May 2020

TEXAS
The University of Texas at Austin

What's in your cart?

Analytical database using 2017 Instacart order data and USDA ERS price database

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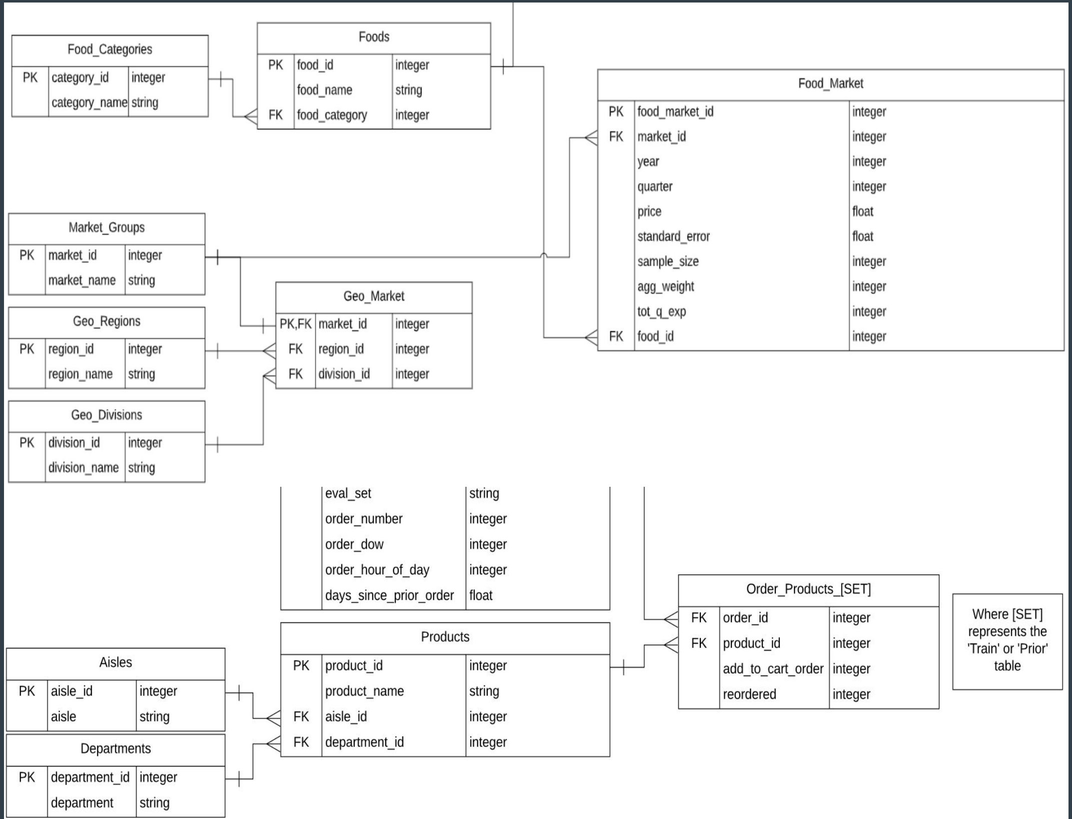
Mission

Analyze the spending trends of Instacart users to improve Instacart efficiency

Datasets

instacart

USDA



Food_Categories

PK	category_id	integer
	category_name	string

Foods

PK	food_id	integer
	food_name	string
FK	food_category	integer

Food_Market

PK	food_market_id	integer
FK	market_id	integer
	year	integer
	quarter	integer
	price	float
	standard_error	float
	sample_size	integer
	agg_weight	integer
	tot_q_exp	integer
FK	food_id	integer

Market_Groups

PK	market_id	integer
	market_name	string

Geo_Market

PK,FK	market_id	integer
FK	region_id	integer
FK	division_id	integer

Geo_Regions

PK	region_id	integer
	region_name	string

Geo_Divisions

PK	division_id	integer
	division_name	string

	eval_set	string
	order_number	integer
	order_dow	integer
	order_hour_of_day	integer
	days_since_prior_order	float

Order_Products_[SET]

FK	order_id	integer
FK	product_id	integer
	add_to_cart_order	integer
	reordered	integer

