

# The Process of Comparing Acceptance Production Data

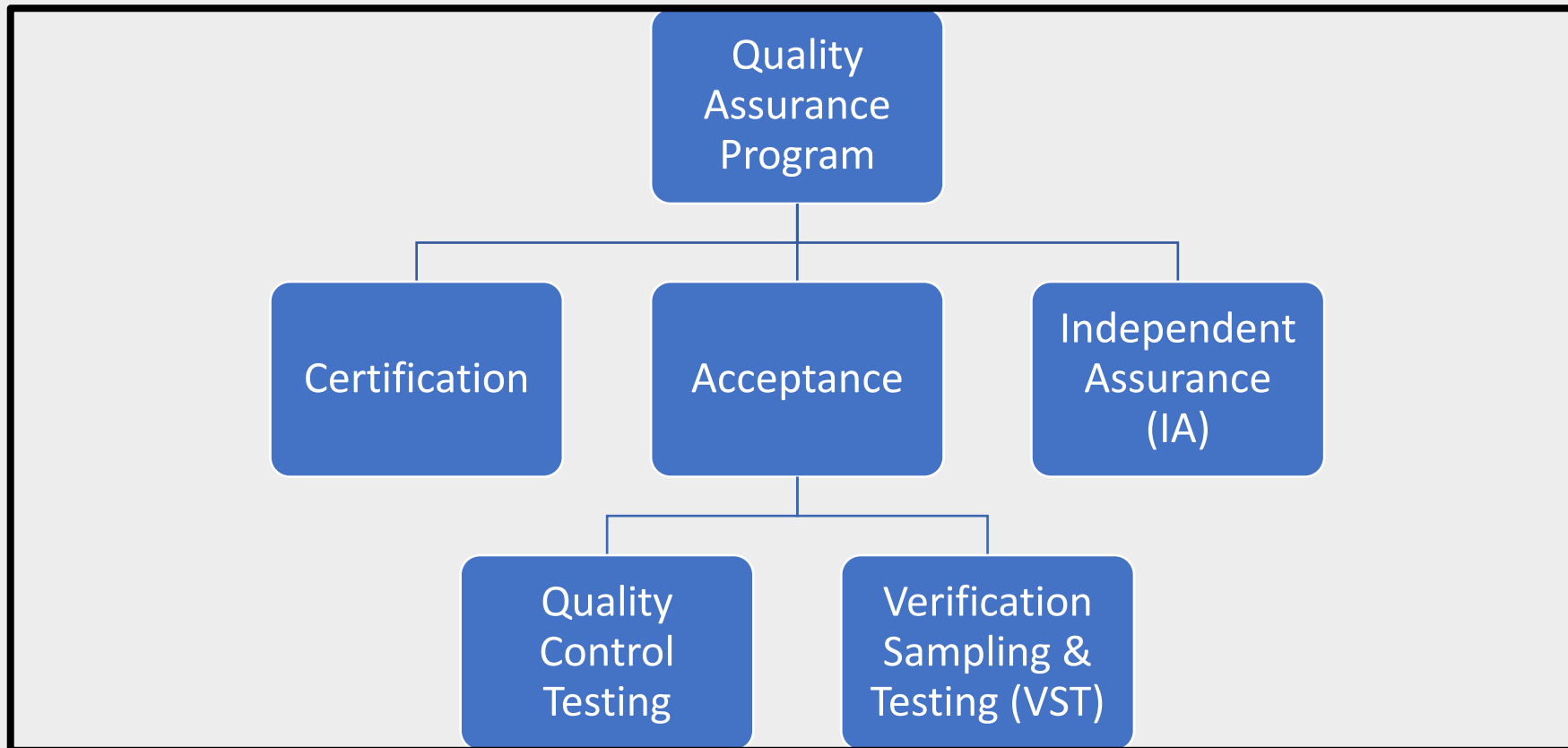
Back to Basics Workshop

November 18, 2022



# Why do we need to compare data?

23 CFR Part 637 requires states have quality assurance program to ensure materials and workmanship meet requirements



# VDOT's Asphalt Acceptance Documents

Section 211

Testing  
frequency  
