ECE 468: Digital Image Processing

Lecture 12

Prof. Sinisa Todorovic

sinisa@eecs.oregonstate.edu

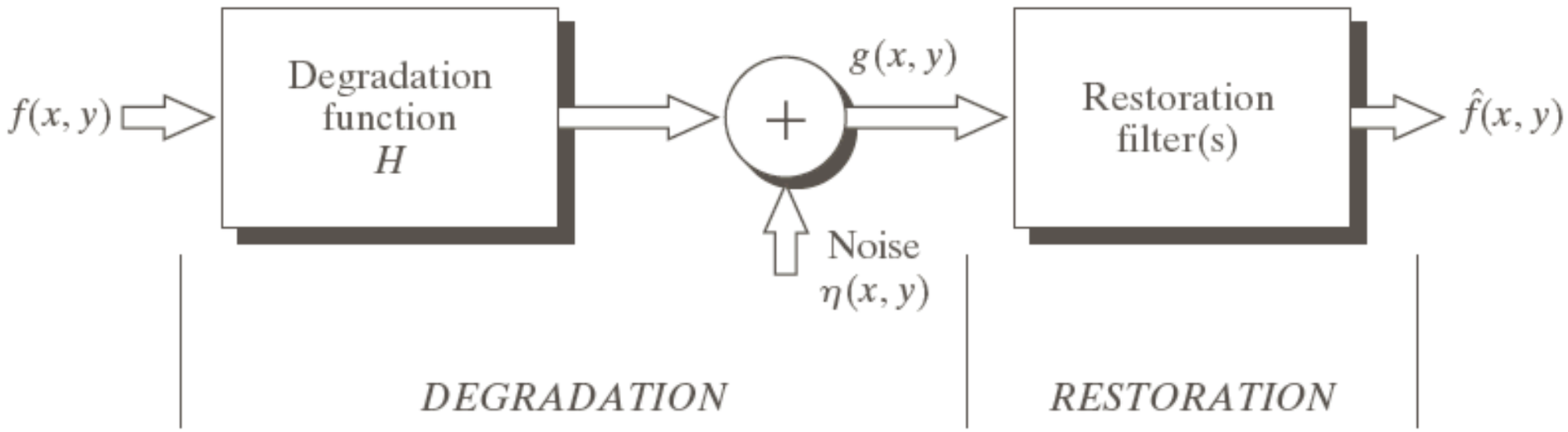
OSU Oregon State University

Image Restoration vs. Image Enhancement

- Unlike enhancement, improve an image in an objective sense
- Model the degradation and use the model for image restoration

Model of Image Degradation/Restoration

FIGURE 5.1
A model of the image degradation/restoration process.



$$g(x,y) = h(x,y) \star f(x,y) + \eta(x,y)$$

$$G(u,v) = H(u,v)F(u,v) + N(u,v)$$

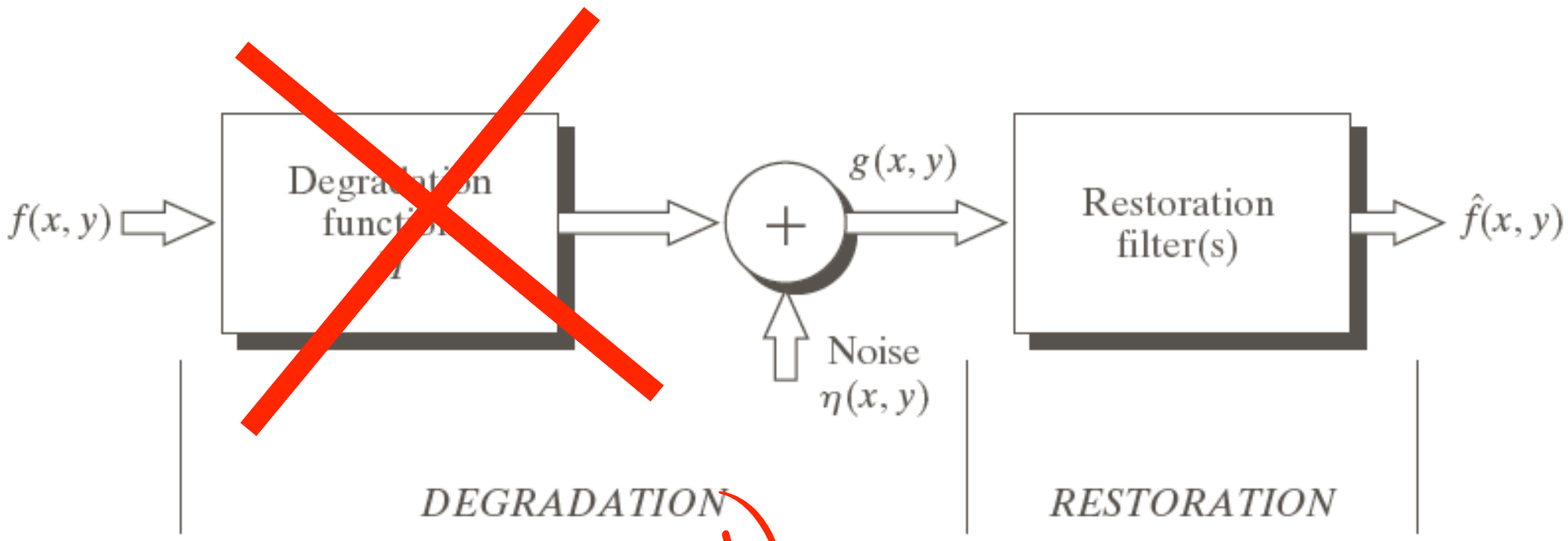
Noise Models

Assumptions:

