Project 2: The Plight of the Late Flight

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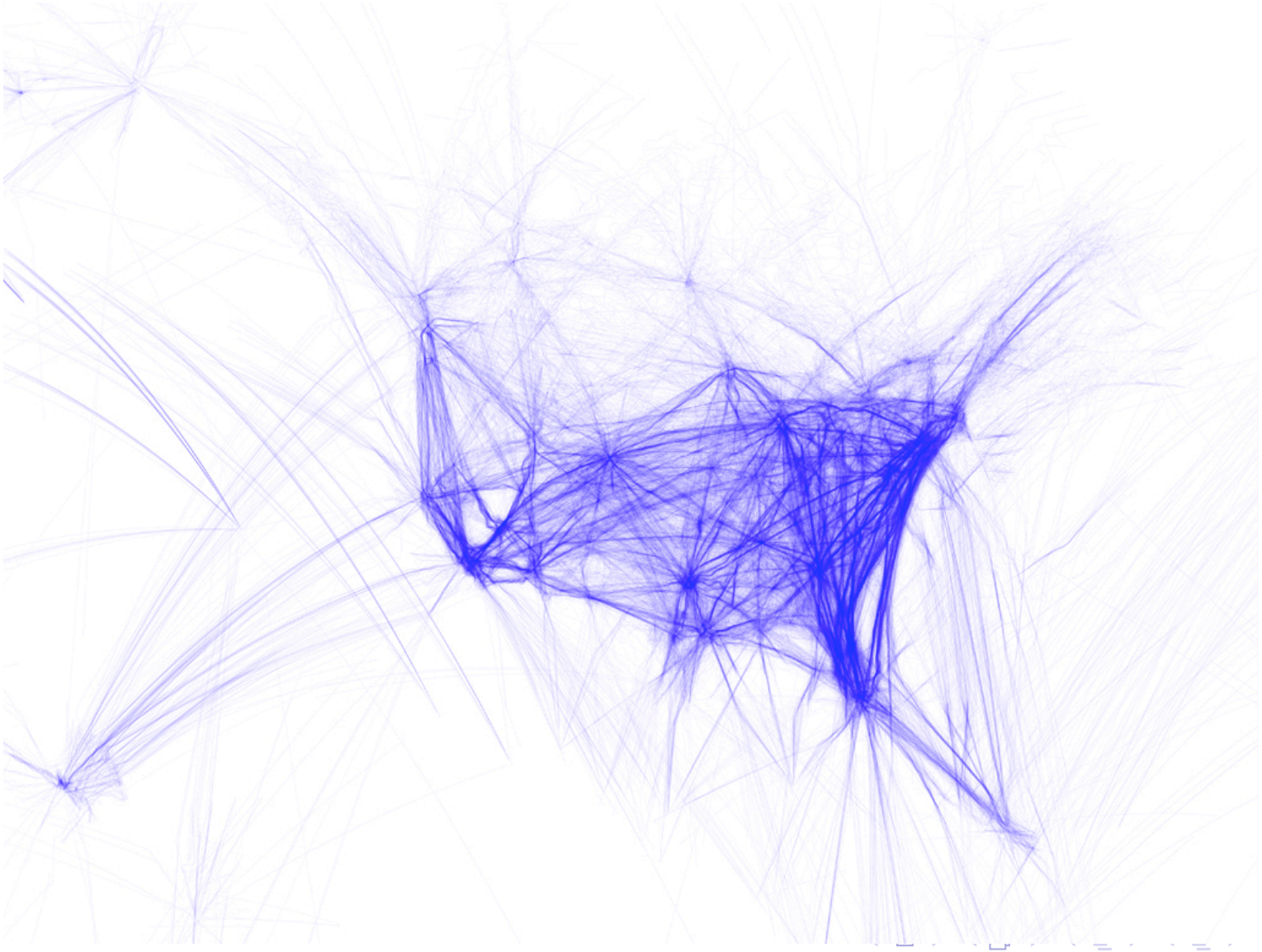


Contents

Overview

- Data: Bureau of Transportation Statistics (BTS)
- Last 25 years
- 30 Unique carriers
- 376 Unique origins

Question of Interest

Are there any airlines that have shown consistent improvement in delays, across the entire country, over the 25 years of flight data?

