

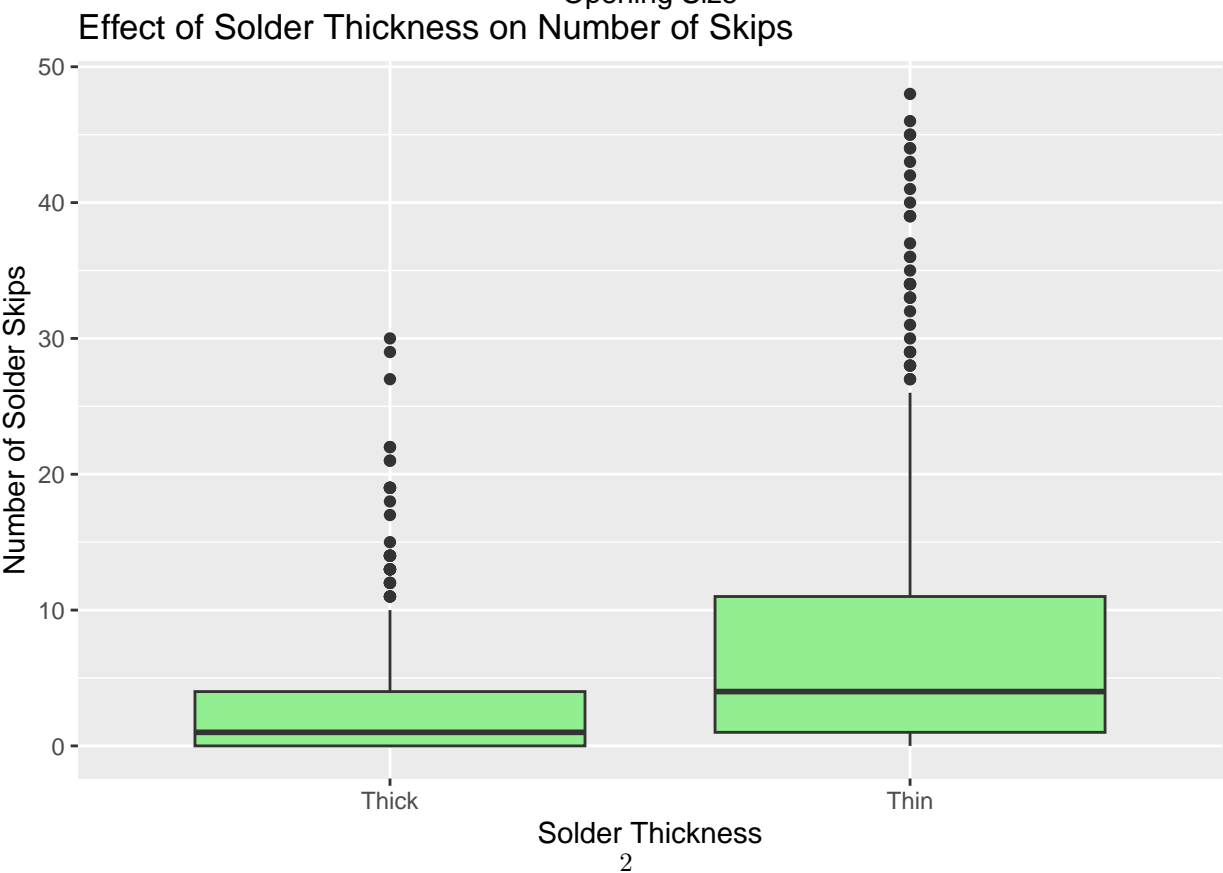
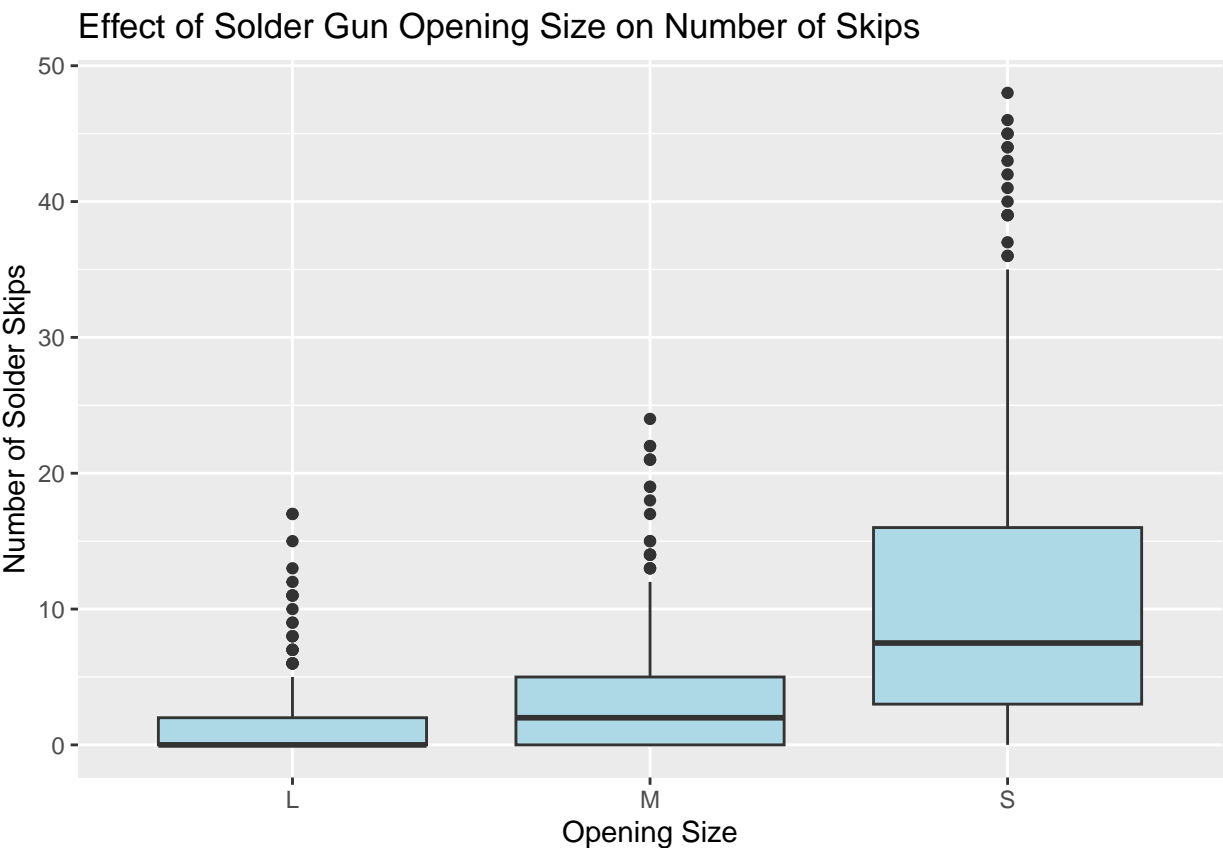
SDS315 HW9 - Palash Pawar ppp625