and  
requirements

MOI Chapter V

IA and VST  
procedures

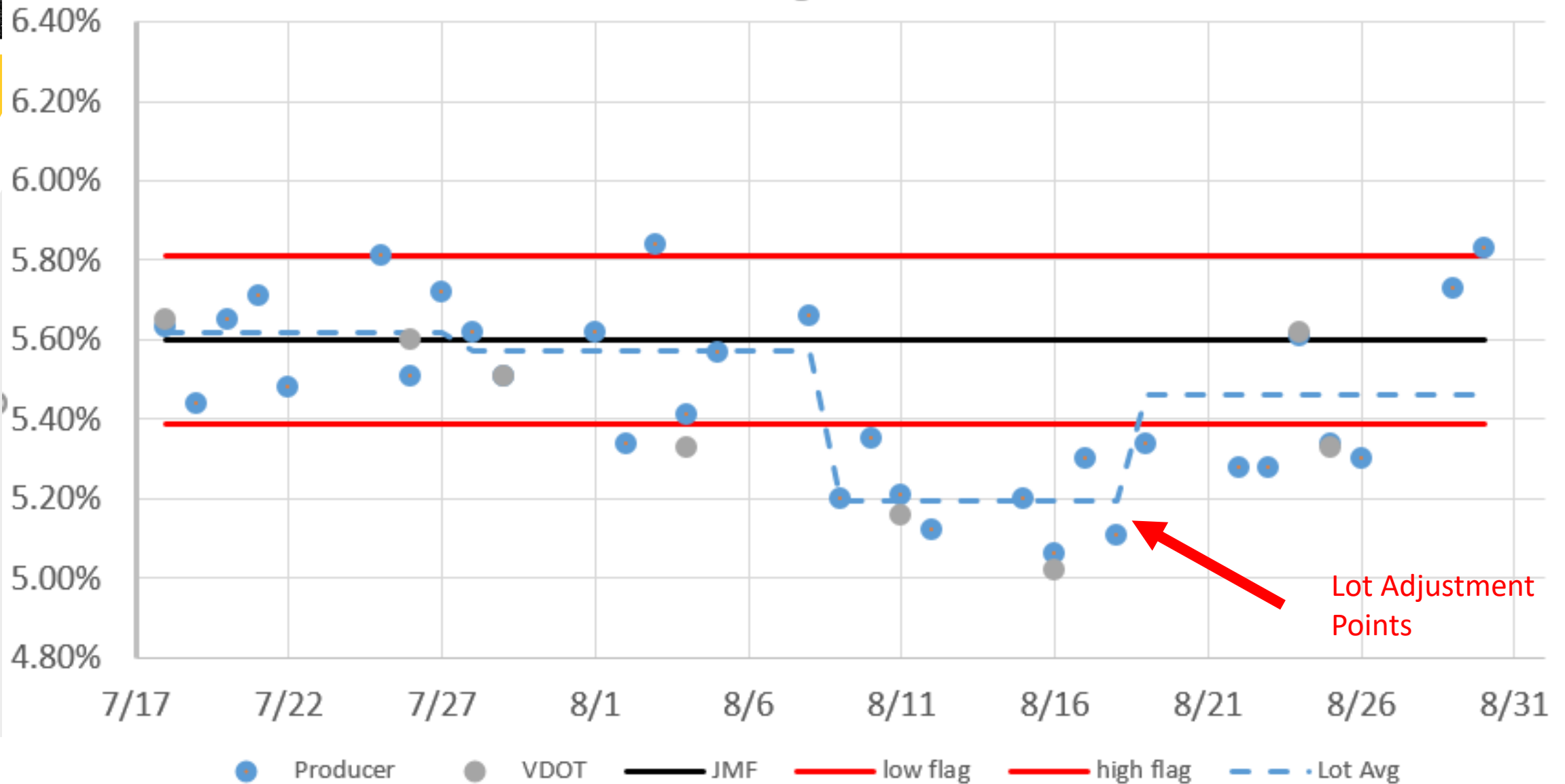
VTM 59

Statistical  
comparison  
procedure

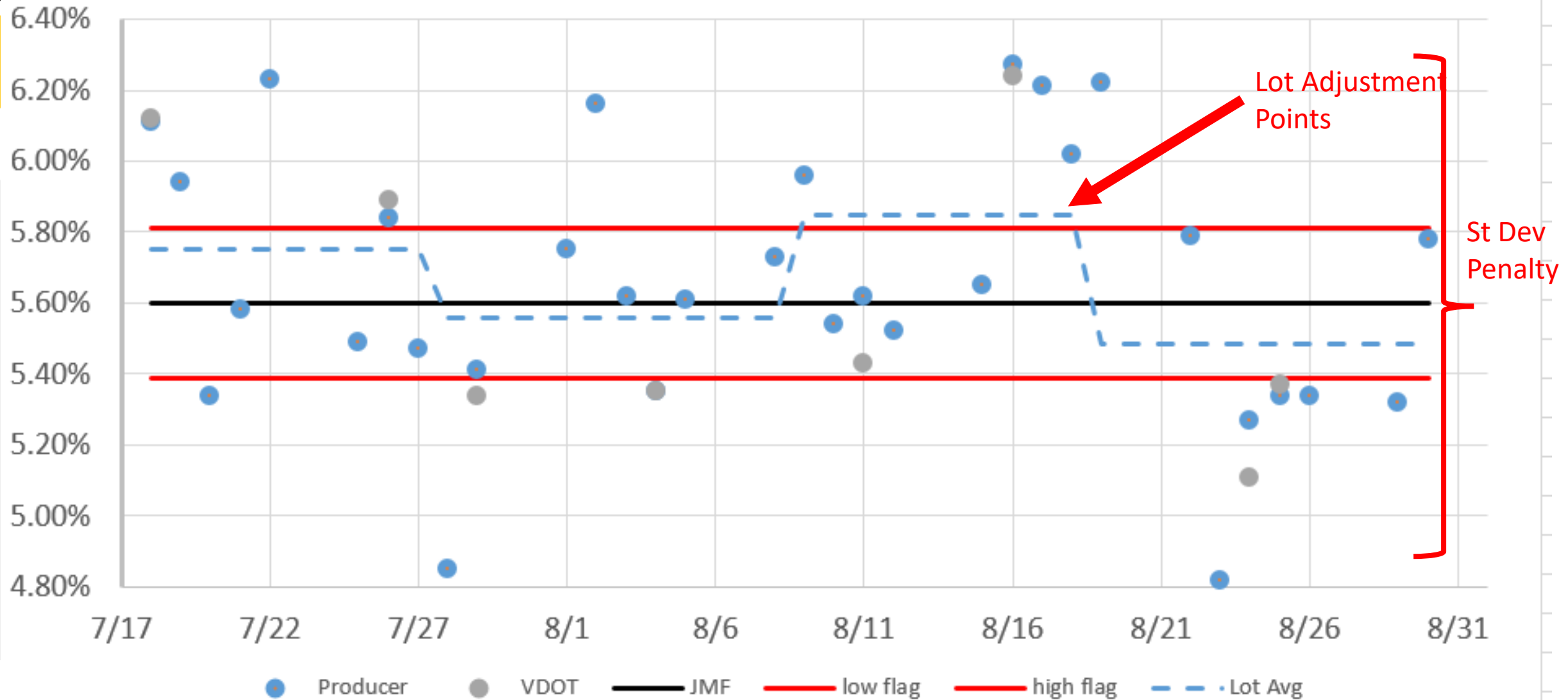
# Gradation and Asphalt Content Testing

- Used for acceptance and payment
- VDOT gets split sample – used for IA and VST
- Pay adjustment when lot average differs from JMF or by St dev
  
