Technical Report

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Report Title: Reverse engineering the Carcase Optimisation Tool to determine lamb value

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Citation

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Contents

Abstract

Data from a previous case study to optimise the profit from a population of lambs processed to a domestic lamb specification was used in a ’reverse engineering’ exercise to establish the relative value of lamb carcase types contributing to the carcase inventory; categorised by weight and fat.

An improved understanding of the true value of carcases to processors when they are processed through the boning room to a market specification may make it possible for processors to establish pricing signals to lamb suppliers that better reflect processing outcomes. With the deployment of devices in plants that improve the precision and accuracy of measurement of yield and eating quality, it is ever more important for the industry to extract as much value as possible through processing, and to attract supply of carcases that best meet these outcomes.

A population of 3,000 lamb carcases with weights from 13kg to 39kg, and lean meat yield from 49% to 65% was optimally allocated to one of three cutting plans according to a domestic lamb specification. Using outputs from the optimisation task, the purchase price for carcases contributing to each of the cutting plans was determined that achieved a nominal processing profit margin of 20% for each carcase processed. The distribution of carcase labour costs, income generated and recommended purchase price was then plotted across the range of carcase and lean meat yield values for the population contributing to each cutting plan.

This study demonstrated that within a cutting plan, the profit extracted varied little with weight and fat (<3%) which supports industry practice of having very flat price grids. However, as heavier and fatter carcasses must be trimmed to meet retail requirements of portion size or visual fat they trigger a change of cutting plans and the impact of this is large (>$1.50/kg or >10%). Current lamb price grids do not adequately reflect this value change by lowering the buy price for these carcase types.

By reverse engineering the outputs from the carcase optimisation tool, it is possible can gain a better understanding of the relative contribution of carcase types to profit. This may help inform processors to shape lamb purchases (price grids) to better reflect processing outcomes.

1. Introduction

Australian sheep meat processors currently purchase lambs from producers either as live animals in saleyards or as carcases after slaughter on an 'over the hooks' basis. Saleyard transactions are made on a lot basis where an average price is paid per head for all animals in the lot. In contrast, over-the-hooks trades are completed on an individual carcase basis, and the price paid is determined by a payment grid that may vary payment for carcases of different weight and fat.

In practice, carcase payment grids are relatively simple and tend to encourage producers to maximise carcase weight, irrespective of carcase fat. This is a problem for the processors since heavier carcases tend to be fatter, and excess carcase fat must be trimmed from the fabricated cuts to satisfy consumer requirements. Trimming comes at a cost of increased labour requirements in the boning room, reduced processing speed and boning room throughput, and a loss of product value (downgrade) as trimmed fat is sold at a lower value than the cut from which it was removed.

The simplicity of current pricing grids is a factor of the supply-limited nature of the lamb industry at this time. Lamb processors are engaged in a highly competitive environment to procure sufficient stock to support the day-to-day operations of each plant. Therefore, in recent years they have not been in a position to be innovative at the pricing level. However, with the development and adoption of more accurate objective carcase measurement devices being installed in plants, and the development of decision-making tools such as the Lamb Carcase Optimisation Tool, an opportunity has emerged to consider innovative approaches to pricing that reflect the individual profitability of each carcase when it is processed to its most profitable endpoint.

The aim of this work was to understand the difference between current and potential lamb carcase payment grids. Data generated in an earlier case study that used the carcase optimisation tool to optimise the allocation of carcases to cutting plans to achieve maximum profit was used in this report to explore the profit potential of the range of carcase types (combination of weight and yield). This information was then used to back-calculate how payment for each carcase type may be shaped to lamb producers that reflect the value of the carcase to the processor.

2. Methods

Data from an earlier case study and reported in the Technical Report *The tactical model in optimisation of boning room management* (Wang 2020) was used to model the pricing of lamb carcases. In that case study, carcase data from a population of 3,000 lamb carcases with weights from 13kg to 39kg, and lean meat yield from 49% to 65% (Fig.1) was optimally allocated to one of three cutting plans according to a domestic lamb specification (Fig. 2). A constraint requiring that 1,000 carcases were required to be allocated to each of the three cutting plans was imposed on the optimisation task to simulate a market order for particular products.

