2019 UDOT RESEARCH PROBLEM STATEMENT

*** **Problem statement deadline is Feb. 6, 2019. Submit statements to UTRAC@utah.gov.** ***

Title: Quantifying potential impacts of free UTA fares on regional air quality **No. (Office Use):** 19.07.03

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Select ONE Subject Area ☐ Materials/Pavements ☐ Maintenance ☐ Traffic Mgmt/Safety ☐ Structures/Geotech ☐ Planning ☐ Perf Mgmt/Data Analytics ☒ Public Transportation ☐ Other

1. Describe the problem to be addressed:

Poor air quality along the Wasatch Front during wintertime inversions continues to grow as a public health concern and a focus of policy concern for UDOT and UTA. Because vehicle transportation is the source of approximately half of the region's pollutant emissions, one possible action would be to promote mode substitution from cars to transit in the run-up to an inversion event with the effect of slowing the accumulation of pollutants in the airshed.

State lawmakers considered a bill this year that would appropriate funds for fare-free periods leading into predicted inversion events. The appropriation of such funding would set up conditions for a large scale experiment, where the impact of free transit fares on transit and vehicle trip taking, in the week preceding a forecasted inversion event, could be observed directly. Unfortunately, the bill is considered unlikely to be passed into law and by the time of this presentation it is probable that such a system-scale direct experiment will not be a possibility for UTA, during the coming year at least.

Instead of looking *forward* towards an opportunity for collecting data from what amounts to a large-scale controlled experiment of the impacts on transit ridership of free fares (during bad AQ events), we propose instead to pivot UTA's analytic gaze to the *past*, and examine the inverse impacts on *automobile* ridership in times when UTA's typical services operated on atypically restricted schedules, which effectively *increases* the costs of transit mobility.

UTA's holiday service schedule contains the kernel of a natural experiment. For the region's most widely-celebrated holidays (e.g. Christmas, Thanksgiving, New Year), transit service is reduced significantly at the same time that transit trip-taking demand declines significantly, when most employers and schools and many retailers observe these holidays by shutting for the day. However, on President's Day (formally, under US law Washington's Birthday), which by Federal statute always falls on a Monday in February, there is a mismatch between typical commuting demands and UTA's scheduled service. On Monday 18 February 2019, UTA ran bus, TRAX, and FrontRunner services following Saturday, Sunday, and Saturday schedules, respectively. While this day is a Federal Holiday and as such observed as a work holiday by Federal employers and a school holiday by the University of Utah and many school districts, a national survey for the Society for Human Resource Management has estimated that only between a fifth and a third of private employers offer this day as a paid holiday. Martin Luther King Day is another winter-season Federal Holiday falling each year on a Monday, and is offered as a paid holiday by a similar fraction of private employers. However, this holiday saw regular weekday UTA transit service in 2019. This mismatch between service schedule and otherwise likely commuting demand for transit trips affords UTA the opportunity to examine the substitution of automobile for transit trip taking for these natural experiment days (NEDs), and to compare the respective traffic volumes with other widely observed paid holidays, with non-holiday Mondays, and with actual weekends.

We propose to analyze APC and ATR data for "treatment" days (President's Day) and control days (Martin Luther King Day, non-holiday Mondays in January and February, the major winter holidays of Thanksgiving, Christmas, and New Year), and actual weekends to look for statistically significant signals of mode substitution attributable to the natural experiment. We will examine this for all years for which UTA and UDOT data are available and for which UTA service schedules create the natural experiment conditions, and will estimate the volume of trip substitution between these modes, disaggregating results temporally by hour of day, and spatially by 0.002 deg (~200m) grid cells. Using findings from the research literature on cross-elasticity of demand, we will estimate the inverse *increase* to transit ridership that might be induced by mode-switching from automobiles given the hypothetical "treatment" of free fares during inversion events.

Then, leveraging previous research investments from UTA, we will apply our previously developed methods for estimating net impacts of these mode-shifted trips to total on-road pollutant emissions, extending that previous work to include estimates of cold-start vehicle emissions which contribute a disproportionate fraction of emissions. Using the data processing and analysis infrastructure from that research, we will produce estimates of net impacts, both globally (for the UTA system) and also disaggregated by time and space.

2. Write the project objective (25 words or less):

Estimate quantified potential for a hypothetical UTA free fare policy in days running up to inversion events to offset vehicle emissions.

3. Explain why this research is important:
(In response, consider addressing specific UDOT goals, applicability in Utah or other states, etc.)

There is continuing interest at UTA, UDOT, and the State Legislature in policies that could reduce vehicle emissions. Quantitative findings on likely impacts from the free-fare subsidization policy embodied in legislative language under debate would inform and assist policy decision-making in this area, including possible legislative appropriations underwriting such a policy.

4. List the major tasks:

1. Analyze geocoded automated passenger count (APC) data from UTA and automated traffic recorder (ATR) data from UDOT to look for statistically significant signals of mode substitution attributable to the natural experiment, and characterize volume, timing, and spatial footprint of substituted trips.
2. Estimate the inverse *increase* to transit ridership that might be induced by mode-switching from automobiles given the hypothetical "treatment" of free fares during inversion events, and model avoided vehicle emissions (CO2, PM2.5, NOx, CO) associated with these hypothetical mode-shifted transit trips.
3. Produce report documenting research findings for UTA and other audiences.

5. List the expected deliverables (reports, manual, specification, design method, training, etc.):

1. Two meetings with UTA staff to discuss interim progress and findings (one each for observed mode substitution analysis and hypothetical mode shift modeling).
2. A final report with findings of the analysis.

6. Describe how the research results will be implemented:
(In response, consider addressing UDOT leader support, process or standard improvement, etc.)

We anticipate that the report detailing findings of this research would inform UTA's internal deliberations and engagement with UDOT, the Utah State Legislature, and other policy makers (e.g. county and municipal governments, UT DAQ, metropolitan planning organizations, etc.) on the question of subsidized fare reductions leading up to winter inversion events.

7. Requested from UDOT: $30,000.00 **Other/Matching Funds:** $ **Total Cost:** $
(or UTA for Public Transportation)

8. Outline the proposed schedule, including start and major event dates:

Jul 2019: Collect data from UTA and UDOT sources (geocoded APC and service schedules, and ATR data, respectively).
Aug – September 2019: Conduct mode substitution signal analysis using APC and ATR data.
Oct 2019: Meet with pertinent UTA staff to report on and discuss findings from mode substitution analysis
Nov – Dec 2019: Estimate inverse mode shifts under hypothetical free fare policy, and model associated net emissions impacts (UTA vehicle emissions minus avoided vehicle emissions)
Jan 2020: Meet with pertinent UTA staff to report on and discuss findings from inverse mode shifts and net emissions impacts modeling.
Jan – Feb 2020: Draft the final report
28 Feb 2020: Deliver final version of report to UTA.