<https://github.com/palashpawar/SDS315>

2025-04-21

Problem 1: Manufacturing flaws in circuit boards

Part A:



Part B:

```
##
## Call:
## lm(formula = skips ~ Opening * Solder, data = solder)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -17.4533  -2.8000  -0.6733   1.4800  30.5467
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      0.3933     0.5203   0.756  0.44990
## OpeningM         2.4067     0.7359   3.270  0.00111 **
## OpeningS         5.1267     0.7359   6.967 6.29e-12 ***
## SolderThin       2.2800     0.7359   3.098  0.00201 **
## OpeningM:SolderThin -0.7400     1.0407  -0.711  0.47723
## OpeningS:SolderThin  9.6533     1.0407   9.276 < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 6.373 on 894 degrees of freedom
## Multiple R-squared:  0.434, Adjusted R-squared:  0.4308
## F-statistic: 137.1 on 5 and 894 DF, p-value: < 2.2e-16

##              2.5 %    97.5 %
## (Intercept)    -0.6279108  1.414577
## OpeningM        0.9624094  3.850924
## OpeningS        3.6824094  6.570924
## SolderThin      0.8357427  3.724257
## OpeningM:SolderThin -2.7824882  1.302488
## OpeningS:SolderThin  7.6108451 11.695822

## # A tibble: 6 x 7
##   term                estimate std_error statistic p_value lower_ci upper_ci
##   <chr>                <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl>
## 1 intercept            0.39      0.52     0.76    0.45    -0.63     1.41
## 2 Opening: M           2.41      0.74     3.27     0      0.96     3.85
## 3 Opening: S           5.13      0.74     6.97     0      3.68     6.57
## 4 Solder: Thin         2.28      0.74     3.1      0      0.84     3.72
## 5 Opening: M:SolderThin -0.74      1.04    -0.71    0.48    -2.78     1.3
## 6 Opening: S:SolderThin  9.65      1.04     9.28     0      7.61    11.7
```

Part C:

Intercept: This is the expected number of skips when the Opening is “L” (large) and the Solder is “Thick”. The baseline category combination.

Opening[T.M]: When switching from a large to a medium opening (with thick solder), the number of skips increases by about 2.41 on average.

Opening[T.S]: When switching from a large to a small opening (with thick solder), the number of skips increases significantly by about 5.13 on average.

Solder[T.Thin]: When using thin solder instead of thick (with a large opening), the number of skips increases by about 2.28 on average.

