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Data Files: Bi-Objective Optimization for Battery Electric Bus Deployment Considering Cost and Environmental Equity

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GENERAL INFORMATION-----

1. Title

The Metadata for Bi-objective Optimization for Battery Electric Bus Deployment Considering Cost and Environmental Equity

2. Creator Information

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CONTEXTUAL INFORMATION-----

1. Abstract for the dataset

The dataset contains 9 separate categories of data, all of which are used to generate, analyze or visualize the results of the project. The dataset

is collected through multiple sources and organized into different formats including CSV format, JSON format, shapefile and code repository.

2. Context of the research project that this dataset was collected for. The research project develops a bi-objective model that aims to help transit agencies to optimally deploy BEB while considering both capital investment and environmental equity. The unique spatio-temporal characteristic of BEB system, charging limitations (on-route and in-depot charging), and operational constraints are also considered and incorporated into the model.

3. Date of data collection:
The data was collected during 2019-08-01 to 2020-04-30.

4. Last modification date
Date dataset was last modified on 2021-01-10.

5. Funding sources that supported the collection of the data:
This project was funded by the National Institute for Transportation and Communities (NITC; grant number 1222) a U.S. DOT University Transportation Center.

SHARING/ACCESS INFORMATION-----1.

Publications related to the dataset:
A. Y. Zhou, X. C. Liu, R. Wei and A. Golub, "Bi-Objective Optimization for Battery Electric Bus Deployment Considering Cost and Environmental Equity," in IEEE Transactions on Intelligent Transportation Systems, doi: 10.1109/TITS.2020.3043687.
B. Ran Wei, Xiaoyue Liu, Yi Ou, S. Kiavash Fayyaz, "Optimizing the spatio-temporal deployment of battery electric bus system," in Journal of Transport Geography, doi:10.1016/j.jtrangeo.2018.03.013.

DATA & FILE OVERVIEW-----

File List 1. Filename: BusRoutes_UTA Containing subfiles: YES
Source: Utah Transit Authority (UTA)
Summary: The folder contains the shapefile of bus routes of UTA in year 2016. Shapefile format consists of files with common filename prefix, stored in the same directory.
Software used for processing the data: ArcMap
Subfiles: A. BusRoutes_UTA.cpg
Description: Specifying the code page (only for .dbf) for identifying the character encoding to be used.

B. BusRoutes_UTA.dbf
Description: Attribute format; columnar attributes for each shape, in dBase IV format.

C. BusRoutes_UTA.prj
Description: Projection description, using a well-known text representation of coordinate reference systems.

D. BusRoutes_UTA.sbn
Description: A spatial index of the features.

E. BusRoutes_UTA.sbx
Description: A spatial index of the features.

F. BusRoutes_UTA.shp
Description: Shape format; the feature geometry itself.

G. BusRoutes_UTA.shp.xml
Description: Geospatial metadata in XML format, such as ISO 19115 or other XML schema

H. BusRoutes_UTA.shx
Description: Shape index format; a positional index of the feature geometry to allow seeking forwards and backwards quickly.

2. Filename: BusStops_UTA Containing subfiles: YES
Source: Utah Transit Authority (UTA)
Summary: The folder contains the shapefile of bus stops of UTA in year 2016. Shapefile format consists of files with common filename prefix, stored in the same directory.
Software used for processing the data: ArcMap
Subfiles:

A. BusStops_UTA.cpg
Description: Specifying the code page (only for .dbf) for identifying the character encoding to be used.

B. BusStops_UTA.dbf
Description: Attribute format; columnar attributes for each shape, in dBase IV format.

C. BusStops_UTA.prj
Description: Projection description, using a well-known text representation of coordinate reference systems.

