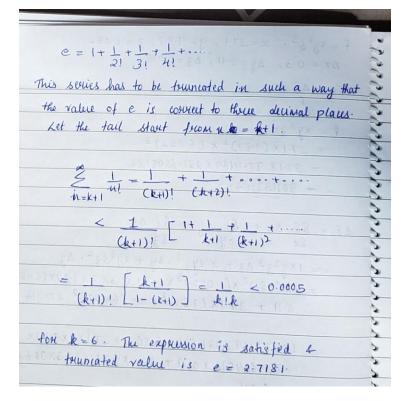
Solved Question Papers

June 2008

1. a) Find the value of e correct to three decimal places.



1. b)Add 0.2315×10^2 and 0.9443×10^2 using concept of normalized floating point. Steps for addition :

1. Check if the numbers are in normalized form

Both the numbers are in normalized form.

2. Check if the exponents are equal, if not adjust accordingly.

In our question, the mantissas are equal.

3. Add the mantissas of given numbers.

0.2315 + 0.9443 = 1.1758



Check if the result is in normalized form, if not adjust it.

So, the final answer is 0.1176(rounded upto 4 decimal places)

4. It is given that 3% of the electric bulbs manufactured by a company are defective. Using Poisson distribution, find the probability that a sample of 100 bulbs will contain no defective bulb. Given thate-3=0.05.

Let X be a Poisson random variable, "bulb is defective".

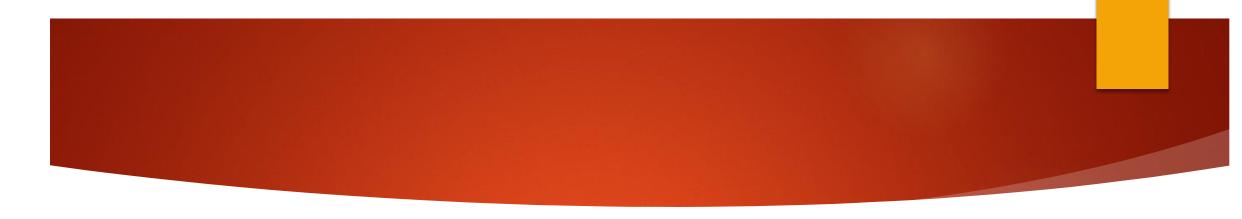
$$n=100$$
, $p=3/100$

$$m=np=100*3/100=3$$

Probability that a sample of 100 bulbs will contain no defective bulb=P(X=0)

$$P(X=x)=e^{-m*}m^{x}/x!$$

$$P(X=0)=e^{-3}*3^{0}/0!$$



$$P(X=0)=e^{-3*}3^{0}/0!$$

$$=0.05*1/1$$

$$=0.05$$

December 2008

1. a)If 0.333 is the approximate value of 1/3, find absolute, relative and percentage errors.

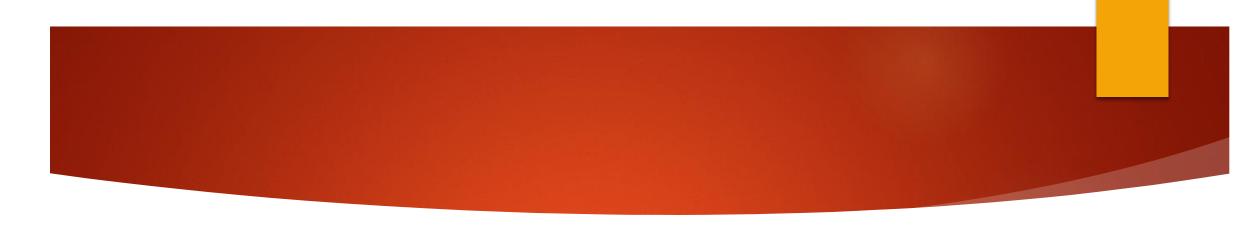
True value=1/3

Approximate value=0.333

Absolute error= | true value-approximate value |

Relative error =absolute error/true value

$$=0.000333/(1/3)=0.000999$$



Percentage error= relative error * 100

=0.000999*100

=.099%

1. f) The probability that an evening college student will graduate is 0.4. Determine the probability that out of 5 students (i) none (it) one and (iii) atleast one will be graduate.

Let X be a binomial Random Variable "student will graduate".

$$n=5$$
, $p=0.4$

$$q = 1 - 0.4 = 0.6$$

$$P(X=x)={}^{n}C_{x}p^{x}q^{n-x}$$

P(none will graduate)=
$$P(X=0)={}^{5}C_{0}(0.4)^{0}(0.6)^{5}$$

P(one will graduate)= $P(X=1)={}^{5}C_{1}(0.4)^{1}(0.6)^{4}$ =0.2592 P(atleast one will graduate)= $P(X\geq 1)=1-P(X=0)$ =1-0.07776 =0.92224

June 2009

1. a) Differentiate between absolute, relative and percentage error with an example.

Absolute error: It is defined as the magnitude of the difference between the actual value (x) and the approximated value(xa).

Suppose, true value = 22/7 approximate value=3.14

Absolute error= | x-xa |

Absolute error= | 22/7-3.14 | =0.0028571

Relative error:

It is defined as the ratio of absolute error and the actual value.

Relative error = |(x-xa)/x|

Relative error= |(22/7-3.14)/22/7| = 0.00090908

Percentage error : relative error in percentage is called percentage error.

100er = 100* | x-xa | /x

Percentage error = 100* 0.00090908

=0.090908

4. c) Explain the effect of round off error in scientific calculations.

Round off error: It is also known as rounding errors. It is due to the fact that floating point numbers are represented by finite precision. Round off error is the difference between an approximation of a number used in computation and its exact (correct) value. When this approximated data is to be further utilized in successive calculations, then it causes the propagation of error, and if the error starts growing abnormally then some big disasters may happen.

Error and accuracy are inter-related. Less the error, more the accuracy.

5. a) If a bank receives on an average λ =6 bad cheques per dap what is the probability that it will receive 4 bad cheques on any given day.

Let X be a Poisson RV, "bank receives bad cheque".

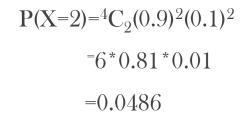
$$\lambda = 6$$

5. c) A farmer buys a quantity of cabbage seeds from a company that claims that approximately 90% of the seeds will germinate if planted properly. If four seeds are planted, what is the probability that exactly two will germinate.

Let X be a Binomial RV of "seed will germinate".

=0.1

P(exactly two will germinate)=P(X=2)



December 2009

1. a) Explain truncation error. Show that a(b-c) is not $\neq ab-ac$, where a=0.5555 E¹ b

 $=.4545 E^{1} C = .4535 E^{1}$.

