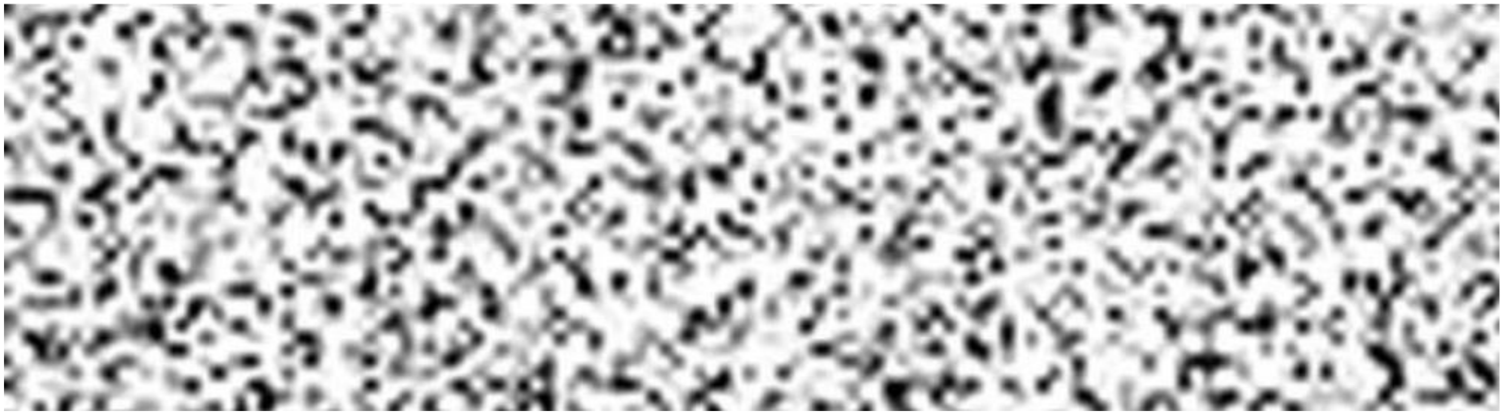
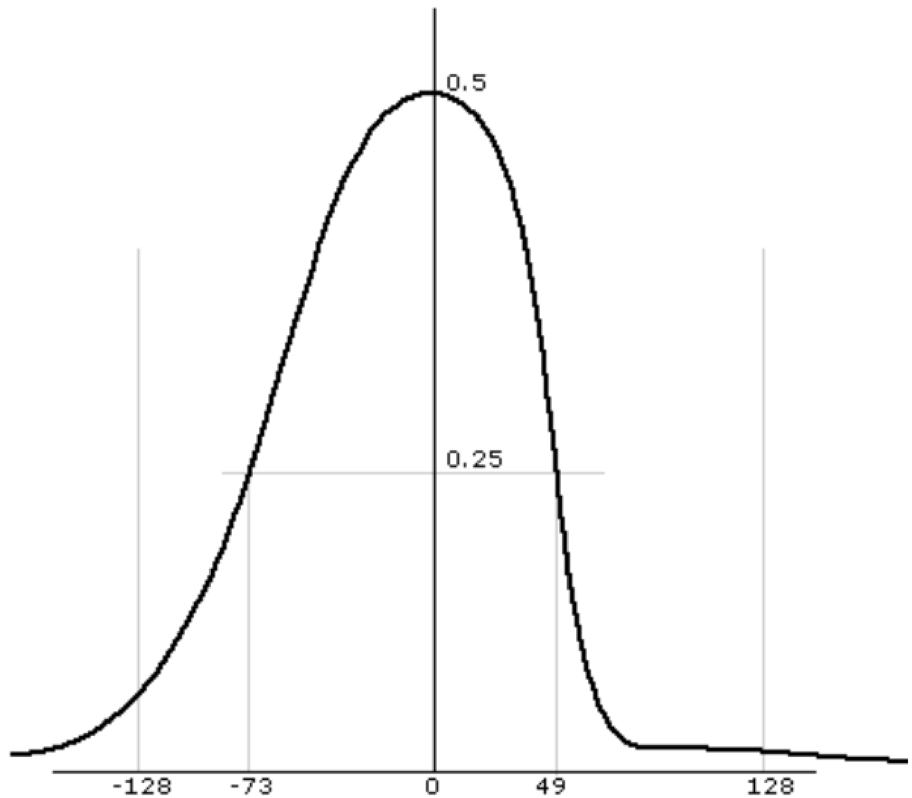


Noise Models

Probability Distributive Functions



A random distribution

In this graph, the vectical axis represents probability. And the horizontal axis represents numbers.

