The Weighted Average of Abbreviated Math Anxiety Scale (AMAS)

Studies on College Students

by Cass Dykeman, PhD

Technical Bulletin 2017-01
Counseling Academic Unit
College of Education
Oregon State University
Corvallis, OR
Date: 1-1-2017

Abstract

This technical bulletin contains a calculation of the weighted average of mean scores from published studies involving college students. The measure used in these studies was the Abbreviated Math Anxiety Scale (AMAS). Only reports of the AMAS' full scale scores were examined. The weighted average for the 17 studies ($N = 6439$) was 22.66. The weighted median of these mean scores was 22.90.

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Introduction

The Abbreviated Math Anxiety Scale (hereafter AMAS) is a common measure used in math anxiety research. As an instrument frequently employed throughout the world, AMAS research presents a unique opportunity to assess what is an average level of math anxiety in a college population across a large number of participants and cultures. Knowledge of this level permits researchers to test whether the college student participants in their study differ from a broad population of colleges students.

Abbreviated Math Anxiety Scale

The AMAS is a nine item scale derived from factor analytical studies of the Math Anxiety Rating Scale-Revised (Hopko, Mahadevan, Bare, and Hunt, 2003). The AMAS uses a fully anchored five point Likert scale (1 = Low Anxiety, 2 = Some Anxiety, 3 = Moderate Anxiety, 4 = Quite a bit of Anxiety, 5 = High Anxiety). Thus, the overall score can range from 9 to 45. Hopko et al. (2003) reported excellent internal consistency (α = .90) and test-retest reliability (r = .85).

Scope of This Technical Bulletin

The majority of research using the AMAS had been on college students and thus this technical bulletin is limited to that population. Only studies published in peer review journals were included in the calculations. The studies were identified by searching in Google Scholar for the following: “Abbreviated Math Anxiety Scale”. The time frame was from the initial publication of AMAS in 2003 to 2016. Excluded studies were those: (a) not reporting full scale means (e.g., Maloney, Risko, Ansari, & Fugelsang, 2010), (b) focusing on solely community college or vocational technology students (e.g., Schommer-Aikins,

Unruh, & Morphew, 2015), or (c) containing an extreme outlier (e.g., Vahedi & Farrokhi, 2011). One article reported only item averages (Ferguson et al., 2015). Full scale means were extrapolated from the item averages by multiplying these item means by nine.

AMAS Studies of College Students Included in the Calculation

There were 17 studies that met the aforenoted scope criteria. These studies appeared across 11 published journal articles. The total number of participants was 6439. The numbers of participants in each study of this analysis varied widely (range = 61 to 2057). These participants came from eight countries.

Statistical Analysis

Given the differing number of participants among the 17 studies, the appropriate statistic to establish an overall mean is a weighted average (Sokal & Rohlf, 2012). All calculations were completed using Microsoft Excel. The formulas used appear in Figure 1. The weighted formulas were drawn from the following sources: average (Microsoft, 2017), variance (Lapan-Dennis, 2012), standard deviation (Lapan-Dennis, 2012), and median (Houdini, 2014 [average function]; Shg, 2014 [index function]; Weaver, 2011[lookup function]). All three weighted median formulas returned the same answer.

Results

The minimum mean among the 17 studies was 18.70. The maximum mean encountered among the 17 studies was 25.37. The weighted average of the means was 22.66. The weighted standard deviation of the means was 1.50. The weighted median of the means was 22.90.

Cut Scores for High and Low Math Anxiety

AMAS researchers have suggested two algorithms for classifying participants as possessing high or low math anxiety. One research group suggested participants scoring below 20 (9 to 19) have low math anxiety and those scoring above 30 (31 to 45) have high math anxiety (Maloney, Risko, Ansari, & Fugelsang, 2010). Maloney et al. noted that the low and high groups roughly corresponded to the bottom and top quartiles in their sample. Morsanyi, Busdraghi, and Primi (2014) suggested classifying low and high participants by use of a median split. In the case of the Morsanyi et al., low working alliance occurred at a score of 20 or below. In math anxiety research, another long-standing cut score algorithm suggests scores at least one standard deviation below mean represent low math anxiety and scores at least one standard deviation above the mean represent high math anxiety (Ashcraft & Kirk, 2001).

Statistical Procedures Using The Weighted Average From This Technical Bulletin

When the goal of research is to compare a set of data on a measure to a known mean, a one sample t-test is used (Stone, 2010). The weighted average of the means provided by this technical bulletin can be used as an appropriate test value in such research. Figure 2 contains mock AMAS full scale scores from 20 students in a teacher education course on elementary school math methods. The mock data was created by the following Excel function: RANDBETWEEN(9,45). The formula for the t values was drawn from McDonald (2014). Figures 3 and 4 contain the one sample t-test results using this data from two popular online statistical programs (Lowry, 2017; Social Science Statistics, 2017).

Conclusion

This technical bulletin presented research designed to determine the weighted average of mean scores from published studies involving college students that used the AMAS' full scale. The hope is that this bulletin can assist math anxiety researchers.

