

Using LTPP Weigh-in-Motion (WIM) Data for Analyzing the Effects of Legal Vehicle Load Limits on Pavement Performance

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Using LTPP Weigh-in-Motion (WIM) Data for Analyzing the Effects of Legal Vehicle Load Limits on Pavement Performance

- a. Use LTPP WIM data to characterize the effects of increasing allowable gross vehicle loads, on individual axle weights for a pilot case study in the State of Maine in 2010
- b. Analyze the effects of increasing axle loads on pavements using the AASHTO Mechanistic-Empirical Pavement Design Guide

Legal axle and gross vehicle loads (pounds) for six axle combinations per Maine and Federal Laws





Axle Configuration	Maine State Roads	2010 Pilot Interstate	Federal Interstate
Single axle load	22,400	22,400	20,000
Tandem axle load	38,000	41,000	34,000
Tridem axle load	48,000	50,000	43,000*
Gross vehicle weight 6 axle combinations	100,000	100,000	80,000

*** Based on bridge formula with 9 foot 4 inch axle spacing**

POPULATED PLACES

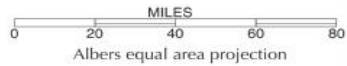
- 25,000 – 99,999 • Portland
- 24,999 and less • Millinocket
- State capital ★ Augusta

TRANSPORTATION

- Interstate; limited access highway 
- Other principal highway 
- Railroad 
- Ferry 

PHYSICAL FEATURES

- Streams 
- Lakes 
- Highest elevation in state (feet) +5267
- The lowest elevation in Maine is sea level (Atlantic Ocean).



Traffic Inputs for Mechanistic-Empirical Pavement Design

- ✓ AADTT in design lane
- ✓ Vehicle class distribution by month
- ✓ Average number of single, tandem, tridem and quad axles per truck, for each class 4 to 13
- ✓ Growth function (linear or compound) and rate
- ✓ Monthly distributions by class
- ✓ Hourly distribution by class
- ✓ Wheelbase's of tractors, tridems and quads
- ✓ Average axle spacing's for tandem
- ✓ Operating speed {for asphalt concrete modulus function}
- ✓ Default tire pressure (120 psi)

US Route 2 – near LTPP section 23-1028



**HIGH SEVERITY CENTERLINE CRACK ON ME I-95 OPEN
GRADED FRICTION COURSE AFTER 23 YEARS OF TRAFFIC**



HIGH SEVERITY TRANSVERSE CRACK ON ME I-95 OPEN GRADED FRICTION COURSE AFTER 23 YEARS OF TRAFFIC



ME DOT STAFF TAKING NUCLEAR DENSITY OF FRESH MIXTURE ON AN SPS-5 SECTION ON JUNE 27TH, 1995





ME DOT STAFF MEASURING LOCATION OF WHEELPATHS AND DENSITY ON AN SPS-5 SECTION ON OCTOBER 5TH, 1995



LTPP Vehicle Classification Schema

(Adopted by Traffic Expert Task Group, March 2006)

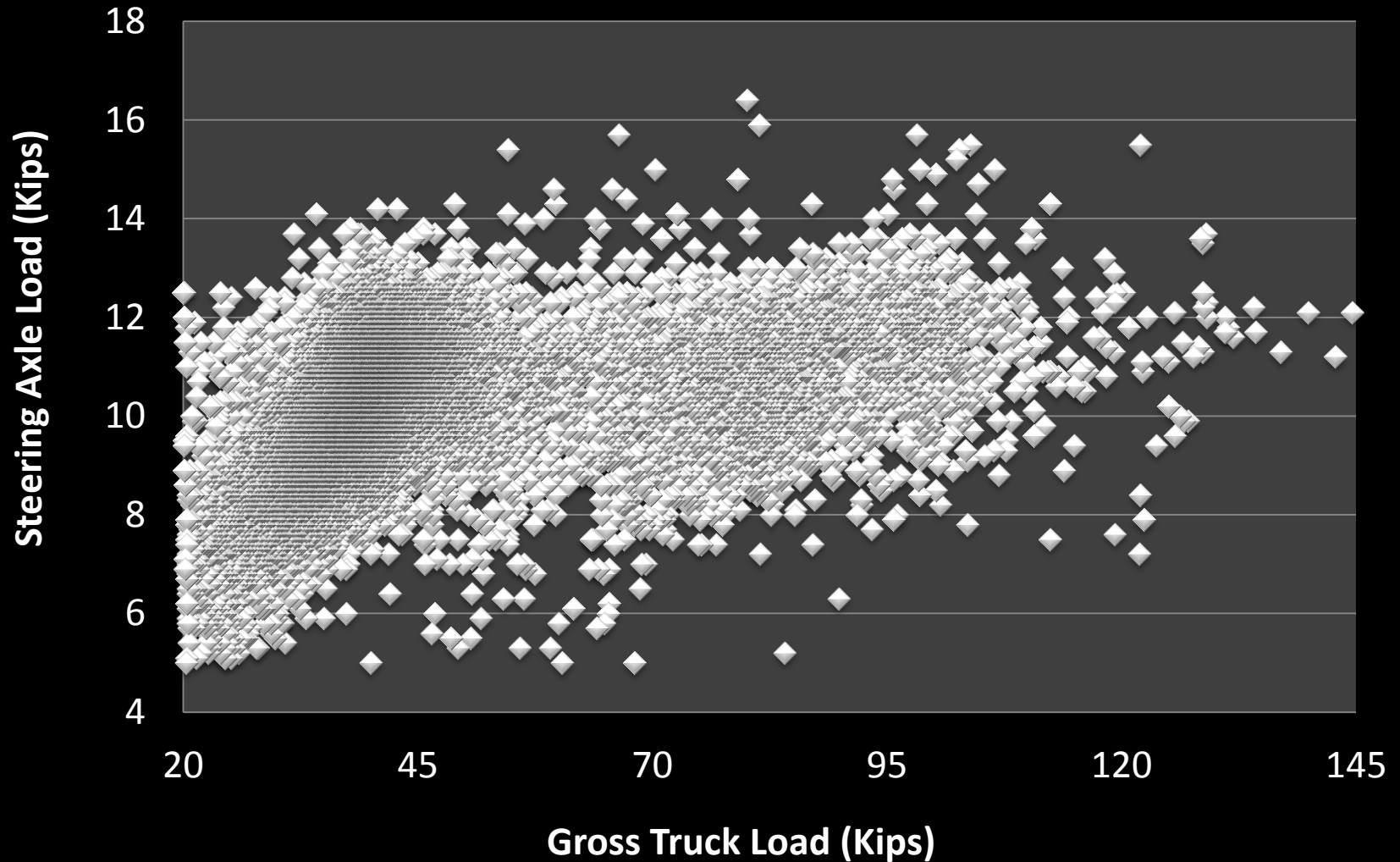
<u>VEHICLE CLASS AND TYPE</u>	<u>NO. AXLES</u>	<u>1ST SPACE</u>	<u>2ND SPACE</u>	<u>3RD SPACE</u>	<u>4TH SPACE</u>	<u>5TH SPACE</u>	<u>6TH SPACE</u>	<u>7TH SPACE</u>	<u>8TH SPACE</u>	<u>GROSS LOAD</u>	<u>STEERING AXLE LOAD</u>
4 Bus	Two	23.1 to 40								>12	
4 Bus	Three	23.1 to 40	3 to 7							>20	
5 2D Single unit	Two	6 to 23.1								>8	>2.5
6 Single unit	Three	6 to 23.1	2.5 to 6.3							>12	>3.5
7 Single unit	Four	6 to 23.1	2.5 to 6.3	2.5 to 13						>12	>3.5
7 Single unit	Five	6 to 23.1	2.5 to 6.3	2.5 to 6.3	2.5 to 6.3					>12	>3.5
8 Semi (3S1)	Four	6 to 26	2.5 to 6.3	13 to 50						>20	>5.0
8 Semi (2S2)	Four	6 to 26	8 to 45	2.5 to 20						>20	>3.5
9 Semi (3S2)	Five	6 to 30	2.5 to 6.3	6.3 to 45	2.5 to 12					>20	>5.0
9 Truck + trailer (3-2)	Five	6 to 30	2.5 to 6.3	6.3 to 50	12 to 27					>20	>3.5
9 Semi (2S3)	Five	6 to 30	16 to 45	2.5 to 6.3	2.5 to 6.3					>20	>3.5
10 Semi (3S3)	Six	6 to 26	2.5 to 6.3	6.1 to 50	2.5 to 12	2.5 to 11				>20	>5.0
11 Semi + trailer (2S12)	Five	6 to 30	11 to 26	6 to 20	11 to 26					>20	>3.5
12 Semi + trailer (3S12)	Six	6 to 26	2.5 to 6.3	11 to 26	6 to 24	11 to 26				>20	>5.0
13 7 Axle multist	Seven	6 to 45	3 to 45	3 to 45	3 to 45	3 to 45	3 to 45			>20	>5.0
13 8 Axle multist	Eight	6 to 45	3 to 45	3 to 45	3 to 45	3 to 45	3 to 45	3 to 45		>20	>5.0
13 9 Axle multist	Nine	6 to 45	3 to 45	3 to 45	3 to 45	3 to 45	3 to 45	3 to 45	3 to 45	>20	>5.0