Input values for the model were based on retail market prices for each cut at the time. Labour costs to process the carcases were modelled to take into account the impact of heavier, fatter carcases on the processing rate.

Data visualisations were prepared that illustrated the pattern of allocation of carcases to each cutting plan based on their contribution to profit. For the purposes of this report, a nominal profit margin of 20% was adopted. From this, we were able to model the purchase price for carcases contributing to each of the cutting plans.

If we knew the purchase price, then the profit rate would be calculated as:

$$\mathrm{R}\ (\mathrm{Profit\ Rate}) = (Income - Purchase\ Cost)/(Purchase\ Cost + Labour\ Cost)$$

However, in this case we are using a fixed profit rate (R) of 20%, and purchase price is the variable of interest so:

$$Purchase\ Price = \frac{Income}{(1+R)} - Labour\ Cost$$

The distribution of carcase labour costs, income generated and recommended purchase price was then plotted across the range of carcase and lean meat yield values for the population contributing to each cutting plan.

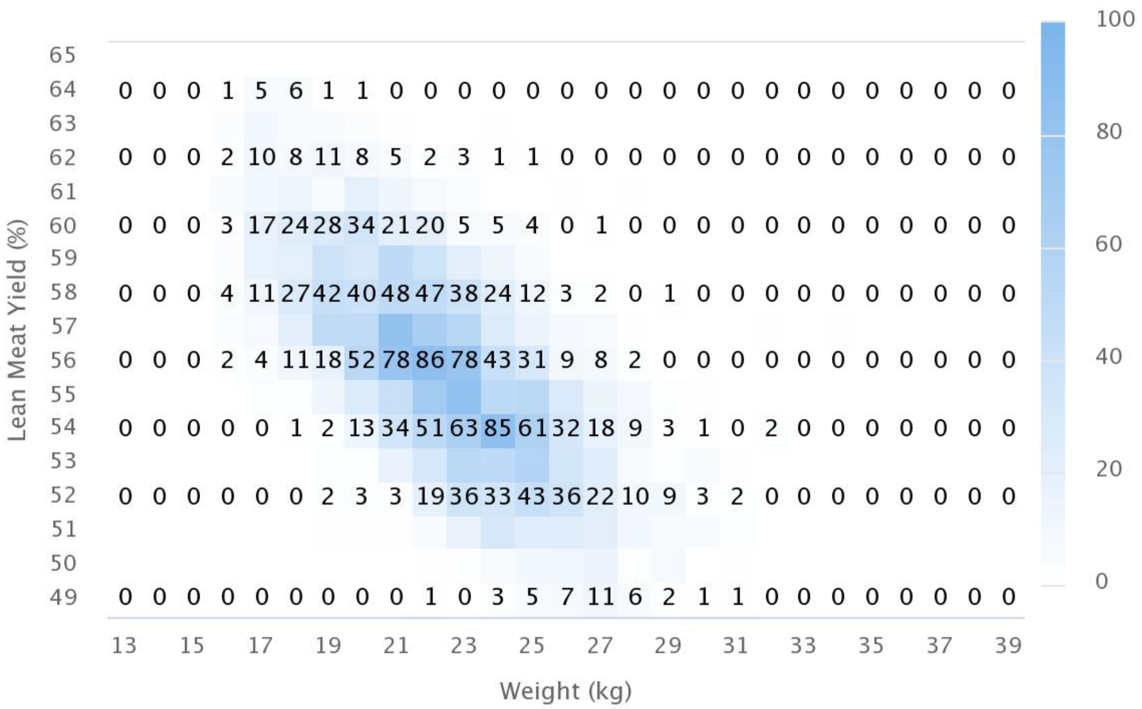

Figure 1. Distribution of carcase types (carcase weight by lean meat yield) in the slaughter population.

