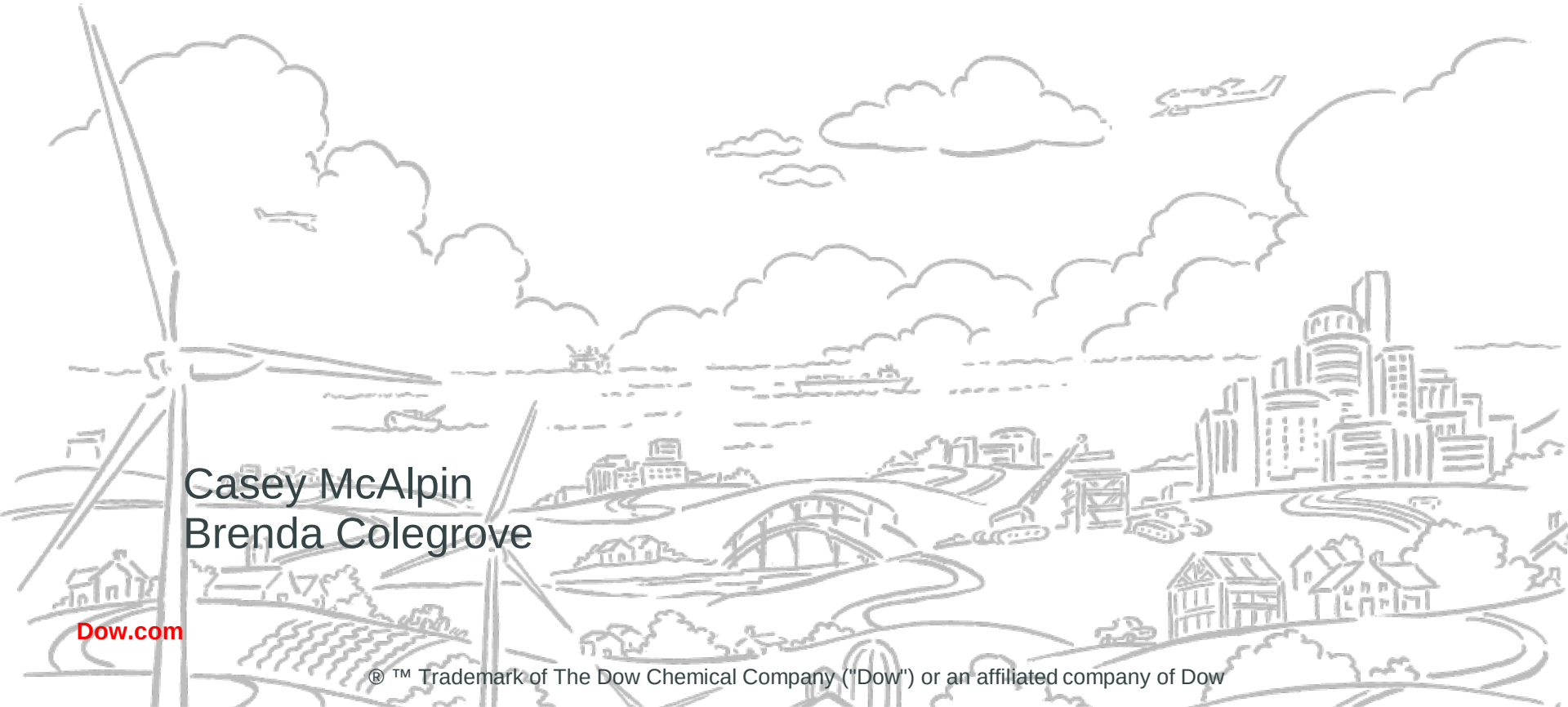
Managing Global Color Analysis and Minimizing Bias Impacts with a Data-Based, Targeted Approach



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Background

- Color properties of polyolefin products are analyzed by Dow and its partners in more than 25 locations globally via ASTM D-6920

- Historically, it has been challenging to compare color data from different geographies. This can confound our ability to compare the actual appearance of material which is produced globally

