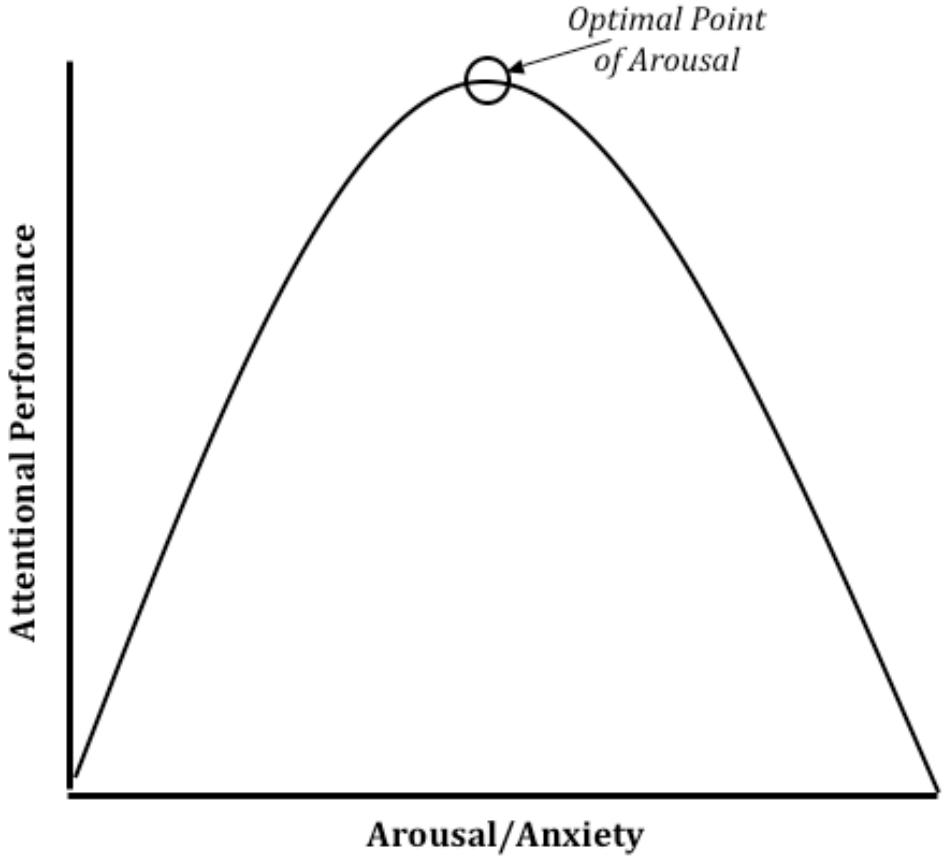
Understanding Math Anxiety: How Do We Optimize Success on Quizzes?

Maggie Weinreb

Union College ‘13

Background: Yerkes-Dodson Law

- Yerkes & Dodson (1908) developed the Inverted-U relationship between arousal/anxiety and performance



Background: Test Anxiety

Test Anxiety: Separate from general anxiety, test anxiety is only activated in an examination setting (Cassidy & Johnson, 2001)

- Able to function normally in daily activities without any symptoms of anxiety
- The moment a test hits, anxiety strikes
- Two components: emotionality & worry

