Will you be late? Maybe.

Andrew Aguilar, Samantha Batham, Felice Dacpano, Morgan Hogue, Teresa Martin, Jonathan Moss, Jasmin Rodriguez, and Juan Valencia

Advisors: Dr. Jessica De Silva and Dr. Curtis Pro

Departments of Mathematics, Computer Science, Chemistry, and Physics

Abstract

If you signed up for two MWF classes back-to-back, you have approximately ten minutes to travel from one course location to the next. This time constraint induces student traffic across campus and can result in consistent tardiness. We collected data to approximate the typical walking speed of a Stan State student and used this to produce the average time it will take to walk between pairs of buildings on campus. Our data suggests that you may be late for your next class if you are a slow walker or if walking paths are congested. The goal of this project is to incorporate our data into the Stan State mobile application so students can use it as a reference as they plan their course schedules.

Data Collection and Results

Method of Data Collection for Average Walking Speed

- To standardize data, we designated paths to start and stop between the main entrances of each of the buildings.
- Our research team and Stan State student volunteers recorded travel times between buildings.
- Path distances were measured with a Garmin Watch and Google Earth. Distances were similar enough so that most distances were measured with Google Earth.

Average and Standard Deviation Computation

- We collected 450 travel times which span 66 different paths between buildings on campus.
- To calculate the average walking speed, we grouped data based on the pair of buildings defining the path.

$$\frac{1}{450}\sum_{j=1}^{66} d_j \sum_{i=1}^{n_j} \frac{1}{x_{i,j}} \approx 88.75 \text{ m/min}$$

- The standard deviation is computed using the formula below and measures the spread of the data.

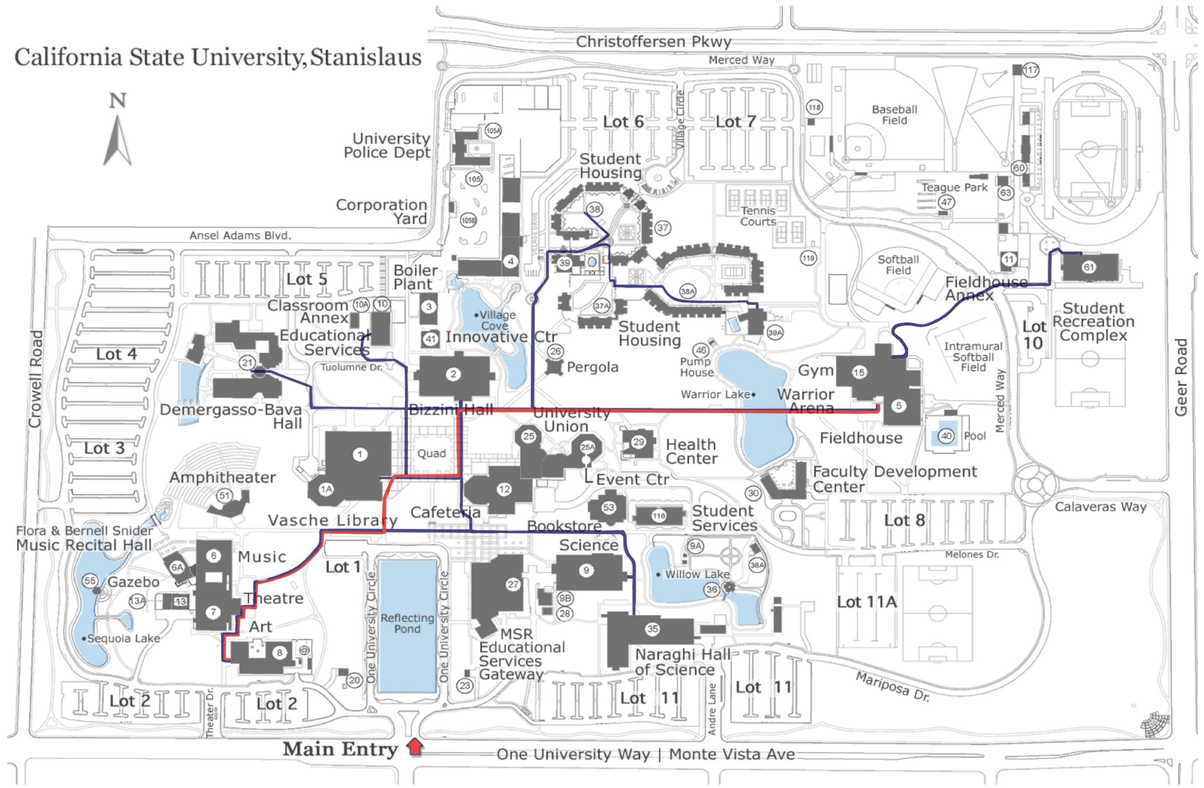
$$\sqrt{\frac{1}{449}\sum_{i=1}^{450}(s_1-\mu)^2} \approx 19.03 \text{ m/min}$$

Conclusion

By the Empirical Rule from Statistics, approximately 95% of Stan State students have an average walking speed in the following interval given in meters per minute:

$$[50.70, 126.81]$$

Campus Walking Paths



	Science 1	Naraghi	Bizzini	DBH	Library	Art	Music/Theater	Fitzpatrick	Gym	Residence Halls	Village Cafe	Classroom Annex
Science 1		01:07	03:16	05:52	03:27	06:10	05:04	04:37	08:21	05:23	05:04	05:53
Naraghi			04:10	06:43	04:25	06:31	05:59	05:22	09:05	05:50	05:34	06:45
Bizzini				02:46	01:58	04:55	04:43	04:54	08:41	03:27	05:18	01:27
DBH					02:21	06:32	05:37	07:37	11:15	06:09	07:41	01:50
Library						02:53	03:05	05:59	10:30	04:18	05:51	01:59
Art							01:16	10:42	14:40	07:56	10:29	05:28
Music/Theater								09:44	13:57	08:06	09:31	05:53
Fitzpatrick									03:07	07:20	02:23	06:51
Gym										08:06	06:01	06:51
Residence Halls											05:49	02:46
Village Cafe												07:03
Classroom Annex												

Future Work

- Record open spaces in campus parking lots to predict their availability throughout the day.
- Analyze travel time across campus via other modes of transportation, e.g., bikes and scooters.
- Compare travel time via paved paths versus natural walking paths students take to get to class.
- Assess wheelchair accessibility on campus by applying our techniques to travel via wheelchair between handicap accessible entrances of buildings.
- Incorporate other entrances of buildings into our data, including elevator and stair times to get to upper levels.

Mobile Application Outline

- To make these results available for students, we plan to display it on the Stan State website and/or mobile app.
- Using the *MIT App Inventor*, we plan to create a mobile app which will:
  - Pinpoint the location of the user.
  - Prompt the user to select the destination building on campus.
  - Give an estimated travel time.
  - Display an optimal route, including the nearest available parking lot.
- Ideally, we would add this app as a feature of the Stan State Mobile App.

References

Elementary Statistics, Third Edition, W. Navidi and B. Monk (2019).

California State University, Stanislaus Map of Campus, csustan.edu/campus-maps.

California State University, Stanislaus Mobile App, csustan.edu/mobile.

MIT App Inventor, appinventor.mit.edu.

Acknowledgments

This work was supported in part by the CSU Louis Stokes Alliance for Minority Participation program. CSU-LSAMP is funded by the National Science Foundation under grant number HRD-1826490.