

Northwind Traders

Hypothesis Testing

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Executive Summary Must-Haves

Your presentation should:

- Contain between 5-10 professional quality slides detailing:
 - A high-level overview of your methodology
 - The results of your hypothesis tests
 - Any real-world recommendations you would like to make based on your findings (ask yourself--why should the executive team care about what you found? How can your findings help the company?)
- Take no more than 5 minutes to present
- Avoid technical jargon and explain results in a clear, actionable way for non-technical audiences.

The Tests

Hypothesis

- **Discounts orders ship a higher quantity of products than those without.**
- **Northwind Traders has a preferred shipper by total order \$\$.** They use one shipping company more than the others.
- **Meat Orders are \$100 more than other categories on average.**
- **San Francisco ships 80% of the western orders by quantity.**

Null-Hypothesis

- **There is no difference in between orders with discounts**
- **There is no favored shipper. Northwind uses all of them the same amount.**
- **All categories are stocked the same amount.**
- **The West Region earns more \$\$ than other regions.**

The Process

Ask the Question

Tailor the Query

Test the Hypothesis

Prove Yourself Wrong

Use Your Findings to Inform Your Next Question

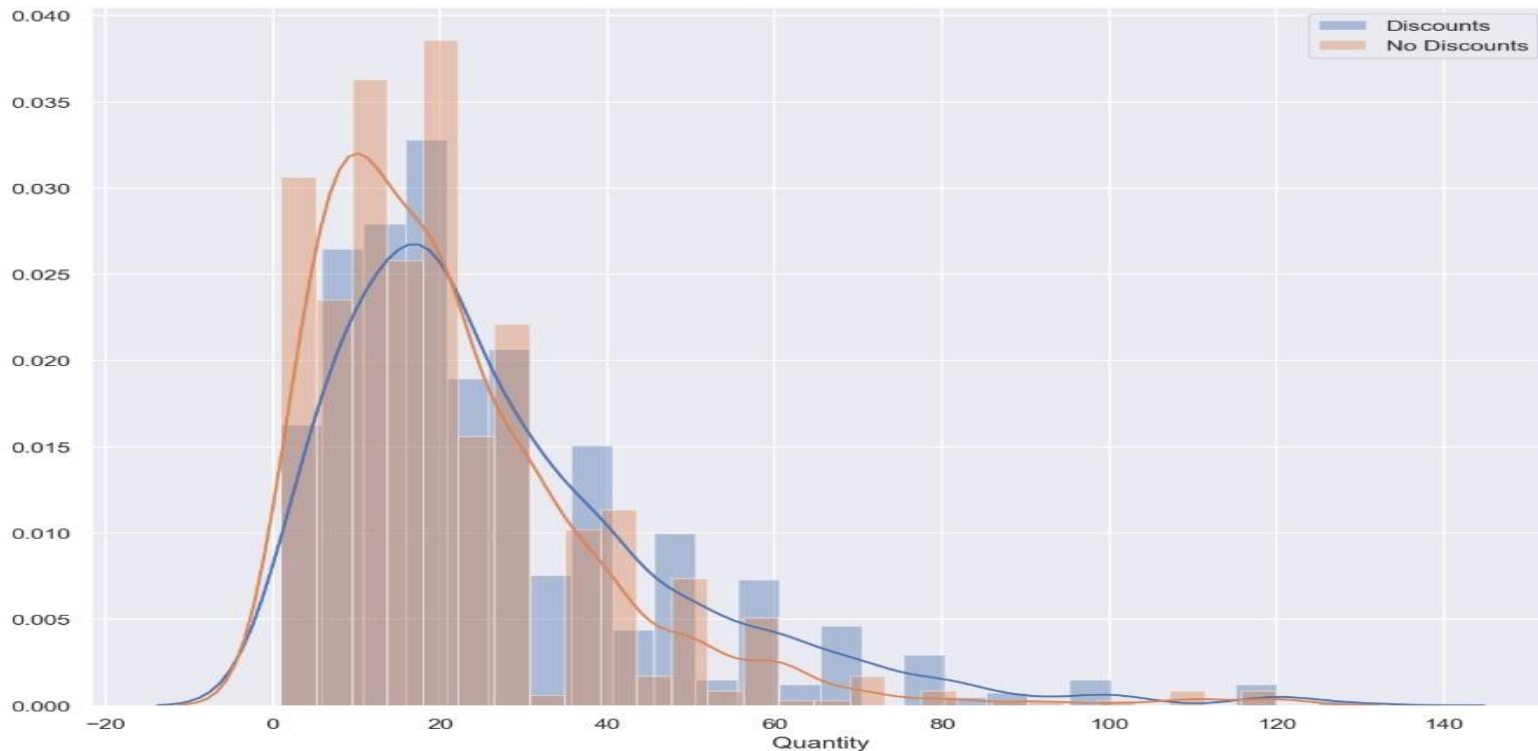
A Word of Caution

Goodhart's Law and Metric
Tracking

"Any measure which becomes a
target ceases to be an effective
measure!"

Discounts

Discounts orders ship a higher quantity of products than those without.



Quantity

Discounts

No Discount

Means:

27

21

Mean Difference:

6

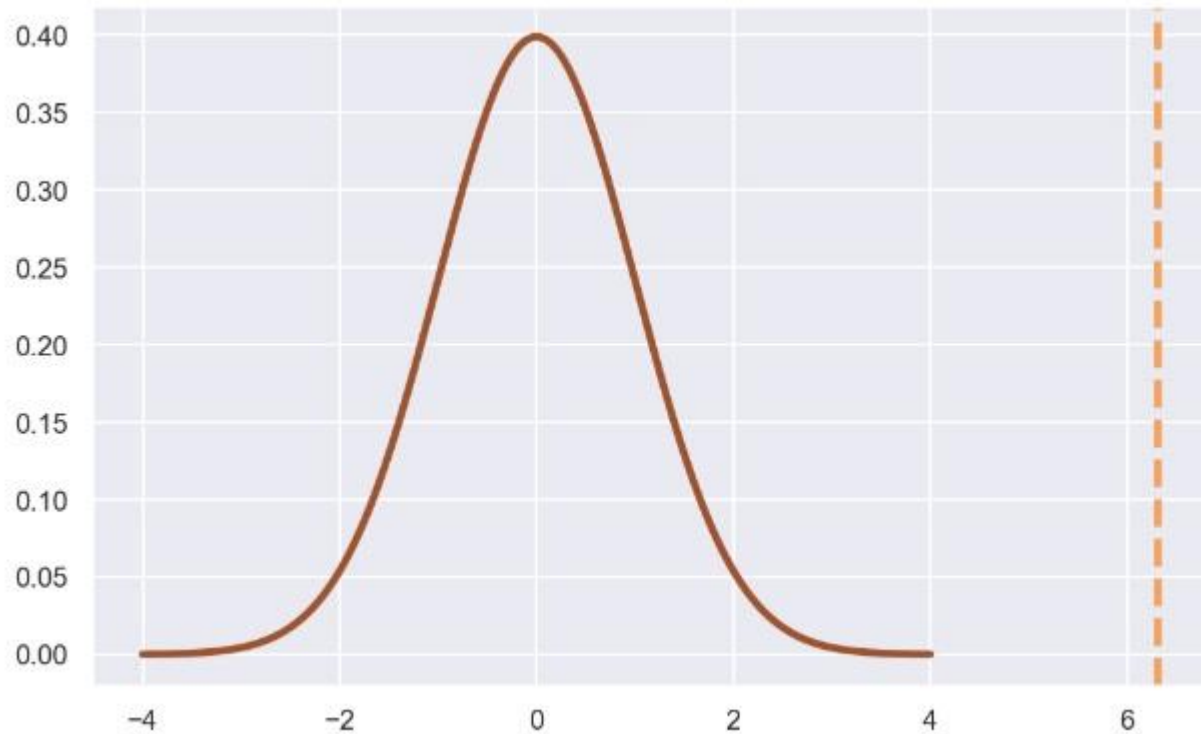
Standard deviations:

21

17

T Value : 6.23

P Value : 1.6 e-10



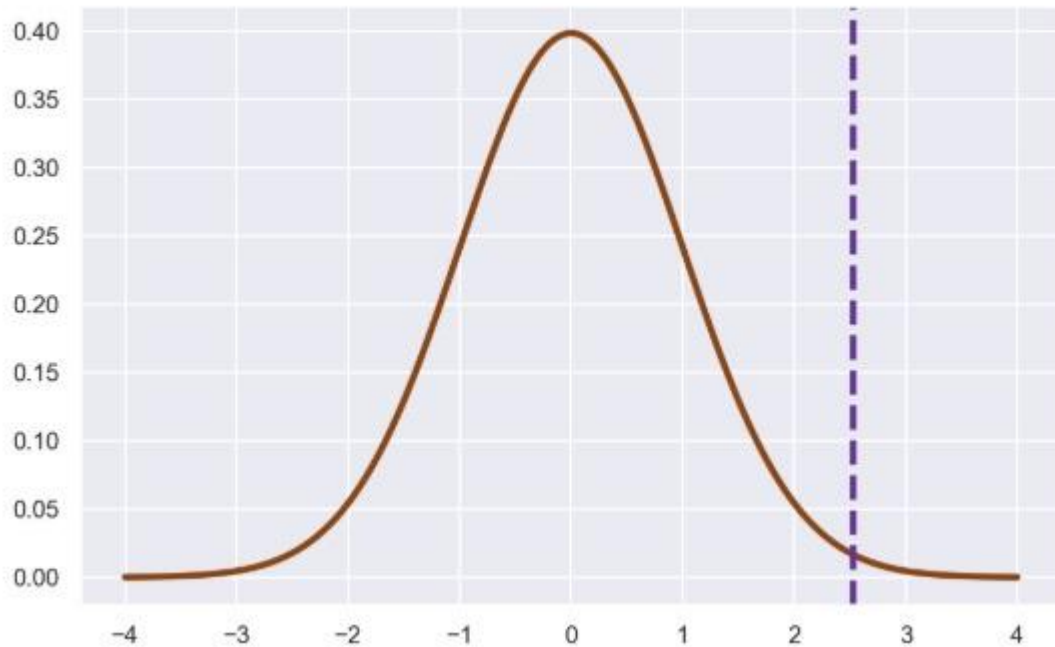
Summary

There is enough evidence to support the claim that orders with discounts are placed with a larger quantity than orders without discounts.

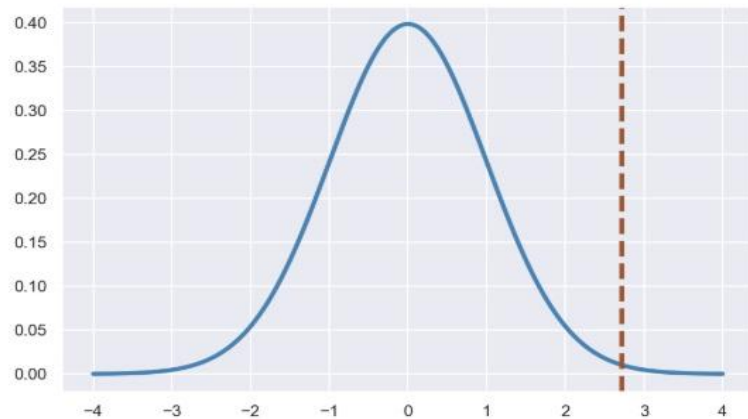


Discount by Percentage

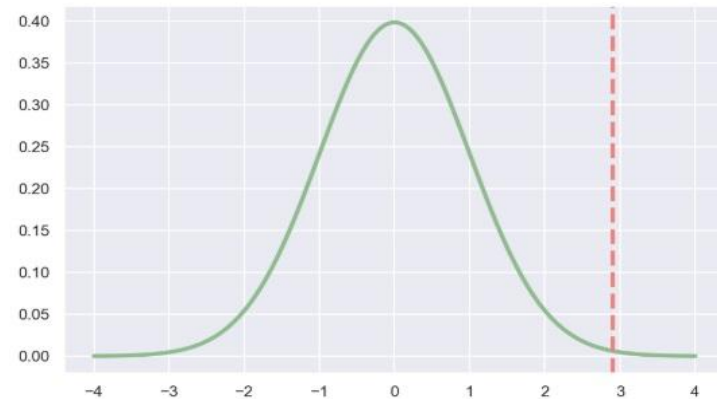
Discount Level: 0.1: Probability of error: 0.01175638486446167



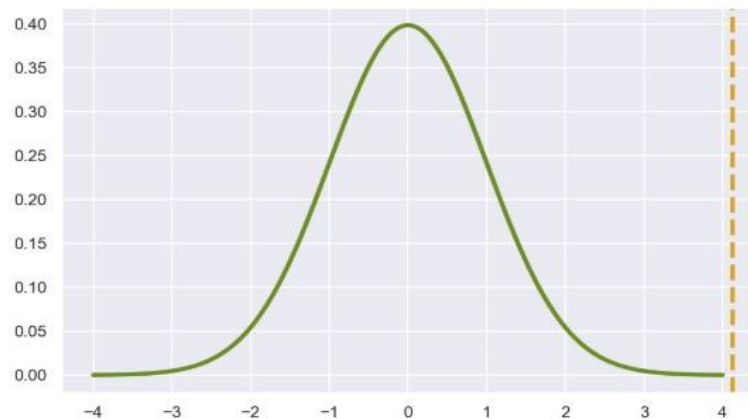
Discount Level: 0.2: Probability of error: 0.006917136252883391



