UGBA 141 Final Project Report - Shipt Quality Control

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Problem

A grocery delivery company measures its performance on various dimensions, such as on time percentage, out-of-stocks, and pay per hour. How would you identify when the performance is outside of the normal day-to-day variation and merits further investigation? Bonus question: Are there certain techniques that do or don't work well for particular measures of performance?

Background

Process quality is essential when measuring the performance of grocery delivery platforms. With Shipt's mission of going beyond delivery and creating community and positive relationships, there is nothing more important than ensuring that bad variation does not occur. Additionally, Shipt's key values include being caring, authentic, and positive, we want to ensure that further investigation encapsulates helping Shipt achieve these goals. With Shipt's business model in mind, our task of identifying outliers within the KPI's extends our purpose beyond numbers but to benefitting both the shopper and customer experience.

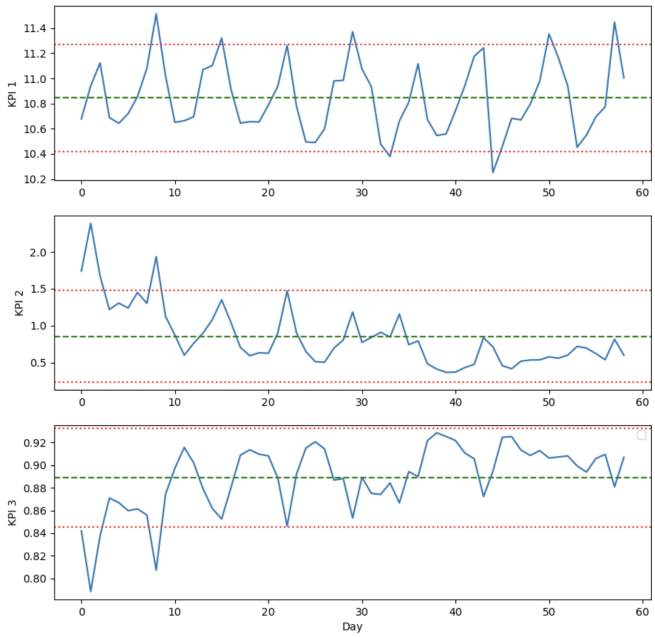
Approach

Our main approach drew from the course concept of Quality Control. We Identify trends and outliers within the data based on mean, standard deviation, and other statistical metrics. After doing so, we analyzed the dates on which the outliers occurred. Additionally, we drew on concepts from our other data science classes to perform Linear Regression Analysis to predict where the KPIs should land to generalize trends. Upon analyzing the data, we considered what external factors could affect and improve performance and drew on some of our course concepts like operational transparency and the psychology of queuing in order to generate new ideas for improvement. Finally, we addressed the bonus question using key insights.

Data Analysis

	KPI_1	KPI_2	KPI_3
count	59.000000	59.000000	59.000000
mean	10.844990	0.856851	0.889012
std	0.285102	0.412964	0.029058
min	10.251074	0.368525	0.788569
25%	10.654492	0.569152	0.873220
50%	10.788893	0.742956	0.894191
75%	11.044118	1.061565	0.909516
max	11.513513	2.386313	0.928403

Courtesy of Shipt, we were given a data set of three KPIs: on time percentage, out-of-stocks, and pay per hour for a total of 59 days. We first computed the mean, standard deviation, range, quartiles and median of the raw data. This is described in the table above.



These are three plots of the given KPIs, pay per hour, out-of-stocks, and on time percentage, respectively. We use 1.5 standard deviations to determine if a kpi is out of control.