Opening[T.M]:Solder: This interaction term captures how the effect of using thin solder changes when the opening is medium instead of large. It reduces the expected skips by about 0.74, but the confidence interval includes zero, suggesting the interaction may not be statistically significant.

Part D:

Based on the regression results, the combination that consistently yields the fewest solder skips is:

Opening: Large

Solder: Thick

This is the baseline category in the regression (represented by the intercept), and all other combinations show higher expected skip counts. Small openings and thin solder, in particular, significantly increase the number of defects. Therefore, to minimize solder skips and improve manufacturing quality, AT&T should use thick solder with a large opening.

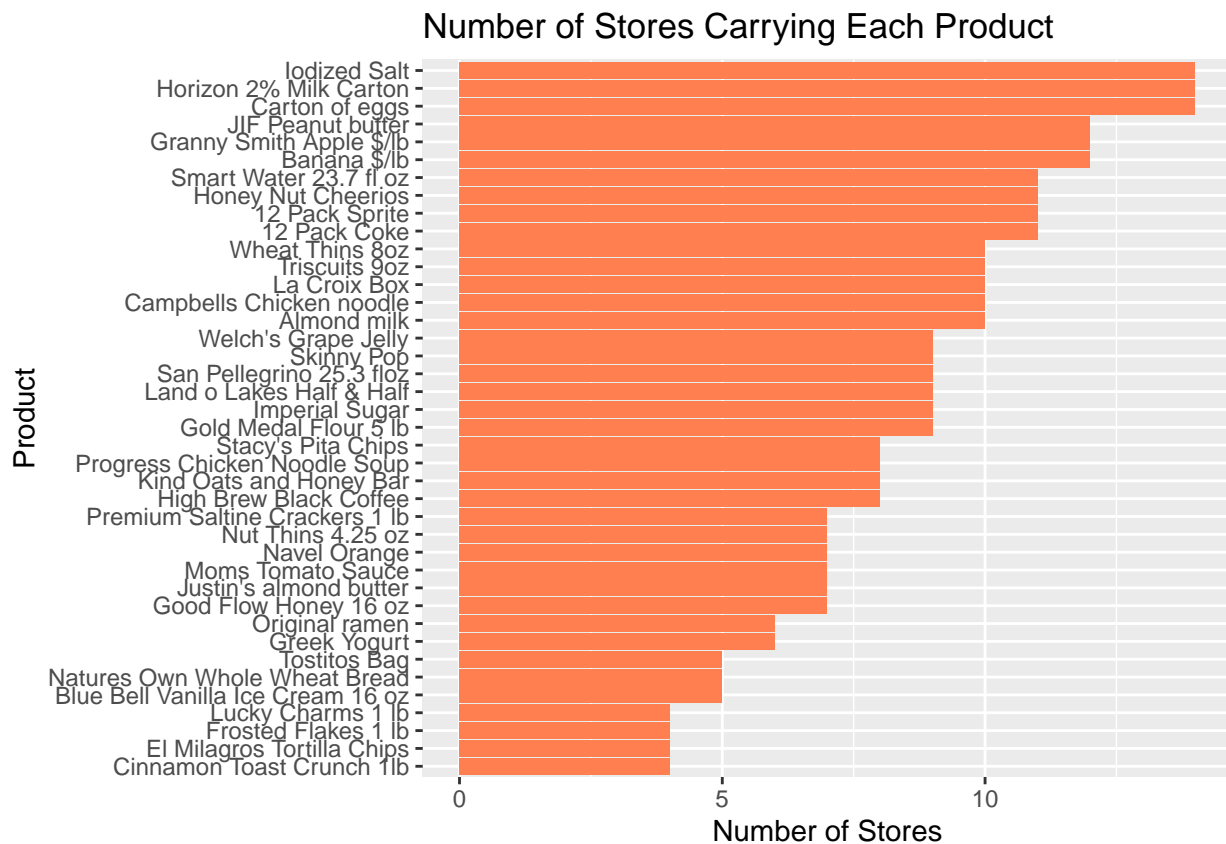
Problem 2: Grocery store prices

Part A:



This bar graph shows the average price of products sold at each store in the dataset. Stores like Wal-Mart, Kroger, and Fiesta tend to have the lowest average prices, while Whole Foods, Natural Grocers, and Albertsons have the highest, supporting their reputations for premium pricing.

Part B:



This bar graph displays the number of stores that carry each product. Staples like eggs, milk, and salt are the most widely available, appearing in all 16 stores. In contrast, specialty items like Cinnamon Toast Crunch, Frosted Flakes, and Lucky Charms are carried by far fewer locations, highlighting disparities in product availability.

