Tutorial Book

M.Sc Higher Mathematics II

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Theory of Probability

[Q1] Assembling Computers

Sam is going to assemble a computer by himself. He has the choice of chips from 3 brands, a hard drive from 4, memory from 3, and an accessory bundle from 5 local stores.
How many different ways can Sam order the parts?

(**Answer:** 180)

[Q2] Four Digits

How many even four-digit numbers can be formed from the digits 0, 1, 2, 5, 6, and 9 if each digit can be used only once?

(**Answer:** 156)

[Q3] Choosing the President in the Club

A president and a treasurer are to be chosen from a student club consisting of 50 people. How many different choices of officers are possible if:

i. there are no restrictions;

ii. A will serve only if he is president;

iii. B and C will serve together or not at all;

iv. D and E will not serve together?

(**Answer:** i. 2450, ii. 2401, iii., 2258, iv. 2448)

[Q4] The Lineup

In a rugby training session, the defensive coordinator needs to have ten (10) players standing in a row. Among these ten (10) players, there are one (1) freshman, two (2) sophomores, four (4) juniors, and three (3) seniors. How many different ways can they be arranged in a row if only their class level will be distinguished?

(**Answer:** 12 600)

[Q5] Arranging Accommodation

In how many ways can 7 graduate students be assigned to one triple and two double hotel rooms during a conference?

(**Answer:** 210)

[Q6] Buying Games

A young boy asks his mother to get 5 games from his collection of 10 arcade and 5 sports games. How many ways are there that his mother can get 3 arcade and 2 sports games?

(**Answer:** 1200)

[Q7] Letter Soup

How many different letter arrangements can be made from the letters in the word STATISTICS ?

(**Answer:** 50400)

[Q8] Flip of a Coin

A coin is tossed twice. What is the probability that at least 1 head occurs?

(**Answer:** $3/4$)

[Q9] That's not Fair!

A die is loaded in such a way that an even number is twice as likely to occur as an odd number. If E is the event that a number less than 4 occurs on a single toss of the die, find $\Pr E$.

(**Answer:** $4/9$)

[Q10] Who Wants to Help

A statistics class for engineers consists of 25 industrial, 10 mechanical, 10 electrical, and 8 civil engineering students.

If a person is randomly selected by the instructor to answer a question, find the probability that the student chosen is:

a. an industrial engineering major,

b. a civil engineering or an electrical engineering major.

(**Answer:** a.$25/53$, b. $18/53$)

[Q11] I Fold

In a poker hand consisting of 5 cards, find the probability of holding 2 aces and 3 jacks.

(**Answer:** 0.9×10^{-5})

[Q12] Any Colour, as Long as it is Black

If the probabilities are, respectively, 0.09, 0.15, 0.21, and 0.23 that a person purchasing a new automobile will choose the color green, white, red, or blue, what is the probability that a given buyer will purchase a new automobile that comes in one of those colours?

(**Answer:** 0.68)

[Q13] Check your Engine Light

If the probabilities that an automobile mechanic will service 3, 4, 5, 6, 7, or 8 or more cars on any given workday are, respectively, 0.12, 0.19, 0.28, 0.24, 0.10, and 0.07, what is the probability that he will service at least 5 cars on his next day at work?

(**Answer:** 0.69)

[Q14] Got to Catch My Flight

The probability that a regularly scheduled flight departs on time is $\Pr D = 0.83$; the probability that it arrives on time is $\Pr A = 0.82$; and the probability that it departs and arrives on time is $\Pr D \cap A = 0.78$. Find the probability that a plane:

a. arrives on time, given that it departed on time, and

b. departed on time, given that it has arrived on time.

(**Answer:** a. 0.94, b. 0.95)

[Q15] The Calculation Looms

The concept of conditional probability has countless uses in both industrial and biomedical applications. Consider an industrial process in the textile industry in which strips of a particular type of cloth are being produced. These strips can be defective in two (2) ways, length and nature of texture. For the case of the latter, the process of identification is very complicated. It is known from historical information on the process that 10% of strips fail the length test, 5% fail the texture test, and only 0.8% fail both tests. If a strip is selected randomly from the process and a quick measurement identifies it as failing the length test, what is the probability that it is texture defective?

(**Answer:** 0.08)

[Q16] Fuse In, Fuse Out

Suppose that we have a fuse box containing 20 fuses, of which 5 are defective. If 2 fuses are selected at random and removed from the box in succession without replacing the first, what is the probability that both fuses are defective?

(**Answer:** $1/19$)

[Q17] White or Black

One bag contains 4 white balls and 3 black balls, and a second bag contains 3 white balls and 5 black balls. One ball is drawn from the first bag and placed unseen in the second bag. What is the probability that a ball now drawn from the second bag is black?

(**Answer:** $^{38}/_{63}$)

[Q18] Achtung!

A small town has one fire engine and one ambulance available for emergencies. The probability that the fire engine is available when needed is 0.98, and the probability that the ambulance is available when called is 0.92. In the event of an injury resulting from a burning building, find the probability that both the ambulance and the fire engine will be available, assuming they operate independently.

(**Answer:** 0.9016)

[Q19] It's your Turn

Three cards are drawn in succession, without replacement, from an ordinary deck of playing cards. Find the probability that the event $A_1 \cap A_2 \cap A_3$ occurs, where A_1 is the event that the first card is a red ace, A_2 is the event that the second card is a 10 or a jack, and A_3 is the event that the third card is greater than 3 but less than 7.

(**Answer:** $^{8}/_{5525}$)

[Q20] This Car went to Vegas and Back

If a car agency sells 50% of its inventory of a certain foreign car equipped with side airbags, find a formula for the probability distribution of the number of cars with side airbags among the next 4 cars sold by the agency.

(**Answer:** $f(x) = \frac{1}{16}\binom{4}{x}$, for $x = 0, 1, 2, 3, 4$.)

[Q21] Let me Get my Pen

A lot containing 7 components is sampled by a quality inspector; the lot contains 4 good components and 3 defective components. A sample of 3 is taken by the inspector. Find the expected value of the number of good components in this sample.

(**Answer:** 1.7)