ECR - 24th June 2020
Optimising Markdowns

WAITROSE
& PARTNERS

Introductions

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Background - Managing Reductions in Waitrose

- **Pre 2006 - Shop owned, manual process with Partners defining the price and reduction timings - a strong culture of local ownership, intuition not science.**
- **2006 - Introduced a level of automation - PRR - (Potential Reduction Reporting) and label printers**
- **In house designed algorithm to optimise margin**
- **BUT, with Partners only 'advised' not to override the algorithm; no system restrictions and timings of the reductions still a local decision**
- **Wastage budgets historically set based on historic performance not what might be possible**
- **No overall business ownership of the Reduction Process and Algorithm movement until a Stock Operations team was formed within Profit Protection**
- **2018 - Work started to review and update both the Price Optimisation and the Shop Implementation (timing of reductions) process.**

Why do we need to Optimise Reductions

- **Data suggested a large cost saving through either / or**
  - Improving the price optimisation algorithm
  - Restricting partner interventions
  - Being more targeted on margin, than 'in the bin' waste
- **Productivity**
  - Override costs add time to the process
- **Availability**
  - Every markdown impacts the forecasting and future order calculations
- **Growth of E Commerce**
  - Customers want longer dates so driving forecast accuracy aids this, plus fewer future customers to buy reduced product

Outcomes

Now: 2019 - 2020

- **Improve 'saved sales' across the shop estate = increase to margin**
- **Decrease the shop intervention levels and culture of overriding = increase to productivity**

Future: 2020 - 2021

- **Develop a machine learning algorithm to further optimise price**
- **Enable a fully automated algorithm where end of day overrides are not required to mitigate food waste**
- **Reduce <u>total</u> waste exposure to both cost of reductions and 'in the bin' waste**

What we did

- **Phase 1 - May 2019 - Jan 2019**

  - **Develop an alternative more price aggressive variation on the current algorithm and two sub-variations of this - eg**

  - **Restricted shop overrides to the algorithm price except for 5 hours pre close, where shop Partners can override to ensure food waste is avoided and test optimal timings**

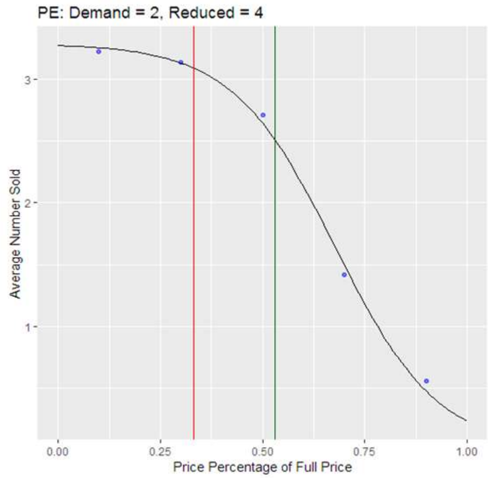
  - **Tested existing algorithm vs the three new algorithms in a 24 shop pilot. This suggested the proposed Algorithm B was the best returning option.**

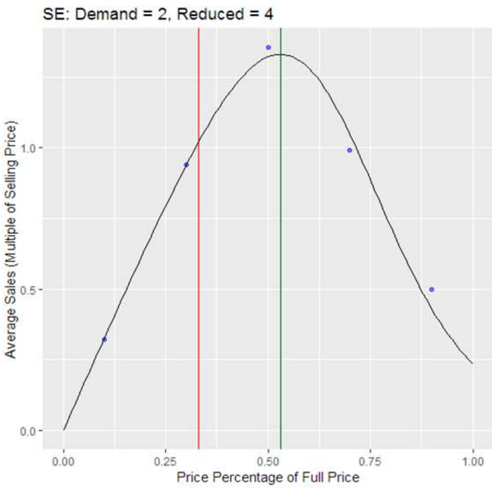
  - **Scaled it up to all shops in the estate. By test and analysis, we eliminated two options until we were left with two - Existing and Algo C. The pilot results did not match the estate result, when scaled up.**

  - **With 50% vs 50%, the results from the existing algorithm proved to be the best returning.**

What we did - variations explained

- **To create data led alterations to existing algorithm we aggregated the data to expected demand, items to sell pairs**
    - Modelled the historical data into sigmoidal curves (top)
    - Multiplied by price to get reduction percentage versus sales retained
    - Clear optimal price at top of parabola, aggregated the optimal changes
- **Picked out various ranges of demand / number of items and price percentage to come up with 5 scenarios**
    - The modelling approach gives error so for each scenario, 4 groups of changes were recommended





Results in Phase 1 - The big news was…….

