UNIT I – Random Variables and Statistical Averages

1. The height of persons in a country is a random variable of the type
   (a) Continuous (b) Discrete (c) Neither discrete nor continuous
   (d) Continuous as well as discrete
2. $\underset{x\to\infty}{Lt}\, F(x) =$ ______
   (a) 0 (b) 2 (c) 1 (d) - 1
3. A random variable X has the following probability function:

x	0	1	2	3	4
P(x)	k	2k	5k	7k	9k

   The value of k = __________
   (a) $\frac{2}{24}$ (b) $\frac{21}{24}$ (c) $\frac{7}{12}$ (d) $\frac{1}{24}$
4. The probability density function of a continuous random variable is $f(x) = ce^{-|x|}; -\infty < x < \infty$ then the value of c = ______
   (a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) $\frac{3}{4}$ (d) $\frac{1}{6}$
5. If X is a random variable which can take only non – negative values, then
   (a) $E(X^2) = [E(X)]^2$ (b) $E(X^2) \geq [E(X)]^2$
   (c) $E(X^2) \leq [E(X)]^2$ (d) None of the above
6. If c is a constant (non random variable), then $E(c)$ is
   (a) 0 (b) 1 (c) $cf(c)$ (d) c
7. If $f(x) = \frac{1}{10}; x = 10$ then E(x) is
   (a) 0 (b) 2 (c) 1 (d) - 1
8. $\text{var}(4x+8)$ is
   (a) $12.\text{var}(x)$ (b) $4.\text{var}(x)+8$ (c) $16.\text{var}(x)$ (d) $16.\text{var}(x)+8$
9. Family size can be represented by the random variable x. determine the average family size

x	2	3	4	5
P(x)	0.17	0.47	0.26	0.10

   (a) 2.94 (b) 3.00 (c) 3.29 (d) 3.86
10. If X is a random variable and r is an integer, then $E(X^r)$ represents
    (a) r^{th} central moment (b) r^{th} factorial moment
    (c) r^{th} raw moment (d) none of the above

11. If random variable x has the p.d.f $f(x)=\begin{cases}3x; & 0<x<1\\ 0; & otherwise\end{cases}$, then the p.d.f of $y=4x+3$ is

(a) $\frac{3}{4}(y-3)$ (b) $\frac{3}{16}(y-3)$ (c) $\frac{1}{4}(y-3)$ (d) $\frac{3}{2}(y-3)$

12. If the exponential distribution is given as $f(x)=e^{-x};\ 0\le x\le\infty$, then the mean of the distribution is

(a) 1 (b) 0 (c) 2 (d) - 1

13. The expectation of the number on a die when thrown

(a) 1 (b) $\frac{7}{2}$ (c) 3 (d) 2

14. A coin is tossed until a head appears. What is the expectation of the number of tosses required?

(a) 2 (b) 1 (c) 4 (d) 5

15. A random variable x has the p.d.f given by $f(x)=\begin{cases}2e^{-2x}; & x\ge 0\\ 0; & x<0\end{cases}$, then the m.g.f is

(a) $\frac{2}{2-t}$ (b) $\frac{3}{3-t}$ (c) $2(2-t)^{-3}$ (d) $3(3-t)^{-2}$

16. If a random variable x has the p.d.f $f(x)=\frac{1}{4};-2<x<2$, then $P(x<1)$ is

(a) $\frac{2}{3}$ (b) $\frac{3}{4}$ (c) $\frac{1}{4}$ (d) $\frac{1}{2}$

17. If $E[x^2]=8$ and E[x] = 2, then var(x) is _____

(a) 3 (b) 2 (c) 1 (d) 4

18. A random variable x has mean $\mu=12$ and variance $\sigma^2=9$ and an unknown probability distribution, then $P(6<x<18)$ is

(a) $\frac{1}{2}$ (b) $\frac{3}{4}$ (c) $\frac{1}{4}$ (d) $\frac{1}{8}$

19. The C.D.F of a continuous random variable is given by $F(x)=\begin{cases}0; & x<0\\ 1-e^{-x/5}; & 0\le x\le\infty\end{cases}$

