Homework Assignment
Statistics, Source Detection, and Noise in the Optical/Infrared
Due: 3:30 PM, Wednesday, October 6

For any of the questions involving calculations, you should show the details of these calculations. You will be graded not only on the answers that you provide, but on demonstration of the steps and reasoning involved in deriving those answers.

1. In Lab 4, you determined full image statistics and local statistics for each quadrant of the B35A K-Band image. Record these results in the table below, and determine the best median pixel value and standard deviation to adopt for this image.

	Mean [ADU]	**Median [ADU]**	**Standard Deviation [ADU]**
Full Image Statistics			
NE Local Statistics			
NW Local Statistics			
SE Local Statistics			
SW Local Statistics			

Adopted Median [ADU] = ______________________ (not explicitly used in the source detection routine)

Adopted Standard Deviation [ADU] = ______________________

2. In Lab 4, you also selected three well isolated, non-saturated sources. Record the approximate position (column and row) and estimated FWHM of each of these sources in the table below. From these estimates, determine the best FWHM to adopt (to the nearest 0.1 pix).

	Column Number [pix]	**Row Number [pix]**	**FWHM [pix]**
Source #1			
Source #2			
Source #3			

Adopted FWHM [pix] = ______________________

3. The **Intensity Threshold** (above the local background) may be expressed in terms of the **Standard Deviation** by:

Intensity Threshold = N x (Standard Deviation)

In Lab 4, you detected sources with intensities 50 times the standard deviation above the median background, or N = 50. In the table below, record the value of the intensity threshold, total number of sources detected (*and accepted*) by the PhotVis **AutoDetect** routine , estimated number of anomalous sources detected in a smaller sub-region, and the number of sources detected (and accepted) by **AutoDetect** in that same sub-region. Using these numbers from the sub-region, calculate the Fractional Contamination in source detection:

Fractional Contamination = Number of Anomalous Sources Detected / Number of Sources Detected

Repeat this procedure, using different values of **Intensity Threshold**, as given by the values of **N** listed in the table.

	Intensity Threshold (ADU)	**Total Number of Sources Detected in Image**	**Number of Anomalous Sources Detected in Sub-Region**	**Number of Sources Detected in Sub-Region**	**Fractional Contamination**
N = 50					
N = 30					
N = 10					
N = 8					
N = 6					
N = 5					

4. Using IDL, create an array of **N** values:

```
IDL>  N = [5, 6, 8, 10, 30, 50]
```

Similarly create an array (e.g., named **TotalNumber**) of the total number of sources detected in image (second column of table in Question 3) as well as an array (e.g., **FracContam**) of the fractional contamination (last column of table in Question 3). Plot **TotalNumber** as a function of **N**, and overplot the estimated total number of anomalous sources detected in image (i.e., **TotalNumber * FracContam**) by:

```
IDL>  plot, N, TotalNumber
IDL>  plots, N, TotalNumber, psym=2
IDL>  oplot, N, TotalNumber*FracContam, linestyle=2
IDL>  plots, N, TotalNumber*FracContam, psym=2
```

Revise the first *plot* statement in order to label the axes and, if necessary, adjust the range of each axis so that each data point (plotted as an asterisk) is clearly visible. Save the plot as a PostScript file. **Print this file and attach to this homework assignment.**