"The Game of Pig" Teacher Guide

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Figure 1 shows an Excel spreadsheet that combines the theoretical and empirical results for the activities suggested for students of probability and statistics as well as computer science. The graph shows two plots. One of these is column C versus column A—blue dots, theoretical. The other is column F versus column A—red dots, empirical.

Roll #	Theoretical Probability of First "1" ON Roll#	Theoretical Probability of First "1" ON or BEFORE Roll#	500 Simulation Trials Tallies of First "1"on Roll#	Empirical Probability of First "1" ON Roll#	Empirical Probability of First "1" ON or BEFORE Roll#
1	0.166666667	0.166666667	81	0.162	0.162
2	0.138888889	0.305555556	80	0.16	0.322
3	0.115740741	0.421296296	40	0.08	0.402
4	0.096450617	0.517746914	57	0.114	0.516
5	0.080375514	0.598122428	46	0.092	0.608
6	0.066979595	0.665102023	37	0.074	0.682
7	0.055816329	0.720918353	27	0.054	0.736
8	0.046513608	0.767431961	17	0.034	0.77
9	0.03876134	0.806193301	18	0.036	0.806
10	0.032301117	0.838494417	14	0.028	0.834
11	0.026917597	0.865412014	9	0.018	0.852
12	0.022431331	0.887843345	12	0.024	0.876
13	0.018692776	0.906536121	11	0.022	0.898
14	0.015577313	0.922113434	13	0.026	0.924
15	0.012981094	0.935094528	5	0.01	0.934
16	0.010817579	0.945912107	4	0.008	0.942
17	0.009014649	0.954926756	9	0.018	0.96
18	0.007512207	0.962438963	2	0.004	0.964
19	0.006260173	0.968699136	2	0.004	0.968
20	0.005216811	0.973915947	3	0.006	0.974
21	0.004347342	0.978263289	3	0.006	0.98
22	0.003622785	0.981886074	3	0.006	0.986

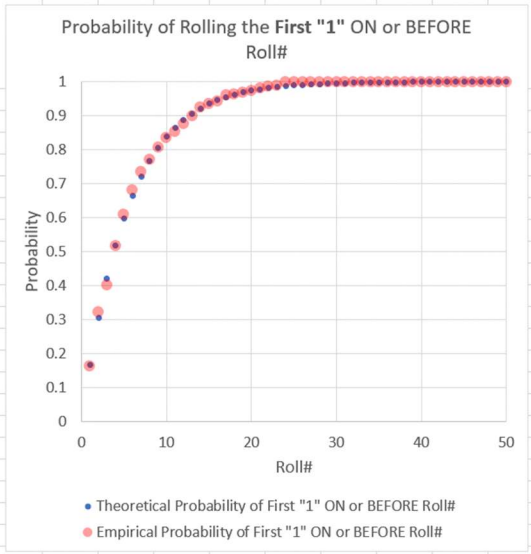

Figure 1

Figure 2 shows the formulas used. Column B applies the theoretical formula

$$\left(\frac{5}{6}\right)^{n-1} \bullet \frac{1}{6} \quad \textit{(Formula 1),}$$

and column C applies the theoretical formula

$$\sum_{k=0}^{n-1} \left(\frac{5}{6}\right)^{k} \left(\frac{1}{6}\right) \quad \textit{(Formula 2).}$$