- Referee procedure in Section 211.10 if discrepancy between VDOT and Contractor

# Example Asphalt Content Control Chart

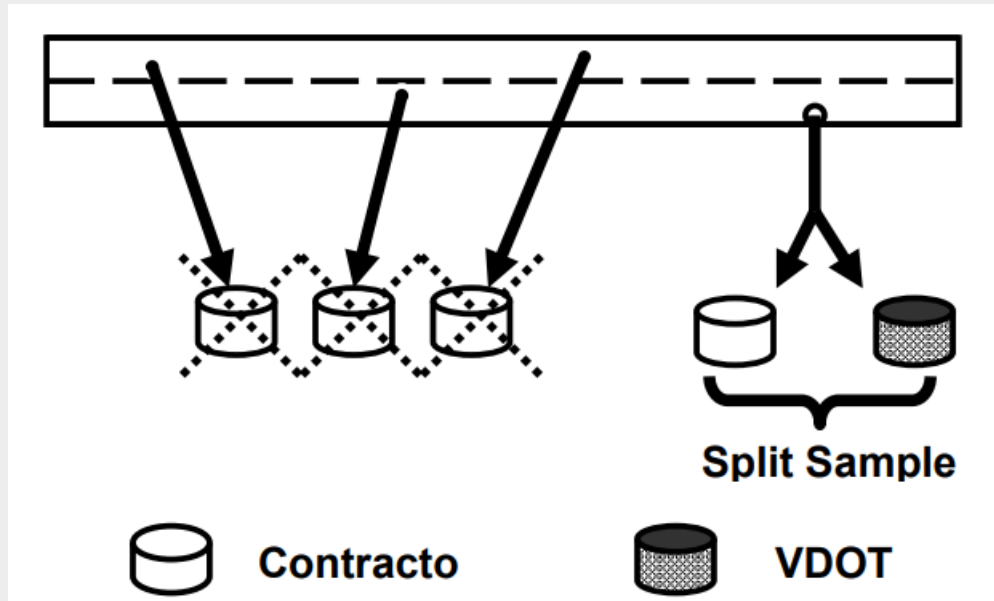


# Example Asphalt Content Control Chart - 2



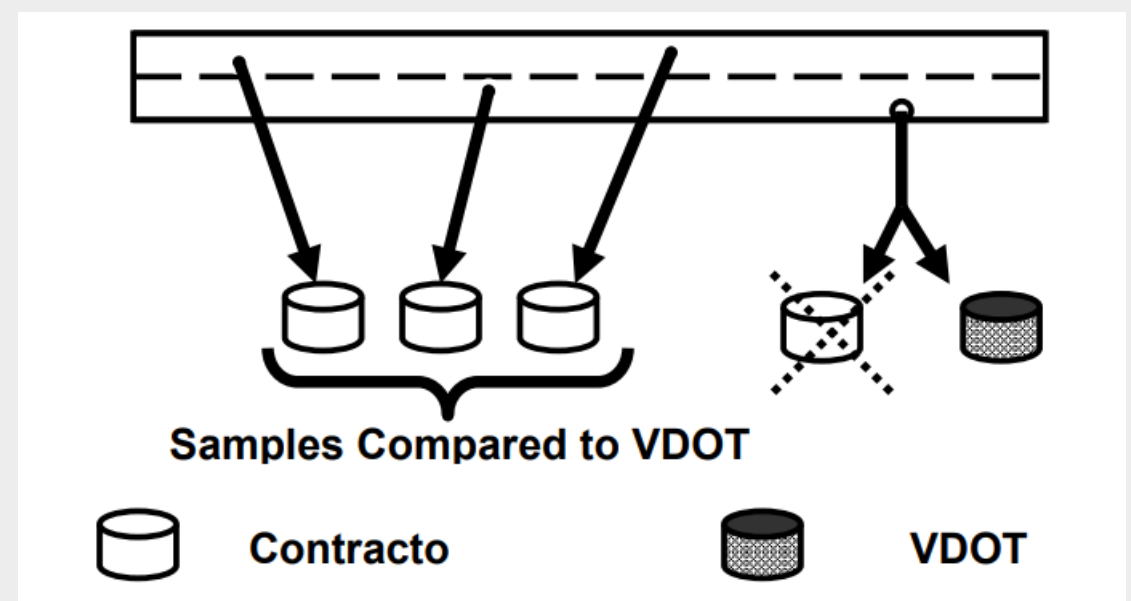
# IA and VST Testing Comparisons (VTM 59)

Independent Assurance



D2s comparison shown on TL50.  
Matched Comparison– **Paired t-test** and F-test  
Shown on MITS TL50 for last 8 samples.

Verification Sampling and Testing



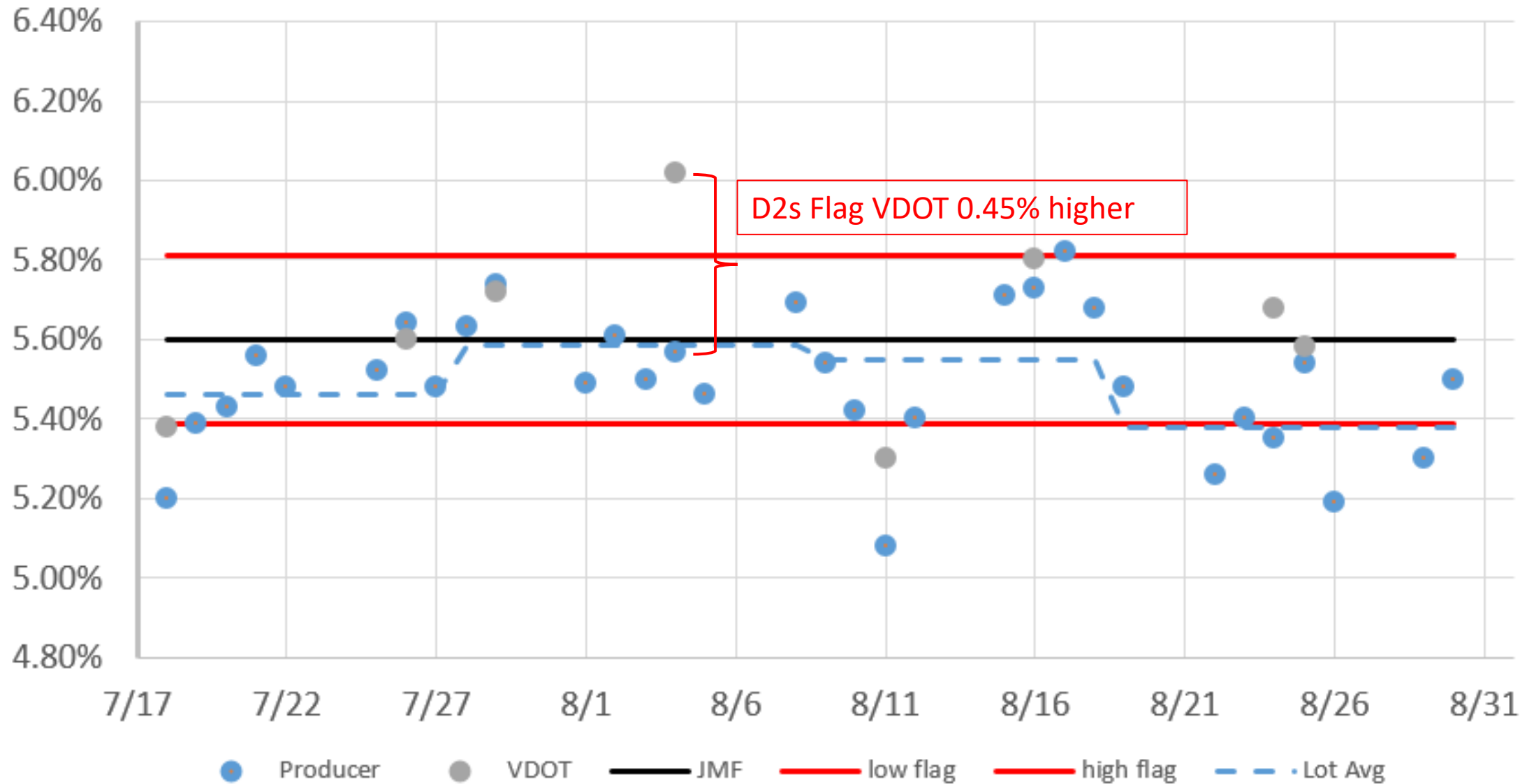
Non-Matched Comparison Report - **F-Test** and t-test

