Travel Times By Mode of Transit:
Bike-Sharing vs MBTA "T"

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Introduction

Background
- Access to transit affects how people interact with their cities
- Bikesharing as substitute vs complement for other forms of public transit? (Kong et al 2020)
- Interested in whether bikeshare is a time-efficient choice in the Cambridge context

Research Questions
- RQ1: In Cambridge, MA in summer 2023, for what percent of start/stop Blue Bikes station pairs was bikeshare faster (slower) than the T (within Cambridge)? How much faster (slower) was bikeshare?
  - H1: Bikeshare was faster
- RQ2: What was the relationship between initial walking time to a T station and the difference in total travel times across modes?
  - H2: As initial walking distance to a T station increases, bikeshare was relatively faster
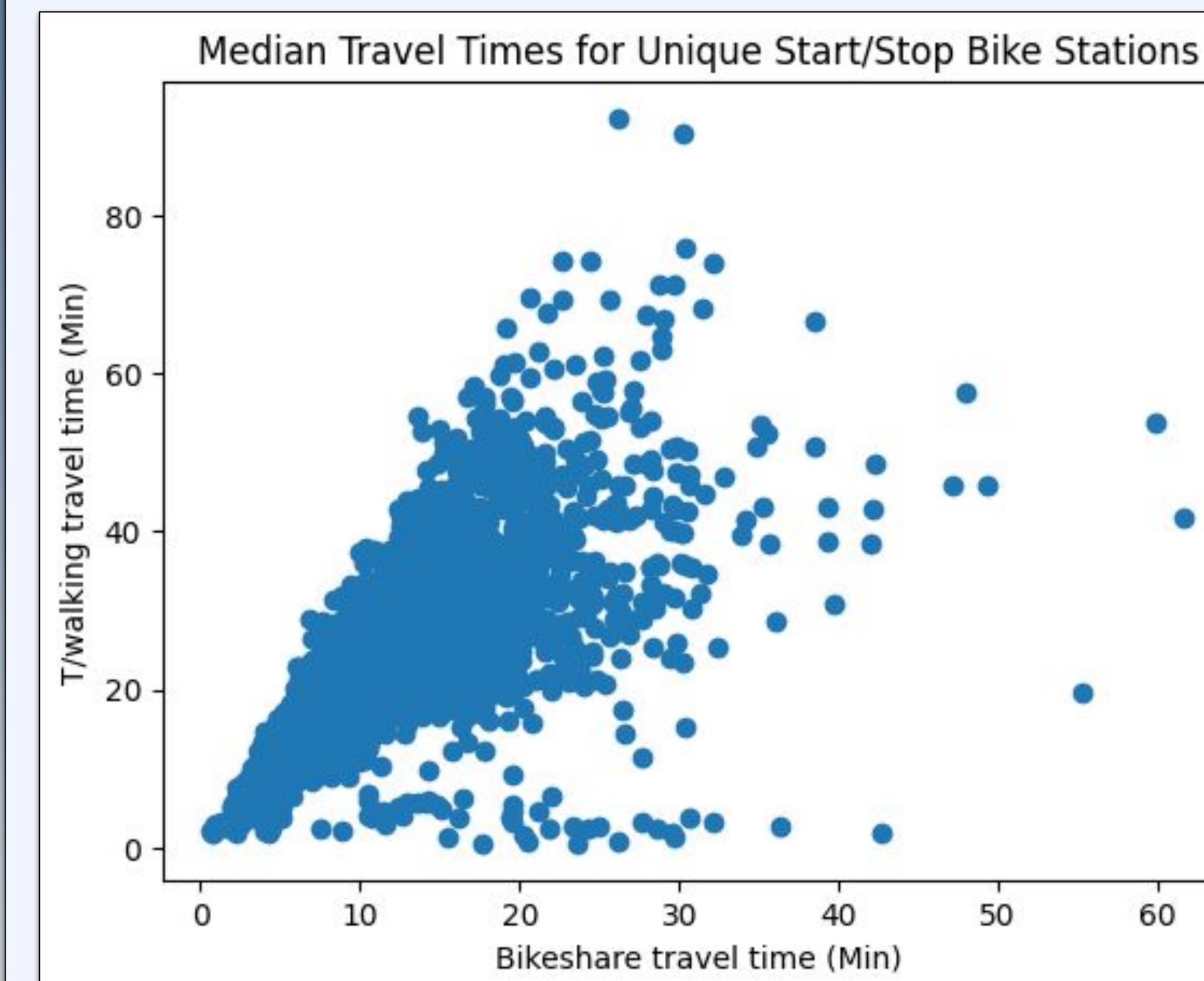
Visualizations

