Issues in the Analysis of Novice Teenage Driving

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Co- Investigators
NICHD: Marie Claude Ouimet; Jing Wang
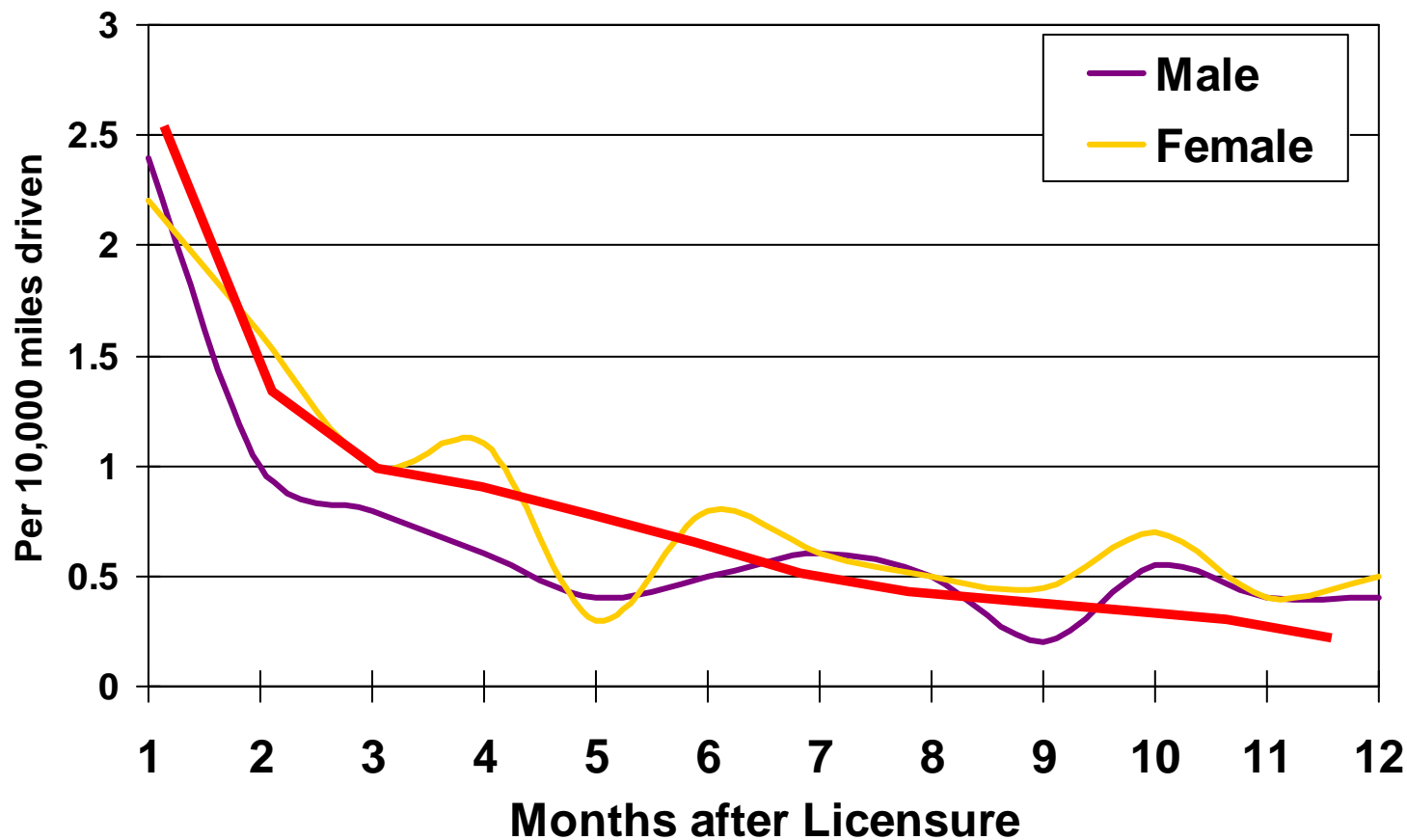VTTI: Tom Dingus; Charlie Klauer; Suzie Lee
Sponsors
NICHD
NHTSA

Issues in the Analysis of The Novice Teenage Driving

Overview

1) Study background, purpose, methods
2) Preliminary analyses
3) Apply Latent Growth Modeling & Growth Mixture Modeling to small sample, uneven exposure problem

Background
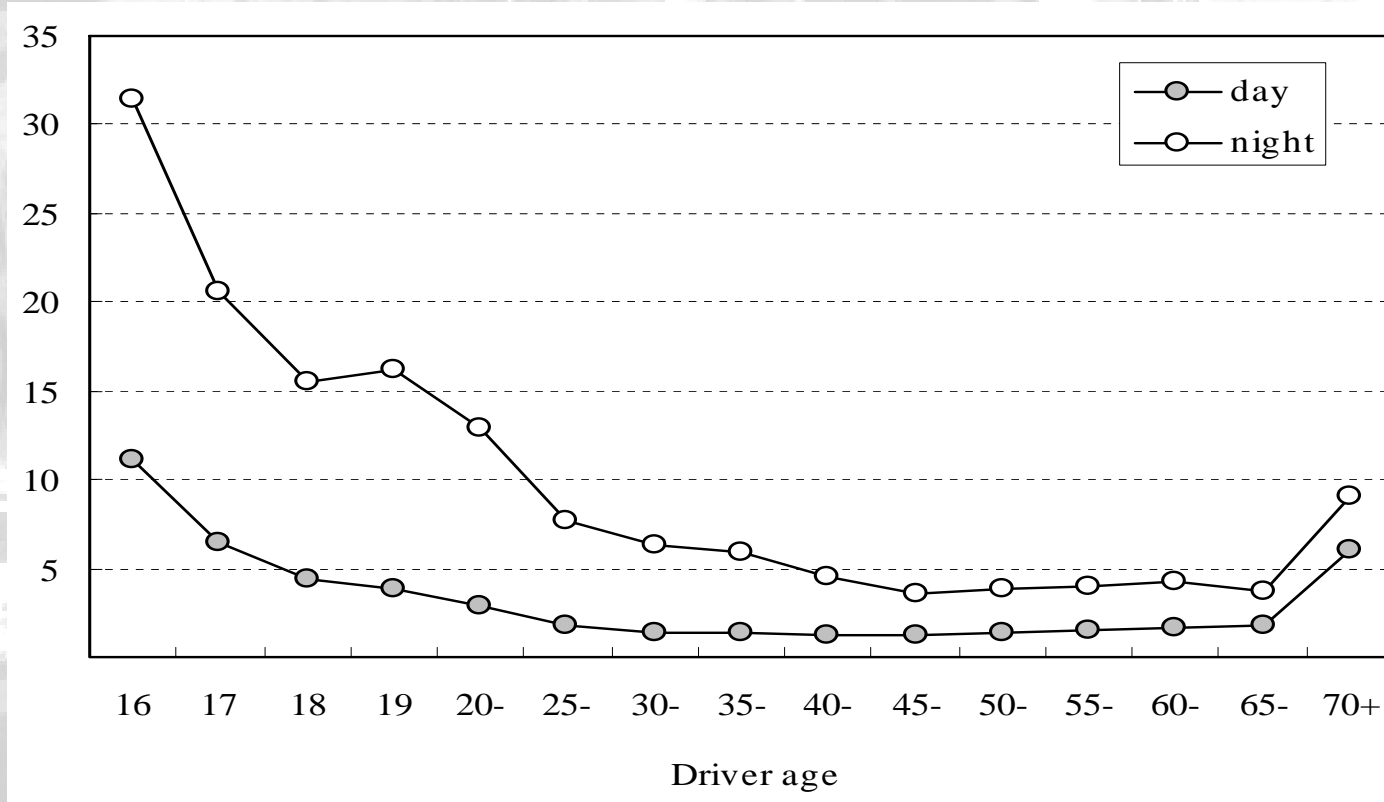## Crashes Decline With Practice/Experience

