

hw2.R

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```
#Use package arules
library(arules)

## Loading required package: Matrix

##
## Attaching package: 'arules'

## The following objects are masked from 'package:base':
##
##      abbreviate, write

### Import dataset
### a)
movie_df <- read.csv("movies_binary.csv")
movie_matrix <- as.matrix(movie_df)
?as
movie_transactions <- as(movie_matrix, Class = "transactions")
inspect(head(movie_transactions))

##      items
## [1] {Fracture.2007.,
##      JohnWick.2014.,
##      StarWars.EpisodeIV.ANewHope.1977.,
##      StarWars.EpisodeV.TheEmpireStrikesBack.1980.,
##      BigHero6.2014.,
##      VeryBadThings.1998.,
##      DownwithLove.2003.,
##      ForbiddenKingdom.The.2008.,
##      MeettheRobinsons.2007.,
##      BourneUltimatum.The.2007.,
##      HappyGilmore.1996.,
##      BillabongOdyssey.2003.,
##      TheDUFF.2015.,
##      DarkKnightRises.The.2012.,
##      X.Men.2000.,
##      X.MenOrigins.Wolverine.2009.,
##      Up.2009.,
##      LionKing.The.1994.,
##      Hobbit.AnUnexpectedJourney.The.2012.}
## [2] {Warrior.2011.,
##      Departed.The.2006.,
##      Fracture.2007.,
##      MyBestFriend.sWedding.1997.,
##      StarWars.EpisodeIV.ANewHope.1977.,
```

```

##      StarWars.EpisodeV.TheEmpireStrikesBack.1980.,
##      BigHero6.2014.,
##      VeryBadThings.1998.,
##      MeettheRobinsons.2007.,
##      BourneUltimatum.The.2007.,
##      HappyGilmore.1996.,
##      BillabongOdyssey.2003.,
##      TheDUFF.2015.,
##      DarkKnightRises.The.2012.,
##      X.Men.2000.,
##      X.MenOrigins.Wolverine.2009.,
##      Proof.1991.,
##      TopGun.1986.,
##      Up.2009.,
##      LionKing.The.1994.,
##      AlmostFamous.2000.,
##      Hobbit.AnUnexpectedJourney.The.2012.}
## [3] {Departed.The.2006.,
##      Fracture.2007.,
##      JohnWick.2014.,
##      StarWars.EpisodeIV.ANewHope.1977.,
##      StarWars.EpisodeV.TheEmpireStrikesBack.1980.,
##      BigHero6.2014.,
##      ForbiddenKingdom.The.2008.,
##      MeettheRobinsons.2007.,
##      BourneUltimatum.The.2007.,
##      HappyGilmore.1996.,
##      TheDUFF.2015.,
##      DarkKnightRises.The.2012.,
##      X.Men.2000.,
##      X.MenOrigins.Wolverine.2009.,
##      TopGun.1986.,
##      Anchorman.TheLegendofRonBurgundy.2004.,
##      Up.2009.,
##      LionKing.The.1994.}
## [4] {Warrior.2011.,
##      Departed.The.2006.,
##      Fracture.2007.,
##      MyBestFriend.sWedding.1997.,
##      Interstellar.2014.,
##      StarWars.EpisodeIV.ANewHope.1977.,
##      StarWars.EpisodeV.TheEmpireStrikesBack.1980.,
##      ForbiddenKingdom.The.2008.,
##      MeettheRobinsons.2007.,
##      BourneUltimatum.The.2007.,
##      HappyGilmore.1996.,
##      EternalSunshineoftheSpotlessMind.2004.,
##      TheDUFF.2015.,
##      DarkKnightRises.The.2012.,
##      X.Men.2000.,
##      X.MenOrigins.Wolverine.2009.,
##      Proof.1991.,
##      TopGun.1986.,
##      Up.2009.,

```

```

##      LionKing.The.1994.,
##      AlmostFamous.2000.}
## [5] {Fracture.2007.,
##      MyBestFriend.sWedding.1997.,
##      JohnWick.2014.,
##      StarWars.EpisodeIV.ANewHope.1977.,
##      PulpFiction.1994.,
##      DownwithLove.2003.,
##      ForbiddenKingdom.The.2008.,
##      MeettheRobinsons.2007.,
##      BourneUltimatum.The.2007.,
##      HappyGilmore.1996.,
##      BillabongOdyssey.2003.,
##      DarkKnightRises.The.2012.,
##      X.Men.2000.,
##      X.MenOrigins.Wolverine.2009.,
##      Proof.1991.,
##      TopGun.1986.,
##      InvincibleIronMan.The.2007.,
##      AlmostFamous.2000.,
##      Hobbit.AnUnexpectedJourney.The.2012.}
## [6] {Warrior.2011.,
##      Departed.The.2006.,
##      Fracture.2007.,
##      MyBestFriend.sWedding.1997.,
##      Interstellar.2014.,
##      JohnWick.2014.,
##      StarWars.EpisodeIV.ANewHope.1977.,
##      DownwithLove.2003.,
##      ForbiddenKingdom.The.2008.,
##      MeettheRobinsons.2007.,
##      HappyGilmore.1996.,
##      TheDUFF.2015.,
##      DarkKnightRises.The.2012.,
##      X.Men.2000.,
##      X.MenOrigins.Wolverine.2009.,
##      TopGun.1986.,
##      InvincibleIronMan.The.2007.,
##      Anchorman.TheLegendofRonBurgundy.2004.,
##      AlmostFamous.2000.,
##      Hobbit.AnUnexpectedJourney.The.2012.}

```

