Statistics 1B Interludes

1. Celebrity deaths in 2016

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Magazine

Have more famous people died in 2016?

By Charlotte McDonald
BBC News

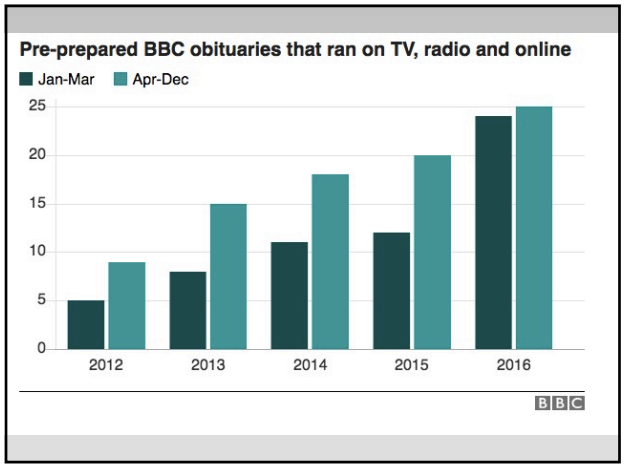
30 December 2016 | Magazine Share

Memorial to David Bowie GETTY IMAGES

It's been held up as a particularly gloomy year for celebrity deaths. But has the grim reaper really claimed the souls of more notable people than usual in 2016?

In today's Magazine

Studying at the secret



1	Robert Stigwood	26	Burt Kwouk
2	Ed Stewart	27	Carla Lane
3	David Bowie	28	Muhammed Ali
4	Alan Rickman	29	Peter Shaffer
5	Glenn Frey	30	Caroline Aherne
6	Cecil Parkinson	31	Elie Wiesel
7	Frank Finlay	32	Gene Wilder
8	Terry Wogan	33	Pierre Boulez
9	Margaret Forster	34	Arnold Palmer
10	Eric Lubbock	35	Shimon Peres
11	Boutros Boutros Ghali	36	Andrew Sachs
12	Harper Lee	37	Leonard Cohen
13	John Chilton	38	Jimmy Young
14	Tony Warren	39	Robert Vaughn
15	Nancy Reagan	40	Fidel Castro
16	George Martin	41	Peter Vaughan
17	Peter Maxwell Davies	42	Greg Lake
18	Paul Daniels	43	Zsa Zsa Gabor
19	Cliff Michelmore	44	Lional Blue
20	Barry Hines	45	Liz Smith
21	Garry Shandling	46	Rick Parfitt
22	Ronnie Corbett	47	Richard Adams
23	Zaha Hadid	48	George Michael
24	Victoria Wood	49	Carrie Fisher
25	Prince		

The "birthday paradox"

- 23 random people: 51% chance that 2 share a birthday
- 23 random people: 51% chance that 2 share a deathday
- 49 people: 97% chance that 2 share a death-day

Why does this happen?

- Imagine 49 people in a line
- First deathday can be anything
- 2nd deathday must be different from first: probability 364/365 = 0.997
- 3rd deathday must be different from 1st and 2nd: probability 363/365 = 0.995
- …..
- Probability that all 49 are different = 0.997 x 0.995 x …. 0.868 = 0.03

Useful approximate formulae
(Diaconis and Mosteller)

- Suppose a single 'match' between 2 people has a chance $1/K$
  eg same birthday: $K = 365$
- Then for a 50% chance of a match, need around $1.2\sqrt{K}$ people (eg 1.2 x √365 = 23)
- Then for a 95% chance of a match, need around $2.5\sqrt{K}$ people (eg 2.5 x √365 = 48)

'Proof' of approximation.

Probability of a match between a random pair is $1/K$
Probability that there are no matches in n people denoted $p(n, K)$. Then

$$p(n,K) = \left(1-\frac{1}{K}\right) \times \left(1-\frac{2}{K}\right) \times \left(1-\frac{3}{K}\right) \times \cdots \times \left(1-\frac{(n-1)}{K}\right).$$

If n small compared to K, then $\left(1-\frac{t}{K}\right) \approx e^{-t/K}$ for $t = 1,2,..n-1$. So

$$p(n,K) = e^{-\frac{[1+2+..+(n-1)]}{K}} = e^{-\frac{n(n-1)/2}{K}} \approx e^{-\frac{n^2}{2K}}.$$

So $n \approx \sqrt{-2K \ln p}$; setting $p = 0.50, 0.05$ gives approximation.

Alternative 'proof' of approximation

There are $n(n-1)/2 \approx n^2/2$ pairs of people, each with probability $1/K$ of matching.

So expected number of matches $\approx \frac{n^2}{2K}$ [expectation additive for dependent events]

Assuming number of matches is Poisson, then $p(n,K) \approx e^{-\frac{n^2}{2K}}$.

Gap between birthdays	Odds of 2 random people 'matching' 1 in K K	Number needed for chance of match = 50% 1.2 √K	Number needed for chance of match = 95% 2.5 √K
Same day	365	23	48
Within 1 day	122	13	28
Within 3 days	52	9	18
Within 1 week	24	6	12
Within 2 weeks	13	4	9

In 49 celebrity deaths?

We would expect around

$$\frac{n^2}{2K} = \frac{49^2}{2.365} = 3.3 \text{ pairs}$$

1	Robert Stigwood	04 January 2016	26	Burt Kwouk	24 May 2016
2	Ed Stewart	09 January 2016	27	Carla Lane	31 May 2016
3	David Bowie	10 January 2016	28	Muhammed Ali	03 June 2016
4	Alan Rickman	14 January 2016	29	Peter Shaffer	06 June 2016
5	Glenn Frey	18 January 2016	30	Caroline Aherne	02 July 2016
6	Cecil Parkinson	22 January 2016	31	Elie Wiesel	02 July 2016
7	Frank Finlay	30 January 2016	32	Gene Wilder	29 August 2016
8	Terry Wogan	31 January 2016	33	Pierre Boulez	05 September 2016
9	Margaret Forster	08 February 2016	34	Arnold Palmer	25 September 2016
10	Eric Lubbock	14 February 2016	35	Shimon Peres	28 September 2016
11	Boutros Boutros Ghali	16 February 2016	36	Andrew Sachs	03 November 2016
12	Harper Lee	19 February 2016	37	Leonard Cohen	07 November 2016
13	John Chilton	25 February 2016	38	Jimmy Young	07 November 2016
14	Tony Warren	01 March 2016	39	Robert Vaughn	11 November 2016
15	Nancy Reagan	06 March 2016	40	Fidel Castro	25 November 2016
16	George Martin	08 March 2016	41	Peter Vaughan	06 December 2016
17	Peter Maxwell Davies	14 March 2016	42	Greg Lake	07 December 2016
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24	Victoria Wood	20 April 2016	49	Carrie Fisher	27 December 2016
25	Prince	21 April 2016			