3) a = .5555 E' b = .4545 E' C = .4535 E' P. T. a (b-c) = ab-ac b-C = .4545 E - .4535 E' = .0010E1 a(b-1) = (.5555 E') (.1E-1) = · 05555 E° = 0.5555 E-1 ab = .5555 E' x .4545 E' = . 2524 E2 ac = . 5555 E | X - 4535 E | = · 2519 E2 ab - ac = .2524 E2 - .2519 E2 .. hence proved, a(b-c) + ab-ac.

Truncation error

It is defined as an error created by approximating a mathematical operation. It is a consequence of doing finite number of steps in a calculation that would require infinite number of steps to do exactly.

Example is : evaluation of infinite sum

Consider the Maclaurin Series:

$$e^{x}=1+x+x^{2}/2!+x^{3}/3!+...$$

Suppose if we have to find the value of e^x when x=0.5,

then.

$$e^{0.5}=1+0.5+(0.5)^2/2!+(0.5)^3/3!+\dots$$

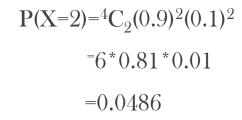
Suppose if we are using only first 3 terms to find the value of $e^{0.5}$, then whatever is left over is truncation error.

Another example for an operation that is affected by truncation error is numerical integration.

5. a) A farmer buys a quantity of cabbage seeds from a company that claims that approximately 90% of the seeds will germinate if planted properly. If four seeds are planted, what is the probability that exactly two will germinate.

Let X be a Binomial RV of "seed will germinate".

P(exactly two will germinate)=P(X=2)



June 2010

1. a) Estimate the relative error in z = x - y when $x = 0.1234 \times 10^4$ and $y = 0.1232 \times 10^4$ as stored in a system with four-digit mantissa.

$$x=0.1234 \times 10^4 \text{ y}=0.1232 \times 10^4$$

$$x*=0.123 \times 10^4 \text{ y}=0.123 \times 10^4$$

True value= $0.1234 \times 10^4 - 0.1232 \times 10^4$

= 0.0002

Approximate value= $0.123 \times 10^4 - 0.123 \times 10^4$

=0

Relative error = | (true value-approximate value)/true value |

1. a) A book contains 100 misprints distributed randomly throughout its 100 pages. What is the probability that a page observed at random contains atleast two misprints.

Let X be a Poisson RV "page has mistakes"

$$P(x)=(e^{-m*}m^{x})/x!$$

In 100 pages there are 100 mistakes

$$m=np=100*1/100=1$$

$$P(X \ge 2) = 1 - P(X \le 1)$$

$$=1-[P(X=0)+P(X=1)]$$

$$P(X=0)=(e^{-1}*1^0)/0!$$

P(X=0)=(0.3679*1)/1 =0.3679 $P(X=1)=(e^{-1}*1^{1})/1!$ =(0.3679*1)/1 =0.3679 $P(X\geq 2)=1-[0.3679+0.3679]$ =1-0.7358 =0.2642

5. c) What is a random variable? Write down the expression which define Binomial, Poisson and Normal probability distribution. Give two physical situation illustrating a Poisson random variable.

A variable whose values depends on the outcomes of a random phenomenon is called a random variable.

There are two types of random variable:

- 1) Discrete Random Variable
- 2) Continuous Random Variable

Discrete Random Variable: A random variable X is said to be discrete, if the total number of values X can take is finite, i.e. the support of X is either finite or countable.

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Binomial Distribution:

It is a discrete distribution. Binomial distribution is also known as Bernoulli's distribution. It is used with the experiments where there are only two possible outcomes.

Characteristics of a binomial distribution:

- Fixed number of trials.
- Each trial is independent of the others.
- Each trial has two outcomes.
- Probability of each outcome remains constant from trial to trial.

Formula:

 $P(X=x) = {}^{n}C_{x} p^{X}q^{n-x}$ where n is total number of outcomes, p is probability of success and q is probability of failure.

$${}^{n}C_{x}=n!/(n-r)!r!$$

Poisson Distribution:

It is a discrete distribution. It is the limiting case of binomial distribution. It is used to find the probability of an experiment in a given time interval or specified region of space.

Characteristics of Poisson Distribution:

- a) The average occurrence rate per unit time is constant.
- b) Occurrence in an interval is independent of what has happened previously.
- c) The chance that more than one occurrence will happen at the same time is negligible.

Formula:

$$P(x)=(e^{-m*}m^x)/x!$$

m=np, where n: total number of outcomes, p: probability of success

Few examples of situation where we use Poisson Random Variable:

- Number of typing errors on a page
- Traffic flow on a particular street
- Number of accidents on a particular stretch of read in a week
- Number of telephone calls to a call center

December 2010

1. b) Find the truncation error in the result of the following function for x=1/5 when we use first three terms.

```
\begin{array}{l} e^{x} = 1 + x + x^{2}/2! + x^{3}/3! + x^{4}/4! + x^{5}/5! + x^{6}/6! \\ \text{Now, assign } x = 1/5, \\ e^{1/5} = \left(1 + x + x^{2}/2! + x^{3}/3! + x^{4}/4! + x^{5}/5! + x^{6}/6!\right) - \left(1 + x + x^{2}/2! + x^{3}/3!\right) \\ = \left(1 + 0.2 + 0.04/2 + 0.008/6 + 0.0016/24 + 0.00032/120 + 0.000064/720\right) - \left(1 + 0.2 + 0.04/2 + 0.0013333 + 0.0000666 + 0.0000026 + 0.000000089\right) - \left(1 + 0.2 + 0.02 + 0.0013333\right) \\ = 1.2214025 - 1.2213333 = 0.0000692 \end{array}
```

3. b)Suppose that a manufactured product has 2 defects per unit of product inspected. Using Poisson distribution calculate the probabilities of finding a product without any defect, 3 defects and 4 defects.

Let X be a Poisson RV "product has defect"

m=2

$$P(x)=(e^{-m*}m^{x})/x!$$

P(product without any defect)= $P(X=0)=(e^{-2}*2^0)/0!$

=0.135*1/1

=0.135

P(product with 3 defects)= $P(X=3)=(e^{-2}*2^3)/3!$ =0.135*8/6

P(product with 4defects)= $P(X=4)=(e^{-2} \cdot 2^4)/4!$ =0.135*16/24 =0.09

June 2011

1. a) Define Absolute Error, Relative Error and Percentage Error. Show that $(a - b) \neq a/c - b/c$ where a = 0.41, b = 0.36 and c = 0.70.

Absolute error: It is defined as the magnitude of the difference between the actual value (x) and the approximated value(xa).

Absolute error= | x-xa |

Relative error:

It is defined as the ratio of absolute error and the actual value.

Relative error = |x-xa|/x

Percentage error: relative error in percentage is called percentage error.

100er = 100* | x-xa | /x

PHONE	41, b=0.36, c	0 - h		CK/Links
	c	2 2		
LHS			A 2130	Access
(a-b)	= (0.41-0.36)	= 0.05 = 0	07	La line
RHS:	0.70			
a -b	= 0.41 - 0	36 = 0.58-	0-59-0-51	
0	0.70 0.	70 = 0.08	Tenan	Land III
				100000000
i. hun	e phoved, Ca-b) # a-6		

5. c) Ten coins are thrown simultaneously. Find the probability of getting at least seven heads.

