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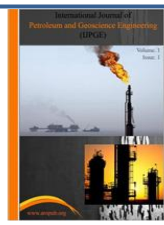

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Well planning Practices; Fuzzy interface Modeling

Zahid Hafeez Khokhar [a,*]

[a] Petroleum Engineering, MIACSIT, Faisalabad, Pakistan.

* Corresponding author. Tel.: +985144012861;
E-mail address: hafeezzahid@hotmail.com

A b s t r a c t

Training and testing predictions of data were planned and carried. Well, log data was available. The data was trained. The fuzzy interface made it plausible to run the model. Triangular membership function was used to go for training and testing. Control of training was performed by a design driver. Matching and comparison showed predictions. Good training predictions were attained. Trained model was verified by testing. Training and testing patterns are similar. Improvements are seen in testing. A fuzzy interface system is constructed among training, testing and design driver. The relationships show that the training is responsible for good testing. Difficulties were faced at memory level due to computational power. Experience matters and higher speed machines will learn and response better.

Keywords:

Artificial Intelligence,
Fuzzy logic,
FIS Sugeno type,
Training and Testing
FIS Mamdani type.

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1. Introduction

Science is knowledge of unknown, naming the known and classification of known on the basis of characteristics, properties, and application to mention. Artificial Intelligence is theory and development enables to perform tasks requiring intelligence. Training a model and testing the model are the ways to get such outcome which can be implemented soundly. Fuzzy logic is a form of the valued logic which deals with approximate rather fixed. Fuzzy sets [1] were introduced. Knowledge representation in fuzzy logic [2] and a representation for languages were presented. Fuzzy logic and approximate reasoning and the concept of a linguistic variable and its application to approximate reasoning were also presented. A new approach to the analysis of complex systems and decision processes was outlined. It is all about fuzzy sets toward a theory of fuzzy information granulation and its centrality in human reasoning fuzzy logic. A summary and update of; fuzzy logic; and computational intelligence were reported. Artificial neural network [3] was studied using well log data.

The soil is skin layer of earth ground. Underground, there are many layers to rock layer. The porosity of soil is the capacity of the soil to retain water. The permeability is the capability of soil or resistance of soil offered to allow water flow. For details, relative texts may be found. Well is a boring and is designed and drilled to bring out materials to the surface of the earth. The well is constructed by drilling a hole. After drilling and casing, the well is completed and outfitted with a collection of valves called a Christmas tree (Date palm tree) for the production.

2. Background

Fuzzy logic has been applied to many problems to explore different variables. Learning fuzzy logic control was published. Applications of fuzzy classification for mineral mapping [4] were presented using simulation data. Modeling coastal environments by fuzzy logic approach was presented. Remote sensing, fuzzy logic and geographic information system [5] were presented. Application of fuzzy logic to the evaluation of runoff was carried out. Fuzzy logic analysis of flood disaster monitoring and assessment of damage [6] was presented. The performance of fuzzy and crisp classifiers was compared. Fuzzy set theory and data from data viewers [7] were used to model. The fuzzy classification was compared. Measurement of flow injection heat mixing in the pipeline with side tee and fuzzy interface system is included. Phenol capacity fuzzy modeling works were carried out to report. The introduction of a change was made in fuzzy modeling of a reaction. Range effects on a constructed fuzzy interface system of a reaction process were reported. Fuzzy open up processing based on value was reported. The graduation of the polymer by the fuzzy model by taking a new sample not available from within the data was carried out. Fuzzy process modeling, a design order of fuzzy logic of continuous batch polymerization reactions and further investigation of fuzzy batch polymerization were carried out. Rules base normal process fuzzy modeling [8] was reported.

