BUAN 573 Individual Assignment, Week 6

Your Name

July 18, 2022

Competitive Auctions on Ebay The file *eBayAuctions.csv* contains information on 1972 auctions transacted on eBay.com during May–June 2004. The goal is to use these data to build a model that will distinguish competitive auctions from noncompetitive ones. A competitive auction is defined as an auction with at least two bids placed on the item being auctioned. The data include variables that describe the item (auction category), the seller (his or her eBay rating), and the auction terms that the seller selected (auction duration, opening price, currency, day of week of auction close). In addition, we have the price at which the auction closed. The goal is to predict whether or not an auction of interest will be competitive.

    a. Load the eBayAuctions.csv file into R and and convert the categorical variables into factors. The categorical variables are Category (18 categories), currency (USD, GBP, Euro), endDay (Monday–Sunday), and Duration (1, 3, 5, 7, or 10 days).

answer

```
##            Category currency sellerRating Duration endDay ClosePrice OpenPrice
## 1 Music/Movie/Game       US         3249        5    Mon       0.01      0.01
## 2 Music/Movie/Game       US         3249        5    Mon       0.01      0.01
## 3 Music/Movie/Game       US         3249        5    Mon       0.01      0.01
## 4 Music/Movie/Game       US         3249        5    Mon       0.01      0.01
## 5 Music/Movie/Game       US         3249        5    Mon       0.01      0.01
## 6 Music/Movie/Game       US         3249        5    Mon       0.01      0.01
##   Competitive
## 1           0
## 2           0
## 3           0
## 4           0
## 5           0
## 6           0
```

```
## Rows: 1,972
## Columns: 8
## $ Category     <chr> "Music/Movie/Game", "Music/Movie/Game", "Music/Movie/Game~
## $ currency     <chr> "US", "US", "US", "US", "US", "US", "US", "US", "US", "US~
## $ sellerRating <int> 3249, 3249, 3249, 3249, 3249, 3249, 3249, 3249, 3249, 324~
## $ Duration     <int> 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 7, 7, 7, ~
## $ endDay       <chr> "Mon", "Mon", "Mon", "Mon", "Mon", "Mon", "Mon", "Mon", "~
## $ ClosePrice   <dbl> 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.0~
## $ OpenPrice    <dbl> 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.0~
## $ Competitive  <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ~
```

```
## Rows: 1,972
## Columns: 8
## $ Category     <fct> Music/Movie/Game, Music/Movie/Game, Music/Movie/Game, Mus~
## $ currency     <fct> US, US, US, US, US, US, US, US, US, US, US, US, US, US, U~
## $ sellerRating <int> 3249, 3249, 3249, 3249, 3249, 3249, 3249, 3249, 3249, 324~
## $ Duration     <fct> 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 7, 7, 7, ~
## $ endDay       <fct> Mon, Mon, Mon, Mon, Mon, Mon, Mon, Mon, Mon, Mon, Mon, Mo~
## $ ClosePrice   <dbl> 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.0~
## $ OpenPrice    <dbl> 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.0~
## $ Competitive  <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ~
```