Where [SET] represents the 'Train' or 'Prior' table

Products

PK	product_id	integer
	product_name	string
FK	aisle_id	integer
FK	department_id	integer

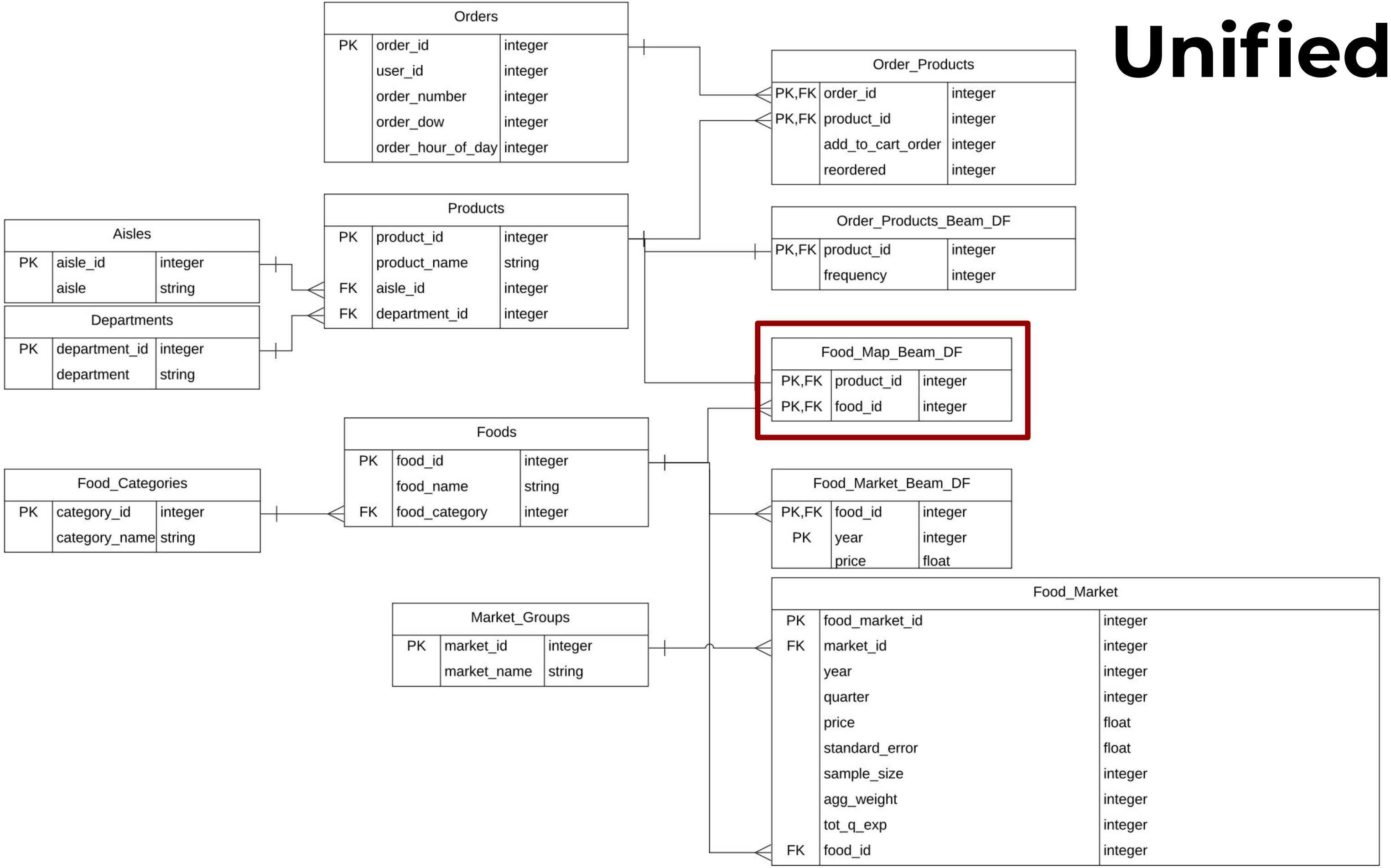
Aisles

PK	aisle_id	integer
	aisle	string

Departments

PK	department_id	integer
	department	string

Unified ERD



Orders		
PK	order_id	integer
	user_id	integer
	order_number	integer
	order_dow	integer
	order_hour_of_day	integer

