Video Game Performance Data: Summarizing with Statistics and Graphs

Based on *Serious Statistics Reprocessed: Statistics and Scripts*

Jim Pitchford

November 5, 2019

Presentation and Article

Problem: Summarizing Data in Representative Way

Line	Application	ProcessID	SwapChainAddress	Runtime	SyncInterval	PresentFlags	AllowsTearing	PresentMode	WasBatched	DwmNotified	Dropped	TimeInSeconds	MsBetweenPresents	MsBetweenDisplayChange	MsInPresentAPI	MsUntilRenderComplete	MsUntilDisplayed	MsEstimatedDriverLag	Width	Height
1	Sam2017.exe	1812	0x0000000004372630	DXGI	0	0	1	Hardware Composed: Independent Flip	1	0	0	0.005609	4.257	3.884	0.166	3.284	3.284	7.446	1920	1080
2	Sam2017.exe	1812	0x0000000004372630	DXGI	0	0	1	Hardware Composed: Independent Flip	1	0	0	0.009513	3.904	3.729	0.080	3.109	3.109	6.847	1920	1080
3	Sam2017.exe	1812	0x0000000004372630	DXGI	0	0	1	Hardware Composed: Independent Flip	1	0	0	0.012988	3.475	3.628	0.072	3.262	3.262	6.658	1920	1080
⋮																				
81356	Sam2017.exe	1812	0x0000000004372630	DXGI	0	0	1	Hardware Composed: Independent Flip	1	0	0	300.306738	3.682	3.687	0.362	4.023	4.023	7.343	1920	1080
81357	Sam2017.exe	1812	0x0000000004372630	DXGI	0	0	1	Hardware Composed: Independent Flip	1	0	0	300.310425	3.687	3.690	0.363	4.026	4.026	7.351	1920	1080

- Video game performance measurements can result in rather large recordings

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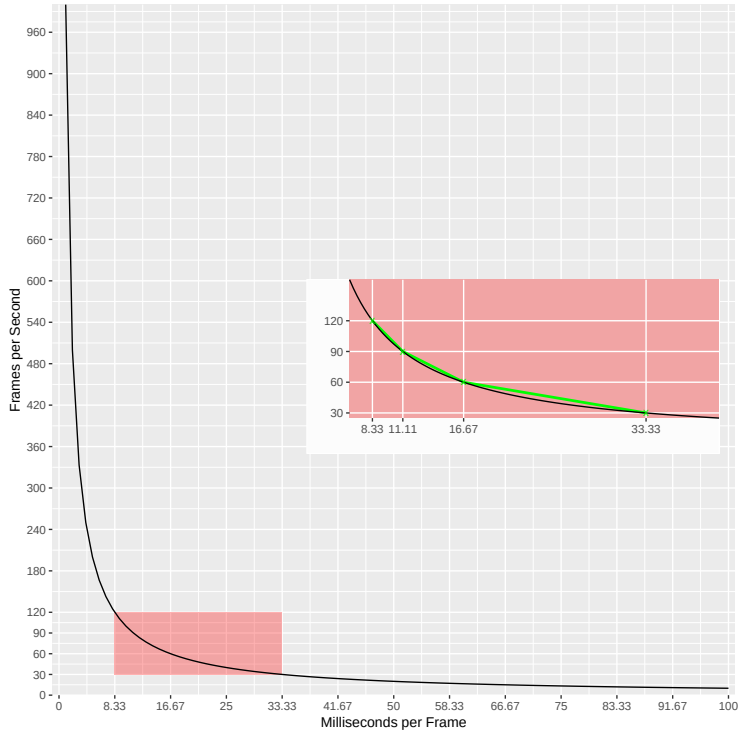
- Even after ignoring developer-oriented data, there can still be a lot
- Clear statistics and graphs to provide representative summaries of data are necessary

Problem: FPS vs milliseconds

How you measure the data and the units the statistics are in also matter



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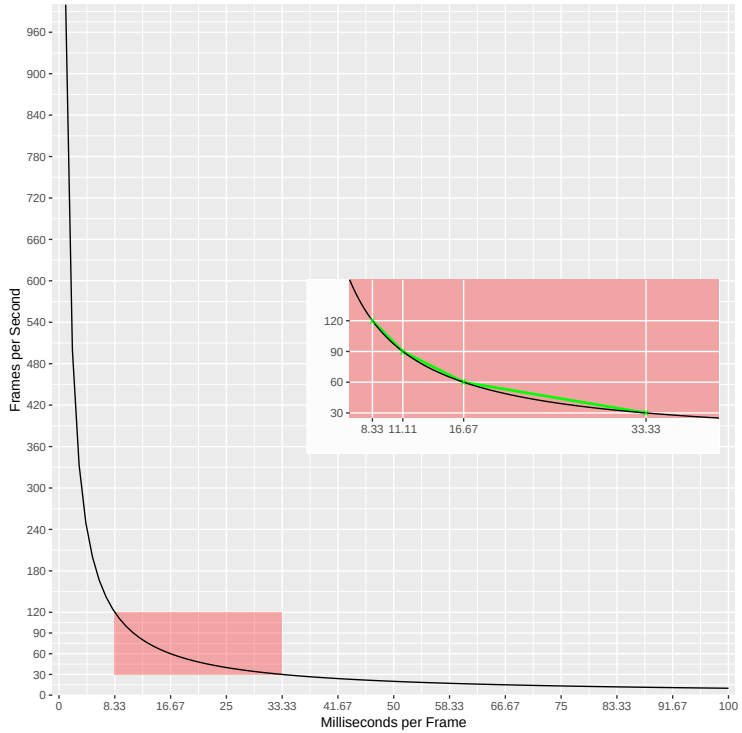

- FPS is a **non-linear** measurement but **clear**
- milliseconds is **linear** but not as **clear**

Problem: Which Statistics

Average is an ambiguous term, but can assume

Arithmetic Mean:

$$\sum^{n} \frac{x_n}{n}$$

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Median:

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Geometric Mean:

$$\prod^{n} \sqrt[n]{x_n} \quad \text{or} \quad e^{\overline{log(x)}}$$

Advantages and disadvantages make it context sensitive

Problem: Which Statistics

Central tendencies may or may not be sensitive to outliers

Performance bounds are also useful information

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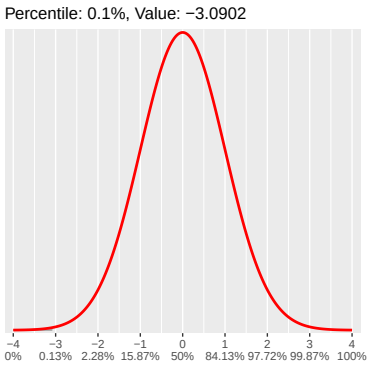
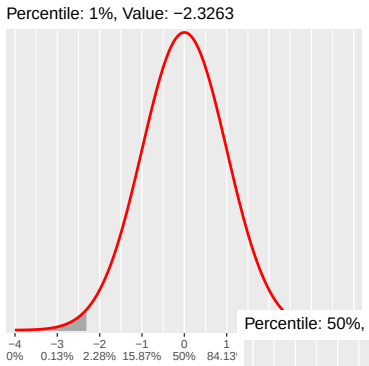
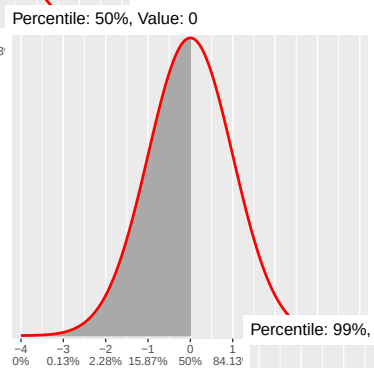
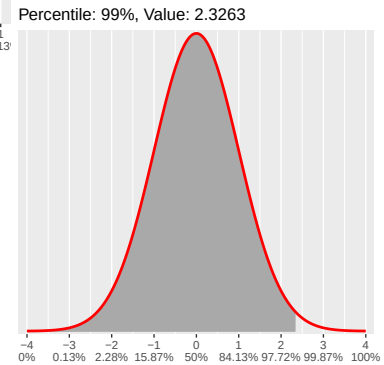
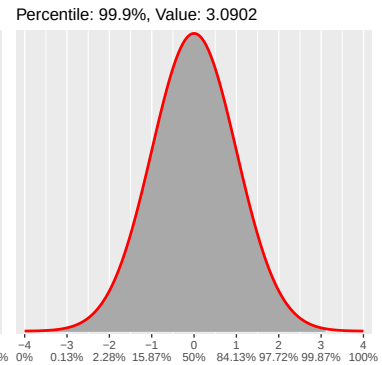
Percentiles (Quantiles):







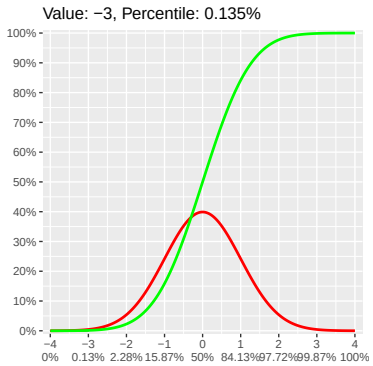


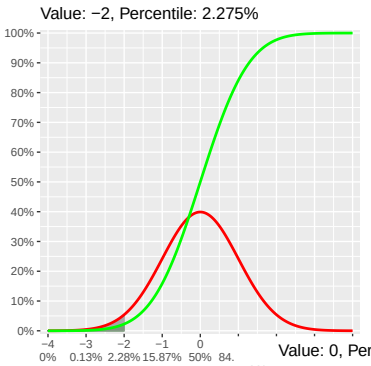


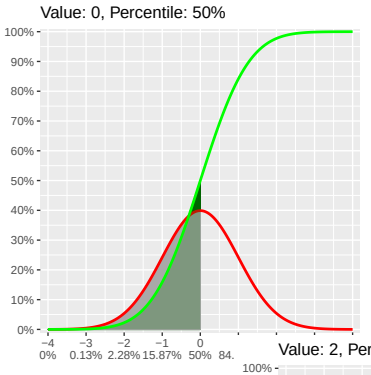
Problem: Which Statistics

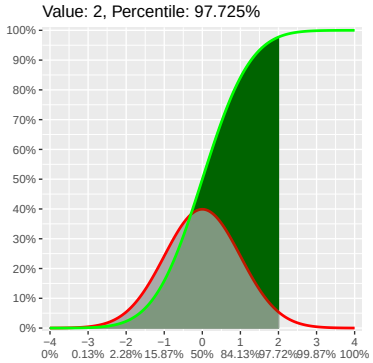
Reverse: Finding the bound for a value

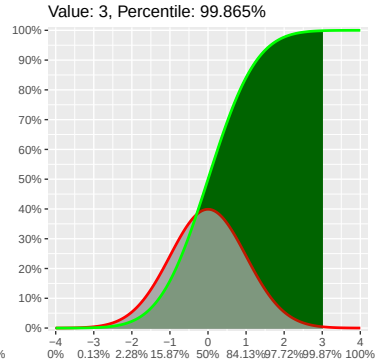
Empirical Cummulative Distribution Function (ECDF):









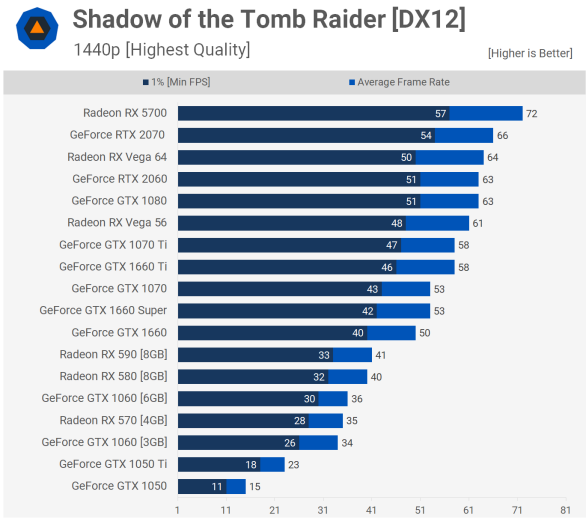


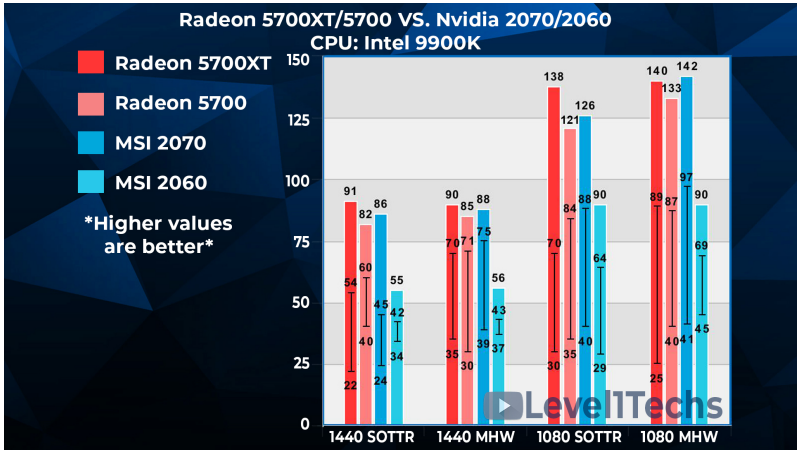
Results:

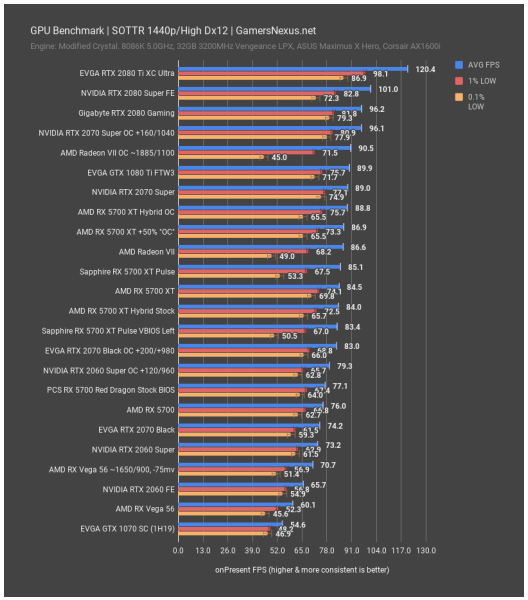
Serious Sam Fusion 2017 - DirectX 11

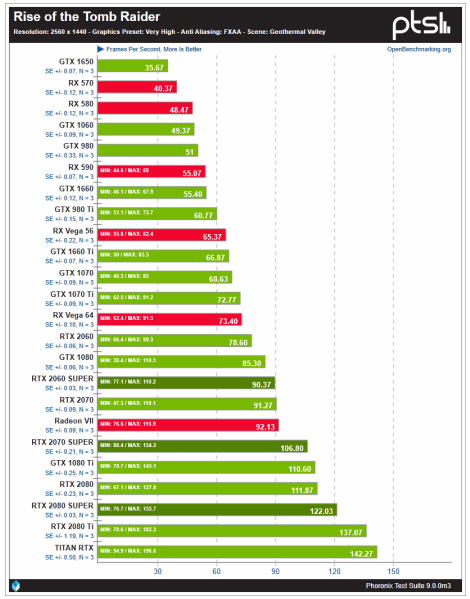
GPU	Location		Mean	Median	0.1%	1%	99%	99.9%	60 FPS
RX Vega 64	Hatsheput	FPS	270.91	267.52	393.65	365.5	226.55	209.9	0
RTX 2060	Hatsheput	FPS	226.67	226.09	303.57	288.18	180.34	172.21	0
RX Vega 64	Hatsheput	ms	3.69	3.74	2.54	2.74	4.41	4.76	0
RTX 2060	Hatsheput	ms	4.41	4.42	3.29	3.47	5.54	5.81	0

Example Graphs:





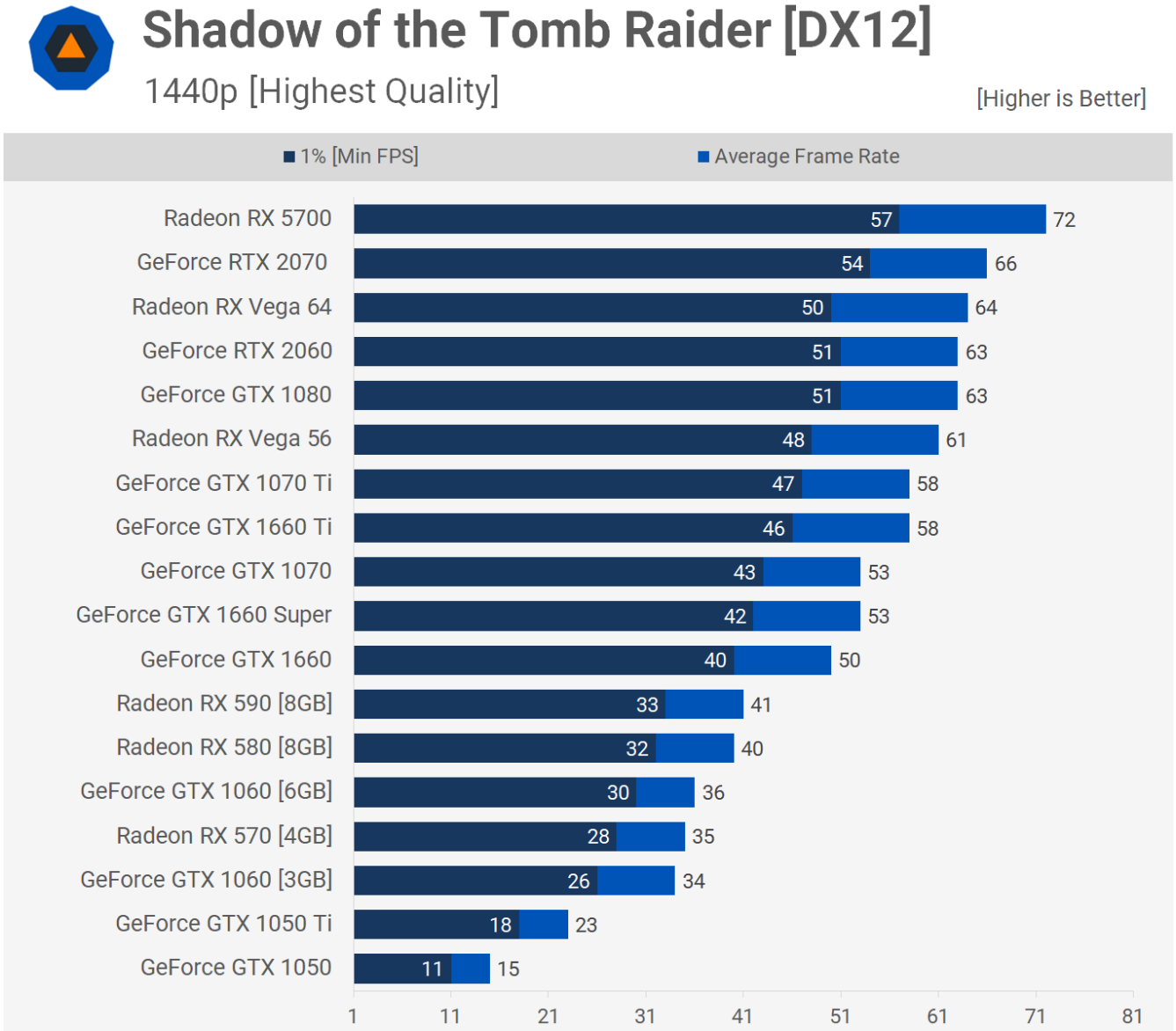




Sources:

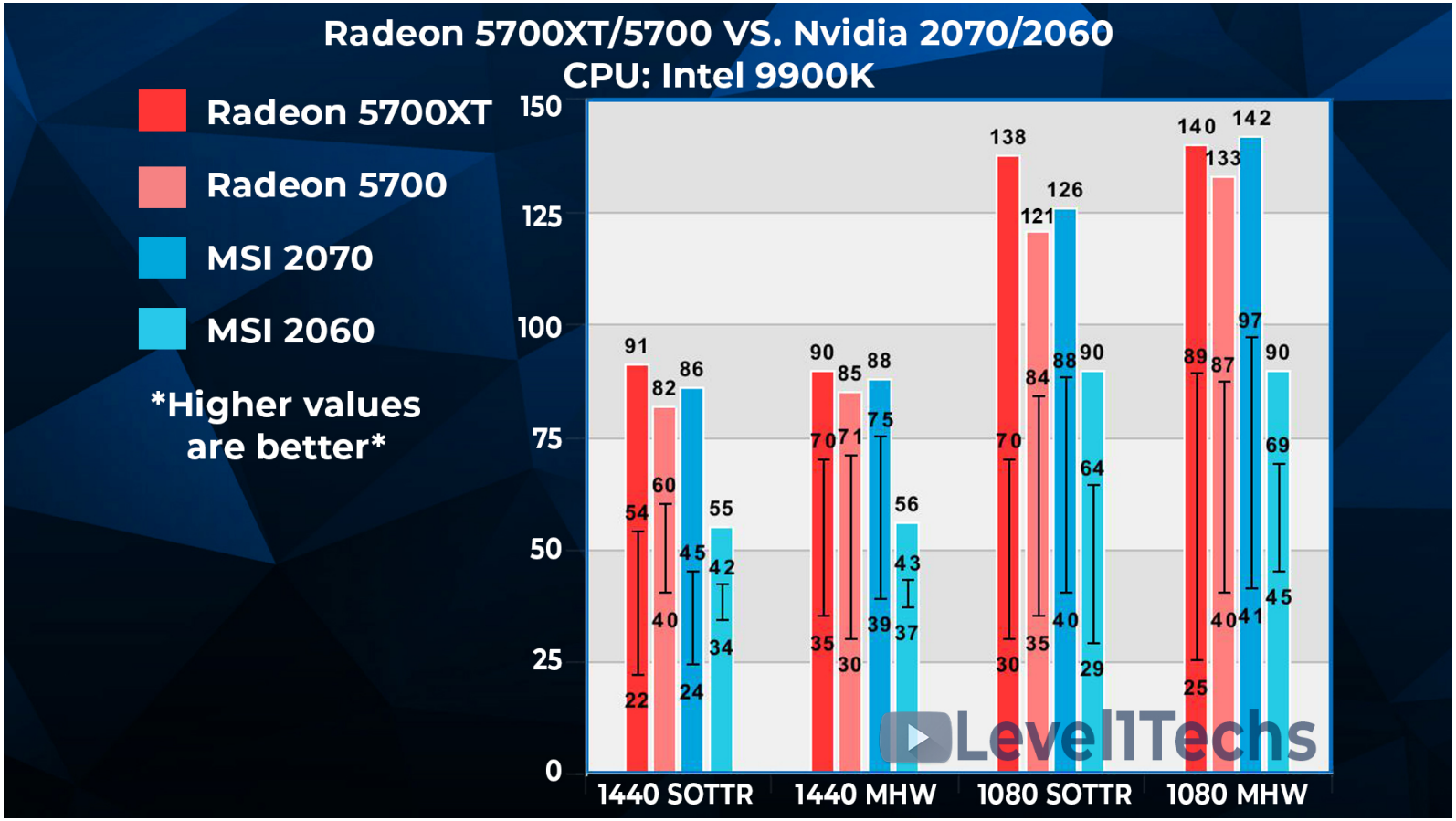
•Techspot/Hardware Unboxed	•Level1Techs
•Gamers Nexus	•Phoronix