(a) $\frac{1}{5}e^{-\frac{1}{5}x}$ (b) $\frac{1}{10}e^{-\frac{1}{5}x}$ (c) $e^{-\frac{1}{5}x}$ (d) $\frac{1}{2}e^{-\frac{1}{2}x}$

20. A continuous random variable x has a p.d.f $f(x)=3x^2;0\le x\le 1$, find the value of b such that $P(x>b)=0.05$

(a) $\left(\frac{16}{20}\right)^{1/3}$ (b) $\left(\frac{19}{20}\right)^{1/3}$ (c) $\left(\frac{13}{20}\right)^{1/3}$ (d) $\left(\frac{15}{19}\right)^{1/4}$

21. If $\mu_1=0,\mu_2=\frac{1}{5},\mu_3=0$ and $\mu_4=\frac{3}{35}$, then $\beta_2=$ ___

(a) $\frac{13}{7}$ (b) $\frac{17}{9}$ (c) $\frac{15}{7}$ (d) $\frac{13}{5}$

22. If the random variable x has the p.d.f $f(x)=\begin{cases} ax^3; & 0<x<1 \\ 0; & otherwise \end{cases}$ then the value of a is

(a) 3 (b) 4 (c) $\frac{1}{2}$ (d) $\frac{3}{4}$

23. Let x be a continuous random variable with p.d.f $f(x)=\frac{x}{2};1<x<5$, then the p.d.f of $y=2x-3$ is

(a) $\frac{y+3}{8}$ (b) $\frac{y+2}{8}$ (c) $\frac{y-3}{8}$ (d) $\frac{y+4}{8}$

24. If $P(X=x)=\frac{x}{15};x=1,2,3,4,5$ then $P\left(\frac{1}{2}<X<\frac{5}{2}/X>1\right)$ is.

(a) $\frac{2}{15}$ (b) $\frac{1}{15}$ (c) $\frac{2}{7}$ (d) $\frac{1}{7}$

MULTIPLE CHOICE QUESTIONS- ANSWERS

1. (a)
2. (c)
3. (d)
4. (a)
5. (c)
6. (d)
7. (c)
8. (c)
9. (c)
10. (c)
11. (b)
12. (a)
13. (b)
14. (a)
15. (a)
16. (b)
17. (d)
18. (b)
19. (a)
20. (b)
21. (c)
22. (b)
23. (a)
24. (d)

Theoretical Distributions

1. The mean and variance of a binomial distribution is
   (a) $\mu = np, \sigma^2 = npq$ (b) $\mu = npq, \sigma^2 = np$ (c) $\mu = nq, \sigma^2 = npq$
   (d) $\mu = np, \sigma^2 = pq$
2. The MGF of binomial distribution is
   (a) $(p+qe^t)^n$ (b) $(pe^t+q)^n$ (c) $(p+qe^{-t})^n$ (d) $(pe^{-t}+q)^n$
3. If on an average, 9 ships out of 10 arrive safely to a port, then mean and S.D of the no. Of ships returning safely out of 150 ships are
   (a) mean = 135, S.D = 2.674 (b) mean = 125, S.D = 3.674
   (c) mean = 135, S.D = 3.674 (d) mean = 125, S.D = 2.674
4. A radar system has probability of 0.1 of detecting a certain target during a single scan then the probability that the target will be detected atleast once in twenty scans is
   (a) 0.8784 (b) 0.7884 (c) 0.8748 (d) 0.8478
5. The mean and variance of a binomial distribution are 4 & 4/3 respectively. Find $P(X \geq 1)$ of n = 6.
   (a) $\frac{725}{729}$ (b) $\frac{726}{729}$ (c) $\frac{727}{729}$ (d) $\frac{728}{729}$
6. Mean of the Poisson distribution is
   (a) λ (b) $\lambda+1$ (c) λ^2 (d) $\lambda-1$
7. If the random variable X follows a Poisson distribution with mean 3, then P(X=0) is
   (a) e^{-3} (b) e^3 (c) e^2 (d) e
8. Poisson distribution is limiting case of
   (a) Geometric distribution (b) Normal distribution
   (c) Binomial distribution (d) Exponential distribution
9. If X is a Poisson variate such that $E(X^2)=6$ then E(X) is
   (a) 3 (b) 2 (c) 1 (d) 0
10. If X is a Poisson variate such that P(X=0)=0.5, then var(X) is
    (a) e^2 (b) $\log 2$ (c) 0.5 (d) $\log 4$
11. The mean of a geometric distribution whose pdf is $pq^{r-1}, r = 1,2,...$
    (a) $\frac{1}{p}$ (b) $\frac{p}{q}$ (c) $\frac{q}{p}$ (d) $\frac{1}{q}$
12. If the probability of success on each trial is $\frac{1}{3}$. What is the expected no. of trials required for the first success?
    (a) 2 (b) 3 (c) 4 (d) 5
13. A candidate applying for driving license has the probability of 0.8 in passing the road test in a given trial. The probability that he will pass the test on the fourth trial is
    (a) 0.0046 (b) 0.0064 (c) 0.0604 (d) 0.0406

