

Question 1) Let's make an automated recommendation system for the PicCollage mobile app.

You may either use `read.csv()` and `data.frame` to load the file as before, or you can try learning how to use `data.table` – a high performance package for reading, writing, and managing large data sets.

```
install.packages("data.table", repos = "http://cran.us.r-project.org")

##
## The downloaded binary packages are in
## /var/folders/mf/14vfr0p53ps7vvtlfbghnsbr0000gn/T//RtmpVIGKie/downloaded_packages

library(data.table)
ac_bundles_dt <- fread("piccollage_accounts_bundles.csv")
ac_bundles_matrix <- as.matrix(ac_bundles_dt[, -1, with=FALSE])
```

(a) Let's explore to see if any sticker bundles seem intuitively similar:

(i) (recommended) Download PicCollage onto your mobile from the App Store and take a look at the style and content of various bundles in their Sticker Store: how many recommendations does each bundle have? (NOTE: the Android app might not have recommendations)

ans : 6

(ii) Find a single sticker bundle that is both in our limited data set and also in the app's Sticker Store (e.g., "sweetmothersday"). Then, use your intuition to recommend (guess!) five other bundles in our dataset that might have similar usage patterns as this bundle.

- single sticker bundle : doodleholiday (which name is holiday doodle in the app's Sticker Store)
- five other bundles in our dataset : pacmanholiday, washiholiday, hipsterholiday, jollyholiday, holiday-cheerss

(b) Let's find similar bundles using geometric models of similarity:

(i) Let's create cosine similarity based recommendations for all bundles:

1. Create a matrix or data.frame of the top 5 recommendations for all bundles

```

cossin <- cosine(ac_bundles_matrix)
accounts_bundles <- function(x) {
  sorted <- sort(x, decreasing = TRUE)
  names(sorted)[2:6]
}
recommand_matrix <- NULL
for (i in c(1:ncol(cossin))){
  recommand_vec <- accounts_bundles(cossin[i, ])
  recommand_matrix <- cbind(recommand_matrix, recommand_vec)
}
colnames(recommand_matrix) <- colnames(cossin)
recommand_matrix

```

```

##      Maroon5V      between      pellington
## [1,] "OddAnatomy" "BlingStickerPack" "springrose"
## [2,] "beatsmusic" "xoxo" "8bit2"
## [3,] "xoxo" "gwen" "mmlm"
## [4,] "alien" "OddAnatomy" "julyfourth"
## [5,] "word" "AccessoriesStickerPack" "tropicalparadise"
##      StickerLite      saintvalentine      HipsterChicSara      OddAnatomy
## [1,] "HeartStickerPack" "nashnext" "Random" "alien"
## [2,] "HipsterChicSara" "givethanks" "HeartStickerPack" "xoxo"
## [3,] "Mom2013" "teenwitch" "wonderland" "between"
## [4,] "Emome" "togetherwerise" "Emome" "KLL"
## [5,] "Random" "lovestinks2016" "StickerLite" "BlingStickerPack"
##      wonderland      V10      lovestinks2016
## [1,] "Random" "Mom2013" "nashnext"
## [2,] "HipsterChicSara" "HeartStickerPack" "teenwitch"
## [3,] "Maroon5V" "CampusLife" "givethanks"
## [4,] "supercute" "DecktheHall" "togetherwerise"
## [5,] "supersweet" "Halloween2012StickerPack" "bubbleletters"
##      Random      supercute      retrosummer
## [1,] "HipsterChicSara" "xoxo" "peanutmangif"
## [2,] "wonderland" "BlingStickerPack" "gwen"
## [3,] "supercute" "gwen" "betweenspring"
## [4,] "StickerLite" "supersweet" "BlingStickerPack"
## [5,] "food" "between" "between"
##      Emome      toMomwithLove      thebouqs      HeartStickerPack
## [1,] "HeartStickerPack" "halloweenparty" "alien" "StickerLite"
## [2,] "WordsStickerPack" "babyanimals" "OddAnatomy" "Emome"
## [3,] "HalloweenScream2013" "family" "word" "WordsStickerPack"
## [4,] "HipsterChicSara" "hellobaby" "betweenspring" "HipsterChicSara"
## [5,] "2014summer" "hipsteroverlays" "between" "BlingStickerPack"
##      bubbleletters      gwen      food
## [1,] "hbd2016" "BlingStickerPack" "supersweet"
## [2,] "babyanimals" "between" "alien"
## [3,] "halloweenparty" "AccessoriesStickerPack" "OddAnatomy"
## [4,] "family" "xoxo" "Maroon5V"
## [5,] "toMomwithLove" "Monsterhigh" "Random"
##      Monsterhigh      supersweet      word      xmasquotes
## [1,] "BlingStickerPack" "supercute" "OddAnatomy" "wpbear"
## [2,] "AccessoriesStickerPack" "Monsterhigh" "supersassy" "4thofjuly3"
## [3,] "gwen" "xoxo" "KLL" "snowflakeee"

```

```

## [4,] "xoxo" "OddAnatomy" "alien" "newyearsparty"
## [5,] "between" "gwen" "thebouqs" "warmncozy"
## WinterWonderland fallinlovewiththefall alien nashnext
## [1,] "PhotoboothFest" "cny2017" "OddAnatomy" "givethanks"
## [2,] "DecktheHall" "kungfood" "thebouqs" "teenwitch"
## [3,] "StickerLite" "cometobe" "word" "togetherwerise"
## [4,] "japan2015" "pacmanholiday" "between" "mrcurlsport"
## [5,] "CampusLife" "vintagexmas" "Maroon5V" "saintvalentine"
## carfriends peanutmangif KLL
## [1,] "newyearsparty" "retrosummer" "xoxo"
## [2,] "peanutmangif" "carfriends" "supersassy"
## [3,] "fallinlovewiththefall" "pellington" "OddAnatomy"
## [4,] "supercute" "frombierun" "ladolcevita"
## [5,] "lovestinks2016" "aroundtheworld" "starrytribe"
## CutieV snowflakes newyearsparty betweenspring
## [1,] "Valentine2013StickerPack" "halloweenparty" "bubbleletters" "OddAnatomy"
## [2,] "AntiV" "cny2017" "hbd2016" "supersassy"
## [3,] "Mom2013" "family" "wpbear" "word"
## [4,] "wonderland" "kungfood" "xmasquotes" "KLL"
## [5,] "Random" "babyanimals" "warmncozy" "xoxo"
## simplyautumn beatsmusic xoxo togetherwerise
## [1,] "fallinlovewiththefall" "xoxo" "BlingStickerPack" "nashnext"
## [2,] "snowflakes" "ladolcevita" "OddAnatomy" "teenwitch"
## [3,] "thebouqs" "KLL" "between" "givethanks"
## [4,] "supercute" "supersassy" "gwen" "aesthetics"
## [5,] "carfriends" "starrytribe" "KLL" "chubbles"
## RageComics chubbles happycny2016 happy
## [1,] "Emome" "frombierun" "cometobe" "cutevalentine"
## [2,] "CatpixCubie" "togetherwerise" "pacmanholiday" "starrytribe"
## [3,] "Music1D" "arrows" "vintagexmas" "ladolcevita"
## [4,] "2014summer" "happycny2016" "yummyfood" "cutoutluv"
## [5,] "2014fifa" "bmnesis" "watercolorywinter" "watercolor"
## seaamo hellobaby doodlewords chloecaroline
## [1,] "hellobaby" "halloweenparty" "seaamo" "graduation2015"
## [2,] "happy" "family" "pacmanholiday" "aroundtheworld"
## [3,] "bubbleletters" "babyanimals" "vintagexmas" "bemine"
## [4,] "word" "toMomwithLove" "yummyfood" "HipsterChicSara"
## [5,] "doodlewords" "bubbleletters" "watercolorywinter" "alien"
## bmnesis arrows hbd2016 freshempire
## [1,] "springrose" "bmnesis" "bubbleletters" "warmncozy"
## [2,] "pacmanholiday" "chubbles" "newyearsparty" "bubbleletters"
## [3,] "vintagexmas" "kungfood" "betweenspring" "halloweenparty"
## [4,] "yummyfood" "nashnext" "toMomwithLove" "family"
## [5,] "watercolorywinter" "givethanks" "between" "babyanimals"
## Mom2013 stpatrick icecreamsocial sassyhween
## [1,] "Dad2013" "WinterWonderland" "Maroon5V" "summerlovin"
## [2,] "HeartStickerPack" "StickerLite" "between" "nashnext"
## [3,] "StickerLite" "Maroon5V" "pellington" "frombierun"
## [4,] "Random" "between" "StickerLite" "mmlm"
## [5,] "CampusLife" "pellington" "saintvalentine" "julyfourth"
## sphalloween CatpixCubie kungfood
## [1,] "Maroon5V" "cherngs" "cny2017"
## [2,] "between" "NaiveLittleThings" "aesthetics"
## [3,] "pellington" "Eggotown" "fallinlovewiththefall"

```

```

## [4,] "StickerLite"      "WinterWonderland"  "snowflakes"
## [5,] "saintvalentine" "CampusLife"        "togetherwerise"
##      eastersurprise  happyeaster2016    frombierun
## [1,] "cutoutluv"       "eastersurprise"    "chubbles"
## [2,] "bemine"          "StickerLite"       "fallinlovewiththefall"
## [3,] "watercolor"      "Maroon5V"          "hbd2016"
## [4,] "hipsterholiday" "between"            "sassyhween"
## [5,] "mmlm"            "pellington"        "pellington"
##      DecktheHall      Eggotown            papertapes
## [1,] "PhotoboothFest"  "christmassnow"     "Random"
## [2,] "WherezSanta"     "Mom2013"           "Mom2013"
## [3,] "WinterWonderland" "CatpixCubie"       "wonderland"
## [4,] "HeartStickerPack" "StickerLite"       "Emome"
## [5,] "StickerLite"     "CutieV"            "HipsterChicSara"
##      Valentine2013StickerPack peanutman            Dad2013
## [1,] "CutieV"           "bananaman"         "Mom2013"
## [2,] "HeartStickerPack" "eastersurprise"    "StickerLite"
## [3,] "StickerLite"     "mmlm"              "CampusLife"
## [4,] "Mom2013"         "julyfourth"         "HeartStickerPack"
## [5,] "AntiV"           "tropicalparadise"   "RobinThicke2013"
##      PhotoboothFest    WherezSanta         bananaman
## [1,] "WinterWonderland" "DecktheHall"        "peanutman"
## [2,] "DecktheHall"     "StickerLite"        "chloecaroline"
## [3,] "StickerLite"     "WinterWonderland"   "CutieV"
## [4,] "HeartStickerPack" "PhotoboothFest"     "wonderland"
## [5,] "CampusLife"     "HeartStickerPack"   "Eggotown"
##      Halloween2012StickerPack mmlm                julyfourth
## [1,] "alphabet"          "julyfourth"         "julyfourth"
## [2,] "4thofjuly3"        "tropicalparadise"   "tropicalparadise"
## [3,] "CampusLife"        "bestdaddy"          "bestdaddy"
## [4,] "StickerLite"       "justmytype"         "justmytype"
## [5,] "HeartStickerPack"  "gudetama"           "gudetama"
##      tropicalparadise  bestdaddy            sweetmothersday
## [1,] "julyfourth"      "julyfourth"         "mmlm"
## [2,] "tropicalparadise" "tropicalparadise"   "julyfourth"
## [3,] "bestdaddy"       "bestdaddy"          "tropicalparadise"
## [4,] "justmytype"      "justmytype"         "bestdaddy"
## [5,] "gudetama"        "gudetama"           "justmytype"
##      springrose        wpbear               autumn                justmytype
## [1,] "8bit2"           "warmncozy"         "mmlm"                "julyfourth"
## [2,] "bmnnemesis"      "xmasquotes"         "julyfourth"          "tropicalparadise"
## [3,] "tropicalparadise" "snowflakeee"        "tropicalparadise"    "bestdaddy"
## [4,] "cometobe"        "holidaycheers"      "bestdaddy"           "justmytype"
## [5,] "mmlm"            "newyearsparty"      "justmytype"          "gudetama"
##      gudetama          backtocol            8bit2                4thofjuly3
## [1,] "julyfourth"      "julyfourth"         "mmlm"                "alphabet"
## [2,] "tropicalparadise" "tropicalparadise"   "julyfourth"          "babyanimals"
## [3,] "bestdaddy"       "bestdaddy"          "tropicalparadise"    "halloweenparty"
## [4,] "justmytype"      "justmytype"         "bestdaddy"           "toMomwithLove"
## [5,] "gudetama"        "gudetama"           "justmytype"          "xmasquotes"
##      summerlovin       superherodad2        hipsteroverlays      watercolor
## [1,] "sassyhween"      "cometobe"           "happy"               "hipsterholiday"
## [2,] "superherodad2"   "pacmanholiday"      "starrytribe"         "cutevalentine"
## [3,] "tropicalparadise" "vintagexmas"        "cutoutluv"           "happy"

