Descriptive Statistics
Unit - 3

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2M

1) what is a statistics? Mention its types
statistics is the science, or a branch of mathematics that involves collecting, classifying, analyzing, interpreting, and presenting numerical facts & data
i) descriptive statistics ii) Inferential statistics

2) compare Descriptive statistics & Inferential statistics
• Descriptive statistics is used to summarize & describe the data. where as population statistics make a prediction about a population based on a sample data

3) what are the 4 types of data & measurement scale
a) Nominal b) ordinal c) Interval d) Ratio

4) what are nominal & ordinal data? Give ex
nominal: Nominal scales are used for labeling varia-bles, without any quantitative value.
ex: blood type, eye color, gender
ordinal: it is used to rank or order objects.
ex: education level (highschool, puc, BS, MS, phd)

5) what are interval & ratio data? Give ex
Interval: interval scales are numeric scales in which we know both the order & exact difference b/w the values.
ex: Celsius temperature bcz diff b/w each value is same
ratio: ratio have the same properties as interval data, but ratio have an absolute zero, & the ratio of 2 numbers is meaningful.
ex: ratio data are height, weight, time, volume

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6) Define Measure of central Tendency. list its types
It yields information about the center, or middle part, of a group of numbers
1) Mode 2) Median 3) Mean

7) Define mode. Determine the mode for the following numbers
2 4 8 4 6 2 7 8 4 3 8 9 4 3 5
mode is a most frequently occuring value in a set of data.
2 2 3 3 4 4 4 4 5 6 7 8 8 8 9
mode: 4

9) 8) a) Define median
median is the middle value in an ordered array of numbers.
b) write the steps to calculate Median
Step 1: Arrange the observations in an ordered data array.
Step 2: For an odd number of terms, find the middle term of the ordered array. It is the medium.
Median $= \{(n+1)/2\}^{th}$ term
Step 3: For an even number of terms, find the avg of middle two terms. This avg is the medium.
median $= [(n/2)^{th} \text{ term} + \{(n/2)+1\}^{th}]/2$
c) Determine the median
2 4 8 4 6 2 7 8 4 3 8 9 4 3 5
2, 2 3 3 4 4 4 4 5 6 7 8 8 8 9
$n = 15$
median $= \frac{(n+1)}{2}$
$= 16/2 = 8^{th}$ location $= 4$

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10) Determine mode & median for
213 345 609 073 167 243 444 524 199 682
Mode: There is no repeating numbers. so the mode is not applicable
Median:
073 167 199 213 243 345 444 524 609 682
Median $= \frac{243+345}{2} = 294$

11) Compute the mean for the following numbers
17.3 44.5 31.6 40.0 52.8 38.8 30.1 78.5
$\mu = \frac{\Sigma x}{N} = \frac{17.3+44.5+31.6+40.0+52.8+38.8+30.1+78.5}{8}$
$= 41.7$

12) Define Percentiles. Write the steps to calculate location of percentile.
percentiles are measures of central tendency that divide a gap of data into 100 parts.
Steps
1) Organize the numbers into an ascending-order array.
2) Calculate the percentile location (i) by:
$i = \frac{P}{100}(N)$ where p = the percentile of interest
i = percentile location
N = number in the data set
3) determine the location by either (a) or (b)
a) if i is a whole number, the p^{th} percentile is the avg of the value at the i^{th} location & the value at the $(i+1)^{th}$ location
b) if i is not a whole number, the p^{th} percentile value is located at the whole number part of i+1.

13) What is Quartile? Determine Q3 for

14 12 19 23 5 13 28 17

Quartile are measures of central tendency that divide a grp of data int four subgrps or parts. The 3 quartiles are denoted as Q1, Q2, Q3

Q3 = 75

N = 8 $i = \frac{75}{100}(8)$

= 6th location → i is whole num

P_{75} is found as avg of 6th & 7th term

5 12 13 14 17 19 23 28 = $\frac{19+23}{2}$ = $\underline{21}$

14) determine 30th percentile of the following 8 numbers: 14, 12, 19, 23, 5, 13, 28, 17

P = 30   N = 8

$i = \frac{30}{100}(8) = 2.4$ → odd num

5 12 13 14 17 19 23 28

(2.4+1) = 3rd location

= $\underline{13}$

15) Define range. write the range of following num

it is difference b/w the largest value of a data set and smallest value of a set

16 28 29 13 17 20 11 34 32 27 25

30 19 18 33

11 13 16 17 18 19 20 25 27 28 29 30 32 33

34

= 34 − 11 = $\underline{23}$

16) Define Interquartile Range. write its formula

it is the range of values b/w the first & 3rd quartile.

$IQR = Q_3 - Q_1$

19) Define standard Deviation. write its formulae.

it is a spread of a grp of numbers from the mean. standard deviation is the square root of the variance

population standard deviation: $\sigma = \sqrt{\frac{\Sigma(x-\mu)^2}{N}}$

Sample SD: $s = \sqrt{\frac{\Sigma(x-\bar{x})^2}{n-1}}$

17) Define mean Absolute Deviation. write its formulae

The MAD is the avg of absolute values of the deviations around the mean for a set of numbers.

$MAD = \frac{\Sigma|x-\mu|}{N}$

18) Define variance. write its formulae.

variance is the avg of the squared deviations about the arithmetic mean for a set of members.

population variance = $\sigma^2 = \frac{\Sigma(x-\mu)^2}{N}$

sample variance = $\sigma^2 = \frac{\Sigma(x-\bar{x})^2}{N-1}$

20) write the formulae of sample variance ~~Q18~~ & sample SD

Sample variance = $\sigma^2 = \frac{\Sigma(x-\bar{x})^2}{N-1}$

Sample SD = $s = \sqrt{\frac{\Sigma(x-\bar{x})^2}{n-1}}$

21) Define z score, write its formula.

it gives you an idea of how far from the mean a data point is

$$Z = \frac{(x - \mu)}{\sigma} \rightarrow \text{population}$$

$$Z = \frac{(x_i - \bar{x})}{s} \rightarrow \text{sample}$$

22) State Empirical Rule. list the condition

it is an important rule of thumb that is used to state the approximate percentage of value that lie within a given num of SD from the mean of a set of data if the data are normally distributed.

rate: Distance from the mean	values within Distance
$\mu \pm 1\sigma$	68%
$\mu \pm 2\sigma$	95%
$\mu \pm 3\sigma$	99.7%

23. Define Coefficient of variation. write its formula.

it is a statistic that is the ratio of the standard deviation to the mean expressed in percentage, and is denoted Cv.

$$Cv = \frac{\sigma}{\mu}(100)$$

~~33~~)

long

1) explain 4 Types of data & measurement scale with ex:

2M) refer 4 & 5th question

1) Nominal:
- the data can only be categorized
- it is the lowest level of data measurement

2) ordinal:
- the data can be categorized & ranked.
- it is higher than the nominal level.

3) Interval:
- the data can be categorized, ranked & evenly spaced.

4) Ratio:
- the data can be categorized, ranked, evenly spaced & has a natural zero.
- highest level of data measurement

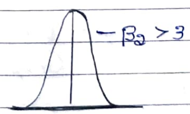
2.) Explain kurtosis types with diagram

2m-29) kurtosis is a numerical method in statistic that measures the sharpness of the peak, in the data distribution.