- Our goal is to minimize the impact of instrumental biases

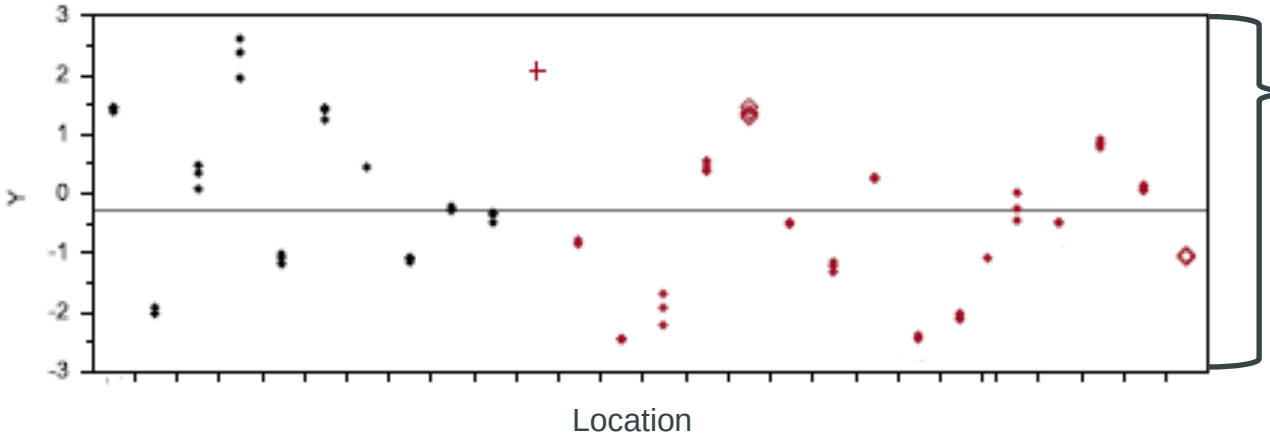
Global Biases

- Color measurements by D-6920 are confounded by differences in illuminant geometry (4 types).

- Additionally, factors such as sample preparation and differential aging of the illuminant in the spectrophotometer can introduce wide between-unit variability

- One strategy to minimize the bias problem is to select one instrument manufacturer to be the “preferred supplier” of your instruments

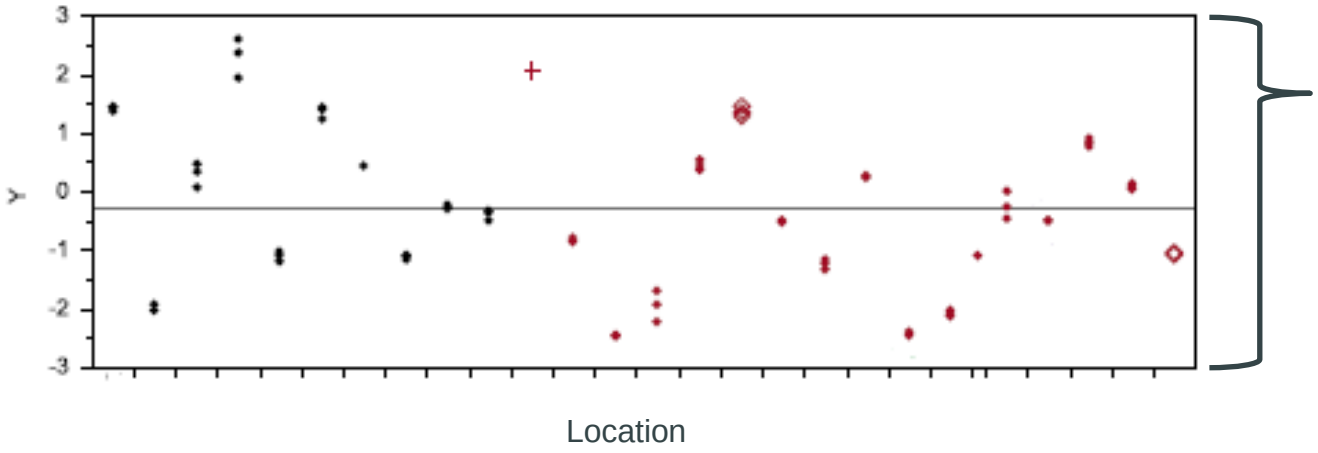
Between Instrument Bias



Interlaboratory Uniformity data for a single product. YI range ~3 to -3

- Even with a singular instrument specified, sample preparation and presentation can lead to wide variability!
- As instruments age biases are exacerbated
- Instruments were becoming obsolete and a new preferred instrument was defined which was far less susceptible to differences in sample presentation