LTTP Classification Schema

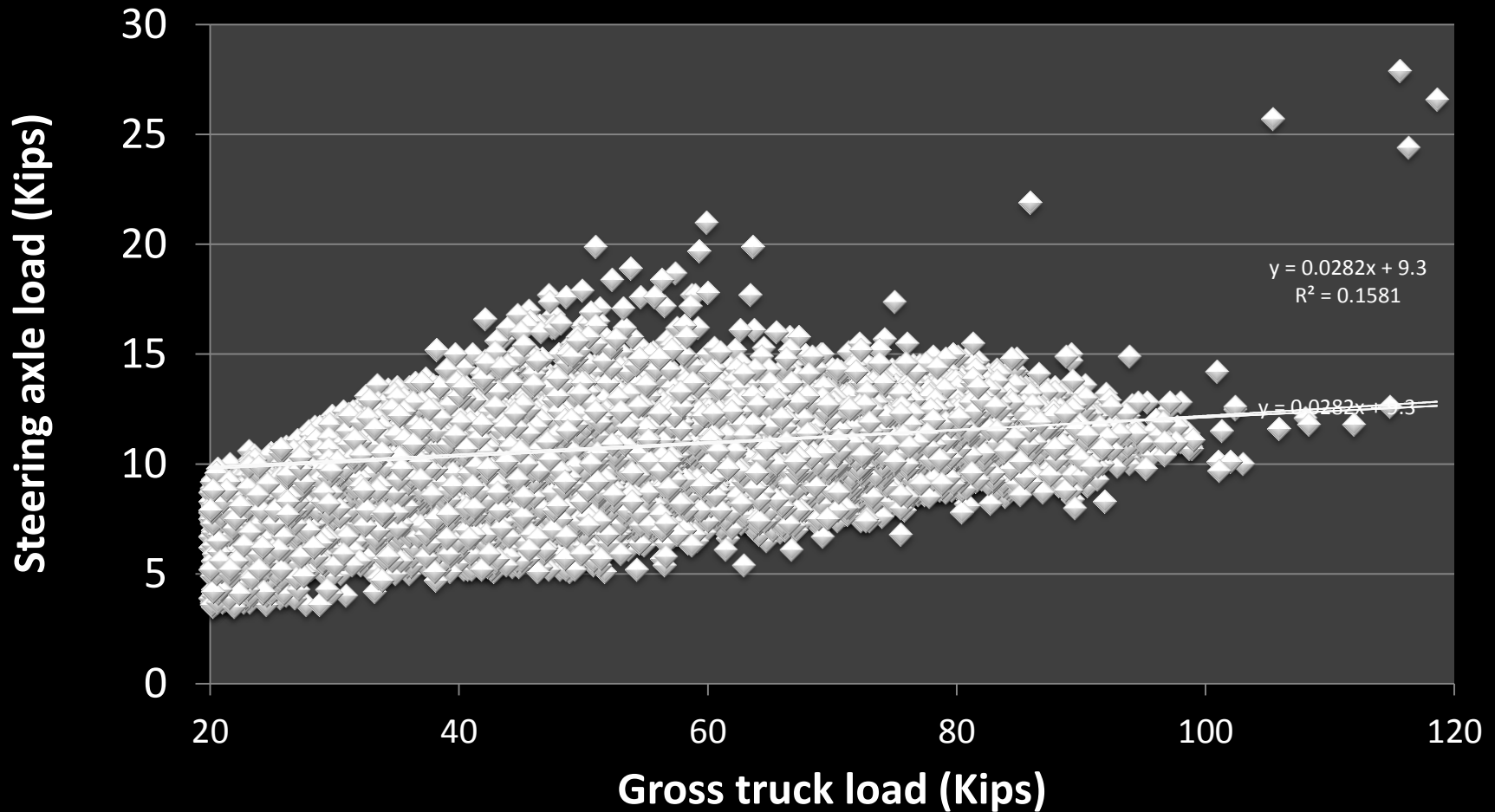
(January 2013)

<u>VEHICLE CLASS AND TYPE</u>		<u>NUMBER OF AXLES</u>	<u>1ST SPACE</u>	<u>2ND SPACE</u>	<u>3RD SPACE</u>	<u>4TH SPACE</u>	<u>5TH SPACE</u>	<u>6TH SPACE</u>	<u>7TH SPACE</u>	<u>8TH SPACE</u>	<u>GROSS WEIGHT</u>	<u>STEERING AXLE WEIGHT</u>
4	Bus	Two	23.1 to 40								>12	
4	Bus	Three	23.1 to 40	3 to 7							>20	
5	2D Single unit	Two	6 to 23.1								>8	>2.5
6	Single unit	Three	6 to 23.1	2.5 to 6.3							>12	>3.5
7	Single unit	Four	6 to 23.1	2.5 to 6.3	2.5 to 13						>12	>3.5
7	Single unit	Five	6 to 23.1	2.5 to 6.3	2.5 to 6.3	2.5 to 15					>12	>3.5
7	Single unit	Six	6 to 23.1	2.5 to 6.3	2.5 to 6.3	2.5 to 6.3	2.5 to 15				>12	>3.5
7	Single unit	Seven	6 to 23.1	2.5 to 6.3	2.5 to 6.3	2.5 to 6.3	2.5 to 6.3	2.5 to 15			>12	>3.5
8	Semi (2S1)	Three	6 to 23.1	11 to 45							>20	>3.5
8	Semi 3S1	Four	6 to 26	2.5 to 6.3	13 to 50						>20	>5.0
8	Semi 2S2	Four	6 to 26	8 to 45	2.5 to 20						>20	>3.5
9	Semi 3S2	Five	6 to 30	2.5 to 6.3	6.3 to 45	2.5 to 12					>20	>5.0
9	Truck + trailer 3-2	Five	6 to 30	2.5 to 6.3	6.3 to 50	12 to 27					>20	>3.5
9	Semi 2S3	Five	6 to 30	16 to 45	2.5 to 6.3	2.5 to 6.3					>20	>3.5
10	Semi 3S3	Six	6 to 26	2.5 to 6.3	6.1 to 50	2.5 to 12	2.5 to 11				>20	>5.0
10	Truck (3) / trailer (4)	Seven	6 to 26	2.5 to 6.3	6.1 to 45	2.5 to 12	2.5 to 11	2.5 to 11			>20	>3.5
10	Truck (4) / trailer (3)	Seven	6 to 26	2.5 to 6.3	2.5 to 6.3	6.1 to 45	2.5 to 11	2.5 to 11			>20	>5.0
10	Truck (3) / trailer (5)	Eight	6 to 26	2.5 to 6.3	6.1 to 45	2.5 to 12	2.5 to 11	2.5 to 11	2.5 to 15		>20	>3.5
10	Truck (4) / trailer (4)	Eight	6 to 26	2.5 to 6.3	2.5 to 6.3	6.1 to 45	2.5 to 11	2.5 to 11	2.5 to 15		>20	>5.0
11	Semi + trailer 2S12	Five	6 to 30	11 to 26	6 to 20	11 to 26					>20	>3.5
12	Semi + trailer 3S12	Six	6 to 26	2.5 to 6.3	11 to 26	6 to 24	11 to 26				>20	>5.0
13	7 Axle multis	Seven	6 to 45	3 to 45	3 to 45	3 to 45	3 to 45	3 to 45			>20	>5.0
13	8 Axle multis	Eight	6 to 45	3 to 45	3 to 45	3 to 45	3 to 45	3 to 45	3 to 45		>20	>5.0
13	9 Axle multis	Nine	6 to 45	3 to 45	3 to 45	3 to 45	3 to 45	3 to 45	3 to 45	3 to 45	>20	>5.0

