

1. Dr. Ty Pest is a human factors psychologist who is interested in testing the impact of different keyboard layouts on typing speed. To that end, he chooses four different conditions: a normal keyboard with normal (QWERTY) keyboard layout, a normal keyboard with the Dvorak layout of keys (supposedly a more efficient layout), an ergonomic (split) keyboard with normal keyboard layout, and an ergonomic (split) keyboard with the Dvorak layout of keys. His participants are ten secretaries who have at least 5 years of typing experience. The DV is the number of words per minute of typing of complex textual material in 15 minutes. Below are the incomplete analyses of his experiment. Complete the analyses and interpret the results as completely as you can. [15 pts]

Descriptive Statistics

	Mean	Std. Deviation	N
NormQWERTY	73.7000	3.88873	10
NormDvorak	39.2000	3.48967	10
ErgoQWERTY	70.4000	4.47710	10
ErgoDvorak	36.5000	2.87711	10

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power ^a	
Keyboard	Sphericity Assumed	11787	3	3929	344.4	.000	.975	1.000
Error(Keyboard)	Sphericity Assumed	308	27	11.41				

Decision: Reject H_0 , because $p < .001$.

$HSD = 3.87 \sqrt{\frac{11.41}{10}} = 4.13$		NQ	ND	EQ	ED
	NQ	---			
	ND	34.5	---		
	EQ	3.3	31.2	---	
	ED	37.2	2.7	33.9	---

There is a significant effect of type of keyboard, $F(3,27) = 344.4$, $MSE = 11.41$, $p < .001$, $\eta^2 = .975$. Post hoc analyses using Tukey's HSD indicate that typists were faster on the Normal QWERTY keyboard ($M = 73.7$) and the Ergonomic QWERTY keyboard ($M = 70.4$) compared to both the Normal Dvorak keyboard ($M = 39.2$) and the Ergonomic Dvorak keyboard ($M = 36.5$). However, you should note that the study could not have been properly counterbalanced, because to do so with four condition (and using complete counterbalancing) would require 24 orders and, therefore, 24 participants.

2. Dr. Justin Case was interested in determining if temperature had an impact on performance on a quiz. He took a class of 100 statistics students and randomly assigned a quarter of the class to a room where the temperature was 50°, another quarter was assigned to a room where the temperature was 70°, another quarter was assigned to a room where the temperature was 80°, and the final quarter was assigned to a room where the temperature was 100°. The students all took the same quiz (max.score = 10). Using the summary data below, conduct as complete an analysis of this experiment as you can, then provide a detailed interpretation of the results of the experiment. [15 pts]

	50°	70°	80°	100°	
$T(\Sigma X)$	175	215	200	185	$G = 775$
Mean	7.0	8.6	8.0	7.4	$\Sigma X^2 = 6331$
SS	127	36	67	58	

Source	SS	df	MS	F
Between	36.75	3	12.25	4.08
Within	288	96	3	
Total	324.75	99		

$F_{\text{Max}} = 127/36 = 3.53$ $F_{\text{MaxCrit}} = 3.0$, thus concerns about heterogeneity of variance would lead you to use $\alpha = .01$ (to control for an inflated chance of Type I Error). $F_{\text{Crit}}(3,96) = 3.99$.

Decision: Reject H_0 , because $F_{\text{Obt}} \geq F_{\text{Crit}}$.

$HSD = 3.7 \sqrt{\frac{3}{25}} = 1.28$		50°	70°	80°	100°
	50°	---			
	70°	1.6	---		
	80°	1.0	.6	---	
	100°	.4	1.2	.6	---

There was a significant effect of temperature, $F(3,96) = 4.08$, $MSE = 3$, $p < .01$, $\eta^2 = .11$. Post hoc tests using Tukey's HSD indicate that people in the 50° condition perform significantly worse ($M = 7.0$) than people in the 70° condition ($M = 8.6$).

3. Suppose that in the not-too-distant future you conduct a single factor experiment using a repeated measures design, but you can't remember how to perform a repeated measures ANOVA. All you can remember from your PS217 class is how to conduct an independent groups ANOVA, so you go ahead and analyze the data from the repeated measures design using an independent groups ANOVA. Your analysis is significant (i.e., you can reject H_0). Even though you've conducted an inappropriate analysis, would you be inclined to believe the results of your analysis? Why or why not? Under which circumstances might you be disinclined to believe the results of your analysis? [10 pts]

You should be inclined to believe that the effects are significant. Because the RM design is more powerful, you would expect that the F would be larger for a RM analysis and smaller for an IG analysis. Thus, if the F is significant with an IG analysis, you should expect that it would also be significant with a RM analysis.

However, if the individual differences are minor, then you might find that the results are significant with an IG analysis, but the F wouldn't be significant with a RM analysis.

4. Suppose that you've analyzed a set of data from an experiment as a repeated measures ANOVA. You've obtained $F(3,12) = 5$. Your $MS_{\text{Error}} = 1$ and there are 5 scores in each condition. Now, however, you find out that you *should have* computed an independent groups ANOVA. Fill in the source table below as it should appear with the appropriate analysis (i.e., assuming that all the scores are the same). [Hint: Pay attention to the df . If you're confused, first try to construct as much of the repeated measures source table as you can.] [5 pts]

Source	SS	df	MS	F
Between	15	3	5	2.5
Within	32	16	2	
Total	47	19		

Here's what the RM ANOVA would have looked like:

Source	SS	df	MS	F
Between	15	3	5	5
Within	32	16		
Subj	20	4		
Error	12	12	1	
Total	47	19		

5. A researcher studying the impact of caffeine on life expectancy adds two types of caffeine (i.e., found in coffee and chocolate) to the water supply of groups of laboratory-bred rats. This species typically survives about 13 months. The water supply of a control group of rats did not have any caffeine added. The DV is the number of days that each rat lives. Analyze the results of this experiment as completely as you can. What would you do next? [10 pts]

Coffee Caffeine	Chocolate Caffeine	No Caffeine
398	401	412
379	420	386
423	413	394
389	396	409
418	406	415
383	410	401
387	406	394
390	409	398

Descriptives

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
coffee	8	395.8750	16.21672	5.73348	382.3175	409.4325	379.00	423.00
chocolate	8	407.6250	7.30826	2.58386	401.5151	413.7349	396.00	420.00
none	8	401.1250	10.09155	3.56790	392.6883	409.5617	386.00	415.00
Total	24	401.5417	12.30404	2.51155	396.3461	406.7372	379.00	423.00

ANOVA

dayslive

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	554.4	2	277.2	1.99	.162
Within Groups	2927.6	21	139.4		
Total	3482	23			

No need for Hartley's F_{Max} , because the results aren't significant.

Decision: Retain H_0 , because $p > .05$.

You need more power for this study: (1) increase sample size (n), (2) increase the treatment (e.g., using more concentrated caffeine), (3) decrease individual differences (e.g., rats all from the same litter, or genetic background), and (4) decrease random variability (e.g., be sure to feed all rats at the same time, be sure that cages and testing situation are identical).