Background: Math Anxiety

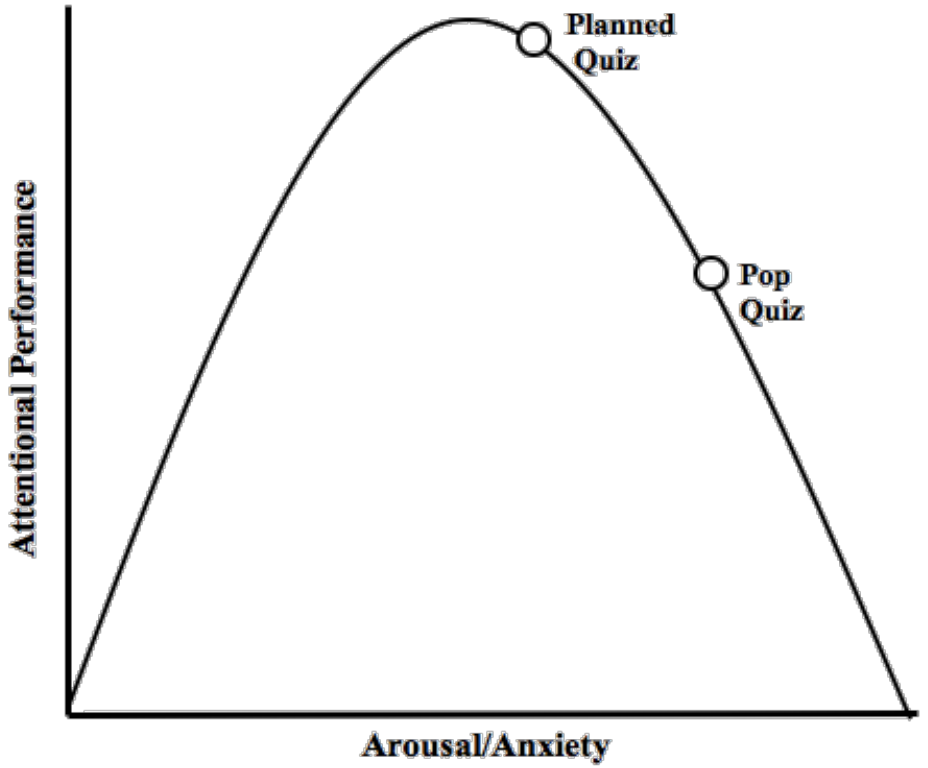
Math Anxiety: An anxiety with dealing with numbers in both educational and daily activities

- Differs from general anxiety and test anxiety
- Avoidance of math classes
- Richardson & Suinn (1972) created the Mathematics Anxiety Rating Scale (MARS) as a diagnostic

The Present Study

My Hypothesis:

Students with high math anxiety will perform better on a planned quiz than on a pop quiz. However, students who have low math anxiety will perform similarly on both a planned quiz and a pop quiz.