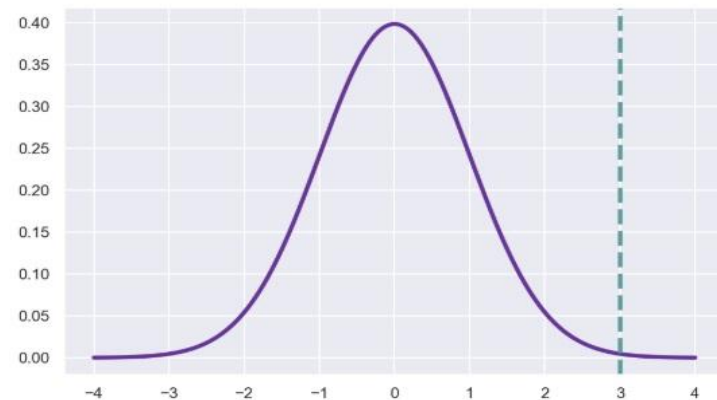
Discount Level: 0.15: Probability of error: 0.003899114297712308



Discount Level: 0.25: Probability of error: 4.77333721632627e-05



Discount Level: 0.05: Probability of error: 0.0028292023288866617

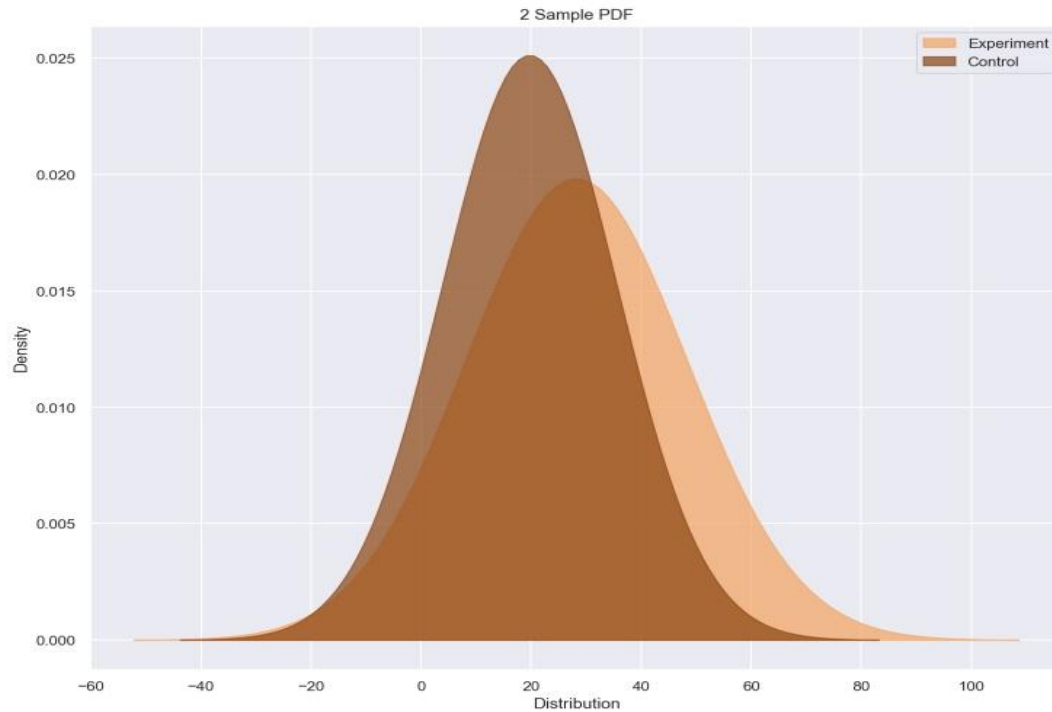


Simple Threshold: 23
The midpoint between two means.

Overlap: 0.7727
The total AUC.

Superiority: 62.34
Probability that a randomly chosen sample from the first group is [higher] than one of the second group.

Misclassification Rate: 0.3864
The chance of misclassification if using this metric alone as a predictor.

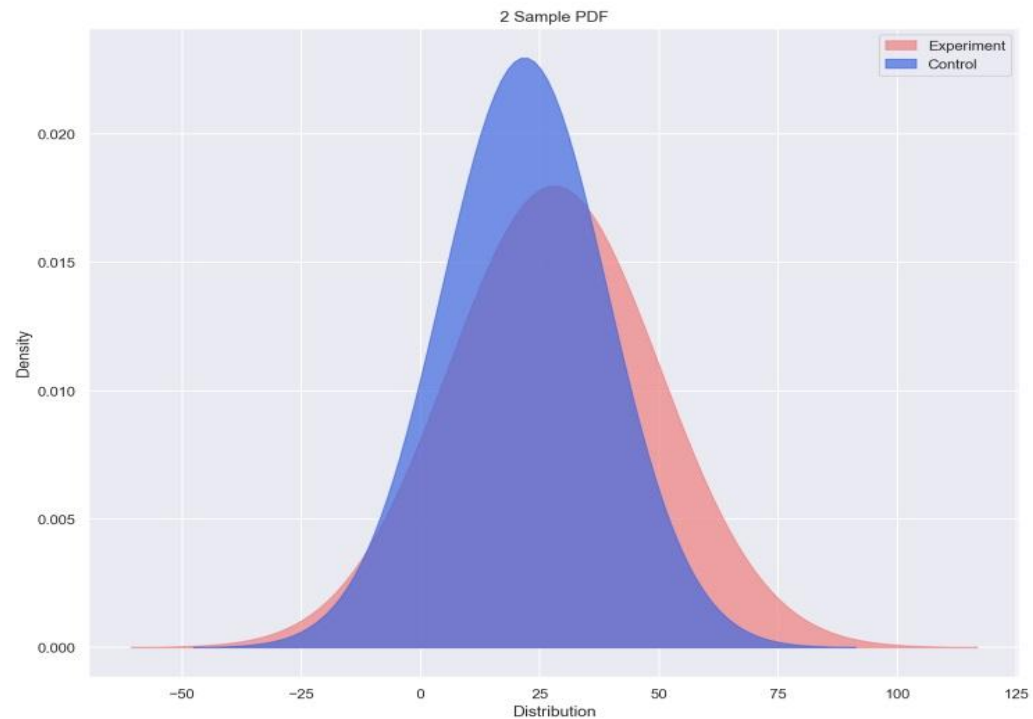


Simple Threshold: 24
The midpoint between two means.

Overlap: 0.9297
The total AUC.

Superiority: 52.97
Probability that a randomly chosen sample from the first group is [higher] than one of the second group.

Misclassification Rate: 0.4649
The chance of misclassification if using this metric alone as a predictor.