Example Graph - Techspot/Hardware Unboxed



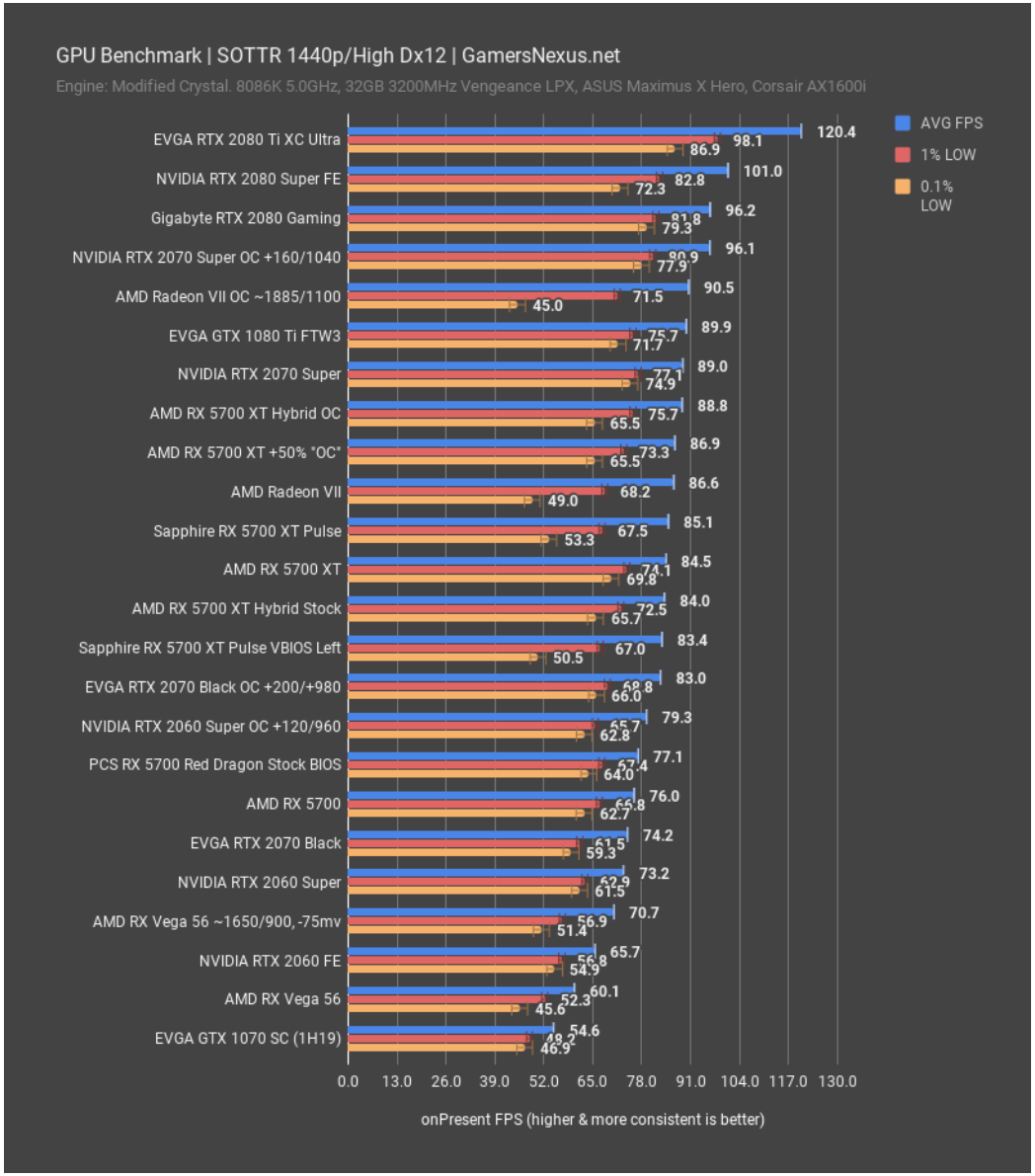
NVIDIA GeForce GTX 1660 Super Review

Example Graph - Level1Techs



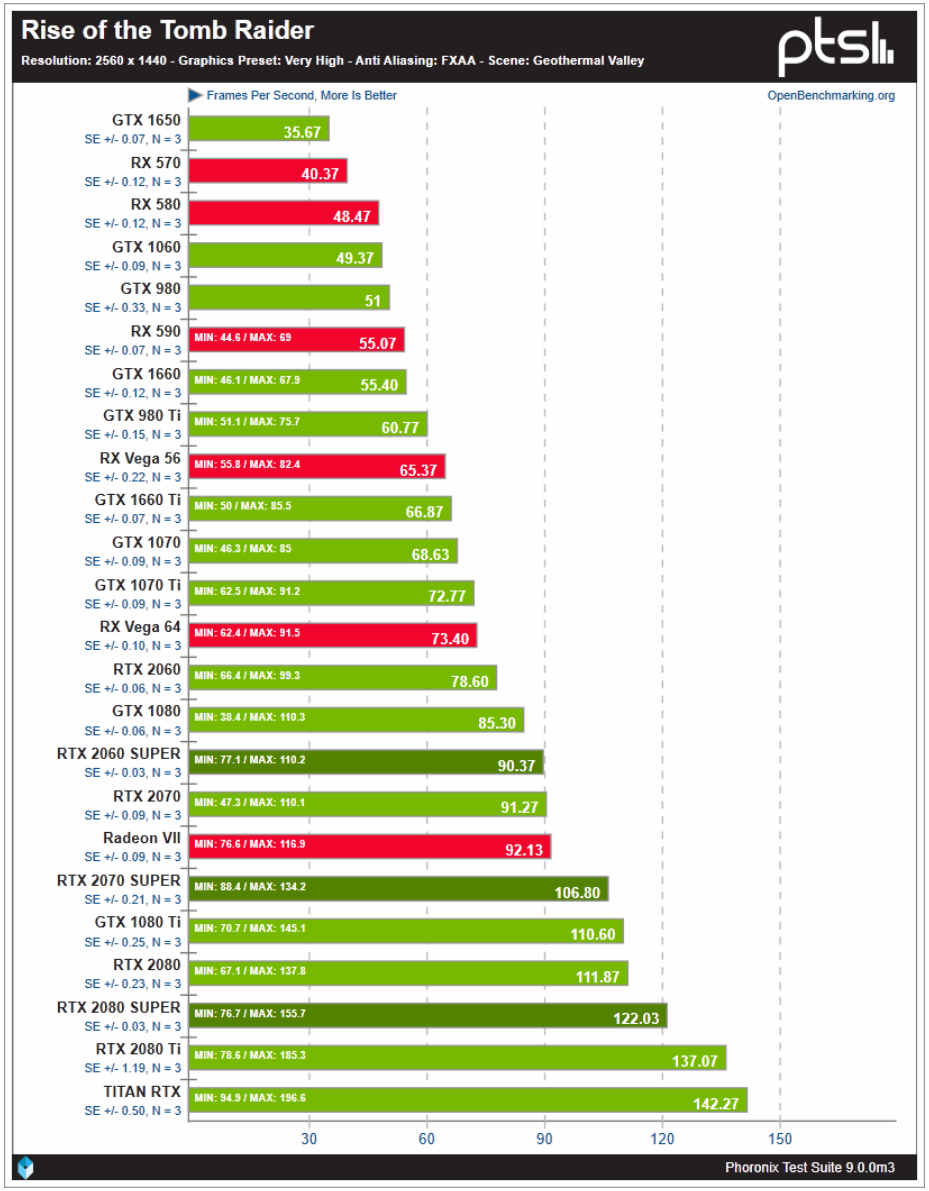
Radeon 5700 & 5700XT Launch Coverage & Testing

Example Graph - Gamers Nexus



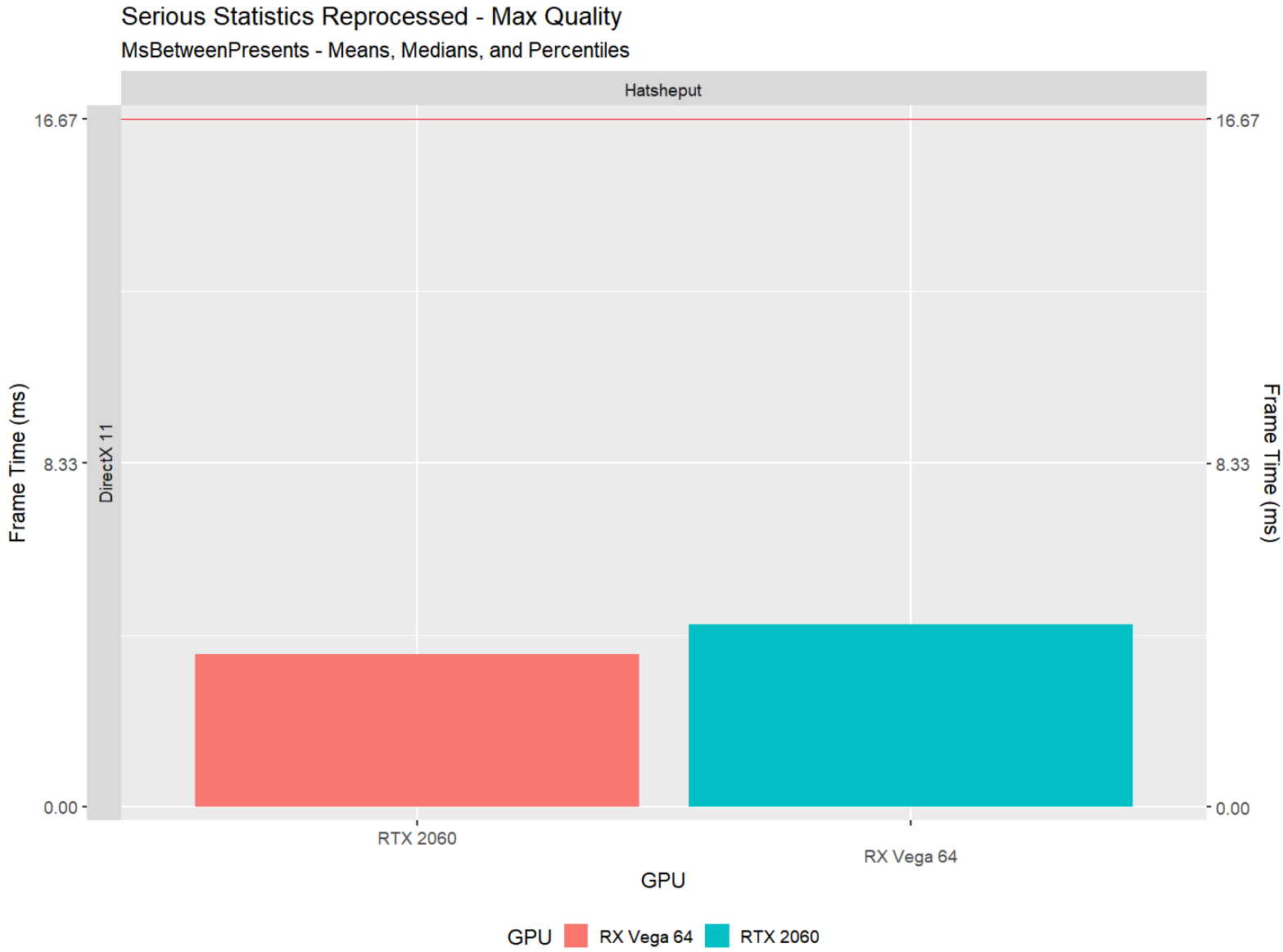
PowerColor RX 5700 Red Dragon Review: First of the Partners