Types:

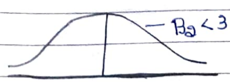
1) leptokurtic distribution:

distributions that are high & thin.



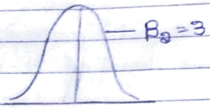
2) platykurtic distribution:

distributions that are flat & spread out



3) Mesokurtic distribution

Between these two types are distributions that are more "normal" in shape.



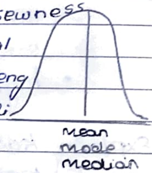
3) Explain measure of skewness with its type

Skewness is a statistical measure, that describe the assymetry of a probability distribution

Types:

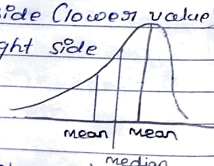
1) Zero skewness

• A distribution is zero skewness when it is perfectly symmetrical with both tails being of equal length. & mean, mode, median coinciding at the center.



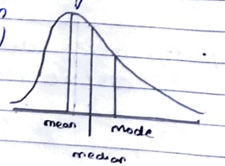
2) Negative skewness (left skewed)

• when the tail of left side (lower value) is longer or fatter than right side (higher value).



3) Positive skewness (right skewed)

• the tail of right side (higher value) is longer or fatter than left side (lower value)



4) The number of U.S cars in service by top car rental companies in a recent year according to Auto Rental News follows. Compute mode, the median, and the mean.

Company	Number of cars in serv
enterprise	643,000
Hertz	327,000
National/Almo	233,000
Avis	204,000
Dollar	167,000
Budget	144,000
Advantage	20,000
U-Save	12,000
payless	10,000
ACE	9,000
Fox	9,000
Rent-A-work	7,000
Triangle	6,000

⇒ Mode : 9000 → repeated 2 times

Median = $\frac{(n+1)}{2} = \frac{(13+1)}{2} = 7^{th}$ position $= 20,000$

Mean = $\mu = \frac{\Sigma x}{N} = \frac{1,791,000}{13} = 137,769.23$

5) compute the 25th percentile, the 55th percentile, Q1, Q2, and Q3

16 28 29 13 17 20 11 34 32 27 25 30 19 18 33

⇒ 11 13 16 17 18 19 20 25 27 28 29 30 31 32 33 34

i) P = 35 P = 15 $i = \frac{P}{100}(N) \Rightarrow \frac{35}{100}(15) \Rightarrow 5.25$

5.25 is not a whole number

$= 5.25 + 1 = 6^{th}$ location

$= 19$

ii) p = 55   i = 15 $i = \frac{P}{100}(N) \Rightarrow \frac{55}{100}(15) \Rightarrow 8.25$

8.25 is not a whole ∴ 8.25 + 1 = 9th location

27

iii) $Q_1 = \frac{25}{100}(15) \Rightarrow 3.75 + 1 \Rightarrow 4^{th}$ location = 17

iv) $Q_2 = \frac{50}{100}(15) \Rightarrow 7.5 + 1 \Rightarrow 8^{th}$ location = 25

v) $Q_3 = \frac{75}{100}(15) \Rightarrow 11.25 + 1 \Rightarrow 12^{th}$ location = 30

6) The following shows the top 16 global marketing categories for advertising spending for a recent year according to advertising Age. spending is given in millions of U.S. dollars. determine the 1st, 2nd & 3rd quartile for the data

category	Ad spending
Automotive	\$22,195
personal care	19,526
entertainment	9,538
Food	7,793
Drug	7,707
electronics	4023
soft drinks	3916
retail	3576
cleaners	3571
Re	3553
com	3247
tele	2488
fin	2433
Bees	2050
Candy	1137
Toys	699

⇒ N = 16

i) $Q_1 = 25$

$i = \frac{25}{100}(16) \Rightarrow 4$ whole num ∴ add 4th & 5th term

$\frac{(4+5)^{th} \text{ term}}{2} = \frac{2433 + 2488}{2} = 2460.5$

ii) $Q_2 = 50$

$i = \frac{50}{100}(16) \Rightarrow \frac{3571 + 3576}{2} = 3573.5$

iii) $Q_3 = 75$

$i = \frac{75}{100}(16) \Rightarrow \frac{7707 + 7793}{2} = 7750$

7) 6 2 4 9 1 3 5

a) Find range

range = 9 − 1 = 8

b) Find the mean absolute deviation

x	$x - \mu$	$(x-\mu)^2$	$\lvert x-\mu \rvert$
1	−3.28	10.75	3.28
2	−2.28	5.19	2.28
3	−1.28	1.63	1.28
4	−0.28	0.07	0.28
5	0.72	0.52	0.72
6	1.72	2.95	1.72
9	4.72	22.2	4.72
		43.3	14.28

$\mu = \frac{\Sigma x}{N} = \frac{30}{7} = 4.28$

$MAD = \frac{\Sigma |x - \mu|}{N} = \frac{14.28}{7} = 2.04$

8) 4 3 0 5 2 9 4 5

Same as 7

c) Find the population variance

$$\sigma^2 = \frac{\Sigma(x-\mu)^2}{N} = \frac{43.3}{7} = \underline{6.18}$$

d) Find the population standard deviation

$$\sigma = \sqrt{\frac{\Sigma(x-\mu)^2}{N}} = \sqrt{\frac{43.3}{7}} = \sqrt{6.18} = \underline{2.48}$$

e) Find the interquartile range.

1 2 3 4 5 6 9

$Q1 = 25$ $n = 7$

$i = \frac{25}{100}(7) = 1.75 + 1 = 2^{nd}$ pos $= \underline{2}$

$Q3 = 75$

$i = \frac{75}{100}(7) = 5.25 + 1 = 6^{th}$ pos $= \underline{6}$

$IQR = 6 - 2 = \underline{4}$

f) Find the zscore for each value.

$z = \frac{x-\mu}{\sigma}$ $\sigma = 2.48$

$x_i - \mu$	z
-3.28	-3.28/2.48 = -1.32
-2.28	-0.91
-1.28	-0.51
-0.28	-0.11
0.72	0.29
1.72	0.69
4.72	1.90

g) calculate coefficient of variation

$$CV = \frac{\sigma}{\mu}(100)$$

$$= \frac{2.48}{4.28}(100) \Rightarrow \underline{57.94}$$

9) Shown here is a sample of 6 of the largest accounting firms in the US and the no of partners associated with each firm as reported by the public Accounting Report. Calculate Sample variance & Sample standard deviation

Firm	Number of partners
Deloitte & Touche	2654
Ernst & Young	2108
Pricewater	2069
KPMG	1664
RSM	720
Grant	309

x	$(x-\bar{x})$	$(x-\bar{x})^2$
2654	1066.67	1137784.88
2108	520.67	271097.24
2069	481.67	232,005.98
1664	76.67	5878.28
720	-867.33	752261.32
309	-1278.33	1634127.58
		4033155.28

$N = 6$

$$\bar{x} = \frac{\Sigma x_i}{N} = \frac{9524}{6} = 1587.33$$

Sample variance

$$s^2 = \frac{\Sigma(x-\bar{x})^2}{N-1} = \frac{4033155.28}{5} = \underline{806631.056}$$