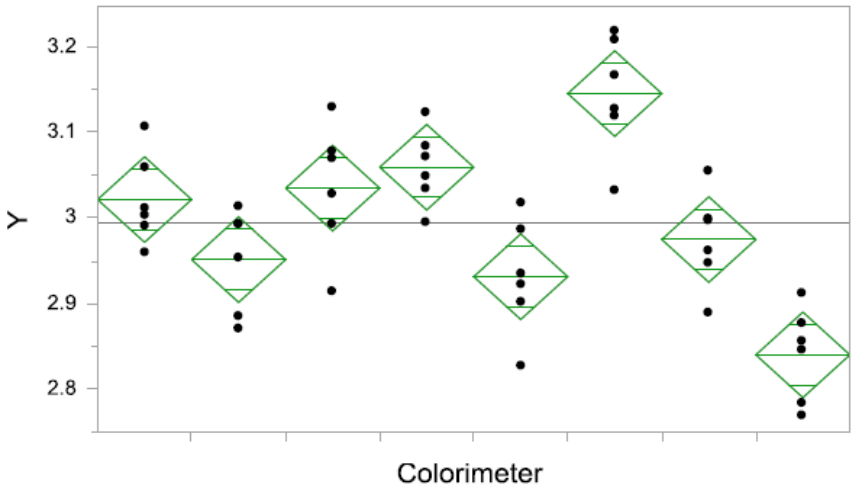
Path Forward: Putting It Together

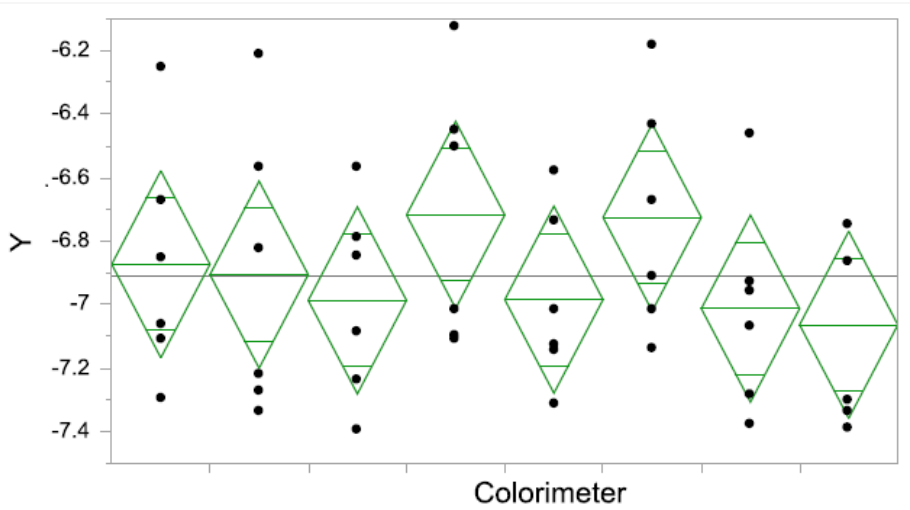


It is necessary to understand the bias expected for each geography

- To properly implement the new instrumentation we need to understand:
  - Variability expected between new instruments
  - Difference between old and new instrument for each location
  - Where the plant at each location was historically operating
  - For products produced at multiple locations which plant is the "worst"

Between Instrument Variability for New Instruments

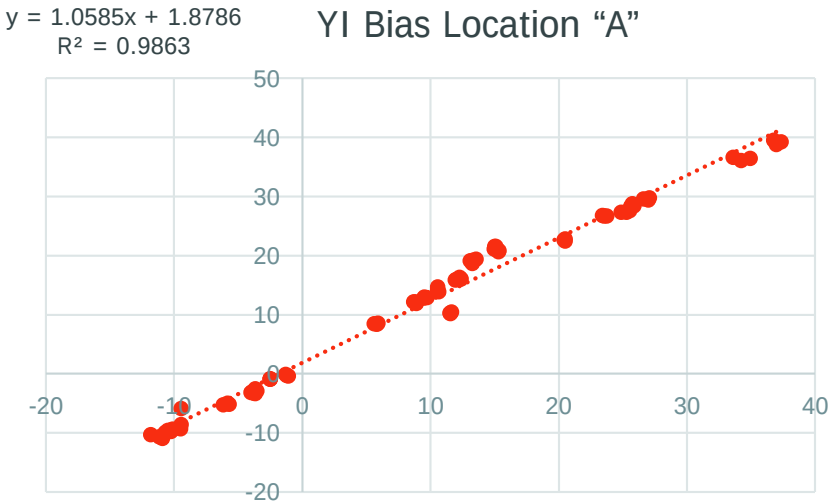


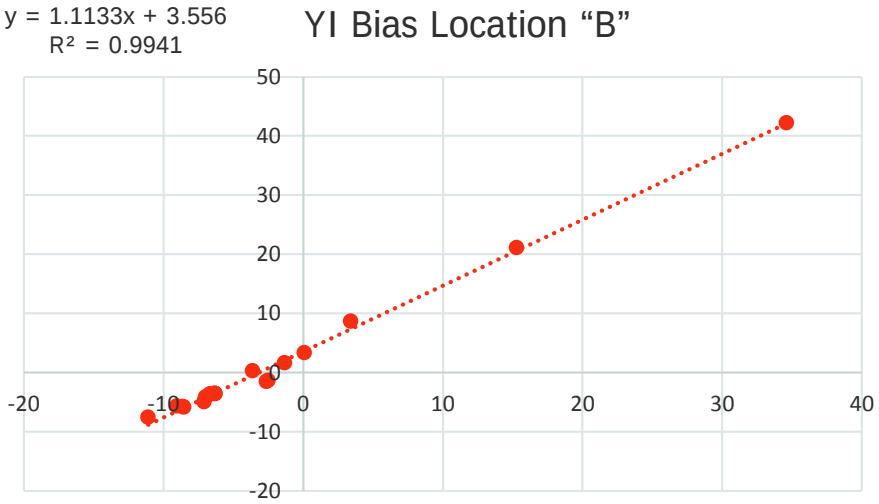


- A variety of materials were tested on eight different spectrophotometers of the new model

- Fortunately the range of yellowness index data was never more than 0.3 YI units.