Index	HQ	LOIN	FQ	Note
1-1000	Chump BO (6mm) Leg chump off, shk on, tip on, 6mm fat cap	Abdominal Flap Rib Flap B/I Rack, 8x100mm rib, CFO, scap in, 6mm fat, cap on Shortloin cap 50mm tail, 10mm fat cap	Breast ForeShank Tipped Neck Straight Cut Sq Cut Shldr 10mm Fat Cap, St. Cut (4Rib)	PATTERN 1
1001-2000			Breast ForeShank Tipped Neck Straight Cut Best End Shldr Chops 6mm Fat Cap Neck off Cut, St. Cut Round Bone Piece BO, 6mm Fat Cap	PATTERN 2
2001-3000	Butt tenderloin Heel Muscle_2 Hind Shank Tipped_2 Round Rump Silverside fat cap on Topside Fat Cap On	Flap French rack, 8x100mm rib, 50mm Fr., Capoff, False capoff Shortloin eye TDR Butt off/Side Off	Breast ForeShank Tipped Neck Straight Cut Boneless Shldr 6mm fat cap, chuck roll out Chuck roll	PATTERN 3

Figure 2. Cutting plans and allocations for the case study with 3,000 carcases.

3. Results and Discussion

Within cutting pattern

Calculated price per kg varied with carcass weight and fatness. The relationship with weight was to increase to an optimum between 15-20kg and then decrease (Fig. 3). In cutting plan 1 (Fig. 4) there is minimal trimming so changes associated with weight were expected to be small. Indeed, the price only varied from $14.28 up to $14.34, then down to $14.10. Retail cuts were valued the same per unit weight regardless of size. Heavier carcasses resulted in greater retail value. Also, as expected, per kg labour costs decreased with heavier carcasses. However, the increase in retail value with increasing carcass weight was at a slightly lower rate than the actual increase in carcass weight. Thus, the price per kg (retail value / carcass weight) slightly decreased with increasing carcass weight. This is slightly counter intuitive as it was expected that heavier carcasses would dilute the fixed cost of slaughter and carcass dressing. This is likely still true but not captured in the model herein so the relationship with weight is actually very small.

The effect of fat on carcass value (calculated purchase price) was, as expected, very small for cutting plans with little trimming (Figures 3,4,5). However, when carcasses are trimmed, fat has a greater impact. The retail cut values depended on the cut and were representative of published values at the time. The value of meat trim was $6.50/kg and fat trim $2.50/kg, both of which are significantly less than the retail value. When carcasses are boned out, there is a labour cost in the action and a loss of value in the weight of trim. Thus, for cutting plan 3 (Fig. 6) where the shoulder, saddle and leg are all boned out, the value or calculated price per kg was significantly affected by fatness. The effect was about 30-40c/kg across the fatness range.

Between cutting patterns

By far the biggest impact on price was across cutting patterns with at least $1.50/kg lower value in cutting plan 3 (Fig. 3, 6) than 1 and 2 (Fig. 3, 4, 5). The additional labour of around 10c/kg was only a small part of this. The biggest impact by far was that the per kg retail price of trimmed cuts (e.g. French rack or boned leg) was not able to be raised sufficiently to account for the loss of weight from the bone-in or untrimmed product. Simply put, profit is maximised when bone and fat can be sold for a good price rather than trimming and selling trimmed products for a high price.

4. Conclusion

This study has clearly demonstrated two things. Within a cutting plan the profit extracted varied little with weight and fat (<3%) which supports industry practice of having very flat price grids. However, in practice, heavy and fat carcasses must be trimmed to meet retail requirements of portion size or visual fat. Thus, they would trigger a change from cutting plans such as numbers 1 and 2 to 3 herein. The impact of this is large being >$1.50/kg or >10%. This is where price grids should capture a drop in price and are not currently doing so. The effect is not driven by the additional labour, but by the inability of greater per kg retail price to account for the loss of saleable meat.

This exercise has shown that reverse engineering the outputs from the carcase optimisation tool is a novel approach to inform processors how they may shape lamb purchases (price grids) to better reflect processing outcomes.