14. The MGF of geometrical distribution is

(a) $\frac{1}{1-qe^t}$ (b) $\frac{1}{1-pe^t}$ (c) $\frac{q}{1-pe^t}$ (d) $\frac{pe^t}{1-qe^t}$

15. If the probability of a target to the destroyed on any one shot is 0.5. What is the probability that it would be destroyed on 6^{th} attempt?

(a) $(0.5)^4$ (b) $(0.5)^5$ (c) $(0.5)^6$ (d) $(0.5)^7$

16. If X is random variable in (-2, 2), $P(X<0)$ is

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) $\frac{1}{3}$ (d) $-\frac{1}{2}$

17. If the MGF of a uniform distribution for a random variable is $\frac{1}{t}(e^{5t}-e^{4t})$ then $E(X)$ is

(a) $\frac{5}{4}$ (b) $\frac{9}{2}$ (c) 4 (d) $\frac{5}{2}$

18. A random variable X has a uniform distribution over (-3, 3). The value of k for which $P(X>k)=\frac{1}{3}$ is

(a) 3 (b) 2 (c) 1 (d) -2

19. If X has uniform distribution in (-1, 3), then $P(X>0)$ is

(a) $\frac{1}{2}$ (b) $\frac{3}{4}$ (c) $\frac{1}{3}$ (d) $\frac{1}{4}$

20. If X is uniform distributed in (0, 10), then $P(X>8)$ is

(a) $\frac{1}{5}$ (b) $\frac{1}{10}$ (c) $\frac{3}{5}$ (d) $\frac{1}{3}$

21. The mean of uniform distribution $u(a,b)$ is

(a) $a+b$ (b) $\frac{a+b}{2}$ (c) $\frac{a+b}{3}$ (d) $\frac{a+b}{4}$

22. The variance (x) of uniform distribution $U(a,b)$ is

(a) $\frac{1}{12}(b-a)^2$ (b) $\frac{(b-a)^2}{8}$ (c) $\frac{(b-a)^2}{6}$ (d) $\frac{(b-a)^2}{3}$

23. The mean of the exponential distribution with pdf $\lambda.e^{-\lambda x}, x>0$ is

(a) λ (b) $\frac{1}{\lambda}$ (c) $\frac{1}{\lambda^2}$ (d) 1

24. If the random variable X has the P.D.F $Ce^{-x/5}, x>0$ then the value of C is

(a) 5 (b) $-\frac{1}{5}$ (c) $\frac{1}{5}$ (d) -5

25. If X is exponentially distributed with mean 10 then the pdf is

(a) $10e^{-10x}, x\ge 0$ (b) $\frac{1}{10}e^{-10x}, x\ge 0$ (c) $\frac{1}{10}e^{x/10}, x\ge 0$ (d) $\frac{1}{10}e^{-x/10}, x\ge 0$

