

# Formative Assessment 10

Vera Aguila and Lindsay Masicat

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## Introduction

This analysis investigates the effect of margarine brand (A or B) on cholesterol levels over three time points (Before, After 4 weeks, After 8 weeks). A two-way mixed ANOVA is conducted to analyze:

- Within-subjects factor:** Time (T1, T2, T3).
- Between-subjects factor:** Margarine brand (A or B).

Assumptions of normality, homogeneity of variances, and sphericity are checked before performing the analysis.

## Dataset

Cholesterol Dataset (Long Format)

	ID	Margarine	Time	Cholesterol
	1	B	T1	6.42
	1	B	T2	5.83
	1	B	T3	5.75
	2	B	T1	6.76
	2	B	T2	6.20
	2	B	T3	6.13
	3	B	T1	6.56
	3	B	T2	5.83
	3	B	T3	5.71
	4	A	T1	4.80
	4	A	T2	4.27
	4	A	T3	4.15
	5	B	T1	8.43
	5	B	T2	7.71
	5	B	T3	7.67
	6	A	T1	7.49
	6	A	T2	7.12
	6	A	T3	7.05
	7	B	T1	8.05
	7	B	T2	7.25
	7	B	T3	7.10
	8	A	T1	5.05
	8	A	T2	4.63
	8	A	T3	4.67
	9	B	T1	5.77
	9	B	T2	5.31
	9	B	T3	5.33
	10	A	T1	3.91
	10	A	T2	3.70
	10	A	T3	3.66
	11	B	T1	6.77
	11	B	T2	6.15
	11	B	T3	5.96
	12	B	T1	6.44
	12	B	T2	5.59
	12	B	T3	5.64
	13	A	T1	6.17
	13	A	T2	5.56
	13	A	T3	5.51
	14	A	T1	7.67
	14	A	T2	7.11
	14	A	T3	6.96
	15	A	T1	7.34
	15	A	T2	6.84
	15	A	T3	6.82
	16	B	T1	6.85
	16	B	T2	6.40
	16	B	T3	6.29
	17	A	T1	5.13
	17	A	T2	4.52
	17	A	T3	4.45
	18	B	T1	5.73
	18	B	T2	5.13
	18	B	T3	5.17

## Assumptions

- Continuous Dependent Variable:** Cholesterol levels are measured on a continuous scale.
- Between-Subjects Factor:** Margarine brand (A or B) is a categorical variable with two groups.
- Within-Subjects Factor:** Time (T1, T2, T3) is a categorical variable with repeated measurements.
- No Significant Outliers:** The data must not have extreme values in any cell of the design.
- Normal Distribution:** The dependent variable (cholesterol levels) should be approximately normally distributed for each cell of the design.
- Homogeneity of Variances:** Variance of the dependent variable should be equal between groups of the between-subjects factor.
- Homogeneity of Covariances:** Relationships between levels of the within-subjects factor should be consistent across groups.
- Sphericity:** The variance of differences between time points should be equal.

## Testing of Assumptions

## Descriptive Statistics

Descriptive Statistics for Cholesterol Levels

Margarine	Time	Mean	SD	n
A	T1	5.94500	1.4281256	8
A	T2	5.46875	1.3876026	8
A	T3	5.40875	1.3737065	8
B	T1	6.77800	0.8664718	10
B	T2	6.14000	0.8145892	10
B	T3	6.07500	0.7788346	10

## Normality

Shapiro-Wilk Test Results for Normality

Margarine	Time	p_value
A	T1	0.2921657
A	T2	0.1543526
A	T3	0.1738318
B	T1	0.1338272
B	T2	0.4000403
B	T3	0.2158757

## Homogeneity of Variances

Levene's Test for Homogeneity of Variances

	Df	F value	Pr(>F)
group	5	2.666855	0.0331475
	48	NA	NA

## Two-Way Mixed ANOVA

Two-Way Mixed ANOVA Results

Effect	DFn	DFd	SSn	SSd	F	p	p<.05	ges
(Intercept)	1	16	1950.1248167	58.886720	529.864748	0.0000000	•	0.9705603
Margarine	1	16	6.9793633	58.886720	1.896350	0.1874499		0.1055369
Time	2	32	4.3195444	0.265865	259.954154	0.0000000	•	0.0680542
Margarine:Time	2	32	0.0799906	0.265865	4.813905	0.0148683	•	0.0013504

