

Northwind Insights

Statistical Analysis & Hypothesis
Testing with the Company Database

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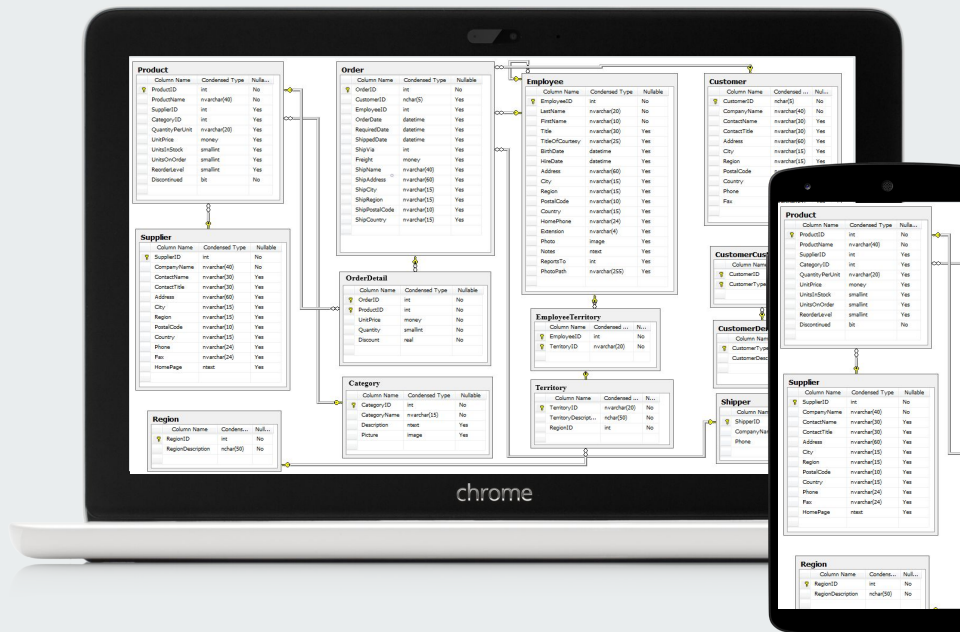
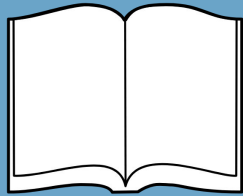


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Background



Company

- The Northwind Trading Company imports and exports specialty foods from around the globe
- Northwind keeps track of its business metrics in a company database
 - employees, orders, customers, suppliers, etc.

Goal

- Produce analytical insights to improve performance, increase profits, and boost sales volume

Method

- perform hypothesis testing to reach actionable answers to critical business questions

Business Questions

1. Does discount affect the quantity of a product in an order?
 - 1.1. If so, for which levels?
2. Does discount affect the total revenue in an order?
 - 2.1. If so, for which levels?
3. Does product category affect the total revenue in an order?
 - 3.1. If so, for which categories?
4. Does ship region affect the total revenue in an order?
 - 4.1. If so, for which regions?
5. Does reorder level affect the cost of units in stock?
 - 5.1. If so, for which levels?



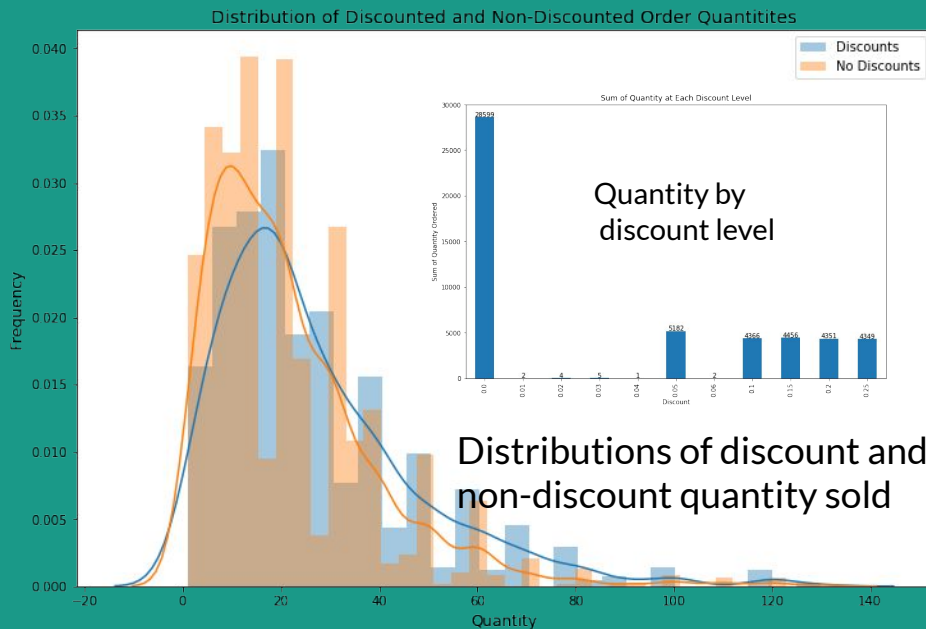
1. Does discount amount have a statistically significant effect on the quantity of a product in an order? Yes
 - 1.1. If so, at what levels of discount? 5%, 10%, 15%, 20%, 25% ↑

