PHYS 434 A

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LAB 6

Application Of Computers To Physical Measurement

Problem 1

The 5σ sensitivity threshold is at 0.175

Problem 2

Now create a set of injected (simulated) signals of a *single strength*. You will want to make your signal moderately strong, say somewhere in the 8-30σ range. Inject this signal into your background data many times.

a) Histogram how bright the observed signal appears to be, and discuss its shape. Say in words what this histogram is telling you.

Solution

The brightness of the histogram increases because the injected simulated signal distorts the shape of the histogram at the peaks to an irregular peak.

This means that the injected signals increase the signal strength of the original observed signal.

b) Is your observed signal biased? (e.g. is the observed value equally likely to be stronger or weaker than the true injected signal?) Is it symmetric?

Solution

The observed signal is biased and it is symmetrical even though there is distortion. The signal is stronger than true injected signal.

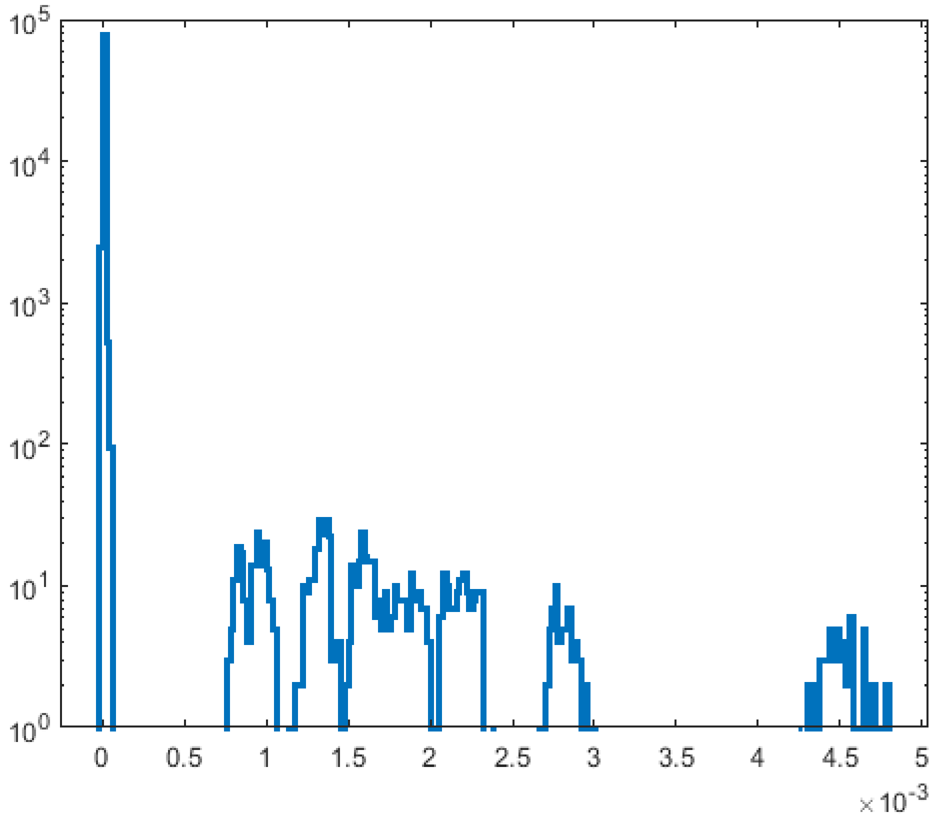
Problem 3

Now make a suite of injected signals. You will want to have a range of injected signal strengths, starting at zero and extending well above 5σ (30σ or more).

a) Clearly state what you are simulating, and make a 2D histogram of injected signal vs. observed signal.

Solution

Observed signal



b) Now reverse the problem, select an observed signal (pick something quite a bit stronger than 5σ) and create a 1D histogram of the injected signal pdf (). Describe the meaning of this histogram.

Solutions

Increased observed signal more than 5σ distorts the histogram shape but increases the peaks for a short duration.

c) For your observed signal, what is the 1σ uncertainty on the true signal strength?

solution

95%

d) Discuss the answer to part d in some depth. Is it symmetric? Is it biased? Does this make sense?

Solution

The 1σ uncertainty is symmetric and biased. This end up not making sense.

Problem 4

Using the same setup as in problem 3, now pick a relatively weak signal (say in the 1 σ range, exact strength not important).

a. Describe what it means to have the true signal pdf() extend to zero.

solution

The true signal extends because the data is normalized. Relatively weak signal tries to compensate for strength with observed signal.

b. Calculate a 95% confidence upper bound. [Hints: make sure your pdf() is normalized. The statistical question is: if I observe this candidate signal (and it is too weak to claim a detection), then the true signal would be less than *X* 95% of the time.]

solution

$$\frac{95}{100} \times 0.175 = 0.16625$$