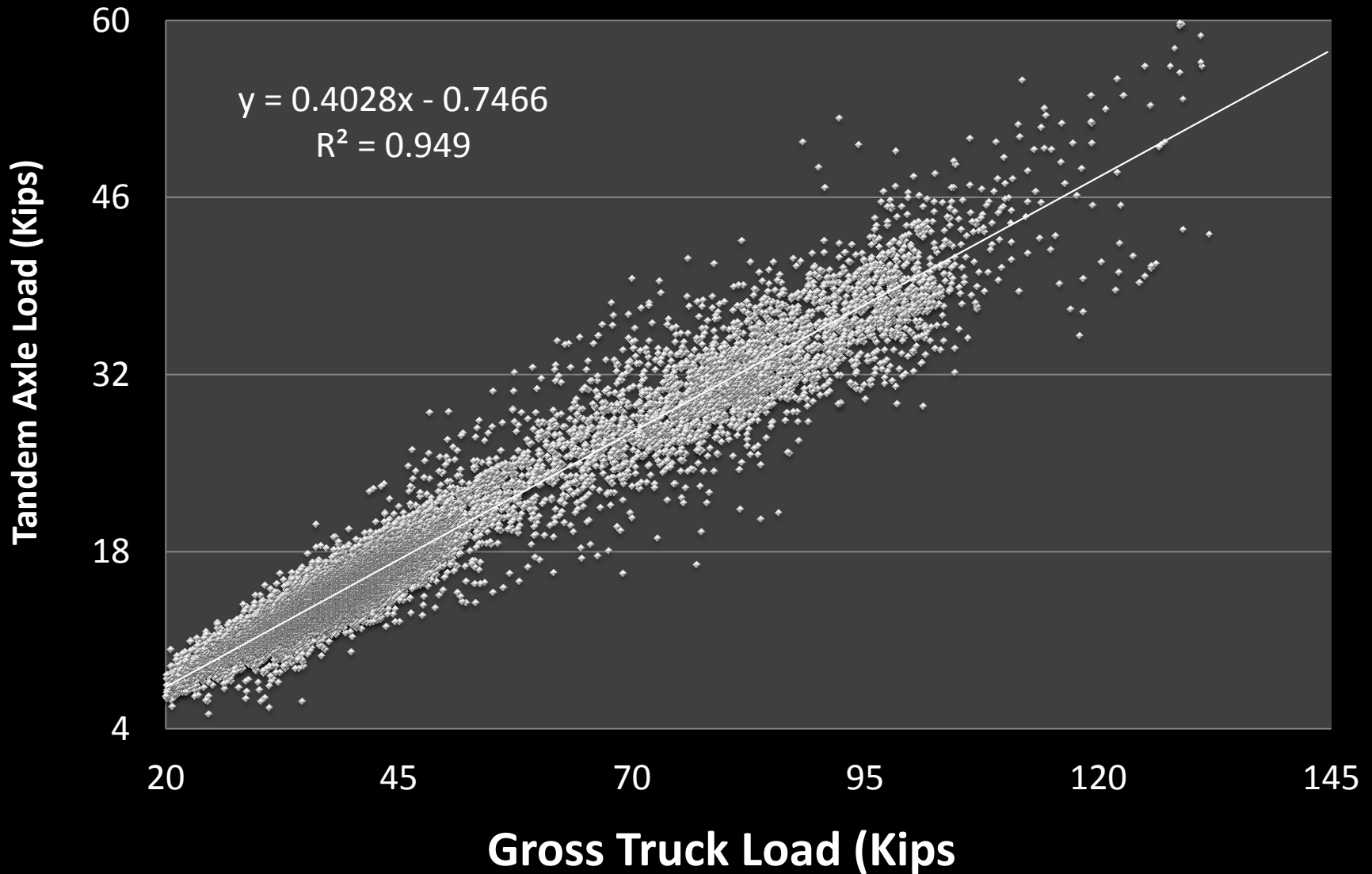
Steering axle load as a function of gross truck weight for 31,105 Class 10 - Six Axle Semis (1/1/09 - 12/18/09)



Steering axle load as a function of gross load on 104,029 Class 9 in 2009



Tandem axle load as a function of gross truck weight for 31,105 Class 10 - Six Axle Semis (1/1/09 - 12/18/09)



LTPP TABLES - MEPDG TRAFFIC VEHICLE CLASS DISTRIBUTION

LTPP Section 23-1028 U.S. Route 2

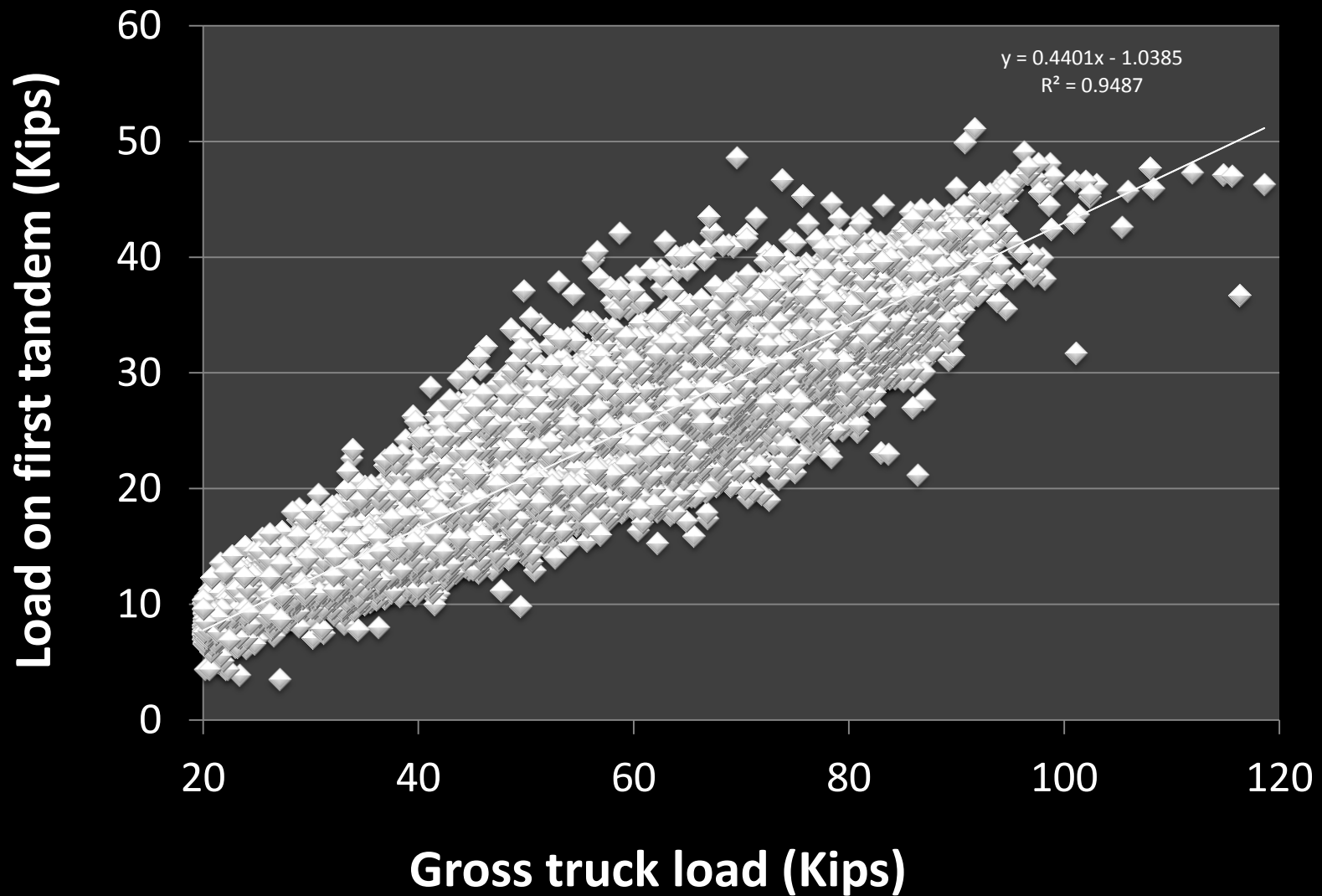
Class	00	01	02	03	04	05	06	08	09	10
4	6.7	6.1	5.2	5.3	5	5.6	6	5	5	5.4
5	18	21	23	26	28	24	23	31	31	21
6	7.9	6.1	5.5	6.8	9.7	5.7	6	6.3	6	5.6
7	2.3	1.7	1.6	1.6	1.6	1.9	1	2	2	2.4
8	2.5	2.3	2	2	2	2	2	1.6	1	1.2
9	24	23	18	18	16	16	16	12	14	14
10	38	40	44	41	38	47	47	43	41	50
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0
13	0.1	0	0.1	0.3	0.1	0.1	0	0	0	0.1