Let X be a Binomial RV "getting a head".

$$n = 10$$

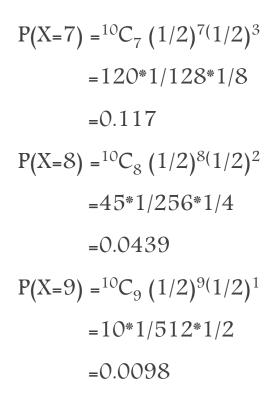
$$p=1/2$$

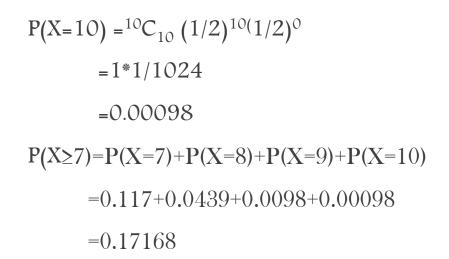
$$q=1-1/2=1/2$$

P(getting at least 7 heads)= $P(X \ge 7) = P(X = 7) + P(X = 8) + P(X = 9) + P(X = 10)$

$$P(X=x) = {}^{n}C_{x} p^{X}q^{n-x}$$

$$P(X=7) = {}^{10}C_7 (1/2)^7 (1/2)^3$$





December 2011

1. a) Define Error.

Solve the quadratic equation x2 + 9.9x - 1 = 0 using two decimal digit arithmetic with rounding

Error is defined as the difference between the actual value and the approximate value obtained from numerical computation.

Suppose x is actual value and xa is approximate value,

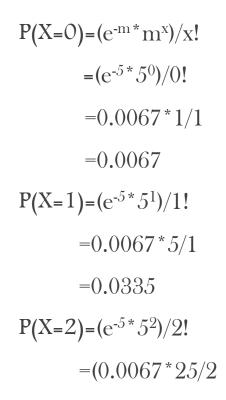
then
$$Error = x - xa$$

$$x2 + 9.9x - 1 = 0$$

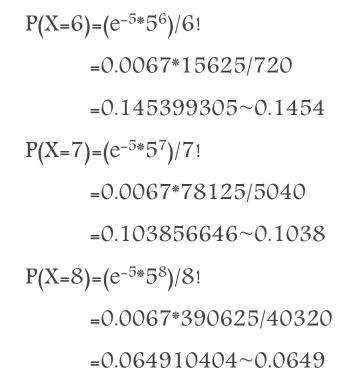
Example: 5 textbook page: Block 1 Page 14

5. a) A manufacturer of cotton pins knows that 5% of his product is defective. If he sells cotton pins in boxes of 100 and guarantees that not more than 10 pins will be defective. What is the approximate probability that a box will fail to meet the guaranteed quality?

m=np n=100,p=5%=5/100 m=np=100*5/100=5 $P(x)=(e^{-m}m^x)/x!$ $P(a box will fail to meet the guaranteed quality)=P(X<math>\geq$ 10)=1-P(X \leq 10)



=0.0838 $P(X=3)=(e^{-5*}5^3)/3!$ =0.0067*125/6 =0.1396 $P(X=4)=(e^{-5}*5^4)/4!$ =0.0067*625/24 =0.1745 $P(X=5)=(e^{-5*}5^5)/5!$ =0.0067*3125/120 =1.0469



```
\begin{split} P(X=9) = & (e^{-5*}5^9)/9! \\ & = 0.0067*1953125/362880 \\ & = 0.036061335 \sim 0.036 \\ P(X=10) = & (e^{-5*}5^{10})/10! \\ & = 0.0067*9765625/3628800 \\ & = 0.018030667 \sim 0.0180 \\ P(a box will fail to meet the guaranteed quality) = P(X \ge 10) = 1 - P(X \le 10) \\ & = 1 - \\ [0.0067 + 0.0335 + 0.0838 + 0.1396 + 0.1745 + 1.0469 + 0.1454 + 0.1038 + 0.0649 + 0.036 + 0.0180] \\ & = 0.8531 \end{split}
```

June 2012

1. a)If 0.333 is the approximate value of 1/3, find absolute, relative and percentage errors. Explain how these errors measure accuracy.

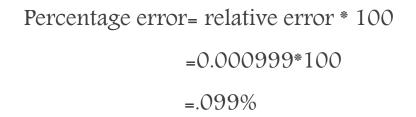
```
True value=1/3

Approximate value=0.333

Absolute error=|true value-approximate value|
=|1/3-0.333|
=0.000333

Relative error =absolute error/true value
```

=0.000333/(1/3)=0.000999



1. i) Write the probability distribution formula for Binomial distribution, Poisson distribution and Normal distribution.

Formula:

Poisson distribution:

$$P(x)=(e^{-m*}m^x)/x!$$

m=np, where n: total number of outcomes, p: probability of success

Binomial distribution:

 $P(X=x) = {}^{n}C_{x} p^{X}q^{n-x}$ where n is total number of outcomes, p is probability of success and q is probability of failure.

$${}^{n}C_{x}=n!/(n-r)!r!$$

2. d) For $x = 0.5555 E^1$; $y = 0.4545 E^1$ and $3z = 0.4535 E^1$, prove that x(y - z) # xy - xz

3) a= .5555 E' b= .4545 E' C=.	4535 E'
P. T. a(b-c) ≠ ab-ac	COLOR DE TRANSPORTE
LHS -	3 4 1 5
6-C = .4545 E4535 E'	
= · 0010 E1	- College Calmillion
= • log= "!	050 050
The same of	DE MELLON L
a(b-c) = (.5555 E') (.1E-1)	000 000 000
≈ · 05555 €°	
= 0.5555 E ⁻¹	and the same
RHS	
ab = .5555 E' x .4545 E'	
= . 2524 E2	The same and the
	ARCHITA SPECIAL
ac = - 5555 E x - 4535 E	
= · 2519 E 2	
	AND THE PARTY OF
$ab - ac = .2524 E^22519$	E 2
$= .0005 E^2 = .50$	
2 0009 E	
	Maria
hence provid, a(b-c) \$ ab-ac	
The state of the s	the year of the same of
	2 002T - 2

4. c) If a bank receives on an average λ =6 bad cheques per day. What is the probability that it will receive 4 bad cheques on any given day?

Let X be a Poisson RV, "bank receives bad cheque".

$$\lambda = 6$$

$$P(X=4)=e^{-6} * 6^{4}/4!$$

$$=(0.0024*1296)/24$$

$$=(0.0025*1296)/24$$

$$=0.135$$

5. c) A book contains 100 misprints distributed randomly throughout its 100 pages. What is the probability that a page observed at random contains atleast two misprints.