Difference Between Old-New Instruments for Each Location



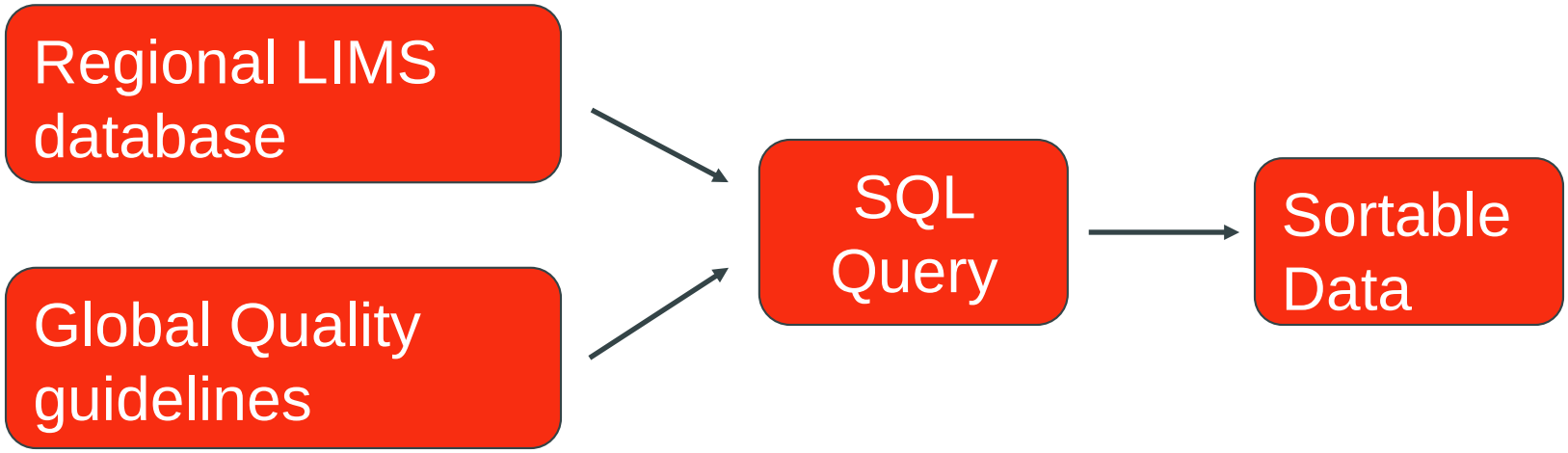


- Since each obsolete instrument performed differently the impact of switching instruments needs to be evaluated for each location

- To establish this a wide variety of materials and standards were analyzed with both instruments in parallel

