DMC2015: Data Mining Cup 2015

Cory's LLR Statistics

Spring 2015, Iowa State University Data Mining Cup Team

Name:	Ian Mouzon
email:	`imouzon@iastate.edu`
Instructions:	
Assignment:	
Due Date:	May 6, 2015

I am using the following pacakges:

```
library(ggplot2)
library(lubridate)
library(xtable)
library(foreach)
library(rCharts)
library(magrittr)
library(tidyr)
library(dplyr)
library(reshape2)
library(gtools)
library(sqldf)
library(missForest)
source("~/dmc2015/ian/R/renm.R")
```

and my working directory is set to `dmc2015/ian`.

0.1 Pete's LLR Code

Pete has written some wonderful functions to compute One-way and Two-Way loglikelihood estimates based on the historical data. I am recopying them here for preservation.

```
# Code to compute estimated log-likelihood ratios for categorical variables
# and binary response. The second function is to calculate the
# log-likelihood ratios for an interaction between two categorical
# variables.  This is based on the work by Cory Lanker.  If you want to
# understand exactly what the code below is doing, I recommend running the
# code within the functions step-by-step using the examples that I created
# below each function. Let me know if you have any questions. The
# justification for this approach is explained in Cory Lanker's thesis
# paper.

compute_ll <- function(x, y, targetX, epsilon1 = NULL, epsilon2 = NULL) {
    # x A character vector y A numeric vector of 0's and 1's targetX A character
    # vector with the same categories as x Takes a categorical predictor
    # variable, x, and a binary response variable, y, and produces a vector of
    # the estimated log-likelihood statistics for the targetX column. An epsilon
    # > 0 is added to the numerator and denominator to prevent numerical
    # instability.  Non-matching categories will result in NA entries
    stopifnot(all(y %in% c(0, 1)))  # response has to be binary
```

```
    if (is.null(epsilon1) | is.null(epsilon2)) {
        epsilon1 = mean(y)
        epsilon2 = 1 - epsilon1
    }
    levs <- unique(x)
    # This will create a vector of the estimated log-likelihood ratios for each
    # level of the explanatory variable.
    lls <- sapply(levs, FUN = function(levs) {
        log((sum(x == levs & y == 1) + epsilon1)/(sum(x == levs & y == 0) +
            epsilon2))
    })
    res <- lls[targetX]
    names(res) <- targetX
    res[is.na(res)] <- log(epsilon1/epsilon2)
    return(res)
}

compute_ll_2w <- function(x1, x2, y, targetX1, targetX2, epsilon1 = NULL, epsilon2 = NULL) {
    # x1 A character vector x2 A character vector y A numeric vector of 0's and
    # 1's targetX1 A character vector with the same categories as x1 targetX2 A
    # character vector with the same categories as x2 Takes 2 categorical
    # predictor variables, x1 and x2, and a binary response variable, y, and
    # produces a vector of the estimated log-likelihood statistics for all
    # combinations between the levels of each predictor for targetX1 and
    # targetX2.  An epsilon > 0 is added to the numerator and denominator to
    # prevent numerical instability.  Non-matching categories will result in NA
    # entries
    stopifnot(all(y %in% c(0, 1)))  # response has to be binary
    if (is.null(epsilon1) | is.null(epsilon2)) {
        epsilon1 = mean(y)
        epsilon2 = 1 - epsilon1
    }
    levs_1 <- unique(x1)
    levs_2 <- unique(x2)
    # Using sapply within sapply will create a matrix. This will create a matrix
    # of the estimated log-likelihood ratios for each unique combination of the
    # levels of each explanatory variable.
    lls <- sapply(levs_2, FUN = function(levs_2) {
        sapply(levs_1, FUN = function(levs_1) {
            log((sum(x1 == levs_1 & x2 == levs_2 & y == 1) + epsilon1)/(sum(x1 ==
                levs_1 & x2 == levs_2 & y == 0) + epsilon2))
        })
    })
    index <- 1:length(targetX1)
    res <- sapply(index, FUN = function(index) {
        if (targetX1[index] %in% rownames(lls) & targetX2[index] %in% colnames(lls)) {
            lls[targetX1[index], targetX2[index]]
        } else {
            NA
        }
    })
    res[is.na(res)] <- log(epsilon1/epsilon2)
    return(res)
}
```

0.2 Reading the data into R

```
# clean data
d = readRDS("~/dmc2015/data/clean_data/clean_simple.rds")
S1 = readRDS("~/dmc2015/data/featureMatrix/HTVset1.rds")
S2 = readRDS("~/dmc2015/data/featureMatrix/HTVset2.rds")
S3 = readRDS("~/dmc2015/data/featureMatrix/HTVset3.rds")
```

and we need to manipulate the variables so that we have couponID in the key and the order status as the primary response.

```
source("./R/stackCoupons.R")

TV = stackCoupons(S1$T, S1$V, nms = c("train", "validation"))
```

```
## using the following as id:
##  orderID,
##  orderTime,
##  userID,
##  couponsReceived,
##  basketValue,
##  couponsReceivedDate,
##  couponsReceivedTime,
##  couponsReceivedDoW,
##  couponsReceivedWeekend,
##  couponsReceivedFriSat,
##  orderTimeDate,
##  orderTimeTime,
##  orderTimeDoW,
##  orderTimeWeekend,
##  orderTimeFriSat,
##  batchID,
##  couponsExpire,
##  couponsSent,
##  TimeBtwnSentRec,
##  TimeBtwnRecExpire,
##  TimeBtwnRecOrder,
##  TimeBtwnOrderExpire
##
## using the following as measure columns:
##  couponID1,
##  price1,
##  basePrice1,
##  reward1,
##  premiumProduct1,
##  brand1,
##  productGroup1,
##  categoryIDs1,
##  coupon1Used,
##  couponID2,
##  price2,
##  basePrice2,
##  reward2,
##  premiumProduct2,
##  brand2,
```

```
##  productGroup2,
##  categoryIDs2,
##  coupon2Used,
##  couponID3,
##  price3,
##  basePrice3,
##  reward3,
##  premiumProduct3,
##  brand3,
##  productGroup3,
##  categoryIDs3,
##  coupon3Used
```

```
TC = stackCoupons(S1$T, S1$C, nms = c("train", "class"))
```

```
## using the following as id:
##  orderID,
##  orderTime,
##  userID,
##  couponsReceived,
##  basketValue,
##  couponsReceivedDate,
##  couponsReceivedTime,
##  couponsReceivedDoW,
##  couponsReceivedWeekend,
##  couponsReceivedFriSat,
##  orderTimeDate,
##  orderTimeTime,
##  orderTimeDoW,
##  orderTimeWeekend,
##  orderTimeFriSat,
##  batchID,
##  couponsExpire,
##  couponsSent,
##  TimeBtwnSentRec,
##  TimeBtwnRecExpire,
##  TimeBtwnRecOrder,
##  TimeBtwnOrderExpire
##
## using the following as measure columns:
##  couponID1,
##  price1,
##  basePrice1,
##  reward1,
##  premiumProduct1,
##  brand1,
##  productGroup1,
##  categoryIDs1,
##  coupon1Used,
##  couponID2,
##  price2,
##  basePrice2,
##  reward2,
##  premiumProduct2,
##  brand2,
```

```
##  productGroup2,
##  categoryIDs2,
##  coupon2Used,
##  couponID3,
##  price3,
##  basePrice3,
##  reward3,
##  premiumProduct3,
##  brand3,
##  productGroup3,
##  categoryIDs3,
##  coupon3Used
```

```
trn = TV$combined %>% filter(dsn == "train")
val = TV$combined %>% filter(dsn == "validation")
cls = TC$combined %>% filter(dsn == "class")

TVC = trn %>% rbind(val) %>% rbind(cls)

H = stackCoupons(S1$T, S1$H, nms = c("train", "historical"))$combined %>% filter(dsn ==
    "historical")
```

```
## using the following as id:
##  orderID,
##  orderTime,
##  userID,
##  couponsReceived,
##  basketValue,
##  couponsReceivedDate,
##  couponsReceivedTime,
##  couponsReceivedDoW,
##  couponsReceivedWeekend,
##  couponsReceivedFriSat,
##  orderTimeDate,
##  orderTimeTime,
##  orderTimeDoW,
##  orderTimeWeekend,
##  orderTimeFriSat,
##  batchID,
##  couponsExpire,
##  couponsSent,
##  TimeBtwnSentRec,
##  TimeBtwnRecExpire,
##  TimeBtwnRecOrder,
##  TimeBtwnOrderExpire
##
## using the following as measure columns:
##  couponID1,
##  price1,
##  basePrice1,
##  reward1,
##  premiumProduct1,
##  brand1,
##  productGroup1,
##  categoryIDs1,
```

```
##  coupon1Used,
##  couponID2,
##  price2,
##  basePrice2,
##  reward2,
##  premiumProduct2,
##  brand2,
##  productGroup2,
##  categoryIDs2,
##  coupon2Used,
##  couponID3,
##  price3,
##  basePrice3,
##  reward3,
##  premiumProduct3,
##  brand3,
##  productGroup3,
##  categoryIDs3,
##  coupon3Used
```

Occasionally, there are issues with factor conversion. To avoid this, I am converting the following values to characters:

```
TVC$userID = as.character(TVC$userID)

TVC$couponID = as.character(TVC$couponID)
TVC$categoryIDs = as.character(TVC$categoryIDs)
TVC$reward = as.character(TVC$reward)
TVC$brand = as.character(TVC$brand)
TVC$productGroup = as.character(TVC$productGroup)
TVC$premiumProduct = as.character(TVC$premiumProduct)
TVC$couponCol = as.character(TVC$couponCol)
```

And we do the same for the historical data

```
H$userID = as.character(H$userID)

H$couponID = as.character(H$couponID)
H$categoryIDs = as.character(H$categoryIDs)
H$reward = as.character(H$reward)
H$brand = as.character(H$brand)
H$productGroup = as.character(H$productGroup)
H$premiumProduct = as.character(H$premiumProduct)
H$couponCol = as.character(H$couponCol)
```

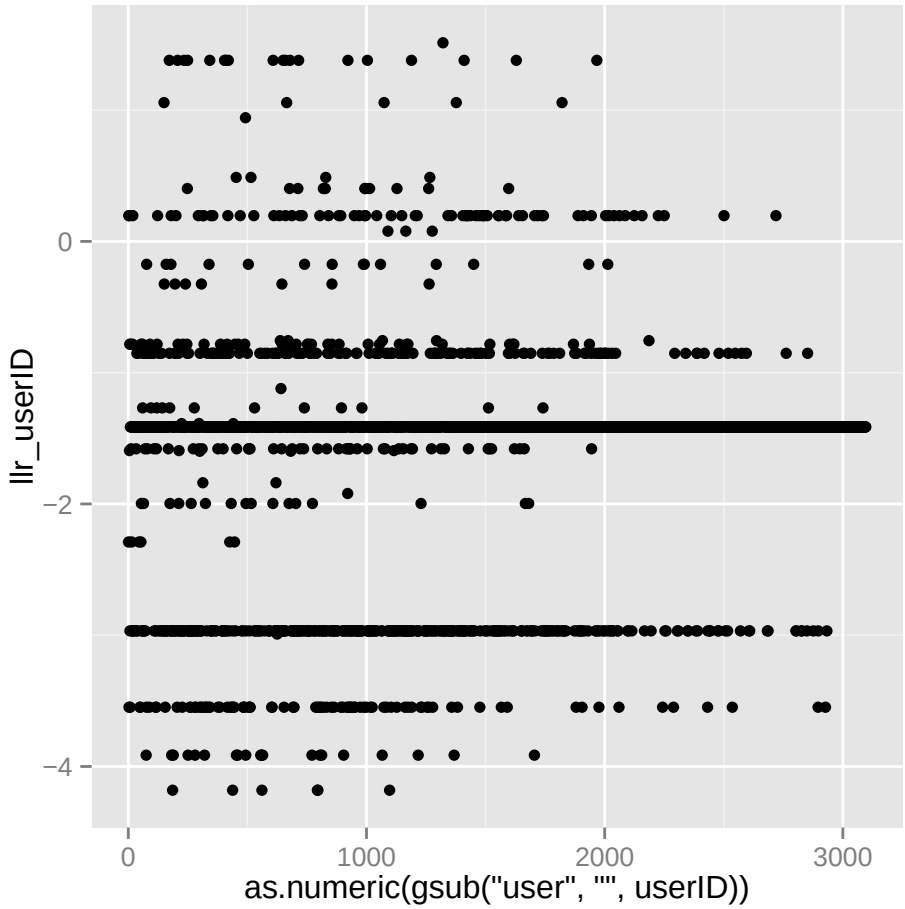
0.3 Calculating Coupon 1-Way Likelihoods

0.3.1 Raw Data Variables

userID

```
# userID
llr = compute_ll(as.character(H$userID), H$couponUsed, as.character(TVC$userID))
llr_userID = data.frame(userID = names(llr), llr_userID = llr) %>% arrange(userID) %>%
    unique
```

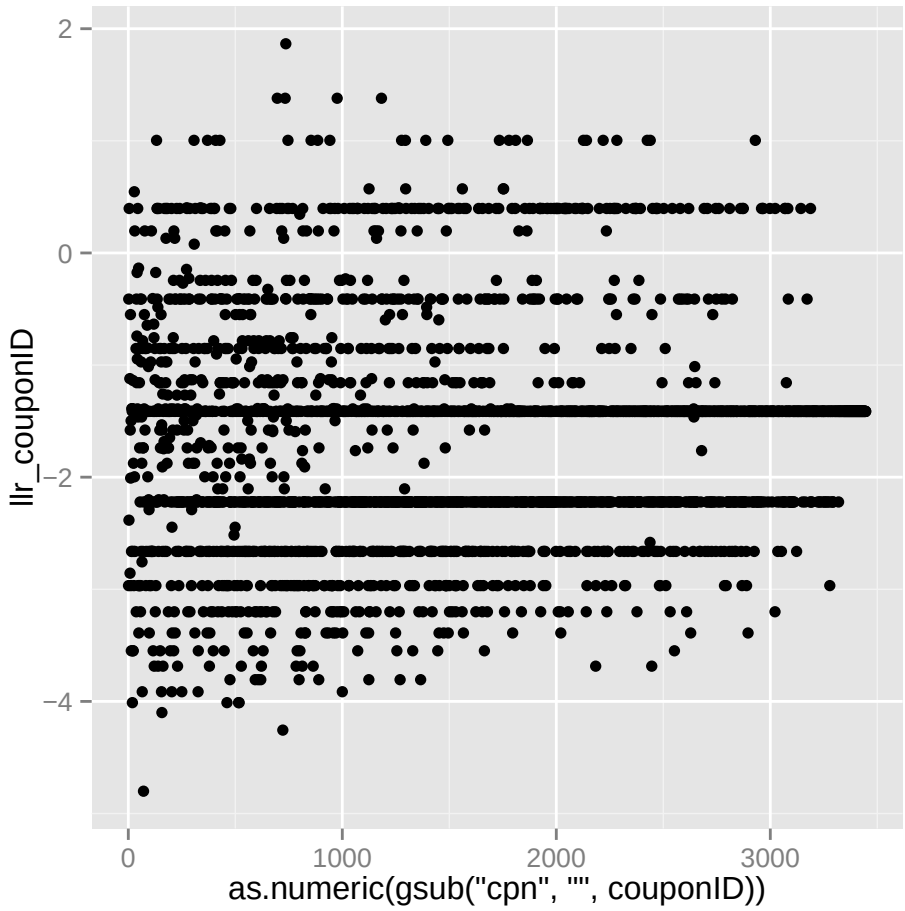
```r
# plot the results
if (nrow(TVC) - sum(TVC$userID %in% llr_userID$userID)) warning("Things aren't adding up")
qplot(as.numeric(gsub("user", "", userID)), llr_userID, data = llr_userID)

# Isolate the features
llr_userID_long = TVC %>% left_join(llr_userID, by = "userID") %>% arrange(orderID,
    couponCol) %>% select(orderID, couponCol, dsn, llr_userID)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

trn = llr_userID_long %>% filter(dsn == "train") %>% select(orderID, couponCol,
    llr_userID)
val = llr_userID_long %>% filter(dsn == "validation") %>% select(orderID, couponCol,
    llr_userID)
cls = llr_userID_long %>% filter(dsn == "class") %>% select(orderID, couponCol,
    llr_userID)

llr_userID_long = list(T = trn, V = val, C = cls)

saveRDS(llr_userID_long, "../features/feature_files/llr_userID_long_set1.rds")

# save the results to RDS in WIDE format
llr_userID_wide = TVC %>% left_join(llr_userID, by = "userID") %>% arrange(orderID,
    couponCol) %>% select(orderID, couponCol, dsn, llr_userID) %>% spread(couponCol,
    llr_userID) %>% renm(c("orderID", "dsn", "llr_userID1", "llr_userID2", "llr_userID3"))

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

trn = llr_userID_wide %>% filter(dsn == "train") %>% select(orderID, llr_userID1,
    llr_userID2, llr_userID3)
val = llr_userID_wide %>% filter(dsn == "validation") %>% select(orderID, llr_userID1,
    llr_userID2, llr_userID3)
cls = llr_userID_wide %>% filter(dsn == "class") %>% select(orderID, llr_userID1,
    llr_userID2, llr_userID3)

llr_userID_wide = list(T = trn, V = val, C = cls)

saveRDS(llr_userID_wide, "../features/feature_files/llr_userID_wide_set1.rds")
```



couponID

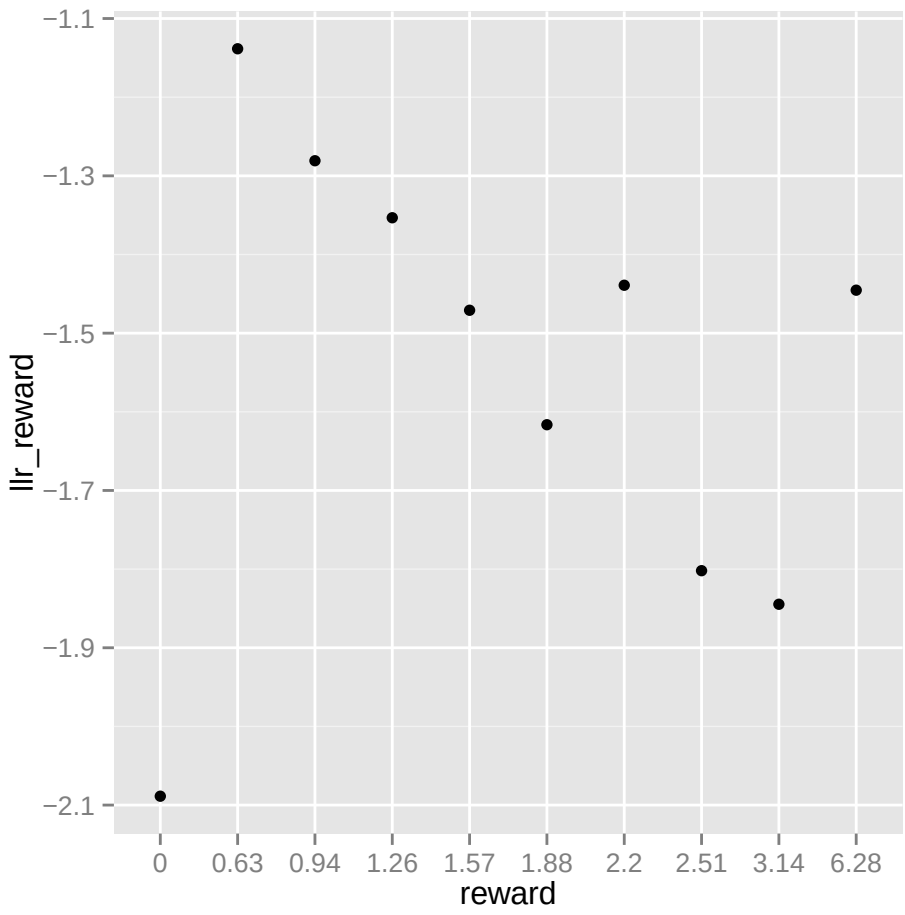
```
# couponID
llr = compute_ll(as.character(H$couponID), H$couponUsed, as.character(TVC$couponID))
llr_couponID = data.frame(couponID = names(llr), llr_couponID = llr) %>% arrange(couponID) %>%
    unique

# plot the results
if (nrow(TVC) - sum(TVC$couponID %in% llr_couponID$couponID)) warning("Things aren't adding up")
qplot(as.numeric(gsub("cpn", "", couponID)), llr_couponID, data = llr_couponID)

# Isolate the features
llr_couponID_long = TVC %>% left_join(llr_couponID, by = "couponID") %>% arrange(orderID,
    couponCol) %>% select(orderID, couponCol, dsn, llr_couponID)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

trn = llr_couponID_long %>% filter(dsn == "train") %>% select(orderID, couponCol,
    llr_couponID)
val = llr_couponID_long %>% filter(dsn == "validation") %>% select(orderID,
    couponCol, llr_couponID)
cls = llr_couponID_long %>% filter(dsn == "class") %>% select(orderID, couponCol,
    llr_couponID)
```

```
llr_couponID_long = list(T = trn, V = val, C = cls)

saveRDS(llr_couponID_long, "../features/feature_files/llr_couponID_long_set1.rds")

# save the results to RDS in WIDE format
llr_couponID_wide = TVC %>% left_join(llr_couponID, by = "couponID") %>% arrange(orderID,
    couponCol) %>% select(orderID, couponCol, dsn, llr_couponID) %>% spread(couponCol,
    llr_couponID) %>% renm(c("orderID", "dsn", "llr_couponID1", "llr_couponID2",
    "llr_couponID3"))

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

trn = llr_couponID_wide %>% filter(dsn == "train") %>% select(orderID, llr_couponID1,
    llr_couponID2, llr_couponID3)
val = llr_couponID_wide %>% filter(dsn == "validation") %>% select(orderID,
    llr_couponID1, llr_couponID2, llr_couponID3)
cls = llr_couponID_wide %>% filter(dsn == "class") %>% select(orderID, llr_couponID1,
    llr_couponID2, llr_couponID3)

llr_couponID_wide = list(T = trn, V = val, C = cls)

saveRDS(llr_couponID_wide, "../features/feature_files/llr_couponID_wide_set1.rds")
```



reward

```
# reward
llr = compute_ll(as.character(H$reward), H$couponUsed, as.character(TVC$reward))
llr_reward = data.frame(reward = names(llr), llr_reward = llr) %>% arrange(reward) %>%
    unique

# plot the results
if (nrow(TVC) - sum(TVC$reward %in% llr_reward$reward)) warning("Things aren't adding up")
qplot(reward, llr_reward, data = llr_reward)

# Isolate the features
llr_reward_long = TVC %>% left_join(llr_reward, by = "reward") %>% arrange(orderID,
    couponCol) %>% select(orderID, couponCol, dsn, llr_reward)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

trn = llr_reward_long %>% filter(dsn == "train") %>% select(orderID, couponCol,
    llr_reward)
val = llr_reward_long %>% filter(dsn == "validation") %>% select(orderID, couponCol,
    llr_reward)
cls = llr_reward_long %>% filter(dsn == "class") %>% select(orderID, couponCol,
    llr_reward)

llr_reward_long = list(T = trn, V = val, C = cls)

saveRDS(llr_reward_long, "../features/feature_files/llr_reward_long_set1.rds")

# save the results to RDS in WIDE format
llr_reward_wide = TVC %>% left_join(llr_reward, by = "reward") %>% arrange(orderID,
    couponCol) %>% select(orderID, couponCol, dsn, llr_reward) %>% spread(couponCol,
    llr_reward) %>% renm(c("orderID", "dsn", "llr_reward1", "llr_reward2", "llr_reward3"))

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

trn = llr_reward_wide %>% filter(dsn == "train") %>% select(orderID, llr_reward1,
    llr_reward2, llr_reward3)
val = llr_reward_wide %>% filter(dsn == "validation") %>% select(orderID, llr_reward1,
    llr_reward2, llr_reward3)
cls = llr_reward_wide %>% filter(dsn == "class") %>% select(orderID, llr_reward1,
    llr_reward2, llr_reward3)

llr_reward_wide = list(T = trn, V = val, C = cls)

saveRDS(llr_reward_wide, "../features/feature_files/llr_reward_wide_set1.rds")
```



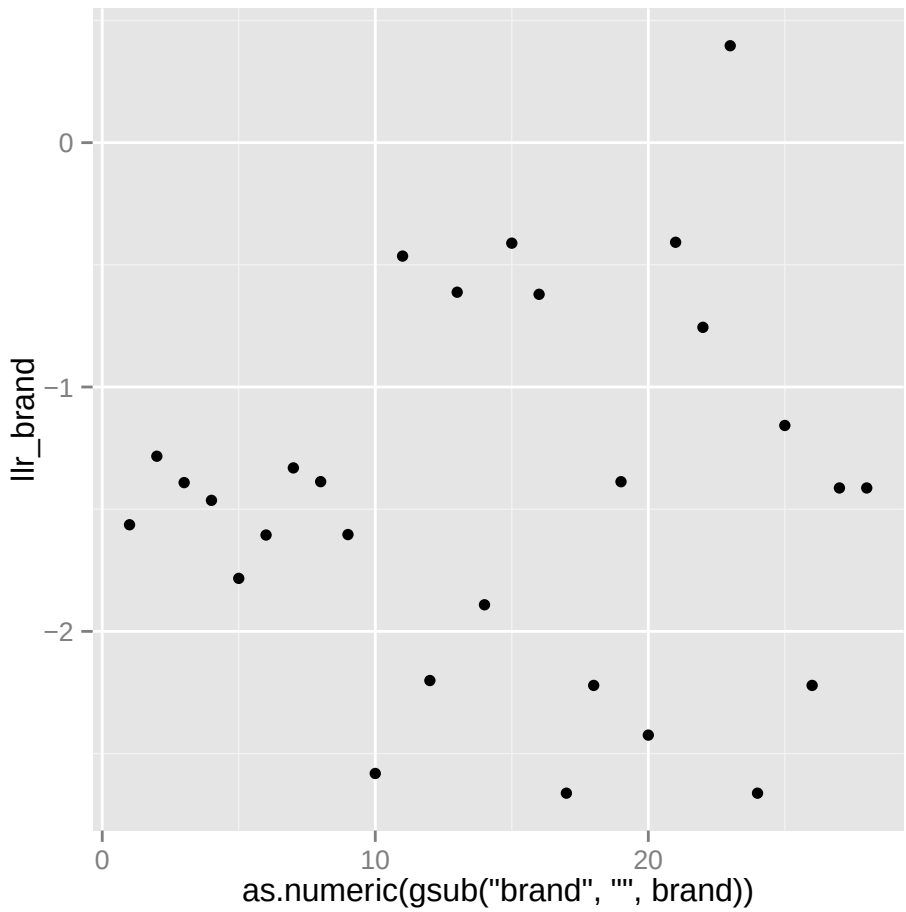
brand

```
# brand
llr = compute_ll(as.character(H$brand), H$couponUsed, as.character(TVC$brand))
llr_brand = data.frame(brand = names(llr), llr_brand = llr) %>% arrange(brand) %>%
    unique

# plot the results
if (nrow(TVC) - sum(TVC$brand %in% llr_brand$brand)) warning("Things aren't adding up")
qplot(as.numeric(gsub("brand", "", brand)), llr_brand, data = llr_brand)

# Isolate the features
llr_brand_long = TVC %>% left_join(llr_brand, by = "brand") %>% arrange(orderID,
    couponCol) %>% select(orderID, couponCol, dsn, llr_brand)
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector
```

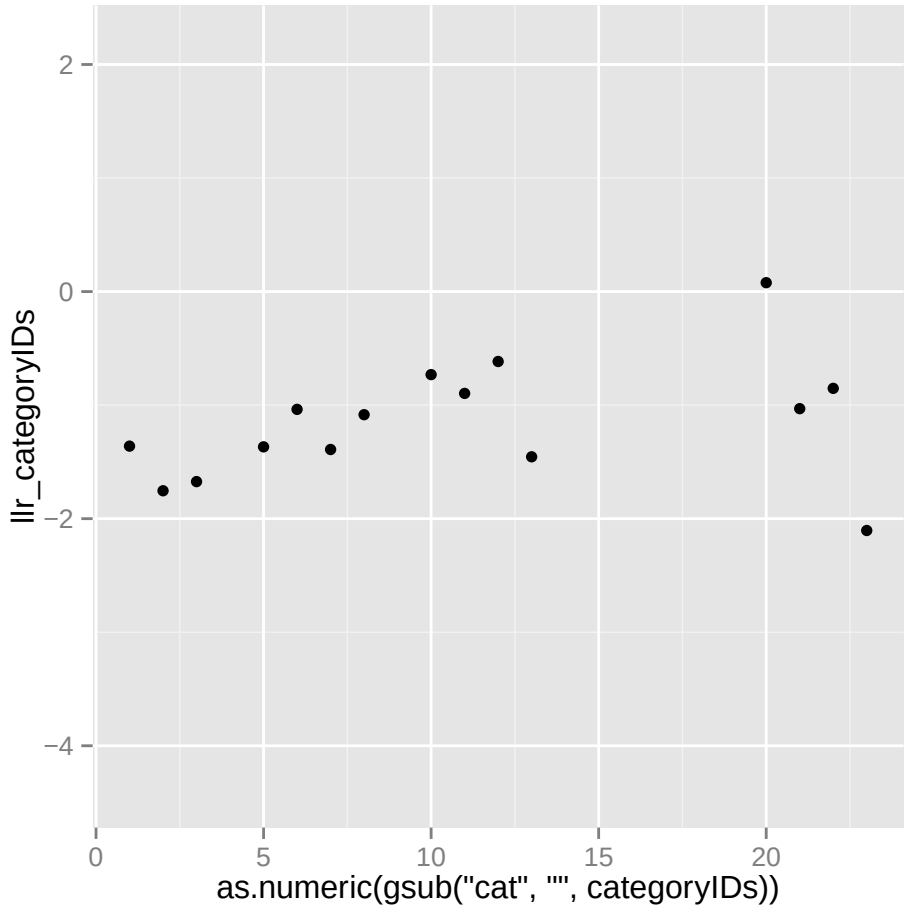
```
trn = llr_brand_long %>% filter(dsn == "train") %>% select(orderID, couponCol,
    llr_brand)
val = llr_brand_long %>% filter(dsn == "validation") %>% select(orderID, couponCol,
    llr_brand)
cls = llr_brand_long %>% filter(dsn == "class") %>% select(orderID, couponCol,
    llr_brand)
```

```
llr_brand_long = list(T = trn, V = val, C = cls)

saveRDS(llr_brand_long, "../features/feature_files/llr_brand_long_set1.rds")

# save the results to RDS in WIDE format
llr_brand_wide = TVC %>% left_join(llr_brand, by = "brand") %>% arrange(orderID,
    couponCol) %>% select(orderID, couponCol, dsn, llr_brand) %>% spread(couponCol,
    llr_brand) %>% renm(c("orderID", "dsn", "llr_brand1", "llr_brand2", "llr_brand3"))

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

trn = llr_brand_wide %>% filter(dsn == "train") %>% select(orderID, llr_brand1,
    llr_brand2, llr_brand3)
val = llr_brand_wide %>% filter(dsn == "validation") %>% select(orderID, llr_brand1,
    llr_brand2, llr_brand3)
cls = llr_brand_wide %>% filter(dsn == "class") %>% select(orderID, llr_brand1,
    llr_brand2, llr_brand3)

llr_brand_wide = list(T = trn, V = val, C = cls)

saveRDS(llr_brand_wide, "../features/feature_files/llr_brand_wide_set1.rds")
```



categoryIDs (aggregated)

```
# categoryIDs
llr = compute_ll(as.character(H$categoryIDs), H$couponUsed, as.character(TVC$categoryIDs))
llr_categoryIDs = data.frame(categoryIDs = names(llr), llr_categoryIDs = llr) %>%
    arrange(categoryIDs) %>% unique

# plot the results
if (nrow(TVC) - sum(TVC$categoryIDs %in% llr_categoryIDs$categoryIDs)) warning("Things aren't adding up
qplot(as.numeric(gsub("cat", "", categoryIDs)), llr_categoryIDs, data = llr_categoryIDs)

## Warning: NAs introduced by coercion

## Warning: NAs introduced by coercion

## Warning in loop_apply(n, do.ply): Removed 159 rows containing missing
## values (geom_point).

# Isolate the features
llr_categoryIDs_long = TVC %>% left_join(llr_categoryIDs, by = "categoryIDs") %>%
    arrange(orderID, couponCol) %>% select(orderID, couponCol, dsn, llr_categoryIDs)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

trn = llr_categoryIDs_long %>% filter(dsn == "train") %>% select(orderID, couponCol,
    llr_categoryIDs)
val = llr_categoryIDs_long %>% filter(dsn == "validation") %>% select(orderID,
    couponCol, llr_categoryIDs)
cls = llr_categoryIDs_long %>% filter(dsn == "class") %>% select(orderID, couponCol,
    llr_categoryIDs)

llr_categoryIDs_long = list(T = trn, V = val, C = cls)

saveRDS(llr_categoryIDs_long, "../features/feature_files/llr_categoryIDs_agg_long_set1.rds")

# save the results to RDS in WIDE format
llr_categoryIDs_wide = TVC %>% left_join(llr_categoryIDs, by = "categoryIDs") %>%
    arrange(orderID, couponCol) %>% select(orderID, couponCol, dsn, llr_categoryIDs) %>%
    spread(couponCol, llr_categoryIDs) %>% renm(c("orderID", "dsn", "llr_categoryIDs1",
    "llr_categoryIDs2", "llr_categoryIDs3"))

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

trn = llr_categoryIDs_wide %>% filter(dsn == "train") %>% select(orderID, llr_categoryIDs1,
    llr_categoryIDs2, llr_categoryIDs3)
val = llr_categoryIDs_wide %>% filter(dsn == "validation") %>% select(orderID,
    llr_categoryIDs1, llr_categoryIDs2, llr_categoryIDs3)
cls = llr_categoryIDs_wide %>% filter(dsn == "class") %>% select(orderID, llr_categoryIDs1,
    llr_categoryIDs2, llr_categoryIDs3)

llr_categoryIDs_wide = list(T = trn, V = val, C = cls)

saveRDS(llr_categoryIDs_wide, "../features/feature_files/llr_categoryIDs_agg_wide_set1.rds")
```



categoryIDs (individually)
We may need to compute statistics with respect to each category apart from the aggregated one:

```
# categoryIDs individually
source("./R/splitColumn.R")
TVC.cat = splitColumn(TVC, "categoryIDs", "orderID", splitby = ":") %>% select(orderID,
    couponCol, categoryIDs1, categoryIDs2, categoryIDs3, categoryIDs4, categoryIDs5) %>%
    gather(tmp, categoryID, -orderID, -couponCol) %>% mutate(categoryEntry = gsub("categoryIDs",
    "", tmp)) %>% select(orderID, couponCol, categoryEntry, categoryID) %>%
    left_join(TVC, by = c("orderID", "couponCol")) %>% arrange(orderID, couponCol,
    categoryEntry) %>% filter(!is.na(categoryID))
```

```
## Loading required package: tcltk
```

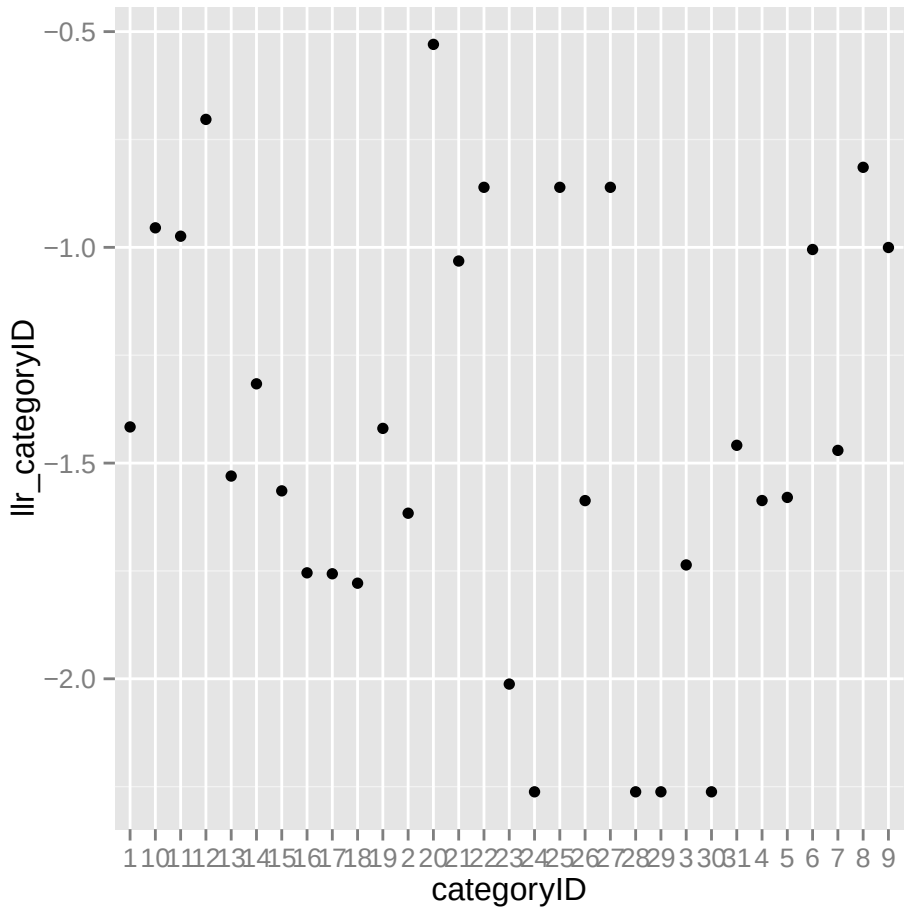
```
H.cat = splitColumn(H, "categoryIDs", "orderID", splitby = ":") %>% select(orderID,
    couponCol, categoryIDs1, categoryIDs2, categoryIDs3, categoryIDs4, categoryIDs5) %>%
    gather(tmp, categoryID, -orderID, -couponCol) %>% mutate(categoryEntry = gsub("categoryIDs",
    "", tmp)) %>% select(orderID, couponCol, categoryEntry, categoryID) %>%
    left_join(H, by = c("orderID", "couponCol")) %>% arrange(orderID, couponCol,
    categoryEntry) %>% filter(!is.na(categoryID))
```

```
# categoryID
llr = compute_ll(as.character(H.cat$categoryID), H.cat$couponUsed, as.character(TVC.cat$categoryID))
llr_categoryID = data.frame(categoryID = names(llr), llr_categoryID = llr) %>%
```

```
    arrange(categoryID) %>% unique %>% arrange(categoryID)

# plot the results
if (nrow(TVC.cat) - sum(TVC.cat$categoryID %in% llr_categoryID$categoryID)) warning("Things aren't addi
qplot(gsub("cat", "", categoryID), llr_categoryID, data = llr_categoryID, xlab = "categoryID")

# Isolate the features (long, long)
llr_categoryID_long_long = TVC.cat %>% left_join(llr_categoryID, by = "categoryID") %>%
    arrange(orderID, couponCol, categoryEntry) %>% select(orderID, couponCol,
    categoryEntry, dsn, llr_categoryID)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

trn = llr_categoryID_long_long %>% filter(dsn == "train") %>% select(orderID,
    couponCol, categoryEntry, llr_categoryID)
val = llr_categoryID_long_long %>% filter(dsn == "validation") %>% select(orderID,
    couponCol, categoryEntry, llr_categoryID)
cls = llr_categoryID_long_long %>% filter(dsn == "class") %>% select(orderID,
    couponCol, categoryEntry, llr_categoryID)

llr_categoryIDs_long_long = list(T = trn, V = val, C = cls)

saveRDS(llr_categoryIDs_long_long, "../features/feature_files/llr_categoryIDs_ind_long_long_set1.rds")

# Isolate the features (long)
llr_categoryID_long = TVC.cat %>% left_join(llr_categoryID, by = "categoryID") %>%
    arrange(orderID, couponCol, categoryEntry) %>% select(orderID, couponCol,
    categoryEntry, dsn, llr_categoryID) %>% spread(categoryEntry, llr_categoryID) %>%
    arrange(orderID, couponCol) %>% renm(c("orderID", "couponCol", "dsn", "llr_categoryIDs1",
    "llr_categoryIDs2", "llr_categoryIDs3", "llr_categoryIDs4", "llr_categoryIDs5"))

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

trn = llr_categoryID_long %>% filter(dsn == "train") %>% select(orderID, couponCol,
    llr_categoryIDs1, llr_categoryIDs2, llr_categoryIDs3, llr_categoryIDs4,
    llr_categoryIDs5)
val = llr_categoryID_long %>% filter(dsn == "validation") %>% select(orderID,
    couponCol, llr_categoryIDs1, llr_categoryIDs2, llr_categoryIDs3, llr_categoryIDs4,
    llr_categoryIDs5)
cls = llr_categoryID_long %>% filter(dsn == "class") %>% select(orderID, couponCol,
    llr_categoryIDs1, llr_categoryIDs2, llr_categoryIDs3, llr_categoryIDs4,
    llr_categoryIDs5)

llr_categoryIDs_long = list(T = trn, V = val, C = cls)

saveRDS(llr_categoryIDs_long, "../features/feature_files/llr_categoryIDs_ind_long_set1.rds")

# Isolate the features (wide)
llr_categoryID_wide = TVC.cat %>% left_join(llr_categoryID, by = "categoryID") %>%
    arrange(orderID, couponCol, categoryEntry) %>% mutate(entryid = paste0("llr_cpnCol",
    couponCol, "_catEntry", categoryEntry)) %>% select(orderID, dsn, entryid,
    llr_categoryID) %>% spread(entryid, llr_categoryID) %>% arrange(orderID,
    dsn)
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector
```

```
trn = llr_categoryID_wide %>% filter(dsn == "train") %>% select(-dsn)
val = llr_categoryID_wide %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_categoryID_wide %>% filter(dsn == "class") %>% select(-dsn)

llr_categoryIDs_wide = list(T = trn, V = val, C = cls)

saveRDS(llr_categoryIDs_wide, "../features/feature_files/llr_categoryIDs_ind_wide_set1.rds")
```

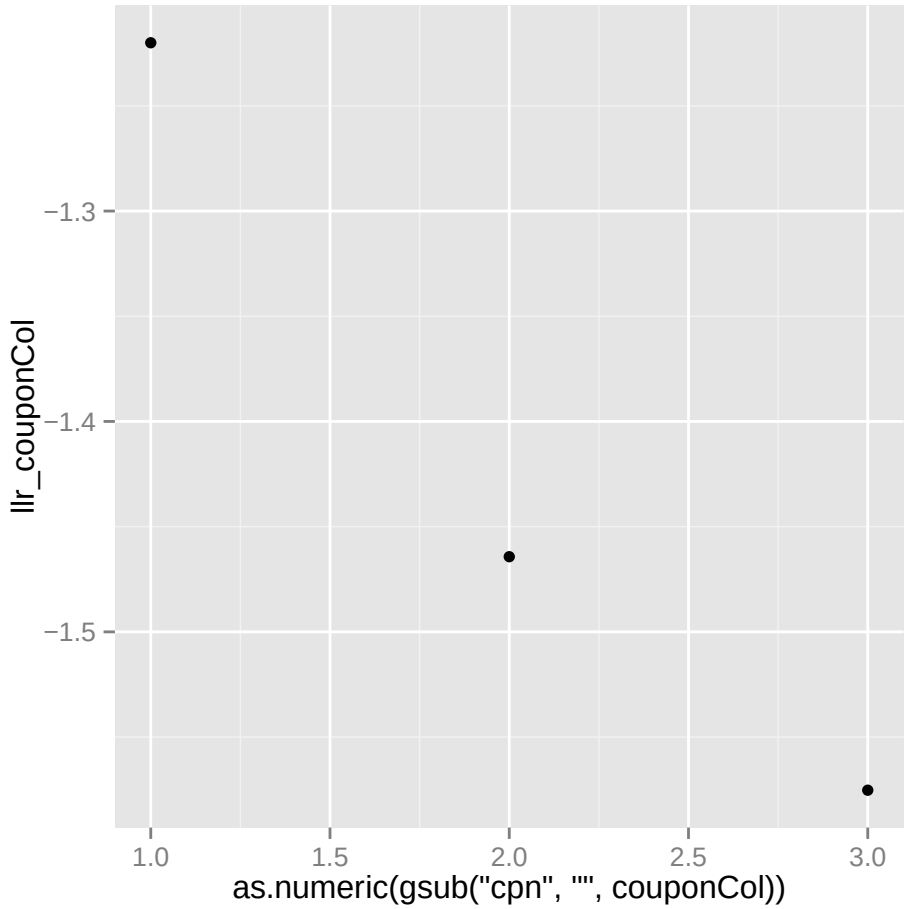


0.3.2 Created Variables

couponCol

```
# couponCol
llr = compute_ll(as.character(H$couponCol), H$couponUsed, as.character(TVC$couponCol))
llr_couponCol = data.frame(couponCol = names(llr), llr_couponCol = llr) %>%
    arrange(couponCol) %>% unique
llr_couponCol$couponCol = as.character(llr_couponCol$couponCol)

# plot the results
if (nrow(TVC) - sum(TVC$couponCol %in% llr_couponCol$couponCol)) warning("Things aren't adding up")
qplot(as.numeric(gsub("cpn", "", couponCol)), llr_couponCol, data = llr_couponCol)
```

```
# Isolate the features
llr_couponCol_long = TVC %>% left_join(llr_couponCol, by = "couponCol") %>%
    arrange(orderID, couponCol) %>% select(orderID, couponCol, dsn, llr_couponCol)

trn = llr_couponCol_long %>% filter(dsn == "train") %>% select(orderID, couponCol,
    llr_couponCol)
val = llr_couponCol_long %>% filter(dsn == "validation") %>% select(orderID,
    couponCol, llr_couponCol)
cls = llr_couponCol_long %>% filter(dsn == "class") %>% select(orderID, couponCol,
    llr_couponCol)

llr_couponCol_long = list(T = trn, V = val, C = cls)

saveRDS(llr_couponCol_long, "../features/feature_files/llr_couponCol_long_set1.rds")

# save the results to RDS in WIDE format
llr_couponCol_wide = TVC %>% left_join(llr_couponCol, by = "couponCol") %>%
    arrange(orderID, couponCol) %>% select(orderID, couponCol, dsn, llr_couponCol) %>%
    spread(couponCol, llr_couponCol) %>% renm(c("orderID", "dsn", "llr_couponCol1",
    "llr_couponCol2", "llr_couponCol3"))

trn = llr_couponCol_wide %>% filter(dsn == "train") %>% select(orderID, llr_couponCol1,
    llr_couponCol2, llr_couponCol3)
val = llr_couponCol_wide %>% filter(dsn == "validation") %>% select(orderID,
    llr_couponCol1, llr_couponCol2, llr_couponCol3)
cls = llr_couponCol_wide %>% filter(dsn == "class") %>% select(orderID, llr_couponCol1,
    llr_couponCol2, llr_couponCol3)

llr_couponCol_wide = list(T = trn, V = val, C = cls)

saveRDS(llr_couponCol_wide, "../features/feature_files/llr_couponCol_wide.rds")
```



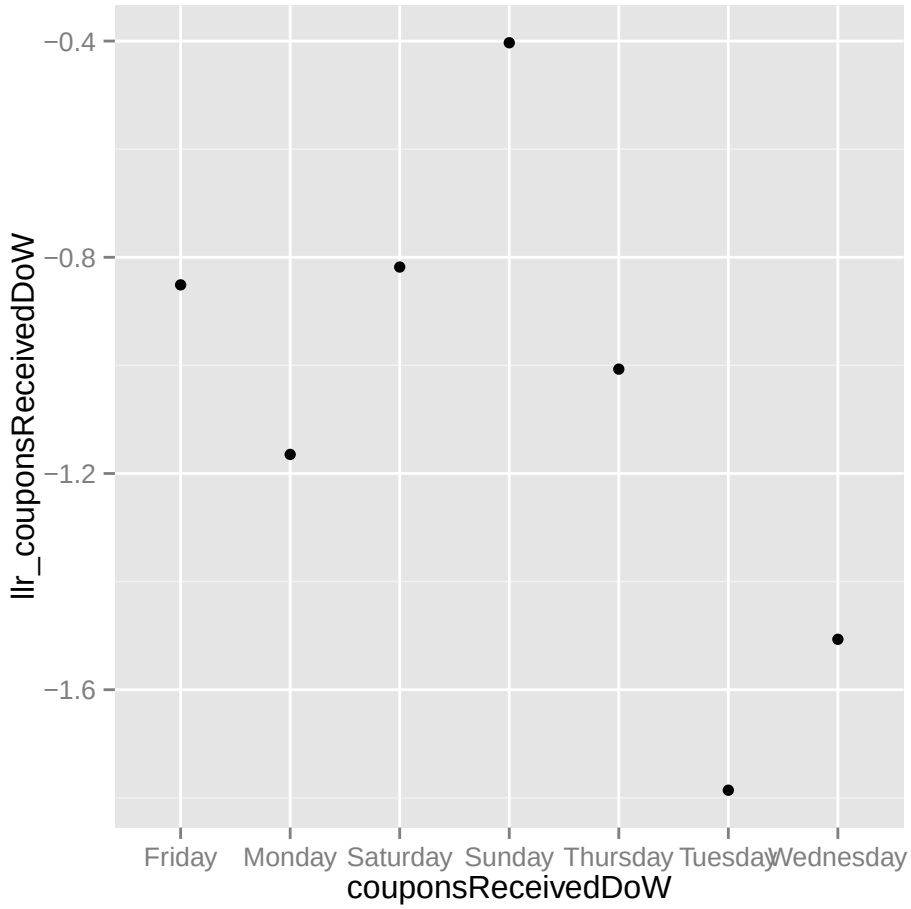
couponsReceivedDoW

```
# couponsReceivedDoW
llr = compute_ll(as.character(H$couponsReceivedDoW), H$couponUsed, as.character(TVC$couponsReceivedDoW)
llr_couponsReceivedDoW = data.frame(couponsReceivedDoW = names(llr), llr_couponsReceivedDoW = llr) %>%
    arrange(couponsReceivedDoW) %>% unique

# plot the results
if (nrow(TVC) - sum(TVC$couponsReceivedDoW %in% llr_couponsReceivedDoW$couponsReceivedDoW)) warning("Th
qplot(couponsReceivedDoW, llr_couponsReceivedDoW, data = llr_couponsReceivedDoW)

# Isolate the features
llr_couponsReceivedDoW_long = TVC %>% left_join(llr_couponsReceivedDoW, by = "couponsReceivedDoW") %>%
    arrange(orderID, couponsReceivedDoW) %>% select(orderID, couponsReceivedDoW,
    dsn, llr_couponsReceivedDoW)
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factors with
## different levels, coercing to character vector
```

```
trn = llr_couponsReceivedDoW_long %>% filter(dsn == "train") %>% select(orderID,
    couponsReceivedDoW, llr_couponsReceivedDoW)
val = llr_couponsReceivedDoW_long %>% filter(dsn == "validation") %>% select(orderID,
    couponsReceivedDoW, llr_couponsReceivedDoW)
cls = llr_couponsReceivedDoW_long %>% filter(dsn == "class") %>% select(orderID,
```

```
    couponsReceivedDoW, llr_couponsReceivedDoW)

llr_couponsReceivedDoW_long = list(T = trn, V = val, C = cls)

saveRDS(llr_couponsReceivedDoW_long, "../features/feature_files/llr_couponsReceivedDoW_long_set1.rds")

# save the results to RDS in WIDE format
llr_couponsReceivedDoW_wide = TVC %>% left_join(llr_couponsReceivedDoW, by = "couponsReceivedDoW") %>%
    arrange(orderID, couponCol) %>% select(orderID, couponCol, dsn, llr_couponsReceivedDoW) %>%
    spread(couponCol, llr_couponsReceivedDoW) %>% renm(c("orderID", "dsn", "llr_couponsReceivedDoW1",
    "llr_couponsReceivedDoW2", "llr_couponsReceivedDoW3"))

## Warning in left_join_impl(x, y, by$x, by$y): joining factors with
## different levels, coercing to character vector

trn = llr_couponsReceivedDoW_wide %>% filter(dsn == "train") %>% select(orderID,
    llr_couponsReceivedDoW1, llr_couponsReceivedDoW2, llr_couponsReceivedDoW3)
val = llr_couponsReceivedDoW_wide %>% filter(dsn == "validation") %>% select(orderID,
    llr_couponsReceivedDoW1, llr_couponsReceivedDoW2, llr_couponsReceivedDoW3)
cls = llr_couponsReceivedDoW_wide %>% filter(dsn == "class") %>% select(orderID,
    llr_couponsReceivedDoW1, llr_couponsReceivedDoW2, llr_couponsReceivedDoW3)

llr_couponsReceivedDoW_wide = list(T = trn, V = val, C = cls)

saveRDS(llr_couponsReceivedDoW_wide, "../features/feature_files/llr_couponsReceivedDoW_wide.rds")
```