How do we define "improvement" in delay?

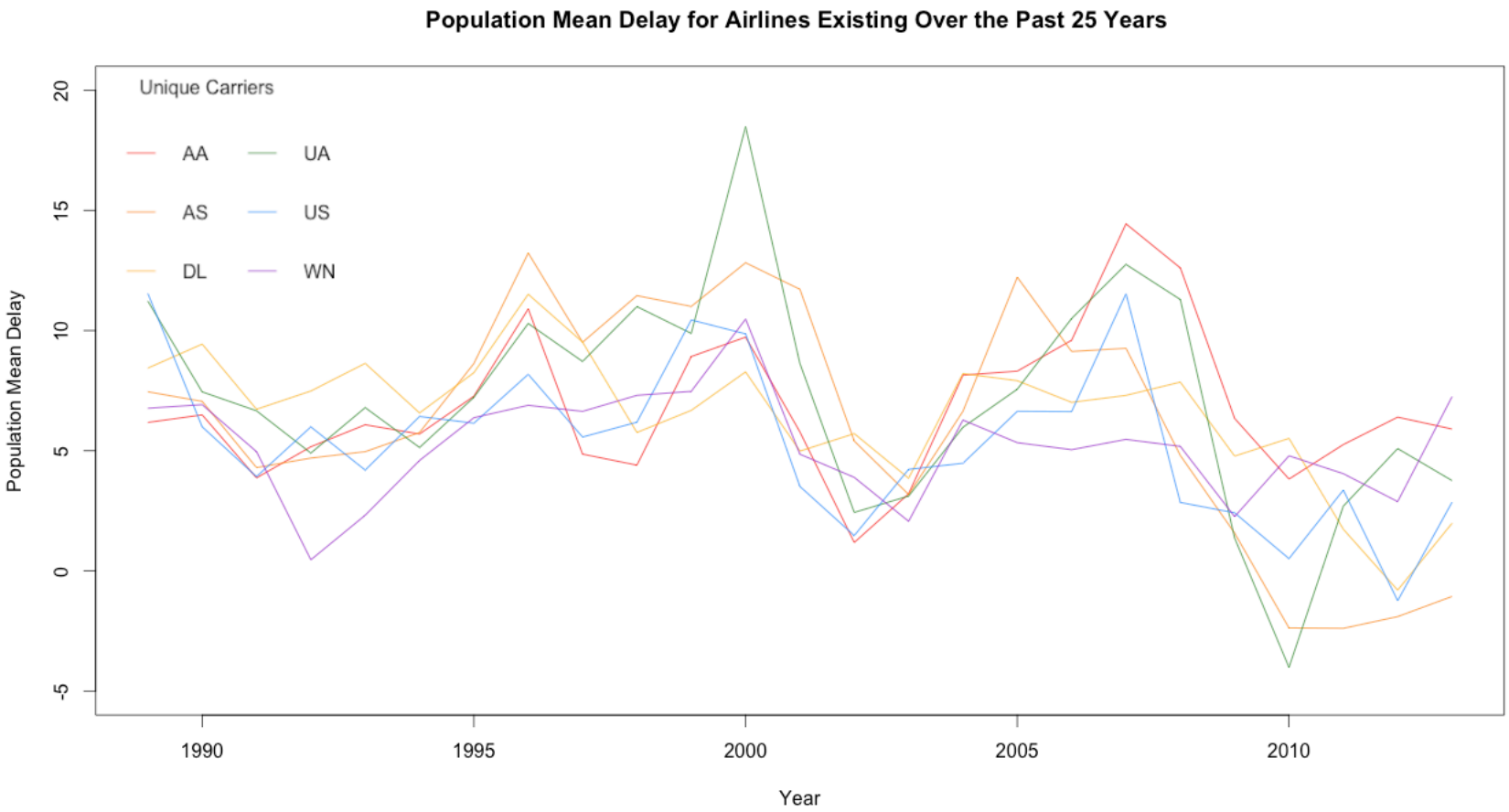
- Improvement is defined as negative change in delay time, where delay can be measured using the following metrics:
  - Arrival delay
    - What customers care about

