* Recall the equation for estimating the standard error of the mean:

$$\hat{\sigma}_M = \sqrt{\frac{\hat{\sigma}^2}{n}}$$

Calculating standard error bars for the levels of a repeated measure factor-A

A. Use overall error term from ANOVA

The model assumes sphericity, so we can estimate the common population variance using MS_{error} from the repeated measures ANOVA. Then, we just plug in MS_{error} as our estimate of the variance in the equation:

$$\hat{\sigma}_M = \sqrt{\frac{MS_{S\times A}}{n}}$$

B. Estimate variance separately for each treatment

When sphericity is violated, we want to use separate estimates of the population variance (one for each level). Because we have a repeated measure design, we will need to adjust the scores for between-participants variability:

1. Calculate the deviation of each participant's overall average from the grand mean. To do this, take each participant's marginal mean across levels of the repeated measure and subtract the grand mean from it.
2. Calculate the adjusted score for each participant. To do this, subtract the deviations calculated in #1 from each participant's observed score.
3. Estimate the variance separately for each treatment condition using the adjusted scores.
4. Plug in that estimate of the variance in the standard error equation:

$$\hat{\sigma}_{M_i} = \sqrt{\frac{est.\mathrm{var}@level_i}{n}}$$

* Remember, if you use method A, you will have the same standard error estimate for each level of your repeated measures factor. If you use method B, you will have a separate standard error estimate for each level of your repeated measures factor.

Example of Method B within-subject standard error calculations using data on Handout #24.

	A1	A2	A3	$\overline{Y}_{sj}$	$\overline{Y}_{sj} - \overline{Y}_T$
S1	13	24	22	19.67	-1.72
S2	6	30	29	21.67	.28
S3	25	13	23	20.33	-1.06
S4	20	16	25	20.33	-1.06
S5	25	37	16	26.00	4.61
S6	19	30	12	20.33	-1.06
$\overline{Y}_{Ai}$	18.00	25.00	21.17	$\overline{Y}_T = 21.39$	
$\sum Y_{ij}^2$	2216	4.70	2979		
$S_{A_i}^2$	54.40	84.00	38.00		
incorrect est. SE	3.01	3.74	2.52		

Not adjusted for participant differences

Table of scores adjusted for participant differences.

	A1	A2	A3
S1	14.72	25.72	23.72
S2	5.72	29.72	28.72
S3	26.06	14.06	24.06
S4	21.06	17.06	26.06
S5	20.39	32.39	11.39
S6	20.06	31.06	13.06
$\overline{Y}_{Ai}$	18.00	25.00	21.17
$\sum Y_{ij}^2$	2190.20	4047.36	2945.78
$S_{A_i}^2$	49.24	59.47	51.35
est. SE by Method B	**2.86**	**3.15**	**2.93**