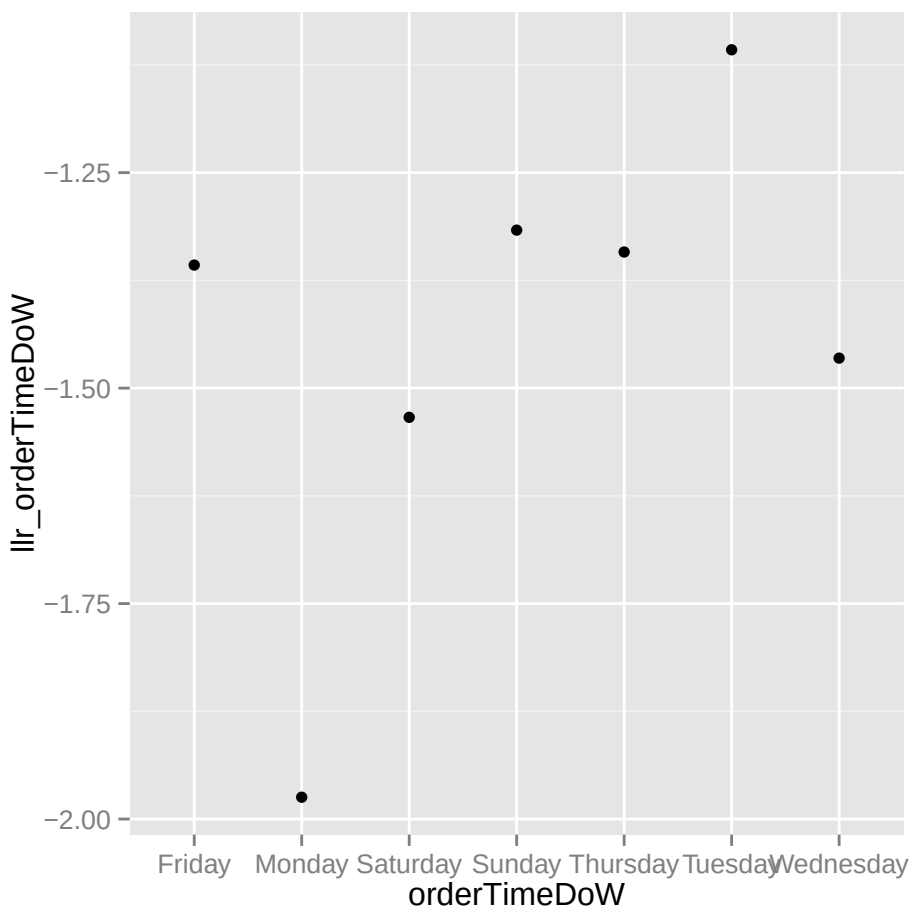
orderTimeDoW

```
# orderTimeDoW
llr = compute_ll(as.character(H$orderTimeDoW), H$couponUsed, as.character(TVC$orderTimeDoW))
llr_orderTimeDoW = data.frame(orderTimeDoW = names(llr), llr_orderTimeDoW = llr) %>%
    arrange(orderTimeDoW) %>% unique

# plot the results
if (nrow(TVC) - sum(TVC$orderTimeDoW %in% llr_orderTimeDoW$orderTimeDoW)) warning("Things aren't adding
qplot(orderTimeDoW, llr_orderTimeDoW, data = llr_orderTimeDoW)

# Isolate the features
llr_orderTimeDoW_long = TVC %>% left_join(llr_orderTimeDoW, by = "orderTimeDoW") %>%
    arrange(orderID, orderTimeDoW) %>% select(orderID, orderTimeDoW, dsn, llr_orderTimeDoW)
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factors with
## different levels, coercing to character vector
```

```
trn = llr_orderTimeDoW_long %>% filter(dsn == "train") %>% select(orderID, orderTimeDoW,
    llr_orderTimeDoW)
val = llr_orderTimeDoW_long %>% filter(dsn == "validation") %>% select(orderID,
    orderTimeDoW, llr_orderTimeDoW)
cls = llr_orderTimeDoW_long %>% filter(dsn == "class") %>% select(orderID, orderTimeDoW,
    llr_orderTimeDoW)
```

```
llr_orderTimeDoW_long = list(T = trn, V = val, C = cls)

saveRDS(llr_orderTimeDoW_long, "../features/feature_files/llr_orderTimeDoW_long_set1.rds")

# save the results to RDS in WIDE format
llr_orderTimeDoW_wide = TVC %>% left_join(llr_orderTimeDoW, by = "orderTimeDoW") %>%
    arrange(orderID, couponCol) %>% select(orderID, couponCol, dsn, llr_orderTimeDoW) %>%
    spread(couponCol, llr_orderTimeDoW) %>% renm(c("orderID", "dsn", "llr_orderTimeDoW1",
    "llr_orderTimeDoW2", "llr_orderTimeDoW3"))

## Warning in left_join_impl(x, y, by$x, by$y): joining factors with
## different levels, coercing to character vector

trn = llr_orderTimeDoW_wide %>% filter(dsn == "train") %>% select(orderID, llr_orderTimeDoW1,
    llr_orderTimeDoW2, llr_orderTimeDoW3)
val = llr_orderTimeDoW_wide %>% filter(dsn == "validation") %>% select(orderID,
    llr_orderTimeDoW1, llr_orderTimeDoW2, llr_orderTimeDoW3)
cls = llr_orderTimeDoW_wide %>% filter(dsn == "class") %>% select(orderID, llr_orderTimeDoW1,
    llr_orderTimeDoW2, llr_orderTimeDoW3)

llr_orderTimeDoW_wide = list(T = trn, V = val, C = cls)

saveRDS(llr_orderTimeDoW_wide, "../features/feature_files/llr_orderTimeDoW_wide.rds")
```



0.4 Calculating Coupon 2-Way Likelihoods

We have a sligthly more complicated task on this one:

```
names(TVC)[-c(1, 2, 4, 5, 6, 7, 11, 12, 16, 17:22, 24:25, 31)]
```

```
##  [1] "userID"                 "couponsReceivedDoW"
##  [3] "couponsReceivedWeekend" "couponsReceivedFriSat"
##  [5] "orderTimeDoW"           "orderTimeWeekend"
##  [7] "orderTimeFriSat"        "dsn"
##  [9] "basePrice"              "reward"
## [11] "premiumProduct"         "brand"
## [13] "productGroup"           "couponUsed"
## [15] "couponCol"
```

```
names(TVC)
```

```
##  [1] "orderID"                "orderTime"
##  [3] "userID"                 "couponsReceived"
##  [5] "basketValue"            "couponsReceivedDate"
##  [7] "couponsReceivedTime"    "couponsReceivedDoW"
##  [9] "couponsReceivedWeekend" "couponsReceivedFriSat"
## [11] "orderTimeDate"          "orderTimeTime"
## [13] "orderTimeDoW"           "orderTimeWeekend"
## [15] "orderTimeFriSat"        "batchID"
## [17] "couponsExpire"          "couponsSent"
## [19] "TimeBtwnSentRec"        "TimeBtwnRecExpire"
## [21] "TimeBtwnRecOrder"       "TimeBtwnOrderExpire"
## [23] "dsn"                    "couponID"
## [25] "price"                  "basePrice"
## [27] "reward"                 "premiumProduct"
## [29] "brand"                  "productGroup"
## [31] "categoryIDs"            "couponUsed"
## [33] "couponCol"
```

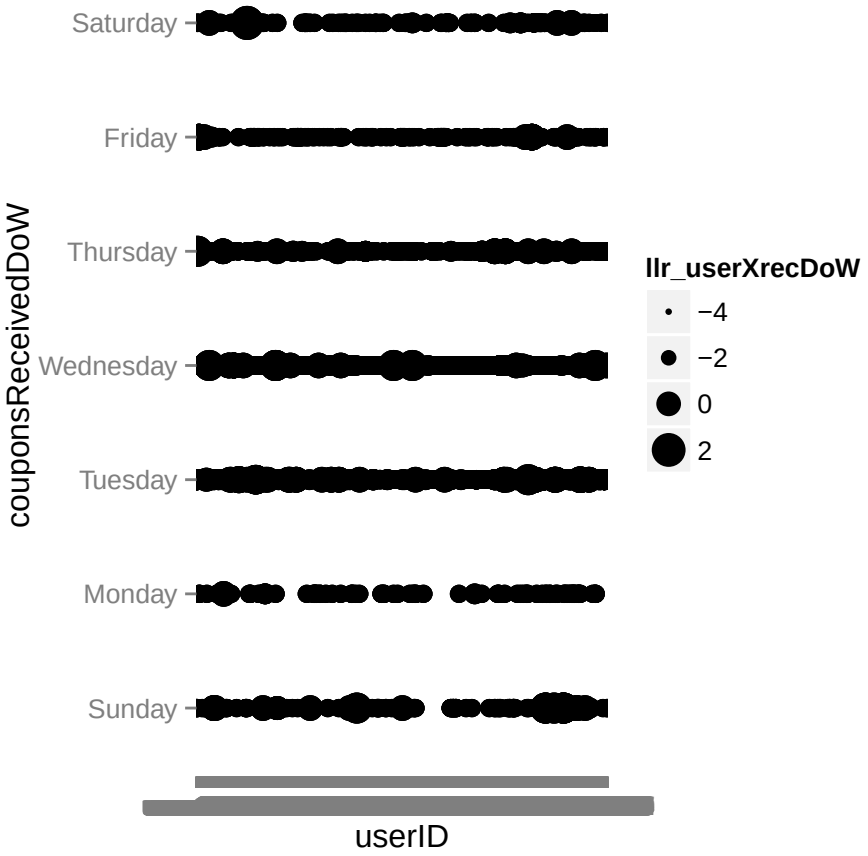
0.4.1 userID and

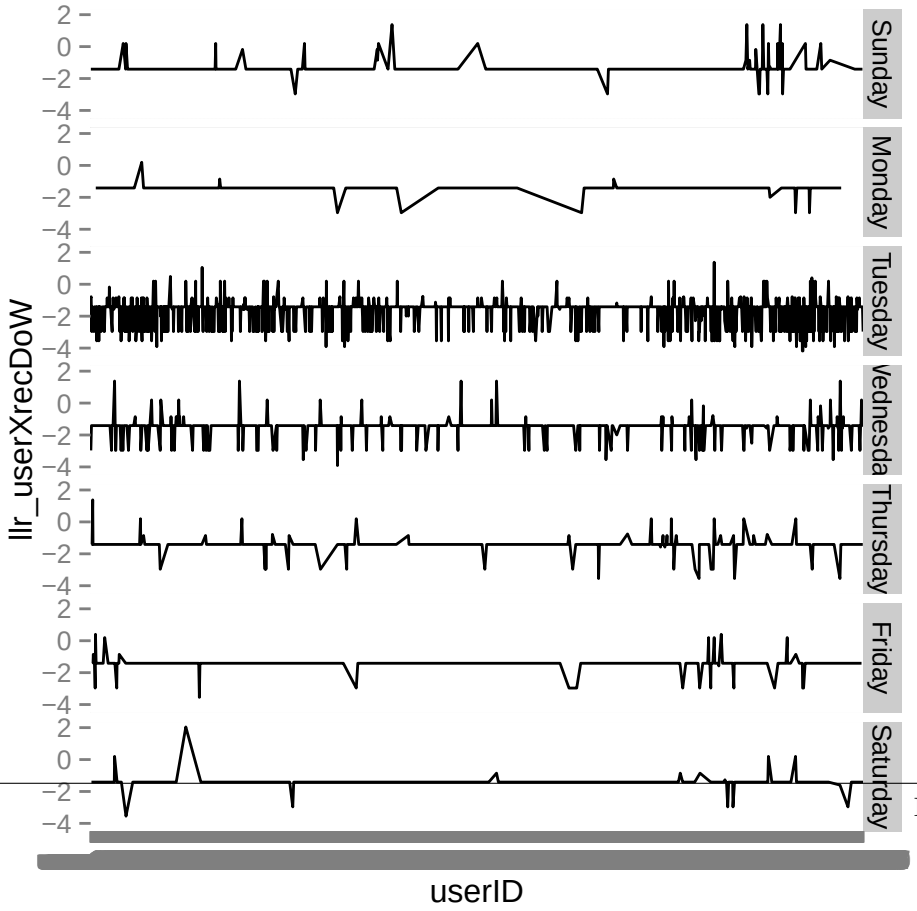
couponsReceivedDoW (as `llr_userXrecDoW`)

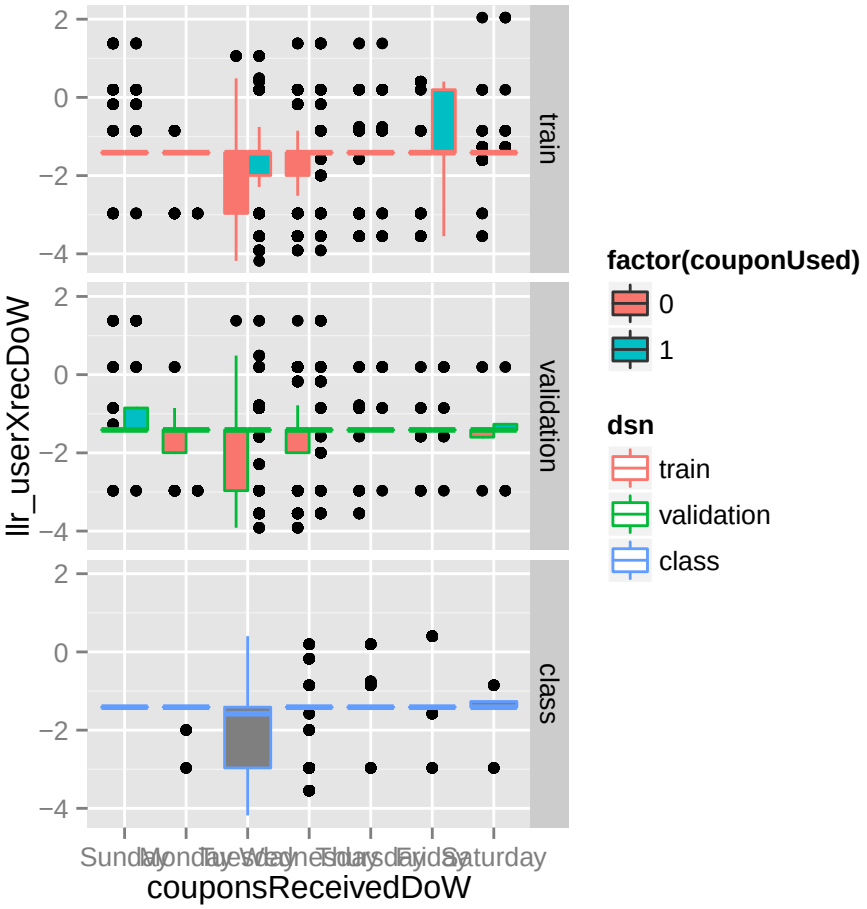
```
# couponsReceivedDoW
llr = compute_ll_2w(as.character(H$userID), as.character(H$couponsReceivedDoW),
    H$couponUsed, as.character(TVC$userID), as.character(TVC$couponsReceivedDoW))
llr_userXrecDoW = data.frame(userID = TVC$userID, couponsReceivedDoW = TVC$couponsReceivedDoW,
    llr_userXrecDoW = llr) %>% arrange(userID)

ggplot(data = llr_userXrecDoW, aes(x = userID, y = couponsReceivedDoW, size = llr_userXrecDoW),
    alpha = 0.1) + geom_point()
qplot(userID, llr_userXrecDoW, data = llr_userXrecDoW, geom = "line", group = couponsReceivedDoW,
    facets = couponsReceivedDoW ~ .)

TVC %>% left_join(llr_userXrecDoW, by = c("userID", "couponsReceivedDoW")) %>%
    select(orderID, userID, dsn, couponsReceivedDoW, llr_userXrecDoW, couponUsed) %>%
    ggplot(aes(x = couponsReceivedDoW, y = llr_userXrecDoW, fill = factor(couponUsed),
        color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector
```

```
llr_userXrecDoW = TVC %>% left_join(llr_userXrecDoW, by = c("userID", "couponsReceivedDoW")) %>%
    select(orderID, dsn, llr_userXrecDoW)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

trn = llr_userXrecDoW %>% filter(dsn == "train") %>% select(-dsn)
val = llr_userXrecDoW %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_userXrecDoW %>% filter(dsn == "class") %>% select(-dsn)

llr_userXrecDoW = list(T = trn, V = val, C = cls)

saveRDS(llr_userXrecDoW, "../features/feature_files/llr_userXrecDoW.rds")
```


Saturday
Friday
Thursday
Wednesday
Tuesday
Monday
Sunday
couponsReceivedDoW
llr_userXrecDoW
−4
−2
0
2
userID


llr_userXrecDoW
Sunday
Monday
Tuesday
Wednesda
Thursday
Friday
Saturday
2
0
−2
−4
userID

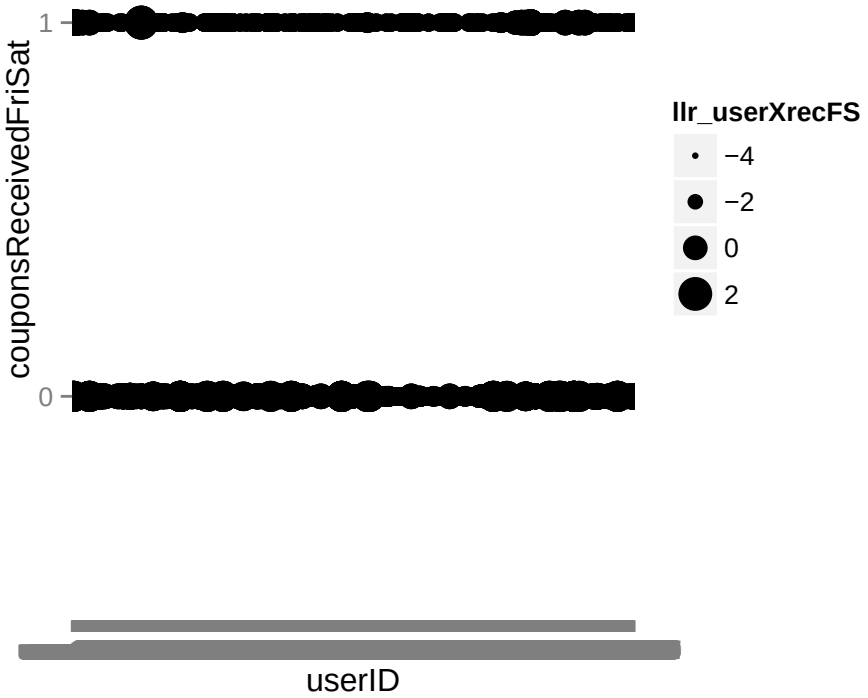


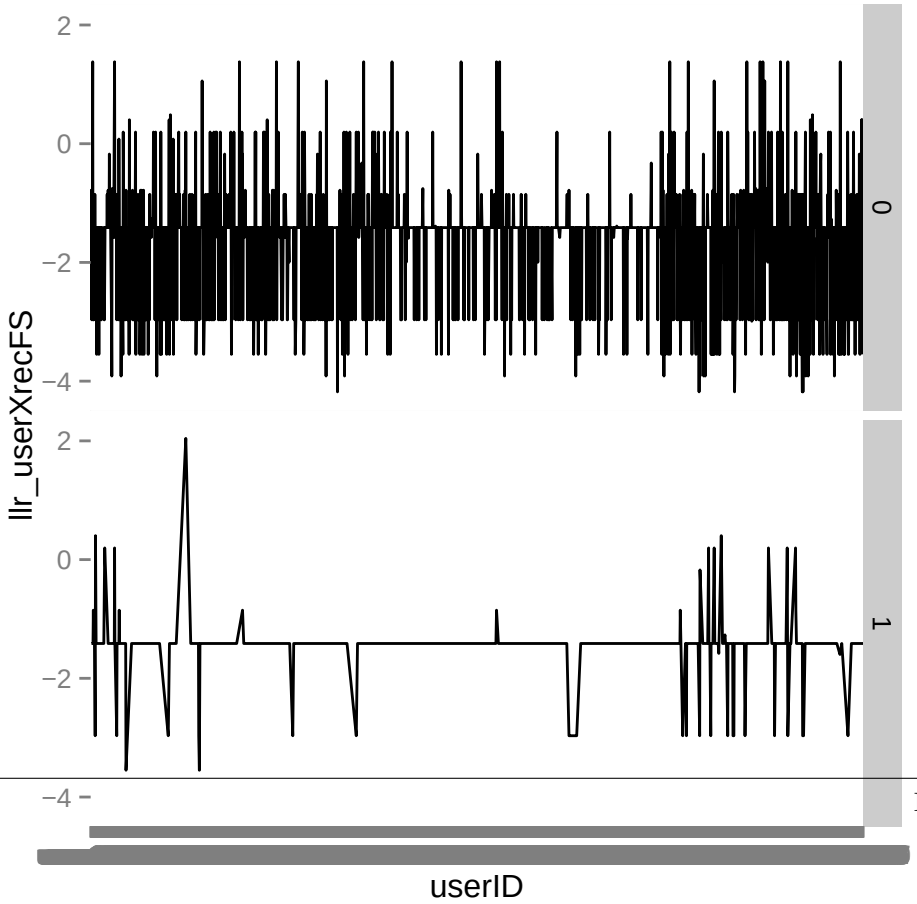
couponsReceivedFriSat (as `llr_userXrecFS`)

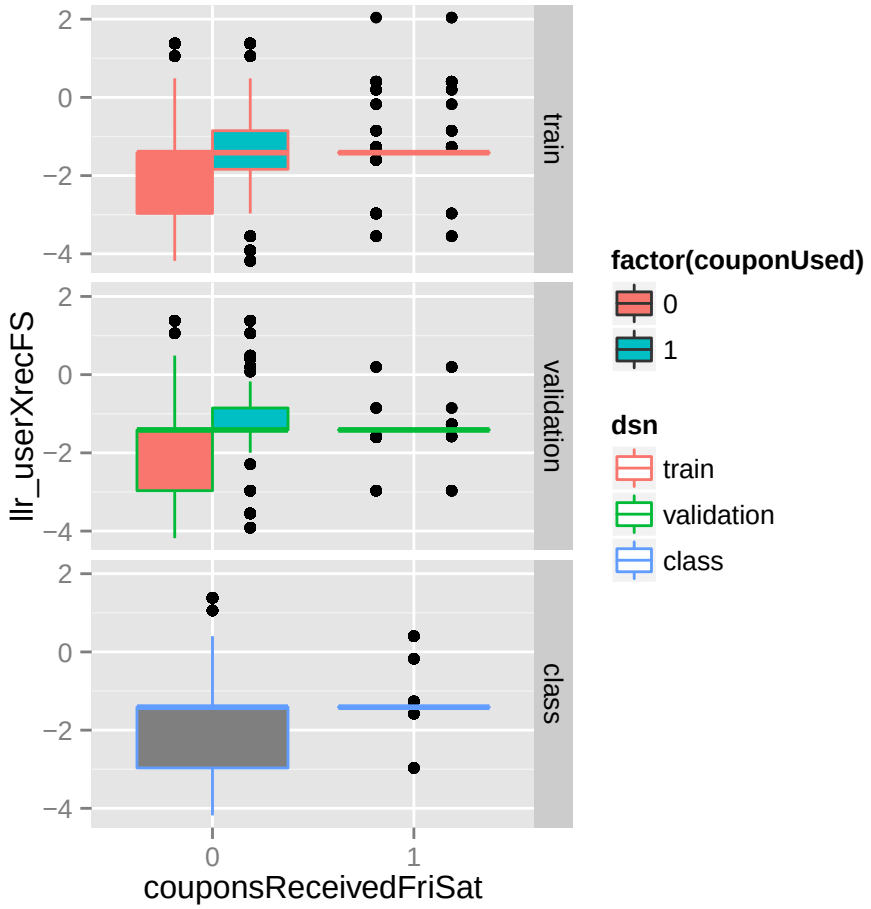
```
# couponsReceivedFriSat
llr = compute_ll_2w(as.character(H$userID), as.character(H$couponsReceivedFriSat),
    H$couponUsed, as.character(TVC$userID), as.character(TVC$couponsReceivedFriSat))
llr_userXrecFS = data.frame(userID = TVC$userID, couponsReceivedFriSat = TVC$couponsReceivedFriSat,
    llr_userXrecFS = llr) %>% arrange(userID)

ggplot(data = llr_userXrecFS, aes(x = userID, y = couponsReceivedFriSat, size = llr_userXrecFS),
    alpha = 0.1) + geom_point()
qplot(userID, llr_userXrecFS, data = llr_userXrecFS, geom = "line", group = couponsReceivedFriSat,
    facets = couponsReceivedFriSat ~ .)

TVC %>% left_join(llr_userXrecFS, by = c("userID", "couponsReceivedFriSat")) %>%
    select(orderID, userID, dsn, couponsReceivedFriSat, llr_userXrecFS, couponUsed) %>%
    ggplot(aes(x = couponsReceivedFriSat, y = llr_userXrecFS, fill = factor(couponUsed),
        color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

llr_userXrecFS = TVC %>% left_join(llr_userXrecFS, by = c("userID", "couponsReceivedFriSat")) %>%
    select(orderID, dsn, llr_userXrecFS)
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector
```

```r
trn = llr_userXrecFS %>% filter(dsn == "train") %>% select(-dsn)
val = llr_userXrecFS %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_userXrecFS %>% filter(dsn == "class") %>% select(-dsn)

llr_userXrecFS = list(T = trn, V = val, C = cls)

saveRDS(llr_userXrecFS, "../features/feature_files/llr_userXrecFS.rds")
```


couponsReceivedFriSat
1
0
llr_userXrecFS
−4
−2
0
2
userID


llr_userXrecFS
2
0
−2
−4
0
1
userID

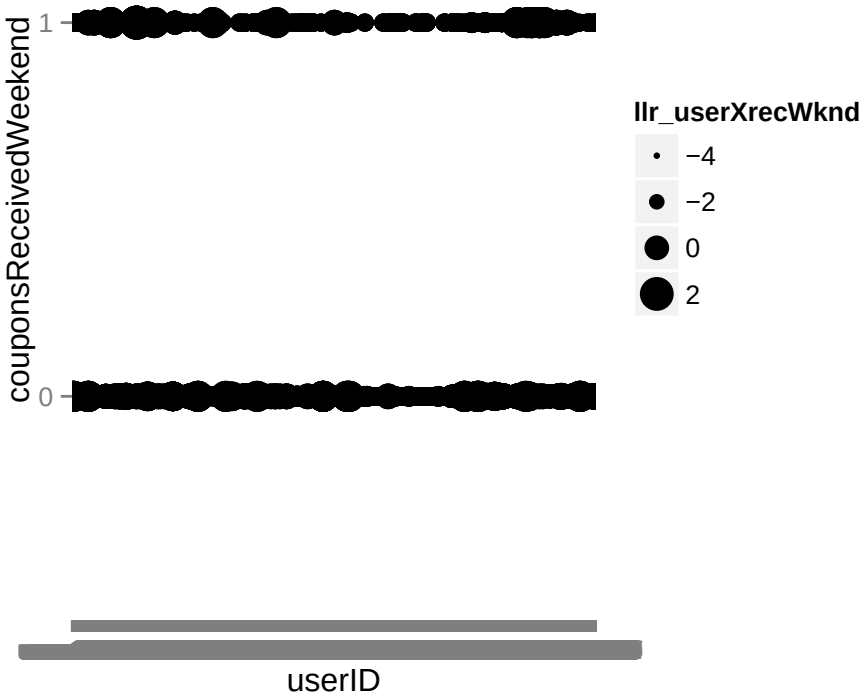


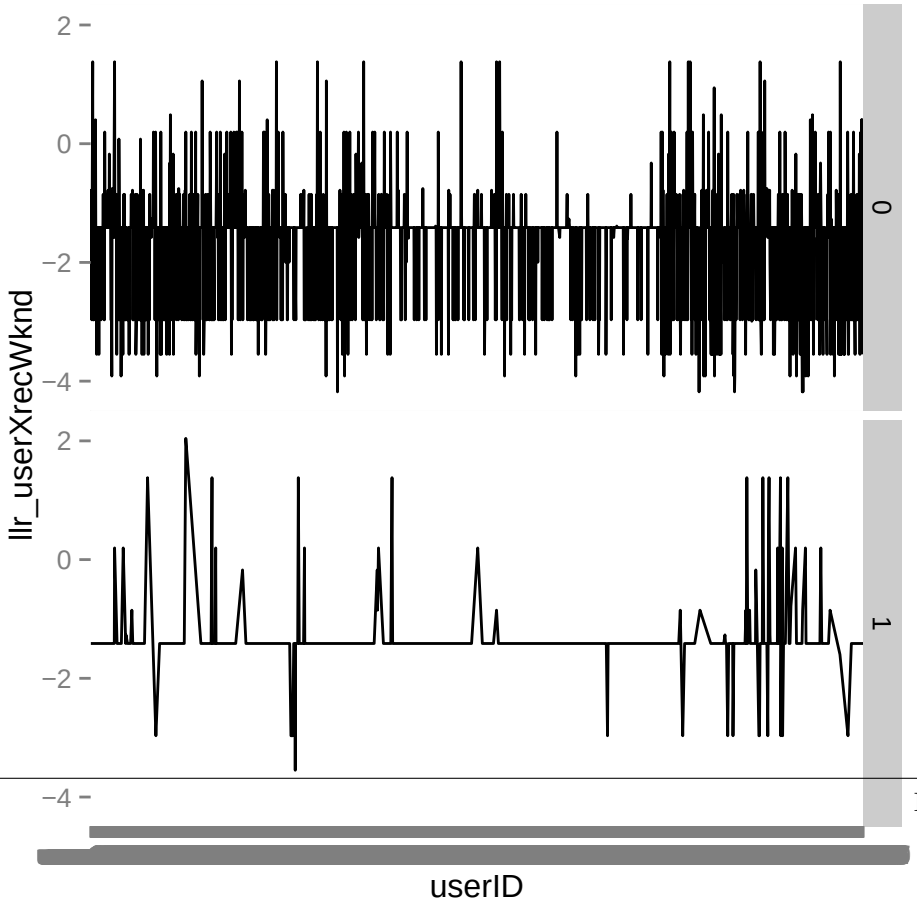
couponsReceivedWeekend (as `llr_userXrecWknd`)

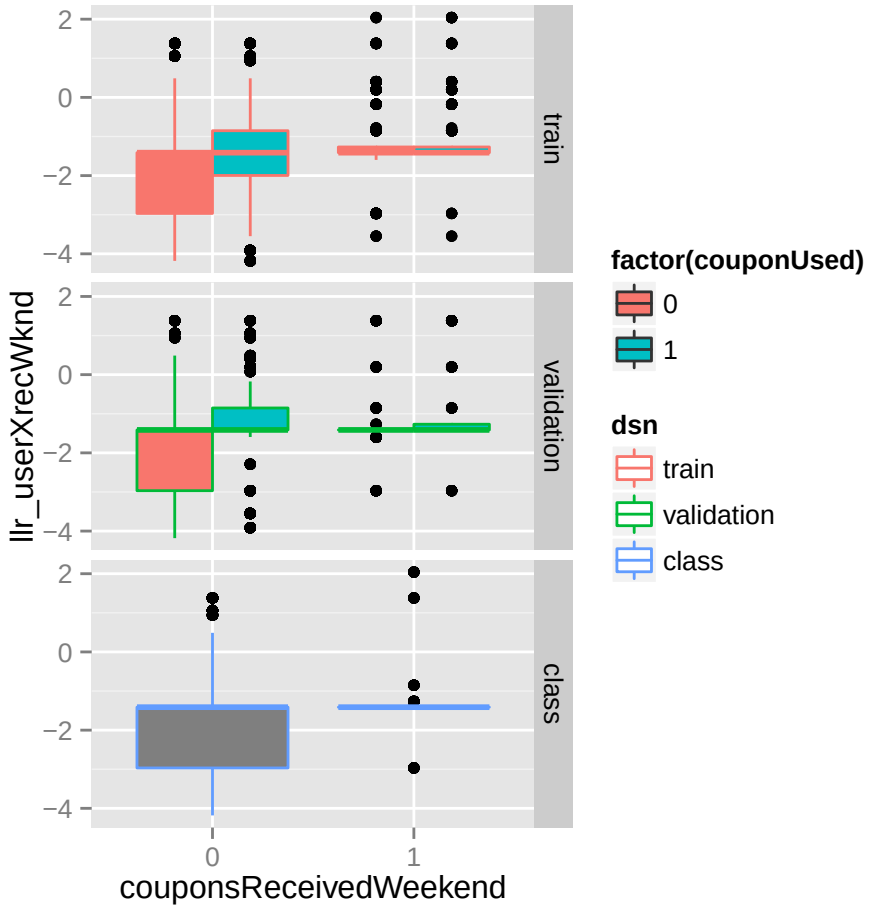
```
# couponsReceivedWeekend
llr = compute_ll_2w(as.character(H$userID), as.character(H$couponsReceivedWeekend),
    H$couponUsed, as.character(TVC$userID), as.character(TVC$couponsReceivedWeekend))
llr_userXrecWknd = data.frame(userID = TVC$userID, couponsReceivedWeekend = TVC$couponsReceivedWeekend,
    llr_userXrecWknd = llr) %>% arrange(userID)

ggplot(data = llr_userXrecWknd, aes(x = userID, y = couponsReceivedWeekend,
    size = llr_userXrecWknd), alpha = 0.1) + geom_point()
qplot(userID, llr_userXrecWknd, data = llr_userXrecWknd, geom = "line", group = couponsReceivedWeekend,
    facets = couponsReceivedWeekend ~ .)

TVC %>% left_join(llr_userXrecWknd, by = c("userID", "couponsReceivedWeekend")) %>%
    select(orderID, userID, dsn, couponsReceivedWeekend, llr_userXrecWknd, couponUsed) %>%
    ggplot(aes(x = couponsReceivedWeekend, y = llr_userXrecWknd, fill = factor(couponUsed),
        color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

llr_userXrecWknd = TVC %>% left_join(llr_userXrecWknd, by = c("userID", "couponsReceivedWeekend")) %>%
    select(orderID, dsn, llr_userXrecWknd)
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector
```

```r
trn = llr_userXrecWknd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_userXrecWknd %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_userXrecWknd %>% filter(dsn == "class") %>% select(-dsn)

llr_userXrecWknd = list(T = trn, V = val, C = cls)

saveRDS(llr_userXrecWknd, "../features/feature_files/llr_userXrecWknd.rds")
```


couponsReceivedWeekend
1
0
llr_userXrecWknd
−4
−2
0
2
userID


llr_userXrecWknd
2
0
−2
−4
0
1
userID

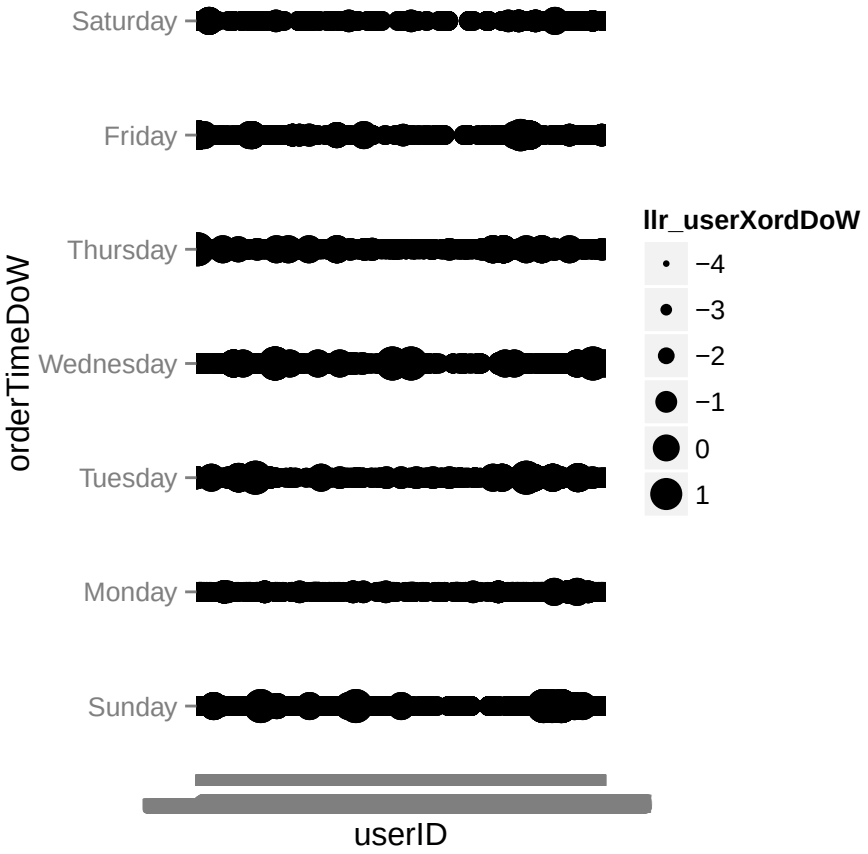


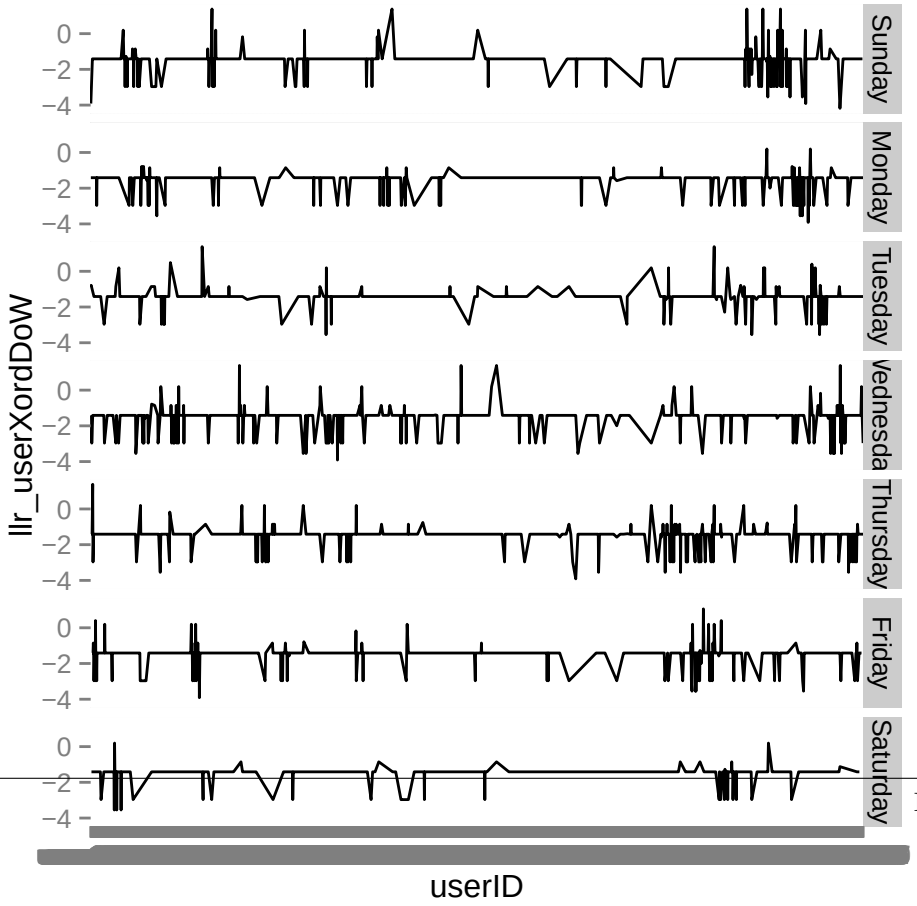
orderTimeDoW (as `llr_userXordDoW`)

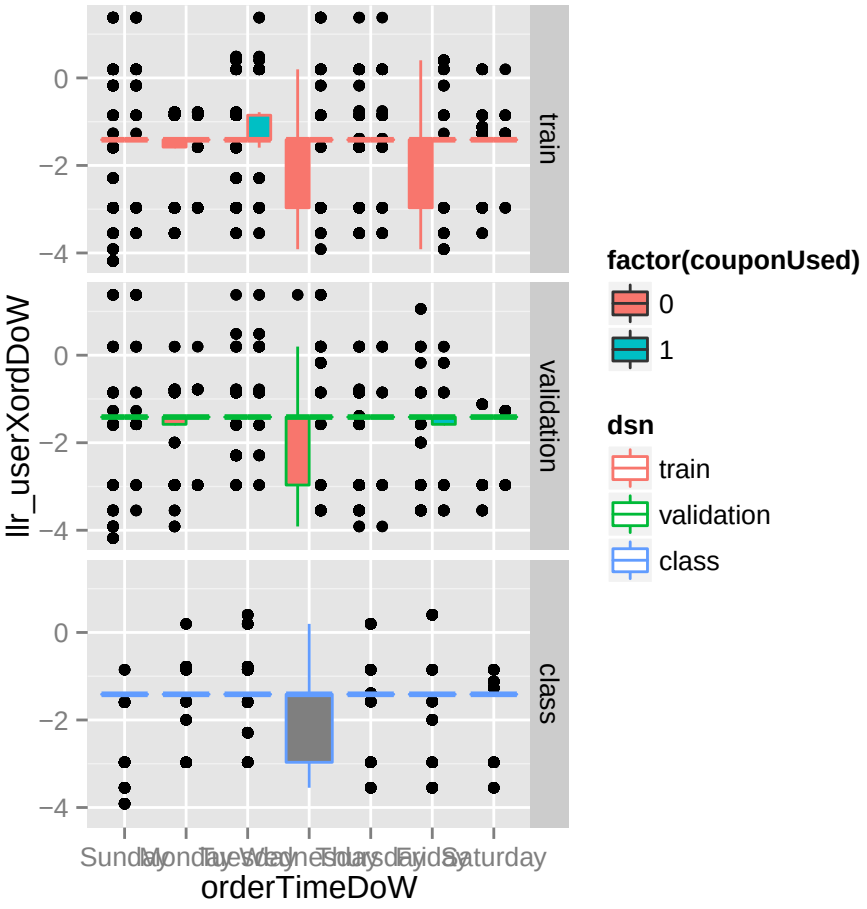
```
# orderTimeDoW
llr = compute_ll_2w(as.character(H$userID), as.character(H$orderTimeDoW), H$couponUsed,
    as.character(TVC$userID), as.character(TVC$orderTimeDoW))
llr_userXordDoW = data.frame(userID = TVC$userID, orderTimeDoW = TVC$orderTimeDoW,
    llr_userXordDoW = llr) %>% arrange(userID)

ggplot(data = llr_userXordDoW, aes(x = userID, y = orderTimeDoW, size = llr_userXordDoW),
    alpha = 0.1) + geom_point()
qplot(userID, llr_userXordDoW, data = llr_userXordDoW, geom = "line", group = orderTimeDoW,
    facets = orderTimeDoW ~ .)

TVC %>% left_join(llr_userXordDoW, by = c("userID", "orderTimeDoW")) %>% select(orderID,
    userID, dsn, orderTimeDoW, llr_userXordDoW, couponUsed) %>% ggplot(aes(x = orderTimeDoW,
    y = llr_userXordDoW, fill = factor(couponUsed), color = dsn)) + geom_boxplot() +
    facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

llr_userXordDoW = TVC %>% left_join(llr_userXordDoW, by = c("userID", "orderTimeDoW")) %>%
    select(orderID, dsn, llr_userXordDoW)
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector
```

```r
trn = llr_userXordDoW %>% filter(dsn == "train") %>% select(-dsn)
val = llr_userXordDoW %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_userXordDoW %>% filter(dsn == "class") %>% select(-dsn)

llr_userXordDoW = list(T = trn, V = val, C = cls)

saveRDS(llr_userXordDoW, "../features/feature_files/llr_userXordDoW.rds")
```


Saturday
Friday
Thursday
Wednesday
Tuesday
Monday
Sunday
orderTimeDoW
llr_userXordDoW
−4
−3
−2
−1
0
1
userID

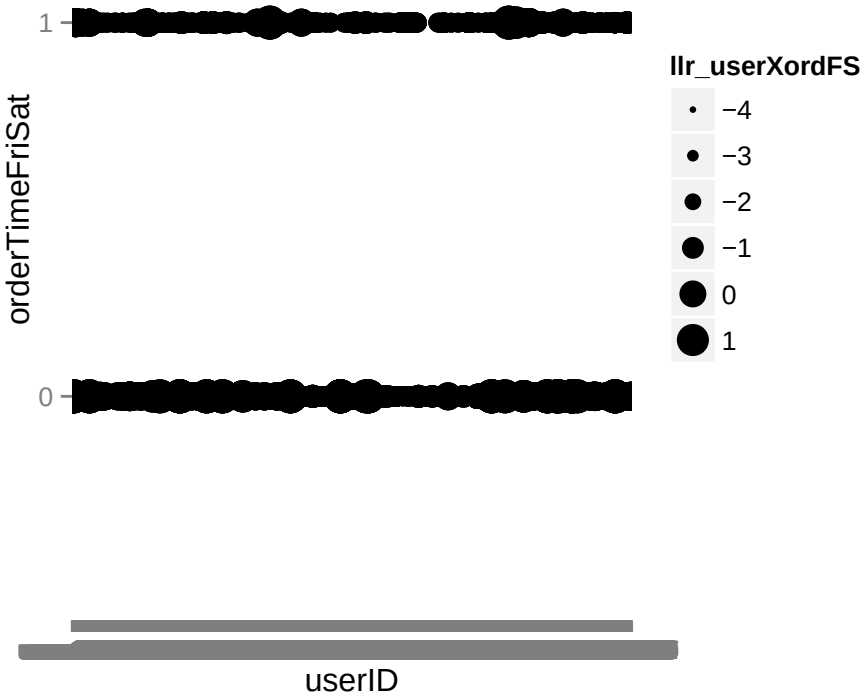

0
−2
−4
Sunday
Monday
Tuesday
Wednesda
Thursday
Friday
Saturday
llr_userXordDoW
userID

