PFG Bank: Credit Card Exercise

true true

Preliminaries

Determine notebook defaults:

Load packages:

Mailing 1

First, let's start by summarising our previous marketing campaign results.

Note: Throughout these steps I am retaining the same (or similar) columns so they can merged.

```
# Response Rates
solicitation.results = read.csv("MKT_482_CreditCard.csv", header = TRUE)
solicitation.results
```

```
        Date  APR     Type Fee Card_Type Num_Mailed Num_Accounts Avg_BK
1      April 16.8    Fixed  20        MC     167000         1533    210
2            16.8    Fixed   0        MC      81000         2896    210
3            19.8    Fixed  20        MC     143000          590    210
4            19.8    Fixed   0        MC     100000         2052    210
5  September 14.9    Fixed  20      Visa     177000         4329    255
6            14.9 Variable  20      Visa     170000         3004    255
7            16.8    Fixed  20      Visa     255000         2983    255
8            19.8    Fixed  20      Visa      35000          175    255
9            16.8    Fixed   0      Visa      65000         2516    255
10           19.8    Fixed   0      Visa      95000         2115    255
11  November 14.9    Fixed  20      Visa      82000         1761    190
12           14.9    Fixed   0      Visa      50000         2451    190
13           14.9 Variable  20      Visa      50000          708    190
14           16.8    Fixed  20      Visa      50000          372    190
```

```
solicitation.results <- solicitation.results %>%
   mutate(Fee=factor(Fee), APR=factor(APR)) %>%
   group_by(APR, Type, Fee) %>%
   select(APR, Type, Fee, Num_Mailed, Num_Accounts, Avg_BK) %>%
   summarise(
      Tot_Mailed=sum(Num_Mailed),
      Tot_Accounts=sum(Num_Accounts),
      Tot_Avg_BK=weighted.mean(Avg_BK, Num_Mailed)
   ) %>% mutate(Resp_Rate=Tot_Accounts / Tot_Mailed)
solicitation.results
```

```
# A tibble: 7 x 7
# Groups:   APR, Type [4]
  APR   Type     Fee   Tot_Mailed Tot_Accounts Tot_Avg_BK Resp_Rate
  <fct> <fct>    <fct>      <int>        <int>      <dbl>     <dbl>
```

```
1 14.9  Fixed    0          50000         2451       190    0.0490
2 14.9  Fixed    20        259000         6090       234.   0.0235
3 14.9  Variable 20        220000         3712       240.   0.0169
4 16.8  Fixed    0         146000         5412       230.   0.0371
5 16.8  Fixed    20        472000         4888       232.   0.0104
6 19.8  Fixed    0         195000         4167       232.   0.0214
7 19.8  Fixed    20        178000          765       219.   0.00430
```

Second, we'll merge a Full Factorial design into our partial results.

```
# Partial Factorial Design
solicitation.design <- list(APR=c("14.9", "16.8", "19.8"), Type=c("Fixed", "Variable"), Fee=c("20", "0"
solicitation.design <- expand.grid(solicitation.design)

solicitation.design <- full_join(solicitation.design, solicitation.results) %>% arrange(APR)
solicitation.design
```

```
    APR     Type Fee Tot_Mailed Tot_Accounts Tot_Avg_BK   Resp_Rate
1  14.9    Fixed  20     259000         6090   234.4208 0.023513514
2  14.9 Variable  20     220000         3712   240.2273 0.016872727
3  14.9    Fixed   0      50000         2451   190.0000 0.049020000
4  14.9 Variable   0         NA           NA         NA          NA
5  16.8    Fixed  20     472000         4888   232.1928 0.010355932
6  16.8 Variable  20         NA           NA         NA          NA
7  16.8    Fixed   0     146000         5412   230.0342 0.037068493
8  16.8 Variable   0         NA           NA         NA          NA
9  19.8    Fixed  20     178000          765   218.8483 0.004297753
10 19.8 Variable  20         NA           NA         NA          NA
11 19.8    Fixed   0     195000         4167   231.9231 0.021369231
12 19.8 Variable   0         NA           NA         NA          NA
```

