

# SDS315 HW 10

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Github Link

## Problem 1: Redlining

### Question:

Is there an association between the number of FAIR policies and the racial/ethnic composition of a ZIP code, adjusting for the fire, age, and income variables?

### Approach:

To answer this question, I fit a multiple linear regression model that predicts the number of fair policies using minority, fire, age, and income as variables. It had the form:  $\text{policies} = \beta_0 + \beta_1 \times \text{minority} + \beta_2 \times \text{fire} + \beta_3 \times \text{age} + \beta_4 \times \text{income}$ . The coefficient for minority,  $\beta_1$ , represents the change in number of policies for a one unit increase in minority percentage holding the other variables constant. Thus, I will use this coefficient and a 95% confidence interval to answer the question above.

Table 1: 95% Confidence Interval

	2.5 %	97.5 %
(Intercept)	-1.4101251	1.1603790
minority	0.0025442	0.0141729
fire	0.0039046	0.0395741
age	-0.0020000	0.0132468
income	-0.0935331	0.0616036

### Results:

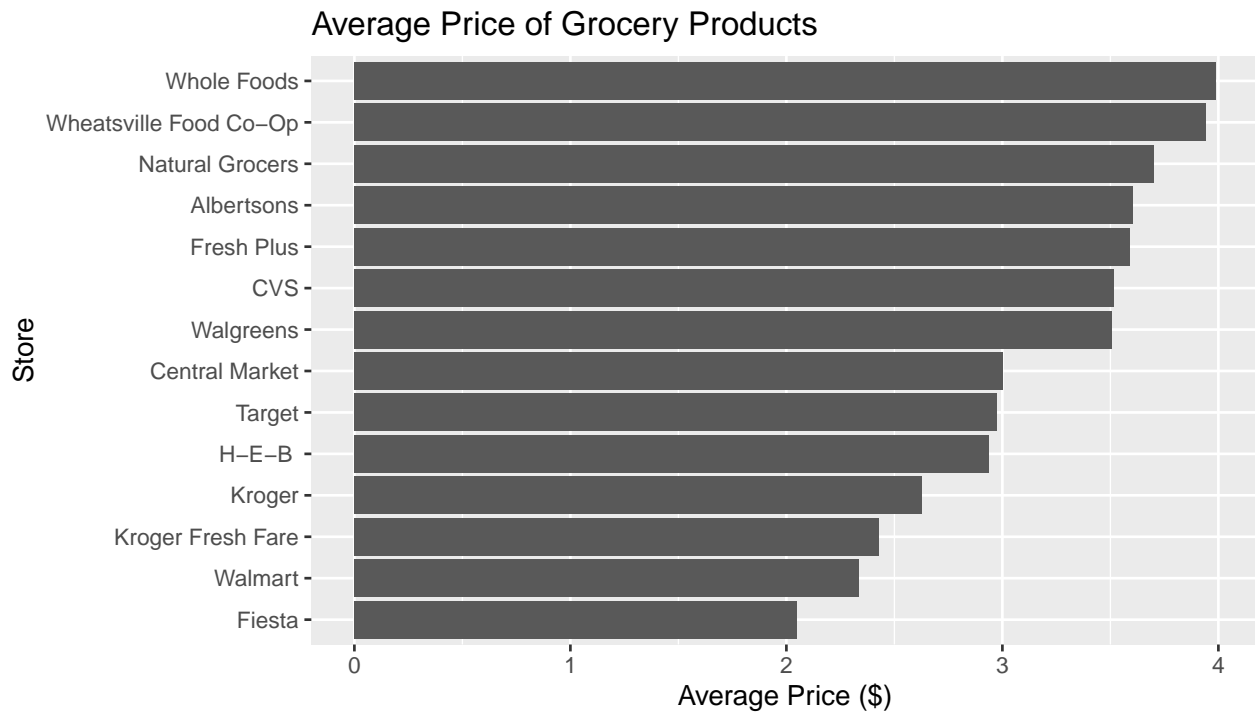
The model's coefficient for minority,  $\beta_1$ , was 0.008359. To account for statistical uncertainty, I determined the 95% confidence interval for  $\beta_1$  to be between 0.00254 and 0.01417. Because it did not include zero, the positive relationship between racial/ethnic composition and number of FAIR policies is statistically significant to the 0.05 level.

### Conclusion:

In conclusion, there is a positive association between the number of FAIR policies and racial/ethnic composition of a zip code, adjusting for the number of fires, ages of homes, and income. This indicates there is evidence for racial discrimination in the private home insurance market.