A general overview of applications of case-based reasoning in oil well was presented. Trajectory tracking in batch processes using neural controllers was reported. A fuzzy logic system for calculation of the interference of overhead transmission lines on buried pipelines was presented. Performance enhancement for neural fuzzy systems using asymmetric membership functions was obtained. A sensor based navigation for a robot using fuzzy logic and reinforcement learning was presented. A fuzzy set theory based control of a phase-controlled converter was reported. Petroleum exploration and visualization for well placement and geo-steering were reported. Well, logging in petroleum exploration and production was presented. Production data to estimate volume factor density and compressibility of reservoir fluids were used. Properties of crude oil and gas systems using radial base function network were modeled [9]. By using well log data, a case study was carried out. A fuzzy expert system for prediction was reported. Fuzzy logic rule base modeling saves time to deal with complex equations.

3. Problem Statement

Whenever something is in between yes and no, is it fuzzy? It is fuzzy while it has links with object out of limits. A single value – wherever it stands – is crisp. To feel or create fuzziness, a third object is needed.

The works mentioned in containing the data and observations which were a handful to translate information to rules for fuzzy logic operations. Implementation was time-saving to draw ready output. In this work, the problem is of a well. The data available was large and scattered. Data from an old well was modeled. Training and testing predictions were performed herein. The deduction was assigned and the works of rules formation were performed. Epoch number depended upon computing machine and its memory. The minimum optimized number was assigned after numerical runs. The presence of negative data, input values being outside of the specified input range and a number of data smaller than the number of modified parameter were noticed. Membership function type is triangular membership function. In the discourse, a fuzzy interface model is constructed. Figure 1 shows the plan of present work. The aim was to train a model. The target was to get a trained model which can test the data. The focus was to keep the membership function and its features remained same by control of a design driver. The proposition was to draw a relationship between training and testing such that unseen points can be opened. Methods and procedures are explained in next section.

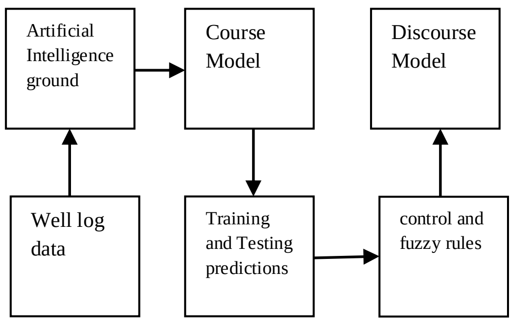

Fig. 1: Course and discourse model scheme.

4. Methods and Procedures

The data and observations are a handful to translate information to rules for fuzzy logic operation - it is an easy system to construct. In this work, well data is large and scattered. The problem is of the well training and testing. A computing environment was available. ANFIS is an adaptive network based fuzzy inference system and is a kind of artificial neural network. It is based on Sugeno fuzzy inference system. It applies a combination of the least-squares method and the back propagation gradient descent method for training fuzzy interface system membership function parameters to emulate a given training data. It interfaces input space to output space. It uses a hybrid learning algorithm to tune the parameters of the Sugeno-type fuzzy interface system. Architecture is layers upon layers. Sugeno model has usually five layer architecture. The architecture contains layers of input, prod, norm, variables and sum to function.

If 'a', 'b' are inputs and 'c' is output of a fuzzy interface system then Fuzzy Sugeno rules are

'[a, b] = [a1, b1] → f=p1a+q1b+r1'
'[a, b] = [a2, b2] → f=p2a+q2b+r2'.
therefore, '[a, b]=[an, bn] → f=pna+qnb+rn'.
Such were used to train the data and then testing was performed.

A fuzzy work on, data details, data format, data indexing and code structure were reported. A network compilation by cross-operations was performed. Probabilistic neural network and radial basis network trials have been performed. Core data consisted of porosity and permeability along the depth. Log data consisted of good logs and marker data. Data was refined into header text and numeric data with filtration of the header to numeric data. Negative data was removed such outlier and misplaced data points were tackled. Mature data was trained by fuzzy ANFIS modeling. Log data was received for measured depth and actual depth. Different intervals were tested from 0.9 to 0.1 for different values of designated epoch. Each epoch contained forward pass and backward pass. An ANFIS training run is shown in table 1. Iteration performance started at 0 and ended at 1. Epoch number assigned was compared with the run number and returned the value.

Table 1: ANFIS Training runs.