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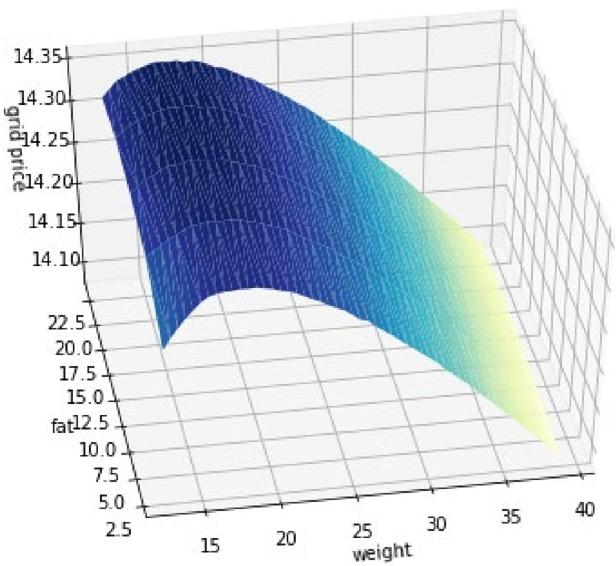

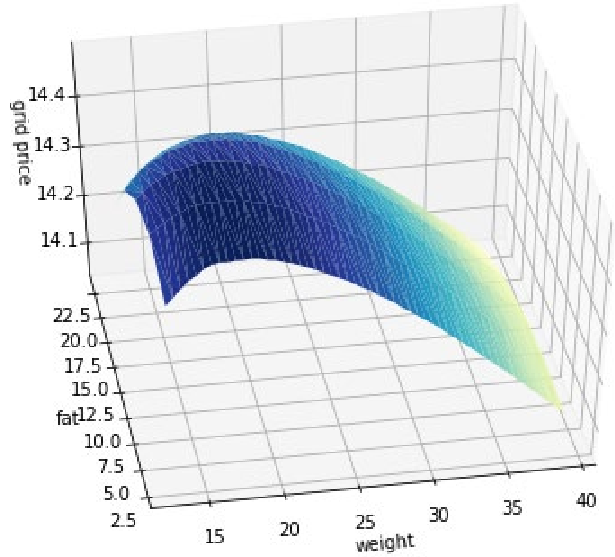

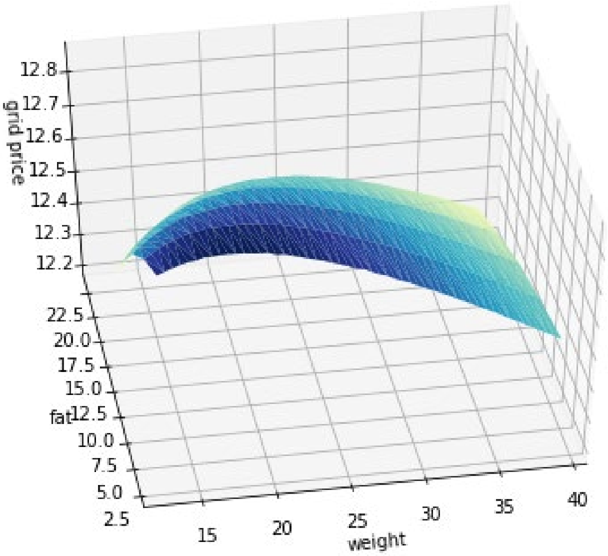

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Figure 3. Pricing for carcases of varying weight and fat (GR) for (top to bottom, $/kg cwt) a) cut plan #1, b) cut plan #2, and c) cut plan #3 to achieve 20% profit.