Let X be a Poisson RV "page has mistakes"

$$P(x)=(e^{-m*}m^x)/x!$$

In 100 pages there are 100 mistakes

$$m=np=100*1/100=1$$

$$P(X \ge 2) = 1 - P(X \le 1)$$

$$=1-[P(X=0)+P(X=1)]$$

$$P(X=0)=(e^{-1}*1^0)/0!$$

P(X=0)=(0.3679*1)/1 =0.3679 $P(X=1)=(e^{-1}*1^{1})/1!$ =(0.3679*1)/1 =0.3679 $P(X\geq 2)=1-[0.3679+0.3679]$ =1-0.7358 =0.2642

December 2012

1. a)If $\prod = \frac{22}{7}$ approximated as 3.14, find the absolute error, relative error and relative percentage error.

```
True value=22/7
Approximated value=3.14
Absolute error = 22/7-3.14
=(22-21.98)/7
=0.02/7
=0.0028571
Relative error=(0.0028571)/(2/3)
=0.0085713/2
=0.00428565=0.0043
```

Percentage error=0.0043*100 =0.43

2. d)Let a = 0.41, b = 0.36 and c = 0.70 prove $(a-b)/c \neq a/c-b/c$

	a = 0.41 , b = 0.36 , C = 0.70
	Prove that $(a-b) \neq a-b$
1	ins:
110	(a-b) = (0.41-0.36) = 0.05 = 0.07
11 %	C 070 070
0	2-b = 0.41 - 0.36 = 0.58 - 0.59 - 0.51
-	C 0.70 0.70 = 0.08
	hunce proved, (a-b) # a-b
• •	hunce phoved, (a-b) # a-b

5) a) What do you mean by the term "Accuracy" and "Precision"? How are they related to the significant digits?

Accuracy and precision are closely related to significant digits.

- 1) Accuracy refers to the number of significant digits in a value. For example, the number 57.396 is accurate to five significant digits.
- 2) Precision refers to the number of decimal positions, i.e. the order of magnitude of the last digit in a value. The number 57.396 has a precision of 0.001 or 10^{-3} . 4.3201 has a precision of 10^{-4} .

5) a) What do you mean by term "Random Variable", classify them? How you analyse which probability distribution is applicable on which type of random variable?

A variable whose values depends on the outcomes of a random phenomenon is called a random variable.

There are two types of random variable:

- 1) Discrete Random Variable
- 2) Continuous Random Variable

Discrete Random Variable: A random variable X is said to be discrete, if the total number of values X can take is finite, i.e. the support of X is either finite or countable.

Binomial distribution:

Binomial distribution is also known as Bernoulli's distribution. It is used with the experiments where there are only two possible outcomes.

Characteristics of a binomial distribution:

- Fixed number of trials.
- Each trial is independent of the others.
- Each trial has two outcomes.
- Probability of each outcome remains constant from trial to trial.

Poisson Distribution:

It is the limiting case of binomial distribution. It is used to find the probability of an experiment in a given time interval or specified region of space.

Characteristics of Poisson Distribution:

- a) The average occurrence rate per unit time is constant.
- b) Occurrence in an interval is independent of what has happened previously.
- c) The chance that more than one occurrence will happen at the same time is negligible.

June 2013

1. a) Explain briefly what are the sources of error? Verify the associative property for the floating point numbers. i.e. prove : (a + b)-c # (a - c) + b, where $a = .5665E^1$, $b = .5556E^2$ and $c = .5644E^1$

Different sources of error are:

- Data input errors
- Error in algorithm and
- Error during computation

Data input errors: The input information is rarely exact since it comes from experiments and any experiment can give results of only limited accuracy. Moreover, the quantity used can be represented in a computer for only a limited number of digits.

Error in algorithm: Such errors occurs where infinite algorithms are used. Exact results are expected only after an infinite number of steps. As this cannot be done in practice, the algorithm has to be stopped after a finite number of steps and the results are not exact.

Error during computation. Such errors occurs when elementary operations such as multiplication and division are used the case when number of digits increases greatly so that the results cannot be held fully in computer register

2)	a = . 5665 6 b = . 5856 6 -1 C = . 5644E 1
	Prove. (a+b)-c \(\psi \) (a-c)+b.
	LHS:
	(a+b) = .5665 E + .5556 E - (exponents are not dome, do charge
\parallel	= .5665E' + .0055E' (5K .5556E' = .005EE'
-11	05720E
\parallel	(a+b)-c385720E'5644E'
	= .0076 E' (not in Standardized nommal tourn so change
	= .7600 E
	RHS:
111	$(a-c) = .5665 \varepsilon'5644 \varepsilon'$
	0021 E' = . Rhot-1
C	a-c) +b = .2100E+ .5556 E-1 = .7656 E-1
	hence proved, (a+b)-c + (a-c)+b.

December 2013

1. a) Verify the distributive property of floating point numbers i.e. prove : $a(b-c) \neq ab-ac$ $a=.5555E^1$, $b=.4545E^1$, $c=.4535E^1$ Define : Truncation error, Absolute Error and Relative

Error.

```
3) a = . 5555 E' b = . 4545 E' C = . 4535 E'
     P. T. a (b-c) + ab-ac
   LHS -
   6-C = .4545 E - .4535 E'
         = .0010 E
  a(b-c) = (.5555 E1) (.1E-1)
         = . 05555 E
          = 0.5555 E-1
   ab = .5555 E' x .4545 E'
      = . 2524 E2
  ac = - 5555 E | x - 4535 E |
      = .2519 E2
  ab - ac = . 2524 E2 - . 2519 E2
           = .0005 E2 = .5000 E-1
 : hence provid, a(b-c) + ab-ac.
```

Truncation error: It is defined as an error created by approximating a mathematical operation. It is a consequence of doing finite number of steps in a calculation that would require infinite number of steps to do exactly.

Example is : evaluation of infinite sum

Absolute error: It is defined as the magnitude of the difference between the actual value (x) and the approximated value(xa).

Absolute error= | x-xa |

Relative error:

It is defined as the ratio of absolute error and the actual value.

Relative error = |x-xa|/x

June 2014

1. d) Ten coins are thrown simultaneously, find the probability of getting at least seven heads.

Let X be a Binomial RV "getting a head".

$$n = 10$$

$$p=1/2$$

$$q=1-1/2=1/2$$

 $P(getting at least 7 heads) = P(X \ge 7) = P(X = 7) + P(X = 8) + P(X = 9) + P(X = 10)$

$$P(X=x) = {}^{n}C_{x} p^{X}q^{n-x}$$

$$P(X=7) = {}^{10}C_7 (1/2)^7 (1/2)^3$$

2. a)Determine the value of expression $X = \sqrt{3} + \sqrt{5} + \sqrt{7}$; accurate up to 4 significant digits, also find the absolute and relative errors.