Restricting partner overriding maximised the best return during the test period

- **Our existing algorithm was the most optimal, but ensuring partners had to adhere to it on the first reduction meant we decreased the cost of reductions**

BUT

Doing this with a 5 hour open window to clear product marginally increases our 'in the bin' food waste

OVERALL

In H2, 2019, while testing, override restrictions improved overall explained wastage performance.

Future Developments

- **Phase 2 - Oct 2019 - current**
    - **Develop a machine learning algorithm to be in test by March**
    - **Currently in 1 shop only (test started 2 weeks before Covid 19 impacts began)**

- **Phase 3 - 2020 H2 - 2021**
    - **Test and learn ML algo and roll out (subject to Covid 19 impacts)**

- **Phase 4 - 2021**
    - **Review overall processes around what and when we reduce**
    - **Mitigate 'in the bin' food waste while using a fully automated algorithm.**

Future Machine Learning Algorithm

DATA

- Data containing observations of reductions and their performance
- Data should include:
  - Percentage of the total sales returned as a result of the reduction event.
  - Percentage that the price was set to.
  - Branch characteristics / metrics.
  - Line characteristics / metrics.
  - Items being reduced.
  - Hours remaining to sell items.
  - Other Metrics

% Sales Returned	Price %	Other Metrics
y	x	z{i}

Algorithm

- Including other metrics other than the price allows us to **specify the price alterations** that Partners would have automatically made e.g. lots of items => lower price

- We can then use Machine Learning techniques to **optimise** the percentage of sales currently using linear regression

- Aligned with current IT process for fast implementation with future development for Decision Tree methodology

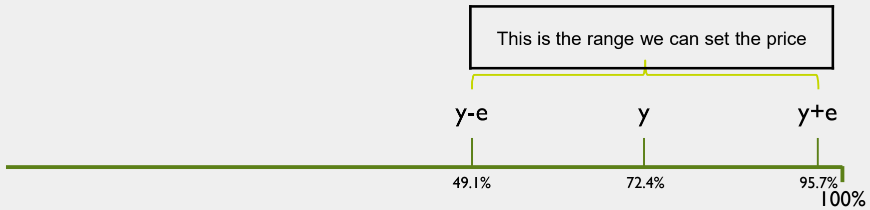
Future Machine Learning Algorithm Example

EXAMPLE

- At 13:00 on a Wednesday in branch 504 we want to reduce 5 punnets of strawberries. The demand for that item, in that branch, on that day is 32.81.

Branch Cluster (z1)	Line Cluster (z2)	Day Of Week (z3)	Bank Holiday (z4)	Demand Forecast (z5)	Number of Items (z6)	Hours Until Sell Time (z7)		Retained Sales Prediction
0.2	0.1667	0.4286	0	32.81	5	7	=	72.4%

Standard Error = 23.3%



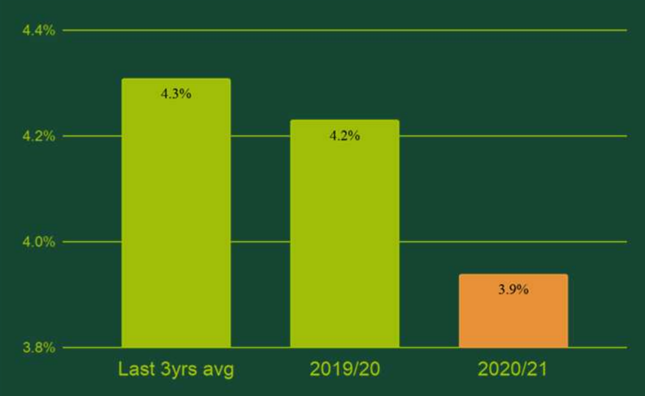
Price as a percentage of full selling price

P5 YTD 2020/21 **WASTAGE** % OF SALES	Last 3yrs avg*	-3bps 2019/20	-30bps 2020/21

P5 YTD we have seen a **30bps** Year-on-Year improvement in Wastage, of which **9bps** is attributable to the implementation of the override restriction, **17bps** driven by Product Supply improvements and the remaining **7bps** resulting from other efficiencies.

