Cold Tire Pressure Identification

How can we predict what cold tire pressure to use to reach the optimal hot TP?

1. Percent Gain
2. Regression Equation
3. Ideal Gas Law (IGL)

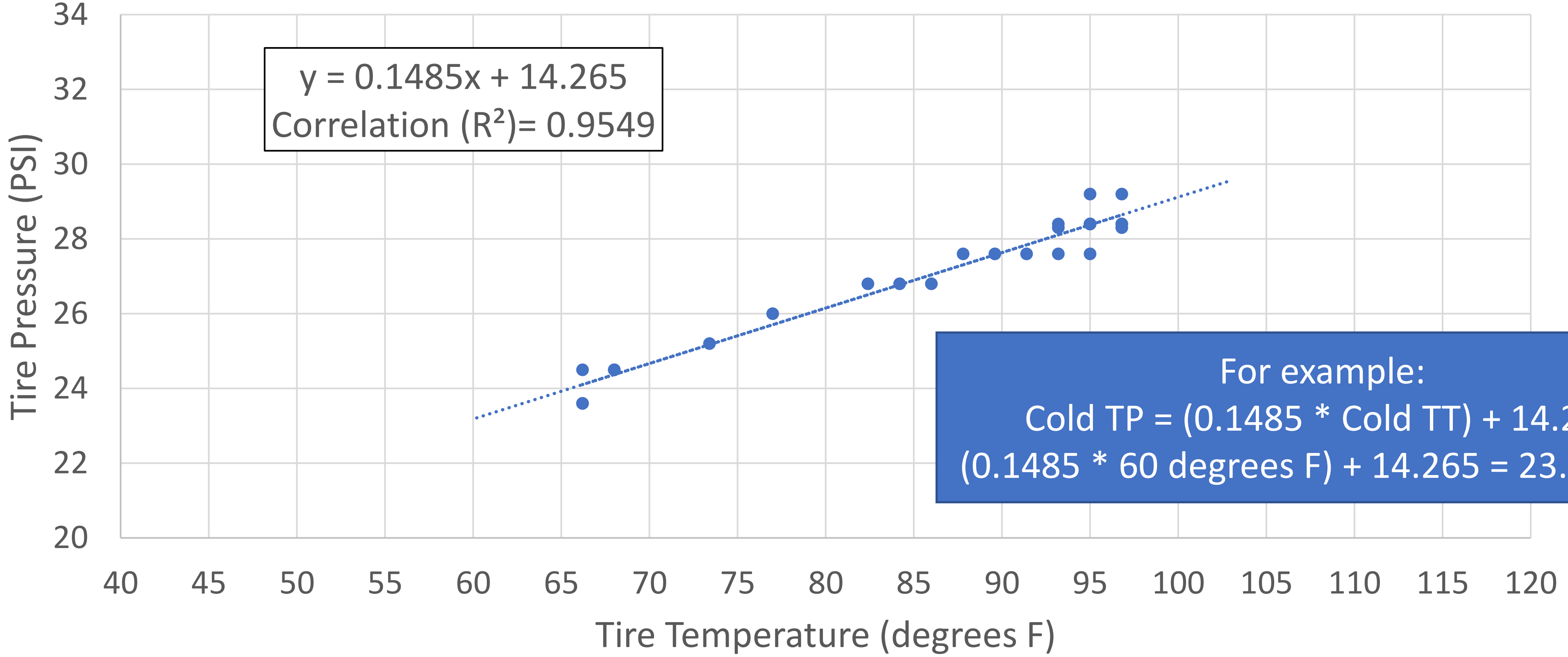
How to Predict TP - Method 1: Percent Gain

TP @ Max G / TP @ Start = % TP Gain
...but there are inconsistencies.