Sample SD

$$s = \sqrt{\frac{\Sigma(x-\bar{x})^2}{N-1}} = \sqrt{806631.056} = \underline{898.12}$$

10) Use your calculator or comp find population variance & population sd

x	$x-\mu$	$(x-\mu)^2$
123	-307.37	94476.31
392	-38.37	1472.25
572	141.63	20059.05
303	-127.37	16223.11
090	-340.37	115851.73
280	-150.37	22611.13
953	522.63	273142.11
468	37.63	1416.01
546	115.63	13370.29
179	-251.37	63186.87
749	318.63	101525.07
531	100.63	10126.39
378	-52.37	2742.61
601	170.625	29111.18
075	355.37	126287.83
646	215.63	46496.29

$\mu = \frac{\Sigma x}{N} = \frac{6886}{16} = 430.375$ 938098.23

Same as 7th q - c & d

11) On a certain day the avg closing price of a grp of stocks on the New York Stock exchange is \$35 (to the nearest dollar) if the median value is \$33 and the mode is \$21, is the distribution of these stock skewed? if so, how?

Yes, based on the information provided, it suggests that the distribution of these stock prices is likely positively skewed. (or right skewed)

bcz 1) The mean (avg) closing price is higher than both the median and the mode

2) In +vely skewed distribution, the mean is typically greater than the median

12) A local offers ball room dancing on friday nights. A researcher observes the customers and estimates their ages. Discuss the skewness of the distribution of ages if the mean age is 51, the median age is 54, and the mode age is 59.

The distribution of ages appears -vely skewed. Since the mean (51) is less than the median (54), and the median is less than the mode (59).

This indicates that there are more younger individuals pulling the distribution to the left.

13) Suppose the following data are the ages of Internet users obtained from a sample. Use these data to compute a Pearsonian coefficient of skewness. What is the meaning of the coefficient?

41	15	31	25	24
23	21	22	22	18
30	20	19	19	16
23	27	38	34	24
19	20	29	17	23

formula $= \frac{3(\bar{x}-M)}{\sigma}$

$\bar{x} = \frac{\Sigma x}{n} = \frac{600}{25} = 24$

M = Median: 15 16 17 18 19 19 19 20 20 21 22 22 23 23 23 24 24 25 27 29 30 31 34 38 41

$\frac{n+1}{2} = \frac{25+1}{2} = \frac{26}{2} = 13^{th}$ location = 23

14) Construct a box-and-wisker plot on the following data. Do the data contain any outliers? Is the distribution of data skewed?

540	690	623	559	558	590	588	580
379	527	570	477	495	490	602	497
510	601	503	495	574	562	609	541

=>

379	477	490	495	495	497	503	510
527	540	541	558	559	562	570	574
580	588	590	601	602	609	623	690

$Q_1 = 25$ $\quad i = \frac{25}{100}(24) = 6 \quad = \frac{(6+7)^{th}}{2}$ term

$= \frac{497+503}{2} = \underline{500}$

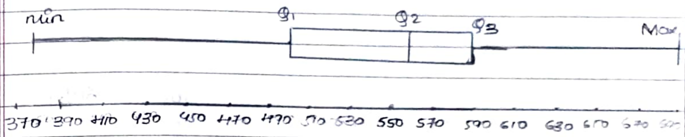
$Q_2 = 50$ $\quad N = 24$ $\quad i = \frac{50}{100}(24) = 12 \Rightarrow \frac{(12+13)^{th}}{2}$ term

$\Rightarrow \frac{558+559}{2} = \underline{558.5}$

$Q_3 = 75$ $\quad i = \frac{75}{100}(24) = 18 \Rightarrow (18+19)$ term

$= \frac{588+590}{2} = 589$

max = 690 $\quad$ min = 379



a) To check the outliers, we can calculate the IQR and identify any datapoints outside the range.

doubt

- $IQR = Q_3 - Q_1 \Rightarrow 589 - 500 \Rightarrow 89$.
- lower bound: $Q_1 - 1.5 * IQR$

  $500 - 1.5 * 89 = \underline{366.5}$
- Upper bound: $Q_3 + 1.5 * IQR$

  $589 + 1.5 * 89 = 722.5$

conclusion: no, since there are no values below 366.5 & above 722.5.

b) • Distribution of data is left skewness (Negatively skewed), bcz the Median (Q_2) is closer to Q_3.

• The left whisker is longer than the right whisker.

15) Shown here is a list of the top five industrial and farm equipment companies in the United States, along with their annual sales ($ million). Construct a pie chart & a bar graph to represent these data, and label the slices with the approximate percentages.

Firm	Revenue ($ million)
Catterpillar	30,251
Deere	19,986
Illinois Tool Works	11,731
Eaton	9,817
American Standard	9,509

a) pie chart

	Firm	Revenue($)	Proportion	degree
a)	Caterpillar	30251	0.372 (37.2)	133.92
b)	Deere	19986	0.246	88.56
c)	Illinois T W	11731	0.144	51.84
d)	Eaton	9817	0.121	43.56
e)	American st	9509	0.117	42.12
		81294	1.000	360

proportion = $\frac{30851}{81294} = 0.372$

degree = 0.372X360° = 133.92

- To construct a pie chart

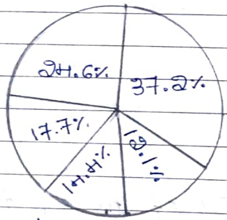
proportion*100 => 0.372*100 = 37.2%

0.246*100 = 24.6%

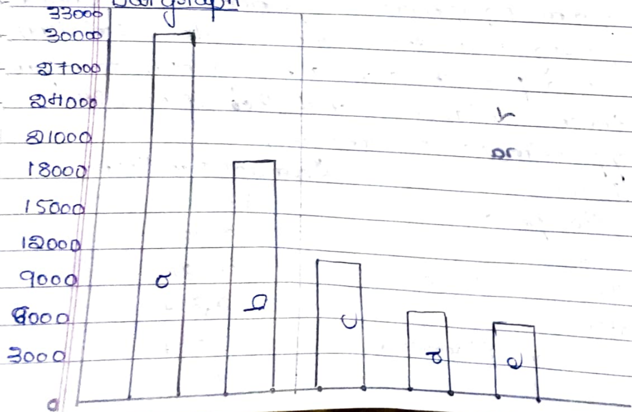
0.144*100 = 14.4%

0.121*100 = 12.1%

0.117*100 = 17.7 %



b) Bar graph



16) The following list shows the top 6 pharmaceutical company. construct pie & bargraph.

phar	Sales
Phizer	52,921
John & Johnson	47,348
Mer	22,939
Bristol	21,886
Abbot	20,473
Wyeth	17,353

Same as 15th question

17) The following data represent the costs (in dollars) of a sample 30 postal mailings by a company

3.67	5.10	9.15	5.11	3.32	2.09
1.83	2.75	1.93	3.89	7.20	2.78
6.72	7.80	5.47	4.15	3.55	3.53
3.34	4.95	5.42	8.64	4.84	4.10
10.94	6.45	4.65	1.97	2.84	3.21

=>

Stem	leaf						
1	83	93	97				
2	09	75	78	84			
3	21	32	34	53	55	67	89
4	10	15	65	84	95		
5	10	11	42	47			
6	45	72					
7	20	80					
8	64						
9	15						
10	94						

24) 329 define stem & leaf plot.

