

REVIEW AND EXTENSION - COMPUTER SIMULATIONS

Computer simulation is the technique of conducting experiments on a computer using mathematical models which take into account the factors of a real system, in order to predict the outcome of certain events or to control these events. Thus computer simulations imitate physical processes. Computer simulation output can be numerical or graphical or both.

The first stage in the design of a simulation is to make a mathematical model of the process. Two types of models can be used to describe a process. A *deterministic* model, in which everything is predicted exactly by the math model (formulae) or a *probabilistic* model, where something depends on chance (probability).

If an object is thrown vertically with initial velocity u the distance d travelled in time t is given by

$d = ut - \frac{1}{2}gt^2$ where g is acceleration due to gravity. This is a deterministic model. This model could help us simulate the motion of a rocket.

The operation of flipping a coin can be simulated by a probabilistic model. Mathematically the model of the process can be written $P(H) = .5$ $P(T) = .5$

REVIEW

Generate the following random numbers.

- a) $1 \leq R \leq 10$
- b) $3 \leq R \leq 17$
- c) Even numbers between 0 and 10
- d) Odd numbers between 1 and 9

ANSWERS

- a) `r.Next(1,11);`
- b) `r.Next(15)+3;`
- c) `r.Next(6)*2;`
- d) `r.Next(5)*2 +1;`

COIN TOSSING PROBLEM

Write a program which will simulate the tossing of 4 fair coins, 50 times. Display the results of each toss of four on a separate line. If exactly 3 heads occur on a give toss, follow the line with an asterisk (*).

For example your output may look like this:

| | |
|--|-------|
| | HTTH |
| | HHTH* |
| | THTT |

Count the number of times exactly 3 heads occur in the 50 tosses.

DICE PROBLEM 1 (DICE SIMULATION)

Write a VB program that simulates the roll of two die. Instead of printing the numbers print the **word** representations of them and also the word representation of their sum.

DICE PROBLEM 2 (DICE COUNTER)

What makes dice such a good tool in a game of chance is, if they are fair, every side has an equal chance of coming up. Write a VB program that simulates 15 rolls of a die and then prints out the number of times each number is generated. How well would you say this random number generator would work in a computing game that required it to simulate dice? Can you think of any modifications to the program that could help you better decide on an answer? If so, make them and test to see if it supports your answer.

GAMBLER PROBLEM

A gambler has a choice of two games. The first costs \$8.00 to play. Two dice are rolled and the player receive the sum of the numbers rolled in dollars. The second game costs \$15.00 to play. Two dice are rolled and the player receives the product of the numbers rolled in dollars. Write a program which simulates each game being played 1000 times and calculates the average winnings per game. Also determine which game the gambler should choose.

DART GAME PROBLEM

Assume you are throwing darts at a 5 by 5 square board. Each throw will hit randomly at any of the 25 possible squares with equal likelihood. After throwing a certain number of darts, you count the total number of *different* squares you hit. Write a program to simulate this game by throwing n darts, where n is a given input value. After all n darts have been thrown, tally the results and display:

| | |
|-----------------------|------|
| Number of Throws | -> 8 |
| Number of Squares Hit | -> 7 |