	Logic	[0,1]	Training Run
Initial	1<5	0	Start
Final	5=5	1	Complete

Triangular membership function was used for present work. It is one of the simplest membership functions which are formed using straight lines. The triangular membership function has the function name trimf. This function is a collection of three points which forms a triangle. The triangular curve is a function of a vector, x, and depends on three scalar parameters a, b, and c. The parameters a and c locate the feet of the triangle and the parameter b locates the peak. Fuzzy trained data system is matched for a new well.

Table 2: Different interval size, interval 0.9-0.1.

Membership function name, Type Design	Design driver Size	Design driver, interval
trimf Triangular membership function	Maximum:	0.9
trimf Triangular membership function	Minimum	0.1

Sample generated points were four hundred seventy-seven. Training and testing were carried out. A number of data is smaller than the number of modifiable parameters. Some input values were outside of the specified input range. ANFIS training completed at designated intervals. During evaluation of fuzzy interface system, negative data was ignored. Different intervals were run from 0.9 to 0.1.

5. Results

Fuzzy modeling work, for given old well data, observed for triangular membership function is gradually trained from the wide interval to narrow interval mapping new well and is compared with the wide interval to narrow interval and thereafter is verified with testing. Prediction graphs using fuzzy ANFIS, an adaptive network based fuzzy inference system, are shown. K is permeability and (md) is measured depth, milli darcy. Kcore and kpred are core permeability point and predicted permeability point. A number of data is smaller than the number of modified parameter was seen. Number of data was needed and reduction in modified was required. Some input values are outside of the specified input range during training. Negative data was ignored. Gird highlights the gap between prediction line and core points. Membership functions type trimf, the name of the triangular membership function, was run for varying intervals. Training and testing are shown in figures for similar epoch number and number of membership functions of type triangular membership function. The interval was varied from 0.9 to 0.1 and training and testing runs were performed.

5.1. Course Model

Selected intervals are selected to show for training. Figure 2 shows training predictions using triangular membership function for interval 0.9. Average is plotted with depth and small circular points show core values. Predictions line is shown to capture the actual value. Many core points are missed by prediction line. For interval 0.9, predictions are too unlike.