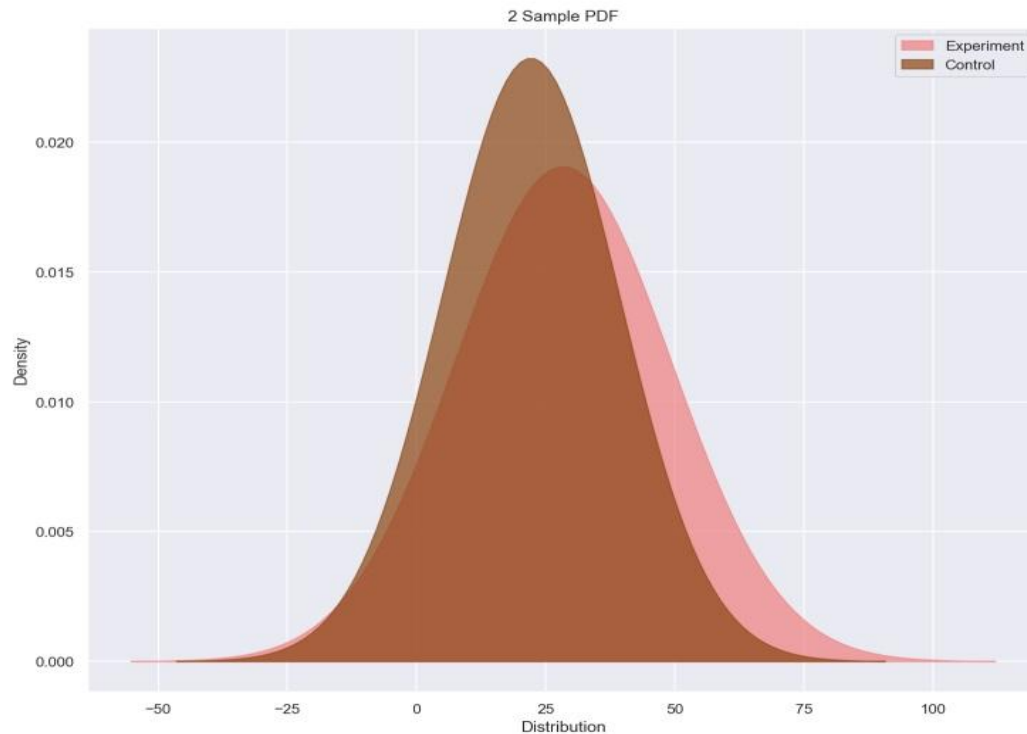


Simple Threshold: 25
The midpoint between two means.

Overlap: 0.9045
The total AUC.

Superiority: 54.78
Probability that a randomly chosen sample from the first group is [higher] than one of the second group.

Misclassification Rate: 0.4522
The chance of misclassification if using this metric alone as a predictor.

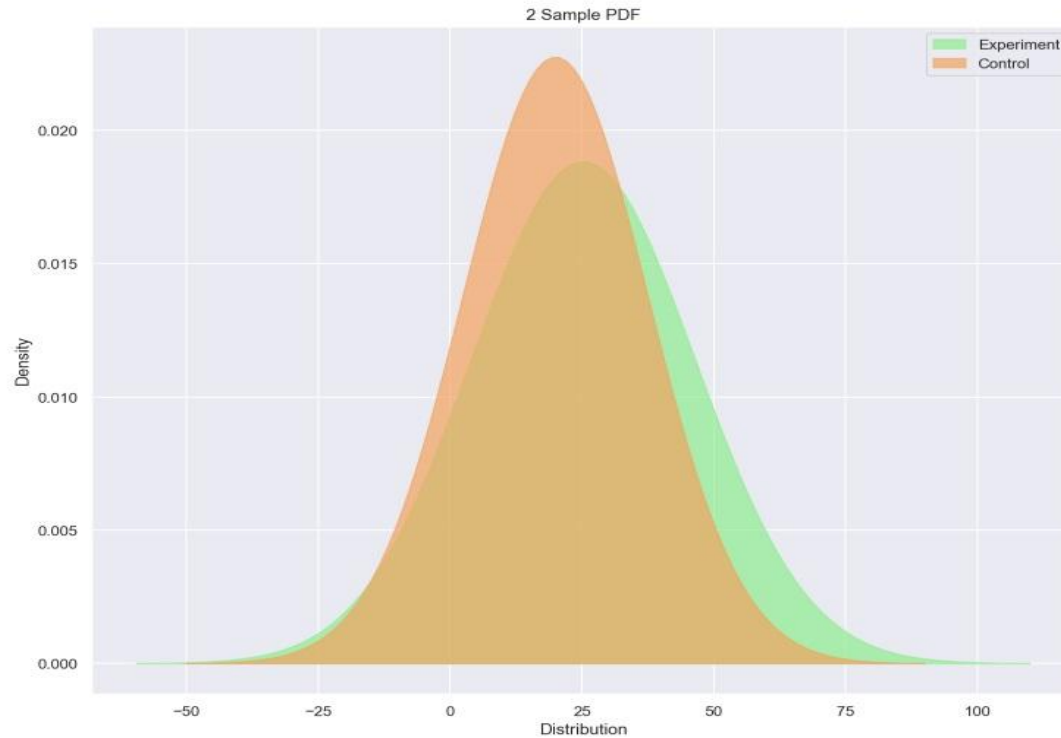


Simple Threshold: 22
The midpoint between two means.

Overlap: 0.8844
The total AUC.

Superiority: 56.65
Probability that a randomly chosen sample from the first group is [higher] than one of the second group.

Misclassification Rate: 0.4422
The chance of misclassification if using this metric alone as a predictor.