26. If a random variable X has the P.D.F $f(x)=\frac{1}{2}e^{-x/2}, x>0$, then $P(X>2)$ is

(a) e (b) $\frac{1}{e}$ (c) $e^{1/2}$ (d) $e^{-1/2}$

27. If the random variable X has the p.d.f $f(x) = \frac{1}{5}e^{-x/5}, x > 0$ then the variance of X is

    (a) 25 (b) 5 (c) 15 (d) 1

28. For a standard normal variable the mean and variance are respectively

    (a) 1 & 0 (b) $\mu \& \sigma^2$ (c) 0 & 1 (d) $\mu \& \sigma$

29. The MGF of normal distribution is

    (a) $e^{\mu t + \frac{\sigma^2 t^2}{2}}$ (b) $e^{\frac{\mu t + \sigma^2 t^2}{2}}$ (c) $e^{\mu t + \frac{\sigma t}{2}}$ (d) $e^{\mu t + \frac{\sigma t^2}{2}}$

30. In a normal distribution about 99% of the observation lie between

    (a) $\mu \pm 2\sigma$ (b) $\mu \pm \sigma$ (c) $\mu \pm 3\sigma$ (d) $\mu \pm \sigma^2$

31. The MGF of standard normal distribution

    (a) $e^{\frac{t^2}{2}}$ (b) $e^{\frac{\mu t^2}{2}}$ (c) $e^{\frac{t}{2}}$ (d) $e^{\frac{\mu^2 t}{2}}$

32. Normal distribution is the limiting form of ________ distribution under suitable statistical conditions

    (a) Binomial (b) Poisson (c) Geometric (d) Uniform

MULTIPLE CHOICE QUESTIONS- ANSWERS

1. (a)
2. (b)
3. (c)
4. (a)
5. (d)
6. (a)
7. (a)
8. (c)
9. (b)
10. (b)
11. (a)
12. (a)
13. (b)
14. (d)
15. (c)
16. (a)
17. (b)
18. (c)
19. (b)
20. (a)
21. (b)
22. (a)
23. (b)
24. (c)
25. (d)
26. (b)
27. (a)
28. (c)
29. (a)
30. (c)
31. (a)
32. (a)

HYPOTHESIS TESTING

1. If a researcher takes a large enough sample, he/she will almost always obtain:
   a. virtually significant results
   b. practically significant results
   c. consequentially significant results
   d. statistically significant results
   ANSWER: d

2. The null and alternative hypotheses divide all possibilities into:
   a. two sets that overlap
   b. two non-overlapping sets
   c. two sets that may or may not overlap
   d. as many sets as necessary to cover all possibilities
   ANSWER: b

3. Which of the following is true of the null and alternative hypotheses?

   a. Exactly one hypothesis must be true
   b. both hypotheses must be true
   c. It is possible for both hypotheses to be true
   d. It is possible for neither hypothesis to be true
   ANSWER: a

4. The chi-square goodness-of-fit test can be used to test for:
   a. significance of sample statistics
   b. difference between population means
   c. normality
   d. probability
   ANSWER: c

5. A type II error occurs when:
   a. the null hypothesis is incorrectly accepted when it is false
   b. the null hypothesis is incorrectly rejected when it is true
   c. the sample mean differs from the population mean
   d. the test is biased
   ANSWER: a

6. The form of the alternative hypothesis can be:
   a. one-tailed
   b. two-tailed
   c. neither one nor two-tailed
   d. one or two-tailed
   ANSWER: d

7. A two-tailed test is one where:
a. results in only one direction can lead to rejection of the null hypothesis
b. negative sample means lead to rejection of the null hypothesis
c. results in either of two directions can lead to rejection of the null hypothesis
d. no results lead to the rejection of the null hypothesis
ANSWER: c

8. The value set for α is known as:
a. the rejection level
b. the acceptance level
c. the significance level
d. the error in the hypothesis test
ANSWER: c

9. Which of the following values is *not* typically used for α?
a. 0.01
b. 0.05
c. 0.10
d. 0.25
ANSWER: d

10. The hypothesis that an analyst is trying to prove is called the:
a. elective hypothesis
b. alternative hypothesis
c. optional hypothesis
d. null hypothesis
ANSWER: b

11. The chi-square test is not very effective if the sample is:
a. small
b. large
c. irregular
d. heterogeneous
ANSWER: a

12. A type I error occurs when:
a. the null hypothesis is incorrectly accepted when it is false
b. the null hypothesis is incorrectly rejected when it is true
c. the sample mean differs from the population mean
d. the test is biased
ANSWER: b

