Causal and Predictive Analytics – Homework 1

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Individual Assignment

This assignment is based on a Facebook advertising dataset. It contains data from a large-scale field experiment of advertisements for various clothing brands on the facebook platform. The dataset was initially provided to a previous MS student, and was the subject of several questions in the hiring process. In this assignment, we will use this data to explore both omitted variable bias and interaction effects. The advertisements were all run in the same week. The business goal is to evaluate which attributes constitute successful advertisements.

Your performance will be evaluated as if you are a job candidate, based on the strength of your arguments, the use of data to support your conclusions, and the clarity of your writing. Do not share, copy, or discuss your written answers with other students.

Submission Checklist

- If you choose to use Generative AI, please use a single session of ChatGPT, and get a link to the chat through the "Share" button. Submit this on blackboard while submitting your assignment.
- Save a copy of your answers in case the browser you are working in closes.
- Submit your answers to the questions through blackboard

Data Dictionary

- **date** date of the week the advertising campaign was run
- **adType** whether the advertisement appeared in a link or a photo post
- **category** type of retailer referenced in the advertisement. The values are Cosmetics, Department, eCom, General, High End, and Retailer.
- **placement** whether the ad appeared on the desktop or mobile client
- **keyword** categorical variable representing which store the purchase was made at
- **body** actual text of the ad. There were 6 values tested:
    1. Check out a sneak peak of what's new in our stores!
    2. Click "Like" to become a fan of Retail Store X!
    3. Click "Like" to see what's new in our stores for Spring!!
    4. Need inspiration for your spring wardrobe? "Like" us for more!
    5. Share your favorite fresh Spring looks on our Facebook page. Click "Like" now!
    6. What's your favorite Spring fashion trend? "Like" us and share!
- **ageMean** average age of the targeted consumers
- **clickPerDollar** number of clicks the ad achieved for each dollar spent

```r
#Set the directory
setwd("C:/Dropbox/Teaching Lectures/Assignments/Homework 2")

homeworkDB = read.csv('Facebook Data.csv')
```

In Analysis A, we run a linear regression of all terms in the dataset.

```r
lm(clickPerDollar~factor(adType)+factor(placement)+factor(keywords)+factor(body)+factor(category)+ageMea
```

```
##
## Call:
## lm(formula = clickPerDollar ~ factor(adType) + factor(placement) +
##     factor(keywords) + factor(body) + factor(category) + ageMean,
##     data = homeworkDB)
##
## Coefficients:
##                                                                                (Intercept)
##                                                                                  56.042064
##                                                                  factor(adType)Photo Post
##                                                                                   7.395170
##                                                                   factor(placement)mobile
##                                                                                  33.650630
##          factor(keywords)#Almay, #Clinique, #CoverGirl, #Maybelline, #Sephora, mac cosmetics
##                                                                                  -1.319535
##                                                          factor(keywords)#Amazon.com, #EBay
##                                                                                  -0.421027
##                                                 factor(keywords)#American Eagle Outfitters
##                                                                                  -0.200383
##                                           factor(keywords)#Ann Taylor (clothing retailer)
##                                                                                  -3.288650
##                                                       factor(keywords)#Anthropologie
##                                                                                  -1.223708
##                                     factor(keywords)#Banana Republic (clothing retailer)
##                                                                                  -0.028768
##                                                         factor(keywords)#Bebe stores
##                                                                                   0.013857
##                                                 factor(keywords)#Burlington Coat Factory
##                                                                                   1.041831
##                                                           factor(keywords)#Dillard's
##                                                                                  -0.629959
##                                                            factor(keywords)#Fashion
##                                                                                   2.188222
##                                                 factor(keywords)#Gap (clothing retailer)
##                                                                                  -0.741172
##                                                         factor(keywords)#Kate Spade
##                                                                                   0.460312
##                                                              factor(keywords)#Kmart
##                                                                                  -2.242984
##                                                            factor(keywords)#Kohl's
##                                                                                  -1.650176
##                                                  factor(keywords)#Lucky Brand Jeans
##                                                                                  -0.167120
##                                              factor(keywords)#Lululemon Athletica
##                                                                                  -1.740610
##                                                            factor(keywords)#Macy's
```

```
##                                                                                -0.575275
##                                                                 factor(keywords)#Nordstrom
##                                                                                 1.028788
##                                                                  factor(keywords)#Old Navy
##                                                                                -2.283174
##                                                                     factor(keywords)#Sears
##                                                                                 0.211964
##                                                                  factor(keywords)#Shopping
##                                                                                -0.395439
##                                                                   factor(keywords)#Talbots
##                                                                                 0.009305
##                                                               factor(keywords)#Urban Outfitters
##                                                                                -1.888074
##                                                                 factor(keywords)#Zappos.com
##                                                                                 1.017146
##                                  factor(body)Click ""Like"" to become a fan of Retail Store X!
##                                                                                12.739781
##                         factor(body)Click ""Like"" to see what's new in our stores for Spring!!
##                                                                                13.409695
##                    factor(body)Need inspiration for your spring wardrobe? ""Like"" us for more!
##                                                                                -0.032314
## factor(body)Share your favorite fresh Spring looks on our Facebook page. Click ""Like"" now!
##                                                                                12.035943
##                   factor(body)What's your favorite Spring fashion trend? ""Like"" us and share!
##                                                                                 0.506791
##                                                                 factor(category)Department
##                                                                                -32.538466
##                                                                      factor(category)eCom
##                                                                                -42.643506
##                                                                   factor(category)General
##                                                                                -45.741606
##                                                                  factor(category)High End
##                                                                                -42.101003
##                                                                  factor(category)Retailer
##                                                                                -28.402593
##                                                                                   ageMean
##                                                                                 2.598849
```