```
### b)
```

```
itemInfo(movie_transactions)
```

```

##                                labels
## 1                                Warrior.2011.
## 2                        Departed.The.2006.
## 3                        Fracture.2007.
## 4      MyBestFriend.sWedding.1997.
## 5                        Interstellar.2014.
## 6                        JohnWick.2014.
## 7      StarWars.EpisodeIV.ANewHope.1977.
## 8      StarWars.EpisodeV.TheEmpireStrikesBack.1980.
## 9                        PulpFiction.1994.

```

```

## 10      HarryPotterandtheSorcererStone.2001.
## 11      HarryPotterandtheChamberofSecrets.2002.
## 12      BigHero6.2014.
## 13      VeryBadThings.1998.
## 14      DownwithLove.2003.
## 15      ForbiddenKingdom.The.2008.
## 16      MeettheRobinsons.2007.
## 17      BourneUltimatum.The.2007.
## 18      HappyGilmore.1996.
## 19      EternalSunshineoftheSpotlessMind.2004.
## 20      BillabongOdyssey.2003.
## 21      TheDUFF.2015.
## 22      DarkKnightRises.The.2012.
## 23      X.Men.2000.
## 24      X.MenOrigins.Wolverine.2009.
## 25      Proof.1991.
## 26      TopGun.1986.
## 27      InvincibleIronMan.The.2007.
## 28      Anchorman.TheLegendofRonBurgundy.2004.
## 29      Up.2009.
## 30      LionKing.The.1994.
## 31      AlmostFamous.2000.
## 32      Hobbit.AnUnexpectedJourney.The.2012.

```

```
### c)
```

```
itemFrequency(movie_transactions)
```

```

##      Warrior.2011.
##      0.5005005
##      Departed.The.2006.
##      0.4844845
##      Fracture.2007.
##      0.4854855
##      MyBestFriend.sWedding.1997.
##      0.4804805
##      Interstellar.2014.
##      0.4874875
##      JohnWick.2014.
##      0.5135135
##      StarWars.EpisodeIV.ANewHope.1977.
##      0.8998999
## StarWars.EpisodeV.TheEmpireStrikesBack.1980.
##      0.8588589
##      PulpFiction.1994.
##      0.7277277
##      HarryPotterandtheSorcererStone.2001.
##      0.8218218
##      HarryPotterandtheChamberofSecrets.2002.
##      0.7217217
##      BigHero6.2014.
##      0.5175175
##      VeryBadThings.1998.
##      0.5125125
##      DownwithLove.2003.
##      0.5005005

```

```

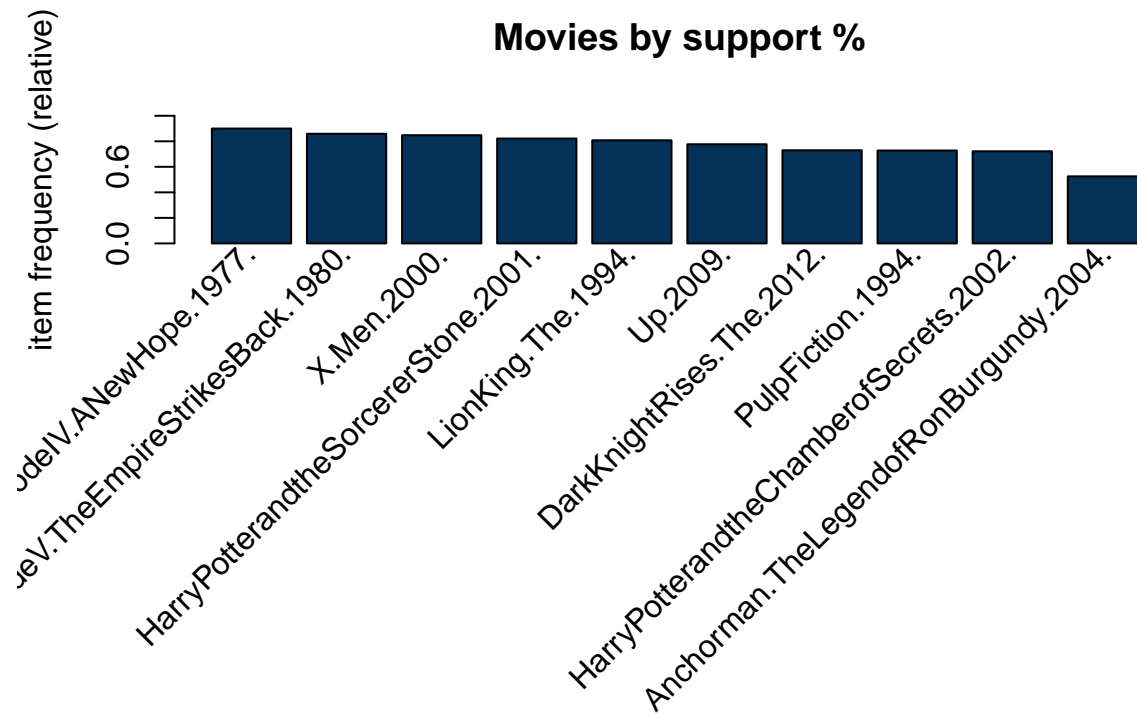
##           ForbiddenKingdom.The.2008.
##           0.5095095
##           MeettheRobinsons.2007.
##           0.5035035
##           BourneUltimatum.The.2007.
##           0.5185185
##           HappyGilmore.1996.
##           0.4994995
##           EternalSunshineoftheSpotlessMind.2004.
##           0.5015015
##           BillabongOdyssey.2003.
##           0.4804805
##           TheDUFF.2015.
##           0.4984985
##           DarkKnightRises.The.2012.
##           0.7297297
##           X.Men.2000.
##           0.8478478
##           X.MenOrigins.Wolverine.2009.
##           0.5035035
##           Proof.1991.
##           0.4904905
##           TopGun.1986.
##           0.5215215
##           InvincibleIronMan.The.2007.
##           0.5065065
##           Anchorman.TheLegendofRonBurgundy.2004.
##           0.5255255
##           Up.2009.
##           0.7767768
##           LionKing.The.1994.
##           0.8078078
##           AlmostFamous.2000.
##           0.5005005
##           Hobbit.AnUnexpectedJourney.The.2012.
##           0.4874875

```