# Statistical Comparisons

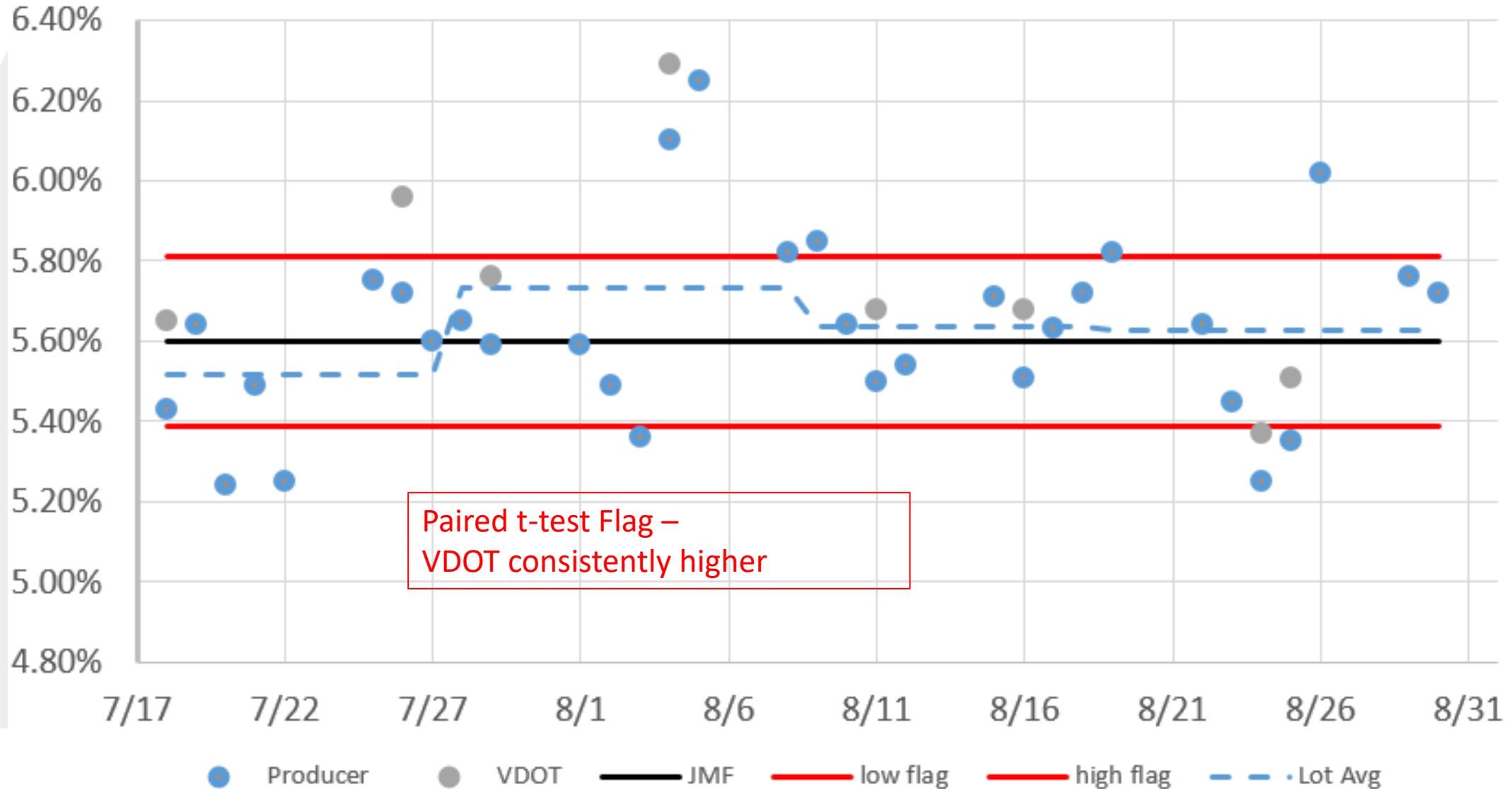
- D2s – are individual split sample results significantly different?
- Paired t-test – is avg. difference between split sample results zero?
- F-test – is the variability among VDOT samples different from contractor's non-split data?
- T-test – are the average VDOT results different from contractor non-split data?



