Conducting a significance test for a population mean (pop. σ is known):

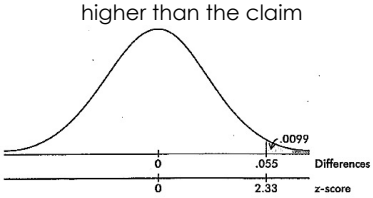
Step 1: Set up your hypothesis based on what you think about the population and identify the parameter of interest. Example: μ = average GPA of NWHS students

H_0 : μ = 3.0	The **Null Hypothesis** states a claim about the value of a parameter. The previous example made a claim that the GPA was 3 so $\mu = 3.0$ There must be evidence to reject this claim.
H_a : μ = 3.0	The **Alternate Hypothesis** states our suspicion about the population. Our suspicion is that there *is* grade inflation which would imply that $\mu > 3.0$

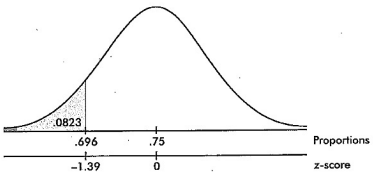
NOTE: The null hypothesis is always stated in terms of $\mu = \mu_o$ and the alternative hypothesis will be stated in one of three ways:

$\underbrace{\mu > \mu_o}$ or $\underbrace{\mu < \mu_o}$ or $\underbrace{\mu \neq \mu_o}$.

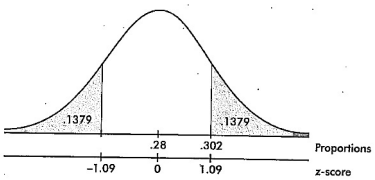
One Sided:
We suspect the true mean is higher than the claim



One Sided:
We suspect the true mean is lower than the claim



Two Sided:
We suspect the true mean is *different* than the claim



Step 2: Have you met the conditions for using a significance test?

Randomly selected sample – Look for the term SRS. Without random selection, we lose the ability to make inferences about the population.

Normal Distribution – We will be using Normal Curves to find probabilities, so we need the distribution to be Normal. For Means: either the population has to be normal, or the sample size n must be at least 30 for the Central Limit Theorem.

Independent Observations – In order to use our standard deviation formula, we need the sample size to be less than 10% of the population size, so 10n < N. This is especially true when sampling without replacement.

Step 3: Find the sample mean, $\bar{x}$, used to estimate the population mean, μ, using an SRS.

Step 4: Calculate the Standard Deviation of the sample mean: $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$

Step 5: Find the Z-Value $Z = \frac{\bar{x} - null}{\sigma_{\bar{x}}}$ Example: $Z = \frac{3.3-3.0}{0.9/\sqrt{40}} = 2.108$

Step 6: Calculate the **p-value:** The probability of getting a result at least as far out as our result if the null is true. Example: P(Z ≥ 2.108) = 0.0175

Step 7: Compare the p-value to the significance level (called an α **–level**)

If the p-value is **below** the significance level:	If the p-value is **above** the significance level:
• Then we reject the null hypothesis H_0 in favor of the alternate hypothesis H_a • We say the results are statistically significant	• Then we fail to reject the null hypothesis H_0 and reject the alternate hypothesis H_a • We say the results are NOT statistically significant

***Step 8*:** State your conclusion using AP Language.

If the mean is really _____ for _____, there is a _____ chance of finding a
(state the null) (state the claim) (state the p-value)

sample of _____ people with an $\bar{x}$ value of _____. We conclude that at the _____
(state sample size, n) (state the test statistic) (state the α-level)

significance level the claim [is rejected] or [fails to be rejected].

Conducting a significance test for a population mean (pop. σ is unknown):

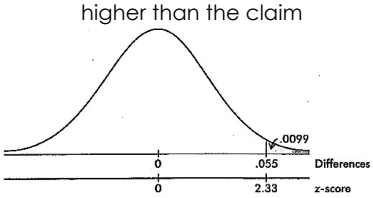
Step 1: Set up your hypothesis based on what you think about the population and identify the parameter of interest. Example: μ = average GPA of NWHS students

H_0 : μ = 3.0	The **Null Hypothesis** states a claim about the value of a parameter. The previous example made a claim that the GPA was 3 so $\mu = 3.0$ There must be evidence to reject this claim.
H_a : μ = 3.0	The **Alternate Hypothesis** states our suspicion about the population. Our suspicion is that there *is* grade inflation which would imply that $\mu > 3.0$

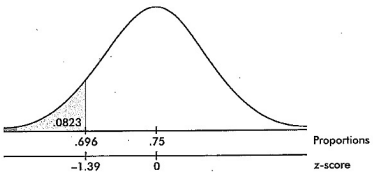
NOTE: The null hypothesis is always stated in terms of $\mu = \mu_o$ and the alternative hypothesis will be stated in one of three ways:

$\underbrace{\mu > \mu_o}$ or $\underbrace{\mu < \mu_o}$ or $\underbrace{\mu \neq \mu_o}$.

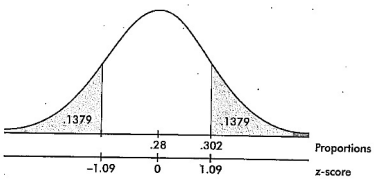
One Sided:
We suspect the true mean is higher than the claim



One Sided:
We suspect the true mean is lower than the claim



Two Sided:
We suspect the true mean is *different* than the claim



Step 2: Have you met the conditions for using a significance test?

Randomly selected sample – Look for the term SRS. Without random selection, we lose the ability to make inferences about the population.

Normal Distribution – We will be using Normal Curves to find probabilities, so we need the distribution to be Normal. For Means: either the population has to be normal, or the sample size n must be at least 30 for the Central Limit Theorem.

Independent Observations – In order to use our standard deviation formula, we need the sample size to be less than 10% of the population size, so 10n < N. This is especially true when sampling without replacement.

Step 3: Find the sample mean, $\bar{x}$, used to estimate the population mean, μ, using an SRS.

Step 4: Calculate the Standard Deviation of the sample mean: $\sigma_{\bar{x}} = \frac{s_x}{\sqrt{n}}$

Step 5: Find the T-Value $T = \frac{\bar{x} - null}{\sigma_{\bar{x}}}$ Example: $T = \frac{3.3-3.0}{0.9/\sqrt{40}} = 2.108$

Step 6: Calculate the **p-value:** The probability of getting a result at least as far out as our result if the null is true. Example: P(T ≥ 2.108) = 0.0175

Step 7: Compare the p-value to the significance level (called an α **– level**)

If the p-value is **below** the significance level:	If the p-value is **above** the significance level:
• Then we reject the null hypothesis H_0 in favor of the alternate hypothesis H_a • We say the results are statistically significant	• Then we fail to reject the null hypothesis H_0 and reject the alternate hypothesis H_a • We say the results are NOT statistically significant

***Step 8*:** State your conclusion using AP Language.

If the mean is really _____ for _____, there is a _____ chance of finding a
(state the null) (state the claim) (state the p-value)

sample of _____ people with an $\bar{x}$ value of _____. We conclude that at the _____
(state sample size, n) (state the test statistic) (state the α-level)

significance level the claim [is rejected] or [fails to be rejected].