



U.S. Department
of Transportation

**Federal Highway
Administration**

Highway **Crash** **Recurring** Patterns

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GSS, Seasonal Adjustment Practitioners Workshop

November 04, 2016

Overview

- Purpose of Presentation
- Highway Safety Concerns
- FHWA and NHTSA roles in safety
- Literature Review for Seasonal Adjustments
- Seasonal and Recurring Patterns in Highway Crashes
- Selected Crash Topics for Recurring Patterns
- Summary of Observations
- Discussion/Questions

Purpose of Presentation

1. Communicate the highway crash seasonal and recurring patterns.
2. Network with government agencies and statistician experts for analyzing data with seasonal and cyclical patterns.
3. Promote highway crash data and related resources to statisticians, and academics (educators and students) for advancing science to improve highway safety.

Canadian Statistics, *“Monthly and Daily Patterns of Death”*

Richard Trudeau Health Reports, Summer 1997, stated;

“While death may happen at any time as a result of illness or accident, to some extent, its timing is predictable. Most obviously, death is likely to occur at older ages. But there is another less obvious element of predictability in the timing of death. Some seasons of the year bring more deaths than do others, and **deaths attributable to a number of specific causes tend to follow a yearly cycle.** These seasonal fluctuations are more than a curiosity. Because **seasonal upsurges of deaths from specific causes are predictable, preventive health and safety measures may be able to reduce the toll.”**

Highway Crash

Major Contributing Factors:

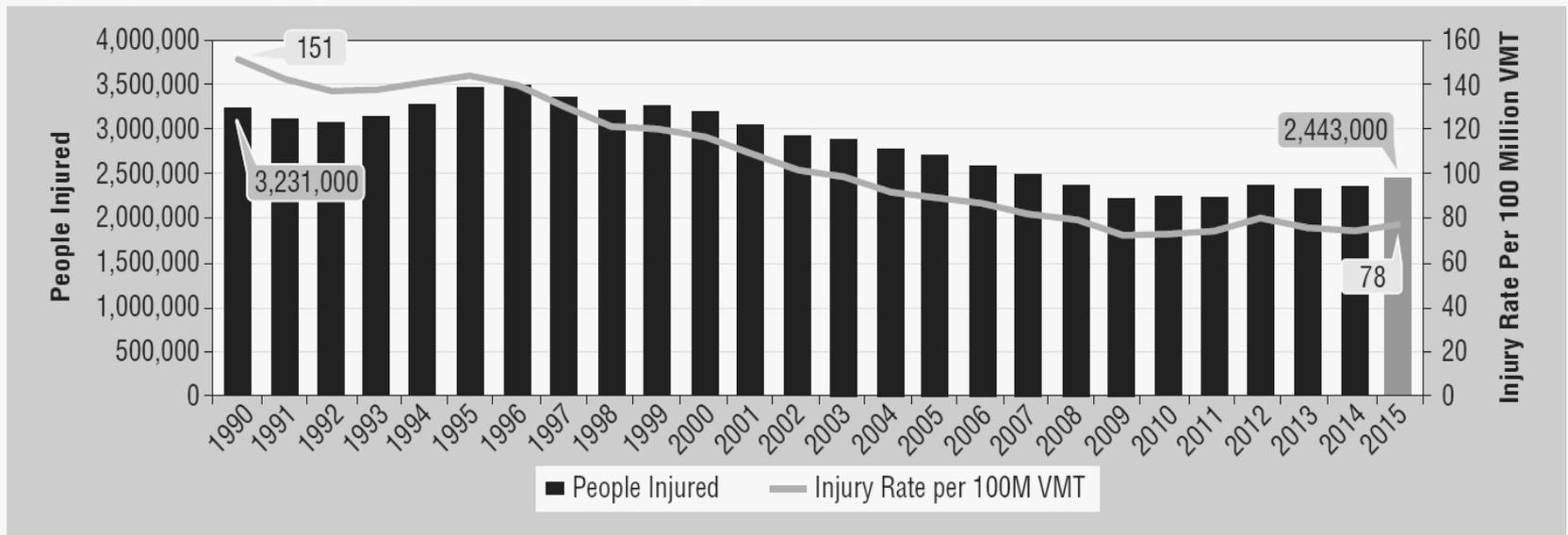
- Driver (age, gender, intoxication)
- Vehicle (body type)
- Road geometric design (number of lanes, speed limit, curve, grade, and median)
- Roadside design (structure, culvert, ditch, curb, sign, light pole, and fence)
- Environment (weather, light, and nature)

FATALITY ANALYSIS REPORTING SYSTEM (FARS)

Crashes with Minimum One Fatality

- Since 1994, highway crashes have caused:
 - Average **39,348** fatalities per year
 - Over **2.4 million** nonfatal injuries per year at a cost of more than \$200 billion annually to our national economy

People Injured and Injury Rate per 100 Million VMT, by Year, 1990–2015



Department of Transportation (DOT)

DOT Administrations:

1. Office of the Secretary (OST)
2. Federal Aviation Administration (FAA)
3. Federal Highway Administration (FHWA)
4. Federal Motor Carrier Safety Administration (FMCSA)
5. Federal Railroad Administration (FRA)
6. Federal Transit Administration (FTA)
7. Maritime Administration (MARAD)
8. National Highway Traffic Safety Administration (NHTSA)
9. Office of Inspector General (OIG)
10. Pipeline and Hazardous Materials Safety Administration (PHMSA)
11. Saint Lawrence Seaway Development Corporation (SLSDC)
12. Surface Transportation Board (STB)

FHWA and NHTSA Roles

FHWA:

Works with State and responsible for:

- the design, construction, and maintenance of the roads
- Responsible for “roads” safety

NHTSA:

Directs the highway safety and consumer programs for:

- Driver
- Vehicle

Literature on Seasonal Adjustment

Limited Application for Highway Safety

- NHTSA, *Statistical Methodology to Make Early Estimates of Motor Vehicle Traffic Fatalities, 2010*.
 - Fatalities in motor vehicle traffic crashes during the first six months of 2010 are projected to decline by about 9.2 percent as compared to the same time period in 2009.
- NHTSA, *2015 Motor Vehicle Crashes: Overview, 2016*
 - The Nation lost 35,092 people in crashes on U.S. roadways during 2015, an increase from 32,744 in 2014. The 7.2-*percent* increase is the largest percentage increase in nearly 50 years. The largest percentage increase previously was an 8.1-percent increase from 1965 to 1966.

Literature on Seasonal Adjustment

- A. Karlsson and K. Willero, *Time Series Analysis of Fatalities in the Traffic*, Swedish National Road and Transport Research Institute, 2005
 - Purpose was to use time series models, including seasonal adjustment, to explain the correlation that exists between the observed and estimated number of people killed in traffic accidents.
- “The estimated predictions from the models showed no indications that "Nollvisionen" (Swedish: the Zero Vision) will be fulfilled without radical changes in traffic. The number of people killed will, according to the predictions, stay at the same level as in recent years.”

Literature on Seasonal Adjustment

- P. Scuffham, *Are There Seasonal Unit Roots in Traffic Crash Data?*, Alstituti Editoriali e Poligrafici Internazionali, 2003
- R. BERGEL, B. Girard, S. LASSARRE, P. Le Breton, *Model Of Seasonally Corrected Indicators Of Road Safety*, PTRC Education and Research Services Limited, 1996

NHTSA Fatality Analysis Reporting System (FARS)

FARS is a database for crashes with Minimum One Fatality.

Used FARS data for: Vehicle “Number 1 that initiated the crash, and, Person Type for “Driver”

Extracted:

1. Non-Intersection cases= 125,680 crashes
2. Intersection cases= 1,948 crashes

Only used Non-Intersection data

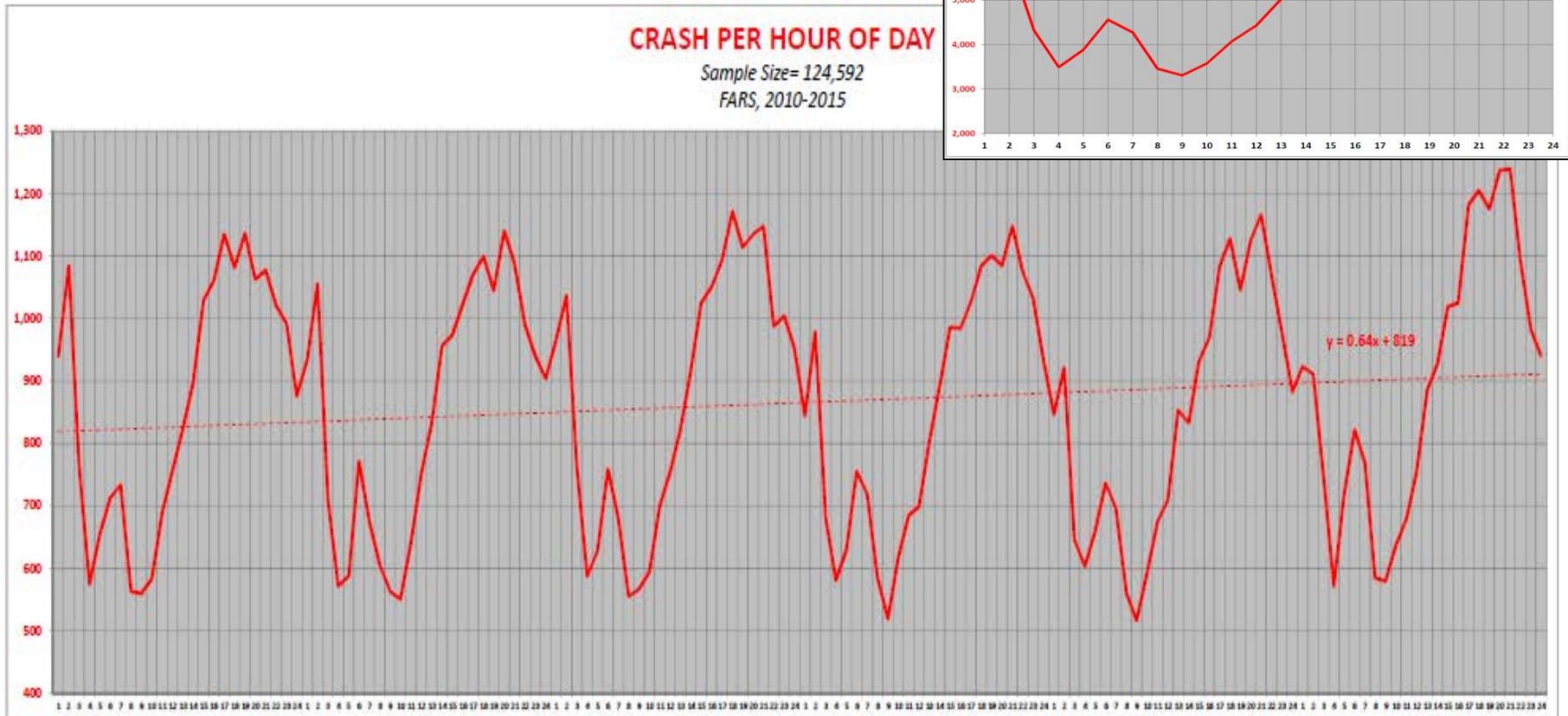
Recurring Highway Crash

FARS Data, 2010-2015

Selected highway crash highlights:

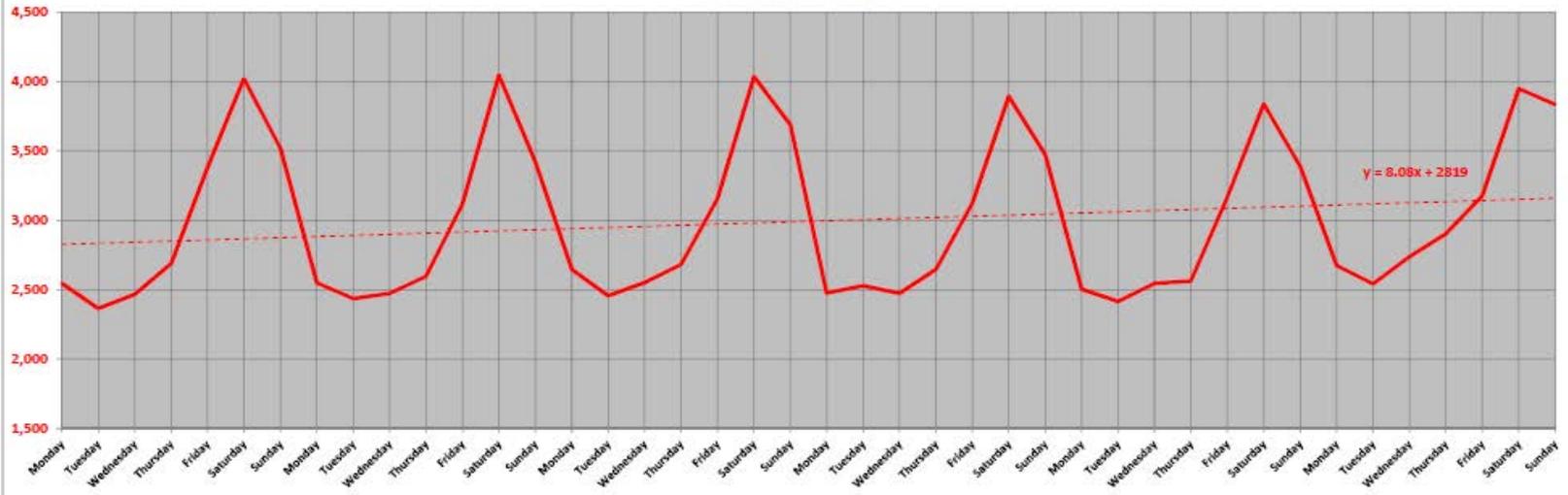
1. Hourly, weekly, and monthly crash reoccurring patterns
2. Driver Age
3. Cause of Crash (first harmful events)
 - a. Motor Vehicle in Transport
 - b. Pedestrian
 - c. Rollover
 - d. Tree
 - e. Curb
4. Vehicle (Example for Motorcycle)

Fatal crashes with Minimum one fatality have 24 hour, weekly, and monthly/seasonal recurring patterns.



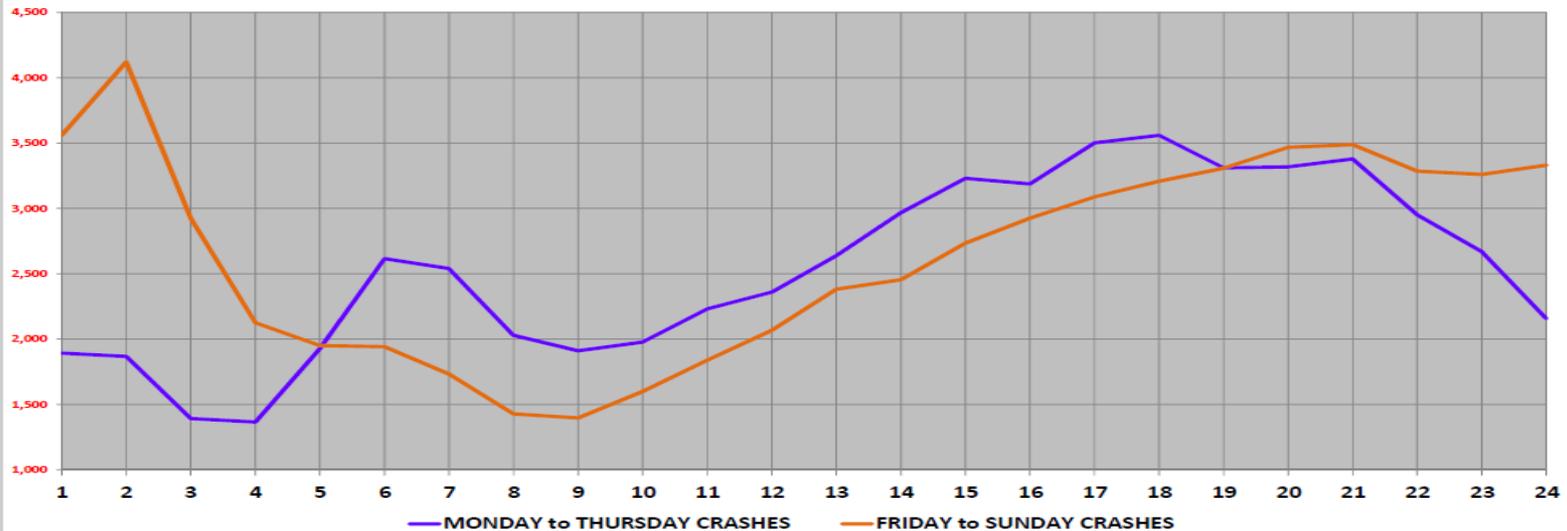
CRASH PER DAY OF WEEK

Sample Size= 125,680
FARS, 2010 to 2015



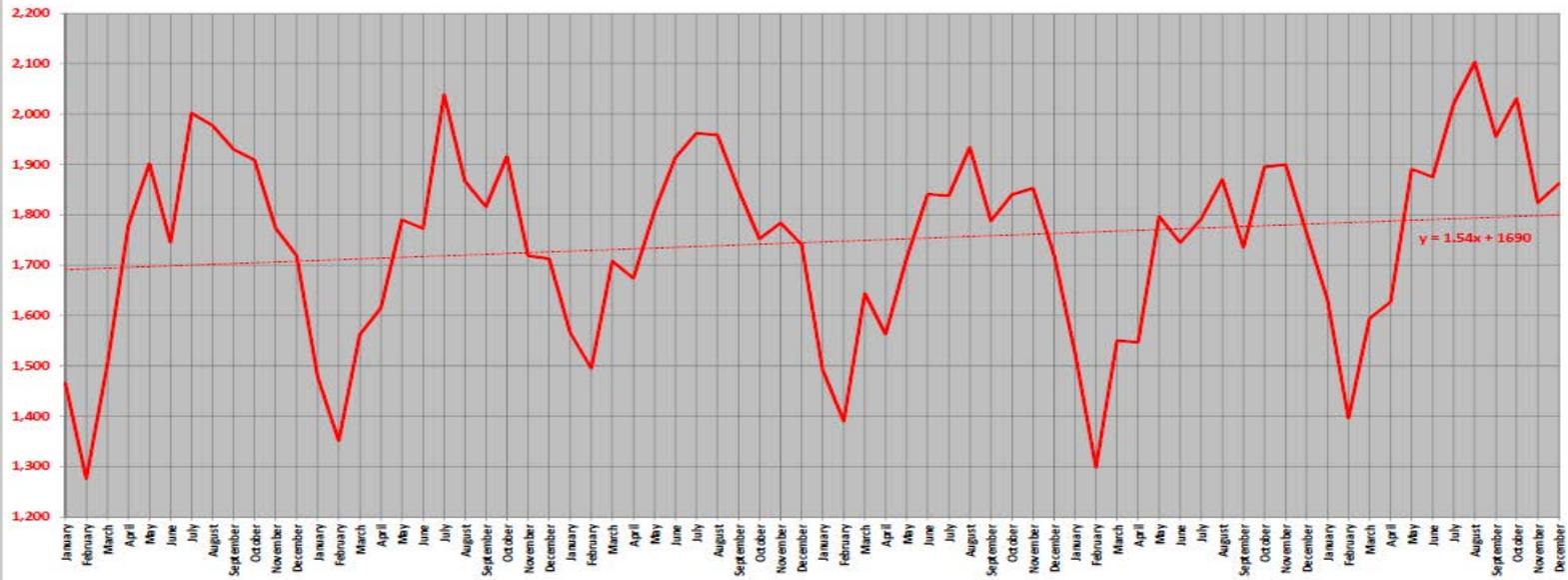
DAYS OF WEEK CRASH PATTERN PER HOUR OF DAY

