PROBLEM 1:

ASSIGNMENT 1

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PROBLEM 1

	Due to an increase in every salary by	
Change in	\$1000	5%
Mean	\$1000	5%
Median	\$1000	5%
Standard deviation	0	5%

Lets say we have n sample of starting salaries of graduating engineers.

$S_1, S_2, S_3, \dots S_n$

$$\text{Mean} = \frac{\text{sum of the terms}}{\text{number of terms}}$$

$$= \frac{\sum_{i=1}^{n} S_i}{n} \Rightarrow \frac{1}{n}\sum_{i=1}^{n} S_i$$

MEAN

Condition 1: (Mean calculation) → If each sample is increased by 1000

Then the n sample of graduating engineers will become

$S_1+1000, S_2+1000, S_3+1000 \dots S_n+1000$

Therefore change in mean will become $= \frac{S_1+1000+S_2+1000+S_3+1000 \dots S_n+1000}{n}$

$$\Rightarrow \frac{(S_1+S_2+S_3+S_4 \dots S_n)+(1000+1000+1000\dots 1000_n)}{n}$$

$$\Rightarrow \frac{(S_1+S_2+S_3+S_4 \dots S_n)+n(1000)}{n}$$

$$\Rightarrow \frac{(S_1+S_2+S_3+S_4 \dots S_n)}{n} + \frac{\cancel{n}(1000)}{\cancel{n}}$$

$$\Rightarrow \boxed{\frac{(S_1+S_2+S_3+S_4+\dots S_n)}{n} + 1000} \Rightarrow \text{change in mean condition 1}$$

Condition 2: If each sample is increased by 5% then Mean value

Original sample $S_1, S_2, S_3 \ldots S_n$ will change to

$$\left(S_1 + \frac{5}{100} \times S_1\right) + \left(S_2 + \frac{5}{100} \times S_2\right) + \left(S_3 + \frac{5}{100} \times S_3\right) + \ldots \ldots \left(S_n + \frac{5}{100} \times S_n\right)$$

$$\Rightarrow \frac{21S_1}{20} + \frac{21S_2}{20} + \frac{21S_3}{20} \ldots \ldots + \frac{21S_n}{20}$$

Therefore change in the sample is

$$\frac{\frac{21}{20}S_1 + \frac{21}{20}S_2 + \frac{21}{20}S_3 \ldots \ldots + \frac{21}{20}S_n}{n}$$

$$\Rightarrow \frac{21}{20} \frac{(S_1 + S_2 + S_3 \ldots \ldots + S_n)}{n}$$

$$\Rightarrow \frac{1.05\,(S_1 + S_2 + S_3 \ldots \ldots + S_n)}{n}$$

Therefore ~~the change in~~ the mean when there is 5% increase in salary is $\boxed{1.05\left(\frac{1}{n}\sum_{i=1}^{n} s_i\right)}$

Therefore the change in the mean is

$$1.05\left(\frac{1}{n}\sum_{i=1}^{n} s_i\right) - \left(\frac{1}{n}\sum_{i=1}^{n} s_i\right) \Rightarrow 0.05\left(\frac{1}{n}\sum_{i=1}^{n} s_i\right)$$

$$= 0.05\left(\frac{1}{n}\sum_{i=1}^{n} s_i\right)$$

MEDIAN

Condition 1: (~~Median~~ Median Calculation) → if each sample is increased by 1000

Then the n sample of graduating engineers will become

$S_1+1000, S_2+1000, S_3+1000, \ldots S_n+1000$

Here we need to consider 2 cases when n is odd and when n is even

i) When n is odd median is equal to

$$\text{Median} = \left(\frac{n+1}{2}\right)^{th} \text{observation}$$

ii) when n is even median is equal to

$$\text{Median} = \frac{1}{2}\left[\left(\frac{n}{2}\right)^{th} \text{observation} + \left(\frac{n}{2}+1\right)^{th} \text{observation}\right]$$

⇒ when n is odd the change in median will be

$$\boxed{S_{\left(\frac{n+1}{2}\right)} + 1000}$$

when n is even the change in median will be

$$\frac{1}{2}\left[S_{(n/2)} + 1000 + S_{\left(\frac{n}{2}+1\right)} + 1000\right]$$

$$= \frac{1}{2}\left[S_{(n/2)} + S_{(n/2+1)} + 2000\right]$$

$$= \frac{1}{2}\left[S_{(n/2)} + S_{(n/2+1)}\right] + \frac{2000}{2}$$

$$\boxed{= \frac{1}{2}\left[S_{(n/2)} + S_{(n/2+1)}\right] + 1000}$$

Therefore the increase in median when the sample is increased by 1000 is 1000

Condition 2: (Median calculation) if each sample increased by 5% ~~p~~

original sample $S_1, S_2, S_3 \ldots S_n$

change in sample $\Rightarrow \left(S_1 + \frac{5}{100}S_1\right) + \left(S_2 + \frac{5}{100}S_2\right) + \left(S_3 + \frac{5}{100}S_3\right) + \ldots \left(S_n + \frac{5}{100}S_n\right)$