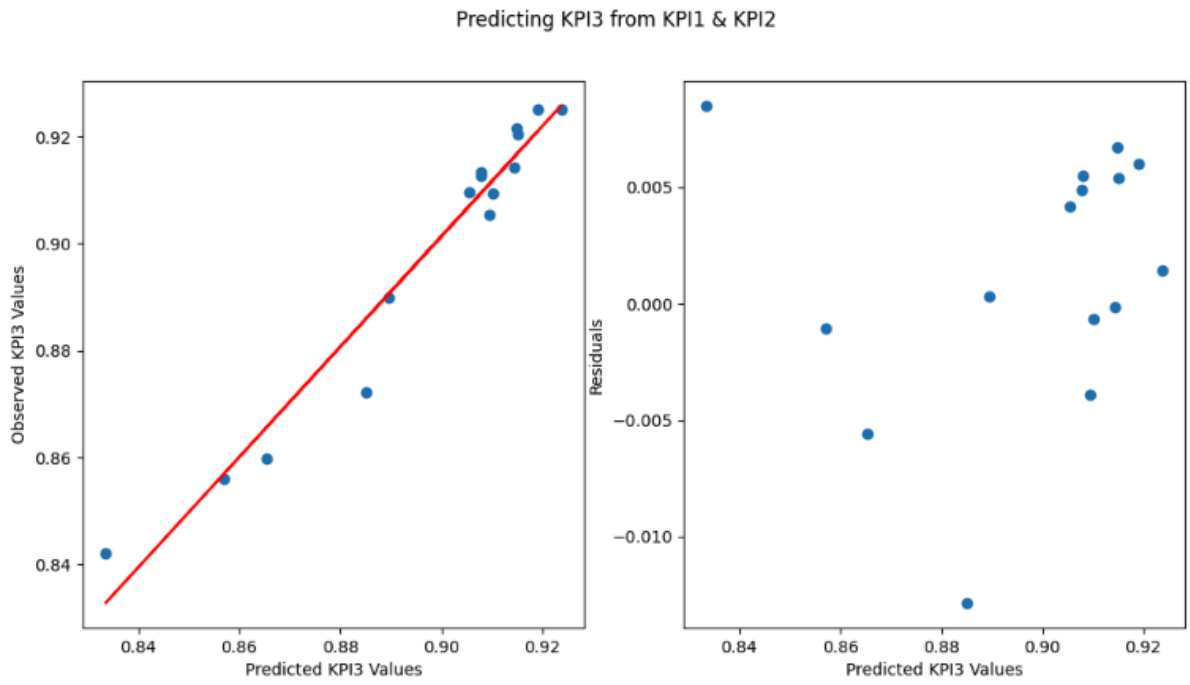
For pay per hour, we observe Day 8, 15, 29, 50, and 57 to be more than 1.5 standard deviations above the mean. All of these days correspond to Sundays. Possible reasons for an increased pay on Sundays is high demand for delivery workers as more people order groceries on the weekends or a low supply for delivery workers as more people are spending time with family / do not want

to work on weekends. Therefore, Shipt offers higher pay on Sundays to incentivize workers. For Day 33 and 44, we observe the pay to be more than 1.5 standard deviations below the mean. Day 33 corresponds to February 3 which is a Thursday and no holiday landing on this day. Further investigation is needed to see why this particular day had lowered pay. Day 44 corresponds to February 14 which is Valentine's Day. We observe non-random patterns within kpi 1 as there are predictable spikes in the data. The data tends to spike during the weekends and level off during the middle of the week.

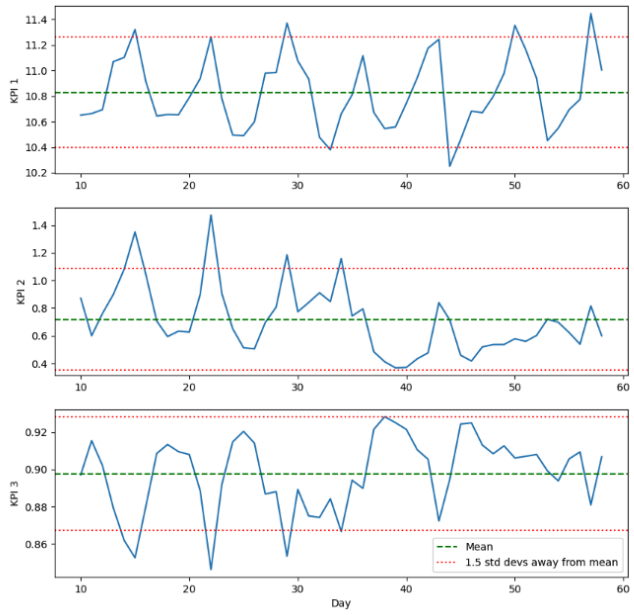
For out-of-stocks, we observe Day 0, 1, 2, 8 to be more than 1.5 standard deviations above the mean. For on time percentage, we observe Day 0, 1, 2, 8 to be more than 1.5 standard deviations below the mean. Day 0, 1, and 2 are all near New Years and Day 8 mentioned above is a Sunday which may be reasons for why these particular days are out of control.

	KPI_1	KPI_2	KPI_3
KPI_1	1.000000	0.348847	-0.463455
KPI_2	0.348847	1.000000	-0.967431
KPI_3	-0.463455	-0.967431	1.000000

We have also included the cross correlations between the three variables. We see that kpi 1 is mildly correlated with kpi 2 and 3. However, kpi 2 and 3 are strongly negatively correlated with a value of -0.967431. This is an indication that we can use some form of linear regression to predict the values of kpi 3 using just kpi 1 and 2.



