

The Ultimate Desmos Guide for the AP Statistics Exam

Probability Distributions: + → Inference → Probability Distribution

Normal Distributions					
<p>Setup</p> <p>Normal distribution</p> <table border="1"> <thead> <tr> <th>mean</th> <th>stdev</th> </tr> </thead> <tbody> <tr> <td>25</td> <td>5</td> </tr> </tbody> </table> <p>Type in the mean and SD.</p> <p>Math Medic Reminder For z-scores: mean = 0 and stdev = 1</p>	mean	stdev	25	5	<p>Output & Showing Work</p> <p><code>normaldist(25,5)</code> mean, stdev</p> <p>▼ Cumulative Probability</p> <p>REGION: <input checked="" type="radio"/> Inner <input type="radio"/> Outer <input type="radio"/> Left <input type="radio"/> Right</p> <p>COMPUTE: <input checked="" type="radio"/> Area <input type="radio"/> Bounds</p> <p>$P(20 \leq x \leq 30) = 0.683$</p> <p>probability statement</p> <p>Switch to Bounds when you know the area and are trying to find the boundary value(s).</p> <p>Showing Work:</p> <p>Normal Distribution $\mu = 25$ $\sigma = 5$ $P(20 \leq X \leq 30) = 0.683$</p>
mean	stdev				
25	5				
Binomial Distributions					
<p>Setup</p> <p>Binomial distribution</p> <table border="1"> <thead> <tr> <th>trials</th> <th>success probability</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>0.3</td> </tr> </tbody> </table> <p>Math Medic Reminder A distribution is binomial when there is a fixed number of trials (n) and the same probability of success (p) for each trial!</p>	trials	success probability	10	0.3	<p>Output & Showing Work</p> <p><code>binomialdist(10,0.3)</code> trials, success probability</p> <p>▼ Cumulative Probability</p> <p>REGION: <input checked="" type="radio"/> Inner <input type="radio"/> Outer <input type="radio"/> Left <input type="radio"/> Right</p> <p>$P(2 \leq x \leq 4) = 0.7$</p> <p>probability statement</p> <p>Click a point on the graph to see the exact probability! (5, 0.102919)</p> <p>Showing Work:</p> <p>Binomial Distribution $n = 10$ $p = 0.3$ $P(2 \leq X \leq 4) = 0.7$ OR $P(X = 5) = 0.1029$</p>
trials	success probability				
10	0.3				

χ² Distributions

Setup

< Probability Distribution

χ² distribution

degrees of freedom

4

one-way table: $df = \# \text{ of categories} - 1$
two-way table: $df = (\# \text{ of rows} - 1)(\# \text{ of columns} - 1)$

Math Medic Reminder

The χ² distribution is used when given categorical data with 2+ categories.

Output & Showing Work

chisqdist(4)

▼ Cumulative Probability

REGION

COMPUTE

Inner Outer Left **Right** Area Bounds

$P(x \geq 6.82) = 0.146$

probability statement:
 $P(\chi^2 \geq 6.82)$

Always choose Right to calculate the p-value when given a χ² test statistic.

Showing Work:

χ² distribution
df = 4
 $P(\chi^2 \geq 6.82) = 0.146$

t-distributions

Setup

< Probability Distribution

t-distribution

degrees of freedom	shift	scale
4	0	1

4

Leave shift as 0 and scale as 1. Type in df.

Math Medic Reminder

Use the t-distribution for means when the population standard deviation (σ) is unknown.

Output & Showing Work

tdist(4)

degrees of freedom, shift = 0, scale = 1

▼ Cumulative Probability

REGION

COMPUTE

Inner Outer Left **Right** Area Bounds

$P(-1 \leq x \leq 1) = 0.626$

probability statement:
 $P(-1 \leq t \leq 1)$

Switch to Bounds when you know the confidence-level and want to find the t* critical value.

Showing Work:

t-distribution
df = 4
 $P(-1 \leq t \leq 1) = 0.626$

Geometric Distributions

Setup

< Probability Distribution

Geometric distribution

success probability p

0.3

Math Medic Reminder

A distribution is geometric when you are counting the number of trials (X) until the first success.

