MA4603 - Lecture 3B - Appendix

(Remark : It would advised to keep this sheet handy for future SULIS homewworks) Basics of Probability
Addition Rule Indepedent Events
The complement rule in Probability
$P(C') = 1 - P(C)$
If the probability of C is 70% then the probability of C' is 30%
Question 1 Events (Important the event names are explained)

F: Student plays footballP(F) = 50

S: Student does SwimmingP(S) = 20

F and S: Student takes part in both swimming and football P(S and F) = 15

Find P (F or S)
Use addition rule

$$P(ForS) = P(F) + P(S)P(FandS)$$
$$= 50\% + 20\% - 15\% = 55\%$$

(We subtract 15% to stop the boths getting counted twice)
Probability of playing neither This is the complement event of playing one or both sports.

$$P(Neither) = 1P(ForS) = 45\%$$

1. 2 components A and B.

   P(A) = event that A is workingP(A) = 0.98

   P(B) = event that B is workingP(B) = 0.95

   P(A and B) = event that both A and B are working = $P(A) \times P(B) = 0.98 \times 0.95 = 0.931$

2. Lots of useless information. Complement event of at least one working is that they are both broken.

   Answer 100 4% = 96

3. ```
   Events
   A components from supplier A  P (A) = 0.8
   B components from supplier B  P (B) = 0.2
   F = resistor fails test

   1\% Probability of a Failure given that component is from Supplier A.      P(F|A) = 0.01
   3\% Probability of a Failure given that component is from Supplier B.      P(F|B) = 0.03
   ```

   Probability of flaw : P(F) Failed resistors either come from A or B

   $$P(F) = P(F \text{ and } A) + P(F \text{ and } B)$$
   ```

Use conditional Probability rule

$$P(F) = P(F|A) \times P(A) + P(F|B) \times P(B)$$

$$P(F) = (0.01x0.8) + (0.03x0.2) = (0.008) + (0.06) = 0.014$$

Answer 1.4

Part ii Given that a component failed, what was the probability of coming from A P(A—F)

P(A—F) = P(A and F) / P(F)We found P(A and F) earlier ; 0.008

P(A—F) = 0.008/0.014 = 0.57[answer : 57

Probability

Question 1 Part A

Consider the experiment where three coins are flipped.

(i) List all possible outcomes.

(ii) Calculate Pr(more heads than tails)?

(iii) Calculate Pr(two tails)?

Remark: draw out a probability tree

Question 3 Part A - Simple Addition Rule for Probability

- P(M) = 0.60
- P(CS) = 0.40
- P(M and CS) = 0.20

$$P(M \cup CS) = P(M) + P(CS) - P(M \cap CS) = 0.60 + 0.40 - 0.20 = 0.80$$

Combining Probabilities - Worked Example
Bayes Rule is given in the Formulae
We can rearrange it as follows

0.1 Combining Probabilities - Worked Example

We can now write our equation in terms of all the information we have :
ANS
For the second part, we simply use Bayes Rule again, using information we have determined previously
The Addition Rule for Probability
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$$\binom{8}{2} = \frac{8!}{2!(8-2)!} = \frac{8 \times 7 \times 6!}{2! \times 6!} = \frac{8 \times 7}{2 \times 1} = \frac{56}{2} = 28$$

0.2 Probability Rules

There are two rules which are very important.

- All probabilities are between 0 and 1 inclusive

$$0 \leq P(E) \leq 1$$

- The sum of all the probabilities in the sample space is 1

0.3 Addition Rule

The addition rule is a result used to determine the probability that event A or event B occurs or both occur. The result is often written as follows, using set notation:

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

- $P(A)$ = probability that event A occurs.
- $P(B)$ = probability that event B occurs.
- $P(A \cup B)$ = probability that either event A or event B occurs, or both occur.
- $P(A \cap B)$ = probability that event A and event B both occur.

Remark: $P(A \cap B)$ is subtracted to prevent the relevant outcomes being counted twice.

0.4 Probability: Addition Rule for Any Two Events

- For any two events A and B, the probability of A or B is the sum of the probability of A and the probability of B minus the probability of both A and B:

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

- We subtract the probability of $A \cap B$ to prevent it getting counted twice.
- *($A \cup B$ and $A \cap B$ denotes "A or B" and "A and B" respectively)*
- If events A and B are **mutually exclusive**, then the probability of A or B is the sum of the probability of A and the probability of B:

$$P(A \cup B) = P(A) + P(B)$$

- If A and B are mutually exclusive, then the probability of both A and B is zero.