b. Using the `aggregate()` function of the base R package, create pivot tables for the mean of the binary outcome (Competitive) as a function of various categories within each categorical variable. Use the information in the tables to reduce the number of categories that will be used in the model. For example, conceptually related categories that appear most similar with respect to the distribution of competitive auctions could be combined. #answer

```
##      Duration             Category endDay currency Competitive
## 1           3    Antique/Art/Craft    Fri      EUR  1.00000000
## 2           7    Antique/Art/Craft    Fri      EUR  1.00000000
## 3          10    Antique/Art/Craft    Fri      EUR  1.00000000
## 4          10           Automotive    Fri      EUR  1.00000000
## 5           5                Books    Fri      EUR  0.00000000
## 6          10                Books    Fri      EUR  1.00000000
## 7          10  Business/Industrial    Fri      EUR  1.00000000
## 8           5 Clothing/Accessories    Fri      EUR  0.50000000
## 9           7 Clothing/Accessories    Fri      EUR  0.33333333
## 10         10 Clothing/Accessories    Fri      EUR  0.50000000
## 11         10         Coins/Stamps    Fri      EUR  1.00000000
## 12          3         Collectibles    Fri      EUR  1.00000000
## 13          5         Collectibles    Fri      EUR  1.00000000
## 14          7         Collectibles    Fri      EUR  0.71428571
## 15         10         Collectibles    Fri      EUR  0.50000000
## 16          7             Computer    Fri      EUR  0.00000000
## 17         10             Computer    Fri      EUR  1.00000000
## 18          5          Electronics    Fri      EUR  1.00000000
## 19          7          Electronics    Fri      EUR  1.00000000
## 20         10          Electronics    Fri      EUR  0.50000000
## 21          7        Health/Beauty    Fri      EUR  0.00000000
## 22          5          Home/Garden    Fri      EUR  0.50000000
## 23          7          Home/Garden    Fri      EUR  0.83333333
## 24         10          Home/Garden    Fri      EUR  0.66666667
## 25          1              Jewelry    Fri      EUR  0.00000000
## 26          3              Jewelry    Fri      EUR  1.00000000
## 27          7              Jewelry    Fri      EUR  0.66666667
## 28          5     Music/Movie/Game    Fri      EUR  0.75000000
## 29          7     Music/Movie/Game    Fri      EUR  0.50000000
## 30         10     Music/Movie/Game    Fri      EUR  1.00000000
## 31         10        SportingGoods    Fri      EUR  0.00000000
## 32          3         Toys/Hobbies    Fri      EUR  1.00000000
## 33          7         Toys/Hobbies    Fri      EUR  1.00000000
## 34         10         Toys/Hobbies    Fri      EUR  1.00000000
## 35          5    Antique/Art/Craft    Mon      EUR  0.50000000
## 36          7    Antique/Art/Craft    Mon      EUR  0.00000000
```

```
## 37    5           Automotive    Mon    EUR    1.00000000
## 38    7           Automotive    Mon    EUR    1.00000000
## 39   10           Automotive    Mon    EUR    0.50000000
## 40    5                Books    Mon    EUR    0.00000000
## 41    7                Books    Mon    EUR    0.00000000
## 42    7    Business/Industrial  Mon    EUR    0.00000000
## 43   10    Business/Industrial  Mon    EUR    1.00000000
## 44    5  Clothing/Accessories   Mon    EUR    0.83333333
## 45    7  Clothing/Accessories   Mon    EUR    1.00000000
## 46   10          Collectibles   Mon    EUR    0.75000000
## 47    5             Computer    Mon    EUR    1.00000000
## 48    5           Electronics   Mon    EUR    1.00000000
## 49    7           Electronics   Mon    EUR    1.00000000
## 50   10           Electronics   Mon    EUR    0.50000000
## 51    5          Health/Beauty  Mon    EUR    0.00000000
## 52    7          Health/Beauty  Mon    EUR    0.00000000
## 53    7           Home/Garden   Mon    EUR    0.00000000
## 54   10           Home/Garden   Mon    EUR    0.75000000
## 55    5               Jewelry   Mon    EUR    0.00000000
## 56    7               Jewelry   Mon    EUR    1.00000000
## 57   10               Jewelry   Mon    EUR    0.66666667
## 58    7      Music/Movie/Game   Mon    EUR    0.20000000
## 59   10      Music/Movie/Game   Mon    EUR    0.37500000
## 60    5         SportingGoods   Mon    EUR    1.00000000
## 61    7         SportingGoods   Mon    EUR    1.00000000
## 62   10         SportingGoods   Mon    EUR    0.40000000
## 63    5           Toys/Hobbies  Mon    EUR    1.00000000
## 64    3      Antique/Art/Craft  Sat    EUR    1.00000000
## 65    7           Automotive    Sat    EUR    1.00000000
## 66   10           Automotive    Sat    EUR    1.00000000
## 67    1                Books    Sat    EUR    0.00000000
## 68   10                Books    Sat    EUR    0.66666667
## 69    3  Clothing/Accessories   Sat    EUR    1.00000000
## 70    5  Clothing/Accessories   Sat    EUR    0.50000000
## 71    7  Clothing/Accessories   Sat    EUR    0.25000000
## 72   10  Clothing/Accessories   Sat    EUR    0.60000000
## 73    7          Collectibles   Sat    EUR    1.00000000
## 74   10          Collectibles   Sat    EUR    1.00000000
## 75    5             Computer    Sat    EUR    1.00000000
## 76    3           Electronics   Sat    EUR    1.00000000
## 77    7           Electronics   Sat    EUR    0.75000000
## 78   10           Electronics   Sat    EUR    1.00000000
## 79    7          Health/Beauty  Sat    EUR    0.00000000
## 80    3           Home/Garden   Sat    EUR    1.00000000
## 81    5           Home/Garden   Sat    EUR    1.00000000
## 82    7           Home/Garden   Sat    EUR    0.00000000
## 83    7               Jewelry   Sat    EUR    1.00000000
## 84   10               Jewelry   Sat    EUR    1.00000000
## 85    3      Music/Movie/Game   Sat    EUR    0.00000000
## 86    5      Music/Movie/Game   Sat    EUR    1.00000000
## 87   10      Music/Movie/Game   Sat    EUR    0.00000000
## 88    7         SportingGoods   Sat    EUR    1.00000000
## 89   10         SportingGoods   Sat    EUR    0.00000000
## 90    5           Toys/Hobbies  Sat    EUR    0.00000000
```

```
## 91    10        Toys/Hobbies    Sat    EUR   0.00000000
## 92     5     Antique/Art/Craft  Sun    EUR   1.00000000
## 93     7     Antique/Art/Craft  Sun    EUR   0.00000000
## 94    10     Antique/Art/Craft  Sun    EUR   0.33333333
## 95     7          Automotive    Sun    EUR   1.00000000
## 96    10          Automotive    Sun    EUR   1.00000000
## 97     7               Books    Sun    EUR   1.00000000
## 98    10               Books    Sun    EUR   1.00000000
## 99     7   Business/Industrial  Sun    EUR   0.00000000
## 100    5 Clothing/Accessories   Sun    EUR   1.00000000
## 101    7 Clothing/Accessories   Sun    EUR   1.00000000
## 102   10 Clothing/Accessories   Sun    EUR   0.71428571
## 103    7         Collectibles   Sun    EUR   1.00000000
## 104   10         Collectibles   Sun    EUR   0.33333333
## 105    3            Computer    Sun    EUR   0.00000000
## 106    5            Computer    Sun    EUR   1.00000000
## 107    7            Computer    Sun    EUR   1.00000000
## 108   10            Computer    Sun    EUR   0.00000000
## 109    3           Electronics  Sun    EUR   1.00000000
## 110    5           Electronics  Sun    EUR   0.50000000
## 111    7           Electronics  Sun    EUR   1.00000000
## 112   10           Electronics  Sun    EUR   1.00000000
## 113   10          Health/Beauty Sun    EUR   0.00000000
## 114    7           Home/Garden  Sun    EUR   0.00000000
## 115   10           Home/Garden  Sun    EUR   0.50000000
## 116    5              Jewelry   Sun    EUR   0.33333333
## 117    7              Jewelry   Sun    EUR   0.66666667
## 118    7      Music/Movie/Game  Sun    EUR   0.66666667
## 119   10      Music/Movie/Game  Sun    EUR   0.00000000
## 120   10          Photography   Sun    EUR   1.00000000
## 121   10         SportingGoods  Sun    EUR   0.00000000
## 122    7         Toys/Hobbies   Sun    EUR   0.62500000
## 123   10         Toys/Hobbies   Sun    EUR   1.00000000
## 124    3     Antique/Art/Craft  Thu    EUR   1.00000000
## 125    7          Automotive    Thu    EUR   1.00000000
## 126   10          Automotive    Thu    EUR   1.00000000
## 127    5               Books    Thu    EUR   0.00000000
## 128    3 Clothing/Accessories   Thu    EUR   0.50000000
## 129    5 Clothing/Accessories   Thu    EUR   1.00000000
## 130    7 Clothing/Accessories   Thu    EUR   0.42857143
## 131   10 Clothing/Accessories   Thu    EUR   0.27272727
## 132    3         Collectibles   Thu    EUR   0.00000000
## 133    7         Collectibles   Thu    EUR   1.00000000
## 134   10         Collectibles   Thu    EUR   0.50000000
## 135    1            Computer    Thu    EUR   1.00000000
## 136    7            Computer    Thu    EUR   0.00000000
## 137   10            Computer    Thu    EUR   0.00000000
## 138    7           Electronics  Thu    EUR   0.00000000
## 139    3           Home/Garden  Thu    EUR   1.00000000
## 140    7           Home/Garden  Thu    EUR   1.00000000
## 141    1              Jewelry   Thu    EUR   0.00000000
## 142    3              Jewelry   Thu    EUR   0.00000000
## 143    7              Jewelry   Thu    EUR   0.00000000
## 144    7      Music/Movie/Game  Thu    EUR   0.33333333
```

```
## 145   10   Music/Movie/Game    Thu   EUR   0.00000000
## 146    3        Photography     Thu   EUR   1.00000000
## 147    3       SportingGoods    Thu   EUR   0.00000000
## 148    7       SportingGoods    Thu   EUR   0.00000000
## 149   10       SportingGoods    Thu   EUR   0.50000000
## 150   10        Toys/Hobbies    Thu   EUR   0.50000000
## 151   10    Antique/Art/Craft   Tue   EUR   1.00000000
## 152   10         Automotive     Tue   EUR   0.50000000
## 153   10             Books      Tue   EUR   0.25000000
## 154   10   Business/Industrial  Tue   EUR   0.00000000
## 155    5  Clothing/Accessories  Tue   EUR   1.00000000
## 156    7  Clothing/Accessories  Tue   EUR   0.42857143
## 157   10  Clothing/Accessories  Tue   EUR   0.14285714
## 158   10        Coins/Stamps    Tue   EUR   1.00000000
## 159    7        Collectibles    Tue   EUR   0.33333333
## 160   10        Collectibles    Tue   EUR   0.66666667
## 161    7           Computer     Tue   EUR   1.00000000
## 162   10         Electronics    Tue   EUR   1.00000000
## 163    5         Home/Garden    Tue   EUR   0.00000000
## 164    7         Home/Garden    Tue   EUR   1.00000000
## 165   10         Home/Garden    Tue   EUR   0.50000000
## 166    7            Jewelry     Tue   EUR   1.00000000
## 167   10            Jewelry     Tue   EUR   0.00000000
## 168   10   Music/Movie/Game     Tue   EUR   0.50000000
## 169    5       SportingGoods    Tue   EUR   0.50000000
## 170   10       SportingGoods    Tue   EUR   0.40000000
## 171    7        Toys/Hobbies    Tue   EUR   1.00000000
## 172   10        Toys/Hobbies    Tue   EUR   0.85714286
## 173    7    Antique/Art/Craft   Wed   EUR   0.00000000
## 174   10         Automotive     Wed   EUR   0.50000000
## 175   10             Books      Wed   EUR   0.00000000
## 176    7  Business/Industrial   Wed   EUR   1.00000000
## 177    7  Clothing/Accessories  Wed   EUR   0.37500000
## 178   10  Clothing/Accessories  Wed   EUR   0.28571429
## 179   10        Coins/Stamps    Wed   EUR   0.33333333
## 180    7        Collectibles    Wed   EUR   1.00000000
## 181   10        Collectibles    Wed   EUR   1.00000000
## 182   10           Computer     Wed   EUR   0.00000000
## 183    7         Electronics    Wed   EUR   1.00000000
## 184   10         Electronics    Wed   EUR   0.66666667
## 185    7        Health/Beauty   Wed   EUR   0.00000000
## 186   10         Home/Garden    Wed   EUR   0.57142857
## 187    7            Jewelry     Wed   EUR   0.00000000
## 188   10            Jewelry     Wed   EUR   1.00000000
## 189   10   Music/Movie/Game     Wed   EUR   0.75000000
## 190    7       SportingGoods    Wed   EUR   1.00000000
## 191   10       SportingGoods    Wed   EUR   0.75000000
## 192   10        Toys/Hobbies    Wed   EUR   0.30769231
## 193    7    Antique/Art/Craft   Thu   GBP   1.00000000
## 194    7         Automotive     Thu   GBP   0.25000000
## 195    7             Books      Thu   GBP   0.57142857
## 196    5  Business/Industrial   Thu   GBP   1.00000000
## 197    7  Clothing/Accessories  Thu   GBP   0.75000000
## 198    7        Coins/Stamps    Thu   GBP   0.25000000
```

```