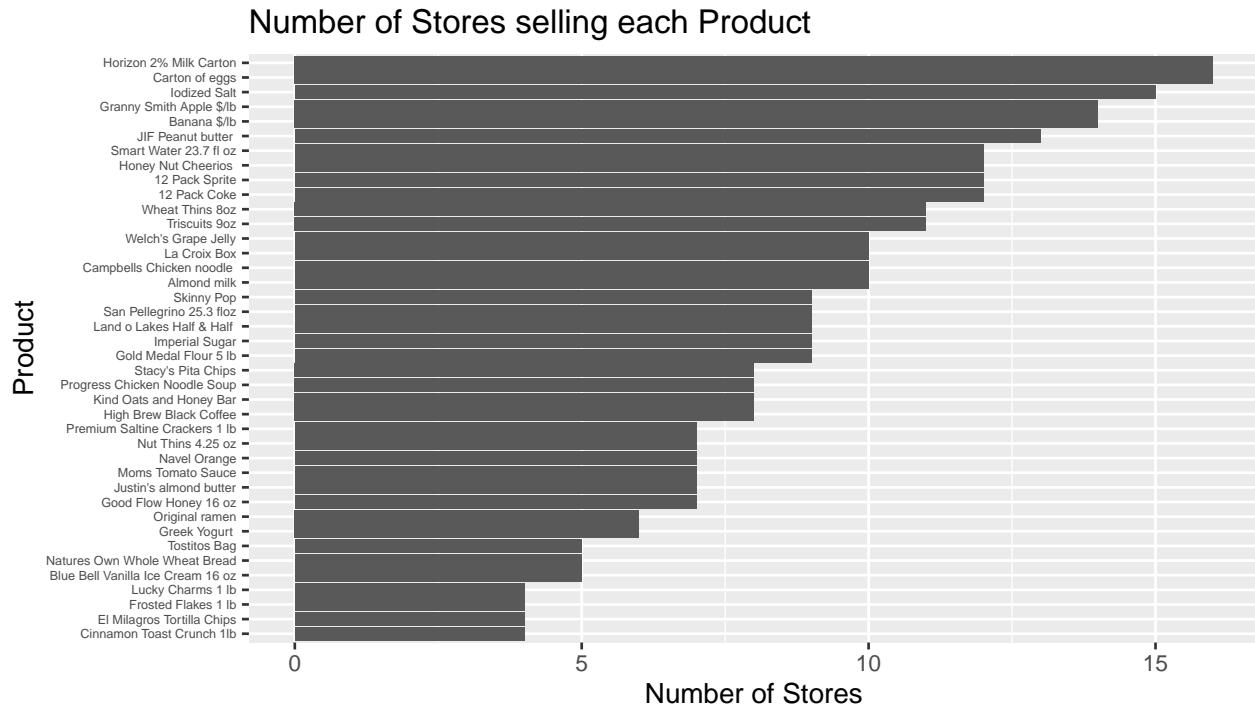
## Problem 2: Grocery Store Prices

### Part A



The bar graph above displays the average price of grocery products for 14 stores across Texas. According to the graph, Whole Foods and Wheatsville Co-Op have the most expensive groceries while Walmart and Fiesta have the cheapest groceries.

## Part B



The plot shows the number of stores selling each product. Horizon 2% Milk Carton and a carton of eggs is in all 16 stores. Lucky Charms, Frosted Flakes, El Milagros Tortilla Chips, and Cinnamon Toast Crunch are only in 4 stores.

## Part C

	2.5 %	97.5 %
(Intercept)	5.4461802	6.4011155
Product12 Pack Sprite	-0.6340950	0.5974283
ProductAlmond milk	-2.8525515	-1.5573897
ProductBanana \$/lb	-5.4799319	-4.2894146
ProductBlue Bell Vanilla Ice Cream 16 oz	-3.7520923	-2.1421359
ProductCampbells Chicken noodle	-4.1115515	-2.8163897
ProductCarton of eggs	-3.5774725	-2.4241177
ProductCinnamon Toast Crunch 1lb	-1.8696613	-0.1241717
ProductEl Milagros Tortilla Chips	-2.9129671	-1.1651607
ProductFrosted Flakes 1 lb	-2.1246613	-0.3791717
ProductGold Medal Flour 5 lb	-2.8372300	-1.5046126
ProductGood Flow Honey 16 oz	0.2808176	1.7240341
ProductGranny Smith Apple \$/lb	-4.3199319	-3.1294146
ProductGreek Yogurt	-4.6079636	-3.0970492
ProductHigh Brew Black Coffee	-3.6121524	-2.2295143
ProductHoney Nut Cheerios	-2.3416352	-1.1094592
ProductHorizon 2% Milk Carton	-1.6774725	-0.5241177
ProductImperial Sugar	-3.1483411	-1.8157237
ProductIodized Salt	-4.4512391	-3.2812049