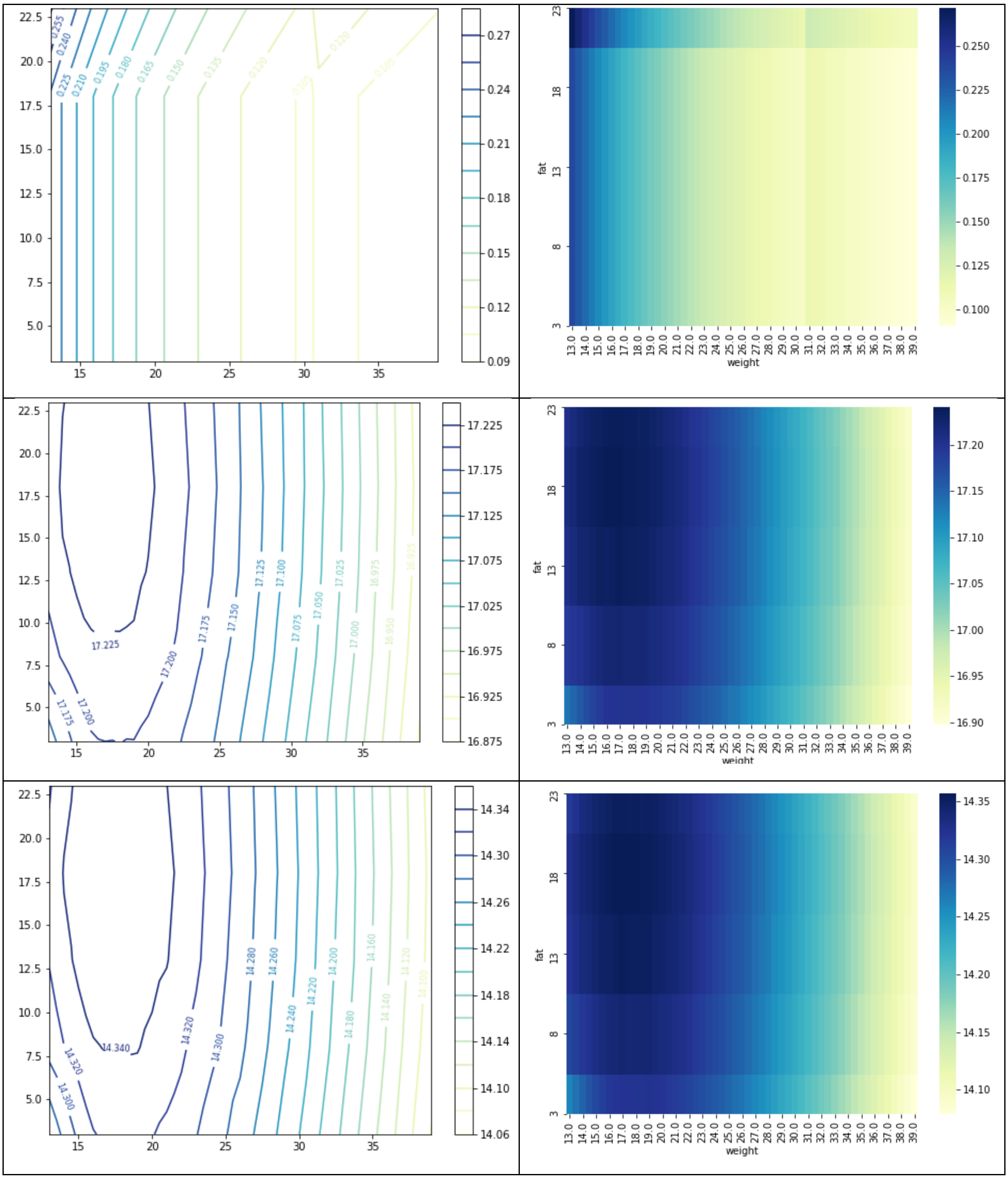

Figure 4. Labour cost, income, and calculated purchase price (top to bottom, $/kg cwt) for carcases optimally allocated to cut plan #1.