Part C:

```
##
## Call:
## lm(formula = Price ~ Product + Type, data = groceries)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.9087 -0.4189 -0.0339  0.3599  3.8461
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      5.92365    0.24268  24.410 < 2e-16
## Product12 Pack Sprite -0.01833    0.31297  -0.059 0.953324
## ProductAlmond milk -2.20497    0.32914  -6.699 9.61e-11
## ProductBanana $/lb -4.88467    0.30255 -16.145 < 2e-16
## ProductBlue Bell Vanilla Ice Cream 16 oz -2.94711    0.40914  -7.203 4.33e-12
## ProductCampbells Chicken noodle -3.46397    0.32914 -10.524 < 2e-16
## ProductCarton of eggs -3.00080    0.29310 -10.238 < 2e-16
## ProductCinnamon Toast Crunch 1lb -0.99692    0.44358  -2.247 0.025302
## ProductEl Milagros Tortilla Chips -2.03906    0.44417  -4.591 6.38e-06
```

## ProductFrosted Flakes 1 lb	-1.25192	0.44358	-2.822	0.005070
## ProductGold Medal Flour 5 lb	-2.17092	0.33866	-6.410	5.28e-10
## ProductGood Flow Honey 16 oz	1.00243	0.36676	2.733	0.006626
## ProductGranny Smith Apple \$/lb	-3.72467	0.30255	-12.311	< 2e-16
## ProductGreek Yogurt	-3.85251	0.38397	-10.033	< 2e-16
## ProductHigh Brew Black Coffee	-2.92083	0.35137	-8.313	2.81e-15
## ProductHoney Nut Cheerios	-1.72555	0.31313	-5.511	7.43e-08
## ProductHorizon 2% Milk Carton	-1.10080	0.29310	-3.756	0.000206
## ProductImperial Sugar	-2.48203	0.33866	-7.329	1.95e-12
## ProductIodized Salt	-3.86622	0.29734	-13.003	< 2e-16
## ProductJIF Peanut butter	-2.72072	0.30691	-8.865	< 2e-16
## ProductJustin's almond butter	6.80528	0.36676	18.555	< 2e-16
## ProductKind Oats and Honey Bar	-1.86262	0.35194	-5.292	2.26e-07
## ProductLa Croix Box	-1.07197	0.32914	-3.257	0.001249
## ProductLand o Lakes Half & Half	-3.29670	0.33938	-9.714	< 2e-16
## ProductLucky Charms 1 lb	-1.50192	0.44358	-3.386	0.000799
## ProductMoms Tomato Sauce	1.44528	0.36676	3.941	0.000100
## ProductNatures Own Whole Wheat Bread	-2.41956	0.40878	-5.919	8.44e-09
## ProductNavel Orange	-3.95900	0.36676	-10.794	< 2e-16
## ProductNut Thins 4.25 oz	-2.47472	0.36676	-6.747	7.19e-11
## ProductOriginal ramen	-5.05616	0.38410	-13.164	< 2e-16
## ProductPremium Saltine Crackers 1 lb	-2.33328	0.36524	-6.388	5.99e-10
## ProductProgress Chicken Noodle Soup	-3.07029	0.35022	-8.767	< 2e-16
## ProductSan Pellegrino 25.3 floz	-3.65003	0.33938	-10.755	< 2e-16
## ProductSkinny Pop	-2.03819	0.33873	-6.017	4.91e-09
## ProductSmart Water 23.7 fl oz	-3.69233	0.31316	-11.790	< 2e-16
## ProductStacy's Pita Chips	-1.80804	0.35102	-5.151	4.57e-07
## ProductTostitos Bag	-1.68111	0.40914	-4.109	5.07e-05
## ProductTriscuits 9oz	-2.25624	0.32017	-7.047	1.15e-11
## ProductWelch's Grape Jelly	-2.93549	0.32855	-8.935	< 2e-16
## ProductWheat Thins 8oz	-2.26533	0.32017	-7.075	9.65e-12
## TypeGrocery	-0.66426	0.12765	-5.204	3.52e-07
## TypeHigh-end Grocery	-0.29769	0.15085	-1.973	0.049316
## TypeNatural	-0.09223	0.15832	-0.583	0.560591
## TypeSmall Format	-0.44416	0.15315	-2.900	0.003991
##				
## (Intercept)	***			
## Product12 Pack Sprite				
## ProductAlmond milk	***			
## ProductBanana \$/lb	***			
## ProductBlue Bell Vanilla Ice Cream 16 oz	***			
## ProductCampbells Chicken noodle	***			
## ProductCarton of eggs	***			
## ProductCinnamon Toast Crunch 1lb	*			
## ProductEl Milagros Tortilla Chips	***			
## ProductFrosted Flakes 1 lb	**			
## ProductGold Medal Flour 5 lb	***			
## ProductGood Flow Honey 16 oz	**			
## ProductGranny Smith Apple \$/lb	***			
## ProductGreek Yogurt	***			
## ProductHigh Brew Black Coffee	***			
## ProductHoney Nut Cheerios	***			
## ProductHorizon 2% Milk Carton	***			
## ProductImperial Sugar	***			

```

## ProductIodized Salt          ***
## ProductJIF Peanut butter    ***
## ProductJustin's almond butter ***
## ProductKind Oats and Honey Bar ***
## ProductLa Croix Box         **
## ProductLand o Lakes Half & Half ***
## ProductLucky Charms 1 lb    ***
## ProductMoms Tomato Sauce    ***
## ProductNatures Own Whole Wheat Bread ***
## ProductNavel Orange         ***
## ProductNut Thins 4.25 oz     ***
## ProductOriginal ramen       ***
## ProductPremium Saltine Crackers 1 lb ***
## ProductProgress Chicken Noodle Soup ***
## ProductSan Pellegrino 25.3 floz ***
## ProductSkinny Pop           ***
## ProductSmart Water 23.7 fl oz ***
## ProductStacy's Pita Chips    ***
## ProductTostitos Bag         ***
## ProductTriscuits 9oz        ***
## ProductWelch's Grape Jelly  ***
## ProductWheat Thins 8oz      ***
## TypeGrocery                 ***
## TypeHigh-end Grocery        *
## TypeNatural                  *
## TypeSmall Format             **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7666 on 316 degrees of freedom
## Multiple R-squared:  0.8746, Adjusted R-squared:  0.8575
## F-statistic: 51.23 on 43 and 316 DF,  p-value: < 2.2e-16

##      2.5 %      97.5 %
## -0.9154098 -0.4131031