MON-THU Sample Size= 60,975
FRI-SUN Sample Size= 63,617
FARS, 2010-2015



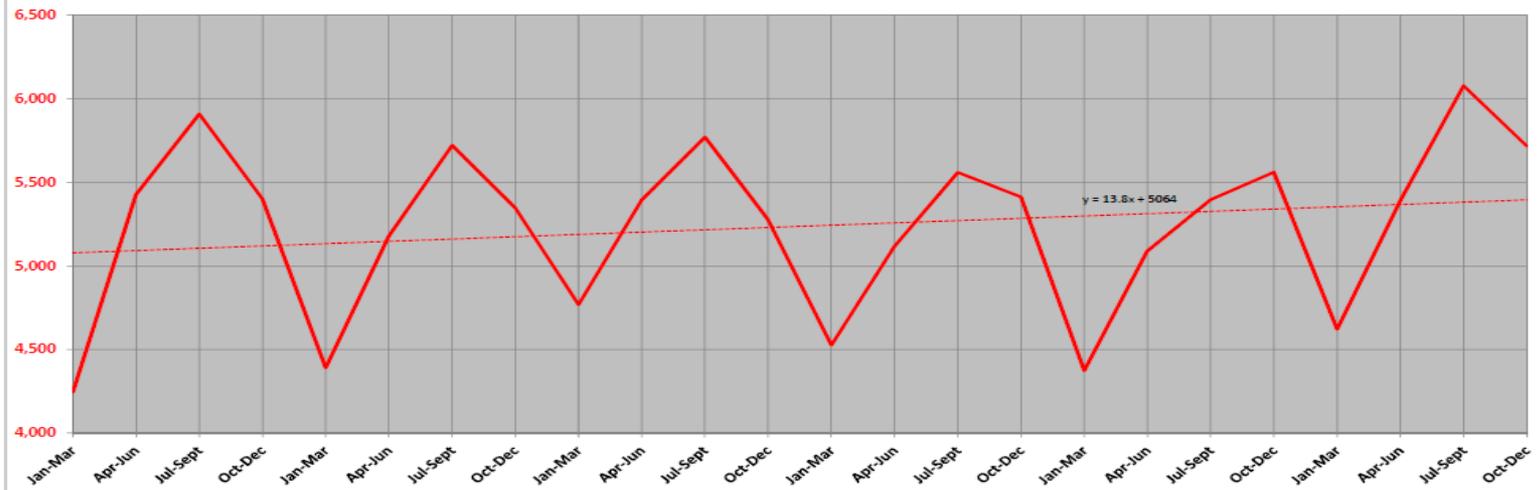
CRASH PER MONTH OF YEAR

Sample Size= 125,680
FARS, 2010-2015

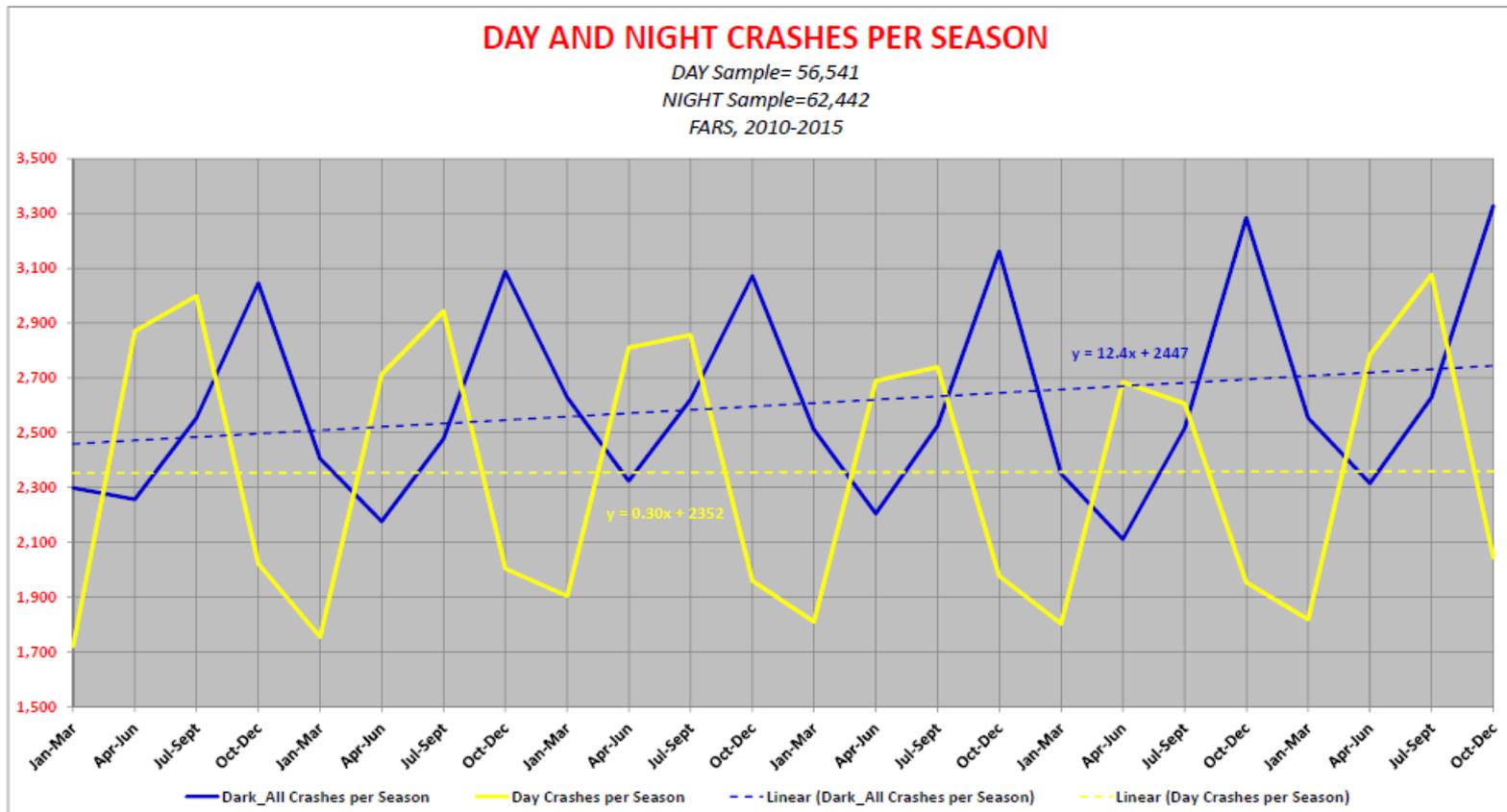


CRASH PER SEASON OF YEAR

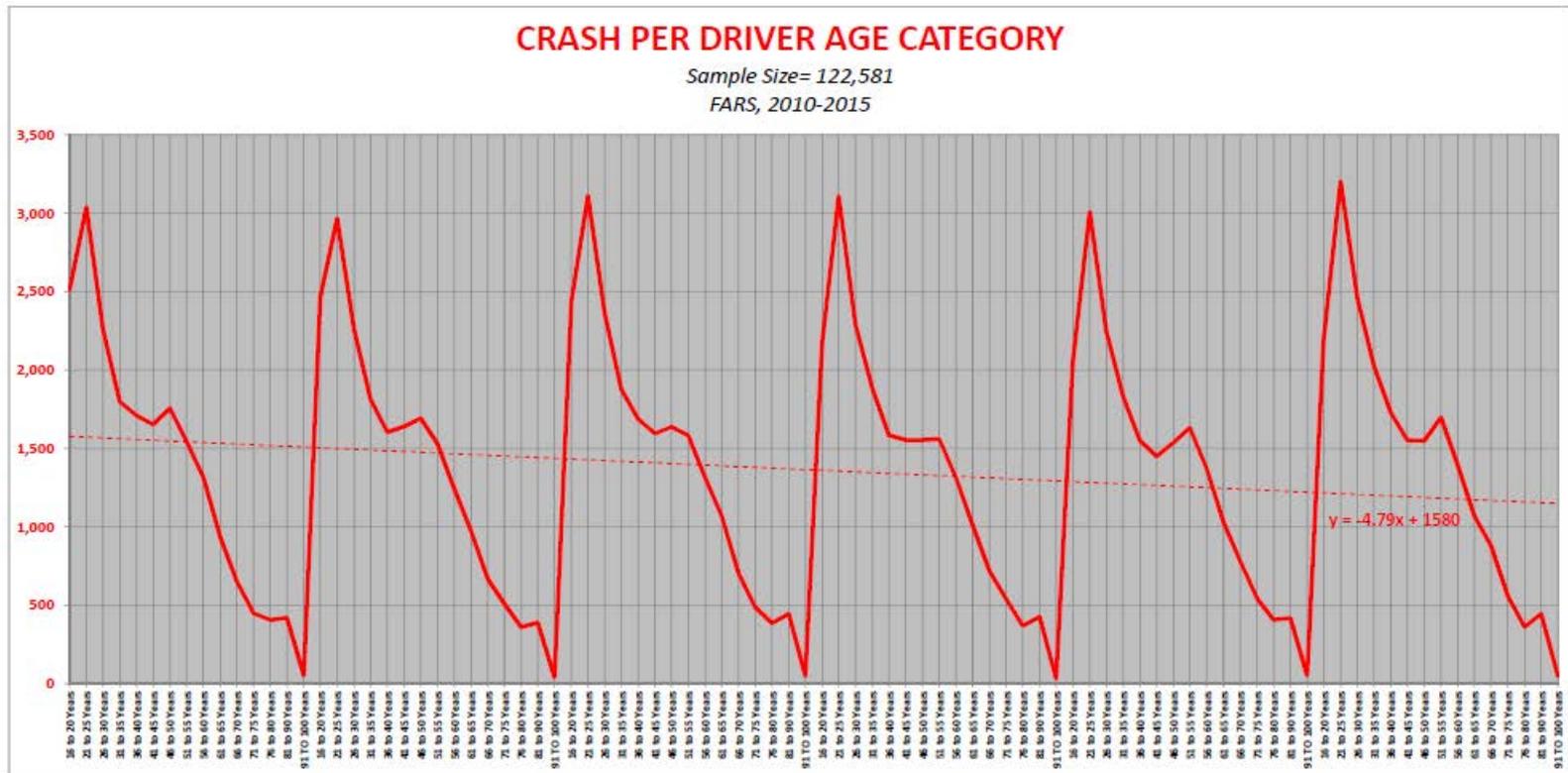
Sample Size= 125,680
FARS, 2010-2015



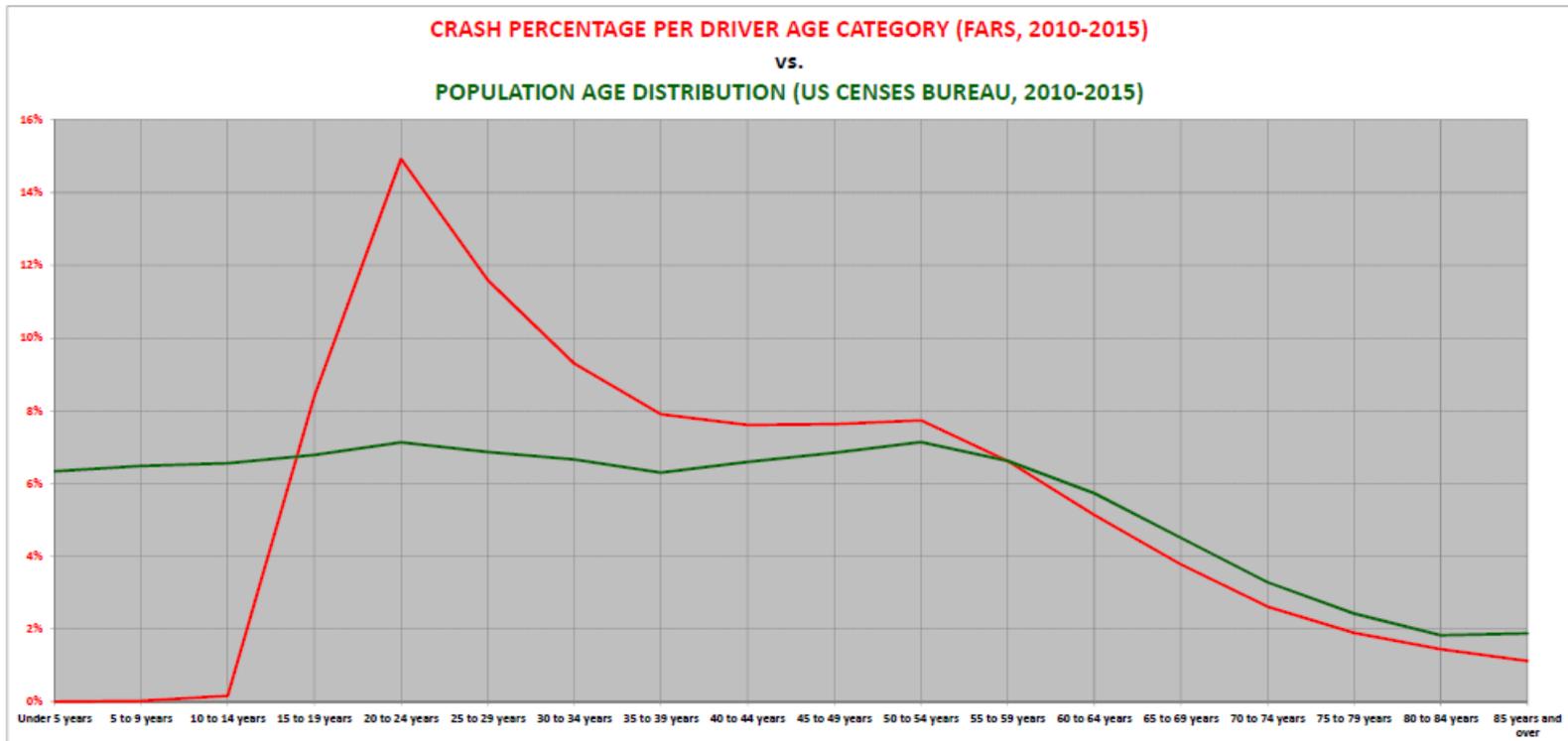