Discounts

- More products are sold if a discount is applied
- Discount levels of 5%, 10%, 15%, 20% and 25% are capable of moving more product
- **Recommendation:** Only provide these 5 proven discount levels

	group1	group2	meandiff	lower	upper	reject
0	0.0	0.01	-19.7153	-80.3306	40.9001	False
1	0.0	0.02	-19.7153	-62.593	23.1625	False
2	0.0	0.03	-20.0486	-55.0714	14.9742	False
3	0.0	0.04	-20.7153	-81.3306	39.9001	False
4	0.0	0.05	6.2955	1.5381	11.053	True
5	0.0	0.06	-19.7153	-80.3306	40.9001	False
6	0.0	0.1	3.5217	-1.3783	8.4217	False
7	0.0	0.15	6.6669	1.551	11.7828	True
8	0.0	0.2	5.3096	0.2508	10.3684	True
9	0.0	0.25	6.525	1.3647	11.6852	True

Pairwise discount comparisons



2. Does discount amount have a statistically significant effect on the total revenue in an order? Conditional
- 2.1. If so, at what level of discount? 5% ↑

Total Revenue

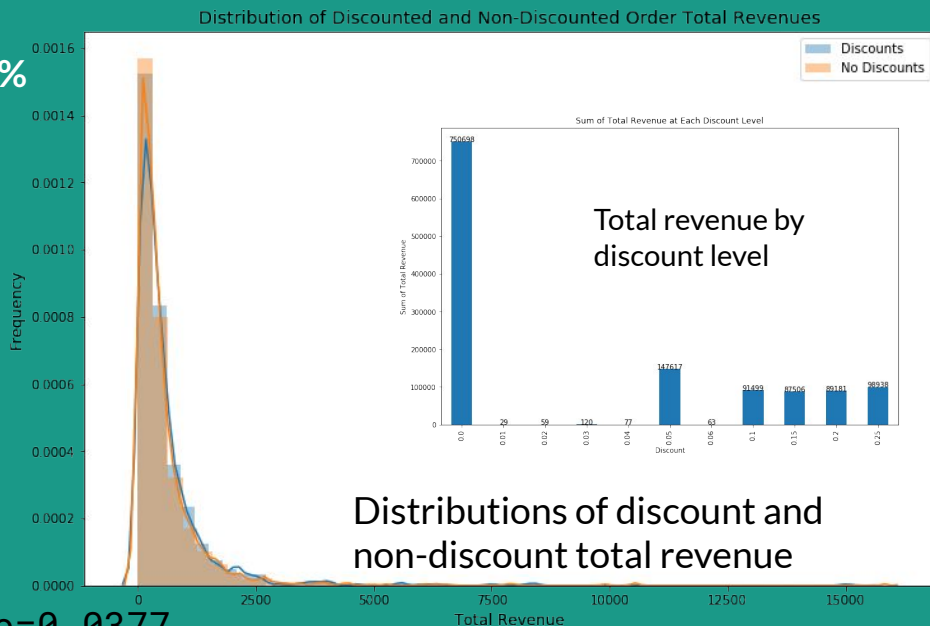
- More revenue is received only if the discount level is 5%
- There is no difference in revenue received from other discount levels (or all levels grouped together)
- **Recommendation:** Only offer the 5% discount