13. What is the standard deviation of a sampling distribution called?
a. Sampling error
b. Sample error
c. Standard error
d. Simple error
ANSWER: c

14. A **______** is a subset of a **_________**.
a. Sample, population
b. Population, sample
c. Statistic, parameter
d. Parameter, statistic
ANSWER: a

15. A **_______** is a numerical characteristic of a sample and a **______** is a numerical characteristic of a population.
a. Sample, population
b. Population, sample
c. Statistic, parameter
d. Parameter, statistic
ANSWER: c

16. **_________** is the values that mark the boundaries of the confidence interval.
a. Confidence intervals
b. Confidence limits
c. Levels of confidence
d. Margin of error
ANSWER: b

17. **_____** results if you fail to reject the null hypothesis when the null hypothesis is actually false.
a. Type I error
b. Type II error
c. Type III error
d. Type IV error
ANSWER: b

18. When the researcher rejects a true null hypothesis, a **____** error occurs.
a. Type I
b. Type A
c. Type II
d. Type B
ANSWER: a

19. __________ is the failure to reject a false null hypothesis.

a. Type I error
b. Type II error
c. Type A error
d. Type B error
ANSWER: a

20. Which of the following statements is/are true according to the logic of hypothesis testing?
a. When the null hypothesis is true, it should be rejected
b. When the null hypothesis is true, it should not be rejected
c. When the null hypothesis is false, it should be rejected
d. When the null hypothesis is false, it should not be rejected
e. Both b and c are true
ANSWER: e

21. A failing student is passed by an examiner, it is an example of
(a) Type I error (b) Type II error (c) Unbiased decision (d) Difficult to tell
ANSWER: b

22. A passing student is failed by an examiner, it is an example of
(a) Type I error (b) Type II error (c) Best decision (d) All of the above
ANSWER: a

23. Area of the rejection region depends on
(a) Size of α (b) Size of β (c) Test-statistic (d) Number of values
ANSWER: a

24. Which hypothesis is always in an inequality form?
(a) Null hypothesis (b) Alternative hypothesis (c)Simplehypothesis
(b) (d) Composite hypothesis
ANSWER: b

25. The degree of freedom for t-test based on n observations is
(a) 2n -1 (b) n -2 (c) 2(n -1) (d) n -1
ANSWER: d

26. Student's t-distribution has (n-1) d.f. when all the n observations in the sample are
(a) Dependent (b) Independent (c) Maximum (d) Minimum
ANSWER: b

27. The number of independent values in a set of values is called
(a) Test-statistic (b) Degree of freedom (c) Level of significance (d)Levelofconfidence
ANSWER: b

