



Acme Gourmet Meals Delivery Strategy

W205 Project 3

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Intro



- The **Berkeley** store brings in the most revenue (over \$25M in 2020) of all Acme stores and is located in a region ripe for optimizing a **delivery / pickup strategy**
- This analysis aims to provide a **recommendation** on:
 - Whether we should open **more locations** in the Bay Area
 - Whether we should utilize public transportation (**BART***), **robots**, **drones**, or a **hybrid** approach to create a delivery / pickup system
- Note: This analysis is enabled by use of a **NoSQL** database

**The Bay Area Rapid Transit (BART) serves the San Francisco Bay Area*

Pickup / Delivery Options

Options we will consider



Options

1. Additional locations - pickup
2. BART - pickup
3. BART - delivery
4. Drones - delivery
5. Robot - delivery
6. Hybrid

Characteristics by which they will be considered

- Solves the “**last mile**” problem
- Serves the largest possible **radius** (in miles)
- Is **cost-effective**
- Is relatively **fast**
- Is **autonomous**; not a lot of manual labor required
- Whether city **rules & regulations** enable scaled usage
- **Weight** (# of meals) that can be carried

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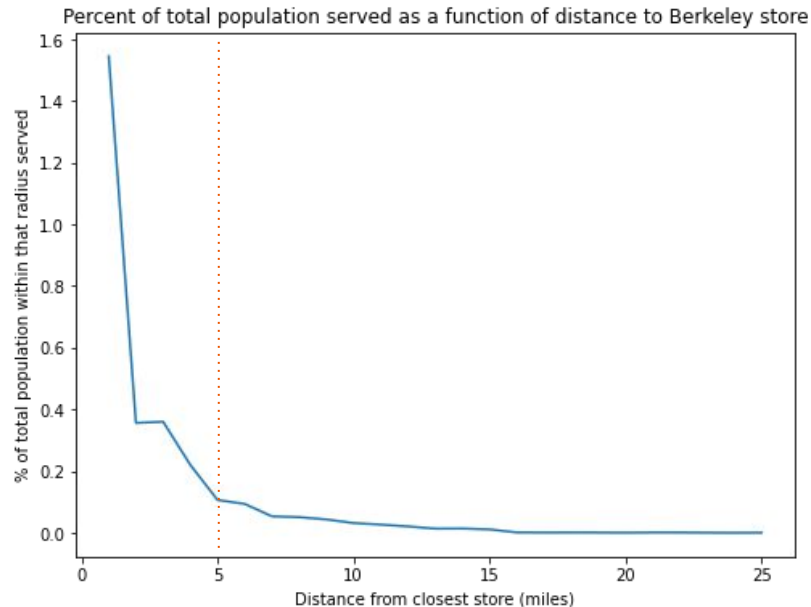
Adding Additional Pickup Locations

Key Takeaway

We should add one (1) more pickup location, located in the Mission, San Francisco

Further Details

- The percent of the total possible population that purchases Acme meals drops off sharply at about the **~5 mile radius** point
- The zip code in San Francisco with the greatest population within 5 miles is 94110, which is the **Mission District** in San Francisco
 - If we serviced the same % of the total possible population within 25 miles, we would grow our customer base by **12,225 customers**