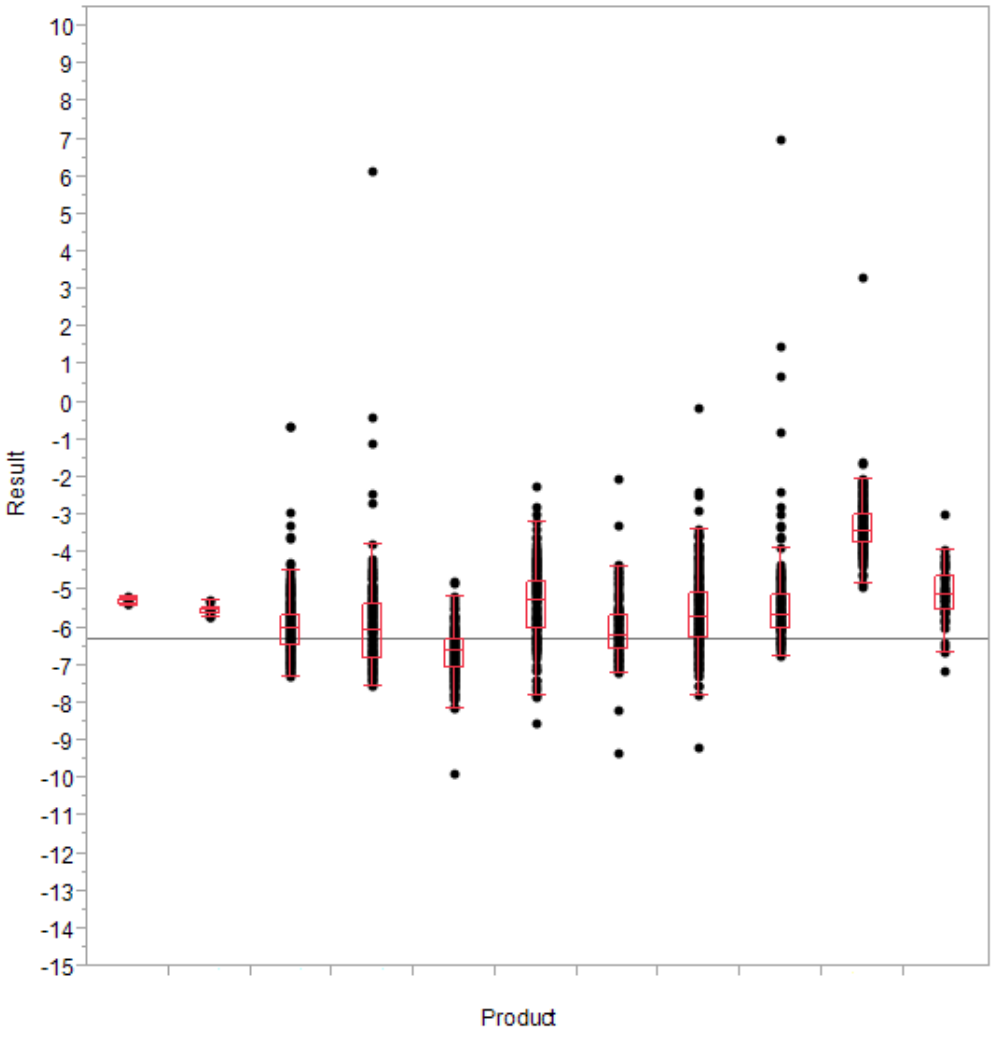
Determination of Historical Performance

Developed a SQL (Structured Query Language) tool to pull production data from LIMS for every product produced at each location for the previous year



