Ministry of Higher Education & Scientific Research/ Salahaddin University-Erbil

College of Administration and Economics

Department: **Statistics and Informatics**

Stage: **Four Year**

**Bank of Question for Stochastic processes**

1. **In New England, 84% of the houses have a garage and 65% of the houses have a garage and a back yard. What is the probability that a house has a back yard given that it has a garage?**
2. **bag contains 7 yellow balls and 5 red balls. One ball is taken from the bag at random and is not replaced. A second ball is then taken from the bag. Determine the probability that at least one ball is yellow?**
3. **Find the mean and variance for binomial distribution by p.g.f**
4. **define 1-Sample Space 2-Stochastic Processes 3-Stationary independent increment 2-Random variable 3-Number of success**
5. **Difference between (stochastic process and probability) with example**

1. **/Prove that 1/**

1. **Classification Stochastic Process**
2. **Show that if is a strict-senses random process is also WSS**

1. **Plays tennis players (A and B) five match, if any player has won three match is the winner**

**1-What Probability win player A in the fourth match**

 **2-Expected the winning player in the third match**

**3-What Probability win the player A in the fifth match  or before that**

1. **A conversation in a wireless Reber network is severely disturbed by interference signals according to a Poisson process of rate λ =0.1 per minute.**
2. **What is the probability that no interference signals occur within the first two minutes of the conversation?**
3. **Given that the first two minutes are free of disturbing effects, what is the probability that in the next minute precisely one interfering signal disturbs the conversation?**

**11- A person plays a game in which the probability of winning 2$ is 0.50 and losing $1 is 0.50. He stops playing if he loses 2$ or win 4$ .**

* **Find the transition Matrix**  .
* **What is the probability that he has lost all his money at the end of 2 plays**
* **How many communicating state, absorbing state , Irreducible Markov chain with transition diagrams**

 **12- If you have the transition Matrix? Find M and F**

**P=**

**13- Prove that**

**14- A counting process {N(t), t ≥ 0} must satisfy(Property)**

**15-Show that if a random process X(t) is WSS then it must also be covariance stationary**

**16-Find the mean and variance for Gamma distribution by p.g.f**

**17- You are fishing with a friend. Suppose that you catch fish as a Poisson process of rate 2 per hour, and your friend catch fish as a Poisson process of rate 3 per hour. Note: fishing (**راوة ماسى **), catch(**دةيطريَت**)**

1. **What is the probability that you catch at least 2 fish in 3 hour?**
2. **What is the probability that you time between the first catch with next catch exceed 2 hour?**
3. **What is the probability that catch 4 fish in 3 hour together (you and friend)**
4. **What is the expectation and the variance of the time till the 6th catch fish your friend (only friend)?**

**18-A psychologist makes the following assumptions concerning the behavior of mice subjected to a particular feeding schedule. For any particular trial 80% of the mice that went right in the previous(**ثيَشوو) **experiment will go right in this trial, and 60% of those mice that went left in the previous experiment will go right in this trial. If 50% went right in the first trial, what would he predict for**

1. **The second trial? (c) The thousandth trial**

**19- If you have the transition Matrix?**

* **Find the transition diagrams**  .
* **How many communicating state, absorbing state , Irreducible Markov chain and Transient and Recurrent States**

**20-** **for the experiment of tossing a coin (a) once and (b) twice.**

**Explain each of them (trial, outcome, random experimental, sample space, events)? and what difference between sample space and Events**

**21- Find the mean and variance for Geometric distribution by p.g.f**

 **22-prove that P(T=t)**

**23- Suppose that cars arriving to a gas station(محطة بنزين) following a Poisson process with λ = 4 car/hour.**

**1. What is the probability that 6 cars arrive in the ﬁrst hour**

**2. Suppose that the operator gets (كريكاري محطة ) to take break after she has served(خزمةت) 10 cars. How long her average work periods?**

**3. Suppose that 3/4’s of all cars are driven by men, 1/4 by women. What is the probability that in one hour exactly 2 men and 3 women will arrive at the station?**

**24- The probability that a patient recovers(ضاك بوون لة نةخؤشي) from blood disease(نةخوشي خوين ) is 0.4 . (and probability female patient recovers is 0.2)**

1. **Find the probability that among 10 blood disease at least 2 survive.**

 **Survive: نةخوش لة ذيان بميَنيَ**

1. **probability that a 6 survive will be from 20th blood disease**
2. **probability that a 4 survive will be from 15th blood disease she is female**
3. **Find the mean and variance survive a from 18th blood disease**

25- **If you have the transition Diagram?**

**0.5**

**0.2**

**1**

**0.2**

**0.6**

**0.25**

**0.25**

 **1**

 **4**

**1**

**2**

**3**

* **Find the transition Matrix**  .
* **How many communicating state, absorbing state , Irreducible Markov chain and Transient and Recurrent States**

**Find M and F**

**26-**Consider a family of exactly two children. We will find the probabilities:

1. **both are girls**
2. **both are girls given that the elder(یه‌كه‌م مندال) child is a girl**

27- The number of types of **service discipline**

28- Classification of Stochastic Processes

**29-** Arrival of virus **attacks** (هيرش كردنة سةر) to a Personal Computer (PC) can be modeled by a Poisson process with rate λ =6 attacks per hour.