```

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## [4,] "mmlm" "yummyfood" "cutevalentine" "starrytribe"
## [5,] "julyfourth" "watercolorywinter" "bemine" "ladolcevita"
## hellospring supersassy cutoutluv ladolcevita
## [1,] "vintage" "cutevalentine" "starrytribe" "cutevalentine"
## [2,] "cutoutluv" "happy" "bemine" "happy"
## [3,] "vintagewashi" "starrytribe" "cutevalentine" "starrytribe"
## [4,] "eastersurprise" "ladolcevita" "happy" "cutoutluv"
## [5,] "bemine" "cutoutluv" "ladolcevita" "watercolor"
## bemine japan2015 doodleholiday washiholiday
## [1,] "cutoutluv" "xoxo" "bemine" "mmlm"
## [2,] "starrytribe" "OddAnatomy" "cutoutluv" "julyfourth"
## [3,] "ladolcevita" "gwen" "ladolcevita" "tropicalparadise"
## [4,] "cutevalentine" "KLL" "stationery" "bestdaddy"
## [5,] "happy" "supersassy" "watercolor" "justmytype"
## hipsterholiday creepycute 2014summer cherngs
## [1,] "watercolor" "starrytribe" "HalloweenScream2013" "springrose"
## [2,] "cutevalentine" "cutevalentine" "tropicalparadise" "pacmanholiday"
## [3,] "happy" "happy" "mmlm" "vintagexmas"
## [4,] "starrytribe" "ladolcevita" "julyfourth" "yummyfood"
## [5,] "ladolcevita" "cutoutluv" "bestdaddy" "watercolorywinter"
## vintage AntiV BlingStickerPack
## [1,] "vintagewashi" "CutieV" "AccessoriesStickerPack"
## [2,] "StampStickerPack" "Valentine2013StickerPack" "Monsterhigh"
## [3,] "hellospring" "HipsterChicSara" "gwen"
## [4,] "washiholiday" "Random" "xoxo"
## [5,] "mmlm" "wonderland" "between"
## HalloweenScream2013 GraffitiStickerPack2013 RobinThicke2013
## [1,] "starrytribe" "xoxo" "Dad2013"
## [2,] "cutevalentine" "Maroon5V" "Music1D"
## [3,] "happy" "wonderland" "HipsterChicSara"
## [4,] "ladolcevita" "beatsmusic" "StickerLite"
## [5,] "cutoutluv" "Eggotown" "CatpixCubie"
## AnimalFriendsStickerPack HipsterChic PartyStickerPack
## [1,] "notetoself" "HipsterChicSara" "WordsStickerPack"
## [2,] "salelabels" "RageComics" "AnimalFriendsStickerPack"
## [3,] "gradparty" "RobinThicke2013" "HalloweenScream2013"
## [4,] "StampStickerPack" "Emome" "2014summer"
## [5,] "hipsterholiday" "CampusLife" "salelabels"
## Music1D CampusLife graduation2015 aroundtheworld
## [1,] "Emome" "Mom2013" "chloecaroline" "graduation2015"
## [2,] "CampusLife" "Dad2013" "bemine" "chloecaroline"
## [3,] "RobinThicke2013" "HeartStickerPack" "aroundtheworld" "pacmanholiday"
## [4,] "RageComics" "StickerLite" "cutevalentine" "vintagexmas"
## [5,] "HipsterChicSara" "Music1D" "happy" "yummyfood"
## WordsStickerPack NaiveLittleThings
## [1,] "HeartStickerPack" "BlingStickerPack"
## [2,] "Emome" "AccessoriesStickerPack"
## [3,] "PartyStickerPack" "HipsterChicSara"
## [4,] "AnimalFriendsStickerPack" "CatpixCubie"
## [5,] "2014summer" "Monsterhigh"
## Holiday2012StickerPack jollyholiday valentineStickers
## [1,] "CampusLife" "floralwedding" "floralwedding"
## [2,] "Halloween2012StickerPack" "chicchristmas" "chicchristmas"
## [3,] "DecktheHall" "forever" "forever"

```

```

## [4,] "StickerLite"          "watercolor"          "jollyholiday"
## [5,] "WherezSanta"         "valentineStickers"  "watercolor"
##      Xmas2012StickerPack  alphabet              forever
## [1,] "PartyStickerPack"    "4thofjuly3"          "floralwedding"
## [2,] "WordsStickerPack"    "babyanimals"         "chicchristmas"
## [3,] "valentineStickers"  "Halloween2012StickerPack" "jollyholiday"
## [4,] "Emome"              "bubbleletters"       "family"
## [5,] "peanutman"          "Monsterhigh"         "watercolor"
##      toyoufromme          AccessoriesStickerPack  fifacomics
## [1,] "alphabet"           "BlingStickerPack"    "hellospring"
## [2,] "BlingStickerPack"   "Monsterhigh"         "stationery"
## [3,] "newyearsparty"      "gwen"                "autumn"
## [4,] "WherezSanta"        "between"              "bemine"
## [5,] "Dad2013"            "xoxo"                 "cutoutluv"
##      2014fifa             StampStickerPack      ouija
## [1,] "RageComics"         "vintagewashi"        "beatsmusic"
## [2,] "word"               "vintage"              "creepycute"
## [3,] "Maroon5V"           "hellospring"          "supersweet"
## [4,] "NaiveLittleThings"  "AnimalFriendsStickerPack" "CatpixCubie"
## [5,] "CatpixCubie"        "notetoself"          "gwen"
##      stationery          ChineseNewYear2013    sanrio
## [1,] "bemine"             "Eggotown"            "halloweenparty"
## [2,] "ladolcevida"        "StickerLite"         "family"
## [3,] "cutoutluv"         "CutieV"              "babyanimals"
## [4,] "starrytribe"        "Holiday2012StickerPack" "hellobaby"
## [5,] "cutevalentine"     "Emome"                "toMomwithLove"
##      family              babyanimals           halloweenparty      costumeparty
## [1,] "halloweenparty"    "halloweenparty"      "family"             "pacmanholiday"
## [2,] "babyanimals"       "family"               "babyanimals"        "vintagexmas"
## [3,] "hellobaby"         "4thofjuly3"           "hellobaby"          "yummyfood"
## [4,] "toMomwithLove"     "hellobaby"            "toMomwithLove"      "watercolorywinter"
## [5,] "hipsteroverlays"  "alphabet"             "hipsteroverlays"    "wordstoliveby"
##      starrytribe          cutevalentine          holidaycheers        givethanks
## [1,] "cutevalentine"     "happy"                "warmncozy"          "nashnext"
## [2,] "happy"             "starrytribe"          "wpbear"              "teenwitch"
## [3,] "cutoutluv"         "ladolcevida"          "nashnext"            "togetherwerise"
## [4,] "ladolcevida"       "cutoutluv"            "givethanks"          "mrcurlsport"
## [5,] "bemine"            "watercolor"           "snowflakeee"        "saintvalentine"
##      teenwitch           mrcurlsport            vote2016              floralwedding
## [1,] "nashnext"          "nashnext"             "pacmanholiday"       "chicchristmas"
## [2,] "togetherwerise"    "givethanks"           "yummyfood"           "forever"
## [3,] "givethanks"        "teenwitch"            "watercolorywinter"   "jollyholiday"
## [4,] "aesthetics"        "togetherwerise"        "wordstoliveby"       "valentineStickers"
## [5,] "mrcurlsport"       "Monsterhigh"           "helloautumn"         "watercolor"
##      happybday           chicchristmas          snowflakeee          hkbts
## [1,] "PartyStickerPack"  "chicchristmas"        "warmncozy"           "Maroon5V"
## [2,] "floralwedding"     "forever"              "wpbear"              "between"
## [3,] "chicchristmas"     "jollyholiday"         "holidaycheers"       "pellington"
## [4,] "forever"           "valentineStickers"    "xmasquotes"          "StickerLite"
## [5,] "jollyholiday"      "watercolor"           "newyearsparty"       "saintvalentine"
##      warmncozy           aesthetics             christmasnow
## [1,] "wpbear"            "cny2017"              "Eggotown"
## [2,] "snowflakeee"       "kungfood"              "RageComics"
## [3,] "holidaycheers"     "teenwitch"             "wonderland"

```

```
## [4,] "freshempire"      "togetherwerise"      "CutieV"
## [5,] "xmasquotes"      "fallinlovewiththefall" "RobinThicke2013"
##      pacmanholiday      vintagexmas      yummyfood
## [1,] "vintagexmas"      "vintagexmas"      "vintagexmas"
## [2,] "yummyfood"        "yummyfood"        "yummyfood"
## [3,] "watercolorywinter" "watercolorywinter" "watercolorywinter"
## [4,] "wordstoliveby"    "wordstoliveby"    "wordstoliveby"
## [5,] "helloautumn"      "helloautumn"      "helloautumn"
##      watercolorywinter wordstoliveby      helloautumn
## [1,] "vintagexmas"      "vintagexmas"      "vintagexmas"
## [2,] "yummyfood"        "yummyfood"        "yummyfood"
## [3,] "watercolorywinter" "watercolorywinter" "watercolorywinter"
## [4,] "wordstoliveby"    "wordstoliveby"    "wordstoliveby"
## [5,] "helloautumn"      "helloautumn"      "helloautumn"
##      dayofdead      summergetaway      gradparty
## [1,] "vintagexmas"      "vintagexmas"      "cometobe"
## [2,] "yummyfood"        "yummyfood"        "salelabels"
## [3,] "watercolorywinter" "watercolorywinter" "pacmanholiday"
## [4,] "wordstoliveby"    "wordstoliveby"    "vintagexmas"
## [5,] "helloautumn"      "helloautumn"      "yummyfood"
##      xmassketches      cometobe      glitterny      vintagewashi
## [1,] "vintagexmas"      "vintagexmas"      "thebouqs"      "vintage"
## [2,] "yummyfood"        "yummyfood"        "bubbleletters" "StampStickerPack"
## [3,] "watercolorywinter" "watercolorywinter" "StickerLite"   "hellospring"
## [4,] "wordstoliveby"    "wordstoliveby"    "Maroon5V"      "supersassy"
## [5,] "helloautumn"      "helloautumn"      "between"      "word"
##      notetoself      salelabels
## [1,] "salelabels"      "salelabels"
## [2,] "gradparty"      "gradparty"
## [3,] "AnimalFriendsStickerPack" "AnimalFriendsStickerPack"
## [4,] "StampStickerPack" "StampStickerPack"
## [5,] "PartyStickerPack" "PartyStickerPack"
##      cny2017
## [1,] "kungfood"
## [2,] "aesthetics"
## [3,] "fallinlovewiththefall"
## [4,] "snowflakes"
## [5,] "togetherwerise"
```

2. Create a new function that automates the above functionality: it should take an accounts-bundles matrix as a parameter, and return a data object with the top 5 recommendations for each bundle in our data set, using cosine similarity.

```
automate_cossin <- function(x) {
  cossin <- cosine(x)
  recommend <- NULL
  for (i in c(1:ncol(cossin))) {
    recommend_vec <- accounts_bundles(cossin[i, ])
    recommend <- cbind(recommend, recommend_vec)
  }
  colnames(recommend) <- colnames(cossin)
  return (recommend)
}
automate_cossin(ac_bundles_matrix)
```

```

##      Maroon5V      between      pellington
## [1,] "OddAnatomy" "BlingStickerPack" "springrose"
## [2,] "beatsmusic" "xoxo" "8bit2"
## [3,] "xoxo" "gwen" "mmlm"
## [4,] "alien" "OddAnatomy" "julyfourth"
## [5,] "word" "AccessoriesStickerPack" "tropicalparadise"
##      StickerLite      saintvalentine      HipsterChicSara      OddAnatomy
## [1,] "HeartStickerPack" "nashnext" "Random" "alien"
## [2,] "HipsterChicSara" "givethanks" "HeartStickerPack" "xoxo"
## [3,] "Mom2013" "teenwitch" "wonderland" "between"
## [4,] "Emome" "togetherwerise" "Emome" "KLL"
## [5,] "Random" "lovestinks2016" "StickerLite" "BlingStickerPack"
##      wonderland      V10      lovestinks2016
## [1,] "Random" "Mom2013" "nashnext"
## [2,] "HipsterChicSara" "HeartStickerPack" "teenwitch"
## [3,] "Maroon5V" "CampusLife" "givethanks"
## [4,] "supercute" "DecktheHall" "togetherwerise"
## [5,] "supersweet" "Halloween2012StickerPack" "bubbleletters"
##      Random      supercute      retrosummer
## [1,] "HipsterChicSara" "xoxo" "peanutmangif"
## [2,] "wonderland" "BlingStickerPack" "gwen"
## [3,] "supercute" "gwen" "betweenspring"
## [4,] "StickerLite" "supersweet" "BlingStickerPack"
## [5,] "food" "between" "between"
##      Emome      toMomwithLove      thebouqs      HeartStickerPack
## [1,] "HeartStickerPack" "halloweenparty" "alien" "StickerLite"
## [2,] "WordsStickerPack" "babyanimals" "OddAnatomy" "Emome"
## [3,] "HalloweenScream2013" "family" "word" "WordsStickerPack"
## [4,] "HipsterChicSara" "hellobaby" "betweenspring" "HipsterChicSara"
## [5,] "2014summer" "hipsteroverlays" "between" "BlingStickerPack"
##      bubbleletters      gwen      food
## [1,] "hbd2016" "BlingStickerPack" "supersweet"
## [2,] "babyanimals" "between" "alien"
## [3,] "halloweenparty" "AccessoriesStickerPack" "OddAnatomy"
## [4,] "family" "xoxo" "Maroon5V"
## [5,] "toMomwithLove" "Monsterhigh" "Random"
##      Monsterhigh      supersweet      word      xmasquotes
## [1,] "BlingStickerPack" "supercute" "OddAnatomy" "wpbear"
## [2,] "AccessoriesStickerPack" "Monsterhigh" "supersassy" "4thofjuly3"
## [3,] "gwen" "xoxo" "KLL" "snowflakeee"
## [4,] "xoxo" "OddAnatomy" "alien" "newyearsparty"
## [5,] "between" "gwen" "thebouqs" "warmncozy"
##      WinterWonderland      fallinlovewiththefall      alien      nashnext
## [1,] "PhotoboothFest" "cny2017" "OddAnatomy" "givethanks"
## [2,] "DecktheHall" "kungfood" "thebouqs" "teenwitch"
## [3,] "StickerLite" "cometobe" "word" "togetherwerise"
## [4,] "japan2015" "pacmanholiday" "between" "mrcurlsport"
## [5,] "CampusLife" "vintagexmas" "Maroon5V" "saintvalentine"
##      carfriends      peanutmangif      KLL
## [1,] "newyearsparty" "retrosummer" "xoxo"
## [2,] "peanutmangif" "carfriends" "supersassy"
## [3,] "fallinlovewiththefall" "pellington" "OddAnatomy"
## [4,] "supercute" "frombierun" "ladolcevida"
## [5,] "lovestinks2016" "aroundtheworld" "starrytribe"

```



