Unit 11 - Week 9

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Assignment 9

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2020-04-01, 23:59 IST.

1) It is known that the tensile strength of a given steel is normally distributed with a standard deviation of 500 kN/m^2. A random sample of 12 specimens are chosen and the tests indicate that the mean of the tensile strengths of the samples is $\bar{x} = 23800\ kN/m^2$. Using R, we wish to test the following hypotheses at a significance value α= 0.01 where μ is the mean tensile strength. *1 point*

$$H_0 : \mu = 24150$$
$$H_1 : \mu \neq 24150$$

Which of the following code snippets can be used for carrying out this hypothesis test?

```
xbar = 24150
mu0 = 23800
sigma = 500
n = 18
z0 = (xbar)/(sigma/sqrt(n))
cat(sprintf("z0=%.2f\n", z0))
alpha = .01
zalphaby2 = qnorm(1-alpha/2)
zalpha = c(-zalphaby2, zalphaby2)
cat(sprintf("zalphaby2=%.2f \t zalphaby2=%.2f\n", -zalphaby2,zalphaby2))
```

```
xbar = 23800
mu0 = 24150
sigma = 500
n = 12
z0 = (xbar-mu0)/(sigma/sqrt(n))
cat(sprintf("z0=%.2f\n", z0))
alpha = .01
zalphaby2 = qnorm(1-alpha/2)
zalpha = c(-zalphaby2, zalphaby2)
cat(sprintf("zalphaby2=%.2f \t zalphaby2=%.2f\n", -zalphaby2,zalphaby2))
```

```
xbar = 23800
mu0 = 24150
sigma = 500
n = 12
z0 = (mu0)/(sigma/sqrt(n))
cat(sprintf("z0=%.2f\n", z0))
alpha = .05
zalphaby2 = qnorm(1-alpha/2)
zalpha = c(-zalphaby2, zalphaby2)
cat(sprintf("zalphaby2=%.2f \t zalphaby2=%.2f\n", -zalphaby2,zalphaby2))
```

```
xbar = 23800
mu0 = 24150
sigma = 415
n = 12
z0 = (xbar-mu0)
cat(sprintf("z0=%.2f\n", z0))
alpha = .01
zalphaby2 = qnorm(1-alpha/2)
zalpha = c(-zalphaby2, zalphaby2)
cat(sprintf("zalphaby2=%.2f \t zalphaby2=%.2f\n", -zalphaby2,zalphaby2))
```

No, the answer is incorrect.
Score: 0
Accepted Answers:

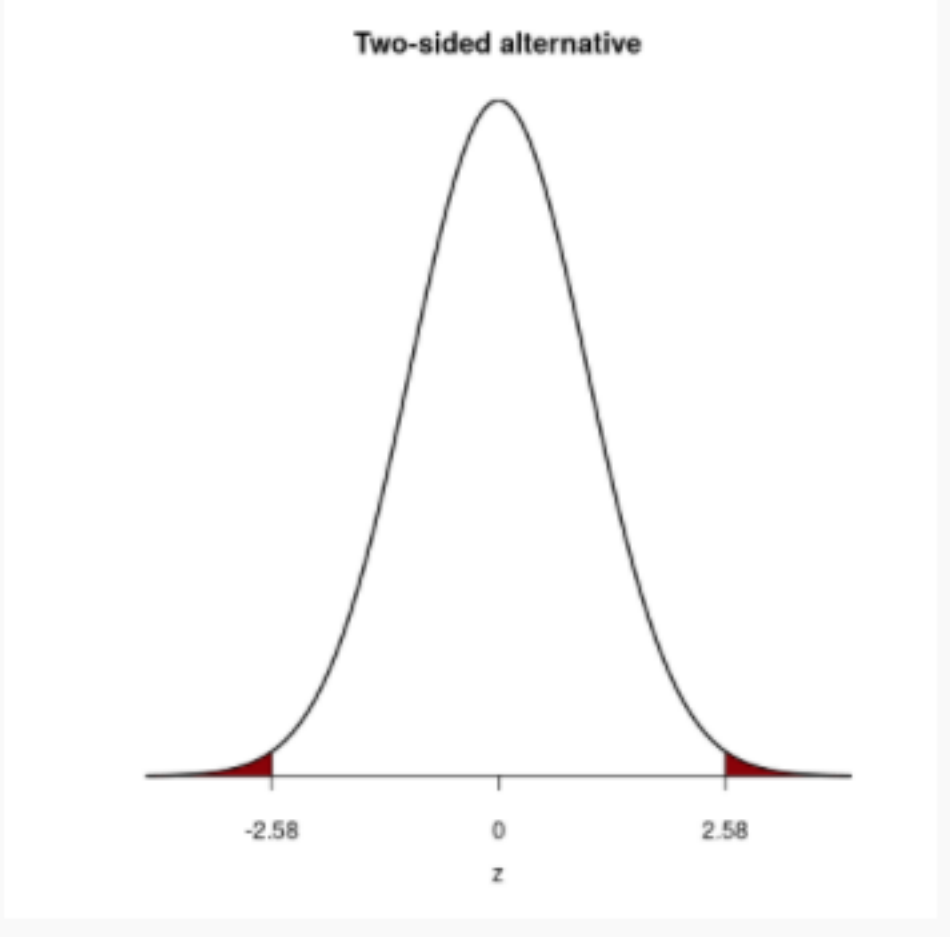
```
xbar = 23800
mu0 = 24150
sigma = 500
n = 12
z0 = (xbar-mu0)/(sigma/sqrt(n))
cat(sprintf("z0=%.2f\n", z0))
alpha = .01
zalphaby2 = qnorm(1-alpha/2)
zalpha = c(-zalphaby2, zalphaby2)
cat(sprintf("zalphaby2=%.2f \t zalphaby2=%.2f\n", -zalphaby2,zalphaby2))
```

