Advanced Excel Functions

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About the Tutorial

This Microsoft Excel tutorial teaches you how to create and use Excel functions. You can use Excel functions to perform various mathematical, statistical, logical calculations. This tutorial takes you step-by-step through the process.

Audience

This tutorial is intended for people who use Excel but are intimidated by the concept of formulas and functions.

Prerequisites

This tutorial assumes your familiarity with basic fomulas for calculations in Excel.

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Compatibility Functions

1. COMPATIBILITY FUNCTIONS – OVERVIEW

In Excel 2010 or later, the functions listed in this category were replaced with new functions that provide improved accuracy and have names that reflect their usage better. The new functions can be found in Statistical functions and Math and trigonometry functions. If backward compatibility is not required, you should start using the new functions.

You can still use these earlier versions of functions for compatibility with earlier versions of Excel. If you are using Excel 2007, you will find these functions in the Statistical or Math & Trig categories on the Formulas tab.

Compatibility Functions

The following table lists all the Compatibility functions-

S. No.	Function and Description
1	BETADIST Returns the cumulative beta probability density function
2	BETAINV Returns the inverse of the cumulative beta probability density function
3	BINOMDIST Returns the individual term binomial distribution probability
4	CEILING Rounds a number to the nearest integer or to the nearest multiple of significance
5	CHIDIST Returns the one-tailed probability of the chi-squared distribution
6	CHIINV Returns the inverse of the one-tailed probability of the chi-squared distribution
7	CHITEST Returns the test for independence
8	CONFIDENCE Returns the confidence interval for a population mean
9	COVAR Returns covariance, the average of the products of paired deviations

S. No.	Function and Description
10	CRITBINOM Returns the smallest value for which the cumulative binomial distribution is less than or equal to a criterion value
11	EXPONDIST Returns the exponential distribution
12	FDIST Returns the F probability distribution
13	FINV Returns the inverse of the F probability distribution
14	FLOOR Rounds a number down, toward 0
15	FTEST Returns the result of an F-Test
16	GAMMADIST Returns the gamma distribution
17	GAMMAINV Returns the inverse of the gamma cumulative distribution
18	HYPGEOMDIST Returns the hypergeometric distribution
19	LOGINV Returns the inverse of the lognormal distribution
20	LOGNORMDIST Returns the cumulative lognormal distribution
21	MODE Returns the most common value in a data set
22	NEGBINOMDIST Returns the negative binomial distribution
23	NORMDIST Returns the normal cumulative distribution
24	NORMINV Returns the inverse of the normal cumulative distribution
25	NORMSDIST Returns the standard normal cumulative distribution
26	NORMSINV Returns the inverse of the standard normal cumulative distribution
27	PERCENTILE Returns the kth percentile of values in a range

S. No.	Function and Description
28	PERCENTRANK Returns the percentage rank of a value in a data set
29	POISSON Returns the Poisson distribution
30	QUARTILE Returns the quartile of a data set
31	RANK Returns the rank of a number in a list of numbers
32	STDEV Estimates standard deviation based on a sample, ignoring text and logical values
33	STDEVP Calculates standard deviation based on the entire population, ignoring text and logical values
34	TDIST Returns the student's t-distribution
35	TINV Returns the inverse of the student's t-distribution
36	TTEST Returns the probability associated with a student's t-Test
37	VAR Estimates variance based on a sample, ignoring logical values and text
38	VARP Calculates variance based on the entire population, ignoring logical values and text
39	WEIBULL Returns the Weibull distribution
40	ZTEST Returns the two-tailed P-value of a z-test

2. BETADIST FUNCTION

The BETADIST function replaces the BETA.DIST function from Excel 2010.

Description

This function returns the cumulative beta probability density function. The beta distribution is commonly used to study variation in the percentage of something across samples.

