Hypothesis Testing Procedure

Step 1: Read the claim and write **SC** and **OC**

Step 2: H_0 (must have $=$ **or** $\leq$ **or** $\geq$) and H_1 (must have $\neq$ **or** $>$ **or** $<$)

Based on H_1 decide if it is (left tailed test, right tailed test, or two tailed test).

Step 3: Find the critical value (**z** or **t** by using Table 2) and label the region as **R** for rejection or **A** for acceptance of H_0

Step 4: Test statistics =TS = $\dfrac{\sqrt{n}(\overline{x}-\mu)}{s}$

Step 5: Conclusion: Accept or reject H_0 ? (H_0 will be **rejected if TS falls in critical region** otherwise accepted)

Step 6: Comment: Accept or reject **SC**? Hint: If H_0 and **SC** are similar same decision **otherwise** different decision.

Step 7: P-value is the **area** from **test statistics** and graphically, it is on the same side of critical value and it can be found by using your **TI calculator**.

Problem 1. At $\alpha = 0.05$, test the claim that **average** life of "Cyan" batteries **exceeds** 50 months. A sample of 64 batteries had a mean of 53 months with standard deviation of 9.5 months.

SC: μ Ho: μ $n=$ $\overline{x}=$ $s=$

OC: μ H_1: μ (left tailed test or two tailed test or right tailed test)

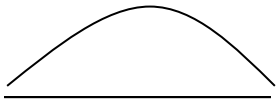
$\alpha=$ and $n=$ then ***CV*** = **TS=** $\dfrac{\sqrt{n}(\overline{x}-\mu)}{s} =$ _____ =

Conclusion: Accept or reject H_0 **Comment:** Accept or reject ***SC*** ***P-Value*** = α

Problem 2. At $\alpha = 0.05$, test the claim that **average** life of "Cyan" batteries **exceeds** 50 months. A sample of 9 batteries had a mean of 53 months with standard deviation of 9.5 months.

SC: μ Ho: μ $n=$ $\overline{x}=$ $s=$

OC: μ H_1: μ (left tailed test or two tailed test or right tailed test)



$\alpha=$ and $n=$ then ***CV*** = **TS=** $\dfrac{\sqrt{n}(\overline{x}-\mu)}{s} =$ _____ =

Conclusion: Accept or reject H_0 **Comment:** Accept or reject ***SC*** ***P-Value*** = α

Problem 3. At $\alpha = 0.05$, test the claim that **average** life of "Cyan" batteries **is** 50 months. A sample of 49 batteries had a mean of 54 months with standard deviation of 9.5 months.

SC: μ Ho: μ $n=$ $\overline{x}=$ $s=$

OC: μ H_1: μ (left tailed test or two tailed test or right tailed test)

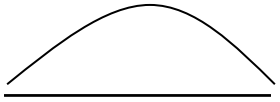
$\alpha=$ and $n=$ then ***CV*** = **TS=** $\dfrac{\sqrt{n}(\overline{x}-\mu)}{s} =$ _____ =

Conclusion: Accept or reject H_0 **Comment:** Accept or reject ***SC*** ***P-Value*** = α

Problem 4. At α = **0.05**, test the claim that **average** life of "Cyan" batteries **is different than** 50 months. A sample of 9 batteries had a mean of 55 months with standard deviation of 9.5 months.

SC: μ Ho: μ $n =$ $\bar{x} =$ $s =$

OC: μ $H_{1:}$ μ (left tailed test or two tailed test or right tailed test)



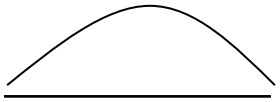
$\alpha =$ and $n =$ then ***CV*** = **TS=** $\dfrac{\sqrt{n}(\bar{x}-\mu)}{s} =$ _____ =

Conclusion: Accept or reject H_0 **Comment:** Accept or reject ***SC*** ***P-Value*** = α

Problem 5. At α = **0.01**, test the claim that **average** life of "Cyan" batteries is **at most** 50 months. A sample of 49 batteries had a mean of 53 months with standard deviation of 8.8 months.