- Noise is independent of image coordinates
- Noise is not correlated with the image

Noise Modeling

FIGURE 5.1
A model of the image degradation/ restoration process.



$$g(x,y) = h(x,y) \star f(x,y) + \eta(x,y)$$

$h(x,y) = \delta(x,y)$

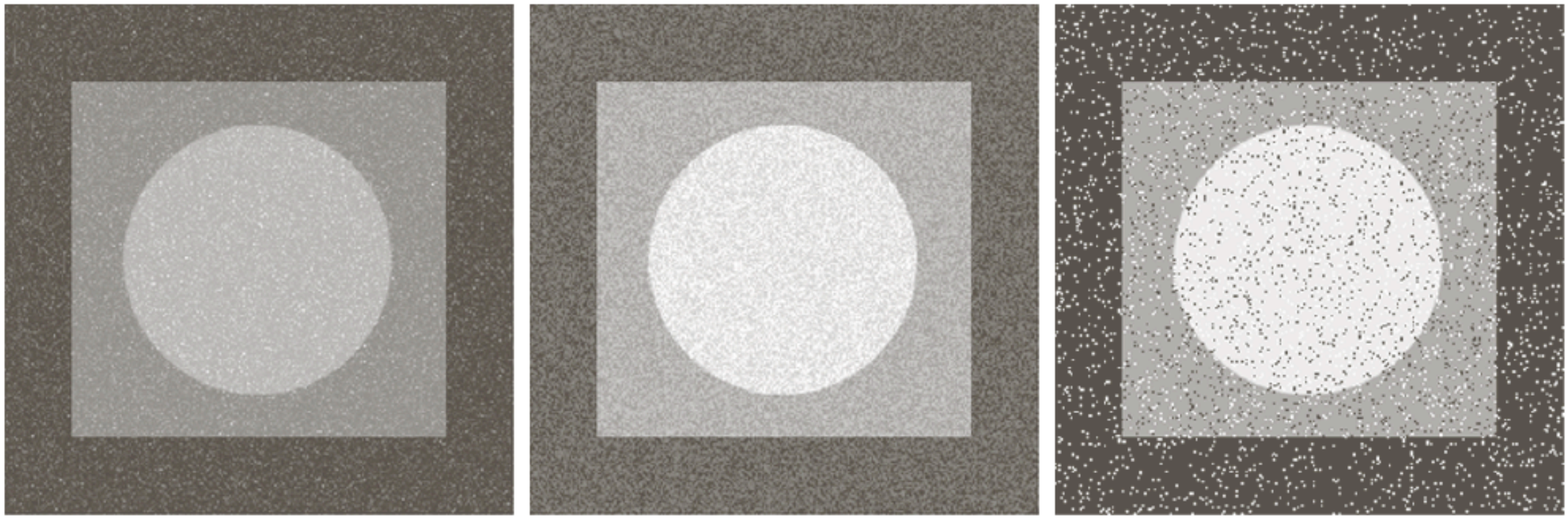
$$G(u,v) = H(u,v)F(u,v) + N(u,v)$$