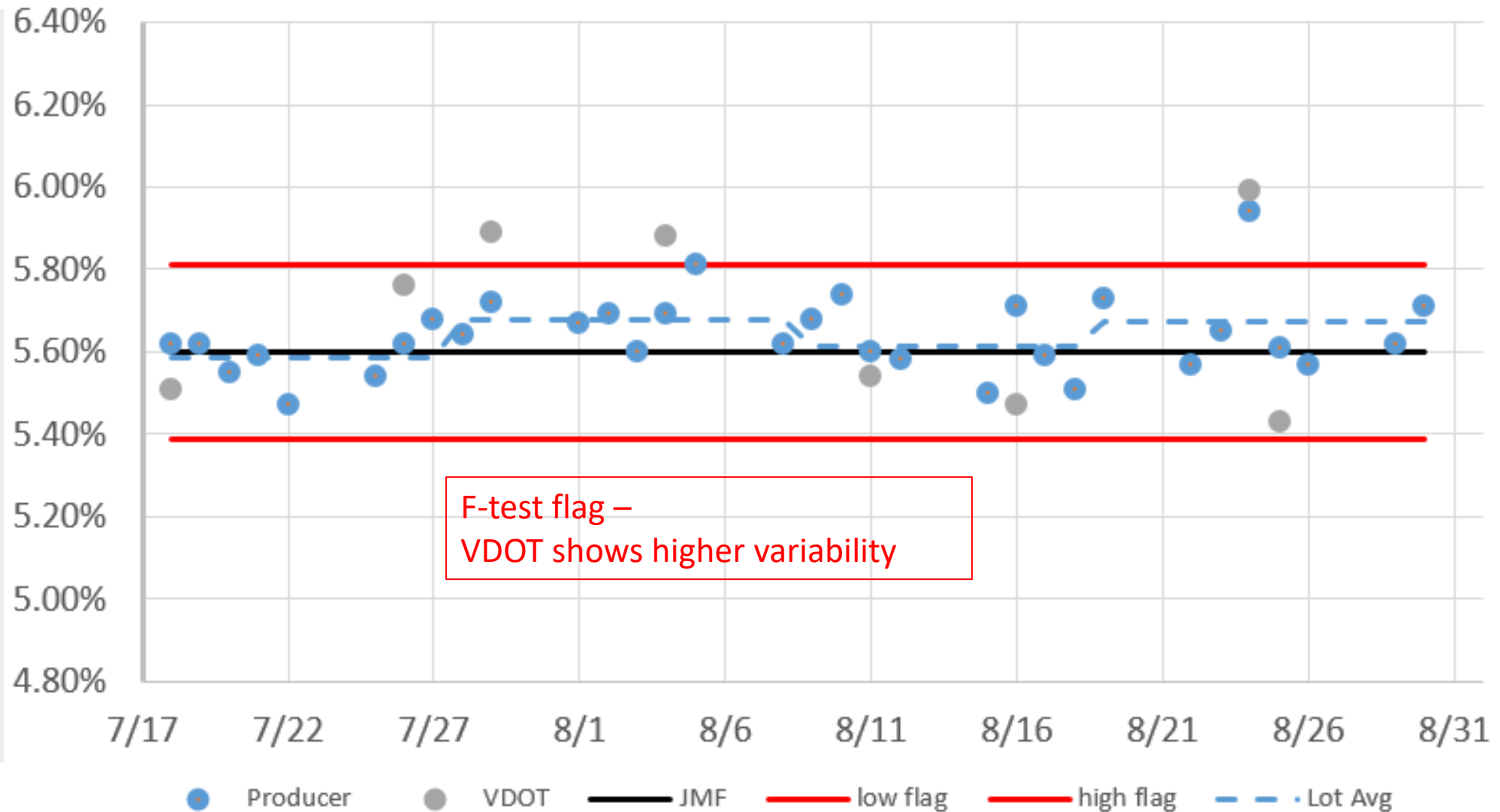
# Example Asphalt Content Control Chart – 3



