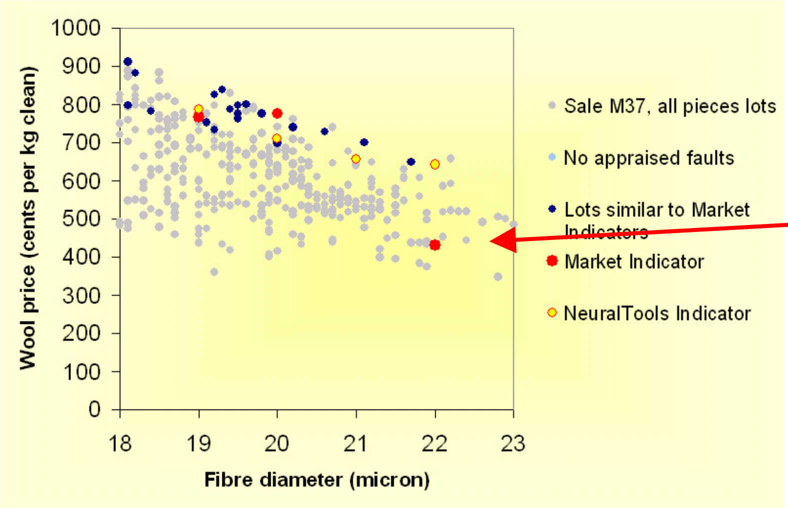
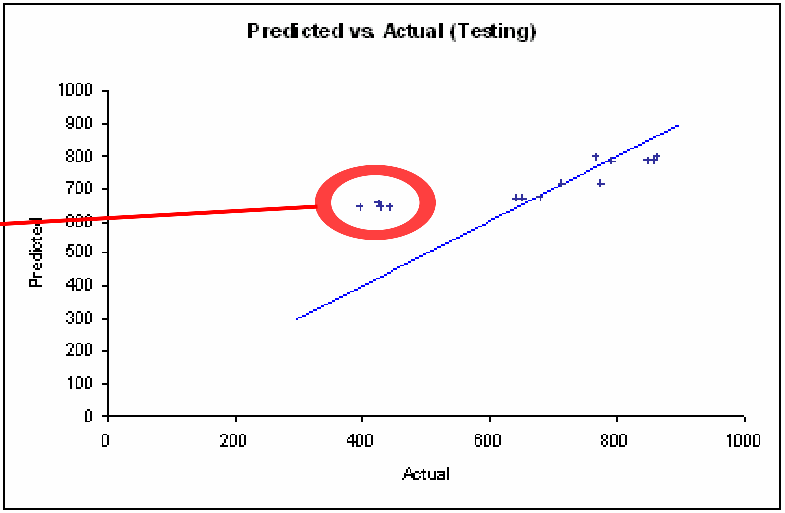