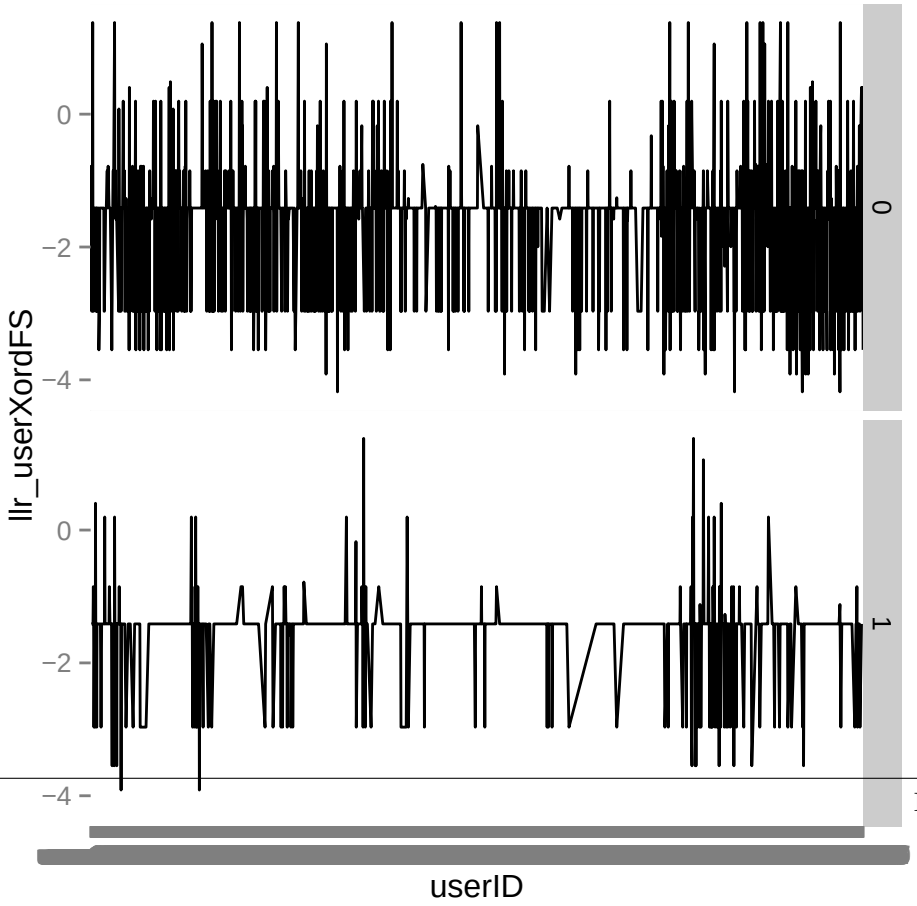


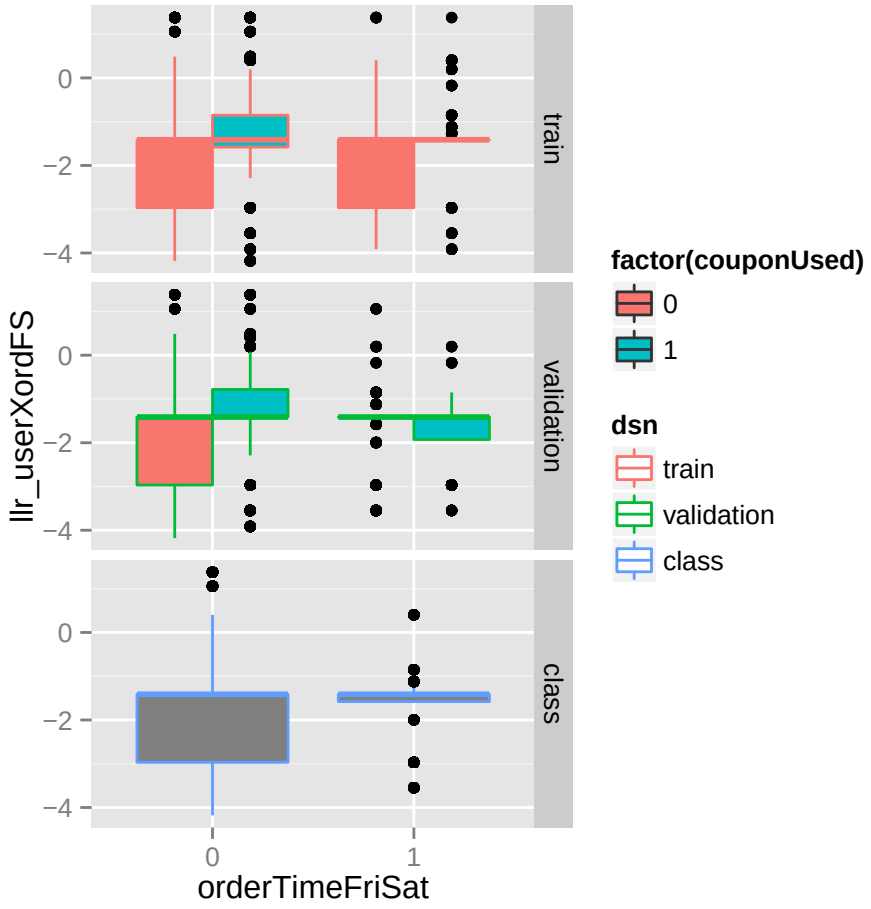
orderTimeFriSat (as `llr_userXordFS`)

```
# orderTimeFriSat
llr = compute_ll_2w(as.character(H$userID), as.character(H$orderTimeFriSat),
    H$couponUsed, as.character(TVC$userID), as.character(TVC$orderTimeFriSat))
llr_userXordFS = data.frame(userID = TVC$userID, orderTimeFriSat = TVC$orderTimeFriSat,
    llr_userXordFS = llr) %>% arrange(userID)

ggplot(data = llr_userXordFS, aes(x = userID, y = orderTimeFriSat, size = llr_userXordFS),
    alpha = 0.1) + geom_point()
qplot(userID, llr_userXordFS, data = llr_userXordFS, geom = "line", group = orderTimeFriSat,
    facets = orderTimeFriSat ~ .)

TVC %>% left_join(llr_userXordFS, by = c("userID", "orderTimeFriSat")) %>% select(orderID,
    userID, dsn, orderTimeFriSat, llr_userXordFS, couponUsed) %>% ggplot(aes(x = orderTimeFriSat,
    y = llr_userXordFS, fill = factor(couponUsed), color = dsn)) + geom_boxplot() +
    facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

llr_userXordFS = TVC %>% left_join(llr_userXordFS, by = c("userID", "orderTimeFriSat")) %>%
    select(orderID, dsn, llr_userXordFS)
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

trn = llr_userXordFS %>% filter(dsn == "train") %>% select(-dsn)
val = llr_userXordFS %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_userXordFS %>% filter(dsn == "class") %>% select(-dsn)

llr_userXordFS = list(T = trn, V = val, C = cls)

saveRDS(llr_userXordFS, "../features/feature_files/llr_userXordFS.rds")
```


1
0
orderTimeFriSat
llr_userXordFS
−4
−3
−2
−1
0
1
userID

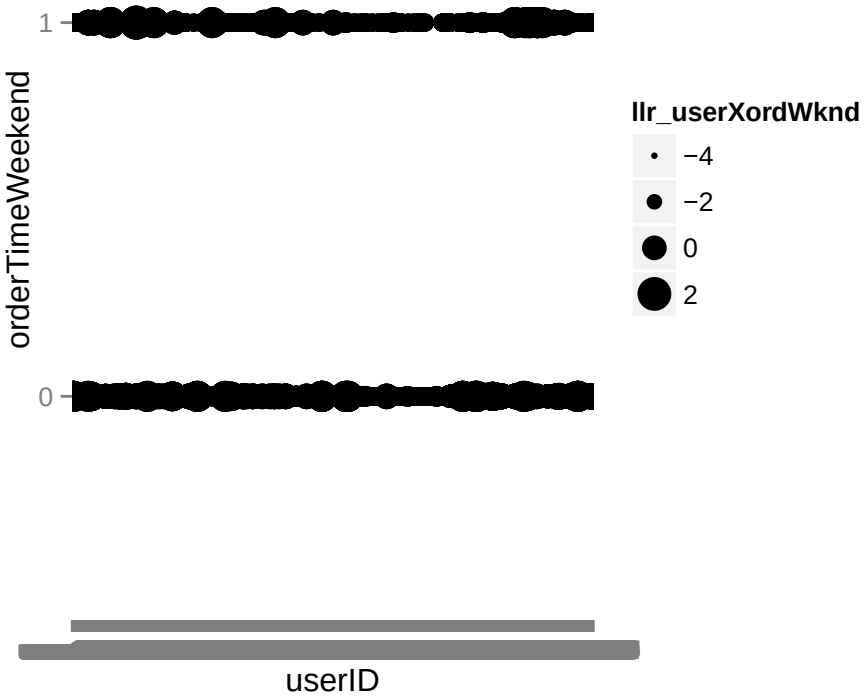

0
−2
−4
0
−2
−4
llr_userXordFS
0
1
userID

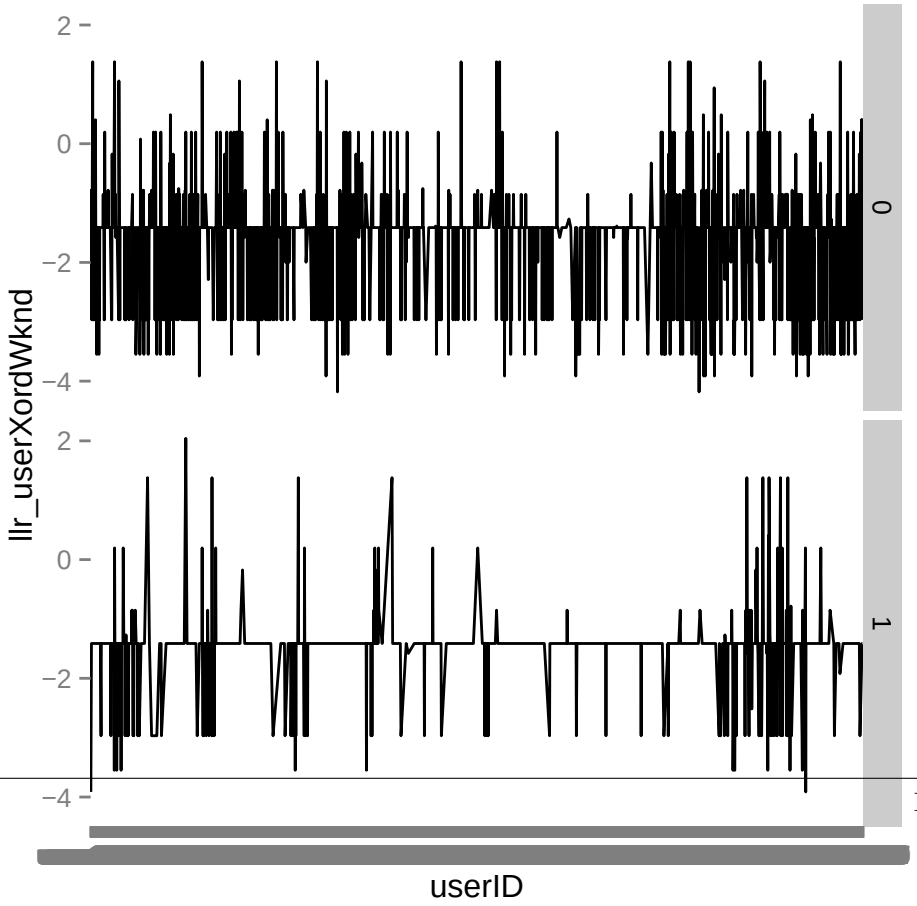


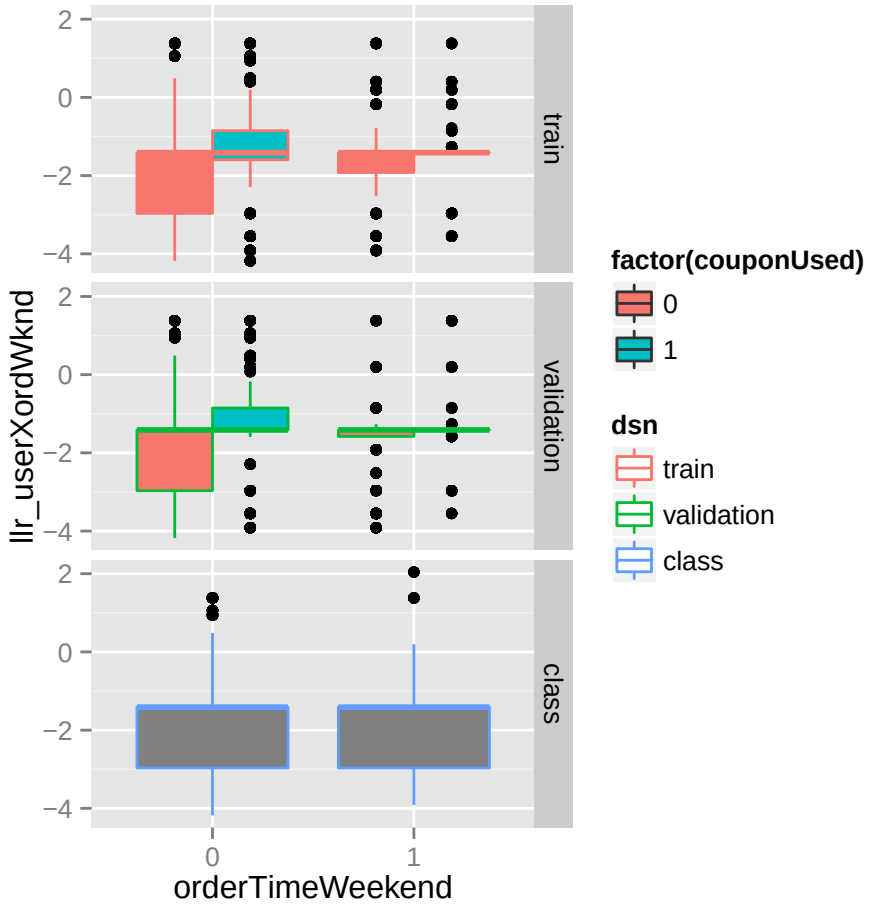
orderTimeWeekend (as `llr_userXordWknd`)

```
# orderTimeWeekend
llr = compute_ll_2w(as.character(H$userID), as.character(H$orderTimeWeekend),
    H$couponUsed, as.character(TVC$userID), as.character(TVC$orderTimeWeekend))
llr_userXordWknd = data.frame(userID = TVC$userID, orderTimeWeekend = TVC$orderTimeWeekend,
    llr_userXordWknd = llr) %>% arrange(userID)

ggplot(data = llr_userXordWknd, aes(x = userID, y = orderTimeWeekend, size = llr_userXordWknd),
    alpha = 0.1) + geom_point()
qplot(userID, llr_userXordWknd, data = llr_userXordWknd, geom = "line", group = orderTimeWeekend,
    facets = orderTimeWeekend ~ .)

TVC %>% left_join(llr_userXordWknd, by = c("userID", "orderTimeWeekend")) %>%
    select(orderID, userID, dsn, orderTimeWeekend, llr_userXordWknd, couponUsed) %>%
    ggplot(aes(x = orderTimeWeekend, y = llr_userXordWknd, fill = factor(couponUsed),
        color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

llr_userXordWknd = TVC %>% left_join(llr_userXordWknd, by = c("userID", "orderTimeWeekend")) %>%
    select(orderID, dsn, llr_userXordWknd)
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

trn = llr_userXordWknd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_userXordWknd %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_userXordWknd %>% filter(dsn == "class") %>% select(-dsn)

llr_userXordWknd = list(T = trn, V = val, C = cls)

saveRDS(llr_userXordWknd, "../features/feature_files/llr_userXordWknd.rds")
```


1
0
orderTimeWeekend
llr_userXordWknd
−4
−2
0
2
userID

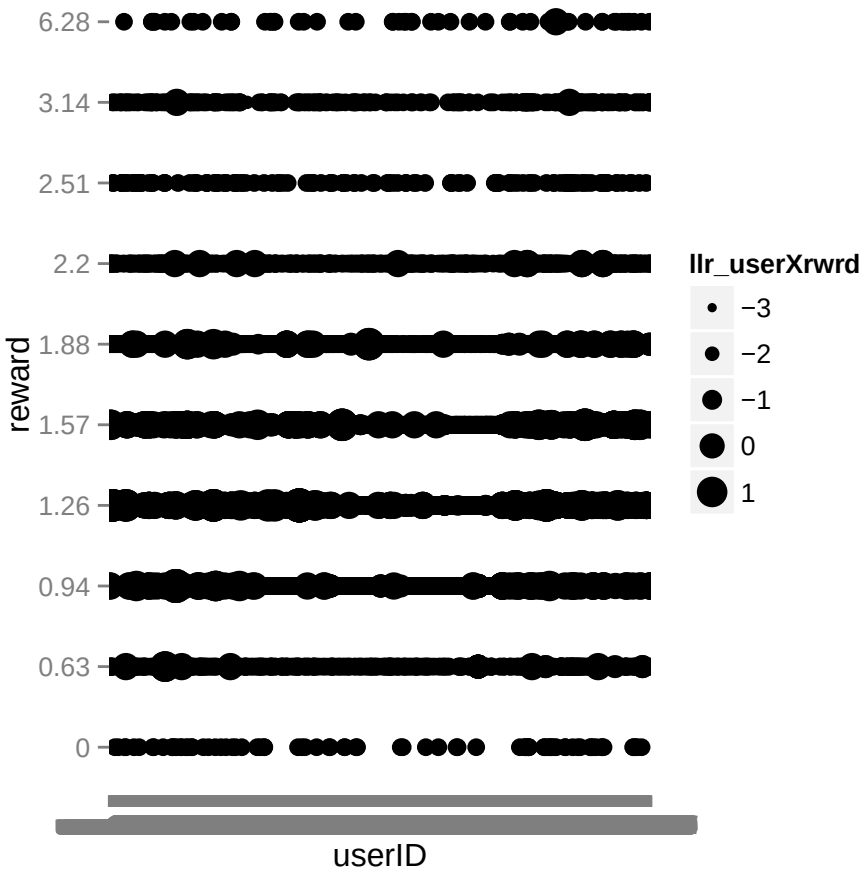

2
0
−2
−4
llr_userXordWknd
0
1
userID

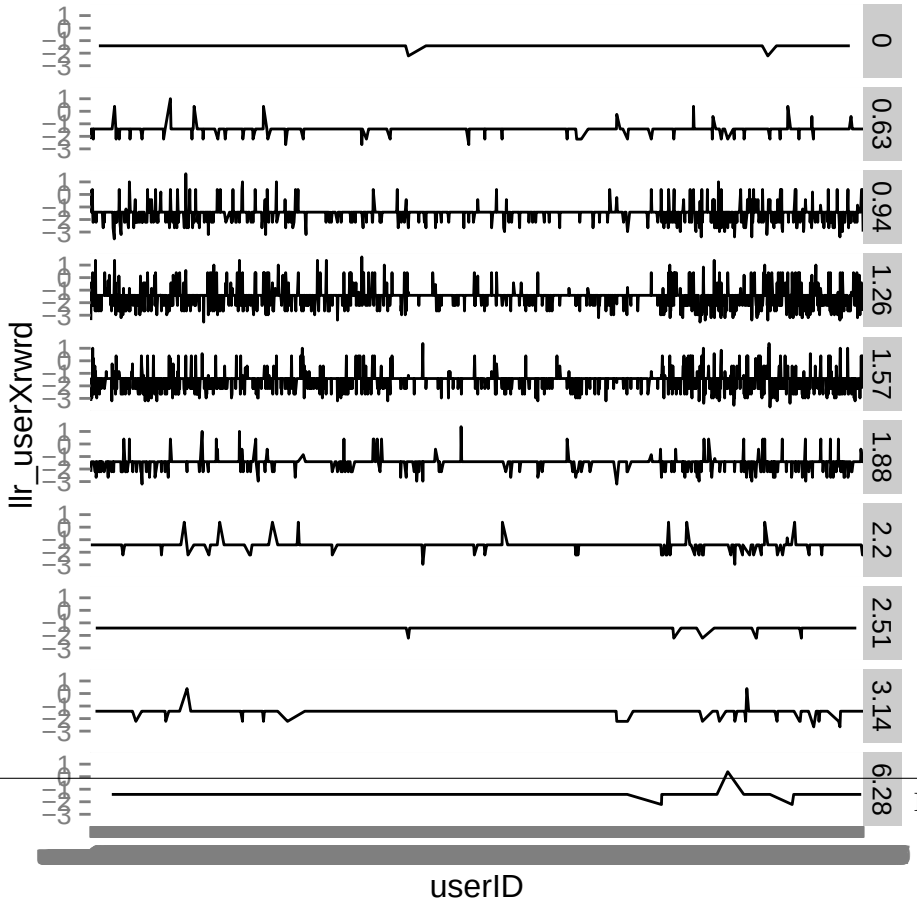


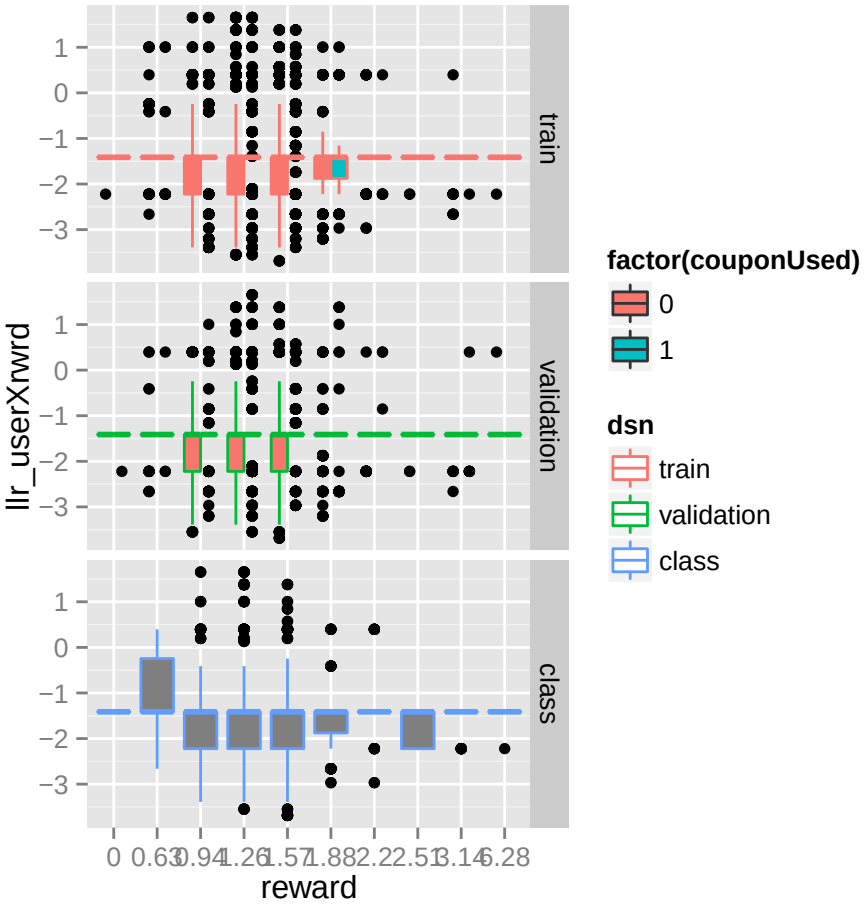
reward (as `llr_userXrwrd`)

```
# reward
llr = compute_ll_2w(as.character(H$userID), as.character(H$reward), H$couponUsed,
    as.character(TVC$userID), as.character(TVC$reward))
llr_userXrwrd = data.frame(userID = TVC$userID, reward = TVC$reward, llr_userXrwrd = llr) %>%
    arrange(userID)

ggplot(data = llr_userXrwrd, aes(x = userID, y = reward, size = llr_userXrwrd),
    alpha = 0.1) + geom_point()
qplot(userID, llr_userXrwrd, data = llr_userXrwrd, geom = "line", group = reward,
    facets = reward ~ .)

TVC %>% left_join(llr_userXrwrd, by = c("userID", "reward")) %>% select(orderID,
    userID, dsn, reward, llr_userXrwrd, couponUsed) %>% ggplot(aes(x = reward,
    y = llr_userXrwrd, fill = factor(couponUsed), color = dsn)) + geom_boxplot() +
    facet_grid(dsn ~ .)

## Warning in
## left_join_impl(x,
## y, by$x, by$y):
## joining factor and
## character vector,
## coercing into
```

```
## character vector

## Warning in
## left_join_impl(x,
## y, by$x, by$y):
## joining factor and
## character vector,
## coercing into
## character vector

llr_userXrwrd = TVC %>% left_join(llr_userXrwrd, by = c("userID", "reward")) %>%
    select(orderID, dsn, llr_userXrwrd)

## Warning in
## left_join_impl(x,
## y, by$x, by$y):
## joining factor and
## character vector,
## coercing into
## character vector

## Warning in
## left_join_impl(x,
## y, by$x, by$y):
## joining factor and
## character vector,
## coercing into
## character vector

trn = llr_userXrwrd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_userXrwrd %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_userXrwrd %>% filter(dsn == "class") %>% select(-dsn)

llr_userXrwrd = list(T = trn, V = val, C = cls)

saveRDS(llr_userXrwrd, "../features/feature_files/llr_userXrwrd.rds")
```


6.28
3.14
2.51
2.2
1.88
1.57
1.26
0.94
0.63
0
reward
llr_userXrwrd
−3
−2
−1
0
1
userID

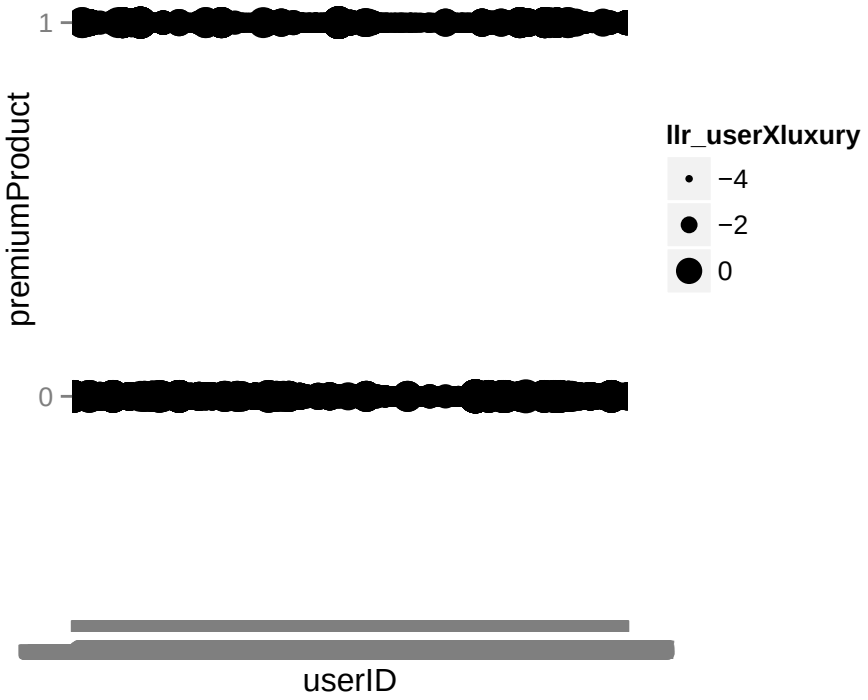

llr_userXrwrd
0
0.63
0.94
1.26
1.57
1.88
2.2
2.51
3.14
6.28
userID

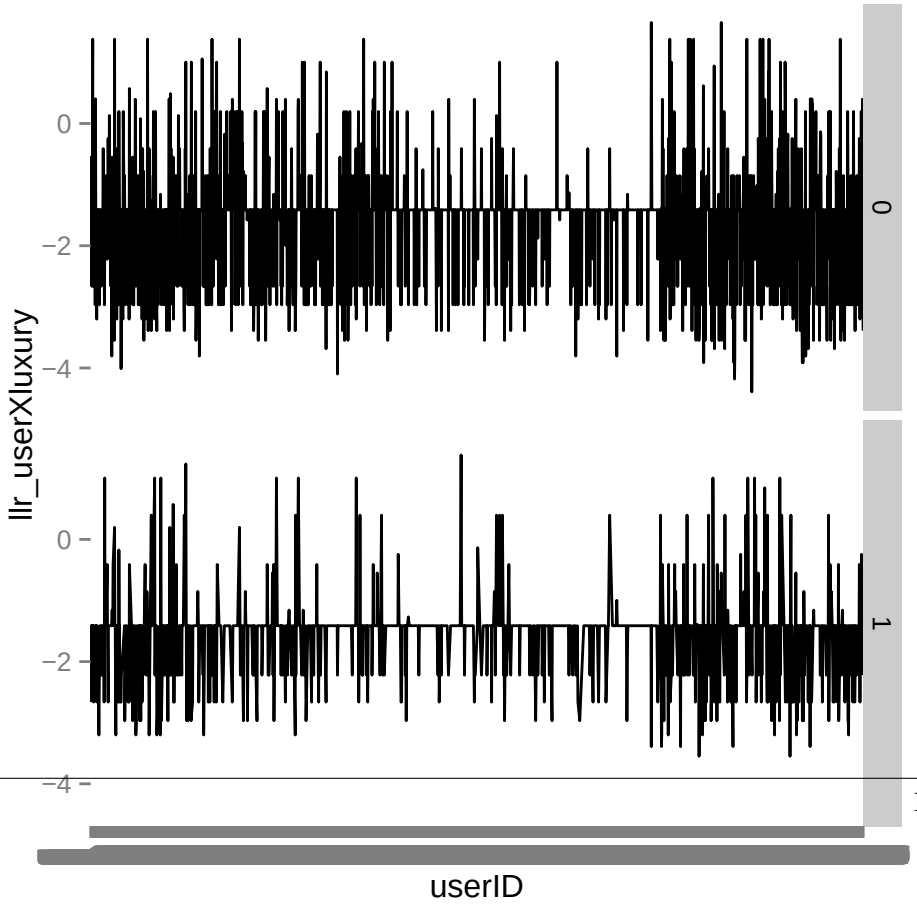


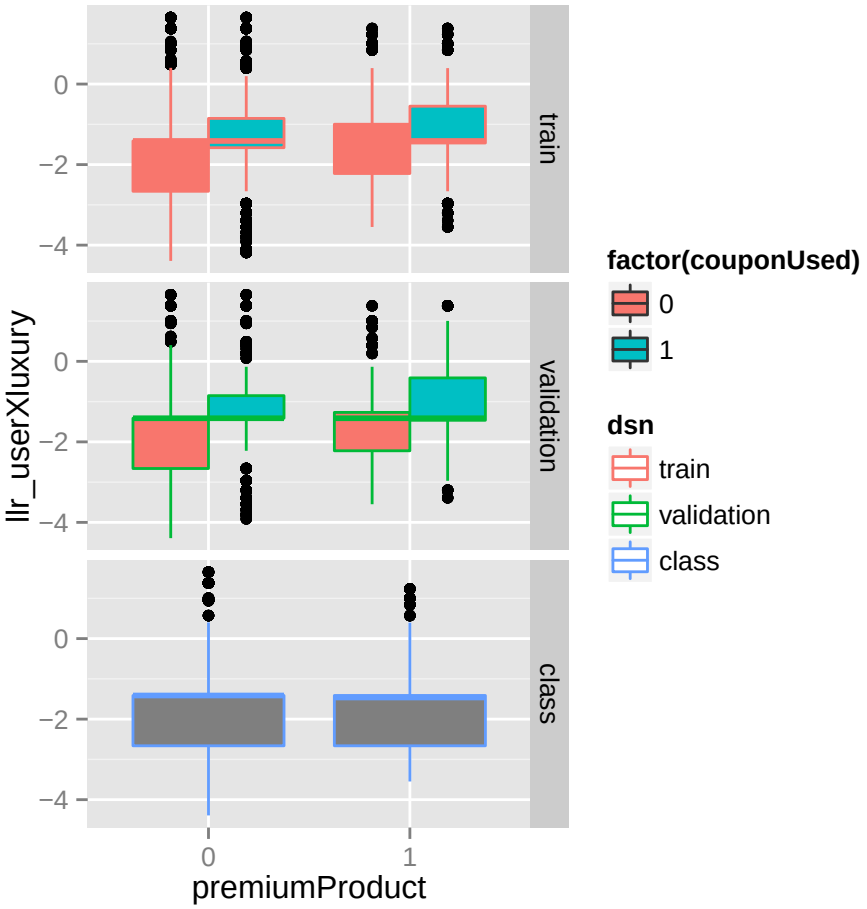
premiumProduct (as `llr_userXluxury`)

```
# premiumProduct
llr = compute_ll_2w(as.character(H$userID), as.character(H$premiumProduct),
    H$couponUsed, as.character(TVC$userID), as.character(TVC$premiumProduct))
llr_userXluxury = data.frame(userID = TVC$userID, premiumProduct = TVC$premiumProduct,
    llr_userXluxury = llr) %>% arrange(userID)

ggplot(data = llr_userXluxury, aes(x = userID, y = premiumProduct,
    size = llr_userXluxury), alpha = 0.1) + geom_point()
qplot(userID, llr_userXluxury, data = llr_userXluxury, geom = "line",
    group = premiumProduct, facets = premiumProduct ~ .)

TVC %>% left_join(llr_userXluxury, by = c("userID", "premiumProduct")) %>%
    select(orderID, userID, dsn, premiumProduct, llr_userXluxury,
        couponUsed) %>% ggplot(aes(x = premiumProduct, y = llr_userXluxury,
    fill = factor(couponUsed), color = dsn)) + geom_boxplot() +
    facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector
```

```
llr_userXluxury = TVC %>% left_join(llr_userXluxury, by = c("userID",
    "premiumProduct")) %>% select(orderID, dsn, llr_userXluxury)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character
## vector, coercing into character vector

trn = llr_userXluxury %>% filter(dsn == "train") %>% select(-dsn)
val = llr_userXluxury %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_userXluxury %>% filter(dsn == "class") %>% select(-dsn)

llr_userXluxury = list(T = trn, V = val, C = cls)

saveRDS(llr_userXluxury, "../features/feature_files/llr_userXluxury.rds")
```


1
0
premiumProduct
llr_userXluxury
−4
−2
0
userID


0
−2
−4
0
−2
−4
llr_userXluxury
0
1
userID

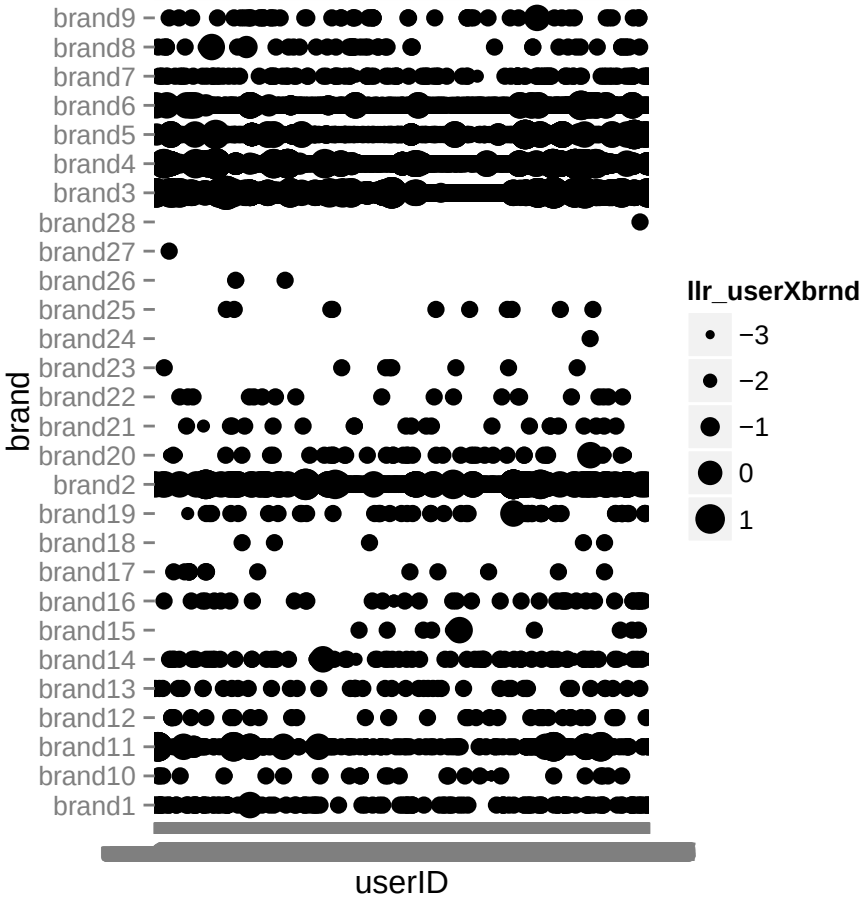


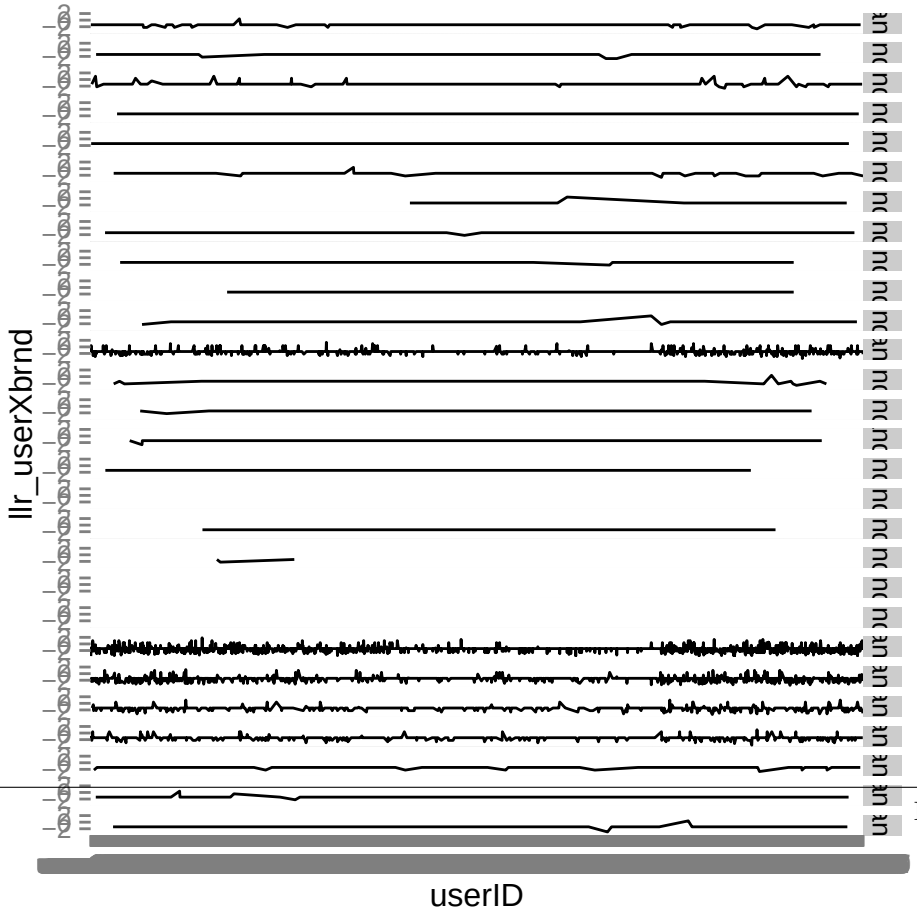
brand (as `llr_userXbrnd`)

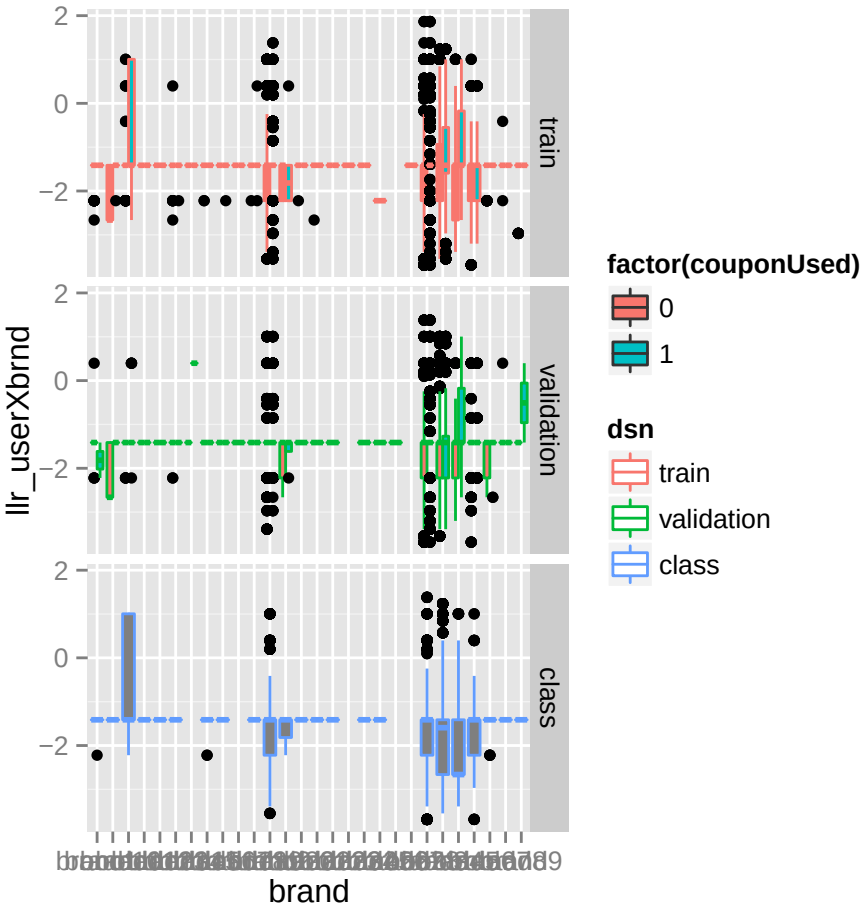
```
# brand
llr = compute_ll_2w(as.character(H$userID), as.character(H$brand), H$couponUsed,
    as.character(TVC$userID), as.character(TVC$brand))
llr_userXbrnd = data.frame(userID = TVC$userID, brand = TVC$brand, llr_userXbrnd = llr) %>%
    arrange(userID)

ggplot(data = llr_userXbrnd, aes(x = userID, y = brand, size = llr_userXbrnd), alpha = 0.1) +
    geom_point()
qplot(userID, llr_userXbrnd, data = llr_userXbrnd, geom = "line", group = brand,
    facets = brand ~ .)

TVC %>% left_join(llr_userXbrnd, by = c("userID", "brand")) %>% select(orderID, userID,
    dsn, brand, llr_userXbrnd, couponUsed) %>% ggplot(aes(x = brand, y = llr_userXbrnd,
    fill = factor(couponUsed), color = dsn)) + geom_boxplot() + facet_grid(dsn ~
    .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_userXbrnd = TVC %>% left_join(llr_userXbrnd, by = c("userID", "brand")) %>% select(orderID,
    dsn, llr_userXbrnd)
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_userXbrnd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_userXbrnd %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_userXbrnd %>% filter(dsn == "class") %>% select(-dsn)

llr_userXbrnd = list(T = trn, V = val, C = cls)

saveRDS(llr_userXbrnd, "../features/feature_files/llr_userXbrnd.rds")
```


brand9
brand8
brand7
brand6
brand5
brand4
brand3
brand28
brand27
brand26
brand25
brand24
brand23
brand22
brand21
brand20
brand2
brand19
brand18
brand17
brand16
brand15
brand14
brand13
brand12
brand11
brand10
brand1
brand
userID
llr_userXbrnd
−3
−2
−1
0
1

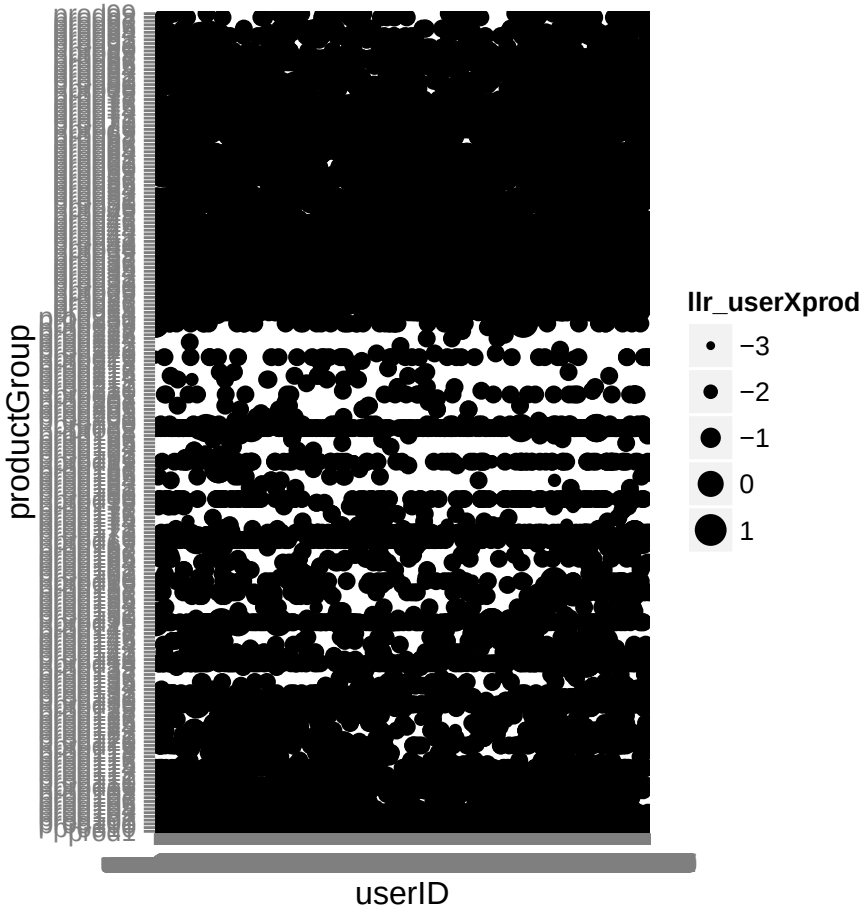

llr_userXbrnd
userID

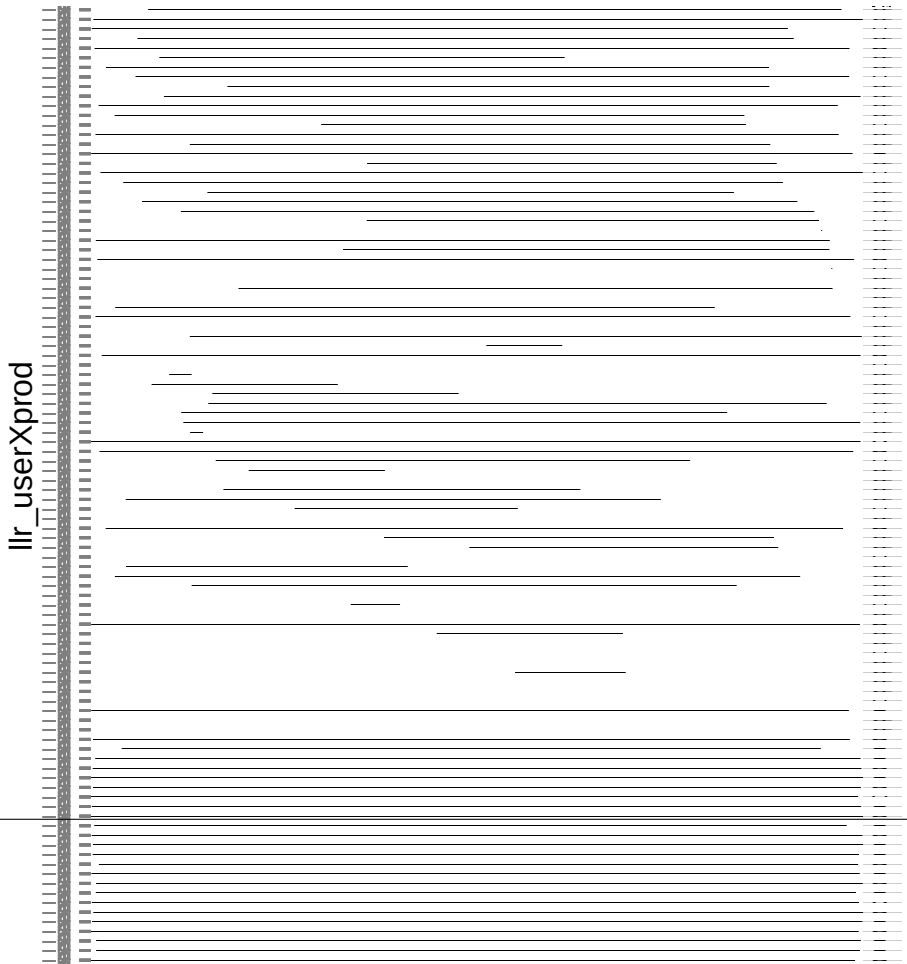


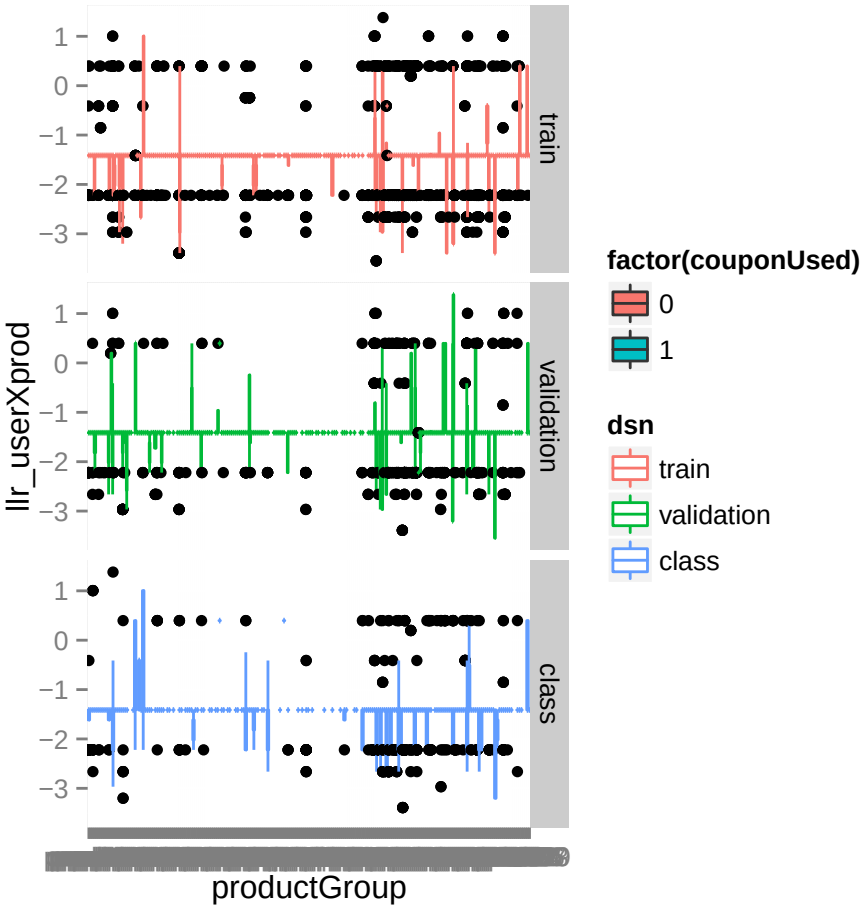
productGroup (as `llr_userXprod`)

```
# productGroup
llr = compute_ll_2w(as.character(H$userID), as.character(H$productGroup), H$couponUsed, as.character(TVC
llr_userXprod = data.frame(userID = TVC$userID, productGroup = TVC$productGroup, llr_userXprod = llr) %

ggplot(data = llr_userXprod, aes(x = userID, y = productGroup, size = llr_userXprod), alpha = 0.1) + geo
qplot(userID, llr_userXprod, data = llr_userXprod, geom = "line", group = productGroup, facets = produc

TVC %>% left_join(llr_userXprod, by = c("userID", "productGroup")) %>% select(orderID, userID, dsn, proc
    fill = factor(couponUsed), color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_userXprod = TVC %>% left_join(llr_userXprod, by = c("userID", "productGroup")) %>% select(orderID, c

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_userXprod %>% filter(dsn == "train") %>% select(-dsn)
val = llr_userXprod %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_userXprod %>% filter(dsn == "class") %>% select(-dsn)

llr_userXprod = list(T = trn, V = val, C = cls)

saveRDS(llr_userXprod, "../features/feature_files/llr_userXprod.rds")
```


productGroup
userID
llr_userXprod
−3
−2
−1
0
1

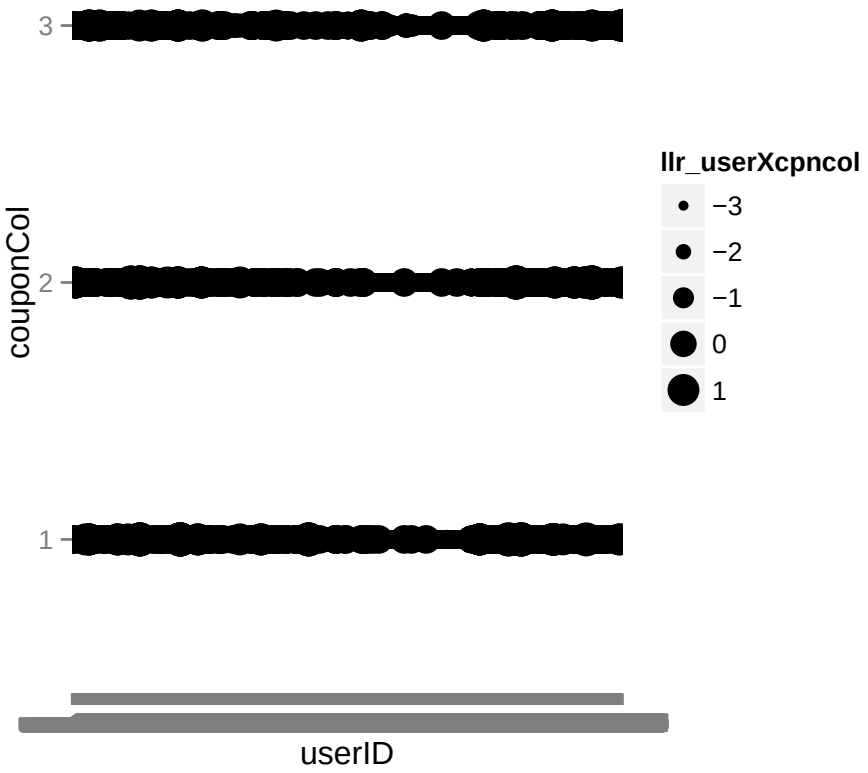

llr_userXprod

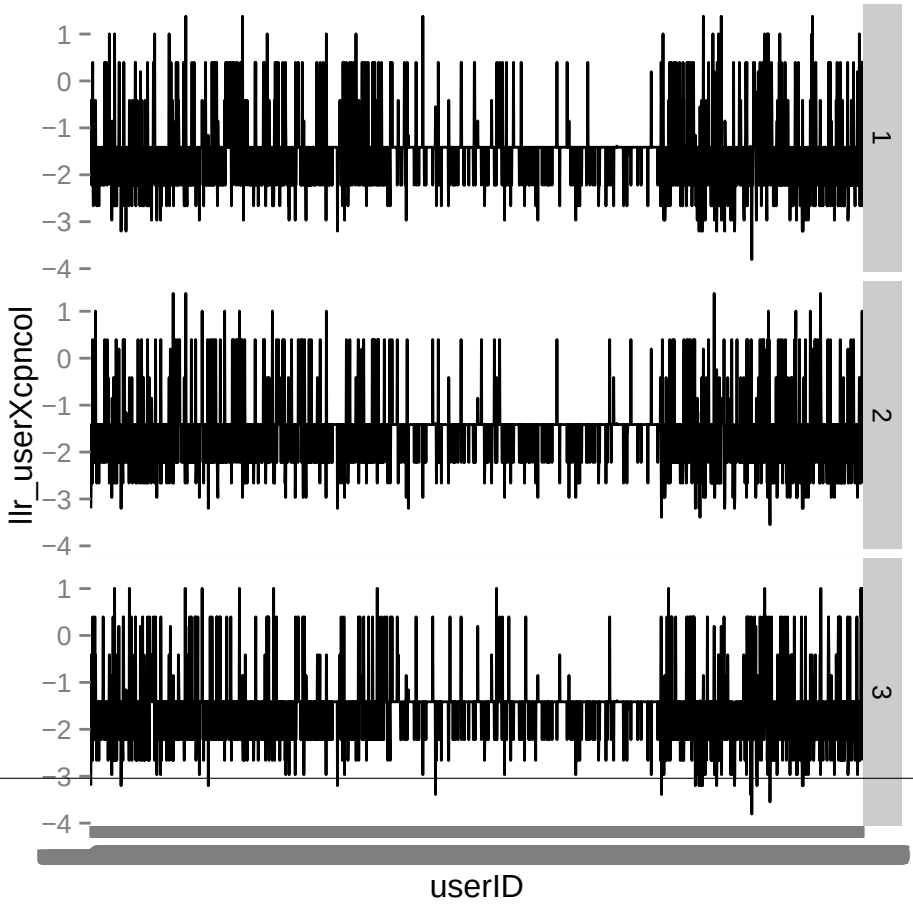


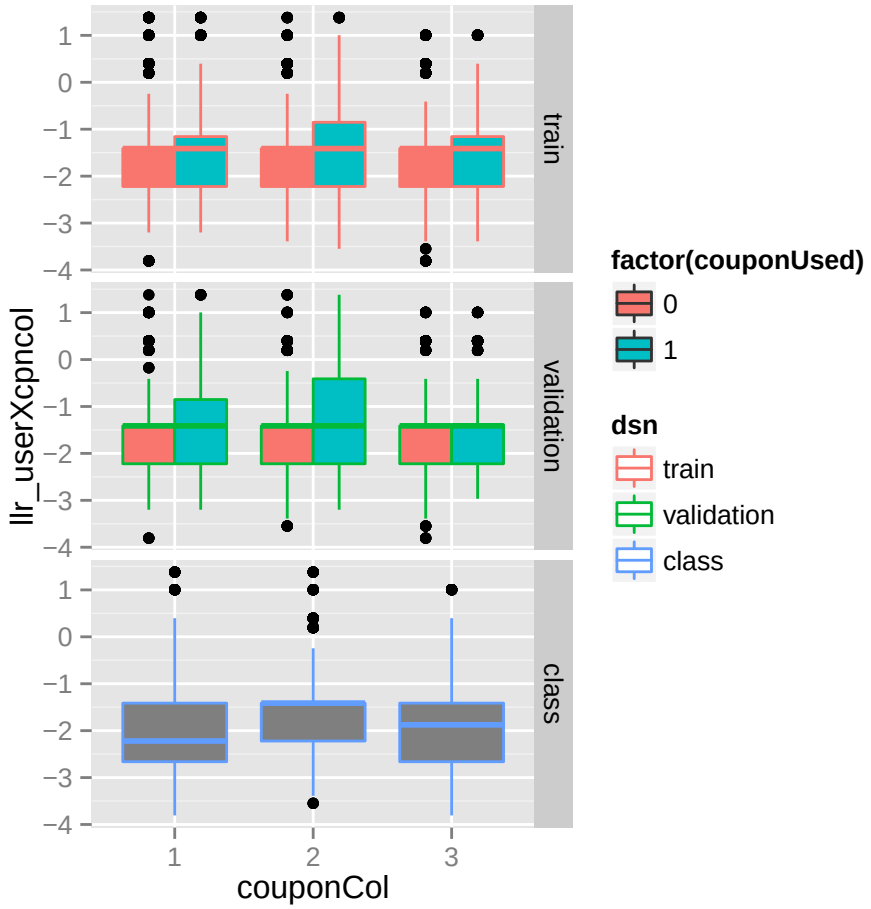
couponCol (as `llr_userXcpncol`)

```
# couponCol
llr = compute_ll_2w(as.character(H$userID), as.character(H$couponCol), H$couponUsed, as.character(TVC$us
llr_userXcpncol = data.frame(userID = TVC$userID, couponCol = TVC$couponCol, llr_userXcpncol = llr) %>%

ggplot(data = llr_userXcpncol, aes(x = userID, y = couponCol, size = llr_userXcpncol), alpha = 0.1) + ge
qplot(userID, llr_userXcpncol, data = llr_userXcpncol, geom = "line", group = couponCol, facets = coupon

TVC %>% left_join(llr_userXcpncol, by = c("userID", "couponCol")) %>% select(orderID, userID, dsn, coupo
    fill = factor(couponUsed), color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_userXcpncol = TVC %>% left_join(llr_userXcpncol, by = c("userID", "couponCol")) %>% select(orderID,

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_userXcpncol %>% filter(dsn == "train") %>% select(-dsn)
val = llr_userXcpncol %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_userXcpncol %>% filter(dsn == "class") %>% select(-dsn)

llr_userXcpncol = list(T = trn, V = val, C = cls)

saveRDS(llr_userXcpncol, "../features/feature_files/llr_userXcpncol.rds")
```


