Non-Parametric Tests

PSYC 300B - Lecture 4
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The Kruskal-Wallis Test

- Non-parametric alternative to the between-groups ANOVA
- The data are converted ranks to counteract the presence of unusual cases, or when a parametric assumption of the between-groups ANOVA has been violated
- This test assesses the hypothesis that three or more independent groups come from different populations, so it looks for differences between groups of scores that come from different participants (Kruskal & Wallis, 1952)
- The one assumption for the Kruskal-Wallis test is that each of the treatment conditions must contain at least five scores

Formula for the Kruskal-Wallis Test

$$H = \frac{12}{N(N+1)}\left(\sum \frac{{R_i}^2}{n_i}\right) - 3(N+1)$$

$${\chi^2}_{CRITICAL}\ df = (\#conditions - 1)$$

No Soya		1 Soya Meal		4 Soya Meals		7 Soya Meals	
Sperm (millions)	Rank	Sperm (millions)	Rank	Sperm (millions)	Rank	Sperm (millions)	Rank
0.35	4	0.33	3	0.40	6	0.31	1
0.58	9	0.36	5	0.60	10	0.32	2
0.88	17	0.63	11	0.96	19	0.56	7
0.92	18	0.64	12	1.20	21	0.57	8
1.22	22	0.77	14	1.31	24	0.71	13
1.51	30	1.53	32	1.35	27	0.81	15
1.52	31	1.62	34	1.68	35	0.87	16
1.57	33	1.71	36	1.83	37	1.18	20
2.43	41	1.94	38	2.10	40	1.25	23
2.79	46	2.48	42	2.93	48	1.33	25
3.40	55	2.71	44	2.96	49	1.34	26
4.52	59	4.12	57	3.00	50	1.49	28
4.72	60	5.65	61	3.09	52	1.50	29
6.90	65	6.76	64	3.36	54	2.09	39
7.58	68	7.08	66	4.34	58	2.70	43
7.78	69	7.26	67	5.81	62	2.75	45
9.62	72	7.92	70	5.94	63	2.83	47
10.05	73	8.04	71	10.16	74	3.07	51
10.32	75	12.10	77	10.98	76	3.28	53
21.08	80	18.47	79	18.21	78	4.11	56
Total (R_j)	927		883		883		547
Average ($\bar{R}_j$)	46.35		44.15		44.15		27.35

Conduct a hypothesis test (α = .05) to determine if there is a significant difference between the groups. The data violate the assumption of normality within groups

I	II	III
14	2	26
3	14	8
21	9	14
5	12	19
16	5	20

Conduct a hypothesis test (α = .05) to determine if there is a significant difference between the treatments. The data violate the assumption of homogeneity of variance

Treatment A	Treatment B	Treatment C
10	24	68
28	27	71
26	35	57
39	44	60
6	58	62

A physician ranked the health of 25 patients that had been previously categorized by their personality type

Type-A	Type-B	Type-C
2	1	4
6	3	9
7	5	14
10	8	18
13	11	20
15	12	22
19	16	24
21	17	25
23		

Conduct a hypothesis test (α = .05) to determine if there is a significant difference in health across the personality types. The data violated the homogeneity of variance assumption

Friedman's ANOVA

- The non-parametric alternative to the repeated measures ANOVA
- Used for testing differences between more than two conditions when the same group of participants have provided scores for each condition (Friedman, 1937)
- Used when the data are ordinal (i.e., ranks), to counteract the presence of unusual cases, or when the data violate a parametric assumption of a repeated-measures ANOVA

Formula for Friedman's ANOVA

$$F_r = \left[\frac{12}{nk(k+1)}\left(\sum {R_i}^2\right)\right] - 3n(k+1)$$

$${\chi^2}_{CRITICAL}\ df = (\#conditions - 1)$$

Conduct a hypothesis test (α = .05) to determine if the diet works (i.e., if participants lose a significant amount of weight)

	Weight			Weight		
	Start	Month 1	Month 2	Start (Ranks)	Month 1 (Ranks)	Month 2 (Ranks)
Person 1	63.75	65.38	81.34	1	2	3
Person 2	62.98	66.24	69.31	1	2	3
Person 3	65.98	67.70	77.89	1	2	3
Person 4	107.27	102.72	91.33	3	2	1
Person 5	66.58	69.45	72.87	1	2	3
Person 6	120.46	119.96	114.26	3	2	1
Person 7	62.01	66.09	68.01	1	2	3
Person 8	71.87	73.62	55.43	2	3	1
Person 9	83.01	75.81	71.63	3	2	1
Person 10	76.62	67.66	68.60	3	1	2
			R_i	19	20	21
			M_i	1.9	2.0	2.1

Participants provided pain relief scores (out of 10, with 10 being the highest) when they took each drug while experiencing a headache on different occasions

Person	Placebo	Drug A	Drug B	Drug C
A	3	4	6	7
B	0	3	3	6
C	2	1	4	5
D	0	1	3	4
E	0	1	4	3

Conduct a hypothesis test (α = .05) to determine if there is a significant difference in the efficacy of the analgesic drugs

After going on a campus tour of four universities students ranked the schools based on their desire to attend

Student	VIU	SFU	UVic	UBC
A	1	3	2	4
B	1	2	3	4
C	2	3	1	4
D	1	4	2	3
E	2	3	1	4
F	1	4	2	3
G	2	3	1	4
H	1	2	3	4

Conduct a hypothesis test (α = .05) to determine if there is a significant difference in preferences

Participants ranked how much they liked the pizza from three different pizzerias

Domino's	Panago	Luigi's
3	2	1
2	1	3
1	2	3
1	2	3
3	1	2
3	2	1
2	3	1

Conduct a hypothesis test ($\alpha = .05$) to determine if there is a significant difference in the rankings

Domino's	Panago	Larry's
3	2	1
2	1	3
1	2	3
1	2	3
3	1	2
3	2	1
2	3	1
$R_D = 15$	$R_P = 13$	$R_L = 14$
$M_D = 2.14$	$M_P = 1.86$	$M_L = 2.0$