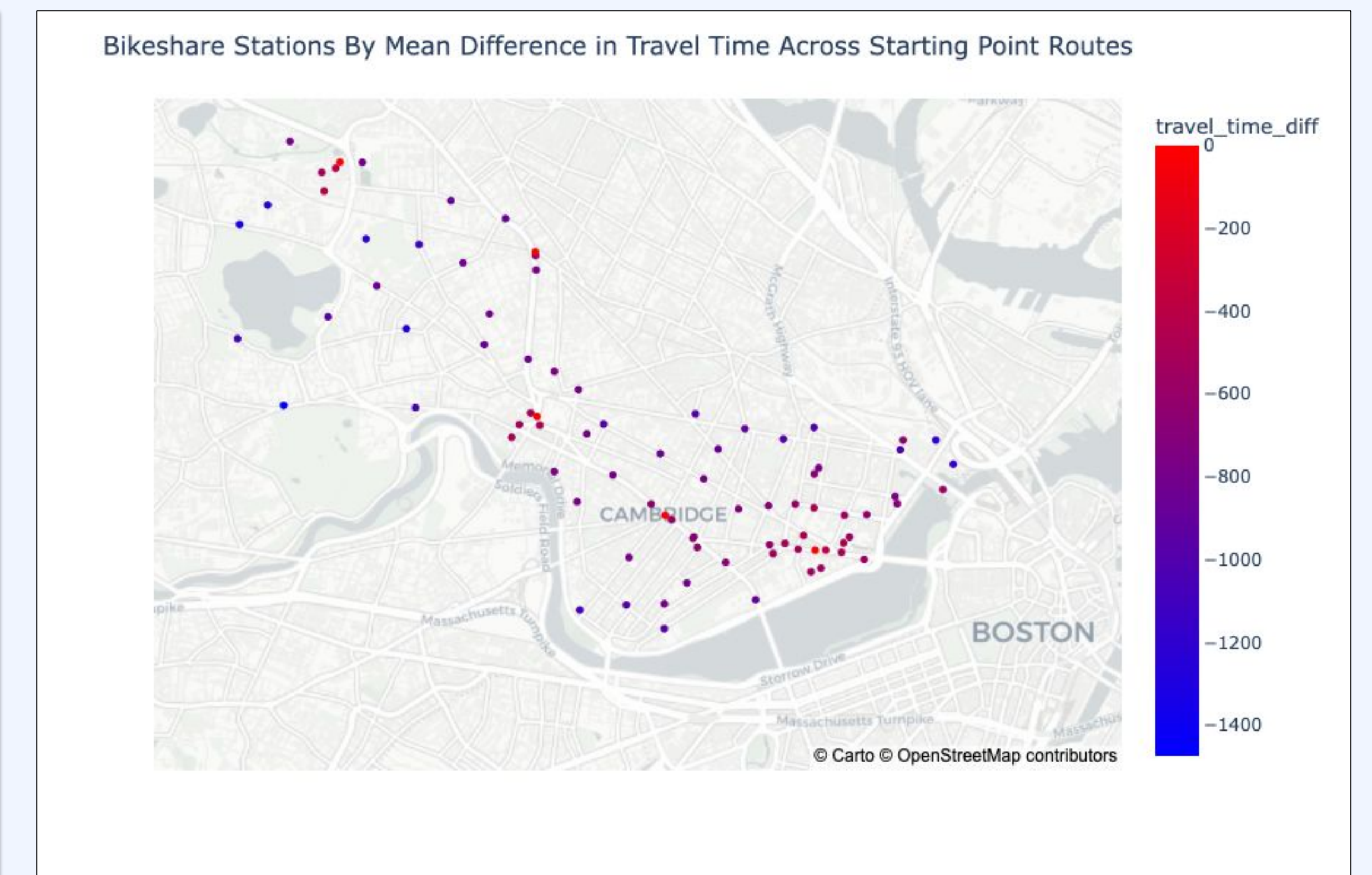Figure 2. Median Travel Times for Unique Start/Stop Bike Stations.

Figure 3. Map of Bikeshare Stations By Mean Difference in Travel Time Across Starting Point Routes. Includes T stations themselves.

Data & Methods

Primary data sources
- All Blue Bike trips (summer 2023)
  - Attributes: Start/end stations (ID, name, coordinates), start/end times
- MBTA "T" trips
  - Attributes: Start/end stations (ID), service date, start/end times, travel times

Secondary data sources
- Blue Bike stations
  - Use: Identify Blue Bike stations in Cambridge
- T stations
  - Use: Match T trips station IDs to T trips station names
- T trips January 2024
  - Use: Match T trips station names to T station start/stop coordinates