FL Tire

	Jul-22		Sep-22				
	Sat Prac AM	Sun Race	Friday Prac AM	Friday Prac PM	Sat Prac AM	Sat Prac PM	Sun Race AM
Starting Pressure	23.63	22.9	22.9	25.2	22.9	23.6	22.9
Cold Temperature	66.2	84.2	87.8	84.2	71.6	82.4	73.4
TP at Max G	28.4	27.6	26.8	25.2	28.4	27.6	28.4
TT (from sensor)	96.8	113	100.4	86	102.2	107.6	102.2
Maximum Lateral G	1.32	1.11	1.15	1.25	1.18	1.21	1.24
Temp Gain	30.6	28.8	12.6	1.8	30.6	25.2	28.8
Press Gain	4.77	4.70	3.90	0.00	5.50	4.00	5.50
% Press Gain	1.202	1.205	1.170	1.000	1.240	1.169	1.240
% Temp Gain	1.462	1.342	1.144	1.021	1.427	1.306	1.392
	Cold	Warm	Warm	Warm	Cold	Warm	Cold

How to Predict TP - Method 2: Regression Equation



For example:
Cold TP = (0.1485 * Cold TT) + 14.265
(0.1485 * 60 degrees F) + 14.265 = 23.175 PSI

If we want to follow the same TP profile, we can just examine the data using a regression equation which will allow us to enter the cold TT to calculate the desired cold TP…but, doesn't indicate how high TP will get.

How to Predict Tire Pressure – Method 3

Ideal Gas Law (IGL): Assumes air is an ideal gas that conforms to a fixed relation between pressure, volume, and temperature.

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \Rightarrow P_1 = P_2 \cdot \frac{T_1}{T_2}$$

Where:
P_1 = Cold tire pressure in bar
T_1 = Temperature at which the cold tire pressure has been set in Kelvin
P_2 = Hot tire pressure in bar
T_2 = Hot tire temperature corresponding to P_2 in Kelvin

Essentially, we should be able to predict cold TP (P_1),
if we have cold TT (T_1), target hot TT (T_2), and target hot TP (P_2).

Excel Forumla=((((**P_2***0.0689475729)+1)*((((**T_1** -32)*5/9)+273.15)/(((**T_2** -32)*5/9)+273.15)))-1)*14.5038

