Second Year – Term II
Systems & Biomedical Eng. Department
Cairo University

Spring Semester
Date: March 2022
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Biostatistics: Sheet 1 –
Probabilty

1. An insurance company pays hospital claims. The number of claims that include emergency room or operating room charges is 85% of the total number of claims. The number of claims that don't include emergency room charges is 25% of the total number of claims. The occurrence of emergency room charge is independent of the occurrence of operating room charges on hospital claims.
   Calculate the probability that a claim submitted to the insurance company includes operating room charges.

2. You are given $P(A \cup B) = 0.7$ and $P(A \cup B`) = 0.9$ where B` is the complement of B. Find $P(A)$.

3. Cooking oil is produced in two main varieties: mono and polyunsaturated. Two common sources of cooking oil are corn and canola. The following table shows the number of bottles of these oils at a supermarket

		Type of oil	
		Canola	Corn
Type of unsaturation	Mono	7	13
	Poly	93	77

If a bottle of oil is selected at random, find the probability:
   a. That the bottle belongs to the polyunsaturated category.
   b. That the chosen bottle is monounsaturated canola oil.
   c. That the chosen bottle is polyunsaturated given that it was corn oil.

4. Samples of Copper plates are classified on the basis of surface finish (in millimeters) and length measurements. The results of 250 parts are summarized as follows:

|		Length	
Surface Finish		Excellent	Good
	Excellent	200	5
	Good	25	20

Let A denote the event that a sample has excellent surface finish, and let B denote the event that a sample has excellent length. Are events A and B independent?

5. A new method to detect defects in Aluminum sheets is being tested. This new method of ultrasound wave analysis is important because, if adopted, it could be used to detect three different defects holes, air bubbles, and contaminants instead of having to use a single test for each defect. The makers of the test claim that it can detect holes with 99.7% accuracy, air bubbles with 99.95% accuracy, and contaminants with 89.7% accuracy. If a defect is not present, the test does not signal. Samples are prepared for the calibration of the test and 60% of them are defected with holes, 27% with air bubbles, and 13% with different contaminants.
   A test sample is selected randomly, if the test signals, what is the probability that contaminants are present?

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6. Ten percent of an insurance company's policyholders are smokers. The rest are nonsmokers. For each nonsmoker, the probability of dying during the year is0.01. For each smoker, the probability of dying during the year is 0.05. Given that a policyholder has died, what is the probability that the policyholder was a smoker? (hint: use Bayes' rule)

7. A defective die is tossed whose sides are mistakenly printed with the number of dots being 1, 1, 2, 3, 3, 5 what is the probability that the outcome is less than 4?

8. A habitually tardy person arrives at the theatre late by si minutes where si=1,2,3,….. If P(si)= (1/2)I, what is the probability that he will be more than 1 minute late?

9. A switching circuit shown in the following figure consists of two potentially faulty switches in parallel. In order for the circuit to operate properly, at least one of the switches must close to allow the overall circuit to be closed. Each switch has a probability of 1/2 of closing the probability that both switched close simultaneously is 1/4. What is the probability that the switching circuit will operate correctly?
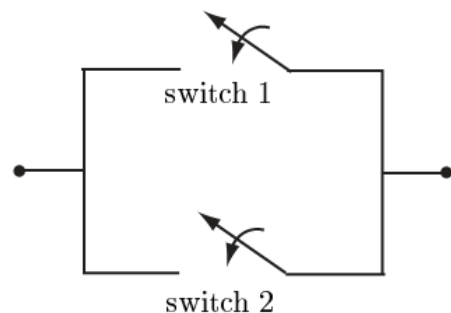
10. An Urn contains 2 red balls, and 3 black balls. Two balls are chosen in succession. The first ball is returned to the urn before the second ball is chosen. Each ball is chosen at random which means that each ball is equally likely to be chosen, what is the probability of choosing first a black ball followed by a black ball (in two different ways)?

11. A probability class has N students enrolled. What is the probability the at least two of the students have the same birthday? (assume all students are born in the same year)

12. Five balls numbered 1, 2, 3, 4, 5 are drawn from an urn without replacement. What is the probability that they are drawn in the same order as their number?

13. Two dice are tossed and the number of dots on each side that come up are added together. Determine the sample space, outcome, impossible event, three different events including a simple event and two mutually exclusive events.

14. How many subsets of size 3 can be made from {A, B, C, D, E}?

15. Workplace accidents are categorized into three groups: minor, moderate and severe. The probability that a given accident is minor is 0.5, that it is moderate is 0.4 and that it is severe is 0.1. Two accidents occur independently in one month. Calculate the probability that at least one is moderate.

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16. Robotic Arm malfunctioning are due to processing bugs (12%) or mechanical defects (88%). Mechanical defects are related to bad joints (27%) or improper assembly (73%). Processing bugs are caused by infinite for loops (35%), unhandled interrupts (13%), or system reset (52%).

(a) Find the probability that a malfunctioning is due to bad joints.
(b) Find the probability that a malfunctioning is due to unhandled interrupts or system reset.

17. A survey of a group's viewing habits over the last year revealed the following information:

- 28% watched gymnastics
- 29% watched baseball
- 19% watched soccer
- 14% watched gymnastics and baseball
- 12% watched baseball and soccer
- 10% watched gymnastics and soccer
- 8% watched all three sports

Calculate the percentage of the group that watched none of the three sports during the last year.

18. An insurance company insures workers' safety for all ages. An actuary compiled the following statistics on the company's insured workers:

Type of worker	Portion of company's insured worker	Probability of injury
Teen	8%	0.15
Young Adult	16%	0.08
Midlife	45%	0.04
Senior	31%	0.05

A randomly selected worker that the company insures has an injury. Calculate the probability that the worker was a young adult.

19. A health study tracked a group of persons for five years. At the beginning of the study, 20% were classified as heavy smokers, 30% as light smokers and 50% as nonsmokers. Results of the study showed that light smokers were twice as likely as nonsmokers to die during the five-year study, but only half as likely as heavy smokers. A randomly selected participant from the study died over the five-year period. Calculate the probability that the participant was a heavy smoker.

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20. A study of automobile accidents produced the following data:

Model year	Proportion of all vehicles	Probability of involvement in an accident
1997	0.16	0.05
1998	0.18	0.02
1999	0.2	0.03
other	0.46	0.04

An automobile of one of the model years 1997,1998 and 1999 was involved in an accident. What is the probability that the model year of the automobile is 1997?