$H(u,v) = 1$

Noise in the Image

original image

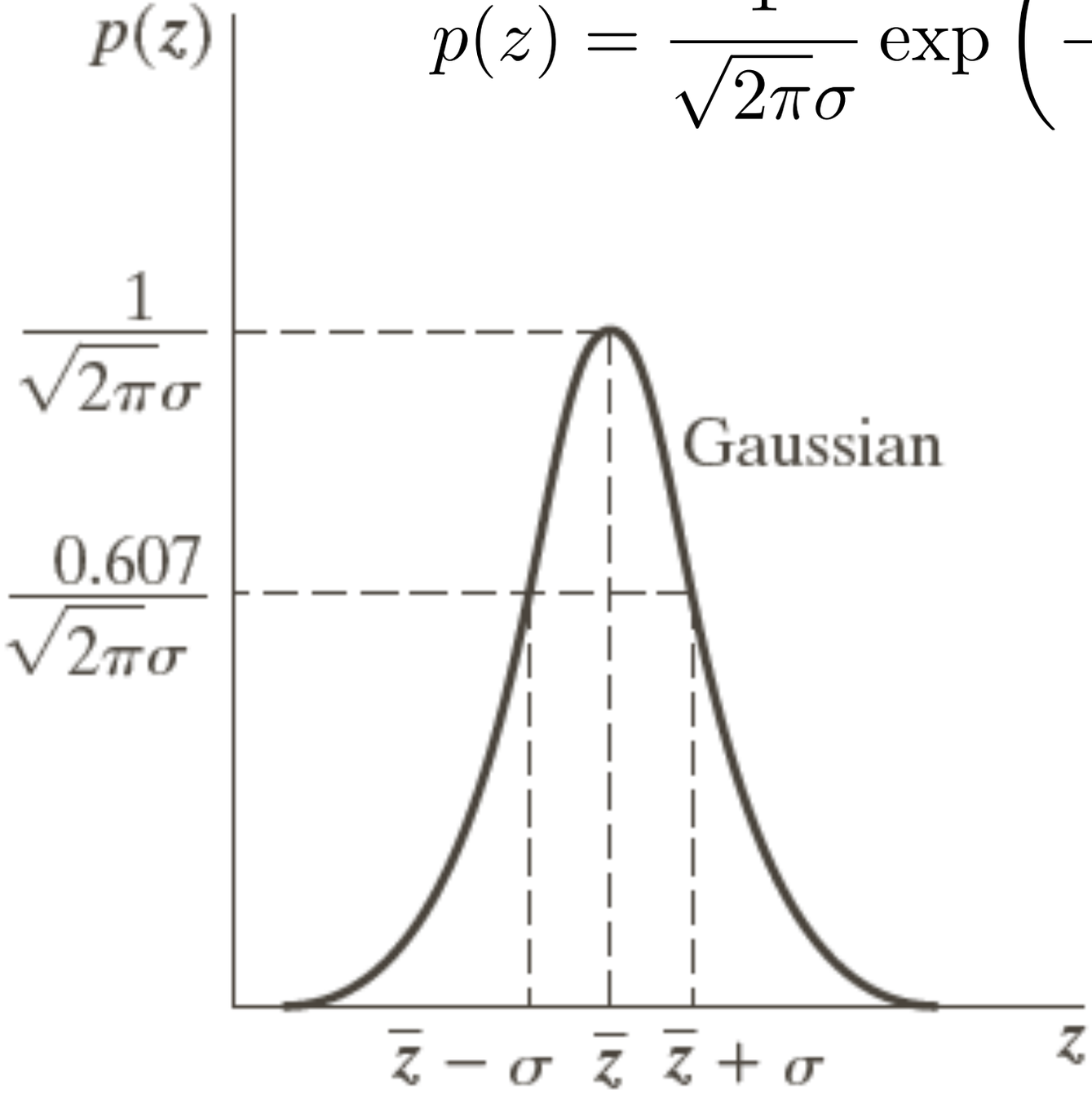
Noise in the Image



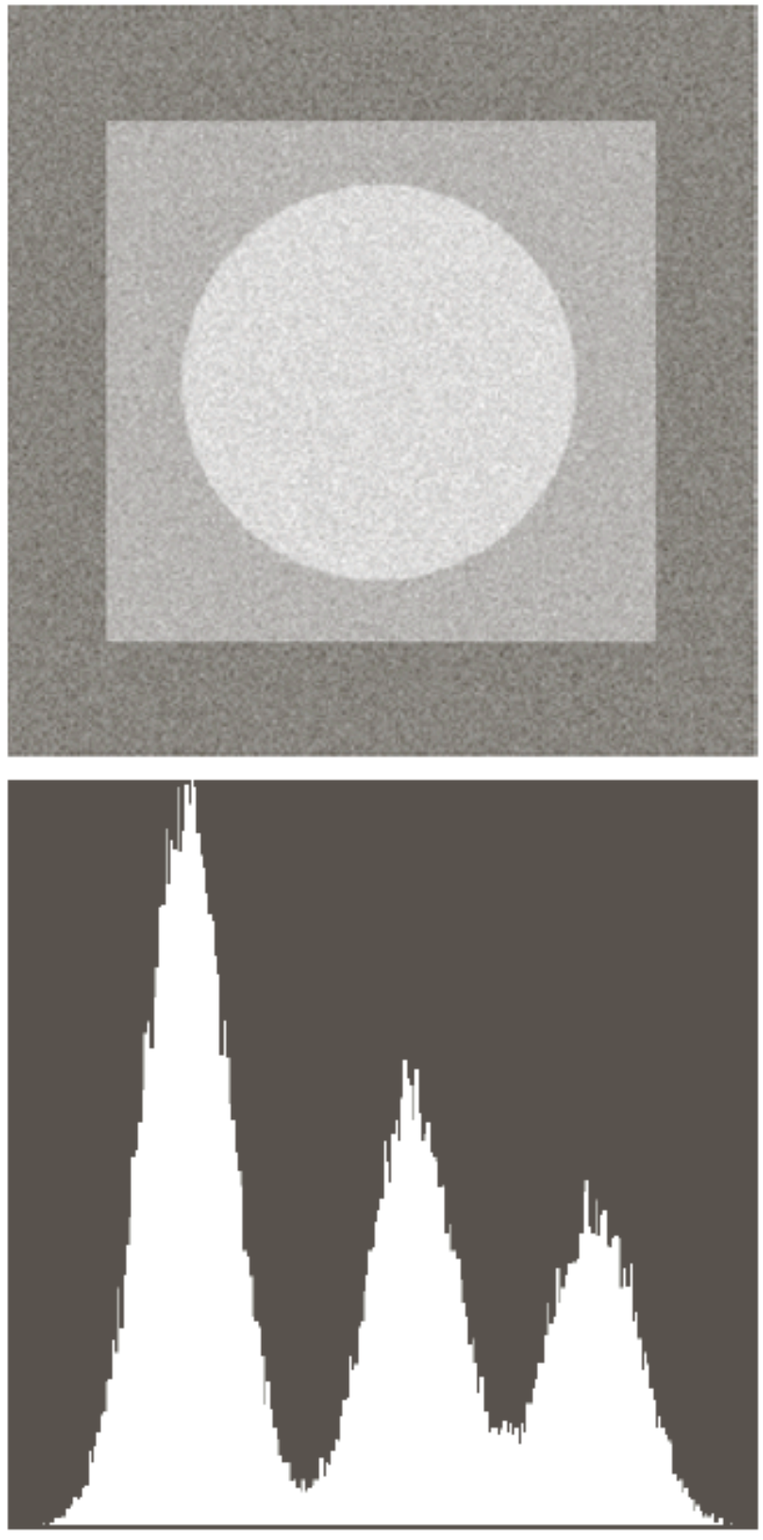
examples of noise corrupted image

Important Noise PDFs

$$p(z) = \frac{1}{\sqrt{2\pi}\sigma} \exp\left(-\frac{(z-\mu)^2}{2\sigma^2}\right)$$