LTPP TABLES - MEPDG TRAFFIC VEHICLE CLASS DISTRIBUTION

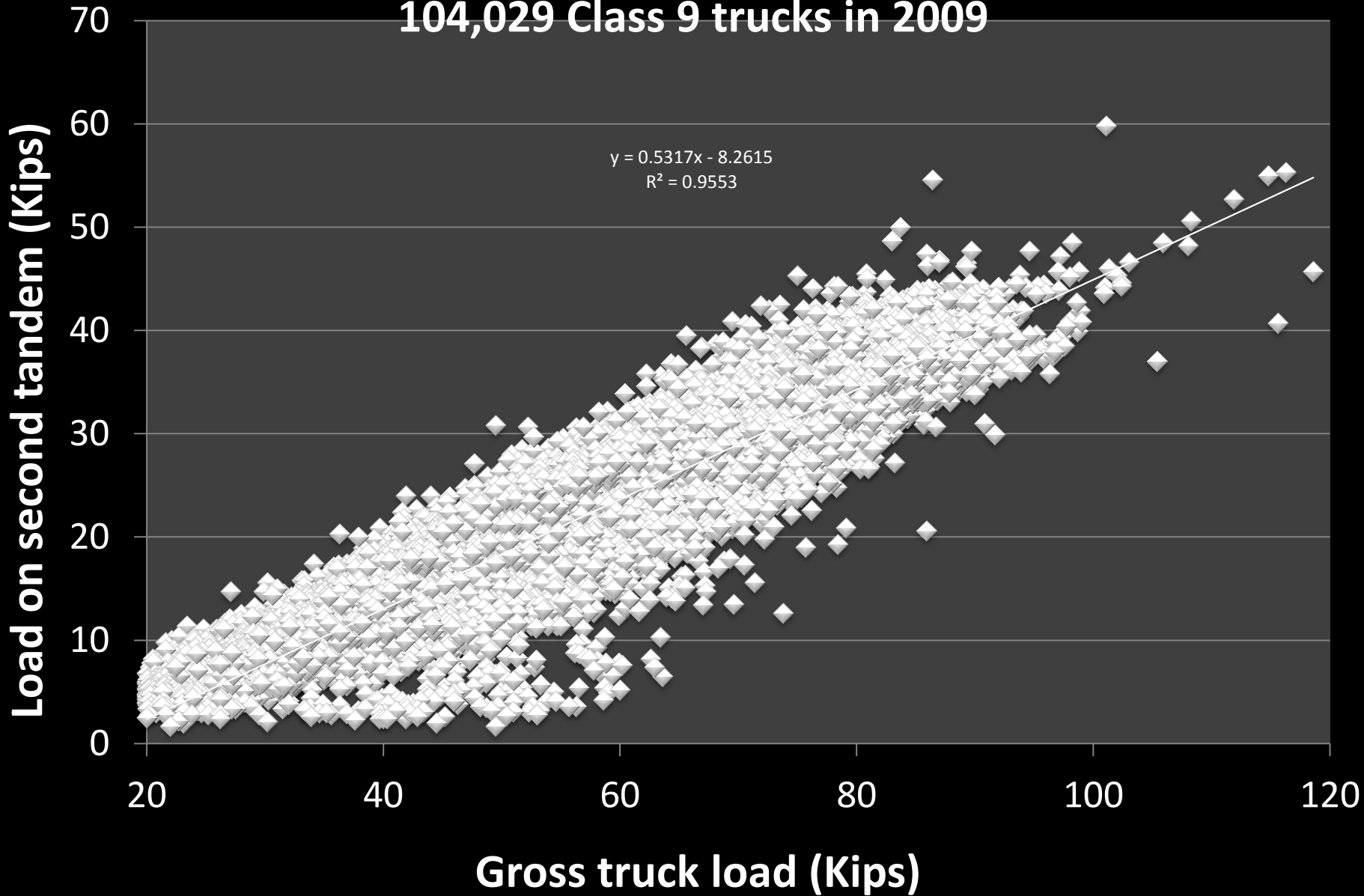
LTPP Section 23-0500 Interstate 95

Class		01	02	03				08	09	10
4		3.9	3.5	2.6				1	1	0.7
5		24	21	26				21	24	26
6		3.7	2.4					3.7	5	3.3
7		0	0.1	0.1				0.1	0	0.1
8		3.9	3.5	3.8				4.5	5	4.2
9		53	58	53				50	50	45
10		11	11	14				17	16	20
11		1	0.9	0.6				0.5	0	0.2
12		0.1	0.1	0.1				0	0	0.1
13		0	0	0				0	0	0