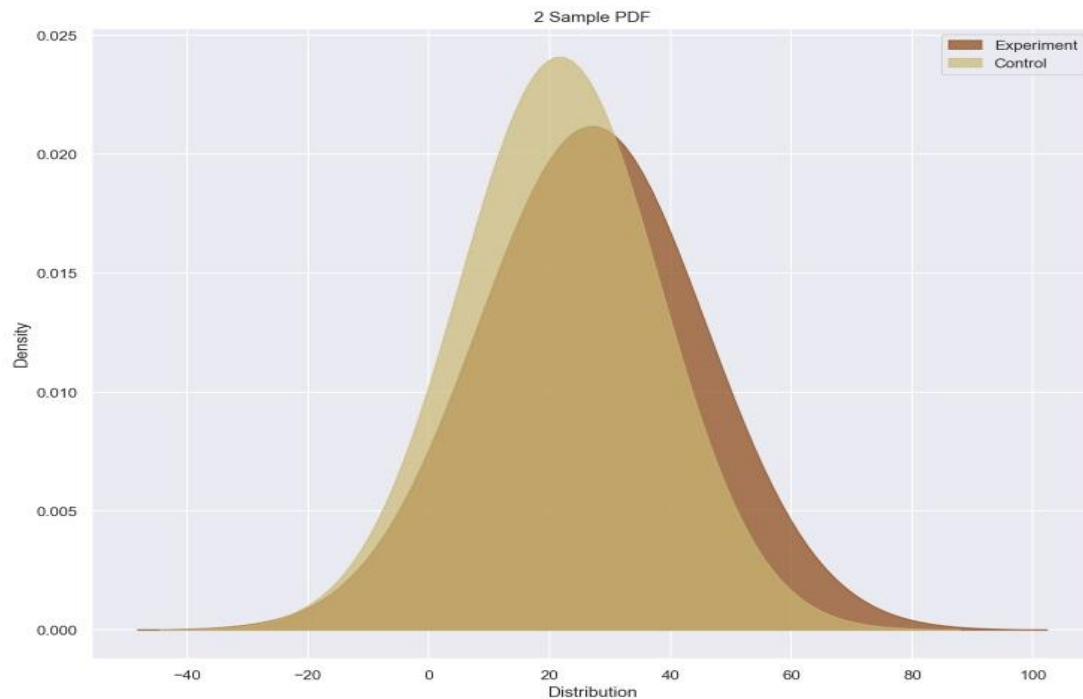


Simple Threshold: 24
The midpoint between two means.

Overlap: 0.882
The total AUC.

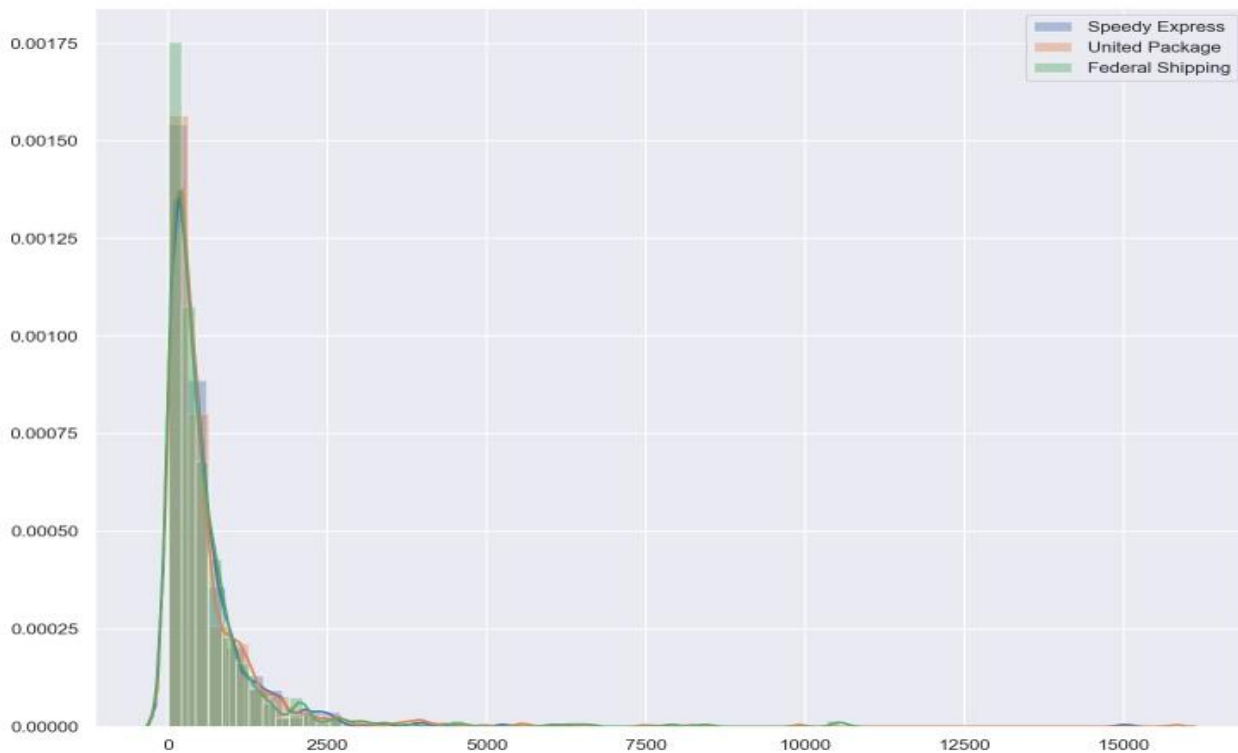
Superiority: 52.8
Probability that a randomly chosen sample from the first group is [higher] than one of the second group.

Misclassification Rate: 0.441
The chance of misclassification if using this metric alone as a predictor.



Best Shipper-

Northwind Traders has a preferred shipper by total order \$\$. They use one shipping company more than the others.



Tukey Results

Multiple Comparison of Means - Tukey HSD, FWER=0.05

| group1 | group2 | meandiff | lower | upper | reject |
|------------------|----------------|----------|-----------|----------|--------|
| Federal Shipping | Speedy Express | -54.4272 | -180.9466 | 72.0922 | False |
| Federal Shipping | United Package | 23.1049 | -95.1715 | 141.3813 | False |
| Speedy Express | United Package | 77.5321 | -40.6919 | 195.7561 | False |

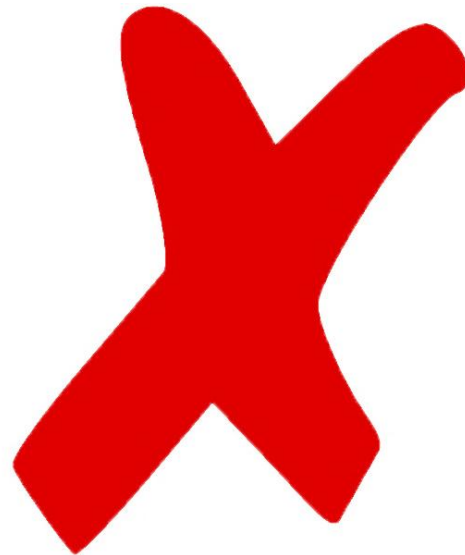
Budget Shipper

Multiple Comparison of Means - Tukey HSD, FWER=0.05

| ===== | | | | | |
|------------------|----------------|----------|---------|--------|--------|
| group1 | group2 | meandiff | lower | upper | reject |
| ----- | | | | | |
| Federal Shipping | Speedy Express | -0.0344 | -0.1565 | 0.0877 | False |
| Federal Shipping | United Package | -0.0256 | -0.1397 | 0.0886 | False |
| Speedy Express | United Package | 0.0088 | -0.1053 | 0.1229 | False |
| ----- | | | | | |

Summary

We fail to reject the Null Hypothesis. All shippers appear to handle the same amount of orders. We can say the same for price among shippers.

