# Northwind Traders

## Hypothesis Testing

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# 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**

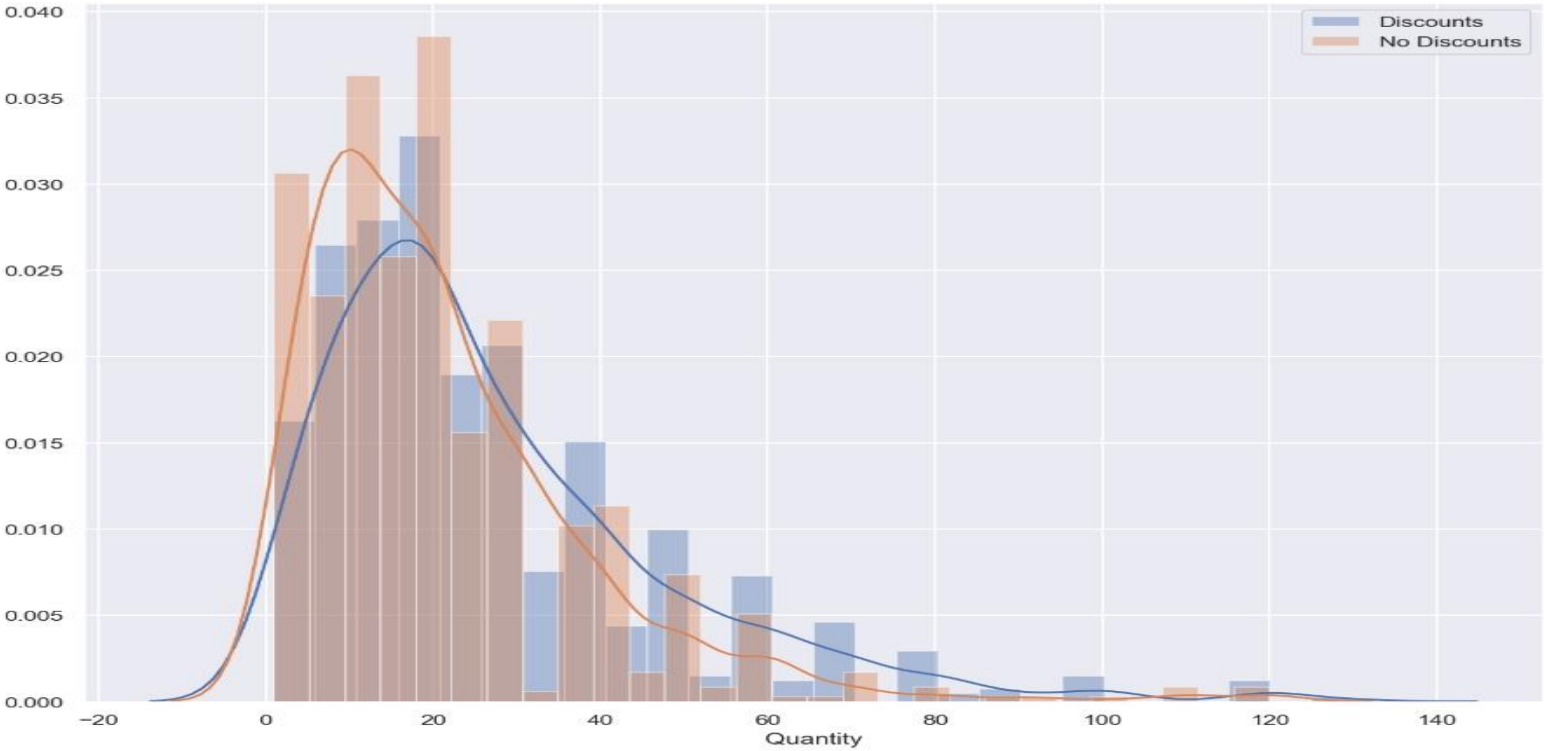
# A Word of Caution

**Goodhart’s Law and Metric Tracking**

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

# Discounts

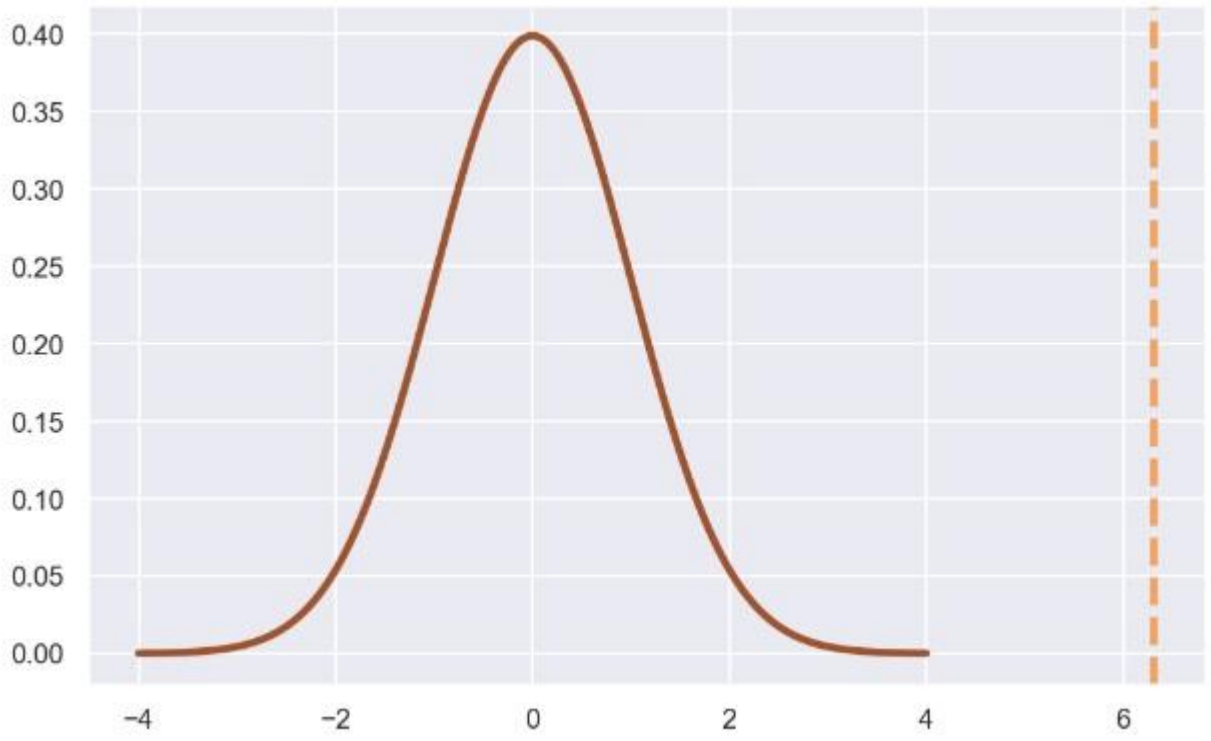
**Discounts orders ship a higher quantity of products than those without.**