Significant Welch's t-Test

[0.05 Discount]: statistic=2.091, pvalue=0.0377

Tukey HSD Test

mean_diff = 227.92



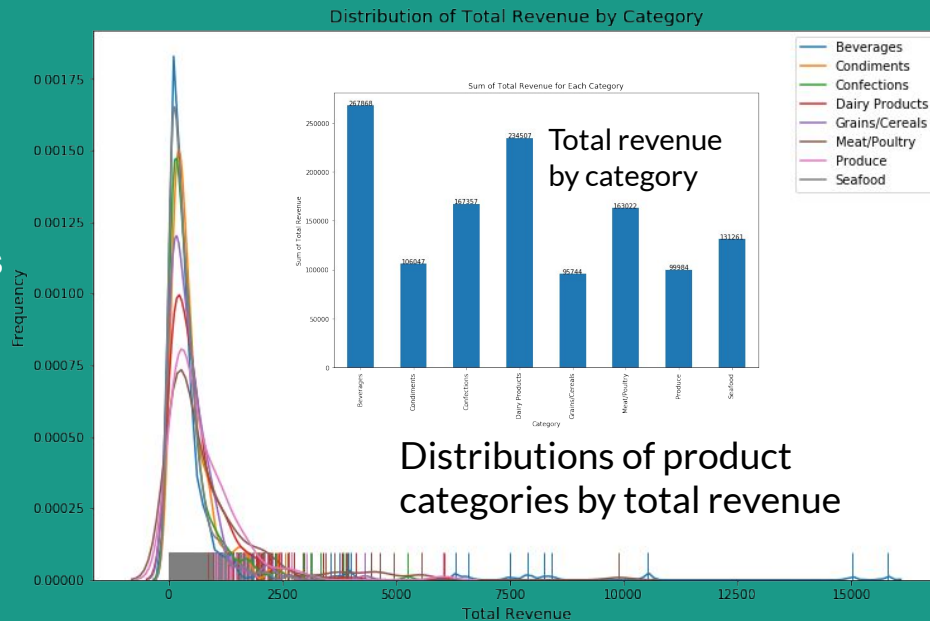
3. Does product category have a statistically significant effect on the total revenue in an order? Yes

3.1. If so, for what product categories? Meat/Poultry, Produce ↑; Condiments, Confections, Grains/Cereals, Seafood ↓

Product Category

- The **Meat/Poultry** and **Produce** categories have a positive impact that increases total revenue
- The **Condiments**, **Confections**, **Grains/Cereals**, and **Seafood** categories negatively affect total revenue, causing it to decrease
- Recommendation:** Advertise struggling categories

	group1	group2	meandiff	lower	upper	reject
0	Beverages	Condiments	-172.0813	-417.4777	73.315	False
1	Beverages	Confections	-161.9705	-377.2755	53.3345	False
2	Beverages	Dairy Products	-22.3098	-232.3991	187.7796	False
3	Beverages	Grains/Cereals	-174.5473	-427.9707	78.8762	False
4	Beverages	Meat/Poultry	279.2857	14.7624	543.8091	True
5	Beverages	Produce	72.1407	-216.4794	360.7608	False
6	Beverages	Seafood	-265.2772	-481.2954	-49.2591	True



Pairwise comparisons with the largest category **Beverage**

4. Does ship region have a statistically significant effect on the total revenue in an order? Yes

4.1. If so, for what ship regions? Western Europe ↑; Central America, Eastern Europe, Scandinavia, Southern Europe ↓

Shipping Region

- The **Western Europe** shipping region has a positive impact that increases total revenue
- The **Central America, Eastern Europe, Scandinavia, and Southern Europe** ship regions negatively affect total revenue, causing it to decrease
- **Recommendation:** Consider discontinuing shipments to all or some of the poor performance regions

Significant Welch's t-Test and Tukey HSD Comparison

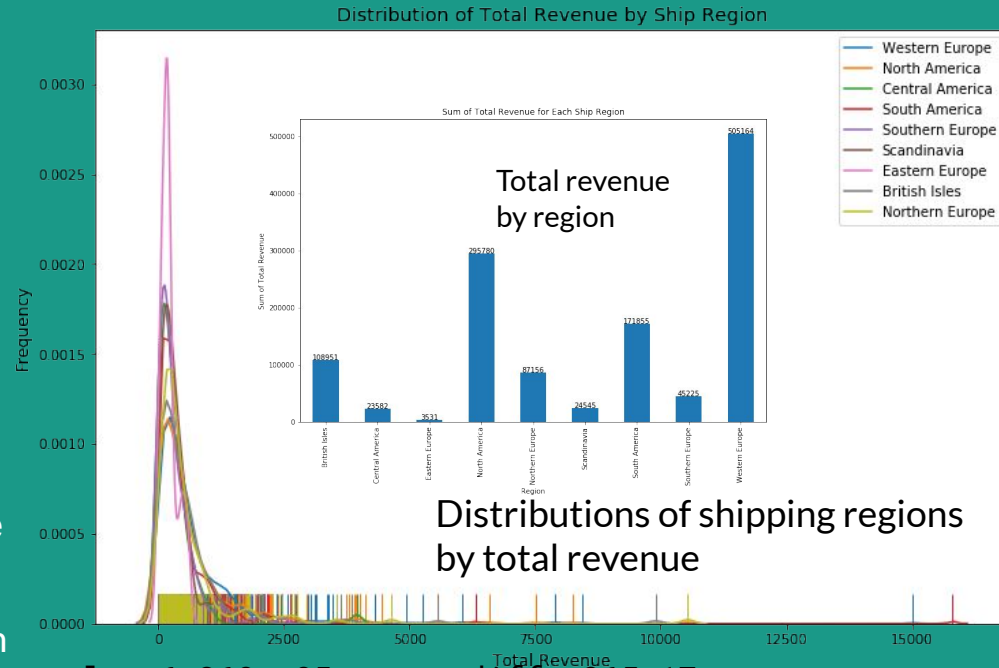
[Central America Region]: statistic=-4.195, pvalue=6.360e-05, mean_diff=-365.17