McCartt et al, 2002

Driving Conditions
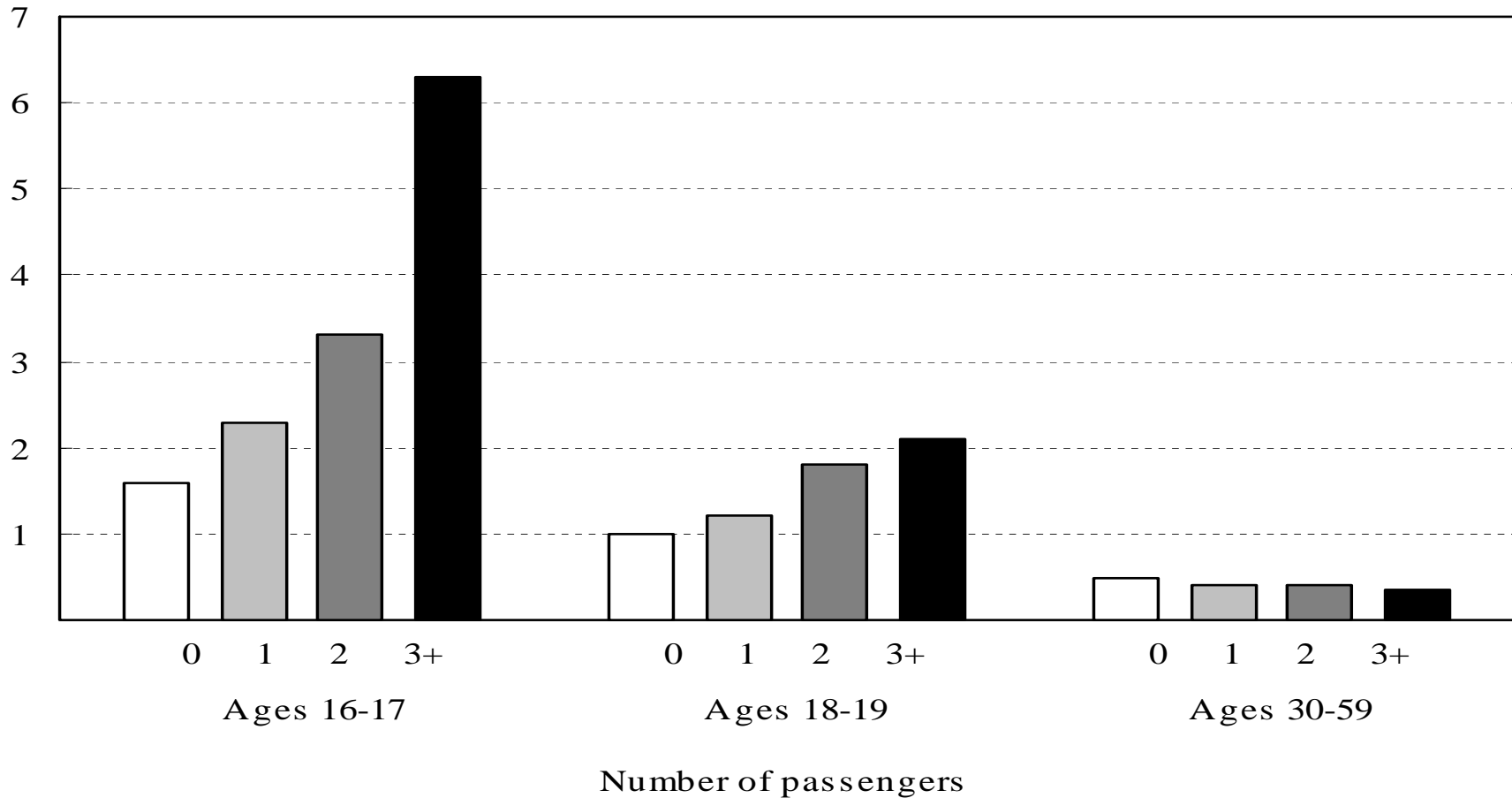## Night Driving Fatal Crash Rate/Miles Driven/Age

