## Graphpad 分析教程-多因素方差分析

今天给大家介绍强大的 graphpad prism 8.0 是如何进行多因素方差分析的, 我们以双(多)分析中的析因分析为例来介绍。

首先我们要明确, 析因分析所关心的问题主要有两个:

- 两个或两个以上处理因素的各处理水平间均数有无差异?及主效应有无统计
   学意义
- 两个或两个以上处理因素之间有无交互作用

话不多说,我们直接开始:

为了方便仍然以 sample data 来介绍,如下图。当然也可以按照第二种选择,设定平行样本数,即可得到数据表。

New table & graph XY Column Grouped	Grouped tables have two grouping variables, one defined by columns and the other defined by rows	Grouped tables have two grouping other defined by rows           NY         Toos bend         A         B           XY         Toos bend         Contrast         Treesed           Column         1         Max         AV3         BV1         BV2         BV3           Grouped         2         Ferme         Image: Second	y variables, one defined by columns and the
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Table format:				样本组别AB Group A					Group B				
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1	3	× A:1		A:2	A:3	A:4	A:5	B:1	B:2	B:3	B:4	B:5	C:1
1	Serum starved		34	36	41	40	) 43	98	87	95	99	9 88	
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19	Title	_	How	to perfo	orm two-v	vay ANOV	Α						
20	Title	_	Click	Analyze,	choose "T	wo-way A	NOVA" from	the list of	f Grouped a	analyses, ai	nd accept	all the defa	ult
21	Title		choic	es on the	e dialog. Cl	ick the link	below for c	letailed ins	tructions, a	and to learn	about tw	o-way ANC	VA.
22	litle	_	😮 St	ep by step i	nstructions for	performing tw	vo-way ANOVA						
23	litle	_											
1		1											۰.

 点击 analyze 或左侧 results 的 new analysis 后进入 creat a new analysis, 按下图示选择 grouped Analyses 下的 two-way ANOVA(or mixed model), 注意不要漏选 data sets 里的 A 和 B, 得到新对话框

Data to analyze		RM Design Data arr	RM Anal	ysis Fact	or names M	ultiple Com	parisons Op	otions Resi	duals	
Tube: footbul		Table	e format:	Gro	oup A	Gro	oup B	Gro	up C	В
Type of analysis Which analysis? Transform, Normalize XY analyses Column analyses Column analyses Couped analyses Multiple thests - one per row Row means with SD or SEM Multiple thests - one per row Bourdisency table analyses Survival analyses Survival analyses Huitiple variable analyses Huitiple variable analyses Huitiple variable analyses Huitiple variable analyses Huitiple variable analyses Surver analyses Huitiple variable analyses Surver analyses Huitiple variable analyses Surver analyses Generate curve Simulate data Recently used	Analyze which data sets? ♥A:Wid-type cells ♥B:GPP5 cell line	 Table Gree 1 2 3 4 Matchine Each Same @ No. @ Yes.	e format: puped Title	A:Y1 A:Y1 a factor(s resents a diff r (equal v isser-Greet ion.	bup A ittle A:Y2 different time erent time po arriability of hhouse correct tabs), Prism v	e point, so n int, so mat f difference ction. Reco	sup B ittle B:Y2 anatched values a ched values a ces)? mmended.	Gro C:Y1 es are sprea are stacked i	d across a r nto a subco	row.

2.1 选择 RM design:注意勾选不同引起的变化(主要下图中的绿色框,注意行列、纵列、组列)。

a arran										-						
Table fo	format:	Grou	A qu	Gro	roup B Group C		1	Tab	le format:	Group A		Group B		Gro	up C	
Grou	ped	Title		Title		Title		31	Grouped		Time1		Time2		Time3	
		A:Y1	A:Y2	B:Y1	B:Y2	C:Y1	C:Y2				A:Y1	A:Y2	B:Y1	B:Y2	C:Y1	C:Y2
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<b>2</b> Ti	Title							5	2	Title						
3 Ti	Title							2	3	Title						
<b>4</b> Ji	itia	han			hn	han	~	LS	4	Titla	han	Low		hn	have	h
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Each ro	ow repres	sents a diffe	rent time po	int, so matc	hed values a	are stacked i	nto a subco	umn.	Eac	h row repres	sents a diffe	erent time po	int, so matc	hed values a	ire stacked i	nto a subc
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2.2 进入 RM analysis 菜单,默认情况下选择如图,一般选系统推荐的,但注

意有的时候推荐选项不是最常用选项,按下图选择

RM Design RM Analysis Factor names Multiple Comparisons Options Residuals
Analyses of repeated measures data can be reported in two ways. - ANOVA (partition sum-of-squares). This is the same as the general linear model (GLM). - Mixed-effects model. This uses the restricted maximum likelihood method. If there are no missing values, the two approaches give the same main results (F and P values). But the methods are very different, so the other reported results differ.
Analyze using which method
<ul> <li>It depends.</li> <li>Use ANOVA if there are no missing values.</li> <li>Use mixed-effects model if there are missing values.</li> </ul>
<ul> <li>What to do if a random effect is zero (or negative)?</li> <li>Remove term(s) from model and fit a simpler model recommended.</li> <li>Fit the full model anyway (corresponds to NOBOUND parameter in SAS).</li> </ul>
Make these choices the default for future ANOVAs (One-, Two- and Three-way).