Example Graph - Phoronix

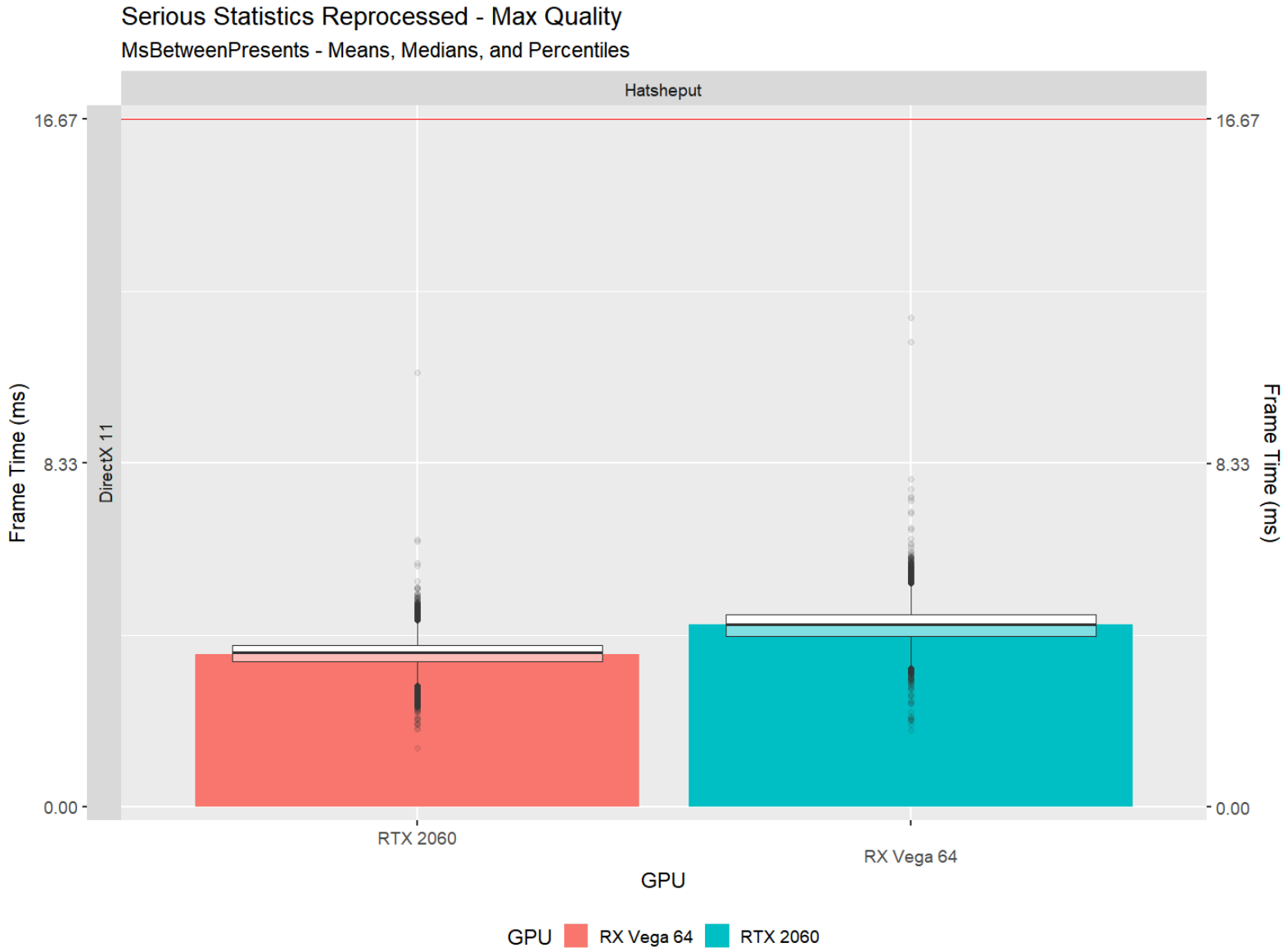


NVIDIA RTX 2060 / 2070 / 2080 SUPER Linux Gaming Performance

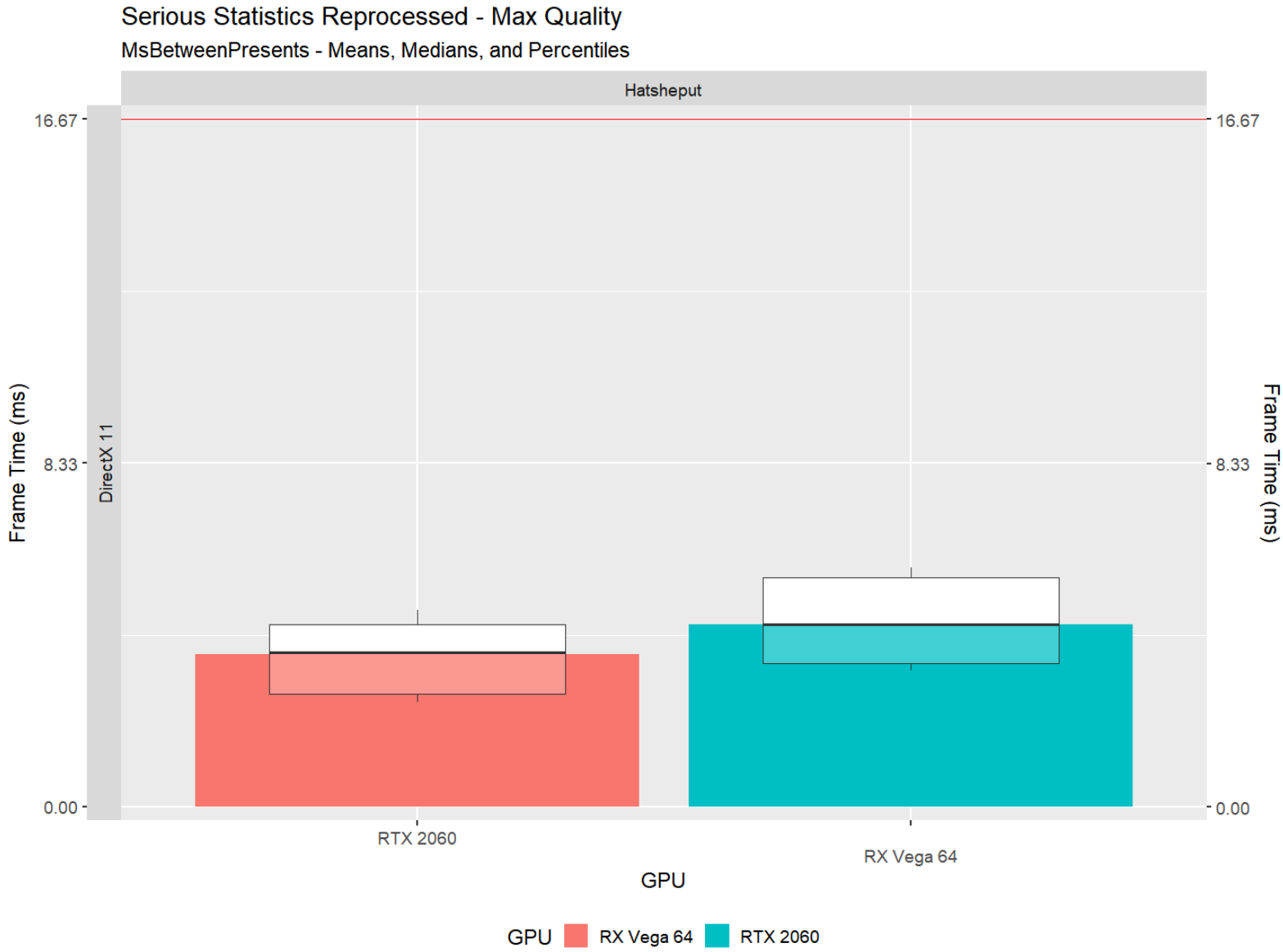
Means


Serious Statistics Reprocessed - Max Quality
MsBetweenPresents - Means, Medians, and Percentiles
Hatsheput
DirectX 11
16.67
8.33
0.00
Frame Time (ms)
RTX 2060
RX Vega 64
GPU
GPU
RX Vega 64
RTX 2060