We next include an interaction between the category and the average age of the targeted consumers.

```
lm(clickPerDollar~factor(adType)+factor(placement)+factor(keywords)+factor(body)+factor(category)*ageMea
```

```
##
## Call:
## lm(formula = clickPerDollar ~ factor(adType) + factor(placement) +
##     factor(keywords) + factor(body) + factor(category) * ageMean,
##     data = homeworkDB)
##
## Coefficients:
##                                                                    (Intercept)
##                                                                       63.40769
##                                                             factor(adType)Photo Post
##                                                                        6.90072
##                                                              factor(placement)mobile
##                                                                       33.70072
```

```
##          factor(keywords)#Almay, #Clinique, #CoverGirl, #Maybelline, #Sephora, mac cosmetics
##                                                                                      -1.03603
##                                                                  factor(keywords)#Amazon.com, #EBay
##                                                                                      -0.17489
##                                                              factor(keywords)#American Eagle Outfitters
##                                                                                      -0.53998
##                                                          factor(keywords)#Ann Taylor (clothing retailer)
##                                                                                      -2.61852
##                                                                 factor(keywords)#Anthropologie
##                                                                                      -0.97063
##                                                      factor(keywords)#Banana Republic (clothing retailer)
##                                                                                       0.26258
##                                                                   factor(keywords)#Bebe stores
##                                                                                      -0.93493
##                                                          factor(keywords)#Burlington Coat Factory
##                                                                                      -0.05584
##                                                                    factor(keywords)#Dillard's
##                                                                                      -0.19698
##                                                                      factor(keywords)#Fashion
##                                                                                       1.16567
##                                                          factor(keywords)#Gap (clothing retailer)
##                                                                                      -1.09804
##                                                                  factor(keywords)#Kate Spade
##                                                                                      -0.56293
##                                                                       factor(keywords)#Kmart
##                                                                                      -1.89209
##                                                                     factor(keywords)#Kohl's
##                                                                                      -1.58733
##                                                             factor(keywords)#Lucky Brand Jeans
##                                                                                      -0.33976
##                                                         factor(keywords)#Lululemon Athletica
##                                                                                      -1.58411
##                                                                     factor(keywords)#Macy's
##                                                                                      -1.52601
##                                                                  factor(keywords)#Nordstrom
##                                                                                       0.42475
##                                                                   factor(keywords)#Old Navy
##                                                                                      -2.11457
##                                                                      factor(keywords)#Sears
##                                                                                      -0.79619
##                                                                   factor(keywords)#Shopping
##                                                                                      -0.82844
##                                                                    factor(keywords)#Talbots
##                                                                                      -0.60640
##                                                               factor(keywords)#Urban Outfitters
##                                                                                      -1.92284
##                                                                  factor(keywords)#Zappos.com
##                                                                                       0.63366
##                                 factor(body)Click ""Like"" to become a fan of Retail Store X!
##                                                                                      12.85738
##                       factor(body)Click ""Like"" to see what's new in our stores for Spring!!
##                                                                                      13.57649
##                  factor(body)Need inspiration for your spring wardrobe? ""Like"" us for more!
##                                                                                       0.04642
```

```
## factor(body)Share your favorite fresh Spring looks on our Facebook page. Click ""Like"" now!
##                                                                                    12.33622
##                 factor(body)What's your favorite Spring fashion trend? ""Like"" us and share!
##                                                                                     0.76565
##                                                                  factor(category)Department
##                                                                                   -48.69836
##                                                                       factor(category)eCom
##                                                                                   -28.29490
##                                                                    factor(category)General
##                                                                                   -60.24087
##                                                                  factor(category)High End
##                                                                                   -48.37628
##                                                                  factor(category)Retailer
##                                                                                   -41.47216
##                                                                                     ageMean
##                                                                                     2.41940
##                                                  factor(category)Department:ageMean
##                                                                                     0.41373
##                                                       factor(category)eCom:ageMean
##                                                                                    -0.36125
##                                                    factor(category)General:ageMean
##                                                                                     0.36446
##                                                  factor(category)High End:ageMean
##                                                                                     0.15944
##                                                  factor(category)Retailer:ageMean
##                                                                                     0.33229
```

Discussion (28 marks)

Please provide written answers to each of the following questions in the blackboard link. Answers will be judged on accuracy and correct spelling/grammar. Pay close attention to what each question is asking for and the course materials. Each answer only requires a short response (Maximum of 3 sentences and 45 words). Additional words and sentences will be deleted. Please use a spelling/grammar check before you submit. Each question is worth 4 marks.

1. Suppose the firm is interested in identifying the keywords they should use to get the largest number of clicks per dollar. Would this be a descriptive, predictive, or causal question? Justify your answer.
2. According to the point estimates from analysis A, which category is associated with the largest number of clicks per dollar?
3. In Analysis A, in quantitative terms, what is the interpretation of the ageMean coefficient?
4. In qualitative terms, what can we conclude from the factor(category)eCom:ageMean coefficient in Analysis B?
5. In Analysis B, what is the marginal effect of a one unit increase in ageMean for an for a store in the 'Department' category
6. Comparing Analysis A and Analysis B, what happens to the coefficient of factor(category)Department? Why did this happen? Be more specific than simply stating it is because of the interaction.
7. Based on Analysis B, recommend the top 3 categories for advertising to a 20-year-old and a 60-year-old.