

# OPPORTUNITIES FOR DATA SCIENCE INNOVATION IN THE FOOD SECTOR

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# CONTENTS

1	The Food Sector	3
2	Challenges Facing the Food Industry	3
3	Opportunities for Innovation from Data Science	4
4	Implementation Considerations and Conclusion	6
5	Reference List	7
6	Appendix A What's Your Innovation?	11
7	Appendix B Online Grocery Sales in Australia	12

# 1 THE FOOD SECTOR

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The food sector is made up of multiple components including fruit and vegetables, nuts, crops, seafood, eggs, livestock, dairy, manufacturing, retail and hospitality (The Food and Agribusiness Growth Centre, National Food Waste Baseline, 2019). With retail businesses facing increasing levels of competition, retailers are investing more money into new products and marketing to keep up with rivals, ultimately adding to the copious amounts of waste. The average Australian purchases five bags of groceries each week, with an equivalent of close to one of those bags being disposed of as waste (GetGreen, 2009). The high level of methane gas produced by this food waste is a large contributing factor to climate change, producing up to eight percent of greenhouse gas emissions (Department of Agriculture, Water and the Environment, 2021). The demands of retailers are also having exhausting effects on the agricultural industry as farmers are resorting to using additives and hormones to meet these demands. It is predicted the world's population will grow to over 9 billion by 2050 (The Government Office for Science, London, 2011) which means greater action needs to be taken to rectify the challenges facing food security, food waste, increasing demands of suppliers and climate change.

## 2 CHALLENGES FACING THE FOOD INDUSTRY

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### 2.1 FOOD WASTE

Food waste is an accrescent issue in the food industry and is yet to be adequately addressed in Australia (Edwards & Mercer, 2013). Each year, it is estimated that 7.6 million tonnes of food is wasted across the supply and consumption chain, which equates to 312kg per person, per year (Department of Agriculture, Water, and the Environment, 2021). Focus typically tends to be on consumers and household waste, however shifting this focus to food and grocery retailers could result in less waste in both supermarkets and households as retailers have a high level of influence on household consumption patterns (National Food Waste Baseline, 2019). This high level of waste is costing the Australian economy \$36.6 billion each year and the Australian household approximately \$2 500 per year (The Food and Agricultural Growth Centre, 2019). The National Food Waste Strategy launched in 2017 aims towards halving Australia's food waste by 2030 (Foodbank, 2022) with focus on avoiding food loss from farmer to retailer, helping businesses identify cost-effective food transport options, educating customers on imperfect produce and utilising organisations such as OzHarvest; Australia's first rescued food supermarket (National Food Waste Strategy, 2017).

### 2.2 PRESSURE ON FARMERS/ SUPPLIERS TO KEEP UP WITH DEMAND

With food demand and population being directly proportional, farmers worldwide need to meet demands of almost double the amount of meat since the 1960's (Springer Nature

Limited, 2019), by employing strategies such as increasing the amount of agricultural land and productivity of this land, as well as using enhancers to speed up the growing process, some of which is currently being used today (Elferink & Schierhorn, 2016). Farmers are competing against multiple variables such as water scarcity in rural areas, rising global temperatures, urbanization and extreme weather which have immense long-term impacts on crop yield (Elferink & Schierhorn, 2016). These challenges farmers are facing need to be approached differently than the current methods of improving transport logistics, advanced irrigation systems and GPS fertiliser dispersion, all of which are a financial burden on farmers. Reducing the pressure and demand may allow farmers to revert to a more natural farming approach, which is less costly and harmful on the environment as agriculture is the leading source of pollution (National Resources Defence Council, 2022).