	2.5 %	97.5 %
ProductJIF Peanut butter	-3.3245622	-2.1168826
ProductJustin's almond butter	6.0836747	7.5268913
ProductKind Oats and Honey Bar	-2.5550655	-1.1701653
ProductLa Croix Box	-1.7195515	-0.4243897
ProductLand o Lakes Half & Half	-3.9644300	-2.6289732
ProductLucky Charms 1 lb	-2.3746613	-0.6291717
ProductMoms Tomato Sauce	0.7236747	2.1668913
ProductNatures Own Whole Wheat Bread	-3.2238381	-1.6152736
ProductNavel Orange	-4.6806110	-3.2373945
ProductNut Thins 4.25 oz	-3.1963253	-1.7531087
ProductOriginal ramen	-5.8118874	-4.3004409
ProductPremium Saltine Crackers 1 lb	-3.0518795	-1.6146755
ProductProgress Chicken Noodle Soup	-3.7593438	-2.3812397
ProductSan Pellegrino 25.3 floz	-4.3177633	-2.9823066
ProductSkinny Pop	-2.7046528	-1.3717357
ProductSmart Water 23.7 fl oz	-4.3084790	-3.0761838
ProductStacy's Pita Chips	-2.4986751	-1.1174141
ProductTostitos Bag	-2.4860923	-0.8761359
ProductTriscuits 9oz	-2.8861621	-1.6263081
ProductWelch's Grape Jelly	-3.5819230	-2.2890646
ProductWheat Thins 8oz	-2.8952530	-1.6353990
TypeGrocery	-0.9154098	-0.4131031
TypeHigh-end Grocery	-0.5944834	-0.0008969
TypeNatural	-0.4037250	0.2192582
TypeSmall Format	-0.7454724	-0.1428388

Compared with ordinary grocery stores (like Albertsons, HEB, or Krogers), convenience stores charge somewhere between 0.41 and 0.92 dollars more for the same product.

## Part D

```
##
## Call:
## lm(formula = Price ~ Product + Store, data = groceries)
##
## Coefficients:
##                (Intercept)
##                5.75467
##      Product12 Pack Sprite
##                -0.01833
##      ProductAlmond milk
##                -2.29297
##      ProductBanana $/lb
##                -4.85694
## ProductBlue Bell Vanilla Ice Cream 16 oz
##                -3.07797
##      ProductCampbells Chicken noodle
##                -3.55197
##      ProductCarton of eggs
##                -2.98094
##      ProductCinnamon Toast Crunch 1lb
```

##		-1.17330
##	ProductEl Milagros Tortilla Chips	
##		-1.91050
##	ProductFrosted Flakes 1 lb	
##		-1.42830
##	ProductGold Medal Flour 5 lb	
##		-2.24497
##	ProductGood Flow Honey 16 oz	
##		0.90422
##	ProductGranny Smith Apple \$/lb	
##		-3.69694
##	ProductGreek Yogurt	
##		-3.93157
##	ProductHigh Brew Black Coffee	
##		-3.01258
##	ProductHoney Nut Cheerios	
##		-1.67833
##	ProductHorizon 2% Milk Carton	
##		-1.08094
##	ProductImperial Sugar	
##		-2.59736
##	ProductIodized Salt	
##		-3.85509
##	ProductJIF Peanut butter	
##		-2.63261
##	ProductJustin's almond butter	
##		6.70708
##	ProductKind Oats and Honey Bar	
##		-1.89547
##	ProductLa Croix Box	
##		-1.15997
##	ProductLand o Lakes Half & Half	
##		-3.38093
##	ProductLucky Charms 1 lb	
##		-1.67830
##	ProductMoms Tomato Sauce	
##		1.34708
##	ProductNatures Own Whole Wheat Bread	
##		-2.42875
##	ProductNavel Orange	
##		-4.05721
##	ProductNut Thins 4.25 oz	
##		-2.57292
##	ProductOriginal ramen	
##		-5.20080
##	ProductPremium Saltine Crackers 1 lb	
##		-2.39373
##	ProductProgress Chicken Noodle Soup	
##		-3.13842
##	ProductSan Pellegrino 25.3 floz	
##		-3.73427
##	ProductSkinny Pop	
##		-2.18538
##	ProductSmart Water 23.7 fl oz	