Williams, 2003

PREVENTION RESEARCH BRANCH * DESPR * NICHD * NIH * DHHS

Driving Conditions
Teen Passengers Increase Error

Number of passengers

Ages 16-17   Ages 18-19   Ages 30-59

Fatal crashes/10,000 trips

PREVENTION RESEARCH BRANCH * DESPR * NICHD * NIH * DHHS

Inattention-related Crashes/Near Crash
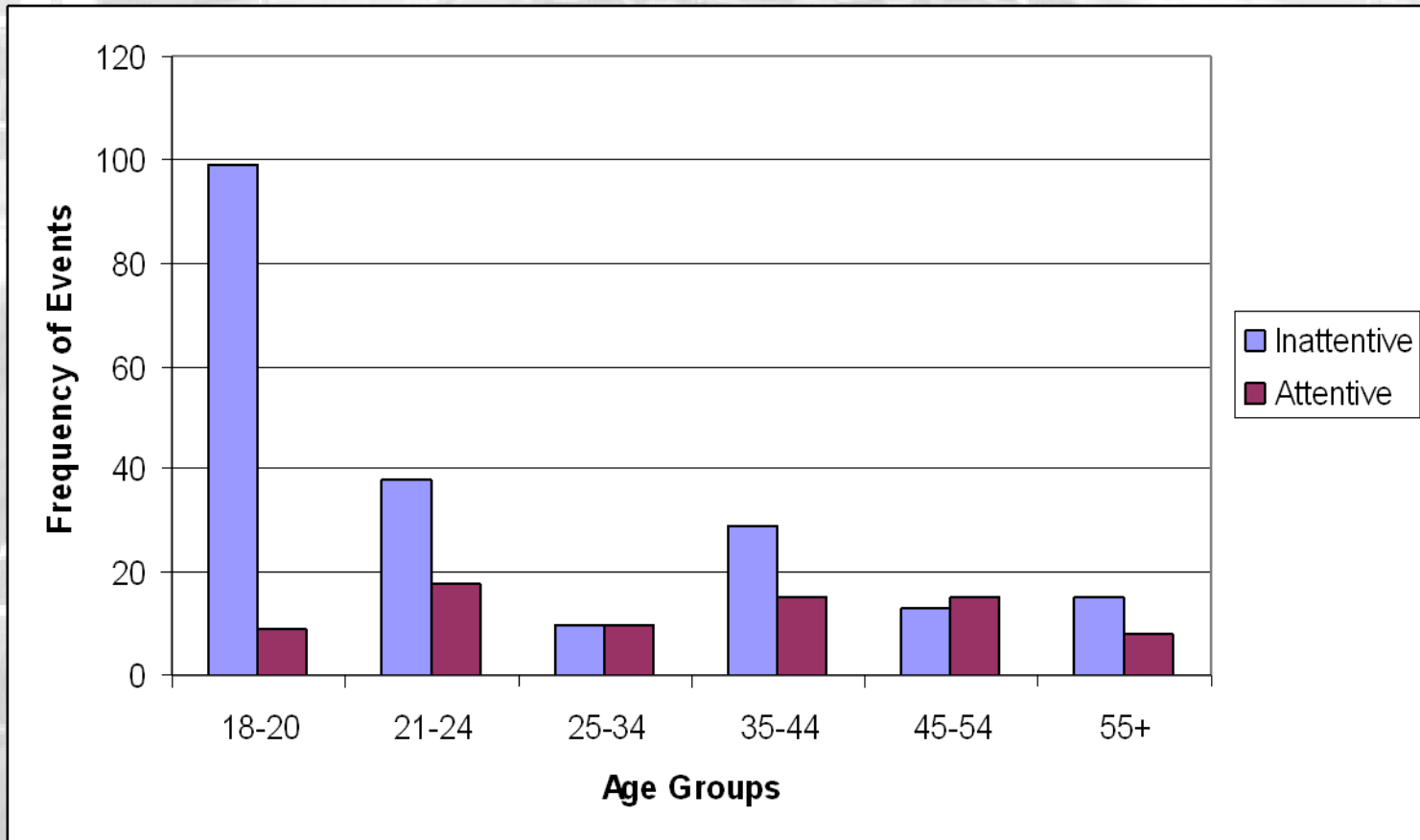
Klauer, Dingus et al., 2006

Naturalistic Novice Teen Driving Study

Study Purpose: Examine the variability in driving performance:

➢ First 18 months of licensure

➢ Teen passenger presence

➢ Day vs night

Specific Purpose: Apply LGM and GMM to analysis of rate over time of 2nd task engagement

Method

Participants: 41 volunteers

- < 17 year old, newly licensed

- own vehicle or share with parents

Instrumentation:

- Linux-based PC
- laser
- accelerometer

- lane tracker
- 6 cameras
- vehicle sensors

Continuous Monitoring

Still Photos

Analysis Issues

➢ Data reduction

- trip files

- Sampled road segments (straight, intersection, merge)

- events (g-force, speed, lane)

➢ Small sample
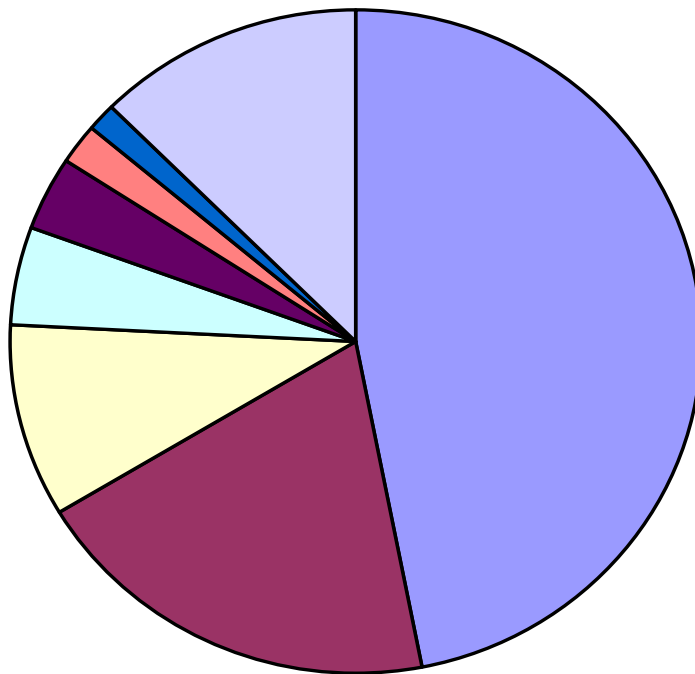
➢ Uneven Exposure

- Miles/trips

- Sampled road segments

➢ Measurement of Performance

- crashes/near crashes

- correct and safe maneuvering

- risky driving (e.g. 2nd task engagement)