| Quantity | Discounts | No Discount |
| --- | --- | --- |
| Means: | 27 | 21 |
| Mean Difference: | 6 | |
| Standard deviations: | 21 | 17 |

T Value : 6.23

P Value : 1.6 e-10

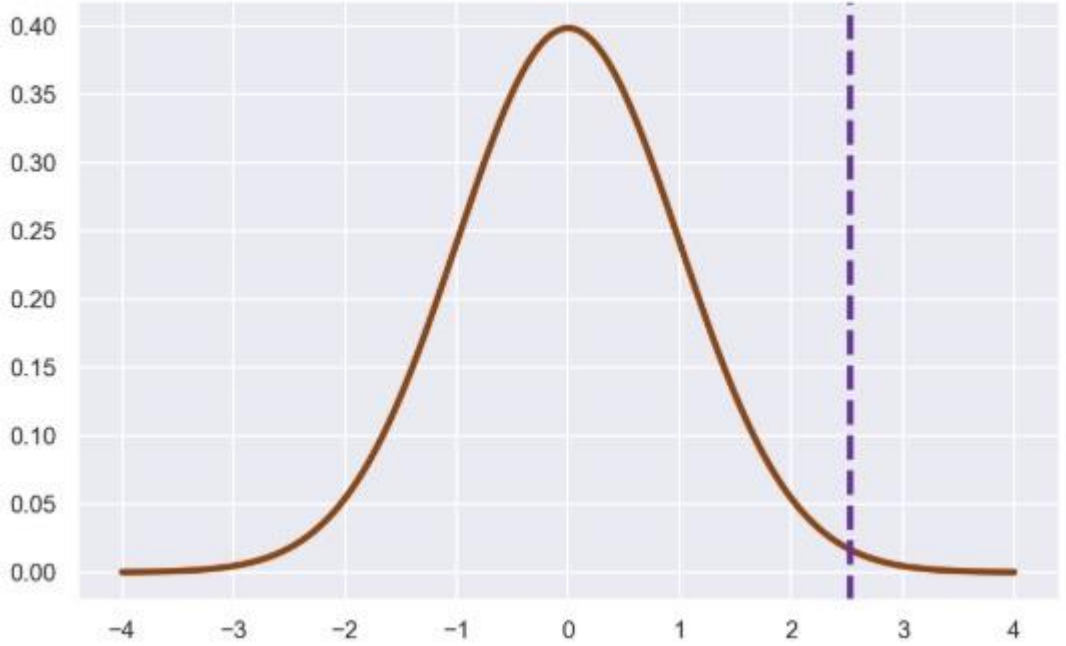


# Summary

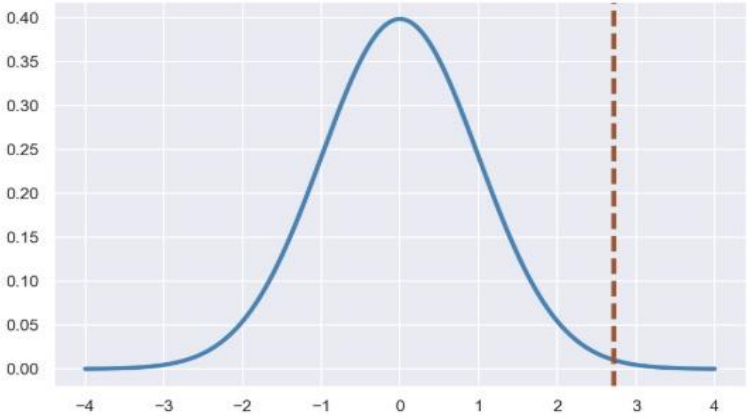
There is enough evidence to support the claim that orders with discounts are placed with a larger quantity than orders without discounts.

# Discount by Percentage

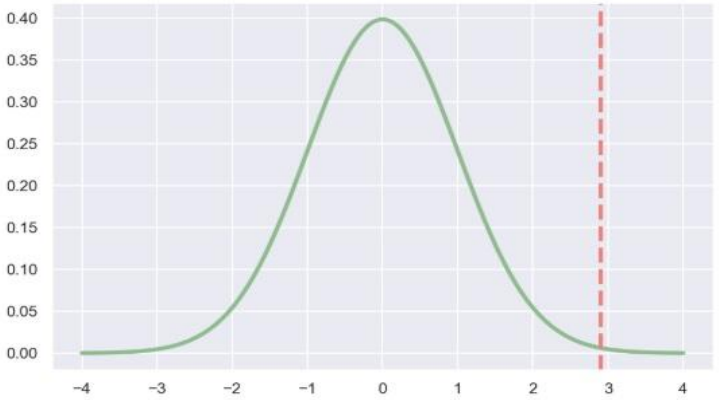
Discount Level: 0.1: Probability of error: 0.011756384864461 67



