

MATH ACT SCORES

Placement	Average	SD	Number
090	15.17	1.4	12
095	17.13	1.6	95
151	19.48	2.2	186
Done	25.48	2.6	165

I used the Online ANOVA Calculator at: <http://www.danielsoper.com/statcalc/calc43.aspx>

Source	SS	df	MS	MSR
Groups	5,571.245	3	1,857.082	372.033
Error	2,266.240	454	4.992	
Total	7,837.485	457		

Bonferroni: I will run all 6 tests and I want my experiment-wise error to be 0.05. Therefore, I will use 0.008 for each test. I will start with the groups with the smallest observed difference...

Comparison	Difference	Standard Error	t-critical	Confidence Interval	Significant?
1 vs 2	-1.96	$\sqrt{4.992\left(\frac{1}{12} + \frac{1}{95}\right)} = 0.6845$	$t_{454}^{\alpha=0.0083} = 2.6512$	-3.77, -0.15	Yes
1 vs. 3	-4.31	$\sqrt{4.992\left(\frac{1}{12} + \frac{1}{186}\right)} = 0.6655$	$t_{454}^{\alpha=0.0083} = 2.6512$	-6.07, -2.54	Yes
1 vs 4	-10.31	$\sqrt{4.992\left(\frac{1}{12} + \frac{1}{165}\right)} = 0.6680$	$t_{454}^{\alpha=0.0083} = 2.6512$	-12.08, -8.54	Yes
2 vs. 3	-2.35	$\sqrt{4.992\left(\frac{1}{95} + \frac{1}{186}\right)} = 0.2818$	$t_{454}^{\alpha=0.0083} = 2.6512$	-3.10, -1.60	Yes
2 vs. 4	-8.35	$\sqrt{4.992\left(\frac{1}{95} + \frac{1}{165}\right)} = 0.2878$	$t_{454}^{\alpha=0.0083} = 2.6512$	-9.11, -7.59	Yes
3 vs. 4	-6.00	$\sqrt{4.992\left(\frac{1}{165} + \frac{1}{186}\right)} = 0.2389$	$t_{454}^{\alpha=0.0083} = 2.6512$	-6.63, -5.37	Yes

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Tukey:

Comparison	Difference	Standard Error	Q-value	HSD	Significant?
1 vs 2	-1.96	$\sqrt{\frac{4.992}{\left(\frac{2(12)(95)}{12+95}\right)}} = 0.4840$	3.66	1.7714	Yes
1 vs. 3	-4.31	$\sqrt{\frac{4.992}{\left(\frac{2(12)(186)}{12+186}\right)}} = 0.4706$	3.66	1.7224	Yes
1 vs 4	-10.31	$\sqrt{\frac{4.992}{\left(\frac{2(12)(165)}{12+165}\right)}} = 0.4724$	3.66	1.7290	Yes
2 vs. 3	-2.35	$\sqrt{\frac{4.992}{\left(\frac{2(95)(186)}{95+186}\right)}} = 0.1992$	3.66	0.7291	Yes
2 vs. 4	-8.35	$\sqrt{\frac{4.992}{\left(\frac{2(95)(165)}{95+165}\right)}} = 0.2035$	3.66	0.7448	Yes
3 vs. 4	-6.00	$\sqrt{\frac{4.992}{\left(\frac{2(165)(186)}{165+186}\right)}} = 0.1690$	3.66	0.6184	Yes

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Scheffe: I will first compare the “Done” group to the combination of the other three groups

Comparison / Contrast	Obs. Diff	Standard Error	Observed test stat	Critical test stat value
$\psi = c_1\mu_1 + c_2\mu_2 + \dots + c_a\mu_a$	ψ	$\sqrt{MS_W \sum \frac{c_a^2}{n_a}}$	$\frac{\psi}{SE}$	$\sqrt{(a-1)_\alpha F_{N-a}^{a-1}}$
$\hat{\psi} = \left(\frac{1}{3}\right)\bar{X}_1 + \left(\frac{1}{3}\right)\bar{X}_2 + \left(\frac{1}{3}\right)\bar{X}_3 + (-1)\bar{X}_4$	-8.22	$\sqrt{(4.992)\left(\frac{(1/3)^2}{12} + \frac{(1/3)^2}{95} + \frac{(1/3)^2}{186} + \frac{(-1)^2}{165}\right)}$ = 0.2921	$\frac{-8.22}{.2921}$ = -28.141	$\sqrt{(4-1)(2.6245)}$ = 2.806

Scheffe: I will now compare the “090” group to the combination of the “095” and “151”

Comparison / Contrast	Obs. Diff	Standard Error	Observed test stat	Critical test stat value
$\psi = c_1\mu_1 + c_2\mu_2 + \dots + c_a\mu_a$	ψ	$\sqrt{MS_W \sum \frac{c_a^2}{n_a}}$	$\frac{\psi}{SE}$	$\sqrt{(a-1)_\alpha F_{N-a}^{a-1}}$
$\hat{\psi} = (1)\bar{X}_1 + \left(\frac{-1}{2}\right)\bar{X}_2 + \left(\frac{-1}{2}\right)\bar{X}_3$	-3.14	$\sqrt{(4.992)\left(\frac{(1)^2}{12} + \frac{(-1/2)^2}{95} + \frac{(-1/2)^2}{186}\right)}$ = 0.6602	$\frac{-3.14}{.6602}$ = -4.756	$\sqrt{(4-1)(2.6245)}$ = 2.806