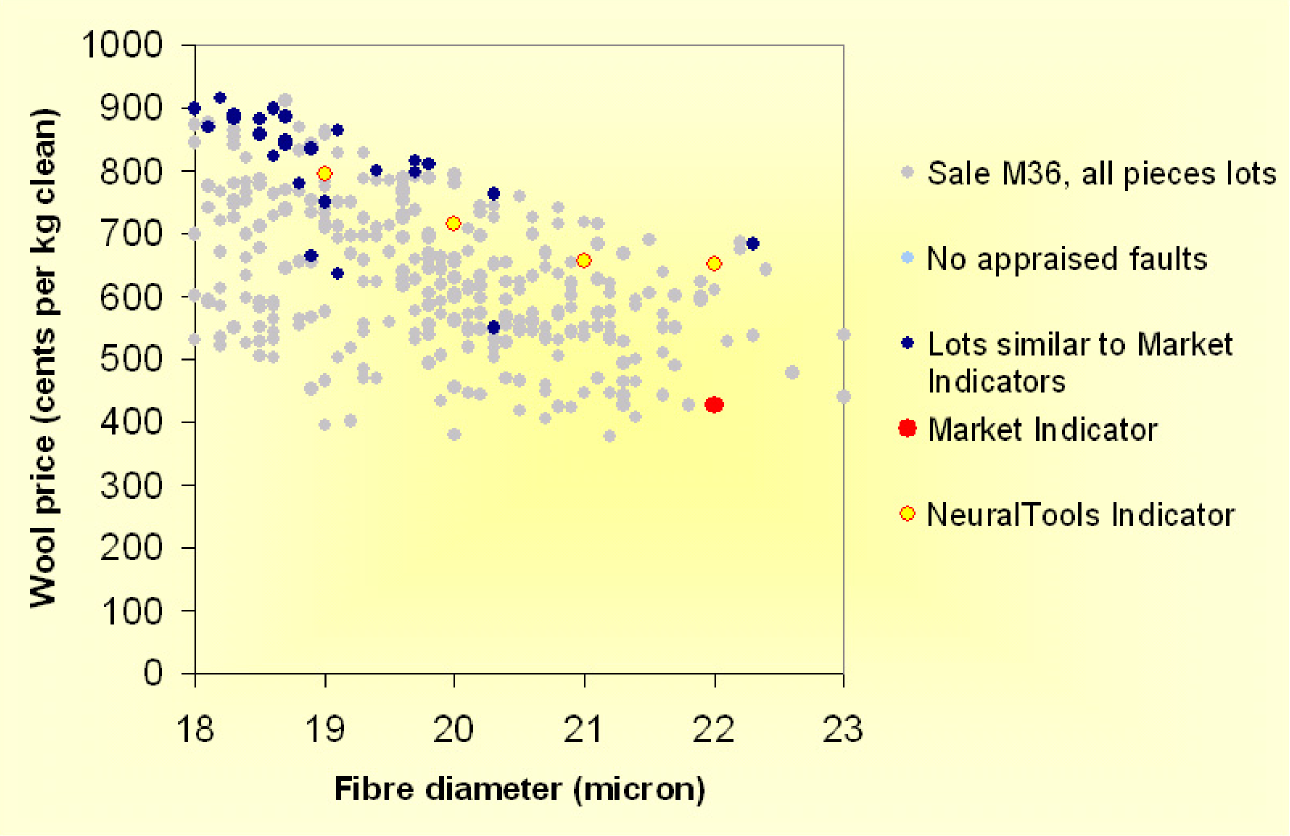
Model evaluation (4) predictive capability