MA1014 – Probability & Queueing Theory

UNIT IV – Queueing Theory

MULTIPLE CHOICE QUESTIONS

1. In which basis the service is provided in queueing theory
   (a) LCFO (b) LIFO (c) FCFS (d) FCLS
2. What stands for 'd' in the queue model (a/b/c : d/e)
   (a) queue discipline (b) system capacity (c) service time (d) number of servers
3. The symbolic notation of queueing model is represented by
   (a) Kendall (b) Euler (c) Fisher (d) Neumann
4. The interval between two consecutive arrivals of a Poisson process follows ________ distribution
   (a) Binomial (b) Uniform (c) Normal (d) Exponential
5. The average number of customers in the system in (M/M/1 : ∞/FIFO) model is
   (a) $\frac{\lambda}{\mu-\lambda}$ (b) $\frac{\mu}{\lambda-\mu}$ (c) $\frac{\lambda}{\mu+\lambda}$ (d) $\frac{\mu}{\lambda+\mu}$
6. In queueing theory, generally the service rate is denoted by __________
   (a) λ (b) μ (c) $\lambda\mu$ (d) λ/μ
7. If the behaviour of the system is independent of time, then the system is said to be
   (a) steady state (b) transient state (c) unsteady state
   (d) all of the above
8. What stands for 'e' in the queue model (a/b/c:d/e)
   (a) queue discipline (b) system capacity
   (c) maximum queue size (d) service time
9. The probability of no customers in the system in (M/M/1:∞/FIFO) model ________
   (a) $\frac{\lambda}{\mu}$ (b) $\frac{\lambda}{\mu}-1$ (c) $1-\frac{\lambda}{\mu}$ (d) $\frac{\lambda}{\mu}+1$
10. The probability of 'n' customers in the system $P_n =$
    (a) $\frac{\lambda}{\mu}P_0$ (b) $\left(\frac{\lambda}{\mu}\right)^n P_0$ (c) $\left(\frac{\mu}{\lambda}\right)^n P_0$ (d) $\frac{\mu}{\lambda}P_0$
11. The overall effective arrival rate is $\lambda' =$
    (a) $\mu(1-P_0)$ (b) $\lambda(1-P_0)$ (c) μP_0 (d) λP_0
12. The probability that the number of customers in the system exceeds k, in (M/M/1:∞/FIFO) model
    (a) $\left(\frac{\lambda}{\mu}\right)^{k+1}$ (b) $\left(\frac{1}{\mu}\right)^{k+2}$ (c) $\left(\frac{\lambda}{\mu}\right)^{k+3}$ (d) $\left(\frac{\lambda}{\mu}\right)^{k}$
13. The average waiting time of a customer in the system in (M/M/1:∞/FIFO) model __
    (a) $\frac{1}{\mu-\lambda}$ (b) $\frac{1}{\lambda-\mu}$ (c) $\frac{1}{\lambda+\mu}$ (d) None
14. What is the mean of the Poisson process?
    (a) λ (b) λt (c) $\frac{\lambda}{t}$ (d) $\frac{t}{\lambda}$

15. The probability that **the system is idle** is denoted by
(a) P_0 (b) P_1 (c) P_2 (d) P_n

16. The probability that **the system is busy** is denoted by
(a) P_0 (b) P_1 (c) P_2 (d) P_n

17. The traffic intensity of a queueing system is
(a) λ (b) μ (c) $\frac{\lambda}{\mu}$ (d) $\frac{\mu}{\lambda}$

18. Which term refers to "A customer who leaves the queue because the queue is too long"
(a) Balking (b) Reneging (c) Jockeying (d) Leaving

19. In all the queueing models, what is the symbol 'M' stands for?
(a) Maths (b) Model (c) Markov (d) Multi

20. In (M/M/1: K /FIFO) model, if $\lambda = 3/hour, \mu = 4/hour$ and effective mean arrival rate of a customer is 2.88 / hour then what is P_0?
(a) 0.18 (b) 0.28 (c) 0.38 (d) 0.48

MULTIPLE CHOICE QUESTIONS- ANSWERS

1. (c)
2. (b)
3. (a)
4. (d)
5. (a)
6. (b)
7. (a)
8. (a)
9. (c)
10. (b)
11. (a)
12. (a)
13. (a)
14. (b)
15. (a)
16. (d)
17. (c)
18. (a)
19. (c)
20. (b)

MARKOVCHAINS

1.Markov process is one in which the future value is independent of _______ values

a) Present b)Past c) Future d) None

2. Chapman- Kolomogorov theorem states that

a) $[P_{ij}^{(n)}] = [Pij]^n$ b) $[P_{(n)}] = [Pij]^n$ c) $[nP_{ij}] = [Pij]^n$ d)$Pij [^{(n)}] = [Pij]^n$

3. Transition matrix is a _______ with sum of the row as 1

a) zero matrix b) Square matrix c) Rectangular matrix d) any order

4..Ergodic means

a) irreducible and periodic b) irreducible and aperiodic c) not irreducible d) regular

5. In a transition probability matrix, the sum of all elements of any row is

a) 0 b) 1 c)2 d)-1

6. If the tpm of the markov chain is $P = \begin{pmatrix} 0 & 1 \\ 1/2 & 1/2 \end{pmatrix}$ the steady – state distribution of the chain is

a)(1/2, ½) b)(5 /6, 1/6) c) (1/6 , 1/6) d)(1,0)

7. The limiting probability $\lim_{\vec{n}\infty}$ $p^{(n)}$= ________

a) 0 b)1 c) π d) P

8. If P is a tpm of the regular Markov chain, then

a) Pπ =π b) πP= π c) $\pi P^2 = \pi$ d) $P^2\pi = \pi$