After plotting the predicted kpi 3 values vs observed kpi 3 values, we see that they form a near straight line. The residuals are all very close to zero with the largest residual being under -0.015. The strong correlation between certain variables could be useful for Shipt's monitoring of kpis in the future.



Following initial investigations, we noticed that KPI 2 & 3 were significantly different during the first 10 days vs. the rest of the days. We then plotted and analyzed the KPIs for days 10–60. We were able to see a greater correlation between KPI 1 and the others, and a better alignment of

outliers. The graphs for KPI 2 and 3 look more consistent with the exclusion of the first 9 days. Previously, KPI 2 looked like it was steadily decreasing and KPI 3 was steadily increasing. This could have been due to the first 9 days corresponding to being near New Year's which is a major holiday which is similar to the start up effect. In the beginning of the year, workers are on vacation leading to a disruption and for business to move more slowly. As time passes on, the business enters a steady state effect. This is where business is running as usual and leads to more consistent data. We also see a slight shift in the data from about day 35 and onward. From days 10 to 35, KPI 2 tends to be above the mean, but after day 35 it shifts to being under the mean. The variation also seems larger in the first 10 - 35 days compared to after day 35. KPI 3 has a similar effect where the data seems to be below the mean in day 10 - 35 and above the mean from day 35 onwards. This could be due to the business being more efficient as the company is maximizing its utility. The company is shifting to be more productive and can generate more revenue.

	KPI_1	KPI_2	KPI_3
KPI_1	1.000000	0.401918	-0.517108
KPI_2	0.401918	1.000000	-0.942338
KPI_3	-0.517108	-0.942338	1.000000

The days of outliers are:
KPI 1: Day 15, 22, 29, 33, 44, 50, 57
KPI 2: Day 15, 22, 29, 34
KPI 3: Day 14, 15, 22, 29, 34, 38

There is now a much clearer overlap of outliers with the overlaps on Day 15, 22 and 29 among all three KPIs and Day 34 between KPI 2 and KPI 3. Days 15, 22, and 29 all correspond to Sundays. For similar reasons mentioned above, Sundays tend to have less workers available, creating a need for increased pay. With low supply of workers on Sundays, there is significantly less on time percentage as workers tend to need to make more deliveries per worker. On Sundays, there are higher out-of-stocks as inventory is not replenished as often, corresponding to less supply of workers from the distributing company.

Recommendations

Our recommended next steps for Shipt can be broken down into two main components: first, identifying out of control variation after it has occurred as well as troubleshooting out of control variation as it occurs. Both of these will work to prevent outliers in the future.

Upon identifying outliers, we recommend diving deep to find the root cause of certain issues to determine whether there was an issue with the Shipt platform or whether there was an issue

externally. We recommend diving deep using an always asking why technique as seen by this example. For example, consider this example of continuously asking "Why?".

> Date XX had unusually high out of stock percentages. We can ask the following:
>
> *"Why did the shopper report high out of stock percentages?"*
>
> Oh, the store did not order enough.
>
> *"Why did the store not order enough?"*
>
> Oh, the store did not accurately predict demand.
>
> *"Why did the store not accurately predict demand?"*
>
> Oh, there was an article released last week that illustrated the health benefits of these foods and the store was not able to order enough.

This is a tool that can be done to further investigate outliers and find the underlying reasons for certain days that exceed the normal day-to-day variation.

Next, we have generated ideas to mitigate customer conflict with the app when key performance indicators exhibit off trend behavior. The first thing our team recommends is **operational transparency** by motivating employees, specifically the shoppers. Having a mission statement directly for shoppers that encapsulates Shipt's values would be key: values of putting the customer first as well as fast delivery.

After doing online research into Shipt's shopper's processes, we recommend turning the optional online course into a required online course in order to ensure valuable customer interactions. In order to address the out of stock KPI, we also recommend offering sample messages within the app so that the shopper can easily access the Shipt Shopper Hub. Here is an example.

> *Shopper Message: "[Item] is out of stock. I am choosing [alternative]. Please let me know if there are any issues."*

By generating messages for the shoppers, variation between interactions of shoppers and customers will decrease. Additionally, it helps build a positive relationship between the two in order to generate understanding of the customer. After the shopper has alerted the customer of the issue with specific reasoning, then Shipt essentially troubleshoots variation as it occurs.

The second thing our team recommends is using key ideas from the **psychology of queueing** in order to decrease complaints from customers in order to address the on time percentage KPI. We recommend having the shopper directly communicate with customers in order to explain any

waits and offering sample messages to the Shopper to decrease negative variation in shopper-customer communication.