Order_Products		
PK,FK	order_id	integer
PK,FK	product_id	integer
	add_to_cart_order	integer
	reordered	integer

Products		
PK	product_id	integer
	product_name	string
FK	aisle_id	integer
FK	department_id	integer

Aisles		
PK	aisle_id	integer
	aisle	string

Departments		
PK	department_id	integer
	department	string

Order_Products_Beam_DF		
PK,FK	product_id	integer
	frequency	integer

Food_Map_Beam_DF		
PK,FK	product_id	integer
PK,FK	food_id	integer

Foods		
PK	food_id	integer
	food_name	string
FK	food_category	integer

Food_Categories		
PK	category_id	integer
	category_name	string

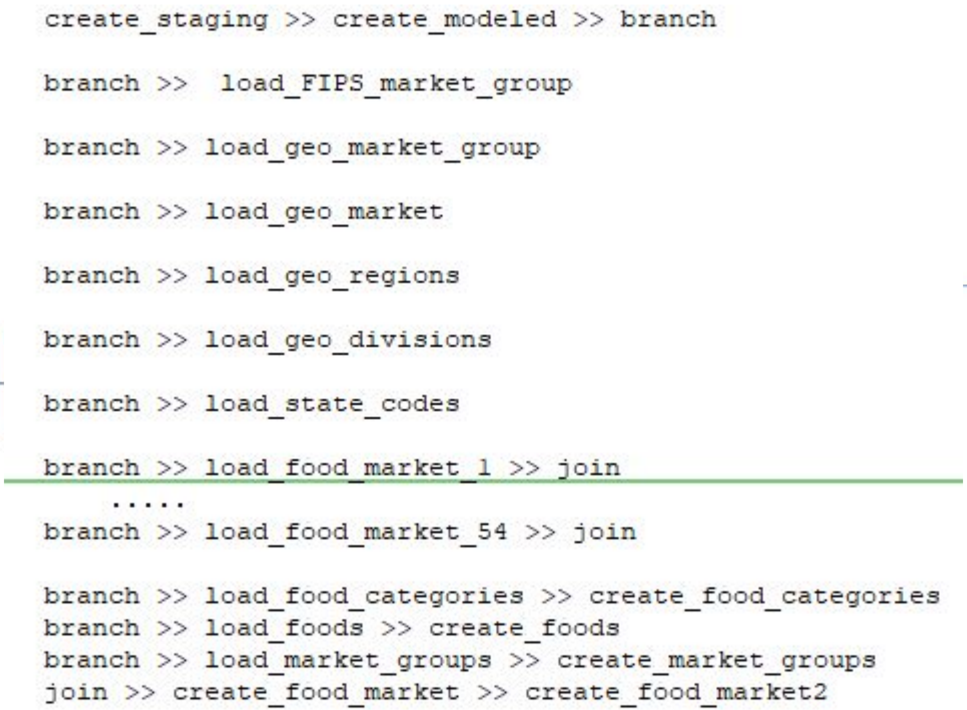
Food_Market_Beam_DF		
PK,FK	food_id	integer
PK	year	integer
	price	float

Market_Groups		
PK	market_id	integer
	market_name	string

Food_Market		
PK	food_market_id	integer
FK	market_id	integer
	year	integer
	quarter	integer
	price	float
	standard_error	float
	sample_size	integer
	agg_weight	integer
	tot_q_exp	integer
FK	food_id	integer

Airflow with Secondary Dataset

create_staging



```
create_staging >> create_modeled >> branch

branch >>  load_FIPS_market_group

branch >> load_geo_market_group

branch >> load_geo_market

branch >> load_geo_regions

branch >> load_geo_divisions

branch >> load_state_codes

branch >> load_food_market_1 >> join
    .....
branch >> load_food_market_54 >> join

branch >> load_food_categories >> create_food_categories
branch >> load_foods >> create_foods
branch >> load_market_groups >> create_market_groups
join >> create_food_market >> create_food_market2
```