## 199    7        Collectibles       Thu   GBP  0.71428571
## 200    7           Computer         Thu   GBP  1.00000000
## 201    3       EverythingElse       Thu   GBP  0.50000000
## 202    7         Home/Garden        Thu   GBP  0.95652174
## 203    7           Jewelry          Thu   GBP  0.60000000
## 204    1      Music/Movie/Game      Thu   GBP  0.00000000
## 205    3      Music/Movie/Game      Thu   GBP  1.00000000
## 206    7      Music/Movie/Game      Thu   GBP  0.66666667
## 207   10      Music/Movie/Game      Thu   GBP  0.40000000
## 208    7         Photography        Thu   GBP  1.00000000
## 209    7        Pottery/Glass       Thu   GBP  0.33333333
## 210   10        Pottery/Glass       Thu   GBP  1.00000000
## 211    7        SportingGoods       Thu   GBP  1.00000000
## 212    7         Toys/Hobbies       Thu   GBP  0.72727273
## 213   10         Toys/Hobbies       Thu   GBP  1.00000000
## 214    7      Antique/Art/Craft     Fri   US   0.55813953
## 215   10      Antique/Art/Craft     Fri   US   1.00000000
## 216    1         Automotive         Fri   US   0.33333333
## 217    3         Automotive         Fri   US   0.17073171
## 218    7         Automotive         Fri   US   1.00000000
## 219    7           Books            Fri   US   1.00000000
## 220    3    Business/Industrial     Fri   US   1.00000000
## 221    7  Clothing/Accessories      Fri   US   0.50000000
## 222    7        Coins/Stamps        Fri   US   0.00000000
## 223    1        Collectibles        Fri   US   0.50000000
## 224    3        Collectibles        Fri   US   0.00000000
## 225    5        Collectibles        Fri   US   0.46666667
## 226    7        Collectibles        Fri   US   0.00000000
## 227   10        Collectibles        Fri   US   1.00000000
## 228    1           Computer         Fri   US   1.00000000
## 229    7           Computer         Fri   US   0.00000000
## 230    3         Electronics        Fri   US   1.00000000
## 231    7         Electronics        Fri   US   1.00000000
## 232    3       EverythingElse       Fri   US   0.00000000
## 233    7       EverythingElse       Fri   US   0.00000000
## 234    1        Health/Beauty       Fri   US   0.00000000
## 235    7        Health/Beauty       Fri   US   0.08333333
## 236    1         Home/Garden        Fri   US   1.00000000
## 237    1           Jewelry          Fri   US   0.00000000
## 238    3           Jewelry          Fri   US   0.00000000
## 239    5           Jewelry          Fri   US   0.00000000
## 240    7           Jewelry          Fri   US   0.14285714
## 241    3      Music/Movie/Game      Fri   US   0.00000000
## 242    7      Music/Movie/Game      Fri   US   0.75000000
## 243    3         Photography        Fri   US   1.00000000
## 244    7         Photography        Fri   US   1.00000000
## 245    7        Pottery/Glass       Fri   US   1.00000000
## 246    1        SportingGoods       Fri   US   1.00000000
## 247    3        SportingGoods       Fri   US   1.00000000
## 248    5        SportingGoods       Fri   US   0.00000000
## 249    7        SportingGoods       Fri   US   0.71428571
## 250    1         Toys/Hobbies       Fri   US   0.66666667
## 251    7         Toys/Hobbies       Fri   US   1.00000000
## 252    5      Antique/Art/Craft     Mon   US   0.25000000
```

```
## 253    7   Antique/Art/Craft    Mon    US  0.55813953
## 254   10   Antique/Art/Craft    Mon    US  1.00000000
## 255    5          Automotive    Mon    US  0.40000000
## 256    7          Automotive    Mon    US  0.42857143
## 257    5               Books    Mon    US  0.00000000
## 258    7               Books    Mon    US  0.71428571
## 259    5         Coins/Stamps    Mon    US  0.57142857
## 260    7         Coins/Stamps    Mon    US  0.50000000
## 261    5         Collectibles    Mon    US  0.50000000
## 262    7         Collectibles    Mon    US  0.64285714
## 263    5            Computer    Mon    US  0.40000000
## 264    7            Computer    Mon    US  1.00000000
## 265    5          Electronics    Mon    US  0.87500000
## 266    7          Electronics    Mon    US  0.66666667
## 267    7        EverythingElse    Mon    US  0.28571429
## 268   10        EverythingElse    Mon    US  0.00000000
## 269    5         Health/Beauty    Mon    US  0.25000000
## 270    7         Health/Beauty    Mon    US  0.33333333
## 271    5          Home/Garden    Mon    US  0.66666667
## 272    7          Home/Garden    Mon    US  1.00000000
## 273   10          Home/Garden    Mon    US  1.00000000
## 274    5              Jewelry    Mon    US  0.20000000
## 275    7              Jewelry    Mon    US  0.20000000
## 276    5     Music/Movie/Game    Mon    US  0.84756098
## 277    7     Music/Movie/Game    Mon    US  0.23529412
## 278    5          Photography    Mon    US  0.00000000
## 279    7          Photography    Mon    US  1.00000000
## 280    7        Pottery/Glass    Mon    US  1.00000000
## 281    5        SportingGoods    Mon    US  1.00000000
## 282    7        SportingGoods    Mon    US  0.50000000
## 283    5         Toys/Hobbies    Mon    US  0.70000000
## 284    7         Toys/Hobbies    Mon    US  0.33333333
## 285   10         Toys/Hobbies    Mon    US  0.00000000
## 286    3   Antique/Art/Craft    Sat    US  0.00000000
## 287    7   Antique/Art/Craft    Sat    US  0.58333333
## 288    3          Automotive    Sat    US  0.19047619
## 289    5          Automotive    Sat    US  1.00000000
## 290    7          Automotive    Sat    US  0.60000000
## 291    3               Books    Sat    US  0.00000000
## 292    7               Books    Sat    US  1.00000000
## 293    3  Business/Industrial    Sat    US  1.00000000
## 294    7  Business/Industrial    Sat    US  0.00000000
## 295    5 Clothing/Accessories    Sat    US  1.00000000
## 296    7 Clothing/Accessories    Sat    US  0.00000000
## 297    3         Coins/Stamps    Sat    US  0.00000000
## 298    5         Coins/Stamps    Sat    US  0.00000000
## 299    7         Coins/Stamps    Sat    US  0.00000000
## 300    3         Collectibles    Sat    US  0.70000000
## 301    5         Collectibles    Sat    US  0.00000000
## 302    7         Collectibles    Sat    US  0.37500000
## 303   10         Collectibles    Sat    US  1.00000000
## 304    3            Computer    Sat    US  1.00000000
## 305    5            Computer    Sat    US  1.00000000
## 306    3          Electronics    Sat    US  1.00000000
```

```
## 307    5           Electronics    Sat    US    1.00000000
## 308    3        EverythingElse    Sat    US    0.50000000
## 309    3         Health/Beauty    Sat    US    0.00000000
## 310    5         Health/Beauty    Sat    US    0.00000000
## 311    7         Health/Beauty    Sat    US    0.50000000
## 312    3           Home/Garden    Sat    US    0.25000000
## 313    7           Home/Garden    Sat    US    0.00000000
## 314    3               Jewelry    Sat    US    1.00000000
## 315    5               Jewelry    Sat    US    0.66666667
## 316    7               Jewelry    Sat    US    0.00000000
## 317    3       Music/Movie/Game    Sat    US    0.37500000
## 318    5       Music/Movie/Game    Sat    US    1.00000000
## 319    7       Music/Movie/Game    Sat    US    0.17948718
## 320    3           Photography    Sat    US    1.00000000
## 321    5           Photography    Sat    US    1.00000000
## 322    3         Pottery/Glass    Sat    US    0.00000000
## 323    7         Pottery/Glass    Sat    US    0.22222222
## 324    3         SportingGoods    Sat    US    0.00000000
## 325    5         SportingGoods    Sat    US    0.00000000
## 326    7         SportingGoods    Sat    US    0.50000000
## 327    3          Toys/Hobbies    Sat    US    0.33333333
## 328    5          Toys/Hobbies    Sat    US    0.33333333
## 329    7          Toys/Hobbies    Sat    US    0.37662338
## 330    3      Antique/Art/Craft    Sun    US    0.00000000
## 331    5      Antique/Art/Craft    Sun    US    0.00000000
## 332    7      Antique/Art/Craft    Sun    US    0.41176471
## 333   10      Antique/Art/Craft    Sun    US    1.00000000
## 334    3            Automotive    Sun    US    0.44444444
## 335    5            Automotive    Sun    US    0.29629630
## 336   10            Automotive    Sun    US    0.50000000
## 337    5                 Books    Sun    US    0.50000000
## 338    7                 Books    Sun    US    0.42857143
## 339    3    Business/Industrial    Sun    US    1.00000000
## 340    7    Business/Industrial    Sun    US    0.66666667
## 341    3  Clothing/Accessories    Sun    US    0.50000000
## 342    7  Clothing/Accessories    Sun    US    0.00000000
## 343    5          Coins/Stamps    Sun    US    0.00000000
## 344    3          Collectibles    Sun    US    0.16666667
## 345    5          Collectibles    Sun    US    0.36363636
## 346    7          Collectibles    Sun    US    0.72727273
## 347   10          Collectibles    Sun    US    1.00000000
## 348    3              Computer    Sun    US    1.00000000
## 349    7              Computer    Sun    US    1.00000000
## 350    5           Electronics    Sun    US    1.00000000
## 351    5         Health/Beauty    Sun    US    0.00000000
## 352    7         Health/Beauty    Sun    US    0.07142857
## 353    3           Home/Garden    Sun    US    0.25000000
## 354    5           Home/Garden    Sun    US    1.00000000
## 355    7           Home/Garden    Sun    US    0.30000000
## 356   10           Home/Garden    Sun    US    1.00000000
## 357    3               Jewelry    Sun    US    1.00000000
## 358    7               Jewelry    Sun    US    0.00000000
## 359    3       Music/Movie/Game    Sun    US    1.00000000
## 360    5       Music/Movie/Game    Sun    US    0.00000000
```

```
## 361      7    Music/Movie/Game   Sun    US   0.33333333
## 362      3         Photography   Sun    US   1.00000000
## 363      7        Pottery/Glass   Sun    US   0.33333333
## 364      3        SportingGoods   Sun    US   0.50000000
## 365      5        SportingGoods   Sun    US   0.00000000
## 366      7        SportingGoods   Sun    US   0.66666667
## 367      3         Toys/Hobbies   Sun    US   0.44444444
## 368      5         Toys/Hobbies   Sun    US   0.75000000
## 369      7         Toys/Hobbies   Sun    US   0.60000000
## 370     10         Toys/Hobbies   Sun    US   1.00000000
## 371      7    Antique/Art/Craft   Tue    US   0.88461538
## 372      5           Automotive   Tue    US   0.20000000
## 373      7           Automotive   Tue    US   0.16666667
## 374      7                Books   Tue    US   1.00000000
## 375      7 Clothing/Accessories   Tue    US   1.00000000
## 376      5          Collectibles   Tue    US   1.00000000
## 377      7          Collectibles   Tue    US   1.00000000
## 378      7             Computer   Tue    US   0.00000000
## 379      5          Electronics   Tue    US   0.33333333
## 380      7          Electronics   Tue    US   0.00000000
## 381      7        Health/Beauty   Tue    US   0.00000000
## 382      5              Jewelry   Tue    US   0.00000000
## 383      7              Jewelry   Tue    US   0.50000000
## 384      5    Music/Movie/Game   Tue    US   0.00000000
## 385      7    Music/Movie/Game   Tue    US   0.60000000
## 386      7         Photography   Tue    US   0.50000000
## 387      7        Pottery/Glass   Tue    US   0.00000000
## 388      7        SportingGoods   Tue    US   0.50000000
## 389      7         Toys/Hobbies   Tue    US   0.50000000


##   Group.1         x
## 1     EUR 0.5515947
## 2     GBP 0.6870748
## 3      US 0.5193498


##   Group.1         x
## 1     Fri 0.4668990
## 2     Mon 0.6733577
## 3     Sat 0.4273504
## 4     Sun 0.4852071
## 5     Thu 0.6039604
## 6     Tue 0.5321637
## 7     Wed 0.4800000


##                 Group.1         x
## 1     Antique/Art/Craft 0.5649718
## 2            Automotive 0.3539326
## 3                 Books 0.5000000
## 4   Business/Industrial 0.6666667
## 5  Clothing/Accessories 0.5042017
## 6          Coins/Stamps 0.2972973
## 7          Collectibles 0.5774059
## 8              Computer 0.6666667
```

```
## 9              Electronics 0.8000000
## 10          EverythingElse 0.2352941
## 11           Health/Beauty 0.1718750
## 12             Home/Garden 0.6568627
## 13                 Jewelry 0.3658537
## 14        Music/Movie/Game 0.6029777
## 15             Photography 0.8461538
## 16           Pottery/Glass 0.3500000
## 17           SportingGoods 0.7258065
## 18            Toys/Hobbies 0.5299145
```