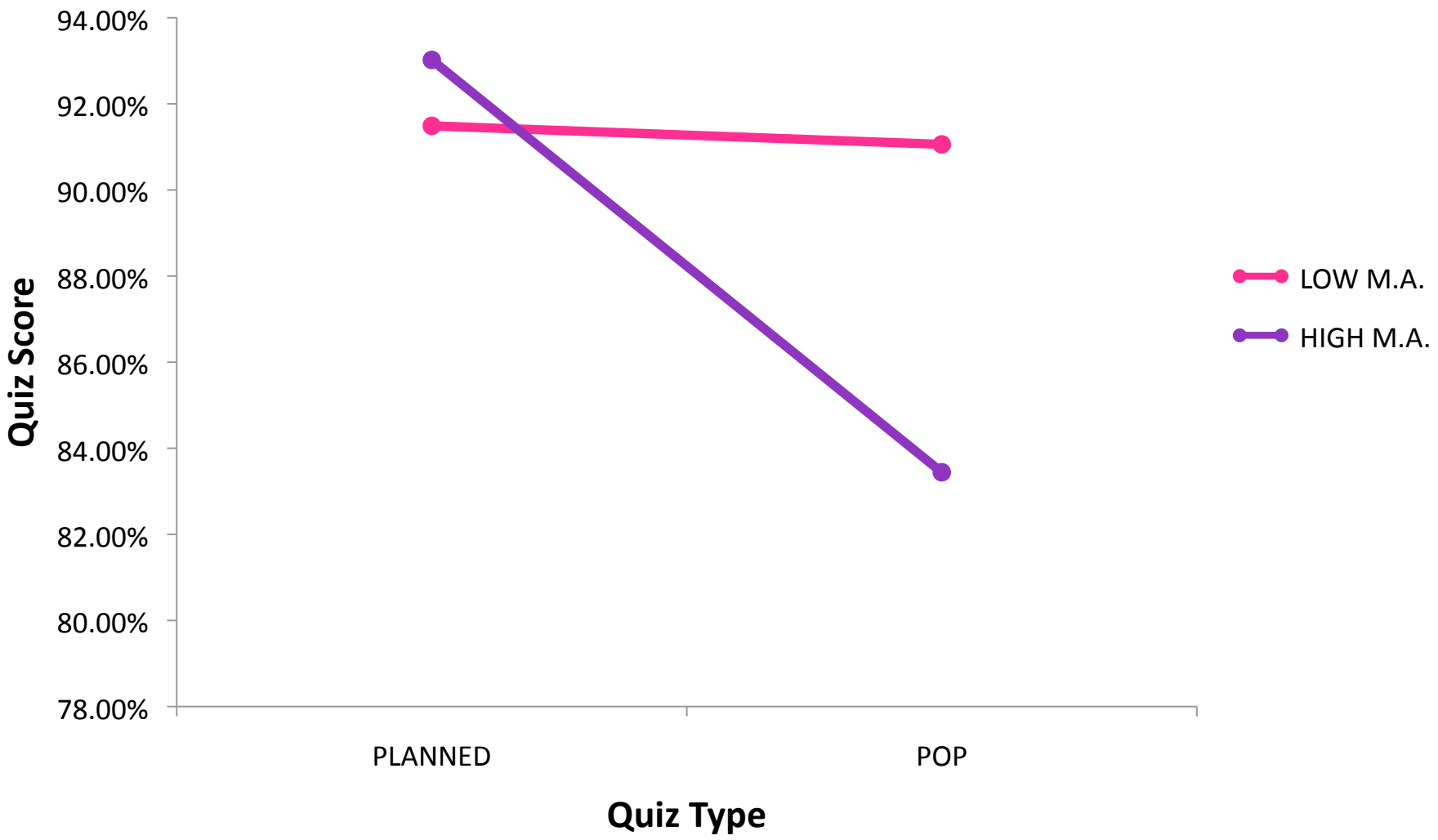
Method: Participants

- 59 participants currently enrolled in 11th grade math at a local high school
- A-MARS (Abbreviated version of the MARS) assessed math anxiety levels
  - We used a median split (Median = 24) to determine low versus high math anxiety

