

V0A Chi-Squared Functions in Excel 2013 1

## Excel 2013: Chi-Squared Functions

---

by  
**Milo Schield**  
Member: International Statistical Institute  
US Rep: International Statistical Literacy Project  
Director, W. M. Keck Statistical Literacy Project

Slides at: [www.StatLit.org/pdf/ChiSquared-Functions-Excel-2013-Slides.pdf](http://www.StatLit.org/pdf/ChiSquared-Functions-Excel-2013-Slides.pdf)

V0A Chi-Squared Functions in Excel 2013 2

## Background

---

There are an infinite number of  $X^2$  distributions. Each is determined by the degrees of freedom (df). The more df, the less skewed the  $X^2$  distribution.

A two-cell table with a fixed total has 1 degree of freedom. The second cell is always determined. It always equals Total minus Value in the first cell.

A row or column table with n cells and a fixed total has n-1 degrees of freedom. The last cell always equals Total minus Sum of first n-1 cells.

V0A Chi-Squared Functions in Excel 2013 3

## Three Uses of the Chi-Squared Distribution

---

- **Chi-square test** – Are the levels of two categorical variables independent of one another.
- **Goodness of fit test** - how well do the observed values of a single categorical variable match with values expected by a theoretical model.
- **Multinomial Experiment** – This is a specific use of a chi-square test.

V0A Chi-Squared Functions in Excel 2013 4

## Excel 2013 has five Chi-Squared functions

---

1. =CHISQ.DIST(X, DOF, 1) = Left Area  
=CHISQ.DIST(X, DOF, 0) = Height of the Probability Distribution Function
2. =CHISQ.DIST.RT(X, DOF) = Right Area
3. =CHISQ.INV(Left\_Area, DOF) = X
4. =CHISQ.INV.RT(Right\_Area, DOF) = X
5. =CHISQ.TEST(test\_cells, expected\_cells)

\* DOF stands for Degrees of Freedom

V0A Chi-Squared Functions in Excel 2013 5

## Chi-Squared functions: Left-tail & Right-Tail Areas

---

=ChiSq.Dist(X, DOF, 1) = Area left tail = 1-p.  
=ChiSq.Dist.RT(X, DOF) = Area right tail = p  
=ChiSq.Dist.Rt(X, D) = 1 - ChiSq.Dist(X, D, 1)  
These are complementary: they always add to 1.

Example:  
=ChiSq.Dist.RT(1, 3) = 0.811  
=ChiSq.Dist(1, 3, 1) = 0.189

V0A Chi-Squared Functions in Excel 2013 6

## Chi-Squared functions: Area and Inverse

---

=ChiSq.Dist(X, DOF, 1) = Area in left tail.  
=ChiSq.Dist(1, 3, 1) = 0.199  
=ChiSq.Inv(Left\_Area, DOF) = X.  
=ChiSq.Inv(0.199, 3) = 1

---

=ChiSq.Dist.RT(X, DOF) = Area in right tail.  
=ChiSq.Dist.RT(1, 3) = 0.801  
=ChiSq.Inv.RT(Right\_Area, DOF)=X.  
=ChiSq.Inv(0.801, 3) = 1

V0A Chi-Squared Functions in Excel 2013 7

### Chi-Squared with 1 degree of freedom

---

N=4. Max chi-squared is  $2 * (4-2)^2 / 2 = 4$   
 N=40. Max chi-sq is  $2 * (40-20)^2 / 20 = 40$   
 N=400. Max chi-sq is  $2 * (400-200)^2 / 200 = 400$

Conjecture: In a table with two cells, the degrees of freedom equal one. If the two cells have equal probability, then the maximum value of chi-squared always equals N: the total count in the two cells.

V0A Chi-Squared Functions in Excel 2013 8

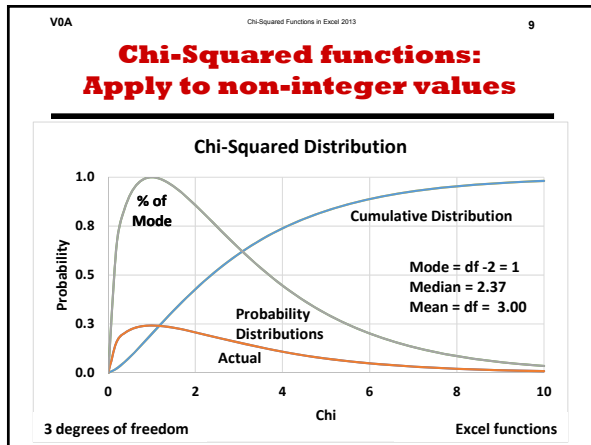
### Non-Integer Values of Chi-Squared

---

Integer counts can give a non-integer chi-squared.

Consider a two-cell table (df=1) and equal chances N=6 with four counts in one cell; two in the other.  
 Chi-sq:  $(4-3)^2 / 3 + (2-3)^2 / 3 = 0.67$

As N increases, non-integer values become more common.



V0A Chi-Squared Functions in Excel 2013 10

### Conclusions

---

The Excel Chi-squared functions:

- handle both integer and continuous chi-squared.
- can graph or model that shape.