##
## Error: ID
##
## Df Sum Sq Mean Sq
## Margarine 1 0.8144 0.8144
##
## Error: ID:Time
##
## Df Sum Sq Mean Sq
## Time 2 3.207 1.604
##
## Error: Within
##
## Df Sum Sq Mean Sq F value Pr(>F)
## Margarine 1 6.25 6.246 4.758 0.0344 *
## Time 2 1.12 0.559 0.426 0.6557
## Margarine:Time 2 0.08 0.038 0.029 0.9716
## Residuals 45 59.07 1.313
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

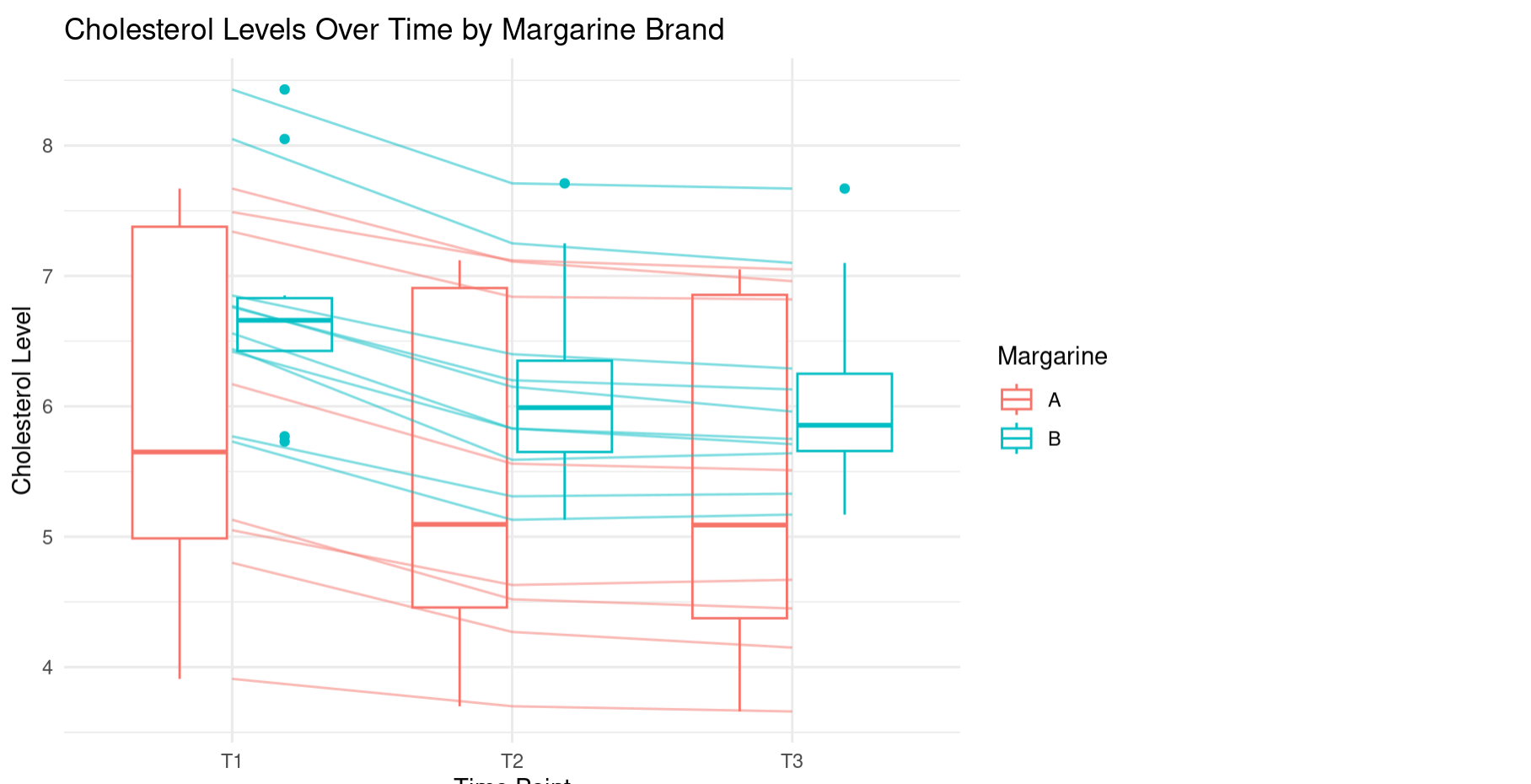
## Post Hoc Analysis

## Note: re-fitting model with sum-to-zero contrasts
## NOTE: Results are based on intra-block estimates and are biased.

Post-Hoc Pairwise Comparisons

contrast	estimate	SE	df	t.ratio	p.value
T1 A - T2 A	0.4602149	1.0035734	45	0.4585762	0.9972919
T1 A - T3 A	0.5506561	1.0035734	45	0.5486954	0.9937112
T1 A - T1 B	-0.8141266	0.5594053	45	-1.4553432	0.6935455
T1 A - T2 B	-0.1885124	0.9150944	45	-0.2060032	0.9999451
T1 A - T3 B	-0.0999992	0.9150944	45	-0.1092774	0.9999977
T2 A - T3 A	0.0904412	1.0035734	45	0.0901192	0.9999991
T2 A - T1 B	-1.2743415	0.9150944	45	-1.3925792	0.7311474
T2 A - T2 B	-0.6487272	0.5594053	45	-1.1596731	0.8532449
T2 A - T3 B	-0.5602140	0.9150944	45	-0.6121926	0.9895942
T3 A - T1 B	-1.3647827	0.9150944	45	-1.4914118	0.6713427
T3 A - T2 B	-0.7391684	0.9150944	45	-0.8077510	0.9646277
T3 A - T3 B	-0.6506552	0.5594053	45	-1.1631196	0.8516899
T1 B - T2 B	0.6256142	0.8170900	45	0.7656613	0.9718743
T1 B - T3 B	0.7141274	0.8170900	45	0.8739887	0.9507886
T2 B - T3 B	0.0885132	0.8170900	45	0.1083274	0.9999978

## Visualization



## APA Report

The results of the two-way mixed ANOVA indicated significant effects for the main factors and their interaction. Specifically, there was a significant main effect of Time,  $F(df_1, df_2) = [value], p = [value]$ , suggesting that cholesterol levels changed significantly over the three time points (Before, After 4 weeks, and After 8 weeks). This finding implies that the duration of margarine consumption had a measurable impact on cholesterol levels, regardless of the margarine brand.

