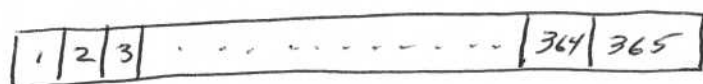


# Birnth day Problem

Concepts

Pidgeon Hole Principle, Partition, Permutations

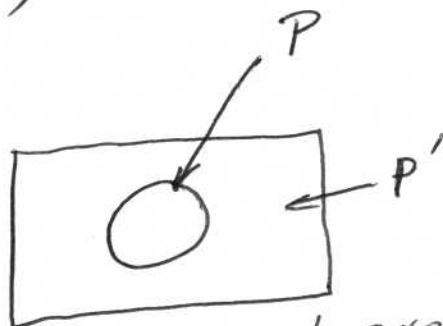
Days in the year "D"



No Leap Years

No twins, etc... in the room

Calculate the probability of two or more individuals in a room having the same birthday



$$P' + P = 1$$

$P' = \text{Prob}(\text{No 2 people have same birthday})$

Calculate  $P' \rightarrow P$

$$P_1 (\text{1st person choosing an empty date}) = \frac{365}{365} = 1$$

$$P_{2/1} (\text{2nd person choosing an empty date given 1}) = \frac{364}{365}$$

$$P_{3/1,2} (\text{3rd person choosing an empty date given 1, 2}) = \frac{363}{365}$$

So the probability given  $N$  people and  $D$  days in the year are

$$P' = P_1 \cdot P_{2/1} \cdot \prod_{i=3}^N P_{i/1, i-1}$$

$$= \frac{{}_D P_N}{D^N} \quad \text{where } {}_D P_N = \frac{D!}{(D-N)!}$$


To approximate

$$\frac{364}{365} = \left(1 - \frac{1}{365}\right) = e^{-1/365}$$

So

$$P' = \prod_{i=0}^{N-1} e^{-i/D} = e^{-\frac{1}{D} \sum_{i=0}^{N-1} i} = e^{-\frac{N(N-1)}{2D}}$$

$$P = 1 - e^{-\frac{N(N-1)}{2D}}$$

  
5/16/14

## Birth Day Problem

Probability(There are 2 or more people in a room with the same Birth Date)