Add price column based on linear regression

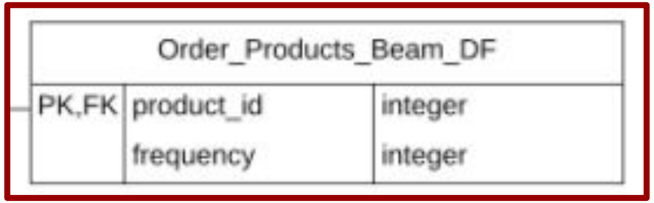
$$price = a\,(year) + b$$

Slope $a = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sum(x_i - \bar{x})^2}$

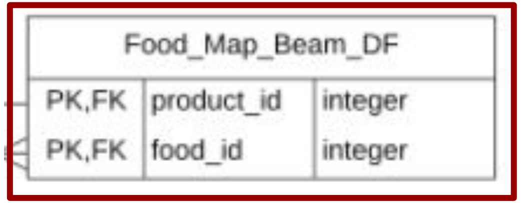
intercept $b = \bar{y} - a\bar{x}$

__where overbar denotes average

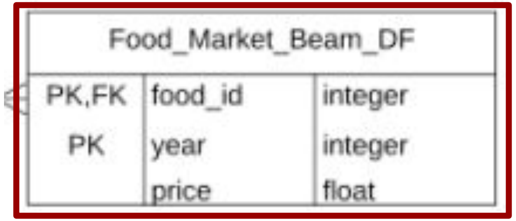
Beam Transforms



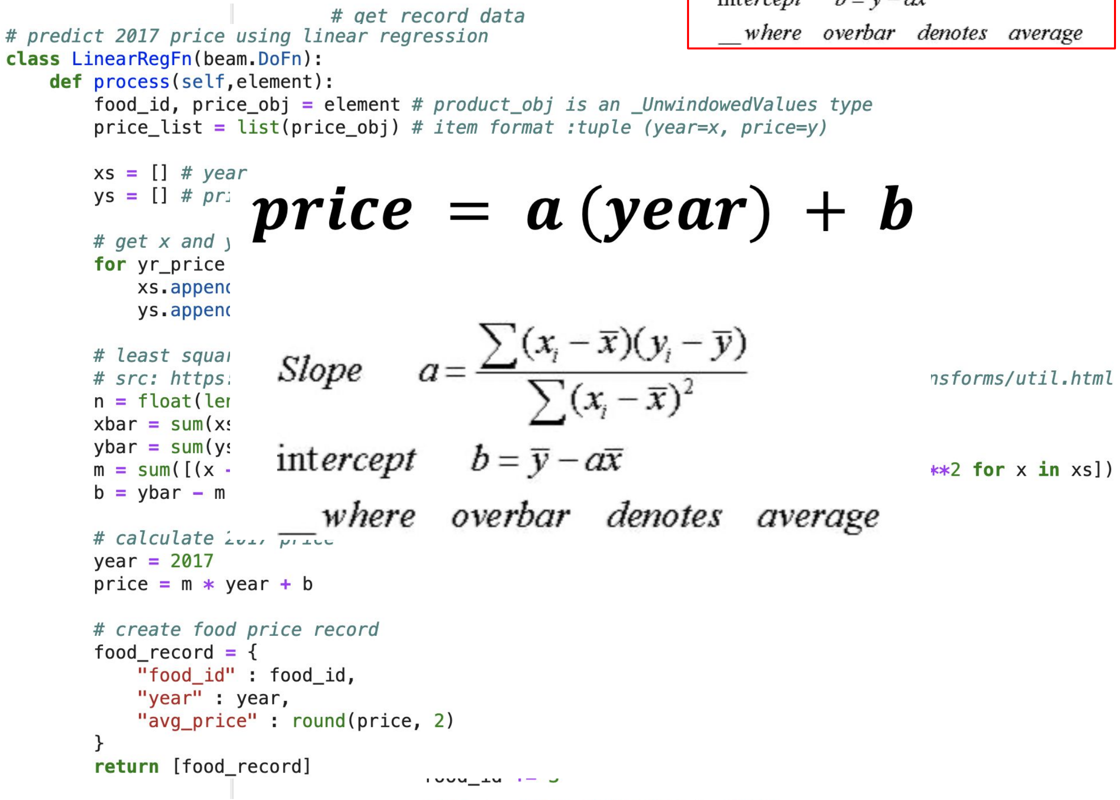
Order_Products_Beam_DF		
PK,FK	product_id	integer
	frequency	integer