##		-3.65721
##	ProductStacy's Pita Chips	
##		-1.91172
##	ProductTostitos Bag	
##		-1.81197
##	ProductTriscuits 9oz	
##		-2.12160
##	ProductWelch's Grape Jelly	
##		-2.81797
##	ProductWheat Thins 8oz	
##		-2.13069
##	StoreCentral Market	
##		-0.57339
##	StoreCVS	
##		0.19311
##	StoreFiesta	
##		-0.70323
##	StoreFresh Plus	
##		-0.03616
##	StoreH-E-B	
##		-0.64596
##	StoreKroger	
##		-0.70332
##	StoreKroger Fresh Fare	
##		-0.90178
##	StoreNatural Grocers	
##		-0.08118
##	StoreTarget	
##		-0.37337
##	StoreWalgreens	
##		0.21548
##	StoreWalmart	
##		-0.99255
##	StoreWheatsville Food Co-Op	
##		0.29029
##	StoreWhole Foods	
##		0.36416

Walmart and Kroger Fresh Fare seem to charge the lowest prices when comparing the same product. Whole Foods and Wheatsville Food Co-Op seem to charge the highest prices when comparing the same product.

## Part E

Central Market charges slightly more than HEB for the same product. However, the difference in price is fairly small, as Central Market had a coefficient of -0.57339 and HEB had a coefficient of -0.64596. This amounts to around a 7 cent difference in price. Other stores had significantly higher price differences. For example, the difference between Whole Foods (the most expensive store) and Walmart (the least expensive store) was around 30 cents.

## Part F

##

```

## Call:
## lm(formula = Price ~ Product + Income10K, data = groceries_3)
##
## Coefficients:
##                (Intercept)
##                5.61626
##      Product12 Pack Sprite
##                -0.01833
##      ProductAlmond milk
##                -2.11398
##      ProductBanana $/lb
##                -4.90810
## ProductBlue Bell Vanilla Ice Cream 16 oz
##                -2.90775
##      ProductCampbells Chicken noodle
##                -3.37298
##      ProductCarton of eggs
##                -2.97369
##      ProductCinnamon Toast Crunch 1lb
##                -1.19525
##      ProductEl Milagros Tortilla Chips
##                -1.99991
##      ProductFrosted Flakes 1 lb
##                -1.45025
##      ProductGold Medal Flour 5 lb
##                -2.09918
##      ProductGood Flow Honey 16 oz
##                1.05625
##      ProductGranny Smith Apple $/lb
##                -3.74810
##      ProductGreek Yogurt
##                -3.91709
##      ProductHigh Brew Black Coffee
##                -2.82309
##      ProductHoney Nut Cheerios
##                -1.69470
##      ProductHorizon 2% Milk Carton
##                -1.07369
##      ProductImperial Sugar
##                -2.41570
##      ProductIodized Salt
##                -3.83801
##      ProductJIF Peanut butter
##                -2.74837
##      ProductJustin's almond butter
##                6.85910
##      ProductKind Oats and Honey Bar
##                -1.68695
##      ProductLa Croix Box
##                -0.98098
##      ProductLand o Lakes Half & Half
##                -3.17021
##      ProductLucky Charms 1 lb
##                -1.70025

```

```

##          ProductMoms Tomato Sauce
##                      1.49911
##    ProductNatures Own Whole Wheat Bread
##                      -2.47081
##          ProductNavel Orange
##                      -3.90518
##    ProductNut Thins 4.25 oz
##                      -2.42089
##          ProductOriginal ramen
##                      -4.97932
##    ProductPremium Saltine Crackers 1 lb
##                      -2.24718
##    ProductProgress Chicken Noodle Soup
##                      -3.02352
##    ProductSan Pellegrino 25.3 floz
##                      -3.52354
##          ProductSkinny Pop
##                      -1.95283
##    ProductSmart Water 23.7 fl oz
##                      -3.73465
##    ProductStacy's Pita Chips
##                      -1.67865
##          ProductTostitos Bag
##                      -1.64176
##          ProductTriscuits 9oz
##                      -2.29216
##    ProductWelch's Grape Jelly
##                      -3.00915
##    ProductWheat Thins 8oz
##                      -2.30125
##                      Income10K
##                      -0.01409

```

The Income10K coefficient is -0.01409. Because the sign is negative, it shows that consumers in poorer ZIP codes seem to pay more for the same product, on average. This is because a negative coefficient in the model indicates that as the mean income of the zipcode increases, price seems to go down. Thus, richer ZIP codes are paying less for the same product.