## 2.3 ENVIRONMENTAL IMPACT

The food industry is one of the leading causes of greenhouse gas emissions in the world. The amount of water and land required to farm and produce such high quantities of food is having an everlasting effect on multiple species, which are now extinct due to pesticides and fertilisers, or other toxic chemicals used on the farm poisoning fresh water, marine life ecosystems, air and soil (World Wildlife Fund, 2022). The amount of methane gas produced by food in landfill and belching livestock is around four times more than the amount of carbon dioxide, having a global warming potential 28 times greater than carbon dioxide (Juneau, 2021). Currently 75% of Australia's rainforests and 50% of the world's total forests have been destroyed (Sustainable Table, 2022) for agricultural purposes. As the world's population is only going to continue to increase, there will simply be no more land available to supply the amount of food if continued in this trajectory. Aside from land, if food production was produced more efficiently, 25% of the world's fresh water would be saved as this water is currently used to grow food that is thrown into landfill (Maple Ridge, British Columbia, 2022).

# 3 OPPORTUNITIES FOR INNOVATIONS FROM DATA SCIENCE

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## 3.1 DATA SCIENCE TO IDENTIFY CONSUMER TRENDS

The Covid-19 pandemic was proof that Australian's can survive with less food on the shelves. There has also been a shift in consumer behaviour as items consumers rarely previously purchased spiked and have altered the consumer trends (Torkington, 2021). This opportunity is perfect for businesses to employ Data Science to help create a less wasteful industry. Data Science is already used to predict the lifespan of products (Shah, 2021), however by including Sentiment Analysis, businesses can determine if customers are happy with the freshness and quality of the items they're purchasing. The results of this analysis paired with consumer purchasing trends could help prevent the amount of waste due to retailers having faster turnovers rather than large amounts of produce at one time. Decision Trees would also allow retailers to identify the choices customers are making when faced with multiple decisions

(SAS Institute Inc., 2022), resulting in mapping the customers complete shopping experience. Adding to this, Time Series Data Mining would then tie all collected data together, giving retailers time- stamps of consumer traffic over time intervals, producing forecasting techniques and eventually assisting with the reduction of over stocked shelves. Since online grocery shopping has increased by 27.2% since 2017 (IBISWorld, 2022) and is continuing to grow, storing fresh produce out the back of the store in conditions which prevent spoiling, could increase customer satisfaction, and decrease food waste. The amount of produced stored away can be determined by using Predictive Analytics. Not only will this analysis separate online and in- store purchasing, but it can also assist with marketing campaigns promoting this shift in fresh food storage and online shopping.

### 3.2 DATA SCIENCE TO IDENTIFY PRECISE DEMAND

The current data collected on consumer behaviour focuses on the products and quantities purchased, rather than the amount of food consumed. Collecting data on food consumption could help reduce the ever-growing supply/demand and assist in preventing food waste. By using Predictive Analysis tools, mainly Regression Models, patterns and specific factors, which influence the movement of products amongst consumers, could help reduce the oversupply of products. This regression tool can also be used to prevent product defects during the manufacturing production line due to human error (Illa, Sin, Fadzil, Safwati, Rosmaini, Fathullah, 2021). Retailers could also begin to collect more information about the demographic of their customers. As a trial, businesses could reduce the amount of meat products in a particular area where there are a high number of vegetarian/ vegan customers. With developed and precise marketing, the Incremental Response model can be used to check the effects of the marketing program and a Sentiment Analysis to confirm the positive response of the customers. This is just one example and shouldn't be limited to meat supply. Retailers need to take on the role of communicating with customers to choose suppliers/producers that fulfil their corporate responsibility (Chan & Schapper, 2009) as roughly 63% of consumers expect a personalised experience when it comes to marketing, product suggestions and any sort of communication between retailer and customer (Truyo, 2021).

### 3.3 DATA SCIENCE TO PREDICT AND PROMOTE POSITIVE IMPACT OF REDUCING WASTE AND DEMAND ON ENVIRONMENT

Data Science is already heavily used in the agricultural business to assist farmers in growing crops with healthy soil as well as to keep track and monitor the health of livestock throughout the growing process. Right now, farmers use data to decide what to produce, when to produce, where to produce and for whom to produce (Maru, 2018). What if farmers could know exactly how much to produce? Receiving this data from retailers could help prevent cultivating more land to meet demands and reduce the amount of food waste. Climate-Induced Disasters (CID) have been increasing in frequency and severity, testing the resilience