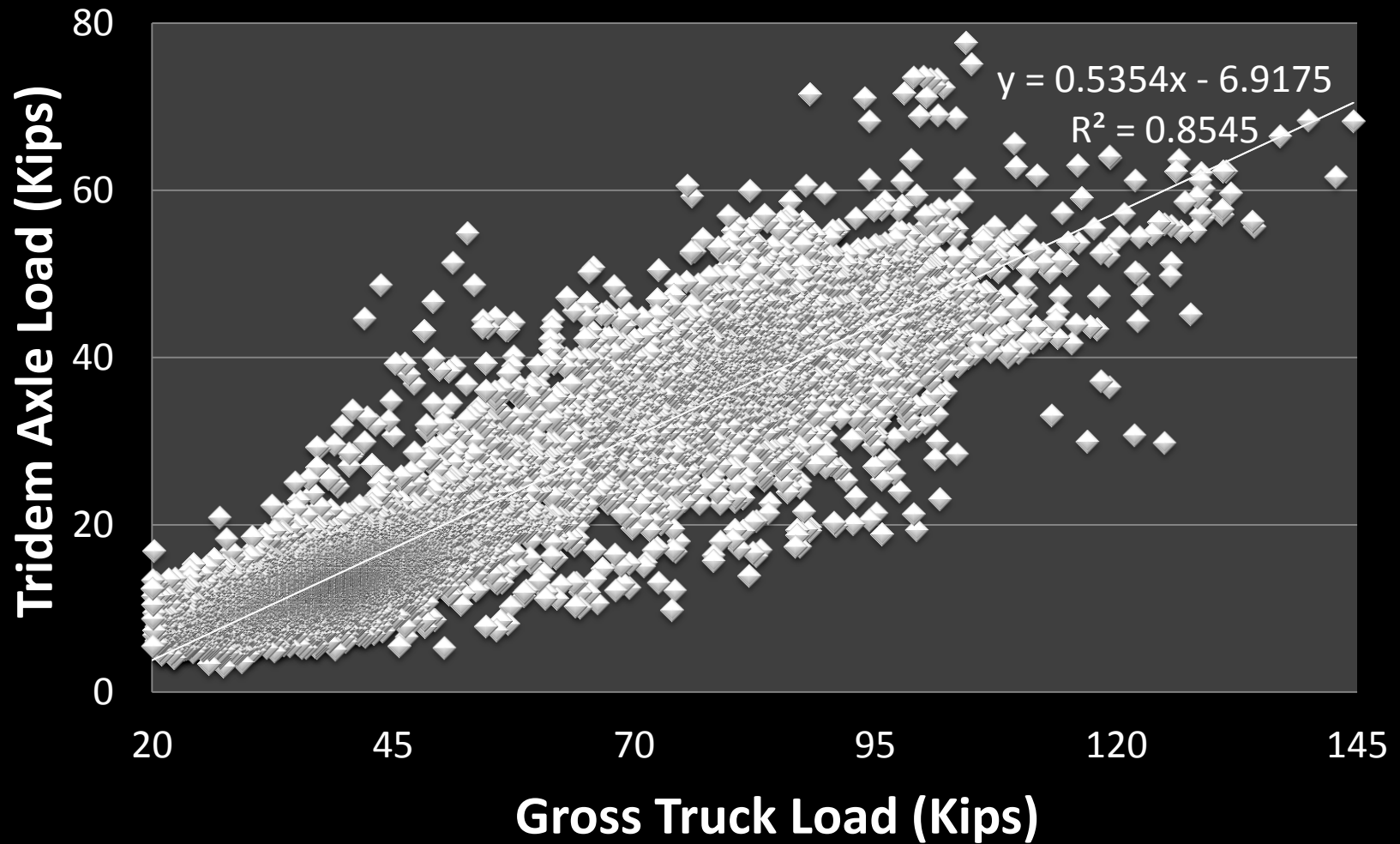
First tandem loading as a function of gross load on 107,840 Class 9 in 2010 up to 12/19



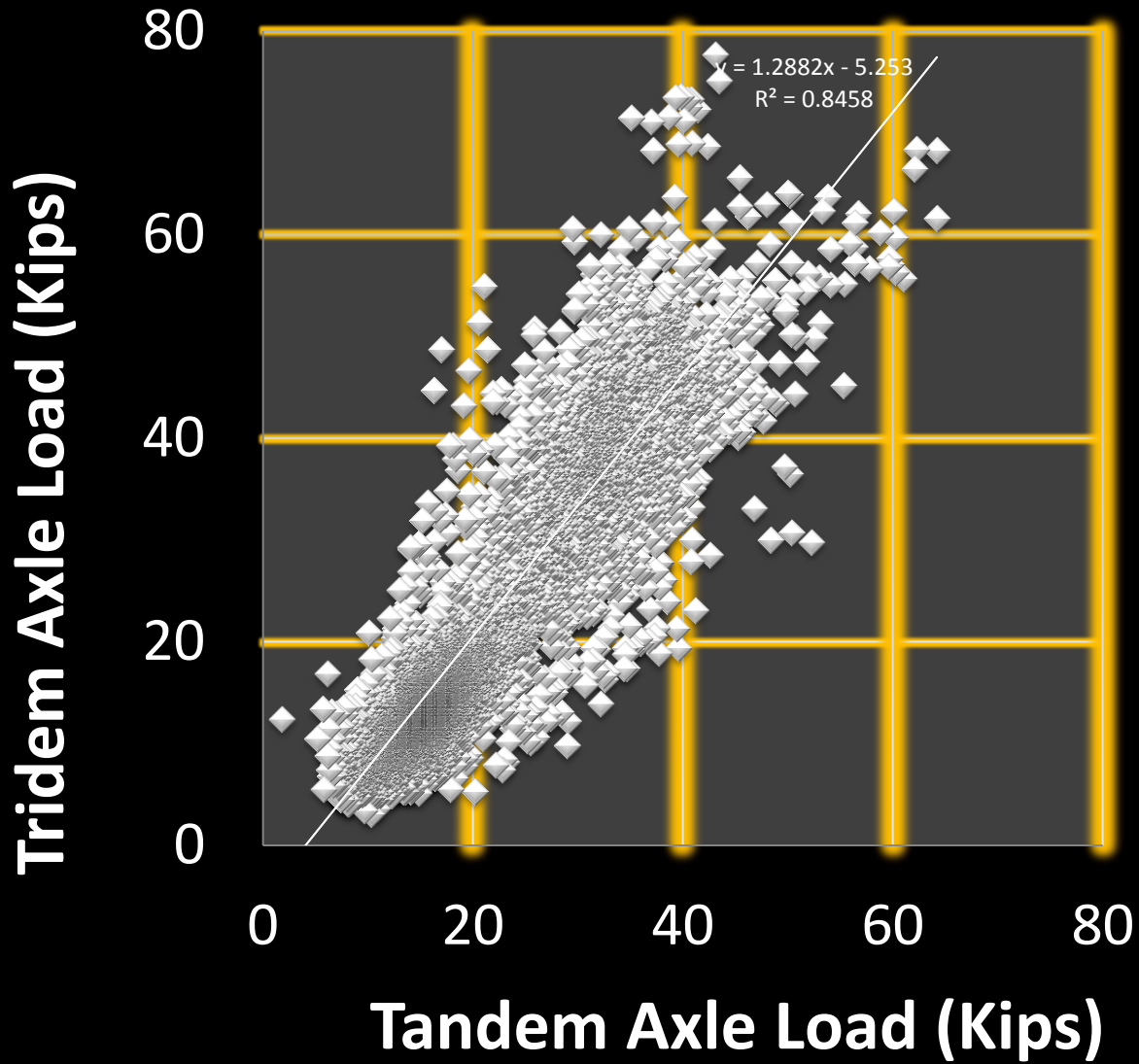
Second tandem loading as a function of gross load on 104,029 Class 9 trucks in 2009