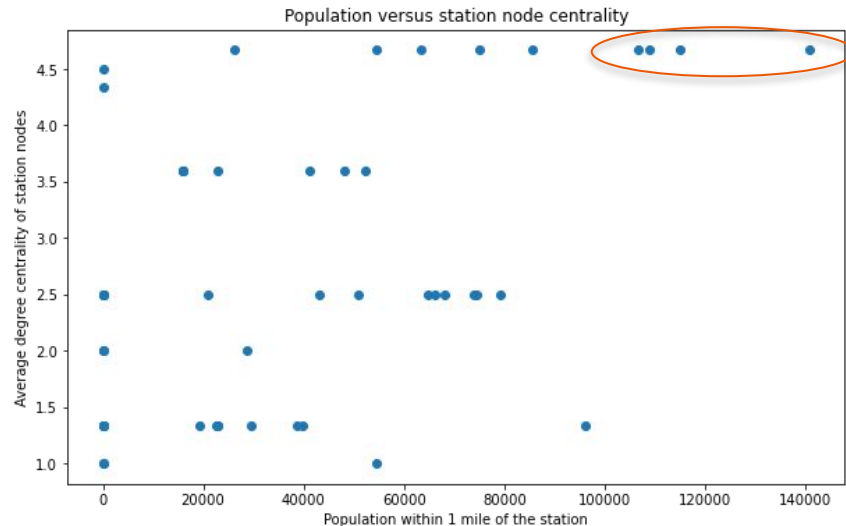
Using BART | Pickup

Key Takeaway

There are two components to using BART as pickup outpost locations: population & degree centrality. We should also use BART stations as pickup outpost locations

Further Details

- There are two important aspects of a BART station with respect to being a **pickup outpost**:
 - The population that lives within 1 mile of the station
 - The degree centrality of the station “node”
- These stations in the top right corner have high population & **degree centrality**:
 - Powell Street
 - Glen Park or 24th Street Mission or Balboa Park



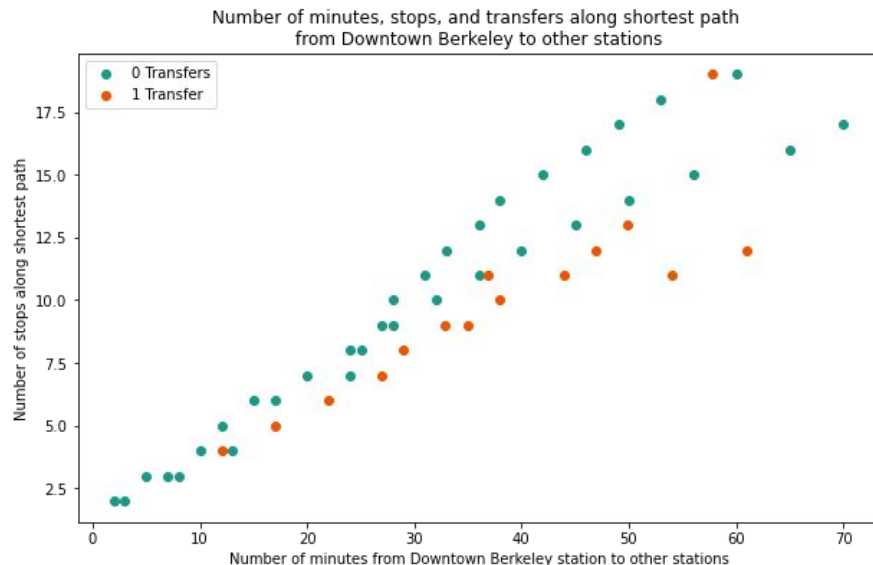
Using BART | Delivery

Key Takeaway

BART is more suitable for a pickup outpost system than a delivery system.

Further Details

- There are 50 stations including the Downtown Berkeley station closest to Acme. To get to other stations takes...
 - 2 to 70 minutes
 - 2 to 19 stops
 - 0 to 1 transfers
- Still requires a solution for **last-mile** delivery.



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Using Drones: Amazon Prime Air

Key Takeaway

Drones solve the last-mile problem, but are not useful for long-range, heavy deliveries.

Further Details

- Amazon Prime Air is an example of a company using drones for solving the last-mile delivery problem
- Their drone can deliver packages under **5 pounds** and can travel **15 miles**
- Many other companies are utilizing this technology as well



Using **Drones**: Advantages and Challenges

Key Takeaway

Drones are useful in certain use cases but have many logistical limitations.

+ PROS +

- Faster & cheaper fulfillment
- More sales & higher revenues
- Lower shipping costs
- Last-mile connectivity to remote locations
- Lower environmental impact

— CONS —

- 5 pound limit for cargo drones
- Dependent on weather conditions
- No Drone Zone restrictions
- Battery only sustains 1 delivery within 15 miles

Using Robots: Nuro

Key Takeaway

Nuro is useful for larger and longer deliveries and optimizes food and pedestrian safety.