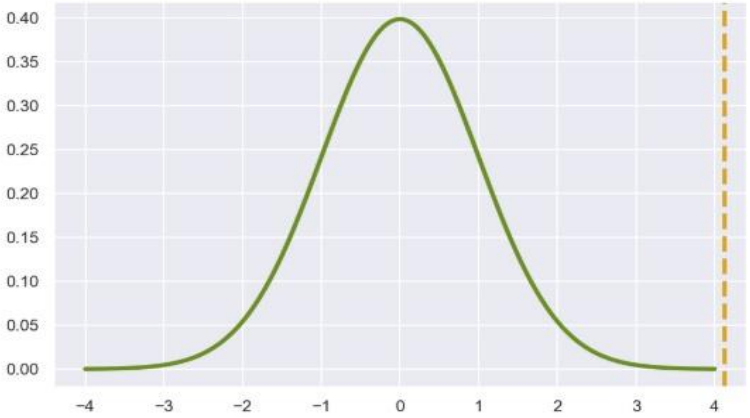
Discount Level: 0.2: Probability of error: 0.006917136252883391



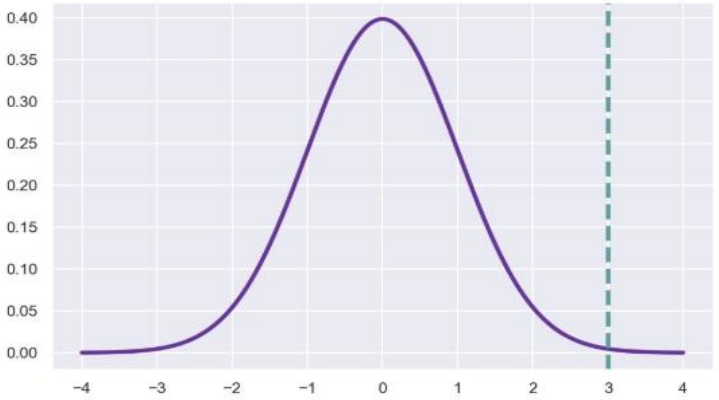

Discount Level: 0.15: Probability of error: 0.003899114297712308



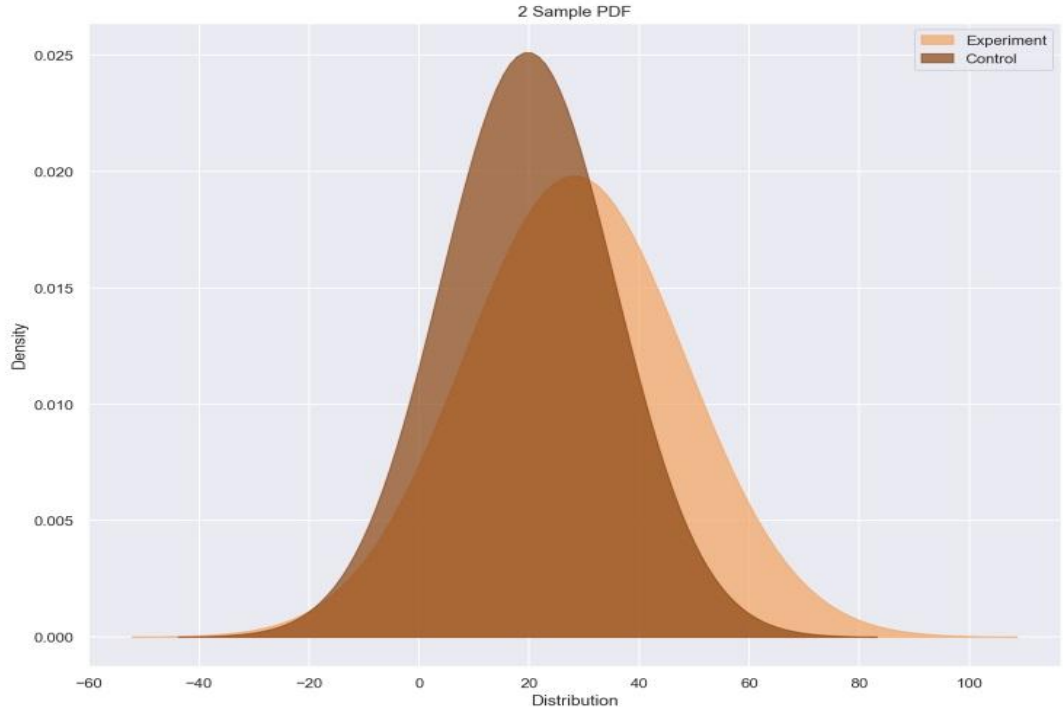

Discount Level: 0.25: Probability of error: 4.77333721632627e-05



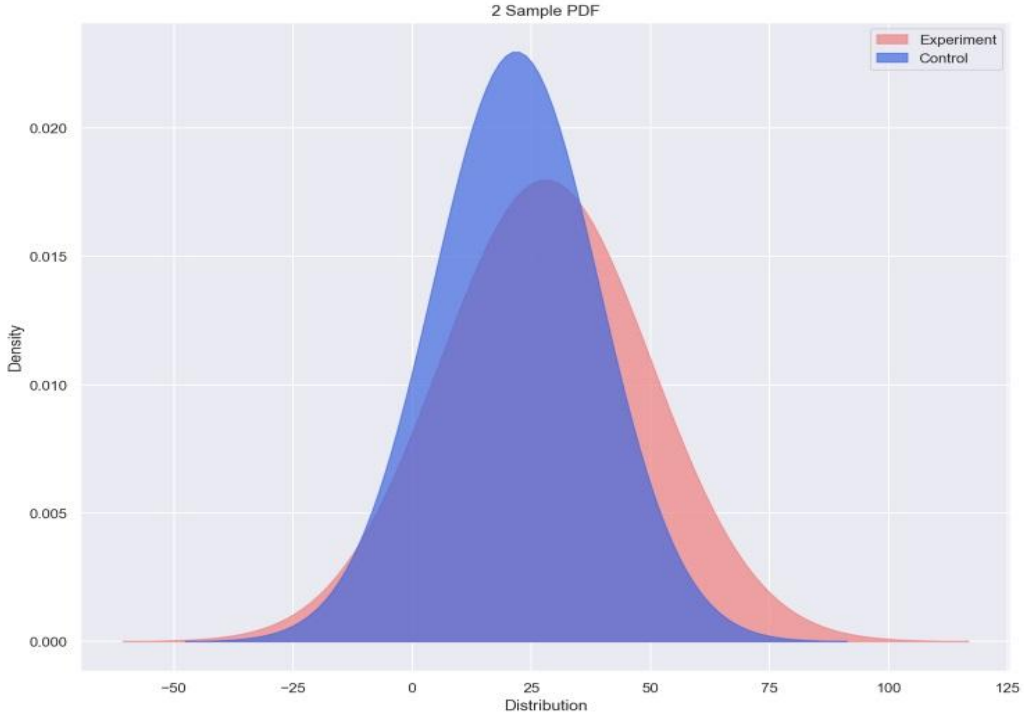

