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1 Introduction

1.1 Transit right now

- Ridership is increasing, but small
- Strong financial support from
- Trends in modal split
 - Auto is above 80%
 - Transit 2-3%
 - Biking and walking are the same as transit

1.2 Funding

- In North America, it's divided into capital and operating expenses
- Fares only pay ~1/3 of operational expenses
- Lots of federal support for capital expenses - almost 40%
 - Since operating expenses are funded less, this encourages more building and less maintenance
- Fuel taxes in NA are 10-20% of what they are in Europe

1.3 Traditional Arguments Supporting Transit

- Equity: travel for those who can't drive
- Congestion
 - Not such a good argument, papers don't support it. The capacity released it quickly filled again
- Better for the environment
 - Actually, effort it better spent making cars cleaner since they're like 80% of transport

1.4 Critical assessment

- Transport has been stabilized
- Success stories (NYC, Houston(?), Seattle)
- Institutional changes are occurring slowly

1.5 Future influences

- Urban form
- More old people
- Better tech to improve performance
- Public has higher expectation (you know exactly when the bus is coming)

1.6 Ingredients for future success

- Maintain supportive coalition
- Expand the definition of public transport
- Greater private sector involvement
- Aggressive implementation of new technology

2 Data Collection Techniques and Program Design

2.1 Summary of current practice

- Used to be manual
- Now is collected with IoT devices
- **Automated Data Collection Systems (ADCS)**
 - **Automated Fare Collection Systems (AFC)**
 - * Tapping your card on/off the vehicle
 - **Automatic Vehicle Location Systems (AVL)**
 - * GPS tracking for buses, train tracking based on circuit occupancy
 - **Automatic Passenger Counting Systems (APC)**
 - * Sensors in bus doors
 - Use break beam sensors to tell if you're getting on or off (out of 2 beams which do you break first)
 - * Counts from fare barriers
 - * Load weight calculators on trains
 - In trains the brakes apply force proportional to the load in each car (lighter cars need less braking, heavier cars need more, so they don't run into each other)

2.2 Passenger counting techniques

- Manual - checker (a person)
 - Ride check (on the bus, on/off counts and running time)
 - Point check (load on board, headway - time between buses)

2.3 Sampling

- **Simple random sampling**
- **Systematic sampling** - every 6 days, etc
- **Cluster sampling** - do as much data collection as possible
- **Ratio estimation/Conversion factors**
- **Stratified sampling** - sample sizes for each thing separately
 - E.g. you want information about students: get a large sample size on routes that serve universities

2.4 Tolerance and confidence level

- Accuracy has 2 dimensions
 - Relative tolerance: $\pm 10\%$
 - Absolute tolerance: ± 3.3