```

##      CutieV                snowflakes      newyearsparty  betweenspring
## [1,] "Valentine2013StickerPack" "halloweenparty" "bubbleletters" "OddAnatomy"
## [2,] "AntiV"                  "cny2017"        "hbd2016"       "supersassy"
## [3,] "Mom2013"                "family"         "wpbear"        "word"
## [4,] "wonderland"            "kungfood"       "xmasquotes"    "KLL"
## [5,] "Random"                "babyanimals"    "warmncozy"     "xoxo"
##      simplyautumn      beatsmusic      xoxo                togetherwerise
## [1,] "fallinlovewiththefall" "xoxo"           "BlingStickerPack" "nashnext"
## [2,] "snowflakes"          "ladolcevita"    "OddAnatomy"      "teenwitch"
## [3,] "thebouqs"           "KLL"           "between"          "givethanks"
## [4,] "supercute"           "supersassy"     "gwen"             "aesthetics"
## [5,] "carfriends"          "starrytribe"    "KLL"              "chubbles"
##      RageComics      chubbles      happycny2016      happy
## [1,] "Emome"         "frombierun"  "cometobe"        "cutevalentine"
## [2,] "CatpixCubie"   "togetherwerise" "pacmanholiday"   "starrytribe"
## [3,] "Music1D"       "arrows"      "vintagexmas"     "ladolcevita"
## [4,] "2014summer"    "happycny2016" "yummyfood"       "cutoutluv"
## [5,] "2014fifa"     "bmnemesis"   "watercolorywinter" "watercolor"
##      seaamo      hellobaby      doodlewords      chloecaroline
## [1,] "hellobaby"    "halloweenparty" "seaamo"          "graduation2015"
## [2,] "happy"        "family"         "pacmanholiday"   "aroundtheworld"
## [3,] "bubbleletters" "babyanimals"    "vintagexmas"     "bemine"
## [4,] "word"         "toMomwithLove" "yummyfood"       "HipsterChicSara"
## [5,] "doodlewords"  "bubbleletters" "watercolorywinter" "alien"
##      bmnemesis      arrows      hbd2016      freshempire
## [1,] "springrose"   "bmnemesis"    "bubbleletters"   "warmncozy"
## [2,] "pacmanholiday" "chubbles"     "newyearsparty"   "bubbleletters"
## [3,] "vintagexmas"  "kungfood"     "betweenspring"   "halloweenparty"
## [4,] "yummyfood"    "nashnext"     "toMomwithLove"   "family"
## [5,] "watercolorywinter" "givethanks" "between"          "babyanimals"
##      Mom2013      stpatrick      icecreamsocial  sassyhween
## [1,] "Dad2013"      "WinterWonderland" "Maroon5V"        "summerlovin"
## [2,] "HeartStickerPack" "StickerLite"     "between"         "nashnext"
## [3,] "StickerLite"   "Maroon5V"        "pellington"      "frombierun"
## [4,] "Random"        "between"         "StickerLite"     "mmlm"
## [5,] "CampusLife"    "pellington"      "saintvalentine"  "julyfourth"
##      sphalloween      CatpixCubie      kungfood
## [1,] "Maroon5V"      "cherngs"         "cny2017"
## [2,] "between"       "NaiveLittleThings" "aesthetics"
## [3,] "pellington"    "Eggotown"        "fallinlovewiththefall"
## [4,] "StickerLite"   "WinterWonderland" "snowflakes"
## [5,] "saintvalentine" "CampusLife"      "togetherwerise"
##      eastersurprise  happyeaster2016  frombierun
## [1,] "cutoutluv"     "eastersurprise" "chubbles"
## [2,] "bemine"        "StickerLite"     "fallinlovewiththefall"
## [3,] "watercolor"    "Maroon5V"        "hbd2016"
## [4,] "hipsterholiday" "between"         "sassyhween"
## [5,] "mmlm"         "pellington"      "pellington"
##      DecktheHall      Eggotown      papertapes
## [1,] "PhotoboothFest" "christmassnow"  "Random"
## [2,] "WherezSanta"   "Mom2013"        "Mom2013"
## [3,] "WinterWonderland" "CatpixCubie"    "wonderland"
## [4,] "HeartStickerPack" "StickerLite"    "Emome"
## [5,] "StickerLite"   "CutieV"         "HipsterChicSara"

```

```

##      Valentine2013StickerPack peanutman      Dad2013
## [1,] "CutieV"                  "bananaman"      "Mom2013"
## [2,] "HeartStickerPack"        "eastersurprise" "StickerLite"
## [3,] "StickerLite"            "mmlm"          "CampusLife"
## [4,] "Mom2013"                "julyfourth"     "HeartStickerPack"
## [5,] "AntiV"                  "tropicalparadise" "RobinThicke2013"
##      PhotoboothFest      WherezSanta      bananaman
## [1,] "WinterWonderland" "DecktheHall"      "peanutman"
## [2,] "DecktheHall"      "StickerLite"      "chloecaroline"
## [3,] "StickerLite"      "WinterWonderland" "CutieV"
## [4,] "HeartStickerPack" "PhotoboothFest"   "wonderland"
## [5,] "CampusLife"      "HeartStickerPack" "Eggotown"
##      Halloween2012StickerPack mmlm      julyfourth
## [1,] "alphabet"            "julyfourth"      "julyfourth"
## [2,] "4thofjuly3"          "tropicalparadise" "tropicalparadise"
## [3,] "CampusLife"          "bestdaddy"        "bestdaddy"
## [4,] "StickerLite"          "justmytype"        "justmytype"
## [5,] "HeartStickerPack"     "gudetama"          "gudetama"
##      tropicalparadise bestdaddy      sweetmothersday
## [1,] "julyfourth"          "julyfourth"      "mmlm"
## [2,] "tropicalparadise"    "tropicalparadise" "julyfourth"
## [3,] "bestdaddy"          "bestdaddy"        "tropicalparadise"
## [4,] "justmytype"          "justmytype"        "bestdaddy"
## [5,] "gudetama"            "gudetama"          "justmytype"
##      springrose      wpbear      autumn      justmytype
## [1,] "8bit2"          "warmncozy" "mmlm"        "julyfourth"
## [2,] "bmnmESIS"       "xmasquotes" "julyfourth"  "tropicalparadise"
## [3,] "tropicalparadise" "snowflakeee" "tropicalparadise" "bestdaddy"
## [4,] "cometobe"       "holidaycheers" "bestdaddy"    "justmytype"
## [5,] "mmlm"           "newyearsparty" "justmytype"    "gudetama"
##      gudetama      backtocol  8bit2      4thofjuly3
## [1,] "julyfourth"    "julyfourth" "mmlm"      "alphabet"
## [2,] "tropicalparadise" "tropicalparadise" "julyfourth" "babyanimals"
## [3,] "bestdaddy"      "bestdaddy"    "tropicalparadise" "halloweenparty"
## [4,] "justmytype"      "justmytype"    "bestdaddy"      "toMomwithLove"
## [5,] "gudetama"        "gudetama"      "justmytype"      "xmasquotes"
##      summerlovin      superherodad2      hipsteroverlays watercolor
## [1,] "sassyhween"      "cometobe"          "happy"          "hipsterholiday"
## [2,] "superherodad2"    "pacmanholiday"      "starrytribe"    "cutevalentine"
## [3,] "tropicalparadise" "vintagexmas"        "cutoutluv"      "happy"
## [4,] "mmlm"            "yummyfood"          "cutevalentine"  "starrytribe"
## [5,] "julyfourth"      "watercolorywinter" "bemine"          "ladolcevita"
##      hellospring      supersassy      cutoutluv      ladolcevita
## [1,] "vintage"          "cutevalentine" "starrytribe"    "cutevalentine"
## [2,] "cutoutluv"        "happy"          "bemine"          "happy"
## [3,] "vintagewashi"     "starrytribe"    "cutevalentine"  "starrytribe"
## [4,] "eastersurprise"   "ladolcevita"    "happy"          "cutoutluv"
## [5,] "bemine"           "cutoutluv"      "ladolcevita"    "watercolor"
##      bemine      japan2015      doodleholiday washiholiday
## [1,] "cutoutluv"    "xoxo"          "bemine"          "mmlm"
## [2,] "starrytribe"  "OddAnatomy"    "cutoutluv"        "julyfourth"
## [3,] "ladolcevita"  "gwen"          "ladolcevita"      "tropicalparadise"
## [4,] "cutevalentine" "KLL"           "stationery"        "bestdaddy"
## [5,] "happy"        "supersassy"    "watercolor"        "justmytype"

```

```

##      hipsterholiday  creepycute      2014summer      cherngs
## [1,] "watercolor"    "starrytribe"    "HalloweenScream2013" "springrose"
## [2,] "cutevalentine" "cutevalentine"  "tropicalparadise"    "pacmanholiday"
## [3,] "happy"         "happy"          "mmlm"               "vintagexmas"
## [4,] "starrytribe"   "ladolcevita"    "julyfourth"         "yummyfood"
## [5,] "ladolcevita"   "cutoutluv"      "bestdaddy"          "watercolorwinter"
##      vintage      AntiV      BlingStickerPack
## [1,] "vintagewashi"  "CutieV"         "AccessoriesStickerPack"
## [2,] "StampStickerPack" "Valentine2013StickerPack" "Monsterhigh"
## [3,] "hellospring"    "HipsterChicSara"    "gwen"
## [4,] "washiholiday"  "Random"             "xoxo"
## [5,] "mmlm"          "wonderland"        "between"
##      HalloweenScream2013 GraffitiStickerPack2013 RobinThicke2013
## [1,] "starrytribe"    "xoxo"             "Dad2013"
## [2,] "cutevalentine"  "Maroon5V"         "Music1D"
## [3,] "happy"         "wonderland"       "HipsterChicSara"
## [4,] "ladolcevita"    "beatsmusic"       "StickerLite"
## [5,] "cutoutluv"      "Eggotown"         "CatpixCubie"
##      AnimalFriendsStickerPack HipsterChic      PartyStickerPack
## [1,] "notetoself"      "HipsterChicSara" "WordsStickerPack"
## [2,] "salelabels"      "RageComics"      "AnimalFriendsStickerPack"
## [3,] "gradparty"      "RobinThicke2013" "HalloweenScream2013"
## [4,] "StampStickerPack" "Emome"           "2014summer"
## [5,] "hipsterholiday"  "CampusLife"      "salelabels"
##      Music1D      CampusLife      graduation2015      aroundtheworld
## [1,] "Emome"       "Mom2013"        "chloecaroline"    "graduation2015"
## [2,] "CampusLife"  "Dad2013"        "bemine"            "chloecaroline"
## [3,] "RobinThicke2013" "HeartStickerPack" "aroundtheworld"    "pacmanholiday"
## [4,] "RageComics"   "StickerLite"    "cutevalentine"    "vintagexmas"
## [5,] "HipsterChicSara" "Music1D"        "happy"             "yummyfood"
##      WordsStickerPack      NaiveLittleThings
## [1,] "HeartStickerPack"    "BlingStickerPack"
## [2,] "Emome"              "AccessoriesStickerPack"
## [3,] "PartyStickerPack"    "HipsterChicSara"
## [4,] "AnimalFriendsStickerPack" "CatpixCubie"
## [5,] "2014summer"         "Monsterhigh"
##      Holiday2012StickerPack      jollyholiday      valentineStickers
## [1,] "CampusLife"                "floralwedding"    "floralwedding"
## [2,] "Halloween2012StickerPack"  "chicchristmas"    "chicchristmas"
## [3,] "DecktheHall"              "forever"          "forever"
## [4,] "StickerLite"              "watercolor"       "jollyholiday"
## [5,] "WherezSanta"              "valentineStickers" "watercolor"
##      Xmas2012StickerPack      alphabet      forever
## [1,] "PartyStickerPack"    "4thofjuly3"       "floralwedding"
## [2,] "WordsStickerPack"    "babyanimals"      "chicchristmas"
## [3,] "valentineStickers"  "Halloween2012StickerPack" "jollyholiday"
## [4,] "Emome"              "bubbleletters"    "family"
## [5,] "peanutman"          "Monsterhigh"      "watercolor"
##      toyoufromme      AccessoriesStickerPack      fifacomics
## [1,] "alphabet"        "BlingStickerPack"    "hellospring"
## [2,] "BlingStickerPack" "Monsterhigh"         "stationery"
## [3,] "newyearsparty"   "gwen"               "autumn"
## [4,] "WherezSanta"     "between"             "bemine"
## [5,] "Dad2013"        "xoxo"               "cutoutluv"

```

```

##      2014fifa      StampStickerPack      ouija
## [1,] "RageComics"      "vintagewashi"      "beatsmusic"
## [2,] "word"      "vintage"      "creepycute"
## [3,] "Maroon5V"      "hellospring"      "supersweet"
## [4,] "NaiveLittleThings" "AnimalFriendsStickerPack" "CatpixCubie"
## [5,] "CatpixCubie"      "notetoself"      "gwen"
##      stationery      ChineseNewYear2013      sanrio
## [1,] "bemine"      "Eggotown"      "halloweenparty"
## [2,] "ladolcevita"      "StickerLite"      "family"
## [3,] "cutoutluv"      "CutieV"      "babyanimals"
## [4,] "starrytribe"      "Holiday2012StickerPack" "hellobaby"
## [5,] "cutevalentine" "Emome"      "toMomwithLove"
##      family      babyanimals      halloweenparty      costume-party
## [1,] "halloweenparty" "halloweenparty" "family"      "pacmanholiday"
## [2,] "babyanimals"      "family"      "babyanimals"      "vintagexmas"
## [3,] "hellobaby"      "4thofjuly3"      "hellobaby"      "yummyfood"
## [4,] "toMomwithLove"      "hellobaby"      "toMomwithLove"      "watercolorywinter"
## [5,] "hipsteroverlays" "alphabet"      "hipsteroverlays" "wordstoliveby"
##      starrytribe      cutevalentine      holidaycheers      givethanks
## [1,] "cutevalentine" "happy"      "warmncozy"      "nashnext"
## [2,] "happy"      "starrytribe" "wpbear"      "teenwitch"
## [3,] "cutoutluv"      "ladolcevita" "nashnext"      "togetherwerise"
## [4,] "ladolcevita"      "cutoutluv"      "givethanks"      "mrcurlsport"
## [5,] "bemine"      "watercolor"      "snowflakeee"      "saintvalentine"
##      teenwitch      mrcurlsport      vote2016      floralwedding
## [1,] "nashnext"      "nashnext"      "pacmanholiday"      "chicchristmas"
## [2,] "togetherwerise" "givethanks"      "yummyfood"      "forever"
## [3,] "givethanks"      "teenwitch"      "watercolorywinter" "jollyholiday"
## [4,] "aesthetics"      "togetherwerise" "wordstoliveby"      "valentineStickers"
## [5,] "mrcurlsport"      "Monsterhigh"      "helloautumn"      "watercolor"
##      happybday      chicchristmas      snowflakeee      hkbts
## [1,] "PartyStickerPack" "chicchristmas"      "warmncozy"      "Maroon5V"
## [2,] "floralwedding"      "forever"      "wpbear"      "between"
## [3,] "chicchristmas"      "jollyholiday"      "holidaycheers"      "pellington"
## [4,] "forever"      "valentineStickers" "xmasquotes"      "StickerLite"
## [5,] "jollyholiday"      "watercolor"      "newyears-party"      "saintvalentine"
##      warmncozy      aesthetics      christmas-snow
## [1,] "wpbear"      "cny2017"      "Eggotown"
## [2,] "snowflakeee"      "kungfood"      "RageComics"
## [3,] "holidaycheers" "teenwitch"      "wonderland"
## [4,] "freshempire"      "togetherwerise"      "CutieV"
## [5,] "xmasquotes"      "fallinlovewiththefall" "RobinThicke2013"
##      pacmanholiday      vintagexmas      yummyfood
## [1,] "vintagexmas"      "vintagexmas"      "vintagexmas"
## [2,] "yummyfood"      "yummyfood"      "yummyfood"
## [3,] "watercolorywinter" "watercolorywinter" "watercolorywinter"
## [4,] "wordstoliveby"      "wordstoliveby"      "wordstoliveby"
## [5,] "helloautumn"      "helloautumn"      "helloautumn"
##      watercolorywinter      wordstoliveby      helloautumn
## [1,] "vintagexmas"      "vintagexmas"      "vintagexmas"
## [2,] "yummyfood"      "yummyfood"      "yummyfood"
## [3,] "watercolorywinter" "watercolorywinter" "watercolorywinter"
## [4,] "wordstoliveby"      "wordstoliveby"      "wordstoliveby"
## [5,] "helloautumn"      "helloautumn"      "helloautumn"

```

```
##      dayofdead      summergetaway      gradparty
## [1,] "vintagexmas"    "vintagexmas"    "cometobe"
## [2,] "yummyfood"     "yummyfood"     "salelabels"
## [3,] "watercolorywinter" "watercolorywinter" "pacmanholiday"
## [4,] "wordstoliveby"  "wordstoliveby"  "vintagexmas"
## [5,] "helloautumn"    "helloautumn"    "yummyfood"
##      xmassketches      cometobe      glitterny      vintagewashi
## [1,] "vintagexmas"    "vintagexmas"    "thebouqs"     "vintage"
## [2,] "yummyfood"     "yummyfood"     "bubbleletters" "StampStickerPack"
## [3,] "watercolorywinter" "watercolorywinter" "StickerLite"  "hellospring"
## [4,] "wordstoliveby"  "wordstoliveby"  "Maroon5V"     "supersassy"
## [5,] "helloautumn"    "helloautumn"    "between"      "word"
##      notetoself      salelabels
## [1,] "salelabels"    "salelabels"
## [2,] "gradparty"     "gradparty"
## [3,] "AnimalFriendsStickerPack" "AnimalFriendsStickerPack"
## [4,] "StampStickerPack" "StampStickerPack"
## [5,] "PartyStickerPack" "PartyStickerPack"
##      cny2017
## [1,] "kungfood"
## [2,] "aesthetics"
## [3,] "fallinlovewiththefall"
## [4,] "snowflakes"
## [5,] "togetherwerise"
```

3. What are the top 5 recommendations for the bundle you chose to explore earlier?

for left to right is the top 5 recommendations in order.