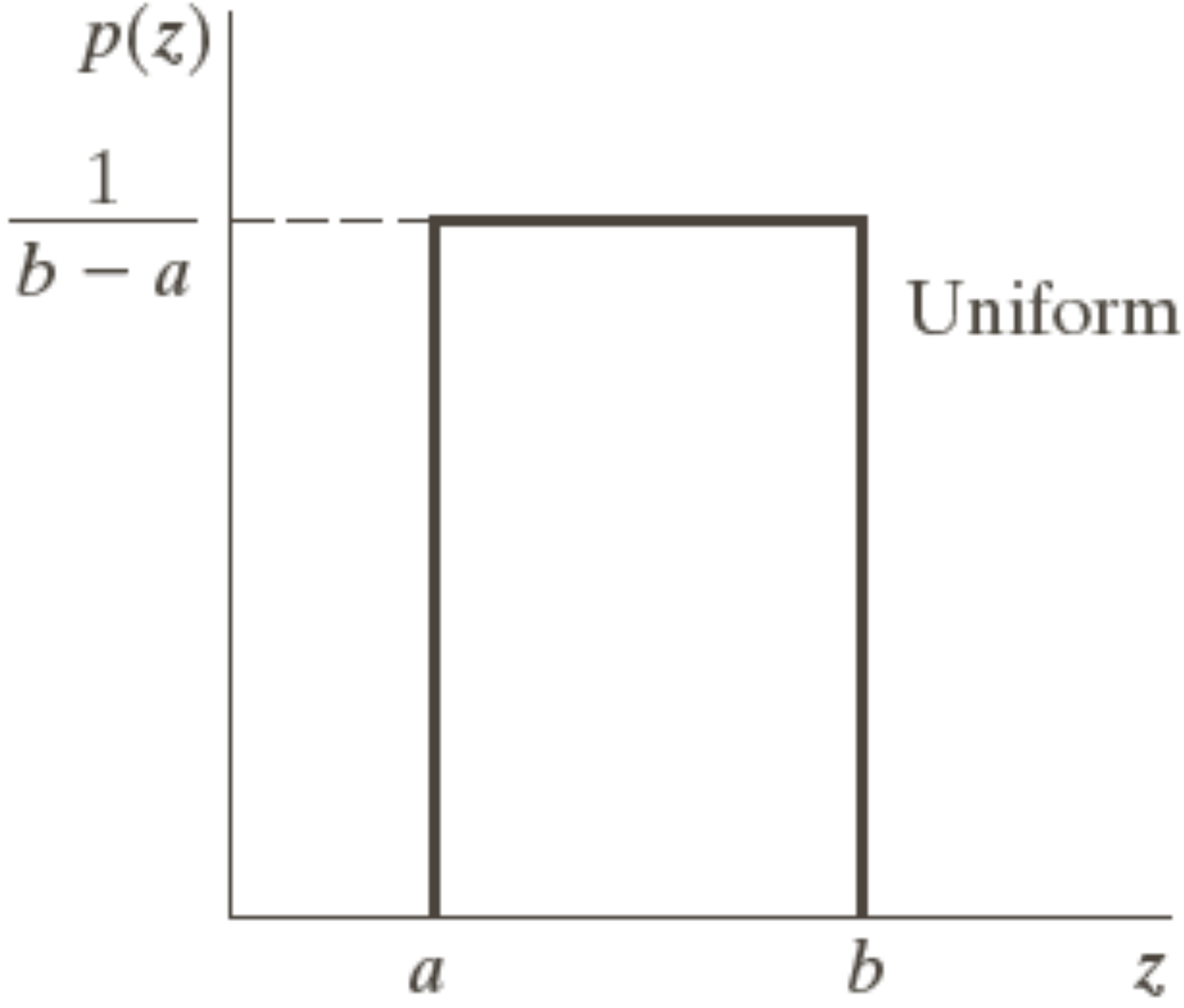


Noise in the Image

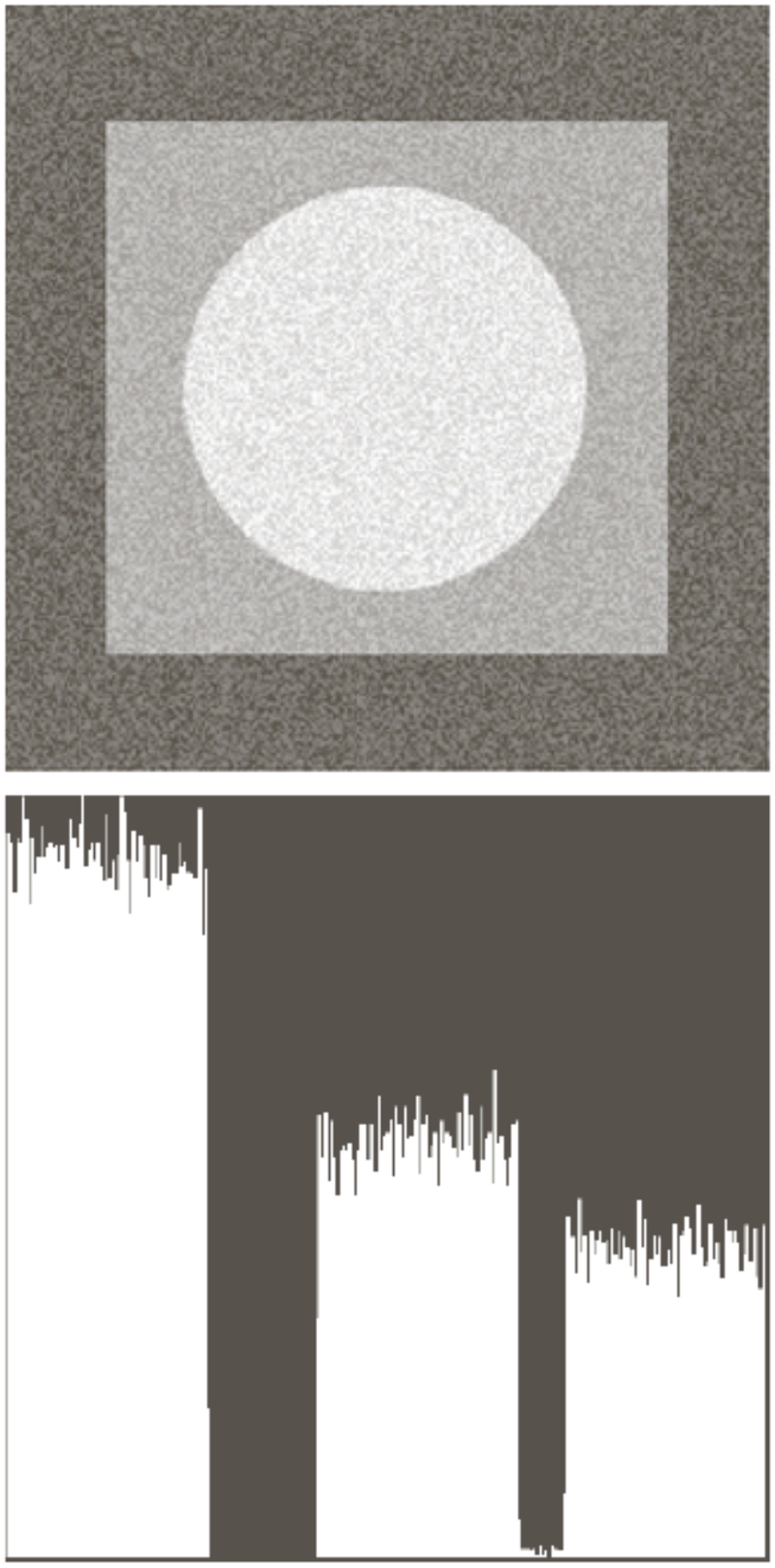


Gaussian