SC: μ Ho: μ $n =$ $\bar{x} =$ $s =$

OC: μ $H_{1:}$ μ (left tailed test or two tailed test or right tailed test)



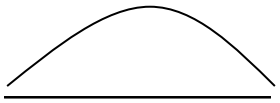
$\alpha =$ and $n =$ then ***CV*** = **TS=** $\dfrac{\sqrt{n}(\bar{x}-\mu)}{s} =$ _____ =

Conclusion: Accept or reject H_0 **Comment:** Accept or reject ***SC*** ***P-Value*** = α

Problem 6. At α **=0 .01**, test the claim that **average** life of "Cyan" batteries is **at most** 50 months. A sample of 16 batteries had a mean of 53 months with standard deviation of 9.4 months.

SC: μ Ho: μ $n =$ $\bar{x} =$ $s =$

OC: μ $H_{1:}$ μ (left tailed test or two tailed test or right tailed test)



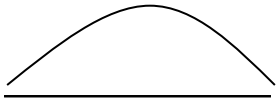
$\alpha =$ and $n =$ then ***CV*** = **TS=** $\dfrac{\sqrt{n}(\bar{x}-\mu)}{s} =$ _____ =

Conclusion: Accept or reject H_0 **Comment:** Accept or reject ***SC*** ***P-Value*** = α

Problem 7. At α **= 0.10**, test the claim that **average** life of "Cyan" batteries is **at least** 50 months. A sample of 36 batteries had a mean of 46 months with standard deviation of 10 months.

SC: μ Ho: μ $n =$ $\bar{x} =$ $s =$

OC: μ $H_{1:}$ μ (left tailed test or two tailed test or right tailed test)



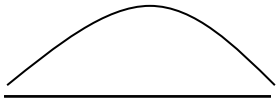
$\alpha =$ and $n =$ then ***CV*** = **TS=** $\dfrac{\sqrt{n}(\bar{x}-\mu)}{s} =$ _____ =

Conclusion: Accept or reject H_0 **Comment:** Accept or reject ***SC*** ***P-Value*** = α

Problem 8: At $\alpha = 0.10$, test the claim that **average** life of "Cyan" batteries is **at least** 50 months. A sample of 16 batteries had a mean of 47 months with standard deviation of 10 months.

SC: μ Ho: μ $n =$ $\bar{x} =$ $s =$

OC: μ $H_{1:}$ μ (left tailed test or two tailed test or right tailed test)



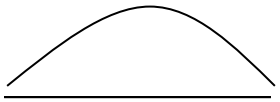
$\alpha =$ and $n =$ then ***CV*** = **TS=** $\dfrac{\sqrt{n}(\bar{x}-\mu)}{s} =$ _____ =

Conclusion: Accept or reject H_0 **Comment:** Accept or reject ***SC*** ***P-Value*** = α

Problem 9: At α **=0 .025**, test the claim that **average** life of "Cyan" batteries is **less than** 50 months. A sample of 36 batteries had a mean of 46 months with standard deviation of 12 months.

SC: μ Ho: μ $n =$ $\bar{x} =$ $s =$

OC: μ $H_{1:}$ μ (left tailed test or two tailed test or right tailed test)



$\alpha =$ and $n =$ then ***CV*** = **TS=** $\dfrac{\sqrt{n}(\bar{x}-\mu)}{s} =$ _____ =

Conclusion: Accept or reject H_0 **Comment:** Accept or reject ***SC*** ***P-Value*** = α

Problem 10: At $\alpha = 0.025$, test the claim that **average** life of "Cyan" batteries is **less than** 50 months. A sample of 16 batteries had a mean of 48 months with standard deviation of 13 months.

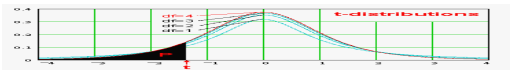
SC: μ Ho: μ $n =$ $\bar{x} =$ $s =$

OC: μ $H_{1:}$ μ (left tailed test or two tailed test or right tailed test)

$\alpha =$ and $n =$ then ***CV*** = **TS=** $\dfrac{\sqrt{n}(\bar{x}-\mu)}{s} =$ _____ =

Conclusion: Accept or reject H_0 **Comment:** Accept or reject ***SC*** ***P-Value*** = α