Determination of Historical Performance

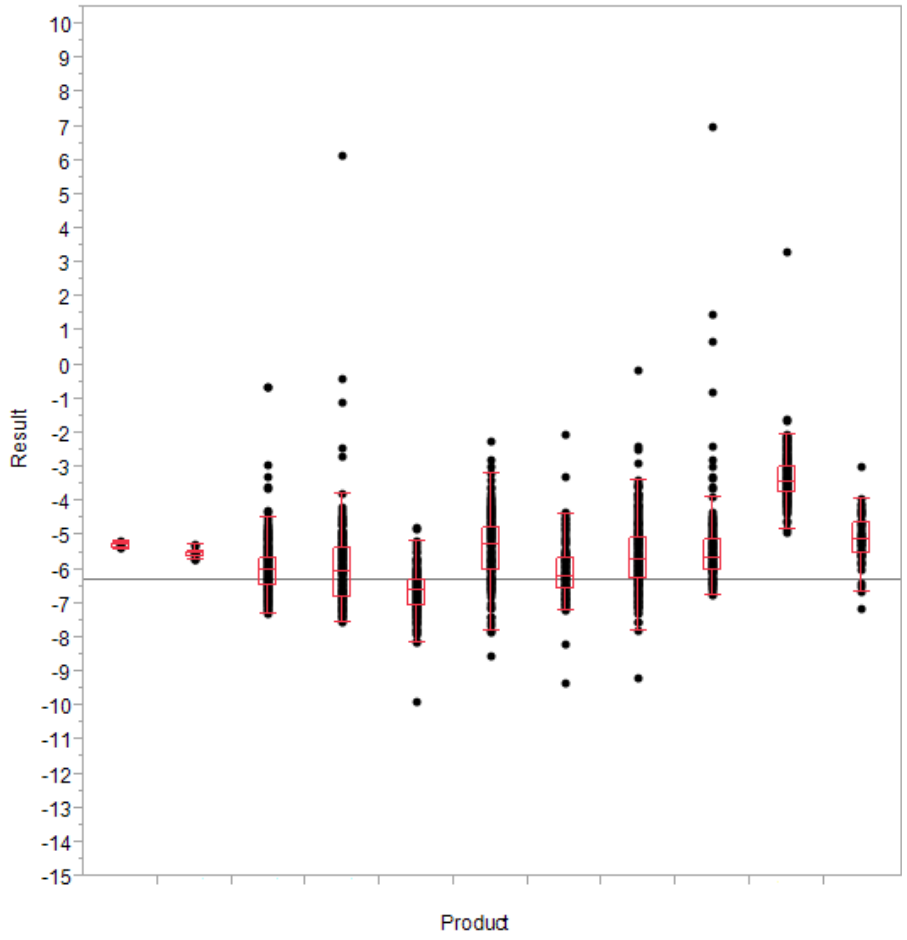
Sortable Data

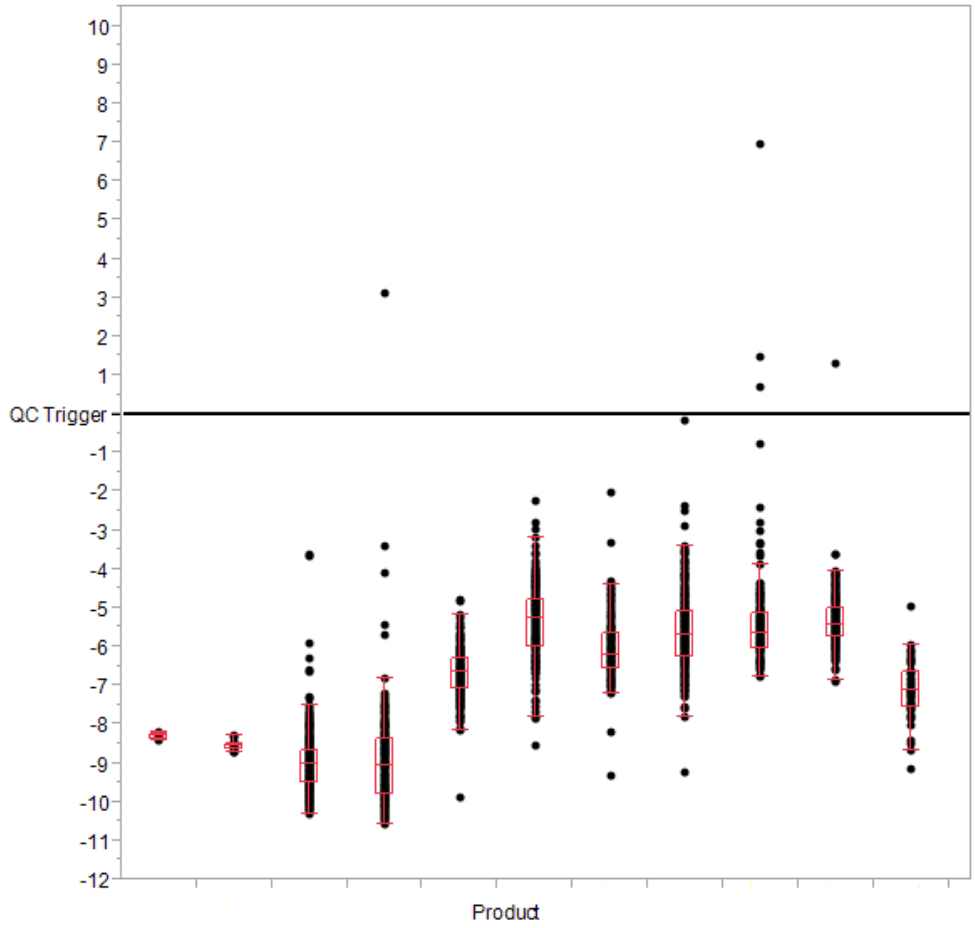


The output from the SQL query allows us to view the performance (YI at right) over all product produced at a given location for the last year.

We still need to capture how that relates to QC guidelines, and how switching to a new instrument would affect the data