    OR
  - Carrier + Late Aircraft delays
    - What carriers are able to control
- Overall improvement metric = Median change in mean delay

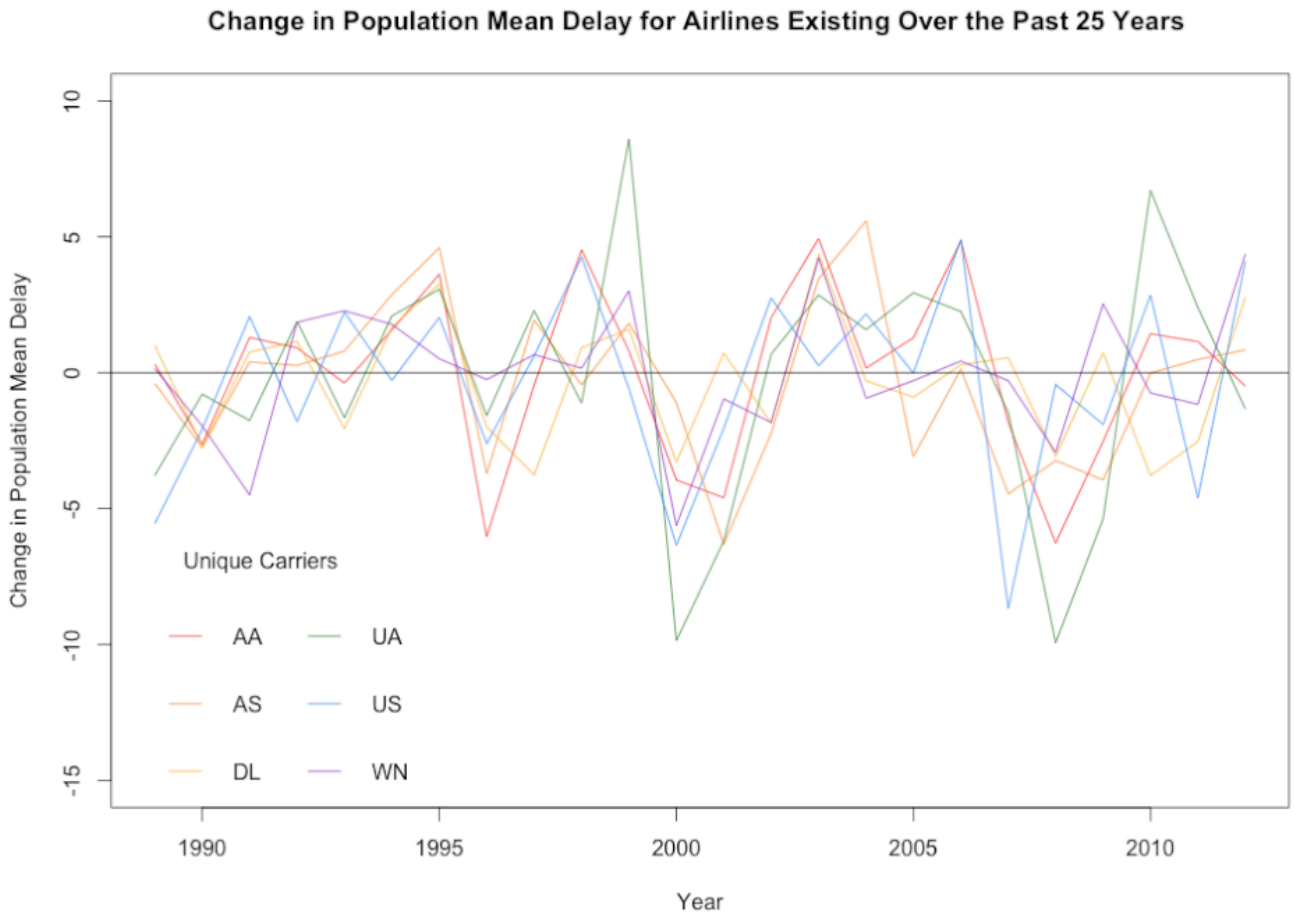
Narrowing Scope

- Ran all airlines and years
- Only kept airlines with 10+ years of service
  - 10+ is enough to discern a pattern
- Aggregating to create yearly averages
  - Average over seasonal effects to compare year to year

Population-Based Findings



Population-Based Findings



Carrier	Median Change in Delay	IQR
FL	-0.563	(-1.98,3.57)
NW	-0.316	(-2.21,1.56)
TW	-0.208	(-2.46,2.13)
HP	-0.207	(-3.35,2.78)
US	-0.147	(-2.05,2.18)
HA	-0.143	(-0.50,0.55)
CO	-0.128	(-1.54,1.68)
MQ	-0.073	(-3.10,3.23)
UA	-0.054	(-1.68,2.31)
WN	-0.052	(-1.01,1.79)
AS	0.059	(-2.84,1.08)
DL	0.421	(-2.18,1.04)
AA	0.561	(-2.01,1.47)
OO	0.640	(-1.13,1.93)
B6	0.986	(-1.13,3.03)
EV	2.636	(-1.41,4.38)

Patterns

- Late 90's overall increase
- Spike at 2000: possible 9/11
- Decrease at 2003-2004
- Steadily increased until 2007
  - Rising jet fuel prices
  - Great Recession