The probability a randomly picked number (say x) lies in a range from a to b (a,b) is equal to the area of the curve between a and b.

If you take infinite random numbers, distributed as shown above, then:

- Similarly, there is a 75% chance that the number will be -73 or 49. Thats because a lot of area under the curve is between -73 and 49.
- There is a 100% chance of picking a number between +infinity or -infinity

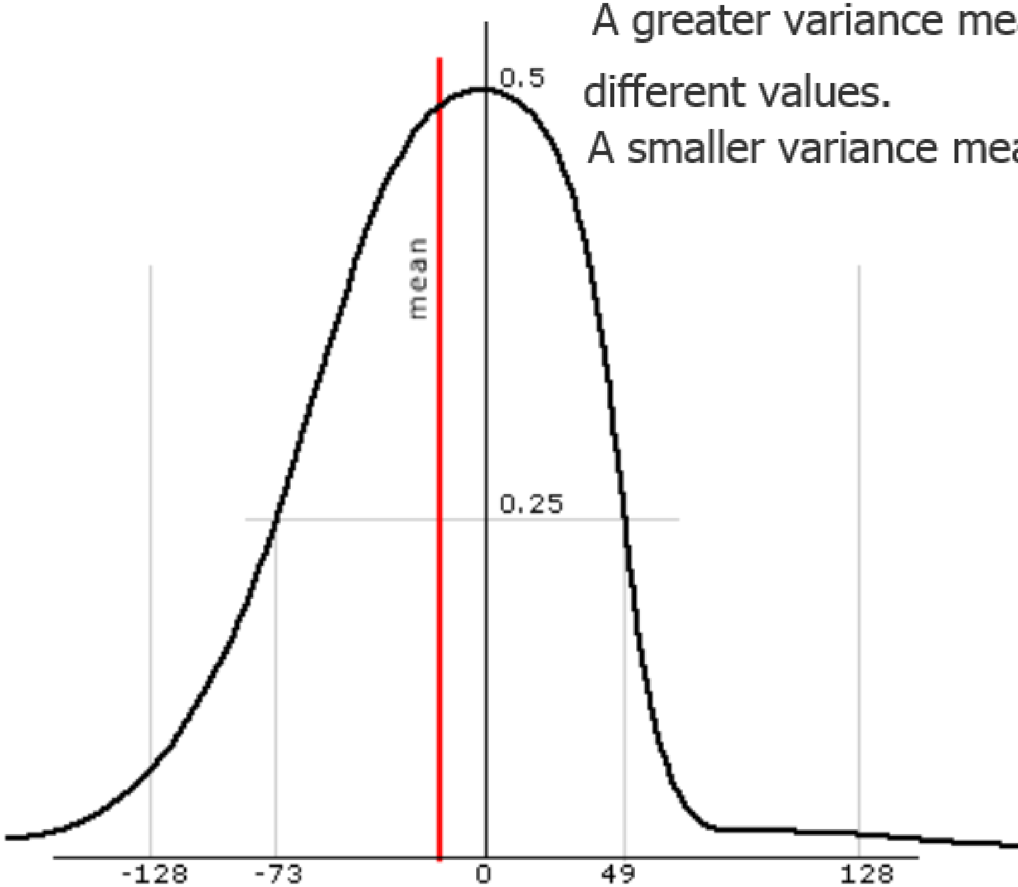
There are certain mathematical properties of the distribution as well: the mean and the variance.

The mean is roughly the "middle value" of the entire distribution. In the distribution above, the mean would be slightly shifted to the left (because of its skewed nature).

The variance is a measure of how much the probabilities vary.