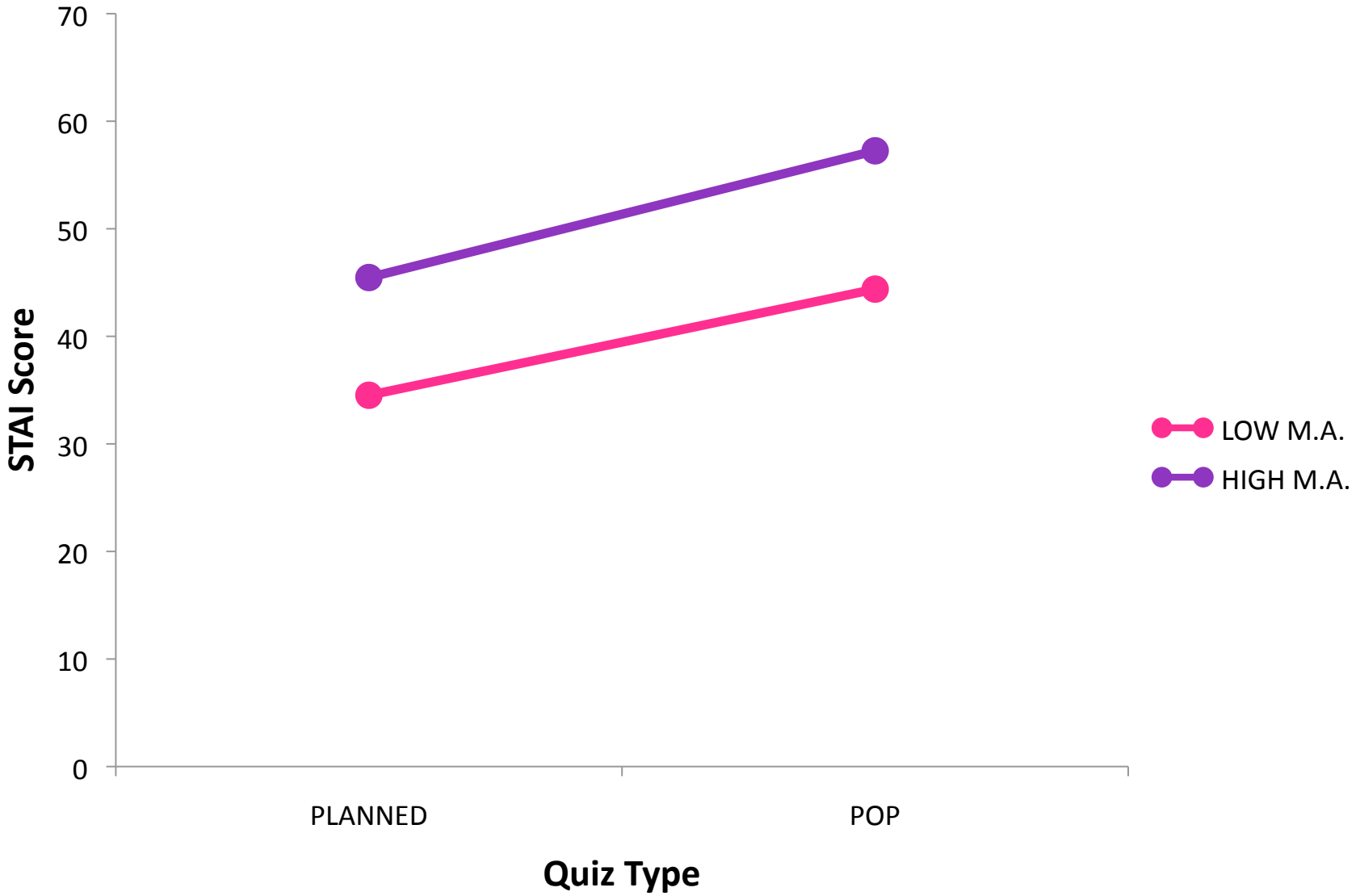
Method: Quizzes

- Students took both a pop quiz and a planned quiz over the course of two weeks
- After each quiz, students took the STAI (Spielberger, 1970) to measure state anxiety

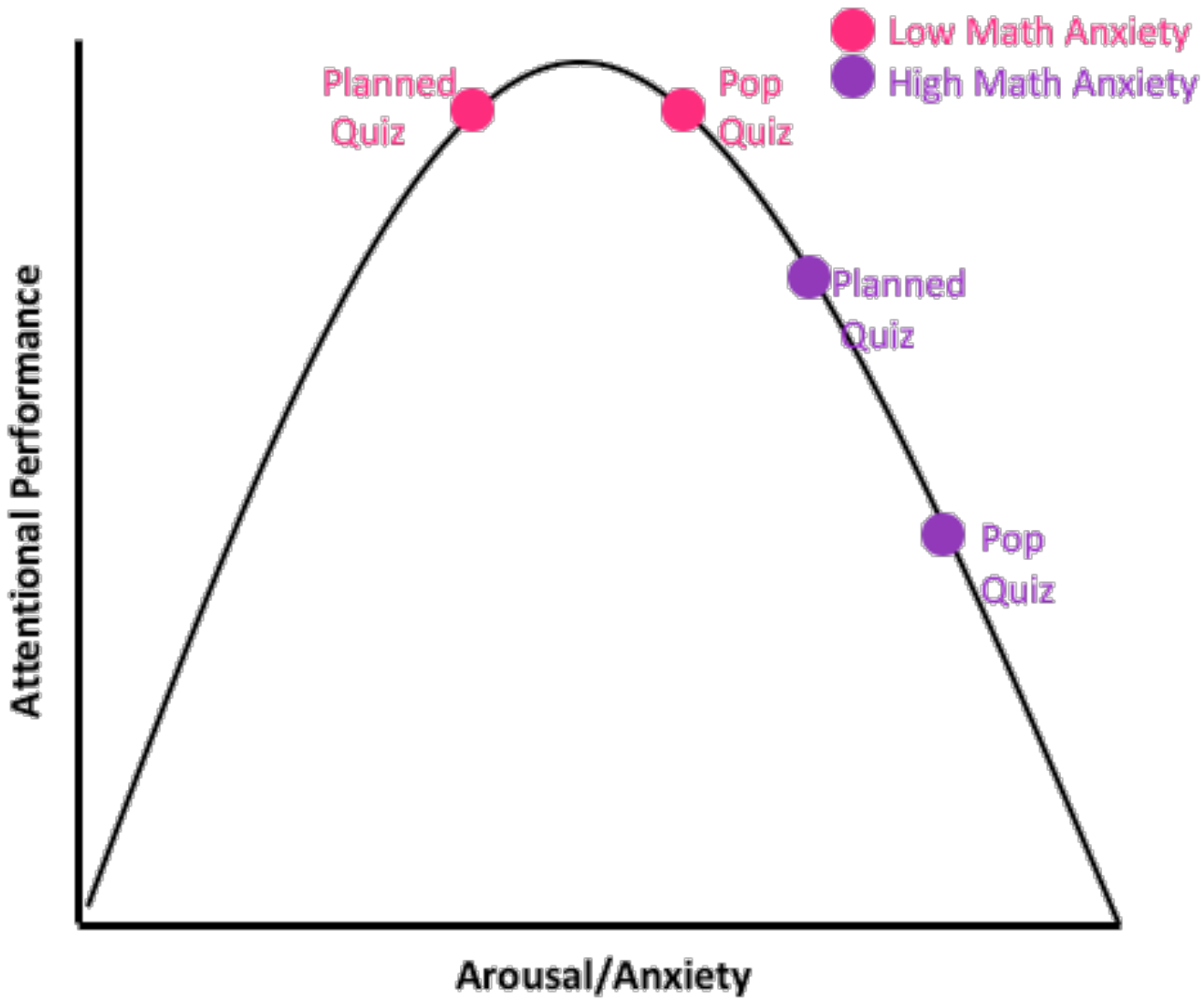
Results: Quiz Type & Math Anxiety Level vs. Quiz Score