Sample-based Findings

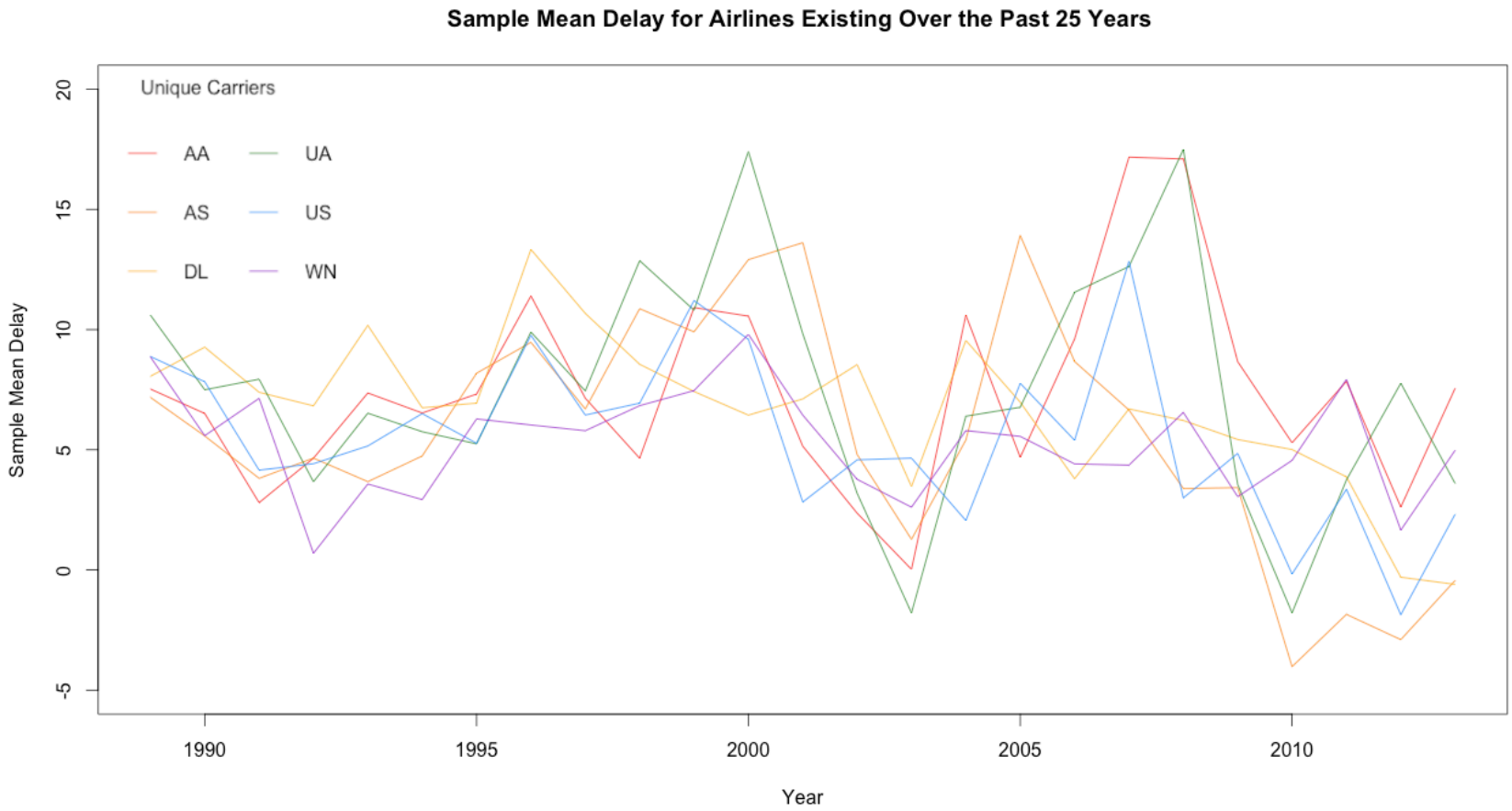
1. Stratify by unique carrier
2. Stratify by year (1989-2013)
3. Stratify by origin airport size
   (as determined by flight traffic volume)
   - Proportional sample from strata based on number of flights