2.3 进入 multiple comparisions,选择第三个「每行进行组别比较,也就是 在每一行里的个组别间进行比较」。

第一个为「无多重比较,各组间各列差异」

第二个为「各组间行间差异」

第四个为「各组间行间列间的复合差异」(见下图)

RM Design	RM Analysis	Factor names	Multiple Comparisons	Options	Residuals
What kind	l of compari	son?			
Compare	e each cell me	an with the othe	r cell mean in that row		- < >
No multi	ple compariso	ns —			
Compare	e each cell me	an with the othe	r cell mean in that colum	n	
Compare	e cell means re	an with the othe egardless of rows	s and columns VU		
1		(Mean) ←		an	
2		Mean +		an y	如何比较
3		(Mean)+	→ (Mea	an	
Comp Comp Cont	are each colu are each colu rol column:	mn mean with ev mn mean with th Group A : Wild-ty	ery other column mean. e control column mean. pe cells	无对照 设置对	两两比较 照后比较 
Which tes	st?				
Use choic	tes on the Op	tions tab to choo	se the test, and to set t	the default	ts for
future Al	NOVAs.				

2.4 然后选择 options,按图示选择推荐选项,切记拿不准的选项就默认。

RM Design	RM Analysis	Factor names	Multiple	Comparisons	Options	Residuals					
Multiple comparisons test											
Orre	ct for multiple	comparisons usi	ng statist	ical <u>h</u> ypothesis	testing. R	ecommende	ed.				
<u>T</u> est:	Test: Sidak (more power, recommended)										
Correct for multiple comparisons by controlling the <u>False Discovery Rate</u> .											
T <u>e</u> st:	Test: Two-stage step-up method of Benjamini, Krieger and Yekutieli (recommended)										
© <u>D</u> on't	correct for mu	Itiple comparisor	ns. Each d	comparison sta	nds alone.						
Te <u>s</u> t:	Fisher's LSD te	est									
Multiple c	omparisons	options									
S <u>w</u> ap	direction of co	mparisons (A-B)	vs. (B-A	).							
Report	rt multiplicity <u>a</u>	djusted P value	for each (	comparison.							
Each	P value is adju	sted to account	for multi	ole comparison	s.						
Family-wi	ise significance	and confidence	level:	0.05 (95% c	onfidence	interval)	-				
Graphing	options										
🔲 <u>G</u> raph	or confidence in	tervals.									
Additiona	l results										
Narra	tive <u>r</u> esults.										
Show	cell/row/colum	n/grand <u>m</u> eans.									
Repor	rt goodness of	fit.									
Output											
Sh <u>o</u> w this	s many signific	ant digits (for ev	/erything	except P value	es): 4	+ 🚖					
P <u>v</u> alue s	tyle: GP: 0.1	234 (ns), 0.0332	2 (*), 0.0	021 (**), 0.(	▶ <u>N</u> = 6						
Make options on this tab be the default for future Two-Way ANOVAs.											

## 3. 最后分析结果 (看每种情况下不同的 P 值):

	ANOVA results		×		= Multiple compari	Sons	×
1	2way ANOVA ANOVA results						
4	Assume sphericity?	No					
5	Alpha	0.05		<b>→</b> p < 0.05			
6	各变量	量对总体方差变异的影响					
7	Source of Variation	% of total variation	P value	P value summary	Significant?	Geisser-Greenhouse's epsilon	
8	Row Factor	49.25	<0.0001	****	Yes	1.000	
9	Column Factor	29.49	0.0001	***	Yes	1.000	
10	Interaction: Row Factor x Column Factor	19.54	0.0001	***	Yes	1.000	
11	Interaction: Row Factor x Subject	0.08267					
12	Interaction: Column Factor x Subject	0.5123					
13	Subject	0.7375					
14							
15	ANOVA table	SS	DF	MS	F (DFn, DFd)	P value	
16	Row Factor	7566	1	7566	F (1, 4) = 2383	P<0.0001	
17	Column Factor	4530	1	4530	F (1, 4) = 230.2	P=0.0001	
18	Interaction: Row Factor x Column Factor	3001	1	3001	F (1, 4) = 198.4	P=0.0001	
19	Interaction: Row Factor x Subject	12.70	4	3.175			
20	Interaction: Column Factor x Subject	78.70	4	19.68			

P < 0.05 说明变量数据中存在具有统计学意义的显著性差异,如果需要明确哪

一对或者几对数据具有差异,则需要查看 Multiple comparisions 里面的结果。

	E ANOVA results		×		Multiple comp	arisons		×
1	2way ANOVA Multiple comparisons							
-								
1	Compare each cell mean with the other cell mean in that row							
2								
3	Number of families	1						
4	Number of comparisons per family	2						
5	Alpha	0.05						
6						•		
7	Sidak's multiple comparisons test	Mean Diff.	95.00% CI of diff.	Significant?	Summary	Adjusted P Value		
8								
9	Wild-type cells - GPP5 cell line							
10	Serum starved	-54.60	-60.95 to -48.25	Yes	****	<0.0001< 0.05		
11	Normal culture	-5.600	-11.95 to 0.7510	No	ns	0.0879 > 0.05		
12								
13								
14	Test details	Mean 1	Mean 2	Mean Diff.	SE of diff.	N1	N2	t
15								
16	Wild-type cells - GPP5 cell line							
17	Serum starved	38.80	93.40	-54.60	2.575	5	5	21.20
18	Normal culture	24.40	30.00	-5.600	2.575	5	5	2.175
19								
20								
21								

## 4. 绘图:可选用散点图(数据较少)或误差线柱状图(数据较多)

