Monopoly – Sum Dice

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Professional Development from Texas Instruments

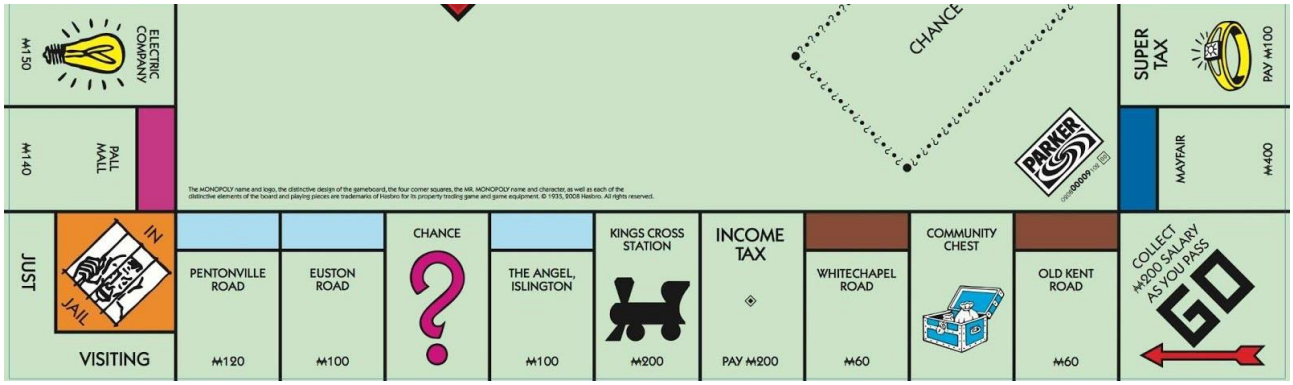
Student Investigation

7 8 9 10 **11** 12

TI-30XPlus MathPrint™ | Investigation | Student | 45 min

Introduction

In the game of Monopoly™ players seek to buy properties and charge other players rent whenever they land on their property. Rent is automatically increased if a player owns a set of properties (set = all the same colour). Rent can be further increased on a set if the player purchases houses or hotels. The overall aim is to develop a financial monopoly, essentially bankrupting other players. Players progress clockwise around the board (right to left in the image below) by rolling two dice and moving forward an amount equal to the sum.



Question: 1.

The following questions assumes play is just starting and all players are positioned on "GO".

Note: "First Roll" refers to a single roll of the two dice and does not account for the free turn provided to a player that rolls a double.

i) What is the maximum number of squares a player might progress on their first roll?

ii) Which square(s) are not possible to land upon for the first roll?

iii) Which square do you think players are most likely to land upon for their first turn?

iv) How likely do you think it is that a player will land on one of the light blue set: The Angel Islington, Euston Road & Pentonville Road in their first roll?

0	0% < B < 20%	20% < B < 40%	40% < B < 60%	60% < B < 80%	80% < B < 100%	100%
Impossible	Unlikely	Somewhat Unlikely	Approximately Even	Somewhat Likely	Likely	Certain

v) On average, how many squares do you think a player is likely to move forward on any given roll?

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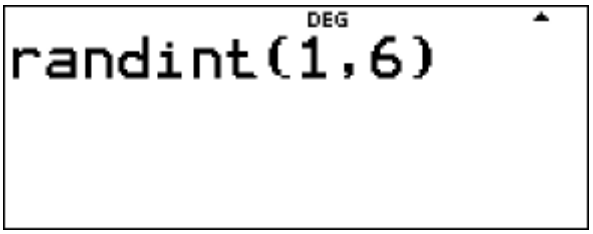
Generating Data

The first task is to simulate a single dice roll, generating whole numbers between 1 and 6. (inclusive).

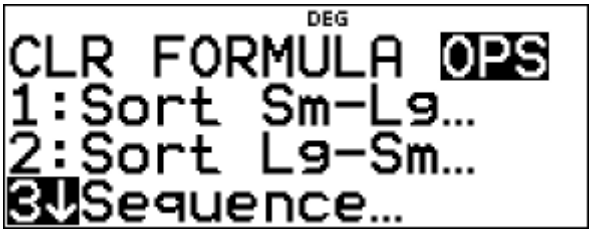
random B A , F op
2nd ! nCr nPr 2 1 2nd . 6)



Press enter repeatedly to see the different numbers.

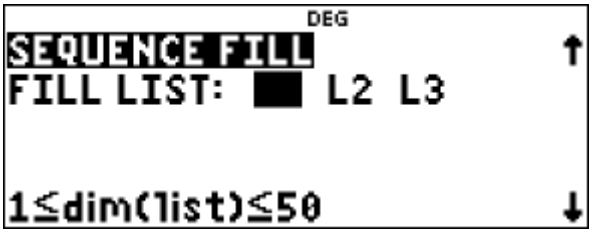
The calculator lists can be used to generate up to 50 samples at a time. The easiest way to do this is to generate a sequence: (OPS = Operations menu)

stat-reg/distr stat-reg/distr C
data data 3



Select L1 (List 1) by using the navigation pad.

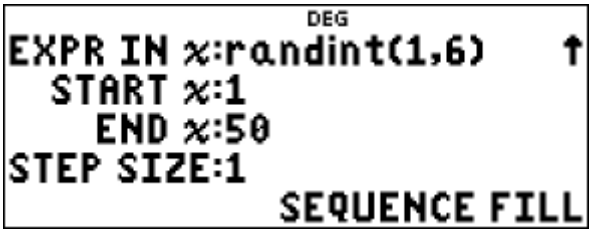
Press enter to select and progress to the expression.



Use the **random** menu again to access the random integer command.