Parameter	Std_Coefficient	CI	CI_low	CI_high
(Intercept)	1.0807133	0.95	0.8556340	1.3057925
Product12 Pack Sprite	-0.0090282	0.95	-0.3270297	0.3089733
ProductAlmond milk	-1.0410336	0.95	-1.3749993	-0.7070678
ProductBanana \$/lb	-2.4170040	0.95	-2.7235163	-2.1104917
ProductBlue Bell Vanilla Ice Cream 16 oz	-1.4319265	0.95	-1.8476062	-1.0162469
ProductCampbells Chicken noodle	-1.6610305	0.95	-1.9949962	-1.3270649
ProductCarton of eggs	-1.4643984	0.95	-1.7618643	-1.1669324
ProductCinnamon Toast Crunch 1lb	-0.5886045	0.95	-1.0387015	-0.1385075
ProductEl Milagros Tortilla Chips	-0.9848615	0.95	-1.4348857	-0.5348373
ProductFrosted Flakes 1 lb	-0.7141802	0.95	-1.1642772	-0.2640832
ProductGold Medal Flour 5 lb	-1.0337443	0.95	-1.3774734	-0.6900153
ProductGood Flow Honey 16 oz	0.5201525	0.95	0.1494513	0.8908537
ProductGranny Smith Apple \$/lb	-1.8457592	0.95	-2.1522715	-1.5392469
ProductGreek Yogurt	-1.9289786	0.95	-2.3190279	-1.5389293



Parameter	Std_Coefficient	CI	CI_low	CI_high
ProductHigh Brew Black Coffee	-1.3902366	0.95	-1.7460668	-1.0344064
ProductHoney Nut Cheerios	-0.8345603	0.95	-1.1525619	-0.5165588
ProductHorizon 2% Milk Carton	-0.5287388	0.95	-0.8262047	-0.2312729
ProductImperial Sugar	-1.1896184	0.95	-1.5335023	-0.8457345
ProductIodized Salt	-1.8900385	0.95	-2.1918570	-1.5882199
ProductJIF Peanut butter	-1.3534426	0.95	-1.6653431	-1.0415420
ProductJustin's almond butter	3.3777821	0.95	3.0070808	3.7484834
ProductKind Oats and Honey Bar	-0.8307445	0.95	-1.1867283	-0.4747607
ProductLa Croix Box	-0.4830847	0.95	-0.8170504	-0.1491190
ProductLand o Lakes Half & Half	-1.5611775	0.95	-1.9051775	-1.2171774
ProductLucky Charms 1 lb	-0.8372931	0.95	-1.2873901	-0.3871961
ProductMoms Tomato Sauce	0.7382384	0.95	0.3675372	1.1089397
ProductNatures Own Whole Wheat Bread	-1.2167576	0.95	-1.6319151	-0.8016000
ProductNavel Orange	-1.9231169	0.95	-2.2938182	-1.5524156
ProductNut Thins 4.25 oz	-1.1921744	0.95	-1.5628756	-0.8214732
ProductOriginal ramen	-2.4520789	0.95	-2.8430091	-2.0611487
ProductPremium Saltine Crackers 1 lb	-1.1066269	0.95	-1.4782100	-0.7350439
ProductProgress Chicken Noodle Soup	-1.4889380	0.95	-1.8453873	-1.1324886
ProductSan Pellegrino 25.3 floz	-1.7351767	0.95	-2.0791767	-1.3911767
ProductSkinny Pop	-0.9616752	0.95	-1.3056898	-0.6176606
ProductSmart Water 23.7 fl oz	-1.8391394	0.95	-2.1571605	-1.5211182
ProductStacy's Pita Chips	-0.8266557	0.95	-1.1826545	-0.4706570
ProductTostitos Bag	-0.8084865	0.95	-1.2241667	-0.3928064
ProductTriscuits 9oz	-1.1287807	0.95	-1.4539424	-0.8036189
ProductWelch's Grape Jelly	-1.4818623	0.95	-1.8154005	-1.1483240
ProductWheat Thins 8oz	-1.1332574	0.95	-1.4584192	-0.8080957
Income10K	-0.0315971	0.95	-0.0740660	0.0108718

A one-standard deviation increase in the income of a ZIP code seems to be associated with a -0.03 standard-deviation change in the price that consumers in that ZIP code expect to pay for the same product.