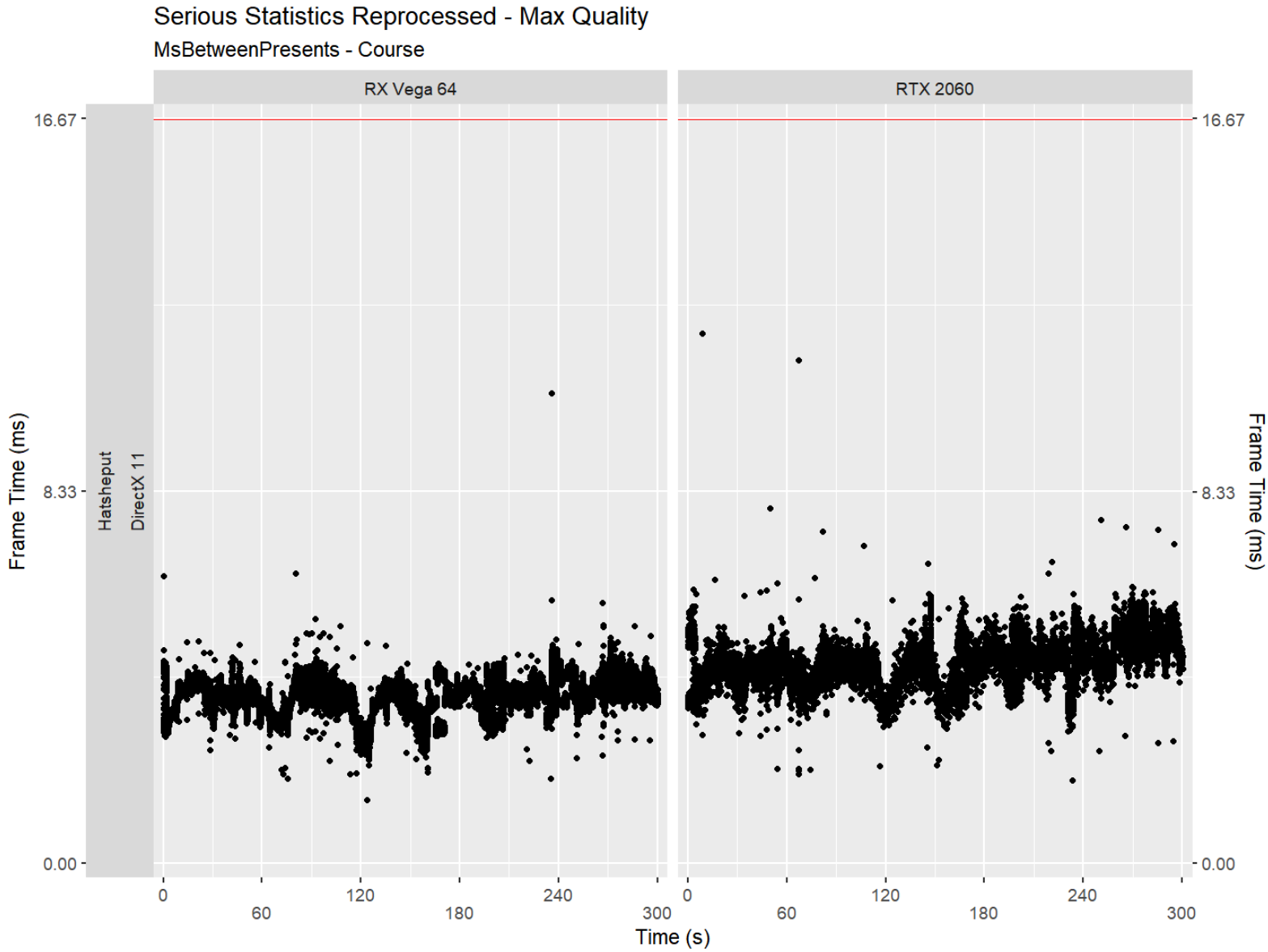
Means, Medians, and Quartiles



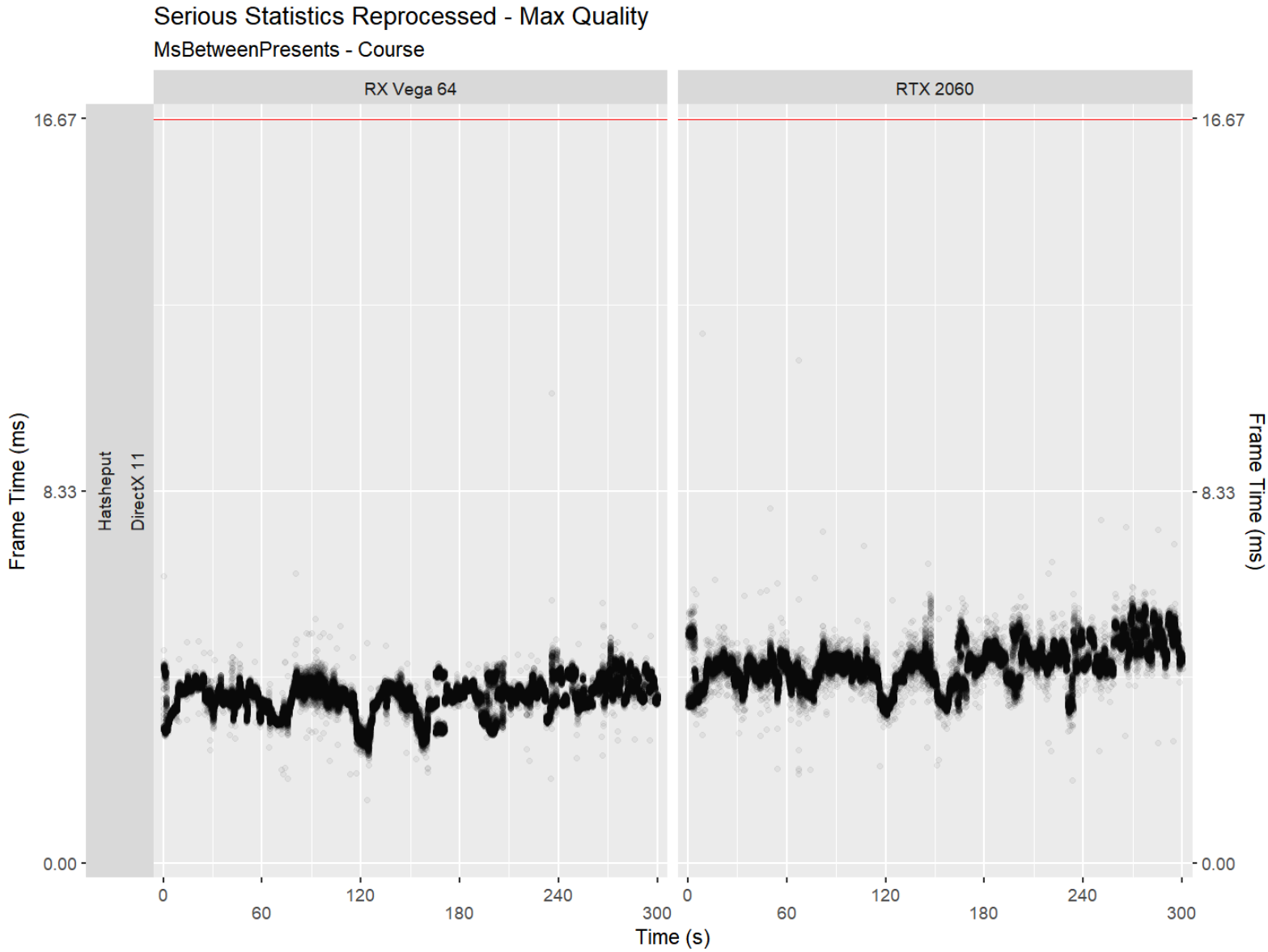
Means, Medians, and Percentiles



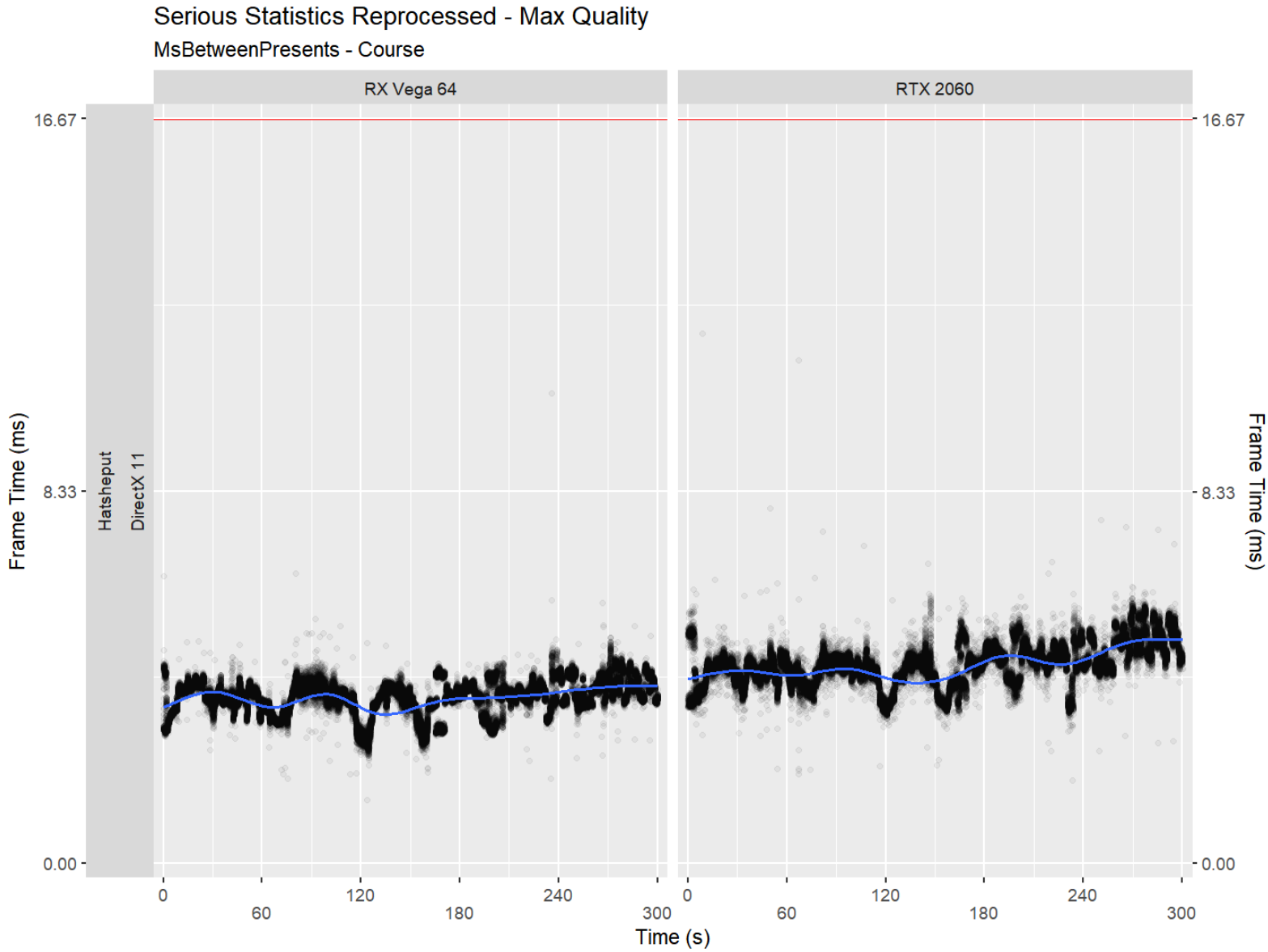
Course



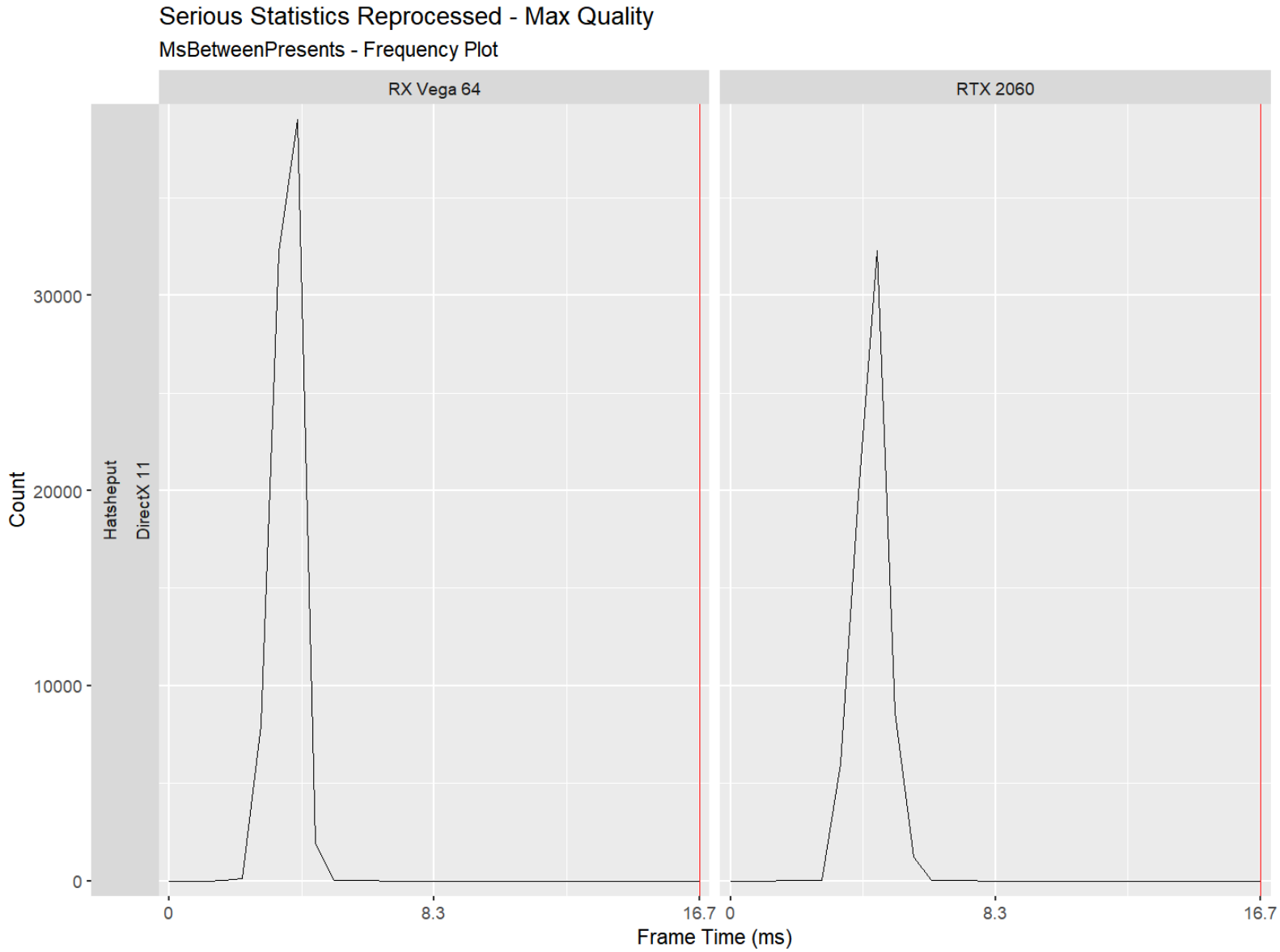
Course and Density



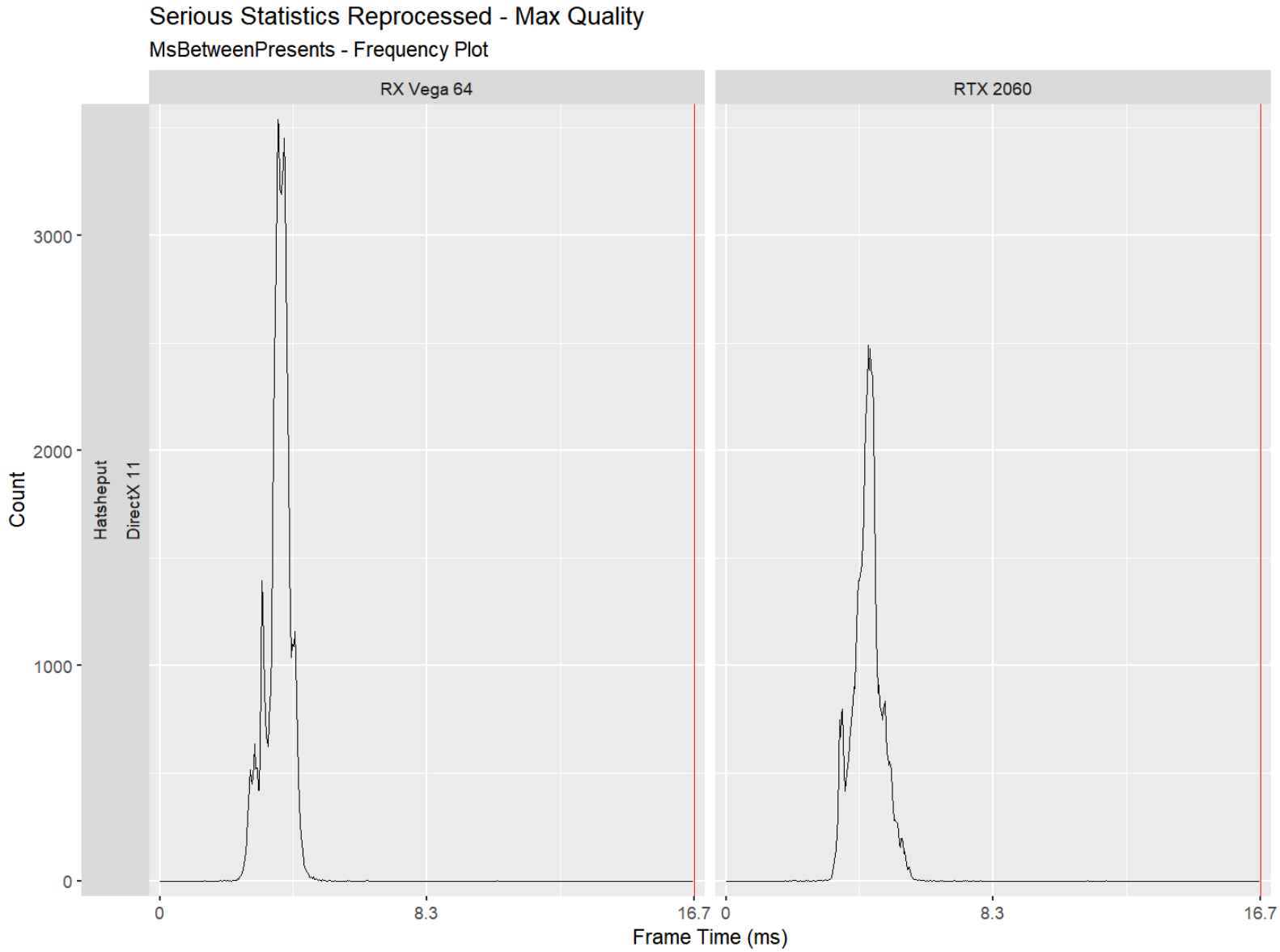
Course, Density, Smooth



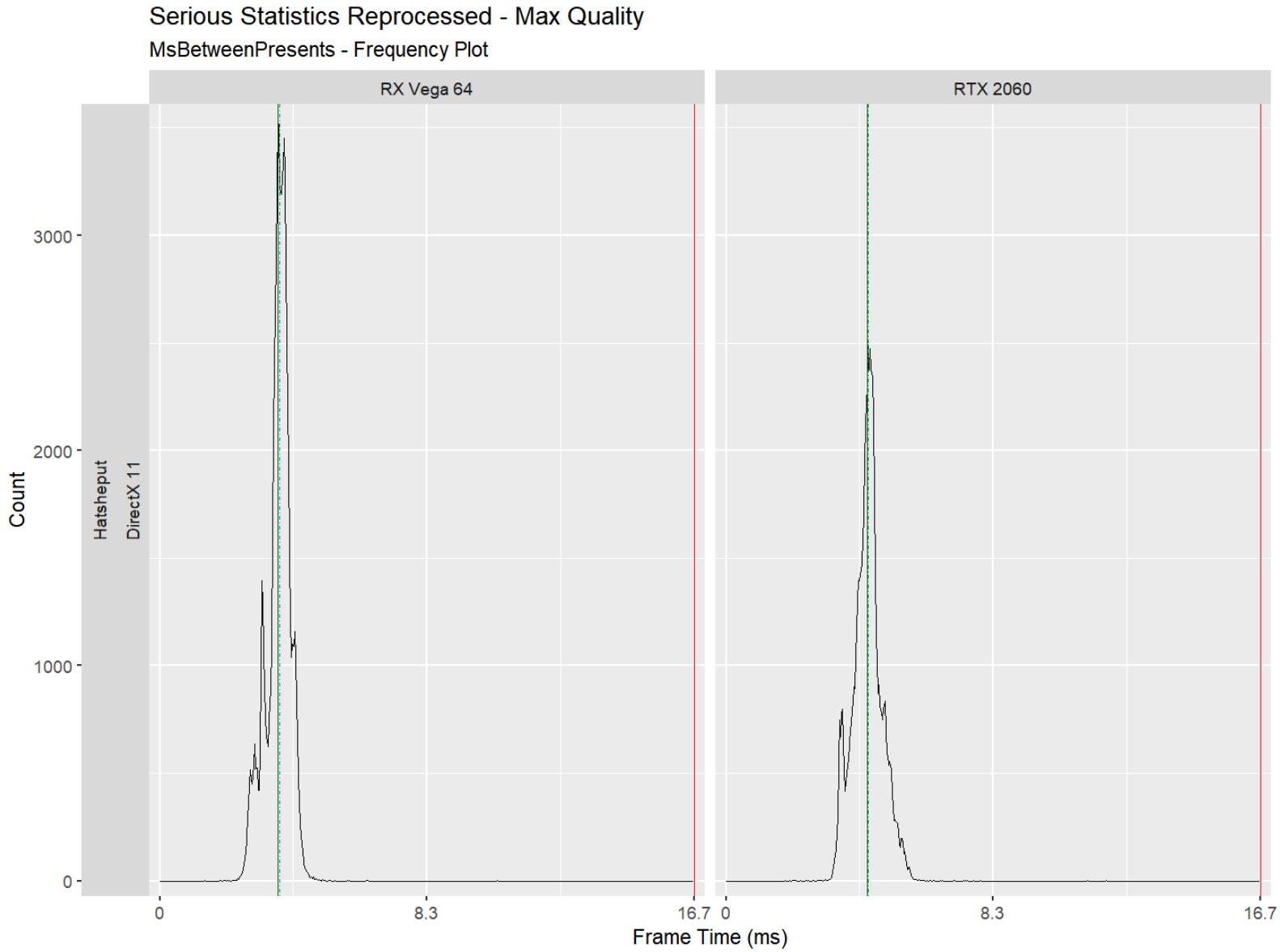
Frequency



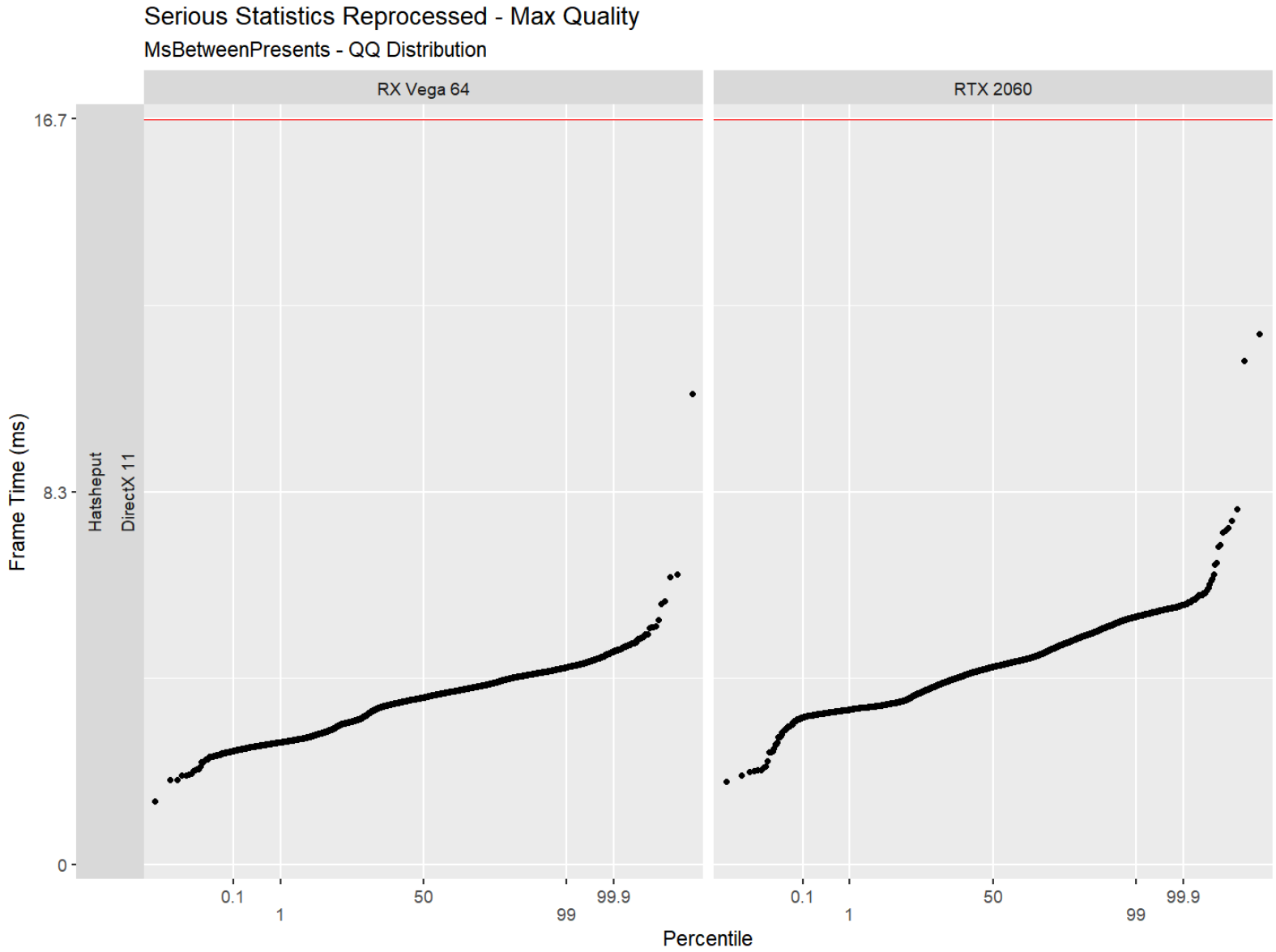
Frequency and Thin Bins