```

Compared with ordinary grocery stores (like Albertsons, HEB, or Kroger), convenience stores charge between \$0.41 and \$0.92 more for the same product, on average. The point estimate of this markup is \$0.66, indicating a statistically significant and economically meaningful premium.

Part D:

```

##
## Call:
## lm(formula = Price ~ Product + Store, data = groceries)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.7620 -0.3580 -0.0314  0.2956  3.4685
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      5.75467    0.23370   24.624 < 2e-16
## Product12 Pack Sprite -0.01833    0.28678  -0.064 0.949069
## ProductAlmond milk -2.29297    0.30331  -7.560 4.70e-13

```

## ProductBanana \$/lb	-4.85694	0.27799	-17.472	< 2e-16
## ProductBlue Bell Vanilla Ice Cream 16 oz	-3.07797	0.37697	-8.165	8.42e-15
## ProductCampbells Chicken noodle	-3.55197	0.30331	-11.711	< 2e-16
## ProductCarton of eggs	-2.98094	0.26928	-11.070	< 2e-16
## ProductCinnamon Toast Crunch 1lb	-1.17330	0.40921	-2.867	0.004427
## ProductEl Milagros Tortilla Chips	-1.91050	0.41169	-4.641	5.15e-06
## ProductFrosted Flakes 1 lb	-1.42830	0.40921	-3.490	0.000553
## ProductGold Medal Flour 5 lb	-2.24497	0.31258	-7.182	5.22e-12
## ProductGood Flow Honey 16 oz	0.90422	0.33806	2.675	0.007880
## ProductGranny Smith Apple \$/lb	-3.69694	0.27799	-13.299	< 2e-16
## ProductGreek Yogurt	-3.93157	0.35459	-11.088	< 2e-16
## ProductHigh Brew Black Coffee	-3.01258	0.32405	-9.297	< 2e-16
## ProductHoney Nut Cheerios	-1.67833	0.28728	-5.842	1.31e-08
## ProductHorizon 2% Milk Carton	-1.08094	0.26928	-4.014	7.50e-05
## ProductImperial Sugar	-2.59736	0.31188	-8.328	2.76e-15
## ProductIodized Salt	-3.85509	0.27328	-14.107	< 2e-16
## ProductJIF Peanut butter	-2.63261	0.28222	-9.328	< 2e-16
## ProductJustin's almond butter	6.70708	0.33806	19.840	< 2e-16
## ProductKind Oats and Honey Bar	-1.89547	0.32398	-5.850	1.26e-08
## ProductLa Croix Box	-1.15997	0.30331	-3.824	0.000159
## ProductLand o Lakes Half & Half	-3.38093	0.31273	-10.811	< 2e-16
## ProductLucky Charms 1 lb	-1.67830	0.40921	-4.101	5.27e-05
## ProductMoms Tomato Sauce	1.34708	0.33806	3.985	8.45e-05
## ProductNatures Own Whole Wheat Bread	-2.42875	0.37776	-6.429	4.90e-10
## ProductNavel Orange	-4.05721	0.33806	-12.001	< 2e-16
## ProductNut Thins 4.25 oz	-2.57292	0.33806	-7.611	3.37e-13
## ProductOriginal ramen	-5.20080	0.35387	-14.697	< 2e-16
## ProductPremium Saltine Crackers 1 lb	-2.39373	0.33699	-7.103	8.54e-12
## ProductProgress Chicken Noodle Soup	-3.13842	0.32309	-9.714	< 2e-16
## ProductSan Pellegrino 25.3 floz	-3.73427	0.31273	-11.941	< 2e-16
## ProductSkinny Pop	-2.18538	0.31208	-7.003	1.59e-11
## ProductSmart Water 23.7 fl oz	-3.65721	0.28772	-12.711	< 2e-16
## ProductStacy's Pita Chips	-1.91172	0.32327	-5.914	8.91e-09
## ProductTostitos Bag	-1.81197	0.37697	-4.807	2.41e-06
## ProductTriscuits 9oz	-2.12160	0.29502	-7.191	4.92e-12
## ProductWelch's Grape Jelly	-2.81797	0.30182	-9.337	< 2e-16
## ProductWheat Thins 8oz	-2.13069	0.29502	-7.222	4.06e-12
## StoreCentral Market	-0.57339	0.17699	-3.240	0.001328
## StoreCVS	0.19311	0.18293	1.056	0.291954
## StoreFiesta	-0.70323	0.26949	-2.609	0.009512
## StoreFresh Plus	-0.03616	0.16197	-0.223	0.823469
## StoreH-E-B	-0.64596	0.15204	-4.249	2.86e-05
## StoreKroger	-0.70332	0.23332	-3.014	0.002790
## StoreKroger Fresh Fare	-0.90178	0.23332	-3.865	0.000136
## StoreNatural Grocers	-0.08118	0.19755	-0.411	0.681406
## StoreTarget	-0.37337	0.18991	-1.966	0.050201
## StoreWalgreens	0.21548	0.18082	1.192	0.234294
## StoreWalmart	-0.99255	0.23332	-4.254	2.79e-05
## StoreWheatville Food Co-Op	0.29029	0.17876	1.624	0.105423
## StoreWhole Foods	0.36416	0.17657	2.062	0.040008
##				
## (Intercept)	***			
## Product12 Pack Sprite				
## ProductAlmond milk	***			


```

## ProductBanana $/lb ***
## ProductBlue Bell Vanilla Ice Cream 16 oz ***
## ProductCampbells Chicken noodle ***
## ProductCarton of eggs ***
## ProductCinnamon Toast Crunch 1lb **
## ProductEl Milagros Tortilla Chips ***
## ProductFrosted Flakes 1 lb ***
## ProductGold Medal Flour 5 lb ***
## ProductGood Flow Honey 16 oz **
## ProductGranny Smith Apple $/lb ***
## ProductGreek Yogurt ***
## ProductHigh Brew Black Coffee ***
## ProductHoney Nut Cheerios ***
## ProductHorizon 2% Milk Carton ***
## ProductImperial Sugar ***
## ProductIodized Salt ***
## ProductJIF Peanut butter ***
## ProductJustin's almond butter ***
## ProductKind Oats and Honey Bar ***
## ProductLa Croix Box ***
## ProductLand o Lakes Half & Half ***
## ProductLucky Charms 1 lb ***
## ProductMoms Tomato Sauce ***
## ProductNatures Own Whole Wheat Bread ***
## ProductNavel Orange ***
## ProductNut Thins 4.25 oz ***
## ProductOriginal ramen ***
## ProductPremium Saltine Crackers 1 lb ***
## ProductProgress Chicken Noodle Soup ***
## ProductSan Pellegrino 25.3 floz ***
## ProductSkinny Pop ***
## ProductSmart Water 23.7 fl oz ***
## ProductStacy's Pita Chips ***
## ProductTostitos Bag ***
## ProductTriscuits 9oz ***
## ProductWelch's Grape Jelly ***
## ProductWheat Thins 8oz ***
## StoreCentral Market **
## StoreCVS
## StoreFiesta **
## StoreFresh Plus
## StoreH-E-B ***
## StoreKroger **
## StoreKroger Fresh Fare ***
## StoreNatural Grocers
## StoreTarget .
## StoreWalgreens
## StoreWalmart ***
## StoreWheatsville Food Co-Op
## StoreWhole Foods *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7025 on 307 degrees of freedom