Third, we'll predict what the response rate is to a solicitation for each product offer.

```
lr <- glm(Resp_Rate~APR*Type*Fee, data=solicitation.design, family=binomial)

predictions <- predict(lr, newdata=solicitation.design, type="response")
solicitation.design <- solicitation.design %>% mutate(Pred_Resp_Rate = predictions)
solicitation.design %>% select(APR, Type, Fee, Resp_Rate, Pred_Resp_Rate)
```

```
    APR     Type Fee   Resp_Rate Pred_Resp_Rate
1  14.9    Fixed  20 0.023513514    0.023513514
2  14.9 Variable  20 0.016872727    0.016872727
3  14.9    Fixed   0 0.049020000    0.049020000
4  14.9 Variable   0          NA    0.035436986
5  16.8    Fixed  20 0.010355932    0.010355932
6  16.8 Variable  20          NA    0.007402994
7  16.8    Fixed   0 0.037068493    0.037068493
8  16.8 Variable   0          NA    0.026704144
9  19.8    Fixed  20 0.004297753    0.004297753
10 19.8 Variable  20          NA    0.003066918
11 19.8    Fixed   0 0.021369231    0.021369231
12 19.8 Variable   0          NA    0.015324538
```

Fourth, we'll create a similar table of the CLV estimates that were given to us in Exhibit 2 and merge them into our analysis.

```
# CLV Estimates
clv.design <- list( APR=c("14.9", "16.8", "19.8"), Type=c("Fixed", "Variable"), Fee=c("20", "0"))
clv.full <- expand.grid(clv.design) %>% arrange(APR)
clv.results <- clv.full %>%
   mutate(
      BK_150=c(83,93,52,62,103,113,72,82, 131,141,100,110),
      BK_200=c(63,73,32,42,83,93,52,62,111,121,80,90),
      BK_250=c(33,43,2,12,53,63,22,32,81,91,50,60)
   ) %>% arrange(APR)
solicitation.design <- full_join(solicitation.design, clv.results)
solicitation.design %>% select(APR, Type, Fee, Pred_Resp_Rate, BK_150, BK_200, BK_250)
```

```
    APR     Type Fee Pred_Resp_Rate BK_150 BK_200 BK_250
1  14.9    Fixed  20    0.023513514     83     63     33
2  14.9 Variable  20    0.016872727     93     73     43
3  14.9    Fixed   0    0.049020000     52     32      2
4  14.9 Variable   0    0.035436986     62     42     12
5  16.8    Fixed  20    0.010355932    103     83     53
6  16.8 Variable  20    0.007402994    113     93     63
7  16.8    Fixed   0    0.037068493     72     52     22
8  16.8 Variable   0    0.026704144     82     62     32
9  19.8    Fixed  20    0.004297753    131    111     81
10 19.8 Variable  20    0.003066918    141    121     91
11 19.8    Fixed   0    0.021369231    100     80     50
12 19.8 Variable   0    0.015324538    110     90     60
```

Fifth, we'll estimate the results of sending 100,000 marketing deals of each product to each CLV customer profile.

```
variable_cost <- 0.50  # from Capital One ("PFG Bank"): Credit Card Exercise doc
solicitation.profit <- solicitation.design %>%
   mutate(
      BK_150_Profit=dollar((100000 * Pred_Resp_Rate * BK_150) - (100000 * variable_cost)),
      BK_200_Profit=dollar((100000 * Pred_Resp_Rate * BK_200) - (100000 * variable_cost)),
      BK_250_Profit=dollar((100000 * Pred_Resp_Rate * BK_250) - (100000 * variable_cost)),
   ) %>% select(APR, Type, Fee, Resp_Rate, Pred_Resp_Rate, BK_150, BK_200, BK_250, BK_150_Profit, BK_200
solicitation.profit %>% select(APR, Type, Fee, Pred_Resp_Rate, BK_150_Profit, BK_200_Profit, BK_250_Pro
```

```
    APR     Type Fee Pred_Resp_Rate BK_150_Profit BK_200_Profit BK_250_Profit
1  14.9    Fixed  20    0.023513514      $145,162       $98,135    $27,594.59
2  14.9 Variable  20    0.016872727      $106,916       $73,171    $22,552.73
3  14.9    Fixed   0    0.049020000      $204,904      $106,864   -$40,196.00
4  14.9 Variable   0    0.035436986      $169,709       $98,835    -$7,475.62
5  16.8    Fixed  20    0.010355932       $56,666       $35,954     $4,886.44
6  16.8 Variable  20    0.007402994       $33,654       $18,848    -$3,361.14
7  16.8    Fixed   0    0.037068493      $216,893      $142,756    $31,550.68
8  16.8 Variable   0    0.026704144      $168,974      $115,566    $35,453.26
9  19.8    Fixed  20    0.004297753        $6,301       -$2,295   -$15,188.20
10 19.8 Variable  20    0.003066918       -$6,756      -$12,890   -$22,091.04
11 19.8    Fixed   0    0.021369231      $163,692      $120,954    $56,846.15
12 19.8 Variable   0    0.015324538      $118,570       $87,921    $41,947.23
```