Discount Level: 0.05: Probability of error: 0.0028292023288866617



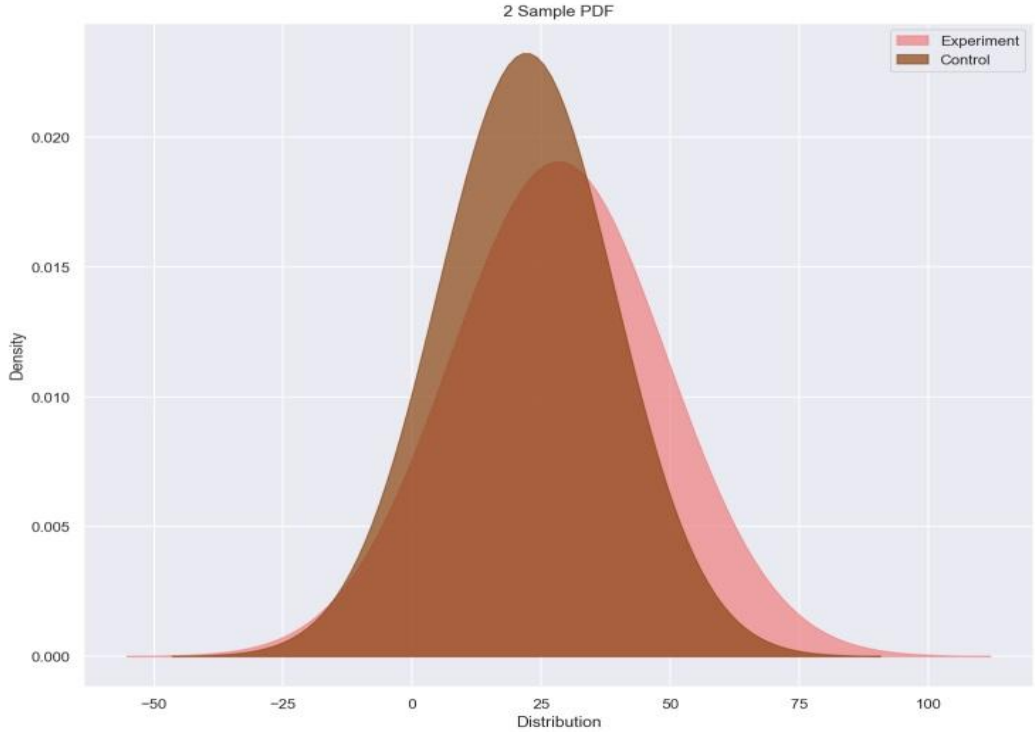
```
     Simple Threshold: 23
The midpoint between two means.

     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.
```



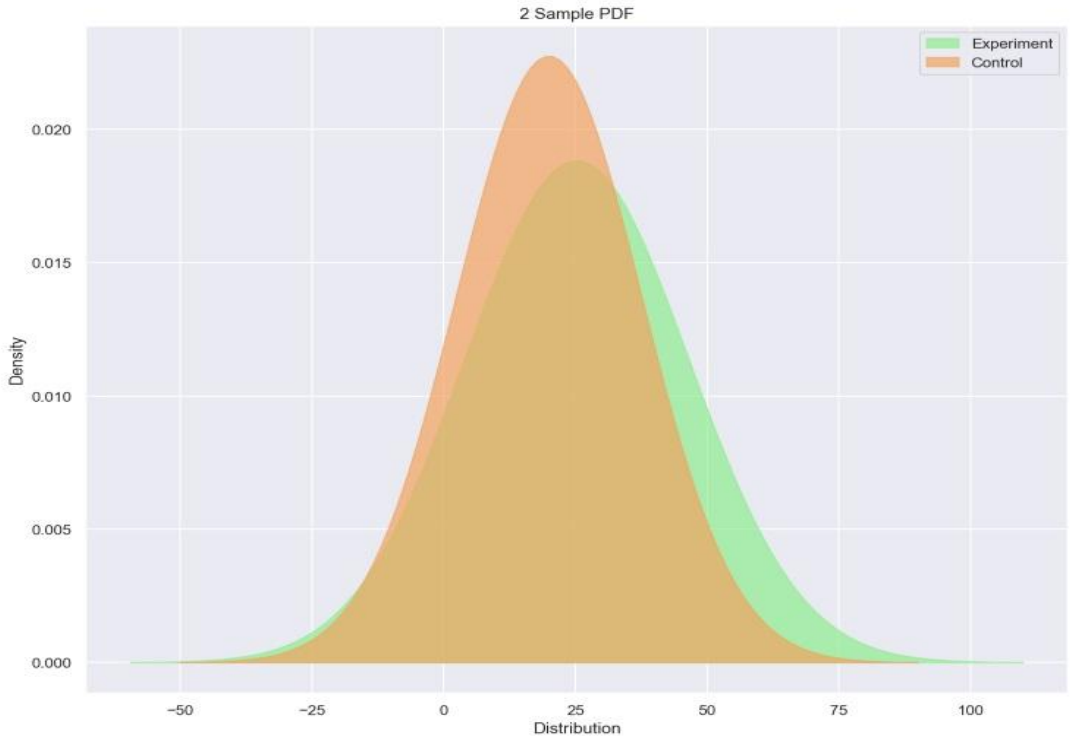
```
     Simple Threshold: 24
The midpoint between two means.

     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.
```