c. Split the data into training (60%) and validation (40%) datasets. Run a logistic model with all predictors on the training set. Report the estimated coefficients. #answer

```
##
## Call:
## glm(formula = Competitive ~ currency + Duration + endDay + Category +
##     OpenPrice + ClosePrice + sellerRating, family = binomial,
##     data = train.data)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -4.7393  -0.8658   0.0000   0.8206   2.4319
##
## Coefficients:
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -3.408e-01  9.415e-01  -0.362 0.717378
## currencyGBP                   1.226e+00  5.978e-01   2.051 0.040262 *
## currencyUS                    1.560e-01  2.732e-01   0.571 0.567989
## Duration3                     3.502e-01  9.050e-01   0.387 0.698781
## Duration5                     6.040e-01  9.025e-01   0.669 0.503316
## Duration7                     7.106e-02  8.868e-01   0.080 0.936135
## Duration10                    2.152e-01  9.284e-01   0.232 0.816731
## endDayMon                    -5.664e-02  2.595e-01  -0.218 0.827226
## endDaySat                    -7.058e-01  2.739e-01  -2.577 0.009964 **
## endDaySun                    -4.915e-01  2.634e-01  -1.866 0.062028 .
## endDayThu                    -7.622e-01  5.635e-01  -1.353 0.176179
## endDayTue                    -5.790e-01  3.288e-01  -1.761 0.078267 .
## endDayWed                    -1.353e+00  4.793e-01  -2.823 0.004752 **
## CategoryAutomotive           -6.556e-01  3.950e-01  -1.660 0.097001 .
## CategoryBooks                 4.013e-01  4.966e-01   0.808 0.419070
## CategoryBusiness/Industrial   9.374e-01  7.812e-01   1.200 0.230140
## CategoryClothing/Accessories -1.659e+00  4.925e-01  -3.369 0.000753 ***
## CategoryCoins/Stamps         -1.009e+00  5.995e-01  -1.682 0.092503 .
## CategoryCollectibles          1.596e-01  3.102e-01   0.514 0.606980
## CategoryComputer             -3.286e-01  6.908e-01  -0.476 0.634332
## CategoryElectronics           8.546e-01  6.359e-01   1.344 0.178995
## CategoryEverythingElse       -2.026e+00  1.092e+00  -1.854 0.063709 .
## CategoryHealth/Beauty        -1.412e+00  5.153e-01  -2.741 0.006133 **
## CategoryHome/Garden           7.546e-02  4.102e-01   0.184 0.854033
## CategoryJewelry              -9.687e-01  4.440e-01  -2.182 0.029119 *
## CategoryMusic/Movie/Game      1.364e-01  2.787e-01   0.489 0.624500
## CategoryPhotography           3.467e-01  1.452e+00   0.239 0.811290
## CategoryPottery/Glass         3.764e-01  6.707e-01   0.561 0.574614
```