Data manipulation
- For each bikeshare trip, calculated the length of the corresponding "T" trip and walking trip → took minimum
  - Used T data from the exact day and time when the bike ride took place
    - T trip time includes time waiting for the next T
  - Used Google Maps API to get all walk times
    - Assumed walk time from bike station to T station and vice versa are the same
- For each start/end bikeshare station pair (with > 10 rides), calculated difference in median trip times for bikeshare vs T/walking
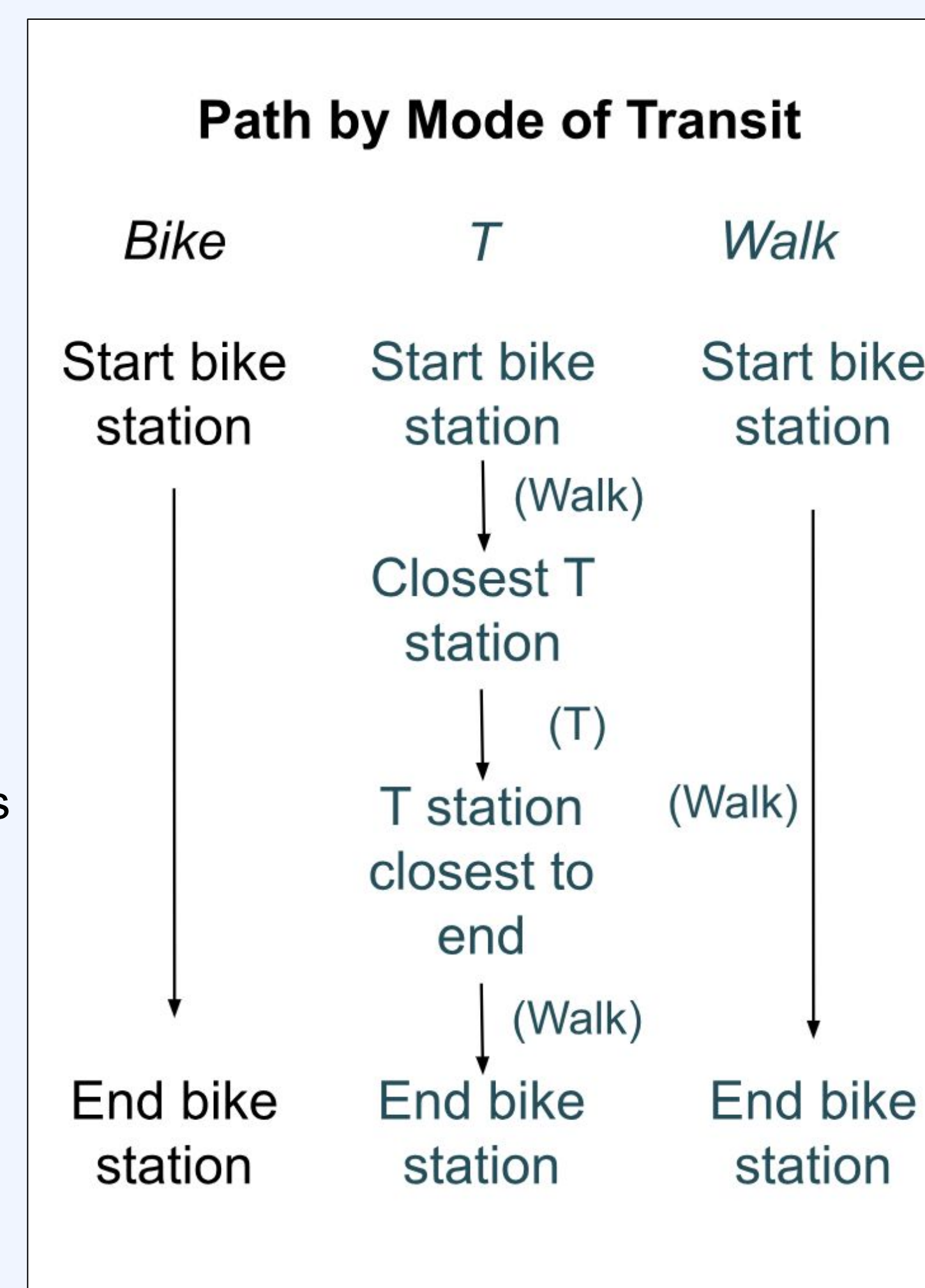
Path by Mode of Transit

Bike	T	Walk
Start bike station	Start bike station	Start bike station
	(Walk)	
	Closest T station	
	(T)	
	T station closest to end	(Walk)
	(Walk)	
End bike station	End bike station	End bike station