- Seasonal crash patterns are different per day and night conditions.
- Night crashes are higher and on the rise, considering lower traffic at night.



Driver Age Category



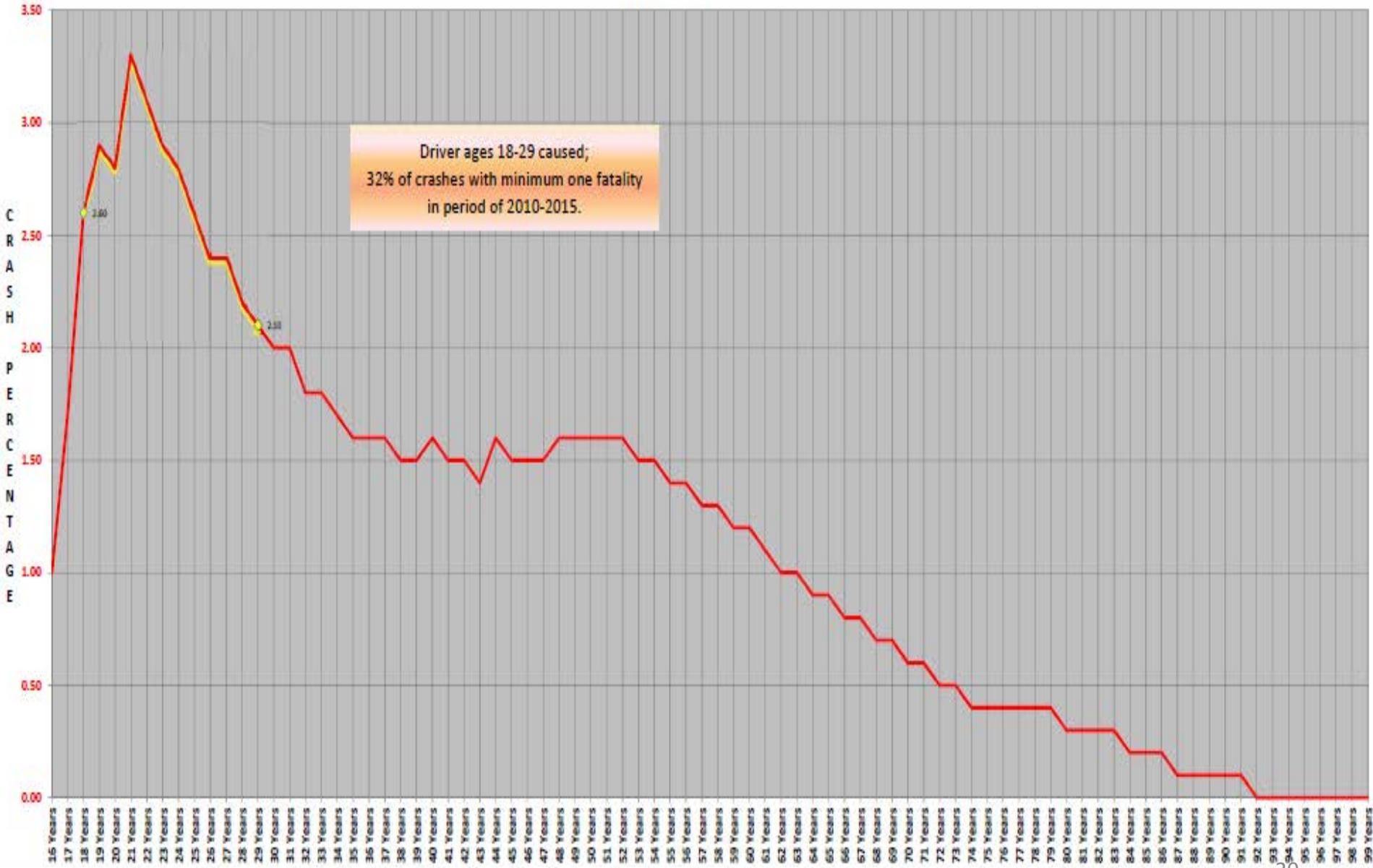
Crash percentages for age categories of **15-19 through 50-54** are higher than their population percentages (Census Bureau data).