3
2
1
couponCol
llr_userXcpncol
−3
−2
−1
0
1
userID


1
0
−1
−2
−3
−4
llr_userXcpncol
1
2
3
userID

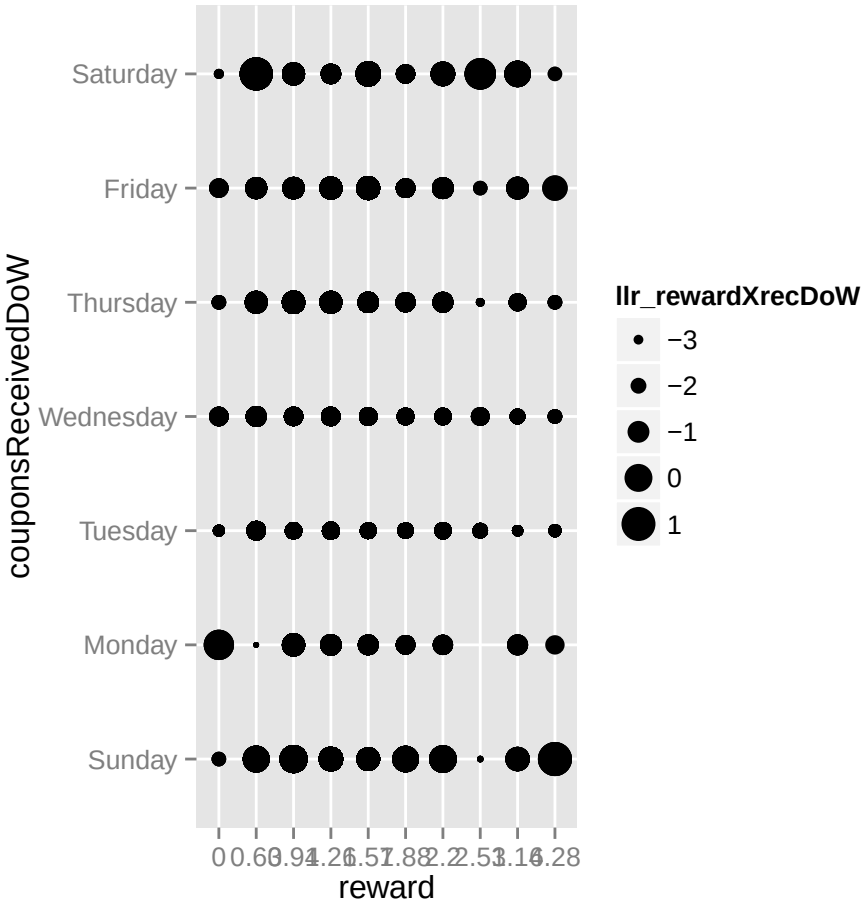


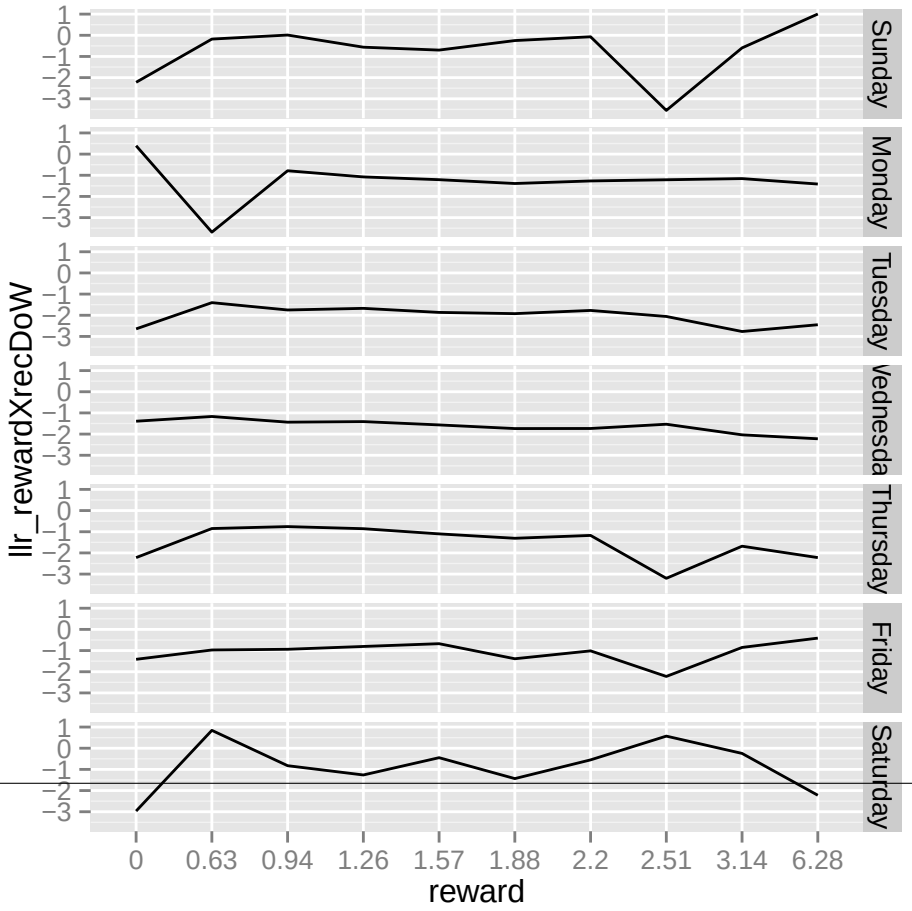
0.4.2 reward and

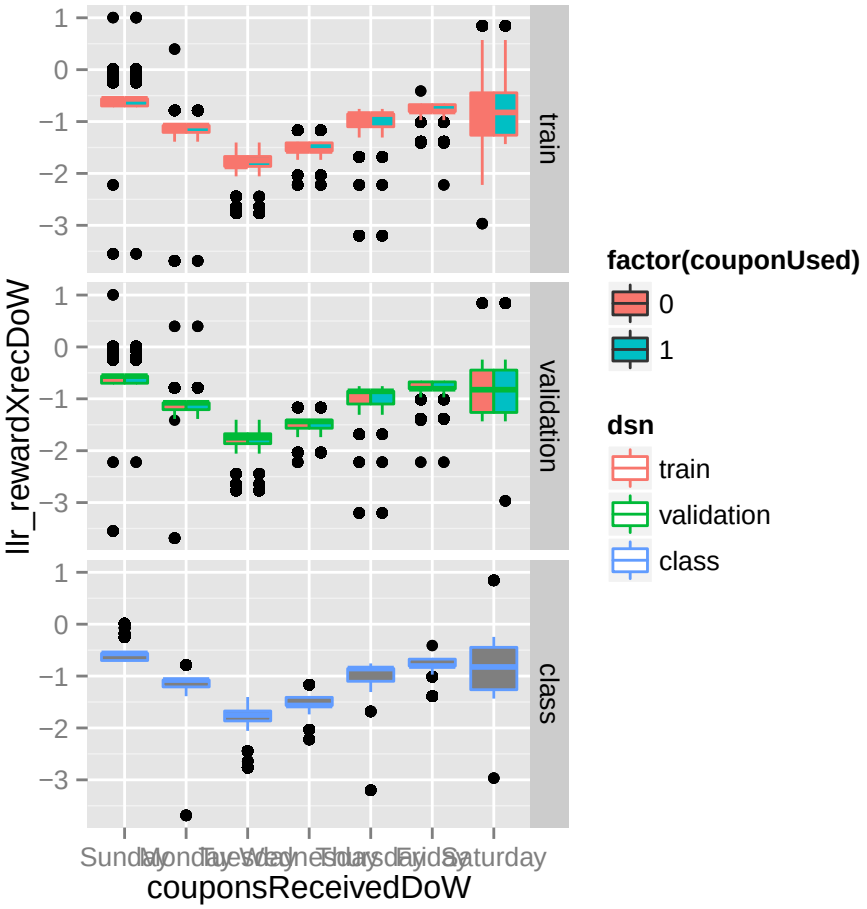
couponsReceivedDoW (as `llr_rewardXrecDoW`)

```
# couponsReceivedDoW
llr = compute_ll_2w(as.character(H$reward), as.character(H$couponsReceivedDoW), H$couponUsed, as.charac
llr_rewardXrecDoW = data.frame(reward = TVC$reward, couponsReceivedDoW = TVC$couponsReceivedDoW, llr_rew

ggplot(data = llr_rewardXrecDoW, aes(x = reward, y = couponsReceivedDoW, size = llr_rewardXrecDoW), alpl
qplot(reward, llr_rewardXrecDoW, data = llr_rewardXrecDoW, geom = "line", group = couponsReceivedDoW, fa

TVC %>% left_join(llr_rewardXrecDoW, by = c("reward", "couponsReceivedDoW")) %>% select(orderID, reward
    y = llr_rewardXrecDoW, fill = factor(couponUsed), color = dsn)) + geom_boxplot() + facet_grid(dsn ~

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_rewardXrecDoW = TVC %>% left_join(llr_rewardXrecDoW, by = c("reward", "couponsReceivedDoW")) %>% sel

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_rewardXrecDoW %>% filter(dsn == "train") %>% select(-dsn)
val = llr_rewardXrecDoW %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_rewardXrecDoW %>% filter(dsn == "class") %>% select(-dsn)
```

```
llr_rewardXrecDoW = list(T = trn, V = val, C = cls)

saveRDS(llr_rewardXrecDoW, "../features/feature_files/llr_rewardXrecDoW.rds")
```

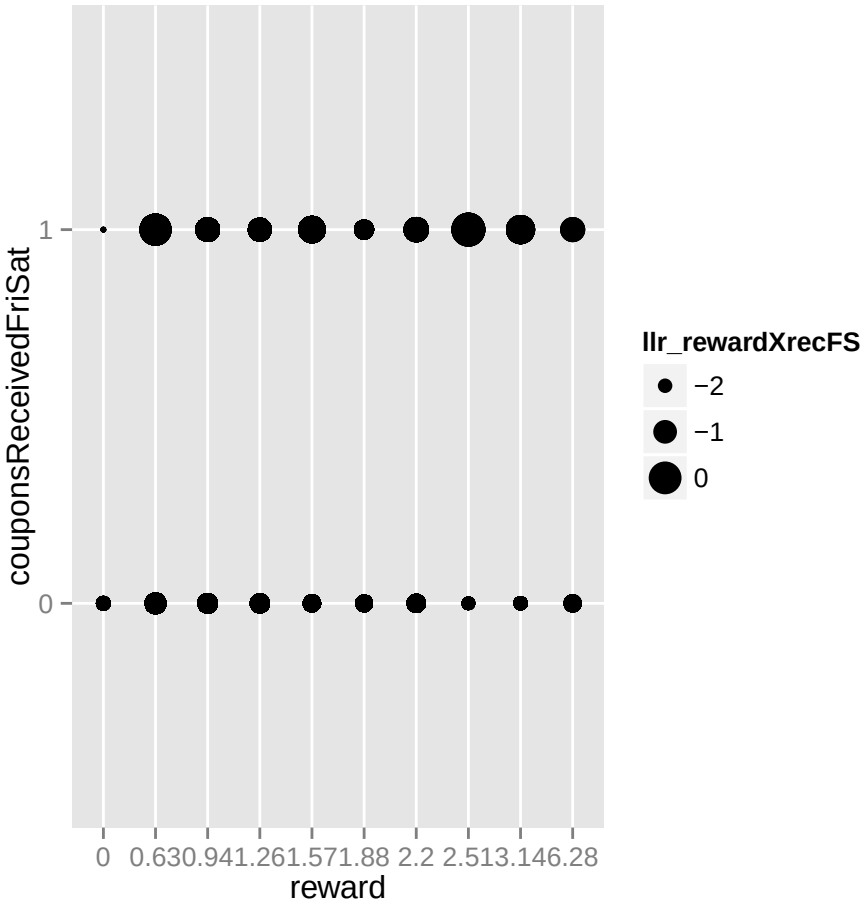

Saturday
Friday
Thursday
Wednesday
Tuesday
Monday
Sunday
couponsReceivedDoW
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward
llr_rewardXrecDoW
−3
−2
−1
0
1

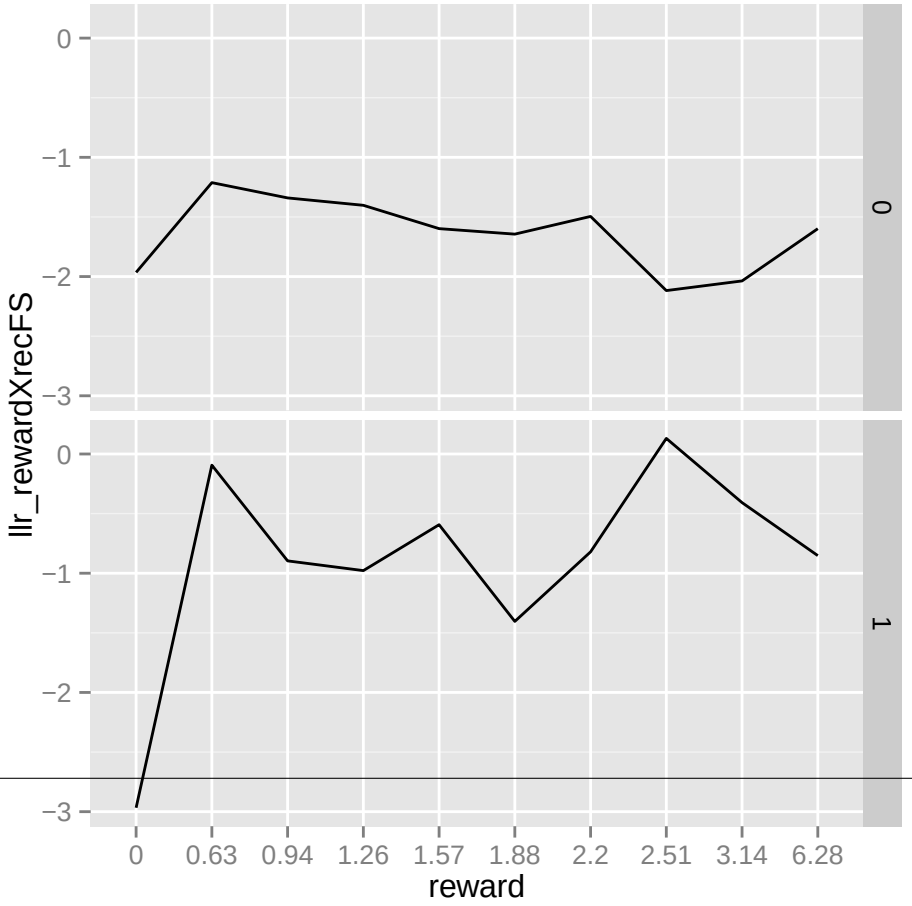

llr_rewardXrecDoW
1 0 −1 −2 −3
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward

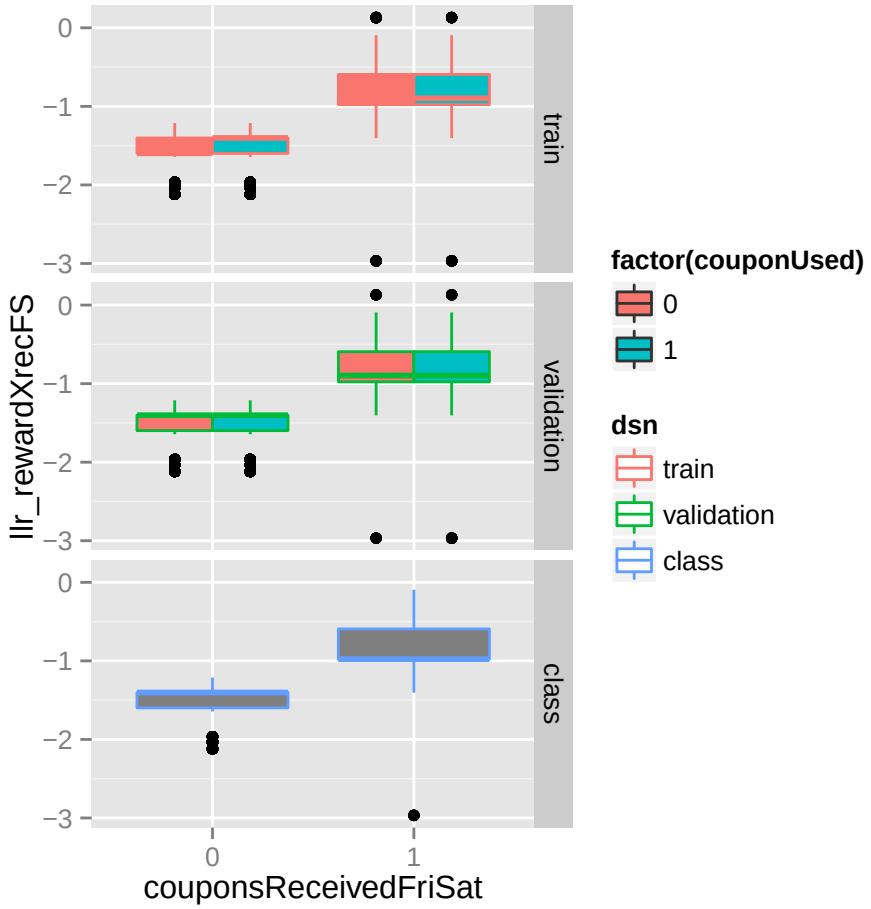


couponsReceivedFriSat (as `llr_rewardXrecFS`)

```
# couponsReceivedFriSat
llr = compute_ll_2w(as.character(H$reward), as.character(H$couponsReceivedFriSat), H$couponUsed, as.char
llr_rewardXrecFS = data.frame(reward = TVC$reward, couponsReceivedFriSat = TVC$couponsReceivedFriSat, ll

ggplot(data = llr_rewardXrecFS, aes(x = reward, y = couponsReceivedFriSat, size = llr_rewardXrecFS), alp
qplot(reward, llr_rewardXrecFS, data = llr_rewardXrecFS, geom = "line", group = couponsReceivedFriSat, 

TVC %>% left_join(llr_rewardXrecFS, by = c("reward", "couponsReceivedFriSat")) %>% select(orderID, rewar
    y = llr_rewardXrecFS, fill = factor(couponUsed), color = dsn)) + geom_boxplot() + facet_grid(dsn ~

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_rewardXrecFS = TVC %>% left_join(llr_rewardXrecFS, by = c("reward", "couponsReceivedFriSat")) %>% se

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_rewardXrecFS %>% filter(dsn == "train") %>% select(-dsn)
val = llr_rewardXrecFS %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_rewardXrecFS %>% filter(dsn == "class") %>% select(-dsn)

llr_rewardXrecFS = list(T = trn, V = val, C = cls)

saveRDS(llr_rewardXrecFS, "../features/feature_files/llr_rewardXrecFS.rds")
```


couponsReceivedFriSat
1
0
0 0.630.941.261.571.88 2.2 2.513.146.28
reward
llr_rewardXrecFS
−2
−1
0

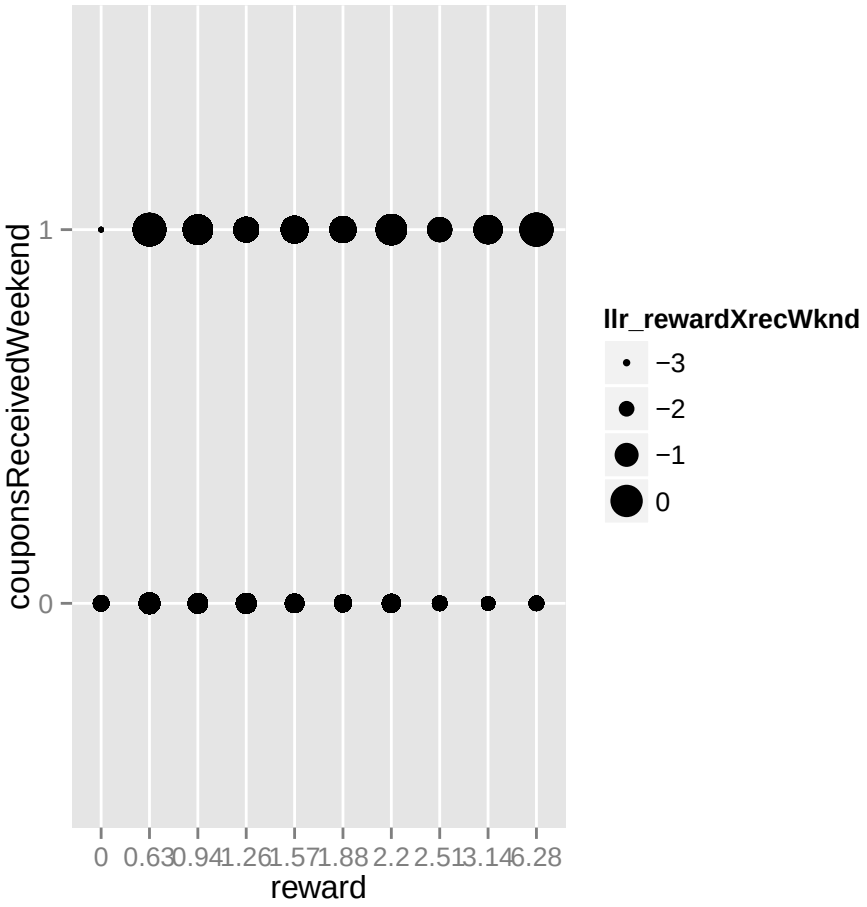

llr_rewardXrecFS
0
−1
−2
−3
0
1
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward

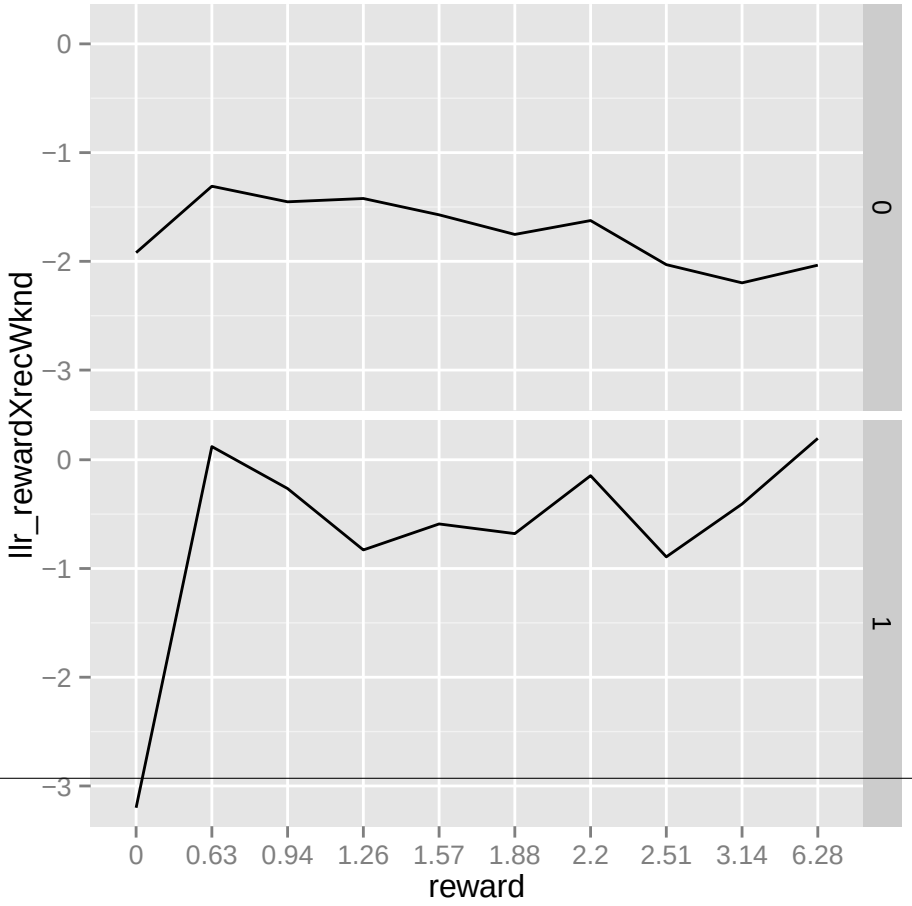


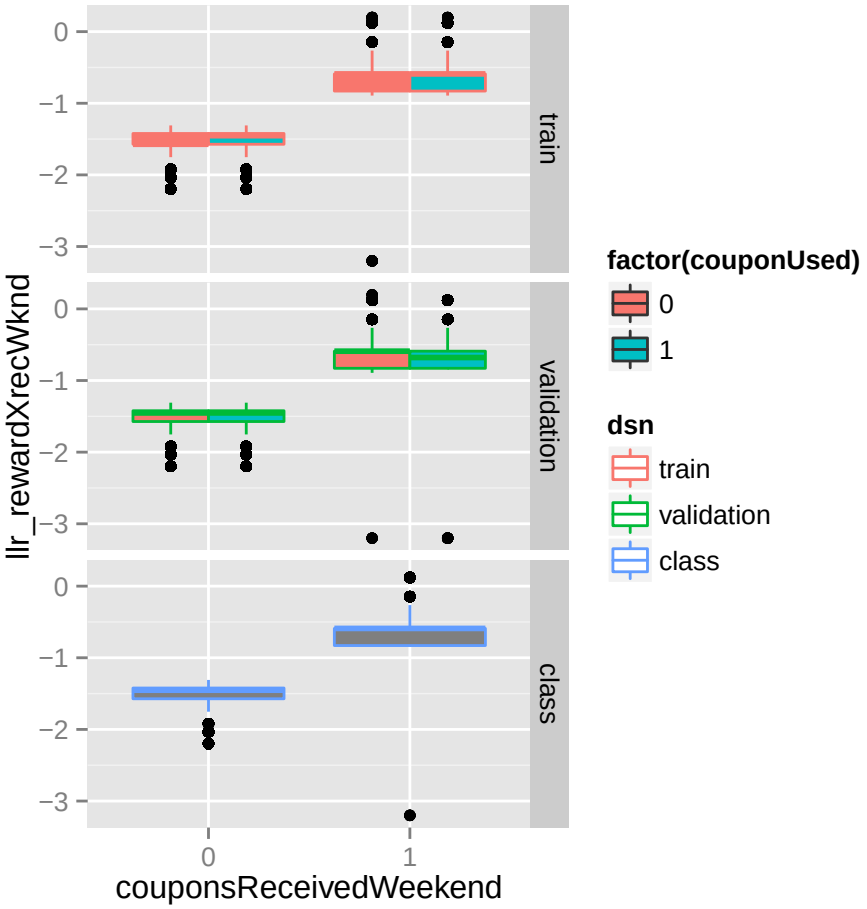
couponsReceivedWeekend (as `llr_rewardXrecWknd`)

```
# couponsReceivedWeekend
llr = compute_ll_2w(as.character(H$reward), as.character(H$couponsReceivedWeekend), H$couponUsed, as.cha
    as.character(TVC$couponsReceivedWeekend))
llr_rewardXrecWknd = data.frame(reward = TVC$reward, couponsReceivedWeekend = TVC$couponsReceivedWeekend
    arrange(reward)

ggplot(data = llr_rewardXrecWknd, aes(x = reward, y = couponsReceivedWeekend, size = llr_rewardXrecWknd
    geom_point()
qplot(reward, llr_rewardXrecWknd, data = llr_rewardXrecWknd, geom = "line", group = couponsReceivedWeek
    .)

TVC %>% left_join(llr_rewardXrecWknd, by = c("reward", "couponsReceivedWeekend")) %>% select(orderID, re
    llr_rewardXrecWknd, couponUsed) %>% ggplot(aes(x = couponsReceivedWeekend, y = llr_rewardXrecWknd, 
    color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_rewardXrecWknd = TVC %>% left_join(llr_rewardXrecWknd, by = c("reward", "couponsReceivedWeekend")) 
    dsn, llr_rewardXrecWknd)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_rewardXrecWknd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_rewardXrecWknd %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_rewardXrecWknd %>% filter(dsn == "class") %>% select(-dsn)

llr_rewardXrecWknd = list(T = trn, V = val, C = cls)

saveRDS(llr_rewardXrecWknd, "../features/feature_files/llr_rewardXrecWknd.rds")
```


couponsReceivedWeekend
1
0
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward
llr_rewardXrecWknd
−3
−2
−1
0

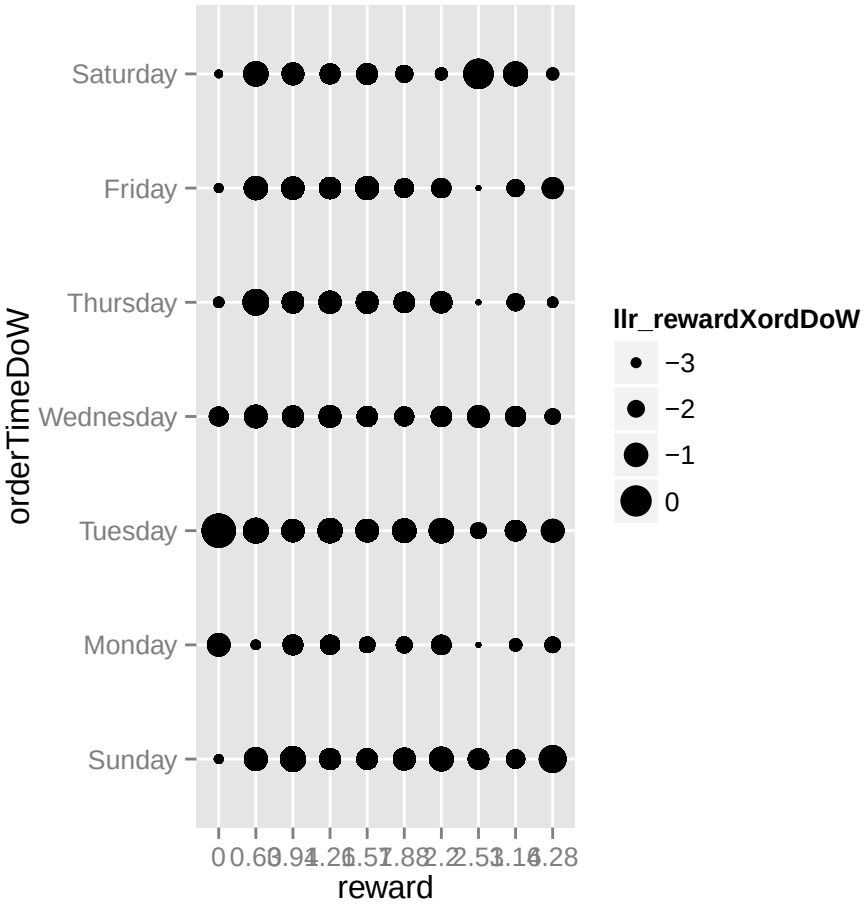

llr_rewardXrecWknd
0
−1
−2
−3
0
1
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward

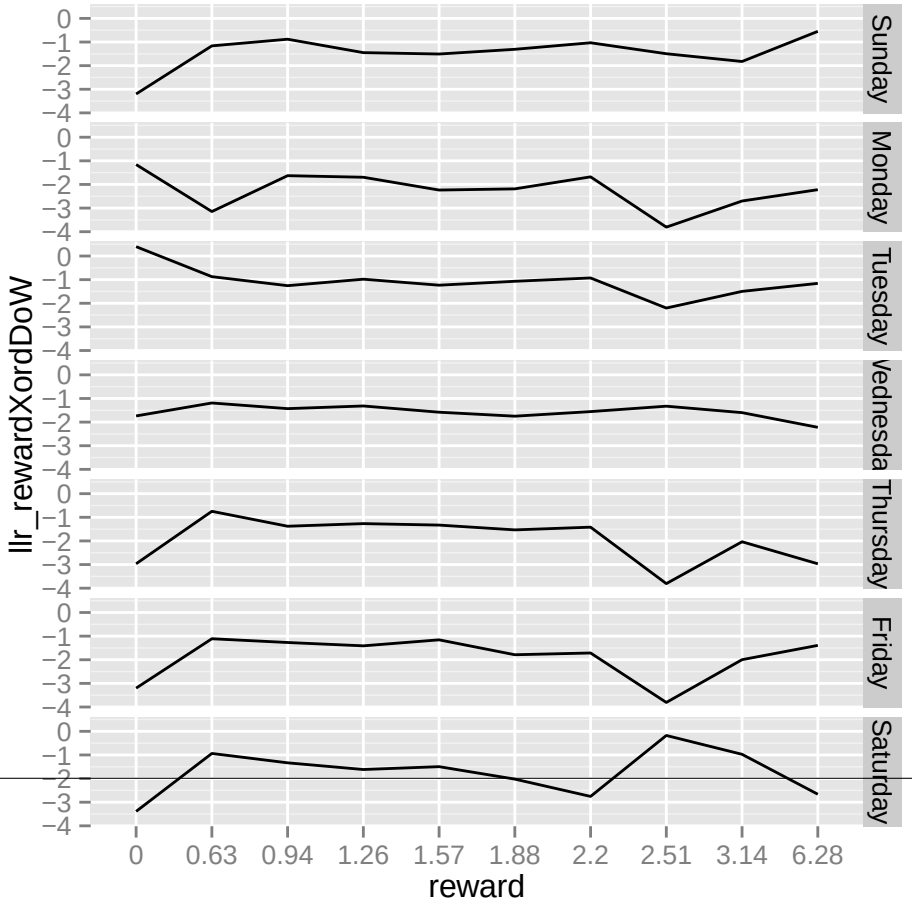


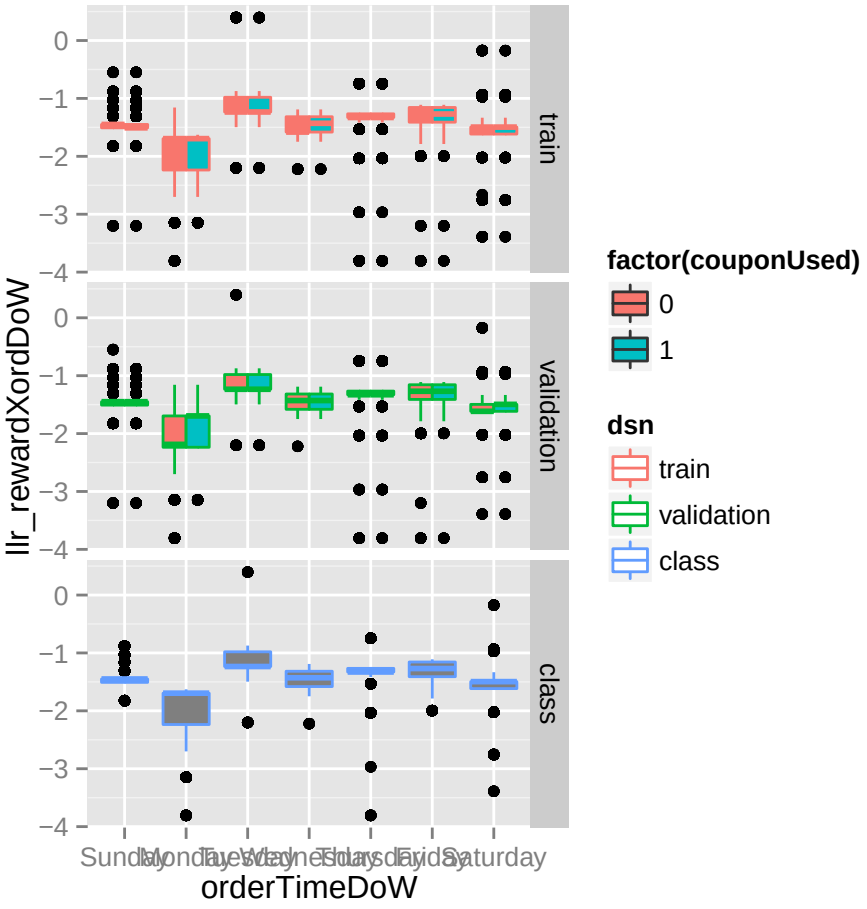
orderTimeDoW (as `llr_rewardXordDoW`)

```
# orderTimeDoW
llr = compute_ll_2w(as.character(H$reward), as.character(H$orderTimeDoW), H$couponUsed, as.character(TVC
llr_rewardXordDoW = data.frame(reward = TVC$reward, orderTimeDoW = TVC$orderTimeDoW, llr_rewardXordDoW =

ggplot(data = llr_rewardXordDoW, aes(x = reward, y = orderTimeDoW, size = llr_rewardXordDoW), alpha = 0
qplot(reward, llr_rewardXordDoW, data = llr_rewardXordDoW, geom = "line", group = orderTimeDoW, facets =
    .)

TVC %>% left_join(llr_rewardXordDoW, by = c("reward", "orderTimeDoW")) %>% select(orderID, reward, dsn,
    couponUsed) %>% ggplot(aes(x = orderTimeDoW, y = llr_rewardXordDoW, fill = factor(couponUsed), colo
    facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_rewardXordDoW = TVC %>% left_join(llr_rewardXordDoW, by = c("reward", "orderTimeDoW")) %>% select(o

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_rewardXordDoW %>% filter(dsn == "train") %>% select(-dsn)
val = llr_rewardXordDoW %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_rewardXordDoW %>% filter(dsn == "class") %>% select(-dsn)
```

```
llr_rewardXordDoW = list(T = trn, V = val, C = cls)

saveRDS(llr_rewardXordDoW, "../features/feature_files/llr_rewardXordDoW.rds")
```


Saturday
Friday
Thursday
Wednesday
Tuesday
Monday
Sunday
orderTimeDoW
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward
llr_rewardXordDoW
−3
−2
−1
0

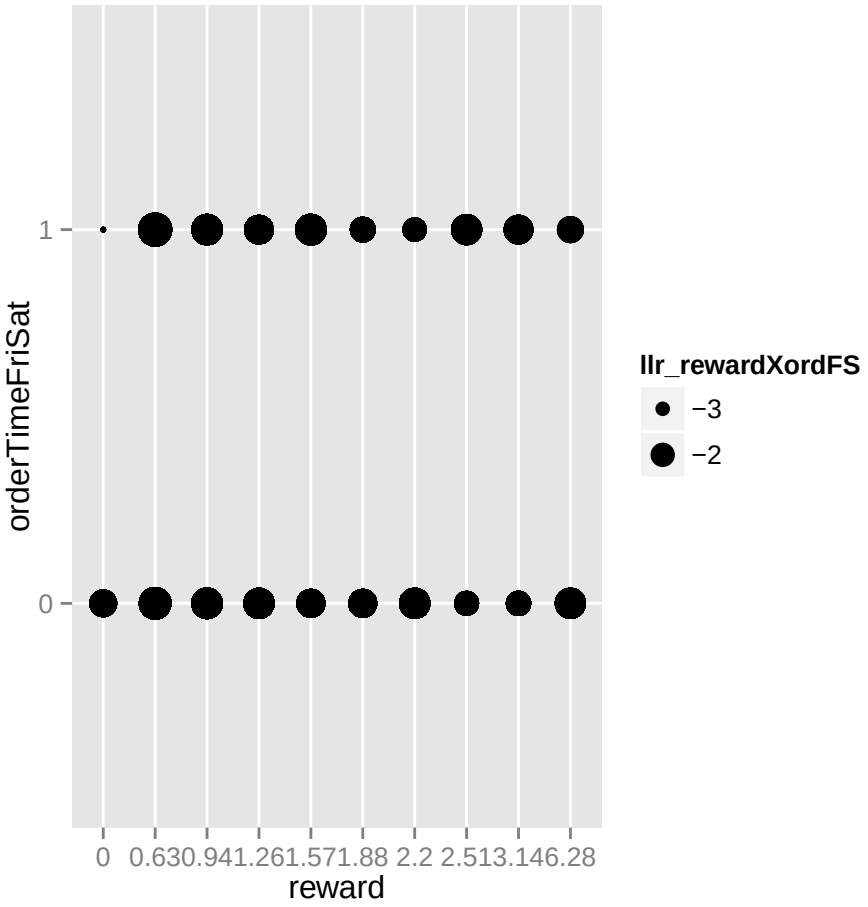

llr_rewardXordDoW
0
−1
−2
−3
−4
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward

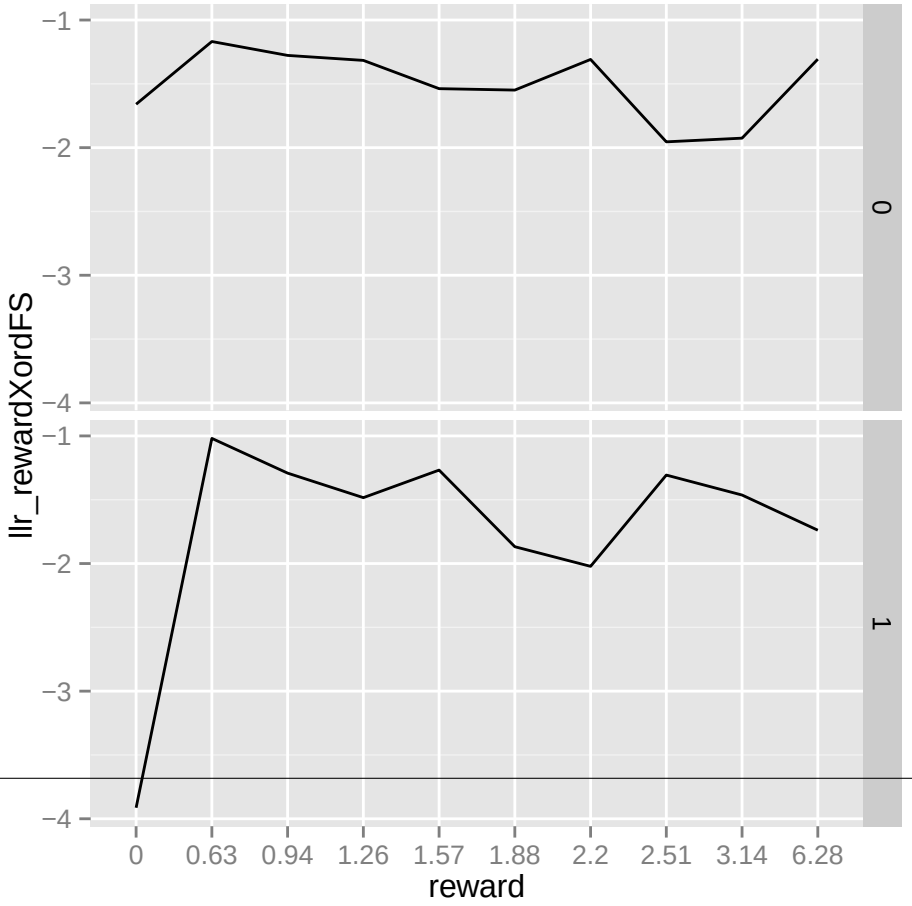


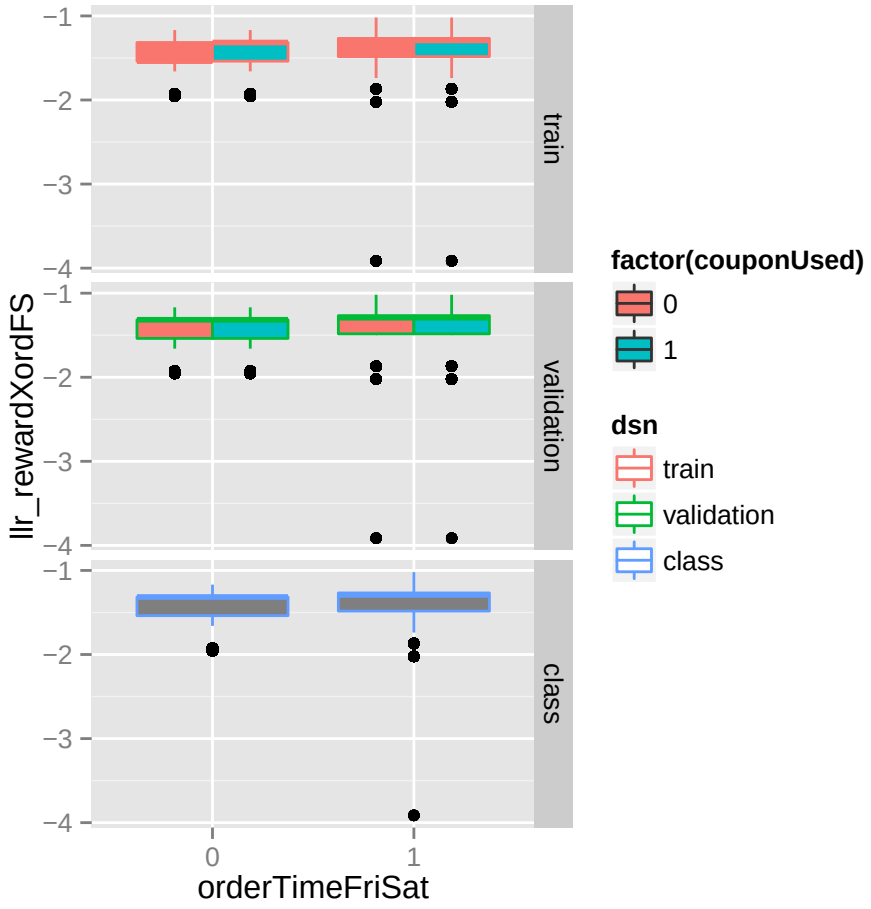
orderTimeFriSat (as `llr_rewardXordFS`)

```
# orderTimeFriSat
llr = compute_ll_2w(as.character(H$reward), as.character(H$orderTimeFriSat), H$couponUsed, as.character
llr_rewardXordFS = data.frame(reward = TVC$reward, orderTimeFriSat = TVC$orderTimeFriSat, llr_rewardXord

ggplot(data = llr_rewardXordFS, aes(x = reward, y = orderTimeFriSat, size = llr_rewardXordFS), alpha = (
qplot(reward, llr_rewardXordFS, data = llr_rewardXordFS, geom = "line", group = orderTimeFriSat, facets
    .)

TVC %>% left_join(llr_rewardXordFS, by = c("reward", "orderTimeFriSat")) %>% select(orderID, reward, dsn
    llr_rewardXordFS, couponUsed) %>% ggplot(aes(x = orderTimeFriSat, y = llr_rewardXordFS, fill = facte
    geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_rewardXordFS = TVC %>% left_join(llr_rewardXordFS, by = c("reward", "orderTimeFriSat")) %>% select(

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_rewardXordFS %>% filter(dsn == "train") %>% select(-dsn)
val = llr_rewardXordFS %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_rewardXordFS %>% filter(dsn == "class") %>% select(-dsn)
```

```
llr_rewardXordFS = list(T = trn, V = val, C = cls)

saveRDS(llr_rewardXordFS, "../features/feature_files/llr_rewardXordFS.rds")
```


orderTimeFriSat
1
0
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward
llr_rewardXordFS
−3
−2