```
recommand_matrix[, "doodleholiday"]
```

```
## [1] "bemine"      "cutoutluv"    "ladolcevida" "stationery"  "watercolor"
```

(ii) Let's create correlation based recommendations.

1. Reuse the function you created above (don't change it; don't use the cor() function)

ans at 2.

2. But this time give the function an accounts-bundles matrix where each bundle (column) has already been mean-centered in advance.

```
bundle_means <- apply(ac_bundles_matrix, 2, mean)
bundle_means_matrix <- t(replicate(nrow(ac_bundles_matrix), bundle_means))
ac_bundles_mc_b <- ac_bundles_matrix - c(bundle_means_matrix)
recommand_mc_b_matrix <- automate_cossin(ac_bundles_mc_b)
recommand_mc_b_matrix
```

```
##      Maroon5V      between      pellington
## [1,] "OddAnatomy" "BlingStickerPack" "springrose"
## [2,] "beatsmusic" "xoxo"              "8bit2"
```

```

## [3,] "xoxo"          "gwen"              "tropicalparadise"
## [4,] "alien"         "OddAnatomy"        "mmlm"
## [5,] "word"         "AccessoriesStickerPack" "julyfourth"
##      StickerLite          saintvalentine  HipsterChicSara
## [1,] "HeartStickerPack"      "nashnext"        "Random"
## [2,] "AnimalFriendsStickerPack" "givethanks"      "HeartStickerPack"
## [3,] "between"              "teenwitch"       "wonderland"
## [4,] "Emome"                "togetherwerise"  "Emome"
## [5,] "HipsterChicSara"      "lovestinks2016"  "StickerLite"
##      OddAnatomy      wonderland      V10              lovestinks2016
## [1,] "alien"          "Random"          "Mom2013"        "nashnext"
## [2,] "xoxo"          "HipsterChicSara" "HeartStickerPack" "teenwitch"
## [3,] "between"      "Maroon5V"        "CampusLife"     "givethanks"
## [4,] "KLL"          "supercute"       "DecktheHall"    "togetherwerise"
## [5,] "BlingStickerPack" "gwen"            "BlingStickerPack" "bubbleletters"
##      Random          supercute      retrosummer
## [1,] "HipsterChicSara" "xoxo"           "peanutmangif"
## [2,] "wonderland"     "BlingStickerPack" "gwen"
## [3,] "supercute"      "gwen"           "betweenspring"
## [4,] "food"           "between"         "BlingStickerPack"
## [5,] "Mom2013"        "supersweet"     "between"
##      Emome            toMomwithLove    thebouqs         HeartStickerPack
## [1,] "HeartStickerPack" "halloweenparty" "alien"          "StickerLite"
## [2,] "WordsStickerPack" "babyanimals"    "OddAnatomy"     "WordsStickerPack"
## [3,] "HalloweenScream2013" "family"         "word"           "Emome"
## [4,] "2014summer"       "hellobaby"      "betweenspring"  "BlingStickerPack"
## [5,] "HipsterChicSara" "hipsteroverlays" "between"        "HipsterChicSara"
##      bubbleletters  gwen            food
## [1,] "hbd2016"      "BlingStickerPack" "supersweet"
## [2,] "babyanimals"  "between"          "alien"
## [3,] "halloweenparty" "AccessoriesStickerPack" "OddAnatomy"
## [4,] "family"        "xoxo"             "Maroon5V"
## [5,] "toMomwithLove" "Monsterhigh"      "Random"
##      Monsterhigh      supersweet      word            xmasquotes
## [1,] "BlingStickerPack" "supercute"     "OddAnatomy"    "wpbear"
## [2,] "AccessoriesStickerPack" "Monsterhigh" "supersassy"    "4thofjuly3"
## [3,] "gwen"            "xoxo"          "KLL"           "snowflakeee"
## [4,] "xoxo"            "OddAnatomy"    "alien"         "newyearsparty"
## [5,] "between"         "gwen"          "thebouqs"      "warmncozy"
##      WinterWonderland fallinlovewiththefall alien      nashnext
## [1,] "PhotoboothFest" "cny2017"       "OddAnatomy"    "givethanks"
## [2,] "DecktheHall"   "kungfood"      "thebouqs"      "teenwitch"
## [3,] "japan2015"     "vintagexmas"   "word"          "togetherwerise"
## [4,] "StickerLite"   "dayofdead"     "between"       "mrcurlsport"
## [5,] "CampusLife"    "xmassketches"  "Maroon5V"      "saintvalentine"
##      carfriends      peanutmangif    KLL
## [1,] "newyearsparty"  "retrosummer"  "xoxo"
## [2,] "peanutmangif"   "carfriends"   "supersassy"
## [3,] "fallinlovewiththefall" "pellington"   "OddAnatomy"
## [4,] "supercute"      "frombierun"   "ladolcevita"
## [5,] "lovestinks2016" "aroundtheworld" "starrytribe"
##      CutieV          snowflakes      newyearsparty  betweenspring
## [1,] "Valentine2013StickerPack" "halloweenparty" "bubbleletters" "OddAnatomy"
## [2,] "AntiV"              "cny2017"      "hbd2016"      "supersassy"

```

```

## [3,] "Mom2013"          "family"          "wpbear"          "word"
## [4,] "wonderland"      "kungfood"        "xmasquotes"      "xoxo"
## [5,] "Random"          "babyanimals"     "warmncozy"       "KLL"
## simplyautumn          beatsmusic         xoxo              togetherwerise
## [1,] "fallinlovewiththefall" "xoxo"            "BlingStickerPack" "nashnext"
## [2,] "snowflakes"      "ladolcevita"     "OddAnatomy"      "teenwitch"
## [3,] "thebouqs"        "KLL"             "between"          "givethanks"
## [4,] "supercute"       "supersassy"      "gwen"             "aesthetics"
## [5,] "carfriends"      "starrytribe"     "KLL"              "chubbles"
## RageComics           chubbles           happycny2016      happy
## [1,] "Emome"           "frombierun"      "vintagexmas"     "cutevalentine"
## [2,] "CatpixCubie"     "togetherwerise"  "dayofdead"       "starrytribe"
## [3,] "2014summer"      "arrows"          "xmassketches"    "ladolcevita"
## [4,] "Music1D"         "happycny2016"    "cometobe"        "cutoutluv"
## [5,] "2014fifa"       "bmnemesis"       "pacmanholiday"   "watercolor"
## seaamo               hellobaby          doodlewords        chloecaroline
## [1,] "hellobaby"       "halloweenparty"  "seaamo"           "graduation2015"
## [2,] "happy"           "family"           "pacmanholiday"    "aroundtheworld"
## [3,] "bubbleletters"   "babyanimals"     "yummyfood"        "bemine"
## [4,] "word"            "toMomwithLove"   "watercolorywinter" "HipsterChicSara"
## [5,] "doodlewords"     "bubbleletters"   "wordstoliveby"    "StickerLite"
## bmnemesis            arrows             hbd2016            freshempire
## [1,] "springrose"      "bmnemesis"       "bubbleletters"    "warmncozy"
## [2,] "pacmanholiday"   "chubbles"        "newyearsparty"    "bubbleletters"
## [3,] "yummyfood"       "kungfood"        "betweenspring"    "halloweenparty"
## [4,] "watercolorywinter" "nashnext"        "toMomwithLove"    "family"
## [5,] "wordstoliveby"   "givethanks"      "StickerLite"      "babyanimals"
## Mom2013              stpatrick          icecreamsocial     sassyhween
## [1,] "Dad2013"         "WinterWonderland" "halloweenparty"    "summerlovin"
## [2,] "HeartStickerPack" "halloweenparty"   "vintagewashi"     "nashnext"
## [3,] "CampusLife"      "mmlm"             "vintagexmas"      "mmlm"
## [4,] "Random"          "julyfourth"       "dayofdead"        "julyfourth"
## [5,] "StickerLite"     "bestdaddy"        "xmassketches"     "bestdaddy"
## sphalloween          CatpixCubie        kungfood
## [1,] "glitterny"       "cherngs"          "cny2017"
## [2,] "frombierun"      "NaiveLittleThings" "aesthetics"
## [3,] "seaamo"          "Eggotown"         "fallinlovewiththefall"
## [4,] "happyeaster2016" "WordsStickerPack" "snowflakes"
## [5,] "cometobe"        "CampusLife"       "togetherwerise"
## eastersurprise       happyeaster2016    frombierun
## [1,] "cutoutluv"       "eastersurprise"   "chubbles"
## [2,] "bemine"          "salelabels"       "fallinlovewiththefall"
## [3,] "watercolor"      "halloweenparty"   "hbd2016"
## [4,] "hipsterholiday"  "sphalloween"      "sassyhween"
## [5,] "tropicalparadise" "vintagexmas"      "pellington"
## DecktheHall           Eggotown           papertapes
## [1,] "PhotoboothFest"   "christmassnow"    "Random"
## [2,] "WhereZSanta"      "CatpixCubie"     "Mom2013"
## [3,] "WinterWonderland" "Mom2013"          "Emome"
## [4,] "Valentine2013StickerPack" "StickerLite"    "wonderland"
## [5,] "HeartStickerPack" "CutieV"           "HipsterChicSara"
## Valentine2013StickerPack peanutman           Dad2013
## [1,] "CutieV"          "bananaman"        "Mom2013"
## [2,] "HeartStickerPack" "eastersurprise"   "CampusLife"

```

```

## [3,] "AntiV" "mmlm" "StickerLite"
## [4,] "StickerLite" "julyfourth" "RobinThicke2013"
## [5,] "Mom2013" "bestdaddy" "HeartStickerPack"
## PhotoboothFest WherezSanta bananaman
## [1,] "WinterWonderland" "DecktheHall" "peanutman"
## [2,] "DecktheHall" "WinterWonderland" "chloecaroline"
## [3,] "StickerLite" "StickerLite" "CutieV"
## [4,] "CampusLife" "PhotoboothFest" "Eggotown"
## [5,] "HeartStickerPack" "freshempire" "wonderland"
## Halloween2012StickerPack mmlm julyfourth tropicalparadise
## [1,] "alphabet" "mmlm" "mmlm" "julyfourth"
## [2,] "4thofjuly3" "julyfourth" "julyfourth" "bestdaddy"
## [3,] "CampusLife" "bestdaddy" "bestdaddy" "justmytype"
## [4,] "babyanimals" "justmytype" "justmytype" "gudetama"
## [5,] "HeartStickerPack" "gudetama" "gudetama" "backtocool"
## bestdaddy sweetmothersday springrose wpbear
## [1,] "mmlm" "mmlm" "8bit2" "warmncozy"
## [2,] "julyfourth" "julyfourth" "bmnesis" "xmasquotes"
## [3,] "bestdaddy" "bestdaddy" "tropicalparadise" "snowflakeee"
## [4,] "justmytype" "justmytype" "vintagexmas" "holidaycheers"
## [5,] "gudetama" "gudetama" "dayofdead" "newyearsparty"
## autumn justmytype gudetama backtocool 8bit2
## [1,] "mmlm" "mmlm" "mmlm" "mmlm" "tropicalparadise"
## [2,] "julyfourth" "julyfourth" "julyfourth" "julyfourth" "mmlm"
## [3,] "bestdaddy" "bestdaddy" "bestdaddy" "bestdaddy" "julyfourth"
## [4,] "justmytype" "justmytype" "justmytype" "justmytype" "bestdaddy"
## [5,] "gudetama" "gudetama" "gudetama" "gudetama" "justmytype"
## 4thofjuly3 summerlovin superherodad2 hipsteroverlays
## [1,] "alphabet" "sassyhween" "vintagexmas" "happy"
## [2,] "babyanimals" "superherodad2" "dayofdead" "starrytribe"
## [3,] "halloweenparty" "tropicalparadise" "xmassketches" "cutoutluv"
## [4,] "toMomwithLove" "mmlm" "cometobe" "cutevalentine"
## [5,] "xmasquotes" "julyfourth" "pacmanholiday" "bemine"
## watercolor hellospring supersassy cutoutluv
## [1,] "hipsterholiday" "vintage" "cutevalentine" "starrytribe"
## [2,] "cutevalentine" "cutoutluv" "happy" "bemine"
## [3,] "happy" "vintagewashi" "starrytribe" "cutevalentine"
## [4,] "starrytribe" "eastersurprise" "ladolcevita" "happy"
## [5,] "ladolcevita" "bemine" "cutoutluv" "ladolcevita"
## ladolcevita bemine japan2015 doodleholiday washiholiday
## [1,] "cutevalentine" "cutoutluv" "xoxo" "bemine" "mmlm"
## [2,] "happy" "starrytribe" "OddAnatomy" "cutoutluv" "julyfourth"
## [3,] "starrytribe" "ladolcevita" "gwen" "ladolcevita" "bestdaddy"
## [4,] "cutoutluv" "cutevalentine" "KLL" "stationery" "justmytype"
## [5,] "watercolor" "happy" "supersassy" "watercolor" "gudetama"
## hipsterholiday creepycute 2014summer cherngs
## [1,] "watercolor" "starrytribe" "HalloweenScream2013" "springrose"
## [2,] "cutevalentine" "cutevalentine" "tropicalparadise" "pacmanholiday"
## [3,] "happy" "happy" "mmlm" "yummyfood"
## [4,] "starrytribe" "ladolcevita" "julyfourth" "watercolorwinter"
## [5,] "ladolcevita" "cutoutluv" "bestdaddy" "wordstoliveby"
## vintage AntiV BlingStickerPack
## [1,] "vintagewashi" "CutieV" "AccessoriesStickerPack"
## [2,] "StampStickerPack" "Valentine2013StickerPack" "Monsterhigh"

```