IGL

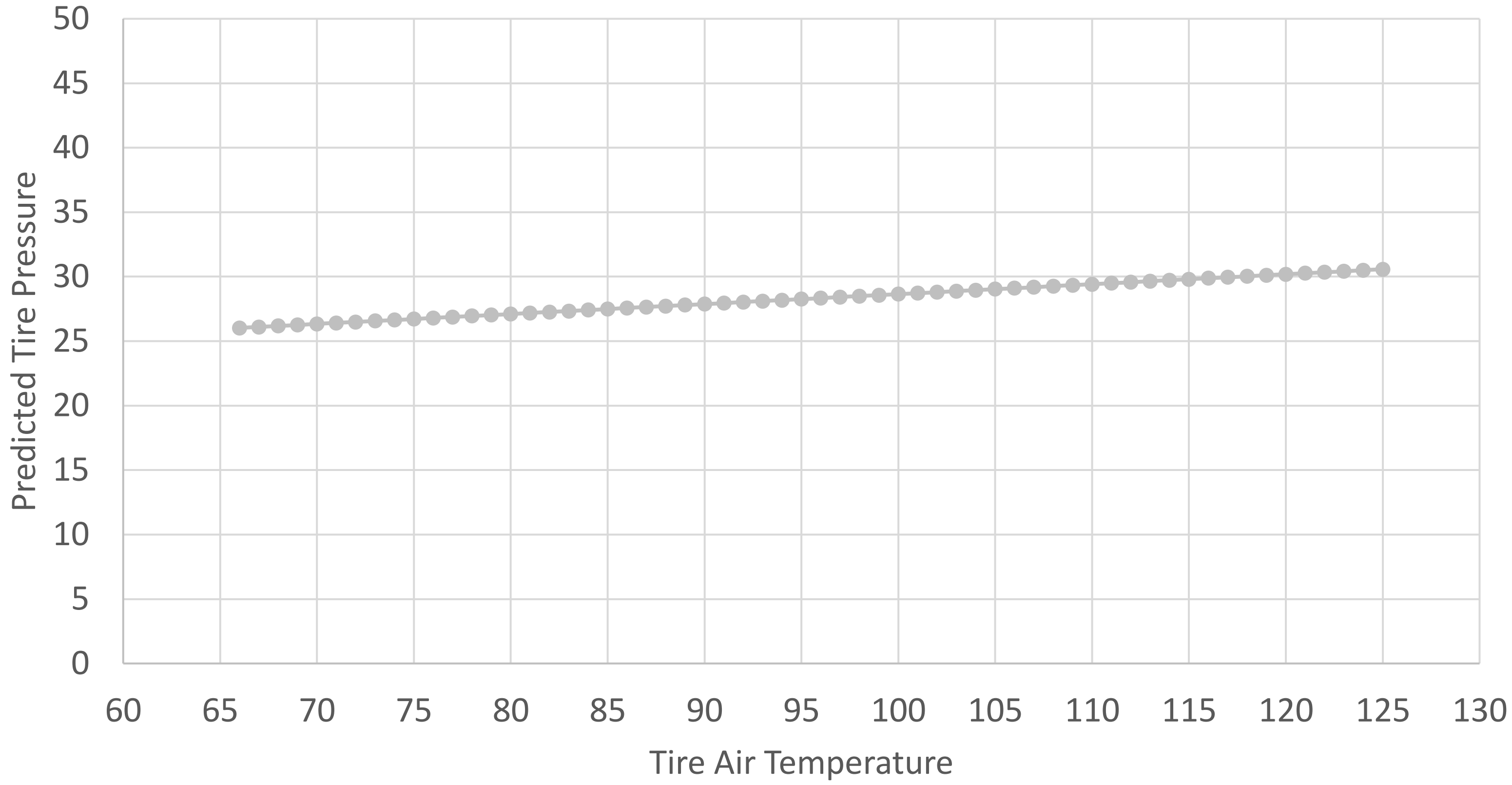
Where:

P_1 = What we want to predict

T_1 = air temp (66 – 125 F)

P_2 = 28.4 PSI

T_2 = 96.8 degrees F



For example:

If T_1 = 66 F, P_2 = 28.4 PSI, and T_2 = 98.6, then: P_1 would be 26.03 PSI--------Difference 2.37 PSI