Saved Sales % - P5 YTD

Reduced Items % - P5 YTD



Last 3yrs avg: *2017/18, 2018/19 & 2019/20*

Impacts and Learns - Discussion Points

There are a number of ongoing impacts and learning from the override restriction thus far;

1. **Around a 1/6th of shops have seen a negative cash impact from restrictions -** we are now assessing why some are impacted vs others who have seen huge benefits. Working assumption is they were always more optimal and Partner's made good decisions on the whole OR the timing of their second reductions means they lose more value too late in the day.

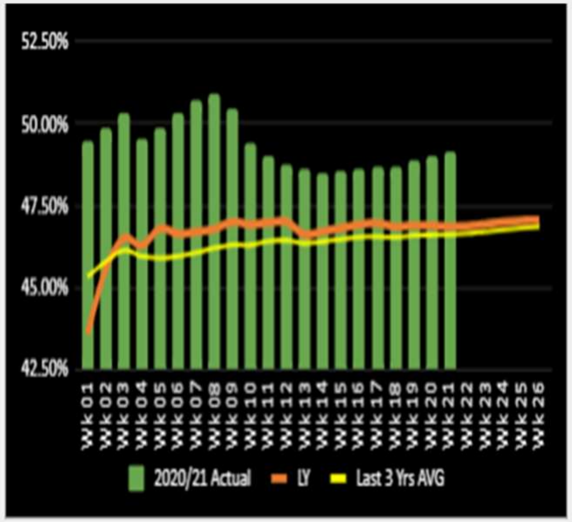
1. **Out of Code (In the Bin waste) has increased - how does this sit with topical CSR / Food Waste issues.** Optimising 'Saved Sales' appears to come at a CSR cost. We are working on how we mitigate this but the answer appears to be either increased labour cost or lower saved sales by dropping the price in the last 5 hours of trade.

1. **Productivity Cost Increase -** Unrestricted, shops would reduce sharply to sell quickly and ensure sell through but it would cost us the 'saved sales' gap. Now, some have to increase their pay budget to re-reduce more lines to clear later in the day than they used to or want to. This cost is being analysed now but we know it nets out clearly as an overall benefit but still creates a tension with the shop teams operationally where they are responsible for the pay line.

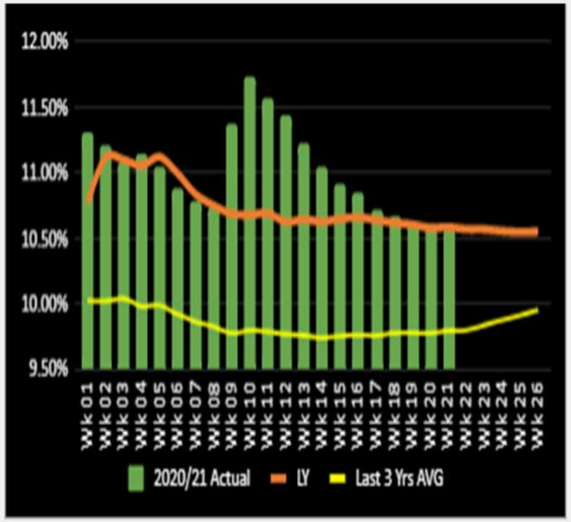
Impacts and Learns - Covid 19

Covid 19 Impacts - This has changed how customers buy reduced product and the trade pattern in commuter areas to the point the algorithm cannot react and does not reduce heavily enough. We now have 25% of shops back on an unrestricted override to protect them operationally and financially until trade returns to more ‘normal’levels.

SAVED SALES % - YTD



OUT OF DATE (OOD) % - YTD



BENEFITS (£K) - YTD