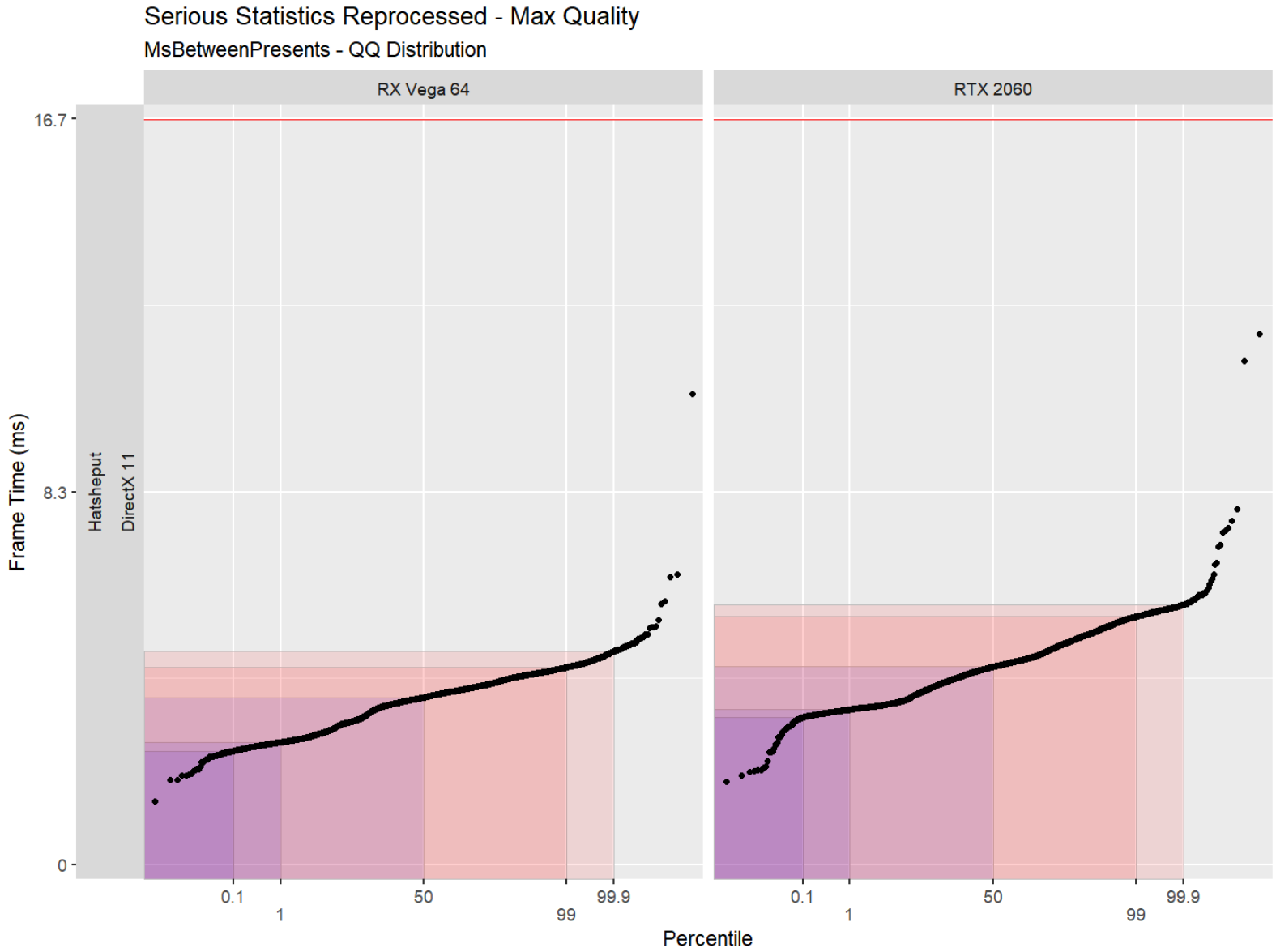
Frequency, Thin Bins, and Statistics



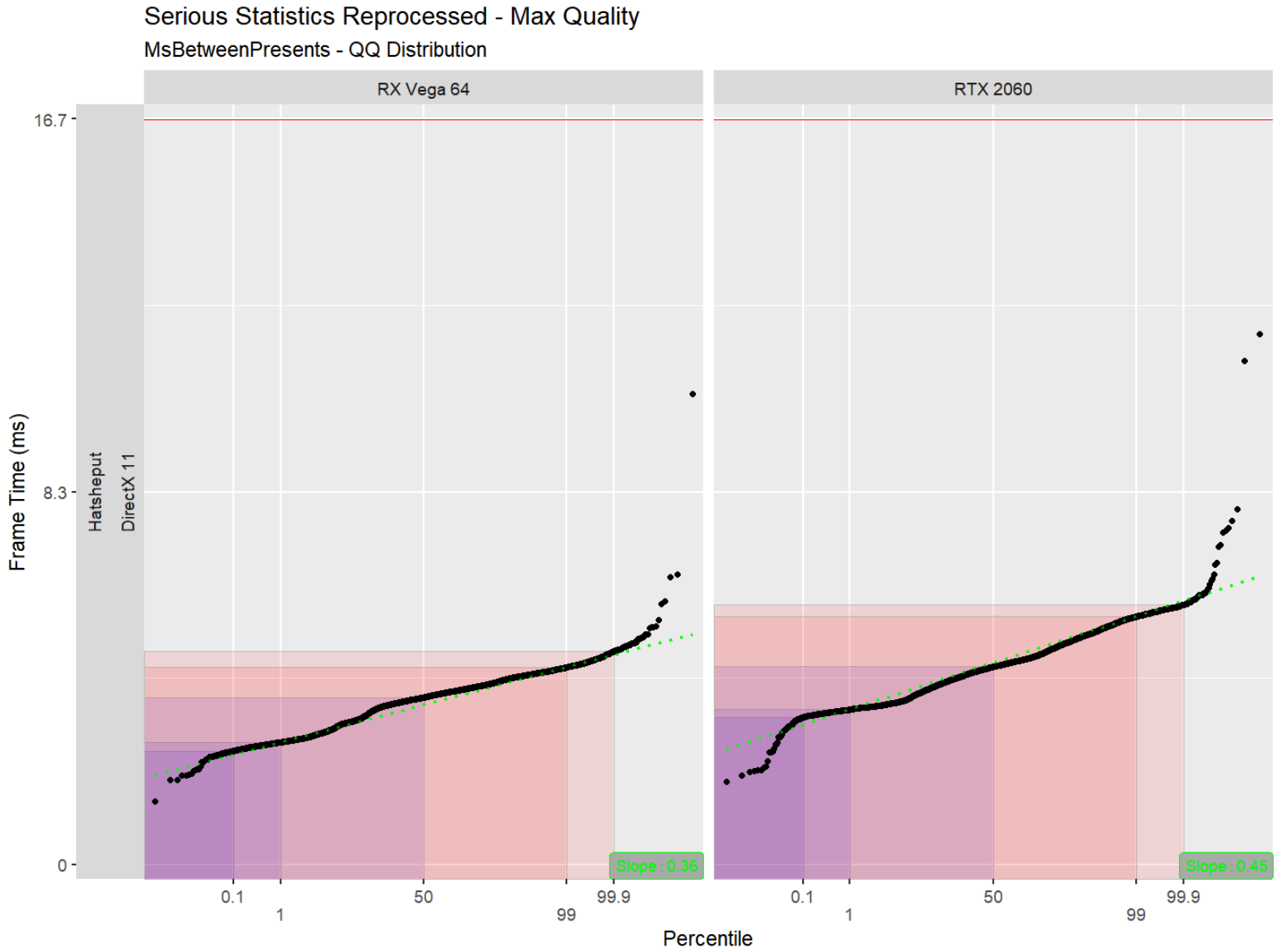
Quantiles



Quantiles and Guides

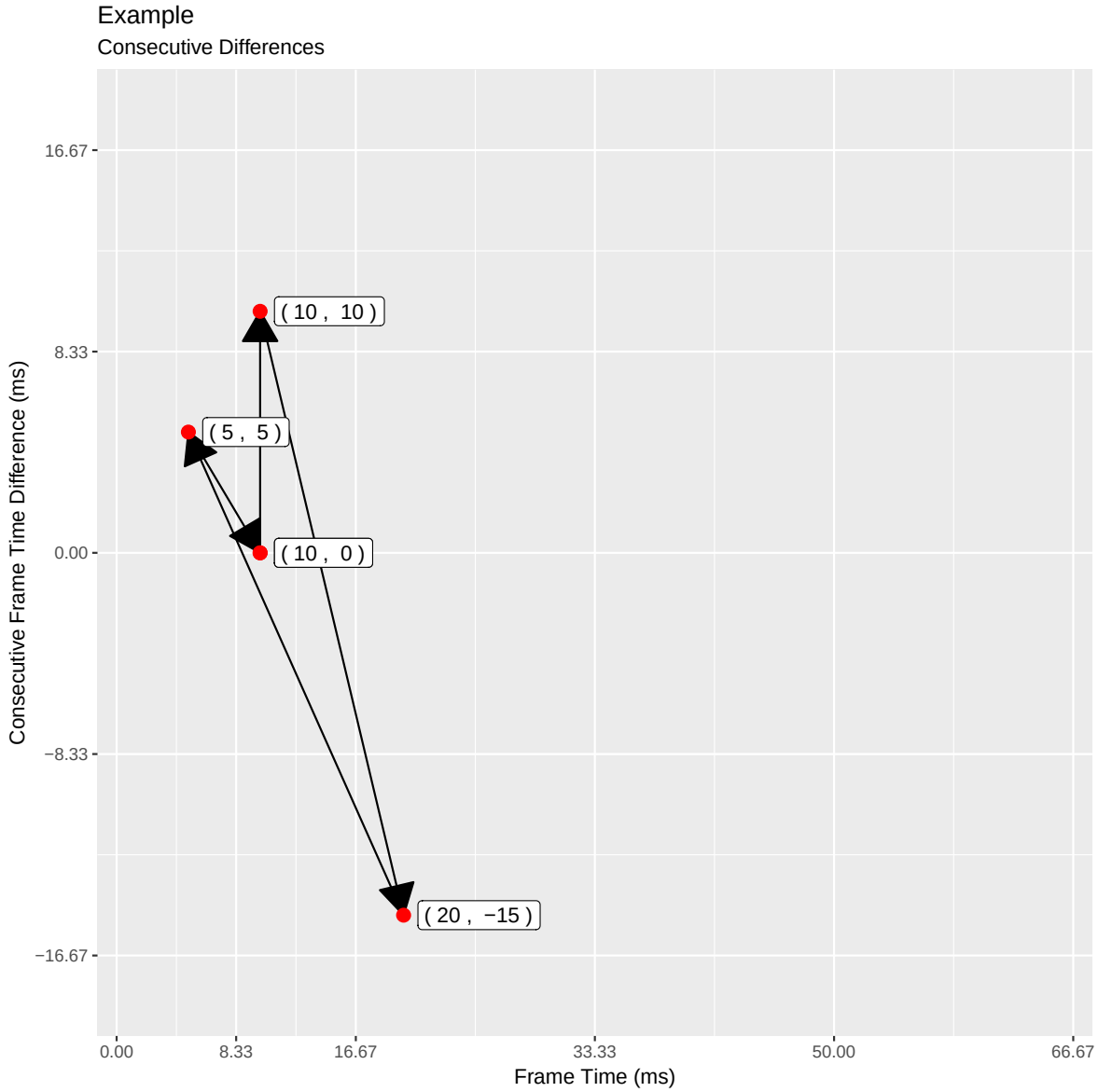


Quantiles, Guides, and Line

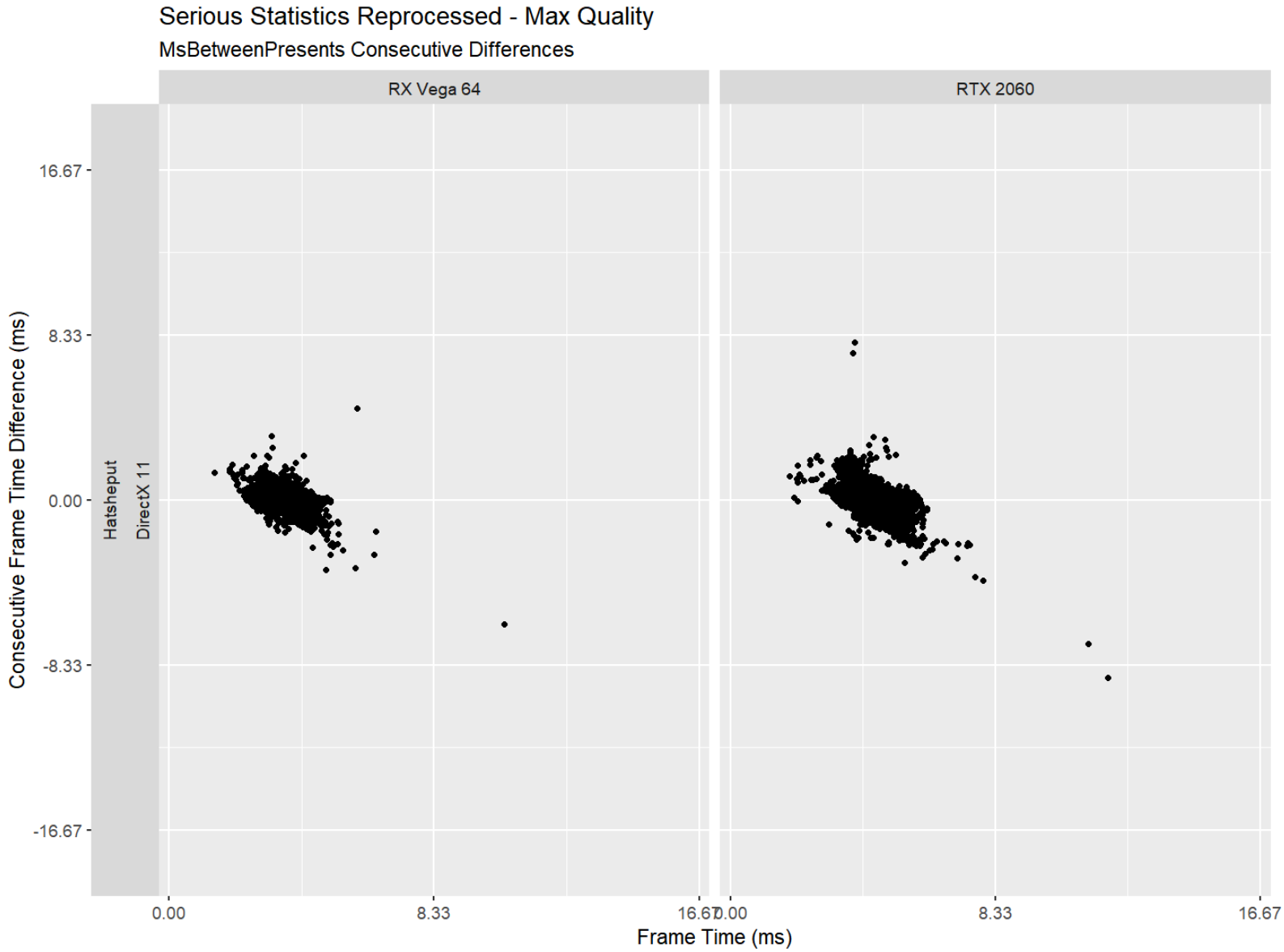


Consecutive Difference - Example

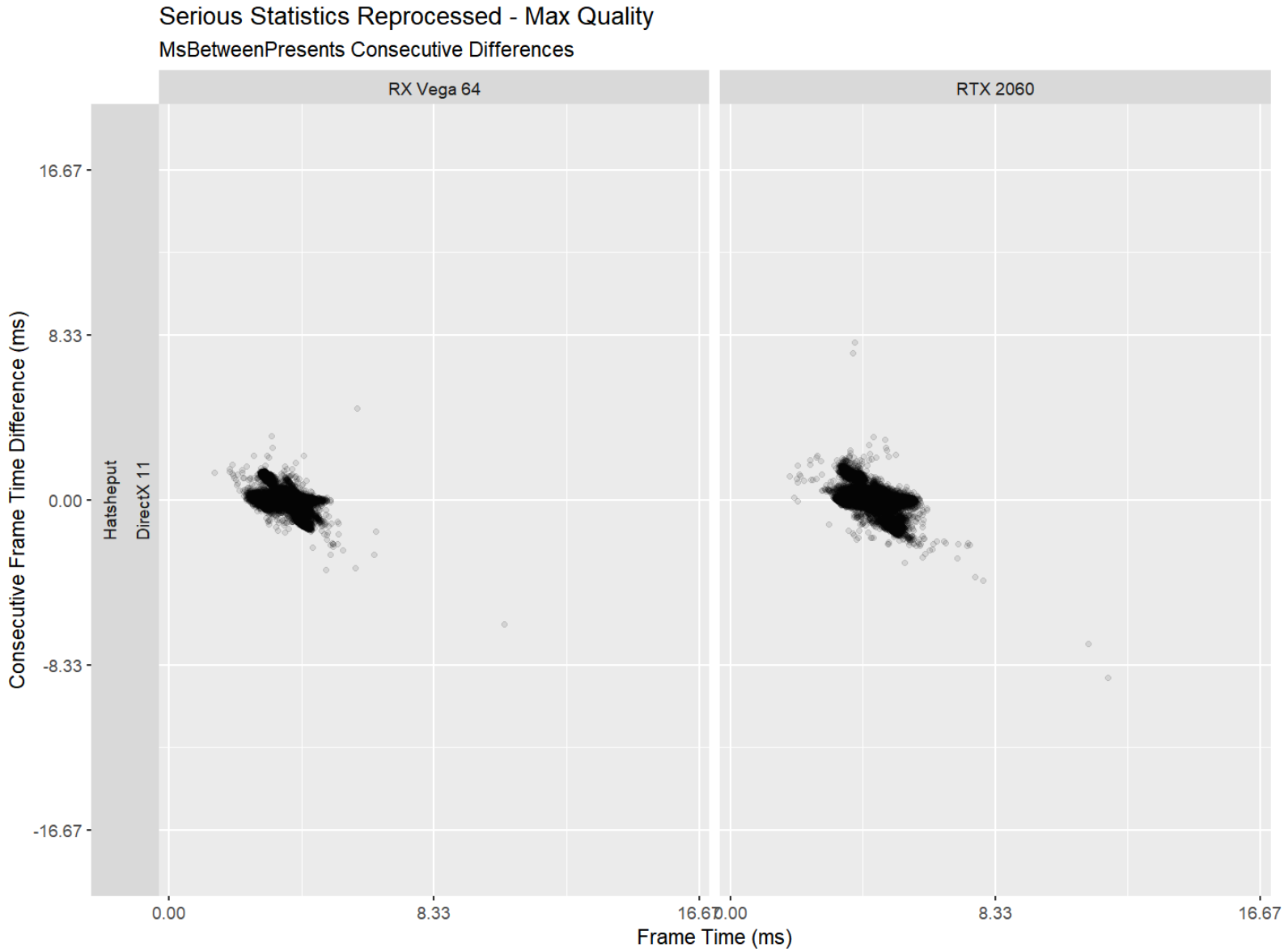
$$10, \ldots 10, 20, 5, 10, \ldots 10$$



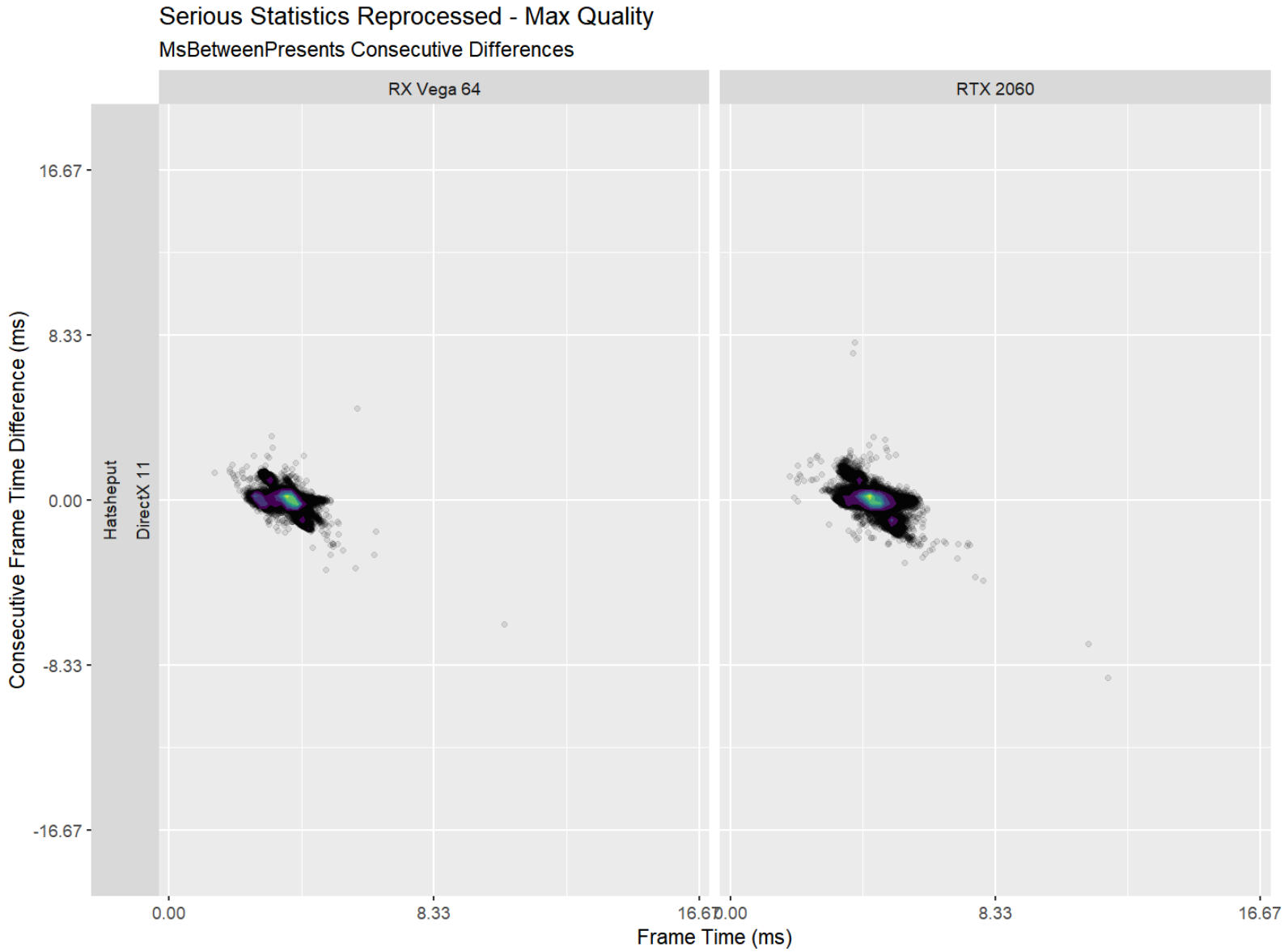
Consecutive Difference



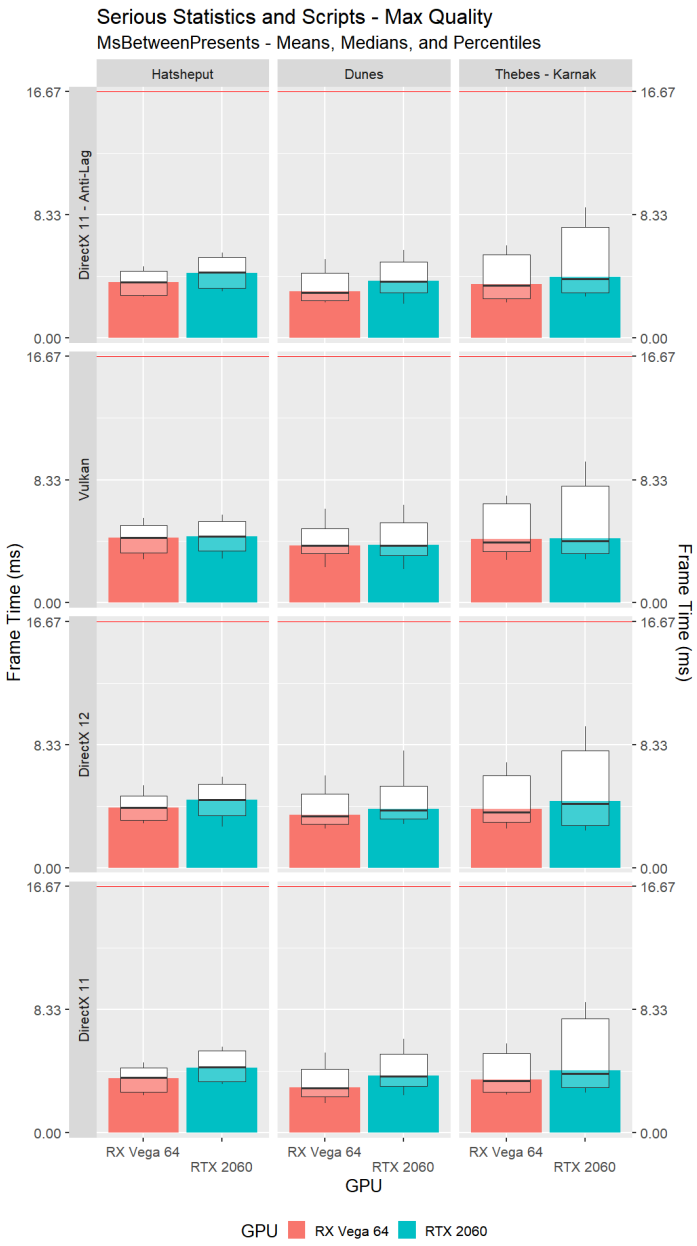