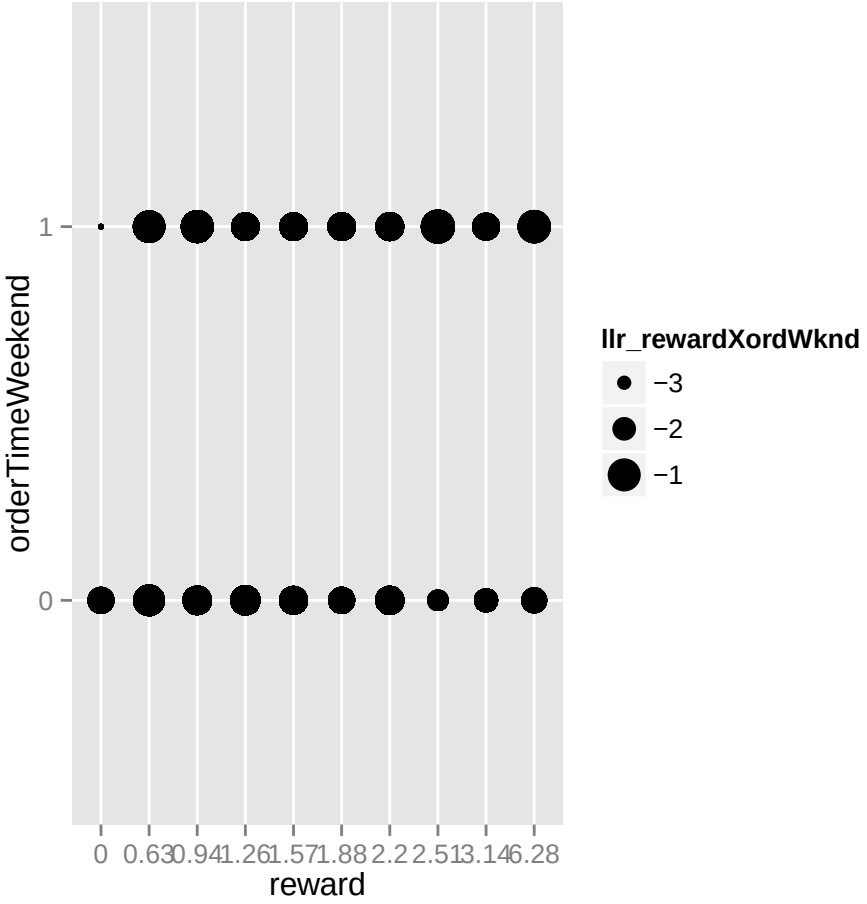

llr_rewardXordFS
−1
−2
−3
−4
0
1
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward

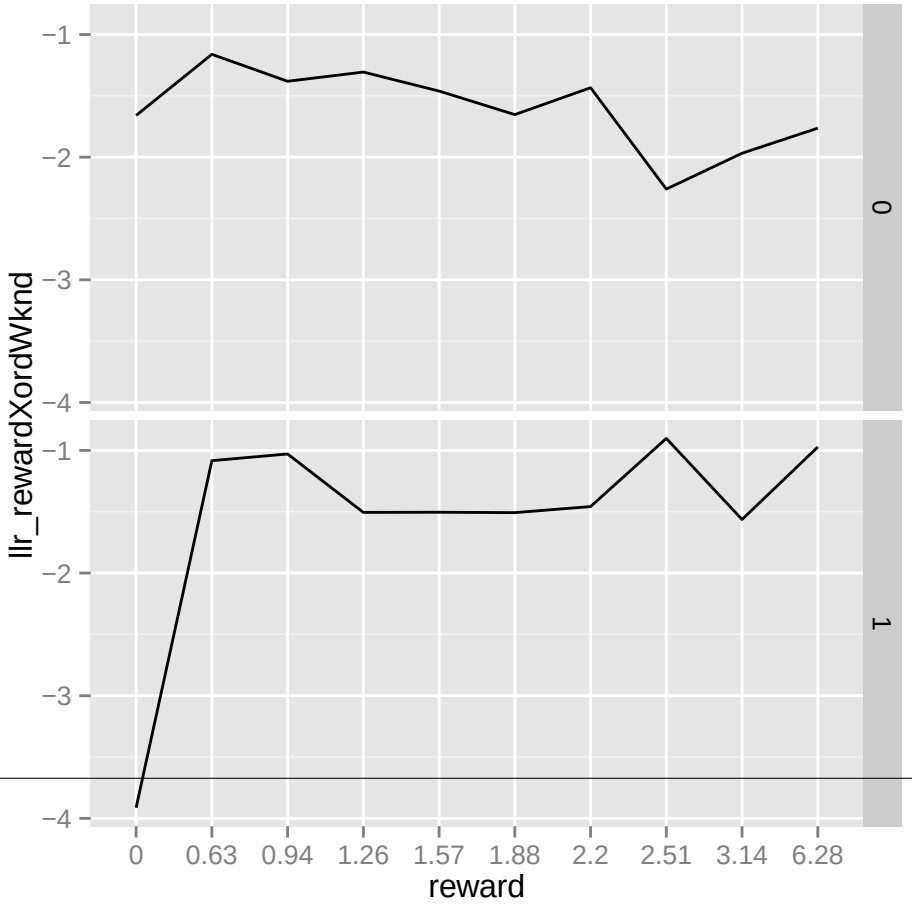


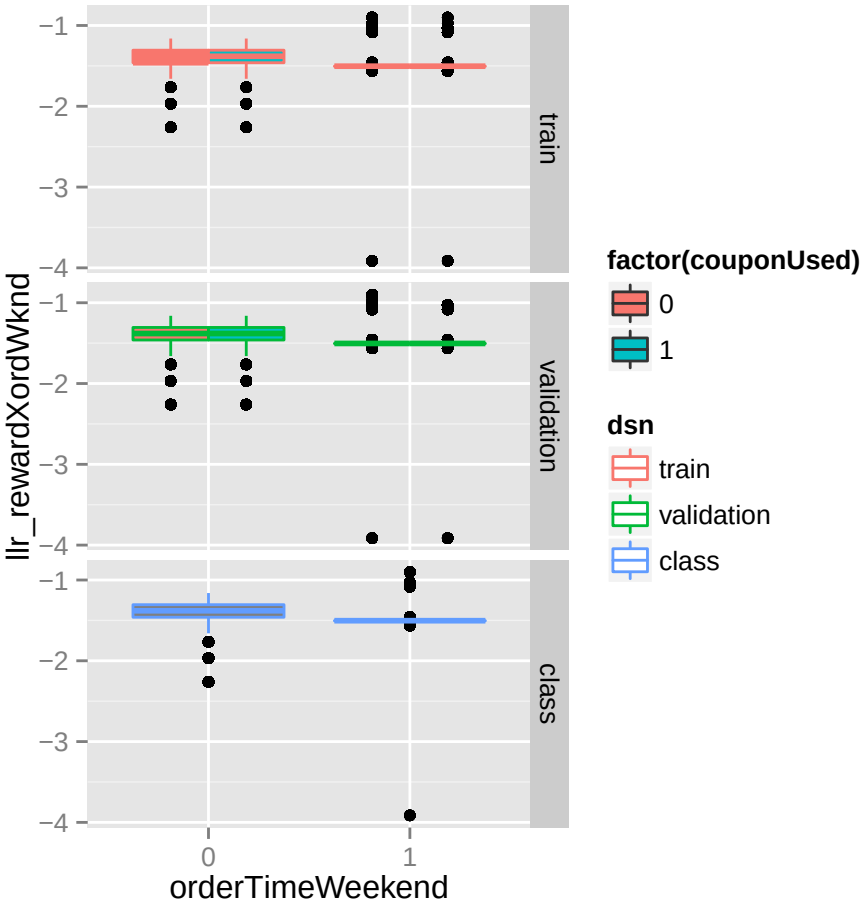
orderTimeWeekend (as `llr_rewardXordWknd`)

```
# orderTimeWeekend
llr = compute_ll_2w(as.character(H$reward), as.character(H$orderTimeWeekend), H$couponUsed, as.characte
llr_rewardXordWknd = data.frame(reward = TVC$reward, orderTimeWeekend = TVC$orderTimeWeekend, llr_rewar
    arrange(reward)

ggplot(data = llr_rewardXordWknd, aes(x = reward, y = orderTimeWeekend, size = llr_rewardXordWknd), alp
qplot(reward, llr_rewardXordWknd, data = llr_rewardXordWknd, geom = "line", group = orderTimeWeekend, f
    .)

TVC %>% left_join(llr_rewardXordWknd, by = c("reward", "orderTimeWeekend")) %>% select(orderID, reward,
    llr_rewardXordWknd, couponUsed) %>% ggplot(aes(x = orderTimeWeekend, y = llr_rewardXordWknd, fill =
    color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into char

llr_rewardXordWknd = TVC %>% left_join(llr_rewardXordWknd, by = c("reward", "orderTimeWeekend")) %>% se
    llr_rewardXordWknd)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into char

trn = llr_rewardXordWknd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_rewardXordWknd %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_rewardXordWknd %>% filter(dsn == "class") %>% select(-dsn)

llr_rewardXordWknd = list(T = trn, V = val, C = cls)

saveRDS(llr_rewardXordWknd, "../features/feature_files/llr_rewardXordWknd.rds")
```


orderTimeWeekend
1
0
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward
llr_rewardXordWknd
−3
−2
−1

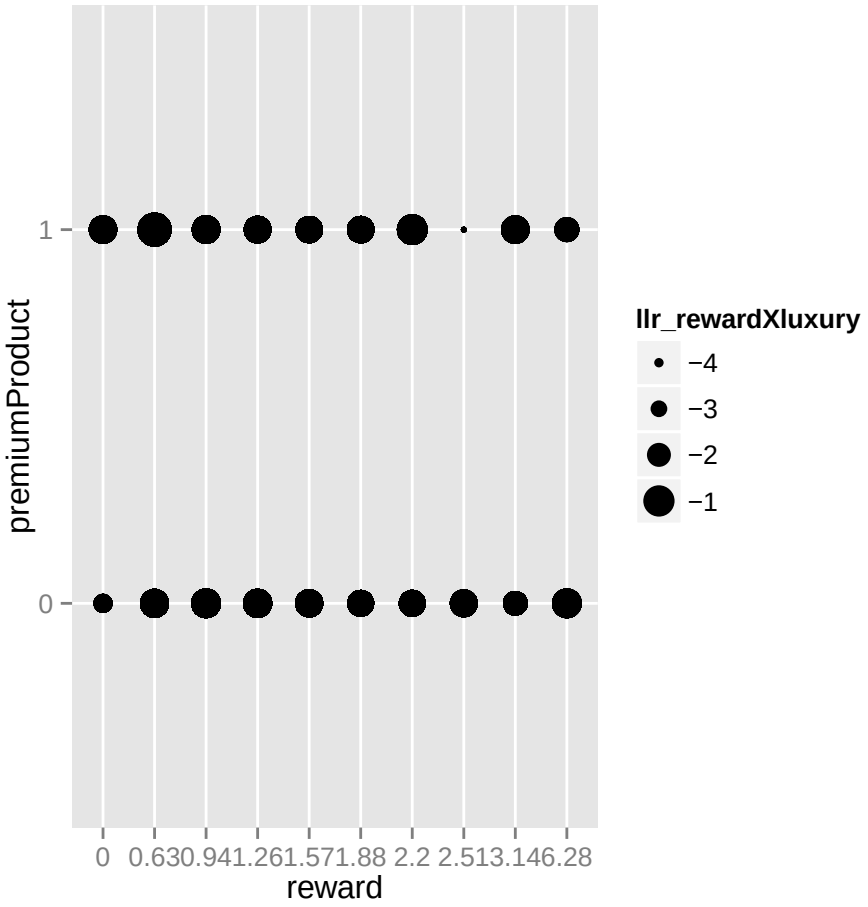

llr_rewardXordWknd
−1
−2
−3
−4
0
1
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward

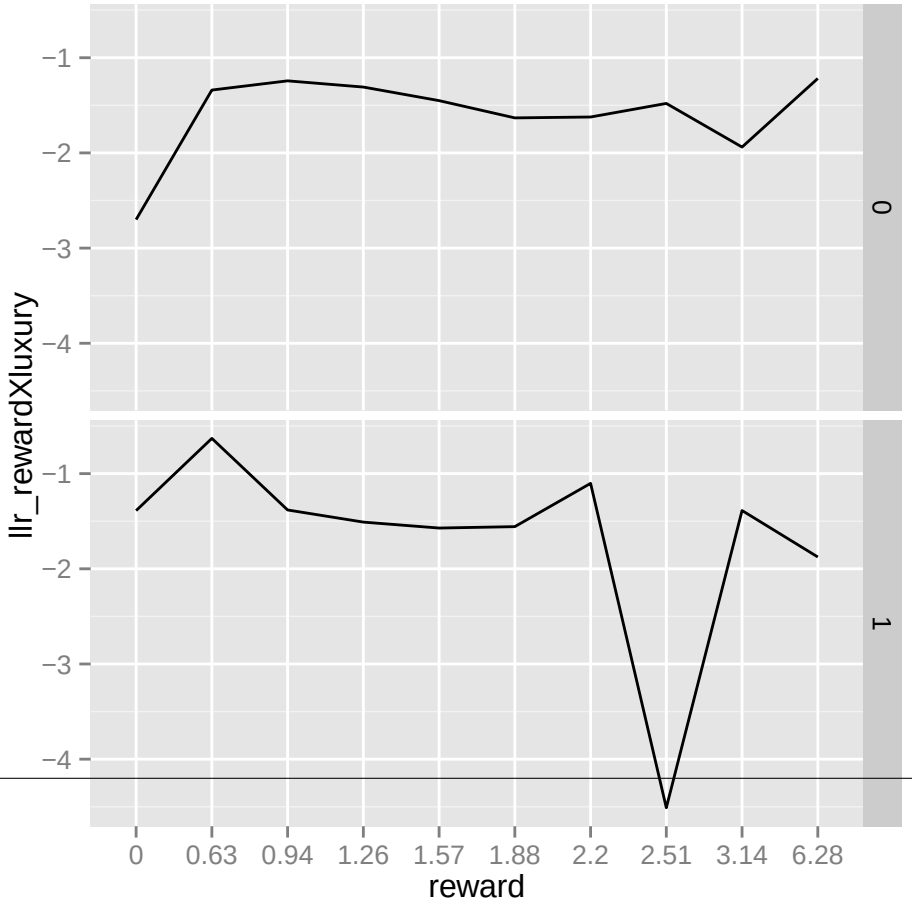


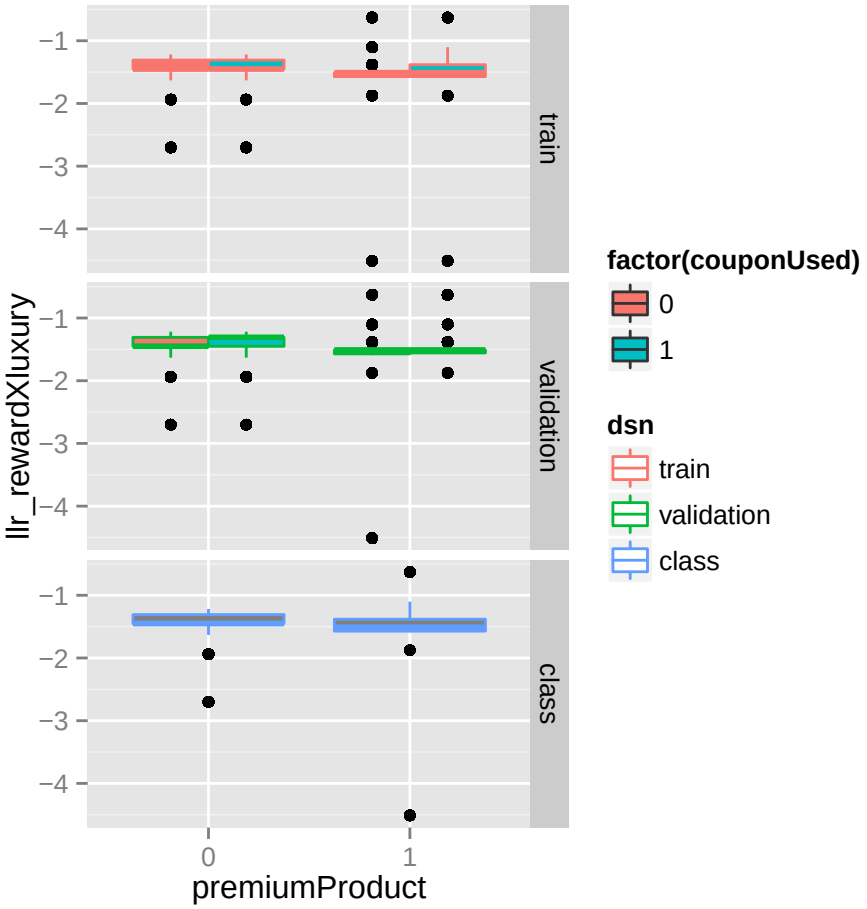
premiumProduct (as `llr_rewardXluxury`)

```
# premiumProduct
llr = compute_ll_2w(as.character(H$reward), as.character(H$premiumProduct), H$couponUsed, as.character(
llr_rewardXluxury = data.frame(reward = TVC$reward, premiumProduct = TVC$premiumProduct, llr_rewardXluxu

ggplot(data = llr_rewardXluxury, aes(x = reward, y = premiumProduct, size = llr_rewardXluxury), alpha =
qplot(reward, llr_rewardXluxury, data = llr_rewardXluxury, geom = "line", group = premiumProduct, facets
    .)

TVC %>% left_join(llr_rewardXluxury, by = c("reward", "premiumProduct")) %>% select(orderID, reward, dsn
    llr_rewardXluxury, couponUsed) %>% ggplot(aes(x = premiumProduct, y = llr_rewardXluxury, fill = fact
    color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_rewardXluxury = TVC %>% left_join(llr_rewardXluxury, by = c("reward", "premiumProduct")) %>% select

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_rewardXluxury %>% filter(dsn == "train") %>% select(-dsn)
val = llr_rewardXluxury %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_rewardXluxury %>% filter(dsn == "class") %>% select(-dsn)

llr_rewardXluxury = list(T = trn, V = val, C = cls)

saveRDS(llr_rewardXluxury, "../features/feature_files/llr_rewardXluxury.rds")
```


premiumProduct
1
0
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward
llr_rewardXluxury
−4
−3
−2
−1

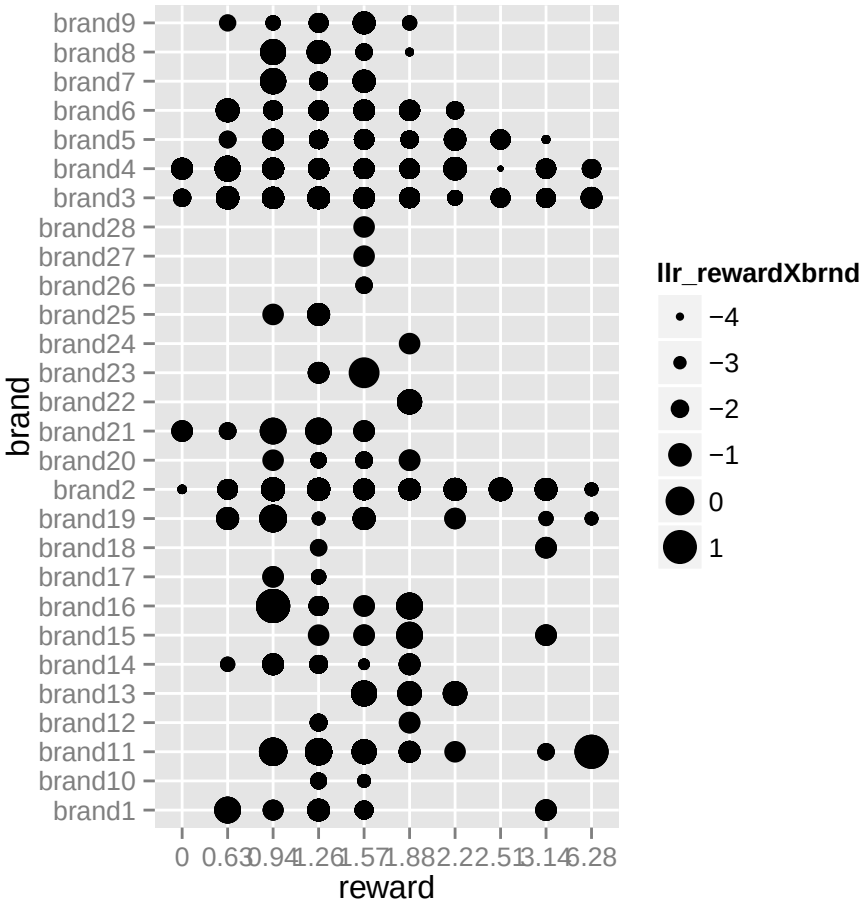

llr_rewardXluxury
−1
−2
−3
−4
0
1
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward

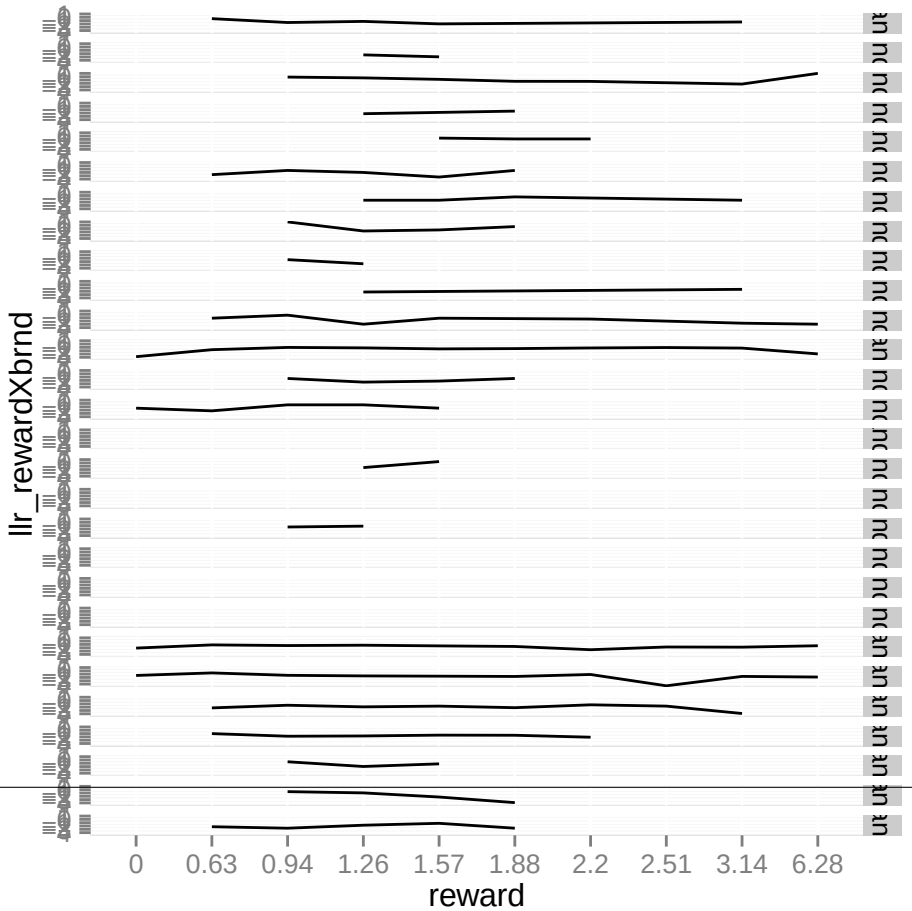


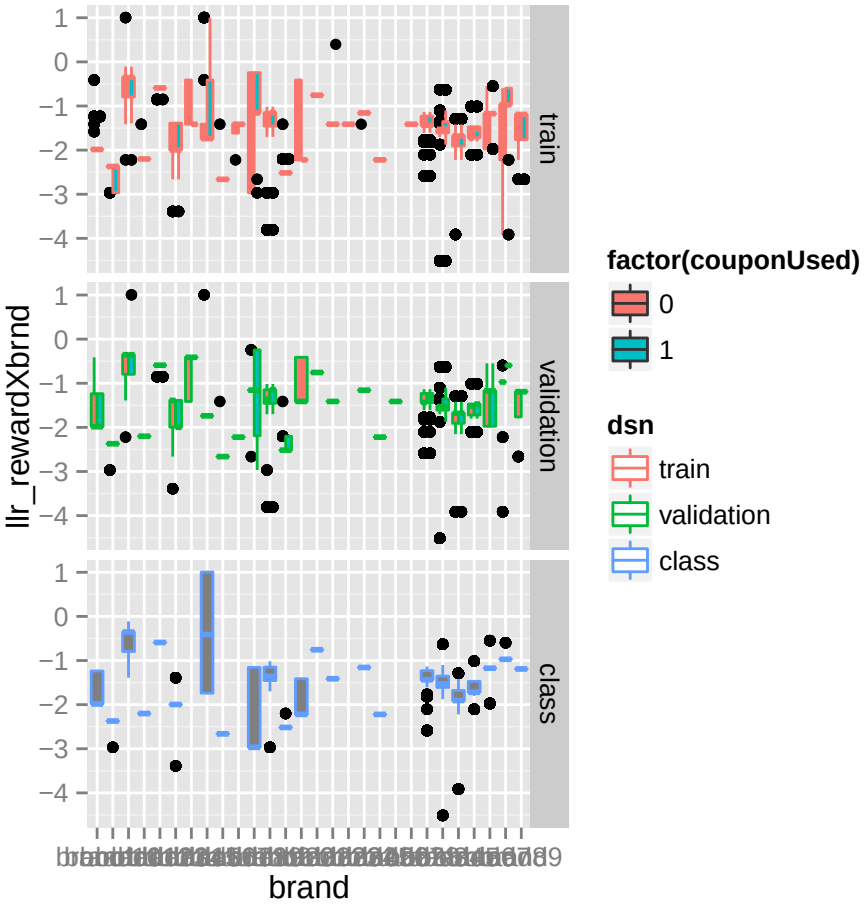
brand (as `llr_rewardXbrnd`)

```
# brand
llr = compute_ll_2w(as.character(H$reward), as.character(H$brand), H$couponUsed, as.character(TVC$rewar
llr_rewardXbrnd = data.frame(reward = TVC$reward, brand = TVC$brand, llr_rewardXbrnd = llr) %>% arrange

ggplot(data = llr_rewardXbrnd, aes(x = reward, y = brand, size = llr_rewardXbrnd), alpha = 0.1) + geom_
qplot(reward, llr_rewardXbrnd, data = llr_rewardXbrnd, geom = "line", group = brand, facets = brand ~ .

TVC %>% left_join(llr_rewardXbrnd, by = c("reward", "brand")) %>% select(orderID, reward, dsn, brand, l
    ggplot(aes(x = brand, y = llr_rewardXbrnd, fill = factor(couponUsed), color = dsn)) + geom_boxplot(
    .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_rewardXbrnd = TVC %>% left_join(llr_rewardXbrnd, by = c("reward", "brand")) %>% select(orderID, dsn

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_rewardXbrnd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_rewardXbrnd %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_rewardXbrnd %>% filter(dsn == "class") %>% select(-dsn)

llr_rewardXbrnd = list(T = trn, V = val, C = cls)

saveRDS(llr_rewardXbrnd, "../features/feature_files/llr_rewardXbrnd.rds")
```


brand9
brand8
brand7
brand6
brand5
brand4
brand3
brand28
brand27
brand26
brand25
brand24
brand23
brand22
brand21
brand20
brand2
brand19
brand18
brand17
brand16
brand15
brand14
brand13
brand12
brand11
brand10
brand1
brand
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward
llr_rewardXbrnd
−4
−3
−2
−1
0
1

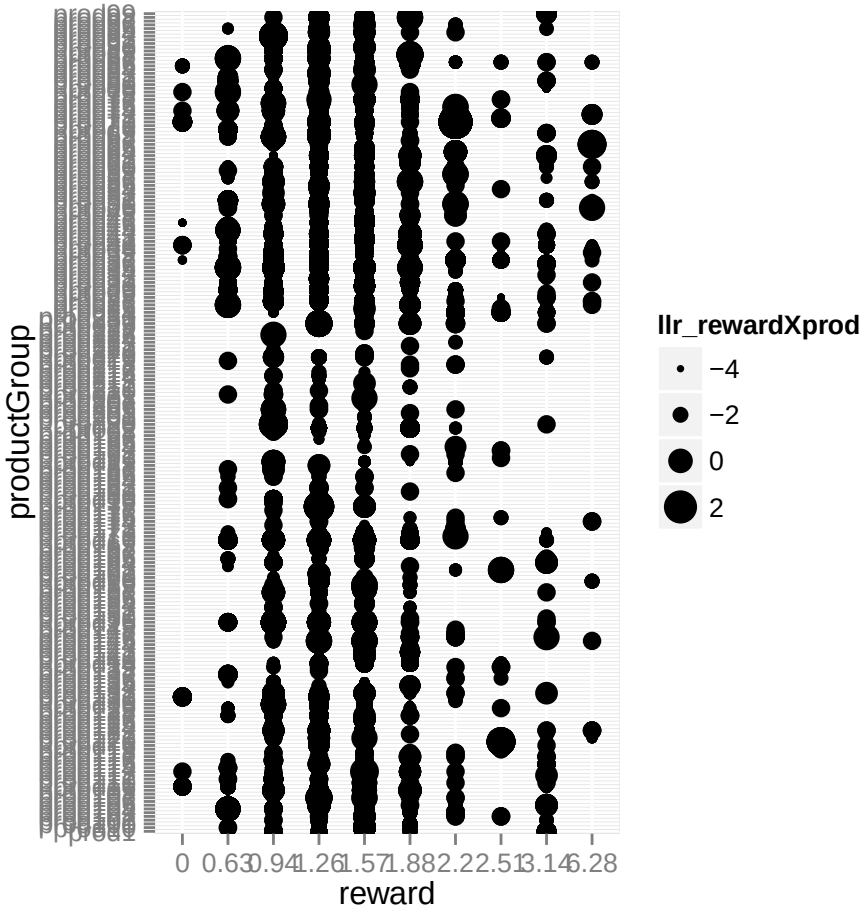

llr_rewardXbrnd
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward

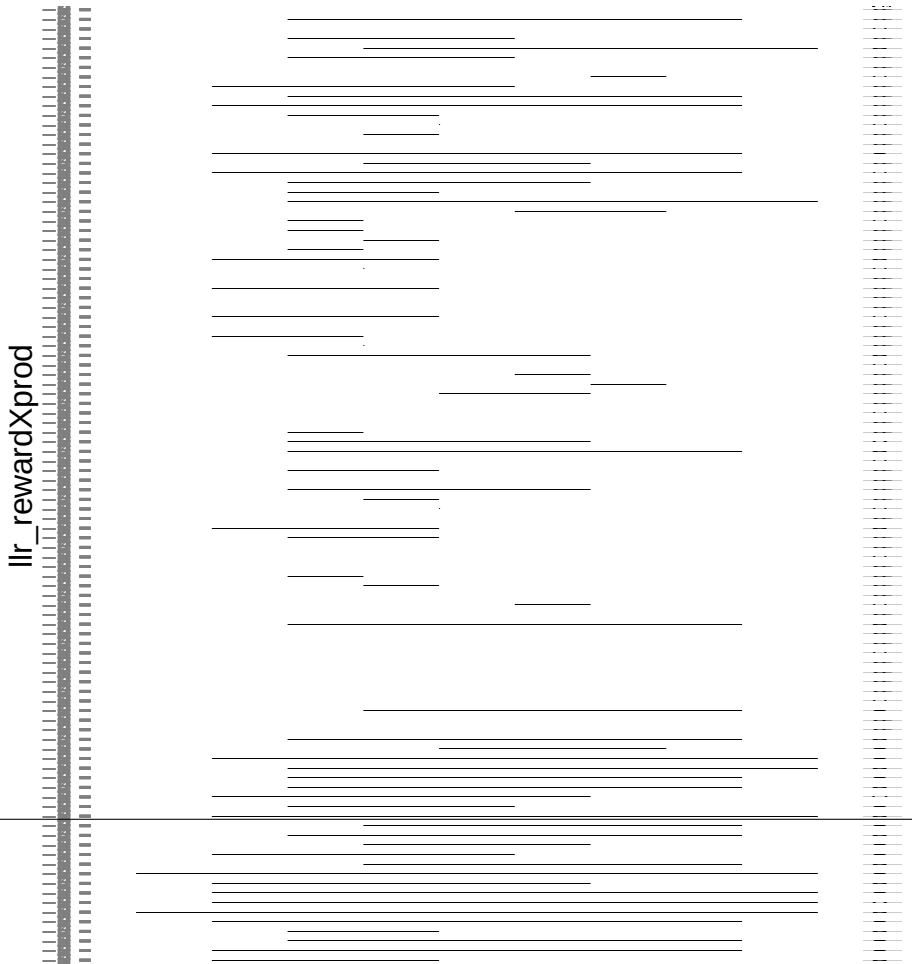


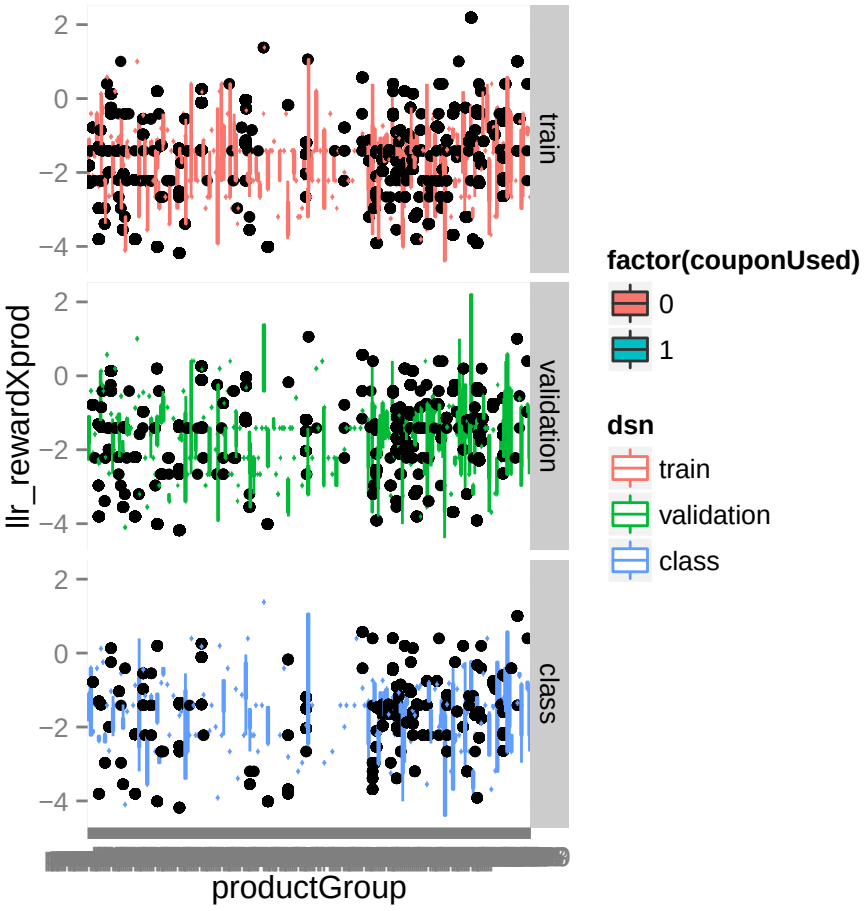
productGroup (as `llr_rewardXprod`)

```
# productGroup
llr = compute_ll_2w(as.character(H$reward), as.character(H$productGroup), H$couponUsed, as.character(TVC
llr_rewardXprod = data.frame(reward = TVC$reward, productGroup = TVC$productGroup, llr_rewardXprod = lli

ggplot(data = llr_rewardXprod, aes(x = reward, y = productGroup, size = llr_rewardXprod), alpha = 0.1) +
qplot(reward, llr_rewardXprod, data = llr_rewardXprod, geom = "line", group = productGroup, facets = pro

TVC %>% left_join(llr_rewardXprod, by = c("reward", "productGroup")) %>% select(orderID, reward, dsn, pr
    couponUsed) %>% ggplot(aes(x = productGroup, y = llr_rewardXprod, fill = factor(couponUsed), color =
    facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_rewardXprod = TVC %>% left_join(llr_rewardXprod, by = c("reward", "productGroup")) %>% select(orderI

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_rewardXprod %>% filter(dsn == "train") %>% select(-dsn)
val = llr_rewardXprod %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_rewardXprod %>% filter(dsn == "class") %>% select(-dsn)

llr_rewardXprod = list(T = trn, V = val, C = cls)

saveRDS(llr_rewardXprod, "../features/feature_files/llr_rewardXprod.rds")
```


productGroup
reward
0
0.63
0.94
1.26
1.57
1.88
2.2
2.51
3.14
6.28
llr_rewardXprod
−4
−2
0
2

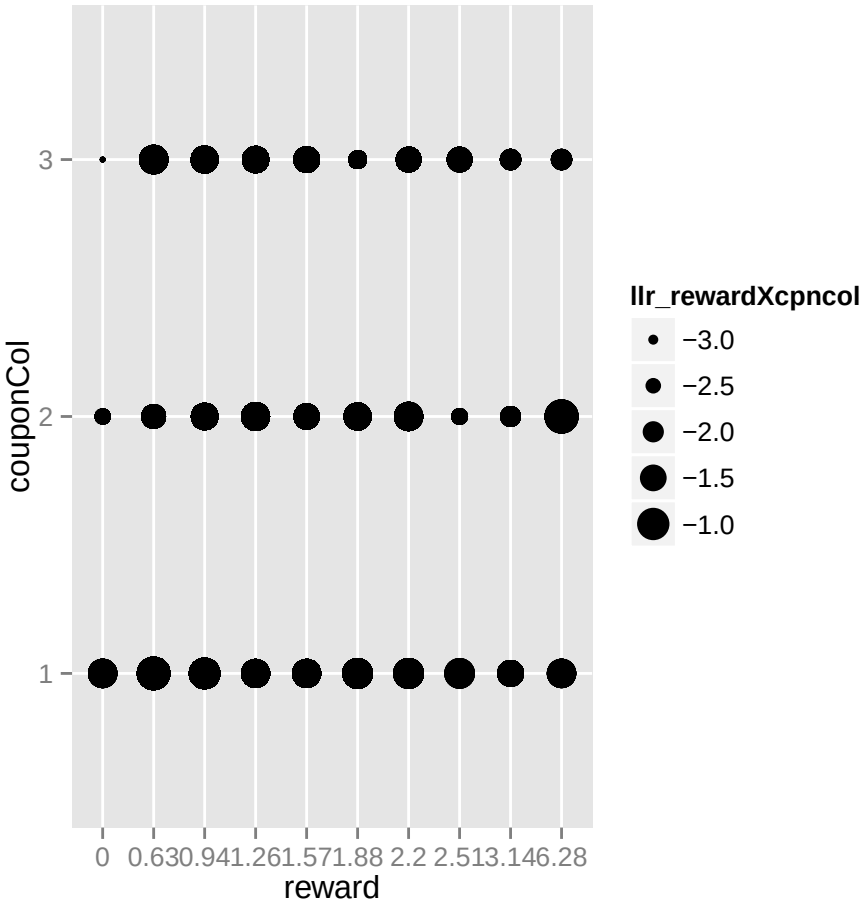

llr_rewardXprod

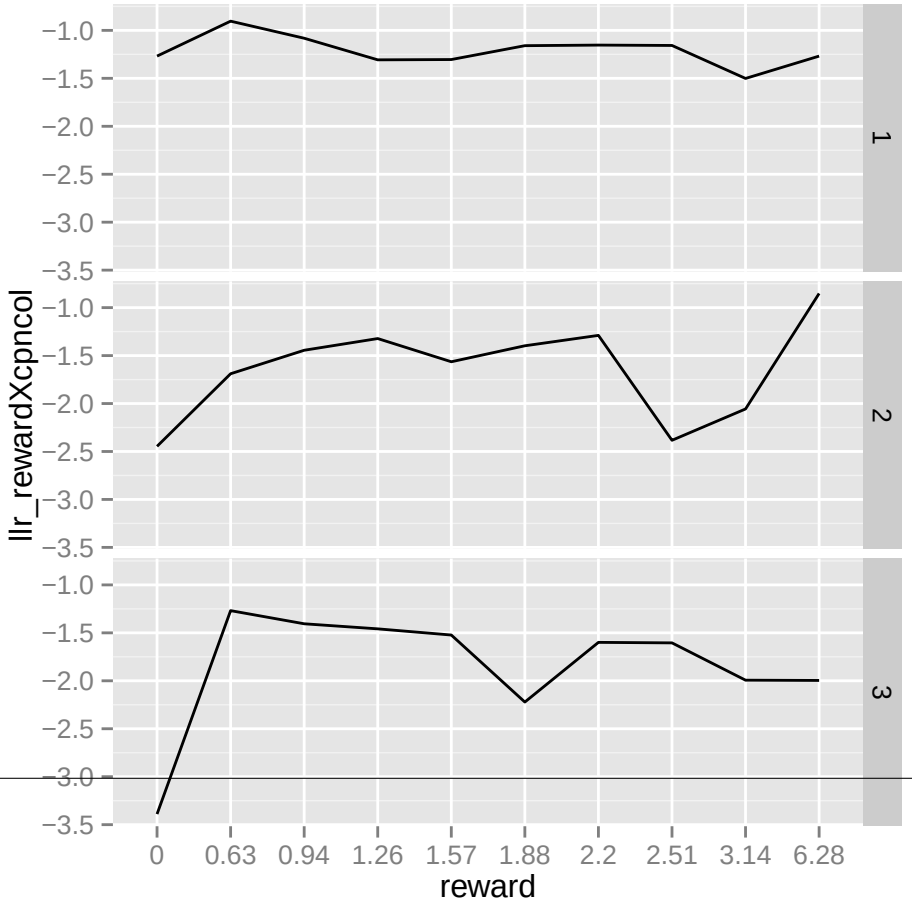


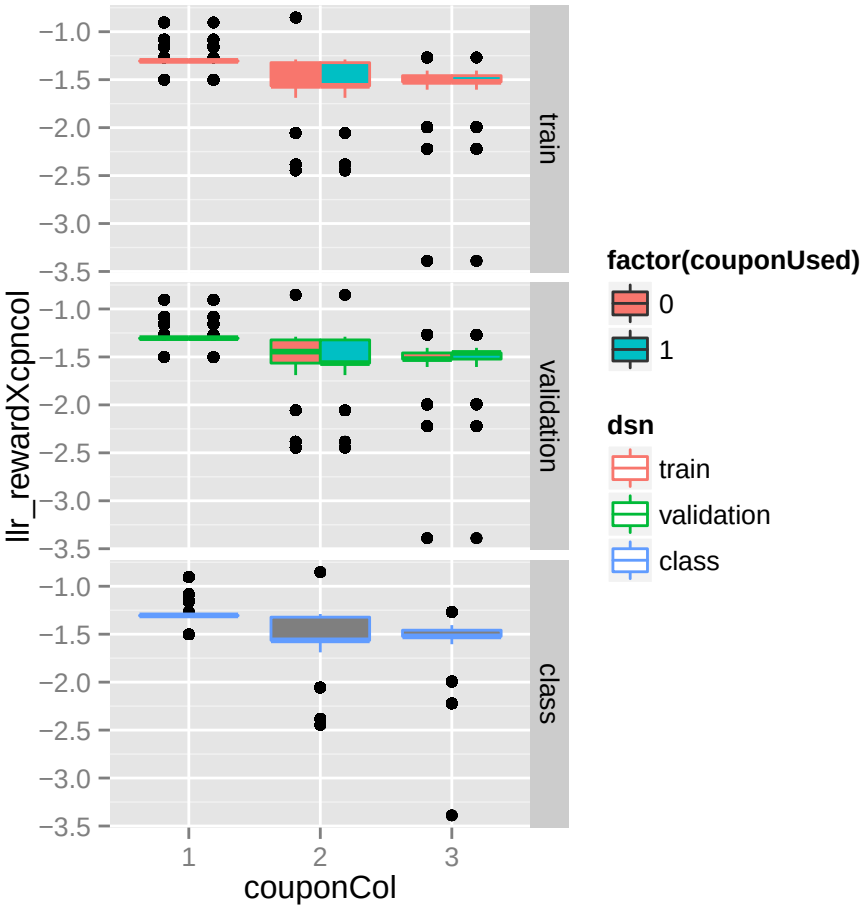
couponCol (as `llr_rewardXcpncol`)

```
# couponCol
llr = compute_ll_2w(as.character(H$reward), as.character(H$couponCol), H$couponUsed, as.character(TVC$re
llr_rewardXcpncol = data.frame(reward = TVC$reward, couponCol = TVC$couponCol, llr_rewardXcpncol = llr)

ggplot(data = llr_rewardXcpncol, aes(x = reward, y = couponCol, size = llr_rewardXcpncol), alpha = 0.1)
qplot(reward, llr_rewardXcpncol, data = llr_rewardXcpncol, geom = "line", group = couponCol, facets = co

TVC %>% left_join(llr_rewardXcpncol, by = c("reward", "couponCol")) %>% select(orderID, reward, dsn, cou
    couponUsed) %>% ggplot(aes(x = couponCol, y = llr_rewardXcpncol, fill = factor(couponUsed), color =
    facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_rewardXcpncol = TVC %>% left_join(llr_rewardXcpncol, by = c("reward", "couponCol")) %>% select(order

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_rewardXcpncol %>% filter(dsn == "train") %>% select(-dsn)
val = llr_rewardXcpncol %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_rewardXcpncol %>% filter(dsn == "class") %>% select(-dsn)

llr_rewardXcpncol = list(T = trn, V = val, C = cls)

saveRDS(llr_rewardXcpncol, "../features/feature_files/llr_rewardXcpncol.rds")
```


couponCol
3
2
1
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward
llr_rewardXcpncol
−3.0
−2.5
−2.0
−1.5
−1.0


llr_rewardXcpncol
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
1
2
3
0 0.63 0.94 1.26 1.57 1.88 2.2 2.51 3.14 6.28
reward