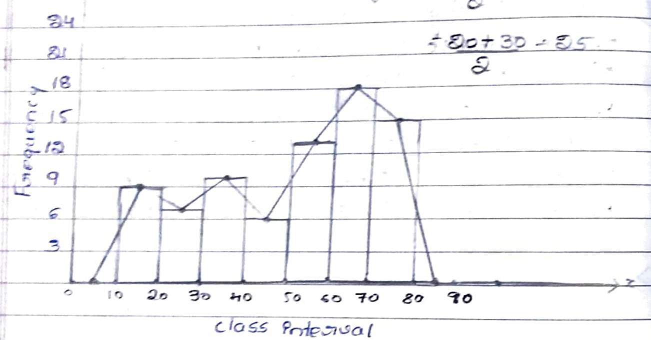
A stem & leaf plot is constructed by separating the digits ~~form~~ for each number of the data into two grps, a stem & leaf. left most digit is stem & rightmost is leaf contains lower value

18) construct a histogram and a frequency polygon

Class Interval	Frequency
10 - under 20	9
20 - under 30	7
30 - under 40	10
40 - under 50	6
50 - under 60	13
60 - under 70	18
70 - under 80	15

For polygon = $\frac{10+20}{2} = 15$

$\frac{20+30}{2} = 25$



19)

Class Interval	Frequency
30 under 32	5
32 under 34	7
34 under 36	15
36 under 38	21
38 under 40	34
40 under 42	24
42 under 44	17
44 under 46	8

construct a histogram and a frequency polygon ; Same as 18)Q

20) Construct the stem and leaf plot using 2 digits for stem

212 239 240 222 249 265 224

etc....

Consider 2 digit as stem and remaining 1 digit as leaf.

Same as 17 Q.	stem	leaf
	21	2

Probability

33) what is probability? Mention its types

probability is a numerical measure of chance of occurence of an event

Types: 1) classical probability
2) empirical-probability
3) subjective probability

34) what is a experiment give ex

it is a process that produce outcome

ex: Rolling a die and observing outcomes

event: it is an outcome of an experiment

ex: experiment is rolling a die

event is the roll a number 5

21) long: Explain general Methods of assigning probabilities with ex

1) the classical Method
2) the relative frequency of occurance method
3) Subjective probability

25-2M : what is the classical method of assigning probability. Give ex.

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classical method:
when probabilities are assigned based on laws and rules, the method is called classical method.

Formula: $P(E) = Ne/N$

N: total no of possible outcomes of an experiment.

Ne: the no of outcomes in which the event occurs out of N outcomes.

ex: A die is rolled, find the probability that even no is obtained.

$S = \{1,2,3,4,5,6\}$ $E = \{2,4,6\}$

$P(E) = N(E)/S(E) \Rightarrow 3/6 \Rightarrow 1/2$

36-2M) what is relative frequency of occurance method assigning of a probability. Give ex.

relative: it is based on cumulated historical data.

Formula:

$$\text{prob} = \frac{\text{Number of Times an Event Occured}}{\text{total no of opportunities for the event to occur}}$$

ex: A Jar contains 4 red marble & 10 white marble. if the marble is drawn from the jar is white. what is the probability that the marble is white

$\Rightarrow 10/14 \Rightarrow 5/7 \Rightarrow 0.71$

37-2M) Subjective probability with ex
it is based on the feelings or insights of the person determining the probability. it comes from person's intuition or reasoning.

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ex: if someone claims that their favorite sports team has an 80% of chance of winning the next game

2M) 38 Define elementary Events. Give an ex
Elements that cannot be decomposed or broken down into other events.
ex: In the experiment of rolling a die. there is 6 elementary events $\{1,2,3,4,5,6\}$.

39) Define Sample space: Give an ex
it is complete listing of all elementary events for an experiment.
ex: Tossing a coin $S = \{H, T\}$

40) Give an example for
a) unions: ex: $A = \{1,2,3\}$ $B = \{4,5,6\}$
$A \cup B = \{1,2,3,4,5,6\}$
b) Intersection: ex: $A = \{1,2,3\}$ $B = \{3,4\}$
$A \cap B = \{3\}$

41) Define with ex
a) Mutually exclusive events
Two or more events are mutually exclusive events if the occurance of one event precludes the occurance of other event
ex: when a coin is tossed then the result will be either head or tail, but we cannot get both the results.

b) Independent Events.
if the occurance or nonoccurance of one of the event does not affect the occurance or nonoccurance of other events.

ex: if we roll a die twice, the outcome of the first roll and second roll have no effect on each other.

42) Define collectively exhaustive events. ex

A list of collectively exhaustive events contains all possible elementary events for an experiments.

ex: rolling a die, 1, 2, 3, 4, 5, 6 outcomes are collectively exhaustive.

43) Define Complementary events. ex

The complement of event A is denoted A', pronounced "not A".

ex: rolling one die

event x is getting even no

complement of x' is odd num

44) if a population consists of the positive even numbers through 30 and if A = {2, 6, 12, 24}, what is A'?

$$P(A') = 1 - P(A) = 1 - \frac{4}{30} = 1 - 0.13 \Rightarrow 0.87$$

A' = {4, 8, 10, 14, 16, 18, 20, 22, 26, 28, 30}

45) what are 3 types of counting the possibilities

1) mn counting rule
2) Sampling from a population with replacement
3) combinations: sampling from a population without replacement

46) write the general Addition & Special Addition laws.

General law of addition

it is used to find the union of 2 events

$$P(x \cup y) = P(x) + P(y) - P(x \cap y)$$

Special law of addition

if the 2 events are mutually exclusive, the probability of the union of the 2 events is the probability of the first event + prob of 2nd event

$$P(x \cup y) = P(x) + P(y)$$

47) write 1) General law of multiplication

it is used to find joint probability.

$$P(x \cap y) = P(x) \cdot P(y/x) = P(y) \cdot P(x/y)$$

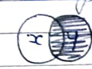
2) special law of multiplication.

if x & y are independent. then this law can be used to find the intersection of x & y.

$$P(x \cap y) = P(x) \cdot P(y)$$

48) write the conditional probability. ex (long)

$$P(x|y) = \frac{P(x \cap y)}{P(y)} = \frac{P(x) \cdot P(y|x)}{P(y)}$$



- it is a probability that E1 will occur, given that E2 is known to have occurred.
- it involves knowledge of some prior information.

ex: $P(y) = 0.70$ $P(x \cap y) = 0.56$

$$P(x|y) = \frac{0.56}{0.70} = 0.80$$

49) what are discrete random variables? Give ex

a random variable is discrete random variable if the set of all possible values is at most a finite or a countable infinite number of possible values.

ex: determining the num of defects in a batch of 50 items

50) what are continuous random variables? Give an ex

continuous random variables are generated from experiments in which things are "measured" not "counted".

ex: measuring the length of newly designed automobiles.

51) write formula for Mean, variance & SD of discrete Distribution.