Sample Frame

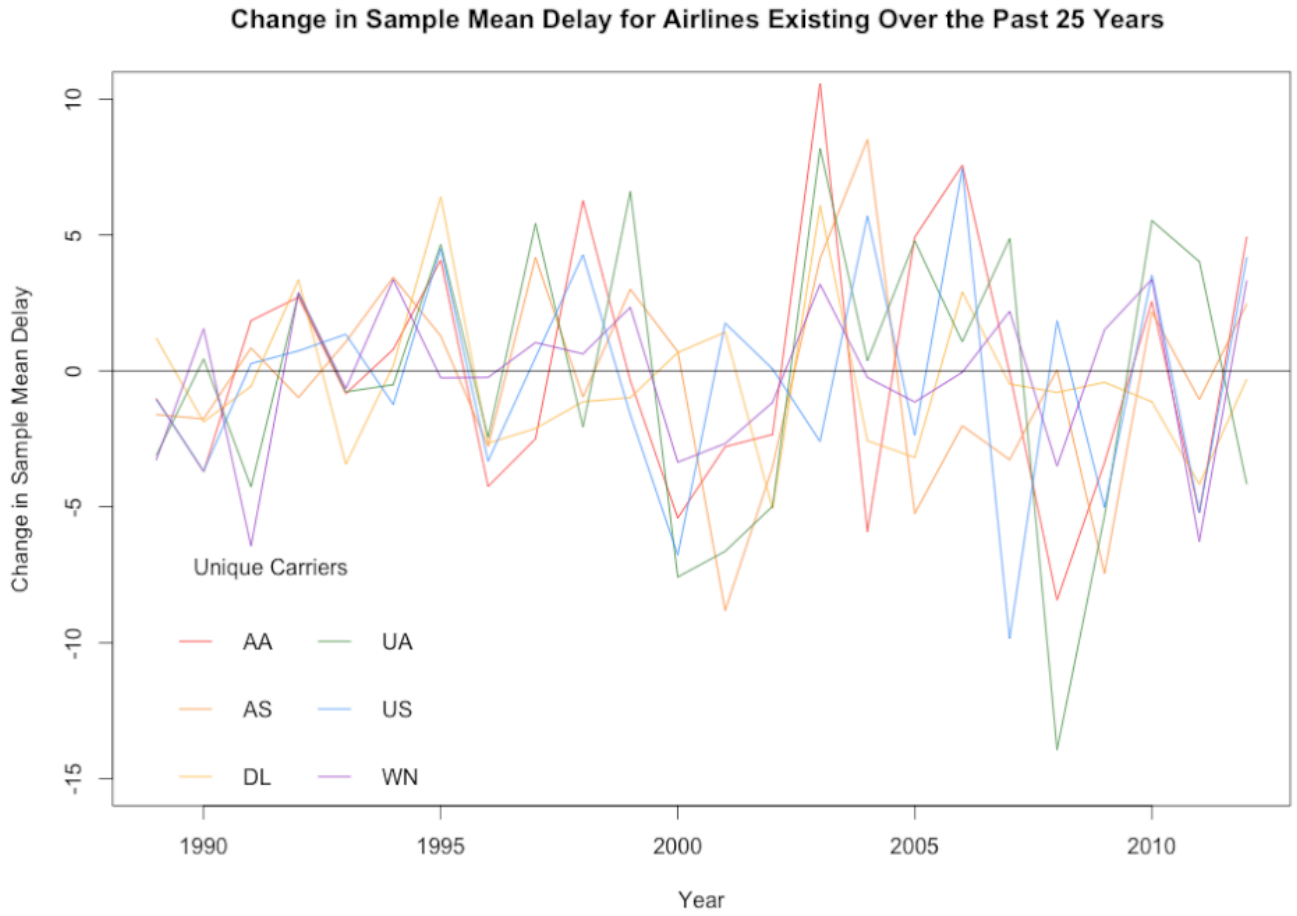
Assumption: Due to coordination of air traffic control efforts, flights originating from airports of similar traffic volume would have similarities in delay patterns

- Found traffic volume for each origin over 25 years
- Found average traffic volume
- Ordered and stratified based on size
  - Create subsets of carriers
  - Used $\%in\%$ when filtering