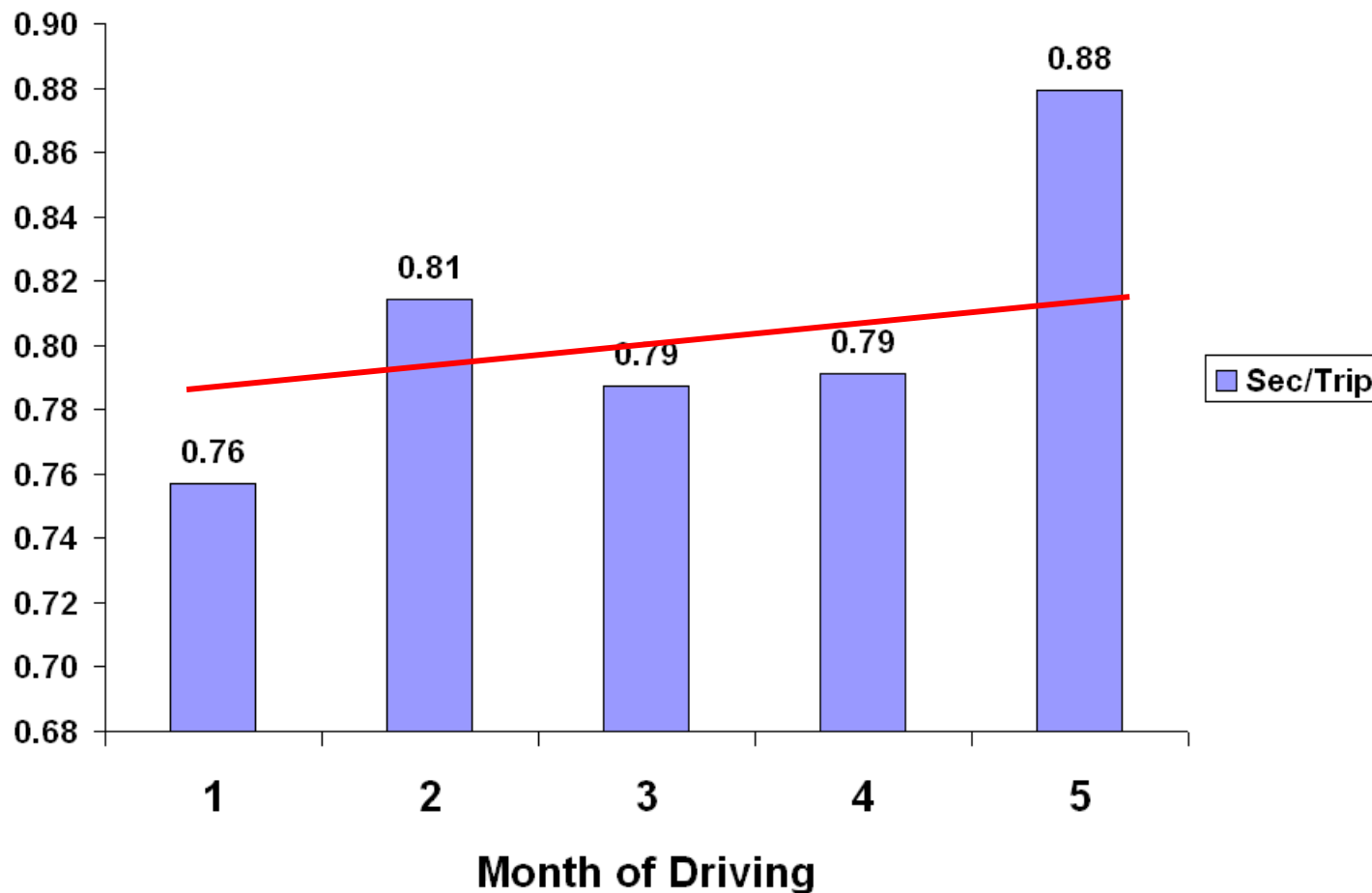# Secondary Task Engagement

Legend:
- Talking/singing/dancing
- Adjusting in-vehicle devices
- Electronic devices
- Personal grooming
- Food activities and smoking
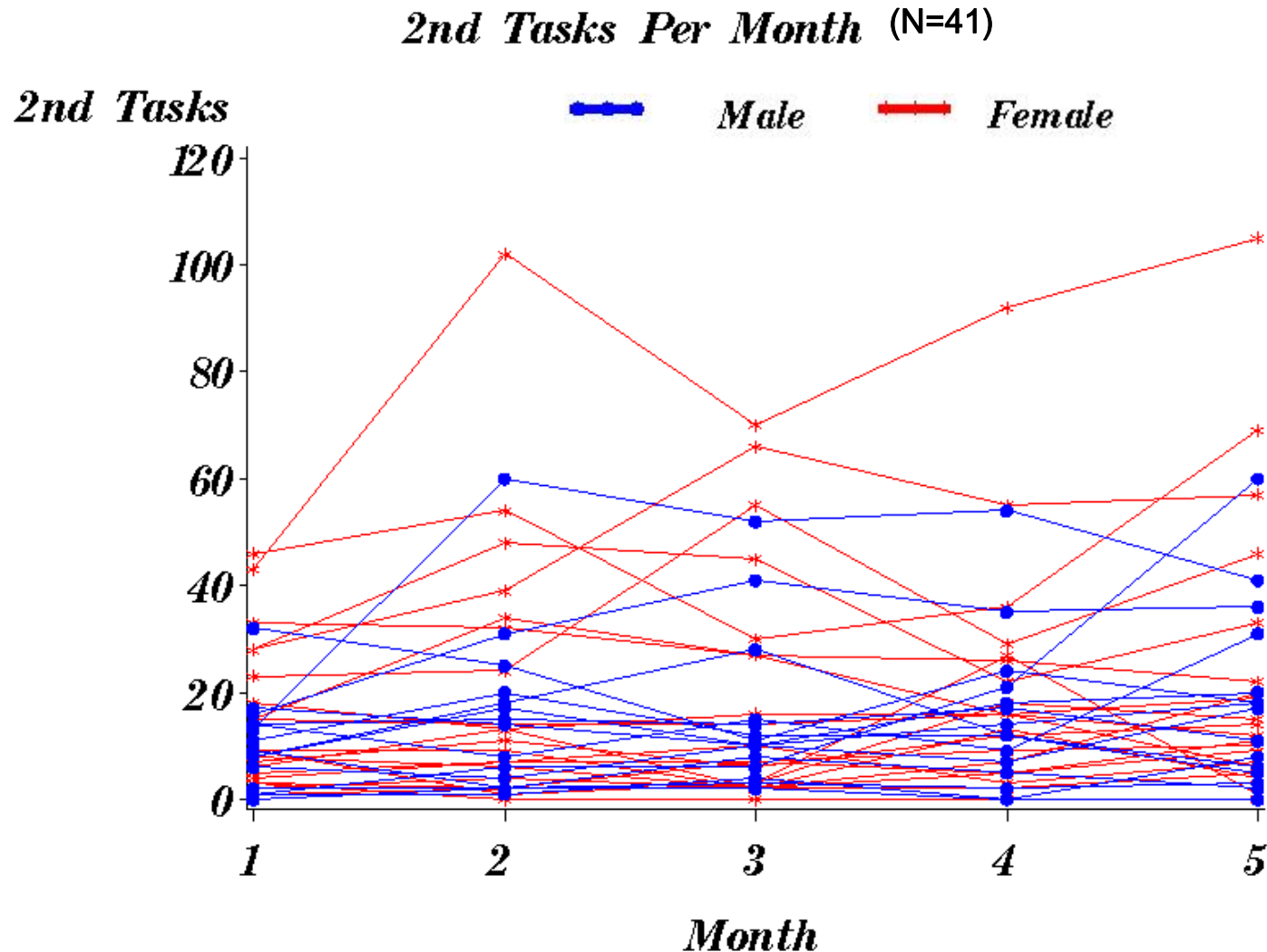- Other in-vehicle activities
- External activities
- Other