[Eastern Europe Region]: statistic=-8.004, pvalue=3.233e-08, mean_diff=-471.95

[Scandinavia Region]: statistic=-5.024, pvalue=2.0482e-06, mean_diff=-342.05

[Southern Europe Region]: statistic=-6.5756, pvalue=2.589e-10, mean_diff=-362.58

[Western Europe Region]: statistic=2.128, pvalue=0.034, mean_diff=-14.62 (compared to North America)



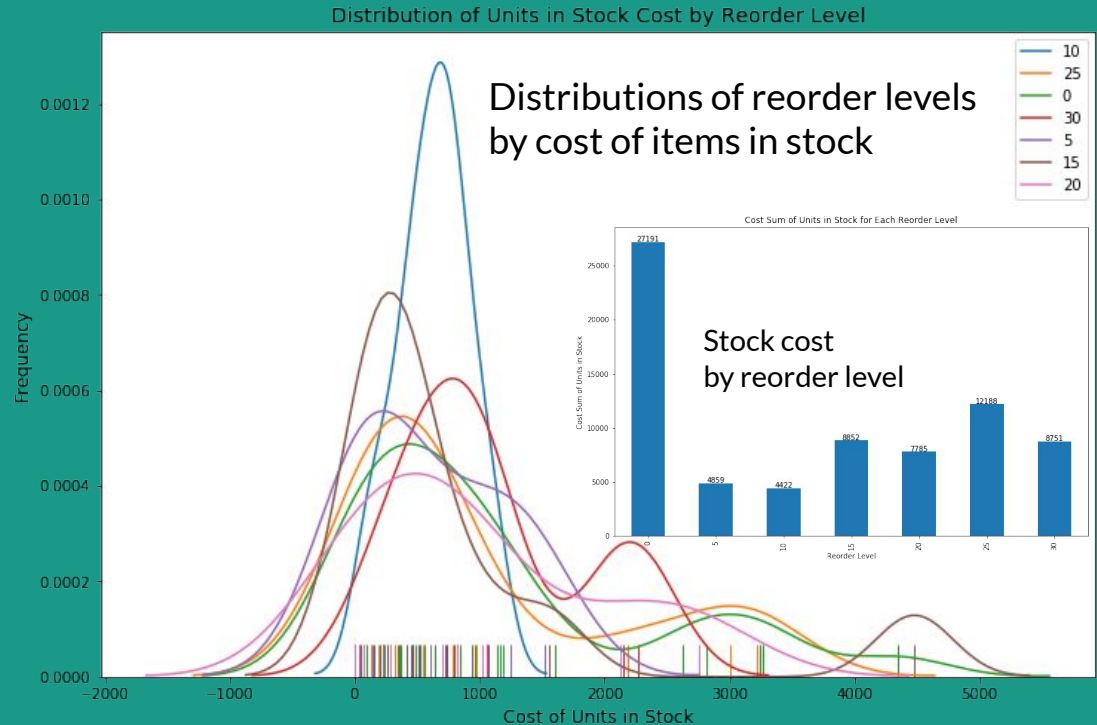
5. Does reorder level have a statistically significant effect on the cost of items in stock? No

Reorder Level

- Reorder level does not affect the cost of units in stock
- Furthermore, none of the individual reorder levels have an effect on cost
- **Recommendation:** None

ANOVA Test Results

$F = 0.403$, $PR(>F) = 0.875$



Future Work

- Analyze employee employee performance related to quantity sold and revenue received
- Look at inventory level fluctuations relative to orders (e.g., stockouts)
- Consider the relationship between supplier and cost
- Determine the major causes of product reorders and discontinuation
- Inspect inefficiencies at the local-level (i.e., ZIP Code, City, Country) and global-level (i.e., Region, Territory)