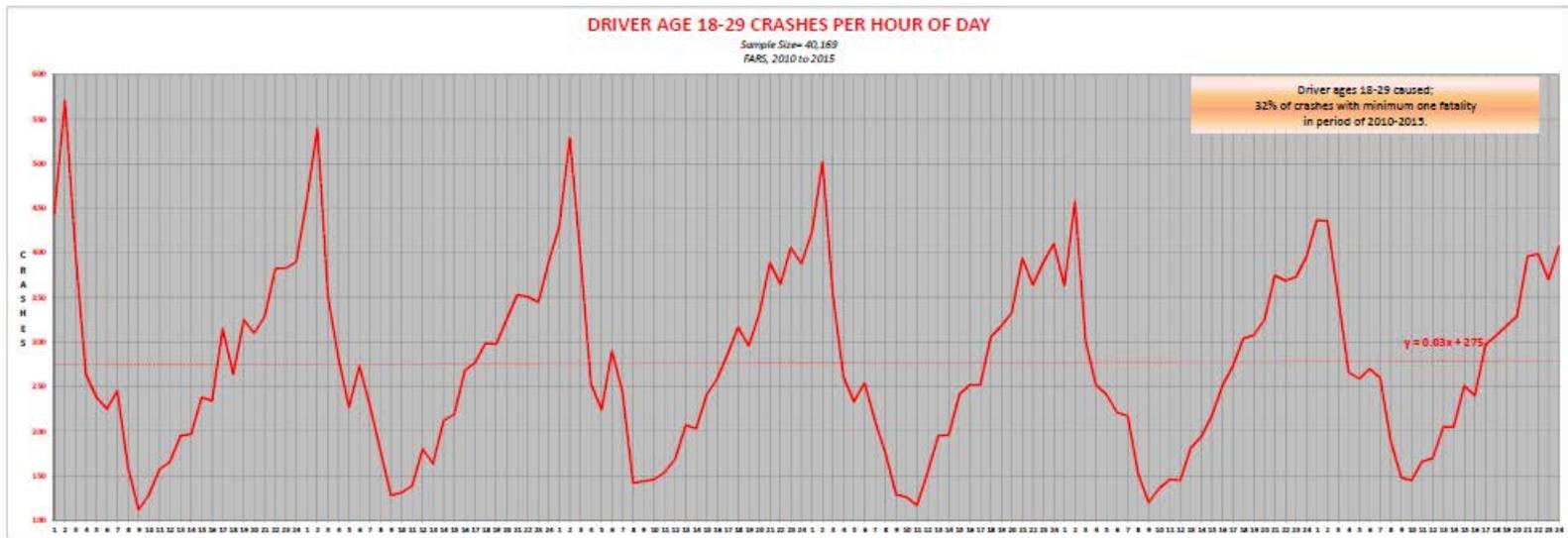
CRASH PERCENTAGE PER DRIVER AGE

Sample Size= 125,680

FARS, 2010 to 2015

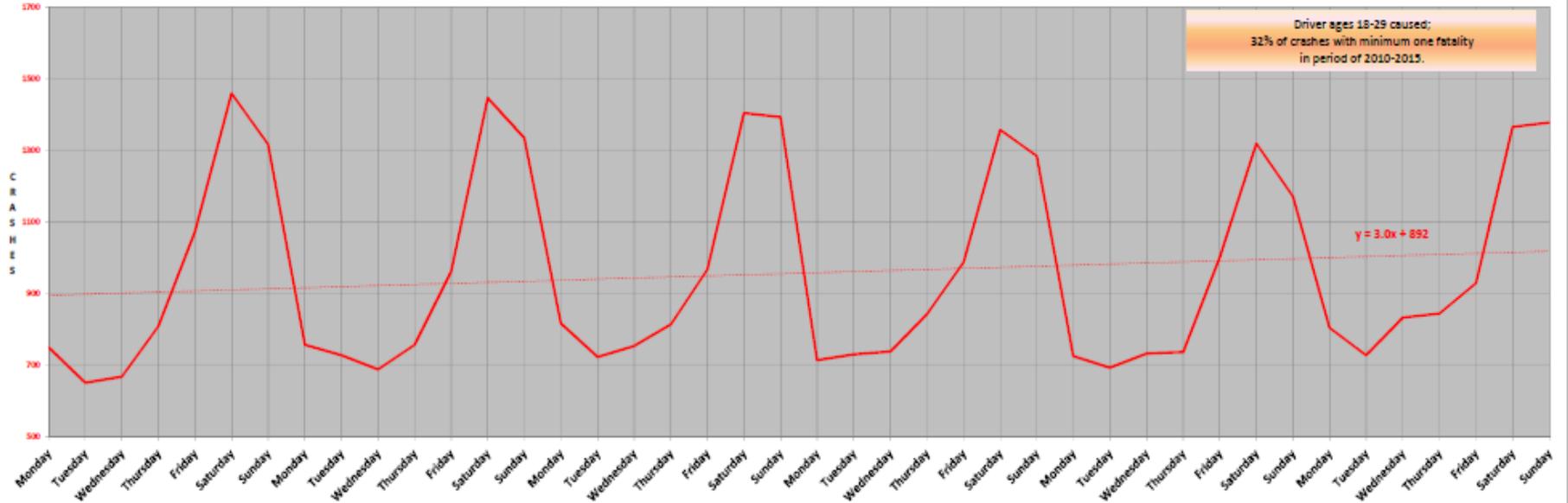


- Age category 18-29 crashes have 24 hour, weekly, and monthly patterns.
- 42% of crashes occurred from 7 pm-3 am.
- 55% of crashes occurred on Friday, Saturday, and Sunday.



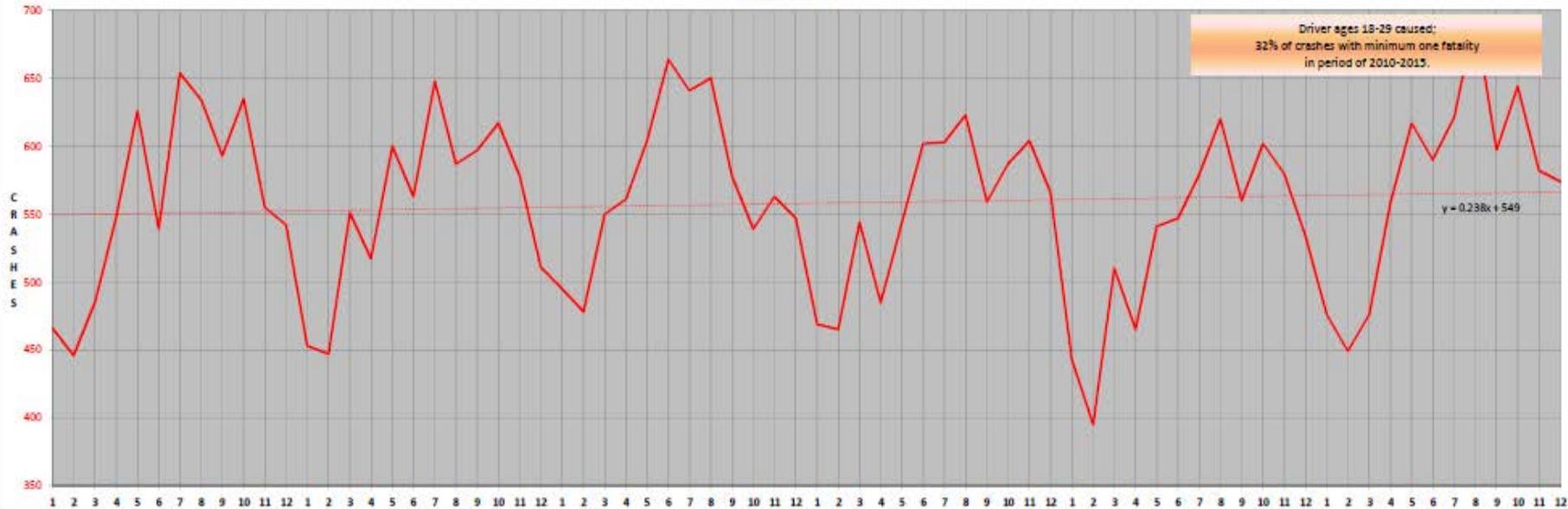
DRIVER AGE 18-29 CRASHES PER DAY OF WEEK

Sample Size= 40,169
FARS, 2010 to 2015



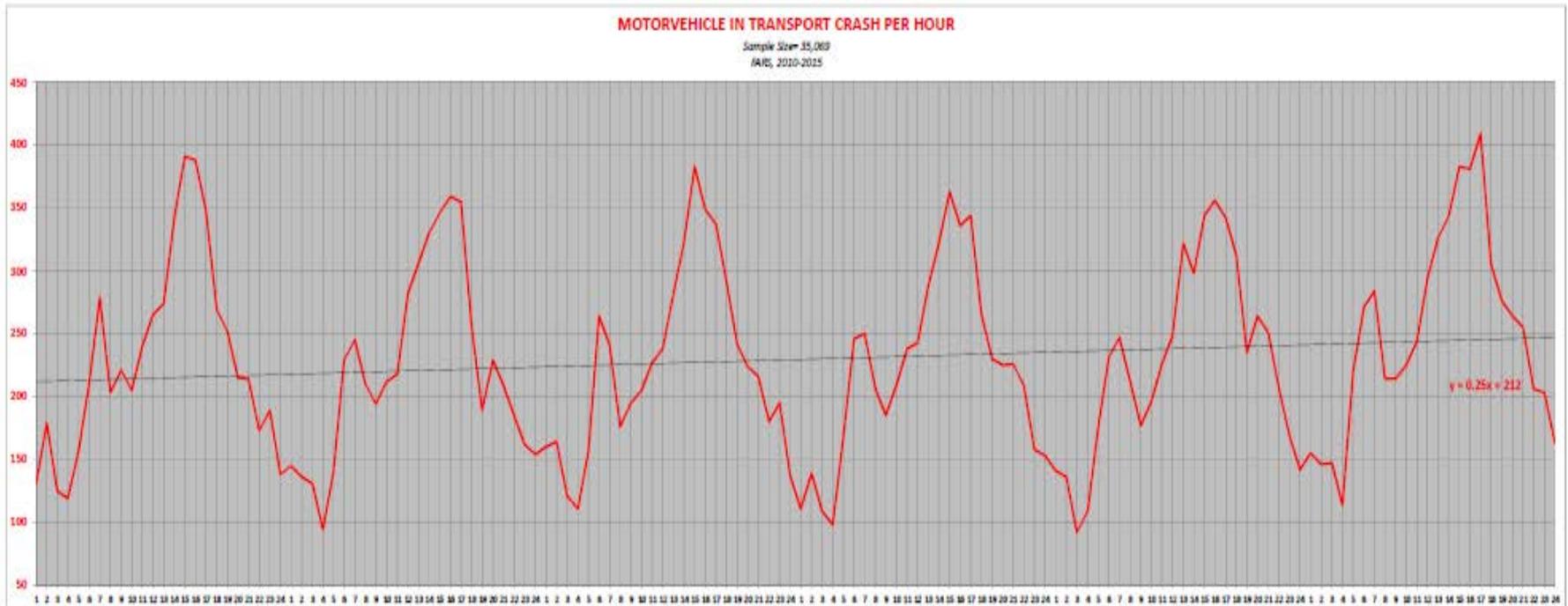
DRIVER AGE 18-29 CRASHES PER MONTH OF YEAR

