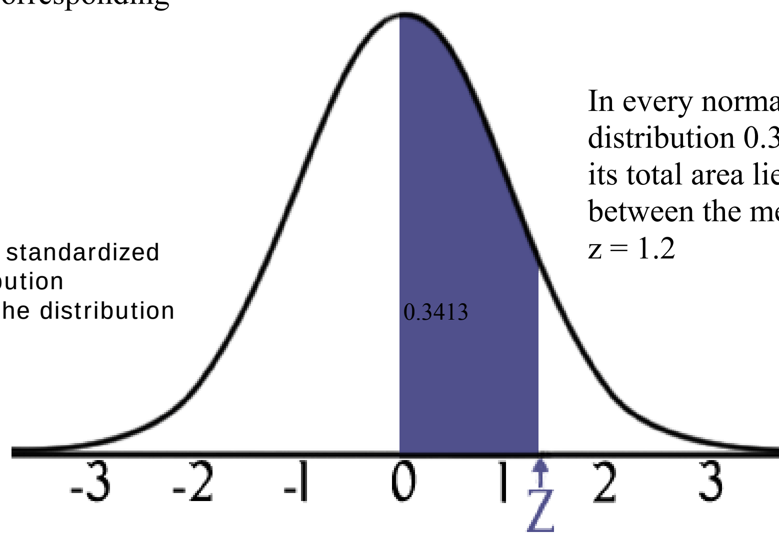
Z-Score & IT'S USES

This is the formula for converting a given value of x into its corresponding z score for raw data:

$$Z = \frac{x - \mu_x}{\sigma_x}$$

x = the value that is being standardized
μ = the mean of the distribution
σ = standard deviation of the distribution



In every normal distribution 0.3413 of its total area lies between the mean and z = 1.2

Z-score for Means

$$Z = \frac{\overline{X}_i - \mu}{\sigma_{\overline{X}}}$$

$\overline{X}_i$ = sample mean
$\sigma_{\overline{X}}$ = standard error
μ = population mean

Standard Error formula:

$$s = \frac{\sigma}{\sqrt{n}}$$

σ = standard deviation
n = sample size

1. Z-score serves 2 purposes
   - Each z-score will tell the exact location of the original x value within the distribution
   - The z-score will form a standardized distribution that can be directly compared to other distributions that also have been transformed into z-scores.

2. Value of z-score
   - The sign tells whether the score is located above (+) or below (-) the mean

- The number tells the distance between the score and the mean in terms of the number of standard deviation.
- The z-score for an item, indicated how far and in what direction, that item deviates from its distribution's mean, expressed in units of its distribution's standard deviation.
- The mathematics of the z score transformation are such that if every item in a distribution is converted to its z score, the transformed scores will necessarily have a mean of zero and a standard deviation and a standard deviation of one.
- Z scores are sometimes called "standard scores".
- The z score transformation is especially useful when seeking to compare the relative standings of items from distributions with different standard deviations.
- Z scores are especially informative when the distribution to which they refer, is normal.
- In every normal distribution, the distance between the mean and a given z score cuts off a fixed proportion of the total area under the curve.

3. Z-score for making comparison
   - For example: bob receive a score of x = 60 on math exam and a score x = 56 on a biology test. For which course he did well?
     - Suppose the biology score had $\mu = 48$ and $\sigma = 4$ and the math score had $\mu = 50$ and $\sigma = 10$.
     - Suppose you use a test for your students and the $\mu = 65$ and $\sigma = 10$ and your friend use a test for your students which have $\mu = 100$ and $\sigma = 15$
     - Three of your students got 75, 45 and 67 respectively in your test what should be the score of your students in your friend test if

you want to say the students' performance in both the tests are same

- Formula for standardized score is $x = \mu + z\sigma$

- Second example: H_o = there is no effect of PBL on average score obtained by the students
  - Average score (μ) of USM 3rd year students is 60 with standard deviation (σ) is 5
  - A sample of 20 students attended PBL and average score of this group of students is 65
  - Is this increase of 5 marks in average due to chance or the effect of PBL?
  - Answer can be obtained by z test

$$Z = \frac{\overline{X}_i - \mu}{\sigma_{\overline{X}}}$$

$\overline{X}_i$ = sample mean
$\sigma_{\overline{X}}$ = standard error
μ = population mean

Standard Error formula:

$$s = \frac{\sigma}{\sqrt{n}}$$

σ = standard deviation
n = sample size

- H_o $\overline{X}_i$ of the students attended PBL = 60
- H_1 $\overline{X}_i$ of students attended PBL > 60 or $\neq 60$
- Level of significance or α level = 0.05 (usually used)
- Z = 1.96
- Z = [sample mean – hypothetical mean]/[standard error between $\overline{X}_i$ and μ]
- Z = [obtained difference]/[difference due to chance]
- Consult normal distribution table to see if calculated value is in the critical region or not to reject or accept null hypothesis