Consecutive Difference and Density

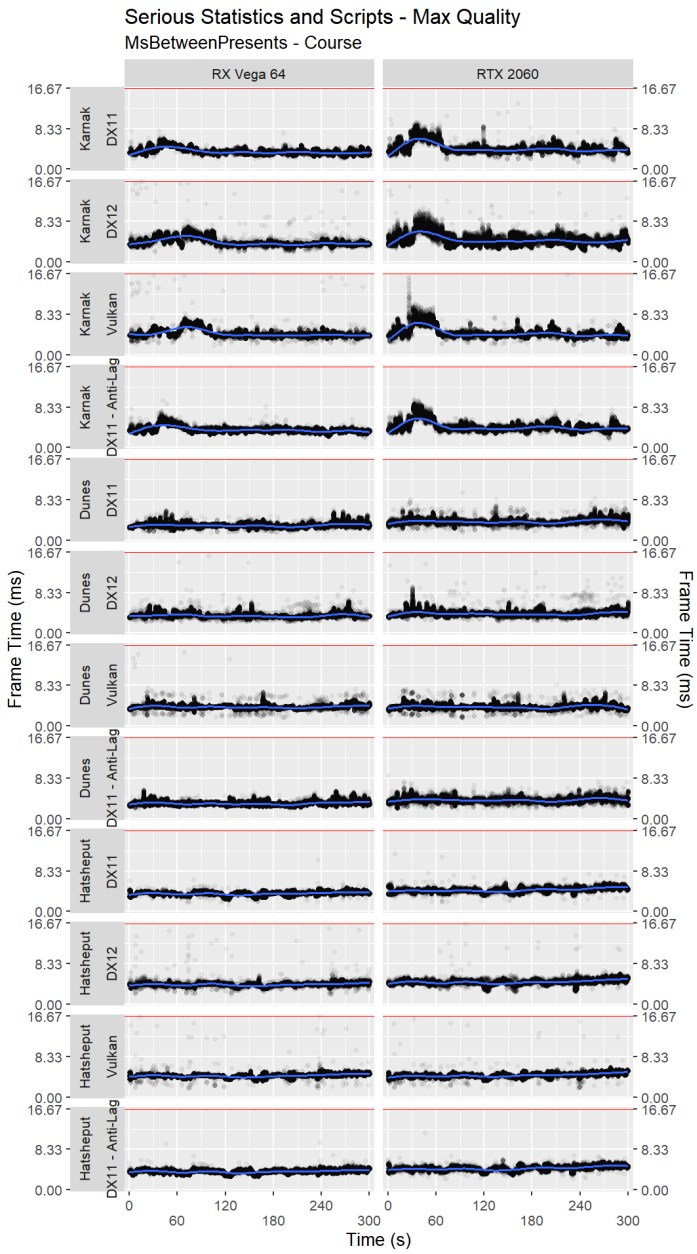


Consecutive Difference, Density, and Heatmap

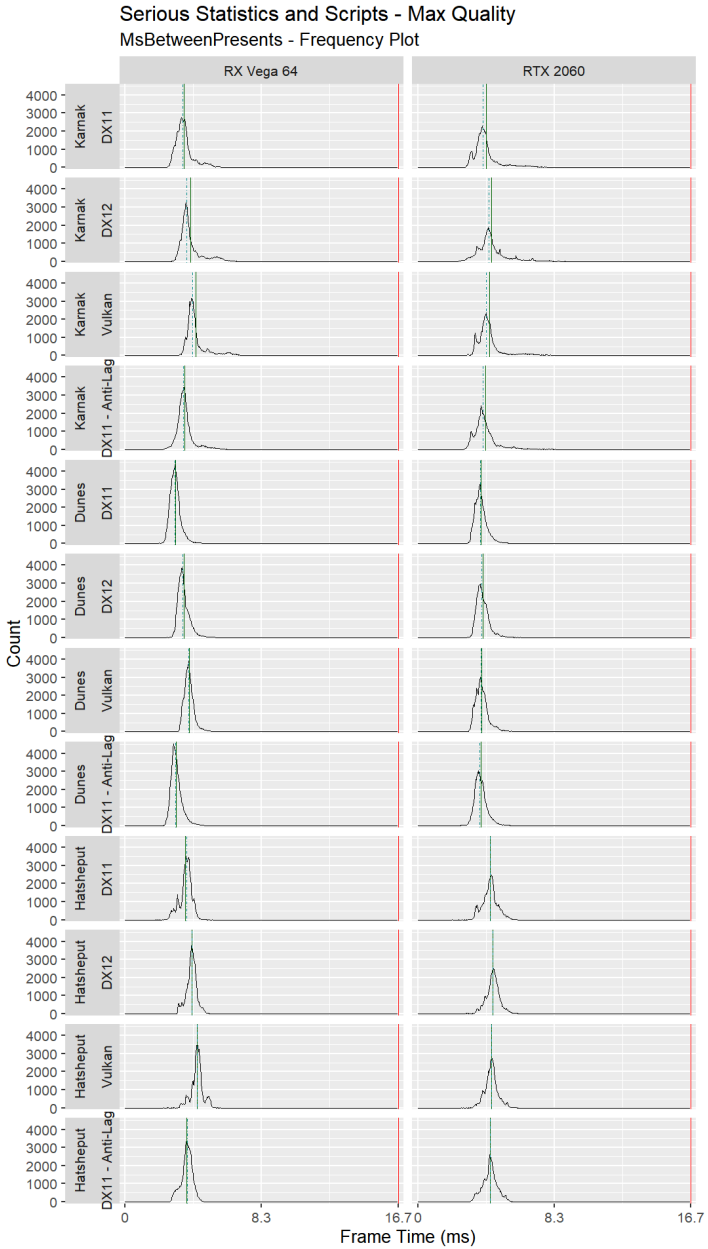


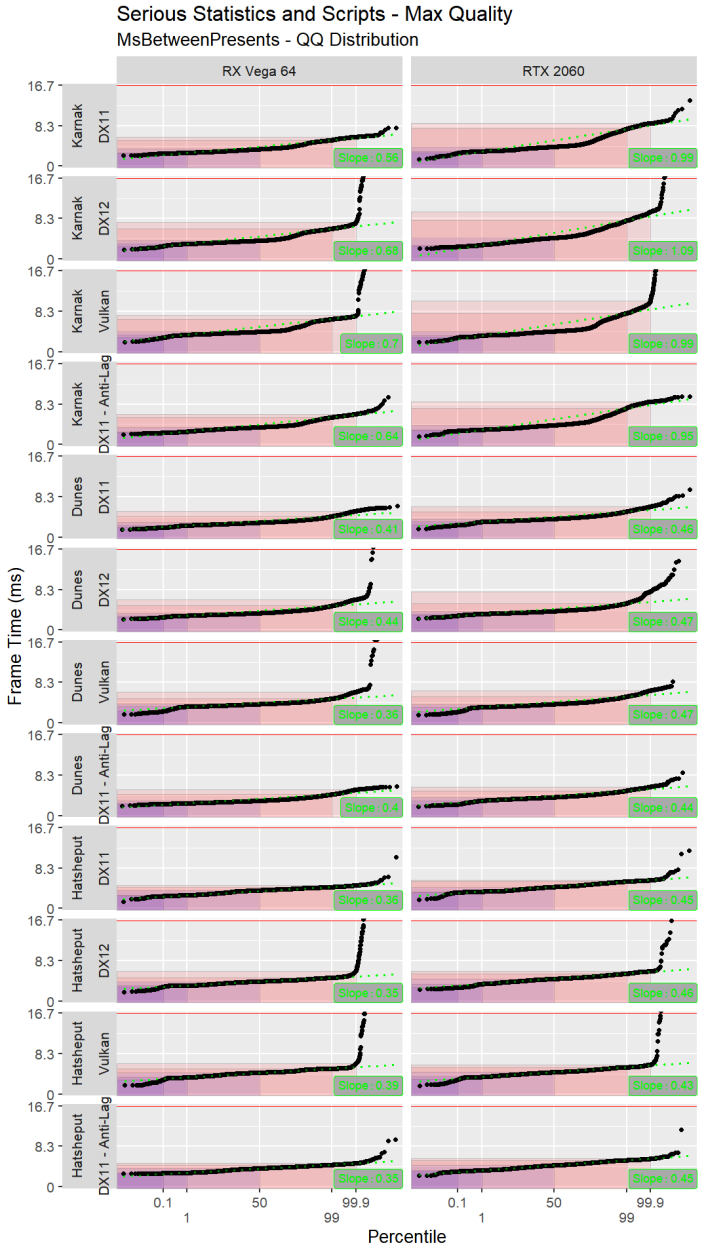
Means, Medians, and Percentiles - Course



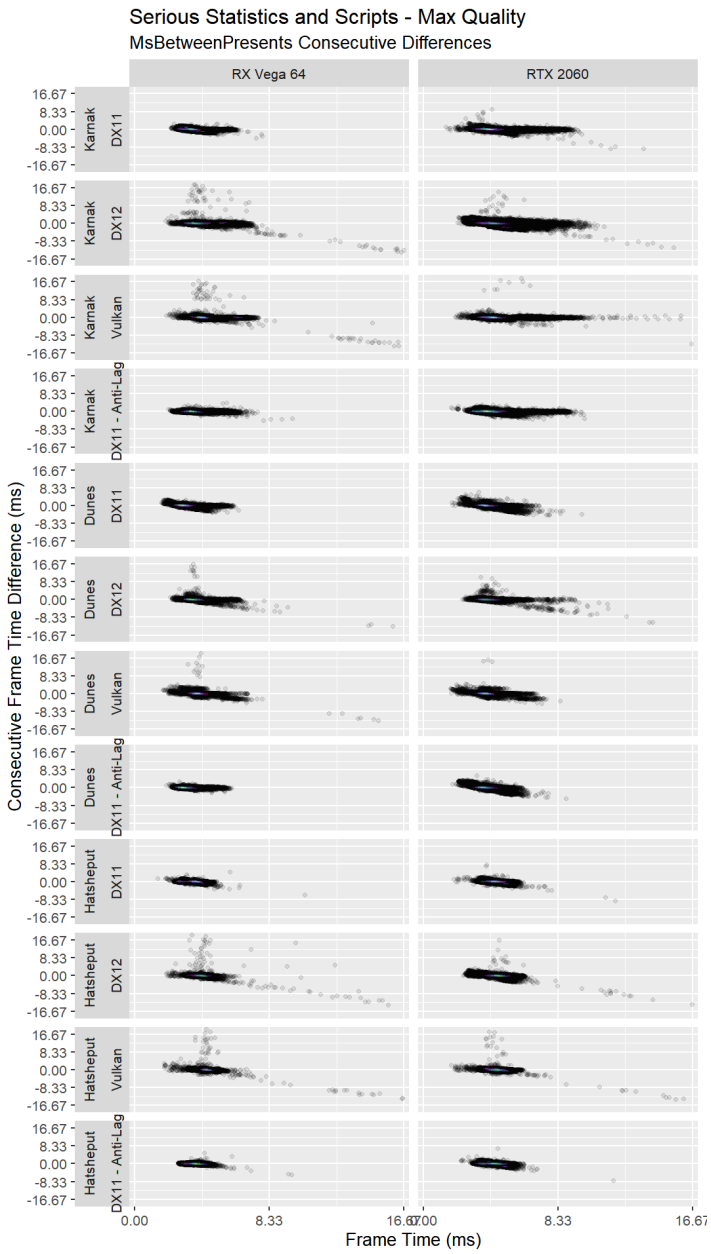


Frequency and Quantile





Consecutive Difference



References:

Example Graphs can be found at:

- Techspot/Hardware Unboxed - NVIDIA GeForce GTX 1660 Super Review
- Level1Techs - Radeon 5700 & 5700XT Launch Coverage & Testing
- Gamers Nexus - PowerColor RX 5700 Red Dragon Review: First of the Partners
- Phoronix - NVIDIA RTX 2060 / 2070 / 2080 SUPER Linux Gaming Performance

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Original **Serious Statistics Reprocessed: Statistics and Scripts** can be found on GitHub

All data, statistics, graphs, and scripts are in the repository

github.com/GuestJim/Serious-Statistics-Reprocessed