```

itemFrequencyPlot(movie_transactions, ylim = c(0, 1), topN = 10,
                  main = "Movies by support %", col = "#053259" )

```



```
sort(itemFrequency(movie_transactions), decreasing = TRUE)
```

```
##          StarWars.EpisodeIV.ANewHope.1977.
##                                0.8998999
## StarWars.EpisodeV.TheEmpireStrikesBack.1980.
##                                0.8588589
##                                X.Men.2000.
##                                0.8478478
##          HarryPotterandtheSorcererStone.2001.
##                                0.8218218
##                                LionKing.The.1994.
##                                0.8078078
##                                Up.2009.
##                                0.7767768
##          DarkKnightRises.The.2012.
##                                0.7297297
##                                PulpFiction.1994.
##                                0.7277277
##          HarryPotterandtheChamberofSecrets.2002.
##                                0.7217217
##          Anchorman.TheLegendofRonBurgundy.2004.
##                                0.5255255
##                                TopGun.1986.
##                                0.5215215
##          BourneUltimatum.The.2007.
##                                0.5185185
##                                BigHero6.2014.
##                                0.5175175
##                                JohnWick.2014.
##                                0.5135135
##          VeryBadThings.1998.
```

```
##                                0.5125125
##      ForbiddenKingdom.The.2008.
##                                0.5095095
##      InvincibleIronMan.The.2007.
##                                0.5065065
##      MeettheRobinsons.2007.
##                                0.5035035
##      X.MenOrigins.Wolverine.2009.
##                                0.5035035
##      EternalSunshineoftheSpotlessMind.2004.
##                                0.5015015
##      Warrior.2011.
##                                0.5005005
##      DownwithLove.2003.
##                                0.5005005
##      AlmostFamous.2000.
##                                0.5005005
##      HappyGilmore.1996.
##                                0.4994995
##      TheDUFF.2015.
##                                0.4984985
##      Proof.1991.
##                                0.4904905
##      Interstellar.2014.
##                                0.4874875
##      Hobbit.AnUnexpectedJourney.The.2012.
##                                0.4874875
##      Fracture.2007.
##                                0.4854855
##      Departed.The.2006.
##                                0.4844845
##      MyBestFriend.sWedding.1997.
##                                0.4804805
##      BillabongOdyssey.2003.
##                                0.4804805
```

```
# Top2 movies
```

```
# No1. StarWars.EpisodeIV.ANewHope.1977.: 0.8998999
```

```
# No2. StarWars.EpisodeV.TheEmpireStrikesBack.1980. : 0.8588589
```

```
# Within all the people in this dataset, 89.9% of the people have watched StarWars.EpisodeIV  
# and 85.8% of the people have watched StarWars.EpisodeV.
```

```
# This shows how popular these two movies are.
```

```
### d) Transactions that contain both up.2009 and lion king
```

```
up2009_and_lionking <- subset(movie_transactions,  
                               items %ain% c("Up.2009.", "LionKing.The.1994."))  
summary(up2009_and_lionking)
```

```
## transactions as itemMatrix in sparse format with
```

```
## 776 rows (elements/itemsets/transactions) and
```

```
## 32 columns (items) and a density of 0.6022068
```

```
##
```

```
## most frequent items:
```

```
##                                Up.2009.
```

```
##                                776
```

```

##                      LionKing.The.1994.
##                      776
##          StarWars.EpisodeIV.ANewHope.1977.
##                      725
## StarWars.EpisodeV.TheEmpireStrikesBack.1980.
##                      691
##                      X.Men.2000.
##                      685
##                      (Other)
##                      11301
##
## element (itemset/transaction) length distribution:
## sizes
## 10 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
##  1  3  9 13 36 49 85 101 110 123 90 73 43 23  9  6  2
##
##      Min. 1st Qu.  Median      Mean 3rd Qu.      Max.
##    10.00  17.00   19.00   19.27   21.00   27.00
##
## includes extended item information - examples:
##           labels
## 1      Warrior.2011.
## 2 Departed.The.2006.
## 3      Fracture.2007.
# Answer: 776 transactions
### E)
?apriori
movie_rules <- apriori(movie_transactions, list(supp = 0.7, conf = 0.7, minlen = 2, maxlen = 2))