Sample Size= 40,169
FARS, 2010 to 2015

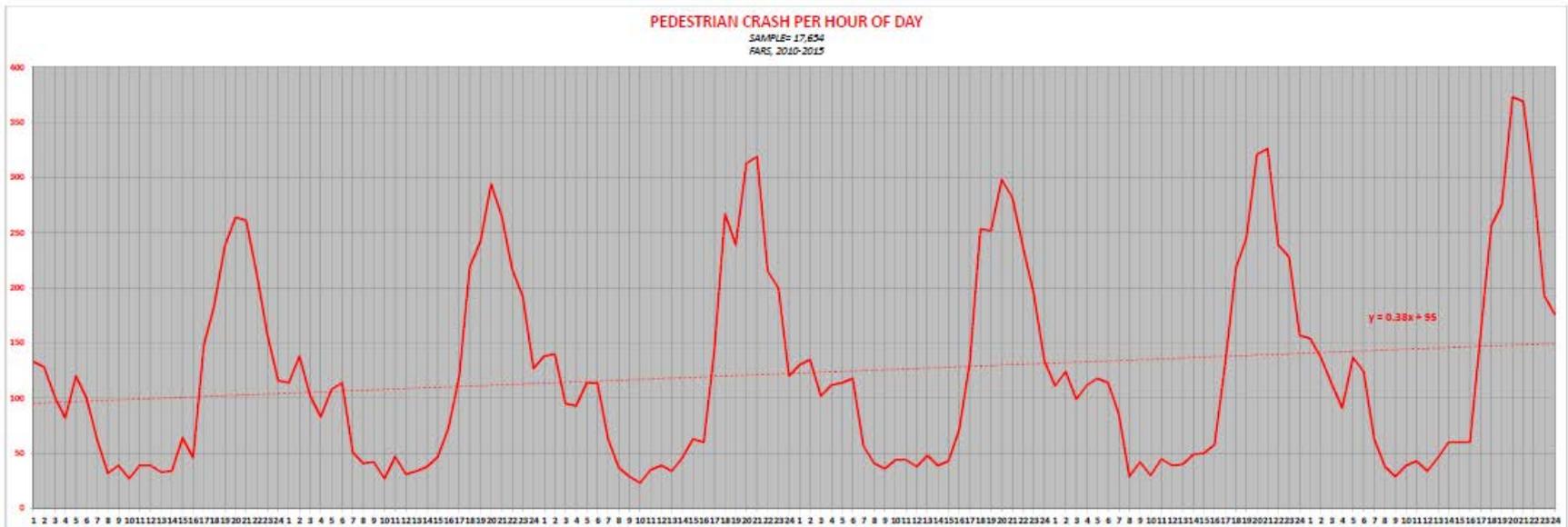


FIRST HARM EVENT		Frequency	Percent
<i>Number</i>	<i>Total</i>	125,680	100
1	Motor Vehicle In-Transport	33,097	26.3
2	Pedestrian	17,755	14.1
3	Rollover/Overturn	14,839	11.8
4	Tree (Standing Only)	13,123	10.4
5	Ditch	5,738	4.6
6	Embankment	5,463	4.3
7	Curb	4,127	3.3
8	Utility Pole/Light Support	3,644	2.9
9	Guardrail Face	3,643	2.9
10	Culvert	2,403	1.9
11	Pedalcyclist	2,385	1.9
12	Fence	2,166	1.7
13	Traffic Sign Support	1,798	1.4
14	Mail Box	1,629	1.3
15	Parked Motor Vehicle	1,548	1.2
16	Other Post, Other Pole or Other Supports	1,329	1.1
17	Other Fixed Object	1,323	1.1
18	Concrete Traffic Barrier	1,101	0.9
19	Live Animal	1,043	0.8
20	Fell/Jumped from Vehicle	990	0.8

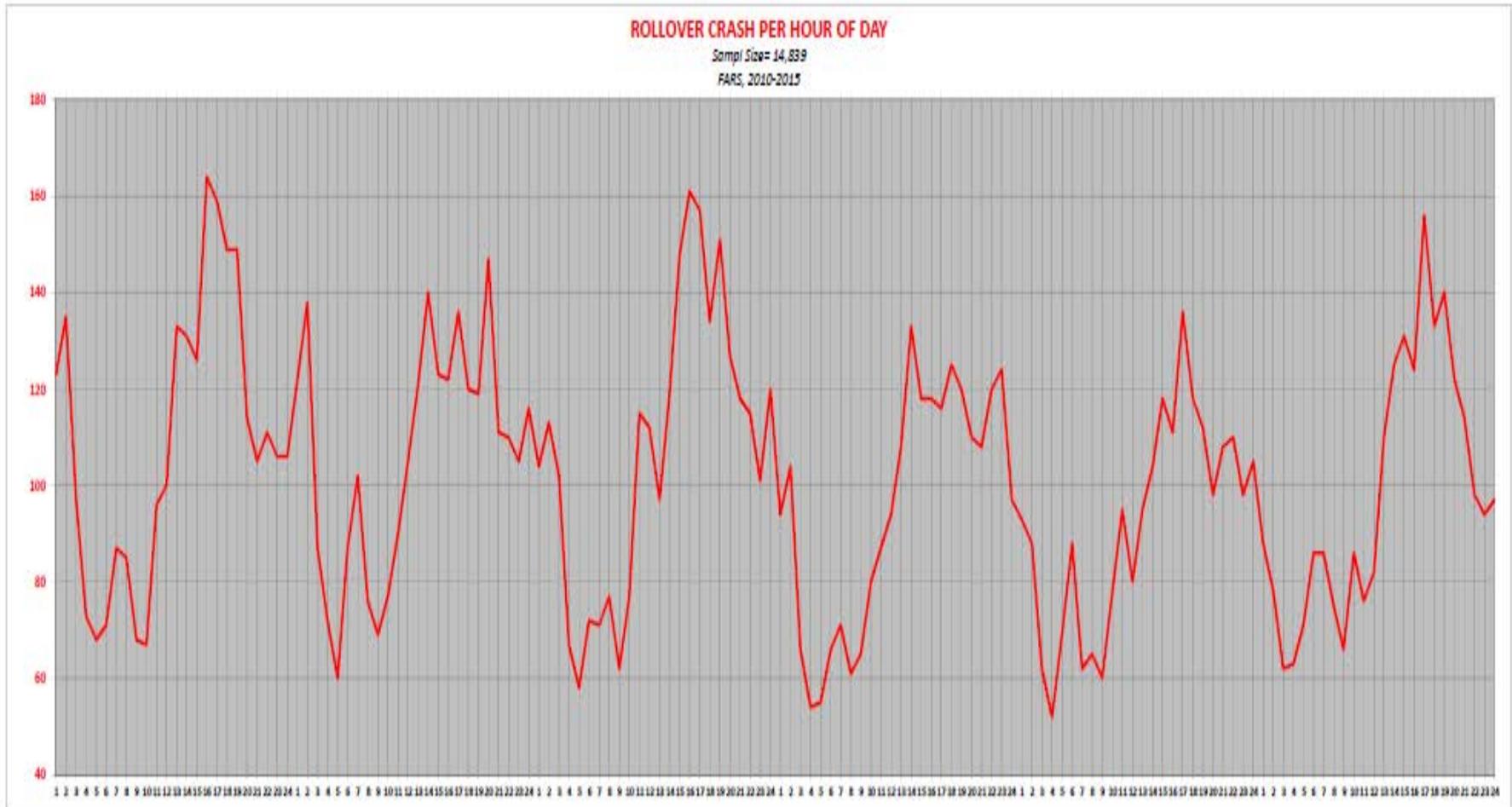
- Motor Vehicle in Transport crashes have a 24 hour recurring pattern.
- **36%** of crashes occurred between 12 pm to 5 pm (5 hours.)
- Crashes were **2.12** times more likely to occur in period of 12 pm-5 pm compared to crashes that occurred in rest of the hours (6 pm-11 pm.)



- Pedestrian crashes have a 24 hour cyclic pattern.
- **61%** of crashes occurred between 5 pm to 12 am (8 hours)
- Crashes were **3.16** times more likely to occur in period of 5 pm-12 am compared to crashes that occurred in rest of the hours (1 am-4 pm.)