2) Which of the following conclusions are true for the hypothesis test discussed in Question 1: *1 point*

- Null hypothesis accepted
- Null hypothesis rejected
- $z_0 = -2.42$
- $z_0 < -z_{0.005}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
Null hypothesis accepted
$z_0 = -2.42$

3) Consider the plot shown below which corresponds to the hypothesis test in described in Question 1. Which of the following code snippets will produce this plot? *1 point*




```
curve(dnorm(x),xlim = c(-4, 4),main = 'Two-sided alternative',yaxs = 'i',xlab = 'z',ylab = '',lwd = 2,axes = 'F')
axis(1, at = c(-1.5, 0, 1.5), padj = 0.75,labels = c(-1.5,0,1.5))
polygon(x = c(-4,seq(-4, -1.5, 0.01),-1.5),y = c(0,dnorm(seq(-4, -1.5, 0.01)),0), col = 'darkred')
polygon(x = c(1.5,seq(1.5, 4, 0.01),4),y = c(0,dnorm(seq(1.5, 4, 0.01)),0), col = 'darkred')
```

```
curve(dnorm(x),xlim = c(-4, 4), main = 'Two-sided alternative',yaxs = 'i',xlab = 'z',ylab = '',lwd = 2,axes = 'F')
axis(1, at = c(-4, 0, -1.5,4),  padj = 0.5,labels = c('',0,-1.5,''))
polygon(x = c(-4,seq(-4, -1.5, 0.01),-1.5),y = c(0,dnorm(seq(-4, -1.5, 0.01)),0), col = 'darkred')
```

```
curve(dnorm(x),xlim = c(-4, 4), main = 'Two-sided alternative',yaxs = 'i',xlab = 'z',ylab = '',lwd = 2,axes = 'F')
axis(1, at = c(-4, 0, 1.5,4),  padj = 0.5,labels = c('',0,1.5,''))
polygon(x = c(1.5,seq(1.5, 4, 0.01),4),y = c(0,dnorm(seq(1.5, 4, 0.01)),0), col = 'darkred')
```

```
curve(dnorm(x),xlim = c(-4, 4), main = 'Two-sided alternative',yaxs = 'i',xlab = 'z',ylab = '',lwd = 2,axes = 'F')
axis(1, at = c(-2.58, 0, 2.58),padj = 0.75,labels = c(-2.58, 0,2.58))
polygon(x = c(-4,seq(-4, -2.58, 0.01),-2.58),y = c(0,dnorm(seq(-4, -2.58, 0.01)),0), col = 'darkred')
polygon(x = c(2.58,seq(2.58, 4, 0.01),4),y = c(0,dnorm(seq(2.58, 4, 0.01)),0), col = 'darkred')
```

No, the answer is incorrect.
Score: 0
Accepted Answers:

```
curve(dnorm(x),xlim = c(-4, 4), main = 'Two-sided alternative',yaxs = 'i',xlab = 'z',ylab = '',lwd = 2,axes = 'F')
axis(1, at = c(-2.58, 0, 2.58),padj = 0.75,labels = c(-2.58, 0,2.58))
polygon(x = c(-4,seq(-4, -2.58, 0.01),-2.58),y = c(0,dnorm(seq(-4, -2.58, 0.01)),0), col = 'darkred')
polygon(x = c(2.58,seq(2.58, 4, 0.01),4),y = c(0,dnorm(seq(2.58, 4, 0.01)),0), col = 'darkred')
```

4) Consider the measurements made by four different laboratories A, B, C and D, of 4 samples; the results of the measurements are as shown in the table. Carry out the one-way ANOVA for the given table and indicate which one of the following options indicates the results of the ANOVA. *1 point*