```

```
## Multiple R-squared:  0.8977, Adjusted R-squared:  0.8803
## F-statistic: 51.79 on 52 and 307 DF,  p-value: < 2.2e-16

##           StoreWalmart      StoreKroger Fresh Fare
##           -0.99254892      -0.90177969
##           StoreKroger      StoreFiesta
##           -0.70331815      -0.70323198
##           StoreH-E-B      StoreCentral Market
##           -0.64595932      -0.57338651
##           StoreTarget      StoreNatural Grocers
##           -0.37336967      -0.08117985
##           StoreFresh Plus      StoreCVS
##           -0.03616437      0.19311241
##           StoreWalgreens StoreWheatsville Food Co-Op
##           0.21548328      0.29029303
##           StoreWhole Foods
##           0.36415850
```

When comparing prices for the same products:

The two **lowest-priced stores** are:

Walmart (charges \$0.99 less than the baseline store)

Kroger Fresh Fare (charges \$0.90 less)

The two **highest-priced stores** are:

Whole Foods (charges \$0.36 more)

Wheatsville Food Co-Op (charges \$0.29 more)

This confirms that Walmart and Kroger Fresh Fare are the most budget-friendly, while Whole Foods and Wheatsville are relatively more expensive even for identical products.

Part E:

```
## StoreCentral Market
##           -0.5733865
```

The model treats H-E-B as the reference store (its coefficient is 0), and Central Market has a coefficient of -0.57. That means Central Market charges \$0.57 less than H-E-B for the same product, on average.

So contrary to the popular belief that Central Market is more expensive:

Central Market actually charges *less* than H-E-B for the same items in this dataset.

The difference between Central Market and H-E-B (\$0.57) is larger than the price gap between Whole Foods and the average store (\$0.36 more). Thus, this finding challenges the reputation of Central Market as a high-priced store, it may offer higher-end products overall, but for overlapping items, it's not more expensive.