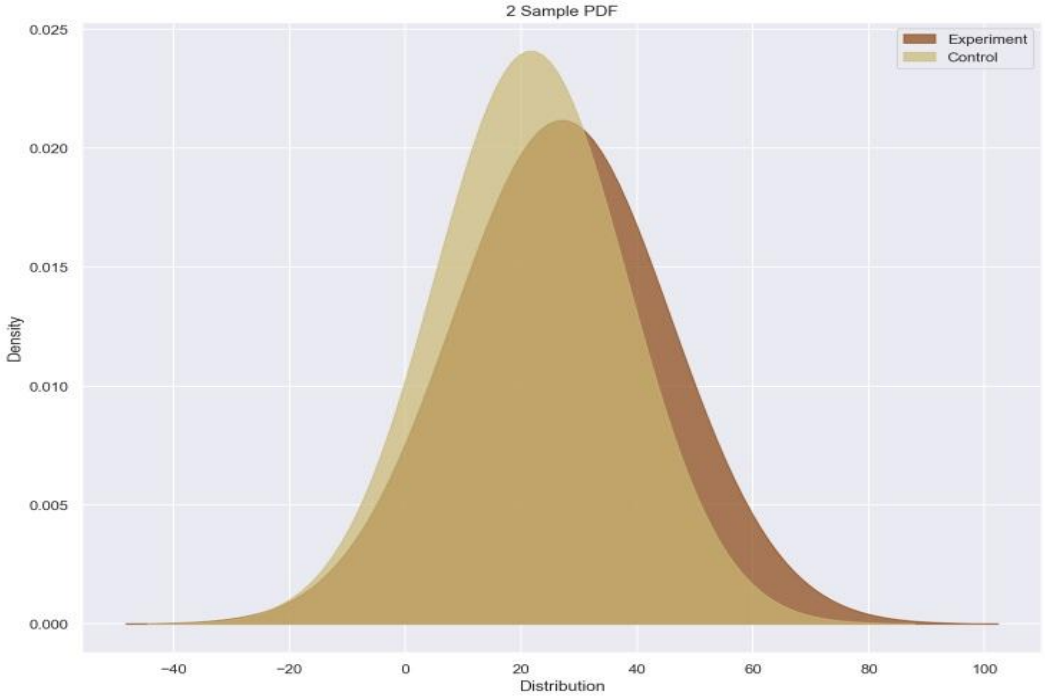
```
     Simple Threshold: 25
The midpoint between two means.

     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.
```