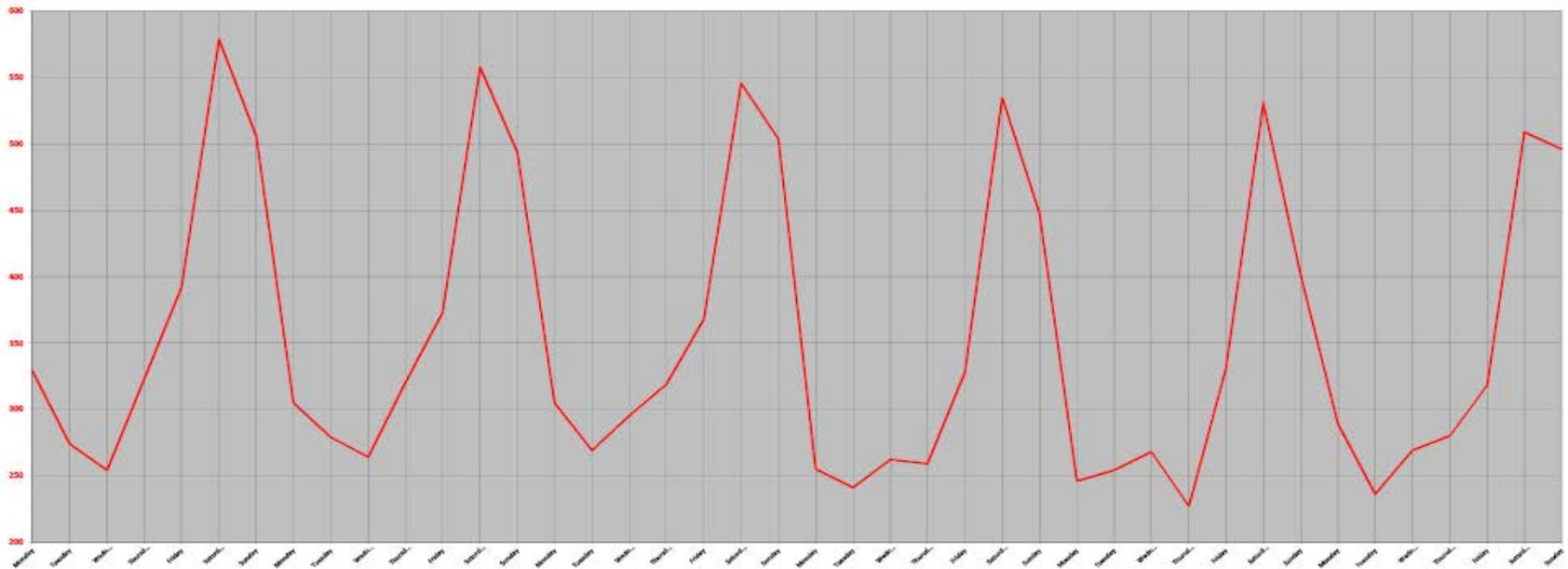


- Rollover crashes have 24 hour, weekly, and monthly patterns.
- **51%** of crashes occurred between 5 pm to 12 am (7 hours)
- Crashes were **2.52** times more likely to occur in period of 5 pm-12 am compared to crashes that occurred in rest of the hours (1 am-4 pm.)



ROLLOVER CRASH PER DAY OF WEEK

Sample Size= 14,839
FAIS, 2010-2015



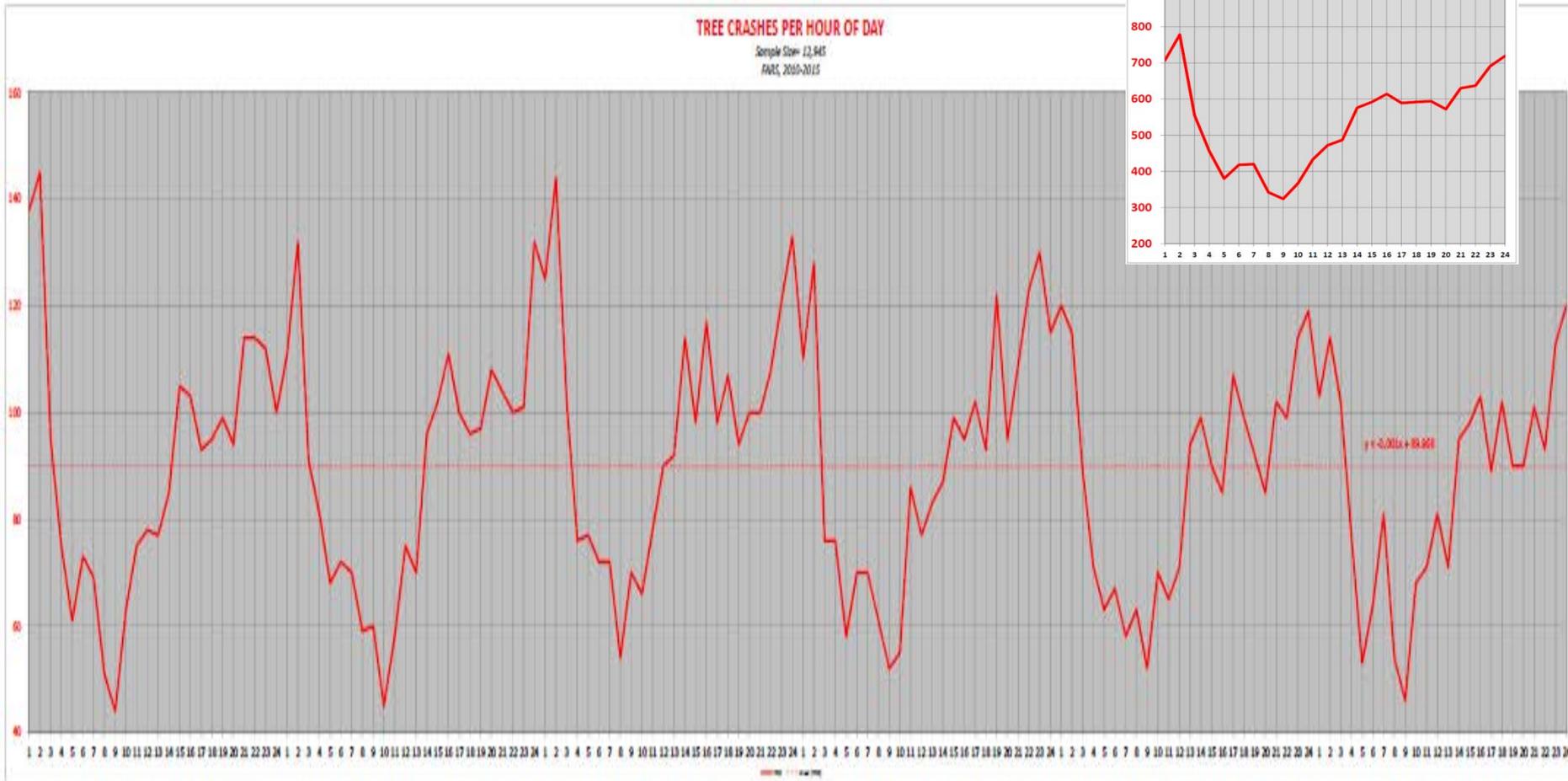
ROLLOVER CRASH PER MONTH OF YEAR

Sample Size= 14,839
FAIS, 2010-2015

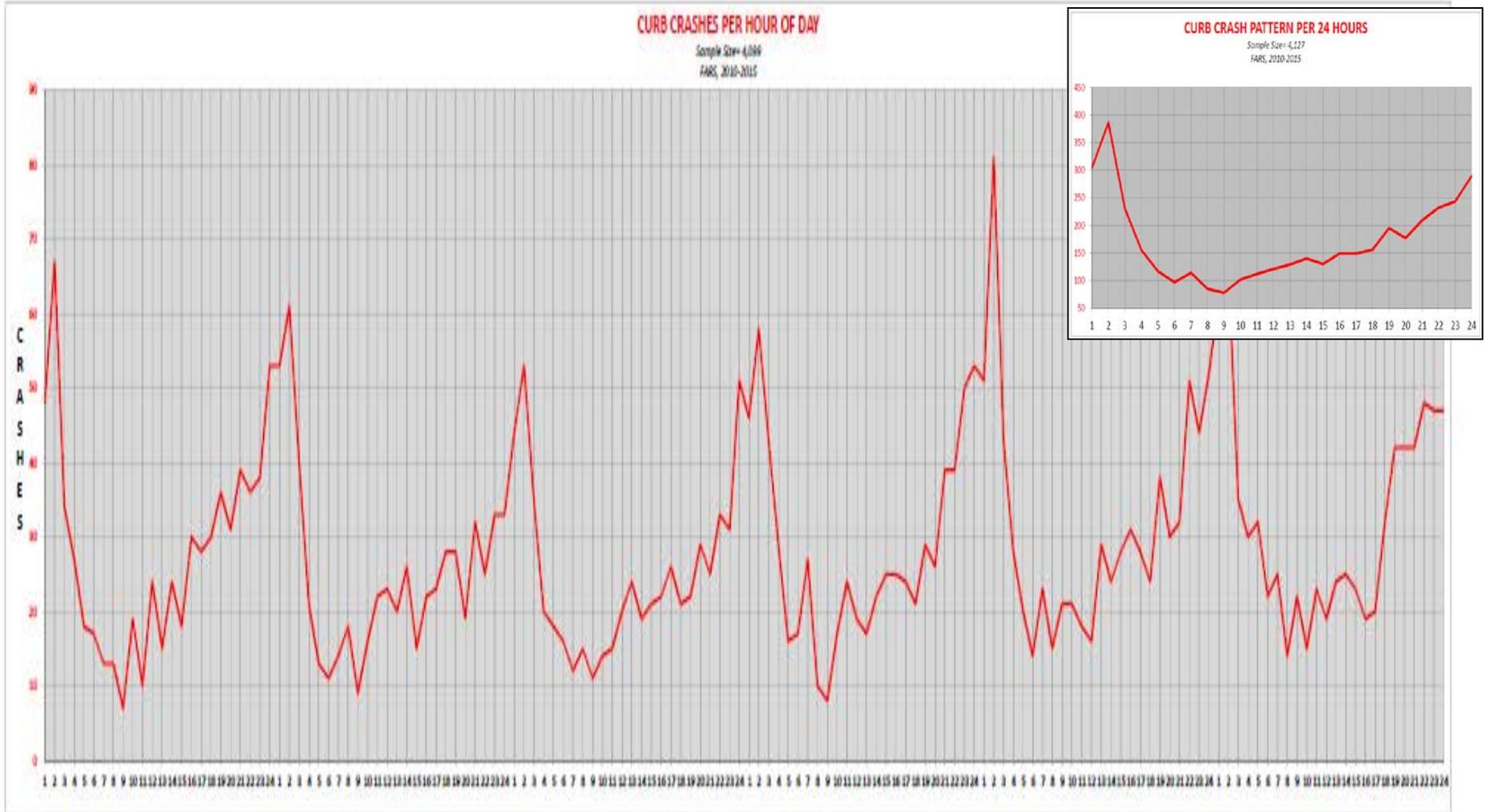


-36% of Tree crashes occurred from 9 pm to 3 am.