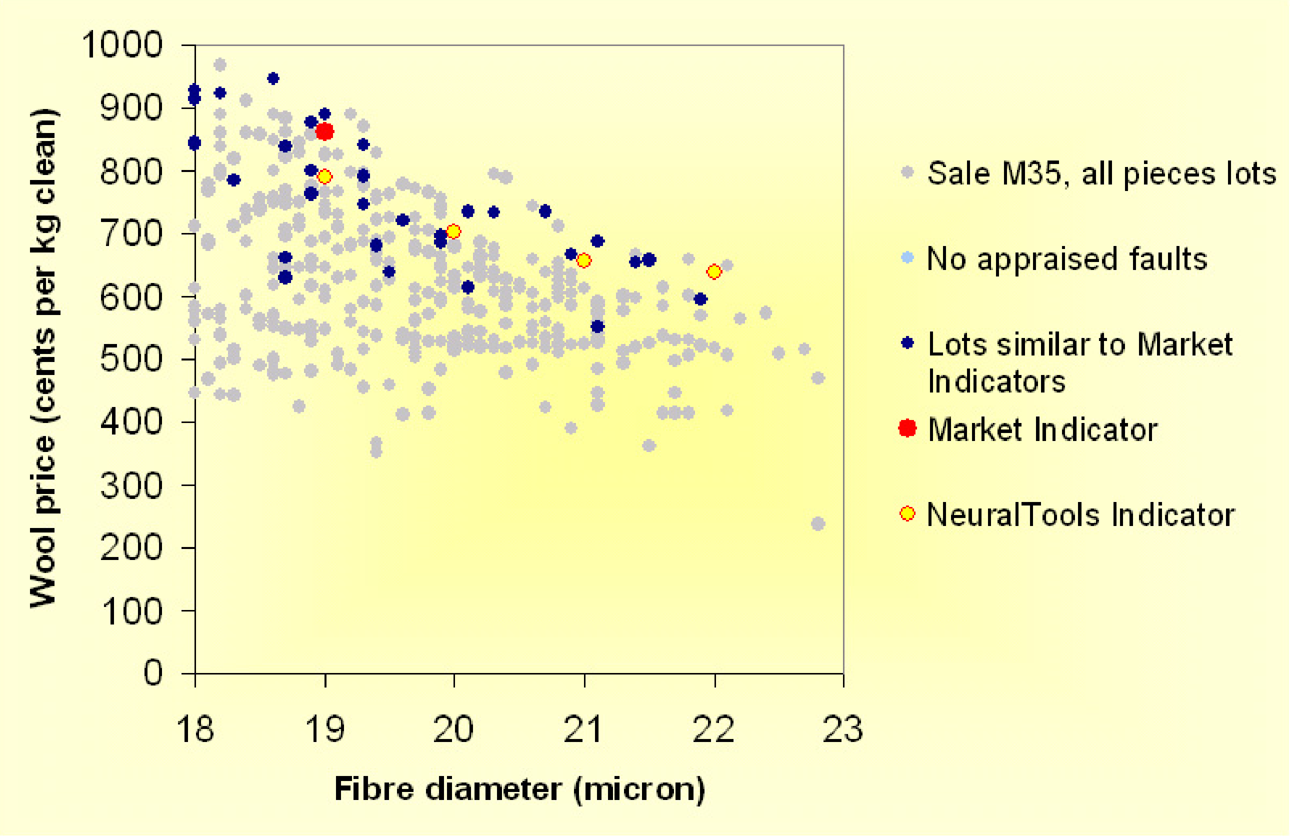
Melbourne
Week 37

Model evaluation (4) predictive capability



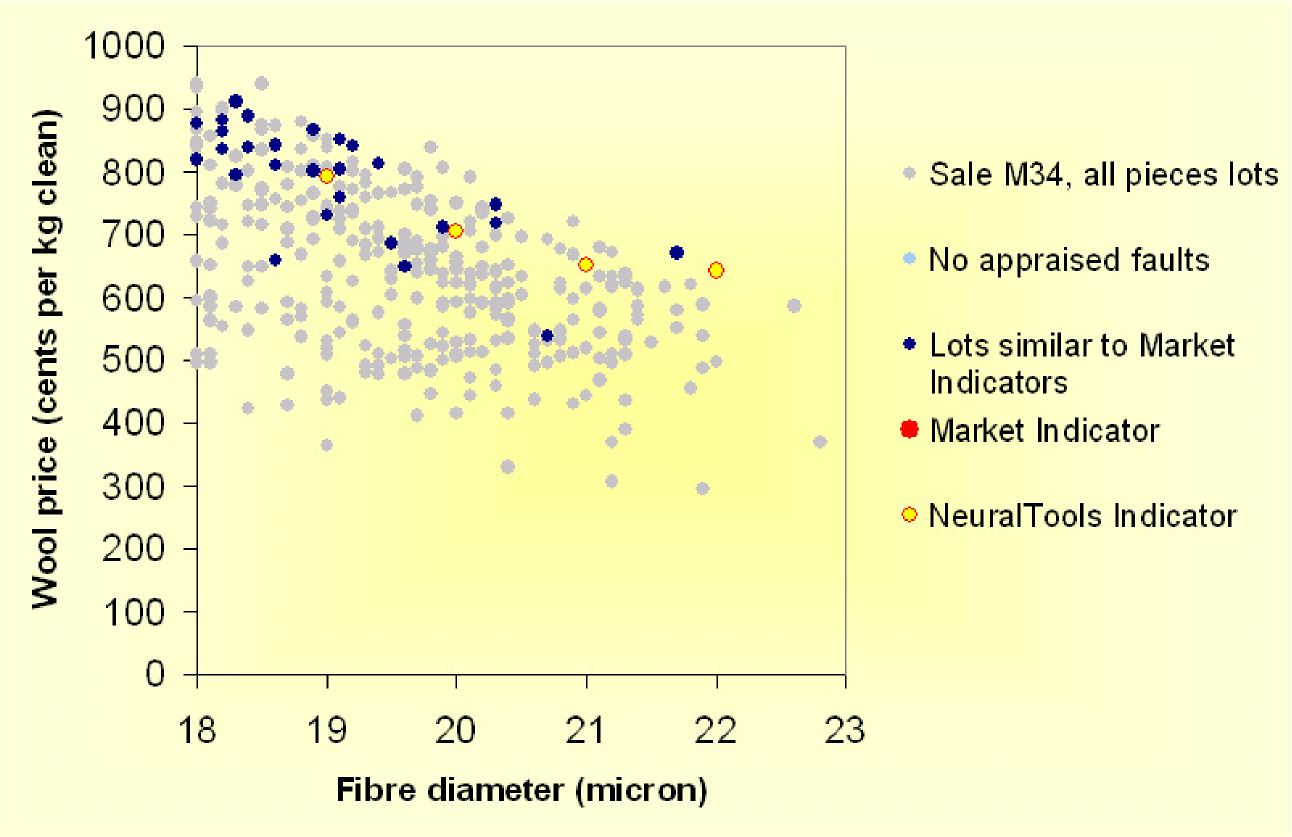
Melbourne Week 36

Model evaluation (4) predictive capability



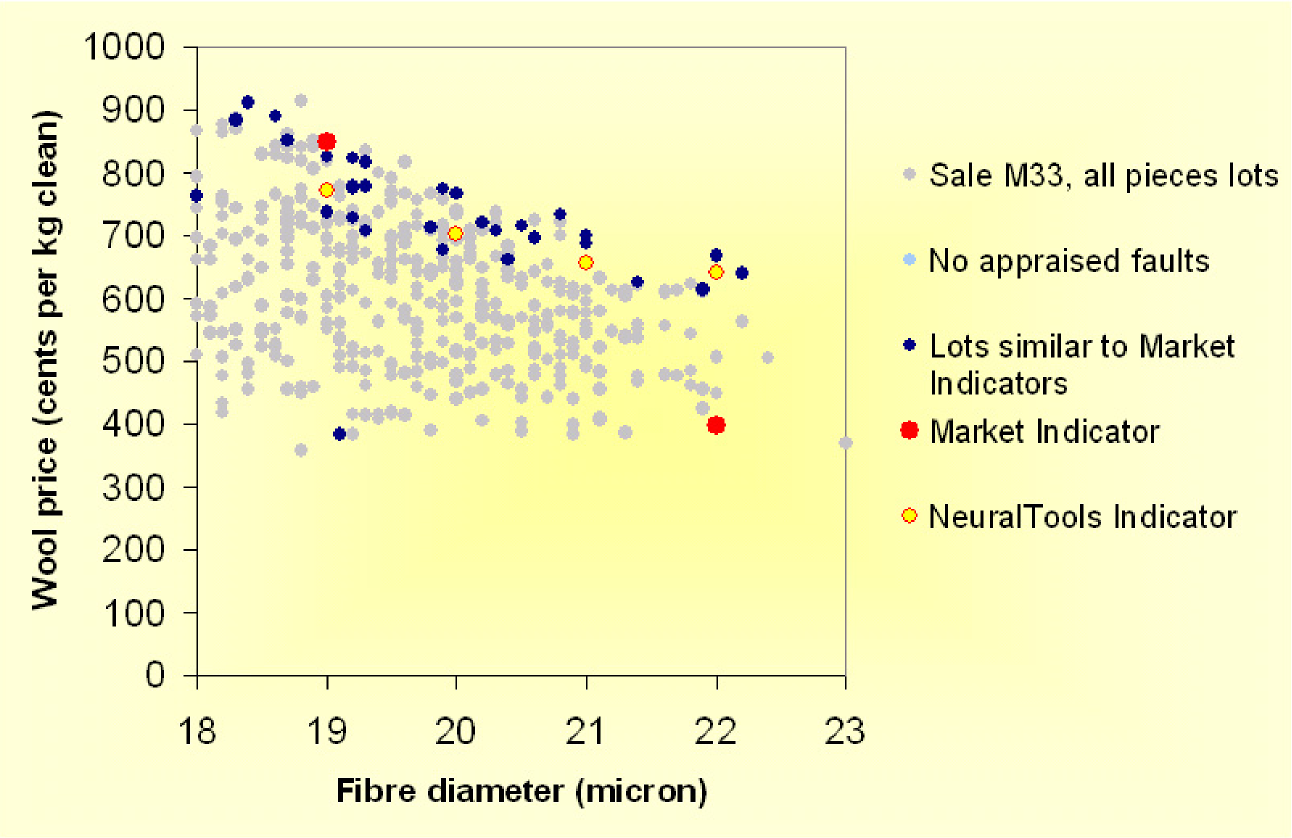
Melbourne Week 35

Model evaluation (4) predictive capability



