Comparing Centers of Several Independent Groups (2024 Spring EN5423 – week13)

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Quiz

Suppose a climate scientist explores three different strategies (A, B, and C) for communicating climate change impacts to three different communities. Each community is exposed to one of the strategies, and at the end of the intervention period, the scientist measures the level of climate change awareness and engagement in each community. The engagement scores for each community (group) are:

- **Method A**: Scores = [82, 76, 88, 95, 85]
- **Method B**: Scores = [78, 74, 72, 77, 76]
- **Method C**: Scores = [88, 84, 90, 85, 90]

Step 1: Calculate Overall Mean (μ)

$$\mu = \frac{(\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad)}{15} =$$

Step 2: Calculate Group Means

Calculate the mean for each method.

- **Method A**: $\bar{y}_A = \frac{(\qquad\qquad)}{5} =$
- **Method B**: $\bar{y}_B = \frac{(\qquad\qquad)}{5} =$
- **Method C**: $\bar{y}_C = \frac{(\qquad\qquad)}{5} =$

Step 3: Compute Sum of Squares

- **Total Sum of Squares (SST)**:

$$\sum_{j=1}^{k}\sum_{i=1}^{n_i}\left(y_{ij}-\bar{y}\right)^2$$

$$SST = (82-\mu)^2 + \cdots + (90+\mu)^2 =$$

- **Sum of Squares Between Groups (SSF or SSB)**:

$$SSF = \sum_{j=1}^{k} n_j\left(\bar{y}_j - \bar{y}\right)$$

$$SSF = 5(2.4)^2 + 5(-7.4)^2 + 5(4.6)^2 =$$

- **Sum of Squares Within Groups (SSE or SSB)**:

$$SSE = \sum_{j=1}^{k}\sum_{i=1}^{n_i}\left(y_{ij}-\bar{y}_j\right)^2 = SST - SSF = 470.8 - 259.4 =$$

Step 4: Calculate F-Statistic

• **Mean Squares**:

$$MSF = \frac{SSF}{DF} =$$
$$MSE = \frac{SSE}{DFE} =$$

• **F-Statistic**:

$$F = \frac{MSF}{MSE} =$$

Step 5: Conduct F-test

Compare the calculated F-statistic to a critical value from the F-distribution with $df_1 = DF$ and $df_2 = DFE$. If the F-statistic is greater than the critical value at 0.01 significance level, we reject the null hypothesis.

F - Distribution ($\alpha = 0.01$ in the Right Tail)

df_2 \ df_1	Numerator Degrees of Freedom								
Denominator Degrees of Freedom	1	2	3	4	5	6	7	8	9
1	4052.2	4999.5	5403.4	5624.6	5763.6	5859.0	5928.4	5981.1	6022.5
2	98.503	99.000	99.166	99.249	99.299	99.333	99.356	99.374	99.388
3	34.116	30.817	29.457	28.710	28.237	27.911	27.672	27.489	27.345
4	21.198	18.000	16.694	15.977	15.522	15.207	14.976	14.799	14.659
5	16.258	13.274	12.060	11.392	10.967	10.672	10.456	10.289	10.158
6	13.745	10.925	9.7795	9.1483	8.7459	8.4661	8.2600	8.1017	7.9761
7	12.246	9.5466	8.4513	7.8466	7.4604	7.1914	6.9928	6.8400	6.7188
8	11.259	8.6491	7.5910	7.0061	6.6318	6.3707	6.1776	6.0289	5.9106
9	10.561	8.0215	6.9919	6.4221	6.0569	5.8018	5.6129	5.4671	5.3511
10	10.044	7.5594	6.5523	5.9943	5.6363	5.3858	5.2001	5.0567	4.9424
11	9.6460	7.2057	6.2167	5.6683	5.3160	5.0692	4.8861	4.7445	4.6315
12	9.3302	6.9266	5.9525	5.4120	5.0643	4.8206	4.6395	4.4994	4.3875
13	9.0738	6.7010	5.7394	5.2053	4.8616	4.6204	4.4410	4.3021	4.1911
14	8.8616	6.5149	5.5639	5.0354	4.6950	4.4558	4.2779	4.1399	4.0297
15	8.6831	6.3589	5.4170	4.8932	4.5556	4.3183	4.1415	4.0045	3.8948
16	8.5310	6.2262	5.2922	4.7726	4.4374	4.2016	4.0259	3.8896	3.7804
17	8.3997	6.1121	5.1850	4.6690	4.3359	4.1015	3.9267	3.7910	3.6822
18	8.2854	6.0129	5.0919	4.5790	4.2479	4.0146	3.8406	3.7054	3.5971
19	8.1849	5.9259	5.0103	4.5003	4.1708	3.9386	3.7653	3.6305	3.5225
20	8.0960	5.8489	4.9382	4.4307	4.1027	3.8714	3.6987	3.5644	3.4567
21	8.0166	5.7804	4.8740	4.3688	4.0421	3.8117	3.6396	3.5056	3.3981
22	7.9454	5.7190	4.8166	4.3134	3.9880	3.7583	3.5867	3.4530	3.3458
23	7.8811	5.6637	4.7649	4.2636	3.9392	3.7102	3.5390	3.4057	3.2986
24	7.8229	5.6136	4.7181	4.2184	3.8951	3.6667	3.4959	3.3629	3.2560

Step 6: Discuss the results
>> Question: Does all strategies have the same effect? If yes, why?