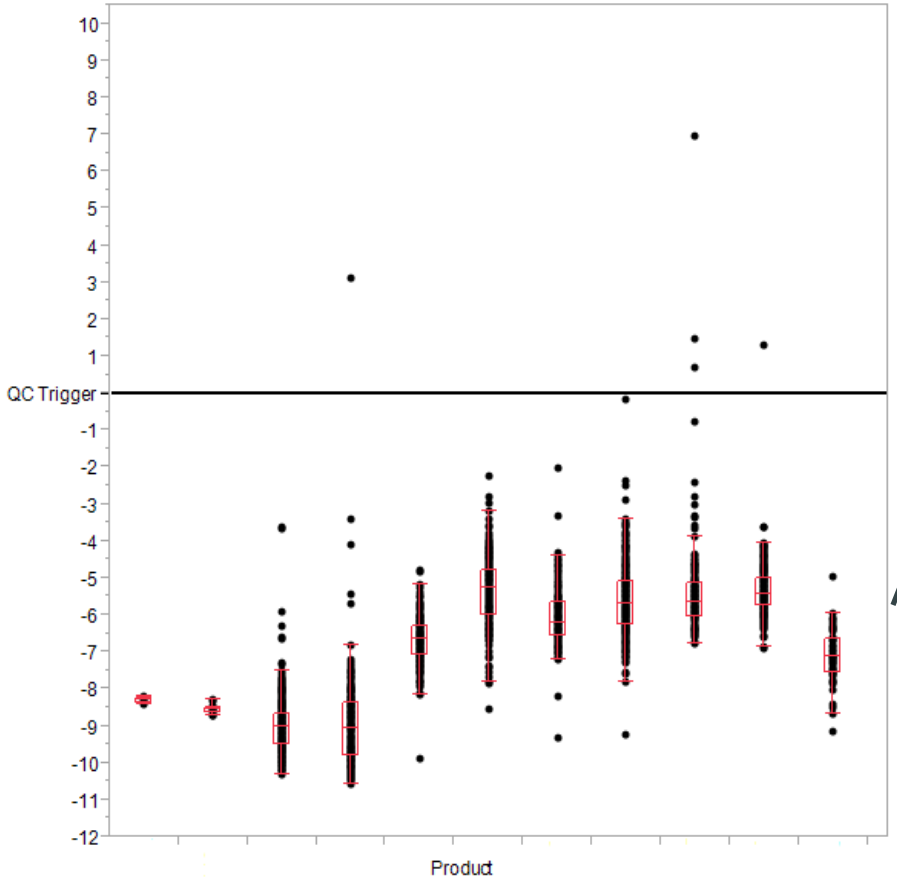
Determination of Historical Performance

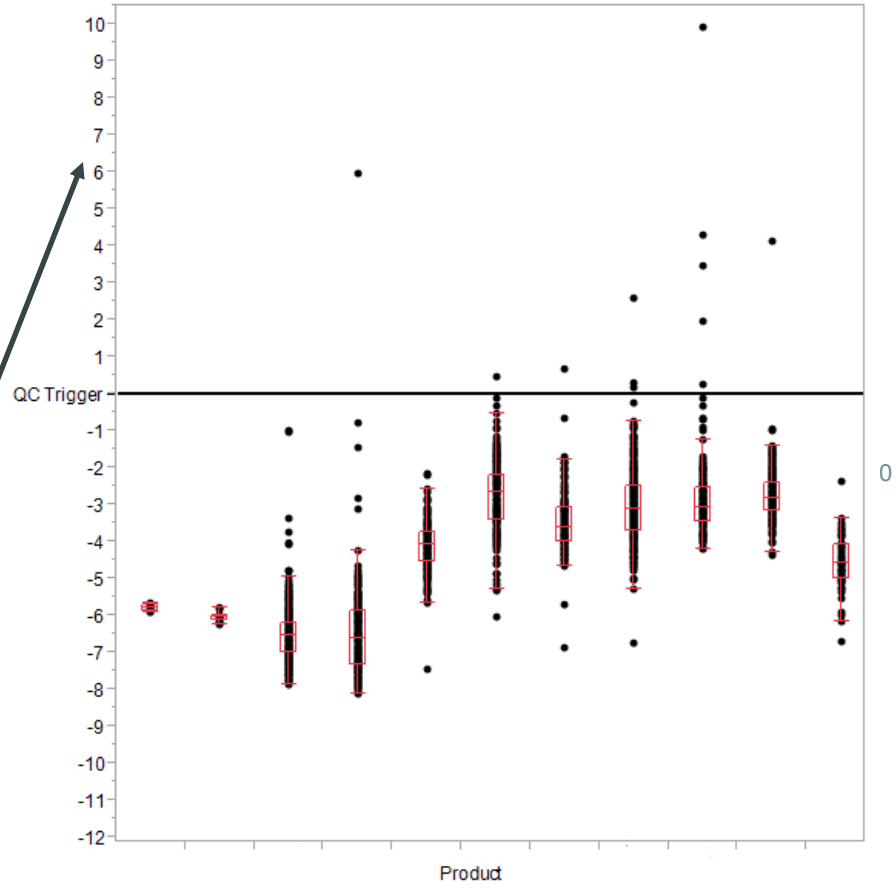




-To give the product specific results more context they were normalized to their respective quality requirements