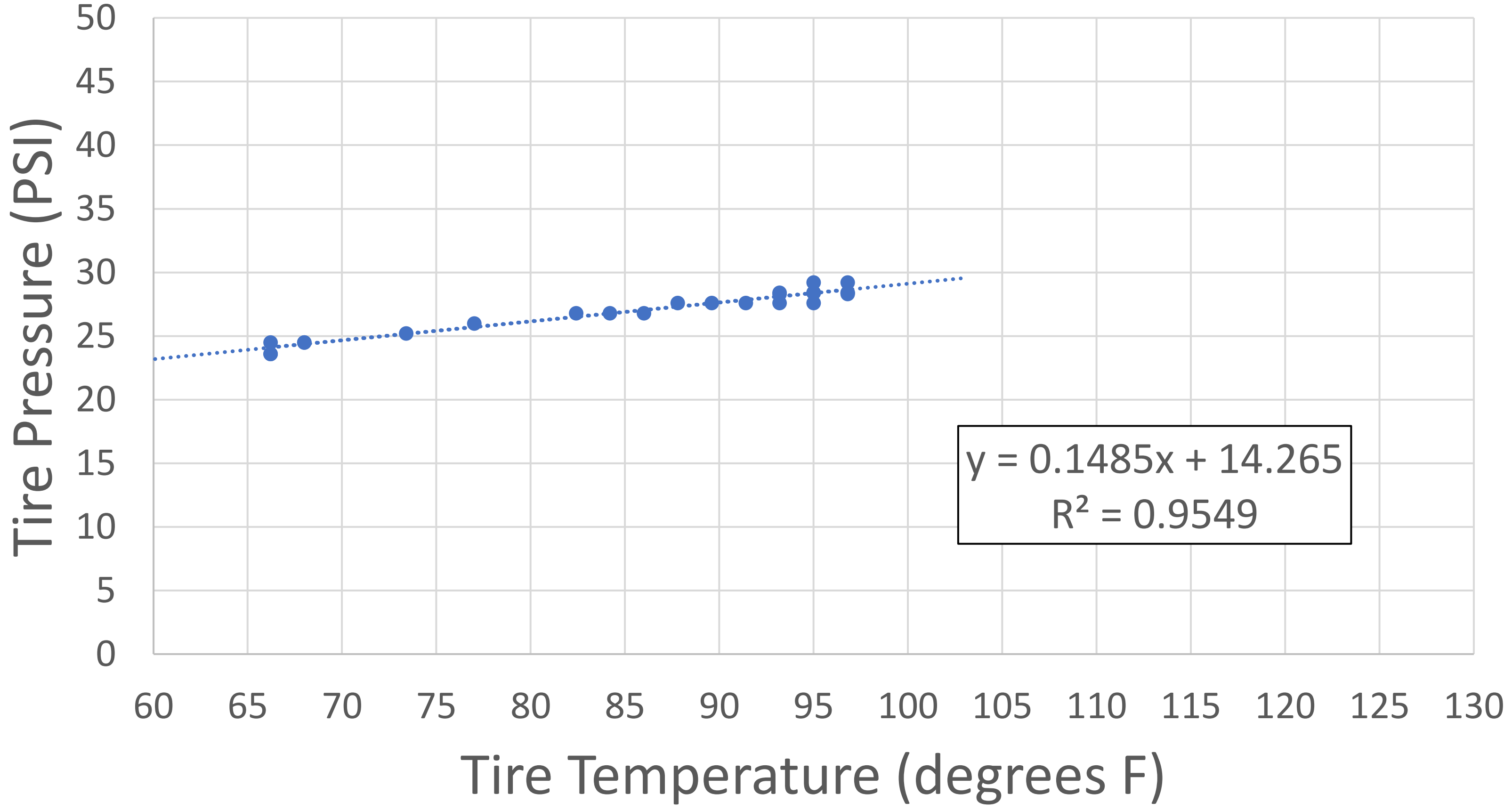
If T_1 = 76 F, P_2 = 28.4 PSI, and T_2 = 98.6, then: P_1 would be 26.79 PSI--------Difference 1.61 PSI

If T_1 = 86 F, P_2 = 28.4 PSI, and T_2 = 98.6, then: P_1 would be 27.56 PSI--------Difference 0.84 PSI

If T_1 = 96 F, P_2 = 28.4 PSI, and T_2 = 98.6, then: P_1 would be 28.33 PSI--------Difference 0.07 PSI

But…prior actual data indicated TP gain from 66.2° F was 4.77 PSI!!!