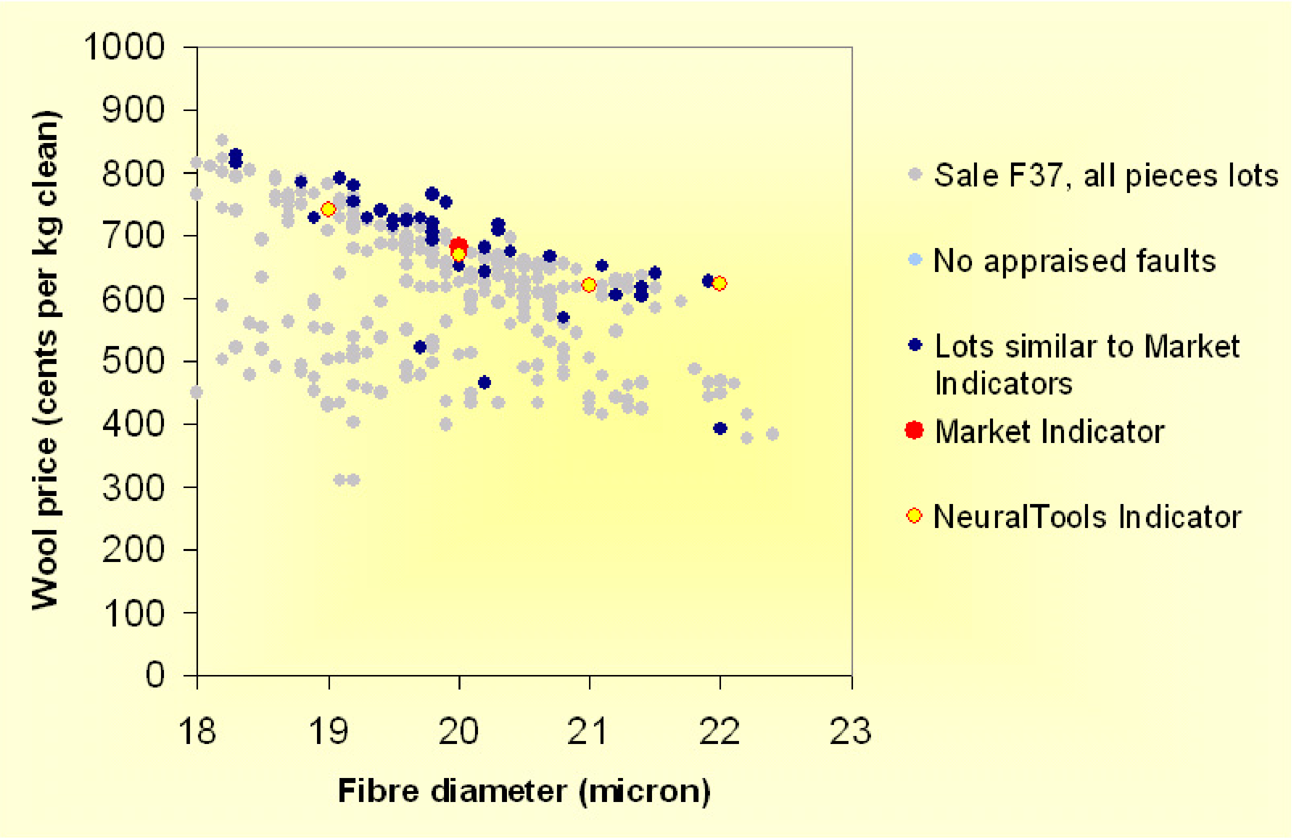
Melbourne Week 34

Model evaluation (4) predictive capability



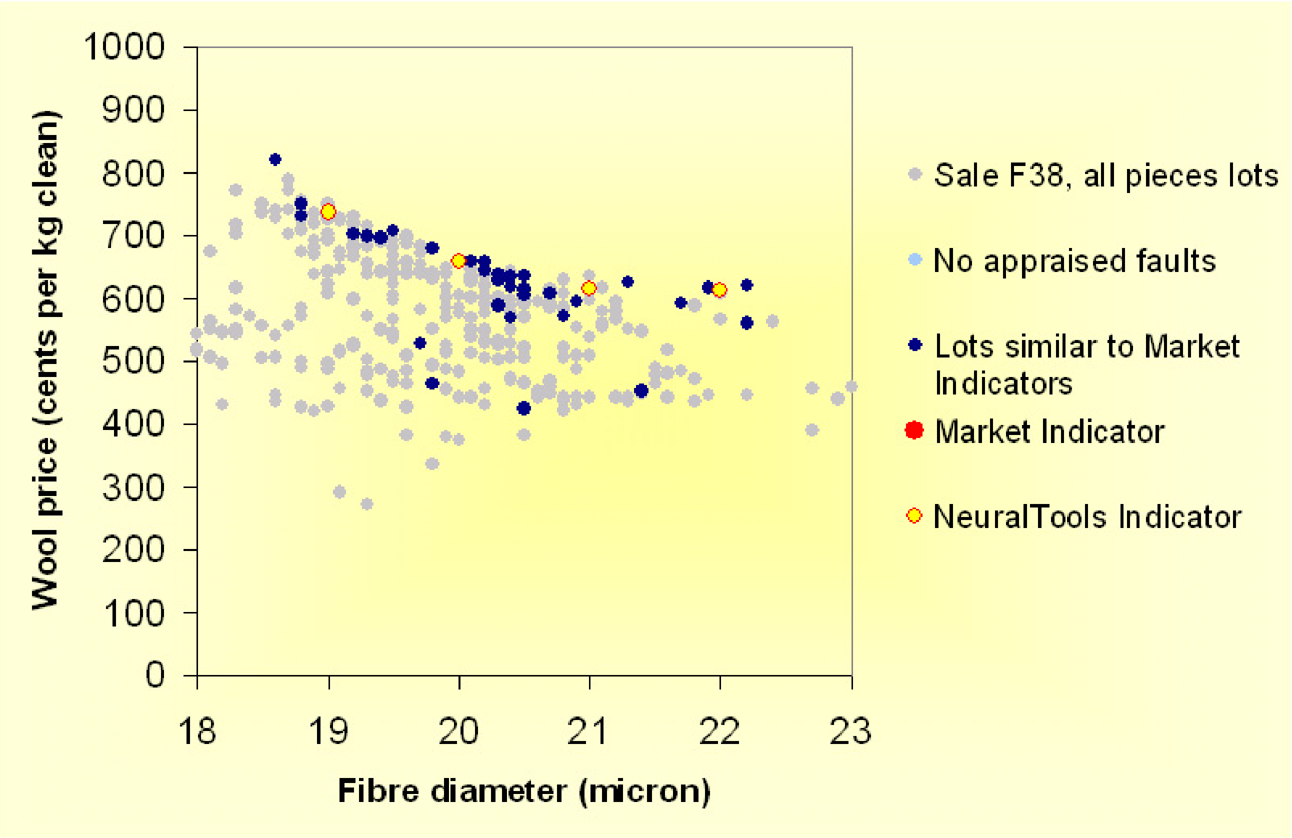
Melbourne Week 33

Model evaluation (4) predictive capability



Fremantle Week 37

Model evaluation (4) predictive capability



Fremantle Week 38

Model development (4)

- Assemble a 6 month data set
- Use *Best Net Search*
- Evaluate predictive capability
- Refine model
  - Reduce variables
  - Combine selling centres
  - Sale week - category variable

Some Neural Net applications

- Market reporting
- Price predictor
- Validation check for other estimates
- Missing sale problem
- Generate price matrices
  - Using *Live Prediction* and *@Risk*

Summary

- Data rich application with characteristics that looked ideal for NeuralTools
- Solutions generated which can support industry analysis and generation of indicators