

1. In your favourite RPG game, let's assume that in selecting your character there are 5 character classes and 2 genders. Let's also assume there are 3 levels of difficulty for this game.
 - (a) How many possible ways can you play this game?
 - (b) What if you always choose the "warrior" class?
 - (c) What if you always choose a female character?
 - (d) What if you always play on the highest difficulty setting?
 - (e) Let's assume the game has a two-player mode. How many possible ways can you play this game? (hint: you cannot play the game on different difficulty levels).
 - (f) What if your friend chooses a different character class to you?
2. Assume that you are going to an exam and you can only bring 3 items. You have the following items: {mobile phone, pen, ruler, calculator, laptop, apple}.
 - (a) In order to make your decision, you first *arrange* these 6 items on your desk. How many possible arrangements are there?
 - (b) How many possible groups of three items can you bring with you?
 - (c) What if you decide that the pen is essential?
 - (d) What if the pen is essential and you also decide that you won't bring an apple or a laptop?
3. The following contingency table gives the results of operations in a hospital according to the complexity of the operation

	Simple	Complex
Successful	1990	950
Unsuccessful	10	50

Let A be the event that an operation is simple and B the event that an operation is successful.

Calculate $P(A)$, $P(B)$, $P(A|B)$, $P(A|B^C)$, $P(B|A)$, $P(B|A^C)$.

4. A software company examined blocks of code written by its employees. Each block of code was tested for bugs and, in addition, the skill level of the employee was also recorded. See table:

		Skill Level			Total
		High	Average	Low	
Bug in Code	No	140	600	100	840
	Yes	5	70	40	115
Total		145	670	140	955

In answering the following questions use appropriate probability notation.

Let B = “bug” and, hence, B^c = “no bug”.

Also let S_H = “skill: high”, S_A = “skill: average” and S_L = “skill: low”.

- (a) Calculate the probability that the programmer has: (i) high skill, (ii) average skill and (iii) low skill. (b) Calculate the probability of a bug. (c) Calculate the probability of a bug *given that* the code was written by a programmer with: (i) high skill, (ii) average skill and (iii) low skill. (d) Comment on the above conditional (i.e., updated) probabilities compared with $\Pr(B)$ calculated in part (b). Is the presence of bugs independent of the skill level? (e) Show that $\Pr(S_A | B) > \Pr(S_L | B)$. Explain the reason for this.
5. A team of 5 people is required to perform a particular task. We are selecting from a group of 7 women and 3 men.
- How many selections are there:
- (a) Altogether?
(b) If one of the men is an expert and must be on the team?
(c) If two of the individuals do not get along and cannot be on the team together?
(d) If the group must contain 3 women and 2 men?
(e) If the group must contain more women than men?
(f) If the group must contain more men than women?
6. In the British national lottery 6 numbers are chosen without replacement from 49. Calculate the probability of
- (a) winning the jackpot (choosing all 6 numbers correctly)
(b) winning the smallest prize (choosing 3 of the 6 numbers correctly)
(c) choosing at least one of the numbers correctly.
7. An urn contains 10 balls: 4 red and 6 blue. A second urn contains 16 red balls and an unknown number of blue balls. A single ball is drawn from each urn. The probability that both balls are the same color is 0.44. Calculate the number of blue balls in the second urn.
- (A) 4
(B) 20
(C) 24
(D) 44
(E) 64
8. A jar contains 4 blue marbles, 5 red marbles and 11 white marbles. If three marbles are drawn from the jar at random, what is the probability that the first marble is red, the second marble is blue, and the third is white?

- The probability that the first marble is red is $5/20$, or $1/4$.
 - The probability of the second marble being blue is $4/19$, since we have one fewer marble, but not one fewer blue marble.
 - And the probability that the third marble is white is $11/18$, because we've already chosen two marbles. This is another measure of a dependent event.
9. Given S is the set of all 5 digit binary strings, E is the set of a 5 digit binary strings beginning with a 1 and F is the set of all 5 digit binary strings ending with two zeroes.
- (a) Find the cardinality of S , E and F .
- (b) Draw a Venn diagram to show the relationship between the sets S , E and F . Show the relevant number of elements in each region of your diagram.
10. The following contingency table shows the age and sex of derby winners

Age	Stallion	Total
age =3	10	30
age =4	30	50
age =5	20	30
Total	60	110

- A winner is chosen at random. Calculate the probability that
- (a) the horse is a filly
- (b) the horse won as a 5-year old.
- (c) the horse was a stallion, given it won as a 3-year old
- (d) the horse was a 4-year old, given it was a filly.
11. 6. A survey of students was carried out before an exam. 20% of students stated that they were very confident, 50% stated that they were confident and 30% were unconfident. 80% of those who said they were very confident, 50% of those who said they were confident and 20% of those who said they were unconfident got at least a B1 grade. Calculate
- (a) the probability that a randomly picked student got at least a B1 grade.
- (b) given that the student got at least a B1 grade, what is the probability that he/she was very confident.
- (c) given that the student got less than a B1 grade, what is the probability that he/she was unconfident.
12. Combinations and Permutations Compute the following:
- (a) $5C2$
- (b) $5P2$
- (c) $4C0$
- (d) $4C4$
- (e) $6C1$
- (f) $6P3$
- (g) $6C2$
- (h) $6C3$

13. A committee of 4 must be chosen from 3 females and 4 males.
- (i) In how many ways can the committee be chosen.
 - (ii) In how many ways can 2 males and 2 females be chosen.
 - (iii) Compute the probability of a committee of 2 males and 2 females are chosen.
 - (iv) Compute the probability of at least two females.
14. An ordered sequence of four digits is formed by choosing digits without repetition from the set $\{1, 2, 3, 4, 5, 6, 7\}$.
- (i) the total number of such sequences; (780)
 - (ii) the number of sequences which begin with an odd number; (480) N(A)
 - (iii) the number of sequences which end with an odd number; (480) (NB)
 - (iv) the number of sequences which begin and end with an odd number; (240)
 - (v) the number of sequences which begin with an odd number or end with an odd number or both; (720)
 - (vi) the number of sequences which begin with an odd number or end with an odd number but not both. (480)
15. In how many ways can a group of four people be selected from three men and four women? In how many of these groups are there more women than men?
16. In how many ways can a group of five be selected from ten people? How many groups can be selected if two particular people from the ten can not be selected in the same group?
17. **Counting Sets using Venn Diagrams** The Venn Diagram shows the number of elements in each subset of set S . If $P(A) = 3/10$ and $P(B) = 1/2$, find the values of x and y
18. How many different four digit numbers greater than 5000 can be formed from the digits **2,4,5,8,9** if each digit can only be used once in any given number. How many of these numbers are odd?