Engineering Measurements Assignment 7

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Problem 1

$\bar{x} = 50.4650$

$s = 0.9719$

$(1-\alpha)(100\%) = 95\%$

$N = 20$

$t_{95} = 2.093$

Matlab

>> t = tinv(0.975, 19)

t = 2.093

confidence interval

$\bar{x} - ts \leq x \leq \bar{x} + ts$

$50.4650 - 2.0930 \times 0.9719 \leq x \leq 50.4650 + 2.0930(0.9719)$

$48.43 \leq x \leq 52.50$

Problem 2

$\bar{x} = 50.465$

$s = 0.9719$

$(1-\alpha)\ 100 = 95\%$

$N = 20$

$t_{95} = 2.093$

Matlab

>> t = tinv(0.975, 19)

t = 2.093

$\bar{x} - t\frac{s}{\sqrt{N}} \leq \mu \leq \bar{x} + t\frac{s}{\sqrt{N}}$

$50.465 - 2.093\left(\frac{0.9719}{\sqrt{20}}\right) \leq \mu \leq 50.465 + 2.0930\left(\frac{0.9719}{\sqrt{20}}\right)$

$50.01 \leq \mu \leq 50.92$

Problem 3

$\bar{x} = 1492.2/9 = 165.8$

Standard deviation $= \sqrt{((x_i - \bar{x})^2/(n-1))}$

$= \sqrt{(544.1/9-1)} = 8.247$

Standard error $= 8.247/\sqrt{9} = 2.749$

$t = (\bar{x} - \mu)/(s/\sqrt{n})$

$= (165.8 - 170)/(8.247/\sqrt{9})$

$= -1.5278$

$t(\alpha, n-1) = t(0.05, 9-1) = 1.86$

$t > t(\alpha, n-1) = (-1.5278 < 1.86)$

$P(t > 1.5278) = 0.9715$

reject null hypothesis if P value $< \alpha = 0.05$

P-value $= 0.9175 > 0.05$ fail reject null hypothesis

Fails to reject null hypothesis

Problem 4

a) $x_i \in \{0, 1, 2, 3, 4\}$

$\bar{x} = \frac{4(15) + 3(26) + 2(39) + 15 + 0}{15 + 26 + 39 + 15 + 5} = \frac{231}{100} = 2.31$

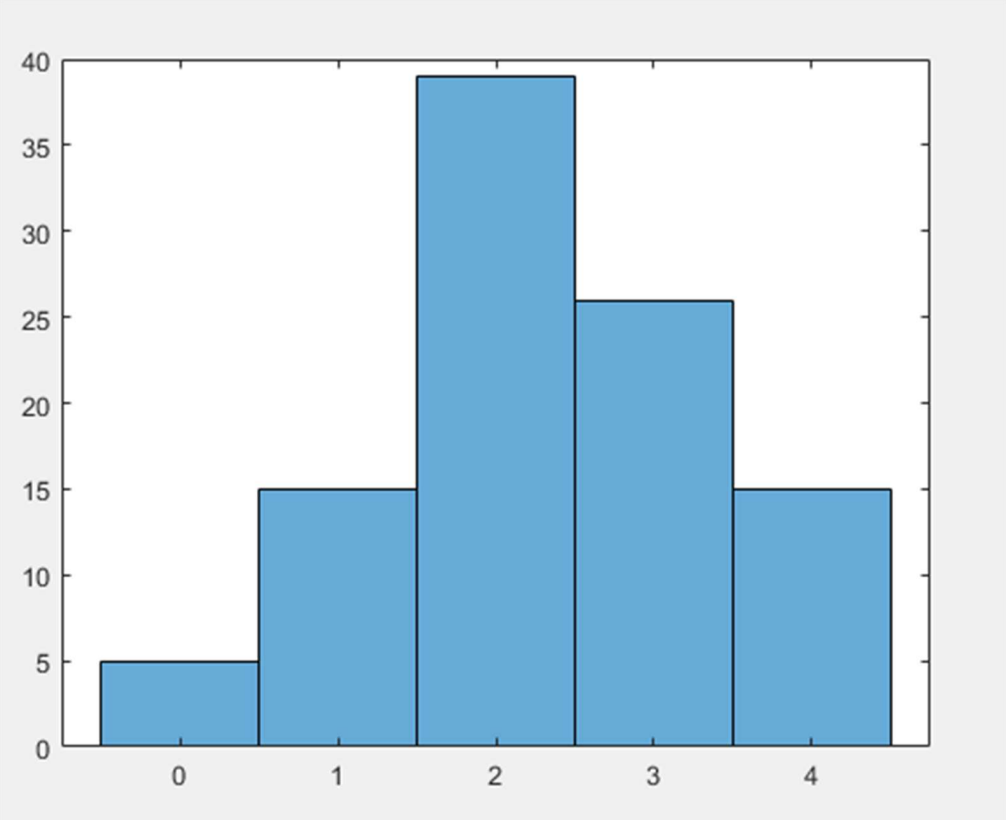
b) $\sum_{i=1}^{n} x_i^2 = (4)^2(15) + 3^2(21) + 2^2(39) + 15 + 0 = 645$