	A	B	C	D	E	F
1	Roll #	Theoretical Probability of First "1" ON Roll#	Theoretical Probability of First "1" ON or BEFORE Roll#	500 Simulation Trials Tallies of First "1"on Roll#	Empirical Probability of First "1" ON Roll#	Empirical Probability of First "1" ON or BEFORE Roll#
2	1	=(5/6)^(A2-1)*(1/6)	=B2	81	=D2/SUM($D$2:$D$51)	=E2
3	2	=(5/6)^(A3-1)*(1/6)	=C2+B3	80	=D3/SUM($D$2:$D$51)	=F2+E3
4	3	=(5/6)^(A4-1)*(1/6)	=C3+B4	40	=D4/SUM($D$2:$D$51)	=F3+E4
5	4	=(5/6)^(A5-1)*(1/6)	=C4+B5	57	=D5/SUM($D$2:$D$51)	=F4+E5
6	5	=(5/6)^(A6-1)*(1/6)	=C5+B6	46	=D6/SUM($D$2:$D$51)	=F5+E6
7	6	=(5/6)^(A7-1)*(1/6)	=C6+B7	37	=D7/SUM($D$2:$D$51)	=F6+E7
8	7	=(5/6)^(A8-1)*(1/6)	=C7+B8	27	=D8/SUM($D$2:$D$51)	=F7+E8
9	8	=(5/6)^(A9-1)*(1/6)	=C8+B9	17	=D9/SUM($D$2:$D$51)	=F8+E9
10	9	=(5/6)^(A10-1)*(1/6)	=C9+B10	18	=D10/SUM($D$2:$D$51)	=F9+E10
11	10	=(5/6)^(A11-1)*(1/6)	=C10+B11	14	=D11/SUM($D$2:$D$51)	=F10+E11
12	11	=(5/6)^(A12-1)*(1/6)	=C11+B12	9	=D12/SUM($D$2:$D$51)	=F11+E12
13	12	=(5/6)^(A13-1)*(1/6)	=C12+B13	12	=D13/SUM($D$2:$D$51)	=F12+E13
14	13	=(5/6)^(A14-1)*(1/6)	=C13+B14	11	=D14/SUM($D$2:$D$51)	=F13+E14
15	14	=(5/6)^(A15-1)*(1/6)	=C14+B15	13	=D15/SUM($D$2:$D$51)	=F14+E15
16	15	=(5/6)^(A16-1)*(1/6)	=C15+B16	5	=D16/SUM($D$2:$D$51)	=F15+E16
17	16	=(5/6)^(A17-1)*(1/6)	=C16+B17	4	=D17/SUM($D$2:$D$51)	=F16+E17
18	17	=(5/6)^(A18-1)*(1/6)	=C17+B18	9	=D18/SUM($D$2:$D$51)	=F17+E18
19	18	=(5/6)^(A19-1)*(1/6)	=C18+B19	2	=D19/SUM($D$2:$D$51)	=F18+E19
20	19	=(5/6)^(A20-1)*(1/6)	=C19+B20	2	=D20/SUM($D$2:$D$51)	=F19+E20
21	20	=(5/6)^(A21-1)*(1/6)	=C20+B21	3	=D21/SUM($D$2:$D$51)	=F20+E21
22	21	=(5/6)^(A22-1)*(1/6)	=C21+B22	3	=D22/SUM($D$2:$D$51)	=F21+E22
23	22	=(5/6)^(A23-1)*(1/6)	=C22+B23	3	=D23/SUM($D$2:$D$51)	=F22+E23

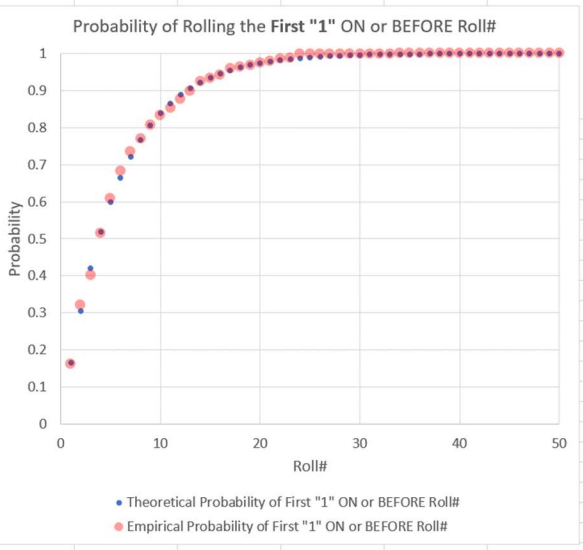

Figure 2

Note that the Excel *.xlsx* file described above accompanies this lesson as a download. There is also an accompanying solution to the computer science programming exercise called *Computer Science Exercise.ozocode*.

Answers to Questions

1. What is the probability of rolling a 1 on roll 1? *[1/6 ≈ 0.167]*
2. What is the probability of rolling a 1 on or before roll 2? *[≈ 0.306]*
3. What is the probability of rolling a 1 on or before roll 3? *[≈ 0.421]*
4. On what roll number is this probability approximately 0.5? *[roll #4]*
5. On what roll number does this probability just exceed 0.8? *[roll #9]*
6. On what roll number does this probability just exceed 0.9? *[roll #13]*
7. On what roll number does this probability just exceed 0.95? *[roll #17]*
8. On what roll number does this probability just exceed 0.99? *[roll #26]*