Number of Secondary Tasks and Trips Per Month on Straight Road Segments
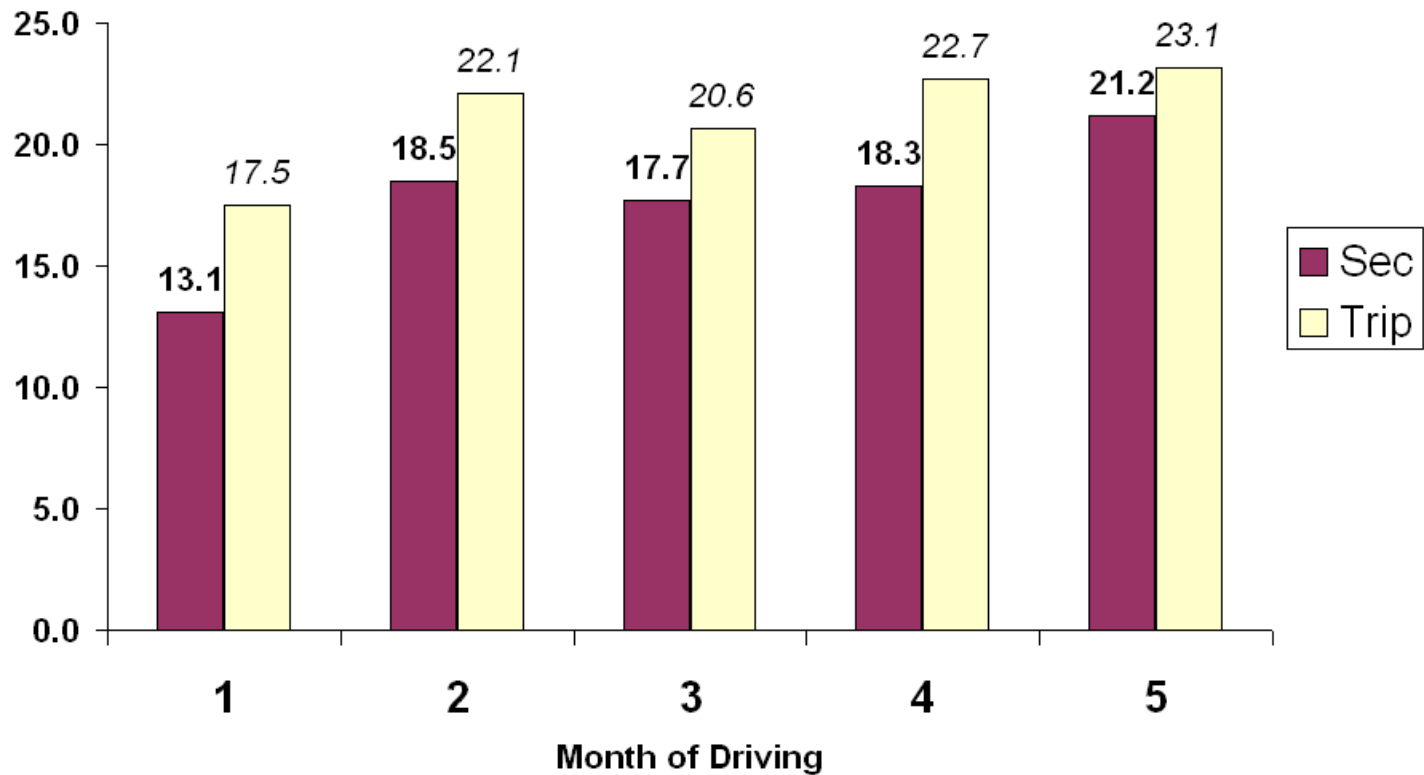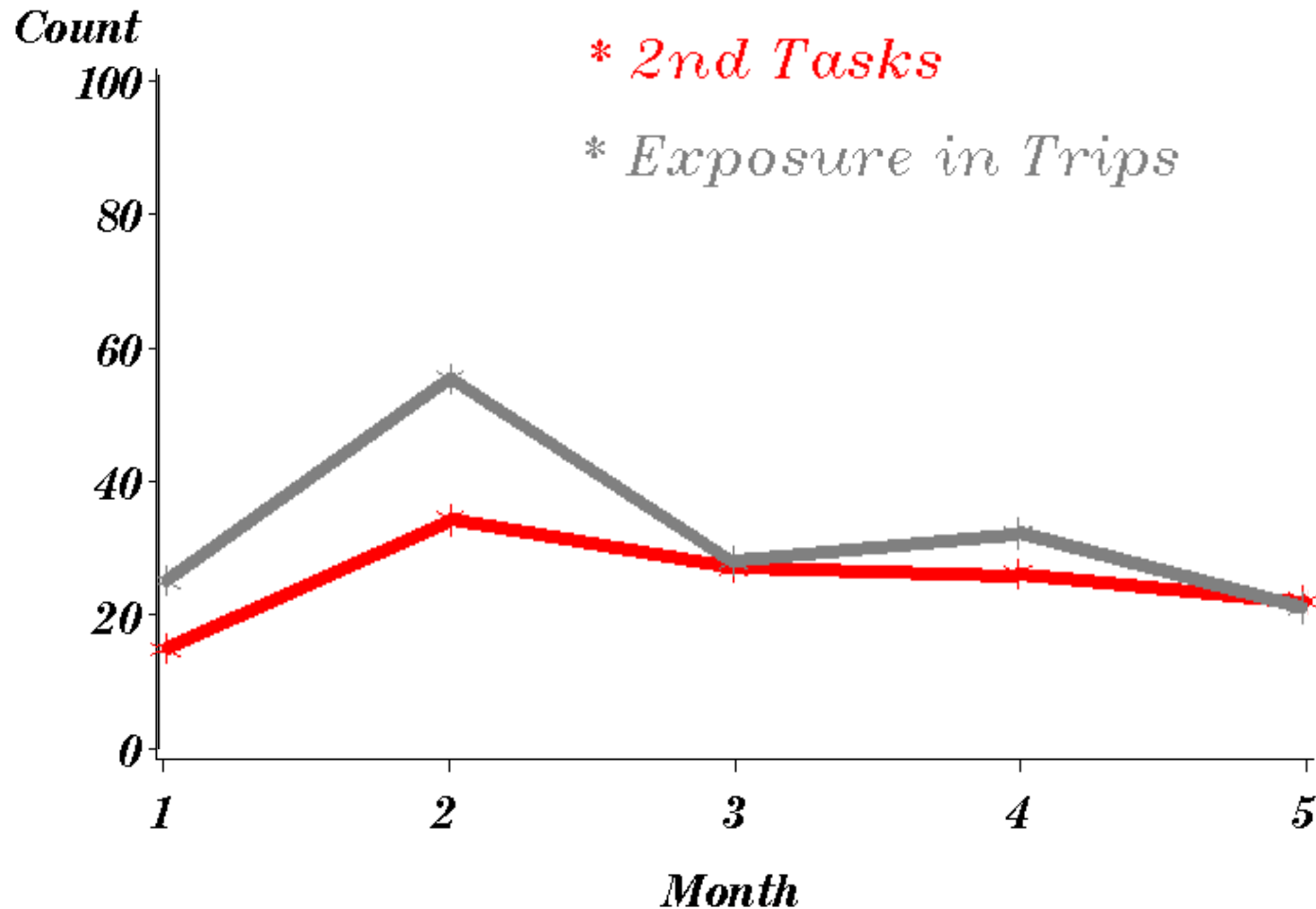
Average Secondary Tasks Per Trip

Variability in 2nd Tasks on Straight Road per Month

2nd Tasks Per Month (N=41)