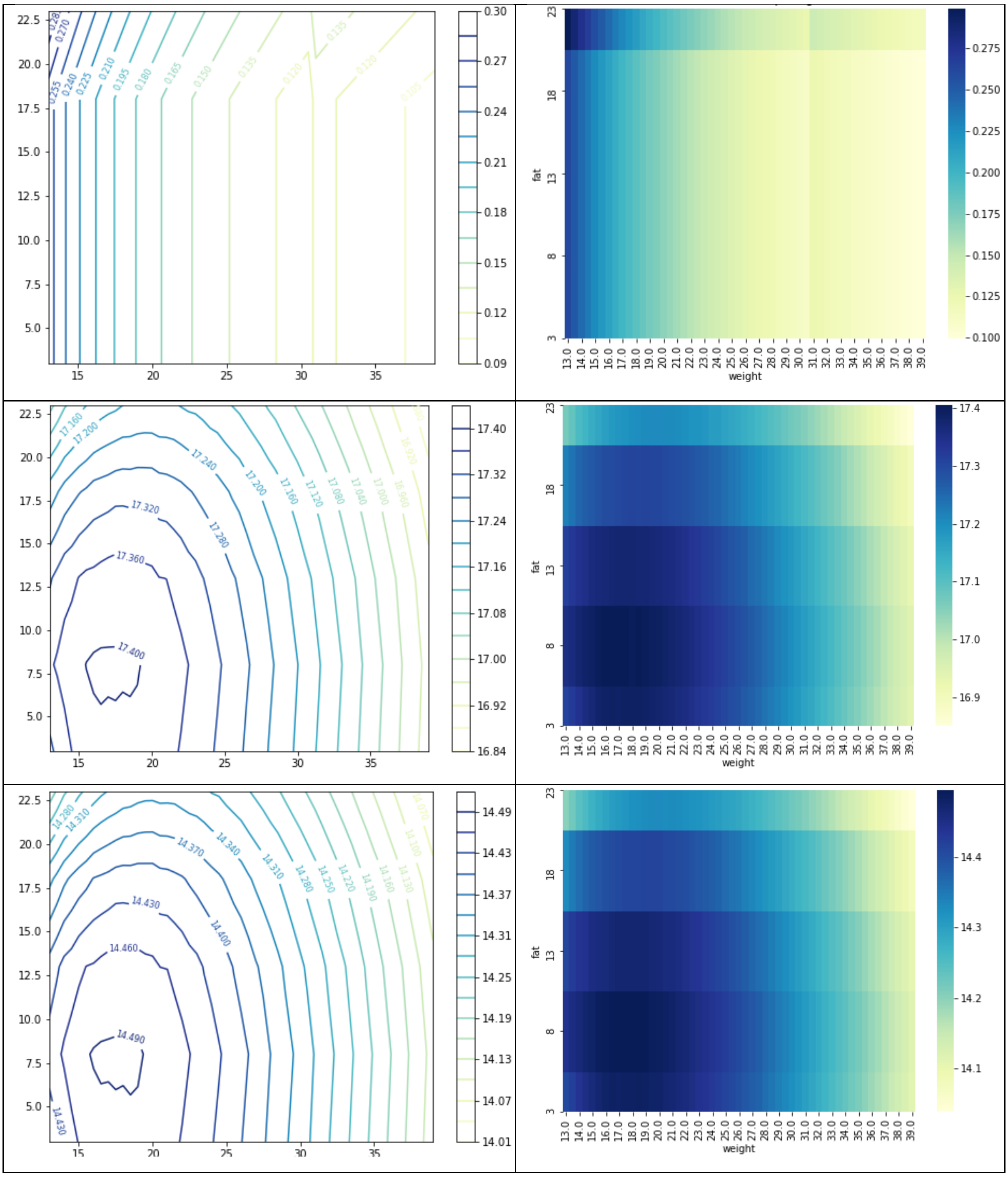

Figure 5. Labour cost, income, and calculated purchase price (top to bottom, $/kg cwt) for carcases optimally allocated to cut plan #2.