D. BusStops_UTA.sbn
Description: A spatial index of the features.

E. BusStops_UTA.sbx
Description: A spatial index of the features.

F. BusStops_UTA.shp
Description: Shape format; the feature geometry itself.

G. BusStops_UTA.shp.xml
Description: Geospatial metadata in XML format, such as ISO 19115 or other XML schema

- H. BusStops_UTA.shx
Description: Shape index format; a positional index of the feature geometry to allow seeking forwards and backwards quickly.
3. Filename: UTA Runcut File Aug2016.xlsx
Containing subfiles: NO
Source: Utah Transit Authority (UTA)
Summary: The file contains network information of UTA buses in year 2016.
Software or Language used for processing the data: Python
4. Filename: TAZ
Containing subfiles: YES
Source: WFRC
Summary: The folder contains the shapefile of Traffic Analysis Zone in the Salt Lake Metropolitan area.
Software or Language used for processing the data: ArcMap
Subfiles:
- A. TAZ.cpg
Description: Specifying the code page (only for .dbf) for identifying the character encoding to be used.
- B. TAZ.dbf
Description: Attribute format; columnar attributes for each shape, in dBase IV format.
- C. TAZ.prj
Description: Projection description, using a well-known text representation of coordinate reference systems.
- D. TAZ.sbn
Description: A spatial index of the features.
- E. TAZ.sbx
Description: A spatial index of the features.
- F. TAZ.shp
Description: Shape format; the feature geometry itself.
- G. TAZ.xml
Description: Geospatial metadata in XML format, such as ISO 19115 or other XML schema
- H. TAZ.shx
Description: Shape index format; a positional index of the feature geometry to allow seeking forwards and backwards quickly.
5. Filename: Marginal_Income.xlsx
Containing subfiles: NO
Source: WFRC
Summary: The file contains the size of four income group at TAZ level.
Software or Language used for processing the data: Python 2.x

6. Filename: SE_File_v83_SE19_Net19.xlsx
Containing subfiles: NO
Source: WFRC
Summary: The file contains the household size, household population, and employment level at TAZ level.
Software or Language used for processing the data: Python 2.x

7. Filename: Pollutant Concentration.xlsx
Containing subfiles: NO
Source: <https://www2.purpleair.com/>
Summary: The file contains readings of pollutant concentration extracted from PurpleAir Sensors from Oct 1st to Oct 14th, 2019.
Software or Language used for processing the data: Python 2.x

8. Filename: Code for Optimization
Containing subfiles: YES
Source: Yirong Zhou
Summary: The folder is the repository of code used for implementing the optimization framework.
Software or Language used for processing the data: Python 2.x
Subfiles:
 - A. ele_bus.py
Description: This file contains the major class defined in order to store necessary information.
 - B. ele_glpk_solve.py
Description: This file stores the function to call GLPK solver.
 - C. ele_gui.py
Description: This file creates a Graphical User Interface for interaction, dynamic input, and multi-threads.
 - D. fileHandler.py
Description: This file reads in and parses all sources of data.

9. Filename: Code for Visualization
Containing subfiles: YES
Source: Yirong Zhou
Summary: The file contains readings of pollutant concentration extracted from PurpleAir Sensors from Oct 1st to Oct 14th, 2019.
Software or Language used for processing the data: Python 2.x
Subfiles:
 - A. vis.html
Description: The main HTML file.
 - B. chart.js
Description: The javascript file that defines dropdown box and processes data.
 - C. firstView.js
Description: The javascript file that generates the first view of the visualization.
 - D. secondView.js
Description: The javascript file that generates the second view of the visualization.
 - E. thirdView.js

Description: The javascript file that generates the third view of the visualization.

F. styles.css

Description: The CSS file that styles all the elements.

G. screencast.mp4

Description: A screen cast that demonstrates how to use the visualization.

H. data

Description; A folder contains the necessary data of deployment plans, bus stops, bus routes, and information of TAZ.

TABULAR DATA-SPECIFIC INFORMATION FOR: 1-B. BusRoutes_UTA.dbf-----

1. Number of variables:

5

2. Number of cases/rows:

114

3. Variable List

A. Name: LineAbbr

Description: Abbreviations for bus lines.

Nominal

B. Name: LineName

Description: Names of bus lines.