Food_Map_Beam_DF		
PK,FK	product_id	integer
PK,FK	food_id	integer



Food_Market_Beam_DF		
PK,FK	food_id	integer
PK	year	integer
	price	float



```
               # get record data
# predict 2017 price using linear regression
class LinearRegFn(beam.DoFn):
    def process(self,element):
        food_id, price_obj = element # product_obj is an _UnwindowedValues type
        price_list = list(price_obj) # item format :tuple (year=x, price=y)

        xs = [] # year
        ys = [] # pri

        # get x and y
        for yr_price
            xs.append
            ys.append

        # least squa
        # src: https:                                                nsforms/util.html
        n = float(len
        xbar = sum(xs
        ybar = sum(ys
        m = sum([(x -                                                **2 for x in xs])
        b = ybar - m

        # calculate 2017 price
        year = 2017
        price = m * year + b

        # create food price record
        food_record = {
            "food_id" : food_id,
            "year" : year,
            "avg_price" : round(price, 2)
        }
        return [food_record]
```

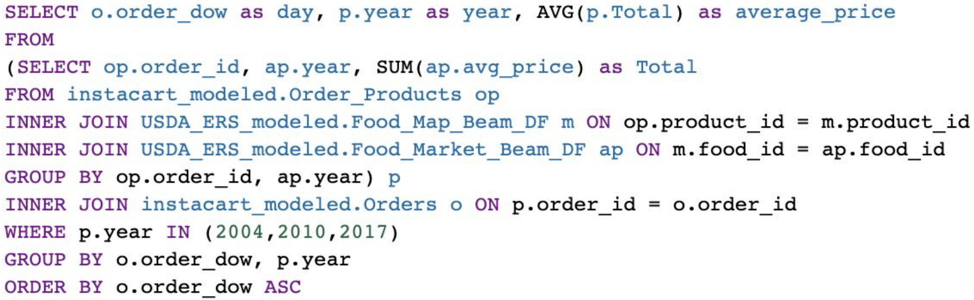
$$price = a\,(year) + b$$

Slope $a = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sum(x_i - \bar{x})^2}$