TABLE 2



Distribution for small sample $n \leq 30$

t -

df = n-1	<---------- alpha α ---------->							
2-Tailed	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.005
1-Tailed	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.0025
Conf. Levl.	60%	70%	80%	90%	95%	98%	99%	99.5%
1	1.376	1.963	3.078	6.314	12.706	31.821	63.656	127.321
2	1.061	1.386	1.886	2.920	4.303	6.965	9.925	14.089
3	0.978	1.250	1.638	2.353	3.182	4.541	5.841	7.453
4	0.941	1.190	1.533	2.132	2.776	3.747	4.604	5.598
5	***0.920***	***1.156***	***1.476***	***2.015***	***2.571***	***3.365***	***4.032***	***4.773***
6	0.906	1.134	1.440	1.943	2.447	3.143	3.707	4.317
7	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.029
8	0.889	1.108	1.397	1.860	2.306	2.896	3.355	3.833
9	0.883	1.100	1.383	1.833	2.262	2.821	3.250	3.690
10	***0.879***	***1.093***	***1.372***	***1.812***	***2.228***	***2.764***	***3.169***	***3.581***
11	0.876	1.088	1.363	1.796	2.201	2.718	3.106	3.497
12	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.428
13	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.372
14	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.326
15	***0.866***	***1.074***	***1.341***	***1.753***	***2.131***	***2.602***	***2.947***	***3.286***
16	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.252
17	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.222
18	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.197
19	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.174
20	***0.860***	***1.064***	***1.325***	***1.725***	***2.086***	***2.528***	***2.845***	***3.153***
21	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.135
22	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.119
23	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.104
24	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.091
25	***0.856***	***1.058***	***1.316***	***1.708***	***2.060***	***2.485***	***2.787***	***3.078***
26	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.067
27	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.057
28	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.047
29	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.038
30	***0.854***	***1.055***	***1.310***	***1.697***	***2.042***	***2.457***	***2.750***	***3.030***
n>30 ⇒ Z	***0.842***	***1.036***	***1.282***	***1.645***	***1.96***	***2.326***	***2.576***	***2.807***

Critical-value n >30

for $n > 30$ Use Bottom row

2-T	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.005
1-T	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.0025
Conf. Levl.	*60%*	*70%*	*80%*	*90%*	*95%*	*98%*	*99%*	*99.5%*

Solution

Hypothesis Testing Procedure (Rejection Region Method)

Step 1**: SC** and **OC** **Step 2:** H_0 and H_1. Decide if it is (left tailed test, right tailed test, or two tailed test).

Step 3: Find the critical value (**z** or **t** by using Table 2) and label the region as **R** for rejection or **A** for acceptance of H_0

Step 4: Test statistics =TS = $\dfrac{\sqrt{n}(\overline{x}-\mu)}{s}$

Step 5: Conclusion: Is H_0 accepted or rejected? (H_0 will be **rejected if TS falls in critical region** otherwise accepted)

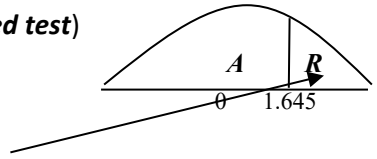
Step 6: Comment: Is **SC** accepted or rejected?

Step 7: Find **P-value- by** using your **TI calculator**.

Problem 1. At **α = 0.05**, test the claim that **average** life of "Cyan" batteries **exceeds** 50 months. A sample of 64 batteries had a mean of 53 months with standard deviation of 9.5 months.

SC: $\mu > 50$ Ho: $\mu \le 50$ $n = 64$ $\overline{x} = 53$ $s = 9.5$

OC: $\mu \le 50$ H_1: $\mu > 50$ (left tailed test, two tailed test***,*** or ***right tailed test***)



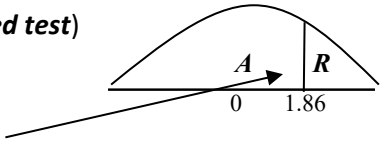
α = 0.05 and $n = 64$ then $CV = 1.645$ **TS=** $\dfrac{\sqrt{n}(\overline{x}-\mu)}{s} = \dfrac{\sqrt{64}(53-50)}{9.5} = 2.526$

Conclusion: Accept or **reject** H_0 **Comment: Accept** or reject ***SC*** ***P-Value*** $= 0.0058 < \alpha$

Problem 2. At **α =0.05**, test the claim that **average** life of "Cyan" batteries **exceeds** 50 months. A sample of 9 batteries had a mean of 53 months with standard deviation of 9.5 months.