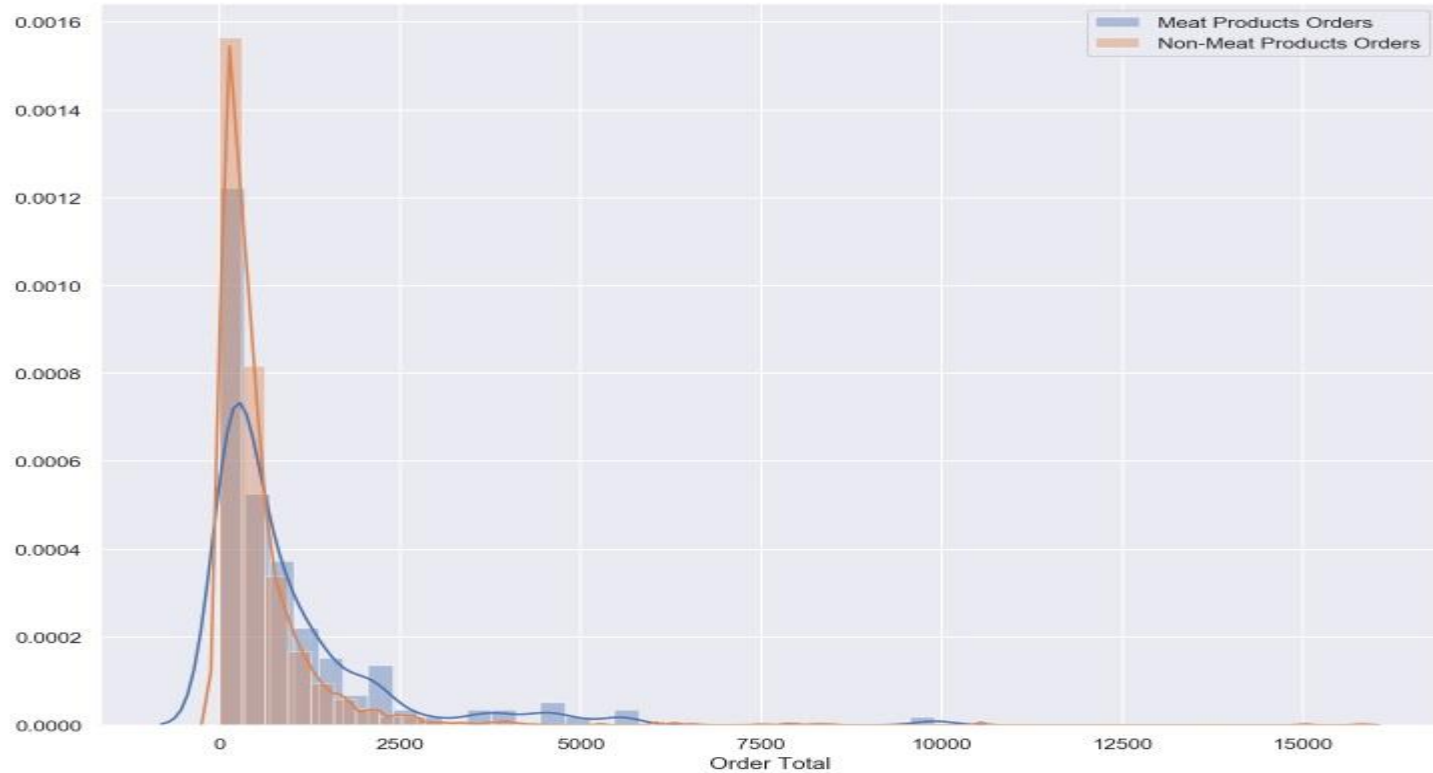


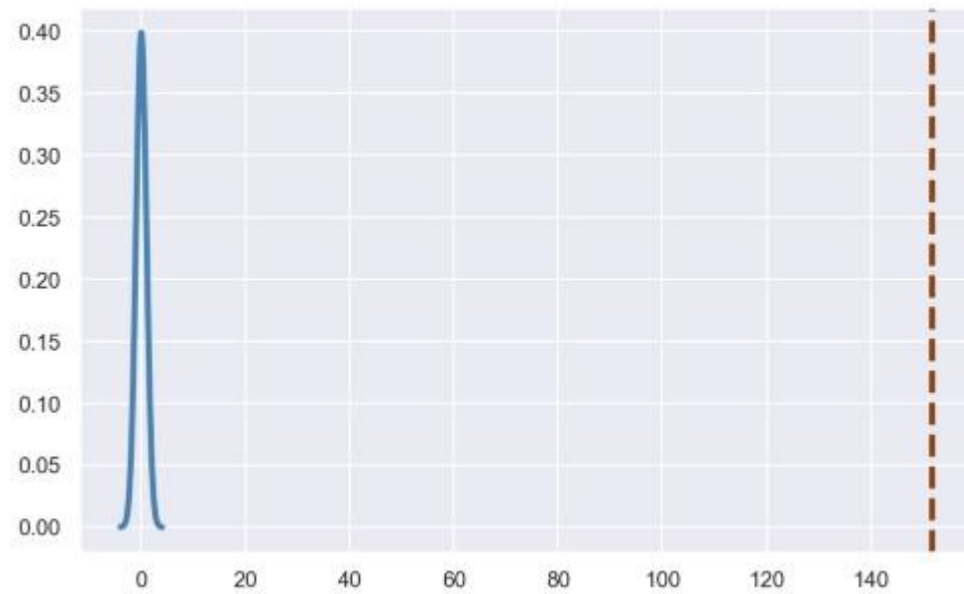
One Category to Rule Them All

H₁: Meat/Poultry is the most lucrative category by total Unit Price per order being at least 100 dollars more than other categories with a confidence of 95%

H₀: There is no significant difference between the Meat/Poultry and the other products.