Results: Quiz Type & Math Anxiety Levels vs. State Anxiety Level



Discussion


Low Math Anxiety
High Math Anxiety
Planned Quiz
Pop Quiz
Planned Quiz
Pop Quiz
Attentional Performance
Arousal/Anxiety

References

- Alexander, L., & Martray, C. (1989). The development of an abbreviated version of the mathematics anxiety rating scale. *Measurement and Evaluation in Counseling and Development, 22,* 143-150.
- Alpert, R., & Haber, R.N. (1980). Anxiety in academic achievement situations. *Journal of Abnormal and Social Psychology, 61*, 207-215.
- Ashcraft, M.H., & Kirk, E. P. (2001). The relationships among working memory, math anxiety, and performance. *Journal of Experimental Psychology: General, 130*, 224-237.
- Betz, N.E. (1978). Prevalence, distribution, and correlates of math anxiety in college students. *Journal of Counseling Psychology, 25*, 441-448.
- Buchwald, P. (2010). Test anxiety and performance in the framework of the conversation of resources theory. *Cognition, Brain, Behavior: An Interdisciplinary Journal, 14,* 283-293.
- Cassidy, J.C., & Johnson, R.E. (2002). Cognitive test anxiety and academic performance. *Contemporary Educational Psychology, 27*, 270-295.
- Chapell, M.S., Blanding, Z.B., Silverstein, M.E., Takahashi, M., Newman, B., Gubi, A., & McCann, N. (2005). Test anxiety and academic performance in undergraduate and graduate students. *Journal of Educational Psychology, 97*, 268-274.
- Daniels, B., & Hewitt, J. (1978). Anxiety and classroom examination performance. *Journal of Clinical Psychology, 34,* 340-345.
- Fennema, E., & Sherman, J.A. (1976). Fennema-Sherman Mathematics Attitudes Scales: Instruments designed to measure attitudes toward the learning of mathematics by males and females. *JSAS Catalog of Selected Dovuments in Psychology, 6,* 31.
- Harriss Dew, K. M., Galassi, J,P., & Galassi, M.D. (1984). Math anxiety: Relation with situational test anxiety, performance, physiological arousal, and math avoidance behavior. *Journal of Counseling Psychology, 31,* 580-583.
- Mandler, G., & Sarason, S.B. (1952). A study of anxiety and learning. *The Journal of Abnormal and Social Psychology, 47,* 166-173,
- Richardson, F.C., & Suinn, R.M. (1972). The mathematics anxiety rating scale: Psychometric data. *Journal of Counseling Psychology, 19*, 551-555.