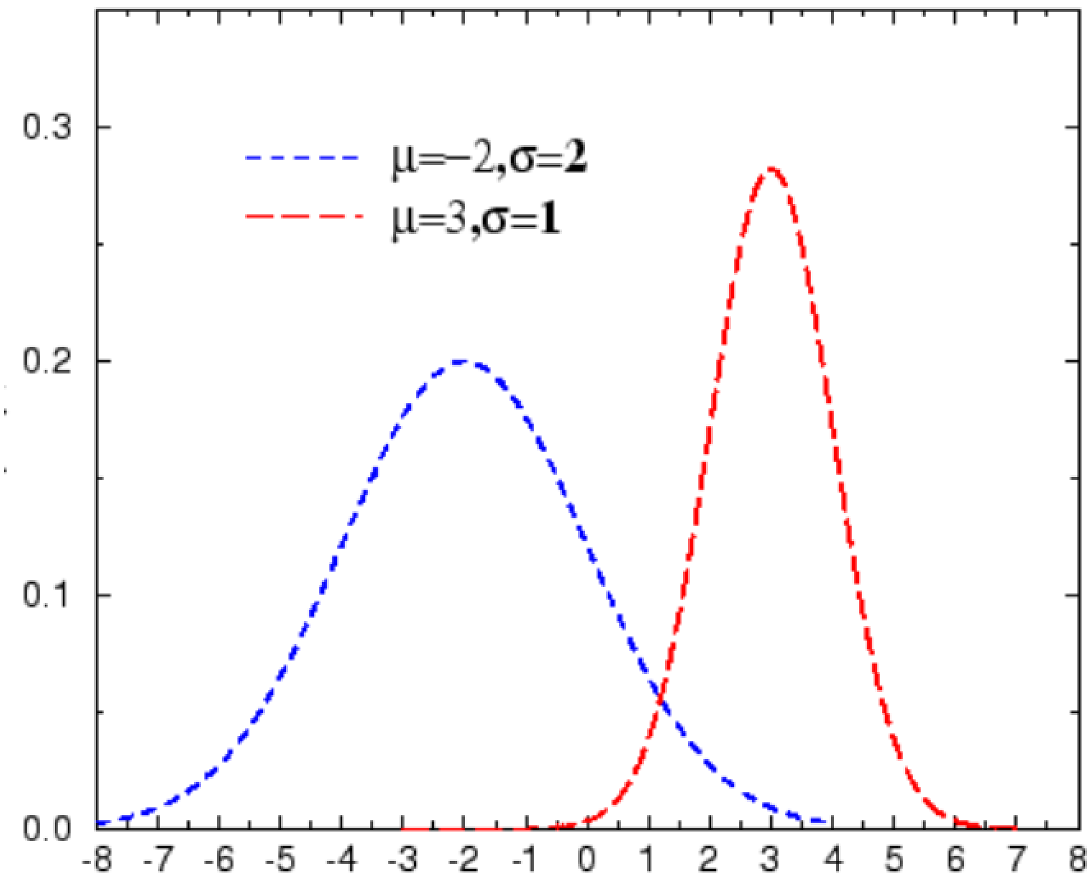
A greater variance means you're more likely several different values.

A smaller variance means you'll get lesser different values.



The mean of the random distribution

The Gaussian Noise Distribution

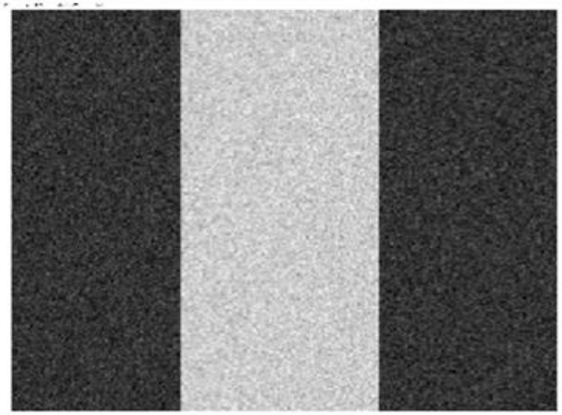


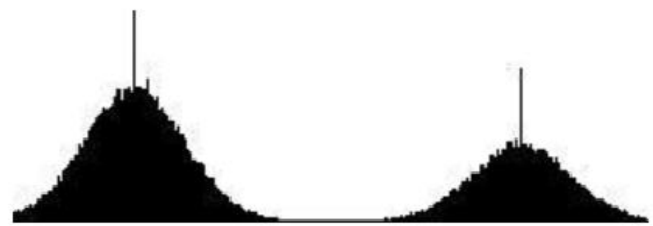
The figure above shows two gaussian PDFs. Now, if they represent noise, what would it mean?

Considering the blue PDF: the mean value of the noise will be -2. So, on an average, 2 would be subtracted from all pixels of the image.
In the red PDF, the mean value is 3. So on an average, 3 would be added to all pixels.

Example:

: The original image.