10

```
## CategorySportingGoods          -2.702e-01  4.385e-01   -0.616 0.537675
## CategoryToys/Hobbies            4.654e-01  3.199e-01    1.455 0.145725
## OpenPrice                       -1.600e-01  1.547e-02 -10.346  < 2e-16 ***
## ClosePrice                       1.481e-01  1.455e-02  10.178  < 2e-16 ***
## sellerRating                    -3.949e-05  1.654e-05  -2.387 0.016969 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 1636.4  on 1182  degrees of freedom
## Residual deviance: 1147.9  on 1150  degrees of freedom
## AIC: 1213.9
##
## Number of Fisher Scoring iterations: 8
```

d. Interpret the meaning of the coefficient for closing price. Does closing price have a practical significance?
Is it statistically significant for predicting competitiveness of auctions? (Use a 10% significance level.)
answer

```
##                                Estimate    Std. Error      z value
## (Intercept)                    -3.408052e-01 9.415424e-01  -0.36196480
## currencyGBP                     1.226132e+00 5.978076e-01   2.05104733
## currencyUS                      1.559848e-01 2.731706e-01   0.57101609
## Duration3                       3.501863e-01 9.049525e-01   0.38696648
## Duration5                       6.040040e-01 9.024675e-01   0.66928062
## Duration7                       7.106123e-02 8.868400e-01   0.08012859
## Duration10                      2.151571e-01 9.283962e-01   0.23175140
## endDayMon                      -5.663756e-02 2.594957e-01  -0.21826008
## endDaySat                      -7.058027e-01 2.738778e-01  -2.57707174
## endDaySun                      -4.914698e-01 2.633683e-01  -1.86609363
## endDayThu                      -7.622349e-01 5.635279e-01  -1.35261238
## endDayTue                      -5.790238e-01 3.288360e-01  -1.76082852
## endDayWed                      -1.353178e+00 4.792798e-01  -2.82335635
## CategoryAutomotive             -6.555589e-01 3.950176e-01  -1.65956858
## CategoryBooks                   4.013061e-01 4.966443e-01   0.80803511
## CategoryBusiness/Industrial     9.374151e-01 7.811811e-01   1.19999723
## CategoryClothing/Accessories   -1.659447e+00 4.924965e-01  -3.36945949
## CategoryCoins/Stamps           -1.008642e+00 5.995475e-01  -1.68233884
## CategoryCollectibles            1.595533e-01 3.101807e-01   0.51438842
## CategoryComputer               -3.285879e-01 6.908363e-01  -0.47563788
## CategoryElectronics             8.545636e-01 6.359036e-01   1.34385717
## CategoryEverythingElse         -2.025557e+00 1.092410e+00  -1.85420825
## CategoryHealth/Beauty          -1.412195e+00 5.152895e-01  -2.74058614
## CategoryHome/Garden             7.545972e-02 4.101618e-01   0.18397548
## CategoryJewelry                -9.687191e-01 4.439841e-01  -2.18187767
## CategoryMusic/Movie/Game        1.364064e-01 2.786746e-01   0.48948246
## CategoryPhotography             3.466521e-01 1.451872e+00   0.23876222
## CategoryPottery/Glass           3.764172e-01 6.706534e-01   0.56126938
## CategorySportingGoods          -2.702398e-01 4.384645e-01  -0.61633227
## CategoryToys/Hobbies            4.654070e-01 3.199113e-01   1.45480033
## OpenPrice                      -1.600213e-01 1.546738e-02 -10.34572900
## ClosePrice                      1.480529e-01 1.454657e-02  10.17785555
## sellerRating                   -3.949282e-05 1.654227e-05  -2.38738737
```

```
##                                     Pr(>|z|)
## (Intercept)                       7.173783e-01
## currencyGBP                       4.026234e-02
## currencyUS                        5.679887e-01
## Duration3                         6.987810e-01
## Duration5                         5.033165e-01
## Duration7                         9.361350e-01
## Duration10                        8.167311e-01
## endDayMon                         8.272265e-01
## endDaySat                         9.964127e-03
## endDaySun                         6.202827e-02
## endDayThu                         1.761795e-01
## endDayTue                         7.826743e-02
## endDayWed                         4.752372e-03
## CategoryAutomotive                9.700127e-02
## CategoryBooks                     4.190704e-01
## CategoryBusiness/Industrial       2.301404e-01
## CategoryClothing/Accessories      7.531576e-04
## CategoryCoins/Stamps              9.250315e-02
## CategoryCollectibles              6.069805e-01
## CategoryComputer                  6.343324e-01
## CategoryElectronics               1.789946e-01
## CategoryEverythingElse            6.370937e-02
## CategoryHealth/Beauty             6.132970e-03
## CategoryHome/Garden               8.540327e-01
## CategoryJewelry                   2.911856e-02
## CategoryMusic/Movie/Game          6.245002e-01
## CategoryPhotography               8.112900e-01
## CategoryPottery/Glass             5.746139e-01
## CategorySportingGoods             5.376752e-01
## CategoryToys/Hobbies              1.457245e-01
## OpenPrice                         4.375732e-25
## ClosePrice                        2.489878e-24
## sellerRating                      1.696860e-02
```

e. Using the validation data, obtain the propensities of auctions being competitive, P(Competitive = 1). Report the head of the prediction vector. #answer

```
##         3         4         6         8        10        12
## 0.5915847 0.5915847 0.5915847 0.5915847 0.5915847 0.5915847
```