Important Noise PDFs



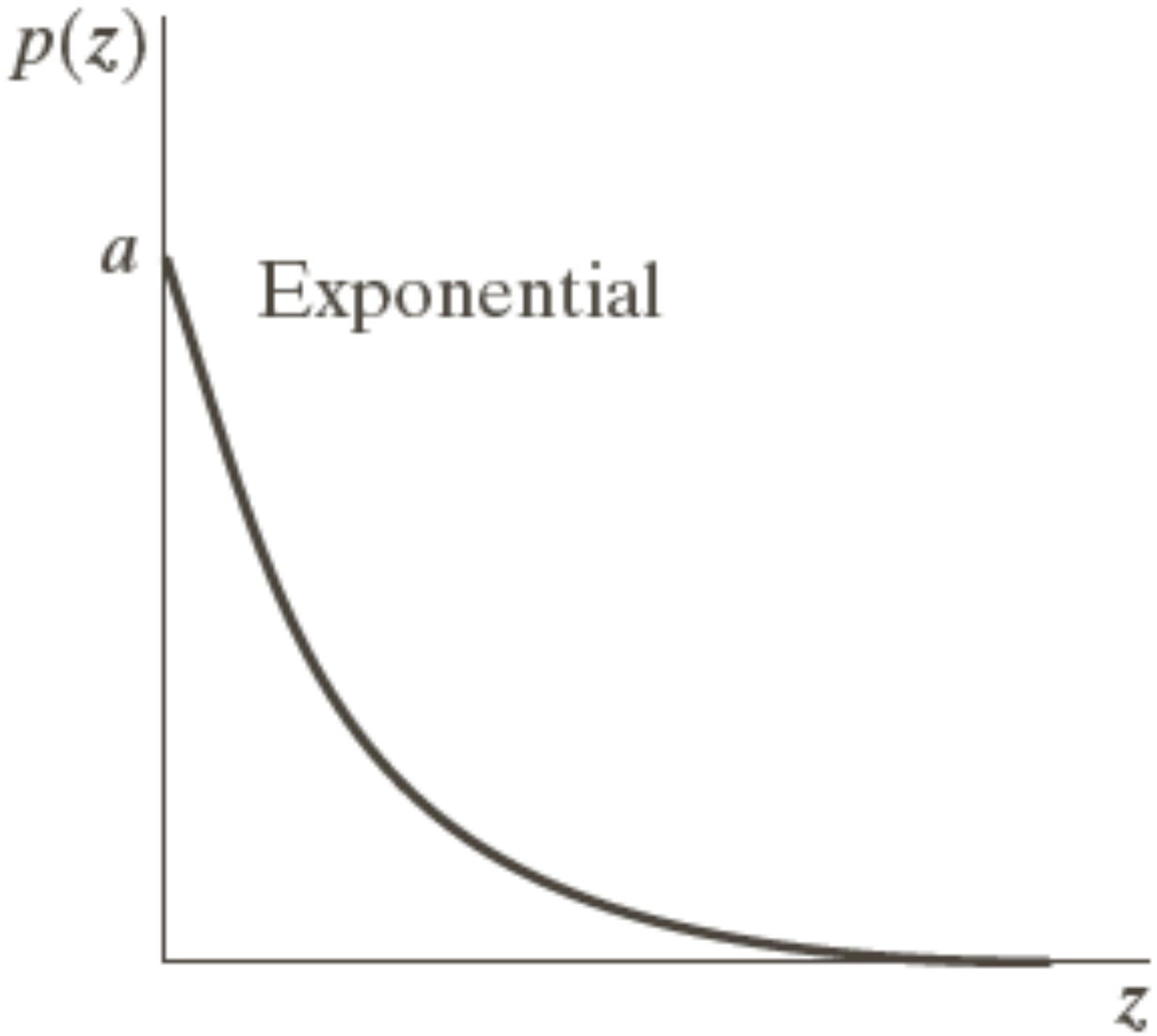
Noise in the Image



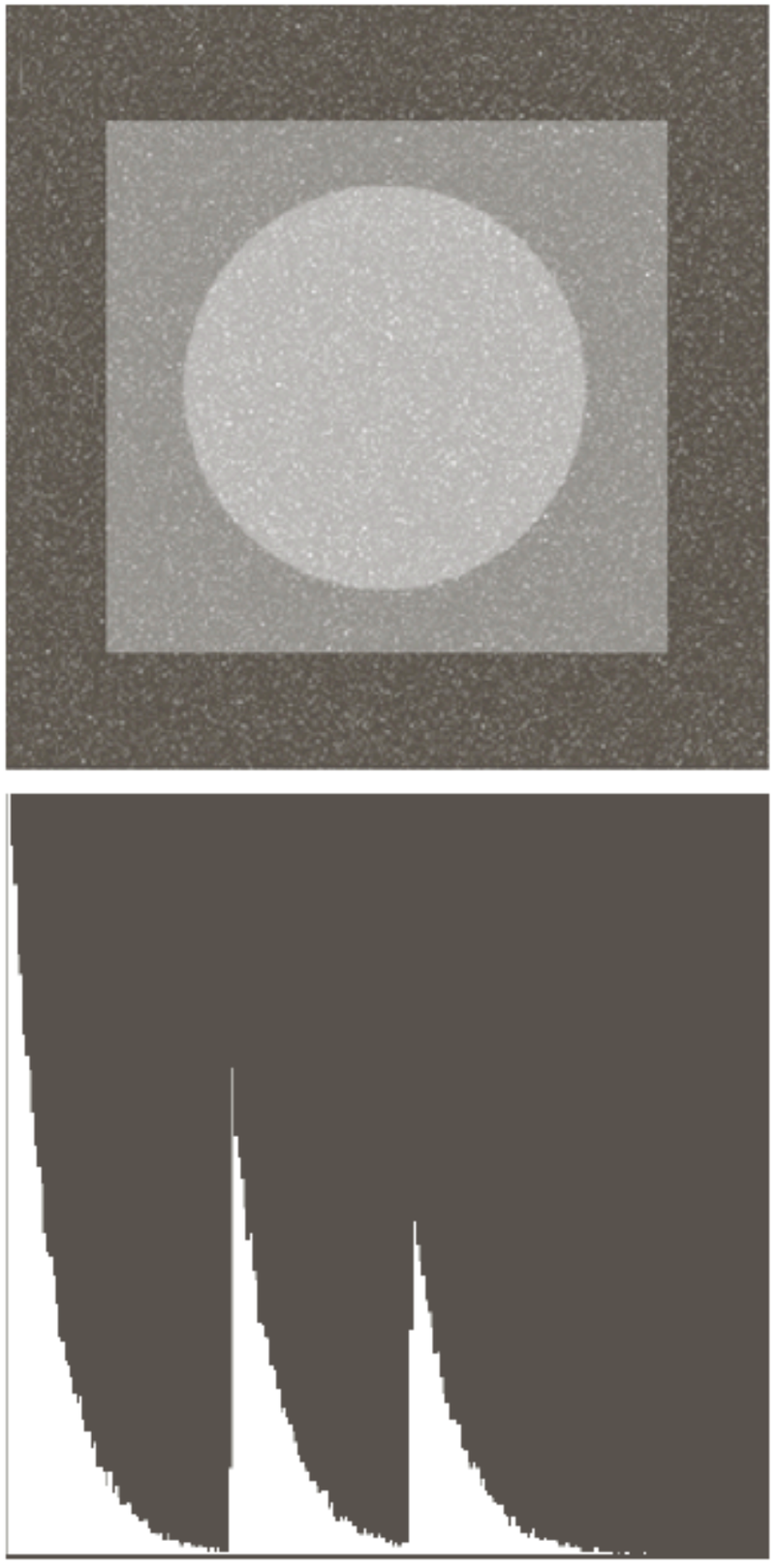
Uniform

Important Noise PDFs

$$p(z) = \begin{cases} a\exp(-az) & , \quad z \geq 0 \\ 0 & , \quad z < 0 \end{cases}$$