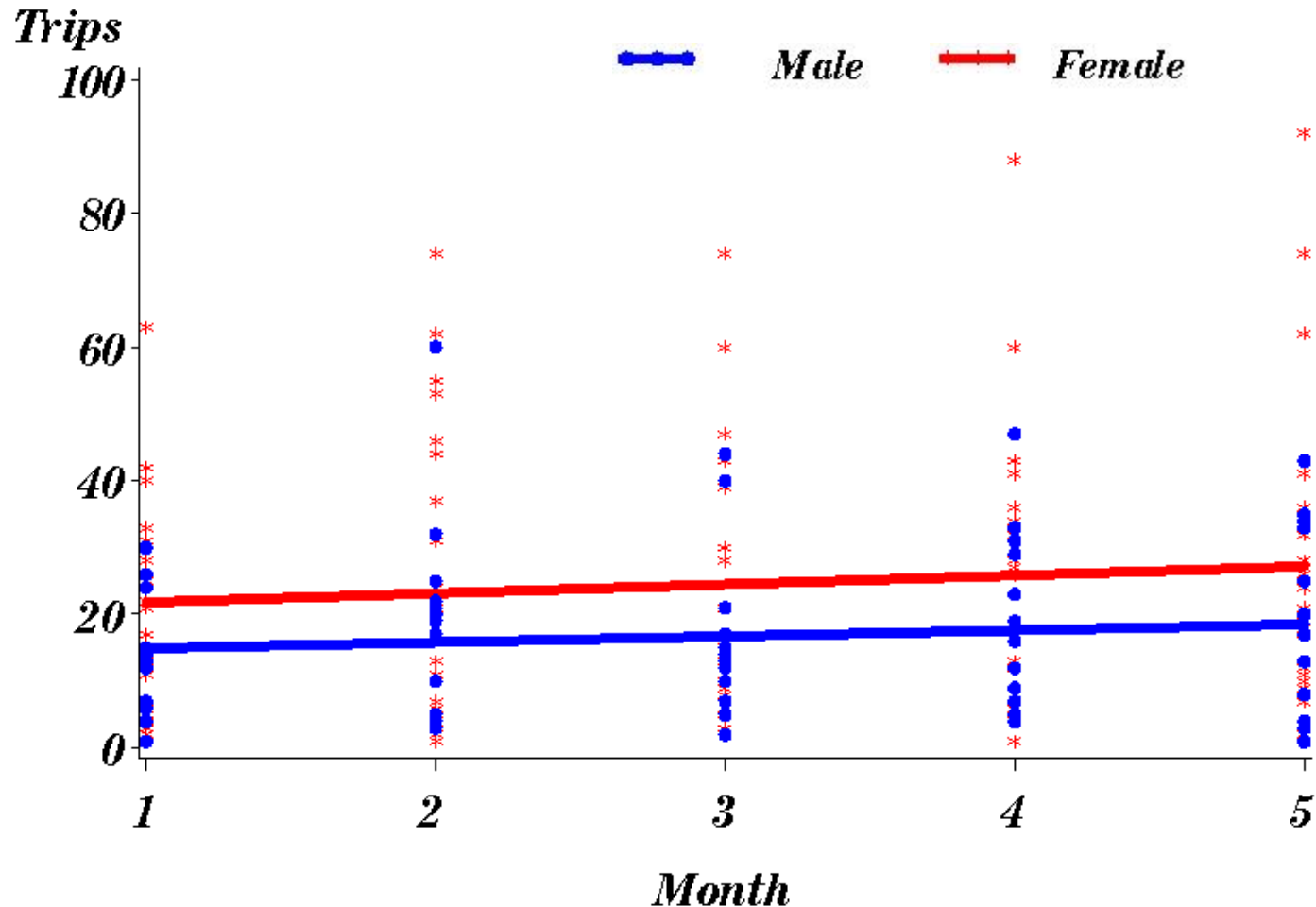2nd Tasks — Male (blue) — Female (red)

2nd Task Engagement and Exposure

2nd Tasks on Straight Road (Teen Driver ID=1)

* 2nd Tasks
* Exposure in Trips

Uneven Exposure – Trips

Trips on Straight Road (35 Teens: 15M & 20F)

2nd Task Trajectory Analysis
Increase Analyzable Sample

Problem

➢ Small sample size, i.e., N = 41 (19 M, 22 F)

➢ Uneven exposure
- 6 teens had no straight road trips
- 10 had very low exposure

➢ Trajectories may vary

➢ LGM, GMM require n~100+

Possible solution

➢ Increase sample by replication
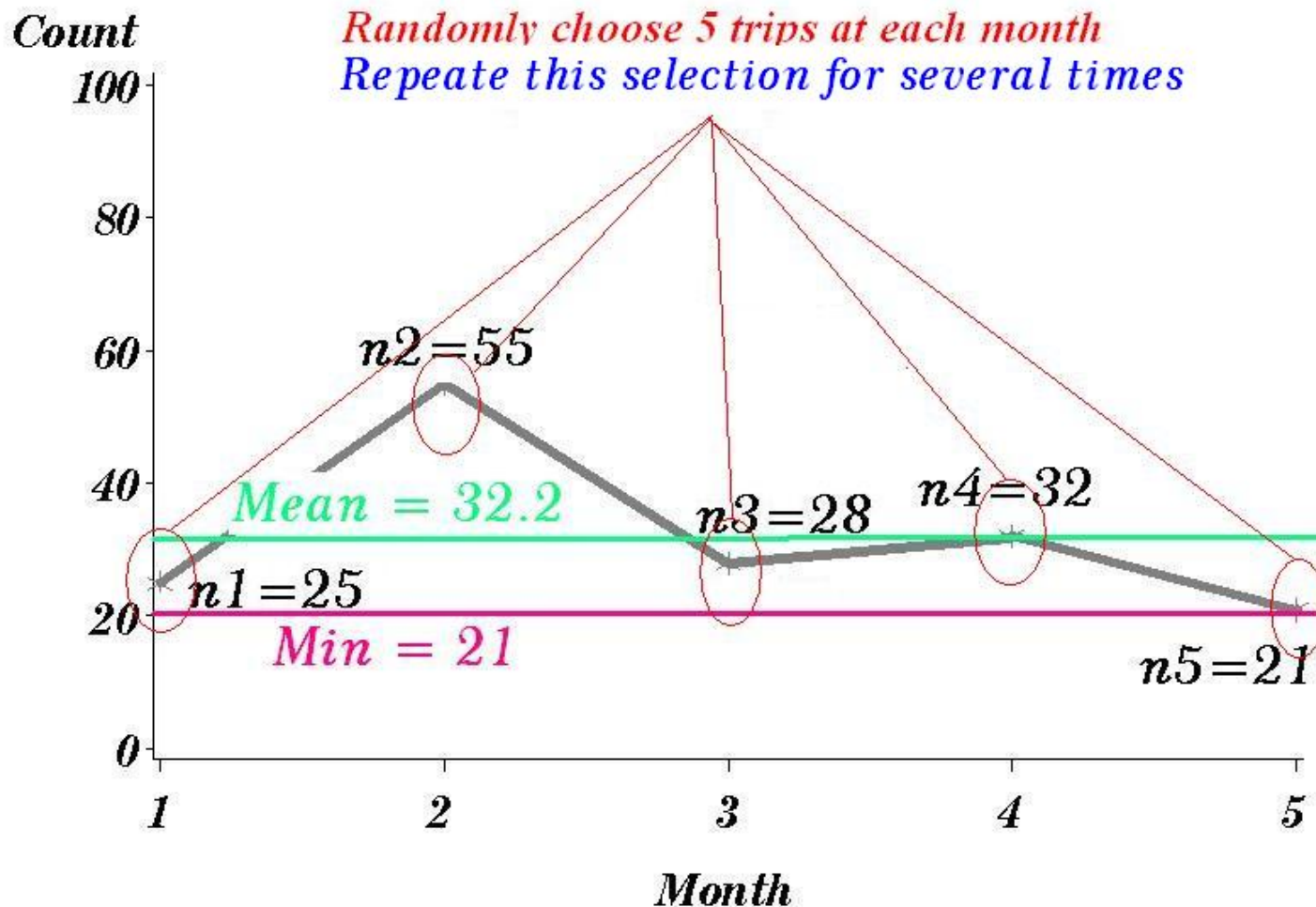
Calculate 2nd Task Rate/5 Trips
Sample Replication Method