$$\Rightarrow \frac{21S_1}{20} + \frac{21S_2}{20} + \frac{21S_3}{20} \ldots + \frac{21S_n}{20}$$

when n is odd the median will become

$$\frac{21}{20} S_{\frac{(n+1)}{2}} \Rightarrow 1.05\, S_{\frac{(n+1)}{2}}$$

when n is even then median will become

$$\text{Median} = \frac{1}{2}\left[S_{(n/2)} + S_{(\frac{n}{2}+1)}\right]$$

$$\Rightarrow \frac{1}{2}\left[\frac{21}{20} S_{(n/2)} + \frac{21}{20} S_{(\frac{n}{2}+1)}\right]$$

$$\boxed{\Rightarrow \frac{21}{40}\left[S_{(n/2)} + S_{(n/2+1)}\right]}$$

Therefore the change in median when n is odd $\Rightarrow$

$$1.05\, S_{\frac{(n+1)}{2}} - S_{\frac{(n+1)}{2}} = 0.05\, S_{\frac{(n+1)}{2}}$$

The change in median when n is even =

$$\frac{21}{40}\left[S_{(n/2)} + S_{(n/2+1)}\right] - \frac{1}{2}\left[S_{(n/2)} + S_{(n/2+1)}\right]$$

$$\frac{21}{20} \times \frac{1}{2}\left[S_{(n/2)} + S_{(n/2+1)}\right] - \frac{1}{2}\left[S_{(n/2)} + S_{(n/2+1)}\right]$$

$$\Rightarrow 0.05\left[\frac{1}{2}\left[S_{(n/2)} + S_{(n/2+1)}\right]\right]$$

~~Condition 3 (Standard deviation).~~

STANDARD DEVIATION:

Condition 1: If each sample is increased by 1000

Standard deviation = $\sqrt{\dfrac{\Sigma(x_i-\mu)^2}{N}}$

σ = standard deviation
N = the size of the sample
x_i = each value from the sample
μ = the mean

$$\sigma_1 = \sqrt{\frac{\Sigma(x_1-\mu)^2}{N}}$$

if each value is increased by 1000

$$\sqrt{\frac{\Sigma((x_1+1000)-(\mu+1000))^2}{N}}$$

$$\Rightarrow \sqrt{\frac{\Sigma(x_i-\mu)^2}{N}}$$

Condition 2: if each sample is increased by 5%

$$\sigma = \sqrt{\frac{\Sigma(x_i-\mu)^2}{N}}$$

$$\sigma = \sqrt{\frac{\Sigma\left(x_i\left(\frac{21}{20}\right)-\mu\left(\frac{21}{20}\right)\right)^2}{N}}$$

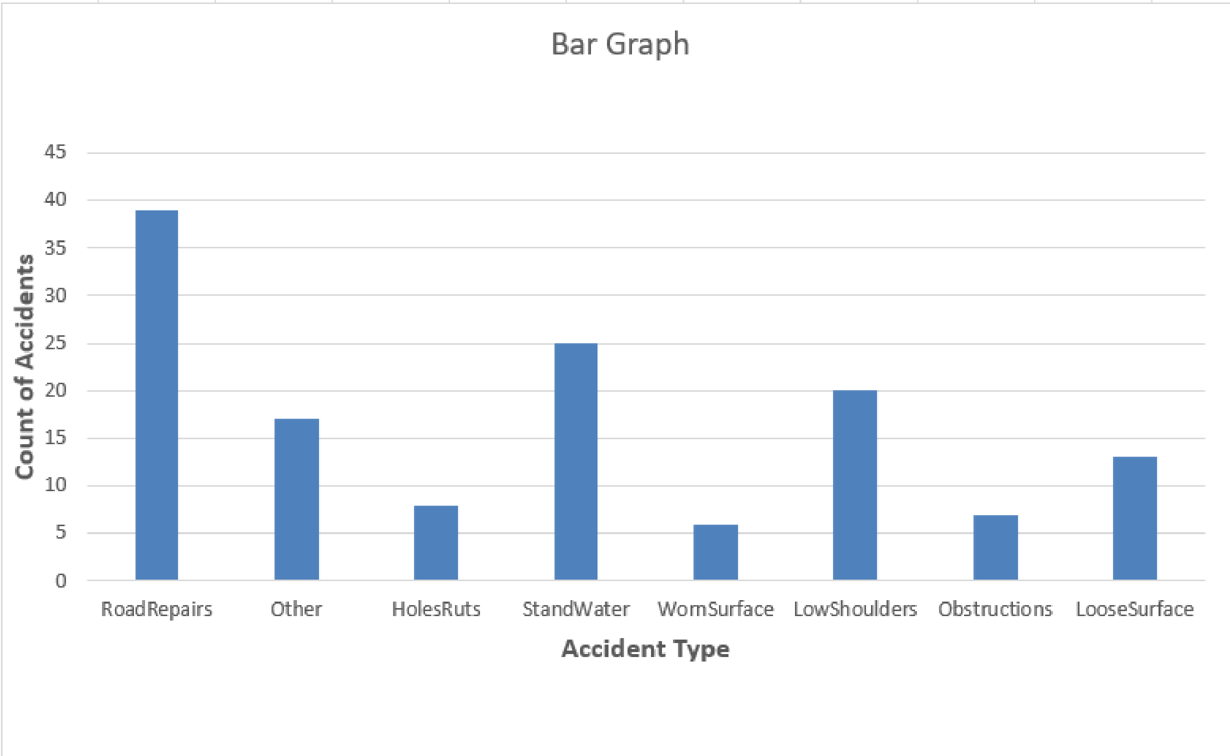
$$\sigma = \frac{21}{20}\sqrt{\frac{\Sigma(x_i-\mu)^2}{N}}$$