Estimation of expected shift with new instrumentation





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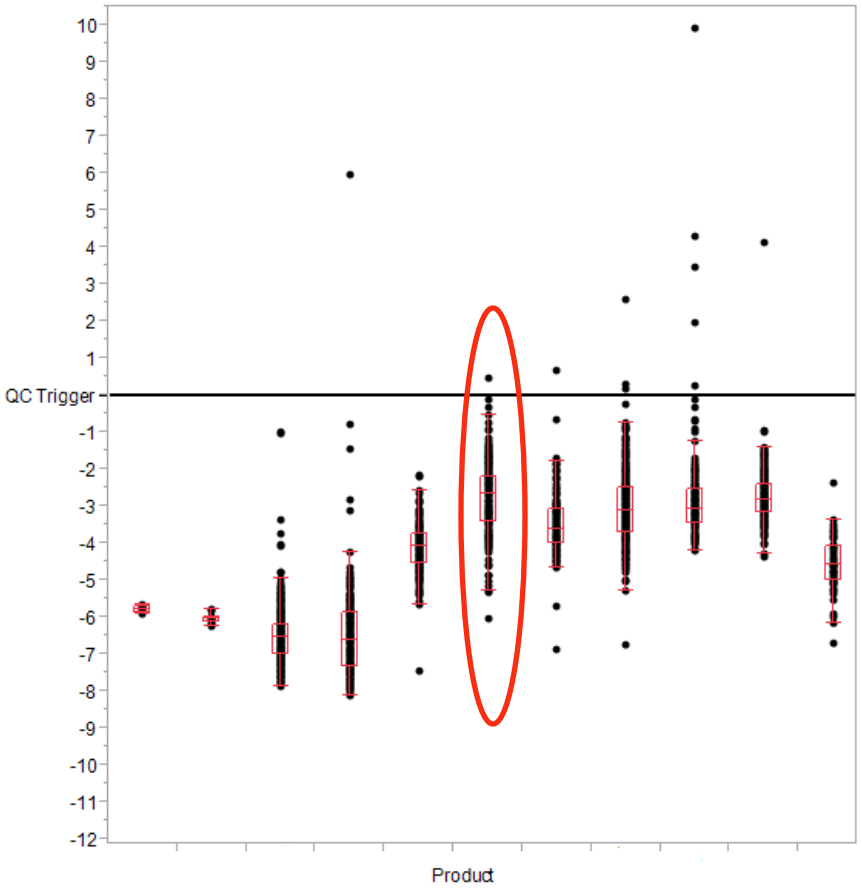
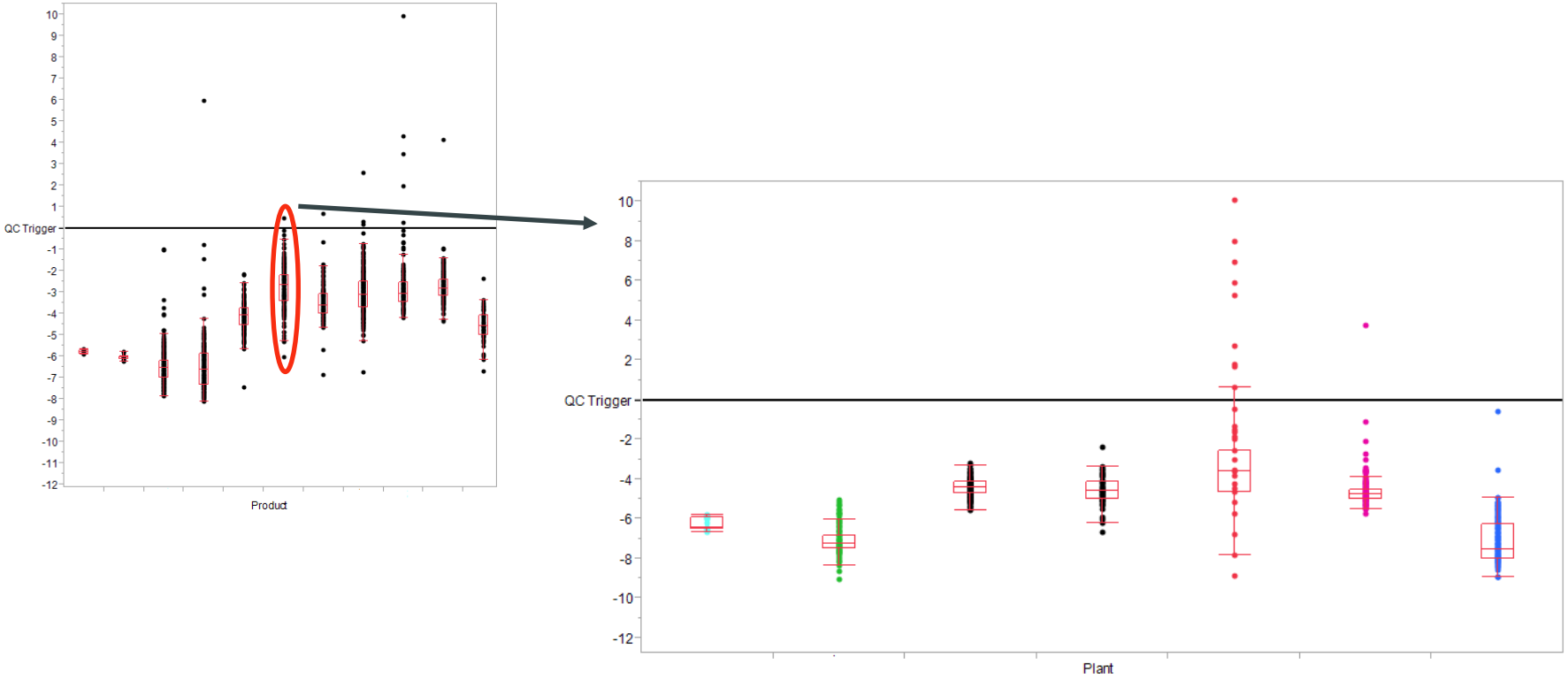


-Using the “projected” historical data we can readily pick out products which may need to have their quality trigger criteria adjusted based on the expected shift to the new instrument.

-What about products produced at different geographic locations?

Estimation of expected shift with new instrumentation: Global scale



By sorting based on location we are able to quickly identify the facility likely to be most impacted by the change

Conclusions

Variability in color measurements between labs was minimized by switching to a different “preferred” instrument.

Using a SQL query to pull annualized data from each facility we were able to join that data with quality trigger data.

Visualizing the data in the context of QC triggers allowed facile determination of facilities and products most likely to be impacted by the change-over

We can use that data to prioritize our efforts.

Questions:

Instrumental differences