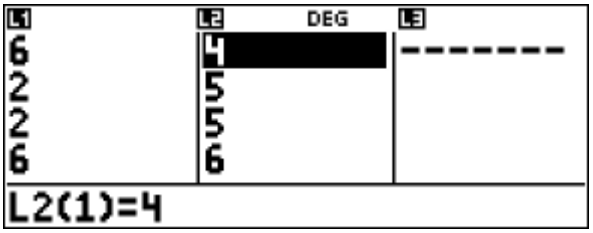
Start the sequence when x = 1 and end at 50.

Select **sequence fill** and List 1 will be populated with 50 random numbers between 1 and 6.



Repeat the above process to place 50 dice rolls in List 2.

In the sample shown opposite the sum of the first pair of dice rolls is 10, the second pair is 7, then 7 again and the fourth roll would be 12.



The dice rolls can be added automatically by using a list formula.

Press: stat-reg/distr data

Navigate across to List 3 then press: stat-reg/distr data

Navigate across to **FORMULA** select: **1: Add/Edit**.

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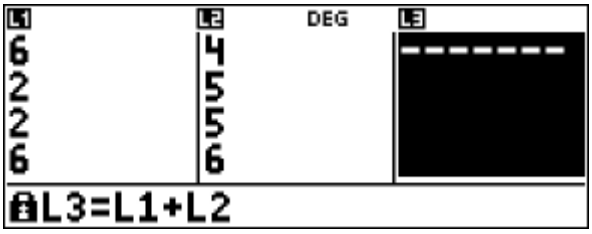
The aim here is to add List 1 and List 2 together.

To access list names, press the stat-reg/distr data key.

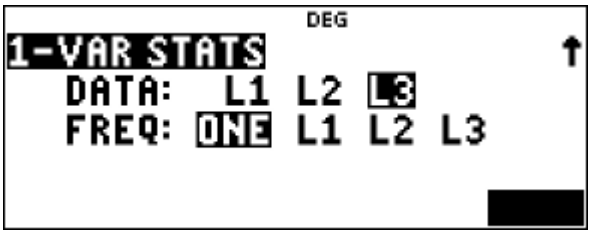
Once the data has been generated, you can scroll through the list of results (L3). To return to the calculator home screen, press: quit 2nd mode



Summary information useful for the following questions can be obtained using statistical analysis.

From the home screen, press: stat-reg/distr 2nd data B 2

Select List 3 and "ONE" for the frequency and then calculate.



Question: 2.

The following questions relate to the data in list 3, the sum of two dice:

i) What is the minimum sum rolled in your dice simulation? Discuss.

ii) What is the maximum sum rolled in your dice simulation? Discuss.

iii) Based on your simulation data, how likely is it that a player will land on one of the light blue set in the first roll?

iv) Based on your simulation data, what is the average number of squares a player is likely to move forward on any given roll?

Question: 3.

Create a frequency table and histogram for your simulated data and comment on the results.

Calculating Probabilities

Theoretical probabilities can be computed by populating a sample space and identifying all possible outcomes.

Sample Space - A sample space is a set of all possible outcomes of a random experiment.

Question: 4.

Copy and complete the table below for the sample space for the sum of two dice.

Dice 2 \ Dice 1	1	2	3	4	5	6
1						
2						
3						
4						
5						
6						

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Question: 5.

Use your previous sample space to complete the probability distribution table and corresponding expected value for the dice sum.

x	2	3	4	5	6	7	8	9	10	11	12
$\mathrm{P}(x)$											
$x.\mathrm{P}(x)$											
$\sum x.\mathrm{P}(x)$											

Question: 6.

Use the sample space and probability distribution table to answer the following:

i) What are the minimum and maximum numbers that can be generated for the sum of two dice.

ii) What sum is most likely to be generated when two dice are rolled, and which square does this correspond to on the first side of the board?

iii) What is the probability that a player will land on one of the light blue properties on the first roll?

iv) What is the probability that a player will roll a double number?

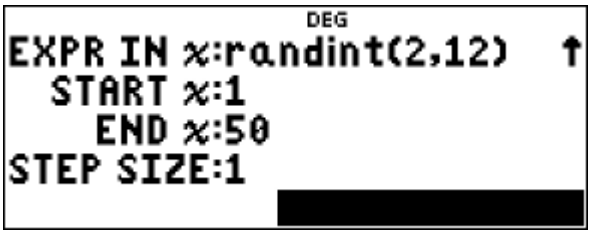
v) On average, how many squares does a player move forward when they roll a double number?
Note: Do not include subsequent rolls, only consider the first roll.

Question: 7.

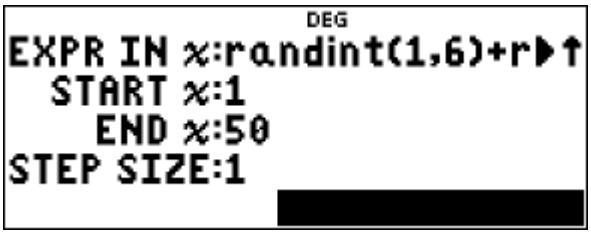
In the game of Monopoly a player receives a second turn if they roll a double. If they roll another double (second double) then they receive another turn, however if they roll a third double, then they do not get to roll again or progress, indeed, they go straight to jail. Based on this information (ignoring forward/backward movement as a player heads to jail), what is the average number of squares a player will move forward each turn in the game of Monopoly.

Question: 8.

Daniel and Leah are trying to produce a simulation in List 1 only for the sum of two dice on their calculator.



Daniel's expression: randint(2,12).



Leah's expression: randint(1,6) + randint(1,6)

i) What numbers will be produced by Daniel's expression?

ii) What numbers will be produced by Leah's expression?

iii) Explain why one of the simulations is not correct.

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