Test of IGL - Step 1 Collect Data



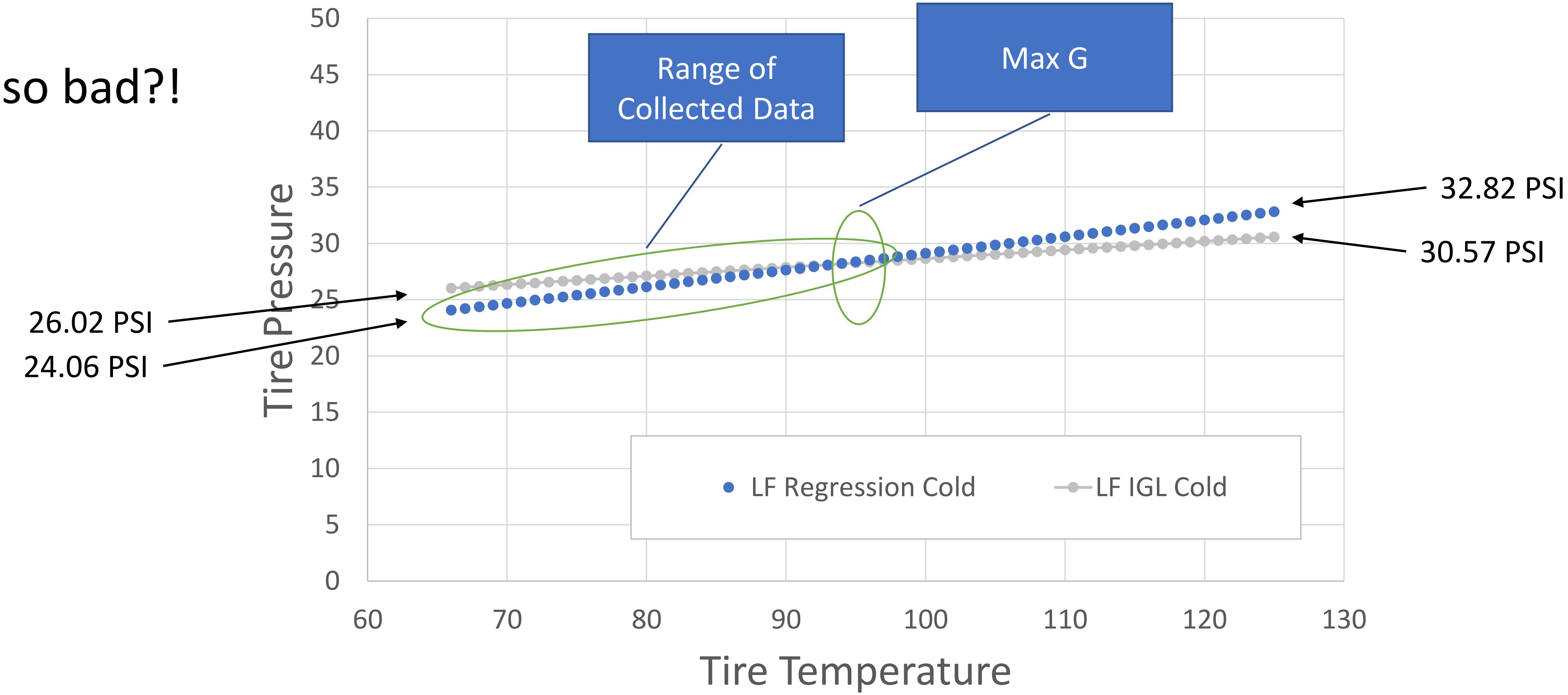
Left Front Tire Pressure x Tire Temperature

July 2022 Morning	
LF Press x LF Temp	
Temp	Press
66.2	23.6
68	24.5
66.2	24.5
66.2	23.6
68	24.5
73.4	25.2
77	26
82.4	26.8
84.2	26.8
86	26.8
87.8	27.6
89.6	27.6
91.4	27.6
93.2	27.6
95	27.6
93.2	28.4
95	28.4
96.8	28.4
95	28.4
95	28.4
96.8	28.4
96.8	29.2
93.2	28.3
96.8	28.3
95	29.2