Part F:

```
##
## Call:
## lm(formula = Price ~ Product + Income10K, data = groceries)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.9105 -0.4594 -0.0742  0.3881  4.0025
##
```

```

## Coefficients:
##
##      Estimate Std. Error t value Pr(>|t|)
## (Intercept)      5.616264   0.248809  22.573 < 2e-16
## Product12 Pack Sprite -0.018333   0.328221  -0.056 0.955491
## ProductAlmond milk -2.113978   0.344698  -6.133 2.55e-09
## ProductBanana $/lb -4.908097   0.316362 -15.514 < 2e-16
## ProductBlue Bell Vanilla Ice Cream 16 oz -2.907746   0.429038  -6.777 5.92e-11
## ProductCampbells Chicken noodle -3.372977   0.344698  -9.785 < 2e-16
## ProductCarton of eggs -2.973685   0.307025  -9.685 < 2e-16
## ProductCinnamon Toast Crunch 1lb -1.195252   0.464561  -2.573 0.010538
## ProductEl Milagros Tortilla Chips -1.999912   0.464486  -4.306 2.22e-05
## ProductFrosted Flakes 1 lb -1.450252   0.464561  -3.122 0.001962
## ProductGold Medal Flour 5 lb -2.099176   0.354775  -5.917 8.46e-09
## ProductGood Flow Honey 16 oz 1.056249   0.382614   2.761 0.006103
## ProductGranny Smith Apple $/lb -3.748097   0.316362 -11.847 < 2e-16
## ProductGreek Yogurt -3.917087   0.402584  -9.730 < 2e-16
## ProductHigh Brew Black Coffee -2.823088   0.367265  -7.687 1.88e-13
## ProductHoney Nut Cheerios -1.694703   0.328221  -5.163 4.28e-07
## ProductHorizon 2% Milk Carton -1.073685   0.307025  -3.497 0.000537
## ProductImperial Sugar -2.415702   0.354935  -6.806 4.98e-11
## ProductIodized Salt -3.838013   0.311518 -12.320 < 2e-16
## ProductJIF Peanut butter -2.748372   0.321924  -8.537 5.69e-16
## ProductJustin's almond butter 6.859104   0.382614  17.927 < 2e-16
## ProductKind Oats and Honey Bar -1.686954   0.367424  -4.591 6.35e-06
## ProductLa Croix Box -0.980977   0.344698  -2.846 0.004715
## ProductLand o Lakes Half & Half -3.170210   0.355055  -8.929 < 2e-16
## ProductLucky Charms 1 lb -1.700252   0.464561  -3.660 0.000295
## ProductMoms Tomato Sauce 1.499106   0.382614   3.918 0.000109
## ProductNatures Own Whole Wheat Bread -2.470813   0.428499  -5.766 1.91e-08
## ProductNavel Orange -3.905184   0.382614 -10.207 < 2e-16
## ProductNut Thins 4.25 oz -2.420893   0.382614  -6.327 8.44e-10
## ProductOriginal ramen -4.979322   0.403493 -12.341 < 2e-16
## ProductPremium Saltine Crackers 1 lb -2.247175   0.383524  -5.859 1.16e-08
## ProductProgress Chicken Noodle Soup -3.023517   0.367904  -8.218 5.24e-15
## ProductSan Pellegrino 25.3 floz -3.523542   0.355055  -9.924 < 2e-16
## ProductSkinny Pop -1.952829   0.355070  -5.500 7.80e-08
## ProductSmart Water 23.7 fl oz -3.734654   0.328241 -11.378 < 2e-16
## ProductStacy's Pita Chips -1.678651   0.367439  -4.569 7.03e-06
## ProductTostitos Bag -1.641756   0.429038  -3.827 0.000156
## ProductTriscuits 9oz -2.292162   0.335611  -6.830 4.31e-11
## ProductWelch's Grape Jelly -3.009148   0.344257  -8.741 < 2e-16
## ProductWheat Thins 8oz -2.301253   0.335611  -6.857 3.65e-11
## Income10K -0.014090   0.009626  -1.464 0.144239
##
## (Intercept) ***
## Product12 Pack Sprite ***
## ProductAlmond milk ***
## ProductBanana $/lb ***
## ProductBlue Bell Vanilla Ice Cream 16 oz ***
## ProductCampbells Chicken noodle ***
## ProductCarton of eggs ***
## ProductCinnamon Toast Crunch 1lb *
## ProductEl Milagros Tortilla Chips ***
## ProductFrosted Flakes 1 lb **

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## ProductGold Medal Flour 5 lb          ***