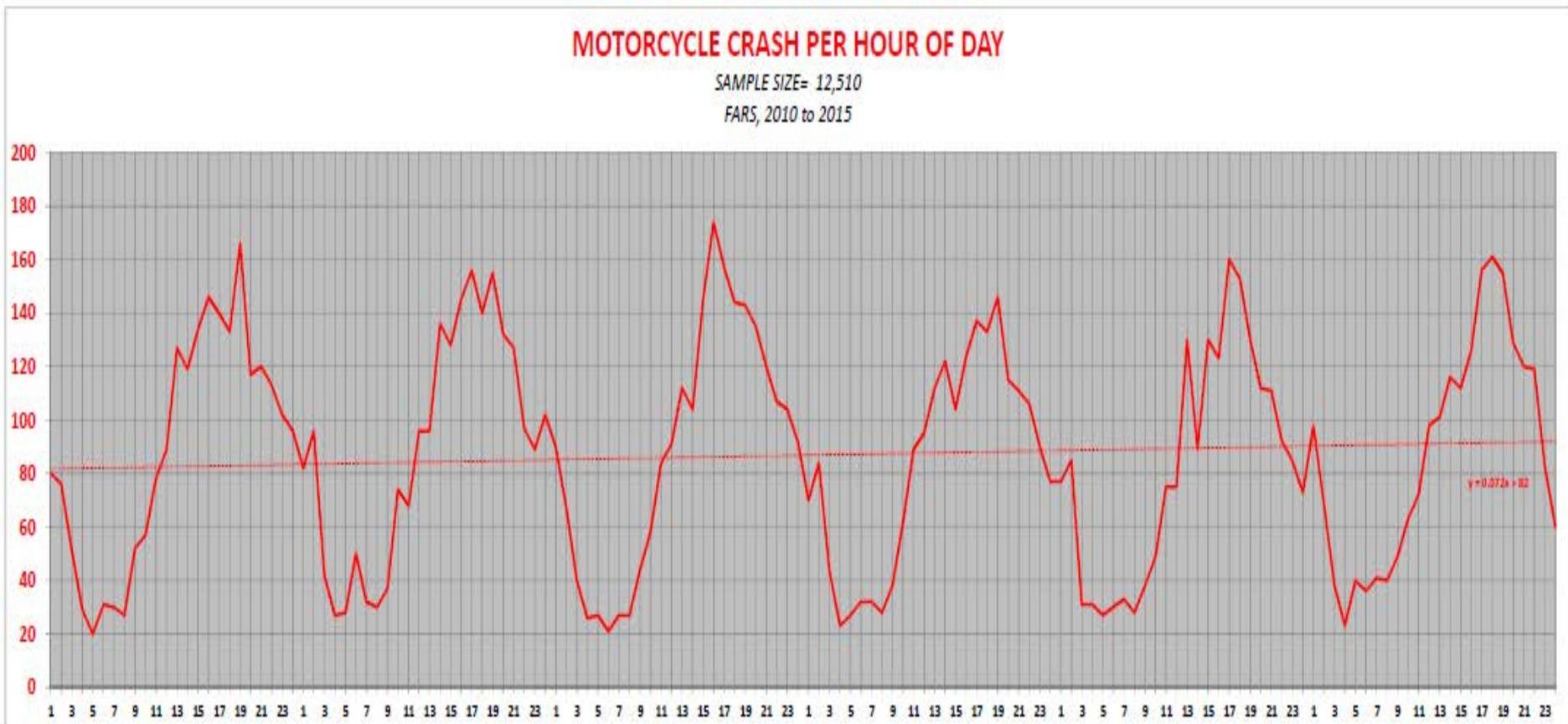
- Crashes were 1.7 times more likely to occur in period of 9 pm-3 am compared to crashes that occurred in rest of the hours (4 am-8 pm.)



- **66%** of Curb Crashes occurred from 7:00 pm to 4:00 am.
- Crashes were **3.3** times more likely to occur in period of 7 pm-4 am compared to crashes that occurred in rest of the hours (5 am-6 pm.)

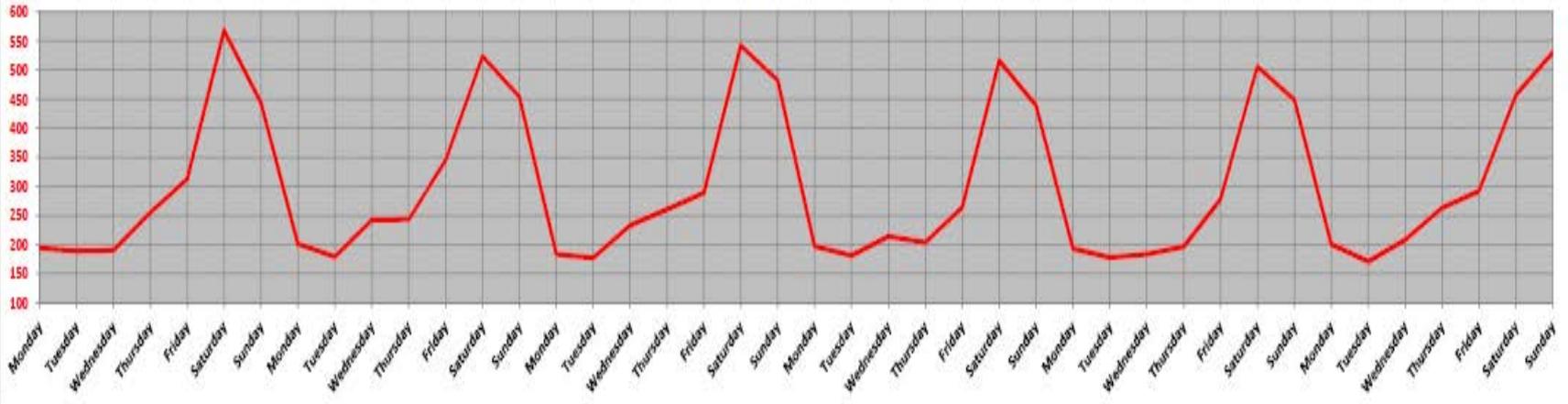


- Motorcycle crashes have 24 hour, weekly, and monthly patterns.
- **51%** of crashes occurred between 5 pm to 12 am (7 hours)
- Crashes were **2.52** times more likely to occur in period of 1 pm-6 pm compared to crashes that occurred in rest of the hours (7 pm-12 pm.)



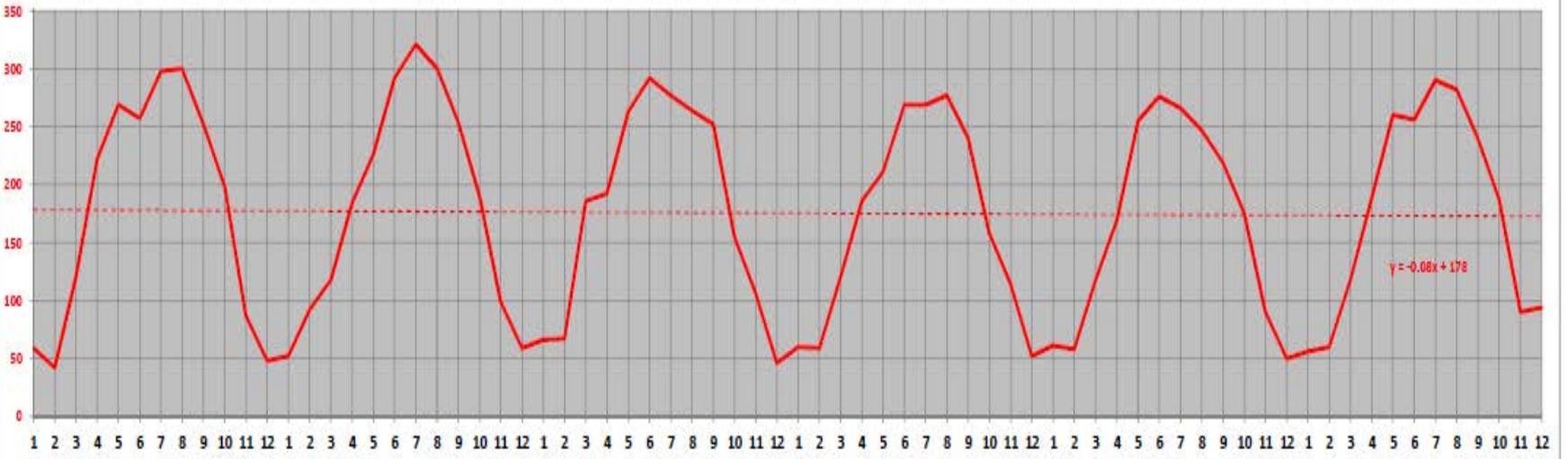
MOTORCYCLE CRASH PER DAY OF WEEK

SAMPLE SIZE= 12,624
FARS, 2010 to 2015



MOTORCYCLE CRASH PER MONTH OF YEAR

SAMPLE SIZE= 12,624
FARS, 2010 to 2015



Major Apparent Factors for Crashes with Minimum One Fatality

For subjects discussed in this presentation:

- **Nighttime**
- Driver age 18-29 at **nights** and weekends
- Congestion (planning/operation/design)
- Pedestrian at **night**
- Rollovers at **nights** and on Friday, Saturday, and Sunday
- Trees at **night**
- Curbs at **night**
- More

Opportunities to Learn From Crash Patterns!

If highway crashes look chaotic and difficult to predict, that means we have not recognized their patterns yet.

– Highway crashes are predictable and preventable.

**“Those who fail to learn from history
are doomed to repeat it”**

Sir Winston Churchill

THANK YOU!

- Questions?

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