Categories vs Meat Category



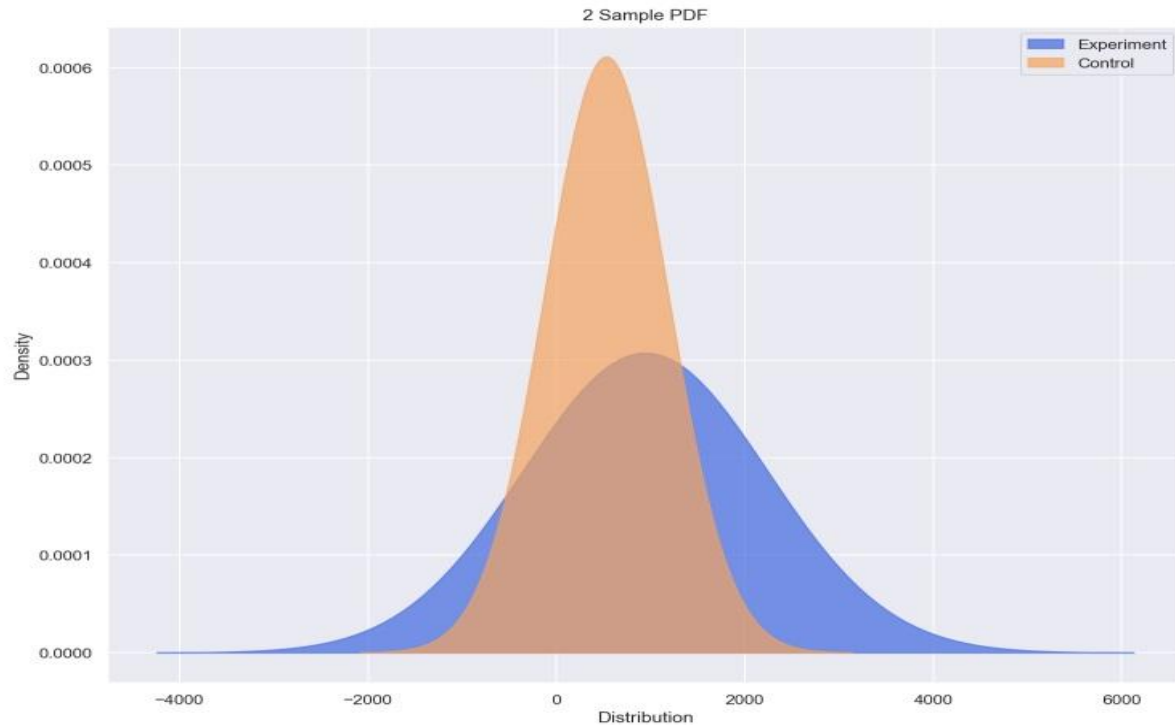


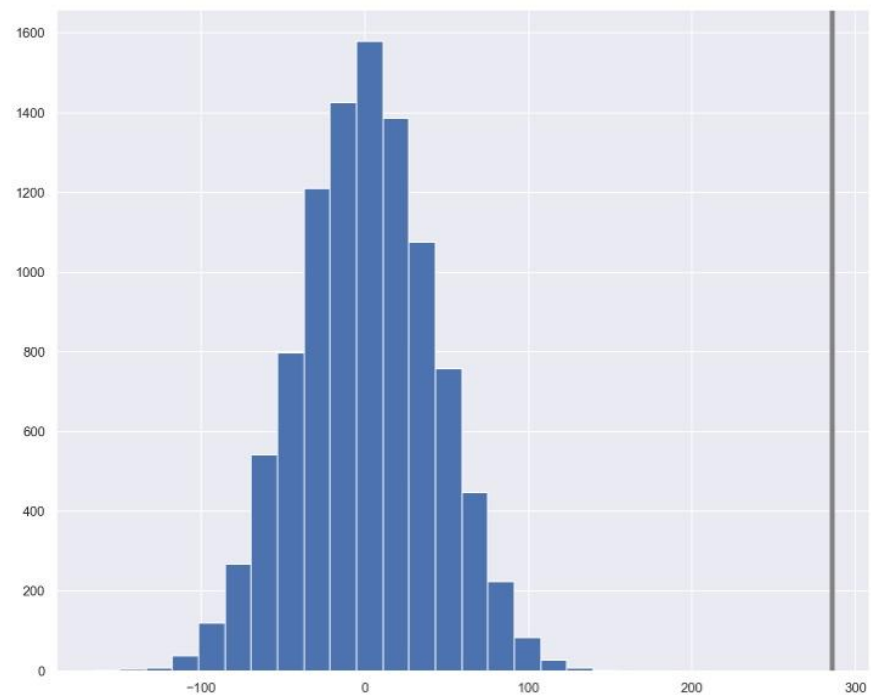
Simple Threshold: 736
The midpoint between two means.

Overlap: 0.4127
The total AUC.

Superiority: 31.33
Probability that a randomly chosen sample from the first group is [higher] than one of the second group.

Misclassification Rate: 0.2063
The chance of misclassification if using this metric alone as a predictor.





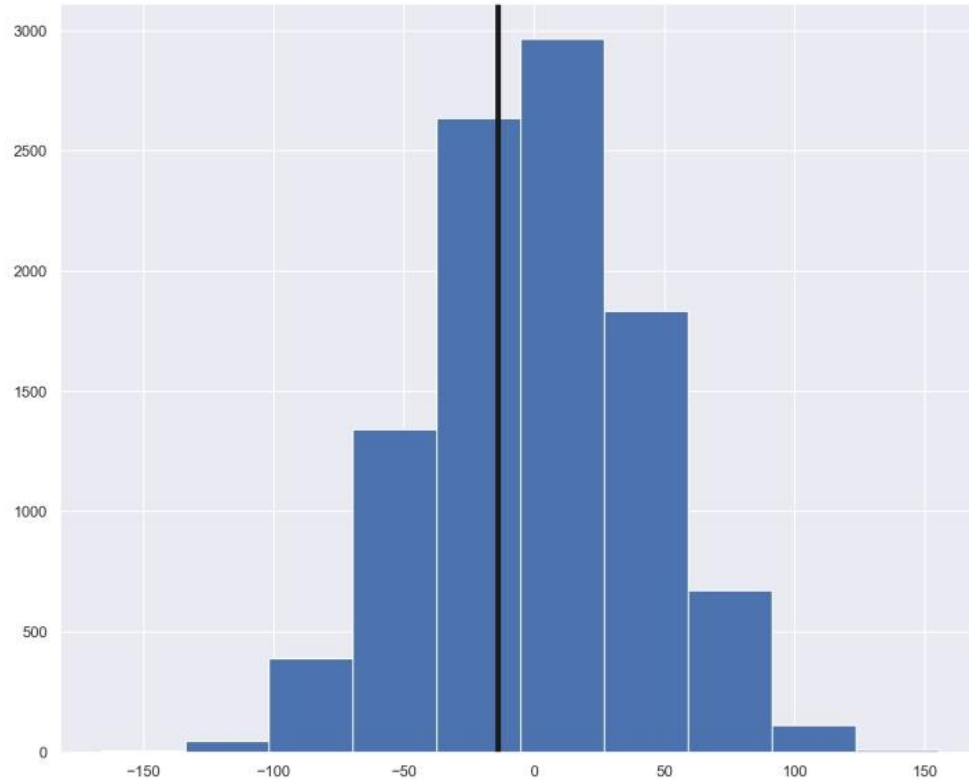
Summary

There is enough evidence to support the claim that orders on meats are placed with a larger order price than other categories, even by \$100.

