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Examples on Simulation Model

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Abstract: A new methodology was developed Further real-time determination gate control operations of a river-reservoir system to minimize flooding conditions. The methodology is based upon an optimization-simulation model approach interfacing the genetic algorithm within simulation software for short-term rainfall forecasting, rainfall–runoff modeling (HEC-HMS), and a one-dimensional (1D), two-dimensional (2D), and combined 1D and 2D combined unsteady flow models (HEC-RAS). Both real-time rainfall data from next-generation radar (NEXRAD) and gaging stations, and forecasted rainfall are needed to make gate control decisions (reservoir releases) in real-time so that at timet, rainfall is known and rainfall over the future time-period(∆t)totimet+ ∆t can be forecasted. This new model can be used to manage reservoir release schedules (optimal gate operations) before, during, and after a rainfall event. Through real-time observations and optimal gate controls, downstream water surface elevations are controlled to avoid exceedance of threshold flood levels at target locations throughout a river-reservoir system to minimize the damage. In an example application, an actual river reach with a hypothetical upstream flood control reservoir is modeled in real-time to test the optimization-simulation portion of the overall model.
Keywords: Simulation – Random numbers- Steps for simulation – Problems.

I. INTRODUCTION

Simulation model is a computer model that imitates a real-life situation. It is like other mathematical models, but it explicitly incorporates uncertainty in one or more inputs variable. When you run a simulation, you allow these random input variables top take on various values, and you keep track of any resulting outputs variables of interest. In this way, you are able to see how the outputs vary as a function of the varying inputs.

A. Definition of Simulation

1) Simulation is the imitation of an operation of a real-word processor system over time.
2) Simulation is a method of understanding, representing and solving complex interdependent system.
3) It is the process of designing a model of a real system and conducting experiments with this model for the purpose either of understanding the behavior of the system or of evaluating various strategies for the operation of the system.

B. Random Number

A random selection of a number from a set or range of numbers is one in which each number in the range is equally likely to be selected.

II. STEPS IN SIMULTION

1) Identify the measure of effectiveness.
2) Decide the variable which influence the measure of effectiveness-choose those variable which affects the measure of effectiveness signification.
3) Identify the measure of effectiveness.
4) Decide the variable which influence the measure of effectiveness-choose those variable which affects the measure of effectiveness signification.
5) Determine the probability distribution for each variable in step (2) and construct the cumulative probability distribution.
6) Choose an appropriate set of random number. Consider each random number as decimal value of the cumulative probability distribution.
7) Use the simulated value so generated into the formula derivate from the measure of effectiveness.
8) Repeat(5)&(6) until the sample is large enough to arrive at a satisfactory and reliable decision

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III. WORKED EXAMPLES

A bakery keeps stock of popular brands of cake previous experience show that the daily demand pattened for the item with associated probability is given below:

Daily	0	10	20	30	40	50
Probability	0.01	0.20	0.15	0.50	0.12	0,02

Use the following sequence of random number to simulate the demand for next 10 days also .Find out the average demand per day.

Solution

Table 1
Probability distribution and assignment of random number interval table

Demand	Probability	Cumulative Probability Distribution	Random Number Interval
0	0.1	01	0-0
10	20	21	1-20
20	15	36	21-35
30	50	86	36-85
40	12	98	86-97
50	02	100	98-99

TABLE 2

Days	Random Number	Demand
1	25	20
2	39	30
3	65	30
4	76	30
5	12	10
6	05	10
7	73	30
8	89	40
9	19	10
10	49	30

Total Demand = 240
Average Demand =240/10 =24 Cakes/day

The automobile company manufactures around 150 scooters. The daily production variance from 146 to 154.

Product per day	146	147	148	149	150	151	152	153	154
Probability	0.04	0.09	0.12	0.14	0.11	0.10	0.20	0.12	0.08

The finished scooters are transported in a lorry 150 scooters, using the following random variables simulate the following

- Along no of scooters waiting in the factors
- Along no of empty space in the lorry

Solution

Production	Probability	Cumulation Probability	Random number
146	0.04	0.04	0-3
147	0.09	0.13	4-12
148	0.12	0.25	13-24
149	0.14	0.39	25-38
150	0.11	0.50	39-49
151	0.10	0.60	50-59
152	0.20	0.30	60-79
153	0.12	0.92	80-91
154	0.02	1.00	92-99

S. No	Random Number	Production Probability	Scooters waiting	No. of empty spaces in the lorry
1	60	153	3	
2	81	153	3	
3	76	152	2	
4	75	152	2	-
5	64	150	-	
6	43	148	-	
7	18	149	-	-
8	26	147	-	2
9	10	147	-	1
10	12	152	-	3
11	15	152	2	3
12	68	152	2	
13	69	152	2	
14	61	152	2	
15	69	152	2	
		151	1	

- scooty waiting =21/15

ii) lorry = 9/15

3) a bakery maintains stock of a particular brand of sweet. Previous experience shows the daily demand pattern for the item with associated probability as given below

Daily demand	0	10	20	30	40	50
Probability	0.01	0.20	0.15	0.50	0.12	0.02

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Use the following sequence of random no's to simulate the demand for next 10 days. Random number are 25, 39, 65, 76, 12, 5, 73, 89, 19, 49. Also estimate the daily average demand for the sweet on the basis of simulated data.

Demand	Probability	Cumulative probability	Random intervals
0	0.01	0.01	0
10	0.20	0.21	1-20
20	0.15	0.36	21-25
30	0.50	0.86	26-85
40	0.12	0.98	86-97
50	0.02	1.00	98-99

Step 2: Simulation table

Day	Random number	Expected demand
1	60	30
2	81	30
3	76	30
4	75	30
5	64	30
6	43	30
7	18	10
8	26	20
9	10	10
10	12	10

Average demand =230 sweets

IV. APPLICATION

A. A hypothetical example application, referred to as the Muncie Project (for Muncie, Indiana), is based upon information from Burner.