## Apriori
##
## Parameter specification:
## confidence minval smax arem aval originalSupport maxtime support minlen
##          0.7    0.1    1 none FALSE              TRUE        5    0.7    2
## maxlen target  ext
##          2 rules TRUE
##
## Algorithmic control:
## filter tree heap memopt load sort verbose
##    0.1 TRUE TRUE  FALSE TRUE    2    TRUE
##
## Absolute minimum support count: 699
##
## set item appearances ...[0 item(s)] done [0.00s].
## set transactions ...[32 item(s), 999 transaction(s)] done [0.00s].
## sorting and recoding items ... [9 item(s)] done [0.00s].
## creating transaction tree ... done [0.00s].
## checking subsets of size 1 2
##
## Warning in apriori(movie_transactions, list(supp = 0.7, conf = 0.7, minlen
## = 2, : Mining stopped (maxlen reached). Only patterns up to a length of 2
## returned!
## done [0.00s].

```



```
## writing ... [22 rule(s)] done [0.00s].
## creating S4 object ... done [0.00s].
```

```
inspect(head(movie_rules))
```

lhs	rhs	support
[1] {HarryPotterandtheChamberofSecrets.2002.}	=> {HarryPotterandtheSorcererStone.2001.}	0.7217217
[2] {HarryPotterandtheSorcererStone.2001.}	=> {HarryPotterandtheChamberofSecrets.2002.}	0.7217217
[3] {Up.2009.}	=> {LionKing.The.1994.}	0.7767768
[4] {LionKing.The.1994.}	=> {Up.2009.}	0.7767768
[5] {Up.2009.}	=> {StarWars.EpisodeIV.ANewHope.1977.}	0.7257257
[6] {StarWars.EpisodeIV.ANewHope.1977.}	=> {Up.2009.}	0.7257257

```
summary(movie_rules)
```

```
## set of 22 rules
```

```
##
```

```
## rule length distribution (lhs + rhs):sizes
```

```
## 2
```

```
## 22
```

```
##
```

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
2	2	2	2	2	2

```
##
```

```
## summary of quality measures:
```

support		confidence		coverage		lift	
Min.	:0.7057	Min.	:0.8065	Min.	:0.7217	Min.	:0.9827
1st Qu.	:0.7227	1st Qu.	:0.8474	1st Qu.	:0.8078	1st Qu.	:1.0173
Median	:0.7397	Median	:0.8809	Median	:0.8478	Median	:1.0382
Mean	:0.7485	Mean	:0.8945	Mean	:0.8387	Mean	:1.0689
3rd Qu.	:0.7598	3rd Qu.	:0.9327	3rd Qu.	:0.8589	3rd Qu.	:1.0993
Max.	:0.8589	Max.	:1.0000	Max.	:0.8999	Max.	:1.2379

```
## count
```

```
## Min. :705.0
```

```
## 1st Qu.:722.0
```

```
## Median :739.0
```

```
## Mean :747.7
```

```
## 3rd Qu.:759.0
```

```
## Max. :858.0
```

```
##
```

```
## mining info:
```

	data	ntransactions	support	confidence
movie_transactions		999	0.7	0.7

```
# X -> Y
```

```
# mean value of support: 0.7485 -> 74.8% of the people in the dataset
```

```
# watch these two movies combination of X and Y. High support value, which shows
# that these movies are popular
```

```
# mean value of confidence: 0.8945 -> When people watch Movie X, 89.45% of the time they watch Movie Y
# mean value of lift: 1.06 -> People who watch movies X in watch movie Y 1.06 times more than
# all the other people. Low lift value.
```

```
### f)
```

```
inspect(movie_rules)
```

lhs	rhs
-----	-----

```

## [1] {HarryPotterandtheChamberofSecrets.2002.} => {HarryPotterandtheSorcererStone.2001.}
## [2] {HarryPotterandtheSorcererStone.2001.} => {HarryPotterandtheChamberofSecrets.2002.}
## [3] {Up.2009.} => {LionKing.The.1994.}
## [4] {LionKing.The.1994.} => {Up.2009.}
## [5] {Up.2009.} => {StarWars.EpisodeIV.ANewHope.1977.}
## [6] {StarWars.EpisodeIV.ANewHope.1977.} => {Up.2009.}
## [7] {LionKing.The.1994.} => {X.Men.2000.}
## [8] {X.Men.2000.} => {LionKing.The.1994.}
## [9] {LionKing.The.1994.} => {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}
## [10] {StarWars.EpisodeV.TheEmpireStrikesBack.1980.} => {LionKing.The.1994.}
## [11] {LionKing.The.1994.} => {StarWars.EpisodeIV.ANewHope.1977.}
## [12] {StarWars.EpisodeIV.ANewHope.1977.} => {LionKing.The.1994.}
## [13] {HarryPotterandtheSorcererStone.2001.} => {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}
## [14] {StarWars.EpisodeV.TheEmpireStrikesBack.1980.} => {HarryPotterandtheSorcererStone.2001.}
## [15] {HarryPotterandtheSorcererStone.2001.} => {StarWars.EpisodeIV.ANewHope.1977.}
## [16] {StarWars.EpisodeIV.ANewHope.1977.} => {HarryPotterandtheSorcererStone.2001.}
## [17] {X.Men.2000.} => {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}
## [18] {StarWars.EpisodeV.TheEmpireStrikesBack.1980.} => {X.Men.2000.}
## [19] {X.Men.2000.} => {StarWars.EpisodeIV.ANewHope.1977.}
## [20] {StarWars.EpisodeIV.ANewHope.1977.} => {X.Men.2000.}
## [21] {StarWars.EpisodeV.TheEmpireStrikesBack.1980.} => {StarWars.EpisodeIV.ANewHope.1977.}
## [22] {StarWars.EpisodeIV.ANewHope.1977.} => {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}

```

22 rules found

Obvious rule: X -> Y and Y -> X.

We could see that from first 2 rule. HarryPotter.2002 -> HarryPotter.2001 and

HarryPotter.2001 -> HarryPotter200.2

Less obvious rule: People who watch X.men watch Lion King.

It is less obvious because X men and lion king are in two different genre (Action and Musical)

g)