Nominal

C. Name: Service

Description: Category of service of bus lines.

Nominal, including local, express, BRT, fast bus, shuttle, ski, flex.

D. Name: Frequency

Description: Frequency of bus lines.

Ratio

E. Name: Shape_Leng

Description: Length of the bus routes.

Ratio, unit: foot

TABULAR DATA-SPECIFIC INFORMATION FOR: 2-B. BusStops_UTA.dbf-----

1. Number of variables:

4

2. Number of cases/rows:
5987

3. Variable List

- A. Name: StopId
Description: Unique identifier for bus stops.
Nominal

- B. Name: StopName
Description: The complete names of bus stops.
Nominal

- C. Name: StreetNum
Description: The number of the streets the stops are on.
Nominal

- D. Name: OnStreet
Description: The name of the streets the stops are on.
Nominal

TABULAR DATA-SPECIFIC INFORMATION FOR: 3. UTA Runcut File Aug2016.xlsx-----

1. Number of variables:
9

2. Number of cases/rows:
6878

3. Variable List

- A. Name: LineAbbr
Description: Abbreviations for bus lines.
Nominal

- B. Name: ServiceName
Description: Weekday or Weekend service.
Nominal, including WEEKDAY, SATURDAY, and SUNDAY.

- C. Name: DirectionName
Description: The name of the destination stop.
Nominal

- D. Name: block_num
Description: The unique identifier for different buses.
Nominal

- E. Name: trip_id
Description: The unique identifier for different trips.

Nominal

F. Name: from_stop

Description: The name of the origin stop.

Nominal

G. Name: FromTime

Description: The time when buses begin the trip.

Interval

H. Name: to_stop

Description: The name of the destination stop.

Nominal

I. Name: ToTime

Description: The time when buses end the trip.

Interval

TABULAR DATA-SPECIFIC INFORMATION FOR: 4-B. TAZ.dbf-----

1. Number of variables:

2

2. Number of cases/rows:

2881

3. Variable List

A. Name: CO_TAZID

Description: Unique identifier for TAZs.

Nominal

B. Name: AREA

Description: The area of the TAZ.

Ratio, Unit: square foot

TABULAR DATA-SPECIFIC INFORMATION FOR: 5. Marginal_Income.xlsx-----

1. Number of variables:

6

2. Number of cases/rows:

2881

3. Variable List

- A. Name: CO_TAZID
Description: Unique identifier for TAZs.
Nominal

- B. Name: INC1
Description: The number of households in income group 1 (\$0 - \$34,999).
Ratio

- C. Name: INC2
Description: The number of households in income group 2 (\$35,000 - \$49,000).
Ratio

- D. Name: INC3
Description: The number of households in income group 3 (\$50,000 - \$99,999).
Ratio

- E. Name: INC4
Description: The number of households in income group 4 (over \$100,000).
Ratio

- F. Name: TOTHH
Description: The number of total households.
Ratio

TABULAR DATA-SPECIFIC INFORMATION FOR: 6. SE_File_v83_SE19_Net19.xlsx-----

1. Number of variables:
5

2. Number of cases/rows:
2881

3. Variable List

- A. Name: CO_TAZID
Description: Unique identifier for TAZs.
Nominal

- B. Name: TOTHH
Description: The number of total households.
Ratio

- C. Name: HHPOP
Description: The total household population.
Ratio

D. Name: HHSIZE
Description: The average household size.
Ratio

E. Name: TOTEMP
Description: The number of total employment.
Ratio

TABULAR DATA-SPECIFIC INFORMATION FOR: 7. Pollutant Concentration.xlsx-----

1. Number of variables:
3

2. Number of cases/rows:
438

3. Variable List

A. Name: lat
Description: Lattitude of the PurpleAir Sensor.
Interval

B. Name: lon
Description: Longitude of the PurpleAir Sensor.
Interval

C. Name: PM2.5_ATM_ug/m3
Description: The concentration of PM 2.5.
ratio, unit: ug/m3