Further Details

- Nuro is a fully autonomous, electric delivery robot that operates on **city roads**
- Can carry ~**500 lb** and can travel ~**90 miles**. Reach speed of 45 mph.
- It can carry frozen or hot food, and has external airbags and self-cleaning functionality
- Domino's, FedEx, Walmart, 7-Eleven, Kroger use Nuro



Using **Robots**: Advantages and Challenges

Key Takeaway

Large robots can transport more meals, but have cost limitations.

+ PROS +

- Zero carbon emissions
- Can transport large number of meals over long distances quickly
- Has federal safety approval to travel roads
- Keeps food fresh and has numerous safety features

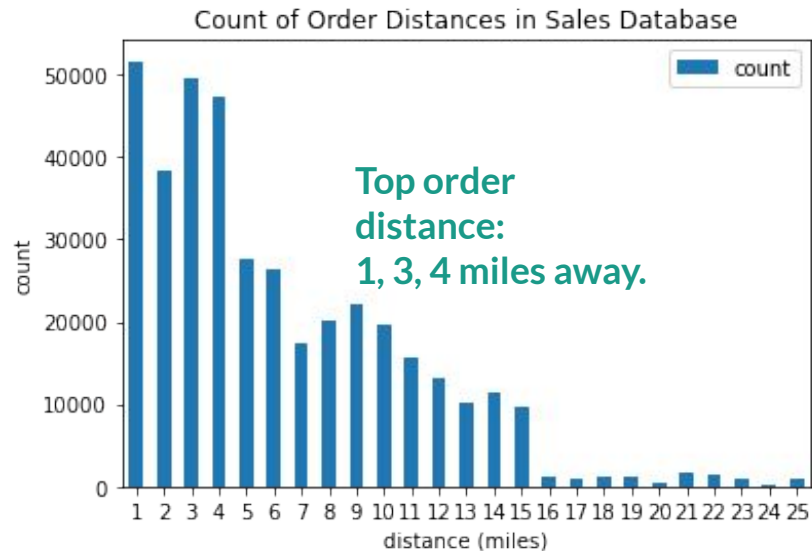
— CONS —

- Could get stuck in traffic during certain hours of day
- Expensive: charges \$5.95 per delivery

Berkeley Store Sales

Key Takeaway

Data from previous deliveries shows that most orders are 1 meal and are from customers within 5 miles from the store location



General Considerations with using Drones & Robots

Key Takeaway

More data is needed to fully evaluate drone versus robot technology for the Acme delivery use case.

Constraint considerations for both drones & robots:

- **Constraints**
 - Weight
 - Distance
 - Regulations/No Drone zone
 - Customer demand
- **Fixed Cost**
 - Overhead of purchase
- **Variable Cost**
 - Maintenance / damages
 - # vehicles per operator

Additional data needed:

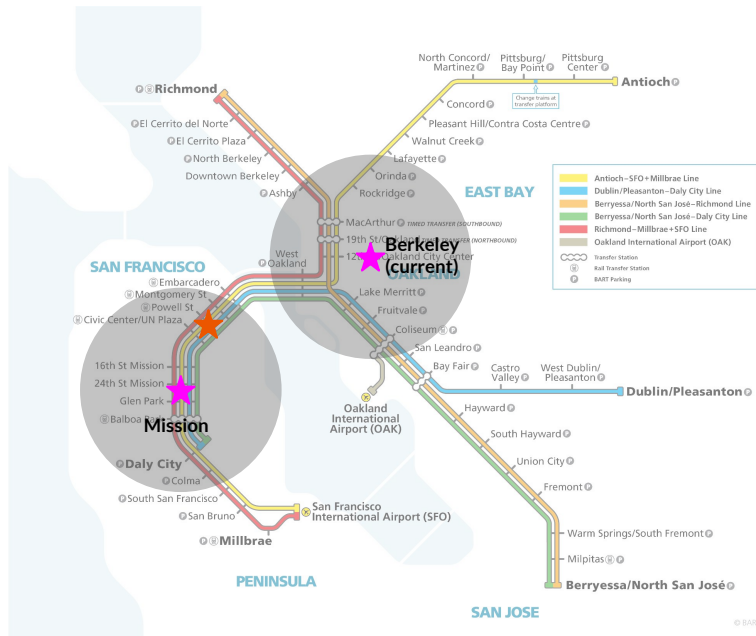
1. Technology cost and technical specifications
2. Order quantity vs different price points for delivery (price sensitivity).
3. Breakdown of variable cost factors
4. Drone/Robot accidents frequency, location, and situations