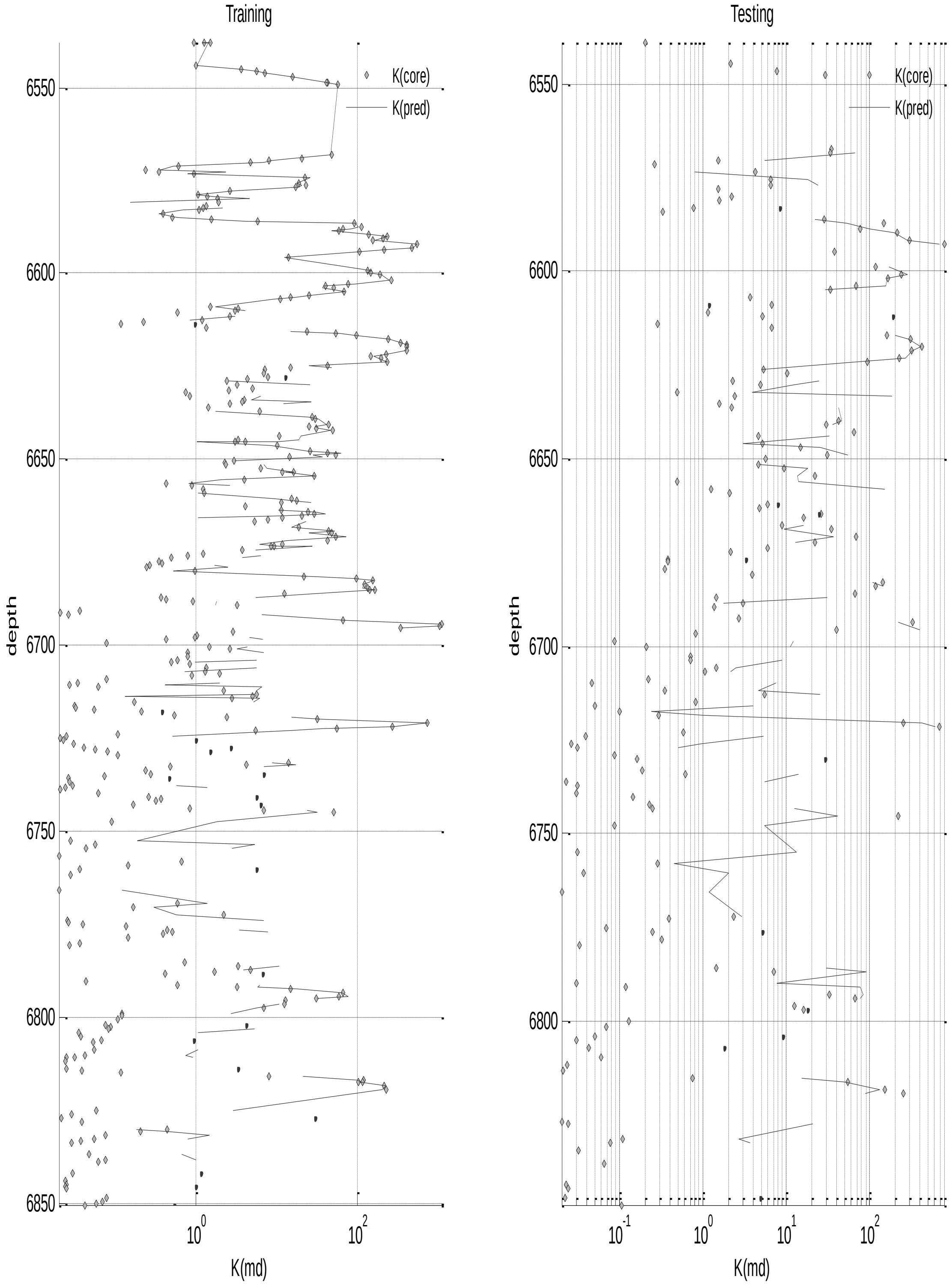

Fig. 2: Training prediction and testing predictions, membership function triangular membership function with interval 0.9