Mean: $\mu = E(x) = \sum [x \cdot p(x)]$

variance: $\sigma^2 = \sum [(x-\mu)^2 \cdot p(x)]$

SD: $\sigma = \sqrt{\sum [(x-\mu)^2 \cdot p(x)]}$

52) list the assumption of binomial distribution

- The experiment involves n identical trails
- Each trails has only 2 possible outcomes denoted as success or a failure
- Each trial is independent of the previous trials
- The p & q remain constant through out the experiment.

p is the prob of getting success.

$q = (1-p)$ " " failure

53) write the formulae of binomial distributn.

$$p(x) = {}^nC_x \cdot p^x \cdot q^{n-x} = \frac{n!}{x!(n-x)!} \cdot p^x \cdot q^{n-x}$$

54) A company places a seven-digit serial number on each part that is made. Each digit of the serial number can be any number from 0 through 9. Digits can be repeated in the serial num. how many different serial numbers are possible?

since Each digit of the seven-digit serial number can be any num from 0 through 9, there are 10 options for each digit.

$\therefore 10^7 = 1,00,00,000$

55) A small company has 20 employees. Six of these employees will be selected randomly to be interviewed as part of an employee satisfaction prgm. how many different grps of 6 can be selected?

$$^{20}C_6 = \frac{20!}{6!(20-6)!} = \frac{20 \times 19 \times 18 \times 17 \times 16 \times 15 \times \cancel{14!}}{6! \cdot \cancel{14!}}$$

$$= \frac{\cancel{20}^{10} \times 19 \times \cancel{18}^{3} \times 17 \times \cancel{16}^{4} \times \cancel{15}^{5}}{\cancel{6} \times \cancel{5} \times \cancel{4} \times \cancel{3} \times \cancel{2} \times 1}$$

$= 38,760$

56) list the characteristics of poisson distribution

- it is a discrete distribution
- it describes rare events.
- Each occurence is independent of other occurences.
- it describes discrete occurences over a continuum or interval.

long

22) A supplier shipped a lot of 6 parts to a company. The lot contained 3 defective parts. Suppose the customer decided to randomly select 2 parts and test them for defects. how large a sample space is the customer potentially working with? list the sample space. Using the sample space list, determine the probability that the customer will select a sample with exactly one defect

the customer is selecting 2 parts out of 6 parts.

$$S = {}^nC_r = {}^6C_2 = \frac{6!}{2!(6-2)!} = \frac{\cancel{6}^3 \times 5 \times \cancel{4!}}{\cancel{2} \times 1 \times \cancel{4!}} = 15$$

The sample space is 15. Now let's list the possible outcomes

S = {(1,2), (1,3), (1,4), (1,5), (1,6), (2,3), (2,4), (2,5), (2,6), (3,4), (3,5), (3,6), (4,5), (4,6), (5,6)}

To find the probability of selecting a sample with exactly one defective part,

defe / not defe

Aa Ab Ac
Ba Bb Bc
Ca Cb Cc
AA AB AC
aa bb cc

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23) Given $x = \{1,3,5,7,8,9\}$ $y = \{2,4,7,9\}$
$z = \{1,2,3,4,7\}$

a) $x \cup z = \{1,2,3,4,5,7,8,9\}$
b) $x \cap z = \{1,3,7\}$
c) $x \cap y \cap z = (x \cap y) = \{7,9\}$
$(x \cap y \cap z) = \{7\}$
d) $x \cap y = \{7,9\}$
e) $x \cup y \cup z = (x \cup y) = \{1,2,3,4,5,7,8,9\}$
$(x \cup y \cup z) = \{1,2,3,4,5,7,8,9\}$
f) $(x \cup y) \cap z = (x \cup y) = \{1,2,3,4,5,7,8,9\}$
$(x \cup y) \cap z = \{1,2,3,4,7\}$
g) $(y \cap z) \cup (x \cap y) = (y \cap z) = \{2,4,7\}$
$(x \cap y) = \{7,9\}$
$(y \cap z) \cup (x \cap y) = \{2,4,7,9\}$
h) x or $y = \{1,2,3,4,5,7,8,9\}$
I) y and $x = \{1,3,7\}$

24) A company's customer service 800 telephone system is set up so that the caller has six options. Each of six options leads to menu with 4 options. for each of these 4 options, 3 more options available. For each of these 3 options, another 3 options are presented. if a person calls the 800 num for assistance, how many total options are possible?

- when a person calls 800, he has six options, the caller then chooses 1 options out of 6, $= {}^6C_1$
- After choosing one of these options, he gets another 4 options & he chooses one out of $4 = {}^4C_1$
- and next menus are again chosen in ${}^3C_1$ and ${}^3C_1$ ways each

Thus the total num of options available when on call 800 =

$^6C_1 \times {}^4C_1 \times {}^3C_1 \times {}^3C_1 = 6 \times 4 \times 3 \times 3 = 216$

hence there are total of 216 options available.

25) • A bin contains six parts. Two of parts are defective & 4 are acceptable. if 3 of 6 parts are selected from the bin, how large is the sample space?

• which counting rule did you use, & why

• For this sample space, what is the probability that exactly one of the three sampled parts is defective?

• 3 of 6 parts are selected.

$^6C_3 = \frac{6!}{3!(6-3)!}$

$= \frac{6 \times 5 \times 4 \times 3!}{3 \times 2 \times 1 \times 3!} = 20$

• Combinations are used to count the sample space bcz sampling is done (with or without) replacement.

• Pending $^4C_2 \times {}^2C_1 = 12$ - 1 defective

let E be the event that exactly one of 3 sampled part is defective

$P(E) = \frac{12}{20} = 0.6$

26) Explain Marginal, Union, Joint & Conditional probabilities with ex.

→ Conditional probability: 2M - 489

a) Marginal:

• it is computed by dividing some subtotals by the whole

• denoted by P(E) & E is some event

ex: a persons on a BMW car

Marginal Prob = $\frac{\text{no/- of BMW owners}}{\text{total num of car owners}}$

b) Union:

• it is second type of probability denoted by $P(E_1 \cup E_2)$, where E_1 & E_2 are 2 events

• $P(E_1 \cup E_2)$ is the probability that E_1 will occur or E_2 will occur or both E_1 & E_2 occur.

ex: A = {1, 2, 3, 4} B = {5, 4, 6}

A ∪ B = {1, 2, 3, 4, 5, 6}

c) Joint:

• it is denoted by $P(E_1 \cap E_2)$, where E_1 & E_2 are 2 events.

• Both events must occur.

ex: A person owning both car & bik

ex: A = {1, 2, 3} B = {2, 3} A ∩ B = {2, 3}

27) The client company data from the decision dilemma reveal that 155 employees worked one of four types of positions. Show here again is the raw value matrix (also called a contingency table) with a frequency counts for each category and for subtotals and totals containing a breakdown of these employees by type of position and by sex. If an employee of the company is selected randomly,

what is the probability that the employee is female or a professional worker

Company human resource Data

Type of Position	Male	Female	
Mangerial	8	3	11
Professional	31	13	44
Technical	52	17	69
Clerical	9	22	31
	100	55	155

(Sex)

⇒ Let F : denote the event of female

P : denote the event of professional workr

$P(F \cup P) = ?$

By the general law of addition.