of the world's infrastructure and ability to rebuild all that was destroyed. Data Science has been used to predict future CID's, specifically flood disasters with an accuracy of around 96% (Haggag, Siam, El- Dakhkhni *et al.*, 2021). By using the data on Australia's disaster history and global climate models, Data Scientists can help develop a model to predict what will happen to the country if no changes are made to current processes. Customers desire trust and transparency in the food they purchase and with over 20 years of research, it has been found that nutrition labelling can drive healthy food choices (Brown, Harris, Knai & Potter, 2020). So what about climate labelling? Data Science can assist in providing consumers with the correct information about what resources went into the product and the carbon footprint of the item. This may lead to both consumers and producers to take additional 'green' actions in the future, reducing the demand of products with a high carbon footprint (Vandenbergh, Dietz & Stern, 2011).

## 4 IMPLEMENTATION CONSIDERATIONS AND CONCLUSION

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The impacts of using Data Science in the methods mentioned above can have an enormous positive outcome, however there are many implications in each example. Focus will be on monetary loss when reducing the amount of produce supplied to retailers and retailers will fear the loss of customers if a product isn't available as items being out of stock results in customers spending less or even shopping elsewhere (InspectorCloud, 2020). There are solutions to this issue, such as supplying a 10% buffer for the "change of mind" customer or increasing supply during holiday seasons, however all solutions will be irrelevant if consumers and retailers aren't educated on the current issues in the food industry.

Retailers are already collecting copious amounts of data through customer loyalty programs. Targeted promotions and opportunities for customers to have their say on reducing food waste can assist with building and maintaining this loyalty as customer retention is cheaper than acquisition. Retailers could also promote waste saving purchases, such as an email sent to a customer who purchased a more environmentally sustainable product or a reward system for sustainable shopping as 75% of customers favour brands that offer rewards (Morgan, 2020).

The biggest implication currently faced and will continue is that of data quality. The degree to which data can be used is largely determined by their quality (O'Reilly, 1982). The use of Big Data is becoming more and more prevalent in businesses. Combining information and forming a data profile on customers could assist with maintaining good quality data, with close attention to the length of time between data updates on customers along with the frequency in which this data is updated (Blake and Mangiameli, 2011). Correct, but infrequently updated data could lead to incorrect predictions as retailers would be not keeping up with consumer trends. Investing in a Data Science driven approach will not only maintain customer loyalty, but it will raise greater awareness of the challenges in the food sector and improve efficacy, which will ultimately decrease food waste and the impacts this has on the environment.

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### Appendix A

#### What's Your Innovation?

**What is your sector?** Brief description of sector context and key facts.

Food Industry. Every day an abundance of food is discarded and wasted, producing methane gases and damaging our environment. Farmers and suppliers are also constantly battling to keep up with the demands of retailers, resulting in unnatural methods used to grow produce quickly and efficiently (added hormones, GM fruit and veg).

<b>Sector challenge 1:</b>  <i>In this box, you want to state the problem or challenge the business or its customers has. This might be about needing efficiency in the market, new kinds of competitor, regulatory challenges, etc.</i>  Food waste	<b>Sector challenge 2:</b>  .... Pressure on farmers/ suppliers to keep up with demand	<b>Sector challenge 3:</b>  .... Negative environmental impact, climate change.
<b>DS Opportunity 1</b> <i>In this box, you want to describe how data science could be used to tackle this challenge. What would the (measureable) impact of this innovation be on that challenge?</i>  DS can identify consumer trends, allowing retailers to purchase specified amounts of a particular product, meeting the demand but not overdoing the supply. DS can also identify when customers are more than likely to buy particular products and choose to only purchase/ stock these items during that time, eg. Turkey during Thanksgiving or Christmas time.	<b>DS Opportunity 2</b> ....  DS can provide an analysis on what the exact demand is for the retailer and how the supplier will soon save money on feed, employees, fertilisers and other expenses associated with growing or producing food.	<b>DS Opportunity 3</b> .... DS can present the projected positive impact that reducing waste will have on the environment and in turn, climate change.

## Appendix B

### Online Grocery Sales in Australia

