- Statistical Inference is divided into two major areas:
  - parameter estimation
  - Statistical Inference, Hypothesis Testing

Parameter Estimation:

- A statistic (mean etc.) that is gained from a sample of a population is called a **point estimate** of that parameter/statistic.
- A statistic is also a random variable, so it has a probability distribution.
- The probability distribution of a statistic is called a sampling distribution.
- θ will be used to represent any parameter, such as mean μ or variance σ^2 etc.
- The objective of point estimation is to select a single number, based on sample data, that is the most plausible value for θ.

> A point estimate of some population parameter θ is a single numerical value $\hat{\theta}$ of a statistic $\hat{\Theta}$. The statistic $\hat{\Theta}$ is called the point estimator.

- We will make point estimates of the following parameters:
  1. The sample mean $\hat{\mu}$
  2. The sample variance $\hat{\sigma^2}$ (or standard deviation $\hat{\sigma}$)
  3. The sample proportion $\hat{p}$ of items in a population, x/n , where x is the number of items in a random sample of size n
  4. The difference in sample means of two populations, $\hat{\mu}_1 - \hat{\mu_2}$
  5. The difference in two population sample proportions, $\hat{p}_1 - \hat{p}_2$

> Central Limit Theorem:
> If $X_1, X_2, \ldots X_n$ is a random sample of size n taken from a population with mean μ and finite variance σ^2 , and if $\bar{X}$ is the sample mean, the form of the distribution of
>
> $$Z = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}}$$
>
> as $n \to \infty$, , is the standard normal distribution.

Example 1:

An electronics company manufactures resistors that have a mean resistance μ of 100 ohms and a standard deviation σ of 10 ohms. The distribution of resistance is normal. Find the probability that a random sample of n = 25 resistors will have an average resistance $\bar{X}$ less than 95 ohms.

Solution:

The distribution is normal, and since because *linear functions of independent, normally distributed random variables are also normally distributed* so the sample mean will be:

$\mu_{\bar{X}} = \mu$, so $\mu_{\bar{X}} = 100$ and

$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$, so $\sigma_{\bar{X}} = \frac{10}{\sqrt{25}} = 2$

After finding sample mean and sample standard deviation, we will solve normally by standardizing $\bar{X}$ = 95 using these statistics and finding the value using Z-table.

- Regarding the difference in sample means of two populations, $\hat{\mu_1} - \hat{\mu_2}$, the mean will be equal to the difference of the means of the population: be: $\mu_{\bar{X}_1 - \bar{X}_2}$ =$\mu_{\bar{X}_1} - \mu_{\bar{X}_2}$= $\mu_1 - \mu_2$ AND standard deviation will be same but SUMMED instead of subtracted.