1. **What is the probability that exactly one attack will arrive between 1 p.m. and 2 p.m.**
2. **Given that six attacks arrive between 1 p.m. and 2 p.m., what is the probability that the fifth attack will arrive between 1:30 p.m. and 2 p.m.?**
3. **What is the expected arrival time of that fifth attack?**

30- If you have the transition Matrix?

* **Find the transition diagrams**  .
* **How many communicating state, absorbing state,**

 **Irreducible Markov chain, and Transient States**

* **Find M**

**31-** It is estimated that 80% of people in Erbil **take(وةردةكرن)** Paracetamol for **headache treatment(ضارةسةري سةر ئيَشة**) ( 40% from the testing is females)

1. **Probability that among 5 patient (نةخؤش) at least 2 people take Paracetamol.**
2. **If you know that a patient is Female، find probability that a 6th patient take Paracetamol from 20th peoples.**

**32-** People arrive at a telephone booth(كؤشكي تةلةفؤن) according to a Poisson process at an average rate of 12 per hour, and the average time for each call is an exponential r.v. with mean 2 minutes. Find

1. **Average number of people in the system**
2. The telephone company decision (كؤمثانياي تةلةفؤن برياريدا) to add a second booth (داناني كؤشكي دووةم) **if** customers wait in the queue an average of 3 or more minutes for the phone (Wq >= 3 minutes). **Find the average arrival rate** needed to justify a second booth?

**33- A math teacher gave her class two tests. 25% of the class passed both tests and 42% of the class passed the first test. What percent of those who passed the first test also passed the second test?**

**34- Find the mean and variance for Exponential distribution by p.g.f**

**35- define 1-Markov Process 2-Mutually Exclusive Events**

**36- You get email according to a Poisson process at a rate of A = 0.2 messages per hour.**

**1-You check your email every hour. What is the probability of finding 0 and 1 new message?**

**2-Suppose that you have not checked your email for a whole day. What is the probability of finding 5 new messages?**

**37- A salesman's territory consists of three cities A, B and C. He never sells in the same city on successive days. If he sells in city A, then the next day he sells in city B. However, If he sells in either A or B, then the next day he is twice as likely (probable) to sell in city A as in other city.**

* **Find the transition Matrix**
* **In the long run, how often does he sell in each of the cities?**

**38- In the diagram mouse is randomly moving from room to room**

* **Find the transition Matrix**

**2-By Matrix diagram, how many communicating state, absorbing state, and Recurrent States**

**39-In tennis club there are 5 boys and 3 girls in training squad. Two are chosen at random. Determine the probability that at least one boy?**

**40-Difference between number of success and inter-arrival time (waiting time)**

**41- Suppose phone calls arrive at a switchboard according to a Poisson process at a rate of 2 per minute.**

1. **What is the probability that exactly 10 calls between 9:30 and 9:45.**
2. **What is the probability that the time between the arrival of the 5th call and the arrival of the 6th call is more than 20 minutes?**
3. **What is the expectation and the variance of the time till the 14th phone calls**

**42- A player has 4$. At each play of game, he loses 1$ with probability 0.75 but wins 1$ with probability 0.25. He stops playing if he loses 4$ or win 3$ .**

* **Find the transition Matrix**  .
* **What is the probability that he has lost all his money at the end of 2 plays**
* **How many communicating state, absorbing state , Irreducible Markov chain with transition diagrams**

**43- If you have the transition Matrix? Find M and F?**



**44-A bag contains 7 yellow balls and 5 red balls. One ball is taken from the bag at random and is not replaced. A second ball is then taken from the bag. Determine the probability that at least one ball is yellow?**

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**46- Plays tennis players (A and B) five match, if any player has won three match is the winner**

**1-What Probability win player A in the fourth match**

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**47-In the diagram mouse is randomly moving from room to room**

* **Find the transition Matrix**
* **By Matrix diagram, how many communicating state, absorbing state, and Recurrent States**