365 = Number of Days in the Year

N People	Pi/[1,i]	Cum(Pi/1,i)	1-Cum(Pi/1,i)	Percent of 1-Cum(Pi/1,i)	Approximation $1-e^{-(N*(N-1)/(2D))}$
1	1	1	0	0	0.00
2	0.997260274	0.997260274	0.002739726	0.27	0.27
3	0.9945205479	0.9917958341	0.0082041659	0.82	0.82
4	0.9917808219	0.9836440875	0.0163559125	1.64	1.63
5	0.9890410959	0.9728644263	0.0271355737	2.71	2.70
6	0.9863013699	0.9595375164	0.0404624836	4.05	4.03
7	0.9835616438	0.9437642969	0.0562357031	5.62	5.59
8	0.9808219178	0.9256647076	0.0743352924	7.43	7.38
9	0.9780821918	0.9053761661	0.0946238339	9.46	9.39
10	0.9753424658	0.8830518223	0.1169481777	11.69	11.60
11	0.9726027397	0.8588586217	0.1411413783	14.11	13.99
12	0.9698630137	0.8329752112	0.1670247888	16.70	16.54
13	0.9671232877	0.8055897248	0.1944102752	19.44	19.24
14	0.9643835616	0.776897488	0.223102512	22.31	22.07
15	0.9616438356	0.7470986802	0.2529013198	25.29	25.00
16	0.9589041096	0.7163959947	0.2836040053	28.36	28.02
17	0.9561643836	0.6849923347	0.3150076653	31.50	31.11
18	0.9534246575	0.6530885821	0.3469114179	34.69	34.24
19	0.9506849315	0.620881474	0.379118526	37.91	37.41
20	0.9479452055	0.5885616164	0.4114383836	41.14	40.58
21	0.9452054795	0.5563116648	0.4436883352	44.37	43.75
22	0.9424657534	0.5243046923	0.4756953077	47.57	46.89
23	0.9397260274	0.4927027657	0.5072972343	50.73	50.00
24	0.9369863014	0.4616557421	0.5383442579	53.83	53.05
25	0.9342465753	0.431300296	0.568699704	56.87	56.04
26	0.9315068493	0.4017591799	0.5982408201	59.82	58.95
27	0.9287671233	0.3731407177	0.6268592823	62.69	61.77
28	0.9260273973	0.3455385277	0.6544614723	65.45	64.50
29	0.9232876712	0.3190314625	0.6809685375	68.10	67.12
30	0.9205479452	0.2936837573	0.7063162427	70.63	69.63
31	0.9178082192	0.2695453663	0.7304546337	73.05	72.03
32	0.9150684932	0.2466524721	0.7533475279	75.33	74.31
33	0.9123287671	0.2250281458	0.7749718542	77.50	76.46
34	0.9095890411	0.2046831354	0.7953168646	79.53	78.50
35	0.9068493151	0.1856167611	0.8143832389	81.44	80.41
36	0.904109589	0.1678178936	0.8321821064	83.22	82.20
37	0.901369863	0.1512659918	0.8487340082	84.87	83.87
38	0.898630137	0.1359321789	0.8640678211	86.41	85.43
39	0.895890411	0.1217803356	0.8782196644	87.82	86.87
40	0.8931506849	0.1087681902	0.8912318098	89.12	88.20
41	0.8904109589	0.0968483885	0.9031516115	90.32	89.42
42	0.8876712329	0.0859695284	0.9140304716	91.40	90.55
43	0.8849315068	0.0760771443	0.9239228557	92.39	91.58
44	0.8821917808	0.0671146314	0.9328853686	93.29	92.51
45	0.8794520548	0.0590241005	0.9409758995	94.10	93.36
46	0.8767123288	0.0517471566	0.9482528434	94.83	94.13
47	0.8739726027	0.0452255972	0.9547744028	95.48	94.83
48	0.8712328767	0.0394020271	0.9605979729	96.06	95.45
49	0.8684931507	0.0342203907	0.9657796093	96.58	96.01
50	0.8657534247	0.0296264204	0.9703735796	97.04	96.51
51	0.8630136986	0.0255680067	0.9744319933	97.44	96.96
52	0.8602739726	0.0219954907	0.9780045093	97.80	97.36
53	0.8575342466	0.0188618865	0.9811381135	98.11	97.71
54	0.8547945205	0.0161230372	0.9838769628	98.39	98.02
55	0.8520547945	0.0137377112	0.9862622888	98.63	98.29
56	0.8493150685	0.0116676451	0.9883323549	98.83	98.53
57	0.8465753425	0.0098775407	0.9901224593	99.01	98.74
58	0.8438356164	0.0083350206	0.9916649794	99.17	98.92
59	0.8410958904	0.0070105516	0.9929894484	99.30	99.08
60	0.8383561644	0.0058773391	0.9941226609	99.41	99.22
61	0.8356164384	0.0049112012	0.9950887988	99.51	99.34
62	0.8328767123	0.0040904251	0.9959095749	99.59	99.44
63	0.8301369863	0.0033956132	0.9966043868	99.66	99.53
64	0.8273972603	0.002809521	0.997190479	99.72	99.60
65	0.8246575342	0.0023168927	0.9976831073	99.77	99.66
66	0.8219178082	0.0019042954	0.9980957046	99.81	99.72
67	0.8191780822	0.001559957	0.998440043	99.84	99.77
68	0.8164383562	0.0012736087	0.9987263913	99.87	99.81
69	0.8136986301	0.0010363337	0.9989836663	99.90	99.84
70	0.8109589041	0.000840424	0.999159576	99.92	99.87
71	0.8082191781	0.0006792468	0.9993207532	99.93	99.89
72	0.8054794521	0.0005471194	0.9994528806	99.95	99.91
73	0.802739726	0.0004391944	0.9995608056	99.96	99.93
74	0.8	0.0003513556	0.9996486444	99.96	99.94
75	0.797260274	0.0002801218	0.9997198782	99.97	99.95
76	0.7945205479	0.000225625	0.999774375	99.98	99.96
77	0.7917808219	0.0001762208	0.9998237792	99.98	99.97
78	0.7890410959	0.0001390454	0.9998609546	99.99	99.97
79	0.7863013699	0.0001093316	0.9998906684	99.99	99.98
80	0.7835616438	8.566805069E-005	0.9999143319	99.99	99.98

## Birth Day Problem

Odds of 2 or more People in a room with Same Birth Day

