CHEM 370 Week 5 Activity

Name: Key

Introduction

This assignment covers Chapters 4 and 5 of *Analytical Chemistry 2.1* by Harvey involving basic analytical chemistry terms, statistical analysis, and confidence intervals.

Lower Limit of Detection

1. The first plot below of signal vs. time was acquired by measuring the baseline (blank) signal from an instrument under development. It was acquired with a signal averaging time of 1 second (sampling rate = 1 Hz). What is the minimum detectable signal level for this instrument?

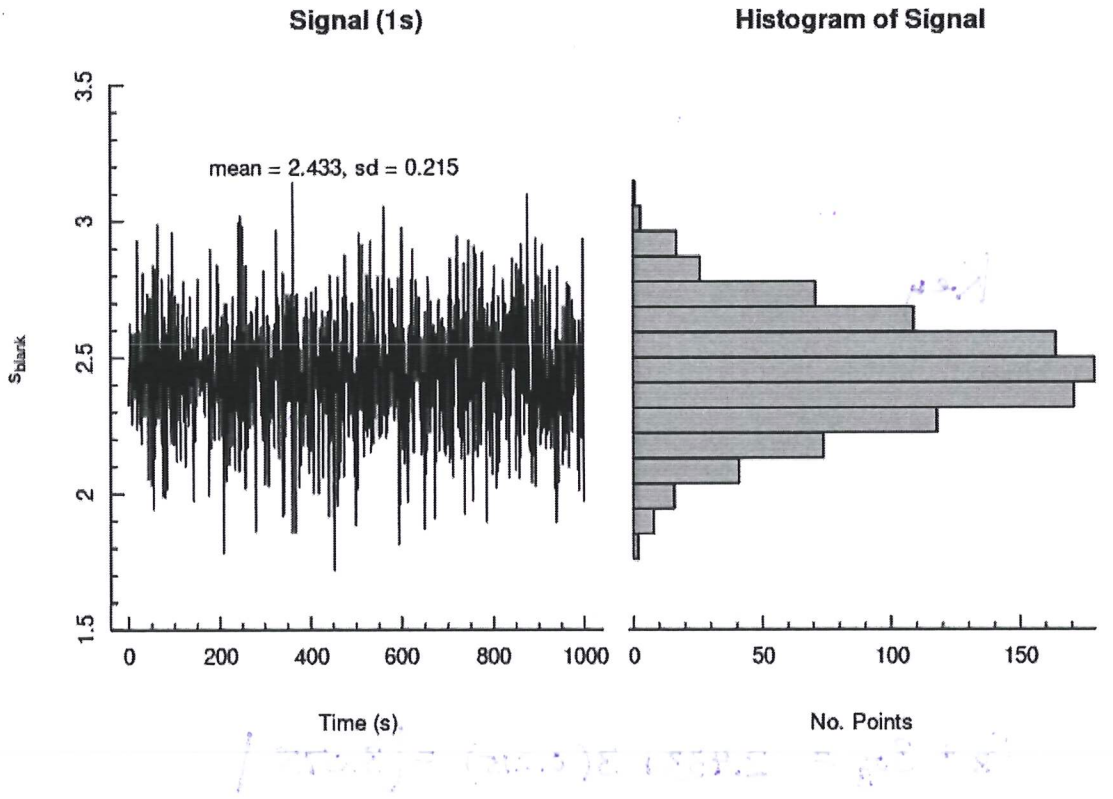
$$S_B + 3\sigma_B = 2.433 + 3(0.215) = \boxed{3.078}$$

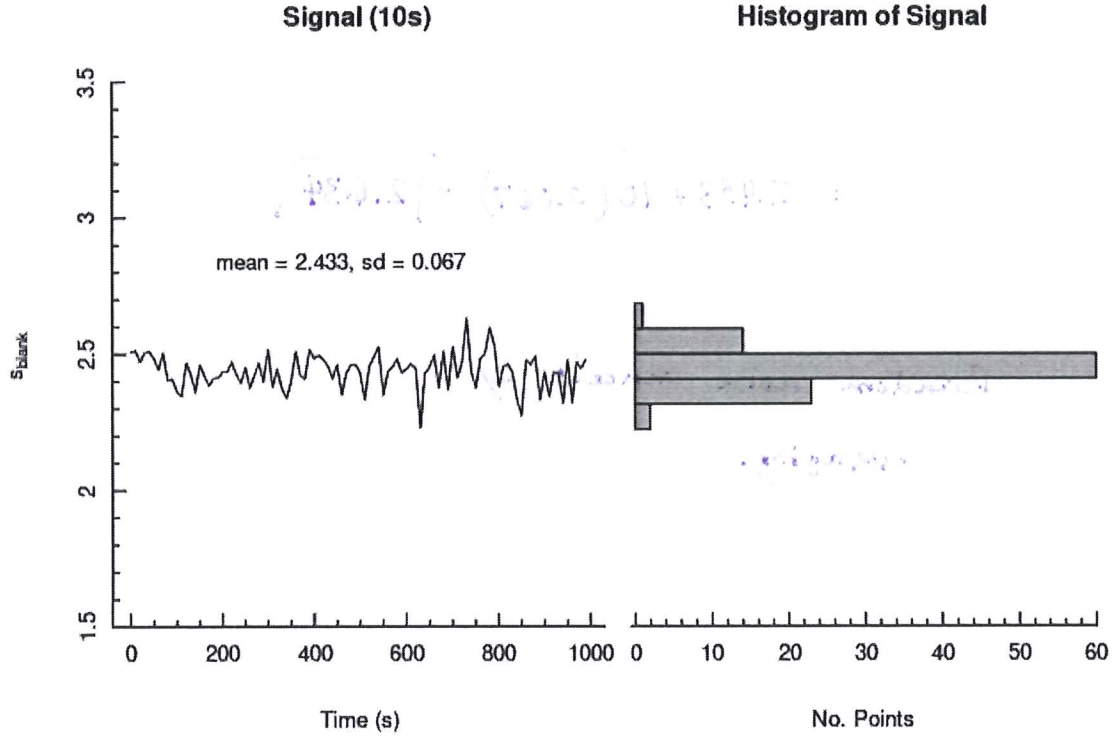
2. The second plot below shows data from the same instrument, but with a signal averaging time of 10 seconds (sampling rate = 0.1 Hz). What is the minimum detectable signal in this case?