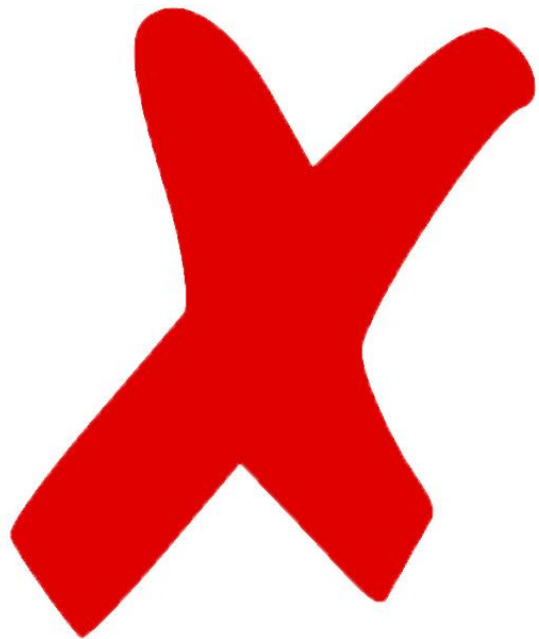
We fail to accept the null hypothesis and accept the Alternative that meat orders bring in more money.



Are more meat products kept in stock?



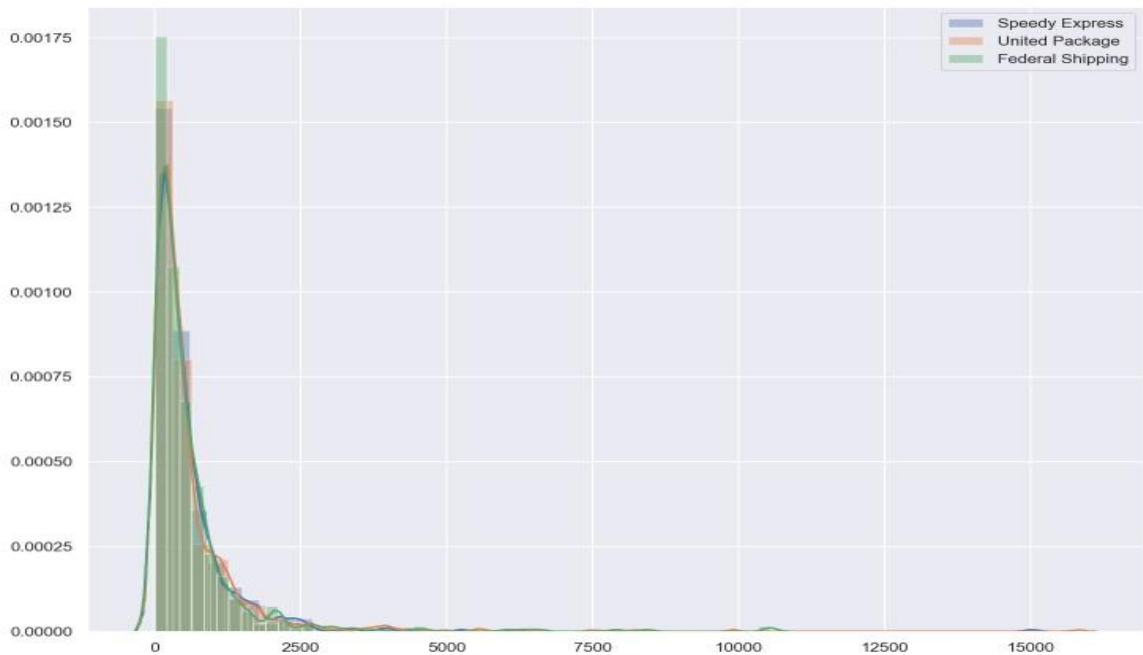
Fail to reject the null

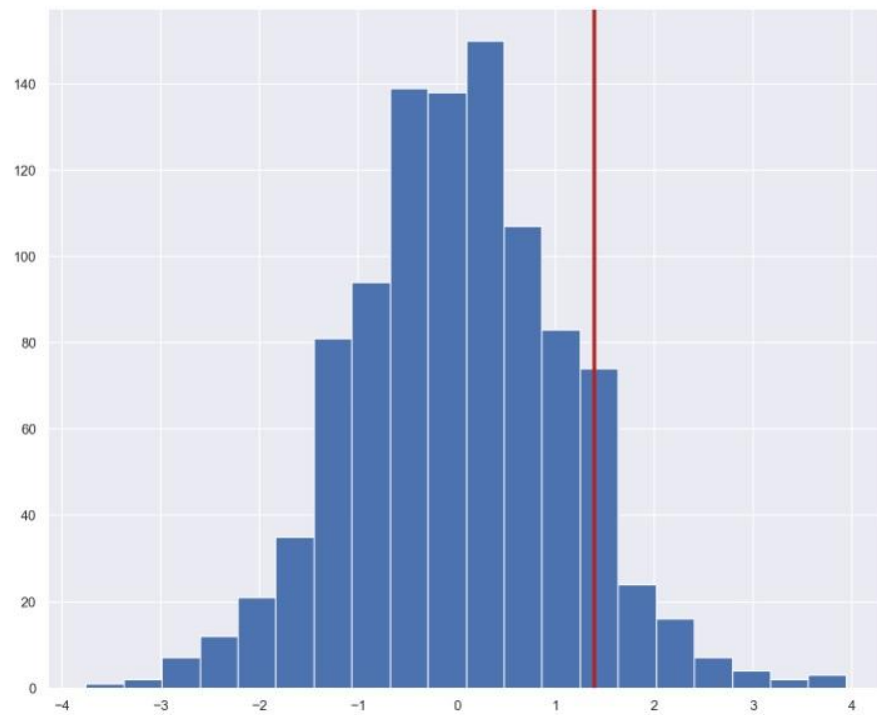


Home Town -

H1: The western region is the most profitable region by quantity of products shipped with a confidence of 95%

H0: There is no significant difference between the western region and the other regions.





Summary

This P value is a little high. Our informal test tells us that we are only shipping more products per order to the west 85% of the time. Nor can we prove that 80% of the product in the west is shipped to San Francisco.



Hypothesis

- ✓ **Discounts orders ship a higher quantity of products than those without.**
- ✗ **Northwind Traders has a preferred shipper by total order \$\$\$. They use one shipping company more than the others.**
- ✓ **Meat Orders are \$100 more than other categories on average.**
- ✗ **San Francisco ships 80% of the western orders by quantity.**

Secondary-Hypothesis

- ✗ **There is no difference in between orders with discounts**
- ✗ **There is a preferred shipper that costs less per order than other shippers.**
- ✗ **Meat is stocked more than other categories**
- ✗ **The West Region earns more \$\$\$ than other regions.**

The Process

Ask the Question

Tailor the Query

Test the Hypothesis

Prove Yourself Wrong

Use Your Findings to Inform Your Next Question

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