Lab A	Lab B	Lab C	Lab D
0.25	0.18	0.19	0.23
0.30	0.23	0.24	0.28
0.31	0.24	0.25	0.24
0.28	0.16	0.19	0.21

```
Response: Al
           Df  Sum Sq    Mean Sq   F value  Pr(>F)
lab         3  0.015525  0.0051750  5.0694 0.01701 *
Residuals  12  0.012250  0.0010208
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
Response: Al
           Df   Sum Sq     Mean Sq    F value  Pr(>F)
lab         3   0.0015525 0.00051750 5.00694 0.001701 *
Residuals  12   0.0012250 0.00010208
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
Response: Al
           Df   Sum Sq  Mean Sq  F value  Pr(>F)
lab         2   863.33  431.67  2.6009  0.1152
Residuals  12   1991.60 165.97
```

```
Response: Al
           Df   Sum Sq    Mean Sq  F value  Pr(>F)
lab         2  863.0033  431.0067  2.06009  0.001152
Residuals  12  1991.006  165.0097
```

No, the answer is incorrect.
Score: 0
Accepted Answers:

```
Response: Al
           Df  Sum Sq    Mean Sq   F value  Pr(>F)
lab         3  0.015525  0.0051750  5.0694 0.01701 *
Residuals  12  0.012250  0.0010208
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

5) A research scholar in the MEMS department at IIT Bombay performed heat treatments on identical steel specimens in three different furnaces. Then, she carried out mechanical tests on these samples and found significant differences in the properties. Given this scenario, she wants to test the null hpothesis, namely, that all three furnaces are actually at the same temperature. So, she has made 5 readings of the temperatures from each of the furnaces, and the data collected is as given below:

Furnace	Temperature				
1	592.4	593.6	598.5	588.6	594.0
2	588.5	585.3	582.0	579.4	578.0
3	602.1	592.0	597.5	595.3	586.7

If she tests the hypothesis at 5 percent level of significance, she will accept the ______ hypothesis (Null / Alternative).

Hint

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: String) Alternative

1 point

6) The F-statistic value obtained from the ANOVA analysis of Question 5 is: *1 point*

- 10.204
- 0.002577
- 21.546
- 219.854

No, the answer is incorrect.
Score: 0
Accepted Answers:
10.204

7) The stress versus strain data of some steel is given in the file tensile.csv. Calculate the elastic modulus of this steel. *1 point*

Note: Select only the data points in the linear regime to get better goodness of fit or R-square.
The elastic modulus of this steel lies in the range of

- 70-80 GPa
- 94 -108 GPa
- 120-130 GPa
- 150-160 GPa

No, the answer is incorrect.
Score: 0
Accepted Answers:
94 -108 GPa

8) Consider the plot of the residuals for the fitting of the linear regime of the stress-strain data given in Question 7 above. What can you say about this plot? *1 point*

- The residuals are randomly distributed about -1.
- The residuals plot shows a non-random pattern.
- Majority of the residuals lie between -2 and 2
- The residuals are randomly distributed about +1.

No, the answer is incorrect.
Score: 0
Accepted Answers:
The residuals plot shows a non-random pattern.
Majority of the residuals lie between -2 and 2

9) The Clausius-Clapeyron relation in the case of a single component material in which one of the phases obeys ideal gas law is known to be given as $\frac{dP}{dT} = \frac{P\Delta H}{RT^2}$ *1 point*

where:
dP= change in pressure P, dT= change in temperature T, ΔH= change in enthalpy, R= universal gas constant

Let P_1 and P_2 be the pressures corresponding to the temperatures T_1 and T_2. Integrate the equation in these given limits: that is, $\int_{P_1}^{P_2} \frac{dP}{P} = \frac{\Delta H}{R} \int_{T_1}^{T_2} \frac{dT}{T^2}$

Can the resultant equation be transformed to be in linear form?

- Yes; and, the linear form is, $ln\left(\frac{P_2}{P_1}\right) = -\frac{\Delta H}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$
- Yes; and, the linear form is, $ln\left(\frac{P_2}{P_1}\right) = -\frac{\Delta H}{R} ln\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$
- Yes; and, the linear form is, $ln\left(\frac{P_2}{P_1}\right) = \frac{\Delta H}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$
- No; the integrated expression can not be transformed to be in linear form.

No, the answer is incorrect.
Score: 0
Accepted Answers:
Yes; and, the linear form is, $ln\left(\frac{P_2}{P_1}\right) = -\frac{\Delta H}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$

10) Consider the vapour pressure data as a function of temperature for a single component system given in the file vapourvstemp.csv. Take the reference temperature and pressure to be T_r and P_r respectively. Fit the given data to the following expression: $ln\left(\frac{P}{P_r}\right) = -\alpha\left(\frac{1}{T} - \frac{1}{T_r}\right)$ *1 point*

where α is a constant. The slope and the intercept for this fit is:

- slope = 4.029 and intercept = 5.349
- 4.029e-03 and intercept = 5.349e+03
- slope = 5.349e+03 and intercept = 4.029e-03
- slope = 5.349 and intercept = 4.029

No, the answer is incorrect.
Score: 0
Accepted Answers:
slope = 5.349e+03 and intercept = 4.029e-03