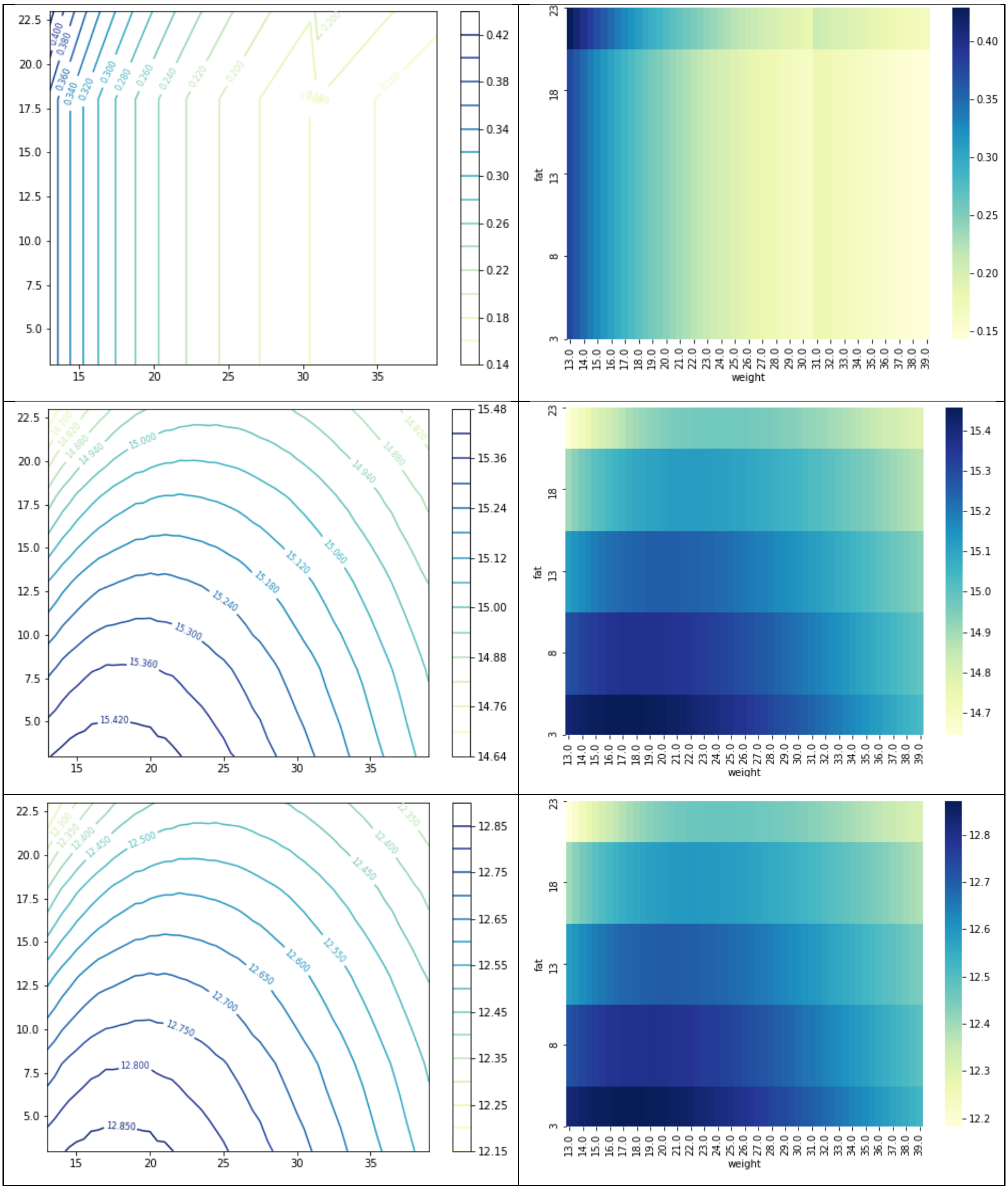

Figure 6. Labour cost, income, and calculated purchase price (top to bottom, $/kg cwt) for carcases optimally allocated to cut plan #3.

5. References

Wang, V. (2020). The tactical model in optimisation of boning room management. An *Advanced Measurement Technologies for Globally Competitive Australian Meat* project.