References (cont.)

- Salehi, B., Cordero, M. I., & Sandi, C. (2010). Learning under stress: The inverted-U-shape function revisited. *Learning and Memory, 17*, 522-530.
- Sarason, I.G. (1957). Test anxiety, general anxiety, and intellectual performance. *Journal of Consulting Psychology, 21,* 485-490.
- Spielberger, C.D., Gonzales, H.P., Taylor, C.J., Anton, W.D., Algaze, B., Ross, G.K., & Westberry, L.G. (1980). Test Anxiety Inventory. Palo Alto, CA: Consulting Psychologists Press
- Spielberger, C.D., Gorsuch, R.L., Luschene, R., Vagg, P.R., & Jacobs, G.A. (1970). Test manual for the state-trait anxiety inventory. *Palo Alto, CA: Consulting Psychology Press.*
- Vogel, G.L. & Collins, A.L. (2002). The relationship between test anxiety and academic performance. *National Research Clearinghouse, 5 .*
- Yerkes, R.M. & Dodson, J.D. (1908). The relation of strength of stimulus to rapidity of habit-formation. *Journal of Comparative Neurology and Psychology, 18*, 459-482.

Math Anxiety Levels- Means

MathAnx

Math Anxiety Level	Mean	N	Std. Deviation
Low Math Anxiety	16.1290	31	6.38092
High Math Anxiety	35.7857	28	8.79123
Total	25.4576	59	12.45173

Quiz Score Averages

Math Anxiety Level		PopQuiz	PlannedQuiz
Low Math Anxiety	Mean	20.0323	20.1290
	N	31	31
	Std. Deviation	2.38724	2.02471
High Math Anxiety	Mean	18.3571	20.4643
	N	28	28
	Std. Deviation	3.95778	1.83045
Total	Mean	19.2373	20.2881
	N	59	59
	Std. Deviation	3.30928	1.92579

Follow up t-tests

Paired Samples Test

Math Anxiety Level			t	df	Sig. (2-tailed)
Low Math Anxiety	Pair 1	PopQuiz - PlannedQuiz	-.182	30	.857
High Math Anxiety	Pair 1	PopQuiz - PlannedQuiz	-2.511	27	.018

ANOVA:
MA Level & Quiz Type vs. Quiz Score

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		F	Sig.
quizType	Sphericity Assumed	5.127	.027
	Greenhouse-Geisser	5.127	.027
	Huynh-Feldt	5.127	.027
	Lower-bound	5.127	.027
quizType * MALevel	Sphericity Assumed	4.266	.043
	Greenhouse-Geisser	4.266	.043
	Huynh-Feldt	4.266	.043
	Lower-bound	4.266	.043

Tests of Between-Subjects Effects

Measure:MEASURE_1
Transformed Variable:Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	45888.290	1	45888.290	6377.253	.000
MALevel	13.206	1	13.206	1.835	.181
Error	410.150	57	7.196		

STAI Averages

Report

Math Anxiety Level		STAIPop	STAIPlanned
Low Math Anxiety	Mean	44.3871	34.5161
	N	31	31
	Std. Deviation	14.16257	9.66737
High Math Anxiety	Mean	57.2500	45.4643
	N	28	28
	Std. Deviation	18.75895	11.43575
Total	Mean	50.4915	39.7119
	N	59	59
	Std. Deviation	17.59347	11.81619

ANOVA:
MA Level & Quiz Type vs. STAI Score

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		F	Sig.
quizType	Sphericity Assumed	28.737	.000
	Greenhouse-Geisser	28.737	.000
	Huynh-Feldt	28.737	.000
	Lower-bound	28.737	.000
quizType * MALevel	Sphericity Assumed	.225	.637
	Greenhouse-Geisser	.225	.637
	Huynh-Feldt	.225	.637
	Lower-bound	.225	.637

Tests of Between-Subjects Effects

Measure:MEASURE_1
Transformed Variable:Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	242634.839	1	242634.839	921.385	.000
MALevel	4170.568	1	4170.568	15.837	.000
Error	15010.212	57	263.337		

Quiz: Week 1 (Logs & Exponents)

Name_____ Section 1 Planned Quiz: logs and exponents 22 pts
Please show work.