Sample Findings

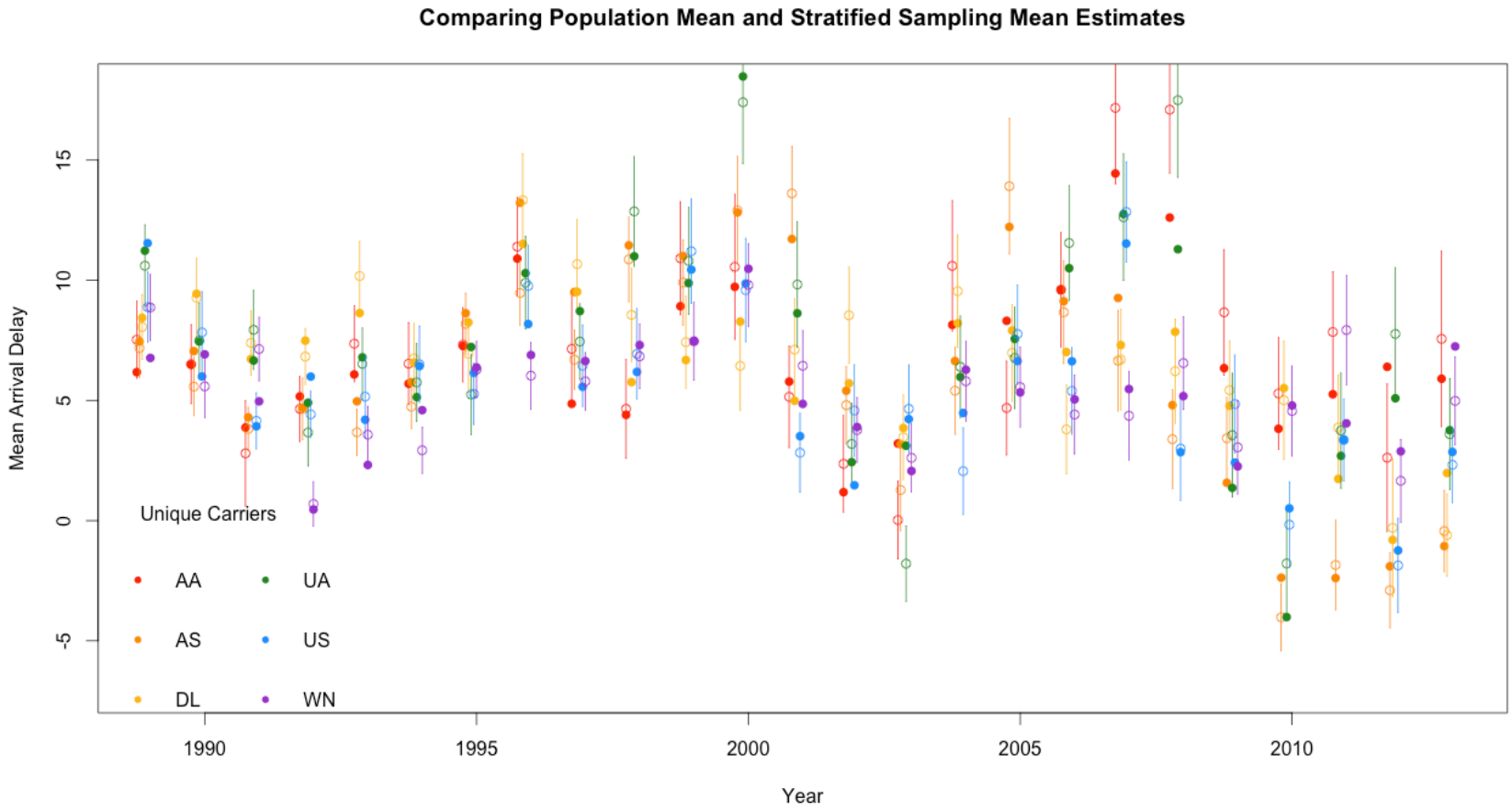


Sample Findings

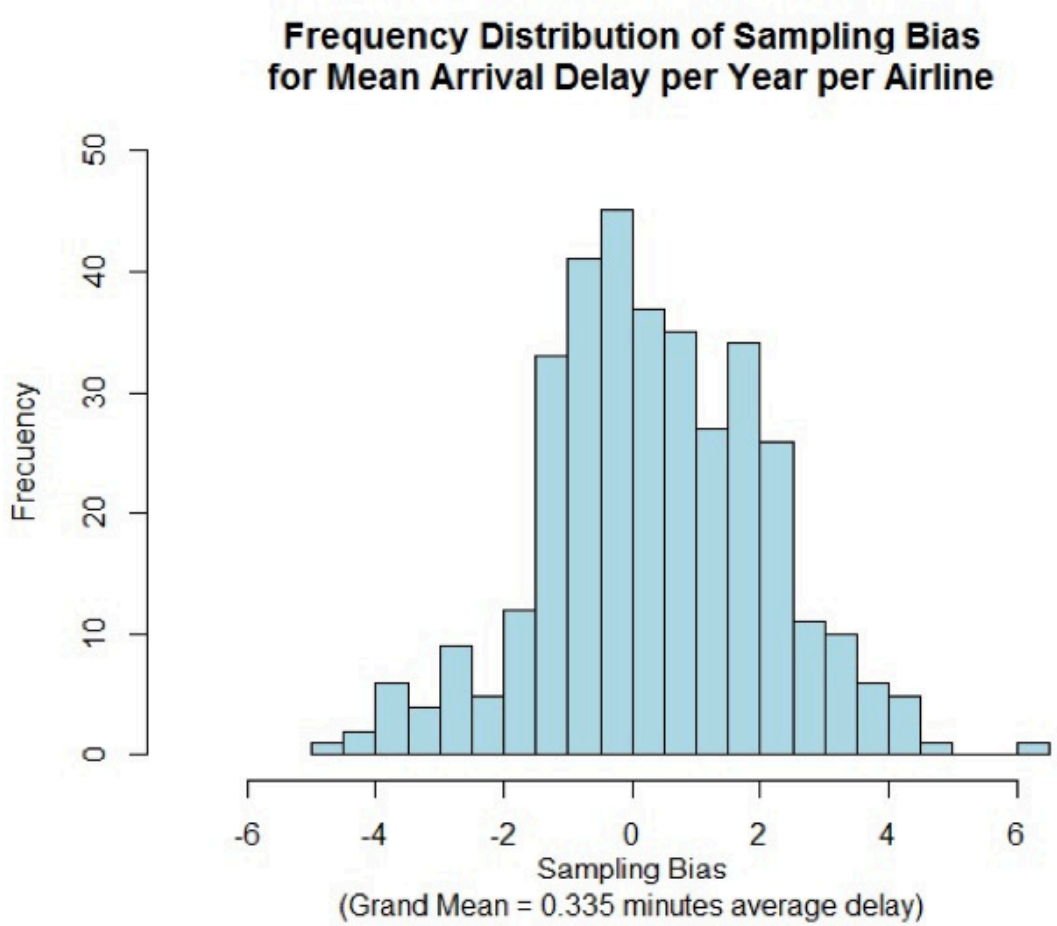


Carrier	Median Change in Delay	IQR
MQ	-1.688	(-3.85, 8.35)
TW	-1.212	(-2.86,1.23)
CO	-1.155	(-2.31,2.28)
FL	-1.073	(-3.79,5.45)
DL	-0.679	(-2.23,0.81)
AA	-0.595	(-3.46,3.06)
AS	-0.463	(-2.21,2.25)
NW	-0.218	(-2.33,2.94)
B6	-0.178	(-4.39,8.11)
WN	-0.145	(-1.54,2.23)
UA	-0.066	(-4.19,4.68)
US	0.171	(-2.78,2.27)
HP	0.702	(-3.90,3.66)
HA	0.864	(-0.47,1.11)
OO	1.478	(-2.76,2.66)
EV	2.878	(-4.35,6.33)

Sampling Performance: 76% Coverage



Bias


Frequency Distribution of Sampling Bias
for Mean Arrival Delay per Year per Airline
Frecuency
0
10
20
30
40
50
-6
-4
-2
0
2
4
6
Sampling Bias
(Grand Mean = 0.335 minutes average delay)

The "Simple" Answer

- No, no one airline carrier is *consistently* improving.
- Nor did one airline carrier show *consistent* improvement above all others.

Cognitive Time vs Computational Time

- Population Summary: 6m 25s
- Sample Summary: 5.5 hrs
  - Sampling and collecting is slow
  - Originally had stratified by airport origins
  - Took 2.5 hours to sample from American Airlines in 1989

Data Visualization

- Combating "spaghetti" plots
- Ploting changes in mean delays
  - Think of this as the derivative

Future Work

- Understanding reasons for delay:
  - Comparing sources of delay that carriers can't control with sources of delay that carriers do control
- How one flight arriving late affect its subsequent stops?
- More specific strata, with access to higher computational resources / computation time

Questions

Google? Which airline is sexy?