$P(P \cup F) = P(P) + P(F) - P(P \cap F)$

- of the 155 employees, 55 are women

Therefore $55/155 = 0.355 \rightarrow P(F)$

- The 155 employees include 44 professional

$\therefore P(P) = 44/155 = 0.284$

- 13 employees are both female & professional $= 13/155 = 0.084 \Rightarrow P(P \cap F)$

$P(P \cup F) = P(P) + P(F) - P(P \cap F)$

$= 0.355 + 0.284 - 0.084$

$= \underline{0.555}$

28) Given $P(A) = 0.10$ $P(B) = 0.12$ $P(C) = 0.21$ $P(A \cap C) = 0.05$ and $P(B \cap C) = 0.03$ solve the following

a) $P(A \cup C) = P(A) + P(C) - P(A \cap C)$

$= 0.10 + 0.21 - 0.05$

$= \underline{0.26}$

b) $P(B \cup C) = P(B) + P(C) - P(B \cap C)$

$= 0.12 + 0.21 - 0.03$

$= \underline{0.3}$

c) if A & B are mutually exclusive, $P(A \cup B) =$

if A & B are mutually exclusive $P(A \cap B) = 0$

$P(A \cup B) = P(A) + P(B) = 0.10 + 0.12 = 0.22$

29) According to the U.S Bureau of Labor Statistics, 75% of the women 25 through 49 years of age participate in the labor force. Suppose 78% of the women in that age group are married. Suppose also that 61% of all women 25 through 49 years of age are married and are participating in the labour force.

a) what is the probability that a random selected woman in that age group is married or is participating in a labour force

b) what is the probability that a randomly selected woman in that age grp is married or is participating in the labour force but not both

c) what is the probability that a randomly selected women in that age grp is neither married nor participating in the labor force.

Given that :

$P(\text{married}) = 78\% = 0.78 = P(A)$

$P(\text{labor force}) = 0.75 = 75\% = P(B)$

$P(\text{married} \cap \text{labor force}) = 61\% = 0.61 = P(A \cap B)$

a) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$= 0.78 + 0.75 - 0.61$

$= \underline{0.92}$

b) $P(A\cap B') \cup P(B \cap A') = (0.78 - 0.61) + (0.75 - 0.61)$
$= 0.17 + 0.14 = \underline{0.31}$

c) $1 - P(A \cup B) = 1 - 0.92 = \underline{0.08}$

30) A company has 140 employees, of which 30 are supervisors. Eighty of the employees are married, and 20% of the married employees are supervisors. If a company employee is randomly selected, what is the probability that the employee is married and is a supervisor?

M : denot married
S : denot supervisor
$P(M \cap S) = ?$

Calculate marginal probability
$P(M) = \frac{80}{140} = \underline{0.5714}$

• 20% of the married employees are supervisors, which is the conditional probability $P(S|M) = 0.20$

Applying general law of multiplication
$P(M \cap S) = P(M) \cdot P(S|M) = (0.5714)(0.20)$
$= \underline{0.1143}$

hence 11.43% of the employees are married and are supervisors.

31) Use the values in the contingency table to solve the equations given.

	C	D	E	F	
A	5	11	16	8	40
B	2	3	5	7	17
	7	14	21	15	

a) $P(A \cap E) = P(A) \cdot P(E/A)$
$= 40 \cdot (16/40)$
$= 16$

$P(A) = 40$
$P(E/A) = 16/40$

b) $P(D \cap B) = P(D) \cdot P(B/D)$
$= 14 \cdot (3/14)$
$= 3$

$P(D) = 14$
$P(B/D) = 3/14$

c) $P(D \cap E) = P(D) \cdot P(E/D)$
$= 14 \cdot (5/14)$
$= 5$

$P(D) = 14$
P

d) $P(A \cap B)$

32) A study by Peter D. Hart Research Associates for the Nasdaq Stock Market revealed that 43% of all American adults are stockholders. In addition, the study determined that 75% of all American adults have some clg education. An American adult is randomly selected
a) what is the probability that the adults does not own stock?
b) what is the probability that the adult owns stock and has some college education
c) what is the probability that the adults owns stock or has some college education

d) what is the probability that the adult has neither some college education nor owns stock?
e) what is the probability that the adult does not own stock or has no clg education
f) what is the probability that the adult has some college education & owns no stock?

A : the event that an American Adult is a stockholder
B : the event that an American adult has some clg education

The given probabilities are:
$P(A) = 43\% = 0.43$ (prob of owning stock)
$P(B) = 37\% = 0.37$ (having some clg education)
$P(A \cap B) = 75\% = 0.75$ (owning stock & having some clg education)

a) $P(A') = 1 - P(A) \Rightarrow 1 - 0.43 \Rightarrow \underline{0.57}$

b) $P(A \cap B) = \underline{0.75}$ — doubt

c) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
$= 0.43 + 0.37 - 0.75 \Rightarrow \underline{0.05}$

d) $P(A' \cap B') = 1 - (A \cup B) \Rightarrow 1 - 0.05 = \underline{0.95}$

e) $P(A' \cup B') = P(A') \cdot P(B')$ — doubt

f) $P(B \cap A') = P(B) - P(A \cap B)$
$= 0.37 - 0.75 = -0.38$

33) Determine the mean, the variance and SD of the following discrete distribution.

x	$P(x)$	$x \cdot p(x)$	$(x-\mu)^2$	$[(x-\mu)^2 \cdot p(x)]$
1	0.238	0.238	2.775	0.660
2	0.290	0.58	0.443	0.128
3	0.177	0.531	0.111	0.0196
4	0.158	0.632	1.779	0.281
5	0.137	0.685	5.447	0.746

Mean $= \underline{2.666}$

variance $= \sigma^2 = \Sigma\,[(x-\mu)^2 \cdot p(x)] = \underline{1.8346}$

$\sigma^2 = \sqrt{\Sigma[(x-\mu)^2 \cdot p(x)]} = \sqrt{1.8346} = \underline{1.354}$

34) Determine the mean, the variance & SD of the following discrete distribution

Discrete Distribution of occurence of daily Corpses

Number of corpses	Probability
0	0.37
1	0.31
2	0.18
3	0.09
4	0.04
5	0.01

x	$P(x)$	$x \cdot P(x)$	$(x-\mu)^2$	$(x-\mu)^2 \cdot P(x)$
0	0.37	0	$(0-1.15)^2 = 1.32$	0.49
1	0.31	0.31	$(1-1.15)^2 = 0.02$	0.01
2	0.18	0.36	0.72	0.13
3	0.09	0.27	3.42	0.31
4	0.04	0.16	8.12	0.32
5	0.01	0.05	14.82	1.15
				1.41

Mean $= \Sigma[x \cdot p(x)] = \underline{1.15}$ $\mu = 1.15$

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variance = $\sigma^2 = \Sigma[(x-\mu)^2 \cdot P(x)] = 1.41$

SD $= \sigma = \sqrt{\Sigma[(x-\mu)^2 \cdot P(x)]} = \sqrt{1.41} = 1.19$

35) A Gallup survey found that 65% of all financial consumers were very satisfied with their primary financial institution. Suppose that 25 financial consumers are sampled and if the Gallup survey result still holds true today, what is the probability that exactly 19 are very satisfied with their primary financial institution? (using binomial distribution formula).