Mailing 2

First, let's get the results from the first mailing into our analysis (New CSV File with added rows)

```r
solicitation.results2 = read.csv("MKT_482_CreditCard_v2.csv", header = TRUE)
solicitation.results2 <- solicitation.results2 %>%
   mutate(
      Resp_Rate=Num_Accounts / Num_Mailed,
      Fee=factor(Fee),
      APR=factor(APR)
   )

# NOTE: This time we include Avg_BK into the regression & don't group first
lr2 <- glm(Resp_Rate~APR*Type*Fee, data=solicitation.results2, family=binomial)

solicitation.results2 <- solicitation.results2 %>%
   group_by(APR, Type, Fee) %>%
   select(APR, Type, Fee, Num_Mailed, Num_Accounts, Avg_BK) %>%
   summarise(
      Tot_Mailed=sum(Num_Mailed),
      Tot_Accounts=sum(Num_Accounts),
      Tot_Avg_BK=weighted.mean(Avg_BK, Num_Mailed)
   ) %>% mutate(Resp_Rate=Tot_Accounts / Tot_Mailed)

# change back to column names - not sure why it wouldn't allow me to keep them as-is
colnames(solicitation.results2)[4] <- "Num_Mailed"
colnames(solicitation.results2)[5] <- "Num_Accounts"
colnames(solicitation.results2)[6] <- "Avg_BK"

# Full Design
solicitation.design2 <- list(APR=c("14.9", "16.8", "19.8"), Type=c("Fixed", "Variable"), Fee=c("20", "0
solicitation.design2 <- expand.grid(solicitation.design2)

solicitation.design2 <- full_join(solicitation.design2, solicitation.results2) %>% arrange(APR)
# New Predictions - note, we don't get predictions this time because we included "BK" which is NA
predictions2 <- predict(lr2, newdata=solicitation.design2, type="response")
solicitation.design2 <- solicitation.design2 %>% mutate(Pred_Resp_Rate = predictions2)

# CLV
solicitation.design2 <- full_join(solicitation.design2, clv.results)

# New Profit
solicitation.profit2 <- solicitation.design2 %>%
   mutate(
      BK_150_Profit=dollar((100000 * Pred_Resp_Rate * BK_150) - (100000 * variable_cost)),
      BK_200_Profit=dollar((100000 * Pred_Resp_Rate * BK_200) - (100000 * variable_cost)),
      BK_250_Profit=dollar((100000 * Pred_Resp_Rate * BK_250) - (100000 * variable_cost)),
   ) %>% select(APR, Type, Fee, Resp_Rate, Pred_Resp_Rate, BK_150, BK_200, BK_250, BK_150_Profit, BK_20
solicitation.profit2 %>% select(APR, Type, Fee, Pred_Resp_Rate, BK_150_Profit, BK_200_Profit, BK_250_Pr
```

```
   APR     Type Fee Pred_Resp_Rate BK_150_Profit BK_200_Profit BK_250_Profit
1 14.9    Fixed  20    0.022966618      $140,623       $94,690    $25,789.84
2 14.9 Variable  20    0.015915294       $98,012       $66,182    $18,435.76
3 14.9    Fixed   0    0.049020000      $204,904      $106,864   -$40,196.00
4 14.9 Variable   0    0.034560000      $164,272       $95,152    -$8,528.00
5 16.8    Fixed  20    0.009439227       $47,224       $28,346        $27.90
6 16.8 Variable  20    0.006948103       $28,514       $14,617    -$6,226.95
7 16.8    Fixed   0    0.027437417      $147,549       $92,675    $10,362.32
```

8	16.8	Variable	0	0.020480000	$117,936	$76,976	$15,536.00
9	19.8	Fixed	20	0.004562937	$9,774	$649	-$13,040.21
10	19.8	Variable	20	0.003394746	-$2,134	-$8,924	-$19,107.81
11	19.8	Fixed	0	0.020373645	$153,736	$112,989	$51,868.23
12	19.8	Variable	0	0.015360000	$118,960	$88,240	$42,160.00

Preparation Questions

Please see accompanying pdf