HW 3 notes

1. See
   1. Value of product videos = increase in sales of products to max profit
   2. No. interference, data will be biased and will not accurately tell if videos had an effect.
2. Excel w/ pivots, view PDF for validation
3. Treatment Effect of Videos on Focal Product Sales

Difference in means estimate: The treatment effect is measuring the average weekly sales, and the treatment group is where the VidWk = 1, meaning a video is shown on a focal product during that week. The diff-in-means for the two groups is $22.49. We used a paired t-test to account for time seasonality changes between weeks. The results are statistically significant at alpha = 0.05 which means that we can reject the null hypothesis that there is no treatment effect. There is evidence that the effect of product videos will increase average weekly focal product sales by $22.49 with a 95% confidence interval of [$8.59,$36.39].

Paired t-test

data: vid\_group$meansales and novid\_group$meansales

t = 3.3203, df = 27, p-value = 0.002585

alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

8.591839 36.388259

sample estimates:

mean of the differences

22.49005

Regression-based estimate: The regression equation has weekly focal product sales as the dependent variable and the video treatment + other promotions as independent variables. The regression equation and output are shown below in the text boxes. All the coefficients are statistically significant except for the price discount week variable. The interpretation of the effect of the product video is adding a focal product video leads to an increase in weekly sales of $26.29 after accounting for other promotional activities. The 95% confidence interval for the product video variable is [$16.29, $36.29].

#Regression FP Analysis

reg1 <- lm(Sales~as.factor(VidWk)+as.factor(PriceDiscWk)+as.factor(EmailWk)+as.factor(CatalogWk)+as.factor(HomePgWk)+as.factor(CatPgWk),data=hw3)

summary(reg1)

Call:

lm(formula = Sales ~ as.factor(VidWk) + as.factor(PriceDiscWk) +

as.factor(EmailWk) + as.factor(CatalogWk) + as.factor(HomePgWk) +

as.factor(CatPgWk), data = hw3)

Residuals:

Min 1Q Median 3Q Max

-311.17 -70.18 -37.18 28.38 2160.58

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 100.176 1.609 62.269 < 2e-16 \*\*\*

as.factor(VidWk)1 26.293 5.102 5.153 2.63e-07 \*\*\*

as.factor(PriceDiscWk)1 -3.506 6.482 -0.541 0.58862

as.factor(EmailWk)1 98.791 30.610 3.227 0.00126 \*\*

as.factor(CatalogWk)1 215.992 23.293 9.273 < 2e-16 \*\*\*

as.factor(HomePgWk)1 94.192 12.795 7.362 2.03e-13 \*\*\*

as.factor(CatPgWk)1 101.453 13.369 7.589 3.65e-14 \*\*\*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 122.5 on 6821 degrees of freedom

(9 observations deleted due to missingness)

Multiple R-squared: 0.0403, Adjusted R-squared: 0.03946

F-statistic: 47.74 on 6 and 6821 DF, p-value: < 2.2e-16

These two estimates are similar but not the same. The reason is the interference effect of other promotional activities. The regression model accounts for the catalog, home page, category page, email promotions and price discount weeks to get an estimated measurement of effect on sales by adding a focal video. The means estimate used a paired t-test to account for variation in individual weeks which increased the standard deviation of our mean difference and resulted in a wider confidence interval. In either case, both results lead to the same overall conclusion – there is evidence that focal product videos do increase weekly sales.

1. Treatment Effect of Videos on Coordinating Product Sales

The first regression analysis we performed was only CpSales (coordinating product sales) ~ Focal Prod Video treatment. This resulted in a significant estimate, but we left out many other factors that could influence CpSales. Next, we performed a regression with all the various promotional variables as independent variables. The formula and results of this regression are below.

The focal product video treatment has an estimate value of 21.36 and it is statistically significant. We can interpret this value as adding a focal product video will increase weekly coordinating product sales by approximately $21.36. The 95% confidence interval for this estimate is [$12.46, $30.27]. From the output we can see that there are many variables that are not statistically significant. The other independent variables that are significant are focal product catalog week, coordinating product email week, and coordinating product home page or category page weeks.

After the earlier regression analysis on focal product sales and this analysis, we can conclude that videos on focal products do lead to increased sales for both focal products and coordinating products.

Call:

lm(formula = CpSales ~ as.factor(VidWk) + as.factor(FpPriceDiscWk) +

as.factor(FpEmailWk) + as.factor(FpCatalogWk) + as.factor(FpHomePgWk) +

as.factor(CpPriceDiscWk) + as.factor(CpEmailWk) + as.factor(CpCatalogWk) +

as.factor(CpHomePgWk) + as.factor(CpCatPgWk), data = cp\_df)

Residuals:

Min 1Q Median 3Q Max

-217.72 -50.48 -31.97 10.52 2320.16

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 63.476 1.989 31.915 < 2e-16 \*\*\*

as.factor(VidWk)1 21.361 4.543 4.702 2.65e-06 \*\*\*

as.factor(FpPriceDiscWk)1 -9.385 6.484 -1.447 0.147837

as.factor(FpEmailWk)1 -19.683 28.494 -0.691 0.489739

as.factor(FpCatalogWk)1 117.984 14.613 8.074 8.56e-16 \*\*\*

as.factor(FpHomePgWk)1 4.524 9.728 0.465 0.641906

as.factor(CpPriceDiscWk)1 1.364 5.985 0.228 0.819732

as.factor(CpEmailWk)1 139.813 33.282 4.201 2.71e-05 \*\*\*

as.factor(CpCatalogWk)1 16.211 27.339 0.593 0.553242

as.factor(CpHomePgWk)1 90.622 25.480 3.557 0.000379 \*\*\*

as.factor(CpCatPgWk)1 92.431 22.418 4.123 3.80e-05 \*\*\*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 115.5 on 4697 degrees of freedom

Multiple R-squared: 0.03993, Adjusted R-squared: 0.03789

F-statistic: 19.54 on 10 and 4697 DF, p-value: < 2.2e-16

#Regression - CP Analysis

reg2 <- lm(CpSales~as.factor(VidWk),data=cp\_df)

summary(reg2)

reg3 <- lm(CpSales~as.factor(VidWk)+as.factor(FpPriceDiscWk)+as.factor(FpEmailWk)+as.factor(FpCatalogWk)+as.factor(FpHomePgWk)+as.factor(CpPriceDiscWk)+as.factor(CpEmailWk)+as.factor(CpCatalogWk)+as.factor(CpHomePgWk)+as.factor(CpCatPgWk),data=cp\_df)

summary(reg3)

1. Marketing-Mix Decision

To test if product videos have an incremental effect on sales when combined with other kinds of marketing promotions, we need to consider interaction variables in the linear regression model. We ran the model below which shows both the regression formula and output.

All of the coefficients in the model are statistically significant at alpha = 0.05 except for the interaction between videos & home page weeks with a p-value of 0.055. This means that the combination of videos and marketing promotions does effect sales. If a product has both a video and it is a price discount week, we can expect sales to increase by $16.65 - $13.72 + $50.63 = $53.56 compared to no video and not a discount week.

An interesting observation is the interaction between product videos and catalog weeks with a coefficient of -224.19. To correctly interpret this, we need to consider 3 cases: if a product is featured in the catalog but does not have a product video, weekly sales increase by $241.63. If a product has a video and it is not a catalog week, weekly sales increase by $16.65. However, the combined strategy of product videos and the catalog promotion negatively impacts sales with a coefficient of -$224.19. One reason for this could be that the products highlighted in the catalog are different from the products with videos.

The incremental effect of a product having a video and being featured on the home page increases weekly sales by $83.99 and the incremental effect of a product having a video and being featured on the category page increases weekly sales by $194.30.

#Regression - Marketing Mix

reg4 <- lm(Sales~as.factor(VidWk)+as.factor(PriceDiscWk)+as.factor(EmailWk)+

as.factor(CatalogWk)+as.factor(HomePgWk)+as.factor(CatPgWk)+

as.factor(VidWk)\*as.factor(PriceDiscWk)+as.factor(VidWk)\*as.factor(CatalogWk)+

as.factor(VidWk)\*as.factor(HomePgWk)+as.factor(VidWk)\*as.factor(CatPgWk),data=hw3)

summary(reg4)

Call:

lm(formula = Sales ~ as.factor(VidWk) + as.factor(PriceDiscWk) +

as.factor(EmailWk) + as.factor(CatalogWk) + as.factor(HomePgWk) +

as.factor(CatPgWk) + as.factor(VidWk) \* as.factor(PriceDiscWk) +

as.factor(VidWk) \* as.factor(CatalogWk) + as.factor(VidWk) \*

as.factor(HomePgWk) + as.factor(VidWk) \* as.factor(CatPgWk),

data = hw3)

Residuals:

Min 1Q Median 3Q Max

-337.87 -70.25 -36.25 28.75 1988.42

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 101.247 1.611 62.866 < 2e-16 \*\*\*

as.factor(VidWk)1 16.650 5.369 3.101 0.001936 \*\*

as.factor(PriceDiscWk)1 -13.721 6.981 -1.966 0.049393 \*

as.factor(EmailWk)1 109.855 30.568 3.594 0.000328 \*\*\*

as.factor(CatalogWk)1 241.628 24.543 9.845 < 2e-16 \*\*\*

as.factor(HomePgWk)1 86.971 13.374 6.503 8.44e-11 \*\*\*

as.factor(CatPgWk)1 47.477 15.345 3.094 0.001983 \*\*

as.factor(VidWk)1:as.factor(PriceDiscWk)1 50.628 18.574 2.726 0.006432 \*\*

as.factor(VidWk)1:as.factor(CatalogWk)1 -224.192 74.705 -3.001 0.002701 \*\*

as.factor(VidWk)1:as.factor(HomePgWk)1 83.994 43.834 1.916 0.055385 .

as.factor(VidWk)1:as.factor(CatPgWk)1 194.301 31.435 6.181 6.74e-10 \*\*\*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 121.9 on 6817 degrees of freedom

(9 observations deleted due to missingness)

Multiple R-squared: 0.05018, Adjusted R-squared: 0.04879

F-statistic: 36.01 on 10 and 6817 DF, p-value: < 2.2e-16