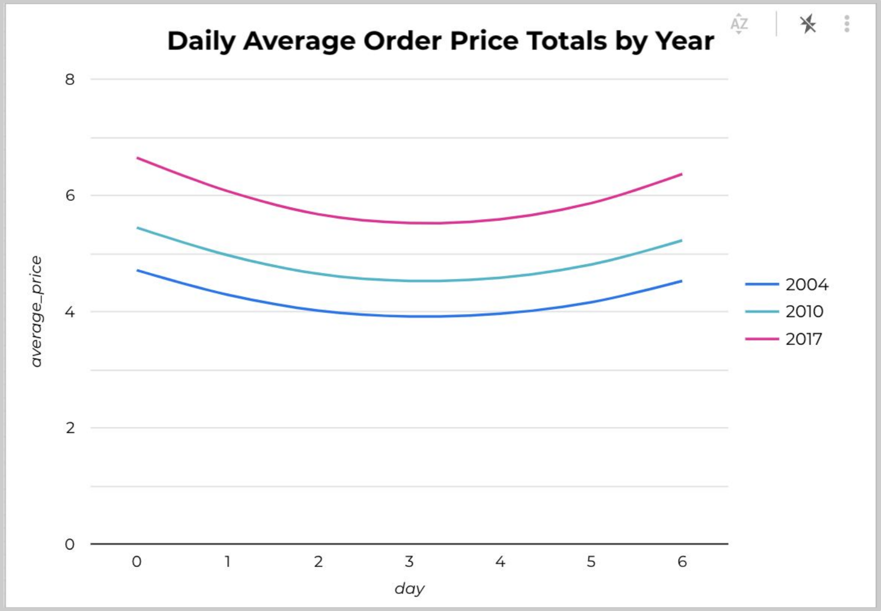
intercept $b = \bar{y} - a\bar{x}$

__where overbar denotes average

Daily Average Order Price Totals by Year



```
SELECT o.order_dow as day, p.year as year, AVG(p.Total) as average_price
FROM
(SELECT op.order_id, ap.year, SUM(ap.avg_price) as Total
FROM instacart_modeled.Order_Products op
INNER JOIN USDA_ERS_modeled.Food_Map_Beam_DF m ON op.product_id = m.product_id
INNER JOIN USDA_ERS_modeled.Food_Market_Beam_DF ap ON m.food_id = ap.food_id
GROUP BY op.order_id, ap.year) p
INNER JOIN instacart_modeled.Orders o ON p.order_id = o.order_id
WHERE p.year IN (2004,2010,2017)
GROUP BY o.order_dow, p.year
ORDER BY o.order_dow ASC
```



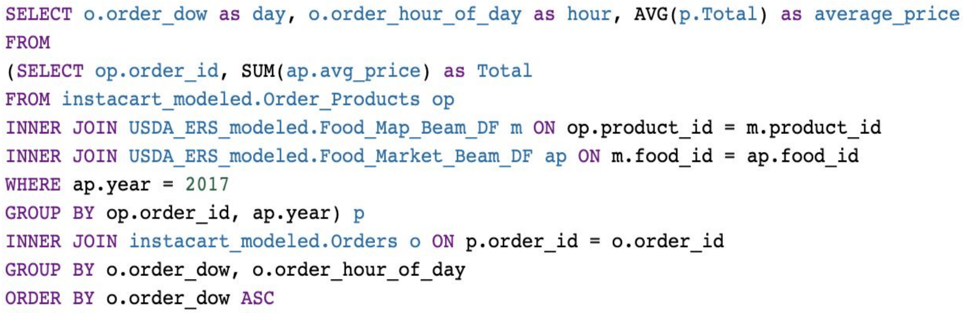
Results:

- Prices have increased dramatically since 2004
- Users spend more on days 0 and 6

Action:

- more shoppers on days 0 and 6

2017 Daily and Hourly User Spending



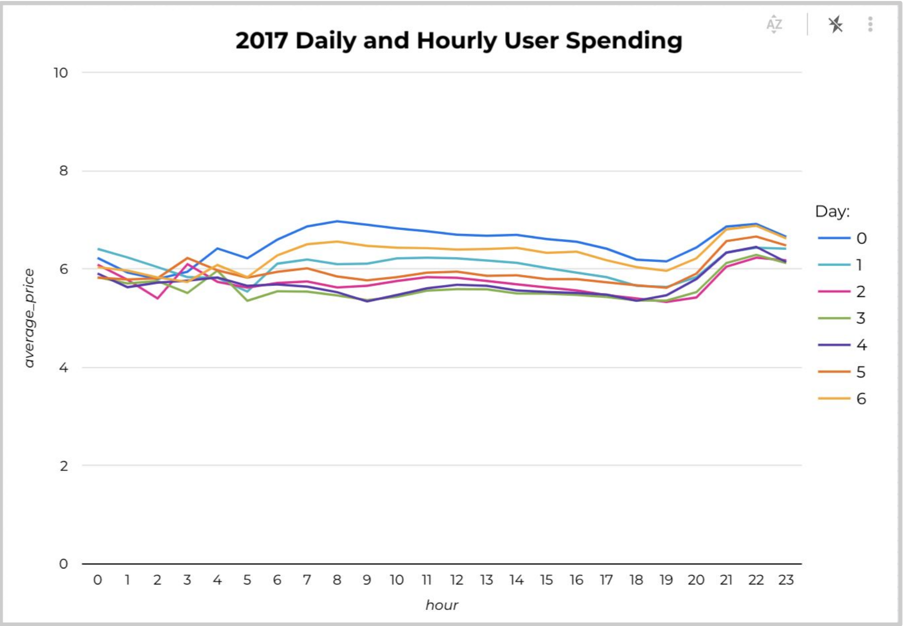
```
SELECT o.order_dow as day, o.order_hour_of_day as hour, AVG(p.Total) as average_price
FROM
(SELECT op.order_id, SUM(ap.avg_price) as Total
FROM instacart_modeled.Order_Products op
INNER JOIN USDA_ERS_modeled.Food_Map_Beam_DF m ON op.product_id = m.product_id
INNER JOIN USDA_ERS_modeled.Food_Market_Beam_DF ap ON m.food_id = ap.food_id
WHERE ap.year = 2017
GROUP BY op.order_id, ap.year) p
INNER JOIN instacart_modeled.Orders o ON p.order_id = o.order_id
GROUP BY o.order_dow, o.order_hour_of_day
ORDER BY o.order_dow ASC
```