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(*n.b.,* studies used in the calculation marked with an asterisk)

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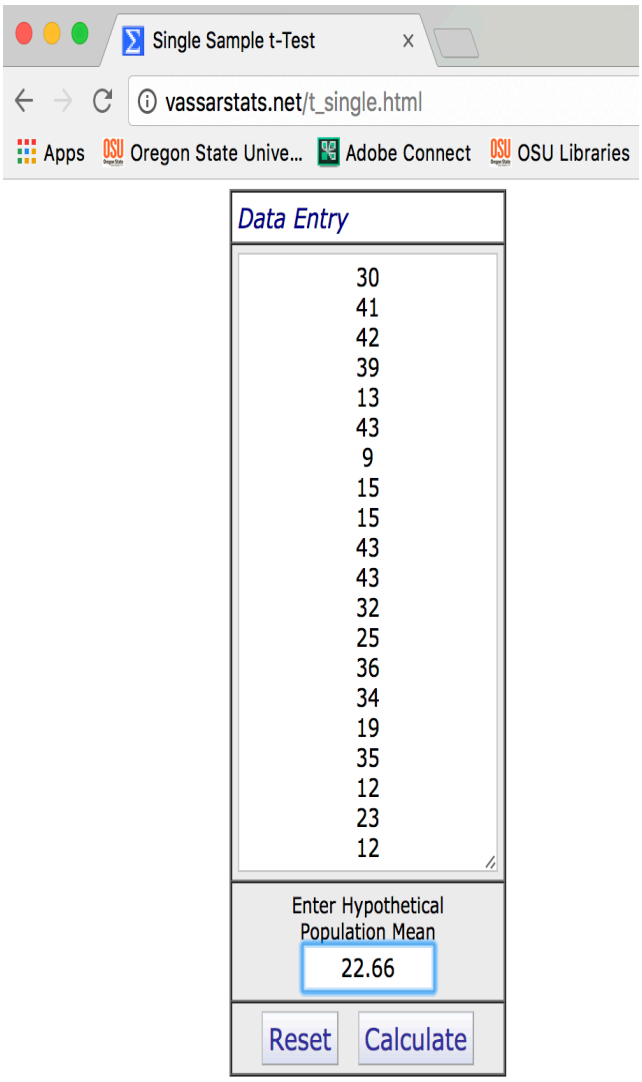
	A	B	C	D	E	F	G	H	I	J
1	**1st Author**	**Year**	**N**	**Score**	**N Weight**	**N Weight Cuml**	**Country**	**N Cuml**		
2	Isiksal #2	2009	276	18.70	4%	4%	Turkey	276		
3	Ferguson #2	2015	251	20.52	4%	8%	Canada	527		
4	Hopko, Mah. #1	2003	206	21.10	3%	11%	US	733		
5	Ferguson #3	2015	242	21.42	4%	15%	Canada	975		
6	Ferguson #4	2015	255	21.42	4%	19%	Canada	1230		
7	Hopko, Crittendon	2005	80	21.50	1%	20%	US	1310		
8	Primi	2014	249	21.60	4%	24%	Italy	1559		
9	Hopko, Hunt	2005	100	21.80	2%	26%	US	1659		
10	Cipora	2015	857	21.90	13%	39%	Poland	2516		
11	Dietrich	2015	61	22.03	1%	40%	Germany	2577		
12	Isiksal #1	2009	234	22.90	4%	44%	US	2811		
13	Ferguson #1	2015	2057	23.04	32%	76%	Canada	4868		
14	Hopko, Mah. #2	2003	218	23.20	3%	79%	US	5086		
15	Morsanyi	2014	405	23.40	6%	85%	Italy	5491		
16	Rancer	2013	144	25.09	2%	88%	US	5635		
17	Brown #2	2016	400	25.13	6%	94%	Mexico	6035		
18	Brown #1	2016	404	25.37	6%	100%	Mexico	6439		
19			6439		100%					
20	**Unweighted**									
21	Min	18.70								
22	Max	25.37								
23										
24	**Weighted**									
25	Average	22.66	{=SUMPRODUCT(d2:d18,c2:c18)/(SUM(c2:c18))}							
26	Variance	2.26	{=SUMPRODUCT(E2:E18,(D2:D18-B31)^2)/(SUM(E2:E18))}							
27	Standard Deviation	1.50	{=SQRT(B32)}							
28	Median	22.90	{=(INDEX(D2:D18,MATCH(SUM(C2:C18)/2,H2:H18))+INDEX(D2:D18,MATCH(SUM(C2:C18)/2-1,H2:H18)))/2}							
29	Median	22.90	{=LOOKUP(SUM(C2:C18)/2,H2:H18,D2:D18)}							
30	Median	22.90	{=AVERAGE(LOOKUP(SUM(C2:C18)/2-{0,1}, H2:H18,D2:D18))}							

