Detector Noise and Drift

Detector Noise and Drift calculations are new in Millennium32 Version 3.20. They are different from the Baseline Noise and Drift calculations performed as part of the existing System Suitability option.

There are 6 calculations performed:

- Detector Noise
- Peak-to-Peak Noise
- Detector Drift
- Average Detector Noise
- Average Peak-to-Peak Noise
- Average Drift

These calculations attempt to mimic the ASTM method for Detector Noise and Drift measurements which is typically performed by hand.

Enabling Detector Noise and Drift Calculations

1. Click the **Noise and Drift** tab in the processing method

2. Enter the **Start** and **Stop** times (in minutes) for the interval of baseline over which the calculations will be made. This interval should not contain any peaks.

   **NOTE:** The interval must contain a minimum of 60 points for noise to be calculated; otherwise there will be a Result Code “NO2”. The available range is 0 to 655 minutes.

3. Enter the segment width (in seconds).

   **NOTE:** The segment must contain a minimum of 30 points for drift to be calculated – otherwise there will be a Result Code “NO3”. The available range is 10 to 300 seconds.

Figure 1 shows the Noise and Drift tab of the Processing Method window.
For all calculations:

A least-squares ("best fit") line is fitted to the whole time interval (specified in the processing method) of the data and is used to perform all calculations.

The formula for a line is:

\[ y = mx + b \]

where:

- \( m \) is the slope of the line
- \( b \) is the y-axis intercept.

Many of the calculations compare the actual value of the data point and the predicted value of the data point based on the least-squares line.

Figure 2 shows a visual representation of the least-squares line.
Detector Drift

Detector drift is the slope of the least-squares line. Drift is expressed in detector units per hour. For example, the drift calculation for a UV detector would be expressed in absorbance units (AU) per hour. Average Drift is calculated by dividing the data into segments (specified in the processing method) and averaging the values for each segment.

Detector Noise

The root mean square (RMS) noise of the data is calculated using the least-squares line. The formula for Detector Noise is:

\[
Detector \ Noise = \sqrt{\frac{\sum(y_i - y_{pi})^2}{n-2}}
\]

where:
- \(y_i\) is the y value of the data point
- \(y_{pi}\) is the y value of the data point predicted by the line
- \(n\) is the number of data points

**NOTE:** The denominator in the above calculation is the degrees of freedom (number of points minus the number of coefficients). This is because a linear fit is used.

Detector Noise is expressed in detector units. For example, the noise calculation for a UV detector would be expressed in absorbance units (AU). Average Detector Noise is calculated by dividing the data into segments (specified in the processing method) and averaging the values for each segment.
Peak to Peak Noise

Peak to Peak Noise is defined to be the algebraic difference of the maximum and minimum residuals between each data point and the least-square line. The “residual” is determined by subtracting the y value of the data point predicted by the line from the y value of the data point. The formula for Peak to Peak Noise is:

$$\text{Peak to Peak Noise} = \max \text{ residual} - \min \text{ residual}$$

where:

- residual = ($y_i - y_{pi}$)
- $y_i$ is the y value of the data point
- $y_{pi}$ is the y value of the data point predicted by the line

Peak to Peak Noise is expressed in detector units. For example, the peak to peak noise calculation for a UV detector would be expressed in absorbance units (AU). Average Peak to Peak Noise is calculated by dividing the data into segments (specified in the processing method) and averaging the values for each segments.

Viewing the Calculated Results

The results of the six calculations can be found in the Chromatogram Results table in the Results window. These results can also be placed in a report.

Figure 3 shows the results displayed in the Results window in Review:
What is the Difference Between Detector Noise and Drift and Baseline Noise and Drift?

The calculations for Baseline Noise and Drift (that are available through the use of the System Suitability option) are fundamentally different from the new Detector Noise and Drift calculations.

- **Baseline Noise** – obtained by averaging the maximum change in signal over the two sections of baseline (specified by the user in the Processing Method) and is expressed in millivolts (mV). This noise calculation does not correct for drift within each segment and tends to report large noise values when there is significant drift.

- **Baseline Drift** – the signal value at the “Baseline Start Time” subtracted from the signal value at the “Baseline End Time” – also expressed in mV. This calculation ignores the behavior of the signal at all times except the start and end times of the noise and drift calculation and can be highly biased.