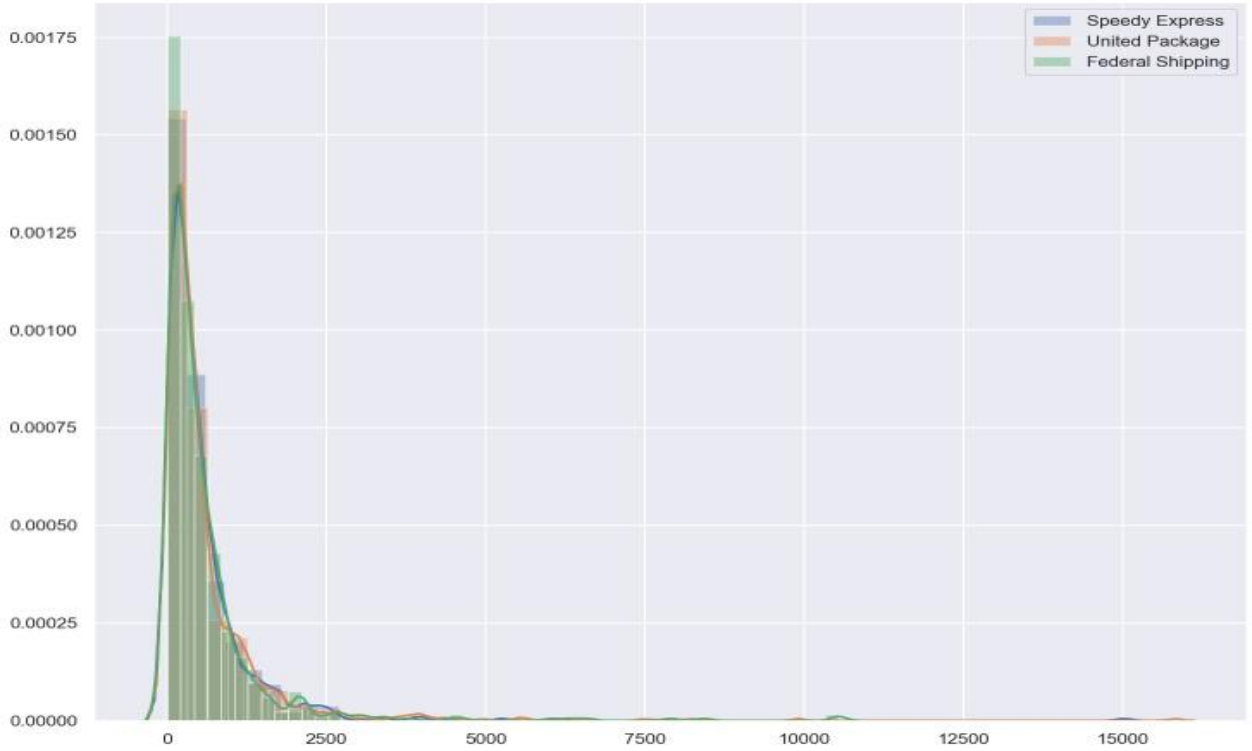


```
     Simple Threshold: 24
The midpoint between two means.

     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

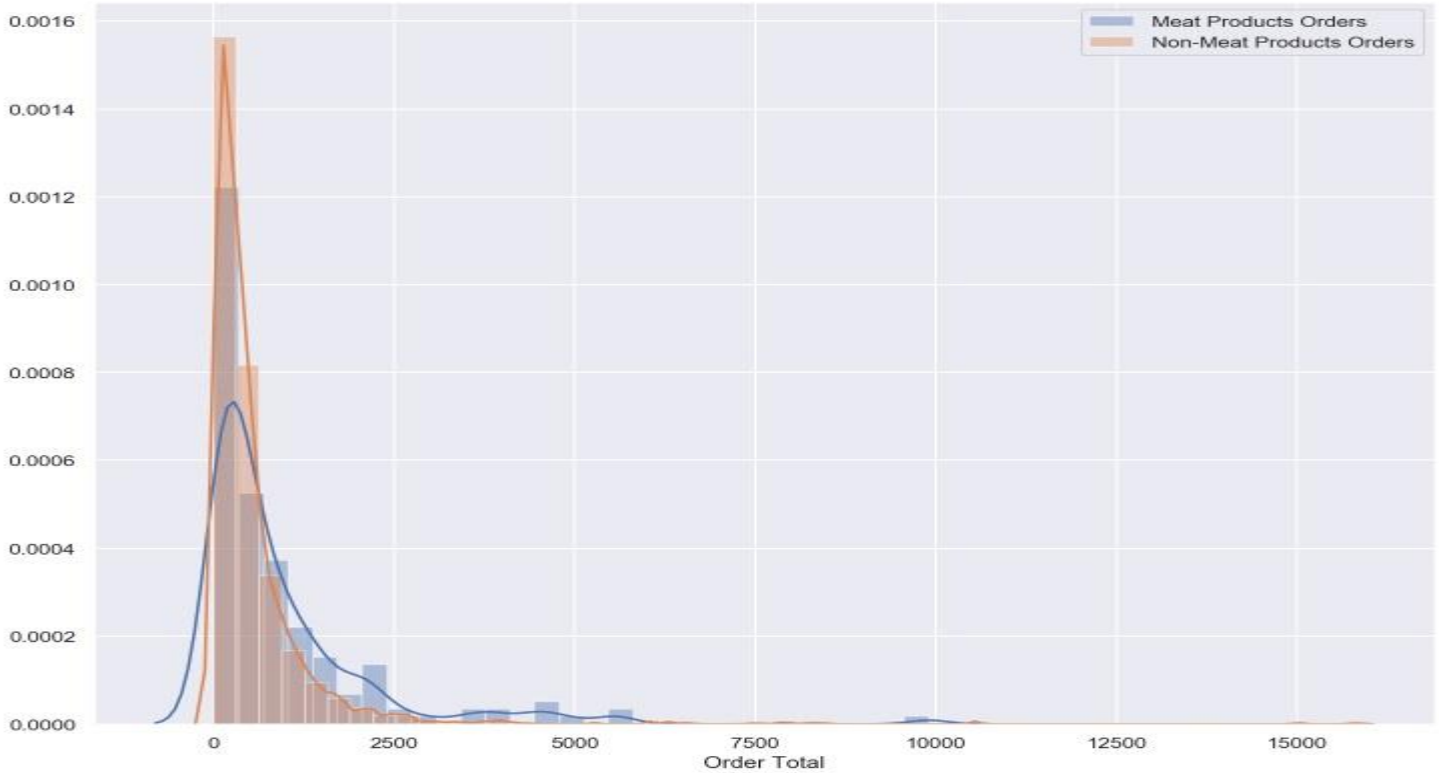
We fail to reject the Null Hypothesis. All shippers appear to handle the same amount of orders. We can say the same for price among shippers.

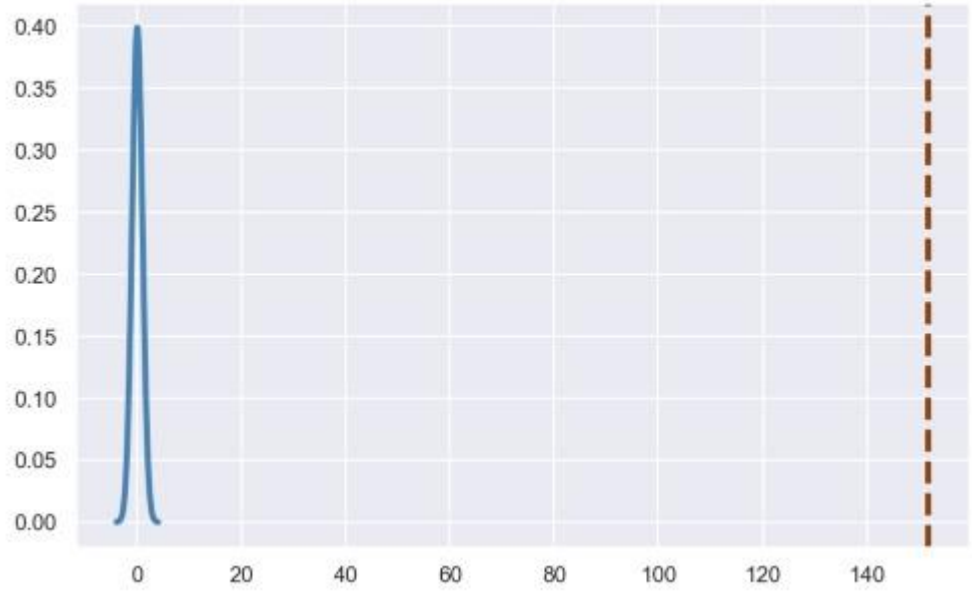
