

CP2403 - Project – Part 2 – CHI Squared

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Step 1: hypothesis

Investigative question:

Is there a significant association between water temperature and salinity levels in a given dataset of water samples?

Null hypothesis (H_0):

There is no significant relationship between water temperature categories (TEMP_CAT) where temperature is below 5 degrees, and salinity categories (SAL_CAT).

$s_1 = s_2 = s_3 = s_4$

Alternative (H_a) hypothesis:

There is a significant relationship between water temperature categories (TEMP_CAT) where temperature is below 5 degrees, and salinity categories (SAL_CAT).

$s_1 \neq s_2 \neq s_3 \neq s_4$

Step 2: Data Selection

- CalCOFI bottle dataset
 - Water temperatures between 0 and 5 degrees, cut into 4 categories: 0-2, 2-3, 3-4, 4-5
 - Water salinity readings taken at these temperatures, cut into two categories, ≤ 34.5 and > 34.5 (digitized to 0 & 1)
 - Null values dropped

Step 3: Assess the evidence (Chi Squared)

Cross Tab (observed numbers)

TEMP_CAT /SAL_CAT	1	2	3	4
0	8	204	8363	20086
1	3548	2991	6318	3336

Cross Tab (Percentages)

TEMP_CAT /SAL_CAT	1	2	3	4
0	0.002250	0.063850	0.569648	0.857570
1	0.997750	0.936150	0.430352	0.142430

Cross Tab (expected numbers)

TEMP_CAT /SAL_CAT	1	2	3	4
0	2272.228	2041.555	9380.928	14966.29

1	1283.772	1153.445	5300.072	8455.711
Chi Squared Value: 15988.267523279752 = 15988.268 p-value: 0.0				
Step 4: Draw Conclusion				
<p>With a very low p-value ($p < 0.05$), provide strong statistical evidence supporting the conclusion that temperature and salinity are not independent variables in this dataset. Thus, we can conclude that there is a significant difference in salinity levels among different temperature categories for extremely cold water (below 5 degrees) in the CalCOFI dataset. The chi-squared statistic (Chi2) was approximately 15,988.27, and the p-value (p) was 0.0. These results indicate that the temperature of the water does affect its salinity in this specific context.</p> <p>Implications</p> <ul style="list-style-type: none">Environmental Impact: Understanding the link between water temperature and salinity is vital for assessing aquatic ecosystems. Temperature-driven changes in salinity can influence marine life, including migration patterns and species distribution.Climate Research: These findings contribute to climate research by revealing temperature-salinity associations. This knowledge aids in climate modeling and predictions, particularly in regions with notable temperature and salinity variations.Resource Management: Industries relying on marine resources, such as fisheries, benefit from knowing how temperature affects salinity. These insights assist in sustainable resource management and understanding shifts in aquatic populations.Scientific Insights: This analysis advances oceanography and hydrology understanding. It highlights significant salinity variations within the narrow temperature range below 5 degrees Celsius, emphasizing the complexity of marine ecosystems.				
Post-hoc test (if any) New p-value: 0.0083 (0.05 / 6 comparisons)				
1 versus 2 Chi value: 207.9295410246399 p value: 3.886795514368588e-47				
1 versus 3 Chi value: 3709.0330728229574 p value: 0.0				
1 versus 4 Chi value: 11879.032761438164 p value: 0.0				
2 versus 3 Chi value: 2687.7700538025792 p value: 0.0				
2 versus 4 Chi value: 9770.439849917746 p value: 0.0				
3 versus 4 Chi value: 3953.1829453406053 p value: 0.0				

These findings repeatedly reveal substantial variations in salinity levels across every combination of temperature categories (1 vs. 2, 1 vs. 3, 1 vs. 4, 2 vs. 3, 2 vs. 4, and 3 vs. 4) within the realm of extremely cold water conditions below 5 degrees Celsius. The consistently minuscule p-values in these comparisons underscore the strong statistical significance of these differences. This underscores the influence of temperature on salinity levels in this particular scenario.

Plot/Chart(s)

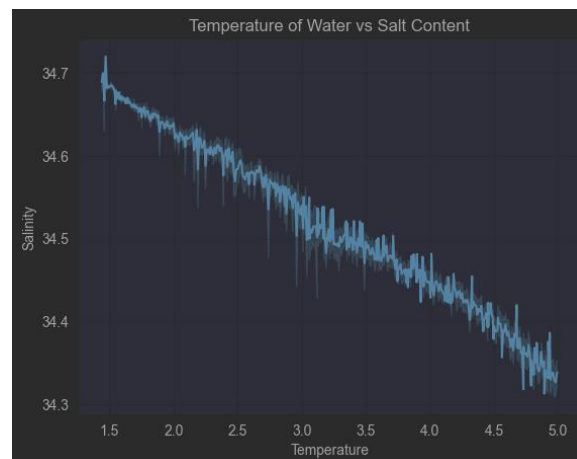


Figure 1: line plot of water temperature (quantitative) vs water salinity (quantitative)
This line plot represents the relationship between water temperature and water salinity. The line plot shows a strong decreasing relationship between the variables; as the temperature decreases, so as the salinity at that level.

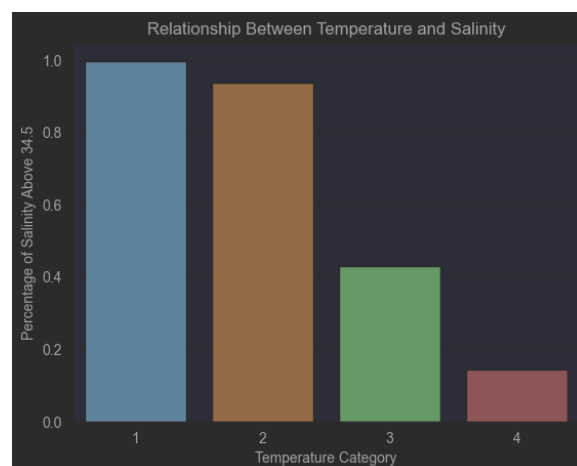


Figure 2: Bar chart of water temperature (categorical) vs water salinity (categorical)

The bar chart demonstrates that as temperature categories become warmer, there is a noticeable reduction in the instances of salinity readings exceeding 34.5.