SC: $\mu > 50$ Ho: $\mu \le 50$ $n = 9$ $\overline{x} = 53$ $s = 9.5$

OC: $\mu \le 50$ H_1: $\mu > 50$ (left tailed test, two tailed test***,*** or ***right tailed test***)



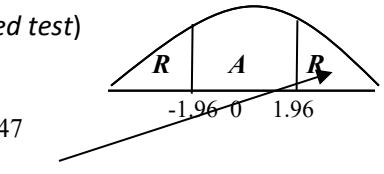
α = 0.05 and $n = 9$ then $CV = 1.86$ **TS=** $\dfrac{\sqrt{n}(\overline{x}-\mu)}{s} = \dfrac{\sqrt{9}(53-50)}{9.5} = 0.947$

Conclusion: **Accept** or reject H_0 **Comment:** Accept or **reject** ***SC*** ***P-Value*** $= 0.1856 > \alpha$

Problem 3. At **α = 0.05**, test the claim that **average** life of "Cyan" batteries **is** 50 months. A sample of 49 batteries had a mean of 54 months with standard deviation of 9.5 months.

SC: $\mu = 50$ Ho: $\mu = 50$ $n = 49$ $\overline{x} = 54$ $s = 9.5$

OC: $\mu \ne 50$ H_1: $\mu \ne 50$ (left tailed test, **two tailed test,** or *right tailed test*)



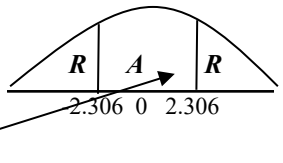
α = 0.05 and $n = 49$ then $CV = \pm 1.96$ **TS=** $\dfrac{\sqrt{n}(\overline{x}-\mu)}{s} = \dfrac{\sqrt{49}(54-50)}{9.5} = 2.947$

Conclusion: Accept or **reject** H_0 **Comment:** Accept or **reject** ***SC*** ***P-Value*** $= 0.0032 < \alpha$

Problem 4. At α = **0.05**, test the claim that **average** life of "Cyan" batteries **is different than** 50 months. A sample of 9 batteries had a mean of 55 months with standard deviation of 9.5 months.

SC: $\mu \neq 50$ Ho: $\mu = 50$ $n = 9$ $\bar{x} = 55$ $s = 9.5$

OC: $\mu = 50$ $H_{1:}\ \mu \neq 50$ (left tailed test, **two tailed test,** or *right tailed test*)



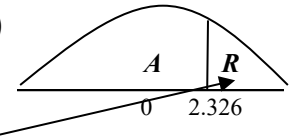
α = 0.05 and $n = 9$ then ***CV*** $= \pm 2.306$ **TS=** $\dfrac{\sqrt{n}(\bar{x}-\mu)}{s} = \dfrac{\sqrt{9}(55-50)}{9.5} = 1.58$

Conclusion: **Accept** or reject H_0 **Comment:** Accept or **reject *SC*** ***P-Value*** $= 0.153 > \alpha$

Problem 5. At α = **0.01**, test the claim that **average** life of "Cyan" batteries is **at most** 50 months. A sample of 49 batteries had a mean of 53 months with standard deviation of 8.8 months.

SC: $\mu \leq 50$ Ho: $\mu \leq 50$ $n = 49$ $\bar{x} = 53$ $s = 8.8$

OC: $\mu > 50$ $H_{1:}\ \mu > 50$ (left tailed test, two tailed test, or ***right tailed test***)



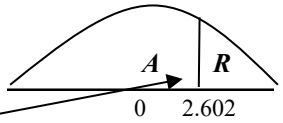
α = 0.01 and $n = 49$ then ***CV*** $= 2.326$ **TS=** $\dfrac{\sqrt{n}(\bar{x}-\mu)}{s} = \dfrac{\sqrt{49}(53-50)}{8.8} = 2.386$

Conclusion: Accept or **reject** H_0 **Comment:** Accept or **reject *SC*** ***P-Value*** $= 0.0085 < \alpha$

Problem 6. At **α =0 .01**, test the claim that **average** life of "Cyan" batteries is **at most** 50 months. A sample of 16 batteries had a mean of 53 months with standard deviation of 9.4 months.

