Statistical Noise

Statistical noise is due to the random nature of emission and/or detection of photons. It is also referred to as quantum noise since each photon is a quantum of energy. On receptor surface exposed to the same average of photon intensity, one area of the surface might receive more particles than another area. A good comparison is the first rainy drops falling on a pavement.

Statistical noise follows a Poisson distribution. Its variance $\sigma^2$ is equal to its mean $\mu$. This means that the signal-to-noise ratio (SNR) depends on the detected number of counts.

$$\text{SNR} = \frac{\mu}{\sigma} = \frac{\mu}{\mu^{\frac{1}{2}}} = \mu^{\frac{1}{2}}$$

Options to increase the detected number of counts have practical drawbacks:
- Increasing the acquisition duration: patient motion, blurring
- Increasing the administered activity: increase irradiation
- Using more sensitive detectors: cost, availability