Output & Showing Work

geodist(0.3)

▼ Cumulative Probability

REGION

Inner

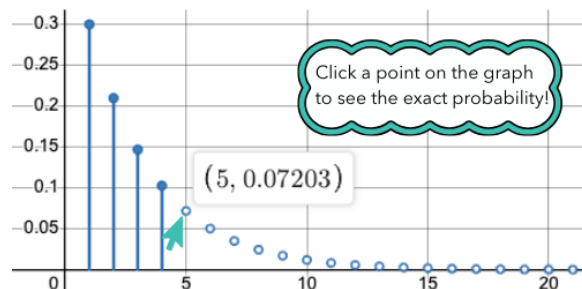
Outer

Left

Right

$P(1 \leq x \leq 4) = 0.76$

probability statement



Showing Work:

Geometric Distribution

$$p = 0.3$$

$$P(1 \leq X \leq 4) = 0.76$$

$$\text{OR } P(X=5) = 0.072$$

Showing work

→ Probability Distributions :

- ①. Distribution w/ parameters
- ②. Boundary
- ③. Direction
- ④. Answer

→ Inference : 4C Method

- choose - procedure
- check
- calculate
 - interval (lower, upper)
 - test : test statistic, p-value
- Conclude

Inference for Proportions: + → Inference → Inference for Categorical Data

The number of successes (X) must be a whole number.

z-test for proportions

SAMPLE 1	
X successes	sample size n
32	50

one-sample z-interval for p

Setup	Output & Showing Work								
<p>zproptest(32,50) successes, sample size</p> <p>Confidence Interval</p> <p>Confidence level: 0.95</p> <p>Point estimate: 0.64</p> <p>Math Medic Reminder A one-sample z-interval for p gives an estimate for a single population proportion.</p>	<table border="1"> <tr> <td>Lower bound</td> <td>0.50695</td> </tr> <tr> <td>Upper bound</td> <td>0.77305</td> </tr> <tr> <td>Point estimate</td> <td>0.64 ← \hat{p}</td> </tr> <tr> <td>Standard error</td> <td>0.06788</td> </tr> </table> <p>Showing Work: 1-sample z-interval for p (0.507, 0.773)</p>	Lower bound	0.50695	Upper bound	0.77305	Point estimate	0.64 ← \hat{p}	Standard error	0.06788
Lower bound	0.50695								
Upper bound	0.77305								
Point estimate	0.64 ← \hat{p}								
Standard error	0.06788								

one-sample z-test for p

Setup	Output & Showing Work				
<p>zproptest(32,50) successes, sample size</p> <p>Significance Test</p> <p>Null hypothesis: $p = 0.55$</p> <p>Tails: Left Both Right</p> <p>p-value = 0.201</p> <p>Math Medic Reminder A one-sample z-test for p tests a claim made about a single population proportion.</p>	<table border="1"> <tr> <td>z-score</td> <td>1.2792</td> </tr> <tr> <td>p-value</td> <td>0.20083</td> </tr> </table> <p>Showing Work: 1-sample z-test for p $z = 1.279$ p-value = 0.2008</p>	z-score	1.2792	p-value	0.20083
z-score	1.2792				
p-value	0.20083				

The number of successes (X) must be a whole number.

z-test for proportions

SAMPLE 1		
X ₁	successes	sample size n ₁
	32	50
SAMPLE 2 (optional)		
X ₂	successes	sample size n ₂
	41	60

two-sample z-interval for $p_1 - p_2$

Setup	Output & Showing Work								
<p>zproptest(32,50,41,60)</p> <p>successes, sample size</p> <p>Confidence Interval</p> <p>Confidence level: 0.95</p> <p>Expand Confidence Interval and set Confidence level.</p> <p>Point estimate: -0.043</p> <p>Click for more info.</p> <p>Math Medic Reminder A two-sample z-interval for $p_1 - p_2$ gives an estimate for a difference between two population proportions.</p>	<table border="1"> <tr> <td>Lower bound</td> <td>-0.22097</td> </tr> <tr> <td>Upper bound</td> <td>0.13431</td> </tr> <tr> <td>Point estimate</td> <td>-0.04333</td> </tr> <tr> <td>Standard error</td> <td>0.09063</td> </tr> </table> <p>→ $\hat{p}_1 - \hat{p}_2$</p> <p>Showing Work: 2-sample z-interval for $p_1 - p_2$ (-0.221, 0.134)</p>	Lower bound	-0.22097	Upper bound	0.13431	Point estimate	-0.04333	Standard error	0.09063
Lower bound	-0.22097								
Upper bound	0.13431								
Point estimate	-0.04333								
Standard error	0.09063								