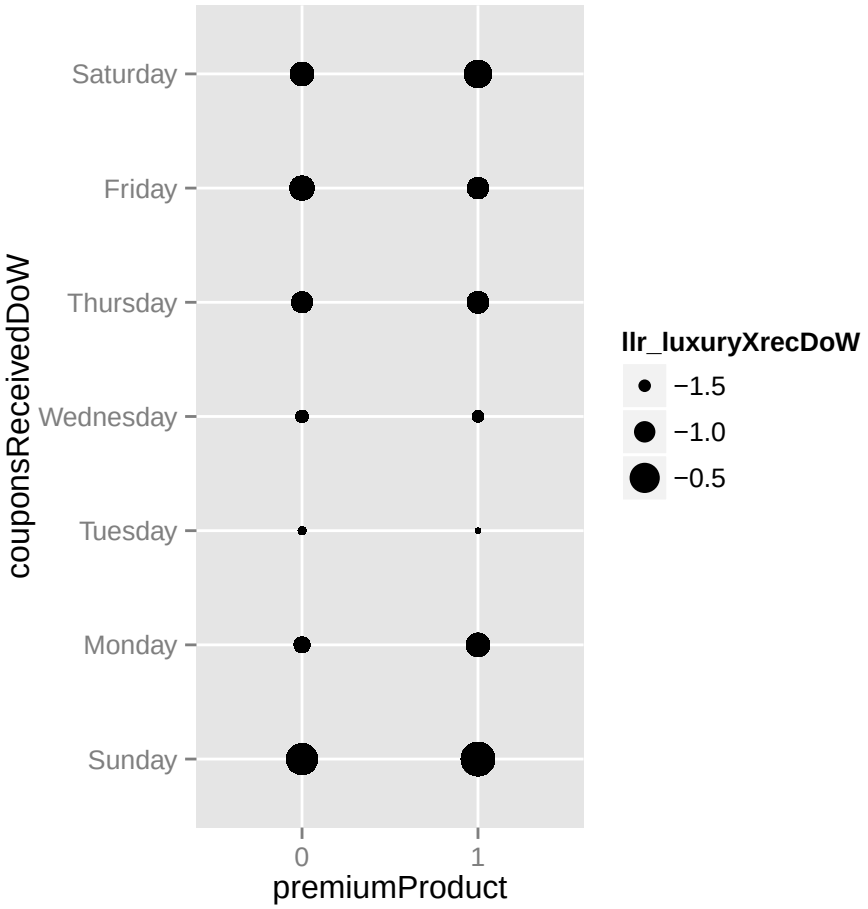
0.4.3 premiumProduct and

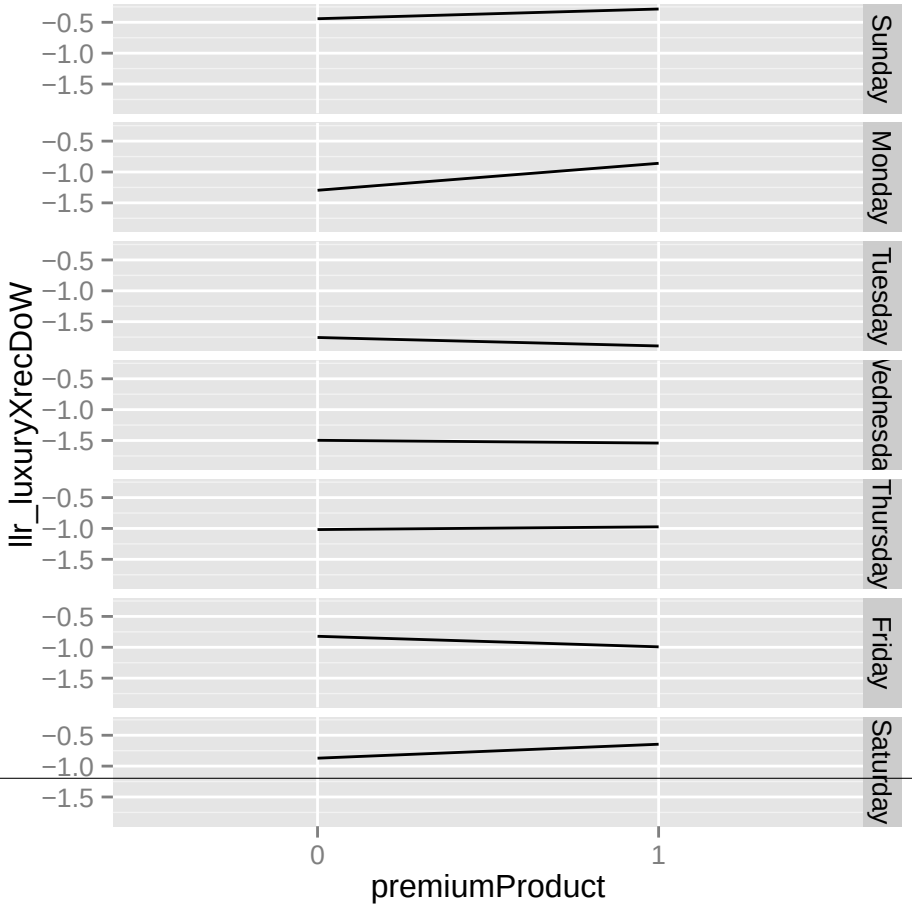
couponsReceivedDoW (as `llr_luxuryXrecDoW`)

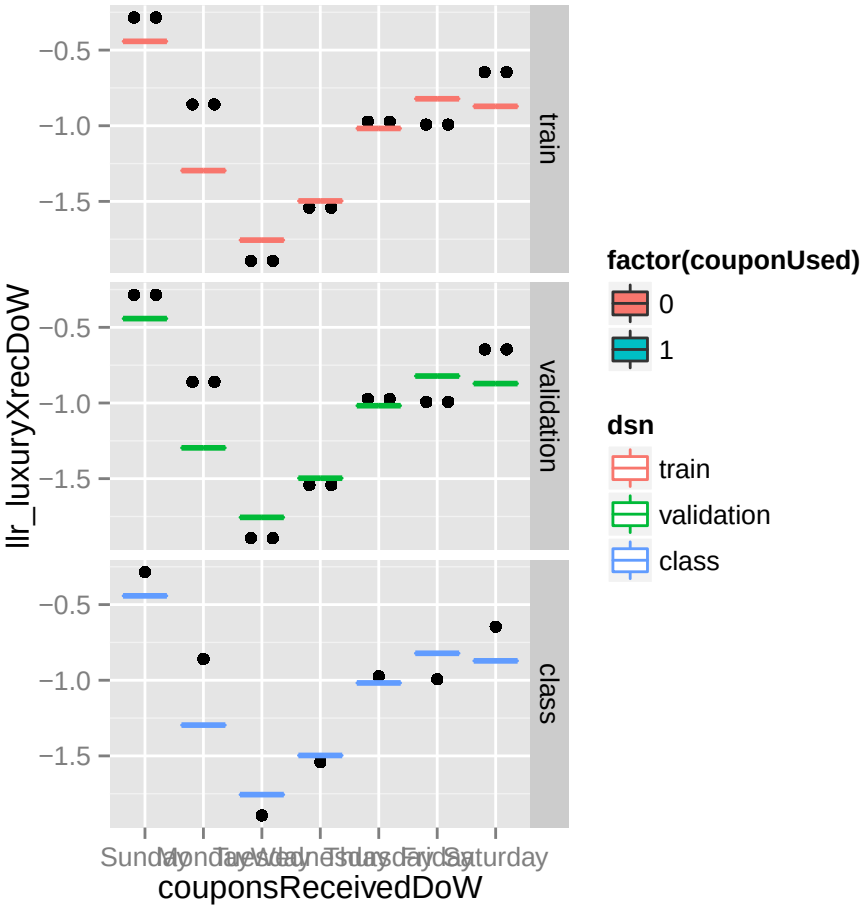
```
# couponsReceivedDoW
llr = compute_ll_2w(as.character(H$premiumProduct), as.character(H$couponsReceivedDoW), H$couponUsed, as
    as.character(TVC$couponsReceivedDoW))
llr_luxuryXrecDoW = data.frame(premiumProduct = TVC$premiumProduct, couponsReceivedDoW = TVC$couponsRec
    arrange(premiumProduct)

ggplot(data = llr_luxuryXrecDoW, aes(x = premiumProduct, y = couponsReceivedDoW, size = llr_luxuryXrecD
    geom_point()
qplot(premiumProduct, llr_luxuryXrecDoW, data = llr_luxuryXrecDoW, geom = "line", group = couponsReceiv
    .)

TVC %>% left_join(llr_luxuryXrecDoW, by = c("premiumProduct", "couponsReceivedDoW")) %>% select(orderID
    dsn, couponsReceivedDoW, llr_luxuryXrecDoW, couponUsed) %>% ggplot(aes(x = couponsReceivedDoW, y = l
    fill = factor(couponUsed), color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_luxuryXrecDoW = TVC %>% left_join(llr_luxuryXrecDoW, by = c("premiumProduct", "couponsReceivedDoW")
    dsn, llr_luxuryXrecDoW)
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_luxuryXrecDoW %>% filter(dsn == "train") %>% select(-dsn)
val = llr_luxuryXrecDoW %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_luxuryXrecDoW %>% filter(dsn == "class") %>% select(-dsn)

llr_luxuryXrecDoW = list(T = trn, V = val, C = cls)

saveRDS(llr_luxuryXrecDoW, "../features/feature_files/llr_luxuryXrecDoW.rds")
```


Saturday
Friday
Thursday
Wednesday
Tuesday
Monday
Sunday
couponsReceivedDoW
0
1
premiumProduct
llr_luxuryXrecDoW
−1.5
−1.0
−0.5

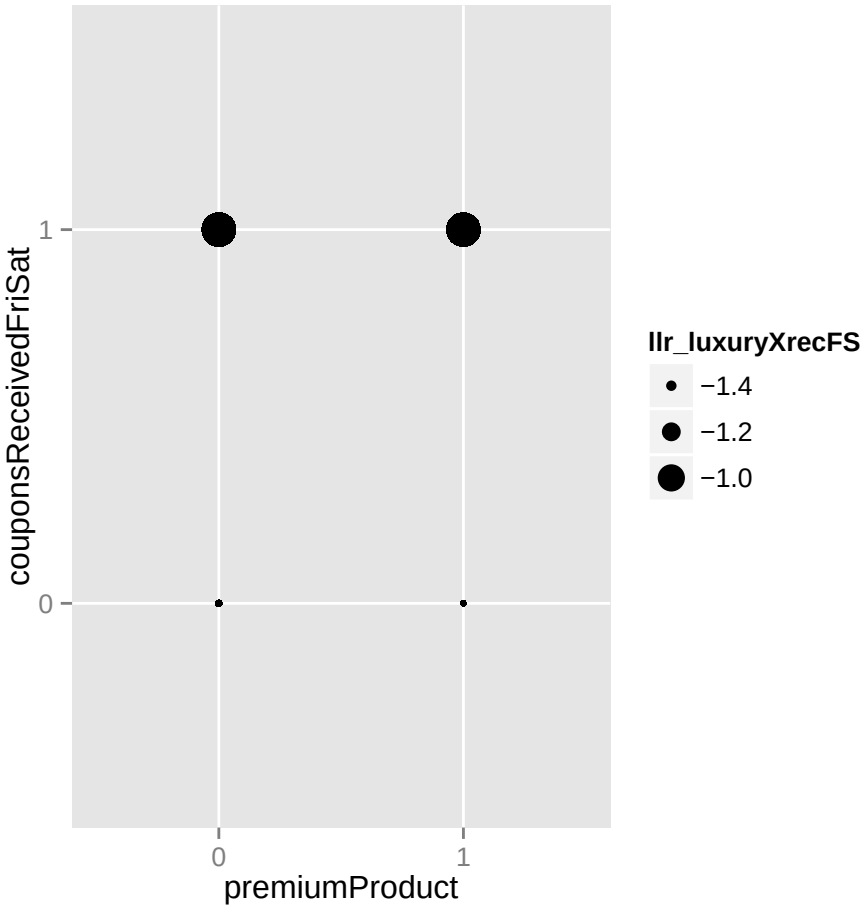

−0.5
−1.0
−1.5
Sunday
Monday
Tuesday
Wednesda
Thursday
Friday
Saturday
llr_luxuryXrecDoW
0
1
premiumProduct

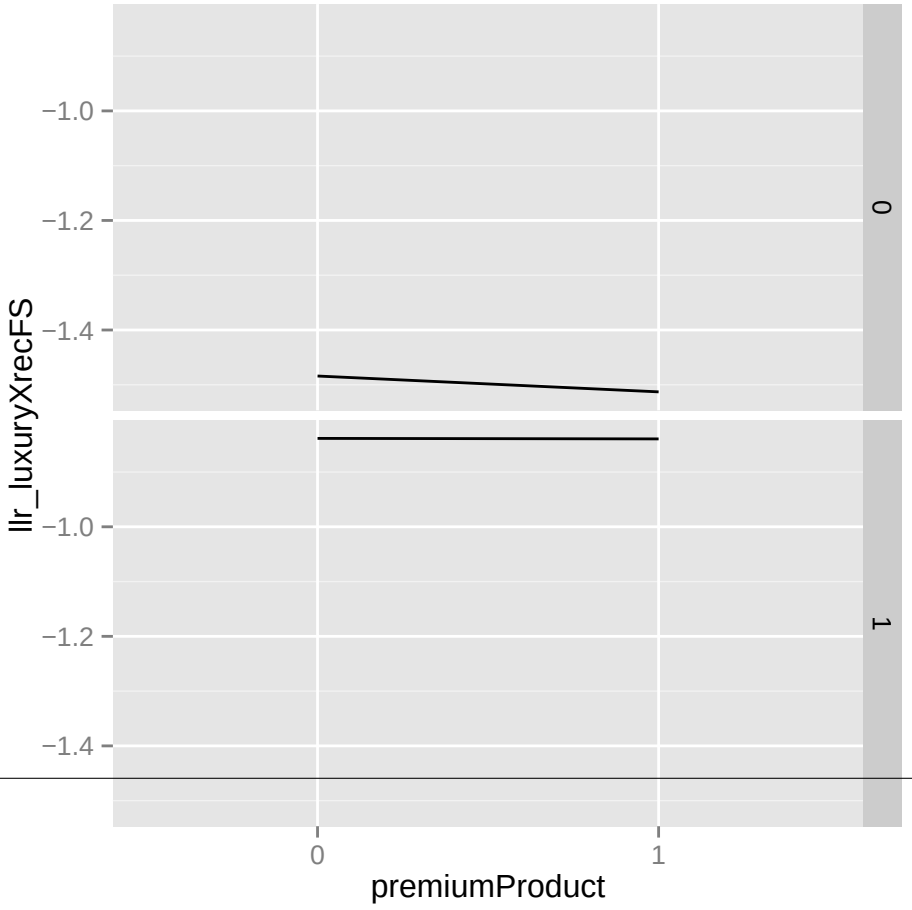


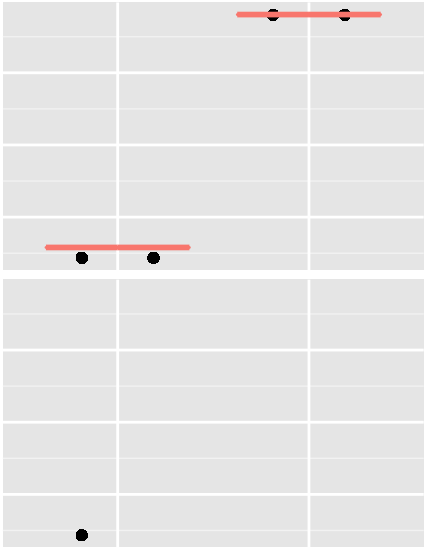
couponsReceivedFriSat (as `llr_luxuryXrecFS`)

```
# couponsReceivedFriSat
llr = compute_ll_2w(as.character(H$premiumProduct), as.character(H$couponsReceivedFriSat), H$couponUsed
    as.character(TVC$couponsReceivedFriSat))
llr_luxuryXrecFS = data.frame(premiumProduct = TVC$premiumProduct, couponsReceivedFriSat = TVC$couponsR
    arrange(premiumProduct)

ggplot(data = llr_luxuryXrecFS, aes(x = premiumProduct, y = couponsReceivedFriSat, size = llr_luxuryXre
    geom_point()
qplot(premiumProduct, llr_luxuryXrecFS, data = llr_luxuryXrecFS, geom = "line", group = couponsReceivedF
    .)

TVC %>% left_join(llr_luxuryXrecFS, by = c("premiumProduct", "couponsReceivedFriSat")) %>% select(order
    dsn, couponsReceivedFriSat, llr_luxuryXrecFS, couponUsed) %>% ggplot(aes(x = couponsReceivedFriSat,
    fill = factor(couponUsed), color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_luxuryXrecFS = TVC %>% left_join(llr_luxuryXrecFS, by = c("premiumProduct", "couponsReceivedFriSat")
    dsn, llr_luxuryXrecFS)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_luxuryXrecFS %>% filter(dsn == "train") %>% select(-dsn)
val = llr_luxuryXrecFS %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_luxuryXrecFS %>% filter(dsn == "class") %>% select(-dsn)

llr_luxuryXrecFS = list(T = trn, V = val, C = cls)

saveRDS(llr_luxuryXrecFS, "../features/feature_files/llr_luxuryXrecFS.rds")
```


couponsReceivedFriSat
1
0
0
1
premiumProduct
llr_luxuryXrecFS
−1.4
−1.2
−1.0

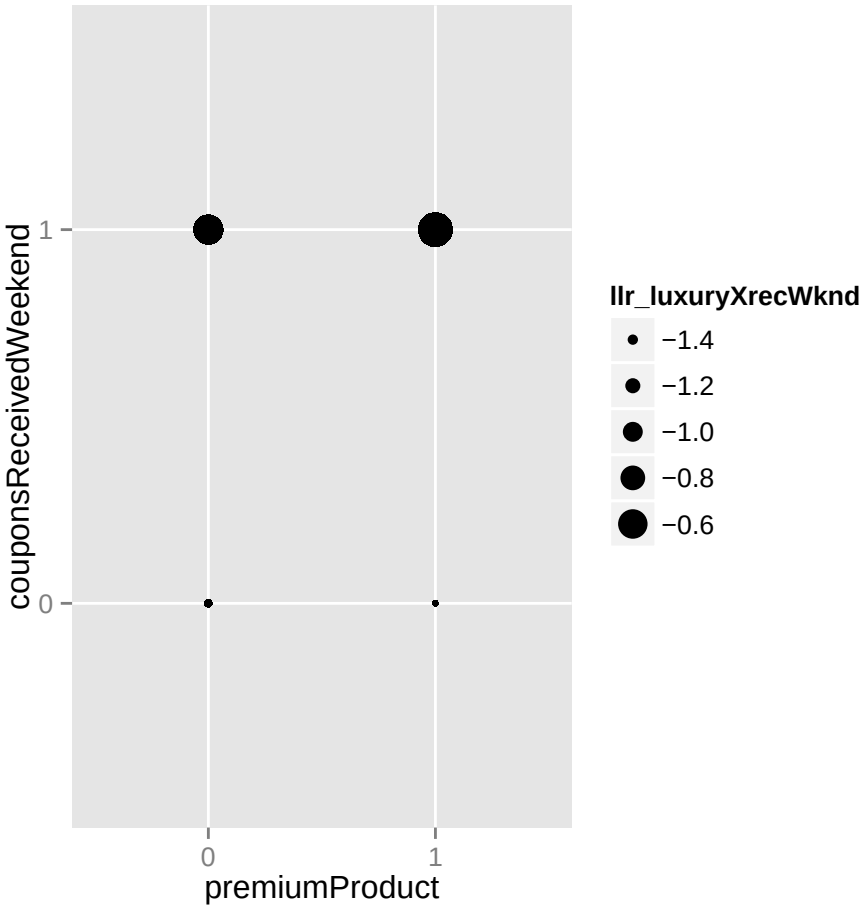

llr_luxuryXrecFS
−1.0
−1.2
−1.4
0
1
0
1
premiumProduct

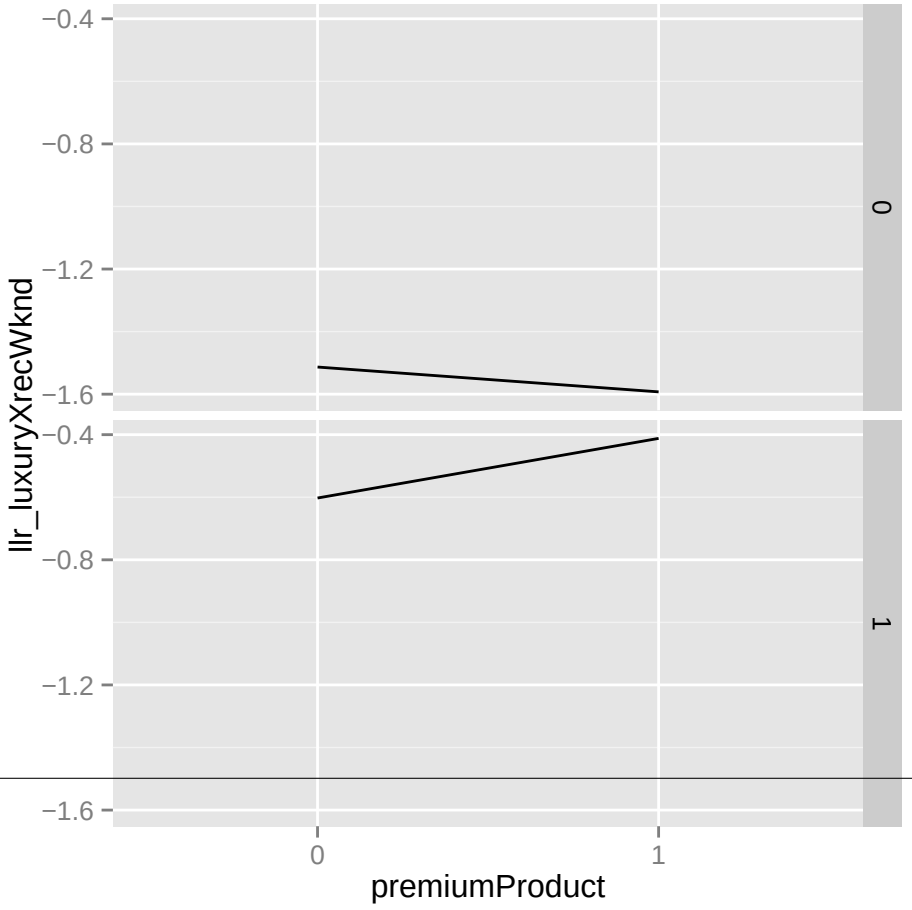


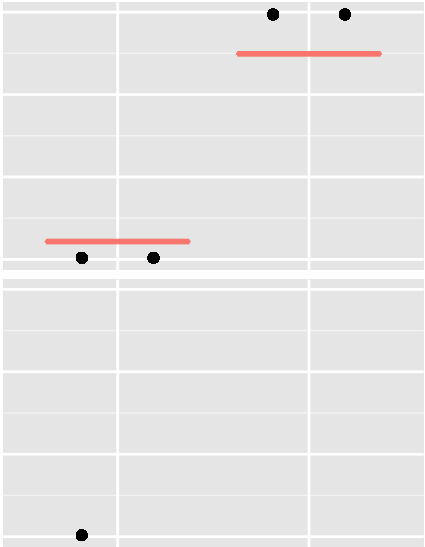
couponsReceivedWeekend (as `llr_luxuryXrecWknd`)

```
# couponsReceivedWeekend
llr = compute_ll_2w(as.character(H$premiumProduct), as.character(H$couponsReceivedWeekend), H$couponUse
    as.character(TVC$couponsReceivedWeekend))
llr_luxuryXrecWknd = data.frame(premiumProduct = TVC$premiumProduct, couponsReceivedWeekend = TVC$coupo
    llr_luxuryXrecWknd = llr) %>% arrange(premiumProduct)

ggplot(data = llr_luxuryXrecWknd, aes(x = premiumProduct, y = couponsReceivedWeekend, size = llr_luxury
    geom_point()
qplot(premiumProduct, llr_luxuryXrecWknd, data = llr_luxuryXrecWknd, geom = "line", group = couponsRece
    .)

TVC %>% left_join(llr_luxuryXrecWknd, by = c("premiumProduct", "couponsReceivedWeekend")) %>% select(or
    dsn, couponsReceivedWeekend, llr_luxuryXrecWknd, couponUsed) %>% ggplot(aes(x = couponsReceivedWeek
    fill = factor(couponUsed), color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into char

llr_luxuryXrecWknd = TVC %>% left_join(llr_luxuryXrecWknd, by = c("premiumProduct", "couponsReceivedWee
    dsn, llr_luxuryXrecWknd)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into char
```

```
trn = llr_luxuryXrecWknd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_luxuryXrecWknd %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_luxuryXrecWknd %>% filter(dsn == "class") %>% select(-dsn)

llr_luxuryXrecWknd = list(T = trn, V = val, C = cls)

saveRDS(llr_luxuryXrecWknd, "../features/feature_files/llr_luxuryXrecWknd.rds")
```


couponsReceivedWeekend
1
0
0
1
premiumProduct
llr_luxuryXrecWknd
−1.4
−1.2
−1.0
−0.8
−0.6


llr_luxuryXrecWknd
−0.4
−0.8
−1.2
−1.6
0
1
premiumProduct



orderTimeDoW (as `llr_luxuryXordDoW`)

```
# orderTimeDoW
llr = compute_ll_2w(as.character(H$premiumProduct), as.character(H$orderTimeDoW), H$couponUsed, as.chara
    as.character(TVC$orderTimeDoW))
llr_luxuryXordDoW = data.frame(premiumProduct = TVC$premiumProduct, orderTimeDoW = TVC$orderTimeDoW, lli
    arrange(premiumProduct)

ggplot(data = llr_luxuryXordDoW, aes(x = premiumProduct, y = orderTimeDoW, size = llr_luxuryXordDoW), al
qplot(premiumProduct, llr_luxuryXordDoW, data = llr_luxuryXordDoW, geom = "line", group = orderTimeDoW,
    .)

TVC %>% left_join(llr_luxuryXordDoW, by = c("premiumProduct", "orderTimeDoW")) %>% select(orderID, premi
    orderTimeDoW, llr_luxuryXordDoW, couponUsed) %>% ggplot(aes(x = orderTimeDoW, y = llr_luxuryXordDoW
    color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)
```

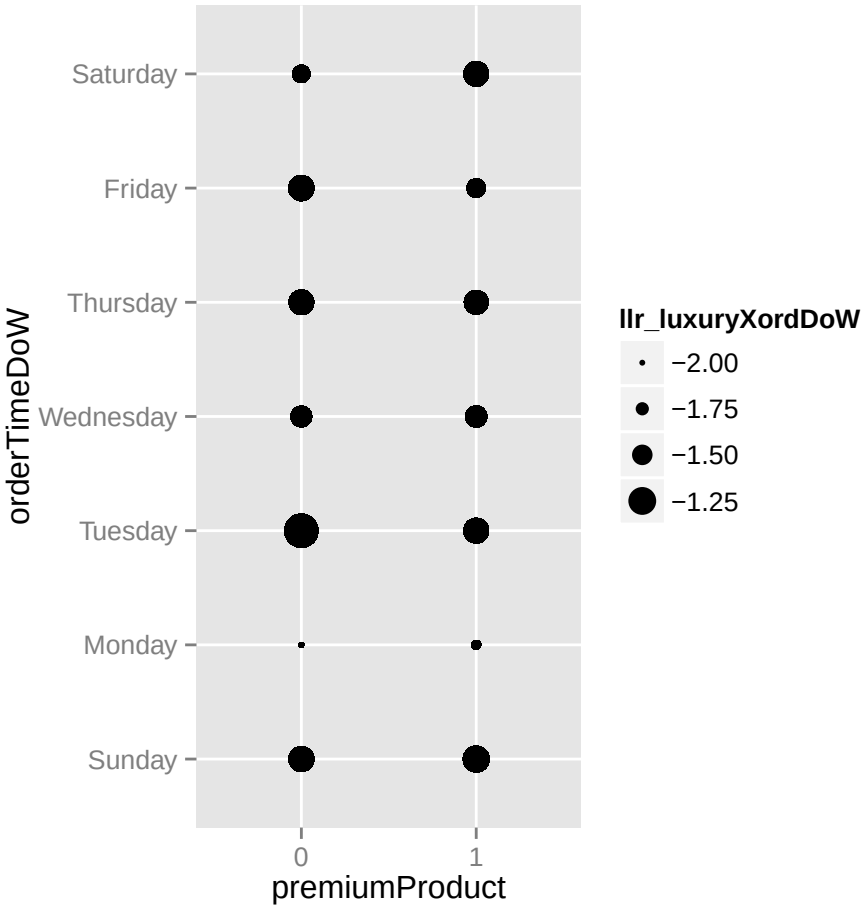
```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

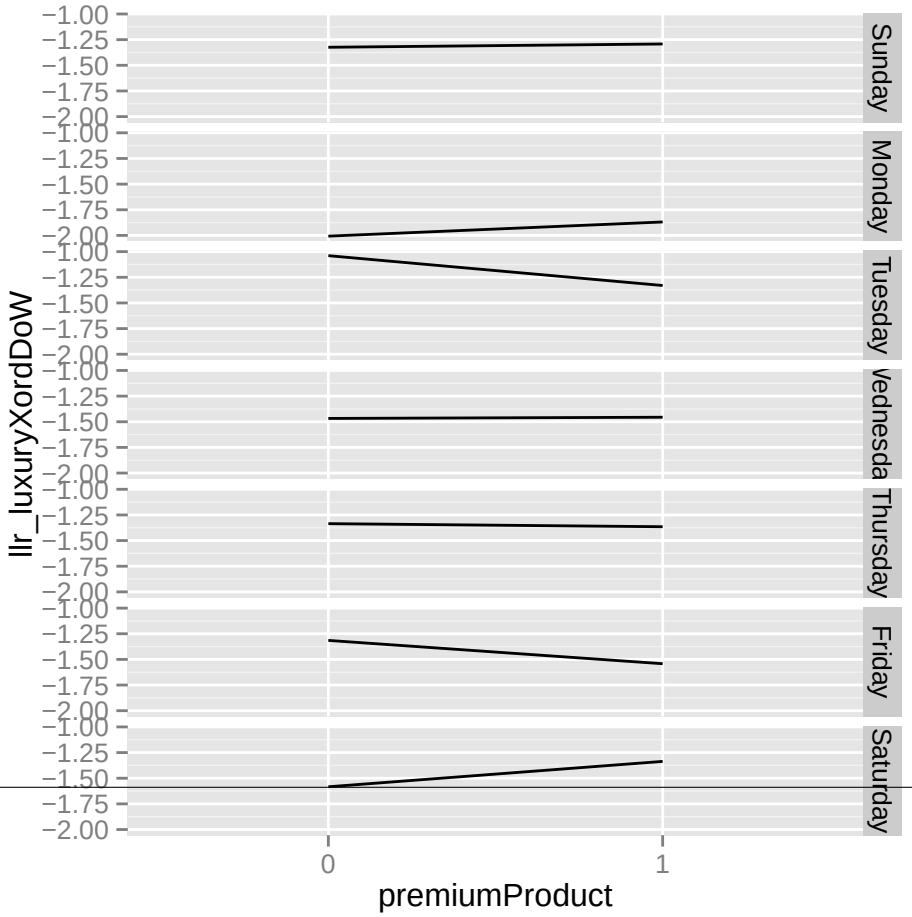
```
llr_luxuryXordDoW = TVC %>% left_join(llr_luxuryXordDoW, by = c("premiumProduct", "orderTimeDoW")) %>% s
    llr_luxuryXordDoW)
```

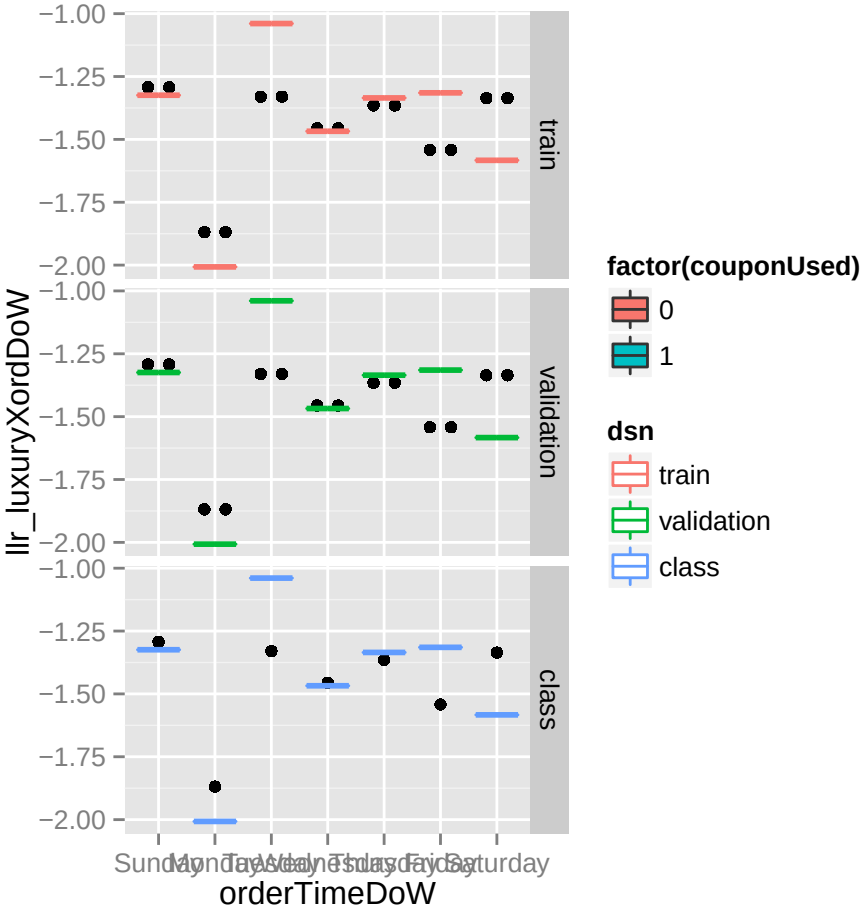
```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_luxuryXordDoW %>% filter(dsn == "train") %>% select(-dsn)
val = llr_luxuryXordDoW %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_luxuryXordDoW %>% filter(dsn == "class") %>% select(-dsn)

llr_luxuryXordDoW = list(T = trn, V = val, C = cls)

saveRDS(llr_luxuryXordDoW, "../features/feature_files/llr_luxuryXordDoW.rds")
```


Saturday
Friday
Thursday
Wednesday
Tuesday
Monday
Sunday
orderTimeDoW
0
1
premiumProduct
llr_luxuryXordDoW
−2.00
−1.75
−1.50
−1.25

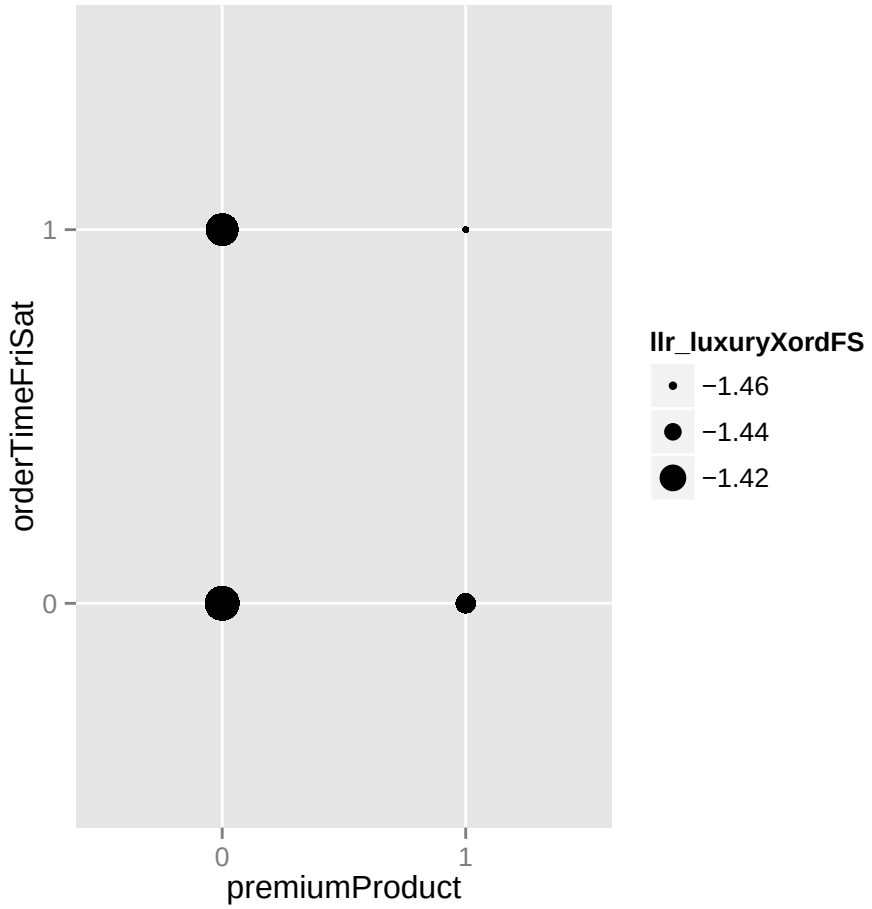

Sunday
Monday
Tuesday
Wednesda
Thursday
Friday
Saturday
−1.00
−1.25
−1.50
−1.75
−2.00
llr_luxuryXordDoW
0
1
premiumProduct

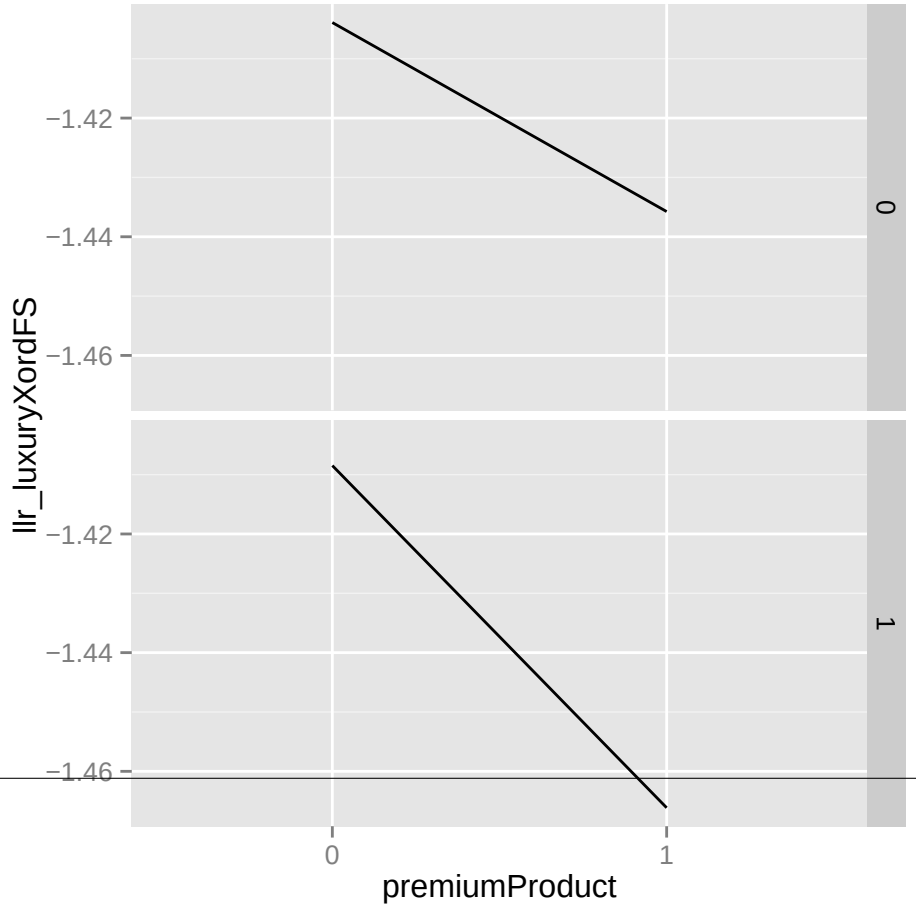


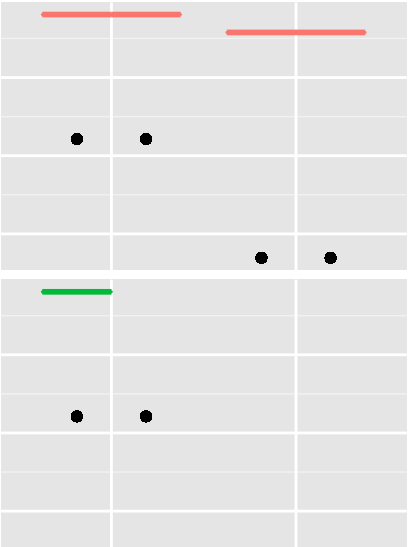
orderTimeFriSat (as `llr_luxuryXordFS`)

```
# orderTimeFriSat
llr = compute_ll_2w(as.character(H$premiumProduct), as.character(H$orderTimeFriSat), H$couponUsed, as.cl
    as.character(TVC$orderTimeFriSat))
llr_luxuryXordFS = data.frame(premiumProduct = TVC$premiumProduct, orderTimeFriSat = TVC$orderTimeFriSat
    arrange(premiumProduct)

ggplot(data = llr_luxuryXordFS, aes(x = premiumProduct, y = orderTimeFriSat, size = llr_luxuryXordFS), a
qplot(premiumProduct, llr_luxuryXordFS, data = llr_luxuryXordFS, geom = "line", group = orderTimeFriSat
    .)

TVC %>% left_join(llr_luxuryXordFS, by = c("premiumProduct", "orderTimeFriSat")) %>% select(orderID, pre
    orderTimeFriSat, llr_luxuryXordFS, couponUsed) %>% ggplot(aes(x = orderTimeFriSat, y = llr_luxuryXor
    color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_luxuryXordFS = TVC %>% left_join(llr_luxuryXordFS, by = c("premiumProduct", "orderTimeFriSat")) %>%
    dsn, llr_luxuryXordFS)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_luxuryXordFS %>% filter(dsn == "train") %>% select(-dsn)
val = llr_luxuryXordFS %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_luxuryXordFS %>% filter(dsn == "class") %>% select(-dsn)

llr_luxuryXordFS = list(T = trn, V = val, C = cls)

saveRDS(llr_luxuryXordFS, "../features/feature_files/llr_luxuryXordFS.rds")
```


orderTimeFriSat
1
0
0
1
premiumProduct
llr_luxuryXordFS
−1.46
−1.44
−1.42

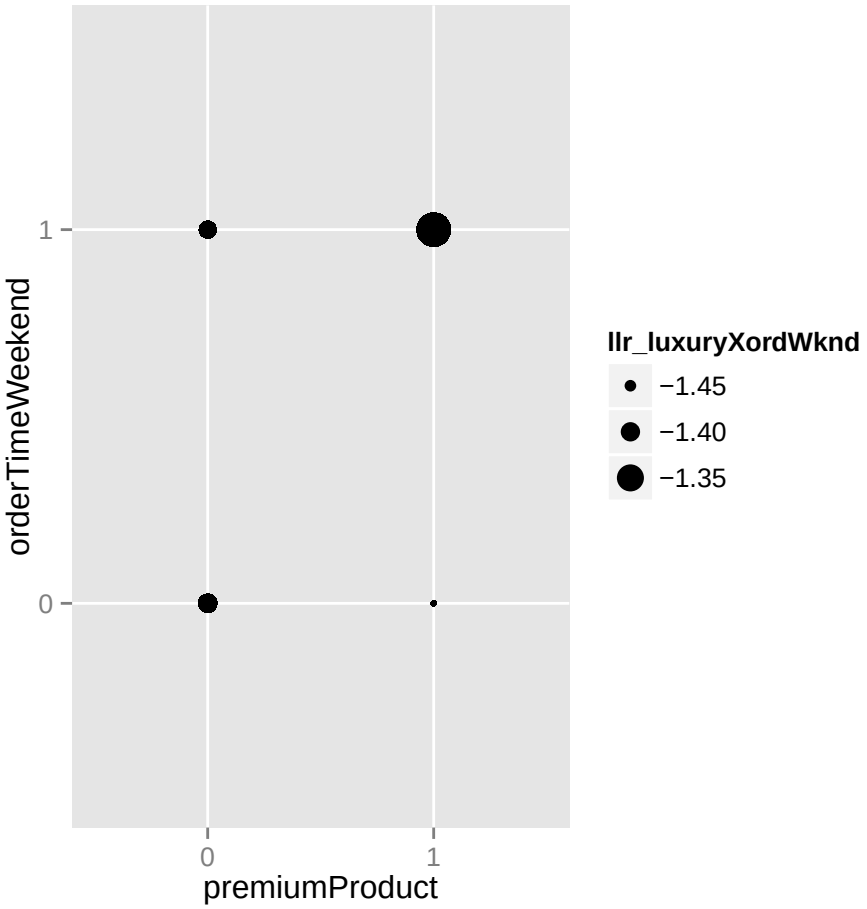

llr_luxuryXordFS
−1.42
−1.44
−1.46
0
1
premiumProduct

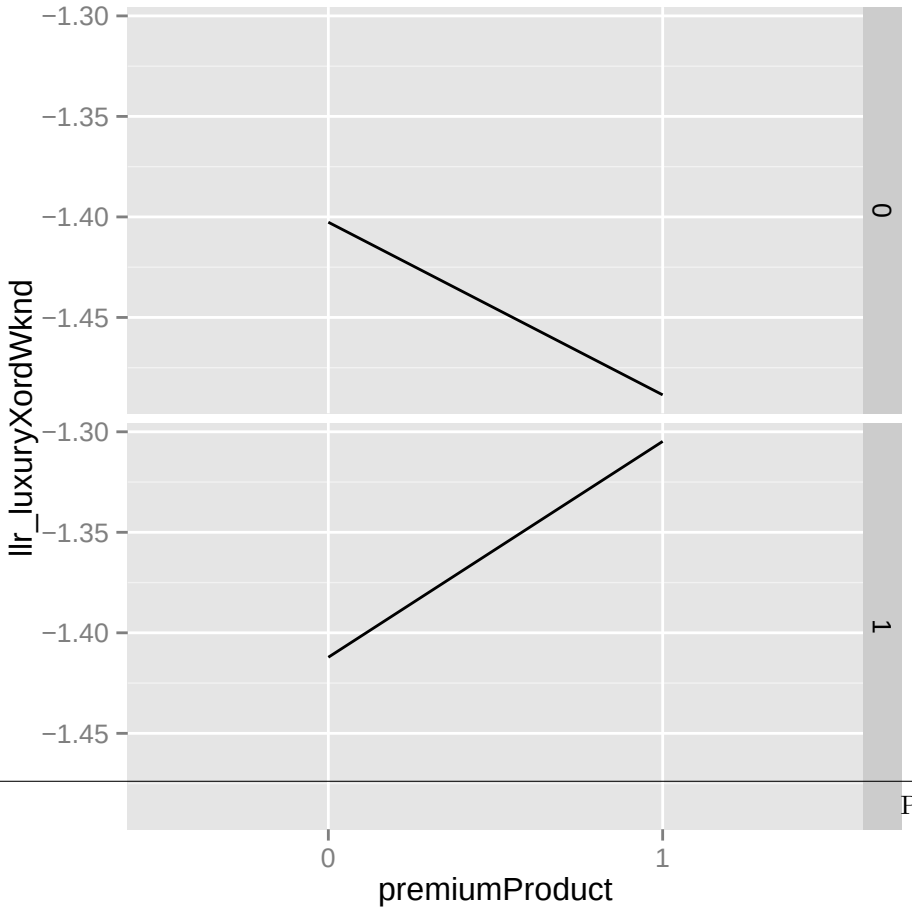


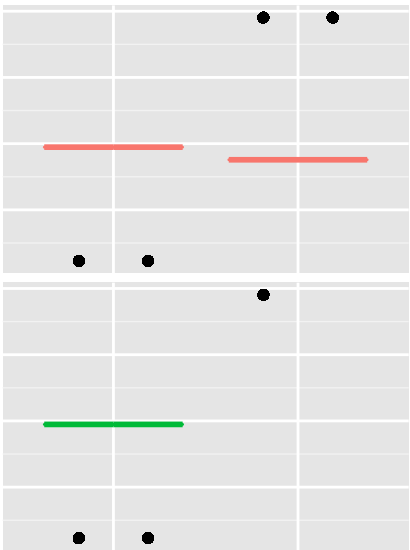
orderTimeWeekend (as `llr_luxuryXordWknd`)

```
# orderTimeWeekend
llr = compute_ll_2w(as.character(H$premiumProduct), as.character(H$orderTimeWeekend), H$couponUsed, as.c
    as.character(TVC$orderTimeWeekend))
llr_luxuryXordWknd = data.frame(premiumProduct = TVC$premiumProduct, orderTimeWeekend = TVC$orderTimeWee
    arrange(premiumProduct)

ggplot(data = llr_luxuryXordWknd, aes(x = premiumProduct, y = orderTimeWeekend, size = llr_luxuryXordWkn
    geom_point()
qplot(premiumProduct, llr_luxuryXordWknd, data = llr_luxuryXordWknd, geom = "line", group = orderTimeWee
    .)

