P1. The study is an experiment since researchers control certain variables to observe effects on others. Population inference is applicable since steel pieces are randomly selected, random sampling applies. Casual inference is not applicable due to no random assignment.

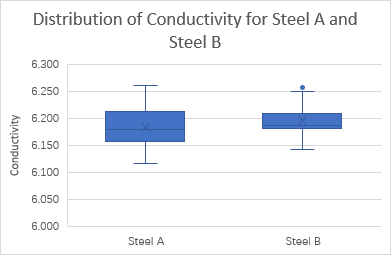
P2. (a)

The mean for Steel B is a little bit higher than the one for Steel A, and the standard deviation for Steel A is higher than the one for Steel B.

Steel B has a better conductivity with a higher mean, and a lower standard deviation as well.

(b)



The distribution for Steel A is almost symmetric (a little bit right-skewed), and the one for Steel B is right-skewed. One outlier exsits for the plot of Steel B.

Median value for Steel B is greater than that for Steel A, IQR for Steel B is smaller than that for Steel A.

(c)

Histogram for Steel A is symmetric, for Steel B is right-skewed.

Both of them are unimodal without outliers.

The assumption is satisfied in distribution of Steel A due to its normality, and the one is not satisfied in distribution of Steel B due to its right-skewed property.

P3. We take 5 decimal places for value of variables in progress and 4 decimal places for result.

(a) 98% two-sided confidence interval, 1-alpha = 0.98

t = T.INV(α/2,df) = T.INV(0.01,29) = -2.46202

Conductivity for Steel A = 6.1824±2.46202\*0.00709 = 6.1824±0.0175 -> (6.1649, 6.1999)

Conductivity for Steel B = 6.1960±2.46202\*0.00479 = 6.1960±0.0118 -> (6.1842, 6.2078)

(b) For Steel A, 6.20 is not included in the 98% two-sided confidence interval, the mean conductivity of Steel A does not meet this target.

For Steel A, 6.20 is included in the 98% two-sided confidence interval, the mean conductivity of Steel A meets this target.

P4. We take 5 decimal places for value of variables in progress and 4 decimal places for result.

(a) Due to unknown population standard deviation, the significance test uses the t distribution instead of the normal distribution.

For Steel A:

Significance level 0.02 is chosen.

H0: μ = 6.2. HA: μ < 6.2

Since the p-value is less than the value of significance level, so H0 would be rejected, that means there is sufficient evidence that the mean conductivity of Steel A does not meet the target value of 6.2.

For Steel B:

Significance level 0.02 is chosen.

H0: μ = 6.2. HA: μ < 6.2

Since the p-value is much higher than the value of significance level, so H0 would not be rejected, that means the mean conductivity of Steel A meets the target value of 6.2.

(b) Assumptions: random sample, independent observations, n ≥ 30 OR population is normal

The assumptions hold for test of Steel A and Steel B, since the 30 samples are random samples, independent observations, and sample size is large (30>=30)

The same assumption applies for confidence intervals on One-Sample CI with σ unknown, and this is exactly what Question three is working on.

P5. (a) Because the sample sizes for Steel A and Steel B (=30) are equal and greater than 15, also the ratio of the larger and smaller standard deviations = 0.03883/0.02625 = 1.4792 < 2.

We apply the t-Test: Two-Sample Assuming Equal Variances

H0: μ1 >= μ2. HA: μ1 < μ2

α = 0.05



t0 follows a t-distribution with df = n1 + n2 – 2 = 58, and δ0 = 0

t0 = -1.5852 for both Steel A and Steel B

p-value = 0.0592 for both Steel A and Steel B

Because the p-value is greater than significance level 0.05, then do not reject the null hypothesis, there is insufficient evidence that the mean conductivity of Steel B is higher than the Steel A.

(b) Assumptions:

First: The sample sizes are approximately equal (within 1-2 observations),

Second: Both sample sizes are at least 15,

Third: The ratio of the larger and smaller standard deviations is less than two (smax / smin < 2).

Because the sample sizes for Steel A and Steel B (=30) are equal and greater than 15, also the ratio of the larger and smaller standard deviations = 0.03883/0.02625 = 1.4792 < 2, The assumptions about the distributions required holds.

(c)



= (6.1824-6.1960) + -1.5852\*(0.0071-0.0048) = -0.0136 + 0.0037 = (-∞, -0.0099)

The interval does not include zero, and is negative, hence we are able to reject the H0 in part a, thus there is sufficient evidence that the mean conductivity of Steel B is higher than the Steel A.

P6. We take 5 decimal places for value of variables in progress and 4 decimal places for result.

(a) Due to unknown population standard deviation, the significance test uses the t distribution instead of the normal distribution.

(μ1 is for Steel B, μ2 is for Tunqstoid)

H0: μ1 >= μ2, HA: μ1 < μ2

α = 0.05



t0 follows a t-distribution with df = n1 + n2 – 2 = 58, and δ0 = 0

t0 = -4.0963 for both Steel A and Steel B

p-value = 0.0001 for both Steel A and Steel B

Because the p-value is much less than significance level 0.05, then reject the null hypothesis, there is sufficient evidence that the mean conductivity of Tunqstoid is higher than the Steel B.

(b)



The 95% confidence interval for the combination change = 0.0094



= 0.0213 + 0.0094 = 0.0307 = (-∞, 0.0307) = (0, 0.0307)

The one side confidence interval includes zero and positive, hence there’s sufficient evidence showing the conductivity of Tunqstoid is higher than Steel B, consistent with that in part A.

(c) Assumptions: random sample, independent observations, n ≥ 30 OR population is normal

The assumptions does not hold for the part a, since the observations for Steel B is not independent with the one for Tunqstoid.