$s^2 = \frac{1}{N-1} \sum_{i=1}^{n} (x_i - \bar{x})^2 = \frac{1}{N-1} \left(\sum_{i=1}^{n} x_i^2 - N\bar{x}^2 \right)$

$= \frac{1}{100-1} (645 - 100 \times 2.312) = \frac{111.39}{99}$

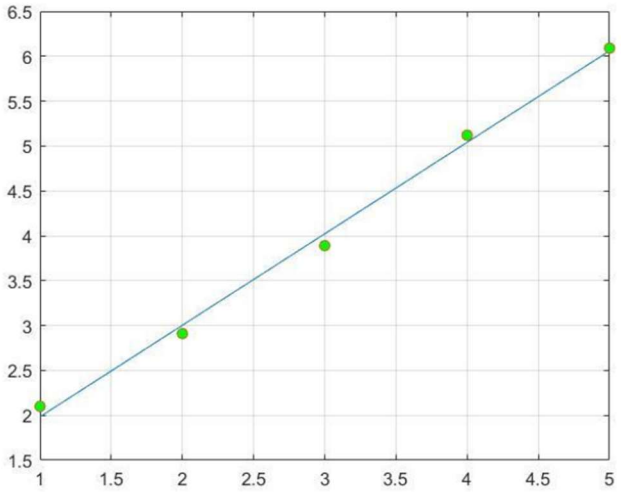
$= 1.125$

```
%%Assignment 7 Arjun Posarajah 104980541
%Question 4
A = 4*ones(1, 15);
B = 3*ones(1, 26);
C = 2*ones(1, 39);
D = 1*ones(1, 15);
F = 0*ones(1, 5);
grade = [A B C D F];
histogram(grade, [-0.5 0.5 1.5 2.5 3.5 4.5])
xticks([0, 1, 2, 3, 4])
```



Problem 5

```
%%Assignment 7 Arjun Posarajah 104980541
%Question 5
yr = coe(1) + coe(2)*x;
yr=1.98 2.949 3.9410 4.8790 5.544;
x = [1.00 2.00 3.00 4.00 5.00];
y = [2.10 2.91, 3.89 5.12, 6.09];
coe = polyfit(x, y, 1);
yr = coe(2) + coe(1)*x;
plot(x, yr, x, y, 'o', 'markerface', 'g');
grid on
```



Problem 5

$$S_{y\hat{x}} = \frac{\sum_{i=1}^{N} (y_i - y_{ei})^2}{v} \qquad v = N - (m+1)$$

$$= \frac{(2.10-1984)^2 + (2.91-3.003)^2 + (3.89-4.022)^2 + (5.12-5.041)^2 + (6.09-6}{5-2}$$