```
inspect(sort(movie_rules, by = "confidence"))
```

```

##      lhs                                rhs
## [1] {HarryPotterandtheChamberofSecrets.2002.} => {HarryPotterandtheSorcererStone.2001.}
## [2] {Up.2009.} => {LionKing.The.1994.}
## [3] {StarWars.EpisodeV.TheEmpireStrikesBack.1980.} => {StarWars.EpisodeIV.ANewHope.1977.}
## [4] {LionKing.The.1994.} => {Up.2009.}
## [5] {StarWars.EpisodeIV.ANewHope.1977.} => {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}
## [6] {Up.2009.} => {StarWars.EpisodeIV.ANewHope.1977.}
## [7] {HarryPotterandtheSorcererStone.2001.} => {StarWars.EpisodeIV.ANewHope.1977.}
## [8] {LionKing.The.1994.} => {StarWars.EpisodeIV.ANewHope.1977.}
## [9] {HarryPotterandtheSorcererStone.2001.} => {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}
## [10] {X.Men.2000.} => {StarWars.EpisodeIV.ANewHope.1977.}
## [11] {LionKing.The.1994.} => {X.Men.2000.}
## [12] {HarryPotterandtheSorcererStone.2001.} => {HarryPotterandtheChamberofSecrets.2002.}
## [13] {StarWars.EpisodeV.TheEmpireStrikesBack.1980.} => {HarryPotterandtheSorcererStone.2001.}
## [14] {LionKing.The.1994.} => {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}
## [15] {X.Men.2000.} => {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}
## [16] {StarWars.EpisodeIV.ANewHope.1977.} => {HarryPotterandtheSorcererStone.2001.}
## [17] {StarWars.EpisodeV.TheEmpireStrikesBack.1980.} => {X.Men.2000.}
## [18] {X.Men.2000.} => {LionKing.The.1994.}
## [19] {StarWars.EpisodeIV.ANewHope.1977.} => {X.Men.2000.}
## [20] {StarWars.EpisodeIV.ANewHope.1977.} => {LionKing.The.1994.}
## [21] {StarWars.EpisodeV.TheEmpireStrikesBack.1980.} => {LionKing.The.1994.}

```

```

## [22] {StarWars.EpisodeIV.ANewHope.1977.}          => {Up.2009.}

# Highest Confidence
# HarryPotter.2002 -> HarryPotter,2001 and Up.2009 -> Lionking.1994 and Starwars.1980 -> StarWars1977
# These three all have a confidence of 1.0 which means, if people watch Harry Potter.2002
# 100% of the time they watch HarryPotter.2001. This applies to all three rules we found
# Lowest Confidence
# StarWars.1977 -> Up.2009
# Confidence of 80%. When people watch StarWars.1977, 80% of the time they watch Up.2009

### h)
inspect(sort(movie_rules, by = "lift"))

##      lhs                                rhs
## [1]  {Up.2009.}                        => {LionKing.The.1994.}
## [2]  {LionKing.The.1994.}              => {Up.2009.}
## [3]  {HarryPotterandtheChamberofSecrets.2002.} => {HarryPotterandtheSorcererStone.2001.}
## [4]  {HarryPotterandtheSorcererStone.2001.} => {HarryPotterandtheChamberofSecrets.2002.}
## [5]  {StarWars.EpisodeV.TheEmpireStrikesBack.1980.} => {StarWars.EpisodeIV.ANewHope.1977.}
## [6]  {StarWars.EpisodeIV.ANewHope.1977.}      => {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}
## [7]  {HarryPotterandtheSorcererStone.2001.}    => {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}
## [8]  {StarWars.EpisodeV.TheEmpireStrikesBack.1980.} => {HarryPotterandtheSorcererStone.2001.}
## [9]  {LionKing.The.1994.}                  => {X.Men.2000.}
## [10] {X.Men.2000.}                        => {LionKing.The.1994.}
## [11] {Up.2009.}                          => {StarWars.EpisodeIV.ANewHope.1977.}
## [12] {StarWars.EpisodeIV.ANewHope.1977.}      => {Up.2009.}
## [13] {HarryPotterandtheSorcererStone.2001.}    => {StarWars.EpisodeIV.ANewHope.1977.}
## [14] {StarWars.EpisodeIV.ANewHope.1977.}      => {HarryPotterandtheSorcererStone.2001.}
## [15] {LionKing.The.1994.}                  => {StarWars.EpisodeIV.ANewHope.1977.}
## [16] {StarWars.EpisodeIV.ANewHope.1977.}      => {LionKing.The.1994.}
## [17] {LionKing.The.1994.}                  => {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}
## [18] {StarWars.EpisodeV.TheEmpireStrikesBack.1980.} => {LionKing.The.1994.}
## [19] {X.Men.2000.}                          => {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}
## [20] {StarWars.EpisodeV.TheEmpireStrikesBack.1980.} => {X.Men.2000.}
## [21] {X.Men.2000.}                        => {StarWars.EpisodeIV.ANewHope.1977.}
## [22] {StarWars.EpisodeIV.ANewHope.1977.}      => {X.Men.2000.}