Syntax

```
BETADIST(x,alpha,beta,[A],[B])
```

Arguments

Argument	Description	Required /Optional
X	The value between A and B at which to evaluate the function.	Required
Alpha	A parameter of the distribution.	Required
Beta	A parameter of the distribution.	Required
A	A lower bound to the interval of x.	Optional
B	An upper bound to the interval of x.	Optional

Notes

- If any argument is nonnumeric, BETADIST returns the #VALUE! error value.
- If alpha ≤ 0 or beta ≤ 0, BETADIST returns the #NUM! error value.
- If x < A, x > B, or A = B, BETADIST returns the #NUM! error value.
- If you omit values for A and B, BETADIST uses the standard cumulative beta distribution, so that A = 0 and B = 1

Example

Function Usage

	A	B	C
1			
2		x	10
3		Alpha	0.08
4		Beta	0.03
5		A	7
6		B	14
7		Beta Distribution Value	=BETADIST(C2,C3,C4,C5,C6)

Results

	A	B	C
1			
2		x	10
3		Alpha	0.08
4		Beta	0.03
5		A	7
6		B	14
7		Beta Distribution Value	0.27

3. BETAINV FUNCTION

The BETAINV function replaces the BETA.INV function from Excel 2010.

Description

The function returns the inverse of the cumulative beta probability density function for a specified beta distribution. i.e.

If probability = BETADIST(x...), then BETAINV (probability...) = x

The beta distribution can be used in project planning to model probable completion times given an expected completion time and variability.

Syntax

```
BETAINV (probability,alpha,beta,[A],[B])
```

Arguments

Argument	Description	Required /Optional
Probability	A probability associated with the beta distribution.	Required
Alpha	A parameter of the distribution.	Required
Beta	A parameter the distribution.	Required
A	A lower bound to the interval of x.	Optional
B	An upper bound to the interval of x.	Optional

Notes

- If you omit values for A and B, BETAINV uses the standard cumulative beta distribution, so that A = 0 and B = 1
- If any argument is nonnumeric, BETAINV returns the #VALUE! error value.
.
- If alpha ≤ 0 or beta ≤ 0, BETAINV returns the #NUM! error value.
- If probability ≤ 0 or probability > 1, BETAINV returns the #NUM! error value.
- Given a value for probability, BETAINV seeks that value x such that BETADIST(x, alpha, beta, A, B) = probability. Hence, precision of BETAINV depends on precision of BETADIST

Example

Function Usage

	A	B	C
1			
2		Probability	0.27
3		Alpha	0.08
4		Beta	0.03
5		A	7
6		B	14
7		x	=BETAINV(C2,C3,C4,C5,C6)

Results

	A	B	C
1			
2		Probability	0.27
3		Alpha	0.08
4		Beta	0.03
5		A	7
6		B	14
7		x	10

4. BINOMDIST FUNCTION

The BINOMDIST function replaces the BINOM.DIST function from Excel 2010.

Description

The function returns the individual term binomial distribution probability. Use BINOMDIST in problems with a fixed number of tests or trials, when the outcomes of any trial are only success or failure, when trials are independent, and when the probability of success is constant throughout the experiment.

Syntax

```
BINOMDIST (number_s,trials,probability_s,cumulative)
```

Arguments

Argument	Description	Required /Optional
Number_s	The number of successes in trials.	Required
Trials	The number of independent trials.	Required
Probability_s	The probability of success on each trial.	Required
Cumulative	A logical value that determines the form of the function. • If cumulative is TRUE, then BINOMDIST returns the cumulative distribution function, which is the probability that there are at most number_s successes • If cumulative is FALSE, then BINOMDIST returns the probability mass function, which is the probability that there are number_s successes	Required

Notes

- Number_s and trials are truncated to integers.
- If number_s, trials, or probability_s is nonnumeric, BINOMDIST returns the #VALUE! error value.

- If number_s < 0 or number_s > trials, BINOMDIST returns the #NUM! error value.
- If probability_s < 0 or probability_s > 1, BINOMDIST returns the #NUM! error value.
- If x = number_s, n = trials, and p = probability_s, then the binomial probability mass function is-

$$b(x;n,p) = \binom{n}{x} p^x (1-p)^{n-x}$$

Where $\binom{n}{x}$ is COMBIN(n,x).