TVC %>% left_join(llr_luxuryXordWknd, by = c("premiumProduct", "orderTimeWeekend")) %>% select(orderID,
    dsn, orderTimeWeekend, llr_luxuryXordWknd, couponUsed) %>% ggplot(aes(x = orderTimeWeekend, y = llr_
    fill = factor(couponUsed), color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_luxuryXordWknd = TVC %>% left_join(llr_luxuryXordWknd, by = c("premiumProduct", "orderTimeWeekend")
    dsn, llr_luxuryXordWknd)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_luxuryXordWknd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_luxuryXordWknd %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_luxuryXordWknd %>% filter(dsn == "class") %>% select(-dsn)

llr_luxuryXordWknd = list(T = trn, V = val, C = cls)

saveRDS(llr_luxuryXordWknd, "../features/feature_files/llr_luxuryXordWknd.rds")
```


orderTimeWeekend
1
0
0
1
premiumProduct
llr_luxuryXordWknd
−1.45
−1.40
−1.35

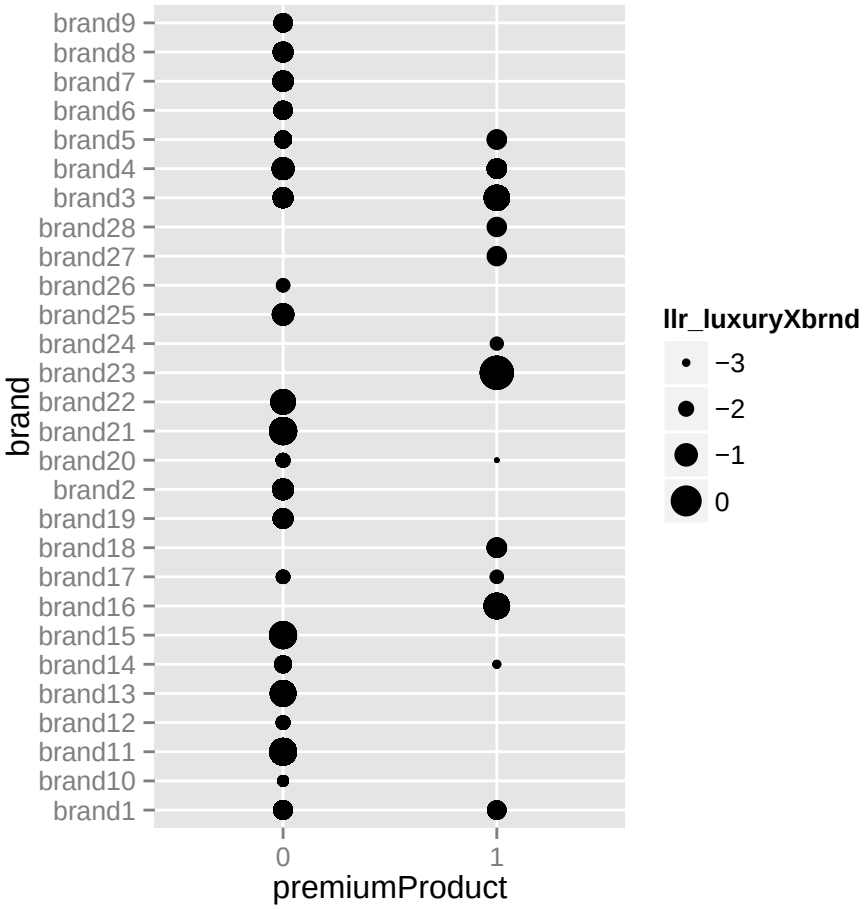

llr_luxuryXordWknd
−1.30
−1.35
−1.40
−1.45
0
1
premiumProduct

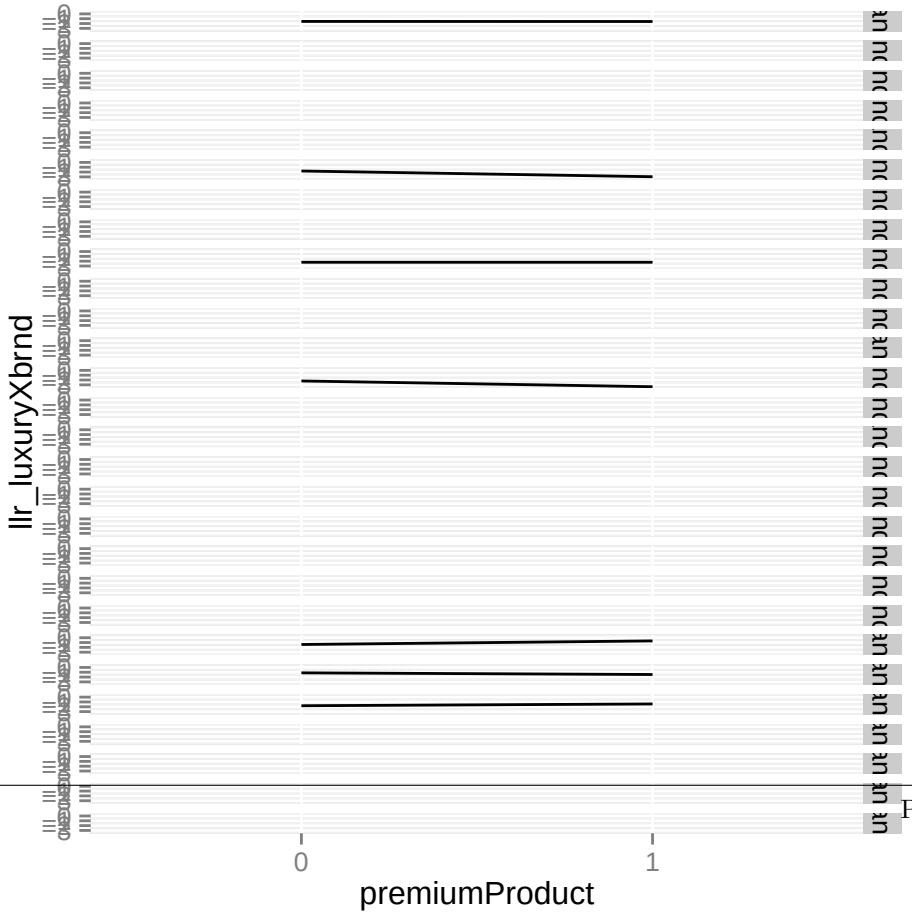


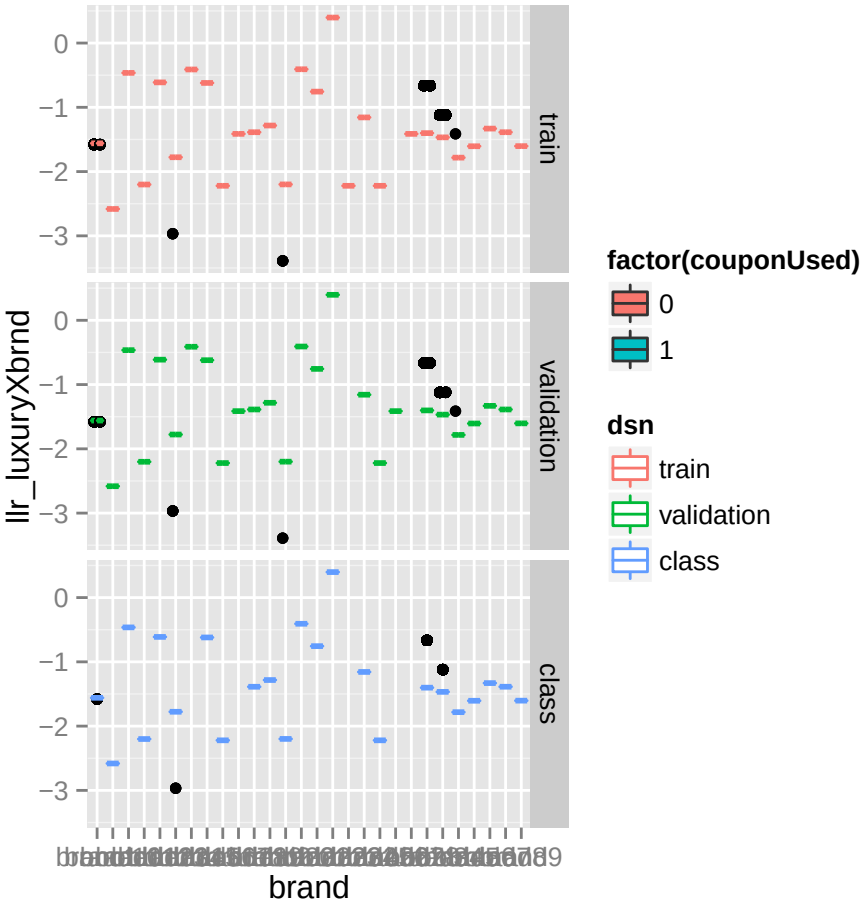
brand (as `llr_luxuryXbrnd`)

```
# brand
llr = compute_ll_2w(as.character(H$premiumProduct), as.character(H$brand), H$couponUsed, as.character(T
    as.character(TVC$brand))
llr_luxuryXbrnd = data.frame(premiumProduct = TVC$premiumProduct, brand = TVC$brand, llr_luxuryXbrnd = l

ggplot(data = llr_luxuryXbrnd, aes(x = premiumProduct, y = brand, size = llr_luxuryXbrnd), alpha = 0.1)
qplot(premiumProduct, llr_luxuryXbrnd, data = llr_luxuryXbrnd, geom = "line", group = brand, facets = bi

TVC %>% left_join(llr_luxuryXbrnd, by = c("premiumProduct", "brand")) %>% select(orderID, premiumProduct
    couponUsed) %>% ggplot(aes(x = brand, y = llr_luxuryXbrnd, fill = factor(couponUsed), color = dsn))
    facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_luxuryXbrnd = TVC %>% left_join(llr_luxuryXbrnd, by = c("premiumProduct", "brand")) %>% select(order

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_luxuryXbrnd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_luxuryXbrnd %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_luxuryXbrnd %>% filter(dsn == "class") %>% select(-dsn)

llr_luxuryXbrnd = list(T = trn, V = val, C = cls)

saveRDS(llr_luxuryXbrnd, "../features/feature_files/llr_luxuryXbrnd.rds")
```


brand9
brand8
brand7
brand6
brand5
brand4
brand3
brand28
brand27
brand26
brand25
brand24
brand23
brand22
brand21
brand20
brand2
brand19
brand18
brand17
brand16
brand15
brand14
brand13
brand12
brand11
brand10
brand1
brand
0
1
premiumProduct
llr_luxuryXbrnd
−3
−2
−1
0


llr_luxuryXbrnd
0
1
premiumProduct

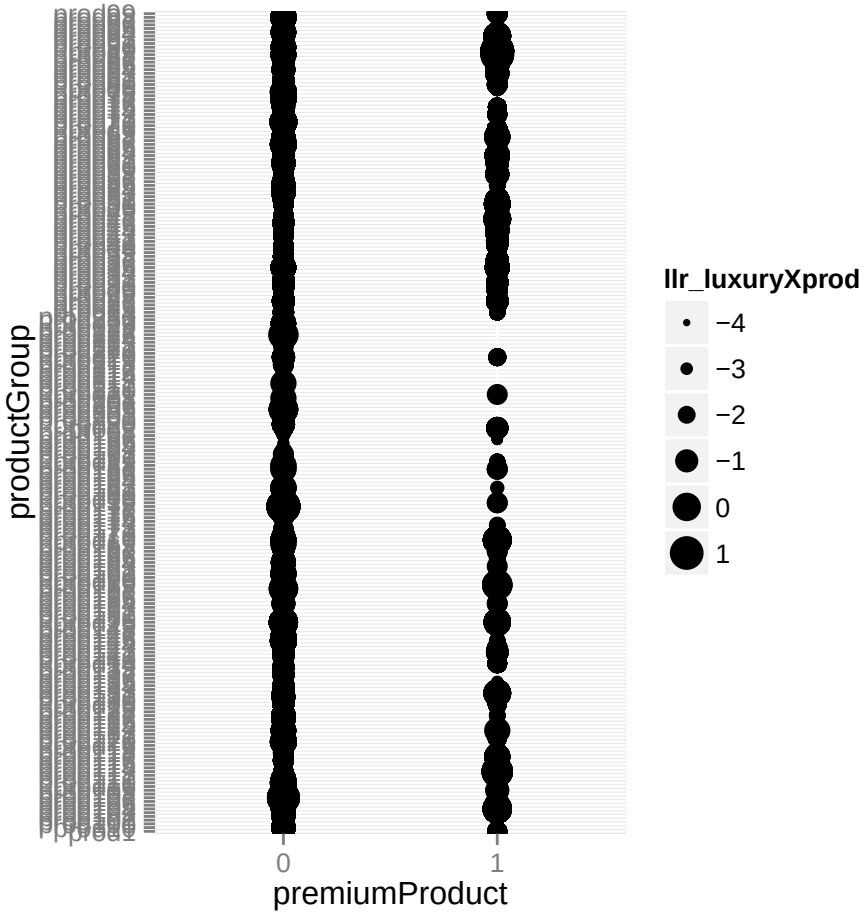


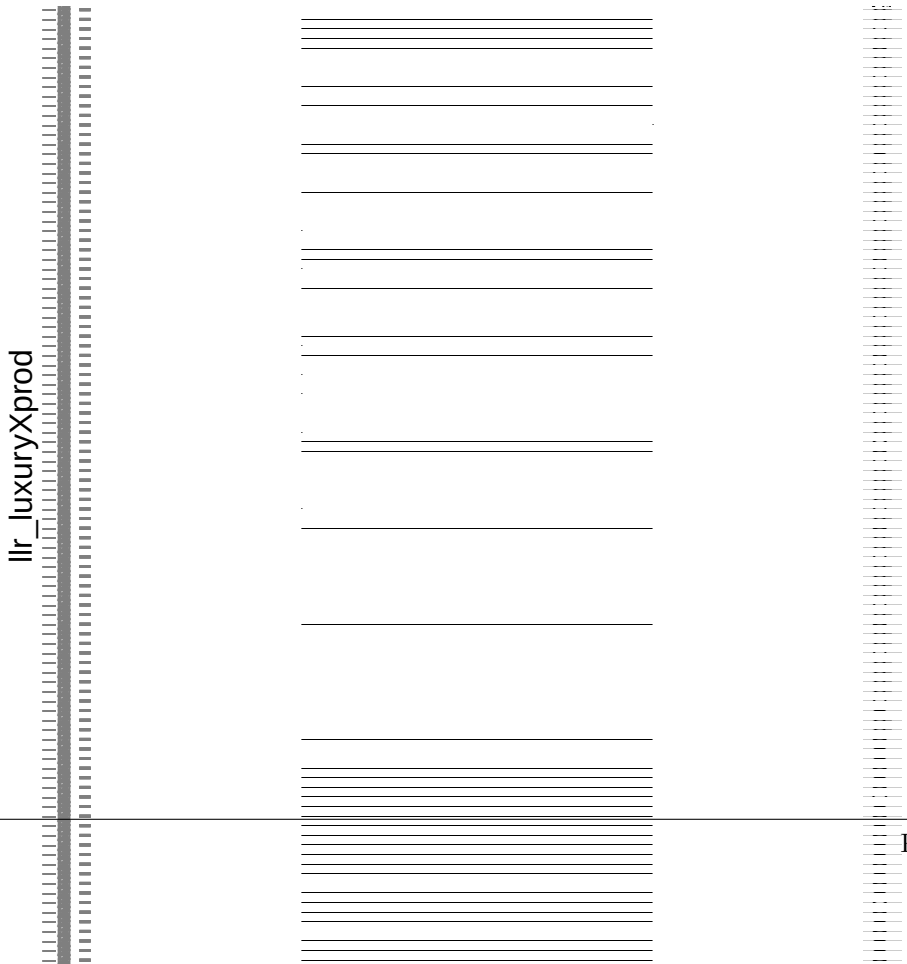
productGroup (as `llr_luxuryXprod`)

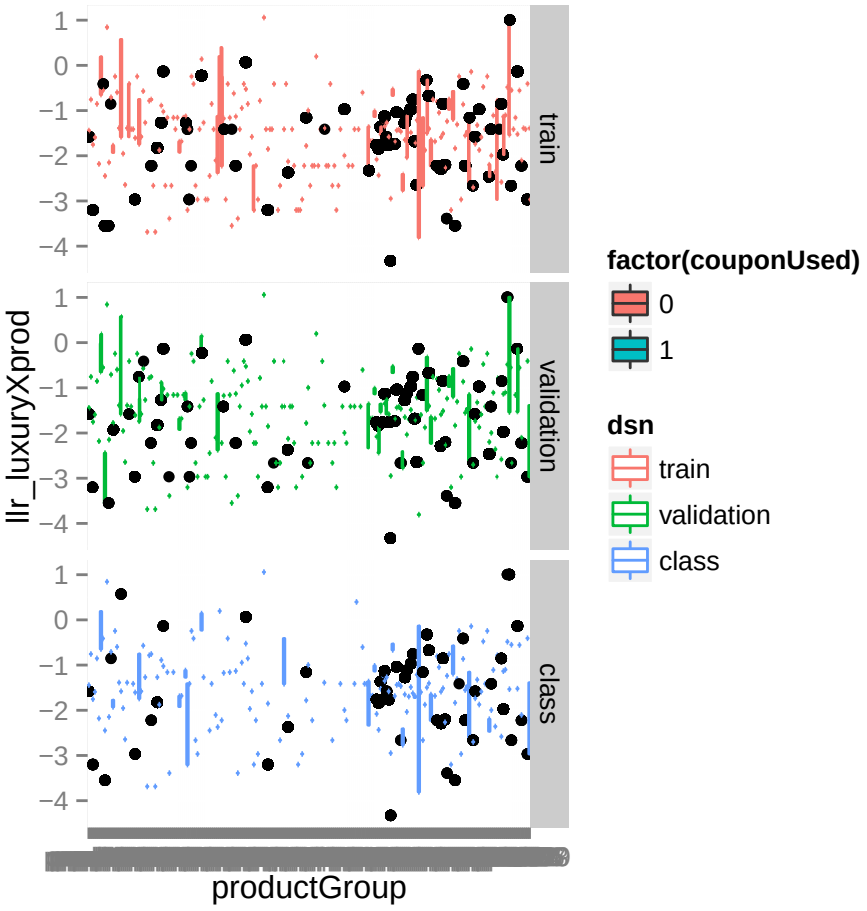
```
# productGroup
llr = compute_ll_2w(as.character(H$premiumProduct), as.character(H$productGroup), H$couponUsed, as.chara
    as.character(TVC$productGroup))
llr_luxuryXprod = data.frame(premiumProduct = TVC$premiumProduct, productGroup = TVC$productGroup, llr_l
    arrange(premiumProduct)

ggplot(data = llr_luxuryXprod, aes(x = premiumProduct, y = productGroup, size = llr_luxuryXprod), alpha
qplot(premiumProduct, llr_luxuryXprod, data = llr_luxuryXprod, geom = "line", group = productGroup, face
    .)

TVC %>% left_join(llr_luxuryXprod, by = c("premiumProduct", "productGroup")) %>% select(orderID, premiu
    llr_luxuryXprod, couponUsed) %>% ggplot(aes(x = productGroup, y = llr_luxuryXprod, fill = factor(cou
    geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_luxuryXprod = TVC %>% left_join(llr_luxuryXprod, by = c("premiumProduct", "productGroup")) %>% sele
    llr_luxuryXprod)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_luxuryXprod %>% filter(dsn == "train") %>% select(-dsn)
val = llr_luxuryXprod %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_luxuryXprod %>% filter(dsn == "class") %>% select(-dsn)

llr_luxuryXprod = list(T = trn, V = val, C = cls)

saveRDS(llr_luxuryXprod, "../features/feature_files/llr_luxuryXprod.rds")
```


productGroup
0
1
premiumProduct
llr_luxuryXprod
−4
−3
−2
−1
0
1


llr_luxuryXprod

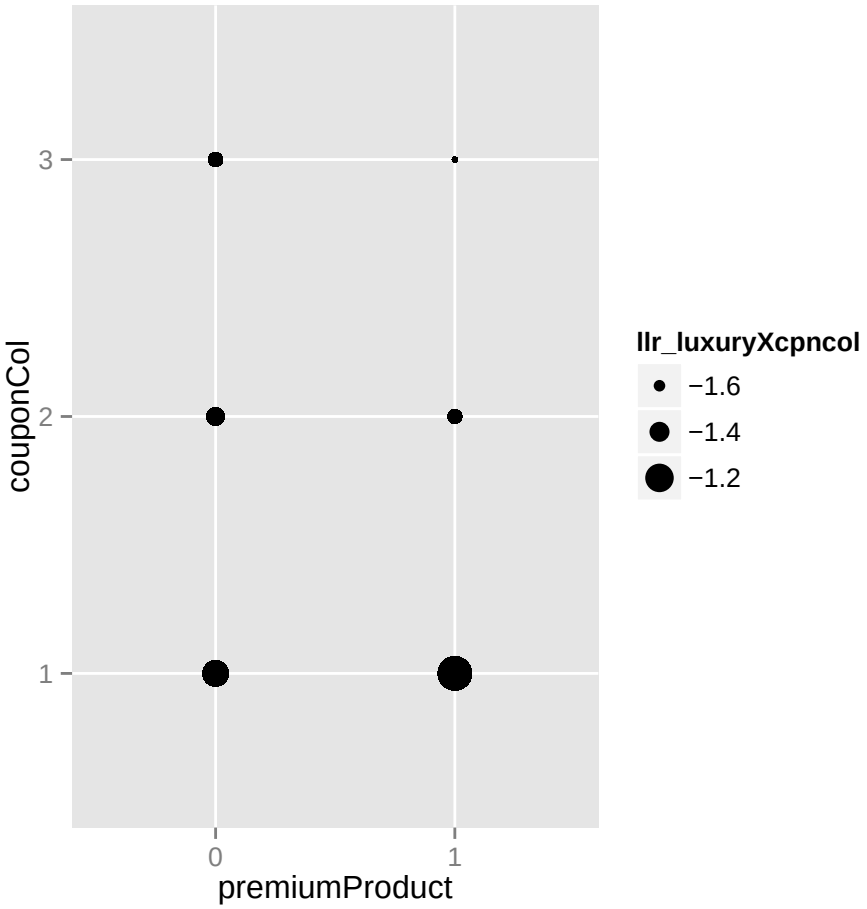


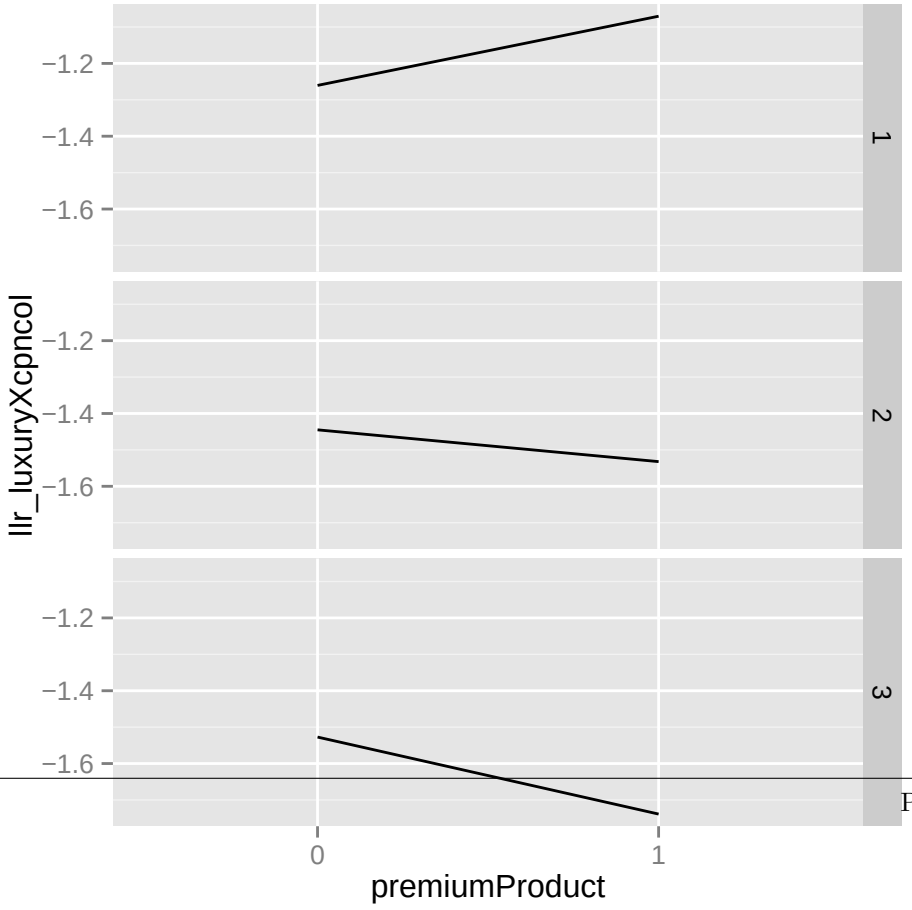
couponCol (as `llr_luxuryXcpncol`)

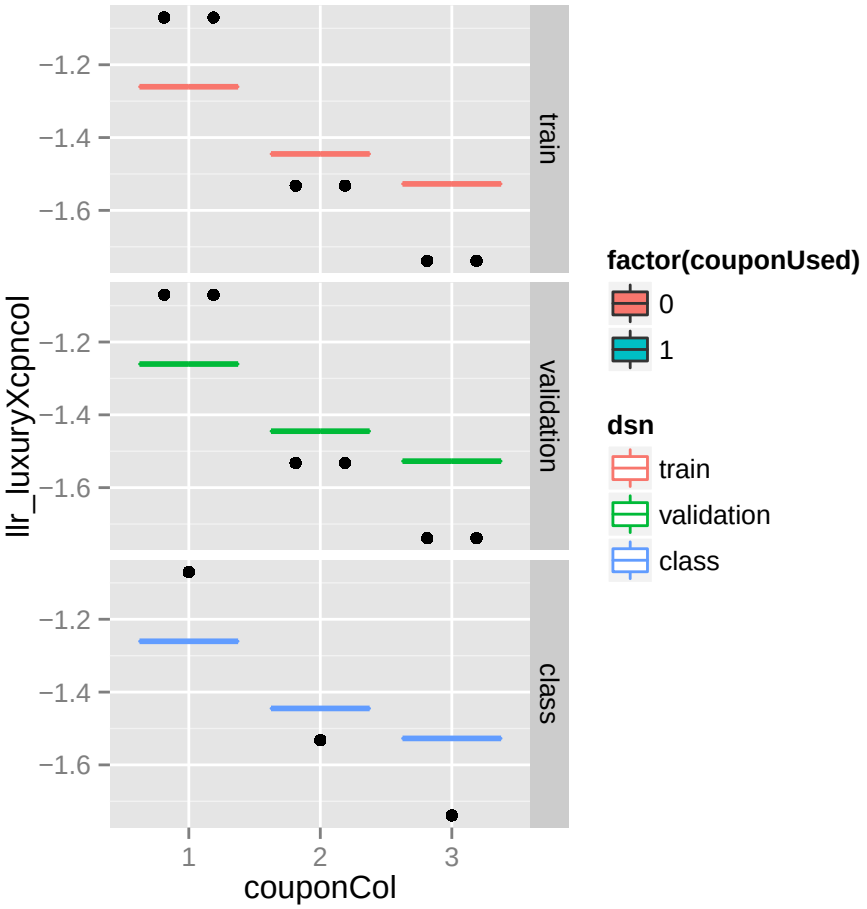
```
# couponCol
llr = compute_ll_2w(as.character(H$premiumProduct), as.character(H$couponCol), H$couponUsed, as.charact
    as.character(TVC$couponCol))
llr_luxuryXcpncol = data.frame(premiumProduct = TVC$premiumProduct, couponCol = TVC$couponCol, llr_luxu
    arrange(premiumProduct)

ggplot(data = llr_luxuryXcpncol, aes(x = premiumProduct, y = couponCol, size = llr_luxuryXcpncol), alpha
qplot(premiumProduct, llr_luxuryXcpncol, data = llr_luxuryXcpncol, geom = "line", group = couponCol, fa
    .)

TVC %>% left_join(llr_luxuryXcpncol, by = c("premiumProduct", "couponCol")) %>% select(orderID, premiuml
    llr_luxuryXcpncol, couponUsed) %>% ggplot(aes(x = couponCol, y = llr_luxuryXcpncol, fill = factor(co
    geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_luxuryXcpncol = TVC %>% left_join(llr_luxuryXcpncol, by = c("premiumProduct", "couponCol")) %>% sel
    llr_luxuryXcpncol)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_luxuryXcpncol %>% filter(dsn == "train") %>% select(-dsn)
val = llr_luxuryXcpncol %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_luxuryXcpncol %>% filter(dsn == "class") %>% select(-dsn)

llr_luxuryXcpncol = list(T = trn, V = val, C = cls)

saveRDS(llr_luxuryXcpncol, "../features/feature_files/llr_luxuryXcpncol.rds")
```


couponCol
3
2
1
0
1
premiumProduct
llr_luxuryXcpncol
−1.6
−1.4
−1.2


llr_luxuryXcpncol
−1.2
−1.4
−1.6
1
2
3
0
1
premiumProduct



0.4.4 brand and

couponsReceivedDoW (as `llr_brandXrecDoW`)

```
# couponsReceivedDoW
llr = compute_ll_2w(as.character(H$brand), as.character(H$couponsReceivedDoW), H$couponUsed, as.charact
llr_brandXrecDoW = data.frame(brand = TVC$brand, couponsReceivedDoW = TVC$couponsReceivedDoW, llr_brand
    arrange(brand)

ggplot(data = llr_brandXrecDoW, aes(x = brand, y = couponsReceivedDoW, size = llr_brandXrecDoW), alpha =
qplot(brand, llr_brandXrecDoW, data = llr_brandXrecDoW, geom = "line", group = couponsReceivedDoW, face
    .)

TVC %>% left_join(llr_brandXrecDoW, by = c("brand", "couponsReceivedDoW")) %>% select(orderID, brand, d
    llr_brandXrecDoW, couponUsed) %>% ggplot(aes(x = couponsReceivedDoW, y = llr_brandXrecDoW, fill = f
    color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)
```

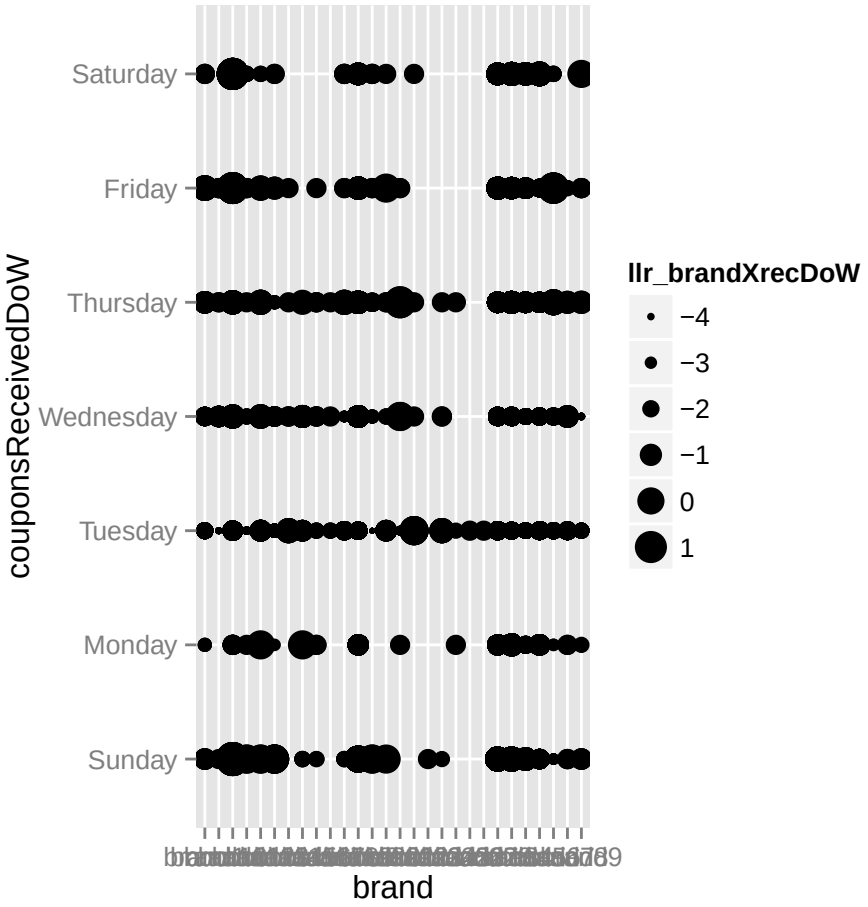
```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

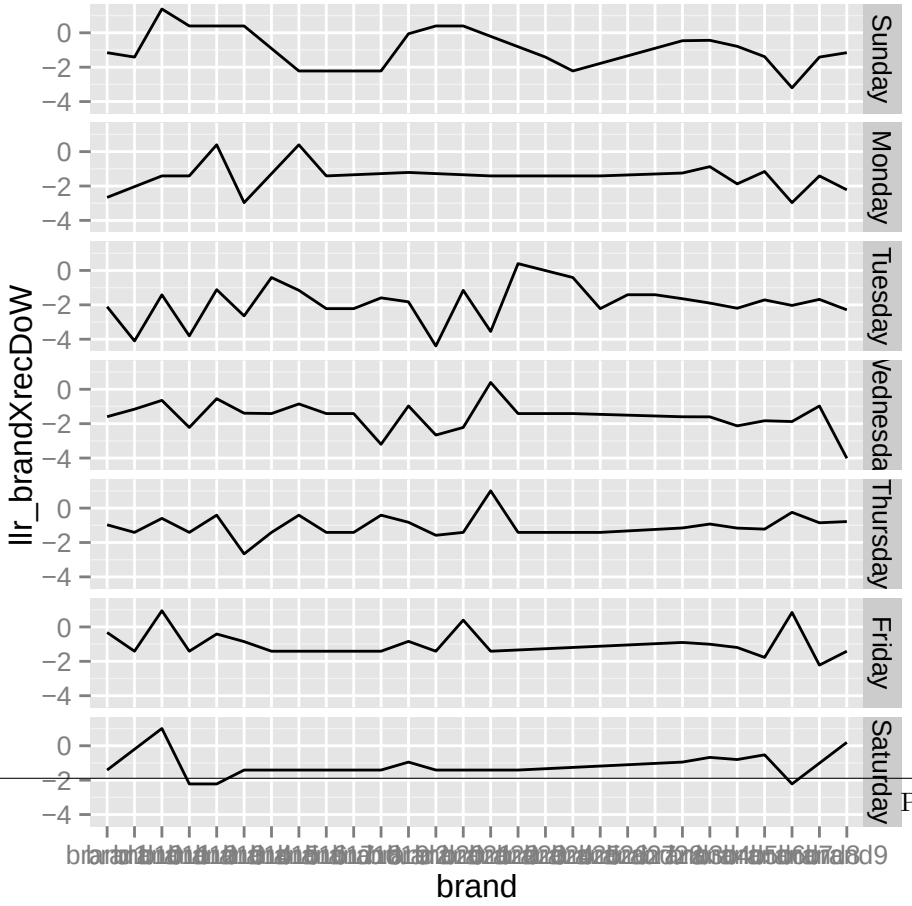
```
llr_brandXrecDoW = TVC %>% left_join(llr_brandXrecDoW, by = c("brand", "couponsReceivedDoW")) %>% selec
```

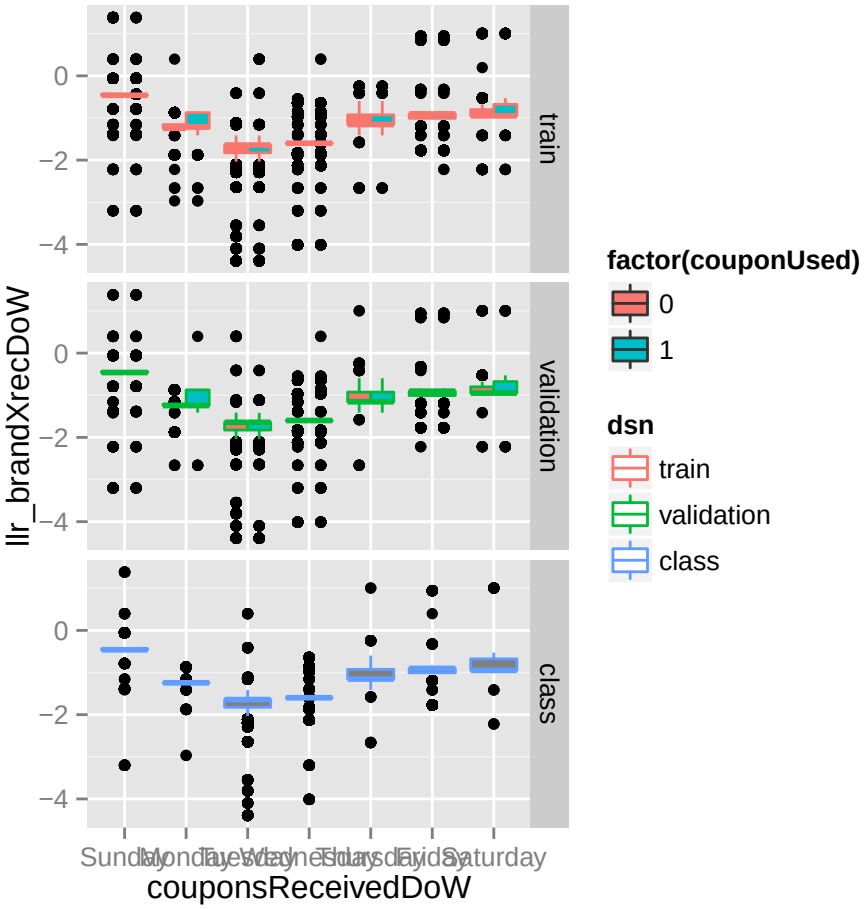
```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_brandXrecDoW %>% filter(dsn == "train") %>% select(-dsn)
val = llr_brandXrecDoW %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_brandXrecDoW %>% filter(dsn == "class") %>% select(-dsn)

llr_brandXrecDoW = list(T = trn, V = val, C = cls)

saveRDS(llr_brandXrecDoW, "../features/feature_files/llr_brandXrecDoW.rds")
```


Saturday
Friday
Thursday
Wednesday
Tuesday
Monday
Sunday
couponsReceivedDoW
brand
llr_brandXrecDoW
−4
−3
−2
−1
0
1

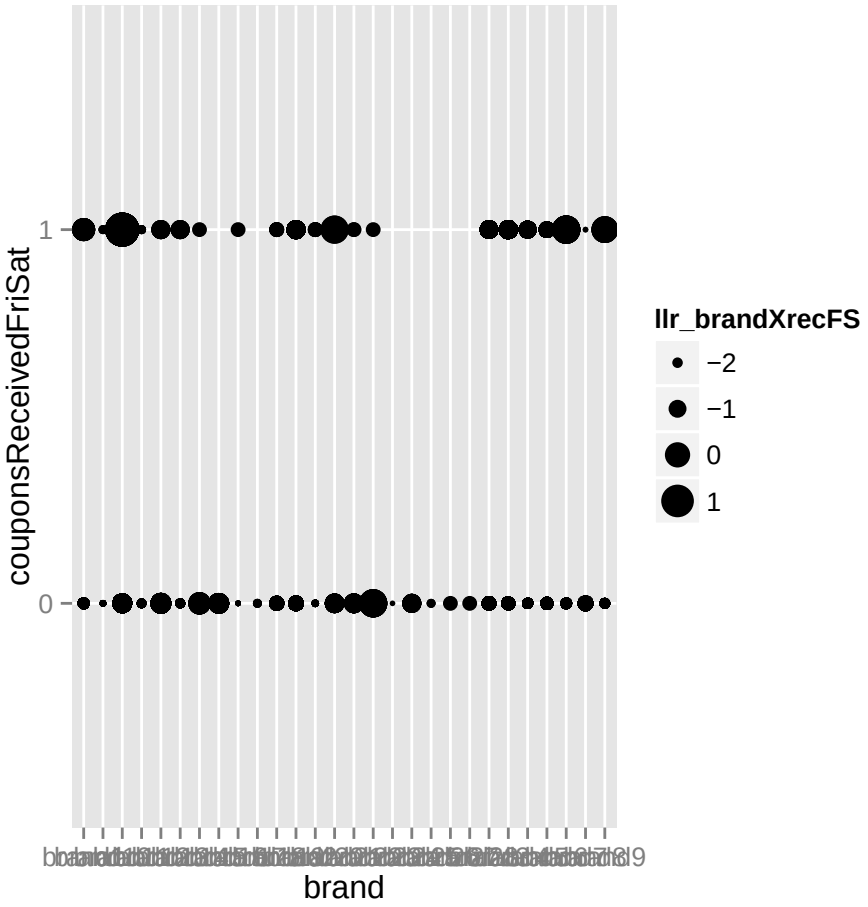

Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
llr_brandXrecDoW
0
−2
−4
brand

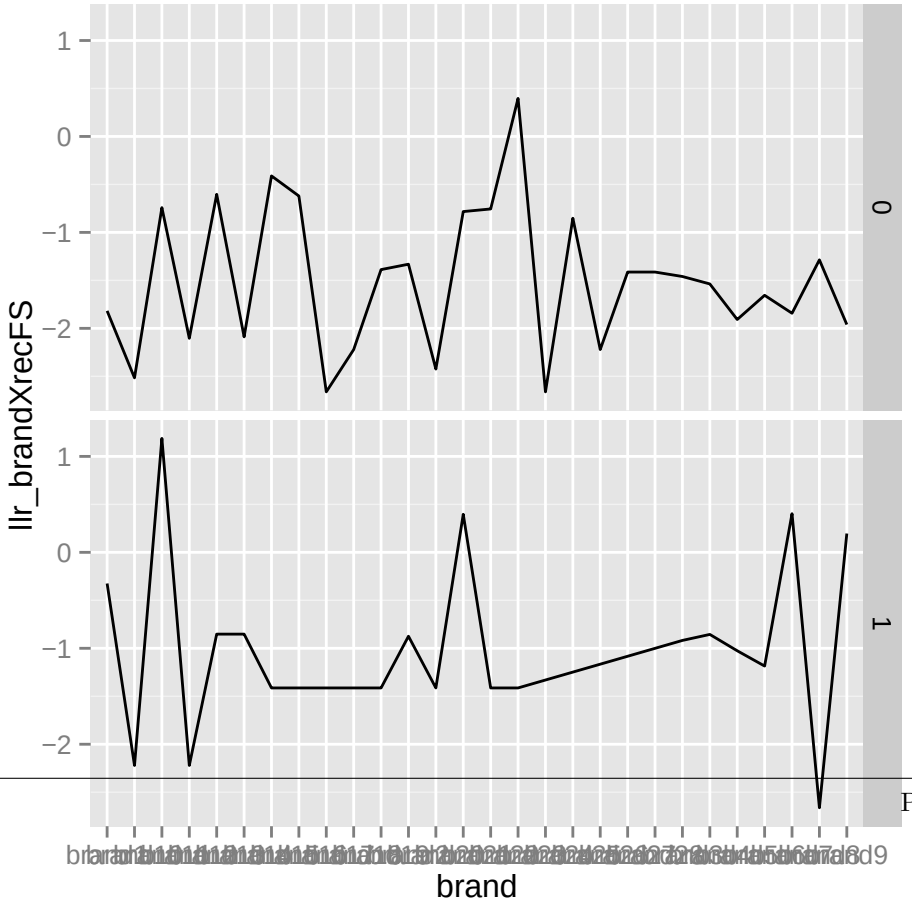


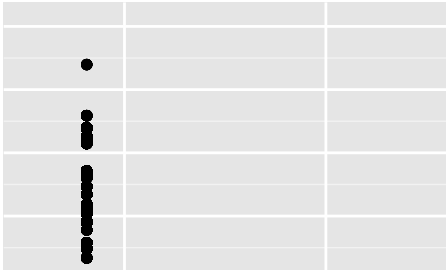
couponsReceivedFriSat (as `llr_brandXrecFS`)

```
# couponsReceivedFriSat
llr = compute_ll_2w(as.character(H$brand), as.character(H$couponsReceivedFriSat), H$couponUsed, as.chara
    as.character(TVC$couponsReceivedFriSat))
llr_brandXrecFS = data.frame(brand = TVC$brand, couponsReceivedFriSat = TVC$couponsReceivedFriSat, llr_
    arrange(brand)

ggplot(data = llr_brandXrecFS, aes(x = brand, y = couponsReceivedFriSat, size = llr_brandXrecFS), alpha
qplot(brand, llr_brandXrecFS, data = llr_brandXrecFS, geom = "line", group = couponsReceivedFriSat, face
    .)

TVC %>% left_join(llr_brandXrecFS, by = c("brand", "couponsReceivedFriSat")) %>% select(orderID, brand,
    llr_brandXrecFS, couponUsed) %>% ggplot(aes(x = couponsReceivedFriSat, y = llr_brandXrecFS, fill =
    color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_brandXrecFS = TVC %>% left_join(llr_brandXrecFS, by = c("brand", "couponsReceivedFriSat")) %>% sele
    llr_brandXrecFS)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_brandXrecFS %>% filter(dsn == "train") %>% select(-dsn)
val = llr_brandXrecFS %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_brandXrecFS %>% filter(dsn == "class") %>% select(-dsn)

llr_brandXrecFS = list(T = trn, V = val, C = cls)

saveRDS(llr_brandXrecFS, "../features/feature_files/llr_brandXrecFS.rds")
```


couponsReceivedFriSat
1
0
brand
llr_brandXrecFS
−2
−1
0
1

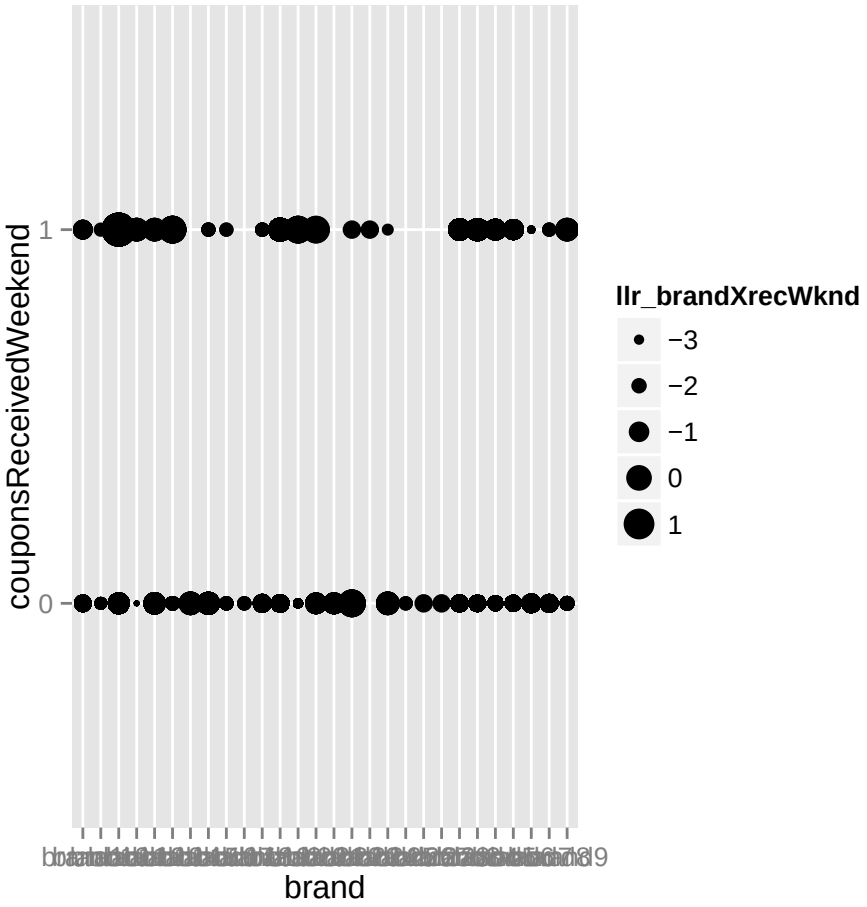

llr_brandXrecFS
1
0
−1
−2
0
1
brand

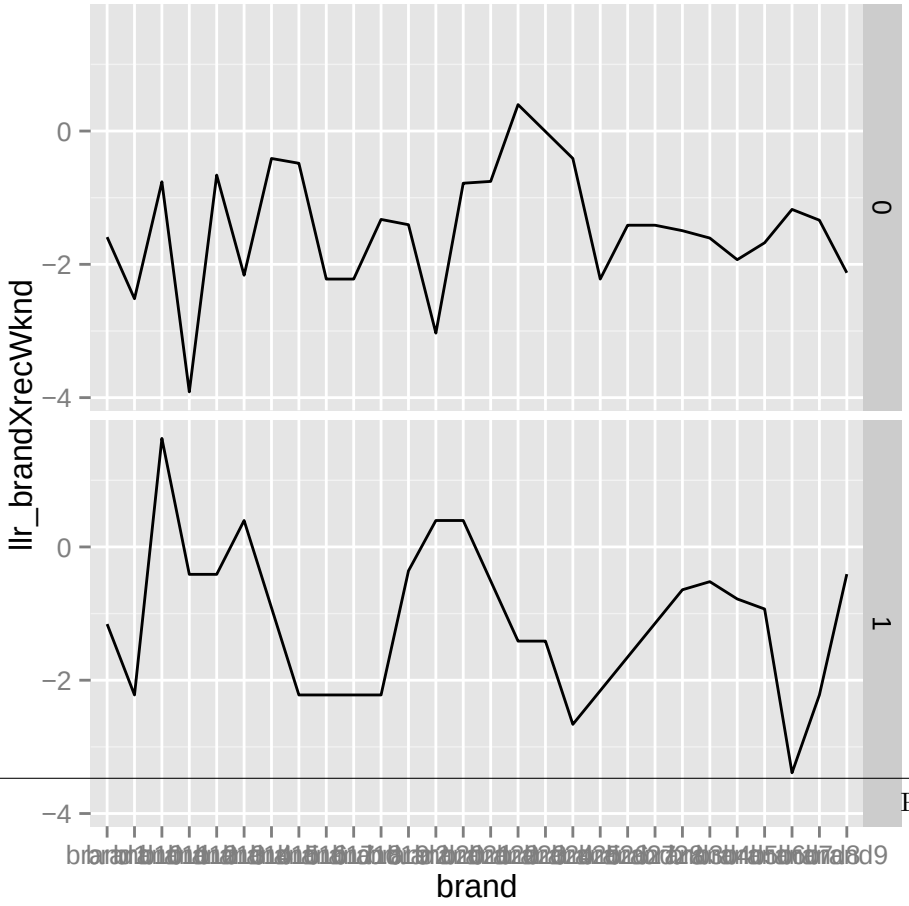


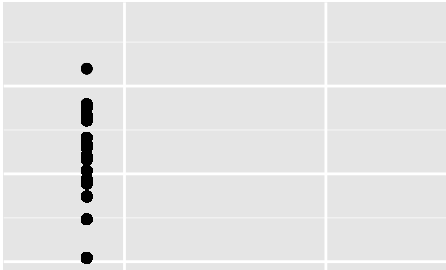
couponsReceivedWeekend (as `llr_brandXrecWknd`)

```
# couponsReceivedWeekend
llr = compute_ll_2w(as.character(H$brand), as.character(H$couponsReceivedWeekend), H$couponUsed, as.char
    as.character(TVC$couponsReceivedWeekend))
llr_brandXrecWknd = data.frame(brand = TVC$brand, couponsReceivedWeekend = TVC$couponsReceivedWeekend, l
    arrange(brand)

ggplot(data = llr_brandXrecWknd, aes(x = brand, y = couponsReceivedWeekend, size = llr_brandXrecWknd), a
qplot(brand, llr_brandXrecWknd, data = llr_brandXrecWknd, geom = "line", group = couponsReceivedWeekend
    .)

TVC %>% left_join(llr_brandXrecWknd, by = c("brand", "couponsReceivedWeekend")) %>% select(orderID, bran
    llr_brandXrecWknd, couponUsed) %>% ggplot(aes(x = couponsReceivedWeekend, y = llr_brandXrecWknd, fil
    color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_brandXrecWknd = TVC %>% left_join(llr_brandXrecWknd, by = c("brand", "couponsReceivedWeekend")) %>%
    dsn, llr_brandXrecWknd)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_brandXrecWknd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_brandXrecWknd %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_brandXrecWknd %>% filter(dsn == "class") %>% select(-dsn)

llr_brandXrecWknd = list(T = trn, V = val, C = cls)

saveRDS(llr_brandXrecWknd, "../features/feature_files/llr_brandXrecWknd.rds")
```


couponsReceivedWeekend
1
0
brand
llr_brandXrecWknd
−3
−2
−1
0
1


llr_brandXrecWknd
0
−2
−4
0
−2
−4
0
1
brand



orderTimeDoW (as `llr_brandXordDoW`)

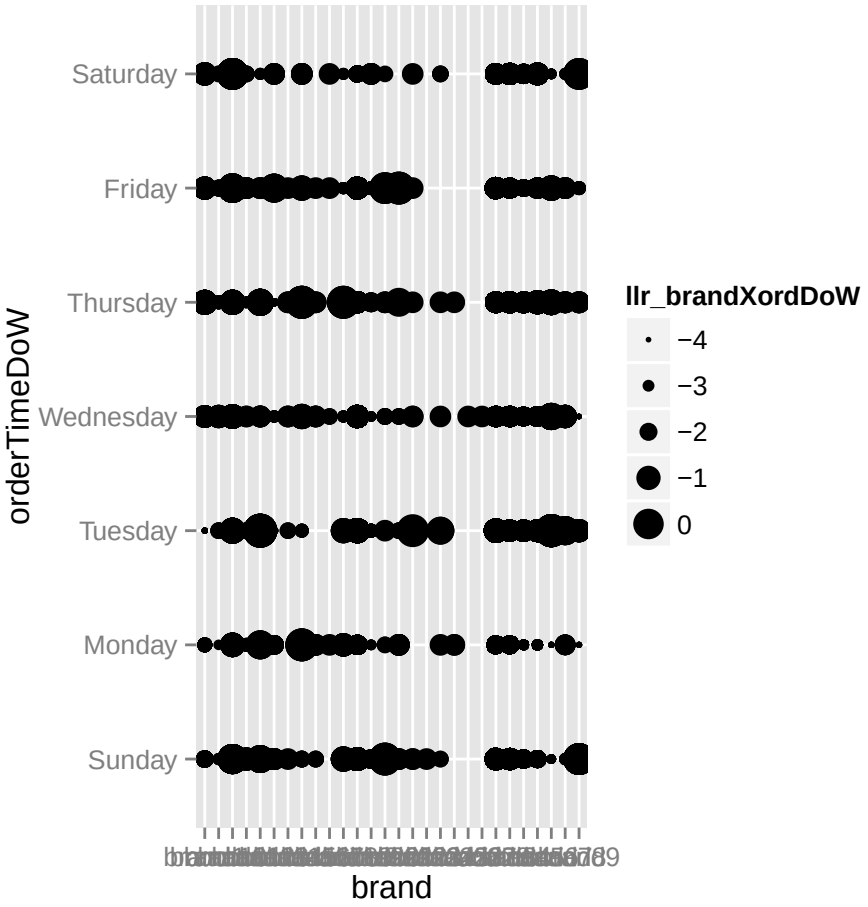
```
# orderTimeDoW
llr = compute_ll_2w(as.character(H$brand), as.character(H$orderTimeDoW), H$couponUsed, as.character(TVC$
llr_brandXordDoW = data.frame(brand = TVC$brand, orderTimeDoW = TVC$orderTimeDoW, llr_brandXordDoW = lli

ggplot(data = llr_brandXordDoW, aes(x = brand, y = orderTimeDoW, size = llr_brandXordDoW), alpha = 0.1)
qplot(brand, llr_brandXordDoW, data = llr_brandXordDoW, geom = "line", group = orderTimeDoW, facets = or

TVC %>% left_join(llr_brandXordDoW, by = c("brand", "orderTimeDoW")) %>% select(orderID, brand, dsn, ord
    couponUsed) %>% ggplot(aes(x = orderTimeDoW, y = llr_brandXordDoW, fill = factor(couponUsed), color
    facet_grid(dsn ~ .)
```