# One Category to Rule Them All

### 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%

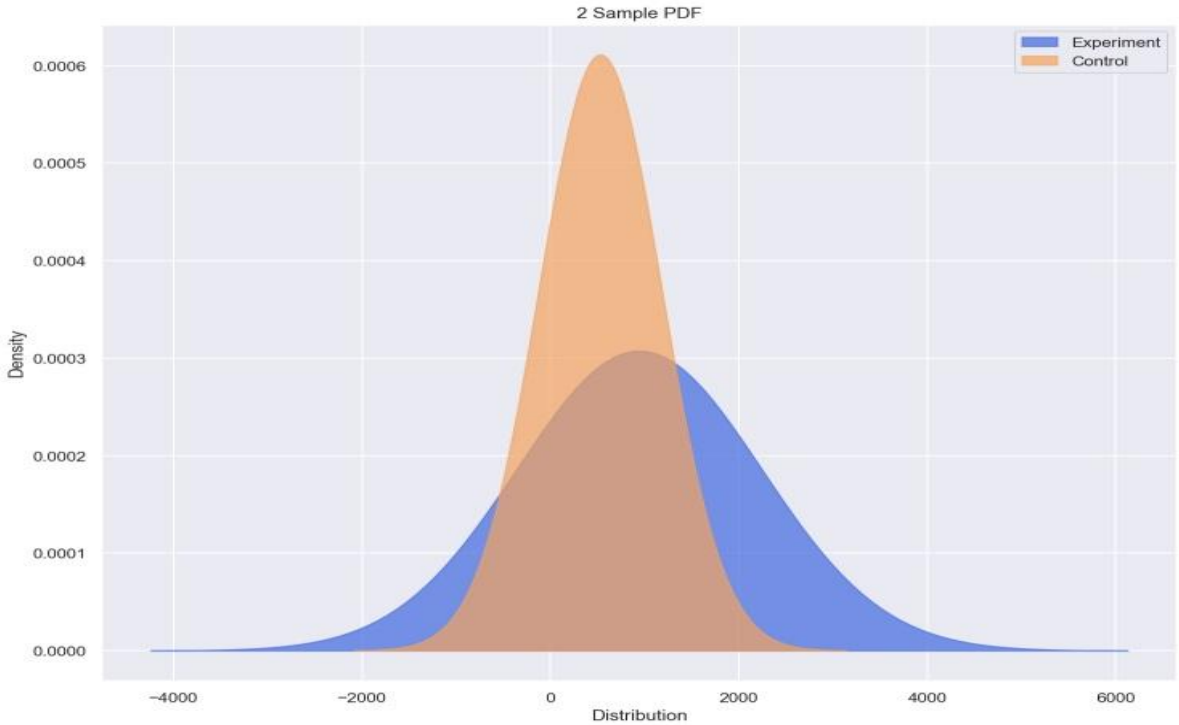
### Ho: There is no significant difference between the Meat/Poultry and the other products.

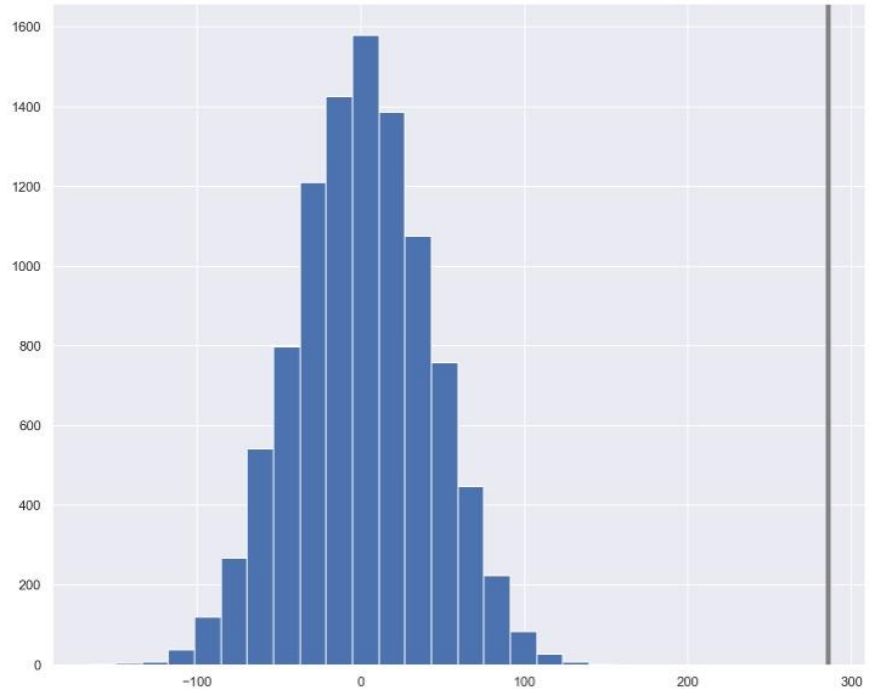
# Categories vs Meat Category




0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
20
40
60
80
100
120
140