 $\sqrt{3}$ =1.732050808

 $\sqrt{5}$ =2.236067978

 $\sqrt{7}$ =2.645751311

Approximated value of $\sqrt{3}$ =1.732

Approximated value of $\sqrt{5}$ =2.236

Approximated value of $\sqrt{7}$ =2.646



=6.613870097

Approximated value of S=1.732+2.236+2.646

=6.614

Absolute error = 6.613870097-6.614

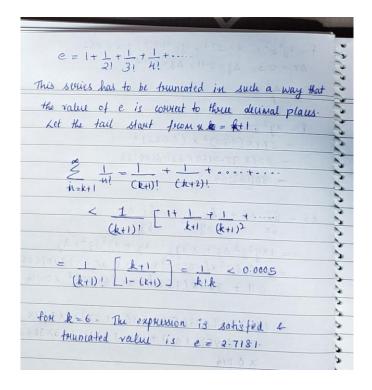
=0.0001299

Relative error=0.0001299/6.613870097

=0.00001964

December 2014

1. a) Find the value of 'e', correct to 3 decimal places. $e = 1 + 1/2! + 1/3! + 1/4! + \dots$



1. b) If 0.333 is the approximate value of 1/3, find absolute, relative and percentage errors. Explain how these errors measure accuracy.

True value=1/3

Approximate value=0.333

Absolute error= | true value-approximate value |

Relative error =absolute error/true value

Percentage error= relative error * 100 =0.000999*100 =.099%

The errors which are used for determination of accuracy are categorized as:

a) Absolute error b) Relative error c) Percentage error

Absolute error: It is defined as the magnitude of the difference between the actual value (x) and the approximated value (xa).

Absolute error= | x-xa |

Relative error:

It is defined as the ratio of absolute error and the actual value.

Relative error = |x-xa|/x

Percentage error: relative error in percentage is called percentage error.

100er=100*|x-xa|/x

1. c) If a bank receives on an average six bad cheques per day, then what is the probability that it will receive four bad cheques on any given day?

Let X be a Poisson RV, "bank receives bad cheque".

$$\lambda = 6$$

$$P(X=4)=e^{-6}*6^{4}/4!$$

$$=(0.0024*1296)/24$$

$$=(0.0025*1296)/24$$

$$=0.135$$

5. b) Write short notes on the following Probability Distributions: (i) Binomial Distribution (ii) Poisson Distribution (iii) Normal Distribution

Binomial distribution is also known as Bernoulli's distribution. It is used with the experiments where there are only two possible outcomes.

Characteristics of a binomial distribution:

- Fixed number of trials.
- Each trial is independent of the others.
- Each trial has two outcomes.
- Probability of each outcome remains constant from trial to trial.

Formula:

 $P(X=x) = {}^{n}C_{x} p^{X}q^{n-x}$ where n is total number of outcomes, p is probability of success and q is probability of failure.

 ${}^{n}C_{x}=n!/(n-r)!r!$

ii. Poisson Distribution: It is the limiting case of binomial distribution. It is used to find the probability of an experiment in a given time interval or specified region of space.

Characteristics of Poisson Distribution:

- a) The average occurrence rate per unit time is constant.
- b) Occurrence in an interval is independent of what has happened previously.
- c) The chance that more than one occurrence will happen at the same time is negligible.

Formula:

$$P(x)=(e^{-m*}m^x)/x!$$

m=np, where n: total number of outcomes, p: probability of success

4. c) Prove that $x(y-z) \neq xy - xz$, where $x = 0.5555 E^1$, $y = 0.4545 E^1$ and $z = 0.4535 E^1$.

3) a= .5555 E' b= .4545E' C= .4535 E' P. T. a (b-c) + ab-ac 6-C = .4545 E - .4535 E' = .0010 E - · look -1 a(b-c) = (.5555 E') (.1E-1) = . 05555 E = 0.5555 E-1 ab = .5555 E' x .4545 E' = . 2524 E2 ac = . 5555 E x - 4535 E = .2519 E2 ab - ac = .2524 E2 - .2519 E2 = .0005 E² = .5000 E⁻¹ s. hence provid, a(b-c) + ab-ac.

4. d) Solve the quadratic equation $x^2 + 9.9x - 1 = 0$, using two decimal digit arithmetic with rounding.

Answer in the text book, example 5 Block 1 Page number 14

June 2015

1. a) Show that a(b - c) ab-ac, where $a = 0.5555 \times 10'$, $b = 0.4545 \times 10'$ and $c = 0.4535 \times 10'$. Use 4-digit precision floating point and significant digit rounding off.

3) Q= .5555 E' b= .4545 E' C= .4535 E'	
P.T. a(b-c) = ab-ac	010-0-40-0
LHS -	2 2 3
b-C = .4545 E 4535 E'	
= · 0010 E 1	200=(38-0-14-0)=
= · loog = 1	04.0
12-0-12-0-13	4 041 4236 4 02
a(b-c) = (.5555 E1) (.1E-1)	0 = 0 + 0 0 + 0
= · 05555 E°	
= 0.5555 E ⁻¹	
RHS	2 2
ab = .5555 E' x .4545 E'	
= · 2524 E2	test to the
= • & D & H & -	3 1200-04
	CHORD IS DECEMBLE
$ac = -5555 E^{1} \times -4535 E^{1}$	
= · 2519 £ 2	
	- 5615e 5554
$ab - ac = .2524 E^22519 E$	= 2
$= \cdot 0005 E^2 = \cdot 5000$	=
hence provid, a(b-c) & ab-ac.	SHEET - SETTER -
	3 9531 × =

1. g) If $\prod = 314159265$, then find out to how many decimal places the approximate value of 22/7 is accurate.

True value=3.14159265

Approximate value=22/7

Absolute error= | true value-approximate value |

= | 22/7-3.14159265 |

= | (22-21.99114855)/7 |

= | 0.00885145/7 |

=0.001264492857

 $0.001264492857 \le 1/2(10)^{-2}$

i.e., k=2

Therefore, ∏=3.14159265 is accurate upto 2 decimal places or 3 significant digits.

2. c) What are the sources of errors in numerical data and processing? How does error measure accuracy?

Different sources of error are:

- Data input errors
- Error in algorithm and
- Error during computation

Data input errors: The input information is rarely exact since it comes from experiments and any experiment can give results of only limited accuracy. Moreover, the quantity used can be represented in a computer for only a limited number of digits.

Error in algorithm: Such errors occurs where infinite algorithms are used. Exact results are expected only after an infinite number of steps. As this cannot be done in practice, the algorithm has to be stopped after a finite number of steps and the results are not exact.

Error during computation. Such errors occurs when elementary operations such as multiplication and division are used the case when number of digits increases greatly so that the results cannot be held fully in computer register.

The errors which are used for determination of accuracy are categorized as:

a) Absolute error b) Relative error c) Percentage error

Absolute error: It is defined as the magnitude of the difference between the actual value (x) and the approximated value(xa).

Absolute error= | x-xa |

Relative error:

It is defined as the ratio of absolute error and the actual value.