# Highest lift
# Up.2009 -> LionKing.1994 and LionKing.1994 and Up.2009
# Lift value of 1.24 shows that people who watch up.2009 are 1.24 times more likley to watch Lionking
# and vice versa
# Lowest lift
# X.Men -> StarWars.1977 and StarWars.1977 -> X.men
# Lift value of 0.98 shows that people who watch X.men are less likely to watch StarWars and vice versa

### i)
# 2 rules I trust
# 1st: HarryPotter.2002 -> HarryPotter.2001
# 2nd: StarWars.1980 -> StarWars1977]
# These two rules have Confidence of 1 and lift of over 1, which means when people watch left hand
# side of the movie 100% of the time they watch right hand side and they are more likely to watch
# them, than other people. Also, these rules make sense because when people watch the newer episode
# in the series they would watch the earlier one too, or they will get confused.
# 2 rules I don't trust
# 1st: StarWars.1980 -> X.men.2000

```

```
# 2nd: StarWars.1977 -> X.men.2000
# They have Confidence of about 0.847 and 0.833 which means when people watch StarWars movies,
# they only watch X.men about 83 - 85 % of the time. Also, they have Lift value of less than one,
# which means people who watch Star.Wars are less likely to watch X.men than others.
```

```
### j)
# Recommendations
# I would suggest the streaming company to give recommendation to customer
```

```
### k)
bad_rules <- apriori(movie_transactions, list(supp = 0.5, conf = 0.6, minlen = 2))
```

```
## Apriori
##
## Parameter specification:
## confidence minval smax arem aval originalSupport maxtime support minlen
##          0.6    0.1    1 none FALSE                TRUE      5     0.5     2
## maxlen target  ext
##          10 rules TRUE
##
## Algorithmic control:
## filter tree heap memopt load sort verbose
##      0.1 TRUE TRUE  FALSE TRUE     2    TRUE
##
## Absolute minimum support count: 499
##
## set item appearances ...[0 item(s)] done [0.00s].
## set transactions ...[32 item(s), 999 transaction(s)] done [0.00s].
## sorting and recoding items ... [23 item(s)] done [0.00s].
## creating transaction tree ... done [0.00s].
## checking subsets of size 1 2 3 4 5 6 done [0.00s].
## writing ... [620 rule(s)] done [0.00s].
## creating S4 object ... done [0.00s].
```

```
inspect(head(bad_rules))
```

	lhs	rhs	support
## [1]	{X.MenOrigins.Wolverine.2009.}	=> {X.Men.2000.}	0.5035035
## [2]	{PulpFiction.1994.}	=> {HarryPotterandtheChamberofSecrets.2002.}	0.5135135
## [3]	{HarryPotterandtheChamberofSecrets.2002.}	=> {PulpFiction.1994.}	0.5135135
## [4]	{PulpFiction.1994.}	=> {Up.2009.}	0.5355355
## [5]	{Up.2009.}	=> {PulpFiction.1994.}	0.5355355
## [6]	{PulpFiction.1994.}	=> {LionKing.The.1994.}	0.5625626