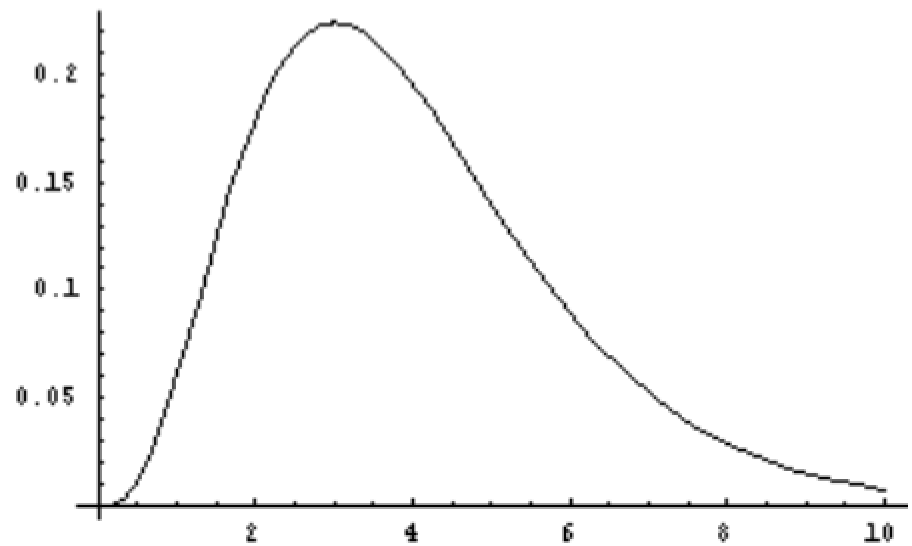
The image with gaussian noise.

The upper image is the histogram for the original image. Because it has only 2 colours, there are just two spikes.

The lower image is the histogram for noisy image. When noise is added, notice how "gaussian-like" the histogram becomes. Each spike in the original image "turns" into something similar to a gaussian distribution. That is exactly the reason why it is called gaussian noise. It usually occurs in an image due to noise in electronic circuits and noise in the sensor itself (maybe due to poor illumination or at times even high temperature).

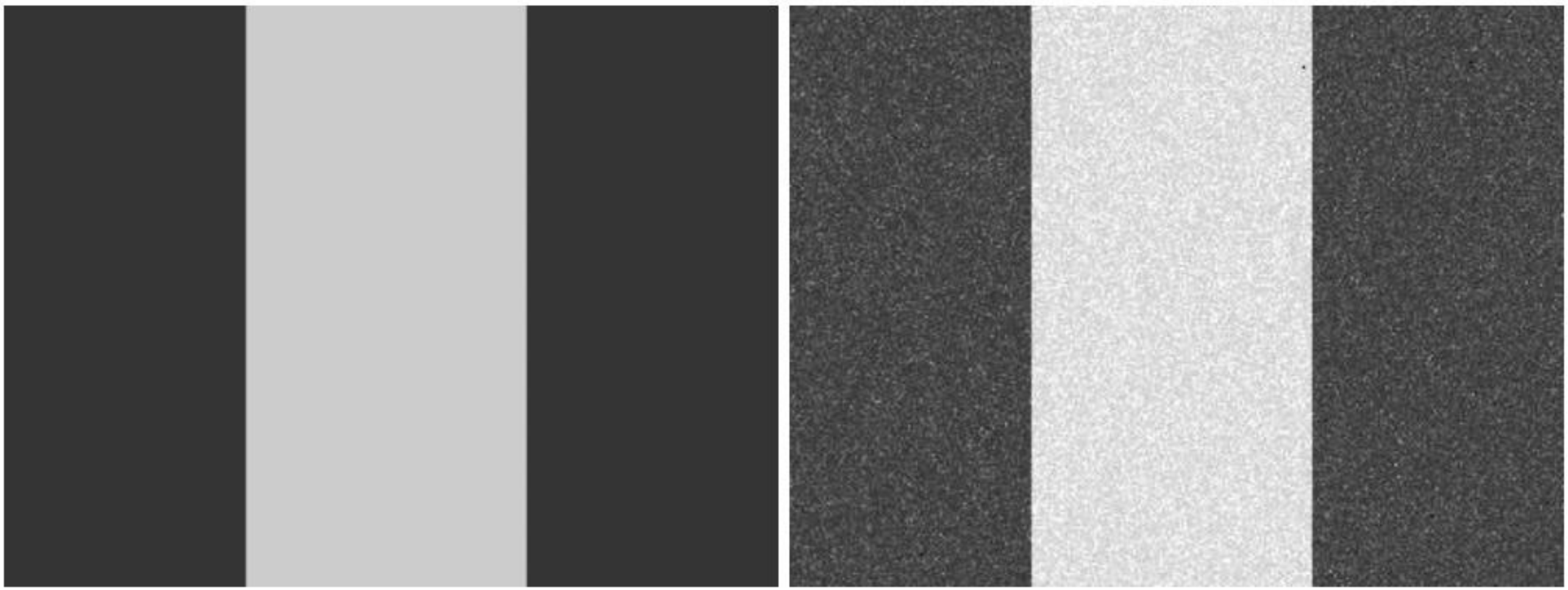
The Gamma Noise Distribution

Just like gaussian, the Gamma distribution has a distinct PDF. Here it is:



The gamma distribution

Applying gamma noise to an image produces the following results:



Original histogram

Histogram after noise