Test of IGL - Step 2 Compare IGL & LF Tire Data

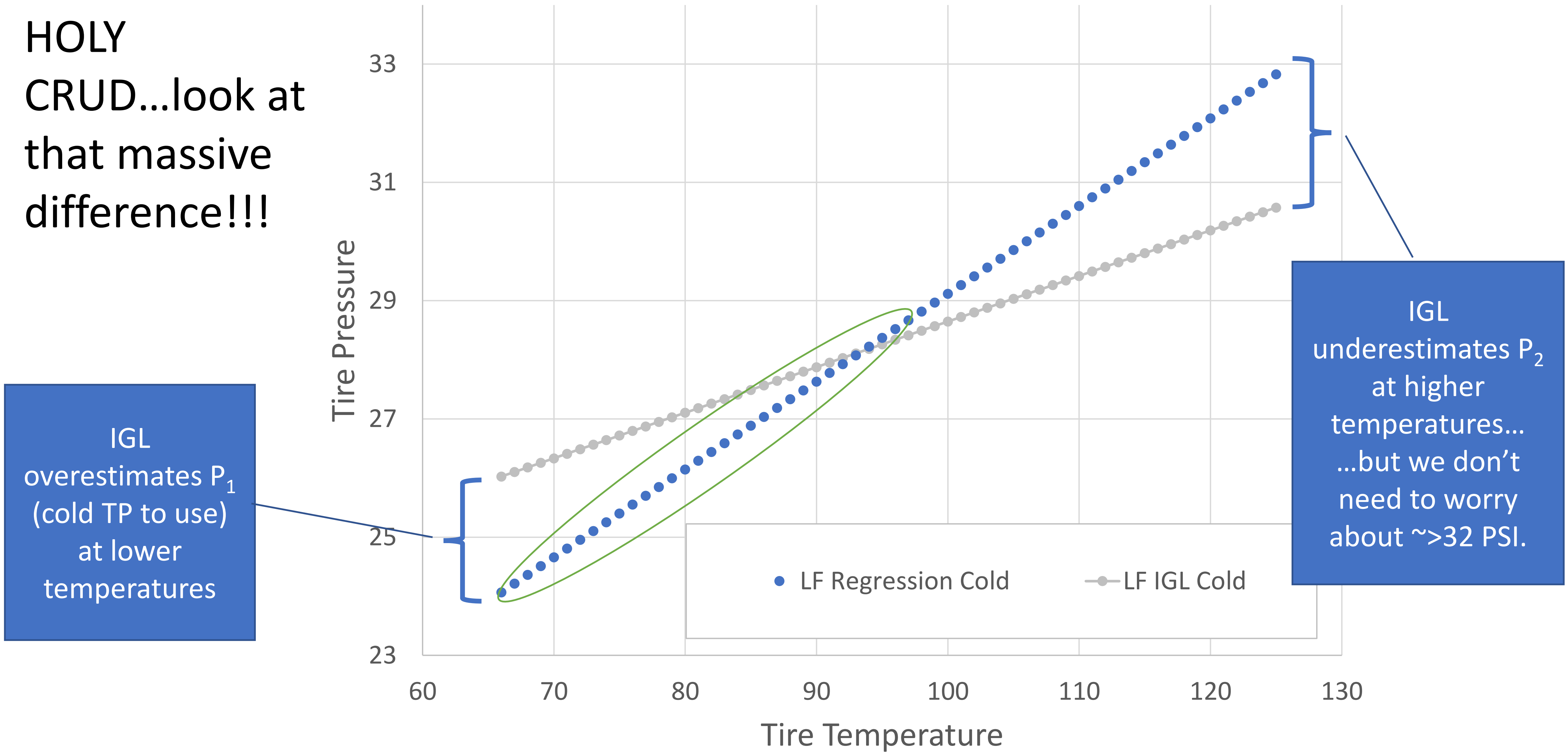
Actual and IGL Left Front TP x TT

Not so bad?!