two-sample z-test for $p_1 - p_2$

Setup	Output & Showing Work				
<p>zproptest(32,50,41,60)</p> <p>successes, sample size</p> <p>Significance Test</p> <p>Null hypothesis: $p_1 - p_2 = 0$</p> <p>Tails: Left Both Right</p> <p>Expand Significance Test and choose the direction of the alternative.</p> <p>always 0 for AP Stats</p> <p>p-value = 0.316</p> <p>z = -0.479</p> <p>Math Medic Reminder A two-sample z-test for $p_1 - p_2$ tests a claim made about a difference between two population proportions.</p>	<p>test statistic</p> <table border="1"> <tr> <td>z-score</td> <td>-0.47898</td> </tr> <tr> <td>p-value</td> <td>0.31598</td> </tr> </table> <p>Showing Work: 2-sample z-test for $p_1 - p_2$ $z = -0.479$ p-value = 0.316</p>	z-score	-0.47898	p-value	0.31598
z-score	-0.47898				
p-value	0.31598				

< χ^2 goodness of fit test

Whole numbers

Observed	Expected (optional)
25	30
42	50
63	50
Expected = n(each p)	

If none are entered, equally likely is assumed.

chi-square test for goodness-of-fit

Setup

chisqgof([25,42,63],[30,50,50])

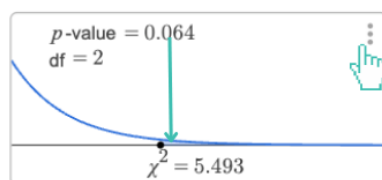
Observed (Expected)

Expected Contributions Totals

Count	χ^2 contribution
25 (30)	0.8333
42 (50)	1.28
63 (50)	3.38
Total: 130	Total: 5.493

χ^2 test statistic

Significance Test



Output & Showing Work

Math Medic Reminder

To test a claim about the distribution of a categorical variable:

- 1 samples, 1 variable: chi-square GOF test

df = # of categories - 1

test statistic

Degrees of freedom	2
χ^2	5.49333
p -value	0.06414

Showing Work:

χ^2 GOF test
 $\chi^2 = 5.493$ df = 2
 p -value = 0.0641

< χ^2 test for independence OR homogeneity

	Group 1	Group 2	Group 3
Group A	20	30	40
Group B	40	50	60

Enter the observed counts from the two-way table.

chi-square test for independence OR homogeneity

Setup

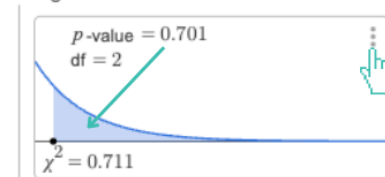
chisqtst([20,40],[30,50],[40,60])

Observed (Expected)

Expected Contributions Totals

	Group 1	Group 2	Group 3	Total
Group A	20 (22.5)	30 (30)	40 (37.5)	90
Group B	40 (37.5)	50 (50)	60 (62.5)	150
Total	60	80	100	240

Significance Test



Output & Showing Work

Math Medic Reminder

To test a claim about the distribution of a categorical variable:

- 2+ samples, 1 variable: chi-square test for homogeneity
- 1 sample, 2 variables: chi-square test for independence

df = (# of rows - 1)(# of columns - 1)

test statistic

Degrees of freedom	2
χ^2	0.71111
p -value	0.70078

Showing Work:

χ^2 test for independence
 $\chi^2 = 0.711$ df = 2
 p -value = 0.7008

Inference for Quantitative Data:



t-test		Data	Stats
SAMPLE 1	n	\bar{x}	s
sample size	mean	stdev	
15	12.1	3.2	

If given summary stats, choose stats. Otherwise, enter data.