```

## [3,] "hellospring"      "HipsterChicSara"      "gwen"
## [4,] "washiholiday"    "Random"                "xoxo"
## [5,] "mmlm"            "wonderland"           "between"
## HalloweenScream2013 GraffitiStickerPack2013 RobinThicke2013
## [1,] "starrytribe"      "xoxo"                  "Dad2013"
## [2,] "cutevalentine"    "Maroon5V"              "Music1D"
## [3,] "happy"            "wonderland"            "HipsterChicSara"
## [4,] "ladolcevita"      "beatsmusic"            "CatpixCubie"
## [5,] "cutoutluv"        "Eggotown"              "CampusLife"
## AnimalFriendsStickerPack HipsterChic PartyStickerPack
## [1,] "notetoself"        "HipsterChicSara"      "WordsStickerPack"
## [2,] "salelabels"        "RageComics"           "AnimalFriendsStickerPack"
## [3,] "gradparty"         "RobinThicke2013"      "HalloweenScream2013"
## [4,] "StampStickerPack"  "Emome"                 "2014summer"
## [5,] "hipsterholiday"    "CampusLife"           "salelabels"
## Music1D CampusLife graduation2015 aroundtheworld
## [1,] "Emome"            "Mom2013"              "chloecaroline" "graduation2015"
## [2,] "CampusLife"        "Dad2013"              "bemine"         "chloecaroline"
## [3,] "RobinThicke2013"  "HeartStickerPack"     "aroundtheworld" "pacmanholiday"
## [4,] "RageComics"        "Music1D"              "cutevalentine" "yummyfood"
## [5,] "WordsStickerPack" "Emome"                "happy"          "watercolorywinter"
## WordsStickerPack NaiveLittleThings
## [1,] "HeartStickerPack"  "BlingStickerPack"
## [2,] "Emome"            "AccessoriesStickerPack"
## [3,] "PartyStickerPack" "HipsterChicSara"
## [4,] "AnimalFriendsStickerPack" "Monsterhigh"
## [5,] "2014summer"       "CatpixCubie"
## Holiday2012StickerPack jollyholiday valentineStickers
## [1,] "CampusLife"        "floralwedding"        "floralwedding"
## [2,] "Halloween2012StickerPack" "chicchristmas"        "chicchristmas"
## [3,] "DecktheHall"       "forever"              "forever"
## [4,] "WherezSanta"       "watercolor"           "jollyholiday"
## [5,] "ChineseNewYear2013" "valentineStickers"    "watercolor"
## Xmas2012StickerPack alphabet forever
## [1,] "PartyStickerPack"  "4thofjuly3"           "floralwedding"
## [2,] "WordsStickerPack" "babyanimals"          "chicchristmas"
## [3,] "valentineStickers" "Halloween2012StickerPack" "jollyholiday"
## [4,] "Emome"            "bubbleletters"        "family"
## [5,] "peanutman"        "Monsterhigh"          "watercolor"
## toyoufromme AccessoriesStickerPack fifacomics
## [1,] "alphabet"          "BlingStickerPack"     "hellospring"
## [2,] "BlingStickerPack" "Monsterhigh"          "stationery"
## [3,] "newyearsparty"    "gwen"                 "autumn"
## [4,] "WherezSanta"      "between"              "bemine"
## [5,] "Dad2013"          "xoxo"                 "cutoutluv"
## 2014fifa StampStickerPack ouija
## [1,] "RageComics"        "vintagewashi"         "beatsmusic"
## [2,] "word"              "vintage"              "creepycute"
## [3,] "Maroon5V"          "hellospring"          "supersweet"
## [4,] "NaiveLittleThings" "AnimalFriendsStickerPack" "CatpixCubie"
## [5,] "CatpixCubie"      "notetoself"           "gwen"
## stationery ChineseNewYear2013 sanrio
## [1,] "bemine"           "Eggotown"             "halloweenparty"
## [2,] "ladolcevita"      "Holiday2012StickerPack" "family"

```

```

## [3,] "cutoutluv"      "CutieV"      "babyanimals"
## [4,] "starrytribe"    "NaiveLittleThings" "hellobaby"
## [5,] "cutevalentine" "Emome"      "toMomwithLove"
##      family      babyanimals      halloweenparty      costumeparty
## [1,] "halloweenparty" "halloweenparty" "family"      "pacmanholiday"
## [2,] "babyanimals"    "family"      "babyanimals" "yummyfood"
## [3,] "hellobaby"      "4thofjuly3"  "hellobaby"   "watercolorywinter"
## [4,] "toMomwithLove"  "hellobaby"   "toMomwithLove" "wordstoliveby"
## [5,] "hipsteroverlays" "alphabet"     "hipsteroverlays" "helloautumn"
##      starrytribe      cutevalentine      holidaycheers      givethanks
## [1,] "cutevalentine" "happy"      "warmncozy"      "nashnext"
## [2,] "happy"      "starrytribe" "wpbear"      "teenwitch"
## [3,] "cutoutluv"    "ladolcevita" "nashnext"     "togetherwerise"
## [4,] "ladolcevita"  "cutoutluv"   "givethanks"   "mrcurlsport"
## [5,] "bemine"      "watercolor"  "snowflakeeee" "saintvalentine"
##      teenwitch      mrcurlsport      vote2016      floralwedding
## [1,] "nashnext"     "nashnext"      "vintagexmas"  "chicchristmas"
## [2,] "togetherwerise" "givethanks"    "dayofdead"    "forever"
## [3,] "givethanks"   "teenwitch"     "xmassketches" "jollyholiday"
## [4,] "aesthetics"   "togetherwerise" "cometobe"     "valentineStickers"
## [5,] "mrcurlsport"  "Monsterhigh"   "pacmanholiday" "watercolor"
##      happybday      chicchristmas      snowflakeeee      hkbts
## [1,] "PartyStickerPack" "chicchristmas"    "warmncozy"      "halloweenparty"
## [2,] "floralwedding"    "forever"          "wpbear"          "cometobe"
## [3,] "chicchristmas"    "jollyholiday"     "holidaycheers"   "vintagexmas"
## [4,] "forever"          "valentineStickers" "xmasquotes"      "dayofdead"
## [5,] "jollyholiday"    "watercolor"       "newyearsparty"   "xmassketches"
##      warmncozy      aesthetics      christmasnow
## [1,] "wpbear"      "cny2017"      "Eggotown"
## [2,] "snowflakeeee" "kungfood"     "RageComics"
## [3,] "holidaycheers" "teenwitch"    "wonderland"
## [4,] "freshempire"  "togetherwerise" "CutieV"
## [5,] "xmasquotes"   "fallinlovewiththefall" "RobinThicke2013"
##      pacmanholiday      vintagexmas      yummyfood
## [1,] "yummyfood"      "dayofdead"      "yummyfood"
## [2,] "watercolorywinter" "xmassketches"   "watercolorywinter"
## [3,] "wordstoliveby"   "cometobe"       "wordstoliveby"
## [4,] "helloautumn"     "pacmanholiday"  "helloautumn"
## [5,] "summergetaway"   "yummyfood"      "summergetaway"
##      watercolorywinter      wordstoliveby      helloautumn
## [1,] "yummyfood"      "yummyfood"      "yummyfood"
## [2,] "watercolorywinter" "watercolorywinter" "watercolorywinter"
## [3,] "wordstoliveby"   "wordstoliveby"   "wordstoliveby"
## [4,] "helloautumn"     "helloautumn"     "helloautumn"
## [5,] "summergetaway"   "summergetaway"   "summergetaway"
##      dayofdead      summergetaway      gradparty      xmassketches
## [1,] "dayofdead"     "yummyfood"      "vintagexmas"  "dayofdead"
## [2,] "xmassketches"  "watercolorywinter" "dayofdead"    "xmassketches"
## [3,] "cometobe"      "wordstoliveby"   "xmassketches" "cometobe"
## [4,] "pacmanholiday" "helloautumn"     "notetoself"   "pacmanholiday"
## [5,] "yummyfood"     "summergetaway"   "salelabels"   "yummyfood"
##      cometobe      glitterny      vintagewashi
## [1,] "vintagexmas"  "thebouqs"      "vintage"
## [2,] "dayofdead"   "bubbleletters" "StampStickerPack"

```

```
## [3,] "xmassketches" "cometobe" "hellospring"
## [4,] "pacmanholiday" "sphalloween" "supersassy"
## [5,] "yummyfood" "halloweenparty" "word"
## notetoself salelabels
## [1,] "salelabels" "notetoself"
## [2,] "gradparty" "gradparty"
## [3,] "AnimalFriendsStickerPack" "AnimalFriendsStickerPack"
## [4,] "StampStickerPack" "StampStickerPack"
## [5,] "PartyStickerPack" "PartyStickerPack"
## cny2017
## [1,] "kungfood"
## [2,] "aesthetics"
## [3,] "fallinlovewiththefall"
## [4,] "snowflakes"
## [5,] "togetherwerise"
```

3. Now what are the top 5 recommendations for the bundle you chose to explore earlier?

```
recommand_mc_b_matrix[, "doodleholiday"]
```

```
## [1] "bemine" "cutoutluv" "ladolcevida" "stationery" "watercolor"
```

(iii) Let's create adjusted-cosine based recommendations.

1. Reuse the function you created above (you should not have to change it)

ans at 2.

2. But this time give the function an accounts-bundles matrix where each account (row) has already been mean-centered in advance.

```
bundle_means <- apply(ac_bundles_matrix, 1, mean)
bundle_means_matrix <- t(replicate(ncol(ac_bundles_matrix), bundle_means))
ac_bundles_mc_b <- ac_bundles_matrix - c(bundle_means_matrix)
recommand_mc_b_matrix <- automate_cossin(ac_bundles_mc_b)
recommand_mc_b_matrix
```

```
## Maroon5V between pellington StickerLite
## [1,] "xoxo" "BlingStickerPack" "8bit2" "HeartStickerPack"
## [2,] "beatmusic" "xoxo" "vintagexmas" "HipsterChicSara"
## [3,] "alien" "gwen" "sweetmothersday" "Mom2013"
## [4,] "supercute" "Monsterhigh" "stationery" "Emome"
## [5,] "OddAnatomy" "AccessoriesStickerPack" "fifacomics" "between"
## saintvalentine HipsterChicSara OddAnatomy wonderland
## [1,] "bmnemesis" "Random" "xoxo" "Random"
## [2,] "nashnext" "HeartStickerPack" "alien" "HipsterChicSara"
## [3,] "julyfourth" "wonderland" "KLL" "supersweet"
## [4,] "togetherwerise" "Emome" "between" "supercute"
## [5,] "vintagewashi" "StickerLite" "BlingStickerPack" "gwen"
## V10 lovestinks2016 Random supercute
## [1,] "Mom2013" "nashnext" "HipsterChicSara" "xoxo"
```

```

## [2,] "CampusLife"      "bubbleletters"  "wonderland"    "BlingStickerPack"
## [3,] "HeartStickerPack" "newyearsparty"  "supercute"      "gwen"
## [4,] "DecktheHall"     "togetherwerise" "food"           "between"
## [5,] "fifacomics"     "hbd2016"        "Mom2013"        "supersweet"
##      retrosummer      Emome              toMomwithLove      thebouqs
## [1,] "peanutmangif"    "HeartStickerPack" "hipsteroverlays" "alien"
## [2,] "gwen"            "WordsStickerPack" "bubbleletters"   "OddAnatomy"
## [3,] "BlingStickerPack" "HipsterChicSara"  "xoxo"            "betweenspring"
## [4,] "betweenspring"   "HalloweenScream2013" "4thofjuly3"      "word"
## [5,] "between"         "StickerLite"      "halloweenparty"  "between"
##      HeartStickerPack bubbleletters  gwen
## [1,] "StickerLite"     "hbd2016"         "BlingStickerPack"
## [2,] "Emome"           "toMomwithLove"   "between"
## [3,] "WordsStickerPack" "between"         "xoxo"
## [4,] "HipsterChicSara" "newyearsparty"   "Monsterhigh"
## [5,] "BlingStickerPack" "4thofjuly3"      "AccessoriesStickerPack"
##      food            Monsterhigh          supersweet      word
## [1,] "supersweet"     "BlingStickerPack" "supercute"     "supersassy"
## [2,] "alien"          "gwen"             "Monsterhigh"   "alien"
## [3,] "HipsterChicSara" "xoxo"             "xoxo"          "OddAnatomy"
## [4,] "Random"         "between"          "gwen"          "KLL"
## [5,] "wonderland"     "AccessoriesStickerPack" "between"      "beatsmusic"
##      xmasquotes      WinterWonderland fallinlovewiththefall alien
## [1,] "wpbear"         "PhotoboothFest"  "vote2016"      "OddAnatomy"
## [2,] "teenwitch"      "DecktheHall"     "frombierun"    "thebouqs"
## [3,] "4thofjuly3"     "StickerLite"     "vintagexmas"   "between"
## [4,] "watercolorywinter" "japan2015"       "BlingStickerPack" "word"
## [5,] "newyearsparty"  "CampusLife"      "nashnext"      "xoxo"
##      nashnext        carfriends          peanutmangif
## [1,] "togetherwerise"  "costumeparty"    "retrosummer"
## [2,] "lovestinks2016"  "GraffitiStickerPack2013" "pacmanholiday"
## [3,] "4thofjuly3"     "summergetaway"   "fifacomics"
## [4,] "Maroon5V"       "sweetmothersday" "vintagewashi"
## [5,] "fallinlovewiththefall" "happy"           "seaamo"
##      KLL            CutieV              snowflakes
## [1,] "starrytribe"    "Valentine2013StickerPack" "halloweenparty"
## [2,] "xoxo"           "AntiV"            "4thofjuly3"
## [3,] "OddAnatomy"     "Mom2013"          "toMomwithLove"
## [4,] "watercolor"     "wonderland"       "xmasquotes"
## [5,] "cutevalentine" "Random"           "bubbleletters"
##      newyearsparty  betweenspring  simplyautumn      beatsmusic
## [1,] "bubbleletters" "xoxo"         "salelabels"      "xoxo"
## [2,] "hbd2016"       "between"      "fallinlovewiththefall" "ladolcevita"
## [3,] "xmasquotes"    "thebouqs"     "fifacomics"       "supersassy"
## [4,] "wpbear"        "OddAnatomy"   "vintagewashi"     "cutoutluv"
## [5,] "warmncozy"     "supersassy"   "wordstoliveby"    "KLL"
##      xoxo            togetherwerise  RageComics        chubbles
## [1,] "BlingStickerPack" "pacmanholiday" "Emome"            "mmlm"
## [2,] "between"         "nashnext"     "CatpixCubie"      "frombierun"
## [3,] "gwen"           "teenwitch"    "Music1D"           "teenwitch"
## [4,] "Monsterhigh"    "mmlm"         "2014fifa"          "fifacomics"
## [5,] "OddAnatomy"     "christmassnow" "HalloweenScream2013" "togetherwerise"
##      happycny2016    happy          seaamo             hellobaby
## [1,] "vintagexmas"    "cutevalentine" "pacmanholiday"    "halloweenparty"

```