Shopper Message: "I am encountering unusually long lines at the grocery store."

Instead of changing the estimated delivery time of the groceries, we encourage communication between the shopper and customer in order to reduce the effects of unexplained waits. Statistically, unexplained waits feel longer than explained waits. So, having the customer aware of any issues and being in communication with them will improve authenticity and customer experience. This will mitigate any issues that arise with the key performance indicator of on time percentage if any negative variation were to occur.

As a highly operationally focussed business Shipt should focus on **Sustainability**. Within operations, sustainability comes not only in the form of conserving the environment (by decreasing fossil fuel consumption or choosing recyclable products), but fundamentally, when asking the question: Over a long horizon (10 to 20 years) will Shipt's grocery delivery business become the mainstream way to get groceries (when compared to traditional retail setting)? Even if Shipt ultimately serves a niche market - will it continue to provide value to drivers and customers, and make profits along the way? There are multiple aspects to this question:

1) *How can Shipt's business model be profitable long term?*

   If Shipt's goal is to achieve long-term profitability through economies of scale and volume, then it should focus on cutting costs and finding more ways to expand its network of customers and drivers. To this end, it is important that Shipt optimizes some core KPI over the longer term. Specifically, it is important that Shipt's total cost per order decreases over time, as this means Shipt's profitability per order will increase. Additionally, reducing the stockout percentages will be vital, if Shipt wants to garner its reputation as a fast and reliable grocery delivery service. It is important that Shipt choose a few core KPI measures that best reflect its business model and its long term optimization goals.

2) *How can Shipt's value proposition be more comprehensive than other competitors? Or, how can Shipt continue to deliver greater value to its customers and drivers?*

   It is important that Shipt tracks both customer and driver satisfaction - as retention of both parties will be critical if Shipt wants to reap the benefits of the **network effect**. As the number of drivers increases, then potentially, customer orders can be delivered faster. And as the number of customers increases the more opportunity there is to make more

deliveries. Shipt should work on enhancing its internal moat - making it hard for both customers and drivers to switch to alternative platforms like Instacart.

Bonus Question - What KPIs are worth tracking?

It's not worth tracking the amount of time taken per order as this metric does not have much room for optimization. The time taken per order, is proportional to the distance the Shipt driver has to travel to deliver the grocery. Any additional time taken per order is dependent on other factors like potential ingredient/grocery stockouts, which in itself can be measured using other KPI like stockout percentage. As such, tracking the time spent per order is not the most useful KPI, as it is an amalgam of other more specific KPI.

Since there are three different parties interacting with each other: drivers, consumers, and Shipt itself: Looking at one of these three following KPI individually without considering the whole picture could be misleading:

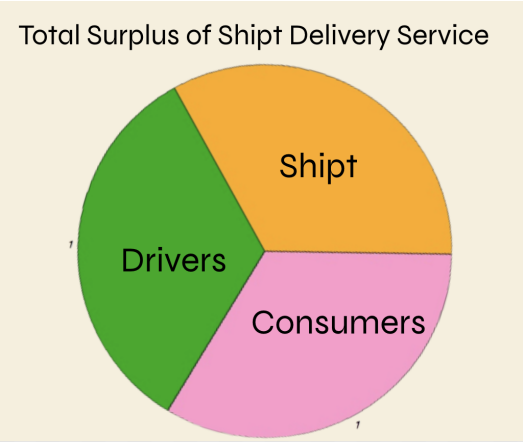
1. Pay per Hour (Drivers will optimize to achieve higher pay)
2. Profit per Order (Shipt should focus on increasing profitability of orders)
3. Value of Delivery Service per Dollar (Consumers will want to most bang for their buck, and will try to extract as much value out of the Shipt delivery platform).

As such, the total size of the economic surplus provided by Shipt service:

= Consumer surplus (usefulness of delivery service to consumer in dollars)

+ Driver surplus (wage)

+ Shipt surplus (profit)



Shipt should focus on optimizing their profits, by increasing the total surplus (enlarging the pie), and not by dividing the surplus differently (dividing the total pie differently). In doing so, both consumers and drivers will feel that the Shipt delivery platform is adding value, increasing both driver and consumer satisfaction/loyalty. Shipt should try to increase the size of the pie by becoming more operationally efficient (delivery and logistics), and by finding new ways to provide value for customers (by both simplifying and adding more features to delivery service).

Sources

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3. https://shoppers.shipt.com/building-your-business/how-to-get-started-with-shipt?from_search=103352737