B. Muncie is located on the West and East Forks of the White River, which flows through Central and Southern Indiana.

C. The application is designed specifically for testing the optimization-simulation model to determine the optimal operation of the floodgates in a hypothetical reservoir with possible downstream flooding in the river and floodplain of the urban area of Muncie, Indiana.

D. The river reaching down stream of Muncie is real, but there server is hypothetical with one large floodgate as shown in Figure 3.

E. The application assumes a major inflow hydrograph to the hypothetical reservoir so that the HEC-HMS, the rainfall input, and the rainfall forecasting portion of the overall model are not employed in this application. The unsteady flow modeling is performed using the combined 1D unsteady and 2D unsteady (diffusion-wave model) approaches.

F. The combined 1D/2D unsteady flow modeling is used with the river reach modeled using the 1D approach (see Figure 4) and the floodplain is modeled using the 2D approach as illustrated in Figure 5.

G. The hypothetical reservoir is connected to the river reach at the very first upstream cross-section (see Figure 5) through a gated spillway in the inline structure.

H. The radial gate is large enough to allow a range of significant discharges for the flooding event.

I. The total gate width is 30 feet with a maximum opening of 21 feet and a discharge coefficient of 0.98.

J. The river channel is assumed to have an initial steady flow of 1000 cfs.

V. CONCLUSION

In this paper, the process of designing a model of a real system and conduction experiments with this model for the purpose either of understanding the behavior of the system or of evaluating various strategies for the operation of the system is discussed. Also, some problem are solved using the simulation model. Moreover the real time flood operation of river reservoir system is applied using simulation model.

VI. ACKNOWLEDGE

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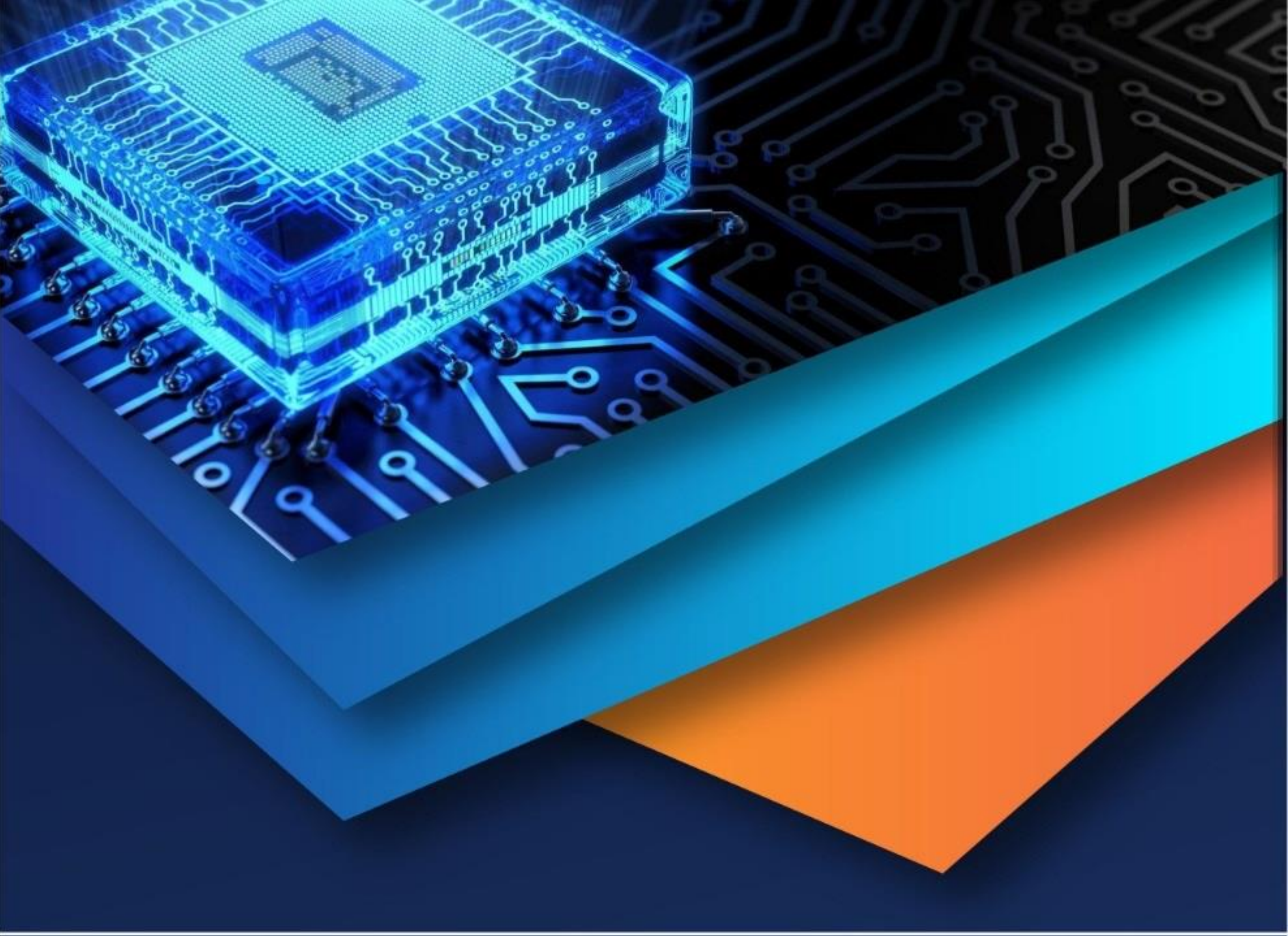

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