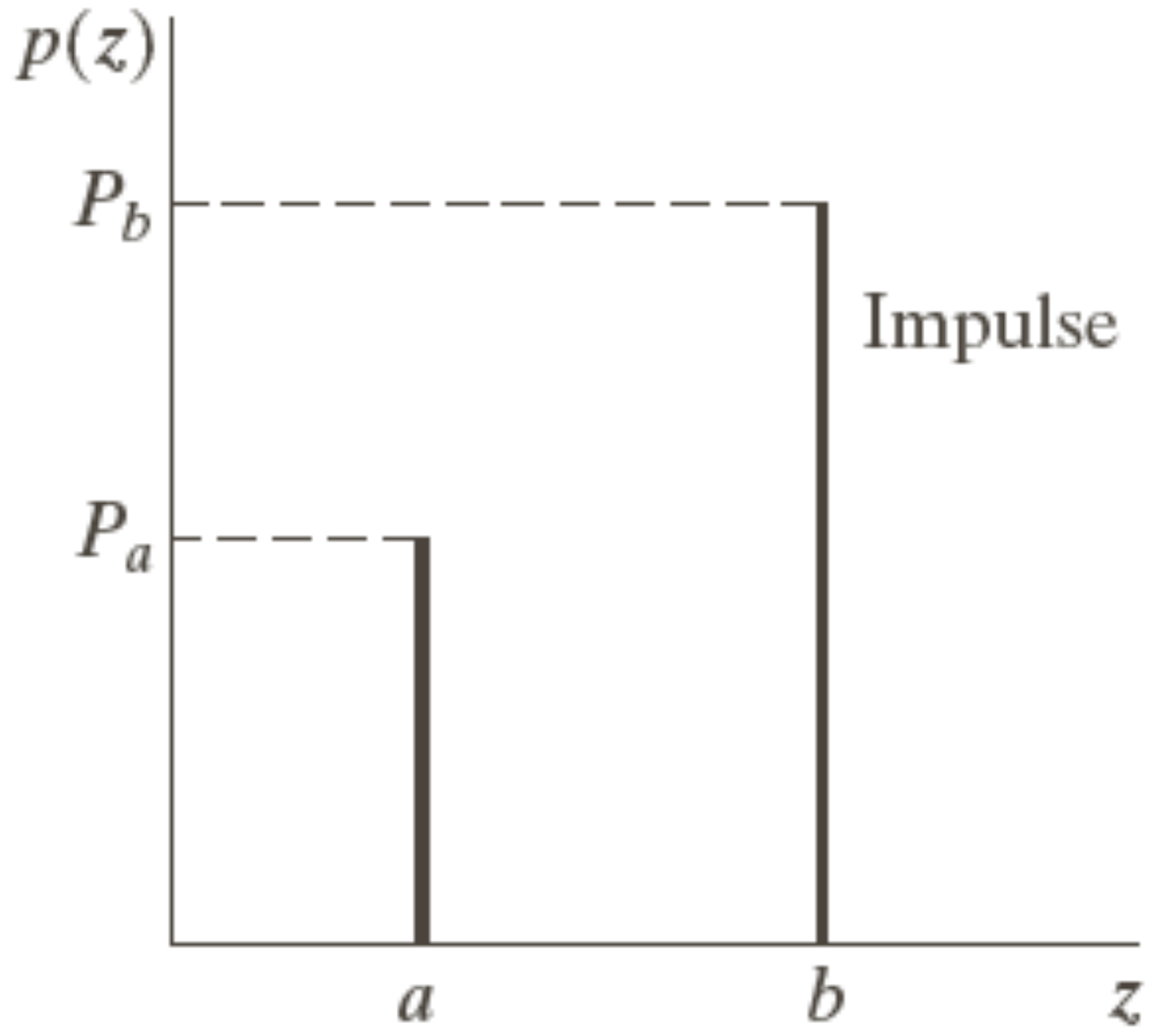


Noise in the Image

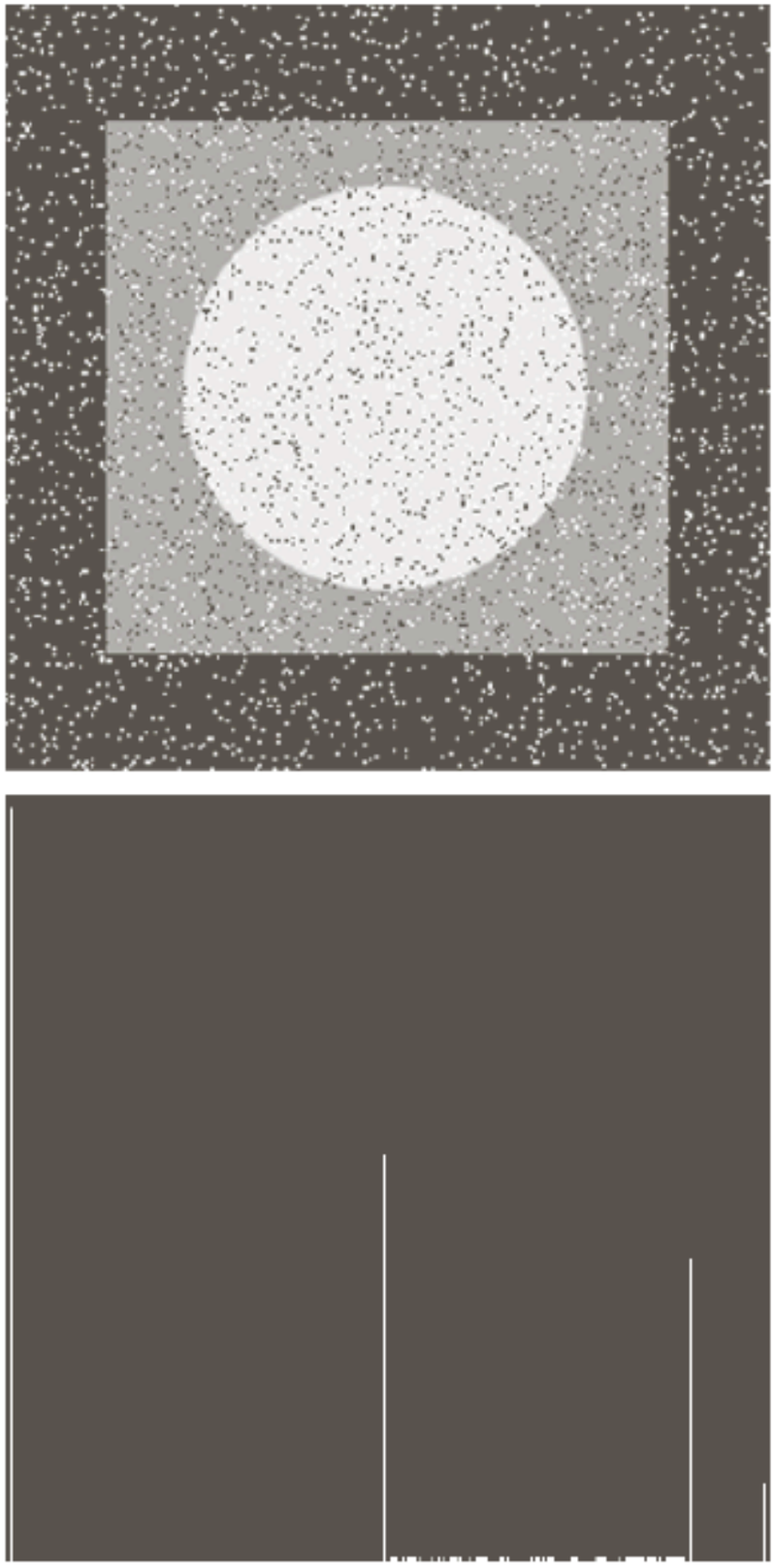


Exponential

Important Noise PDFs



Noise in the Image



Salt & Pepper