Q2.2.1: Yes, the noise signal follows the normal distribution.



Above shown is a histogram of the noise overall the sequence of images fitted with a Gaussian curve. From the figure, we can observe that the noise more or less follows normal distribution, though there are some points where there are deviations.



Above shown is the normal probability plot of the noise overall the sequence of images. It can be observed from the plot, that the noise is not exactly linear and deviates from the red dotted line, which represents the normal distribution. From the above two plots, it can be concluded that the noise signal follows normal distribution.



Above shown is the power spectrum density estimate plot, which should be constant for the noise to called as white noise. Also, the slope of the line passing through the power spectrum density estimate turns out to be closer to zero (-0.024982) using ‘polyfit’ function in matlab (code submitted on Box), which is a characteristic of white noise. Thus, it can be said that the noise signal here is a white noise.

**Code submitted**: “q2background.m” and

**Images submitted**: “q2normplot.tif”, “q2powerspectraldensityspectrum.tif”, “q2noisehistogram.tif”

Q2.2.2: Yes, the noise distribution changes over time. Following are the 2D plots of the mean of the noise of each image and the standard deviation of the noise of each image in the sequence versus the number of images.





From the plots, we can observe that there is a decreasing trend in the means of noises overall images and there is an increasing trend in the standard deviations of the noises overall images. The mean and standard deviation over the noise was calculated over all the images in the sequence and the mean noise vector was plotted against the total number of images, similarly for standard deviation. Thus, we can say from the plots that the noise distribution changes over time.

**Code submitted:** “q2background.m”

**Images submitted:** “q2.2changeovertimeMean.tif”, “q2.2changeovertimeStd.tif”

Q2.2.3: No, the noise distribution doesn’t change over space. Following are the 2D plots of means of noise for different positions in the sequence of images versus the iteration number, and in the similar way the standard deviation versus the iteration number.





Different random positions were selected for each iteration in the sequence of images, i.e. for each iteration random two x and two y coordinates were selected and the minimum of the two x coordinates and two y coordinates was chosen as the starting point coordinate. The difference between the two x and two y coordinates was given as the width and height for the rectangular box to be selected respectively. Then noise is extracted from that box, normalized and then mean, standard deviation over the whole noise for a sequence is calculated. This mean vector and the standard deviation is then plotted to get the above two plots.

From these two plots, it can be observed that the mean and standard deviation don’t show much variation across different space segments selected randomly from the sequence of images.

**Code submitted:** “q2calcchangeoverspace.m”

**Images submitted:** “q2.2changeoverspacemean.tif”, “q2.2changeoverspacestd.tif”