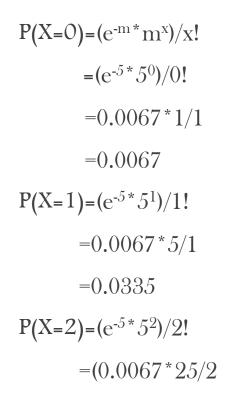
Relative error = |x-xa|/x

Percentage error : relative error in percentage is called percentage error.

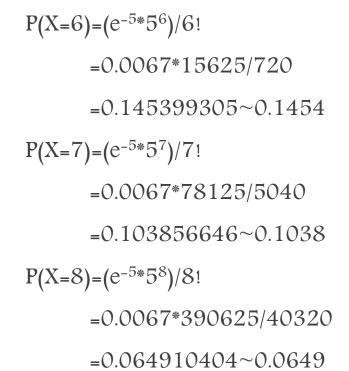
100er = 100* | x-xa | /x

4. b) A manufacturer of cotton pins knows that 5% of his product is defective. If he sells cotton pins in boxes of 100 and guarantees that not more than 10 pins will be defective. What is the approximate probability that a box will fail to meet the guaranteed quality?

m=np n=100,p=5%=5/100 m=np=100*5/100=5 $P(x)=(e^{-m}m^x)/x!$ $P(a box will fail to meet the guaranteed quality)=P(X \ge 10)=1-P(X \le 10)$



=0.0838 $P(X=3)=(e^{-5*}5^3)/3!$ =0.0067*125/6 =0.1396 $P(X=4)=(e^{-5}*5^4)/4!$ =0.0067*625/24 =0.1745 $P(X=5)=(e^{-5*}5^5)/5!$ =0.0067*3125/120 =1.0469



```
\begin{split} P(X=9) = & (e^{-5*}5^9)/9! \\ & = 0.0067*1953125/362880 \\ & = 0.036061335 \sim 0.036 \\ P(X=10) = & (e^{-5*}5^{10})/10! \\ & = 0.0067*9765625/3628800 \\ & = 0.018030667 \sim 0.0180 \\ P(a box will fail to meet the guaranteed quality) = P(X \ge 10) = 1 - P(X \le 10) \\ & = 1 - \\ [0.0067 + 0.0335 + 0.0838 + 0.1396 + 0.1745 + 1.0469 + 0.1454 + 0.1038 + 0.0649 + 0.036 + 0.0180] \\ & = 0.8531 \end{split}
```

5. c) If a bank receives on an average 6 bad cheques per dap what is the probability that it will receive 4 bad cheques on any given day.

Let X be a Poisson RV, "bank receives bad cheque".

$$\lambda = 6$$

December 2015

1. b)Round off the number 4.5126 to 4 significant figures and find the relative percentage error.

True value=4.5126

Approximate value=4.513

Absolute error= | true value-approximate value | = | 4.5126-4.513 |

=0.0004

Relative error= | absolute error/true value | = | 0.0004/4.5126 |

=0.00008864

Percentage error=100*relative error=.008864%

2. a) What do you mean by the term "Accuracy" and "Precision"? How are they related to the significant digits?

Accuracy and precision are closely related to significant digits.

- 1) Accuracy refers to the number of significant digits in a value. For example, the number 57.396 is accurate to five significant digits.
- 2) Precision refers to the number of decimal positions, i.e. the order of magnitude of the last digit in a value. The number 57.396 has a precision of 0.001 or 10^{-3} . 4.3201 has a precision of 10^{-4} .

4. a) If a bank receives on an average X = 6 bad cheques per day, what is the probability that it will receive 4 bad cheques on any given day, where X denotes the average arrival rate per day? Let X be a Poisson RV, "bank receives bad cheque".

$$\lambda = 6$$

$$P(X=4)=e^{-6} * 6^{4}/4!$$

$$= (0.0025*1296)/24$$

$$= 0.135$$

5. c)Round off the number 4.5126 to 4 significant figures and find the relative percentage error.

True value=4.5126

Approximate value=4.513

Absolute error= | true value-approximate value | = | 4.5126-4.513 |

=0.0004

Relative error= | absolute error/true value | = | 0.0004/4.5126 |

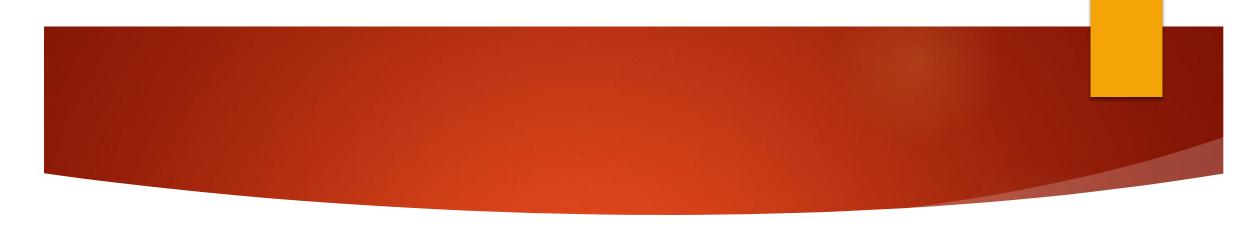
=0.00008864

Percentage error=100*relative error=.008864%

June 2016

1. a)If $\prod = \frac{22}{7}$ approximated as 3.14, find the absolute error, relative error and relative percentage error.

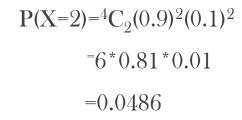
```
True value=22/7
Approximated value=3.14
Absolute error = 22/7-3.14
=(22-21.98)/7
=0.002/7
=0.0028571
Relative error=(0.0028571)/(2/3)
=0.0085713/2
=0.00428565=0.0043
```



Percentage error=0.0043*100 =0.43 3. b) A farmer buys a quantity of cabbage seeds from a company that claims that approximately 90% of the seeds will germinate if planted properly. If four seeds are planted, what is the probability that exactly two will germinate.

Let X be a Binomial RV of "seed will germinate".

P(exactly two will germinate)=P(X=2)



December 2016

1. a)Let $a = 0.345 \times 10^{\circ}$, $b = 0.245 \times 10^{-3}$ and $c = 0.432 \times 10^{-3}$. Using 3-digit decimal arithmetic with rounding, prove that $(a + b) c \neq a + (b + c)$.

Let a = 0.345×10°, b= 0.245×10-3, C=0.432×10-3 - 0.34745 x 10" - 0.34745 By using 3-digit decimal assistantic with sounding, LHS = 0.347 RHS = a+(b+c) $(6+c) = (0.245 \times 10^{-3}) + (0.432 \times 10^{-3})$ $= 0.677 \times 10^{-3}$ 8a+(b+c) = 0.345×10°+ 0.677×10-3 = 0000 0-345 x 10 + 0.00677 x 10° = 0.35177 x10 = 0.35177 By using, 3-digit decimal artithmetic with sounding, RHS = 0.352. : LHS = RHS ie - (a+b)+c = a+(b+c)

2. c) If a bank receives on an average λ =6 bad cheques per dap what is the probability that it will receive 4 bad cheques on any given day.