**48-Types of Queuing characteristics**

**49-** **A Suppose phone calls arrive at a switchboard according to a Poisson process at a rate of 2 per minute.**

1. **What is the probability that exactly 10 calls between 9:30 and 9:45.**
2. **What is the probability that the time between the arrival of the 5th call and the arrival of the 6th call is more than 20 minutes?**
3. **What is the expectation of the time till the 14th phone calls**

**50- The probability that an entering college student will graduate is 0.8, and 60% of students is female.**

1. **Find the probability that among 6 students only 4 students will graduate.**
2. **Probability that a 4th student will graduate is the 14th student who has been entering college.**
3. **Probability that a second female student will graduate is 9th students who has entering college.**

**51-**

1

**4**

1. **Draw a picture corresponding to this transition matrix**
2. **How many communicating state, absorbing state , Irreducible Markov chain with transition diagrams**
3. **Find M**

**52-** **Jobs (customers) arriving at an M/M/2 system according to a Poisson process with an average rate of 8 jobs per second. The Service rate is μ=5 jobs per second.**

**Find 1) The offered load**

**2) The probability that the system is idle (no customers in the system)**

**3) Average number of customers in the system.**

**53- Your neighbor has 2 children. You learn that he has a son, Joe. What is the probability that Joe’s sibling is a brother?**

 **54-**Suppose that ﬁve good fuses and two defective ones have been mixed up. To ﬁnd the defective fuses, we test them one-by-one, at random and without replacement. What is the probability that we are lucky and ﬁnd both of the defective fuses in the ﬁrst two tests?

**55- Number of success and time of success (time of arrival)**

**56- Assuming that 6 in 10 automobile accidents are due mainly to speed violation, and 0.1 she is female**

* **Find the probability that among 8 automobile accidents 6 will be due mainly to a speed violation.**
* **probability that accidents 6 will be due mainly to a speed violation in 20th accidents**
* **probability that accidents 2 will be due mainly to a speed violation in 15th accidents she is female**
* **Find the mean and variance of the number of automobile accidents are due mainly to speed violation in 8th automobile accidents**

**56- Around 1% of men are blue-green color-blind and 1 in 5 men is left-handed. Assuming these characteristics are inherited independently, calculate the probability that a man chosen at random will:**

1. **Be both color-blind and left-handed**
2. **Be color-blind or left-handed**
3. **Be neither color-blind nor left-handed.**

**57- The probability that a student pilot passes the written test for a private pilot’s license is 0.7, and 10% of the test is female.**

* **Find the probability that among 6 students only 4 pilot students passed the written test.**
* **Probability that a 5th pilot student passed the written test is the 14th student who has been tested.**
* **Probability that a first female pilot student passed the written test is 11th student who has been tested.**
* **Find the mean and variance of a pilot student passes the written test for a private pilot’s license in 20th**

**58- In a shipment of 20 computers, 3 are defective. Three computers are randomly selected and tested. What is the probability that all three are defective if the first and second ones are not replaced after being tested?**

59-**At a middle school, 18% of all students play football and basketball and 32% of all students play football. What is the probability that a student plays basketball given that the student plays football?**

**60-**

****

**B/**

**60- 1-Draw a picture corresponding to this transition matrix**

 **2- How many communicating state, absorbing state , Irreducible Markov chain**

61- **A petrol station owner is considering the effect on his business (Dana) of a new petrol station (Sardar) which has opened just down the road. Currently (of the total market shared between Dana and Sardar) Dana has 80% of the market and Sardar 20%.**

**P=**

1. **What will be the probability market share for *Dana* and *Sardar* after another two weeks ?**
2. **What would be the long-run prediction for the probability market share for Dana and Sardar?**

**62- If you have the transition Matrix? Find M and F**

**P=**

62- **Classification of Markov Processes 2- Irreducible Markov chain**

63- **A computer is inspected at the end of every hour. It is found to be either working (up) or failed (down). If the computer is found to be up, the probability of its remaining up for the next hour is 0.90. It it is down, the computer is repaired, which may require more than one hour. Whenever, the computer is down (regardlewss of how long it has been down), the probability of its still being down 1 hour later is 0.35. ( 20 M)**

1. **What is the probability to work for two hours**
2. **What would be the long-run prediction for the probability for failed**

**64-A mouse is put into the maze of the following figure. Each time period it chooses at random one of the doors in the room it is in and moves to another room. From room1 the mouse can escape to the outside (state 5) but in room 3 is a mouse trap**



**65- Customers arrive at the express checkout lane in a supermarket in a Poisson process with a rate of 25 customers per hour. The time to check out a customer is an exponential r.v. with mean of 2 minutes. Find**