```

## [2,] "vote2016"      "starrytribe"      "happyeaster2016"  "dayofdead"
## [3,] "aroundtheworld" "cutoutluv"        "togetherwerise"   "arrows"
## [4,] "toyoufromme"    "bemine"           "valentineStickers" "seaamo"
## [5,] "8bit2"         "ladolcevita"      "hellobaby"        "tropicalparadise"
##      doodlewords      chloecaroline      bmnemesis          arrows
## [1,] "fifacomics"      "graduation2015"   "vintagexmas"      "floralwedding"
## [2,] "arrows"          "aroundtheworld"   "vote2016"          "wordstoliveby"
## [3,] "watercolorywinter" "bemine"           "julyfourth"        "fifacomics"
## [4,] "kungfood"        "alien"            "dayofdead"         "julyfourth"
## [5,] "aesthetics"      "HipsterChicSara" "saintvalentine"   "aesthetics"
##      hbd2016          freshempire          Mom2013
## [1,] "bubbleletters" "notetoself"        "Dad2013"
## [2,] "newyearsparty" "frombierun"        "HeartStickerPack"
## [3,] "betweenspring" "AccessoriesStickerPack" "StickerLite"
## [4,] "toMomwithLove" "julyfourth"        "CampusLife"
## [5,] "between"       "babyanimals"       "Random"
##      stpatrick      icecreamsocial      sassyhween          sphalloween
## [1,] "fifacomics"      "fifacomics"        "holidaycheers"     "togetherwerise"
## [2,] "wordstoliveby" "bestdaddy"         "summerlovin"       "teenwitch"
## [3,] "gudetama"       "happy"             "mmlm"              "stationery"
## [4,] "mmlm"           "arrows"            "teenwitch"         "mmlm"
## [5,] "givethanks"     "notetoself"        "togetherwerise"    "christmassnow"
##      CatpixCubie      kungfood            eastersurprise      happyeaster2016
## [1,] "cherngs"        "givethanks"        "cutoutluv"         "wpbear"
## [2,] "NaiveLittleThings" "mmlm"            "bemine"            "notetoself"
## [3,] "Eggotown"       "dayofdead"         "hipsterholiday"    "justmytype"
## [4,] "WinterWonderland" "hkbts"           "watercolor"        "fifacomics"
## [5,] "CampusLife"     "chicchristmas"    "hellospring"       "helloautumn"
##      frombierun      DecktheHall          Eggotown
## [1,] "toyoufromme"    "PhotoboothFest"    "CatpixCubie"
## [2,] "fifacomics"     "WherezSanta"       "Mom2013"
## [3,] "mmlm"           "WinterWonderland"  "CutieV"
## [4,] "wpbear"         "HeartStickerPack"  "StickerLite"
## [5,] "sweetmothersday" "Valentine2013StickerPack" "CampusLife"
##      papertapes      Valentine2013StickerPack peanutman
## [1,] "Random"        "CutieV"            "bananaman"
## [2,] "Mom2013"       "HeartStickerPack"  "eastersurprise"
## [3,] "wonderland"    "StickerLite"       "cutoutluv"
## [4,] "Emome"         "Mom2013"           "watercolor"
## [5,] "HipsterChicSara" "AntiV"             "hipsterholiday"
##      Dad2013          PhotoboothFest      WherezSanta          bananaman
## [1,] "Mom2013"        "WinterWonderland" "DecktheHall"        "peanutman"
## [2,] "StickerLite"    "DecktheHall"      "WinterWonderland"  "chloecaroline"
## [3,] "CampusLife"     "StickerLite"      "StickerLite"       "Eggotown"
## [4,] "HeartStickerPack" "HeartStickerPack" "PhotoboothFest"    "graduation2015"
## [5,] "RobinThicke2013" "CampusLife"       "HeartStickerPack"  "CutieV"
##      Halloween2012StickerPack mmlm          julyfourth          tropicalparadise
## [1,] "alphabet"        "teenwitch"        "babyanimals"       "vintagewashi"
## [2,] "CampusLife"      "cny2017"          "bmnemesis"         "wpbear"
## [3,] "StickerLite"     "christmassnow"    "mmlm"              "hellobaby"
## [4,] "HeartStickerPack" "chicchristmas"    "arrows"            "8bit2"
## [5,] "4thofjuly3"      "frombierun"       "8bit2"             "backtocol"
##      bestdaddy      sweetmothersday      springrose          wpbear
## [1,] "springrose"     "fifacomics"        "xmassketches"     "warmncozy"

```

```

## [2,] "aesthetics"      "toyoufromme"      "family"            "toyoufromme"
## [3,] "happycny2016"   "frombierun"       "bestdaddy"         "vintagewashi"
## [4,] "family"         "pellington"       "justmytype"        "happyeaster2016"
## [5,] "fifacomics"    "teenwitch"        "vote2016"          "mmlm"
##      autumn          justmytype          gudetama            backtocol
## [1,] "floralwedding"  "springrose"       "mmlm"              "salelabels"
## [2,] "aesthetics"     "xmassketches"    "aesthetics"        "fifacomics"
## [3,] "fifacomics"    "notetoself"      "teenwitch"         "mmlm"
## [4,] "arrows"        "mmlm"            "family"            "8bit2"
## [5,] "8bit2"         "fifacomics"      "forever"           "eastersurprise"
##      8bit2          4thofjuly3          summerlovin          superherodad2
## [1,] "pellington"    "alphabet"         "christmassnow"     "dayofdead"
## [2,] "mmlm"         "babyanimals"      "mmlm"              "vote2016"
## [3,] "cny2017"       "toMomwithLove"    "justmytype"        "xmassketches"
## [4,] "happycny2016"  "bubbleletters"    "fifacomics"        "watercolorwinter"
## [5,] "julyfourth"    "xmasquotes"       "superherodad2"     "mmlm"
##      hipsteroverlays watercolor           hellospring          supersassy
## [1,] "cutoutlrv"     "hipsterholiday"   "vintage"            "cutevalentine"
## [2,] "starrytribe"   "cutoutlrv"        "cutoutlrv"          "starrytribe"
## [3,] "cutevalentine" "cutevalentine"    "bemine"             "cutoutlrv"
## [4,] "bemine"        "starrytribe"      "eastersurprise"     "watercolor"
## [5,] "hipsterholiday" "bemine"           "watercolor"         "hipsterholiday"
##      cutoutlrv      ladolcevrta         bemine               japan2015
## [1,] "bemine"       "cutevalentine"    "cutoutlrv"          "xoxo"
## [2,] "starrytribe"  "starrytribe"      "starrytribe"         "gwen"
## [3,] "cutevalentine" "cutoutlrv"        "cutevalentine"      "between"
## [4,] "hipsterholiday" "hipsterholiday"   "hipsterholiday"     "OddAnatomy"
## [5,] "watercolor"    "watercolor"       "watercolor"          "KLL"
##      doodleholiday  washiholiday        hipsterholiday
## [1,] "bemine"       "eastersurprise"    "watercolor"
## [2,] "cutoutlrv"    "toyoufromme"       "cutoutlrv"
## [3,] "hipsterholiday" "GraffitiStickerPack2013" "cutevalentine"
## [4,] "ladolcevrta"  "8bit2"             "starrytribe"
## [5,] "watercolor"   "givethanks"        "bemine"
##      creepycute     2014summer          cherngs              vintage
## [1,] "starrytribe"  "hkbts"             "vote2016"           "hellospring"
## [2,] "cutevalentine" "HalloweenScream2013" "Catpixonbie"        "StampStickerPack"
## [3,] "hipsterholiday" "fifacomics"         "vintagexmas"        "vintagewashi"
## [4,] "watercolor"    "backtocol"         "aroundtheworld"     "supersassy"
## [5,] "cutoutlrv"    "8bit2"             "chloecaroline"     "word"
##      AntiV          BlingStickerPack     HalloweenScream2013
## [1,] "CutieV"       "Monsterhigh"        "cutevalentine"
## [2,] "Valentine2013StickerPack" "gwen"              "starrytribe"
## [3,] "HipsterChicSara" "xoxo"              "cutoutlrv"
## [4,] "Random"       "between"           "watercolor"
## [5,] "wonderland"   "AccessoriesStickerPack" "hipsterholiday"
##      GraffitiStickerPack2013 RobinThicke2013      AnimalFriendsStickerPack
## [1,] "carfriends"    "Dad2013"           "StampStickerPack"
## [2,] "washiholiday" "Music1D"           "hipsterholiday"
## [3,] "xoxo"         "HipsterChicSara"   "WordsStickerPack"
## [4,] "costumeparty" "CampusLife"        "PartyStickerPack"
## [5,] "summergetaway" "Catpixonbie"       "salelabels"
##      HipsterChic     PartyStickerPack      Music1D
## [1,] "HipsterChicSara" "WordsStickerPack"   "CampusLife"

```

```

## [2,] "RageComics"      "AnimalFriendsStickerPack" "Emome"
## [3,] "RobinThicke2013" "HalloweenScream2013"     "RobinThicke2013"
## [4,] "CampusLife"      "Emome"                    "RageComics"
## [5,] "teenwitch"      "StampStickerPack"        "WordsStickerPack"
##      CampusLife      graduation2015      aroundtheworld
## [1,] "Mom2013"        "chloecaroline"         "graduation2015"
## [2,] "Dad2013"        "bemine"                 "chloecaroline"
## [3,] "HeartStickerPack" "aroundtheworld"         "vintagexmas"
## [4,] "HipsterChicSara" "cutevalentine"          "vote2016"
## [5,] "StickerLite"    "starrytribe"            "happycny2016"
##      WordsStickerPack      NaiveLittleThings
## [1,] "HeartStickerPack"    "BlingStickerPack"
## [2,] "Emome"               "Monsterhigh"
## [3,] "PartyStickerPack"    "CatpixCubie"
## [4,] "AnimalFriendsStickerPack" "HipsterChicSara"
## [5,] "HalloweenScream2013"    "AccessoriesStickerPack"
##      Holiday2012StickerPack      jollyholiday      valentineStickers
## [1,] "CampusLife"               "valentineStickers" "seaamo"
## [2,] "Halloween2012StickerPack" "watercolor"         "pacmanholiday"
## [3,] "DecktheHall"              "hipsterholiday"     "jollyholiday"
## [4,] "WherezSanta"              "forever"             "togetherwerise"
## [5,] "ChineseNewYear2013"        "salelabels"          "hellobaby"
##      Xmas2012StickerPack      alphabet            forever
## [1,] "snowflakeee"             "4thofjuly3"          "teenwitch"
## [2,] "mrcurlsport"             "Halloween2012StickerPack" "gudetama"
## [3,] "pacmanholiday"           "babyanimals"         "fifacomics"
## [4,] "dayofdead"               "bubbleletters"        "ChineseNewYear2013"
## [5,] "helloautumn"             "Monsterhigh"          "floralwedding"
##      toyoufromme      AccessoriesStickerPack      fifacomics
## [1,] "frombierun"       "BlingStickerPack"         "chicchristmas"
## [2,] "wpbear"          "Monsterhigh"              "helloautumn"
## [3,] "sweetmothersday" "gwen"                     "teenwitch"
## [4,] "fifacomics"     "between"                  "frombierun"
## [5,] "happycny2016"   "xoxo"                     "aesthetics"
##      2014fifa          StampStickerPack      ouija
## [1,] "RageComics"      "vintage"                  "beatsmusic"
## [2,] "NaiveLittleThings" "hellospring"              "happyeaster2016"
## [3,] "word"            "AnimalFriendsStickerPack" "mmlm"
## [4,] "Maroon5V"        "vintagewashi"             "christmassnow"
## [5,] "CatpixCubie"     "supersassy"                "teenwitch"
##      stationery      ChineseNewYear2013      sanrio      family
## [1,] "aroundtheworld" "teenwitch"          "halloweenparty" "springrose"
## [2,] "8bit2"         "forever"            "gradparty"      "halloweenparty"
## [3,] "pellington"   "frombierun"         "happyeaster2016" "gudetama"
## [4,] "dayofdead"    "mmlm"               "chicchristmas"   "bestdaddy"
## [5,] "togetherwerise" "gradparty"          "justmytype"      "aesthetics"
##      babyanimals      halloweenparty      costumeparty      starrytribe
## [1,] "julyfourth"     "family"            "carfriends"       "cutevalentine"
## [2,] "4thofjuly3"     "summergetaway"     "mmlm"              "cutoutluv"
## [3,] "halloweenparty" "babyanimals"       "frombierun"        "bemine"
## [4,] "christmassnow"  "christmassnow"     "watercolorywinter" "hipsterholiday"
## [5,] "alphabet"      "hellobaby"         "summergetaway"     "watercolor"
##      cutevalentine      holidaycheers      givethanks      teenwitch
## [1,] "starrytribe"     "sassyhween"       "fifacomics"      "forever"

```