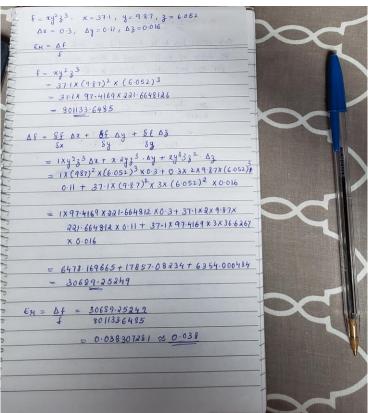
Let X be a Poisson RV, "bank receives bad cheque".

$$\lambda = 6$$

June 2017

1. a) Evaluate the relative error of the function f = xy2z3, if x = 37.1, y = 9.87, z = 6.052

and $\Delta x = 0.3$, $\Delta y = 0.11$, $\Delta z = 0.016$.



1. d) A taxi hire firm has two taxies which it hires out day by day. The number of demands for a car on each day is distributed as Poisson variate with mean 1.5. Calculate the proportion of the day on which (i) neither taxi is used, and (ii) some demand is refused.

m = 1.5

$$P(x)=(e^{-m*}m^{x})/x!$$

P(neither taxi is used)= $P(X=0)=(e^{-1.5}*1.5^0)/0!$

P(some demand is refused)= $P(x \ge 3)=1-[P(X=0)+P(X=1)+P(X=2)]$

```
P(X=0)=(e^{-1.5*}1.5^{0})/0!
      =0.22313016~0.2231
P(X=1)=(e^{-1.5*}1.5^1)/1!
      =0.2231*1.5
      =0.3346
P(X=2)=(e^{-1.5*}1.5^2)/2!
      =0.2509
P(some demand is refused)=P(x\ge3)=1-[P(X=0)+P(X=1)+P(X=2)]
                           =1-[0.2231+0.3346+0.2509]
                           = 0.1914
```

December 2017

1. a) Evaluate the sum $S = \sqrt{7} + \sqrt{5} + \sqrt{3}$ to 4 significant digits and find its absolute and relative error.

```
\sqrt{7}=2.645751311
```

$$\sqrt{5}$$
=2.236067978

$$\sqrt{3}$$
=1.732050808

Approximated value of $\sqrt{7}$ =2.646

Approximated value of $\sqrt{5}$ =2.236

Approximated value of $\sqrt{3}$ =1.732



=6.613870097

Approximated value of S=2.646+2.236+1.732

=6.614

Absolute error = 6.613870097-6.614

=0.0001299

Relative error=0.0001299/6.613870097

=0.00001964

4. a) A thesis contains 100 misprints distributed randomly throughout its 100 pages. What is the probability that a page observed at random contains at least two misprints?

Let X be a Poisson RV "page has mistakes"

$$P(x)=(e^{-m*}m^x)/x!$$

In 100 pages there are 100 mistakes

$$m=np=100*1/100=1$$

$$P(X \ge 2) = 1 - P(X \le 1)$$

$$=1-[P(X=0)+P(X=1)]$$

$$P(X=0)=(e^{-1}*1^0)/0!$$

P(X=0)=(0.3679*1)/1 =0.3679 $P(X=1)=(e^{-1}*1^{1})/1!$ =(0.3679*1)/1 =0.3679 $P(X\geq 2)=1-[0.3679+0.3679]$ =1-0.7358 =0.2642

5) Discuss the formulas for the following: (i) Binomial distribution (ii) Poisson distribution (iii) Normal distribution

Binomial distribution is also known as Bernoulli's distribution. It is used with the experiments where there are only two possible outcomes.

Characteristics of a binomial distribution:

- Fixed number of trials.
- Each trial is independent of the others.
- Each trial has two outcomes.
- Probability of each outcome remains constant from trial to trial.

Formula:

 $P(X=x) = {}^{n}C_{x} p^{X}q^{n-x}$ where n is total number of outcomes, p is probability of success and q is probability of failure.

$${}^{n}C_{x}=n!/(n-r)!r!$$

ii. Poisson Distribution: It is the limiting case of binomial distribution. It is used to find the probability of an experiment in a given time interval or specified region of space.

Characteristics of Poisson Distribution:

- a) The average occurrence rate per unit time is constant.
- b) Occurrence in an interval is independent of what has happened previously.
- c) The chance that more than one occurrence will happen at the same time is negligible.

Formula:

$$P(x)=(e^{-m*}m^x)/x!$$

m=np, where n: total number of outcomes, p: probability of success

5. b) If a bank receives on an average λ =6 bad cheques per dap what is the probability that it will receive 4 bad cheques on any given day.

Let X be a Poisson RV, "bank receives bad cheque".

$$\lambda = 6$$

June 2018

1. a)Define relative and percentage error. Find the relative and percentage error when the value of $\prod = 22/7$ is approximated to 3.14.

Relative error : It is defined as the ratio of absolute error and the actual value. It is denoted by $\boldsymbol{E}_{\!\!\!\!\mathrm{r}}.$

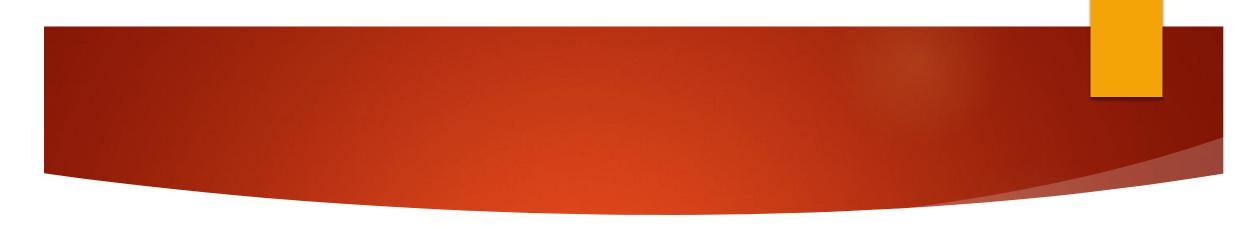
Relative error = |x-xa|/x

Percentage error :relative error in percentage is called percentage error.