- If x = number_s, n = trials, and p = probability_s, then the cumulative binomial distribution is:

$$B(x;n,p) = \sum_{y=0}^{x} b(y;n,p)$$

Example

Function Usage

	A	B	C
1			
2		No. of Trials	1500
3		Number of Successes	135
4		Probabability of Success in each Trial	0.1
5		Cumulative	TRUE
6		Binomial Probability	=BINOMDIST(C3,C2,C4,C5)

Results

	A	B	C
1			
2		No. of Trials	1500
3		Number of Successes	135
4		Probabability of Success in each Trial	0.1
5		Cumulative	TRUE
6		Binomial Probability	10.48%

5. CEILING FUNCTION

Description

The CEILING function returns a number rounded up, away from zero, to the nearest multiple of significance.

Syntax

```
CEILING (number, significance)
```

Arguments

Argument	Description	Required /Optional
Number	The value you want to round.	Required
Significance	The multiple to which Number is to be rounded.	Required

Notes

- Regardless of the sign of number, a value is rounded up when adjusted away from zero. If the number is an exact multiple of significance, no rounding occurs.
- If the number is negative, and significance is negative, the value is rounded down, away from zero.
- If the number is negative, and significance is positive, the value is rounded up towards zero.
- If either argument is nonnumeric, CEILING returns the #VALUE! error value.

Applicability

Excel 2007, Excel 2010, Excel 2013, Excel 2016.

Example

Function Usage

	A	B	C
1			
2		Number	Rounded To
3		2.1	=CEILING(B3,1)
4		1.5	=CEILING(B4,1)
5		-1.5	=CEILING(B5,1)
6		150	=CEILING(B6,30)
7		25	=CEILING(B7,30)
8		40	=CEILING(B8,30)
9		-25	=CEILING(B9,30)
10		-25	=CEILING(B10, 1)
11		-25	=CEILING(B11,0)
12		-25	=CEILING(B12, -30)
13		10	=CEILING(B13, -30)
14		10	=CEILING(B14, "C")

Results

	A	B	C
1			
2		Number	Rounded To
3		2.1	3
4		1.5	2
5		-1.5	-1
6		150	150
7		25	30
8		40	60
9		-25	0
10		-25	-25
11		-25	0
12		-25	-30
13		10	#NUM!
14		10	#VALUE!

6. CHIDIST FUNCTION

The CHIDIST function replaces the CHISQ.DIST.RT function from Excel 2010.

Description

The function returns the right-tailed probability of the chi-squared distribution. The χ2 distribution is associated with a χ2 test. Use the χ2 test to compare the observed and the expected values. By comparing the observed results with the expected ones, you can decide whether your original hypothesis is valid.

Syntax

```
CHIDIST(x,deg_freedom)
```

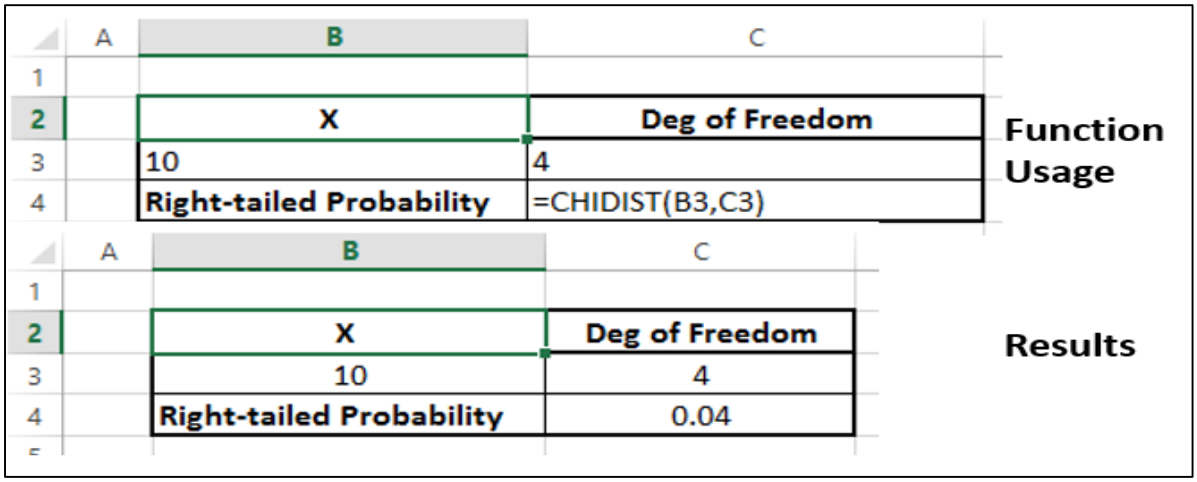
Arguments

Argument	Description	Required /Optional
X	The value at which you want to evaluate the distribution.	Required
Deg_freedom	The number of degrees of freedom.	Required