f. Create a new data frame with the first column equal to the "Competitive" column of the validation set, second column equal to the predicted propensities, and third column equal 1 if the propensity > 0.5 and 0 otherwise. Report the head of this new data frame. #answer

```
##       test.data.Competitive    predicted
## 3                         0 5.915847e-01
## 4                         0 5.915847e-01
## 6                         0 5.915847e-01
## 8                         0 5.915847e-01
## 10                        0 5.915847e-01
## 12                        0 5.915847e-01
## 17                        0 1.867175e-01
```

```
## 18                     0 1.867175e-01
## 21                     1 1.867175e-01
## 24                     1 5.933721e-01
## 28                     1 5.972955e-01
## 31                     1 6.107508e-01
## 32                     1 6.107508e-01
## 33                     1 6.281984e-01
## 34                     1 6.350877e-01
## 36                     1 6.350877e-01
## 38                     1 6.364591e-01
## 39                     1 6.368016e-01
## 40                     1 6.374861e-01
## 41                     1 6.374861e-01
## 42                     1 6.391951e-01
## 43                     1 6.436219e-01
## 46                     1 6.604154e-01
## 49                     1 6.620736e-01
## 52                     1 6.686663e-01
## 53                     1 6.703043e-01
## 65                     1 7.006116e-01
## 66                     1 7.009220e-01
## 67                     1 7.012323e-01
## 69                     1 7.024715e-01
## 72                     1 7.098442e-01
## 73                     1 7.159049e-01
## 77                     1 7.174081e-01
## 78                     1 7.186071e-01
## 79                     1 7.283803e-01
## 80                     1 7.307173e-01
## 81                     1 7.307173e-01
## 82                     1 7.307173e-01
## 87                     1 7.350647e-01
## 91                     1 7.519994e-01
## 94                     1 7.655462e-01
## 95                     1 7.655462e-01
## 97                     1 7.660772e-01
## 99                     1 7.785708e-01
## 101                    1 7.823758e-01
## 104                    1 7.910694e-01
## 107                    1 8.789666e-01
## 108                    1 7.922903e-01
## 109                    1 7.961616e-01
## 112                    1 8.030410e-01
## 116                    1 8.144875e-01
## 119                    1 8.256266e-01
## 124                    1 8.358254e-01
## 125                    1 8.358254e-01
## 126                    1 8.531165e-01
## 128                    1 8.639025e-01
## 131                    1 8.725388e-01
## 133                    1 8.725388e-01
## 134                    1 7.805459e-01
## 137                    1 9.348601e-01
## 138                    1 5.527455e-01
```

```
## 139                         1 9.540864e-01
## 141                         1 9.553306e-01
## 143                         1 9.833499e-01
## 145                         1 9.791115e-01
## 148                         0 5.688388e-01
## 149                         1 6.842686e-01
## 150                         1 6.845625e-01
## 152                         1 9.989001e-01
## 157                         1 5.683103e-01
## 159                         1 9.995473e-01
## 161                         1 9.999414e-01
## 163                         1 5.845753e-01
## 164                         1 7.724046e-01
## 177                         0 6.383917e-01
## 179                         0 5.746586e-01
## 181                         0 3.146885e-01
## 184                         0 3.146885e-01
## 185                         0 6.272069e-01
## 188                         0 1.673395e-01
## 191                         0 3.776143e-01
## 192                         0 2.275161e-01
## 193                         1 3.959916e-01
## 194                         0 6.482181e-01
## 197                         0 6.403662e-01
## 198                         0 4.653672e-01
## 199                         0 6.492223e-01
## 201                         0 5.826117e-01
## 203                         0 5.400177e-01
## 204                         0 3.511021e-01
## 205                         0 6.251664e-02
## 207                         0 4.479879e-01
## 208                         0 4.406360e-01
## 209                         1 2.309249e-01
## 212                         0 4.007559e-01
## 215                         0 4.509289e-01
## 219                         0 5.842562e-01
## 221                         0 3.438766e-01
## 224                         0 1.383990e-01
## 228                         0 2.448257e-01
## 229                         0 2.448257e-01
## 230                         0 1.421010e-01
## 231                         0 3.081777e-01
## 233                         0 3.634553e-01
## 236                         0 3.468261e-01
## 237                         0 3.468261e-01
## 238                         0 4.834463e-01
## 240                         0 4.588973e-01
## 247                         0 4.290449e-01
## 249                         0 3.272650e-01
## 252                         0 2.954454e-01
## 255                         1 4.290449e-01
## 256                         1 6.303171e-01
## 258                         1 9.999999e-01
## 260                         1 5.566619e-01
```

```
## 263                       1 4.386307e-01
## 269                       1 6.454725e-01
## 272                       1 4.733738e-01
## 273                       1 6.324076e-01
## 274                       1 7.022458e-01
## 277                       0 2.739518e-01
## 278                       1 6.005394e-01
## 280                       1 6.062083e-01
## 281                       1 6.069435e-01
## 288                       1 8.977471e-01
## 290                       1 3.402483e-01
## 291                       1 3.402483e-01
## 293                       1 6.316914e-01
## 296                       1 6.392447e-01
## 303                       0 4.045360e-01
## 313                       1 4.434466e-01
## 314                       1 5.110614e-01
## 315                       1 6.488994e-01
## 317                       1 2.615442e-01
## 320                       1 6.434790e-01
## 321                       1 3.330032e-01
## 323                       1 1.268951e-01
## 327                       1 5.477944e-01
## 335                       1 6.888396e-01
## 338                       1 7.802529e-01
## 339                       1 1.000000e+00
## 341                       1 2.758810e-01
## 343                       0 2.072322e-01
## 345                       0 3.506388e-01
## 346                       0 2.070511e-01
## 348                       0 1.526422e-01
## 349                       0 8.167309e-02
## 352                       0 2.831271e-01
## 354                       0 4.574143e-01
## 355                       0 4.574143e-01
## 356                       0 4.574143e-01
## 357                       0 4.574143e-01
## 358                       0 1.023387e-01
## 361                       0 2.708207e-01
## 364                       0 3.748056e-01
## 370                       0 2.421926e-01
## 371                       0 3.795330e-01
## 377                       0 3.752606e-01
## 380                       0 4.812883e-01
## 383                       1 4.782720e-01
## 384                       1 4.782720e-01
## 385                       0 4.717622e-01
## 386                       0 4.717622e-01
## 387                       0 3.060463e-01
## 388                       0 2.555742e-01
## 390                       0 3.218137e-01
## 393                       0 6.164351e-01
## 402                       0 4.651193e-01
## 403                       0 3.408780e-01
```

```
## 404                     0 5.528113e-01
## 406                     0 3.120874e-01
## 408                     0 3.120874e-01
## 411                     1 7.492617e-01
## 412                     1 8.231154e-01
## 414                     1 7.184007e-01
## 415                     1 7.184007e-01
## 420                     1 4.890223e-01
## 428                     1 5.477149e-01
## 435                     1 7.542870e-01
## 436                     1 7.542870e-01
## 439                     1 8.532570e-01
## 441                     1 4.015202e-01
## 442                     1 3.364089e-01
## 450                     1 2.268777e-01
## 451                     1 3.889158e-01
## 456                     1 7.425943e-01
## 458                     0 5.678962e-01
## 462                     0 4.288863e-01
## 464                     1 8.532190e-01
## 467                     1 3.724626e-01
## 468                     1 6.490109e-01
## 471                     1 7.084430e-01
## 473                     1 5.546042e-01
## 476                     1 5.685945e-01
## 478                     1 5.934559e-01
## 479                     1 6.405606e-01
## 483                     1 5.912662e-01
## 486                     0 3.726766e-01
## 490                     0 3.726766e-01
## 494                     0 3.726766e-01
## 498                     0 3.726766e-01
## 502                     1 8.963078e-01
## 503                     1 6.133225e-01
## 505                     1 5.195390e-01
## 507                     1 7.476406e-01
## 511                     1 7.535720e-01
## 513                     1 1.000000e+00
## 516                     0 4.501381e-01
## 523                     1 4.055491e-01
## 526                     0 2.013425e-01
## 527                     0 3.021638e-01
## 529                     0 2.198041e-01
## 532                     1 7.614632e-01
## 534                     0 4.934953e-01
## 535                     0 4.934953e-01
## 538                     0 4.025259e-01
## 541                     0 5.836750e-01
## 543                     1 4.686789e-01
## 544                     1 5.181883e-01
## 550                     1 3.174894e-01
## 553                     1 6.070012e-01
## 555                     1 6.070012e-01
## 558                     1 8.655151e-01
```

```
## 559                         1 9.438087e-01
## 562                         1 8.663745e-01
## 566                         0 4.191486e-01
## 567                         1 5.602250e-01
## 569                         1 5.153540e-01
## 576                         1 6.261934e-01
## 579                         1 7.022597e-01
## 581                         1 8.497477e-01
## 583                         0 3.352979e-01
## 587                         1 1.015984e-01
## 588                         1 5.068460e-01
## 594                         0 4.379185e-01
## 596                         0 4.379185e-01
## 598                         0 4.379185e-01
## 599                         0 4.379185e-01
## 601                         0 3.227671e-01
## 606                         0 3.039332e-01
## 607                         0 3.039332e-01
## 608                         1 4.379185e-01
## 609                         1 2.777968e-01
## 610                         1 5.805349e-01
## 612                         1 8.951018e-01
## 617                         1 2.852833e-01
## 619                         1 3.309103e-01
## 622                         0 3.698828e-01
## 626                         1 2.555318e-01
## 629                         1 9.432603e-01
## 631                         1 3.059820e-01
## 633                         1 7.087347e-01
## 635                         1 8.312726e-01
## 636                         0 4.444001e-01
## 638                         1 4.719980e-01
## 639                         1 7.225301e-01
## 640                         1 4.473218e-01
## 645                         1 4.786441e-01
## 650                         1 7.273144e-01
## 652                         0 6.661675e-01
## 655                         0 8.906337e-02
## 658                         0 4.199157e-01
## 660                         0 3.692136e-01
## 662                         0 3.461248e-01
## 665                         0 3.273465e-01
## 673                         0 2.566762e-01
## 674                         0 3.923849e-01
## 682                         0 4.905040e-01
## 684                         0 4.362640e-01
## 686                         1 6.729926e-01
## 687                         0 3.818198e-01
## 695                         1 3.874925e-01
## 696                         1 3.874925e-01
## 698                         1 9.633795e-01
## 702                         1 4.119595e-01
## 703                         1 3.192595e-01
## 704                         1 1.040702e-01
```

```
## 707                    1 4.823897e-01
## 708                    1 4.512645e-01
## 710                    1 3.474545e-01
## 711                    1 3.664447e-01
## 713                    1 4.447760e-01
## 715                    1 4.897865e-01
## 716                    1 4.146701e-01
## 722                    1 7.154134e-01
## 725                    1 9.888010e-01
## 726                    1 5.079209e-01
## 727                    1 5.079209e-01
## 729                    1 9.316725e-01
## 730                    1 6.465801e-01
## 731                    1 3.847319e-01
## 736                    0 2.916226e-01
## 738                    0 2.597882e-01
## 740                    1 8.301290e-01
## 742                    1 7.042633e-01
## 743                    1 7.986498e-01
## 747                    1 5.655038e-01
## 751                    1 4.414860e-01
## 755                    1 4.296746e-01
## 756                    1 3.513719e-01
## 757                    1 4.611733e-01
## 758                    1 6.352044e-01
## 761                    1 3.905071e-01
## 764                    1 5.829741e-01
## 767                    1 6.716649e-01
## 771                    0 3.665417e-01
## 773                    0 3.665417e-01
## 774                    0 3.665417e-01
## 778                    0 9.950109e-02
## 780                    0 4.752633e-01
## 782                    0 2.932278e-01
## 783                    0 4.241651e-01
## 785                    0 2.170296e-01
## 789                    0 5.495768e-01
## 795                    0 1.069042e-01
## 796                    0 1.069042e-01
## 804                    0 3.664306e-01
## 805                    0 3.664306e-01
## 810                    0 4.140782e-01
## 813                    0 3.895351e-01
## 816                    0 3.895351e-01
## 817                    0 3.417256e-01
## 824                    0 4.875133e-01
## 826                    0 4.854966e-01
## 828                    0 3.646487e-01
## 829                    0 4.361071e-01
## 834                    0 2.402475e-01
## 836                    0 3.767634e-01
## 838                    0 5.322753e-01
## 840                    0 3.846490e-01
## 841                    0 3.284836e-01
```

```
## 842                      1 3.746904e-01
## 845                      1 9.346199e-01
## 846                      1 9.428916e-01
## 847                      1 9.937694e-01
## 848                      1 8.252915e-01
## 849                      1 4.950223e-01
## 855                      1 3.762124e-01
## 860                      1 9.427296e-01
## 862                      0 3.149754e-01
## 863                      0 1.464852e-01
## 864                      1 9.688248e-01
## 865                      1 9.531262e-01
## 867                      1 9.698136e-01
## 871                      1 5.991245e-01
## 874                      1 9.595037e-01
## 876                      1 5.947591e-01
## 877                      1 5.312844e-01
## 878                      1 5.126238e-01
## 879                      1 8.916598e-01
## 880                      1 6.175865e-01
## 884                      1 4.035670e-01
## 885                      1 1.983504e-01
## 886                      0 4.620112e-01
## 887                      0 4.063672e-01
## 888                      0 3.989515e-01
## 890                      1 9.660167e-01
## 891                      1 9.799388e-01
## 893                      1 4.960939e-01
## 895                      1 6.167662e-01
## 896                      1 9.580388e-01
## 901                      1 8.128116e-01
## 908                      1 4.967834e-01
## 910                      1 9.781579e-01
## 915                      1 6.571282e-01
## 918                      1 9.880583e-01
## 921                      1 3.275729e-01
## 930                      0 5.936989e-01
## 931                      0 5.673549e-01
## 934                      0 1.620220e-01
## 935                      0 1.620220e-01
## 936                      0 8.714035e-02
## 937                      0 1.057669e-01
## 938                      0 1.057669e-01
## 940                      0 9.776722e-02
## 941                      0 5.181644e-01
## 947                      0 1.590411e-01
## 951                      1 9.880840e-01
## 954                      1 9.917098e-01
## 955                      1 5.337452e-01
## 956                      1 9.999154e-01
## 957                      0 5.195637e-01
## 960                      1 5.165310e-01
## 961                      1 5.480827e-01
## 962                      1 8.460487e-01
```

```
