

Friedman Test

- non-parametric alternative to the one-way ANOVA with repeated measures
- used χ^2 test for differences between groups when the dependent variable being measured is ordinal

Friedman Test

- ⊕ It can also be used for continuous data that has violated the assumptions necessary to run the one-way ANOVA with repeated measures

ASSUMPTIONS

- **Assumption #1:** One group that is measured on three or more different occasions.
- **Assumption #2:** Group is a random sample from the population.

ASSUMPTIONS

- **Assumption #3:** Your dependent variable should be measured at the ordinal or interval/ratio level
- **Assumption #4:** Samples do NOT need to be normally distributed.

FORMULA

$$M = \frac{12}{nk(k+1)} \sum R_j^2 - 3n(k+1)$$

Where:

k = number of columns (often called “*treatments*”)

n = number of rows (often called “*blocks*”)

R_j = sum of the ranks in column.



EXAMPLE

- The venerable auction house of Snootly & Snobs will soon be putting **three** fine 17th- and 18th-century violins, **A, B, and C**, up for bidding. A certain musical arts foundation, wishing to **determine which** of these instruments to add to its collection, arranges to have them played by each of **10** concert violinists. The players are blindfolded, so that they cannot tell which violin is which; and each plays the violins in a randomly determined sequence (BCA, ACB, etc.).

H_1 : One of the three violins
will be selected by the
musical arts foundation


H_0 : none of the three violins
will be selected by the
musical arts foundation

SUBJECTS	VIOLINS		
	A	B	C
1	9.0	7.0	6.0
2	9.5	6.5	8.0
3	5.0	7.0	4.0
4	7.5	7.5	6.0
5	9.5	5.0	7.0
6	7.5	8.0	6.5
7	8.0	6.0	6.0
8	7.0	6.5	4.0
9	8.5	7.0	6.5
10	6.0	7.0	3.0

SUBJECTS	RANKED MEASURES		
	A	B	C
1	3	2	1
2	3	1	2
3	2	3	1
4	2.5	2.5	1
5	3	1	2
6	2	3	1
7	3	1.5	1.5
8	3	2	1
9	3	2	1
10	2	3	1
TOTAL	26.5	21.0	12.5
MEAN	2.65	2.10	1.25

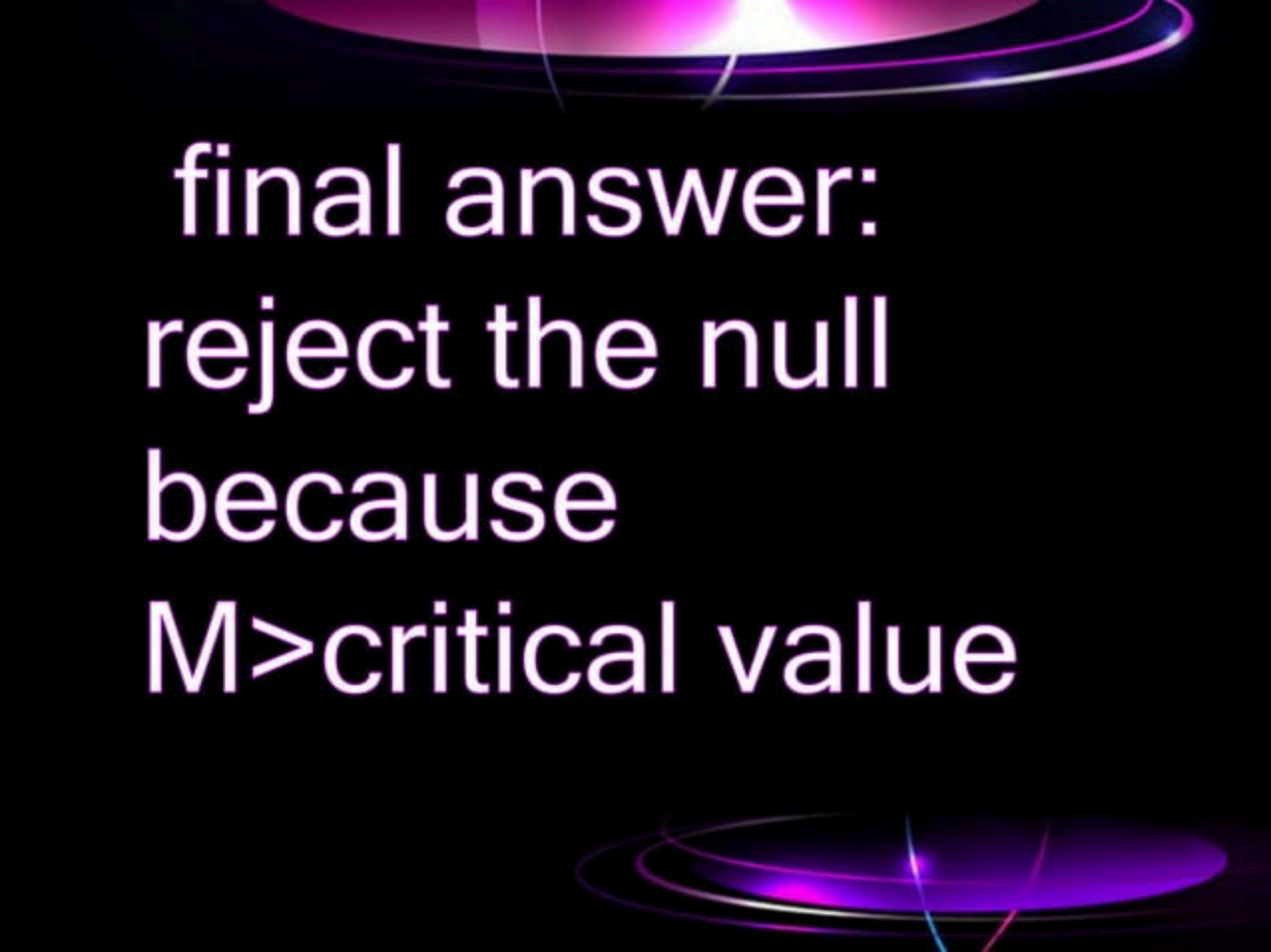
	A	B	C	ALL	
counts	10	10	10	30	n=10 [subjects] _T
sums	26.5	21.0	12.5	60.0	k=3 [measures per subject] _T
means	2.65	2.10	1.25	2.0	nk=30