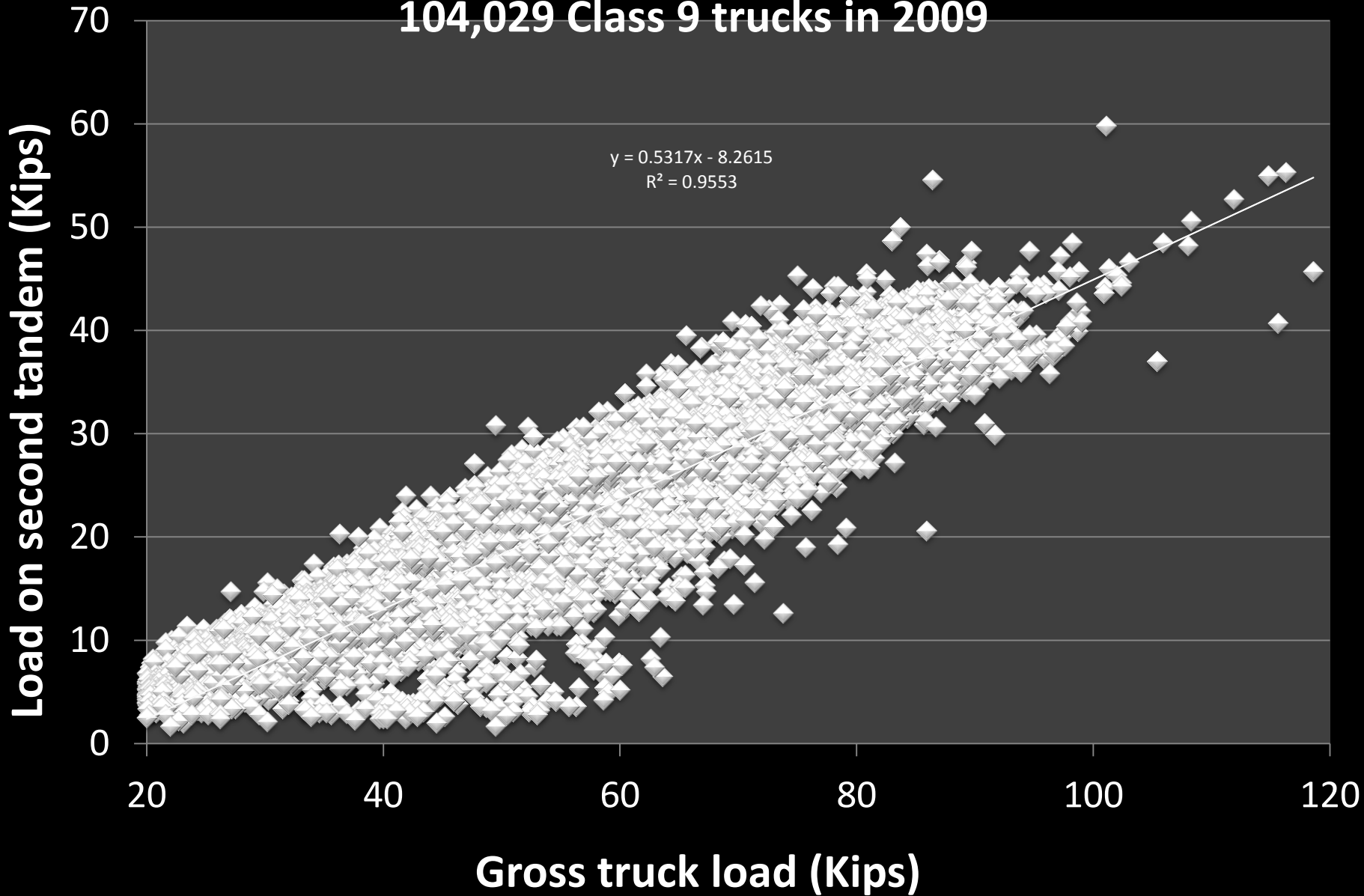
Tridem axle load as a function of gross truck weight for 31,105 Class 10 - Six Axle Semis (1/1/09 - 12/18/09)



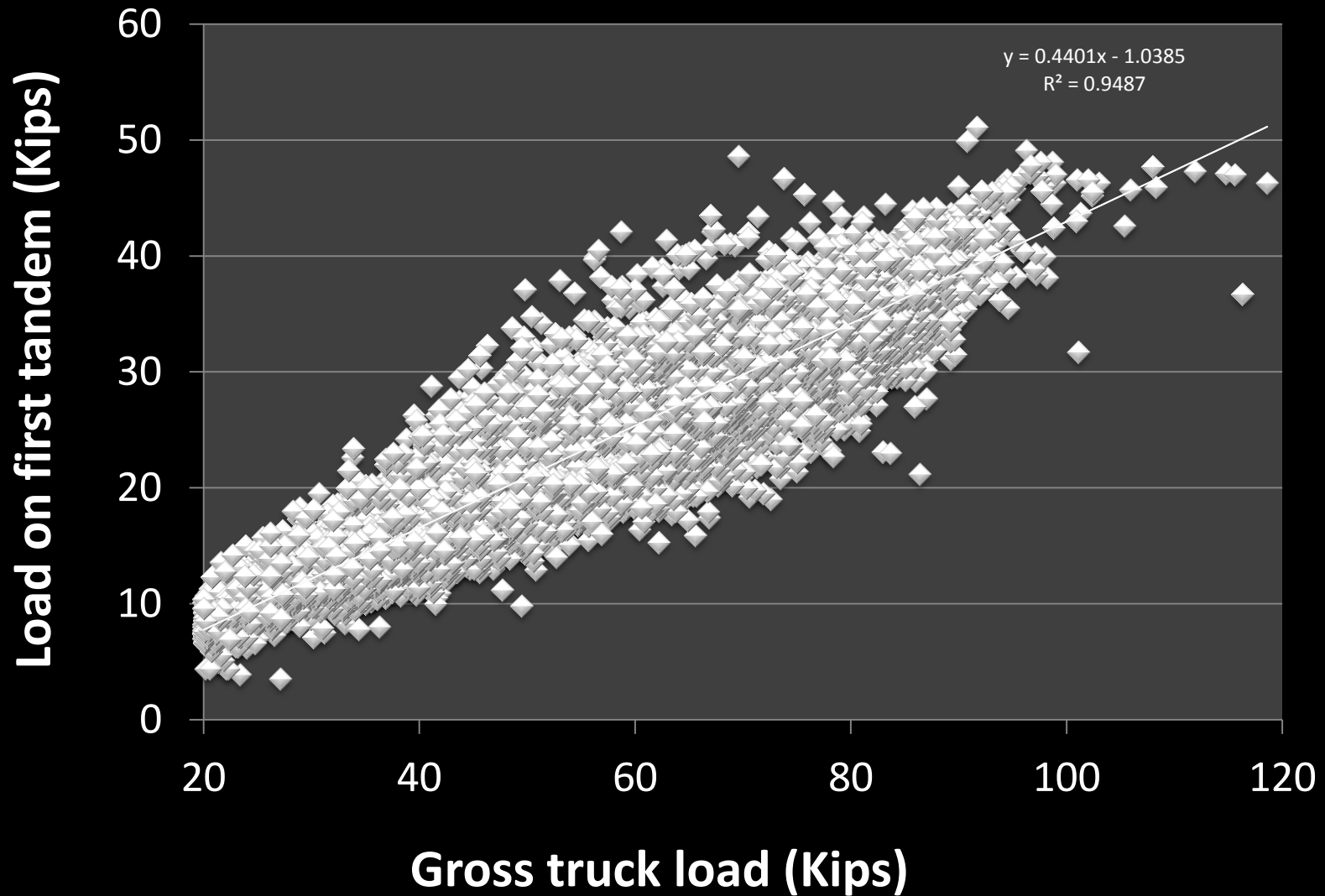
Tridem versus tandem axle loadings on 31,105 Class 10 – trucks (1/1/09 - 12/18/09)