one-sample t -interval for μ

Setup	Output & Showing Work								
<p>ttest(15,12.1,3.2) sample size, mean, stdev</p> <p>▼ Confidence Interval</p> <p>Confidence level: 0.95</p> <p>Point estimate: 12.1</p> <p>Math Medic Reminder A one-sample t-interval for μ gives an <u>estimate</u> for a <u>single population mean</u>. degrees of freedom = $n - 1$</p>	<table border="1"> <tr> <td>Lower bound</td> <td>10.3279</td> </tr> <tr> <td>Upper bound</td> <td>13.8721</td> </tr> <tr> <td>Point estimate</td> <td>12.1</td> </tr> <tr> <td>Standard error</td> <td>0.82624</td> </tr> </table> <p>Showing Work: 1-sample t-interval for μ (10.328, 13.872) $df = 14$</p>	Lower bound	10.3279	Upper bound	13.8721	Point estimate	12.1	Standard error	0.82624
Lower bound	10.3279								
Upper bound	13.8721								
Point estimate	12.1								
Standard error	0.82624								

one-sample t -test for μ

Setup	Output & Showing Work									
<p>ttest(15,12.1,3.2) sample size, mean, stdev</p> <p>► Confidence Interval</p> <p>▼ Significance Test</p> <p>H_0 Null hypothesis: $\mu = 11$</p> <p>H_a Tails: Left Both Right</p> <p>p-value = 0.102 $df = 14$</p> <p>Math Medic Reminder A one-sample t-test for μ <u>tests a claim</u> made about a <u>single population mean</u>.</p>	<table border="1"> <tr> <td>$df = n - 1$</td> <td>Degrees of freedom</td> <td>14</td> </tr> <tr> <td>test statistic</td> <td>t-score</td> <td>1.33134</td> </tr> <tr> <td></td> <td>p-value</td> <td>0.10218</td> </tr> </table> <p>Showing Work: 1-sample t-test for μ $t = 1.331$ $df = 14$ p-value = 0.1022</p>	$df = n - 1$	Degrees of freedom	14	test statistic	t -score	1.33134		p -value	0.10218
$df = n - 1$	Degrees of freedom	14								
test statistic	t -score	1.33134								
	p -value	0.10218								

t-test Data Stats

unknown population standard deviation σ

SAMPLE 1
list of data
2, 2.1, 2.4, 3, 4, 5

SAMPLE 2 (optional)
list of data
3, 4, 4.2, 5, 6

If given data, enter by separating with commas. Otherwise, enter stats.

two-sample t -interval for $\mu_1 - \mu_2$

Setup

$\text{ttest}([2, 2.1, 2.4, 3, 4, 5], [3, 4, 4.2, 5, 6])$

Confidence Interval
Confidence level: 0.95

Expand Confidence Interval and set Confidence level.

Point estimate: -1.357

Click for more info.

Math Medic Reminder
A two-sample t -interval for $\mu_1 - \mu_2$ gives an estimate for a difference between two population means.

The degrees of freedom is calculated with technology for two-sample t -procedures.

Output & Showing Work

Lower bound	-2.9472
Upper bound	0.23386
Point estimate	-1.35667
Standard error	0.70086

$\bar{x}_1 - \bar{x}_2$

Note: to identify the degrees of freedom used, you must expand Significance Test.

Showing Work:
2-sample t -interval for $\mu_1 - \mu_2$
(-2.947, 0.234) $df = 8.816$

two-sample t -test for $\mu_1 - \mu_2$

Setup

$\text{ttest}([2, 2.1, 2.4, 3, 4, 5], [3, 4, 4.2, 5, 6])$

Significance Test
Null hypothesis: $\mu_1 - \mu_2 = 0$

Tails: Left Both Right

Expand Significance Test and choose the direction of the alternative.

always 0 for AP Stats

p -value = 0.086
 $df = 8.816$

$t = -1.936$

The degrees of freedom for both the confidence interval and significance test are included here.

Output & Showing Work

Math Medic Reminder
A two-sample t -test for $\mu_1 - \mu_2$ tests a claim made about a difference between two population means.

Degrees of freedom	8.81578
t -score	-1.9357
p -value	0.08557

$df =$ calculated with technology

test statistic

Showing Work:
2-sample t -test for $\mu_1 - \mu_2$
 $t = -1.936$ $df = 8.816$
 p -value = 0.0856