Figure 1. *Results and Formulas*

	A	B	C	D	E
1	**Partic. #**	**AMAS**	**Stat**	**Result**	**Formula**
2	1	30	N	20	{=COUNT(B2:B21)}
3	2	41	mean	28.05	{=AVERAGE(B2:B21)}
4	3	42	std dev	12.31	{=STDEV(B2:B21)}
5	4	39	test value	22.66	
6	5	13	α	0.05	
7	6	43	tails	2	
8	7	9	*df*	19	{=(D2-1)}
9	8	15	*t* value	1.96	{=ABS((D3-D5)/(STDEV(B2:B21)/SQRT(COUNT(B2:B21))))}
10	9	15			
11	10	43			
12	11	43			
13	12	32			
14	13	25			
15	14	36			
16	15	34			
17	16	19			
18	17	35			
19	18	12			
20	19	23			
21	20	12			

Figure 2: *Mock AMAS Full Scale Data*



Summary Values		
n		20
ΣX		561
ΣX^2		18617
SS		2880.95
variance (inferential)		151.6289
standard deviation (inferential)		12.3138
standard error		2.7534
sample mean		28.05
hypothetical population mean		22.66
difference		5.39
t		1.9576
df		19
P	one-tailed	0.0325645
	two-tailed	0.065129

Figure 3. *Data Entry and Results from the VassarStats Online Program (Lowry, 2017)*

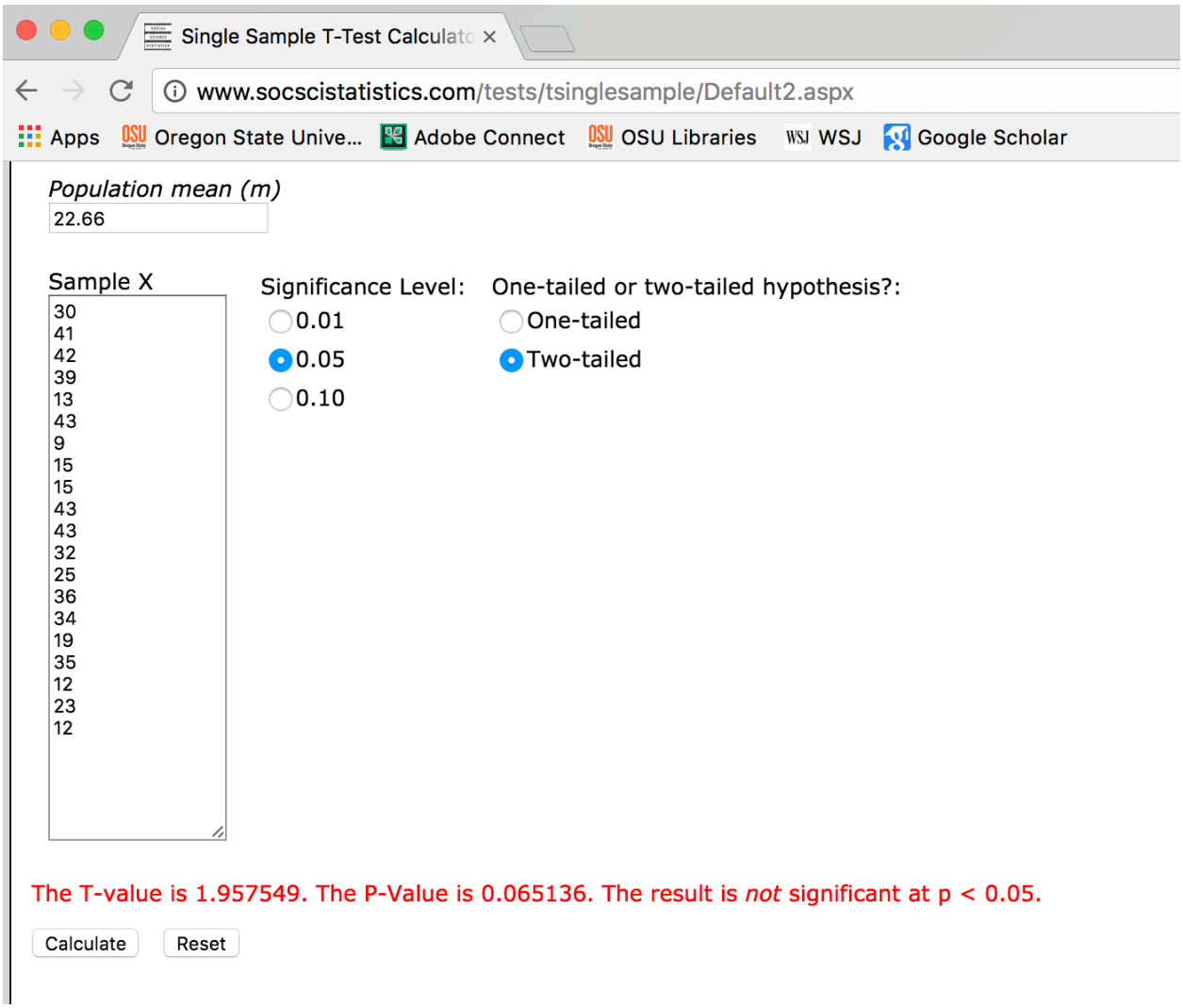


Figure 4. *Data Entry and Results from the Socscistatistics Online Program (Social Science Statistics, 2017).*