➢ Step 1: Replication criteria
  – Minimum of 5/month

➢ Step 2: For each of the remaining 25 teens
  - randomly select 1 trip from each month
  - replicate this selection several times

➢ Step 3: Growth mixture model for 105 replications
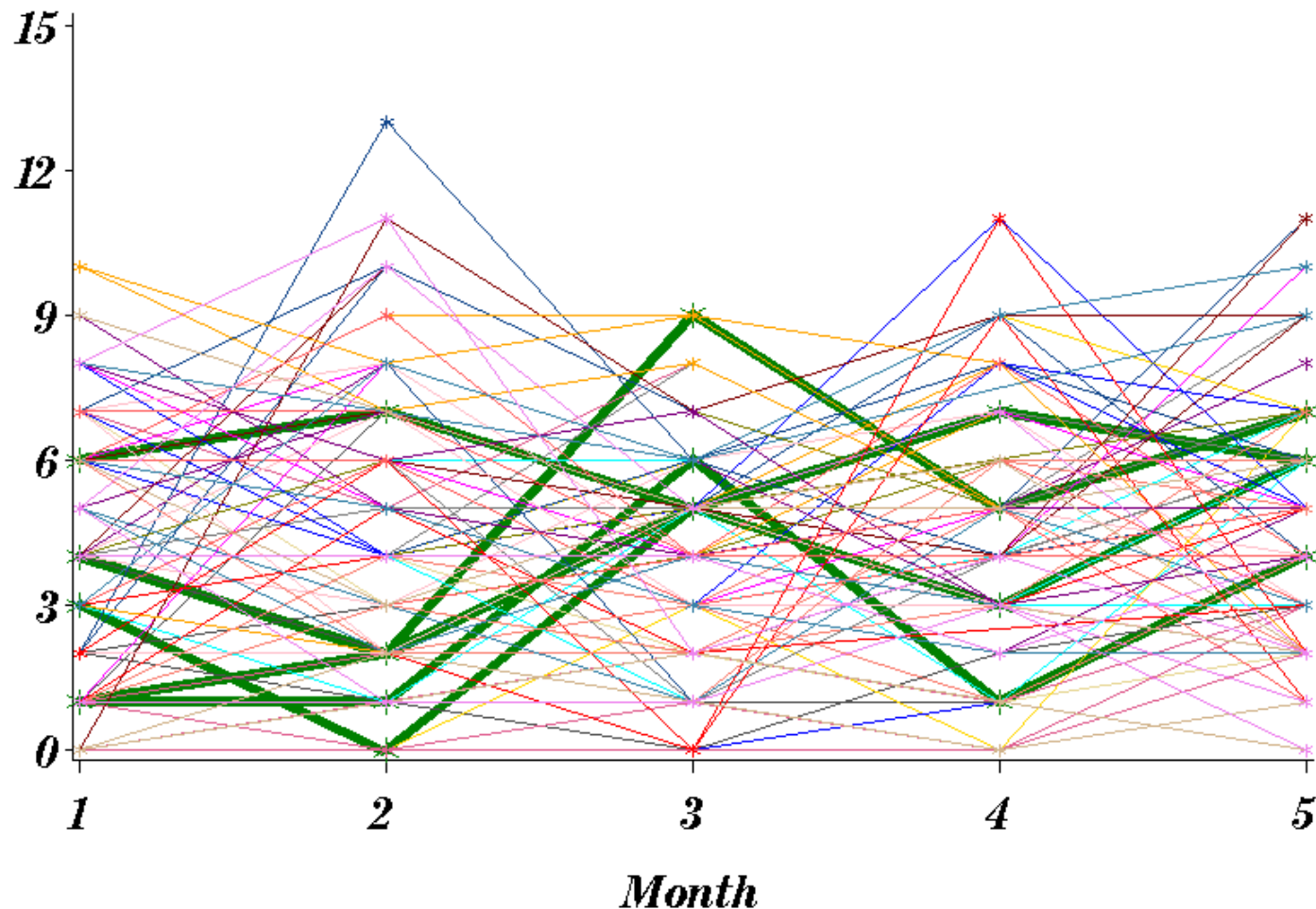 – Controlling for clustering structure
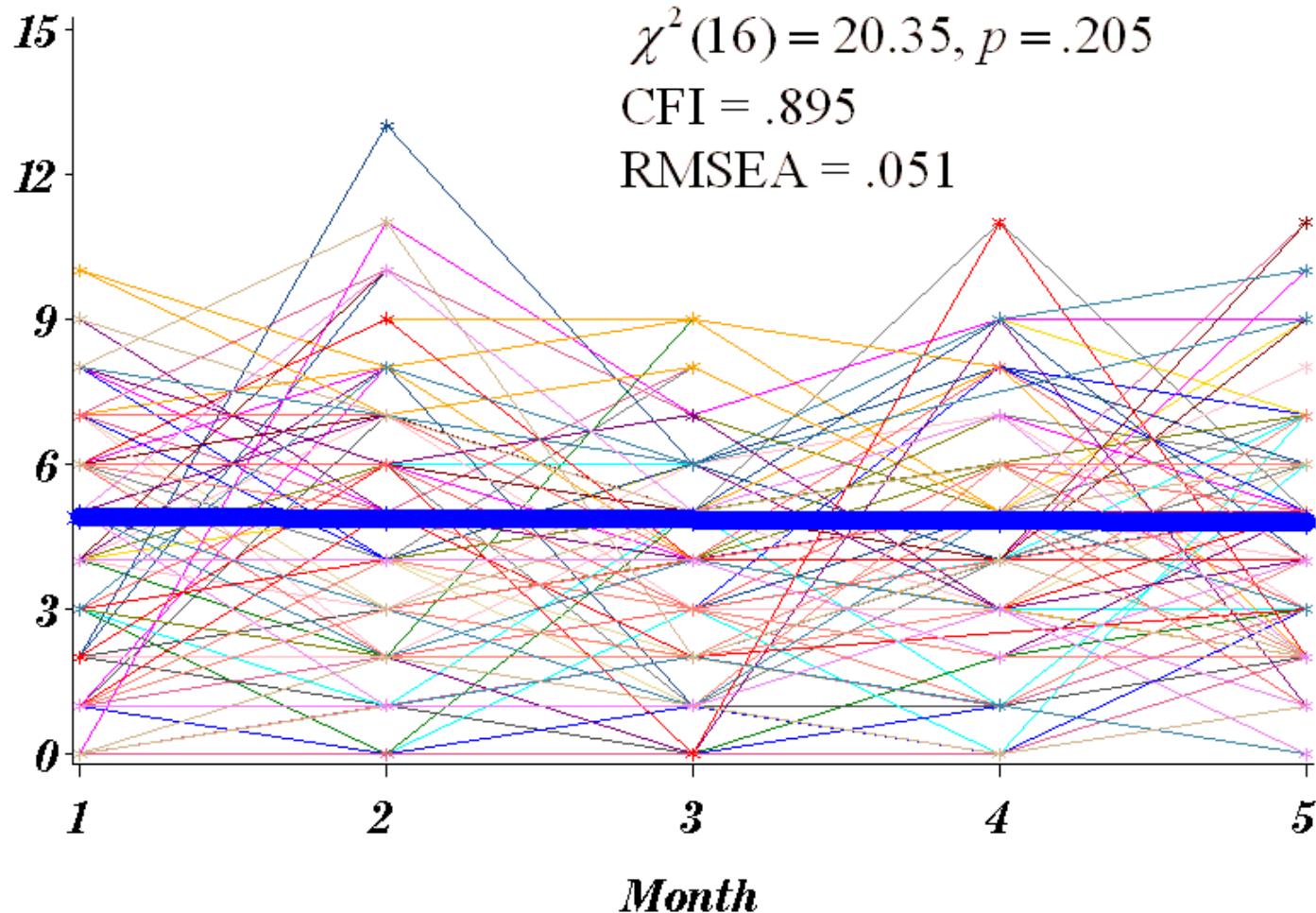
Trips on Straight Road (Teen Driver ID=1)