$$M = \frac{12}{(10)(3)(4)} [(26.5)^2 + (21.0)^2 + (12.5)^2] - (3)(10)(4)$$

$$= (0.1 \times 1299.5) - 120$$

$$= 9.95$$

final answer:
reject the null
because
 $M > \text{critical value}$

Critical values for the Friedman Test

$$M = \frac{12}{nk(k+1)} \sum R_j^2 - 3n(k+1)$$

n	k=3		k=4		k=5		k=6	
	$\alpha=5\%$	$\alpha=1\%$	$\alpha=5\%$	$\alpha=1\%$	$\alpha=5\%$	$\alpha=1\%$	$\alpha=5\%$	$\alpha=1\%$
2	—	—	6.000	—	7.600	8.000	9.143	9.714
3	6.000	—	7.400	9.000	8.533	10.130	9.857	11.760
4	6.500	8.000	7.800	9.600	8.800	11.200	10.290	12.710
5	6.400	8.400	7.800	9.960	8.960	11.680	10.490	13.230
6	7.000	9.000	7.600	10.200	9.067	11.870	10.570	13.620
7	7.143	8.857	7.800	10.540	9.143	12.110	10.670	13.860
8	6.250	9.000	7.650	10.500	9.200	13.200	10.710	14.000
9	6.222	9.556	7.667	10.730	9.244	12.440	10.780	14.140
10	6.200	9.600	7.680	10.680	9.280	12.480	10.800	14.230
11	6.545	9.455	7.691	10.750	9.309	12.580	10.840	14.320
12	6.500	9.500	7.700	10.800	9.333	12.600	10.860	14.380
13	6.615	9.385	7.800	10.850	9.354	12.680	10.890	14.450
14	6.143	9.143	7.714	10.890	9.371	12.740	10.900	14.490
15	6.400	8.933	7.720	10.920	9.387	12.800	10.920	14.540
16	6.500	9.375	7.800	10.950	9.400	12.800	10.960	14.570
17	6.118	9.294	7.800	10.050	9.412	12.850	10.950	14.610
18	6.333	9.000	7.733	10.930	9.422	12.890	10.950	14.630
19	6.421	9.579	7.863	11.020	9.432	12.880	11.000	14.670
20	6.300	9.300	7.800	11.100	9.400	12.920	11.000	14.660
∞	5.991	9.210	7.815	11.340	9.488	13.280	11.070	15.090

For values of n greater than 20 and/or values of k greater than 6, use χ^2 tables with $k-1$ degrees of freedom