$$= 2.433 + 3(0.067) = \boxed{2.634}$$

3. What causes the difference observed when the averaging time changes?

Random noise cancels w/ averaging.


Signal (1s)
Histogram of Signal
mean = 2.433, sd = 0.215
s_{blank}
3.5
3
2.5
2
1.5
0
200
400
600
800
1000
Time (s)
0
50
100
150
No. Points


Signal (10s)
Histogram of Signal
mean = 2.433, sd = 0.067
s_{blank}
3.5
3
2.5
2
1.5
0
200
400
600
800
1000
Time (s)
0
10
20
30
40
50
60
No. Points

Limits of Quantitation

1. The attached calibration curve is for the same instrument described above. What is the minimum *detectable* concentration? - ASSUME LOS DATA

$$LOD = \frac{3\sigma_B}{m} = \frac{3 \cdot 0.067}{0.4179} = \boxed{0.481 \text{ mg/L}}$$

2. What faction of the detected signal is actually due solely to random noise and not true signal?

50%

3. What is the minimum *quantifiable* concentration?

$$LOQ = \frac{10\sigma_B}{m} = \frac{10 \cdot 0.067}{0.4179} = \boxed{1.60 \text{ mg/L}}$$

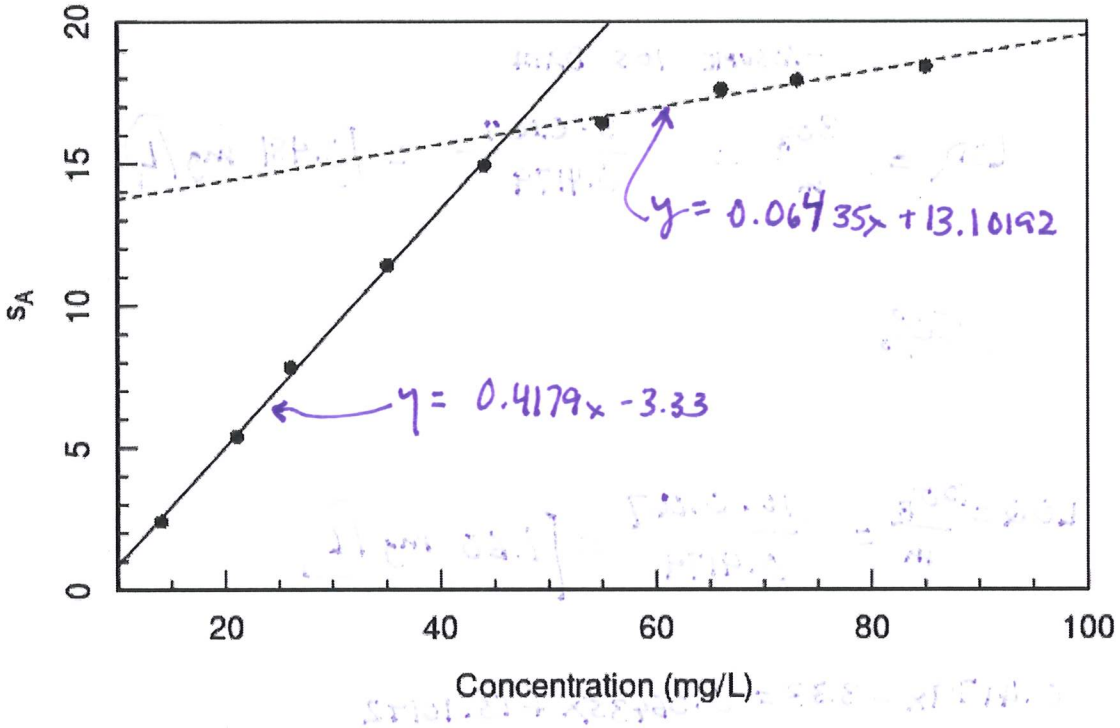
4. What is the maximum quantifiable concentration?

$$0.4179x - 3.33 = 0.06435x + 13.16192$$

$$\boxed{x = 46.5 \text{ mg/L}}$$

5. What is the linear dynamic range (LDR) of the instrument?

1.60 mg/L $\longrightarrow$ 46.5 mg/L



Conc (mg/L)	s_A
14.07	2.406
21.05	5.401
26.04	7.825
35.07	11.43
44.09	14.93
55.05	16.44
66.09	17.60
73.10	17.93
85.05	18.41