$\therefore$ The change in standard deviation $= \left(\frac{21}{20}-1\right)\left(\sqrt{\frac{\Sigma(x_i-\mu)^2}{N}}\right)$

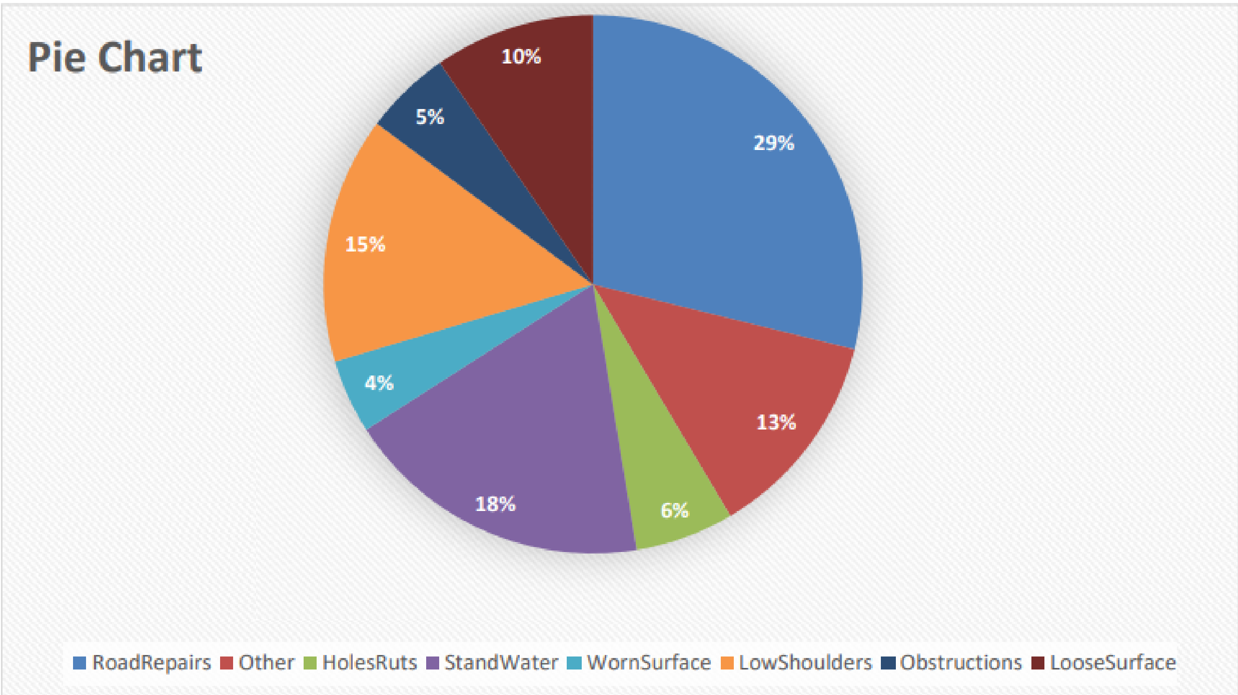
$$= 0.05\left(\sqrt{\frac{\Sigma(x_i-\mu)^2}{N}}\right)$$

PROBLEM 2:

a.
Bar graph:



b.
Pie chart:



c) Bar graph is for absolute values and piechart is for relative percentage

PROBLEM 3:

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a. The time required to produce each tire on an assembly line

ans. Ratio

b. The number of quarts of milk a family drinks in a month

ans. Ratio

c. The ranking - - - and poor

ans. ordinal

d. The telephone . . . in the US

ans. Nominal

e. The age - - - employees

ans. Interval

f. The dollar sales - - - shop each month

ans. Interval

g. An employee : - - number

ans. Nominal

h. The response time. - - unit

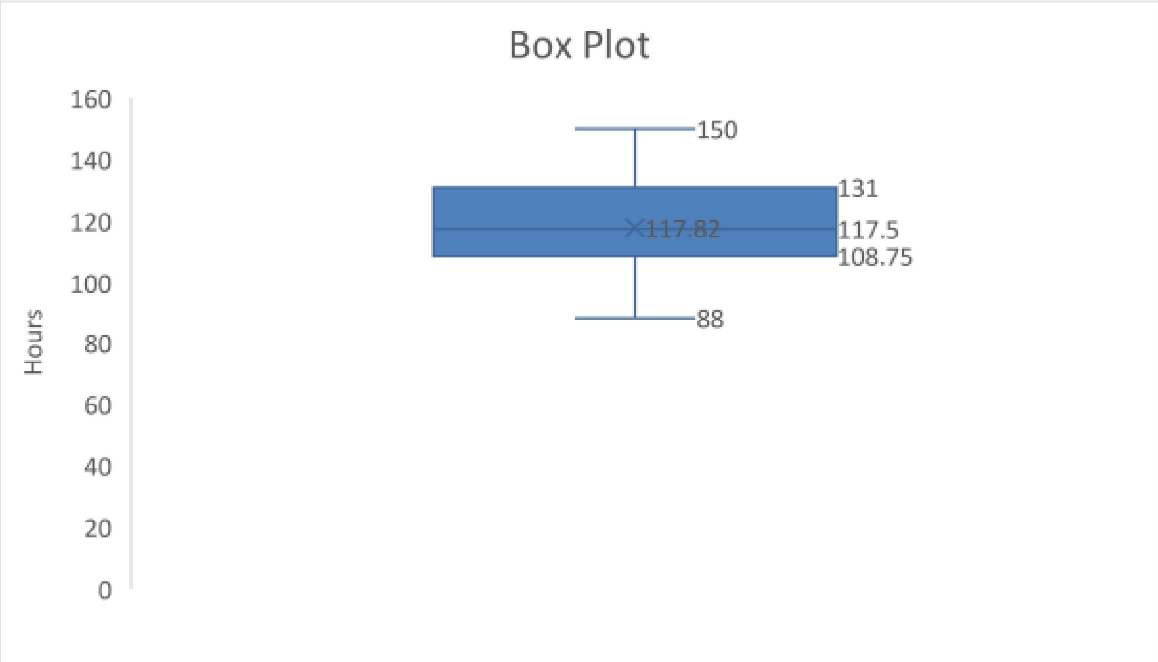
ans. Interval

PROBLEM 4:

a. Mean - 117.82
Median - 117.5
Mode - 128
The data exhibits a left-skewed distribution, indicated by the fact that the mode is larger than both the mean and the median.

b. Max - 150
Min - 88
Range - 62
Variance - 225.3343
SD - 15.01114

c.



d. 70th Percentile - 128 - this is done by using percentile function

PROBLEM 5:

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a) The figure potray quantitative data.

b) The type of graphical method being used to describe the data is a histogram.

c) To estimate the proportion of rods with diameters 1.0025 and 1.0045 centimeters we can do it by estimating the total frequency of rods within these bars and devide it by the total number of rods (500) to get the proportion.

$$\frac{80+70}{10+30+75+70+95+80+70+40+20+10}$$

$$\Rightarrow \frac{150}{500} = 0.3$$

d) Yes, there is an evidence to support this claim. Looking at the graph we can say that the reading present for 0.999 is not present and the 1.000 measurement is more than 1.001 therefore it is clearly be seen that 0.999 rods are added to 1.000. which depicts that its (below) lower specification limit which is 0.999.

PROBLEM 6:

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Let the set of observations be $x_1, x_2, x_3 \dots x_n$

Mean of above set of observations $= \frac{x_1+x_2+x_3+\dots x_n}{n}$

Given formula $= \sum_{i=1}^{n} (x_i - \bar{x})$

$\Rightarrow (x_1-\bar{x})+(x_2-\bar{x})+\dots+(x_n-\bar{x})$

$\Rightarrow (x_1+x_2+\dots x_n) - n(\bar{x})$

$\Rightarrow (n)\bar{x} - n(\bar{x})$

$= 0$

Therefore it is proved that for any sample $x_1, x_2, x_3 \dots x_n$ the given formula for the measure of dispersion will be zero. Hence this formula cannot be used to measure the dispersion in the data.