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Applications of Mathematics in Information Theory

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ABSTRACT:-
Information theory is a new branch of probability theory having no. of applications.Information theory is to study statistical structure of electrical equipment. Basically is the process by which information is conveyed from transmits to a receiver. Here we made a model for a communication system by means statistical tool like probability matrices.

Keywords: Information, Applications, Storage, Probability Matrices.

Introduction:-

Information theory is originated by Claude Shanon through two outstanding contributions to the mathematical theory of communications in 1948 and 1949. Information theory deals with the study of problems concerning any system include information processing, information storage, information storage.

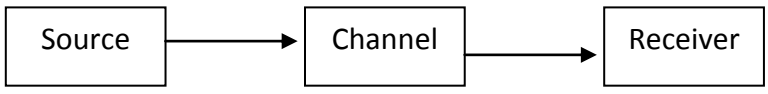
Information retrieval and decisions making: Information theory studies all theoretical problems connected with the transmission of information over communication channels.

This also includes the study of uncertainty (information) measures and various practical and economical methods of coding information for transmission.

The output of the channel is described statically by each permissible input. But around the same time Wiener (1948) and also considered the communication situation and came up in the Shannon Model messages are first encoded and then transmitted, whereas in the Wiener mode the signal is communicated directly through the channel with being encoded.

Formation of the problem:

The geometry of the problem as shown in figure (i) and (ii), Here three main part of communication by which the information is carried from a given source to the receiver.



Parts of communication system **Fig. (i)**

General structure of communication system

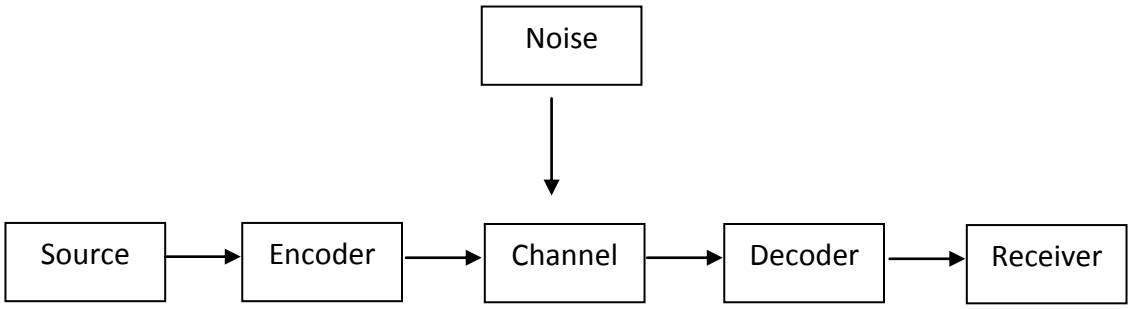


Fig. (ii)

* Source: It is the source of message which produces the information to be communicated or transmitted.
* Communication is the channel

Transmission network (or media) which carries the messages from one source to receiver, e.g. human voice, newspapers, books etc. A communication channel can be with or without noise.

* Receiver: It is the destination t which the message is conveyed from source (or transmitter) through a communication channel.
* Encoder: It is the equipment which is used to improve the efficiency of the transmission channel through which a message is transmitted to the receiver.
* Nose: This term reads interruptions or disturbances in the transmission of message. for example noise in radio or television during relay of a program.

Error in newspaper printing etc.

Decoder: It is used to transform encoded message in to the original form at the receiver end.

The study of communication model using information theory is based upon a fundamental theorem which states that "It is possible to transmit information through a noisy channel at any rate less than the channel capacity with an arbitrarily small probability of error.

Memory less channel

Communication system is statistical in nature because the sources selects and transmits sequence of symbols from a given alphabet to the channel. Based on some statistical rule i.e. probability. To actualize this we introduce here memory less channel.

Memory less Channel : To explain communication tools of matrices :

1. Statics probability.
2. Conditional probability
3. Matrices

Memory less Channel : A memory less channel is by an

input $X = \{x_1, x_2 \ldots x_n\}$

output $Y = \{y_1, y_2 \ldots . y_n\}$

and a set of conditional probabilities $P(y_j/x_i)$ of receiving the symbol y_j

when x_i is sent for all i and j

A memory less channel is described only by two input symbols ($x_1 = 0$, $x_2 = 1$), two output symbols (y1 = 0, y2 = 1) and a set of conditional probabilities $p(y_j / x_i)$ for (i) = 1, 2 then it is called a binary memory less channel.

Probability relation in a channel :

The relation between the probabilities of various input symbols and output symbols

$$\sum piopj, i = poj$$

j = 1, 2 ... n

(i) The joint probabilities of sending a symbol x_i and receiving the symbol y_i ...
$p(xi, y_j) = p\ j/i\ Pio \quad \forall i$

(ii) The conditional backward input probabilities when it is known that symbol y_i has been received is given by

$p(x_i/y_j) = p\ j/i\ (pio / poj)$

$\forall i$ and j

Noiseless channel:

If the channel matrix contains only one non-zero element in each column, then such channel is called a noiseless channel.

e.g. the following channel matrix is a noiseless channel

A binary symmetric channel with probability

p =0 or 1 is also a noiseless channel.

Entropy: Due to Shanon, deals with mathematical models for communicaton problems the concept of entropy given by Shanon in his mathematical model.

Entropy is basically the expected information.

Let there be events E_1, E_2 ... E_n with probabilites p_1, p_2 .. p_n $pi \geq 0$, $\sum_{i=1}^{n} pi = 1$.

The entropy of the probability distribution: (p_1, p_2 ... p_n) is defined to be the mathematical expectation of information $n(p_i)$.

Here communication totally excels through mathematical tools like probability, matrices, conditional theorems on inform theory. On the basis of mathematical analysis it is concluded that mathematics plays a extensive potential role in communication systems.

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