```

## [2,] "cutoutluv"      "happyeaster2016" "mrcurlsport" "mmlm"
## [3,] "hipsterholiday" "wpbear"          "kungfood"    "fifacomics"
## [4,] "ladolcevida"    "warmncozy"       "notetoself"  "chicchristmas"
## [5,] "watercolor"     "aroundtheworld" "teenwitch"   "gudetama"
## mrcurlsport      vote2016          floralwedding  happybday
## [1,] "cometobe"      "vintagexmas"     "arrows"      "mmlm"
## [2,] "pacmanholiday" "watercolorywinter" "autumn"      "pacmanholiday"
## [3,] "givethanks"    "aroundtheworld"  "fifacomics"  "helloautumn"
## [4,] "salelabels"    "summergetaway"   "aesthetics"  "fifacomics"
## [5,] "notetoself"    "happycny2016"    "togetherwerise" "cny2017"
## chicchristmas snowflakeee hkbts          warmncozy
## [1,] "fifacomics"    "wpbear"          "helloautumn" "wpbear"
## [2,] "mmlm"          "warmncozy"       "yummyfood"   "aesthetics"
## [3,] "teenwitch"     "Xmas2012StickerPack" "2014summer"  "snowflakeee"
## [4,] "frombierun"    "fifacomics"      "chicchristmas" "cny2017"
## [5,] "cometobe"     "helloautumn"     "kungfood"    "fifacomics"
## aesthetics christmassnow pacmanholiday vintagexmas
## [1,] "fifacomics"    "summergetaway"   "cometobe"     "vote2016"
## [2,] "bestdaddy"     "mmlm"            "seaamo"       "watercolorywinter"
## [3,] "autumn"        "fifacomics"      "fifacomics"   "aroundtheworld"
## [4,] "gudetama"      "vote2016"        "mrcurlsport"  "happycny2016"
## [5,] "arrows"        "pacmanholiday"   "togetherwerise" "bmnemesis"
## yummyfood          watercolorywinter wordstoliveby  helloautumn
## [1,] "helloautumn"   "vintagexmas"     "arrows"       "yummyfood"
## [2,] "summergetaway" "vote2016"        "xmassketches" "summergetaway"
## [3,] "hkbts"         "xmassketches"    "fifacomics"   "fifacomics"
## [4,] "fifacomics"    "summergetaway"   "mmlm"         "hkbts"
## [5,] "happyeaster2016" "cometobe"        "vintagewashi" "wpbear"
## dayofdead          summergetaway      gradparty
## [1,] "mmlm"          "helloautumn"     "frombierun"
## [2,] "bmnemesis"     "christmassnow"   "wordstoliveby"
## [3,] "vote2016"      "vote2016"        "mmlm"
## [4,] "xmassketches"  "yummyfood"       "vintagexmas"
## [5,] "watercolorywinter" "watercolorywinter" "christmassnow"
## xmassketches cometobe glitterny vintagewashi
## [1,] "springrose"    "pacmanholiday"   "fifacomics"   "wpbear"
## [2,] "vintagexmas"   "mrcurlsport"     "mmlm"         "mmlm"
## [3,] "watercolorywinter" "xmassketches"    "christmassnow" "xmassketches"
## [4,] "cometobe"      "vote2016"        "xmassketches" "vintage"
## [5,] "justmytype"    "vintagexmas"     "backtocool"   "wordstoliveby"
## notetoself salelabels cny2017
## [1,] "happyeaster2016" "backtocool"      "mmlm"
## [2,] "justmytype"     "fifacomics"      "8bit2"
## [3,] "teenwitch"      "frombierun"      "fifacomics"
## [4,] "arrows"         "mrcurlsport"     "wpbear"
## [5,] "mrcurlsport"    "helloautumn"     "happyeaster2016"

```

3. Now what are the top 5 recommendations for the bundle you chose to explore earlier?

```
recommand_mc_b_matrix[, "doodleholiday"]
```

```

## [1] "bemine"      "cutoutluv"      "hipsterholiday" "ladolcevida"
## [5] "watercolor"

```

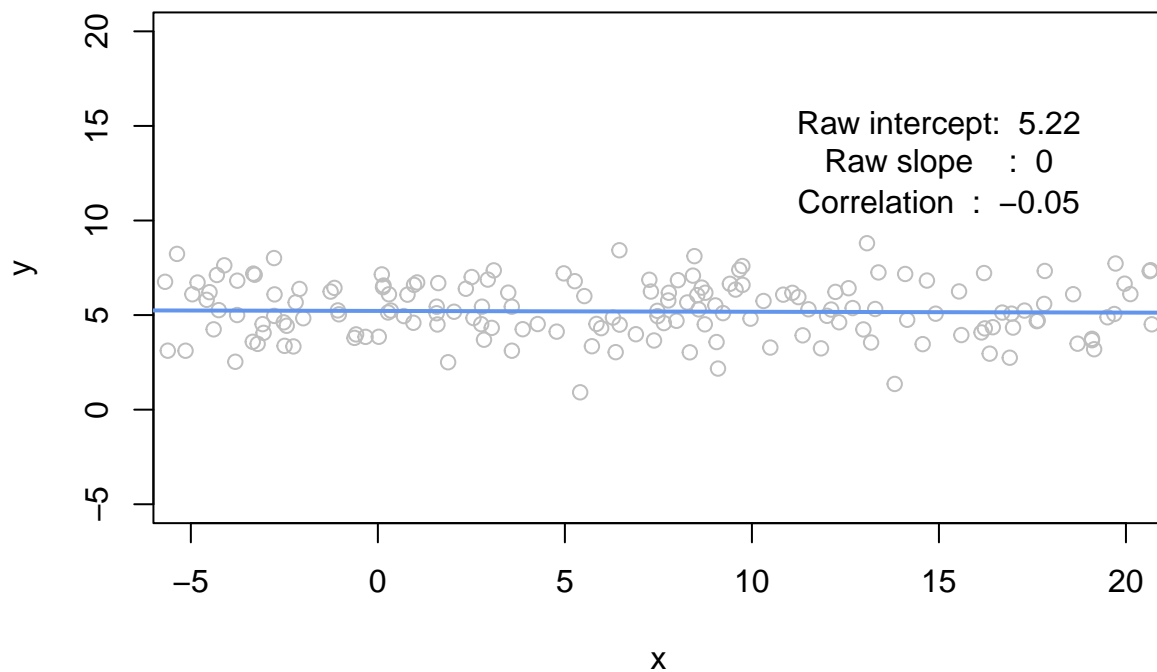

Question 2) Correlation is at the heart of many data analytic methods so let's explore it further.

Download `demo_simple_regression.R` from Canvas – it has a function called `interactive_regression()` that runs a simulation. You can click to add points to the plotting area, to see a corresponding regression line (hitting ESC will stop the simulation). You will also see three numbers: regression intercept – where the regression line crosses the y-axis; regression coefficient – the slope of x on y; correlation - correlation of x and y.

For each of the scenarios below, create the described set of points in the simulation. You might have to create each scenario a few times to get a general sense of them. Visual examples of scenarios a-d are shown below.

(a) Create a horizontal set of random points, with a relatively narrow but flat distribution.

```
set.seed(2)
points = data.frame(
  x = rnorm(300, mean = 1.5, sd=15),
  y = rnorm(300, mean = 5, sd=1.5)
)
plot(points, xlim=c(-5,20), ylim=c(-5,20), col="gray")
model <- lm(points$y ~ points$x)
abline(model, lwd=2, col="cornflowerblue")
text(15, 15, paste(c("Raw intercept: ", round(model$coefficients[1], 2)), collapse=" "))
text(15, 13, paste(c("Raw slope      : ", round(model$coefficients[2], 2)), collapse=" "))
text(15, 11, paste(c("Correlation   : ", round(cor(points$x, points$y), 2)), collapse=" "))
```



(i) What raw slope of x and y would you generally expect?

```
paste(c("Raw intercept: ", round(model$coefficients[1], 2)), collapse=" ")
```

```
## [1] "Raw intercept: 5.22"
```

(ii) What is the correlation of x and y that you would generally expect?

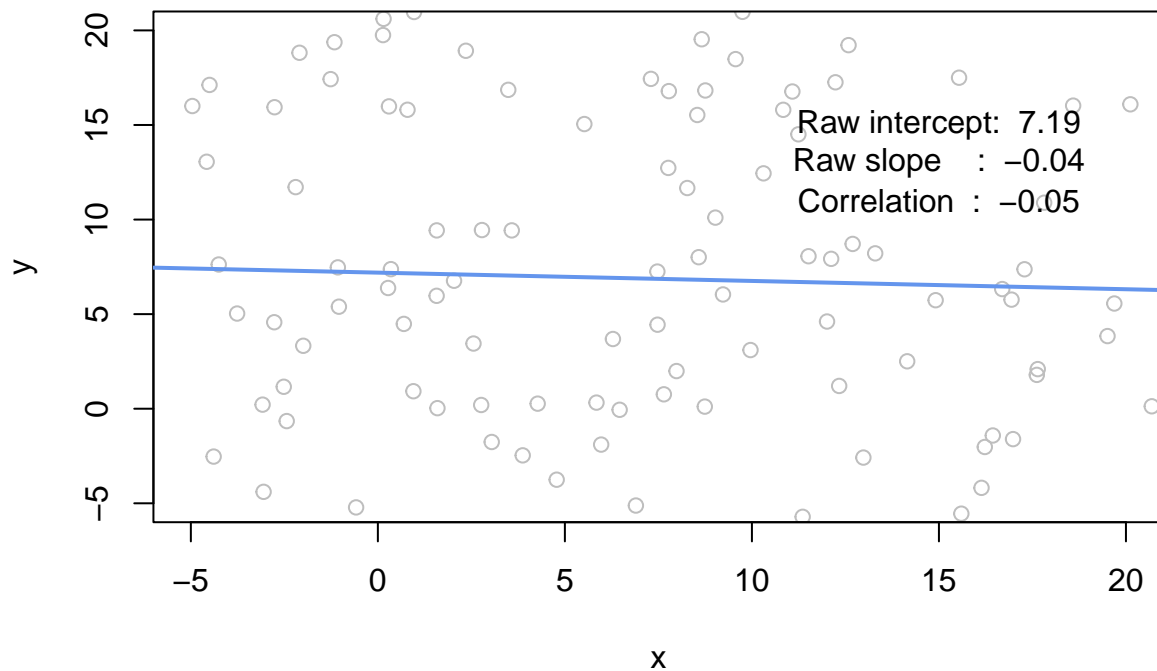
```
paste(c("Correlation : ", round(cor(points$x, points$y), 2)), collapse=" ")
```

```
## [1] "Correlation : -0.05"
```

(b) Create a completely random set of points to fill the entire plotting area, along both x-axis and y-axis

```
set.seed(2)
points = data.frame(
  x = rnorm(300, mean = 1.5, sd=15),
  y = rnorm(300, mean = 5, sd=15)
```

```
)
plot(points, xlim=c(-5,20), ylim=c(-5,20), col="gray")
model <- lm(points$y ~ points$x)
abline(model, lwd=2, col="cornflowerblue")
text(15, 15, paste(c("Raw intercept: ", round(model$coefficients[1], 2)), collapse=" "))
text(15, 13, paste(c("Raw slope   : ", round(model$coefficients[2], 2)), collapse=" "))
text(15, 11, paste(c("Correlation  : ", round(cor(points$x, points$y), 2)), collapse=" "))
```



(i) What raw slope of x and y would you generally expect?

```
paste(c("Raw intercept: ", round(model$coefficients[1], 2)), collapse=" ")
```

```
## [1] "Raw intercept: 7.19"
```

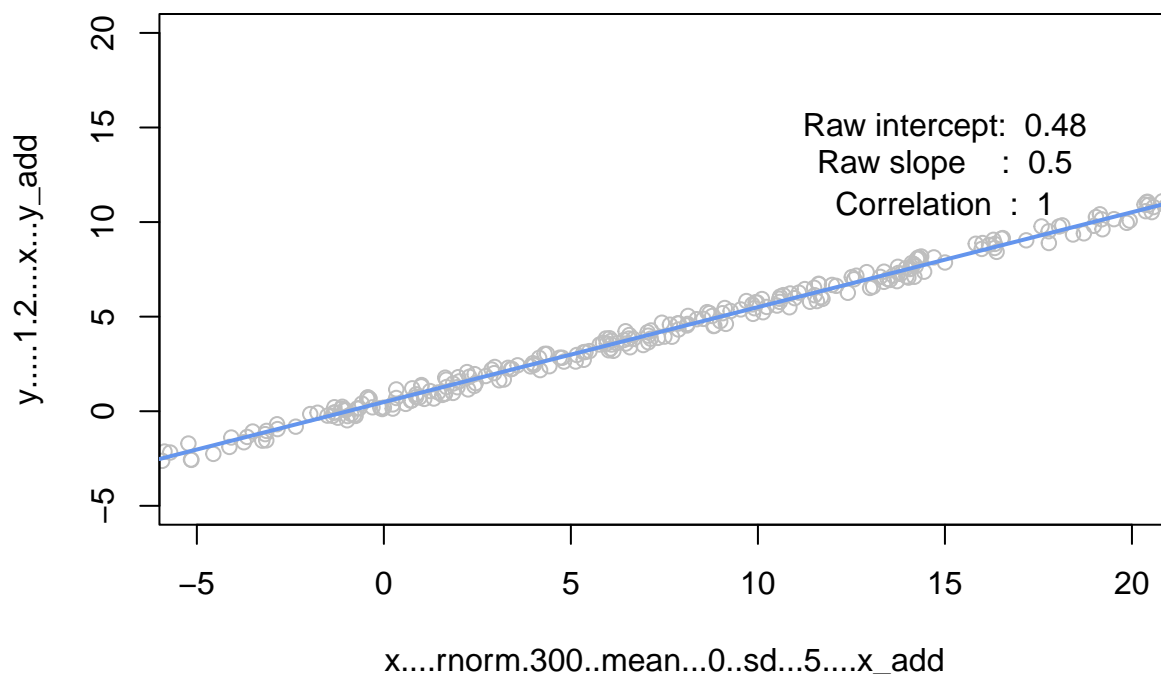
(ii) What is the correlation of x and y that you would generally expect?

```
paste(c("Correlation : ", round(cor(points$x, points$y), 2)), collapse=" ")
```

```
## [1] "Correlation : -0.05"
```

(c) Create a diagonal set of random points trending upwards at 45 degrees

```
set.seed(2)
x_add = runif(300, -5, 20)
y_add = runif(300, 0, 1)
points = data.frame(
  x <- rnorm(300, mean = 0, sd=5) + x_add,
  y <- (1/2) * x + y_add
)
plot(points, xlim=c(-5,20), ylim=c(-5,20), col="gray")
model <- lm(points$y ~ points$x)
abline(model, lwd=2, col="cornflowerblue")
text(15, 15, paste(c("Raw intercept: ", round(model$coefficients[1], 2)), collapse=" "))
text(15, 13, paste(c("Raw slope : ", round(model$coefficients[2], 2)), collapse=" "))
text(15, 11, paste(c("Correlation : ", round(cor(points$x, points$y), 2)), collapse=" "))
```



(i) What raw slope of x and y would you generally expect?