```
     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.
```



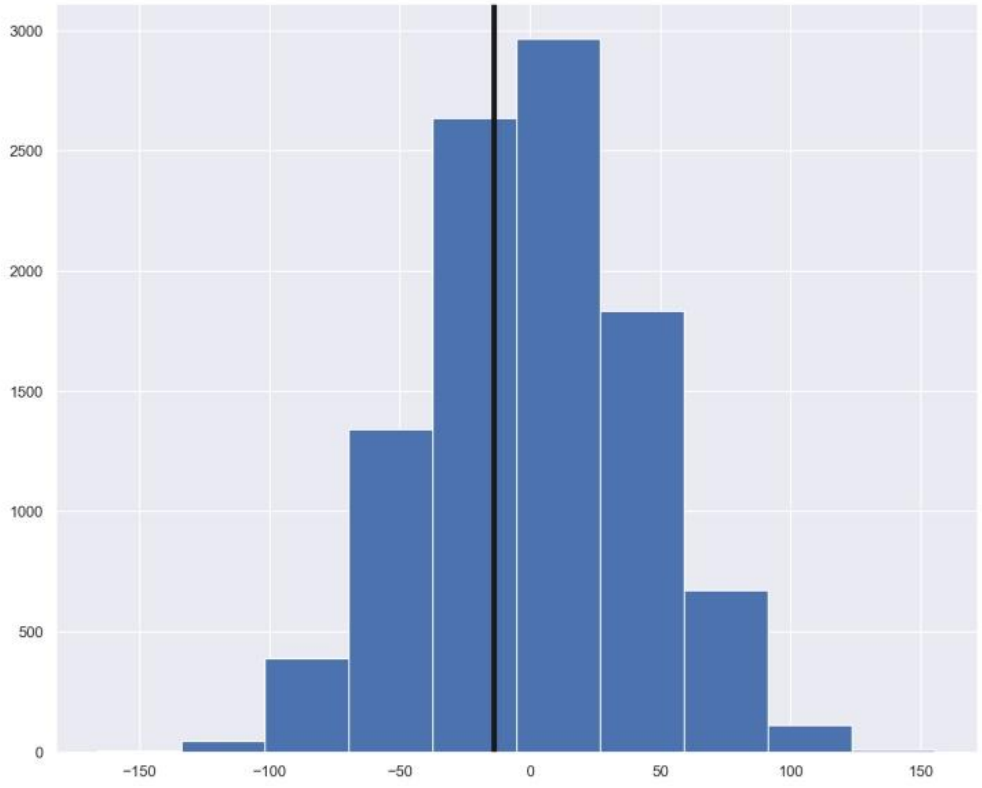

1600
1400
1200
1000
800
600
400
200
0
−100
0
100
200
300

# 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 reject the null hypothesis and accept the Alternative that meat orders bring in more money.

# Are more meat products kept in stock?

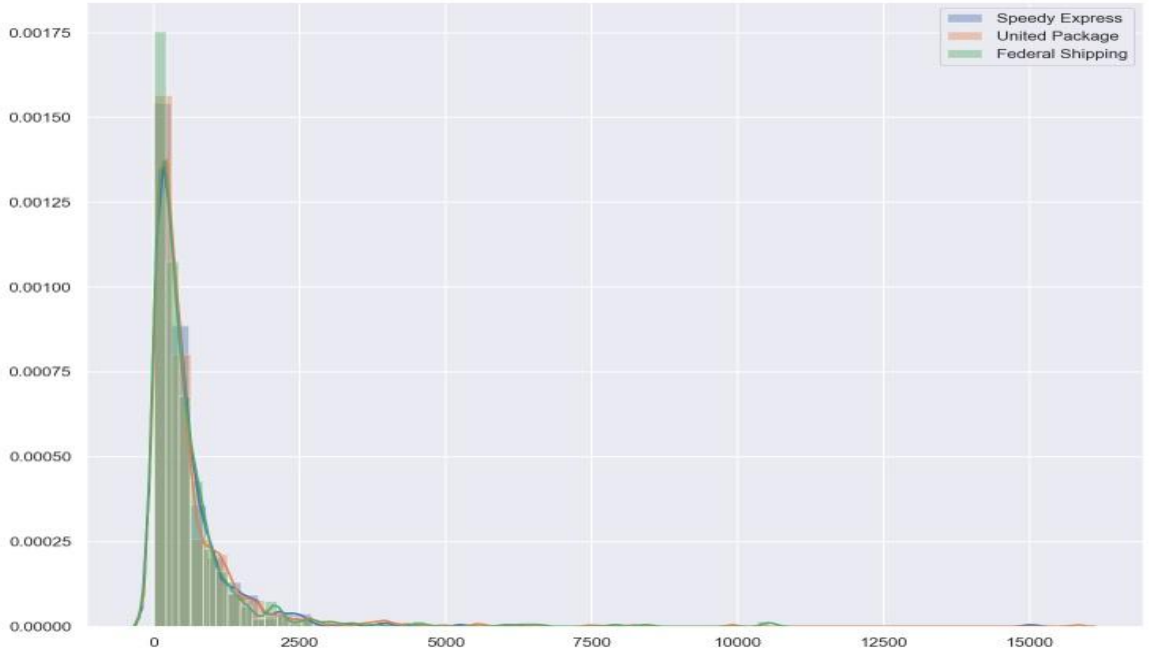


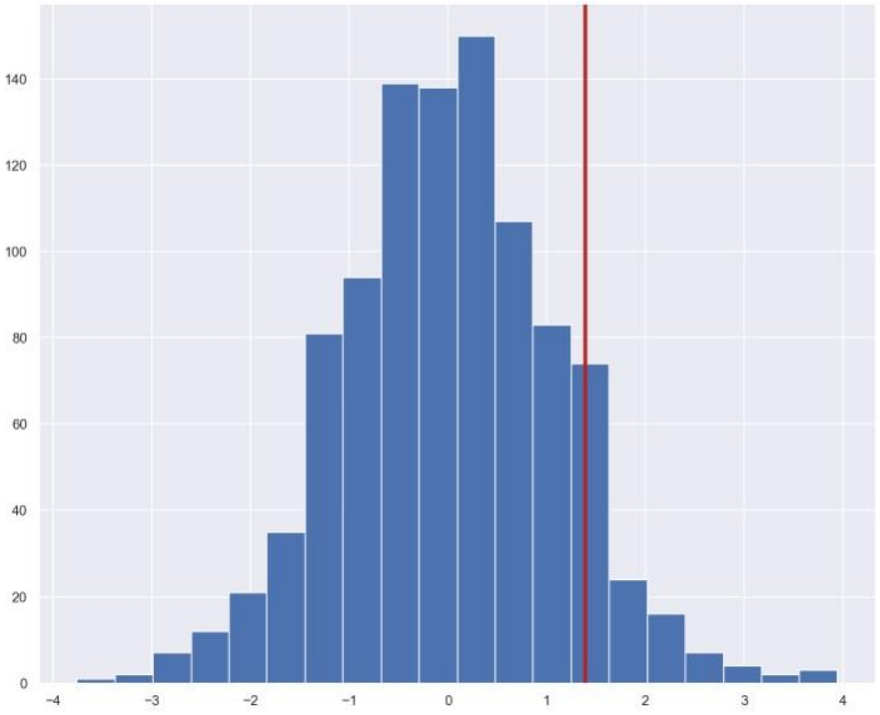
# Fail to reject the null

# 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.**




140
120
100
80
60
40
20
0
−4
−3
−2
−1
0
1
2
3
4

# 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.  We fail to reject both null hypotheses

# 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 prefered 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**

# Northwind Trades