1. Write as a single power of x: $\frac{(x^n)^3}{x^n \bullet x^{n+1}}$ $\frac{X^{3n}}{X^{2n+1}}$ X^{n-1} (3pts)

2. Simplify:

$e^{\ln(4m)} - \ln(e^{2m})$

$4m-2m$

$2m$ (3pts)

$\ln(5e^7) + e^{3\ln(2)}$

$\ln(5)+7+8$

$\ln(5)+15$ (4pts)

3. State the domain of the following with interval notation: (3pts ea)

i) $\log_4(x-5) + \log_4(x+3)$

$x-5>0 \wedge x+3>0$

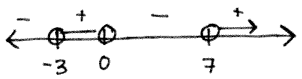
$x>5 \wedge x>-3$

$x>5$

$(5,\infty)$

ii) $\ln\left(\frac{x-7}{x^2(x+3)}\right)$

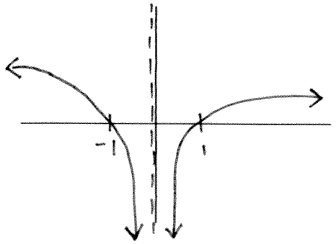
$\frac{x-7}{x^2(x+3)} > 0$



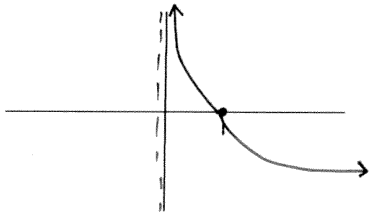
$(-3,0) \cup (7,\infty)$

4. Sketch each of the following and label at least one key pt : (3 pts ea)

i) $y = -\ln(|x|)$



ii) $y = \left|\log_{\frac{1}{2}}(x-4)\right|$



Quiz: Week 2 (Sequences)

Pop Quiz Sequences Name_____Section 1 22 pts

'Brute force only' will receive one credit. Show formulas and work.

1. Give the formulas : (4pts)

A) General term for an arithmetic sequence $a_n = a_1 + (n-1)d$

B) General term for a geometric sequence $a_n = a_1 r^{n-1}$

2. Find the 24th term of the sequence 21, 13, 5, -3, …..

$a_n = a_1 + (n-1)d$

$a_n = 21 + 23(-8)$

$a_n = 21 - 184$

$a_n = -166$

-166 (3pts)

3. 192 is what term of the sequence 3, 6, 12, 24, …..

$a_n = a_1 r^{n-1}$

$192 = 3 \cdot 2^{n-1}$

$64 = 2^{n-1}$

$2^6 = 2^{n-1}$

$6 = n-1$

$n = 7$

7th term (3pts)

4. Given an arithmetic sequence with $a_4 = 24$ and $a_{11} = 52$, find a_3.

$a_1 = 24$ $a_8 = 52$

$a_n = a_1 + (n-1)d$

$52 = 24 + 7d$

$28 = 7d$

$4 = d$

$a_4 = 24$

$a_3 = a_4 - 4$

$a_3 = 20$

20 (4pts)

5. Given the recursive definition $a_1 = 5$, $a_n = 2a_{n-1} + 1$, state the first 4 terms of the sequence.

$a_1 = 5$

$a_2 = 2(5) + 1 = 11$

$a_3 = 2(11) + 1 = 23$

$a_4 = 2(23) + 1 = 47$

5, 11, 23, 47 (4pts)

6. Given a geometric sequence with $a_3 = \frac{1}{2}$ and $a_7 = \frac{1}{32}$, find a_8.

$a_1 = \frac{1}{2}$ $a_5 = \frac{1}{32}$

$\frac{1}{32} = \frac{1}{2} r^4$

$\frac{1}{16} = r^4$

$(\frac{1}{2})^4 = r^4$

$r = \frac{1}{2}$

$a_8 = a_7 \cdot \frac{1}{2}$

$= \frac{1}{32} \cdot \frac{1}{2}$

$= \frac{1}{64}$

$\frac{1}{64}$ (4pts)