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Hybrid Approach

Key Takeaway

Using outpost stations near BART coupled with drone and/or robot technology for the “last mile”






































Brick & mortar “hub” locations from which ...

- customers can pick up their orders (current state)
- drones and/or robots can depart with direct-to-door deliveries



Pickup outpost location inside BART station

Summary of Delivery Options

	BART pickup outpost	Use BART for delivery	Drones	Robots	Hybrid
Solves “last mile” problem					
Large possible radius					
Cost-effective					
Speed					
Autonomous					
City rules & regulations					
Weight					

Our Recommendation

Key Takeaway

The hybrid approach is the best, but we recommend using a phased approach to get there.

Key Phases:

1. Start with one **pickup outpost** location @ Powell Street BART Station
2. Add on **drones** to be able to deliver for short-distance customers with small orders
3. Add another delivery hub / pickup location in the **Mission District**
 - Scale up usage of **drones**
4. Incorporate the use of **large robots** to deliver large orders over long distances directly to customers' door

NoSQL Overview

Neo4j vs SQL



Neo4j

- Stores and presents data as a graph.
- Stores relationships and directions.
- Attributes in form of key-value pairs.
- Labels for classification purposes.
- Suitable for:
 - Column-wide data
 - Path algorithms

SQL

- Stores and presents data in tabular form or json.
- Primary key and Foreign key
- Suitable for large number of records.
- Uses less storage because relationships are not stored.
- When trying to emulate path operations by recursively joining a relational database, query latency grows unpredictably and massively as does memory usage.

MongoDB uses



Brief reminder: In MongoDB, data is stored as collections of documents. These documents are stored in MongoDB in JSON (JavaScript Object Notation) format. JSON documents support embedded fields, so related data and lists of data can be stored with the document instead of an external table.

- Acme could thus have a station collection
 - Each station would have a document with various information described for all the object properties
 - Each property could also have subproperties
- All data for that station could be stored in that collection; if information about a specific station were needed, we would then have all the information about the cost (in minutes) to get to all other stations, etc.

Redis uses



Brief reminder: Redis is a NoSQL in-memory, key-value database that requires the entire database to fit into memory. Redis is much faster than MongoDB for queries by key, but also is much more expensive.

- Use Redis to implement a cache to store user sessions (log in details, credit card info and shopping cart). This can allow for easier transaction process for customer.
- Use Redis Set to analyze customer buying patterns.
- Use Redis Set and Geospatial data structures to store robot records such as robot location, charging level, progress of delivery. A software program will be making constant runs through the robot records to allow Acme to get quick, real-time status updates about robot health and external factors causing delays such as traffic and vehicle collisions.

Thank You!

References



Reference	Link
BART Monthly Ridership Report February 2021 and Trailing 12-months	Link
Advantages and Challenges of Drone Delivery	Link
US Department of Transportation Estimated Drone Delivery Cost	Link
Nuro Reveals Production-Ready Delivery Robot	Link
In a new world, Nuro's delivery pods gain new virtue	Link
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18 Delivery Drones Pros and Cons	Link
Why Amazon, UPS and even Domino's is investing in drone delivery services	Link
Amazon wins FAA approval for Prime Air drone delivery fleet	Link