

# *Chance, Risk & Probability - Basic Statistics*

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Probability, Risk, Statistical Significance, Confidence, Alpha Level ( $\alpha$ ), Type I Error, chance Alpha Error, p, and related matters.

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 Risk is risk...BUT, some people can tolerate more than others!

Error is error...BUT, some people make more errors than others and some errors are more serious ...SOME ARE INTOLERABLE!

RISK, PROBABILITY, & CHANCE may be expressed in one of two mathematical ways:

if the RISK is "1 in 10,"  
 it can be expressed as  $1/10$  or by the decimal====> 0.1

if it is "5 in 10," it can be expressed as  $5/10$  or: 0.5  
 Note:"5 in 10" is what is also meant by "50-50". This means that there are an equal number of possibilities for as there are against an outcome.

"4 in 8" is also "50-50" & can be expressed as  $4/8$  or: 0.5

"3 in 6" is "50-50" too & can be expressed as  $3/6$  or: 0.5

"10 in 100",  $10/100$ , equals the decimal: 0.1  
 Note that 10 in 100 is the same probability as 1 in 10 (above)!

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 "5 in 100,"  $5/100$ , equals the decimal: 0.05  
 This means there are 5 chances in 100 FOR any event.

"1 in 100," equals  $1/100$  or the decimal: 0.01

"1 in 1000,"  $1/1000$ , equals the decimal: 0.001

"1 in 10000,  $1/10000$ , equals the decimal: 0.0001

"1 in 100000,"  $1/100000$ , equals the decimal: 0.00001

"1 in 1000000," a million,  $1/1000000$ , equals: 0.000001

What are your chances of winning the LOTTERY?  
 How about "1 in 3000000,"  $1/3000000$ , or: 0.000000333333  
 or is it  $1/4000000$ ? 0.000000250000  
 or  $1/5000000$ ? 0.000000200000  
 or  $1/6000000$ ? 0.000000166667

In Statistical Decision making, we want to keep the RISK of a wrong decision...known as ALPHA ERROR (or TYPE I ERROR)...small. ALPHA ERROR refers to the situation where we REJECT Ho when we should have accepted it. That is we wrongly state that an outcome is STATISTICALLY SIGNIFICANT when in reality ...in the real world...it is not.

The .05 p (probability) level (the Alpha Level of a test) is the least acceptable risk allowed in the research in many disciplines.

Results that reach significance with less risk, however, are considered to be much more SIGNIFICANT, RELIABLE, CERTAIN, and MEANINGFUL.

## Chance, risk, & probability expressed numerically

Risk, chance or **probability** (symbolized by the letter  $p$ ) may be expressed in several ways. If the likelihood of an event, say getting lung cancer, is thought to be "one-in-14", this risk may be expressed in any of the following ways:

- verbally, as it did in a recent magazine, viz., "one-in-14" or written this way: 1:14
- as a fraction, viz ,  $1/14$
- as a decimal, viz , .07143 (obtained by dividing 1 by 14 )

The latter decimal version has the advantage of allowing us to visualize the proportion of persons likely to be affected by, in this case "at risk" for, this disease. It is telling us that out of every 100 persons in the population, .07143 , or about 7% [  $.07143 \times 100 = 7.143$  ] are vulnerable.

Said another way, 7 people out of every 100 are at risk, 70 out of every 1,000, 700 out of every 10,000, 7,000 out of every 100,000...and so on.

**Note:** At 2:45pm on 10/26/1999 the U.S. population was estimated at 273,835, 921. "One-in-14" of that number, 7%, would represent a group numbering 19,168,514 persons (on your calculator multiply  $273,835,921 \times .07$ ) You can check out the current population at <http://www.census.gov/main/www/popclock.html>

More about probability...  
how it applies on common exams

- On a MULTIPLE CHOICE exam with 4 alternatives, the probability (p) of getting a correct answer on any question is stated as "one-in-four", also written as  $\frac{1}{4}$ , 1:4, or  $p=.25$ . This means that a person ought to be able to get at least 25% correct by CHANCE ALONE. Anyone getting a grade lower than 25, therefore, would be performing BELOW CHANCE. Furthermore, this also means that if you were to give the answer sheet to someone and tell them to fill it in at random, the laws of chance would predict that they should get at least a grade of 25 also.
- On a TRUE-FALSE test, your chances are  $\frac{1}{2}$ , 1:2, or  $p=.50$  ...this means that you should be able to get 50% correct on such an exam by CHANCE ALONE. Your chances of answering correctly are "50-50".
- On a MULTIPLE CHOICE exam with only 3 alternatives your chances of answering correctly would be  $\frac{1}{3}$ , 1:3,  $p=.33$ , or 33% correct by chance alone, and so on.

## Life threats and the “odds”

i.e., the probability of outcomes and risk \*

- 1:2,000,000 - the odds of being killed by lightning [p= .00000005]
- 1:5,500,000 - odds of being killed by a bee sting [p= .000000181]
- 1:10,000,000 - odds of being killed by falling airplane parts [p= .00000001]
- 1:300,000,000 - odds of being killed by a shark [p=.0000000003]

\* Life Magazine, 8/91, p. 25