SC: $\mu \leq 50$ Ho: $\mu \leq 50$ $n = 16$ $\bar{x} = 53$ $s = 9.4$

OC: $\mu > 50$ $H_{1:}\ \mu > 50$ (left tailed test, two tailed test, or ***right tailed test***)



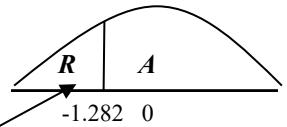
α = 0.01 and $n = 16$ then ***CV*** $= 2.602$ **TS=** $\dfrac{\sqrt{n}(\bar{x}-\mu)}{s} = \dfrac{\sqrt{16}(53-50)}{9.4} = 1.277$

Conclusion: **Accept** or reject H_0 **Comment: Accept** or reject ***SC*** ***P-Value*** $= 0.1106 > \alpha$

Problem 7. At **α = 0.10**, test the claim that **average** life of "Cyan" batteries is **at least** 50 months. A sample of 36 batteries had a mean of 46 months with standard deviation of 10 months.

SC: $\mu \geq 50$ Ho: $\mu \geq 50$ $n = 36$ $\bar{x} = 46$ $s = 10$

OC: $\mu < 50$ $H_{1:}\ \mu < 50$ (**left tailed test**, two tailed test, or *right tailed test*)



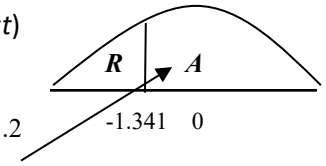
α = 0.10 and $n = 36$ then ***CV*** $= -1.282$ **TS=** $\dfrac{\sqrt{n}(\bar{x}-\mu)}{s} = \dfrac{\sqrt{36}(46-50)}{10} = -2.4$

Conclusion: Accept or **reject** H_0 **Comment:** Accept or **reject *SC*** ***P-Value*** $= 0.0082 < \alpha$

Problem 8: At $\alpha = 0.10$, test the claim that **average** life of "Cyan" batteries is **at least** 50 months. A sample of 16 batteries had a mean of 47 months with standard deviation of 10 months.

SC: $\mu \geq 50$ Ho: $\mu \geq 50$ $n = 16$ $\overline{x} = 47$ $s = 10$

OC: $\mu < 50$ $H_{1:}\ \mu < 50$ (**left tailed test**, two tailed test**,** or *right tailed test*)



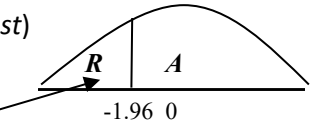
$\alpha = 0.10$ and $n = 16$ then $CV = -1.341$ **TS=** $\dfrac{\sqrt{n}(\overline{x} - \mu)}{s} = \dfrac{\sqrt{16}(47 - 50)}{10} = -1.2$

Conclusion: **Accept** or reject H_0 **Comment: Accept** or reject ***SC*** ***P-Value*** $= 0.1243 > \alpha$

Problem 9: At $\alpha = 0.025$, test the claim that **average** life of "Cyan" batteries is **less than** 50 months. A sample of 36 batteries had a mean of 46 months with standard deviation of 12 months.

SC: $\mu < 50$ Ho: $\mu \geq 50$ $n = 36$ $\overline{x} = 46$ $s = 12$

OC: $\mu \geq 50$ $H_{1:}\ \mu < 50$ (**left tailed test**, two tailed test**,** or *right tailed test*)



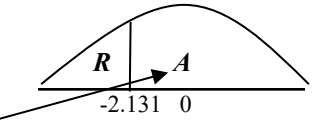
$\alpha = 0.025$ and $n = 36$ then $CV = -1.96$ **TS=** $\dfrac{\sqrt{n}(\overline{x} - \mu)}{s} = \dfrac{\sqrt{36}(46 - 50)}{12} = -2.0$

Conclusion: Accept or **reject** H_0 **Comment: Accept** or reject ***SC*** ***P-Value*** $= 0.0228 < \alpha$

Problem 10: At $\alpha = 0.025$, test the claim that **average** life of "Cyan" batteries is **less than** 50 months. A sample of 16 batteries had a mean of 48 months with standard deviation of 13 months.

SC: $\mu < 50$ Ho: $\mu \geq 50$ $n = 16$ $\overline{x} = 48$ $s = 13$

OC: $\mu \geq 50$ $H_{1:}\ \mu < 50$ (**left tailed test**, two tailed test**,** or *right tailed test*)



$\alpha = 0.025$ and $n = 16$ then $CV = -2.131$ **TS=** $\dfrac{\sqrt{n}(\overline{x} - \mu)}{s} = \dfrac{\sqrt{16}(48 - 50)}{13} = -0.615$

Conclusion: **Accept** or reject H_0 **Comment:** Accept or **reject** ***SC*** ***P-Value*** $= 0.2738 > \alpha$