1 Set Theory

1. The Universal Set $\mathcal{U}$
2. Union
3. Intersection
4. Set Difference
5. Relative Difference

Session 05:Graphs

5A.1 What is a Graph?

5A.2 Paths Cycles and Connectivity

5A.3 Isomorphisms of a graph

5A.4 Adjacency Matrices and Adjacency Lists

Isomorphism

- They have a different number of connected components
- They have a different number of vertices
- They have different degrees sequences
- They have a different number of paths of any given length
- They have a different number of cycles of any length.

Adjacency Lists

u : $\{v\}$

v : $\{w, x\}$

w : $\{v, x\}$

z : $\{v, w\}$

- Spanning Subgraphs of G.
- a vertex is said to be an **emph isolated vertex** if it has a degree of zero.
- a vertex is said to be an **emph end-vertex** if it has a degree of one.
- a vertex is said to be an **emph even vertex** if it has a degree of an even number.
- a vertex is said to be an **emph odd vertex** if it has a degree of an odd number.
- A graph is said to be **emphk-regular** if the degree of each vertex is k.
- Every Graph has an even number of odd vertices.
- A cubic graph is a graph where every vertex has degree three.

Session 05 Graph Theory

- Eulerian Path
- Isomorphism
- Adjacency matrices

Adjacency Matrices

$$\begin{pmatrix} o & 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 & 0 \end{pmatrix}$$

Functions

- Domain of a Function
- Range of a function
- Inverse of a function
- one-one (surjective)
- onto (bijective)

Probability

Binomial Coefficients

- factorials
$$n! = (n) \times (n-1) \times (n-2) \times \ldots \times 1$$
  - $5! = 5 \times 4 \times 3 \times 2 \times 1 = 120$
  - $3! = 3 \times 2 \times 1$
- Zero factorial
$$0! = 1$$

The complement rule in Probability
$P(C') = 1 - P(C)$
If the probability of C is 70% then the probability of C' is 30%

2 Matrices

What are the dimensions of the following matrix

$$\begin{pmatrix} a_1 & a_2 \\ b_1 & b_2 \end{pmatrix}\begin{pmatrix} c_1 & d_1 \\ c_2 & d_2 \end{pmatrix} = \begin{pmatrix} (a_1 \times c_1) + (a_2 \times c_2) & (a_1 \times d_1) + (a_2 \times d_2) \\ (b_1 \times c_1) + (b_2 \times c_2) & (b_1 \times d_1) + (b_2 \times d_2) \end{pmatrix}$$

$$\begin{pmatrix} 1 & 3 \\ 0 & 2 \end{pmatrix}\begin{pmatrix} 1 & 2 \\ 4 & 1 \end{pmatrix} = \begin{pmatrix} (1 \times 1) + (3 \times 4) & (1 \times 2) + (3 \times 1) \\ (0 \times 4) + (2 \times 4) & (0 \times 2) + (2 \times 1) \end{pmatrix} = \begin{pmatrix} 14 & 5 \\ 8 & 2 \end{pmatrix}$$

$$\left(\begin{pmatrix} 1 & 2 \\ 4 & 1 \end{pmatrix} \begin{matrix} 1 & 3 \\ 0 & 2 \end{matrix}\right) =?$$