# Example Asphalt Content Control Chart – 4



# Example Asphalt Content Control Chart – 5



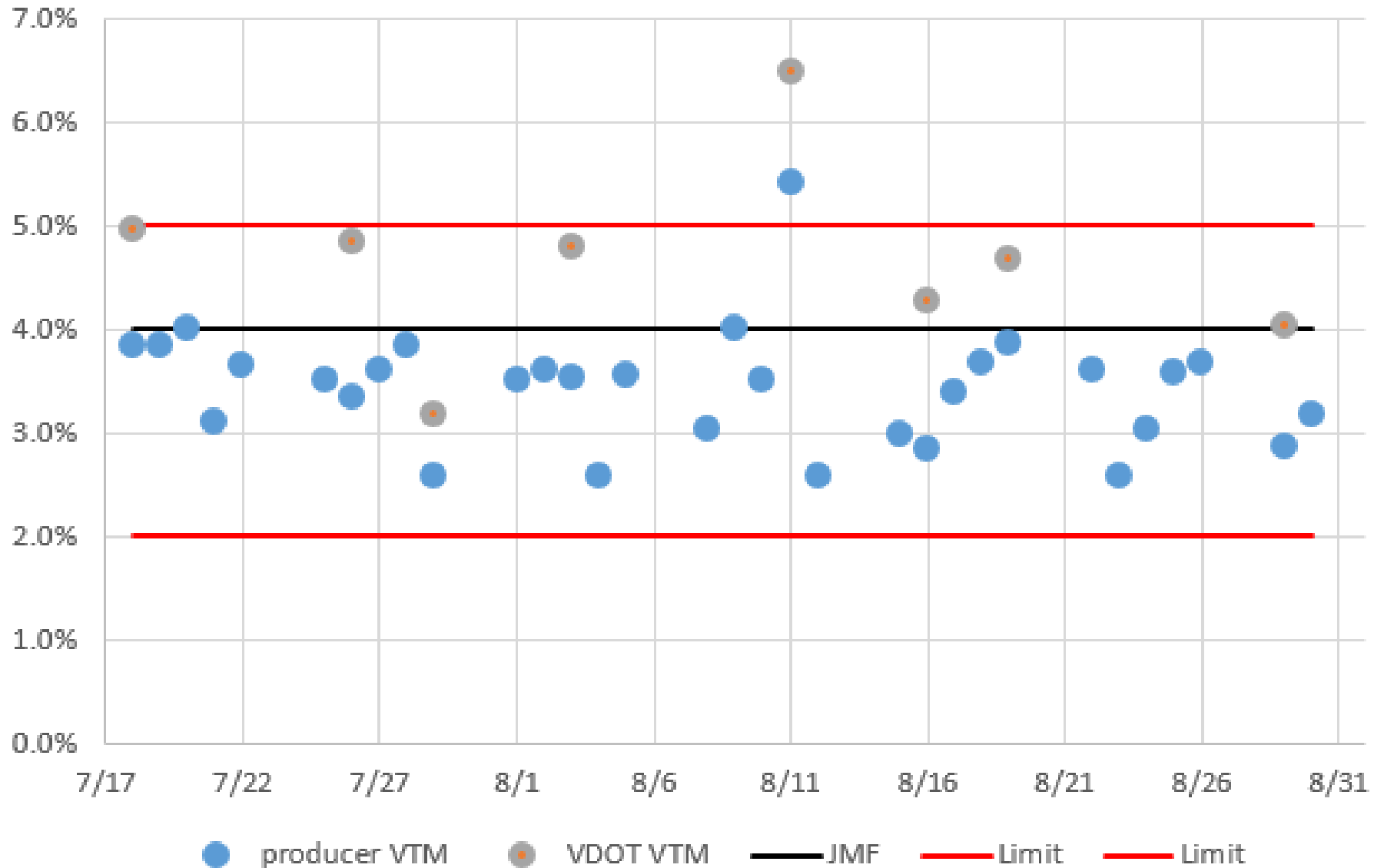
# Volumetric Samples – Process Control

- Volumetric samples used to evaluate process control – failing result may require stopping production or rejecting mix.
- Volumetric sample is from different parts of truck. Both VDOT and contractor samples representative of mix
- Make quality assessment on results from either contractor/VDOT

# Comparing Volumetric Results

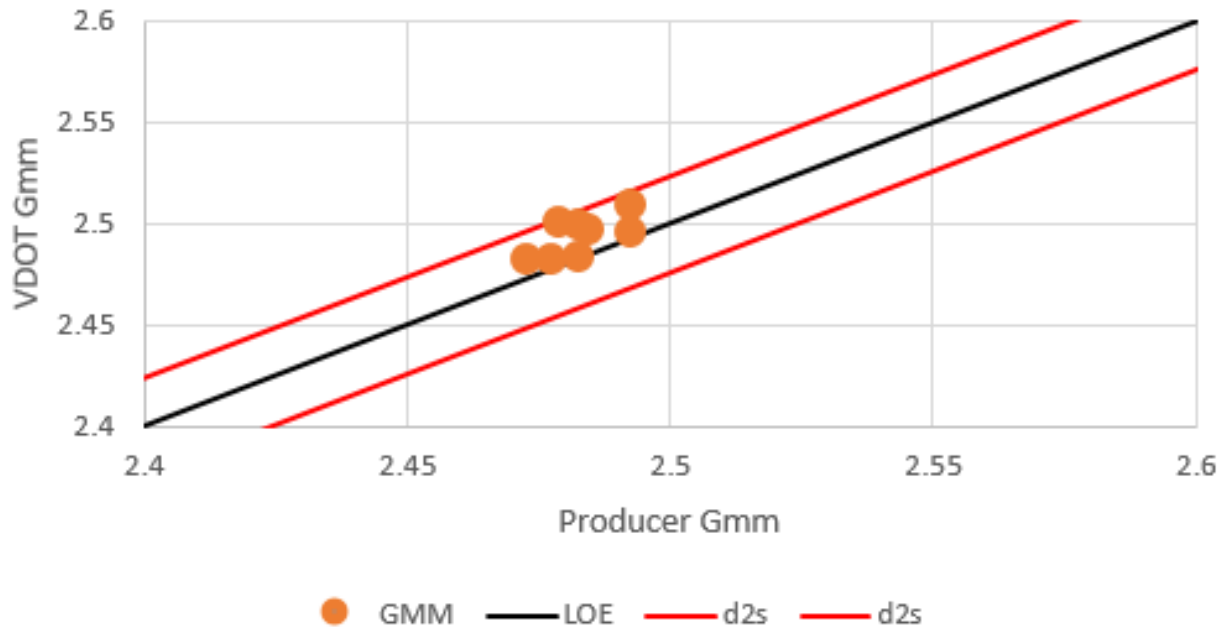
- D2s limit on Gmm and Gmb (and density Nini). Not for VTM, VMA, etc.
- The d2s limit for Gmm and Gmb are 0.024 and 0.042. Wide ranges!!
- No standard practice for statistical comparisons of multiple samples
  - VDOT has manually plotted control chart results for contractor and VDOT together for investigation