## 964                     0 7.112547e-01
## 966                     1 5.201502e-01
## 967                     1 4.168999e-01
## 970                     1 9.954044e-01
## 972                     1 9.967371e-01
## 973                     1 9.986221e-01
## 974                     1 9.934187e-01
## 975                     1 5.533464e-01
## 980                     1 9.995053e-01
## 981                     1 9.939303e-01
## 982                     0 5.515658e-01
## 986                     1 9.985480e-01
## 988                     0 3.125892e-01
## 997                     0 3.125892e-01
## 998                     0 3.125892e-01
## 999                     0 3.125892e-01
## 1001                    0 3.125892e-01
## 1002                    0 3.125892e-01
## 1003                    0 3.125892e-01
## 1006                    0 3.125892e-01
## 1009                    0 3.125892e-01
## 1013                    0 3.125892e-01
## 1017                    1 9.993085e-01
## 1018                    1 9.712529e-01
## 1022                    1 9.984241e-01
## 1029                    1 7.475231e-01
## 1030                    1 7.583333e-01
## 1031                    1 9.997309e-01
## 1032                    1 7.235331e-01
## 1033                    1 9.984679e-01
## 1035                    1 6.460115e-01
## 1036                    1 7.208434e-01
## 1042                    1 1.000000e+00
## 1043                    1 8.871431e-01
## 1045                    0 5.102051e-01
## 1048                    0 4.793999e-01
## 1054                    0 1.604036e-01
## 1060                    0 7.648991e-02
## 1066                    0 3.947403e-01
## 1067                    0 4.640116e-01
## 1069                    1 4.772095e-01
## 1070                    0 4.061878e-01
## 1071                    0 4.639492e-01
## 1072                    0 3.238900e-01
## 1074                    0 3.947422e-01
## 1077                    1 6.157771e-01
## 1079                    1 9.997342e-01
## 1087                    1 9.837707e-01
## 1089                    0 5.602816e-02
## 1097                    0 6.006493e-01
## 1098                    0 6.006493e-01
## 1100                    0 6.006493e-01
## 1101                    0 6.006493e-01
## 1105                    1 9.997339e-01
```

```
## 1106                         1 5.144237e-01
## 1108                         1 6.037355e-01
## 1109                         1 6.182667e-01
## 1112                         1 7.631588e-01
## 1113                         1 7.631588e-01
## 1114                         1 7.674137e-01
## 1115                         1 9.998050e-01
## 1117                         1 7.256787e-01
## 1118                         1 9.997370e-01
## 1119                         1 5.535783e-01
## 1123                         1 3.919985e-01
## 1125                         1 9.997722e-01
## 1126                         1 9.999773e-01
## 1127                         0 3.771570e-01
## 1132                         0 5.879121e-01
## 1135                         0 1.587983e-01
## 1137                         0 8.525497e-02
## 1138                         0 1.035242e-01
## 1140                         0 1.513780e-01
## 1145                         0 3.168936e-01
## 1151                         0 3.849577e-01
## 1152                         0 9.828584e-01
## 1154                         1 4.325787e-01
## 1155                         0 7.429222e-01
## 1158                         1 9.998384e-01
## 1164                         0 3.912856e-01
## 1166                         1 9.999416e-01
## 1167                         1 1.611350e-01
## 1168                         1 1.613352e-01
## 1173                         1 9.999151e-01
## 1176                         1 9.999871e-01
## 1179                         0 2.710111e-01
## 1180                         0 1.550799e-01
## 1181                         0 1.843670e-01
## 1189                         0 3.381959e-01
## 1192                         0 3.082786e-01
## 1196                         0 8.016528e-01
## 1199                         1 4.467332e-01
## 1203                         1 5.076223e-01
## 1204                         1 9.999938e-01
## 1205                         1 2.020155e-01
## 1206                         0 3.475855e-02
## 1208                         0 4.878202e-01
## 1215                         0 1.498469e-01
## 1216                         0 1.498469e-01
## 1217                         0 3.553890e-01
## 1220                         0 3.143085e-01
## 1225                         0 1.811399e-01
## 1240                         1 5.434654e-01
## 1243                         1 1.120289e-01
## 1245                         0 2.877300e-01
## 1246                         1 9.999992e-01
## 1257                         1 9.999999e-01
## 1262                         1 9.232783e-01
```

```
## 1263                         1 9.233832e-01
## 1269                         0 3.057386e-01
## 1271                         1 1.000000e+00
## 1273                         0 9.406208e-01
## 1276                         0 4.394593e-01
## 1277                         0 4.394593e-01
## 1282                         0 7.748879e-02
## 1283                         0 7.145705e-02
## 1286                         0 3.426801e-02
## 1287                         0 6.021491e-02
## 1288                         0 6.021491e-02
## 1290                         0 6.021491e-02
## 1291                         0 6.021491e-02
## 1292                         1 3.845014e-01
## 1294                         0 4.229103e-01
## 1295                         0 3.879663e-01
## 1296                         0 3.879663e-01
## 1300                         0 2.008028e-01
## 1303                         0 5.872422e-01
## 1304                         0 4.647849e-01
## 1305                         0 4.189527e-01
## 1308                         0 1.649490e-01
## 1311                         0 8.725155e-02
## 1313                         0 3.509552e-01
## 1314                         0 4.077944e-01
## 1316                         0 3.709783e-01
## 1318                         0 3.112797e-01
## 1319                         0 2.384181e-01
## 1320                         0 2.863340e-01
## 1321                         0 2.863340e-01
## 1322                         1 3.526519e-01
## 1327                         0 5.658249e-02
## 1334                         0 1.015899e-01
## 1341                         1 9.999998e-01
## 1342                         1 1.000000e+00
## 1343                         1 9.419080e-01
## 1345                         1 5.960054e-01
## 1346                         1 9.999995e-01
## 1347                         1 3.435071e-01
## 1354                         1 9.668788e-01
## 1357                         1 9.999998e-01
## 1358                         1 1.583954e-01
## 1359                         1 4.469726e-01
## 1361                         1 9.999999e-01
## 1362                         1 9.999999e-01
## 1364                         1 4.403418e-01
## 1366                         1 1.000000e+00
## 1367                         1 1.000000e+00
## 1371                         1 9.999999e-01
## 1373                         0 4.964432e-01
## 1374                         0 4.964432e-01
## 1375                         0 3.273863e-01
## 1377                         0 7.984178e-02
## 1379                         1 1.000000e+00
```

```
## 1382                            0 7.414961e-01
## 1383                            0 8.921217e-01
## 1390                            1 4.617130e-01
## 1398                            1 8.339661e-01
## 1399                            1 1.000000e+00
## 1401                            0 1.415997e-01
## 1402                            1 1.000000e+00
## 1404                            1 6.337000e-01
## 1406                            1 5.960869e-01
## 1407                            1 1.000000e+00
## 1409                            0 2.053934e-01
## 1410                            0 2.815645e-01
## 1412                            0 1.154911e-01
## 1414                            0 2.814677e-01
## 1415                            0 2.814677e-01
## 1419                            0 2.628150e-01
## 1420                            0 2.628150e-01
## 1421                            0 8.009103e-01
## 1423                            0 7.814585e-01
## 1425                            1 1.000000e+00
## 1426                            1 8.328515e-01
## 1427                            1 9.953354e-01
## 1428                            1 6.177314e-01
## 1432                            1 1.000000e+00
## 1433                            1 1.000000e+00
## 1434                            1 1.000000e+00
## 1437                            1 4.765757e-01
## 1442                            1 1.000000e+00
## 1445                            1 9.915232e-01
## 1446                            1 1.000000e+00
## 1447                            1 4.659892e-01
## 1453                            1 1.000000e+00
## 1454                            1 1.000000e+00
## 1455                            1 9.177899e-01
## 1456                            1 1.000000e+00
## 1457                            0 3.221373e-01
## 1460                            0 7.904271e-01
## 1462                            0 1.624845e-01
## 1464                            0 7.331935e-01
## 1466                            1 1.000000e+00
## 1471                            1 5.976303e-01
## 1472                            1 9.065492e-01
## 1473                            1 9.792554e-01
## 1475                            1 9.393798e-01
## 1476                            1 4.870215e-01
## 1478                            1 9.517957e-01
## 1481                            1 2.052284e-01
## 1482                            0 7.241372e-01
## 1484                            1 6.678717e-01
## 1486                            1 8.509475e-01
## 1494                            1 1.000000e+00
## 1495                            0 1.579065e-01
## 1497                            1 1.000000e+00
## 1498                            1 9.994225e-01
```

```
## 1499                          1 9.853309e-01
## 1501                          1 7.053234e-01
## 1506                          1 1.000000e+00
## 1508                          1 4.059323e-01
## 1511                          1 7.532895e-01
## 1516                          1 9.999605e-01
## 1518                          0 4.158485e-01
## 1519                          0 4.158485e-01
## 1520                          0 4.158485e-01
## 1521                          0 4.158485e-01
## 1522                          0 2.427696e-01
## 1525                          0 2.427696e-01
## 1530                          0 9.399297e-02
## 1531                          0 9.399297e-02
## 1532                          0 9.399297e-02
## 1539                          0 4.157323e-01
## 1542                          0 2.990421e-01
## 1549                          1 1.000000e+00
## 1552                          1 1.004892e-01
## 1557                          1 1.000000e+00
## 1564                          0 2.602694e-01
## 1565                          0 4.372895e-01
## 1566                          0 4.372895e-01
## 1567                          1 5.023529e-01
## 1571                          1 8.286633e-01
## 1572                          1 9.064215e-01
## 1574                          0 9.055000e-01
## 1576                          0 8.985568e-01
## 1577                          1 5.094228e-01
## 1579                          1 1.000000e+00
## 1580                          1 5.245133e-01
## 1582                          1 1.000000e+00
## 1583                          1 1.000000e+00
## 1586                          1 1.000000e+00
## 1587                          1 8.332208e-01
## 1591                          1 5.808829e-01
## 1592                          1 1.000000e+00
## 1594                          0 7.274560e-01
## 1596                          0 7.274560e-01
## 1598                          1 1.000000e+00
## 1602                          1 9.508695e-01
## 1603                          1 1.000000e+00
## 1604                          1 9.994204e-01
## 1606                          0 2.013121e-01
## 1607                          0 2.013121e-01
## 1608                          0 2.013121e-01
## 1610                          1 9.747879e-01
## 1613                          1 6.020630e-01
## 1614                          1 6.024176e-01
## 1615                          1 9.447770e-01
## 1619                          0 5.085621e-01
## 1620                          0 2.033222e-01
## 1621                          0 2.033222e-01
## 1622                          1 9.865805e-01
```

```
## 1625                       1 8.825211e-01
## 1627                       1 9.942175e-01
## 1628                       1 9.848068e-01
## 1635                       0 2.484111e-01
## 1637                       1 2.609299e-01
## 1639                       0 1.386015e-01
## 1641                       0 9.792965e-01
## 1648                       0 4.013889e-01
## 1651                       0 1.886680e-01
## 1652                       0 2.938784e-01
## 1654                       0 5.280617e-01
## 1658                       0 3.437843e-01
## 1661                       0 4.255469e-01
## 1665                       1 1.000000e+00
## 1666                       1 9.969289e-01
## 1677                       0 1.752731e-01
## 1679                       0 2.424849e-01
## 1681                       0 2.424849e-01
## 1685                       1 9.924358e-01
## 1686                       1 9.785723e-01
## 1687                       1 9.520148e-01
## 1690                       1 5.507188e-01
## 1692                       1 7.293300e-01
## 1698                       1 3.042282e-01
## 1702                       1 9.976099e-01
## 1704                       1 7.839408e-01
## 1709                       0 9.995065e-01
## 1710                       1 9.393268e-01
## 1711                       1 2.518039e-01
## 1712                       1 5.000339e-01
## 1715                       0 8.130142e-02
## 1716                       1 6.869167e-01
## 1717                       1 9.983371e-01
## 1719                       1 1.000000e+00
## 1720                       1 9.993086e-01
## 1722                       1 1.000000e+00
## 1724                       1 1.000000e+00
## 1725                       1 6.799280e-01
## 1726                       0 3.094553e-01
## 1727                       0 2.339071e-01
## 1728                       0 1.318911e-01
## 1730                       0 4.026066e-01
## 1732                       0 1.553341e-01
## 1733                       1 2.791690e-01
## 1736                       0 4.763546e-01
## 1738                       1 9.997421e-01
## 1745                       1 1.000000e+00
## 1748                       0 1.590536e-01
## 1749                       1 9.998791e-01
## 1756                       0 3.379768e-01
## 1757                       1 9.998889e-01
## 1759                       1 9.999758e-01
## 1766                       0 3.728886e-01
## 1773                       0 5.811644e-01
```

```
## 1775                       1 9.999978e-01
## 1776                       1 9.922976e-01
## 1777                       0 2.400991e-01
## 1780                       1 1.000000e+00
## 1786                       0 2.430360e-01
## 1787                       0 3.234132e-01
## 1788                       1 9.999999e-01
## 1789                       1 6.728965e-01
## 1791                       0 1.848481e-01
## 1792                       0 1.848481e-01
## 1793                       1 9.999997e-01
## 1794                       1 9.999998e-01
## 1795                       0 2.363779e-01
## 1796                       0 2.082593e-01
## 1798                       0 2.677174e-01
## 1801                       0 2.677174e-01
## 1802                       0 1.252906e-01
## 1805                       1 1.000000e+00
## 1809                       1 9.213483e-01
## 1816                       1 1.000000e+00
## 1819                       0 1.759312e-01
## 1821                       1 5.815653e-01
## 1822                       0 1.124134e-01
## 1823                       0 2.114196e-01
## 1828                       1 1.000000e+00
## 1830                       1 1.000000e+00
## 1832                       1 7.827589e-01
## 1835                       0 1.295567e-01
## 1836                       1 1.000000e+00
## 1838                       1 7.964240e-01
## 1840                       0 1.964875e-01
## 1843                       1 1.000000e+00
## 1845                       0 2.154594e-01
## 1847                       0 2.449151e-01
## 1849                       0 2.103453e-01
## 1856                       0 1.845125e-01
## 1862                       1 1.000000e+00
## 1863                       1 3.348446e-01
## 1866                       1 6.068944e-01
## 1868                       1 9.975458e-01
## 1870                       1 5.157238e-01
## 1873                       1 1.000000e+00
## 1877                       0 2.098445e-01
## 1879                       1 2.973799e-01
## 1880                       1 1.000000e+00
## 1882                       0 1.720694e-01
## 1884                       1 9.999998e-01
## 1890                       0 1.000000e+00
## 1891                       0 1.424109e-01
## 1894                       0 5.415616e-01
## 1895                       0 1.915894e-01
## 1902                       0 8.537786e-02
## 1903                       1 9.813425e-01
## 1907                       0 1.718576e-01
```

```
## 1910                    0 1.564457e-01
## 1911                    0 1.564457e-01
## 1916                    1 9.999999e-01
## 1919                    0 1.921998e-01
## 1923                    0 1.412920e-01
## 1925                    0 1.572168e-01
## 1927                    0 1.572168e-01
## 1930                    0 8.641610e-02
## 1932                    0 1.116196e-01
## 1935                    0 1.081306e-01
## 1937                    0 1.000000e+00
## 1939                    1 9.967885e-01
## 1940                    1 1.802857e-01
## 1941                    1 9.999758e-01
## 1944                    1 9.999886e-01
## 1945                    1 1.175853e-01
## 1955                    1 1.000000e+00
## 1956                    0 2.663314e-02
## 1957                    0 7.990593e-02
## 1959                    1 1.000000e+00
## 1961                    0 5.829397e-02
## 1964                    1 1.000000e+00
## 1967                    1 1.000000e+00
## 1968                    0 5.742832e-03
## 1971                    1 9.999999e-01
## 1972                    0 1.459657e-06
```

