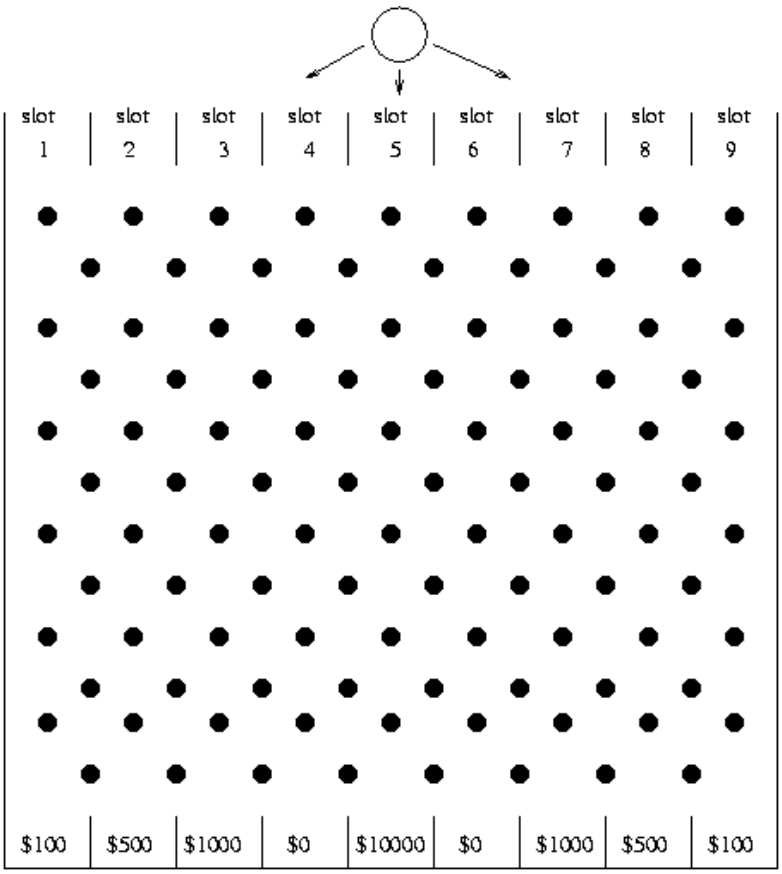
MATH 370 - Probability & Statistics I
Probability Distributions, Means, and Standard Deviations
for Discrete Random Variables

PLINKO!(The Price Is Right)
Game Description: A contestant is shown four small prizes. For each prize, he or she sees two digits, but only one is right. Either the first digit shown is the correct first digit or the last digit shown is the correct last digit. For each small item guessed correctly, the contestant wins a chip. Bob gives the contestant a free chip just for playing the game, so five chips can be earned. The contestant climbs to the top of the Plinko board (see picture below) and drops the chips one at a time. The pegs send the chip bouncing all over the board until they land in slots representing money amounts at the bottom. The slots are, from left to right; \$100, \$500, \$1000, \$0, \$10000, \$0, \$1000, \$500, \$100. After all the chips have dropped, the contestant wins whatever money he or she has earned to that point.



The Plinko board has 12 levels. If you start from Slot 5, for example, you need 6 left bounces and 6 right bounces to hit the \$10000 slot at the bottom.

Simulating Dropping the Plinko Chip

1. You can simulate one "drop" with the random integer function by using `randInt(0,1,12)[STO]->` L_1 on the TI-83. (Note: `randInt(` is found under the `MATH -> PRB` menu, option 5.) If each 0 counts as a left bounce and each 1 as a right bounce, the calculator creates 12 values randomly of either 1 or 0 and stores them in List 1.

2. Tally and record the total number of right bounces. This can be recorded as `sum(L1)` from the home screen (note the `sum()` function is found under the `LIST -> MATH` menu, option number 5).

3. To find your location at the bottom of the Plinko board, use the conversion table below (which accounts for reflections off the wall). The table assumes you drop the Plinko chip from Slot 5.

# of "right bounces"		winnings
6	$\longrightarrow$	\$10,000
0, 4, 8, 12	$\longrightarrow$	\$1,000
1, 3, 9, 11	$\longrightarrow$	\$500
2, 10	$\longrightarrow$	\$100
5, 7	$\longrightarrow$	\$0

4. Repeat steps 1 - 3 five times. Record your results in the table below.

Plinko Chip #	# of right bounces	amount you win
1		\$
2		\$
3		\$
4		\$
5		\$
TOTAL WINNINGS:		\$

Probabilities

1. Record the results of your five chips, along with those of your classmates, in the table below, where x is the amount of your winnings from each Plinko chip

x	
Frequency	

2. Change these frequencies into relative frequencies (probabilities for your experimental results)

x	
Rel. Freq. "probability"	

3. Compare your results to the "true" probability values for x

x	0	100	500	1000	1000
$p(x)$	396/1024	33/1024	116/1024	248/1024	231/1024

   Why are the simulation results not identical to the "true" probability values?

4. Use your simulation data from before to calculate the expected winnings from one Plinko chip.

5. Use the table of "true" probability values to calculate the same expected value.

6. Now calculate the standard deviation for your simulation "probabilities" and for the "true" probabilities. Label them as σ_S and σ_T for Simulation and True results.

Changing Starting Slots

What happens if you drop the chip from Slot 4? The table below gives you this information. Note, this is a different distribution than when we dropped the chip from Slot 5.

# of "right bounces"		winnings
7	$\longrightarrow$	\$10,000
1, 5, 9	$\longrightarrow$	\$1,000
2, 4, 10, 12	$\longrightarrow$	\$500
3, 11	$\longrightarrow$	\$100
0, 6, 8	$\longrightarrow$	\$0

The table below indicates the probability distribution for Plinko if you drop a chip from Slot 4 rather than Slot 5.

x	0	100	500	1000	1000
$p(x)$	355/1024	58/1024	157/1024	256/1024	198/1024

1. Calculate the expected value of this probability distribution.

2. Calculate the standard deviation.

3. Which slot wins you more money in the long run: Slot 4 or Slot 5? Explain.

4. Which slot yield less variability: Slot 4 or Slot 5? Explain.