1. **The offered load (traffic intensity)?**
2. **The probability that there are exact 2 customers in the supermarket.**
3. **Average number of customers in the system**
4. **Average number of customers in the queue**
5. **Average time a customers in the system.**
6. **Increase the number of customers at a rate of 70 per hour. What is the treatment(جاره‌سه‌ر) of the problem.**

**66- A bank counter is currently served by two tellers(كاشير). Customers arrive at a bank according to a Poisson process at a rate 28 customers per hour, and the service time is an exponential r.v. with mean 3 minutes. Find**

1. **Average number of customers in the queue**
2. **Average time a customers in the system.**
3. **If the bank had 10 places to wait for service, what is the impact(تاثير) on the average time in the system (Note : )**

**67- Types of Queuing characteristics.**

**68-What mean that M/D/3/10/100/LCFS**

**69- dental surgery has two operation rooms(ژوری چاره‌سه‌ر). The service times are assumed to be independent, exponentially distributed with mean 15 minutes.**

**70-Ahmad arrives when both operation rooms are empty. Ali arrives 10 minutes later while Ahmad is still under medical treatment. Another 20 minutes later Samir arrives and both Ahmad and Ali are still under treatment. No other patient arrives during this 30-minute interval.**

**Find The offered load**

**71-The professor does not start the tutorial (محاضرة) until at least three students are available. Students who arrive while the tutorial is going on will have to wait for the Students arrive at the professor’s office for extra help according to a Poisson process with an average rate of four students per hour.**

**1-*What is the mean time until another tutorial can start*, given that a tutorial has just ended and there are no students currently waiting for the professor?**

**2-*What is the probability that the next tutorial does not start within the first two hours*, given that one student was waiting when the tutorial ended?**

**72-Cars arrive at a gas station according to a Poisson process at an average rate of 12 cars per hour. The station has only one attendant. If the attendant decides to take a two-minute coffee break when there were no cars at the station, *what is the probability that one or more cars will be waiting when he comes back from the break*, given that any car that arrives when he is on coffee break waits for him to Merging & Splitting Poisson Processes Briefly get back?**

**73-1-Defined 1-Poisson process 2-Merging & Splitting Poisson Processes Briefly**

**2-Properties A counting process**

**3-Prove that A- P(N(t + h) -N(t) =n) = B- P(N(t + h) -N(t) >1) = o(h)**

**74** **At a subway station, eastbound trains and northbound trains arrive independently, both according to a Poisson process. On average, there is one eastbound train every 12 minutes and one northbound train every 8 minutes. Suppose you arrive at the subway station at a certain point in time and start observing trains.**

***(a) What is the probability that no trains arrive between during the first 30 minutes?***

***(b) How many eastbound trains are expected during a 30 minute period?
(c) Assuming you arrived at 8:00, at what time can you expect the 5th eastbound train?
(d) What is the probability that exactly 2 eastbound trains will arrive in the first 24 minutes and exactly 3 northbound trains will arrive in the first 36 minutes?
(e) What is the expected waiting time, in minutes until the first train (of either type) arrives?***

**75-A sells cookie from house to house. The probability that they sell a set of packs of cookies at any house they visit is 0.4**

1. **What is the probability that the ﬁrst house where they make their ﬁrst sale is the ﬁfth house they visit?**
2. **Given that they visited 10 houses on a particular day, what is the probability that they sold exactly 6 sets of cookie packs?**
3. **What is the probability that on a particular day the third set of cookie packs is sold at the seventh house**
4. **What is the expectation and variance of sell in 20 houses?**

 **76/prove that**

**1/ P(T=t) 2/P(N(t + h) -N(t) =1) = λh+0(h)**

**77- A Customers arrive at the neighborhood bookstore according to a Poisson process with an average rate of 10 customers per hour. Each arriving customer buys a book with probability 1/8.**

 **What is the probability that the bookstore sells one book during a particular hour?**

 **78 Customers arrive in a certain store according to a Poisson process with rate= 4 per hour. Given that the store opens at 9:00am,** **what is the probability that exactly one customer has arrived by 9:30**

**79-Foreign phone calls are made to your home phone according to a Poisson process at rate λ = 2 (per hour). Independently, domestic phone calls are made to your home phone according to a Poisson process at rate λ = 5 (per hour). What is the probability that the next call will be foreign**

**80- Hits on a website: Hits on a popular Web page occur according to a Poisson**

**Process with a rate of 10 hits/min.**

1. **Probability of 2 or less hits in the ﬁrst minute**
2. **Probability that the time till the ﬁrst hit exceeds 10 seconds.**
3. **What is the expectation and the variance of the time till the 4th hit**