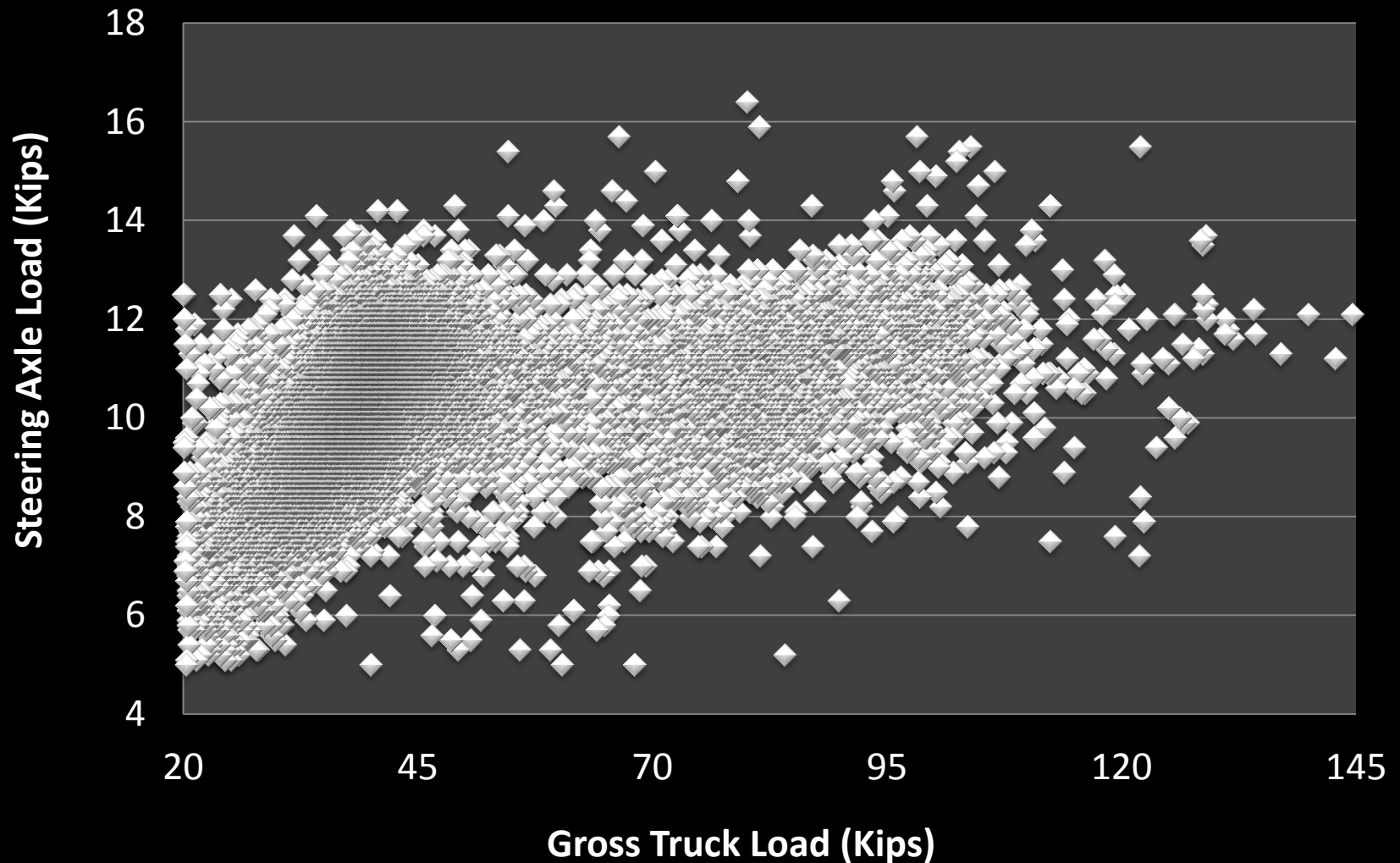
Second tandem loading as a function of gross load on 104,029 Class 9 trucks in 2009



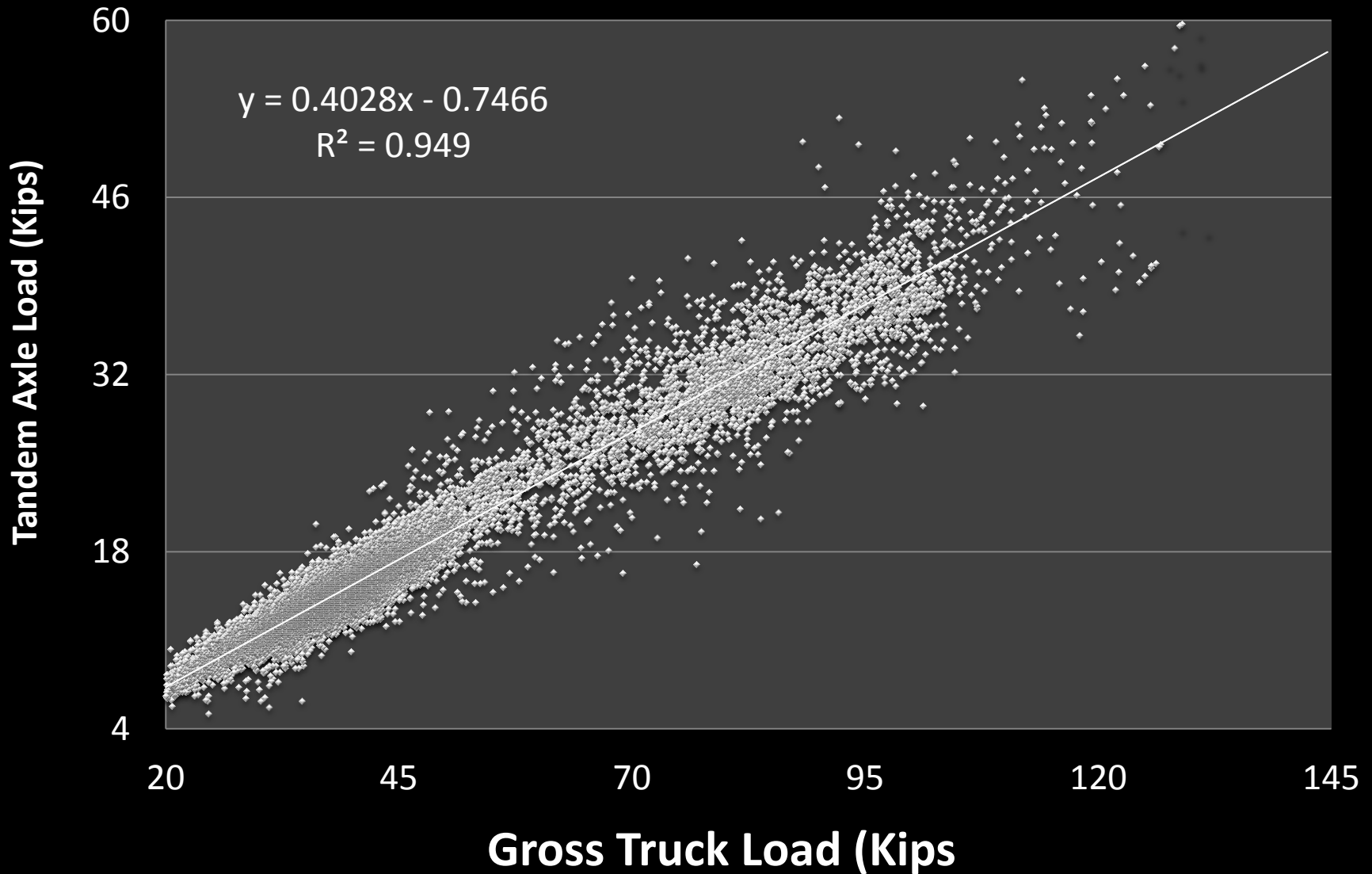
First tandem loading as a function of gross load on 104,029 Class 9 in 2009