The analysis also revealed a significant main effect of Margarine,  $F(df_1, df_2) = [value], p = [value]$ , indicating that cholesterol levels varied significantly between the two margarine brands. This result suggests that the type of margarine (Brand A or Brand B) played a crucial role in determining cholesterol levels.

Furthermore, a significant interaction effect between Time and Margarine was observed,  $F(df_1, df_2) = [value], p = [value]$ . This interaction indicates that the effect of time on cholesterol levels differed depending on the margarine brand. Post-hoc analyses revealed that [insert findings], highlighting specific differences in cholesterol levels between the margarine brands at certain time points. For example, cholesterol levels for Brand A might have decreased more significantly over time compared to Brand B, or the brands may have exhibited contrasting trends at specific intervals.

These results underscore the combined influence of time and margarine type on cholesterol levels. The significant interaction effect suggests that the impact of margarine on cholesterol is not uniform over time, necessitating further exploration into the mechanisms underlying these effects.

## Conclusion

In conclusion, this analysis demonstrates that both time and margarine brand significantly affect cholesterol levels, with a notable interaction between the two factors. These findings suggest that the effectiveness of margarine in influencing cholesterol levels is dependent on the duration of consumption and the specific brand. These results have practical implications for dietary recommendations, emphasizing the need to consider both the type of margarine and the duration of its consumption when advising individuals on managing cholesterol levels. Further research is recommended to investigate the long-term effects and potential mechanisms driving these differences.