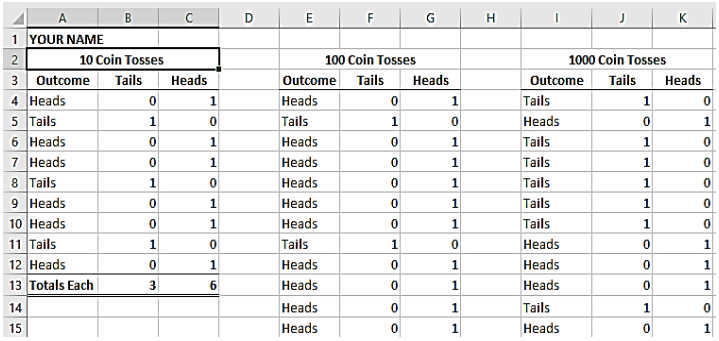
Excel's Random Number Generator & the Law of Large Numbers

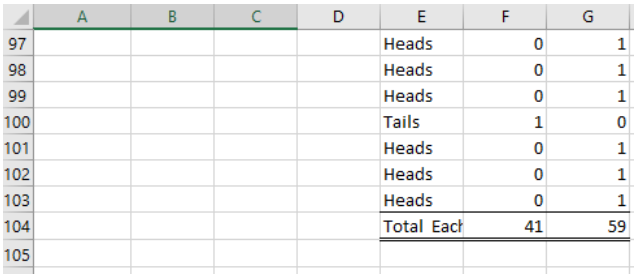
Many events can be modeled and/or predicted by understanding the chances that events will occur. In a statistics class, these chances are called *probabilities*. The *Law of Large Numbers* says that as a sample size or number of trials increases, its outcomes gets closer to the average/expected value of the whole population.

A coin toss has 2 outcomes – heads or tails (we will assume that any toss that is not either result means the coin needs to be flipped again). We can model this using Excel's *Random Number Generator*.

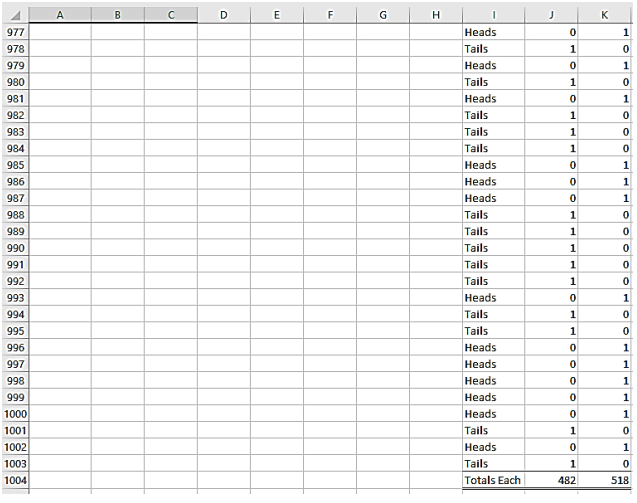


	A	B	C	D	E	F	G	H	I	J	K
1	YOUR NAME										
2		10 Coin Tosses				100 Coin Tosses				1000 Coin Tosses	
3		Outcome	Tails	Heads		Outcome	Tails	Heads		Outcome	Tails	Heads
4		Heads	0	1		Heads	0	1		Tails	1	0
5		Tails	1	0		Tails	1	0		Heads	0	1
6		Heads	0	1		Heads	0	1		Tails	1	0
7		Heads	0	1		Heads	0	1		Tails	1	0
8		Tails	1	0		Heads	0	1		Tails	1	0
9		Heads	0	1		Heads	0	1		Tails	1	0
10		Heads	0	1		Heads	0	1		Tails	1	0
11		Tails	1	0		Tails	1	0		Heads	0	1
12		Heads	0	1		Heads	0	1		Heads	0	1
13		Totals Each	3	6		Heads	0	1		Heads	0	1
14						Heads	0	1		Tails	1	0
15						Heads	0	1		Heads	0	1

1. **Enter your name in cell A-1**. Please apply BOLD to your name so that it stands out.
2. Enter the column headings shown below, right, **centering each across the *ranges*** A3:C3, E3:G3, & I3:K3.
3. The headings **Outcomes, Tails, and Heads** go in cells A3, B3, C3,E3, F3, G3, I3, J3, K3 as shown right
4. In cell A4, **enter**: =TEXT(RANDBETWEEN(0,1),"""Heads"";;""Tails""")
5. In cell B4 **enter**: =IF(A4="tails",1,0)
6. In cell C4, **enter**: =IF(A4="heads",1,0)
7. In cell E4, **enter**: =TEXT(RANDBETWEEN(0,1),"""Heads"";;""Tails""")
8. In cell F4, **enter**: =IF(E4="tails",1,0)
9. In cell G4, **enter**: =IF(E4="heads",1,0)
10. In cell I4, **enter**: =TEXT(RANDBETWEEN(0,1),"""Heads"";;""Tails""")
11. In cell J4, **enter**: =IF(I4="tails",1,0)
12. In cell K4, **enter**: =IF(I4="heads",1,0)
13. FILL DOWN **from the range** A4:C4 to A12:C12 as shown above.
14. FILL DOWN **from the range** E3:G4 to E104:G104
15. FILL DOWN from range I4:K4 to I1003:K1003
16. Use AUTOSUM **to total the values in columns** B & C, F & G, and J & K
17. **Enter the label** *Total Each* as shown in right
18. Using the BORDER BUTTON, apply a line above each set of totals and a double-line below. THIS IS A STANDARD ACCOUNTING FORMAT THAT INDICATES A VALUE REPRESENTS THE SUM OF THE COLUMN ABOVE.
19. **Hit the F9 key and check your totals**. This key recalculates the random number which will change the outcomes (heads or tails), which changes your totals.
20. We know from probabilities analysis that if the coin is "fair" and the toss is done properly, **one-half the time we should get heads and the other half should be tails**.



	A	B	C	D	E	F	G
97					Heads	0	1
98					Heads	0	1
99					Heads	0	1
100					Tails	1	0
101					Heads	0	1
102					Heads	0	1
103					Heads	0	1
104					Total Each	41	59
105							



	I	J	K
977	Heads	0	1
978	Tails	1	0
979	Heads	0	1
980	Tails	1	0
981	Heads	0	1
982	Tails	1	0
983	Tails	1	0
984	Tails	1	0
985	Heads	0	1
986	Heads	0	1
987	Heads	0	1
988	Tails	1	0
989	Tails	1	0
990	Tails	1	0
991	Tails	1	0
992	Tails	1	0
993	Heads	0	1
994	Tails	1	0
995	Tails	1	0
996	Heads	0	1
997	Heads	0	1
998	Heads	0	1
999	Heads	0	1
1000	Heads	0	1
1001	Tails	1	0
1002	Heads	0	1
1003	Tails	1	0
1004	Totals Each	482	518

21. The law of large numbers says that the larger samples (100 and 1000 tosses) should more accurately represent a 50/50 split. REMEMBER: *1000 is 10 TIMES MORE THAN 100, so when you assess those results we need to consider the relative difference and no the absolute difference between our coin toss model and obtaining half heads and half tails equally!*