Analyzing Rates of 2ⁿᵈ Task/5 Trips Replication Result
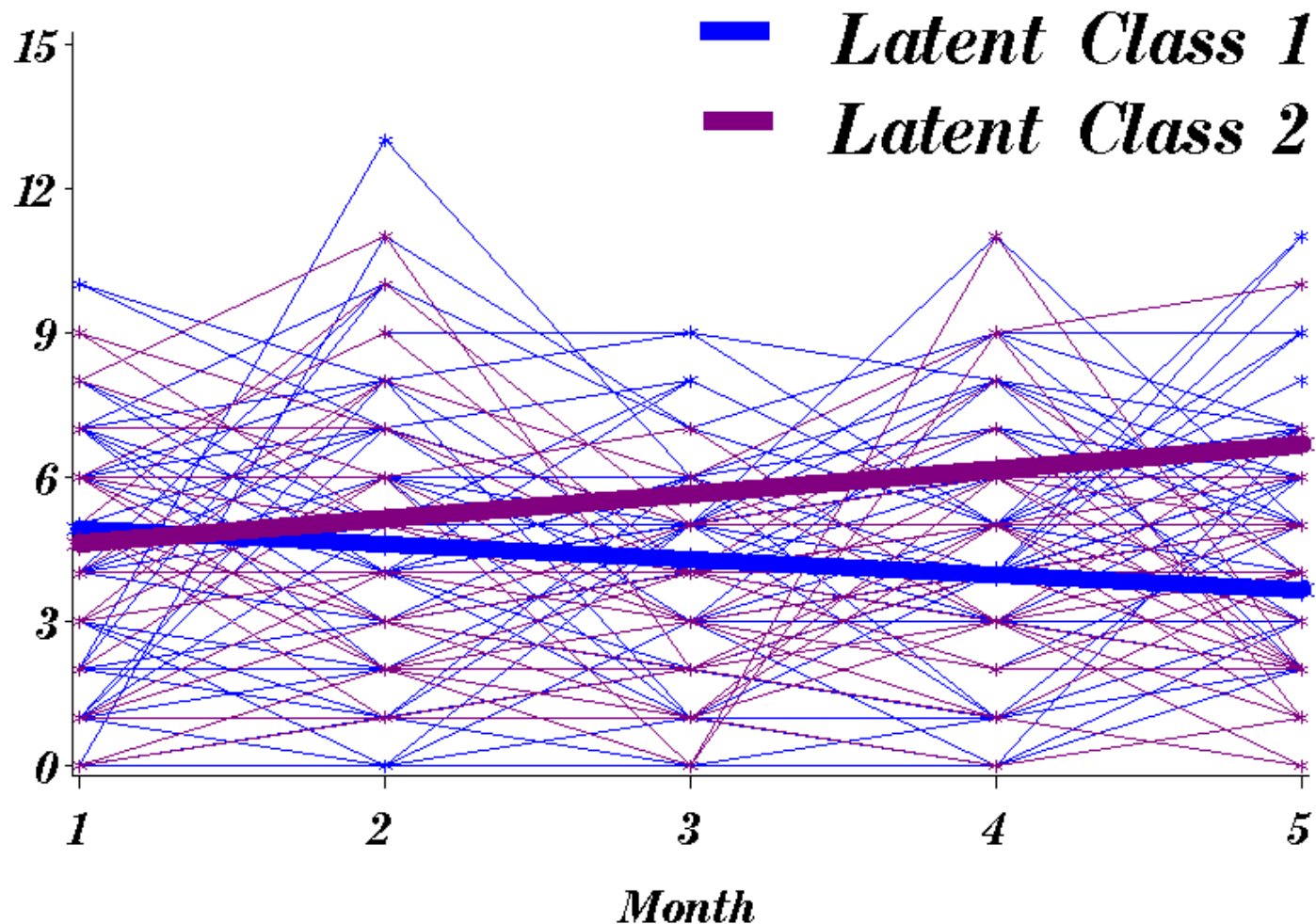

2nd Tasks Per 5 Trips (25 Teens —> 105 Replications)

Growth Curve Model

2nd Tasks Per 5 Trips (Growth Curve Model)

$\chi^2(16) = 20.35, p = .205$

CFI = .895

RMSEA = .051

Month

Growth Mixture Model

2nd Tasks Per 5 Trips (Growth Mixture Model)

Latent Class 1
Latent Class 2

Month

Summary
Solutions to the Small Sample, Uneven Exposure Trajectory Analysis Problem

➢Central tendency & trends not always adequate

➢Growth modeling methods useful for some questions

➢Replication allows growth mixture modeling

- Identify unique trajectory groups with variable risk

- Certain trajectory groups may be most interesting

Thank you

The End