```
paste(c("Raw intercept: ", round(model$coefficients[1], 2)), collapse=" ")
```

```
## [1] "Raw intercept: 0.48"
```

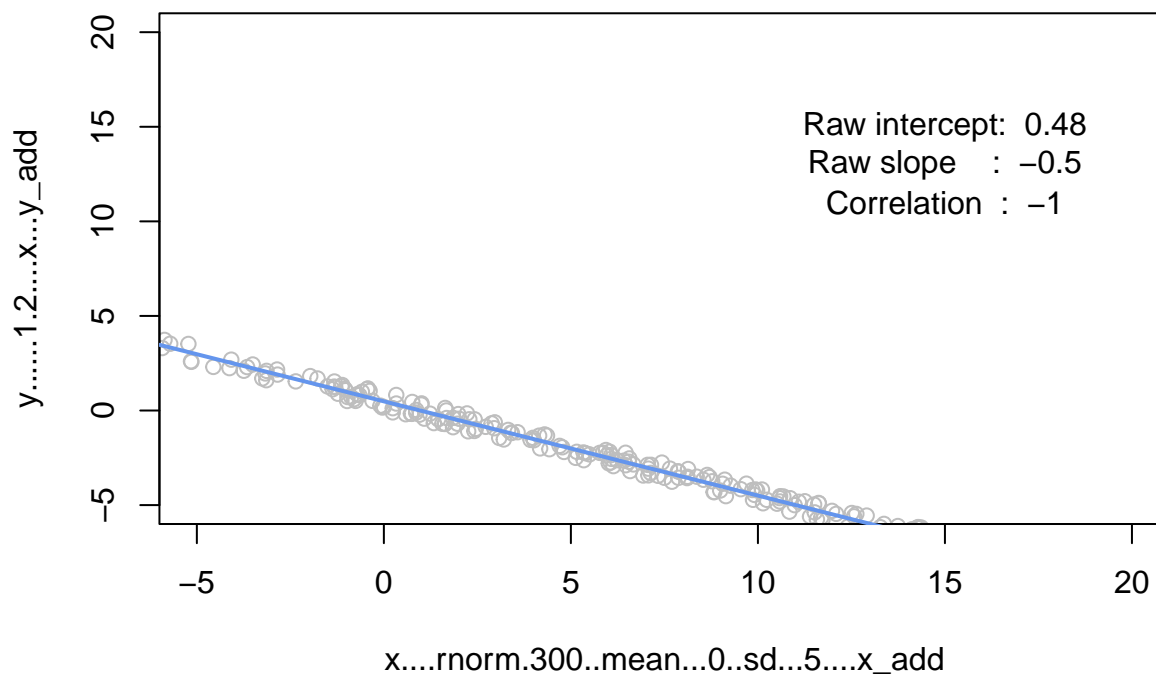
(ii) What is the correlation of x and y that you would generally expect?

```
paste(c("Correlation : ", round(cor(points$x, points$y), 2)), collapse=" ")
```

```
## [1] "Correlation : 1"
```

(d) Create a diagonal set of random trending downwards at 45 degrees

```
set.seed(2)
x_add = runif(300, -5, 20)
y_add = runif(300, 0, 1)
points = data.frame(
  x <- rnorm(300, mean = 0, sd=5) + x_add,
  y <- (-1/2) * x + y_add
)
plot(points, xlim=c(-5,20), ylim=c(-5,20), col="gray")
model <- lm(points$y ~ points$x)
abline(model, lwd=2, col="cornflowerblue")
text(15, 15, paste(c("Raw intercept: ", round(model$coefficients[1], 2)), collapse=" "))
text(15, 13, paste(c("Raw slope : ", round(model$coefficients[2], 2)), collapse=" "))
text(15, 11, paste(c("Correlation : ", round(cor(points$x, points$y), 2)), collapse=" "))
```



(i) What raw slope of x and y would you generally expect?

```
paste(c("Raw intercept: ", round(model$coefficients[1], 2)), collapse=" ")
```

```
## [1] "Raw intercept: 0.48"
```

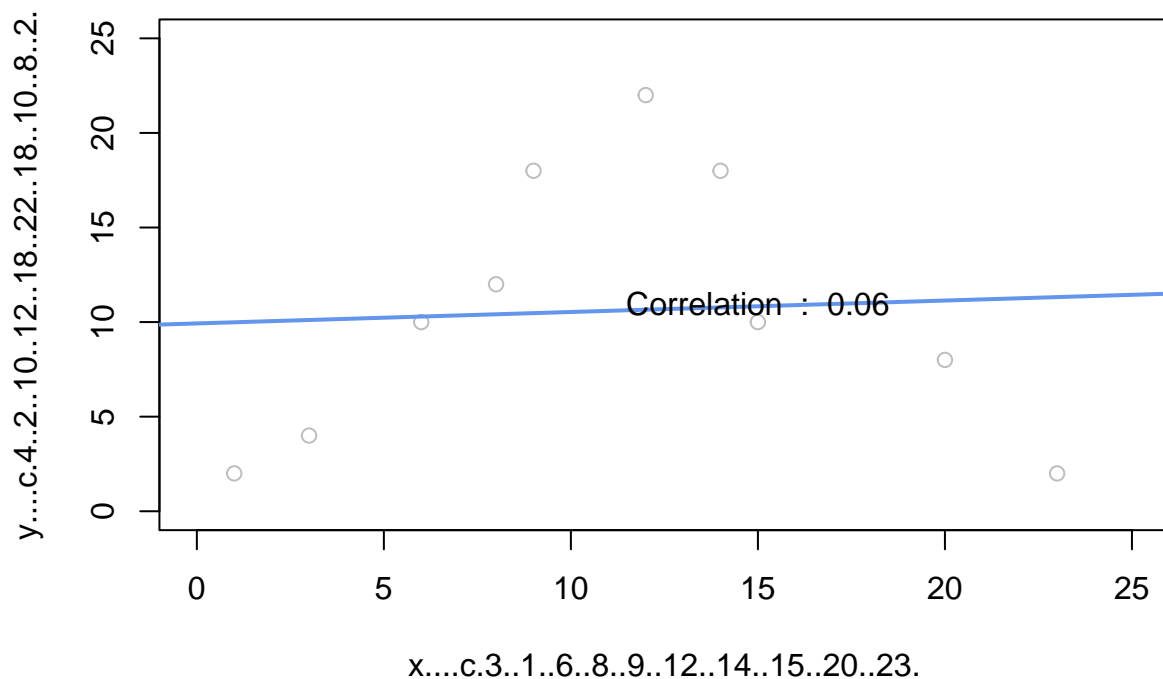
(ii) What is the correlation of x and y that you would generally expect?

```
paste(c("Correlation : ", round(cor(points$x, points$y), 2)), collapse=" ")
```

```
## [1] "Correlation : -1"
```

(e) Apart from any of the above scenarios, find another pattern of data points with no correlation ($r \approx 0$). (can create a pattern that visually suggests a strong relationship but produces $r \approx 0$?)

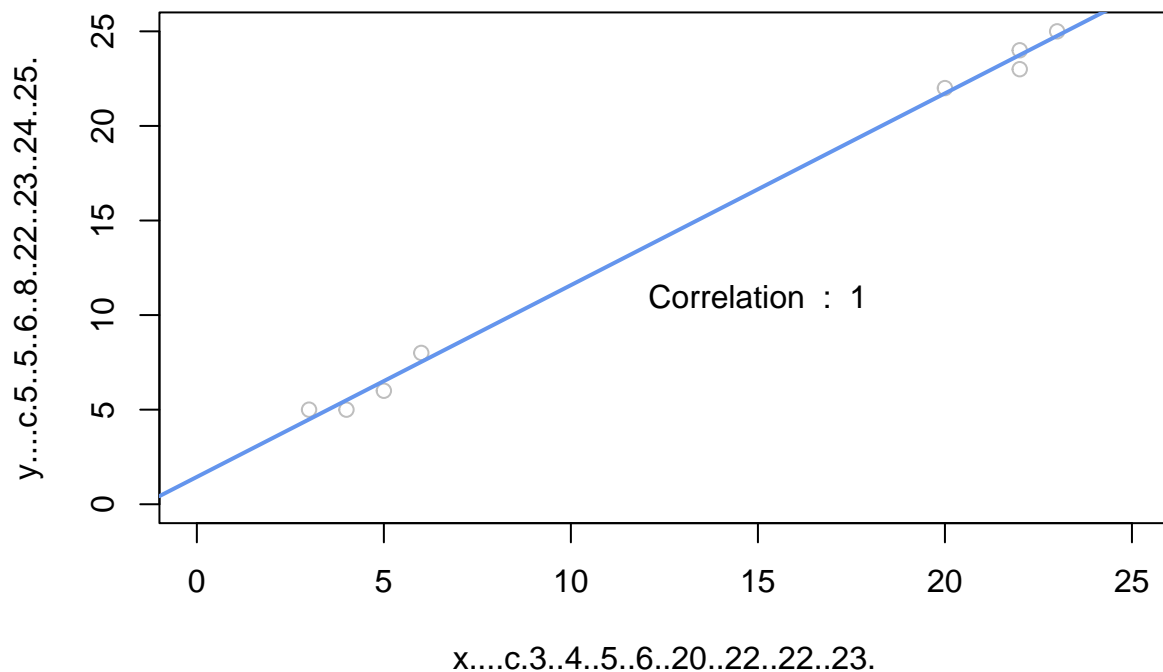
```
set.seed(2)
points = data.frame(
  x <- c(3,1,6,8,9,12,14,15,20,23),
  y <- c(4,2,10,12,18,22,18,10,8,2)
)
plot(points, xlim=c(0,25), ylim=c(0,25), col="gray")
model <- lm(points$y ~ points$x)
abline(model, lwd=2, col="cornflowerblue")
text(15, 11, paste(c("Correlation : ", round(cor(points$x, points$y), 2)), collapse=" "))
```



Ans : Yes, can create a pattern that visually suggests a strong relationship but produces $r \approx 0$. It means there is no LINEAR association. The relation between the two variables could be nonlinear. For example, it could be a U-shaped curvilinear relation.

(f) Apart from any of the above scenarios, find another pattern of data points with perfect correlation ($r \approx 1$). (can you find a scenario where the pattern visually suggests a different relationship?)

```
set.seed(2)
points = data.frame(
  x <- c(3,4,5,6,20,22,22,23),
  y <- c(5,5,6,8,22,23,24,25)
)
plot(points, xlim=c(0,25), ylim=c(0,25), col="gray")
model <- lm(points$y ~ points$x)
abline(model, lwd=2, col="cornflowerblue")
text(15, 11, paste(c("Correlation : ", round(cor(points$x, points$y), 2)), collapse=" "))
```

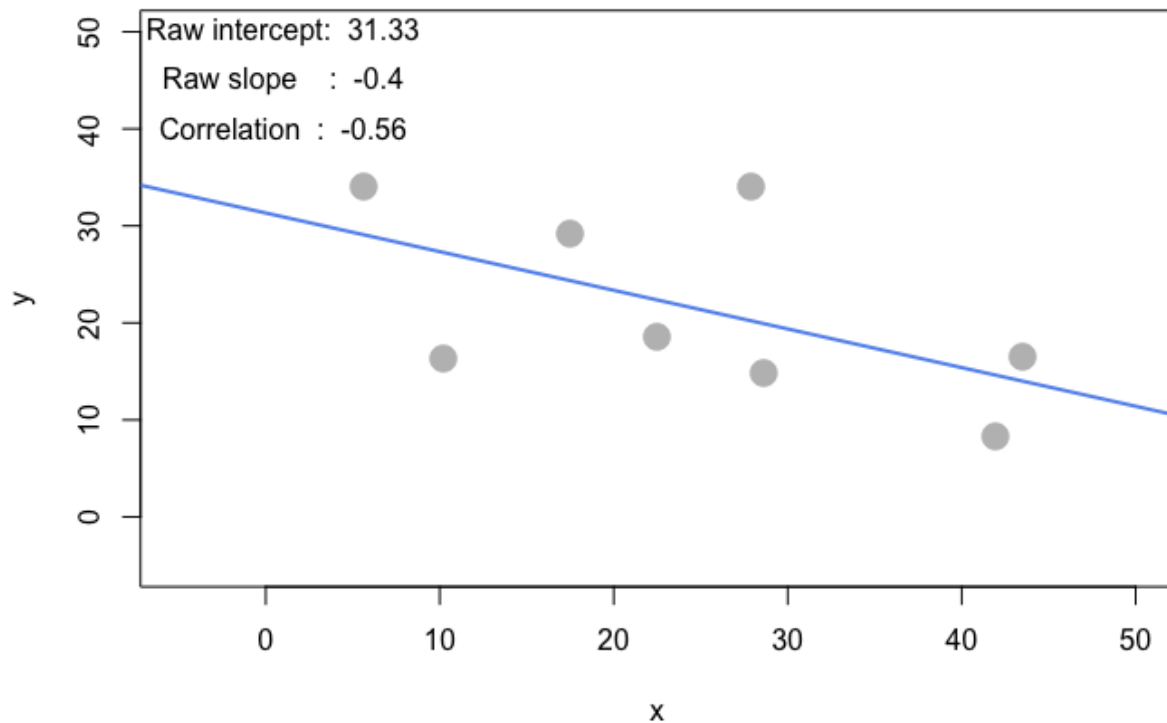


Ans : Yes, can find a scenario where the pattern visually suggests a different relationship.(as pic above)

(g) Let's see how correlation relates to simple regression, by simulating any linear relationship you wish:

(i) Run the simulation and record the points you create: `pts <- interactive_regression()`
(simulate either a positive or negative relationship)

```
source("demo_simple_regression.R")
pts <- interactive_regression()
pts
```

	x	y
1	5.625473	34.049378
2	27.889029	34.049378
3	22.479193	18.563136
4	28.617276	14.831511
5	41.933796	8.301168
6	43.494325	16.510743
7	17.485498	29.198266
8	10.203026	16.324161

(ii) Use the `lm()` function to estimate the regression intercept and slope of `pts` to ensure they are the same as the values reported in the simulation plot: `summary(lm(ptsy ~ ptsx))`

```
summary( lm( pts$y ~ pts$x ))
```

Call:

```
lm(formula = pts$y ~ pts$x)
```

Residuals:

Min	1Q	Median	3Q	Max
-10.9373	-5.3984	-0.6459	4.8700	13.8353

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	31.3271	6.6344	4.722	0.00325 **
pts\$x	-0.3985	0.2384	-1.671	0.14572

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 8.619 on 6 degrees of freedom

Multiple R-squared: 0.3176, Adjusted R-squared: 0.2039

F-statistic: 2.793 on 1 and 6 DF, p-value: 0.1457

(iii) Estimate the correlation of x and y to see it is the same as reported in the plot: `cor(pts)`

```
cor(pts)
```

	x	y
x	1.0000000	-0.5635847
y	-0.5635847	1.0000000

(iv) Now, standardize the values of both x and y from pts and re-estimate the regression slope

```
x <- scale(pts$x,center=TRUE,scale=TRUE)
y <- scale(pts$y,center=TRUE,scale=TRUE)
summary( lm( y ~ x ))
```

Call:

```
lm(formula = y ~ x)
```

Residuals:

Min	1Q	Median	3Q	Max
-1.13222	-0.55884	-0.06686	0.50414	1.43221

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-1.128e-16	3.155e-01	0.000	1.000
x	-5.636e-01	3.372e-01	-1.671	0.146

Residual standard error: 0.8922 on 6 degrees of freedom

Multiple R-squared: 0.3176, Adjusted R-squared: 0.2039

F-statistic: 2.793 on 1 and 6 DF, p-value: 0.1457

(v) What is the relationship between correlation and the standardized simple-regression estimates?

Between the standardized and non-standardized data, they have same R-squared and f-statistic. However, the standard error is different.