Test of IGL - Step 2 Compare IGL & LF Tire Data

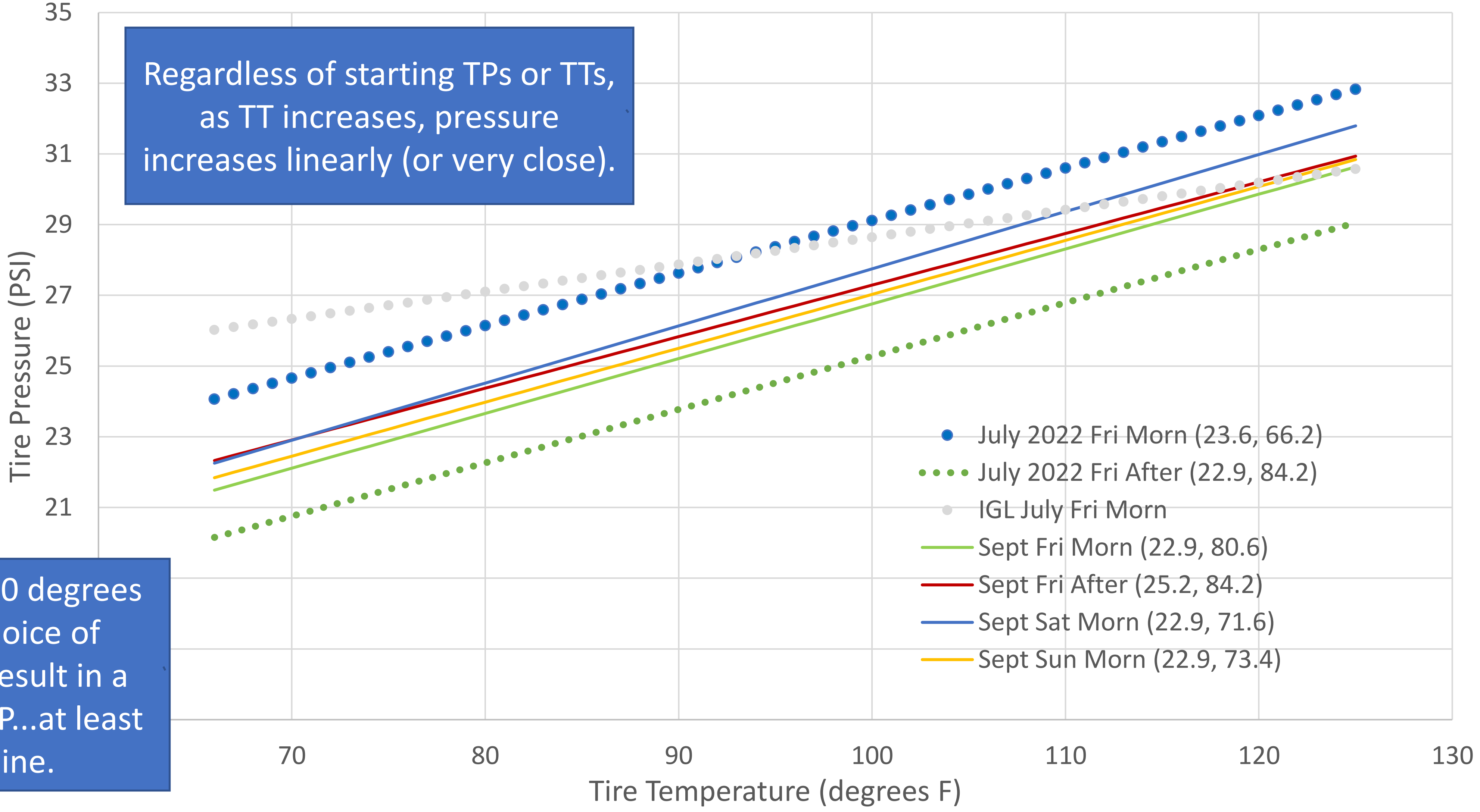
HOLY CRUD…look at that massive difference!!!



Test of IGL - Step Compare Multiple Regression Lines

LF TP x TT

Regardless of starting TPs or TTs, as TT increases, pressure increases linearly (or very close).



For example, at 70 degrees cold TT, our choice of starting TP will result in a predictable hot TP...at least along that line.

Test of IGL - Step 3 Temp and Pressure Change

Left Front TP x TT