## ProductGood Flow Honey 16 oz          **
## ProductGranny Smith Apple $/lb        ***
## ProductGreek Yogurt                   ***
## ProductHigh Brew Black Coffee         ***
## ProductHoney Nut Cheerios             ***
## ProductHorizon 2% Milk Carton         ***
## ProductImperial Sugar                 ***
## ProductIodized Salt                   ***
## ProductJIF Peanut butter              ***
## ProductJustin's almond butter         ***
## ProductKind Oats and Honey Bar        ***
## ProductLa Croix Box                   **
## ProductLand o Lakes Half & Half       ***
## ProductLucky Charms 1 lb              ***
## ProductMoms Tomato Sauce              ***
## ProductNatures Own Whole Wheat Bread  ***
## ProductNavel Orange                   ***
## ProductNut Thins 4.25 oz               ***
## ProductOriginal ramen                  ***
## ProductPremium Saltine Crackers 1 lb   ***
## ProductProgress Chicken Noodle Soup   ***
## ProductSan Pellegrino 25.3 floz        ***
## ProductSkinny Pop                     ***
## ProductSmart Water 23.7 fl oz          ***
## ProductStacy's Pita Chips              ***
## ProductTostitos Bag                   ***
## ProductTriscuits 9oz                   ***
## ProductWelch's Grape Jelly            ***
## ProductWheat Thins 8oz                 ***
## Income10K
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.804 on 319 degrees of freedom
## Multiple R-squared:  0.8607, Adjusted R-squared:  0.8432
## F-statistic: 49.28 on 40 and 319 DF,  p-value: < 2.2e-16

## Income10K
## -0.0315971

```

The coefficient on Income10K is -0.0141, meaning that for every \$10,000 increase in ZIP code income, the expected price of the same product decreases by about 1.41 cents.

Since the coefficient is negative, this implies that consumers in poorer ZIP codes tend to pay *more* for the same product, on average.

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

Problem 3: Redlining

A. ZIP codes with a higher percentage of minority residents tend to have more FAIR policies per 100 housing units.

True, positive correlation between percentage of minority residents and FAIR policies.

B. The evidence suggests an interaction effect between minority percentage and the age of the housing stock in the way that these two variables are related to the number of FAIR policies in a ZIP code.

False, no model includes an interaction term between minority and age.

C. The relationship between minority percentage and number of FAIR policies per 100 housing units is stronger in high-fire-risk ZIP codes than in low-fire-risk ZIP codes.

True, Figure C1 shows that the slope for the high fire risk group is steeper than for the low fire risk group.

D. Even without controlling for any other variables, income “explains away” all the association between minority percentage and FAIR policy uptake.

False, In model D2 (minority + income), the minority variable remains statistically significant ($p = 0.002$), with only a slight reduction in the coefficient (from 0.014 to 0.01).

E. Minority percentage and number of FAIR policies are still associated at the ZIP code level, even after controlling for income, fire risk, and housing age.

True, In model E, which includes all controls (income, fire, age), the minority variable remains statistically significant ($p = 0.006$) with a positive coefficient (0.008).