Notes

- CHIDIST is calculated as CHIDIST = P(X>x), where X is a χ^2 random variable.
- If deg_freedom is not an integer, it is truncated.
- If either argument is nonnumeric, CHIDIST returns the #VALUE! error value.
- If x is negative, CHIDIST returns the #NUM! error value.
- If deg_freedom < 1 or deg_freedom > 10^10, CHIDIST returns the #NUM! error value.

Example



	A	B	C
1			
2		X	Deg of Freedom
3		10	4
4		Right-tailed Probability	=CHIDIST(B3,C3)

Function Usage

	A	B	C
1			
2		X	Deg of Freedom
3		10	4
4		Right-tailed Probability	0.04

Results

7. CHIINV FUNCTION

The CHIINV function replaces the CHISQ.INV.RT function in Excel 2010.

Description

The function returns the inverse of the right-tailed probability of the chi-squared distribution.

If probability = CHIDIST(x...), then CHIINV (probability...) = x

Use this function to compare the observed results with the expected ones in order to decide whether your original hypothesis is valid.

Syntax

```
CHIINV (probability,deg_freedom)
```

Arguments

Argument	Description	Required /Optional
Probability	A probability associated with the chi-squared distribution.	Required
Deg_freedom	The number of degrees of freedom.	Required

Notes

- If deg_freedom is not an integer, it is truncated.
- If either argument is nonnumeric, CHIINV returns the #VALUE! error value.
- If probability < 0 or probability > 1, CHIINV returns the #NUM! error value.
- If deg_freedom < 1, CHIINV returns the #NUM! error value.
- Given a value for probability, CHIINV seeks value x such that CHIDIST(x, deg_freedom) = probability. Hence, precision of CHIINV depends on precision of CHIDIST. CHIINV uses an iterative search technique. If the search has not converged after 100 iterations, the function returns the #N/A error value.

Example

Function Usage

	A	B	C
1			
2		Probability	0.04
3		Deg of Freedom	4
4		Chi-Square Value	=CHIINV(C2,C3)

Results

	A	B	C
1			
2		Probability	0.04
3		Deg of Freedom	4
4		Chi-Square Value	10

8. CHITEST FUNCTION

The CHITEST function replaces the CHISQ.TEST function in Excel 2010.

Description

The function returns the test for independence. CHITEST returns the value from the chi-squared (χ^2) distribution for the statistic and the appropriate degrees of freedom. You can use χ^2 tests to determine whether hypothesized results are verified by an experiment.

Syntax

```
HITEST (actual_range,expected_range)
```

Arguments

Argument	Description	Required /Optional
Actual_range	The range of data that contains observations to test against expected values.	Required
Expected_range	The range of data that contains the ratio of the product of row totals and column totals to the grand total.	Required

Notes

- The χ^2 test first calculates a χ^2 statistic using the formula-

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{\left(A_{ij} - E_{ij}\right)^2}{E_{ij}}$$

Where-

A_{ij} = actual frequency in the i-th row, j-th column

E_{ij} = expected frequency in the i-th row, j-th column

r = number of rows

c = number of columns

- A low value of χ^2 is an indicator of independence. As can be seen from the formula, χ^2 is always positive or 0, and is 0 only if $A_{ij} = E_{ij}$ for every i,j.

- CHITEST returns the probability that a value of the χ^2 statistic at least as high as the value calculated by the above formula could have happened by chance under the assumption of independence. In computing this probability, CHITEST uses the χ^2 distribution with an appropriate number of degrees of freedom, df. If r > 1 and c > 1, then df = (r - 1)(c - 1). If r = 1 and c > 1, then df = c - 1 or if r > 1 and c = 1, then df = r - 1. (r = c= 1) is not allowed and #N/A is returned.
- If actual_range and expected_range have a different number of data points, CHITEST returns the #N/A error value.