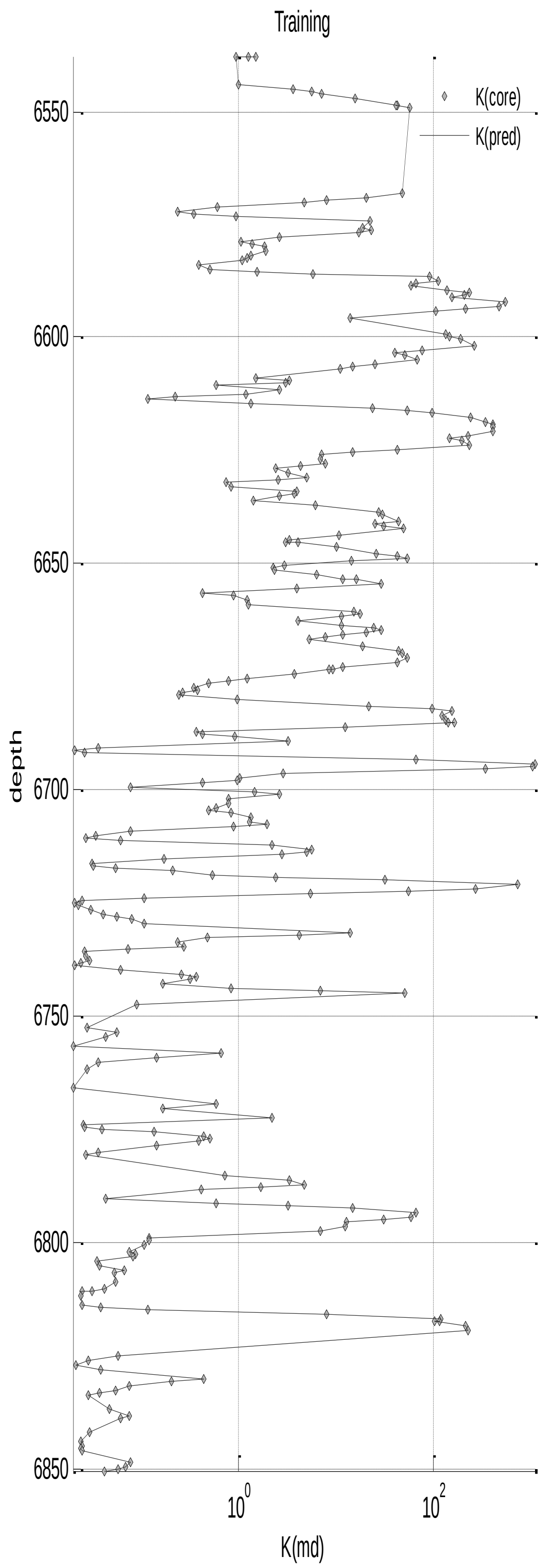

Fig. 3: Training Predictions, membership function triangular membership function with interval 0.1.

At mid of the depth, the core points are turning left. Bigger interval runs were unable to follow the turn.

The reduced interval was applied from 0.9 to 0.1. Training and testing prediction runs were carried out. The best achievement was received at interval 0.1 for present data. Figure 3 shows the training predictions at interval 0.1 with membership function type triangular membership function. Figure 4 shows the testing predictions. Small circular points show core values whereas line shows predictions. Usually, all core points are captured and traced by prediction line.

5.2. Discourse Model

In the previous subsection, training and testing predictions were run. Control of training was carried out to get better predictions. It was seen that at bad training, testing was bad too. At broader interval training was bad as well as testing was not good. Good training with average interval produces average testing. Good testing is obtained at good training and narrow intervals.

Following tasks are presented in this subsection. First, with inputs: training, interval, and output: testing; a fuzzy interface system is constructed. Second, the triangular membership function is used for each input and output assigning three membership functions to each input and output. Third, the information from the course is translated into if-then rules. Figure 5 shows the ready surface fuzzy interface mamdani system relationships between inputs: training and intervals, and output: testing. The shape might be controlled by better training and more trials with various memberships. At narrow intervals, the training is good whereas testing is fine. Table 3 shows testing value for training.