It is denoted by E_p .

$$E_{p} = 100* | x-xa | /x$$

True value=22/7Approximated value=3.14Absolute error = 22/7-3.14=(22-21.98)/7=0.002/7=0.0028571Relative error=(0.0028571)/(2/3)=0.0085713/2=0.00428565=0.0043



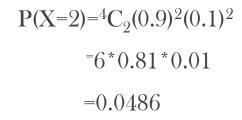
Percentage error=0.0043*100 =0.43 1. b) Find the value of 'e', correct to 3 decimal places. $e = 1 + \frac{1}{2}! + \frac{1}{3}! + \frac{1}{4}! + \dots$

	-
ASSAULT TO NOW, HER SEE THE SEE	
e = 1+ 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1	3
This series has to be truncated in such a way that	30
the value of e is convent to three decimal places.	-
Let the tail start from 1 to 1 th = 1/21.	3
New York Student JOHN A R = MET.	3
	5
$\frac{2}{n+1} = \frac{1}{n!} + \frac{1}{(k+2)!} + \frac{1}{(k+2)!}$	3
n=k+1 " (k+1)! (k+2)!	5
6 1/10:11	3
(k+1)! $[1+1+1+1+1+1+1+1+1+1+1+1+1+1+1+1+1+1+1+$	5
EV - ESSE + HV - CHR K HAVE CHXI	3
= 1	>
(k+1)! [1-(x+1)] k!k < 0.0005	3
Carry 3 Miles + 110	3
free h	5
for k=6. The expression is satisfied 4	>
tournated value is e= 2-7181.	3
X O CIS	>

1. g) A farmer buys a quantity of cabbage seeds from a company that claims that approximately 90% of the seeds will germinate if planted properly. If four seeds are planted, what is the probability that exactly two will germinate.

Let X be a Binomial RV of "seed will germinate".

P(exactly two will germinate)=P(X=2)



December 2018

1. a)Describe the term 'Error'. How are errors generated in the calculation performed by computers?

Ans: Error is defined as the difference between the actual value and the approximate value obtained from numerical computation.

Suppose x is actual value and xa is approximate value,

then Error = x-xa

Generation of errors:

- Every operation has 2 parts: operand and operator. Approximation in either of the two contributes to errors. Approximation to operands causes propagated errors and approximations to operators causes generated errors.
- Sources of error :

Different sources of error are:

- Data input errors
- Error in algorithm and
- Error during computation

Data input errors: The input information is rarely exact since it comes from experiments and any experiment can give results of only limited accuracy. Moreover, the quantity used can be represented in a computer for only a limited number of digits.

Error in algorithm: Such errors occurs where infinite algorithms are used. Exact results are expected only after an infinite number of steps. As this cannot be done in practice, the algorithm has to be stopped after a finite number of steps and the results are not exact.

Error during computation. Such errors occurs when elementary operations such as multiplication and division are used the case when number of digits increases greatly so that the results cannot be held fully in computer register.

1. b) Show that a(b - c) ab-ac, where $a = 0.5555 \times 10^{\circ}$, $b = 0.4545 \times 10^{\circ}$ and $c = 0.4535 \times 10^{\circ}$. Use 4-digit precision floating point and significant digit rounding off.

3) $a = .5555 E'$ $b = .4545 E'$ $c = .4$ P. T. $a(b-c) \neq ab-ac$	535 E'
γ. τ. α(b-c) ≠ ab-ac	
	01:0 - 3 - 20-0
	d-6 4 (8-b)
LHS.	7 7 0
b-C = .4545 E'4535 E'	
= · 0010 E 1	200 = (18-0-18-0)
⇒ • loog = 1	01-0 01-0
12-0-12-0-12	0.017 = 0.02 = 0.02
$a(b-c) = (.5555 E^{\dagger}) (.1E^{-1})$	20 = 070 010
= · 05555 E°	
= 0.5555 E ⁻¹	and A total break
RHS	9 15 11 19
ab = .5555 E' x .4545 E'	
= .2524 E ²	the reserved to
	duction to did no
ac = • 5555 E x - 4535 E	
= · 2519 £ 2	
The state of the same of the s	1 - 3 ct 2 - 1 - 2 1 5 c - 1
$ab - ac = .2524 E^22519$	F 2
$= .0005 E^2 = .500$	=
hence proved, a(b-c) & ab-ac.	34435 - 13646B
Market Street Committee of the Street Street	1 to 1 5 11 00 .

1. g) In turning out certain toys in the manufacturing process in a factory, the average number of defectives is 10%. What is the probability of getting exactly 3 defectives in a sample of 10 toys chosen at random, by using Poisson approximation? (Take e = 2.72).

m=np
=10*1/10=1

$$P(x)=(e^{-m}*m^x)/x!$$

 $P(x=3) = (e^{-1}.1^3)/3!=0.3679/6$
=0.06131666~0.061317

In question, it is given

Take e = 2.72.

So when e=2.72

$$P(x=3) = (e^{-1}.1^{3})/3! = 2.72/6$$
$$= 0.4533333333 \sim 0.4533$$

- 3. a) Write short notes on any four of the following: (i) Discrete Random Variable (ii) Continuous Random Variable (iii) Binomial Distribution (iv) Poisson Distribution (v) Chi-square Distribution
- (i) Discrete Random Variable: A random variable X is said to be discrete, if the total number of values X can take is finite, i.e. the support of X is either finite or countable. Examples of discrete random variable: The number of industrial accidents in each month in West Bengal. The number of defective goods in a shipment of goods from a manufacturer.

iii. Binomial distribution: Binomial distribution is also known as Bernoulli's distribution. It is used with the experiments where there are only two possible outcomes.

Characteristics of a binomial distribution:

- Fixed number of trials.
- Each trial is independent of the others.
- Each trial has two outcomes.
- Probability of each outcome remains constant from trial to trial.

Formula:

 $P(X=x) = {}^{n}C_{x} p^{X}q^{n-x}$ where n is total number of outcomes, p is probability of success and q is probability of failure.

iii. Binomial distribution: Binomial distribution is also known as Bernoulli's distribution. It is used with the experiments where there are only two possible outcomes.

Characteristics of a binomial distribution:

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Formula:

 $P(X=x) = {}^{n}C_{x} p^{X}q^{n-x}$ where n is total number of outcomes, p is probability of success and q is probability of failure.

iv. Poisson distribution: It is the limiting case of binomial distribution. It is used to find the probability of an experiment in a given time interval or specified region of space.

Characteristics of Poisson Distribution:

- a) The average occurrence rate per unit time is constant.
- b) Occurrence in an interval is independent of what has happened previously.
- c) The chance that more than one occurrence will happen at the same time is negligible.

Formula:

$$P(x)=(e^{-m*}m^x)/x!$$

m=np, where n: total number of outcomes, p: probability of success

June 2019

b) What do you mean by the term "Accuracy" and "Precision"? How are they related to the significant digits?

Accuracy and precision are closely related to significant digits.

- 1) Accuracy refers to the number of significant digits in a value. For example, the number 57.396 is accurate to five significant digits.
- 2) Precision refers to the number of decimal positions, i.e. the order of magnitude of the last digit in a value. The number 57.396 has a precision of 0.001 or 10^{-3} . 4.3201 has a precision of 10^{-4} .

1. d) What is the probability of getting at least seven heads, when ten coins are thrown simultaneously?

Let X be a Binomial RV "getting a head".

$$n = 10$$

$$p=1/2$$

$$q=1-1/2=1/2$$

P(getting at least 7 heads)= $P(X \ge 7) = P(X = 7) + P(X = 8) + P(X = 9) + P(X = 10)$

$$P(X=x) = {}^{n}C_{x} p^{X}q^{n-x}$$

$$P(X=7) = {}^{10}C_7 (1/2)^{7}(1/2)^3$$