$p = 0.65 \quad n = 25 \quad x = 19 \quad q = 1-p = 1-0.65 = 0.35$

$P(x) = {}_nC_x \cdot p^x \cdot q^{n-x} = \frac{n!}{x!(n-x)!} \cdot p^x \cdot q^{n-x}$

$= \frac{25!}{19!(25-19)!} \cdot (0.65)^{19} \cdot (0.35)^{25-19}$

$= \frac{25 \times \cancel{24}^{4} \times 23 \times \cancel{22} \times \cancel{21}^{7} \times \cancel{20}^{10} \times \cancel{19!}}{\cancel{19!} \times \cancel{6} \times \cancel{5} \times \cancel{4} \times \cancel{3} \times \cancel{2} \times 1} \cdot (0.65)^{19} \cdot (0.35)^6$

$= (177,100)(0.000278) \cdot (0.00183) = 0.0908$

36) According to the U.S Census Bureau, approximately 6% of all workers in Jackson, Mississippi, are unemployed. In conducting a random telephone survey in Jackson, what is the probability of getting 2 or fewer unemployed workers in a sample of 20? (using Binomial Distribution formulae?)

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- The problem must be worked as the union of 3 problems

a) $x = 0 \quad p = 0.06 \quad q = 1-0.06 = 0.94 \quad n = 20$

$= \frac{20!}{0!(20-0)!} \cdot (0.06)^0 \cdot (0.94)^{20-0} \Rightarrow 0.2901$

b) $x = 1$

$= \frac{20!}{1!(20-1)!} \cdot (0.06)^1 \cdot (0.94)^{20-1} \Rightarrow 0.3703$

c) $x = 2$

$= \frac{20!}{2!(20-2)!} \cdot (0.06)^2 \cdot (0.94)^{20-2} \Rightarrow$ ~~0.2850~~ 0.2246

total $= 0.2901 + 0.3703 + 0.2246 \Rightarrow 0.8850$

37) Suppose bank customers arrive randomly on weekday afternoons at avg of 3.2 customers every 4 minutes. what is the probability of exactly 5 customers arriving in a 4-minute interval on a weekday afternoon? The lamda for this problem is 3.2 customers per 4 minutes. The value of x is 5 customer per 4 minutes. (using Poisson formula)

$P(x) = \frac{\lambda^x e^{-\lambda}}{x!} \quad x = 5 \quad \lambda = 3.2$

$= \frac{(3.2^5)(e^{-3.2})}{5!} \Rightarrow \frac{(335.54)(0.0408)}{120}$

$\Rightarrow 0.1141$

$e = 2.718282$

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38) Bank customers arrive randomly on weekday afternoons at an avg of 3.2 customers every 4 minutes. what is the probability of having more than 7 customers in a 4-minute interval on a weekday afternoon? (Poisson formula)

$\lambda = 3.2$ customers/minutes $\quad e = 2.718282$

$x > 7$ customers/4 minutes

$p(x=8 \mid \lambda=3.2) = \frac{(3.2^8)(e^{-3.2})}{8!} = 0.0111$

$p(x=9 \mid \lambda=3.2) = \frac{(3.2^9)(e^{-3.2})}{9!} = 0.0040$

$p(x=10 \mid \lambda=3.2) = \frac{(3.2^{10})(e^{-3.2})}{10!} = 0.0013$

$p(x=11 \mid \lambda=3.2) = \frac{(3.2^{11})(e^{-3.2})}{11!} = 0.0004$

$p(x=12 \mid \lambda=3.2) = \frac{(3.2^{12})(e^{-3.2})}{12!} = 0.0001$

$p(x=13 \mid \lambda=3.2) = \frac{(3.2^{13})(e^{-3.2})}{13!} = 0.0000$

$p(x>7) = p(x \geq 8) = \underline{0.0169}$

39) A bank has an avg random arrival rate of 3.2 customers every 4 minutes. what is the probability of getting exactly 10 customers during an 8 minute interval? (Poisson formula)

$\lambda = 3.2$ customer/4 minutes

$x = 10$ customer/8 minutes

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40) Find the following values by using Poisson formula

a) $p(x=5 \mid \lambda=2.3) \Rightarrow \frac{(2.3)^5 \cdot (e^{-2.3})}{5!}$

$\Rightarrow \frac{64.363430 \cdot 0.100259}{120} = \underline{0.05378}$

b) $p(x=2 \mid \lambda=3.9) \Rightarrow \frac{(3.9)^2 \cdot (e^{-3.9})}{2!} \Rightarrow \underline{0.15394}$

c) $p(x \leq 3 \mid \lambda=4.1) \Rightarrow p(x=1 \mid \lambda=4.1) + p(x=2 \mid \lambda=4.1) + p(x=3 \mid \lambda 4.1)$

$\Rightarrow \frac{(4.1)^1 \cdot (e^{-4.1})}{1!} + \frac{(4.1)^2 \cdot (e^{-4.1})}{2!} + \frac{(4.1)^3 \cdot (e^{-4.1})}{3!} + \frac{(4.1)^0 \cdot (e^{-4.1})}{0!} = 0.06806 + 0.1395 + 0.22881 + 0.0166 \Rightarrow \underline{0.45297}$

d) $p(x=0 \mid \lambda=2.7) = \frac{(2.7)^0 \cdot (e^{-2.7})}{0!} = \underline{0.0672055}$

f) $p(4 < x < 8 \mid \lambda=4.4) = p(x=5 \mid \lambda=4.4) + p(x=6 \mid \lambda=4.4) + p(x=7 \mid \lambda=4.4)$

e) $p(x=1 \mid \lambda=5.4) = \frac{(5.4)^1 \cdot (e^{-5.4})}{1!}$

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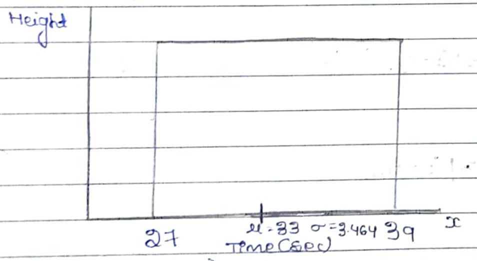
41) Suppose the amount of time it takes to assemble a plastic module ranges from 27 to 39 seconds and that assembly times are uniformly distributed. Describe the distribution. What is the probability that a given assembly will take b/w 30 & 35 seconds? Fewer than 30 seconds.

$f(x) = \text{Height} = \frac{1}{(b-a)} = \frac{1}{39-27} = \frac{1}{12}$

$\mu = a+b/2 = \frac{39+27}{2} = 33$

$\sigma = \frac{b-a}{\sqrt{12}} = \frac{39-27}{\sqrt{12}} = 3.464$



$P(30 \le x \le 35) \Rightarrow \frac{x_2 - x_1}{b-a} \Rightarrow \frac{35-30}{39-27} \Rightarrow \frac{5}{12} = 0.4167$

$p(x < 30) = \frac{30-27}{39-27} = \frac{3}{12} = 0.2500$

There is a 0.2500 probability that it will take less than 30 seconds to assemble the module

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42) According to the National Association of Insurance Commissioners, the avg annual cost for automobile insurance in the United States in a recent year was \$691. Suppose automobile insurance costs are uniformly distributed in the United States with range of from \$200 to \$1,182. What is SD of this uniform distribution? What is the height of the distribution? What is the probability that a person's annal cost for automobile insurance in the United states is b/w \$410 and \$825?