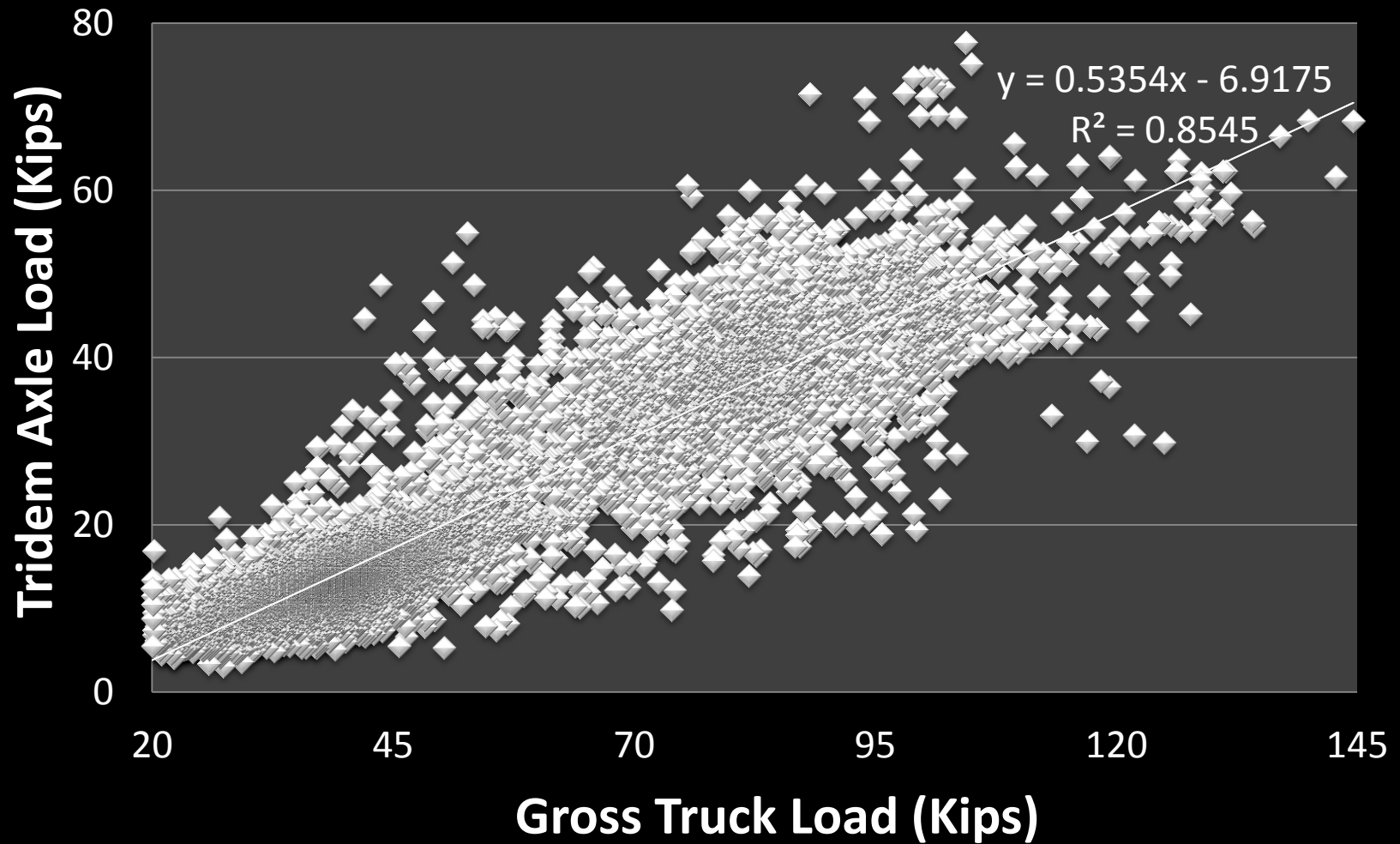
Steering axle load as a function of gross truck weight for 31,105 Class 10 - Six Axle Semis (1/1/09 - 12/18/09)



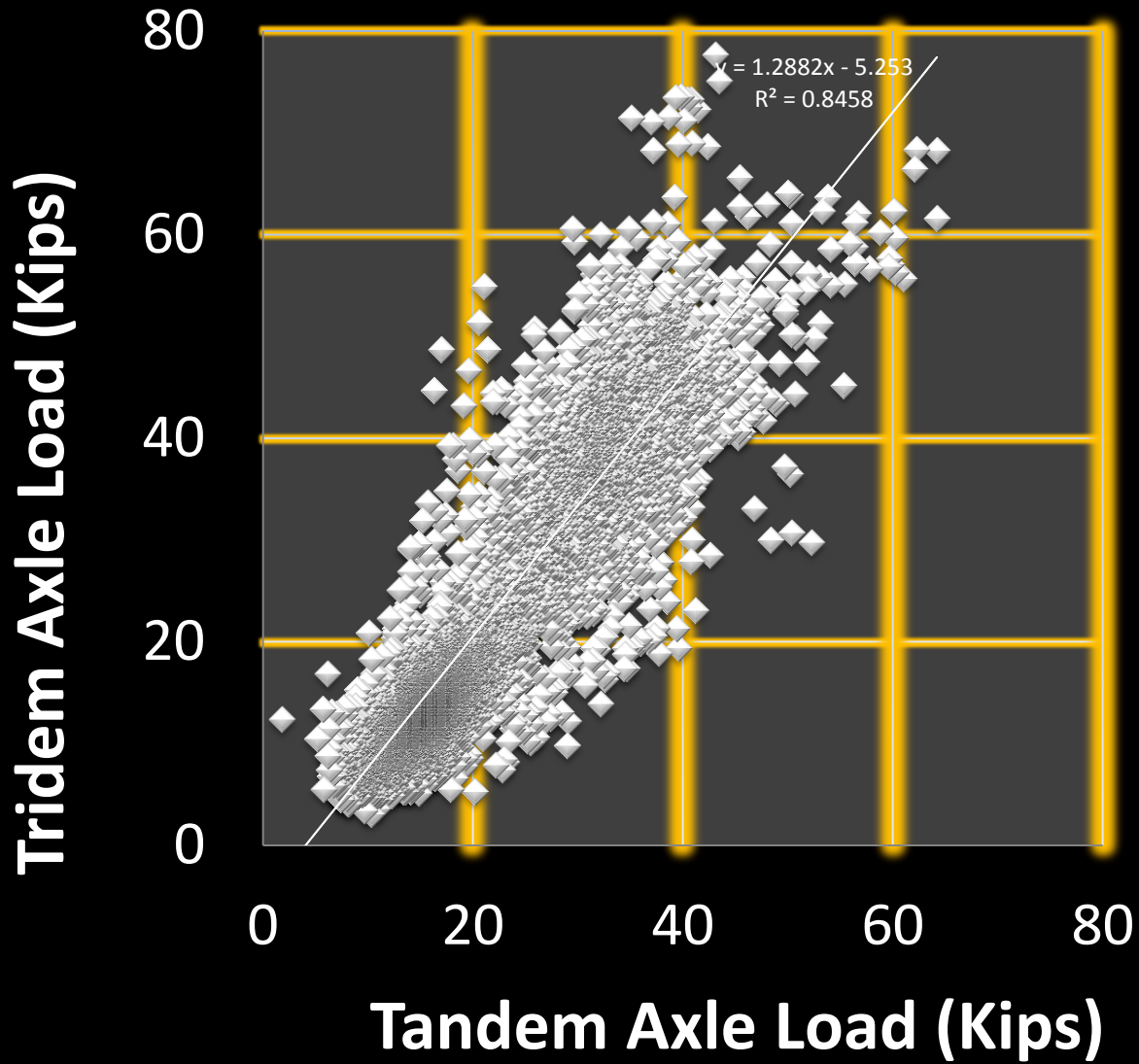
Tandem axle load as a function of gross truck weight for 31,105 Class 10 - Six Axle Semis (1/1/09 - 12/18/09)



Tridem axle load as a function of gross truck weight for 31,105 Class 10 - Six Axle Semis (1/1/09 - 12/18/09)



Tridem versus tandem axle loadings on 31,105 Class 10 – trucks (1/1/09 - 12/18/09)



Average Axle Loads for 80 kip trucks in 2009

CLASS – 10 {12,223 pound steering axle, 31,916 pound tandem, and 35,861 pound tridem}

CLASS – 9 {11,455 pound steering axle, 34,170 pound tandem, 34,275 pound tandem}

Use these loads in MEPDG for computerized Road Test

- Average Axle Loads for 100 kip trucks in 2010
CLASS – 10 {12,000 pound steering axle, `43,000 pound tandem, and 45,000 pound tridem}
Perform Road Test with these loads for Class 10 and 25 % less traffic volume
Use NY and CA