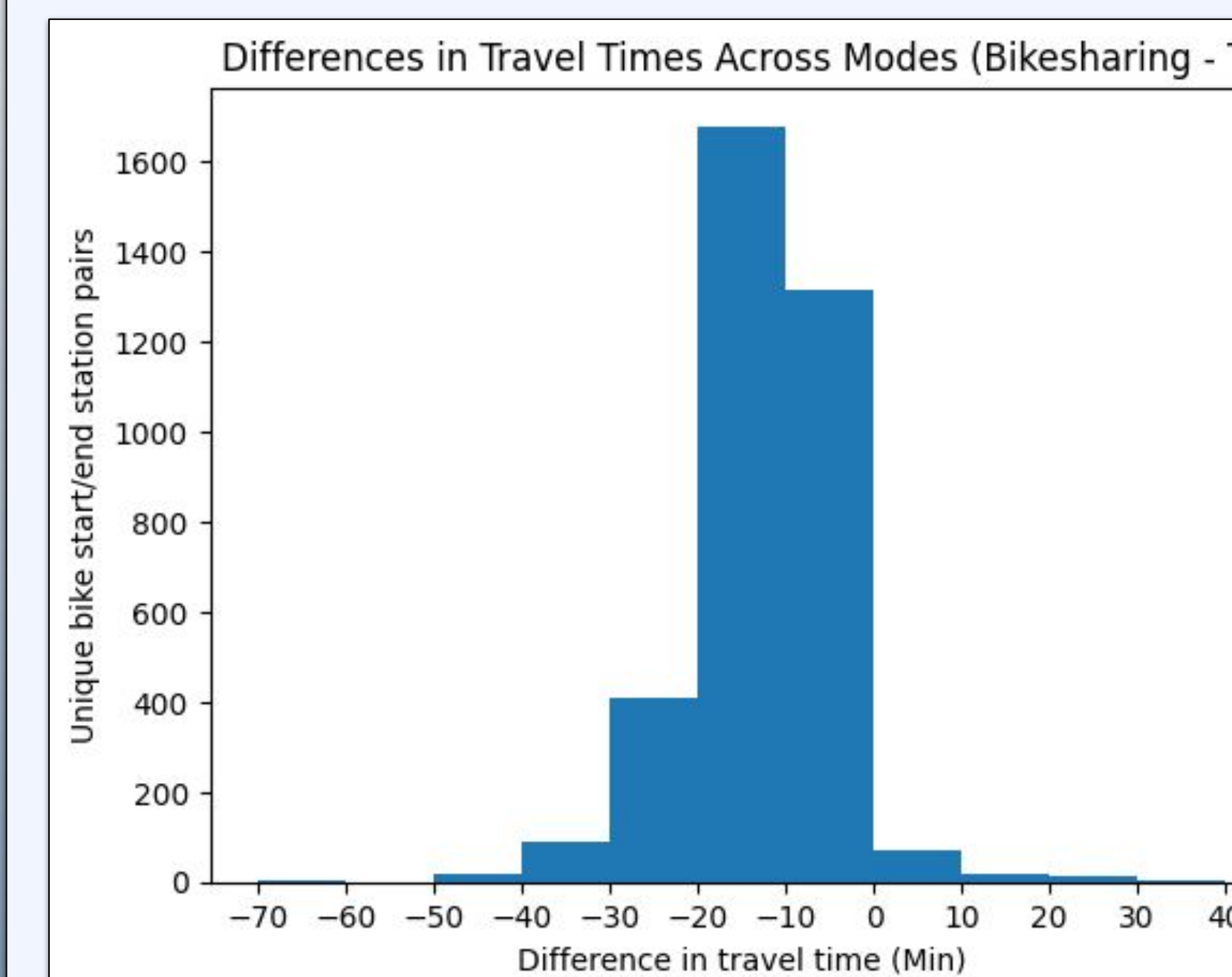Figure 1. Path by Mode of Transit.

Results

Figure 4. Differences in Travel Times Across Modes (Bikesharing-T).

- **Bikeshare is faster for 97.098%** of start/end stop combinations
- On average, **bikeshare is 12.506 minutes faster**
- Travel time differences
  - Min: -66.12
  - 25th: -16.85
  - Median: -12.00
  - 75th: -7.43
  - Max: 40.88

Model

$DiffInTravelTimes = -8.24 - 0.38*(FirstWalkTime)$

- Coefficient and intercept are significant
- Assumption issues: Independence

Figure 5. Differences in Travel Times By Walking Time from Start to Closest T. Allows linearity assumption.

Discussion & Conclusion

- → Provides evidence that bikesharing can be a time-efficient mode of transit
- Limitation: Here, people are 1) starting at bikeshare stations and 2) do not have to wait for bikes, but they do have to wait for the T
- Limitation: Did not allow people to get on or off at Davis Square, which is in Somerville
- Limitation: Did not consider spatial relations
- Future work: Add in bus routes
- Future work: Allow T stations outside of Cambridge

Sources. Kong, Hui, Scarlett T. Jin, and Daniel Z. Sui. "Deciphering the Relationship between Bikesharing and Public Transit: Modal Substitution, Integration, and Complementation." *Transportation Research Part D: Transport and Environment* 85 (August 1, 2020): 102392. https://doi.org/10.1016/j.trd.2020.102392.