Mean = \$691 a = \$200 b = \$1,182

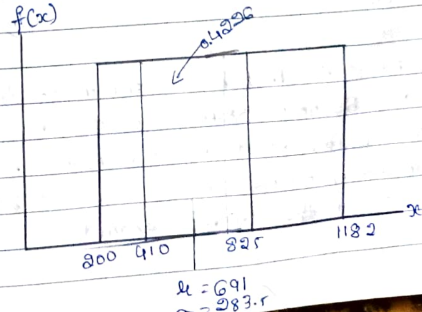
$\sigma = \frac{b-a}{\sqrt{12}} = \frac{1,182-200}{\sqrt{12}} = 283.5$

$\text{height} = \frac{1}{b-a} = \frac{1}{1,182-200} = \frac{1}{982} = 0.001$

$x_1 = 410$ $x_2 = 825$ $p(410 \le x \le 825)$

$= \frac{x_2 - x_1}{b-a} = \frac{825-410}{1,182,200} = \frac{415}{982} = 0.4226$

The probability that a randomly selected person pays b/w \$410 & \$825 annually for automobile insurance in the united state is 0.4226.



#3) What is the probability of obtaining a score greater than 700 on a GMAT test that has a mean of 494 & SD of 100? Assume GMAT scores are normally distributed.

$p(x > 700 \mid \mu = 494$ and $\sigma = 100) = ?$

$\Rightarrow z = \frac{x-\mu}{\sigma} = \frac{700-494}{100} = 2.06$

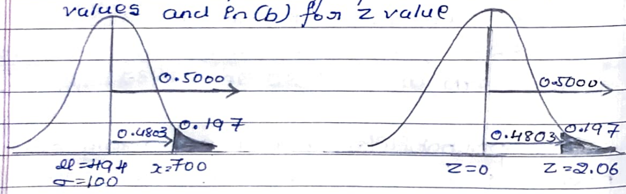
∴ z value in z distribution table is $[2.0\downarrow \;\; \rightarrow 0.06]$

$= 0.4803$

Finding the probability of getting a score > 700, which is a tail distribution, requires substracting prob value 0.4803 from 0.5000, bcz each half of the distribution contains 0.5000 of the area

$$\begin{array}{r} 0.5000 \\ -0.4803 \\ \hline 0.0197 \end{array}$$

The solⁿ is depicted graphically in (a) for x values and in (b) for z value



(a) (b)

#4) GMAT test that has a mean of 494 & SD of 100? Assume GMAT scores are normally distributed. What is the probability of randomly obtaining a score b/w 300 & 600 on the GMAT exam?

$p(300 < x < 600 \mid \mu = 494$ and $\sigma = 100) = ?$

a) $z = \frac{x-\mu}{\sigma} = \frac{600-494}{100} = \frac{106}{100} = 1.06$

z value in z distribution table is $[1.0\downarrow \;\; \rightarrow 0.06]$

$= 0.3554$

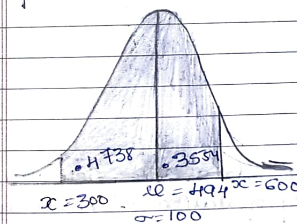
b) $z = \frac{x-\mu}{\sigma} = \frac{300-494}{100} = \frac{-194}{100} = -1.94$

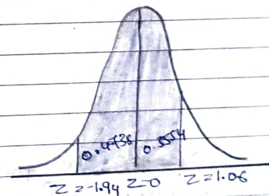
z value in z distribution table is $[1.9\downarrow \;\; \rightarrow 0.04]$

$= 0.4738$

(Note: $z(-1.94)$ is -ve. A -ve z value indicates that the x value is below the mean & z value is left side of distribution.

∴ $p(300 < x < 600)$ is obtained by summing the probabilities. $0.3554 + 0.4738 = 0.8292$





#6) $p(350 < x < 450 \mid \mu = 494$ and $\sigma = 100) = ?$

Same as #4.

#5) GMAT test that has a mean of 494 and SD of 100? Assume GMAT scores are normally distributed. What is the probability ~~of getting a score b/w 350 & 450 on the~~ of randomly drawing a score that is 550 or less!

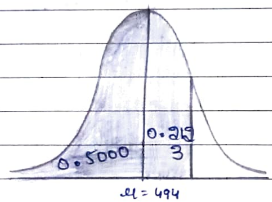
$P(x \le 550 \mid \mu = 494$ and $\sigma = 100) = ?$

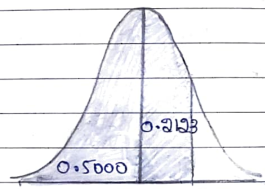
$z = \frac{x-\mu}{\sigma} = \frac{550-494}{100} = \frac{56}{100} = \underline{0.56}$

The area under the curve for $z = 0.56$
$= 0.2123$ $[0.5| \rightarrow 0.060]$

• obtaining the probability for all values less than or equal to 550 also requires including the value less than the mean. $B < z$ 0.5000 of the value are less than the mean.

$0.5000 + 0.2123 = \underline{0.7123}$





47) Suppose the following data are selected randomly from a population of normally distributed values. Construct a confidence interval to estimate the population mean. And 90% confidence level, (using t statistics). The sample mean is 13.56 & the sample SD is 7.8

6	21	17	20	7	0	8	16	29
3	8	12	11	9	21	25	15	16

$\bar{x} = 13.56$ $sd = 7.8$ $\alpha/2 = 0.05$ $df = n-1$
$= 18-1 = 17$

$\Rightarrow \bar{x} \pm t_{\alpha/2, n-1} \frac{s}{\sqrt{n}}$

$t_{0.05, 17} = 1.740$

$\Rightarrow \bar{x} - t_{\alpha/2, n-1} \frac{s}{\sqrt{n}} \le \mu \le \bar{x} + t_{\alpha/2, n-1} \frac{s}{\sqrt{n}}$

$13.56 - t_{0.05,17}\left(\frac{7.8}{\sqrt{17}}\right) \le \mu \le 13.56 + t_{0.05,17}\left(\frac{7.8}{\sqrt{17}}\right)$

$13.56 - 1.740\left(\frac{7.8}{\sqrt{17}}\right) \le \mu \le 13.56 + 1.740\left(\frac{7.8}{\sqrt{17}}\right)$

$13.56 - 1.740\left(\frac{7.8}{4.1231}\right) \le \mu \le 13.56 + 1.740\left(\frac{7.8}{4.1231}\right)$

$13.56 - 3.2917 \le \mu \le 13.56 + 3.2917$

$\underline{10.36 \le \mu \le 16.76}$

48) 3 1 3 2 5 1 2 1 4 2 1 3 1 1

$\bar{x} = 2.14$ (Sample mean) $SD = 1.29$

Same as above.