**Detection Problems in Assuming Gaussian Distribution for Sum of Independent Random variables**

Introduction – In estimation and detection theory many problems have closed form solution for gaussian distribution. We also know that distribution of the sum of independent and identically distributed random variables converges towards gaussian by the central limit theorem. The distribution of the random variables doesn’t matter. It is assumed that central limit theorem doesn’t take sum of too many IID random variables to converge towards a gaussian distribution. In nature, many times we only observe the sum of IID random variables. Hence, it is assumed that detection and estimation methods that work for normal distributions can be applicable to many problems involving other types of distributions. Due to this gaussian is used everywhere in industries like engineering, economics, statistics and sciences. Central limit theorem is considered central to the statistics and some people assume that name of the theorem comes from that.

But normal distribution is a very special type of distribution where probability of random variable goes down as a function of exponential squared. This means that probability of finding a random variable away form mean value is very very low. 99.7% times random variable stays within 3 standard deviations (sigma) away from the mean and probabilty of 6sigma or 7sigma events is almost zero.

In this project, we will examine consequence of making the gaussian assumption in detection errors especially for rare events. We will look at the behaviour of the following the random variable

According to the central limit theorem this random variable should converge towards the normal distribution with mean 0 and variance 1.