```
summary(bad_rules)
```

```
## set of 620 rules
##
## rule length distribution (lhs + rhs):sizes
##    2    3    4    5    6
##  71 189 216 120  24
##
```

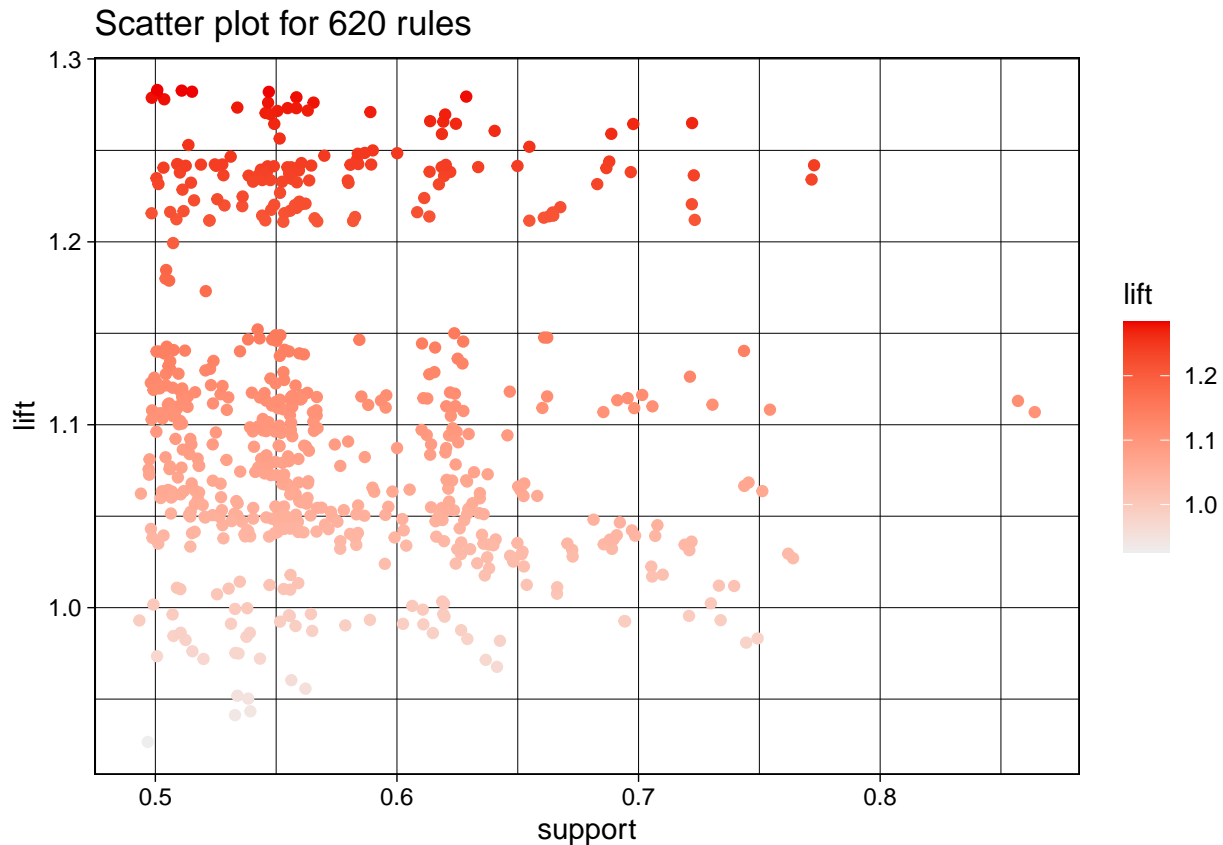
```

##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##      2.000   3.000   4.000   3.737   4.000   6.000
##
## summary of quality measures:
##      support      confidence      coverage      lift
##      Min.      :0.5005      Min.      :0.6766      Min.      :0.5005      Min.      :0.9297
##      1st Qu.:0.5285      1st Qu.:0.8460      1st Qu.:0.5756      1st Qu.:1.0467
##      Median :0.5566      Median :0.8927      Median :0.6296      Median :1.0881
##      Mean   :0.5763      Mean   :0.8976      Mean   :0.6471      Mean   :1.1050
##      3rd Qu.:0.6176      3rd Qu.:0.9814      3rd Qu.:0.7137      3rd Qu.:1.1435
##      Max.   :0.8589      Max.   :1.0000      Max.   :0.8999      Max.   :1.2824
##      count
##      Min.      :500.0
##      1st Qu.:528.0
##      Median :556.0
##      Mean   :575.7
##      3rd Qu.:617.0
##      Max.   :858.0
##
## mining info:
##      data ntransactions support confidence
##      movie_transactions      999      0.5      0.6
# Answer: 620 rules found

### L)
library(arulesViz)
plot(bad_rules, measure = c("support", "lift"), shading = "lift")

## To reduce overplotting, jitter is added! Use jitter = 0 to prevent jitter.

```



```
### m)
# First of all rules that have lift of <=1.0 should be excluded. Lift value of less than or
# equal to one means, they either do not have any association or they negatively affect each other.
badrules_badlift <- subset(bad_rules, subset = lift <= 1)
inspect(sort(badrules_badlift, by = "confidence"))
```

##	lhs	rhs
## [1]	{PulpFiction.1994., LionKing.The.1994.}	=> {StarWars.EpisodeIV.ANewHope.1977.}
## [2]	{X.Men.2000.}	=> {StarWars.EpisodeIV.ANewHope.1977.}
## [3]	{PulpFiction.1994.}	=> {StarWars.EpisodeIV.ANewHope.1977.}
## [4]	{X.Men.2000.}	=> {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}
## [5]	{PulpFiction.1994., X.Men.2000.}	=> {StarWars.EpisodeIV.ANewHope.1977.}
## [6]	{PulpFiction.1994.}	=> {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}
## [7]	{StarWars.EpisodeV.TheEmpireStrikesBack.1980.}	=> {X.Men.2000.}
## [8]	{StarWars.EpisodeIV.ANewHope.1977., StarWars.EpisodeV.TheEmpireStrikesBack.1980.}	=> {X.Men.2000.}
## [9]	{HarryPotterandtheSorcererStone.2001.}	=> {X.Men.2000.}
## [10]	{StarWars.EpisodeIV.ANewHope.1977., HarryPotterandtheSorcererStone.2001., DarkKnightRises.The.2012.}	=> {X.Men.2000.}
## [11]	{StarWars.EpisodeIV.ANewHope.1977., DarkKnightRises.The.2012.}	=> {X.Men.2000.}
## [12]	{StarWars.EpisodeV.TheEmpireStrikesBack.1980., HarryPotterandtheChamberofSecrets.2002.}	=> {X.Men.2000.}
## [13]	{StarWars.EpisodeV.TheEmpireStrikesBack.1980.,	