# Example Lab Air Voids (VTM)

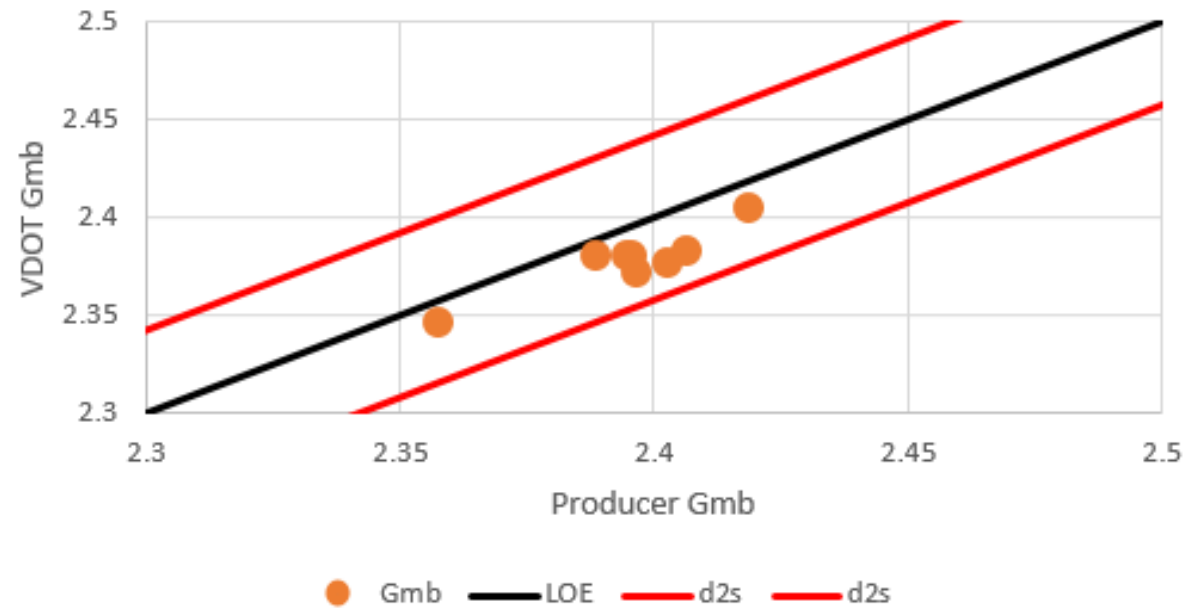


# Comparing Plots with Line of Equality

### Gmm Comparison

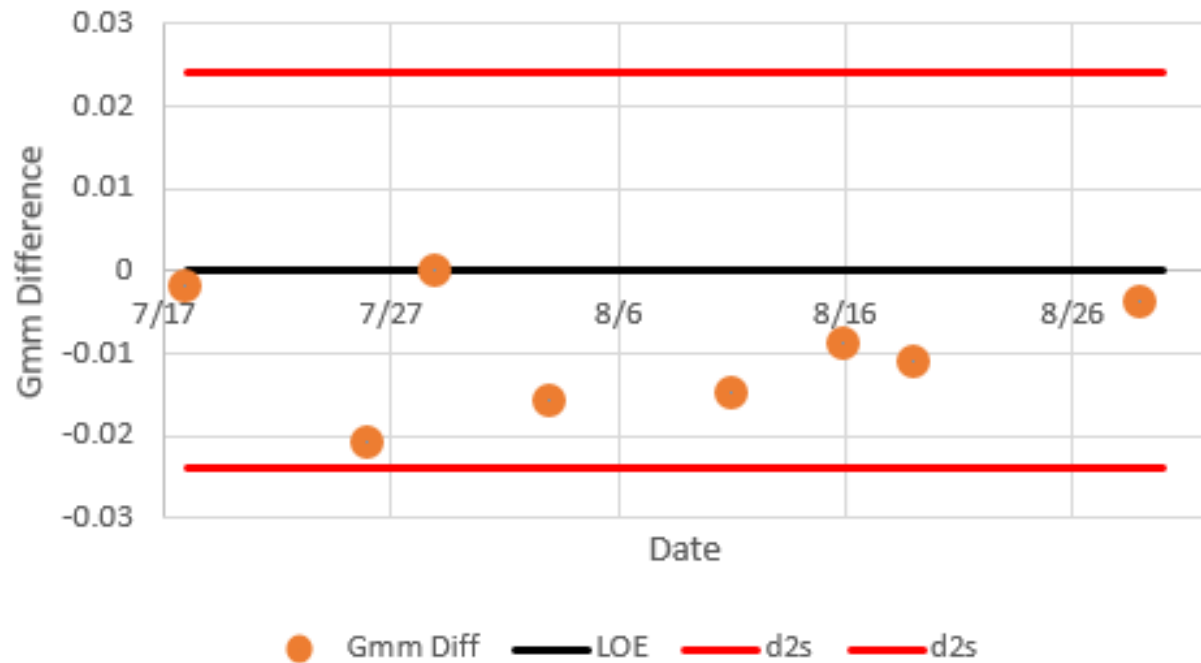


### Gmb Comparison

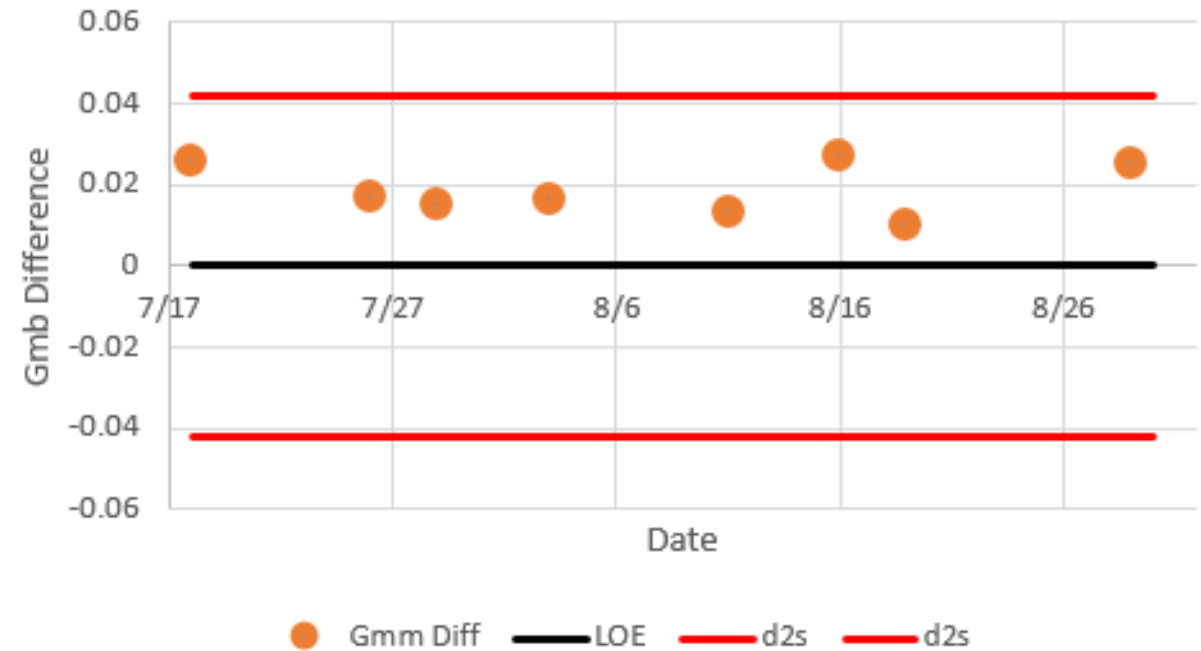


# Comparing Volumetric Differences

Gmm Comparison - Producer minus VDOT



Gmb Comparison - Producer minus VDOT





# What to do if discrepancy?

- Sample Dump can be used to look at all results for initial comparison
  - Some instances may have had 1 sample that is incorrect causing flags
- Look to see if similar issues are showing with different JMFs at same plant, different plants with same producer, or all producers in a district
- Look for any potential lab equipment/processes that could cause difference
- Multi-way split to seek more consensus on results