- Use of CHITEST is most appropriate when the values of E_{ij} are not too small. Some statisticians suggest that each E_{ij} should be greater than or equal to 5.

Example

Function Usage

	A	B	C	D	E
1					
2		Actual Range		Expected Range	
3		3738	4704	3461	4981
4		1494	2827	1771	2550
5		5232	7531	5232	7531
6		Test for Independence	=CHITEST(B3:C5,D3:E5)		

Results

	A	B	C	D	E
1					
2		Actual Range		Expected Range	
3		3738	4704	3461	4981
4		1494	2827	1771	2550
5		5232	7531	5232	7531
6		Test for Independence	7.92589E-25		

9. CONFIDENCE FUNCTION

Description

The CONFIDENCE function returns the confidence interval for a population mean, using a normal distribution.

The confidence interval is a range of values. Your sample mean, x, is at the center of this range and the range is x ± CONFIDENCE. For any population mean μ_0, in this range, the probability of obtaining a sample mean further from μ_0 than x is greater than alpha.

For any population mean, μ_0, not in this range, the probability of obtaining a sample mean further from μ_0 than x is less than alpha.

In other words, assume that we use x, standard_dev, and size to construct a two-tailed test at significance level alpha of the hypothesis that the population mean is μ_0. Then we will not reject that hypothesis if μ_0 is in the confidence interval and will reject that hypothesis if μ_0 is not in the confidence interval.

The confidence interval does not allow us to infer that there is probability 1 – alpha that our next package will take a delivery time that is in the confidence interval.

Syntax

```
CONFIDENCE (alpha,standard_dev,size)
```

Arguments

Argument	Description	Required /Optional
Alpha	The significance level used to compute the confidence level. The confidence level equals 00*(1 - alpha)%, or in other words, an alpha of 0.05 indicates a 95 percent confidence level.	Required
Standard_dev	The population standard deviation for the data range and is assumed to be known.	Required
Size	The sample size.	Required

Notes

- If we assume Alpha equals 0.05, we need to calculate the area under the standard normal curve that equals (1 - alpha), or 95 percent. This value is ± 1.96. The confidence interval is therefore-

$$\bar{x} \pm 1.96\left(\frac{\sigma}{\sqrt{n}}\right)$$

- If Size is not an integer, it is truncated.
- If any argument is non-numeric, CONFIDENCE returns the #VALUE! error value.
- If Alpha is ≤ 0 or ≥ 1, CONFIDENCE returns the #NUM! error value.
- If Standard_dev ≤ 0, CONFIDENCE returns the #NUM! error value.
- If Size < 1, CONFIDENCE returns the #NUM! error value.

Example

Function Usage

	A	B	C
1			
2		Alpha	0.05
3		Population Standard Deviation	22
4		Sample Size	16
5		Confidence Interval	=CONFIDENCE(C2,C3,C4)

Results

	A	B	C
1			
2		Alpha	0.05
3		Population Standard Deviation	22.00
4		Sample Size	16
5		Confidence Interval	10.78

10. COVAR FUNCTION

The COVAR function in Excel 2013 replaces the COVARIANCE.P function in Excel 2010.

Description

The function returns covariance, the average of the products of deviations for each data point pair in two data sets. Use covariance to determine the relationship between two data sets.

Syntax

```
COVAR (array1, array2)
```

Arguments

Argument	Description	Required /Optional
Array1	The first cell range of integers.	Required
Array2	The second cell range of integers.	Required

Notes

- Covariance is given by-

$$Cov(X,Y) = \frac{\sum(x-\bar{x})(y-\bar{y})}{n}$$

- Where $\bar{x}$ and $\bar{y}$ are the sample means of AVERAGE (array1) and AVERAGE (array2), and n is the sample size.

- The arguments must be either numbers, names, arrays, or references that contain numbers.

- The values of an array or reference argument containing text, logical values, or empty cells are ignored. However, cells with the value zero are included.

- If array1 and array2 have different numbers of data points, COVAR returns the #N/A error value.

- If either of the arrays, array1 or array2 is empty, COVAR returns the #DIV/0! error value.