Results

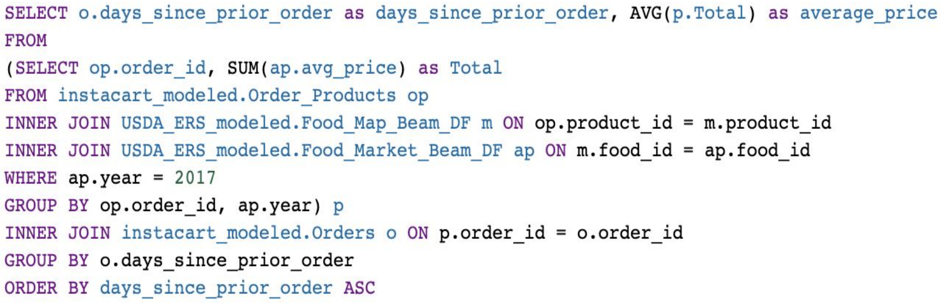
- Similar hourly sales activity across all days
  - 7- 17 hrs steady activity
  - peak at 21-22 hrs
- Day 0 and 1 most active

Action

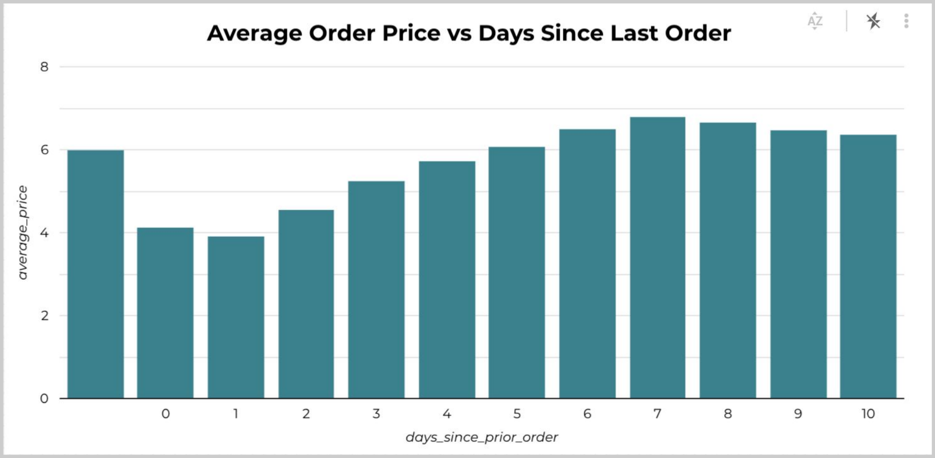
- increase shoppers on days/hours



2017 Daily and Hourly User Spending



```
SELECT o.days_since_prior_order as days_since_prior_order, AVG(p.Total) as average_price
FROM
(SELECT op.order_id, SUM(ap.avg_price) as Total
FROM instacart_modeled.Order_Products op
INNER JOIN USDA_ERS_modeled.Food_Map_Beam_DF m ON op.product_id = m.product_id
INNER JOIN USDA_ERS_modeled.Food_Market_Beam_DF ap ON m.food_id = ap.food_id
WHERE ap.year = 2017
GROUP BY op.order_id, ap.year) p
INNER JOIN instacart_modeled.Orders o ON p.order_id = o.order_id
GROUP BY o.days_since_prior_order
ORDER BY days_since_prior_order ASC
```



Results:

- ordering on a weekly basis is more profitable
- least profitable
  - `days_since_prior_order = 1,2, or 3`

Action:

- target them to raise sales
  - reminders, coupons, promotions

Improvements

- More sophisticated/automated algorithm to create Food-Product mapping
- Extend mapping to all products (incl. non-foods)
- Instacart order locations
    - Product sales fluctuation based on price