

Complex Numbers

$$j^2 = -1 \quad j^3 = -j$$

$$j^4 = 1 \quad z = a + bj$$

$$z = r(\sin \theta + j\sin \theta) \quad z = re^{j\theta}$$

$$\tan^{-1} b/a = \theta \quad \cos^{-1} a/r = \theta$$

$$\sin^{-1} b/r = \theta \quad (a + bj)^* = a - bj$$

$$|z| = r = \sqrt{a^2 + b^2} \quad |z|^x = |z^x|$$

$$\arg(z)^x = x \arg(z) \quad \arg(z) = \theta + 2k\pi$$

$$(\cos \theta + j\sin \theta)^k = \cos k\theta + j\sin k\theta$$

$$= (e^{j\theta})^k = e^{jk\theta} \quad < \text{DeMoivre's Theorem}$$

* means conjugate

$j = i = \sqrt{-1}$ = imaginary unit

Find roots example:

$$z^2 = -4j$$

Convert to exponential form first:

$$z^2 = 4e^{-j\pi/2}$$

$$|z^2| = r^2 = \sqrt{0^2 + 4^2} = 4$$

$$|z| = r = 2$$

$k = (0, 1 \dots n$ where $n = \text{expon' of } z) = 0, 1$

$$\arg(z^2) = 2 \arg(z) = -j\pi/2 + 2k\pi$$

$$\arg(z) = -j\pi/4 + k\pi$$

Substitute values of $k (0, 1)$ for $z = |z|e^{j\arg(z)} =$

$$2e^{-j\pi/4}, 2e^{j3\pi/4}$$

Discrete Probability & Sets & Whatever

Probability

$$1. P(x) = {}^n C_x \cdot p^x \cdot (1-p)^{n-x}$$

$$2. P(x) = ({}^X C_k)({}^{N-X} C_{n-k}) / {}^N C_n$$

Set Theory

$A = B$ when A subset of B & B subset of A

$$A - B = A \cap B'$$

$$A \cup (A \cap B) = A$$

$$A \cap (A \cup B) = A$$

$$A \cup A' = U$$

$$A \cap A' = \text{nullset or } \{\}$$

Power set of S is the set of ALL SUBSETS of

$$S \text{ e.g. } S = \{1,2\}, P(S) = \{\}, \{1\}, \{2\}, \{1,2\}$$

$$|A| = n, |P(A)| = 2^n$$

Sets A and B are disjoint iff $A \cap B = \{\}$

$$\text{Cardinality of union: } |A \cup B| = |A| + |B| - |A \cap B|$$

Proof by induction:

Show that when $p(k)$ is true, $p(k + 1)$ follows.

1. Binomial Distribution

n = trials, x = successes, p = probability of success

2. Hypergeometric Distribution

N = deck size, n = draws, X = copies of card, k = successes

Matrix Manipulations

A^T : Transpose of A - Switch Rows with

Columns (R_1 becomes C_1 , R_2 becomes C_2 etc.)

$$-A = -1 \cdot A$$

A^{-1} : Inverse of A

$$A^{-1} \cdot I = I = A \cdot I$$

$$A^{-1}A = I$$

Augment Identity matrix to matrix and perform

Gauss-Jordan elimination on both to get change Identity matrix to the Inverse.

EROs:

Switch Rows

Scale Row (Multiply entire row)

Add multiple of different row to another

A matrix A is in row echelon form if

1. The nonzero rows in A lie above all zero rows (when there is at least a nonzero row and a zero row).
2. The first nonzero entry in a nonzero row (called a pivot) lies to the right of the pivot in the row immediately above it.

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