# MITS Results Example

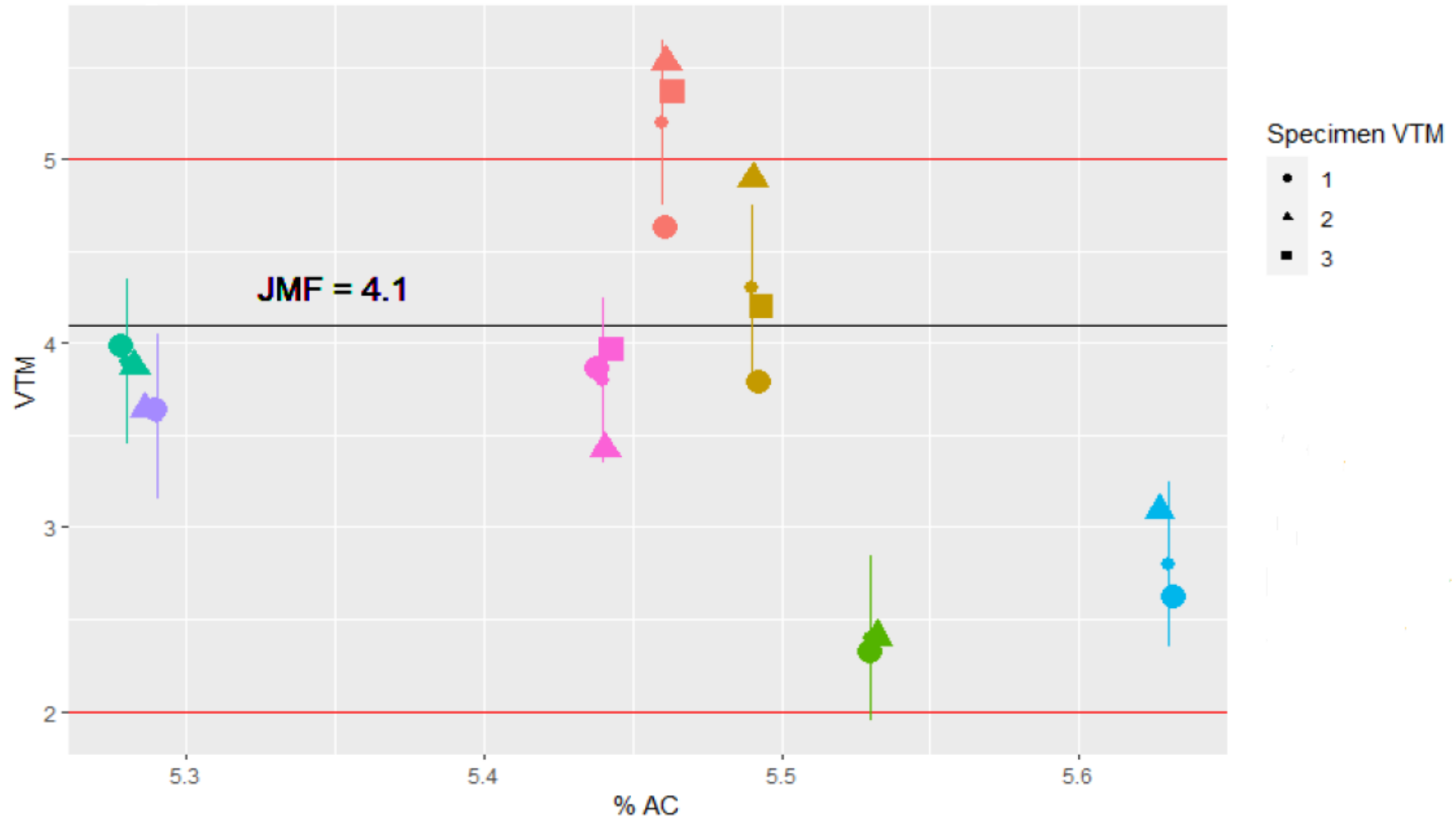
Job-Mix Formula Quality Control (14 found)											
Sieve		Producer				VDOT			D2S	Previous	
English	Metric	JMF	Weight Retained	Percent Retained	Percent Passing	Weight Retained	Percent Retained	Percent Passing	Percent Passing	F	T
2in	50mm			0.00 %	100 %		0.00 %	100 %	0.0 %	0.00	0.00
1 1/2in	37.5mm			0.00 %	100 %		0.00 %	100 %	0.0 %	0.00	0.00
1in	25mm			0.00 %	100 %		0.00 %	100 %	0.0 %	0.00	0.00
3/4in	19mm	100 %		0.00 %	100 %		0.00 %	100 %	0.0 %	0.00	0.71
1/2in	12.5mm	96 %	109.9	6.45 %	94 %	77.1	4.60 %	95 %	1.8 %	4.69	0.49
3/8in	9.5mm	87 %	106.4	6.24 %	87 %	116.9	6.97 %	88 %	1.1 %	8.16	0.63
#4	4.75mm	57 %	554.0	32.50 %	55 %	577.6	34.44 %	* 54 %	0.8 %	10.56	0.26
#8	2.36mm	36 %	291.9	17.13 %	38 %	298.2	17.78 %	36 %	1.5 %	3.16	0.88
#16	1.18mm			0.00 %	38 %	222.9	13.29 %	23 %	14.8 %	1.65	33.68
#30	0.6mm	16 %	366.4	21.50 %	16 %	120.5	7.19 %	16 %	0.5 %	1.78	0.35
#50	0.3mm		81.1	4.76 %	11 %	85.9	5.12 %	11 %	0.8 %	1.00	0.71
#100	0.15mm			0.00 %	11 %	46.9	2.80 %	8 %	3.6 %	2.56	15.84
#200	0.075mm	6.6 %	76.6	4.49 %	6.9 %	32.3	1.93 %	5.9 %	1.0 %	2.98	1.38
Pan	Pan		4.4	0.26 %		3.5	0.21 %			2.25	0.71
<b>Totals</b>			1590.7	100.00 %		1581.8	100.06 %				

Producer Values		VDOT Values		D2S	D2S Tol.	Prev F	Prev T		
JMF AC:	5.40 %	Asphalt Content:	5.46 %	Asphalt Content:	5.56 %	0.10 %	0.33	4.00	0.57

Loss of -200 after wash:	113.8
Total passing -200:	118.2
Gradation Check (%):	0.00 %

Loss of -200 after wash:	96.1
Total passing -200:	99.6
Gradation Check (%):	0.06 %

# Multi-way split example



Lines are single lab d2s range from Average VTM

# Issues to look for

- “Hole in a sieve”
- Calibrations (especially gyro and molds)
- Temperatures (mix, water bath, etc.)
- Other?