```

##      HarryPotterandtheSorcererStone.2001.,
##      HarryPotterandtheChamberofSecrets.2002.}      => {X.Men.2000.}
## [14] {StarWars.EpisodeIV.ANewHope.1977.,
##      StarWars.EpisodeV.TheEmpireStrikesBack.1980.,
##      HarryPotterandtheChamberofSecrets.2002.}      => {X.Men.2000.}
## [15] {StarWars.EpisodeIV.ANewHope.1977.,
##      StarWars.EpisodeV.TheEmpireStrikesBack.1980.,
##      HarryPotterandtheSorcererStone.2001.,
##      HarryPotterandtheChamberofSecrets.2002.}      => {X.Men.2000.}
## [16] {StarWars.EpisodeIV.ANewHope.1977.,
##      HarryPotterandtheChamberofSecrets.2002.}      => {X.Men.2000.}
## [17] {StarWars.EpisodeIV.ANewHope.1977.,
##      HarryPotterandtheSorcererStone.2001.,
##      HarryPotterandtheChamberofSecrets.2002.}      => {X.Men.2000.}
## [18] {StarWars.EpisodeV.TheEmpireStrikesBack.1980.,
##      HarryPotterandtheSorcererStone.2001.}      => {X.Men.2000.}
## [19] {StarWars.EpisodeIV.ANewHope.1977.,
##      StarWars.EpisodeV.TheEmpireStrikesBack.1980.,
##      HarryPotterandtheSorcererStone.2001.}      => {X.Men.2000.}
## [20] {StarWars.EpisodeIV.ANewHope.1977.,
##      HarryPotterandtheSorcererStone.2001.}      => {X.Men.2000.}
## [21] {PulpFiction.1994.,
##      X.Men.2000.}      => {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}
## [22] {StarWars.EpisodeIV.ANewHope.1977.}      => {X.Men.2000.}
## [23] {X.Men.2000.}      => {HarryPotterandtheSorcererStone.2001.}
## [24] {PulpFiction.1994.}      => {HarryPotterandtheSorcererStone.2001.}
## [25] {PulpFiction.1994.,
##      X.Men.2000.}      => {HarryPotterandtheSorcererStone.2001.}
## [26] {StarWars.EpisodeIV.ANewHope.1977.,
##      PulpFiction.1994.}      => {LionKing.The.1994.}
## [27] {PulpFiction.1994.}      => {LionKing.The.1994.}
## [28] {PulpFiction.1994.}      => {Up.2009.}
## [29] {StarWars.EpisodeV.TheEmpireStrikesBack.1980.,
##      X.Men.2000.}      => {PulpFiction.1994.}
## [30] {StarWars.EpisodeIV.ANewHope.1977.,
##      StarWars.EpisodeV.TheEmpireStrikesBack.1980.,
##      X.Men.2000.}      => {PulpFiction.1994.}
## [31] {HarryPotterandtheSorcererStone.2001.}      => {PulpFiction.1994.}
## [32] {StarWars.EpisodeV.TheEmpireStrikesBack.1980.}      => {PulpFiction.1994.}
## [33] {StarWars.EpisodeIV.ANewHope.1977.,
##      StarWars.EpisodeV.TheEmpireStrikesBack.1980.}      => {PulpFiction.1994.}
## [34] {StarWars.EpisodeIV.ANewHope.1977.,
##      X.Men.2000.}      => {PulpFiction.1994.}
## [35] {X.Men.2000.,
##      LionKing.The.1994.}      => {PulpFiction.1994.}
## [36] {StarWars.EpisodeV.TheEmpireStrikesBack.1980.,
##      HarryPotterandtheSorcererStone.2001.}      => {PulpFiction.1994.}
## [37] {StarWars.EpisodeIV.ANewHope.1977.,
##      StarWars.EpisodeV.TheEmpireStrikesBack.1980.,
##      HarryPotterandtheSorcererStone.2001.}      => {PulpFiction.1994.}
## [38] {HarryPotterandtheChamberofSecrets.2002.}      => {PulpFiction.1994.}
## [39] {HarryPotterandtheSorcererStone.2001.,
##      HarryPotterandtheChamberofSecrets.2002.}      => {PulpFiction.1994.}
## [40] {StarWars.EpisodeIV.ANewHope.1977.,

```

```

##      HarryPotterandtheSorcererStone.2001.}      => {PulpFiction.1994.}
## [41] {PulpFiction.1994.}                        => {HarryPotterandtheChamberofSecrets.2002.}
## [42] {StarWars.EpisodeIV.ANewHope.1977.}          => {PulpFiction.1994.}
## [43] {LionKing.The.1994.}                          => {PulpFiction.1994.}
## [44] {Up.2009.}                                    => {PulpFiction.1994.}
## [45] {Up.2009.,
##      LionKing.The.1994.}                      => {PulpFiction.1994.}
## [46] {StarWars.EpisodeIV.ANewHope.1977.,
##      LionKing.The.1994.}                      => {PulpFiction.1994.}

# badrules_badlift is a subset of badrules where lift <= 1, and I sorted the rules by Confidence in des
# By looking at the subset we could clearly see that these rules contains movies that are not in the sa
# For instance the first rule is PulpFiction.1994, LionKing -> StarWars.1977 and it has confidence of 0
# of 0.988. It means when people watch PulpFiction and LionKing, 88.9 % of the time they watch StarWars
# watch PulpFiction and Lionking are less likely to watch StarWars.
# This makes sense because they don't belong in the same genre. This applies to most of the rules in th
# Most of the movies in the left hand side does not belong to the movie genre on the right hand side.

### n)
# Music streaming services.

```