g. Using the `confusionMatrix()` function of the **caret** package, create, report, and interpret the values of the confusion matrix of your classifier. Report your predictor's accuracy and error rates. #answer

h. The exercises above, assumes the cutoff probability = 0.5. Is this the best cutoff probability? Plot the accuracy rate against different cutoff probabilities. What cutoff probability maximizes the accuracy of the your classifier? #answer

```
## [1] 0.5
```

i. Obtain and interpret the sensitivity and specificity measures of your classifier. #answer
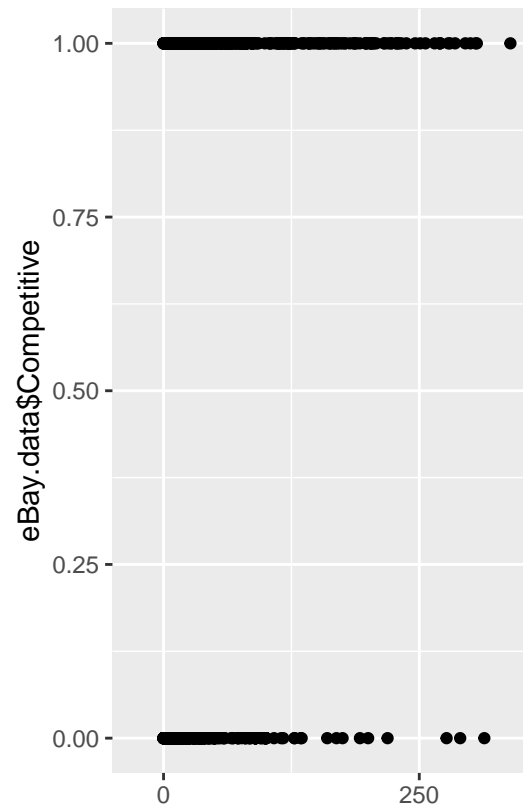
```
## [1] 0.7963801
```

```
## [1] 0.8299712
```

```
## [1] 0.1888
```

j. Using **ggplot**, produce the lift chart of the classifier. To compare, also plot the lift charts of perfect and ignorant classifiers. #answer

```
## A performance instance
##   'False positive rate' vs. 'True positive rate' (alpha: 'Cutoff')
##   with 681 data points
```

Lift curve

Rate of positive predictions
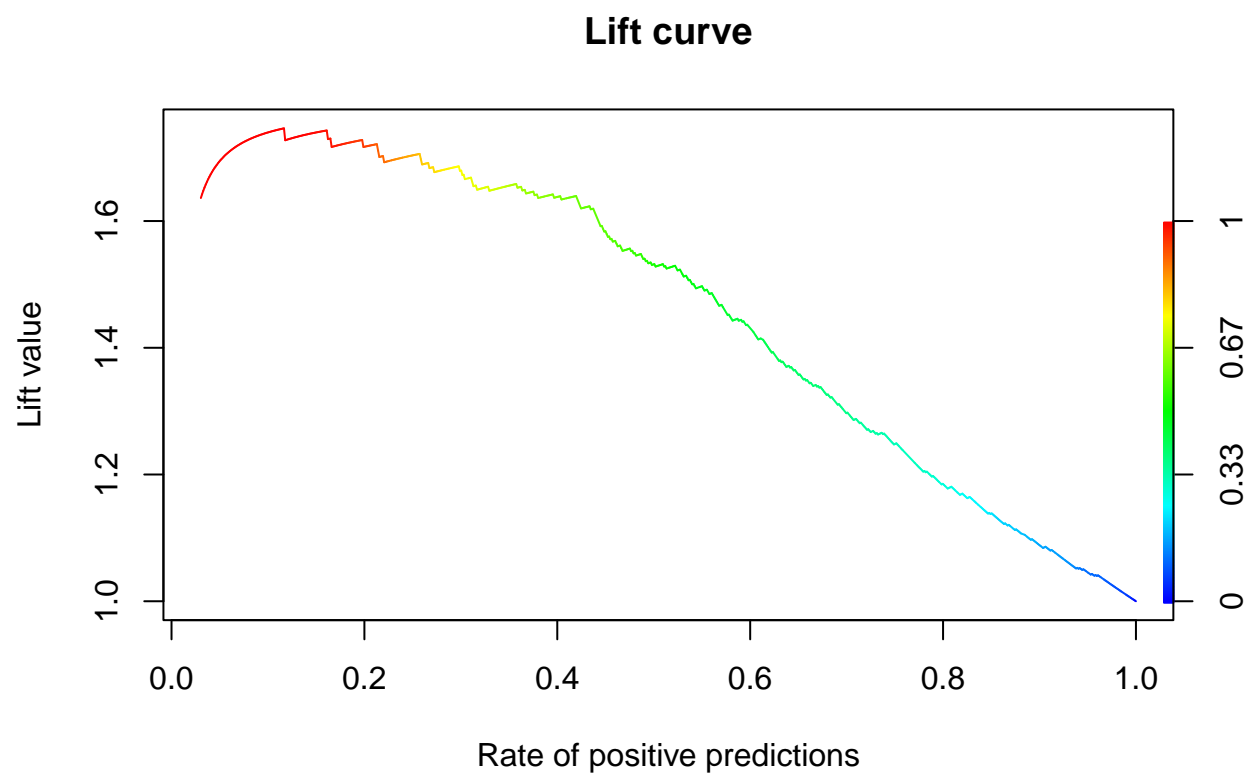
k. Using **ggplot** produce and interpret the decile chart of the classifier. #answer
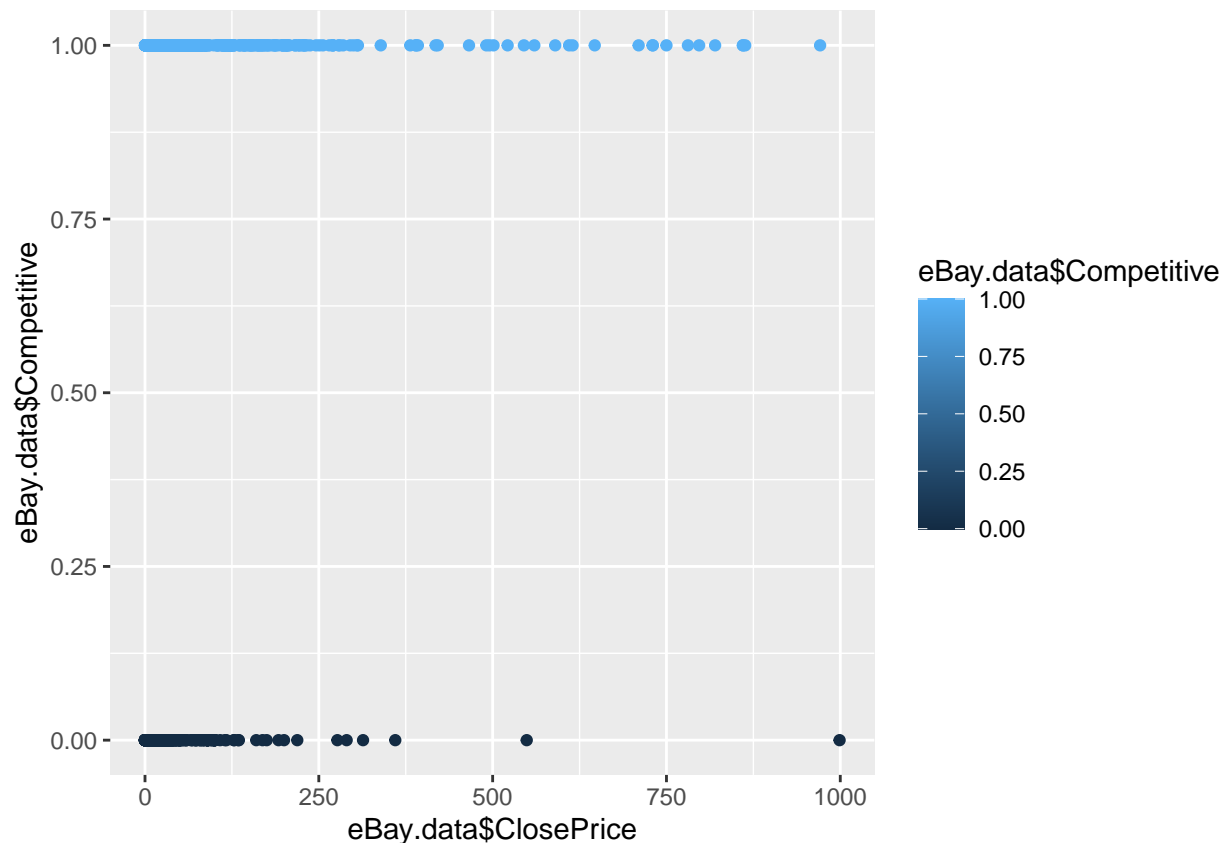
l. Use stepwise selection (use function stepAIC() in the MASS package with `direction="both"`) to find the model with the best fit to the training data. Which predictors are used? # answer

```
## Start:  AIC=1213.87
## Competitive ~ currency + Duration + endDay + Category + OpenPrice +
##     ClosePrice + sellerRating
##
##                 Df Deviance    AIC
## - Duration       4   1153.7 1211.7
## <none>               1147.9 1213.9
## - currency       2   1152.4 1214.4
## - sellerRating   1   1154.1 1218.1
## - endDay         6   1164.1 1218.1
## - Category      17   1210.7 1242.7
## - OpenPrice      1   1402.2 1466.2
## - ClosePrice     1   1465.7 1529.7
##
## Step:  AIC=1211.71
## Competitive ~ currency + endDay + Category + OpenPrice + ClosePrice +
##     sellerRating
##
##                 Df Deviance    AIC
## <none>               1153.7 1211.7
## - currency       2   1158.7 1212.7
## + Duration       4   1147.9 1213.9
## - sellerRating   1   1160.3 1216.3
## - endDay         6   1178.0 1224.0
```

```
## - Category     17   1218.5 1242.5
## - OpenPrice     1   1413.8 1469.8
## - ClosePrice    1   1480.9 1536.9
```

m. Obtain the confusion matrix, accuracy (error) rate, sensitivity, and specificity of the best-fit model (from the question above) evaluated using two different sets of data, the training and validation sets (use 0.5 cutoff probability). What is the danger of using the best model trained on the training set to make predictions on the training set. # answer

n. Explain why the best-fitting model and the best predictive models may be different. # answer