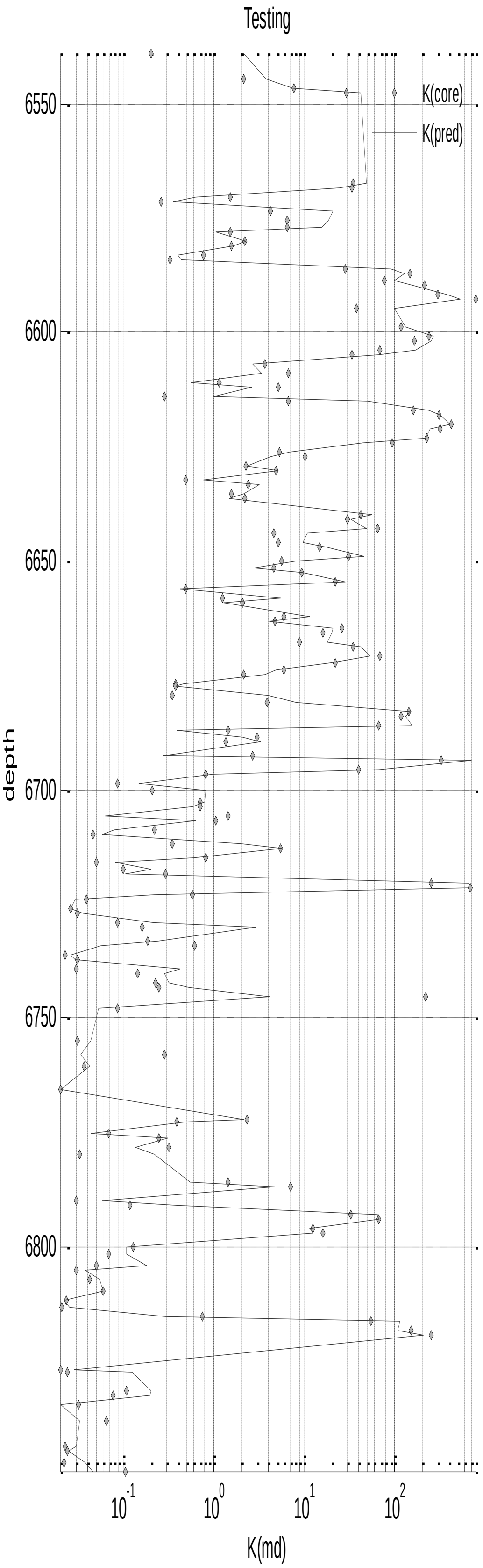

Fig. 4: Testing Predictions, membership triangular membership function with interval 0.1.

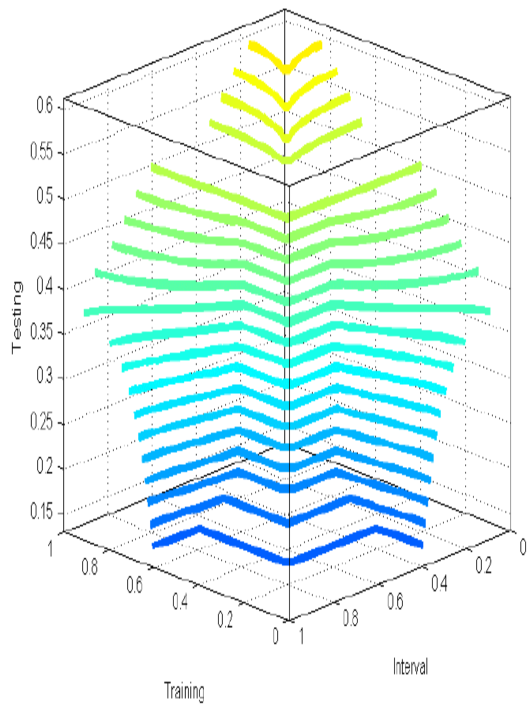

Fig. 5: Discourse model output. Ready surface contours of input: Training and intervals, x-axis and y-axis; for output: testing: z-axis. Ranges are 0 to 1 for each variable. The membership function is triangular membership function namely trimf.

Table 3: Opened unseen input: training, interval and output: testing.

Training	Interval	Testing	%
0.50	0.75	0.163	16
0.50	0.50	0.500	50
0.50	0.25	0.500	50
0.75	0.75	0.411	41
0.75	0.50	0.500	50
0.75	0.25	0.589	60

6. Summary

Machine and code responded well with each other. Machine and computing environment refined the work. Difficulties were faced at memory level adjustment. Narrow interval performed good training and testing. Data was not discovered by larger interval runs. Narrow interval got to the data points. Training and testing pattern were similar.

Good training resulted towards substantial testing. Bad training resulted towards worst testing.

Testing shows that few points are always left over to predict. Membership function approach was good and computationally less expensive. Time expenditure increased when the interval was narrowed.

Training and testing were in the same environment – say in the same language. When training and testing are in different environment – different languages, which results in bad testing – fuzzy logic rule base modeling play a role of translator, an intercourse model, between training and testing. A companion may be supplemented along design driver.

Unseen points of training and testing are seen and can be used to modify the model. In the case of excess computational time, the discourse of different membership functions may be trialed. The model may be accommodated with better membership function. By other approaches, -data and management- based on experience; investigations may be performed. Lucrative support to design a system can be attained by predictions. Other membership functions might run along and present results differently. The data characteristics may become evident with different membership functions trial to ponder the best. By surface structure building of fuzzy interface system, glory hole may be positioned. Many other variables related to well designing may be explored for additional design practices. Impact on future plans for designing new well can be acquired. Discovered fields can be evaluated based on testing and may be related to potential production. Significant guideline for less expensive drilling of new wells may be incorporated. Cross membering and switch of membership with granulation may raise the probability of factualness depending upon the power of the machine. Flowing well may also be incorporated into discourse.

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