Raw Dough & Raw Data

Optimizing Wholesale Distribution for When Pigs Fly Bakery

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Introduction

When Pigs Fly is a well-known local bread company based out of Kittery, Maine. Our sponsors, James and Grant Broom, requested our help to optimize their wholesale distribution process. Currently, this process involves using historical sales data spreadsheets to manually determine (using Excel formulas) how much bread to send to each store. Because When Pigs Fly is currently in 300+ stores, this process is extremely time consuming and inefficient. Our application will also help them improve the credit rate by allowing them to identify underperforming stores and better predict their sales.

Design & Implementation

Front End

- Uses Python library Pyqt5 to create interactive UI
- Displays results of user queries
- Displays credit rate and sales calculations
- Outputs predictions based on specific query inputs

Back End

- Open CSV files in source directory
- Load data into Pandas Dataframe
- Generate store and flavor options
- Take queries based on user input (see Figure 1)
- Calculate credit rate and sales statistics

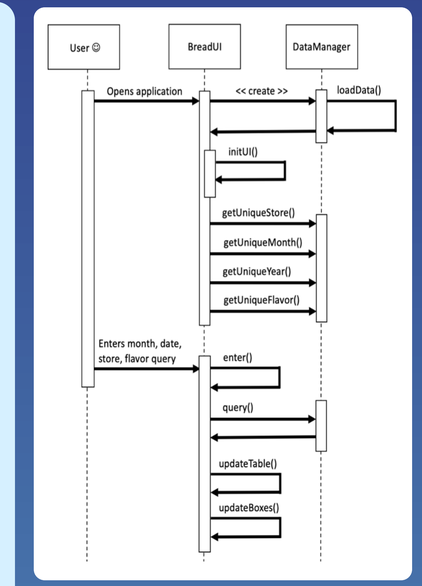


Figure 1: A UML Sequence Diagram Showing the flow of execution for a user query

Predictions

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_{13} X_{13}$$

- Formula calculates Y, which is the predicted credit rate
- β_0 is the intersect value of the regression line
- β_1-β_{13} are coefficients like β_0 that represent the magnitude of effect that each independent variable has on the dependent variable Y
- X_1 - X_{13} are independent variables in the data such as pqty, mqty, and month
- We use linear regression with indicator variables to predict future sales
- The results of the query will be put into a scikit-learn linear regression function in order to make specific predictions
- Predictions are done on a monthly level
- Current limiting factors are granularity of data and amount of data

Requirements

Functional Requirements

- User can select month, year, store, and flavor
- User can filter results by supermarket chain
- Application can calculate credit rate and net sales
- User can enter a target credit rate for predictions

Nonfunctional Requirements

- System provides predictions for any store in < 5 min
- No task takes a user longer than 5 minutes to complete

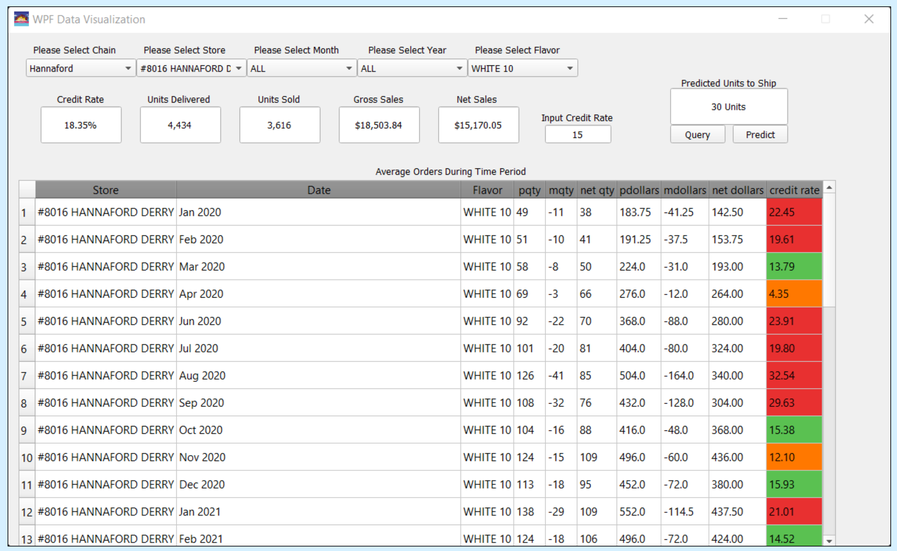
Development Tools

Python Pandas PyQt scikit-learn Gitlab

Acknowledgments

James & Grant Broom, Andrew Mitchell, Craig Smith

Results & Conclusions



	Store	Date	Flavor	pqty	mqty	net qty	pdollars	mdollars	net dollars	credit rate
1	#8016 HANNAFORD DERRY	Jan 2020	WHITE 10	49	-11	38	183.75	-41.25	142.50	22.45
2	#8016 HANNAFORD DERRY	Feb 2020	WHITE 10	51	-10	41	191.25	-37.5	153.75	19.61
3	#8016 HANNAFORD DERRY	Mar 2020	WHITE 10	58	-8	50	224.0	-31.0	193.00	13.79
4	#8016 HANNAFORD DERRY	Apr 2020	WHITE 10	69	-3	66	276.0	-12.0	264.00	4.35
5	#8016 HANNAFORD DERRY	Jun 2020	WHITE 10	92	-22	70	368.0	-88.0	280.00	23.91
6	#8016 HANNAFORD DERRY	Jul 2020	WHITE 10	101	-20	81	404.0	-80.0	324.00	19.80
7	#8016 HANNAFORD DERRY	Aug 2020	WHITE 10	126	-41	85	504.0	-164.0	340.00	32.54
8	#8016 HANNAFORD DERRY	Sep 2020	WHITE 10	108	-32	76	432.0	-128.0	304.00	29.63
9	#8016 HANNAFORD DERRY	Oct 2020	WHITE 10	104	-16	88	416.0	-48.0	368.00	15.38
10	#8016 HANNAFORD DERRY	Nov 2020	WHITE 10	124	-15	109	496.0	-60.0	436.00	12.10
11	#8016 HANNAFORD DERRY	Dec 2020	WHITE 10	113	-18	95	452.0	-72.0	380.00	15.93
12	#8016 HANNAFORD DERRY	Jan 2021	WHITE 10	138	-29	109	552.0	-114.5	437.50	21.01
13	#8016 HANNAFORD DERRY	Feb 2021	WHITE 10	124	-18	106	496.0	-72.0	424.00	14.52

Figure 2: Query Results for the Hannaford in Derry, NH for all records of white bread.

- User interface to query historical data and make predictions
- Sorts store options by chain for easy selection
- Can query all stores of selected chain at once
- Calculates credit rate, units delivered & sold, and gross & net sales based on query results
- Credit rates highlighted if rate is optimal, too low, or too high based on user input for target credit rate
- Predicts bread to send next month based on query data and target credit rate

Our application allows When Pigs Fly to generate predictions for the next month for any of the 300+ stores that sell their products in under a minute. Using our application is vastly more efficient than manually calculating sales predictions using spreadsheet software. This will help them both save time and increase sales.