$$= \frac{(0.116^2) + (-0.093)^2 + (-0.132)^2 + (0.079)^2 + (0.03)^2}{3}$$

$$= \frac{0.0135 + 0.00865 + 0.0174 + 0.00624 + 0.009}{3} = 0.01556$$

$$S_{yx} = \sqrt{0.01556} = 0.125$$

Assignment 7

Problem 6

a) $\sum P_i = \frac{9}{16} + \frac{3}{16} + \frac{3}{16} + \frac{1}{16} = 1$

b) $\chi^2 = \sum_{i=1}^{n} \frac{(f_i - e_i)^2}{e_i}$

$$= \frac{\left(315 - \frac{9}{16}(556)\right)^2}{\frac{9}{16}(556)} + \frac{\left(108 - \frac{3}{16}(556)\right)^2}{\frac{9}{16}(556)} + \frac{(101 - 3/16\,(556))^2}{\frac{3}{16}(556)} + \frac{\left(32 - \frac{1}{16}(556)\right)^2}{\frac{9}{16}(556)}$$

$$= 0.47$$

matlab

$n = 4$

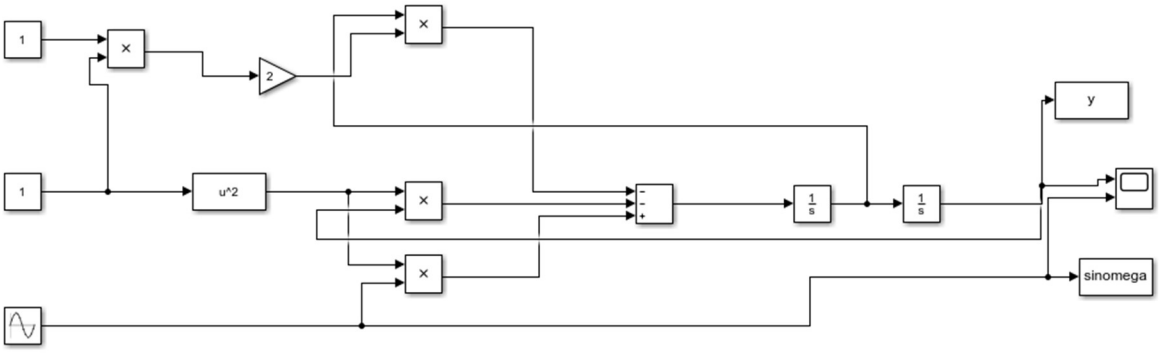
$\leftarrow = 0$

```
>> x = chi2inv(0.95, 4-0-1)
x = 7.8147
```

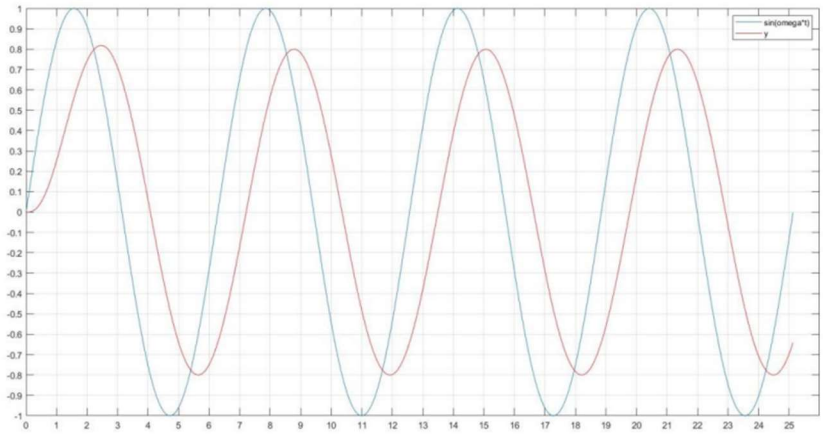
$0.47 < 7.81$

cannot reject null hypothesis

Problem 7



```
plot(tout, sinomega, tout, y, 'r')
grid on
xticks([0:1:8*pi])
yticks([-1:0.1:1])
legend('sin(omega*t)', 'y')
axis([0 26 -1 1])
```



Problem →

$$M(\omega) = \frac{1}{\sqrt{\left[1-(1/2)^2\right]^2 + (2\times 1\times \frac{1}{2})^2}} = 0.8$$

$$\phi(\omega) = -\tan^{-1}\left(\frac{-2\zeta\left(\frac{\omega}{\omega_n}\right)}{1-\left(\omega/\omega_n\right)^2}\right) = -\tan^{-1}\left(\frac{2(1)(1/2)}{1-(1/2)^2}\right) = -0.93$$