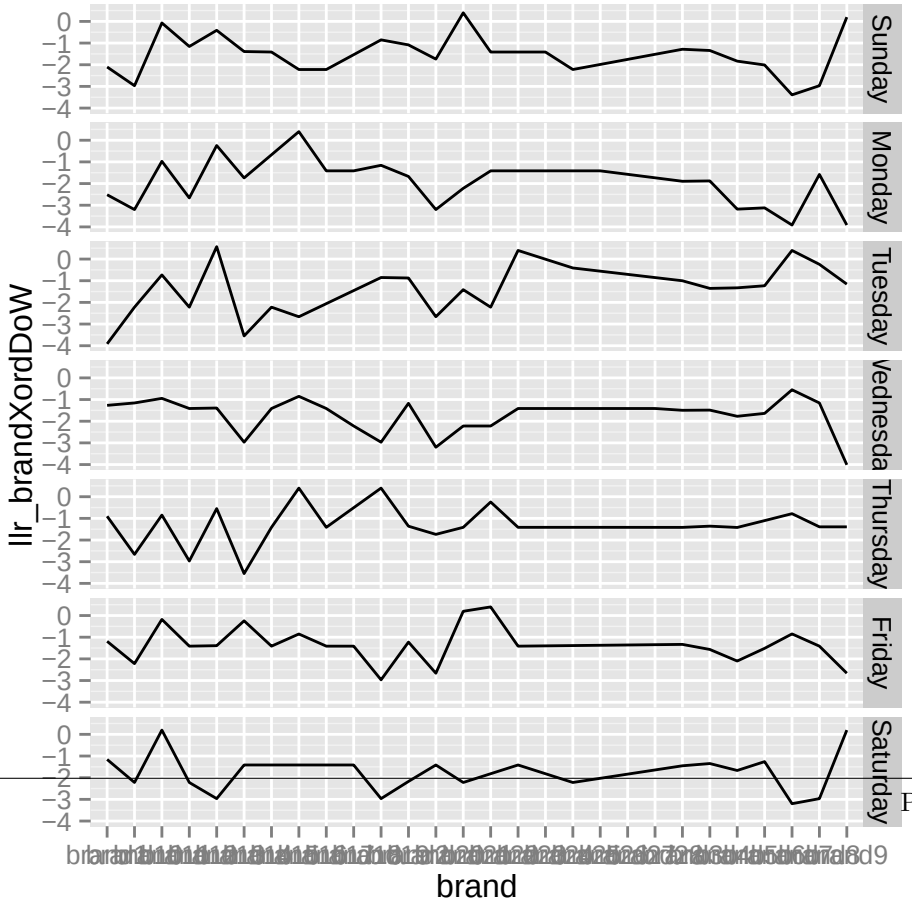
```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

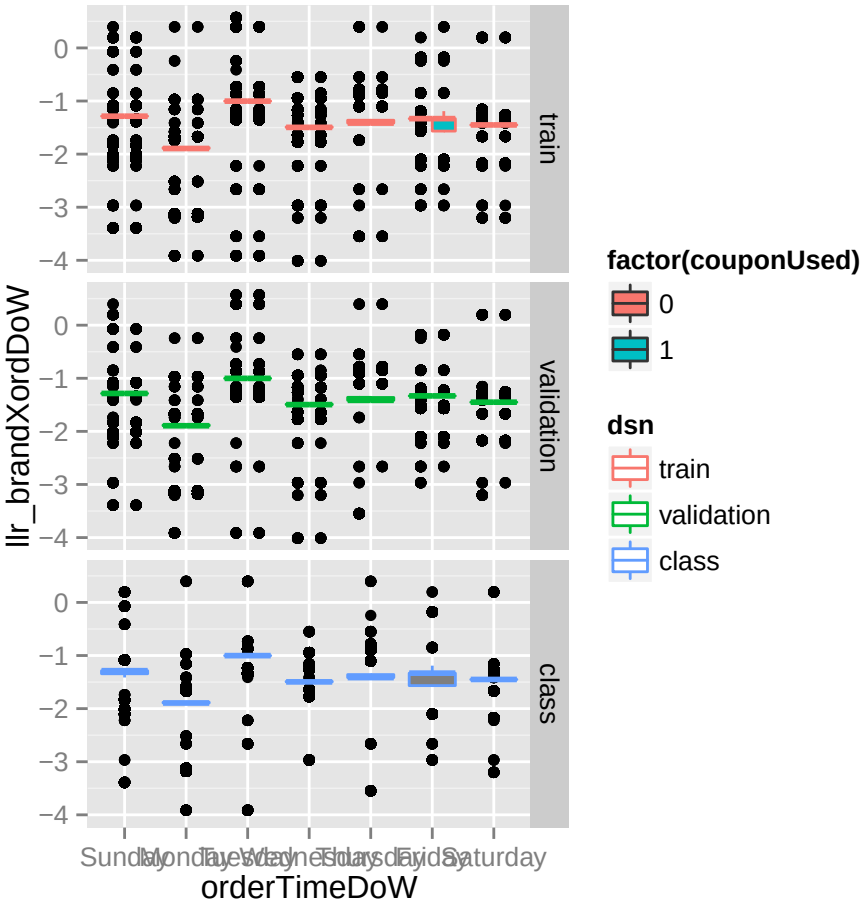
```
llr_brandXordDoW = TVC %>% left_join(llr_brandXordDoW, by = c("brand", "orderTimeDoW")) %>% select(order
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_brandXordDoW %>% filter(dsn == "train") %>% select(-dsn)
val = llr_brandXordDoW %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_brandXordDoW %>% filter(dsn == "class") %>% select(-dsn)

llr_brandXordDoW = list(T = trn, V = val, C = cls)

saveRDS(llr_brandXordDoW, "../features/feature_files/llr_brandXordDoW.rds")
```


Saturday
Friday
Thursday
Wednesday
Tuesday
Monday
Sunday
orderTimeDoW
brand
llr_brandXordDoW
−4
−3
−2
−1
0

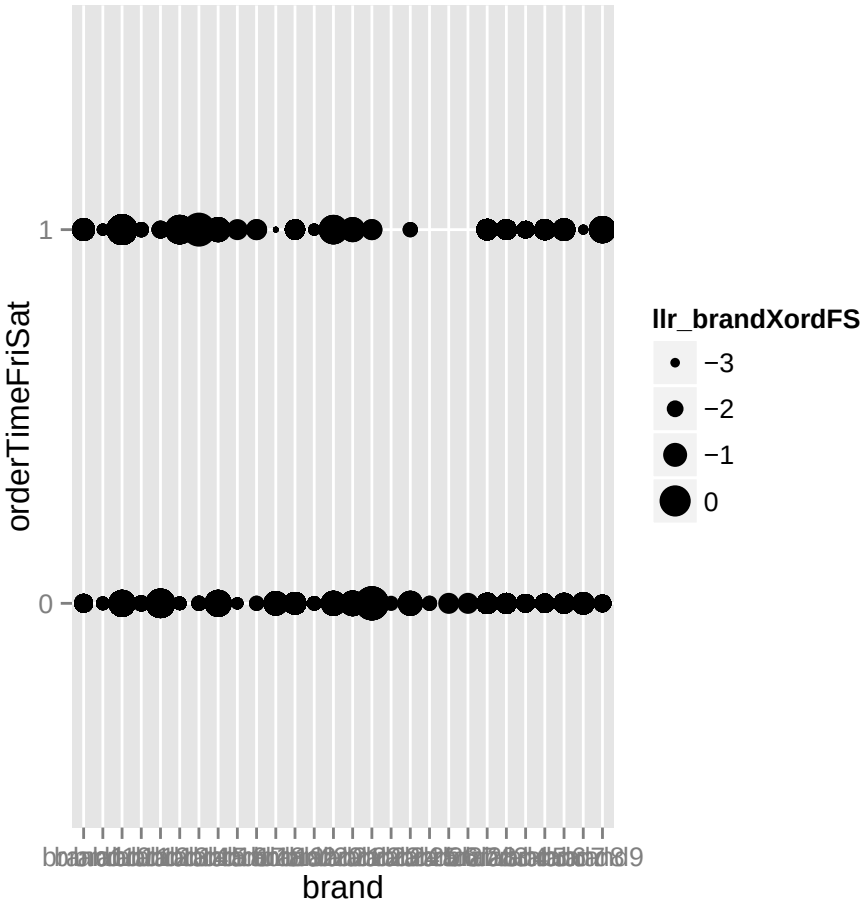

Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
llr_brandXordDoW
brand
0
−1
−2
−3
−4

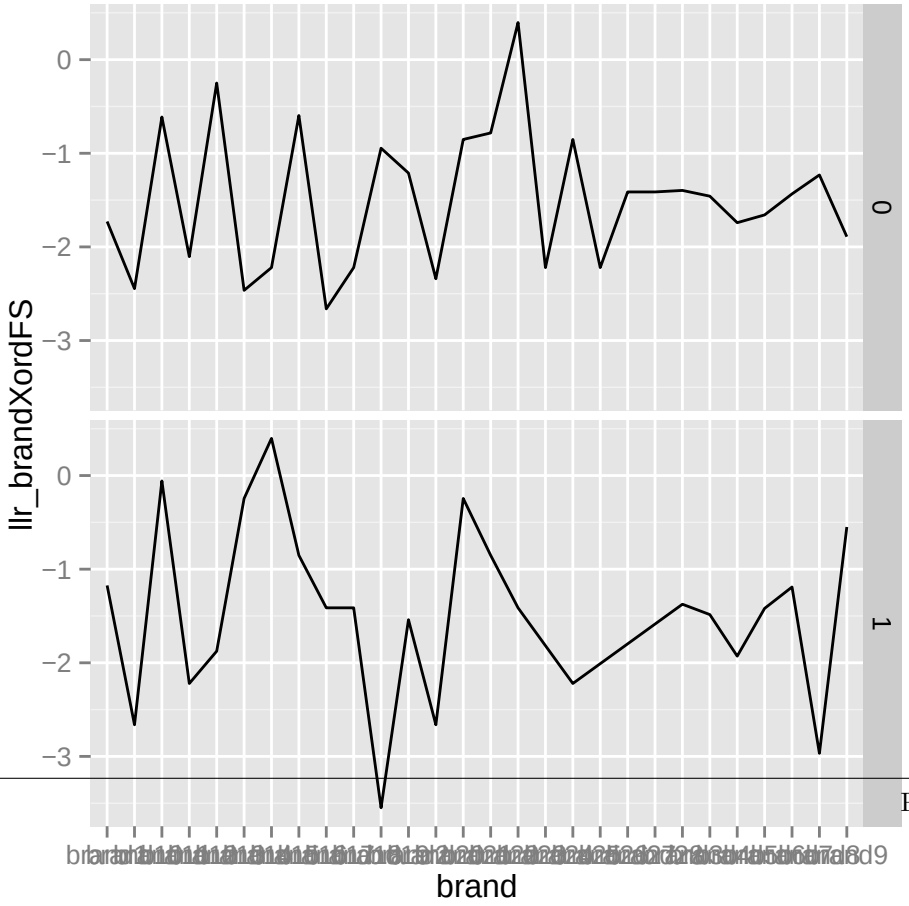


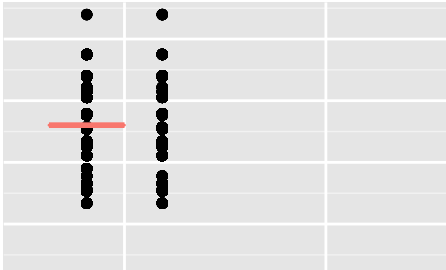
orderTimeFriSat (as `llr_brandXordFS`)

```
# orderTimeFriSat
llr = compute_ll_2w(as.character(H$brand), as.character(H$orderTimeFriSat), H$couponUsed, as.character(
llr_brandXordFS = data.frame(brand = TVC$brand, orderTimeFriSat = TVC$orderTimeFriSat, llr_brandXordFS =

ggplot(data = llr_brandXordFS, aes(x = brand, y = orderTimeFriSat, size = llr_brandXordFS), alpha = 0.1
qplot(brand, llr_brandXordFS, data = llr_brandXordFS, geom = "line", group = orderTimeFriSat, facets = 
    .)

TVC %>% left_join(llr_brandXordFS, by = c("brand", "orderTimeFriSat")) %>% select(orderID, brand, dsn, 
    llr_brandXordFS, couponUsed) %>% ggplot(aes(x = orderTimeFriSat, y = llr_brandXordFS, fill = factor
    geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_brandXordFS = TVC %>% left_join(llr_brandXordFS, by = c("brand", "orderTimeFriSat")) %>% select(orde

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_brandXordFS %>% filter(dsn == "train") %>% select(-dsn)
val = llr_brandXordFS %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_brandXordFS %>% filter(dsn == "class") %>% select(-dsn)
```

```
llr_brandXordFS = list(T = trn, V = val, C = cls)

saveRDS(llr_brandXordFS, "../features/feature_files/llr_brandXordFS.rds")
```


orderTimeFriSat
1
0
brand
llr_brandXordFS
−3
−2
−1
0

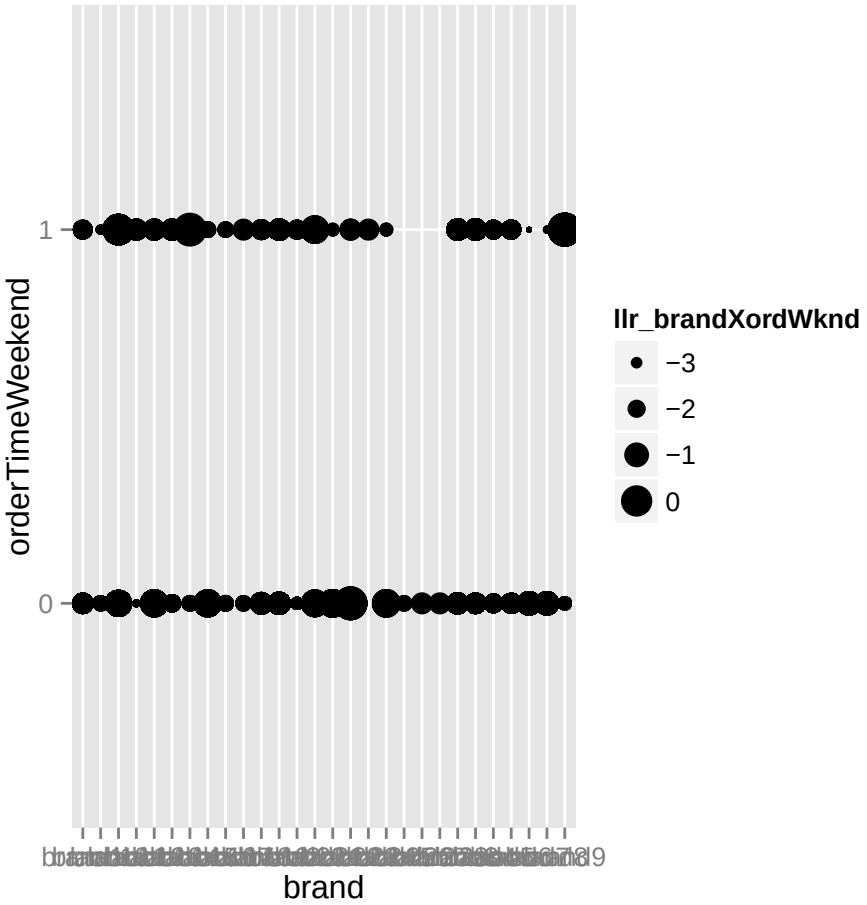

llr_brandXordFS
0
−1
−2
−3
0
1
brand

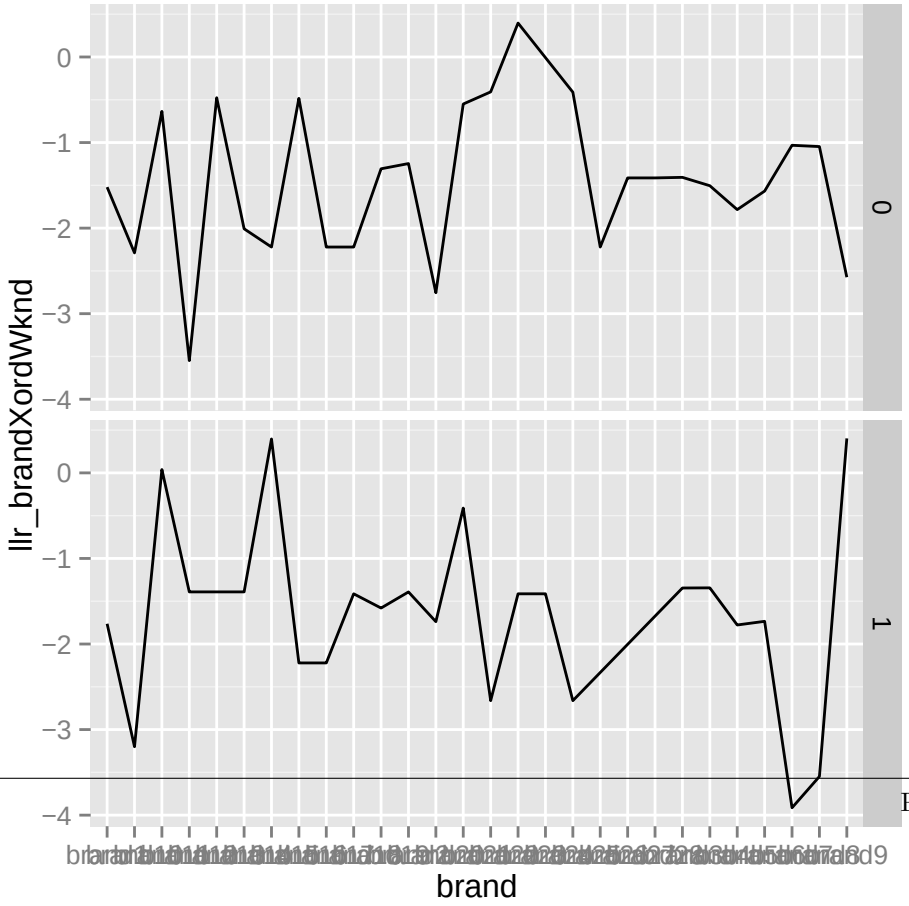


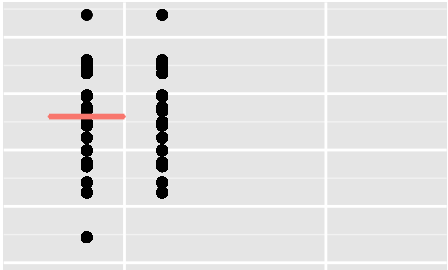
orderTimeWeekend (as `llr_brandXordWknd`)

```
# orderTimeWeekend
llr = compute_ll_2w(as.character(H$brand), as.character(H$orderTimeWeekend), H$couponUsed, as.character
llr_brandXordWknd = data.frame(brand = TVC$brand, orderTimeWeekend = TVC$orderTimeWeekend, llr_brandXord
    arrange(brand)

ggplot(data = llr_brandXordWknd, aes(x = brand, y = orderTimeWeekend, size = llr_brandXordWknd), alpha =
qplot(brand, llr_brandXordWknd, data = llr_brandXordWknd, geom = "line", group = orderTimeWeekend, face
    .)

TVC %>% left_join(llr_brandXordWknd, by = c("brand", "orderTimeWeekend")) %>% select(orderID, brand, ds
    llr_brandXordWknd, couponUsed) %>% ggplot(aes(x = orderTimeWeekend, y = llr_brandXordWknd, fill = fa
    color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_brandXordWknd = TVC %>% left_join(llr_brandXordWknd, by = c("brand", "orderTimeWeekend")) %>% selec

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_brandXordWknd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_brandXordWknd %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_brandXordWknd %>% filter(dsn == "class") %>% select(-dsn)
```

```
llr_brandXordWknd = list(T = trn, V = val, C = cls)

saveRDS(llr_brandXordWknd, "../features/feature_files/llr_brandXordWknd.rds")
```


orderTimeWeekend
1
0
brand
llr_brandXordWknd
−3
−2
−1
0

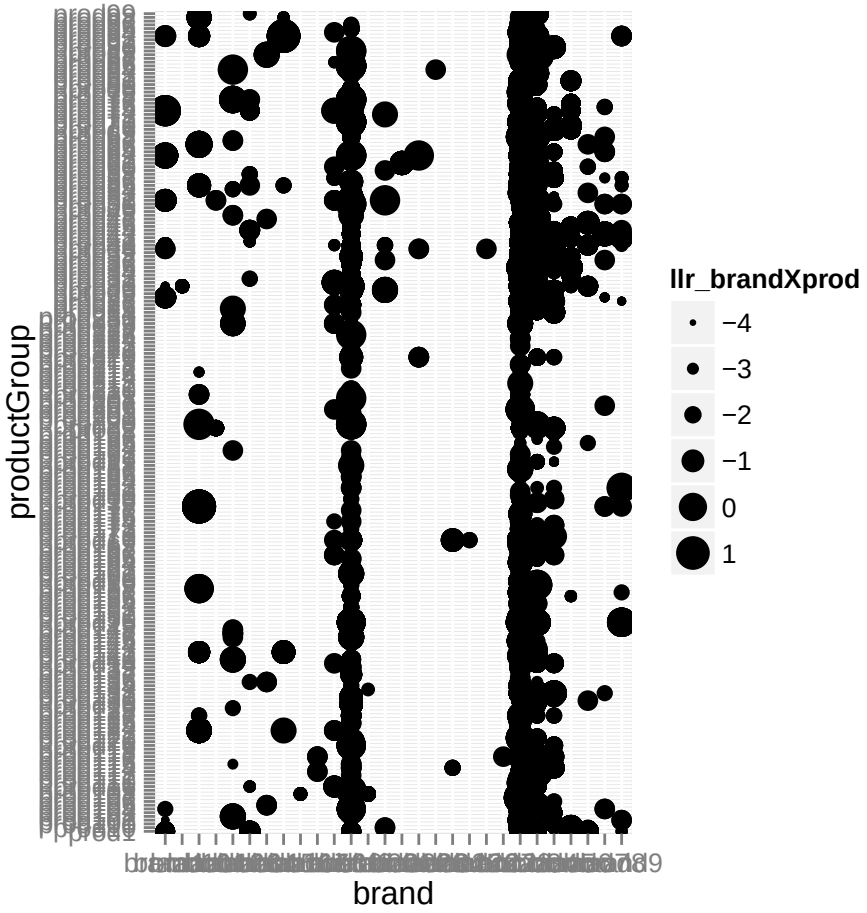

llr_brandXordWknd
0
−1
−2
−3
−4
0
1
brand

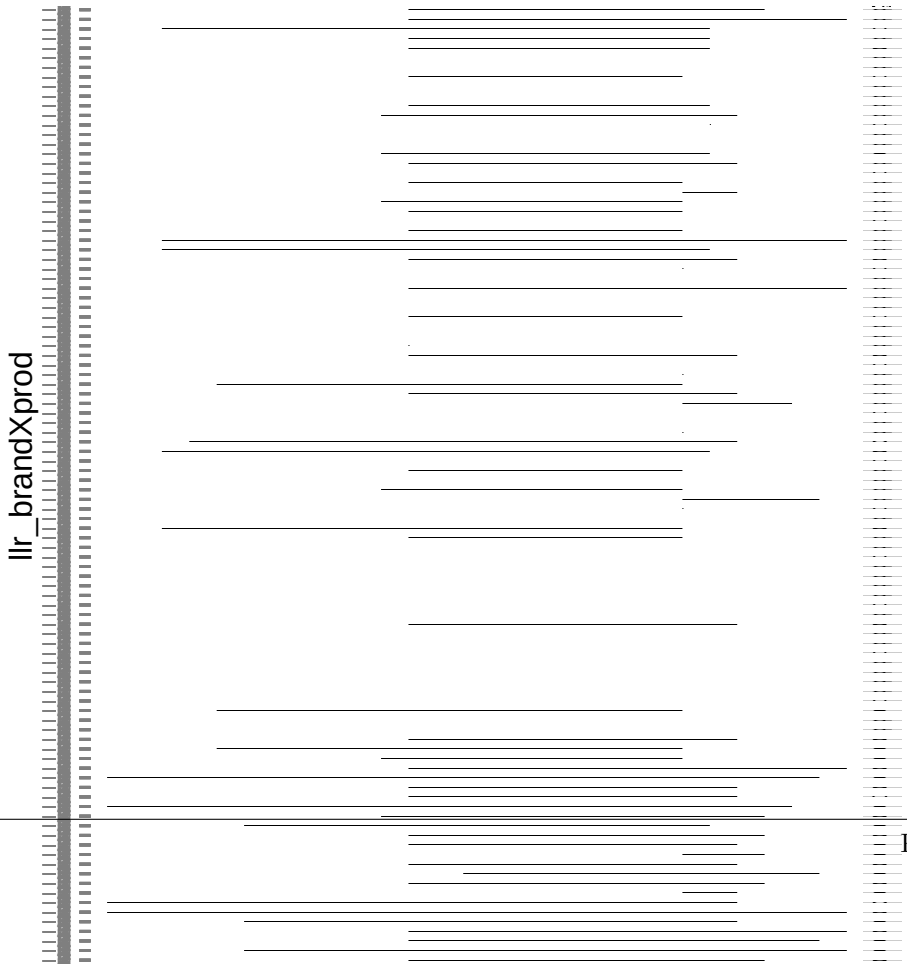


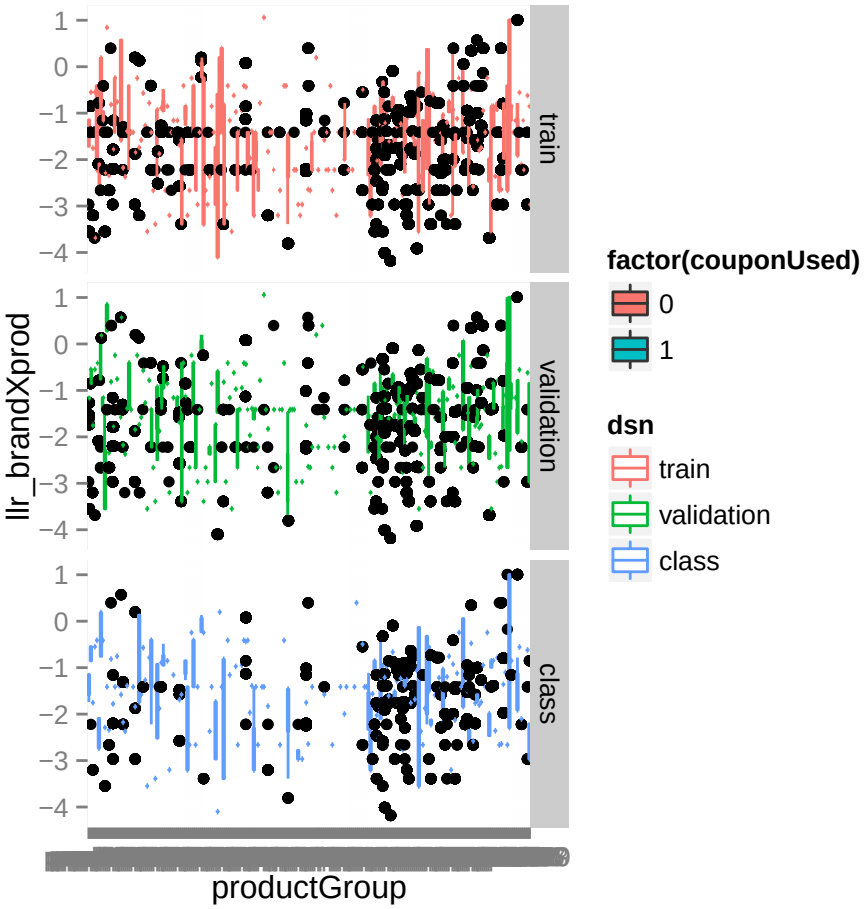
productGroup (as `llr_brandXprod`)

```
# productGroup
llr = compute_ll_2w(as.character(H$brand), as.character(H$productGroup), H$couponUsed, as.character(TVC$
llr_brandXprod = data.frame(brand = TVC$brand, productGroup = TVC$productGroup, llr_brandXprod = llr) %>

ggplot(data = llr_brandXprod, aes(x = brand, y = productGroup, size = llr_brandXprod), alpha = 0.1) + ge
qplot(brand, llr_brandXprod, data = llr_brandXprod, geom = "line", group = productGroup, facets = produc

TVC %>% left_join(llr_brandXprod, by = c("brand", "productGroup")) %>% select(orderID, brand, dsn, produ
    couponUsed) %>% ggplot(aes(x = productGroup, y = llr_brandXprod, fill = factor(couponUsed), color =
    facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_brandXprod = TVC %>% left_join(llr_brandXprod, by = c("brand", "productGroup")) %>% select(orderID,

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_brandXprod %>% filter(dsn == "train") %>% select(-dsn)
val = llr_brandXprod %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_brandXprod %>% filter(dsn == "class") %>% select(-dsn)

llr_brandXprod = list(T = trn, V = val, C = cls)

saveRDS(llr_brandXprod, "../features/feature_files/llr_brandXprod.rds")
```


productGroup
brand
llr_brandXprod
−4
−3
−2
−1
0
1

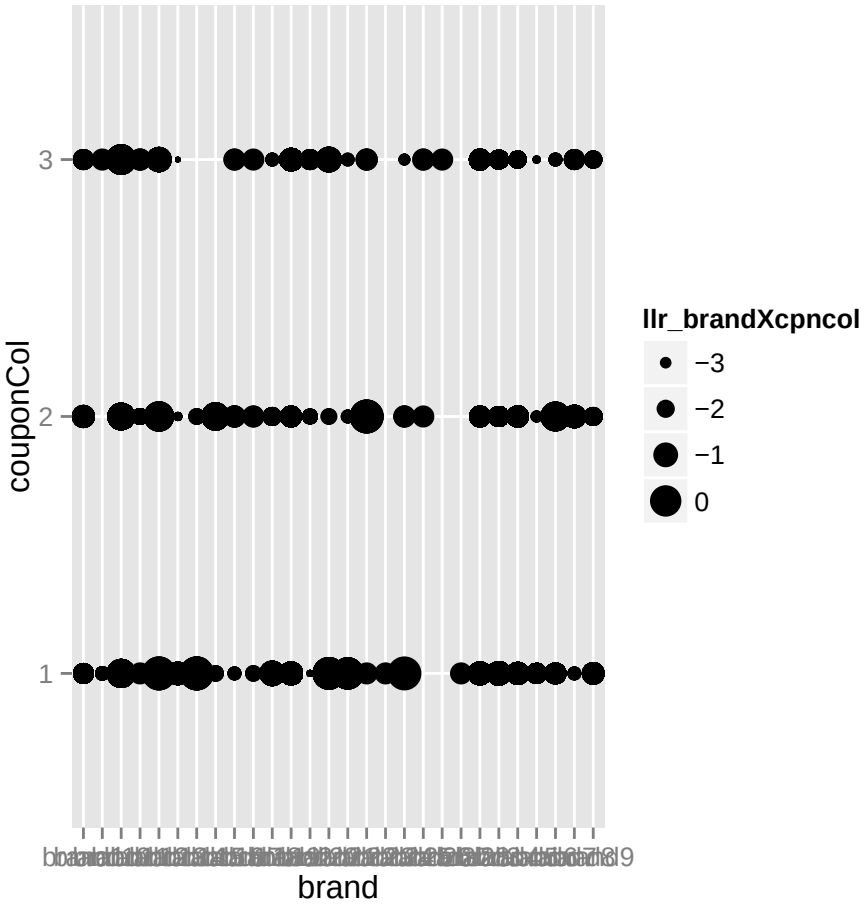

llr_brandXprod

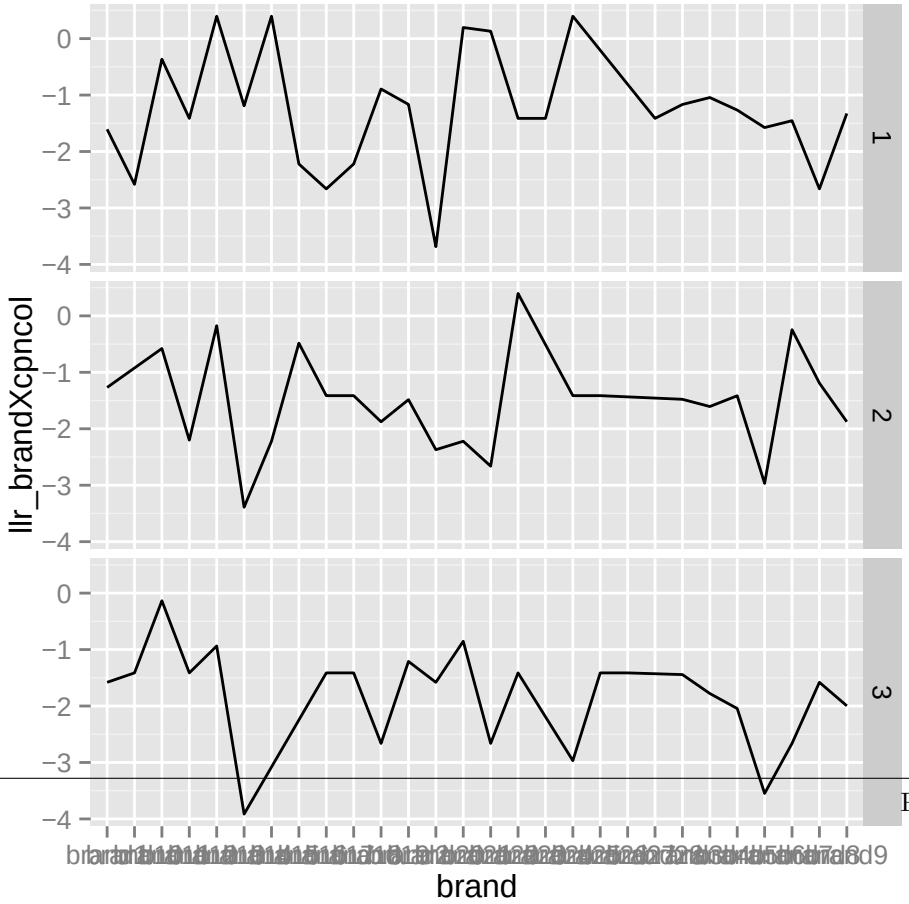


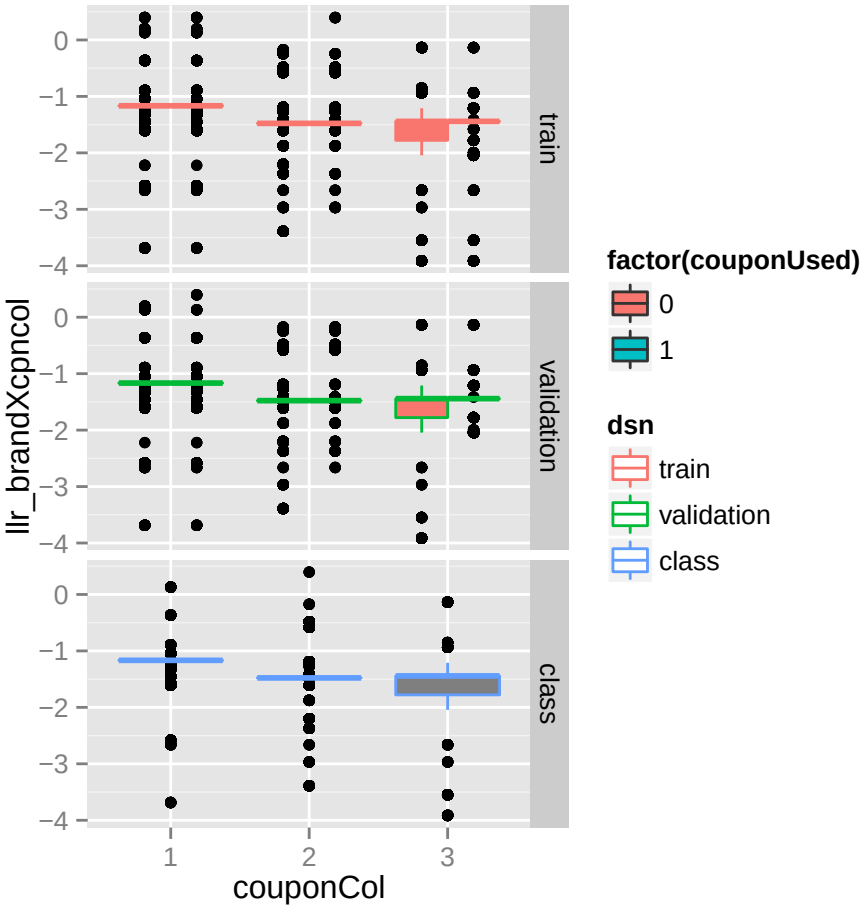
couponCol (as `llr_brandXcpncol`)

```
# couponCol
llr = compute_ll_2w(as.character(H$brand), as.character(H$couponCol), H$couponUsed, as.character(TVC$bra
llr_brandXcpncol = data.frame(brand = TVC$brand, couponCol = TVC$couponCol, llr_brandXcpncol = llr) %>%

ggplot(data = llr_brandXcpncol, aes(x = brand, y = couponCol, size = llr_brandXcpncol), alpha = 0.1) + g
qplot(brand, llr_brandXcpncol, data = llr_brandXcpncol, geom = "line", group = couponCol, facets = coupo

TVC %>% left_join(llr_brandXcpncol, by = c("brand", "couponCol")) %>% select(orderID, brand, dsn, coupon
    couponUsed) %>% ggplot(aes(x = couponCol, y = llr_brandXcpncol, fill = factor(couponUsed), color = c
    facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_brandXcpncol = TVC %>% left_join(llr_brandXcpncol, by = c("brand", "couponCol")) %>% select(orderID

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_brandXcpncol %>% filter(dsn == "train") %>% select(-dsn)
val = llr_brandXcpncol %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_brandXcpncol %>% filter(dsn == "class") %>% select(-dsn)

llr_brandXcpncol = list(T = trn, V = val, C = cls)

saveRDS(llr_brandXcpncol, "../features/feature_files/llr_brandXcpncol.rds")
```


couponCol
3
2
1
brand
llr_brandXcpncol
−3
−2
−1
0


llr_brandXcpncol
0
−1
−2
−3
−4
1
2
3
brand

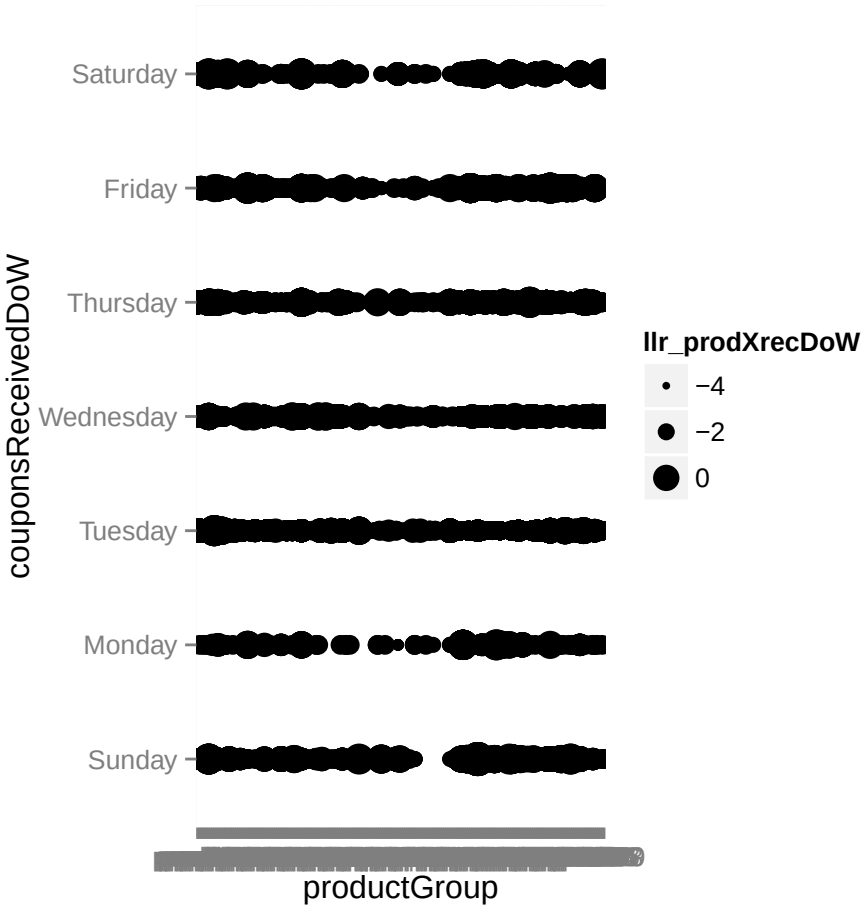


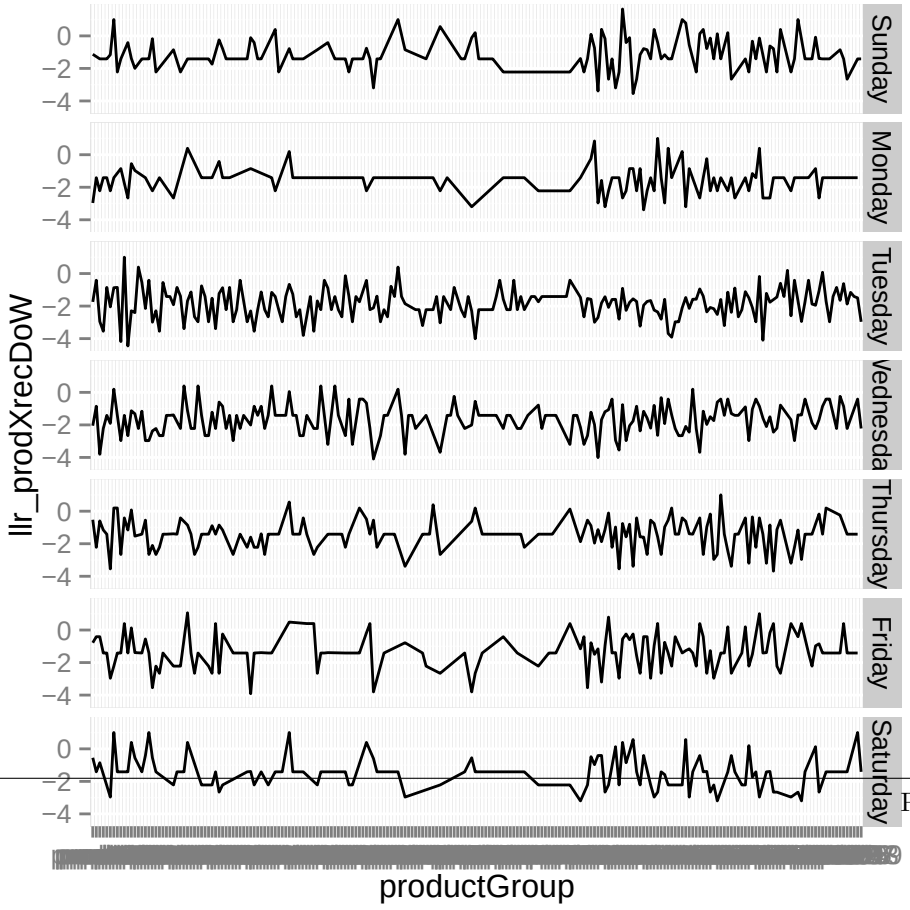
0.4.5 productGroup and

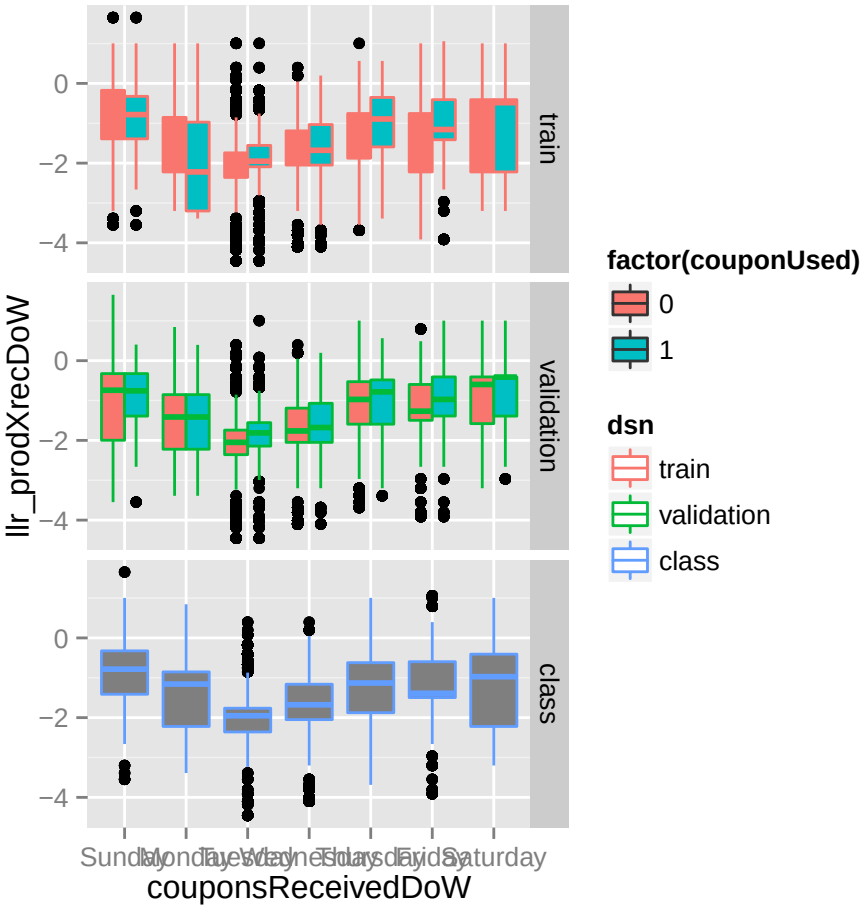
couponsReceivedDoW (as `llr_prodXrecDoW`)

```
# couponsReceivedDoW
llr = compute_ll_2w(as.character(H$productGroup), as.character(H$couponsReceivedDoW), H$couponUsed, as.c
    as.character(TVC$couponsReceivedDoW))
llr_prodXrecDoW = data.frame(productGroup = TVC$productGroup, couponsReceivedDoW = TVC$couponsReceivedDo
    arrange(productGroup)

ggplot(data = llr_prodXrecDoW, aes(x = productGroup, y = couponsReceivedDoW, size = llr_prodXrecDoW), al
qplot(productGroup, llr_prodXrecDoW, data = llr_prodXrecDoW, geom = "line", group = couponsReceivedDoW,
    .)

TVC %>% left_join(llr_prodXrecDoW, by = c("productGroup", "couponsReceivedDoW")) %>% select(orderID, pro
    couponsReceivedDoW, llr_prodXrecDoW, couponUsed) %>% ggplot(aes(x = couponsReceivedDoW, y = llr_proc
    color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_prodXrecDoW = TVC %>% left_join(llr_prodXrecDoW, by = c("productGroup", "couponsReceivedDoW")) %>% s
    llr_prodXrecDoW)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_prodXrecDoW %>% filter(dsn == "train") %>% select(-dsn)
val = llr_prodXrecDoW %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_prodXrecDoW %>% filter(dsn == "class") %>% select(-dsn)

llr_prodXrecDoW = list(T = trn, V = val, C = cls)

saveRDS(llr_prodXrecDoW, "../features/feature_files/llr_prodXrecDoW.rds")
```


Saturday
Friday
Thursday
Wednesday
Tuesday
Monday
Sunday
couponsReceivedDoW
productGroup
llr_prodXrecDoW
−4
−2
0

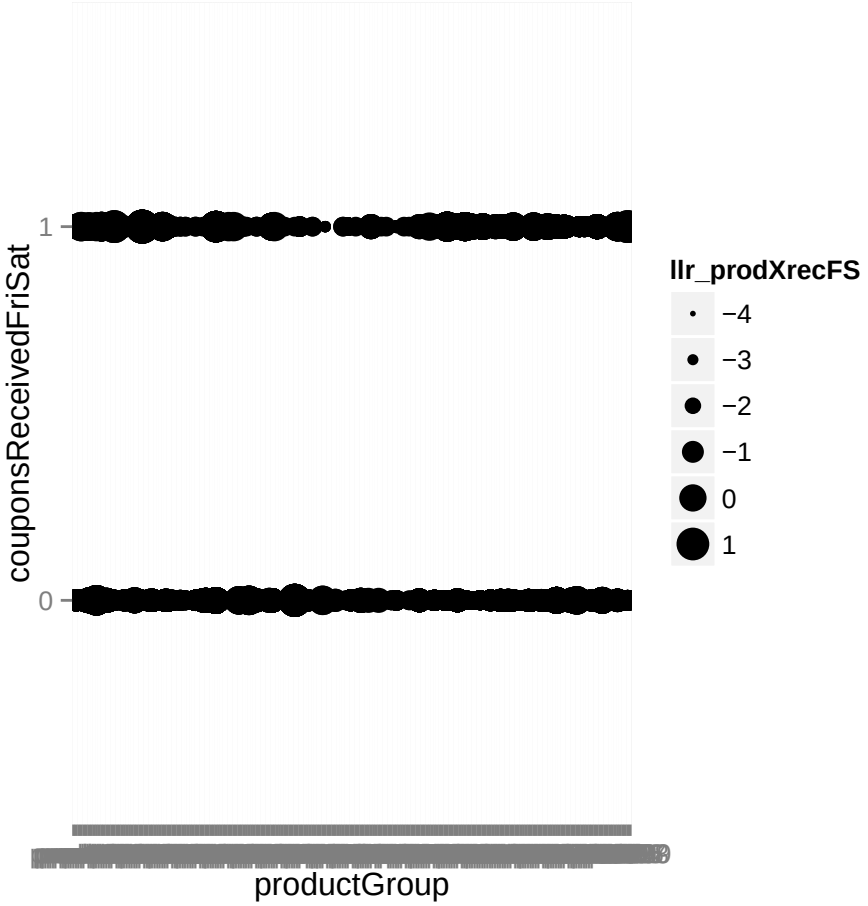

Sunday
Monday
Tuesday
Wednesda
Thursday
Friday
Saturday
0
−2
−4
llr_prodXrecDoW
productGroup

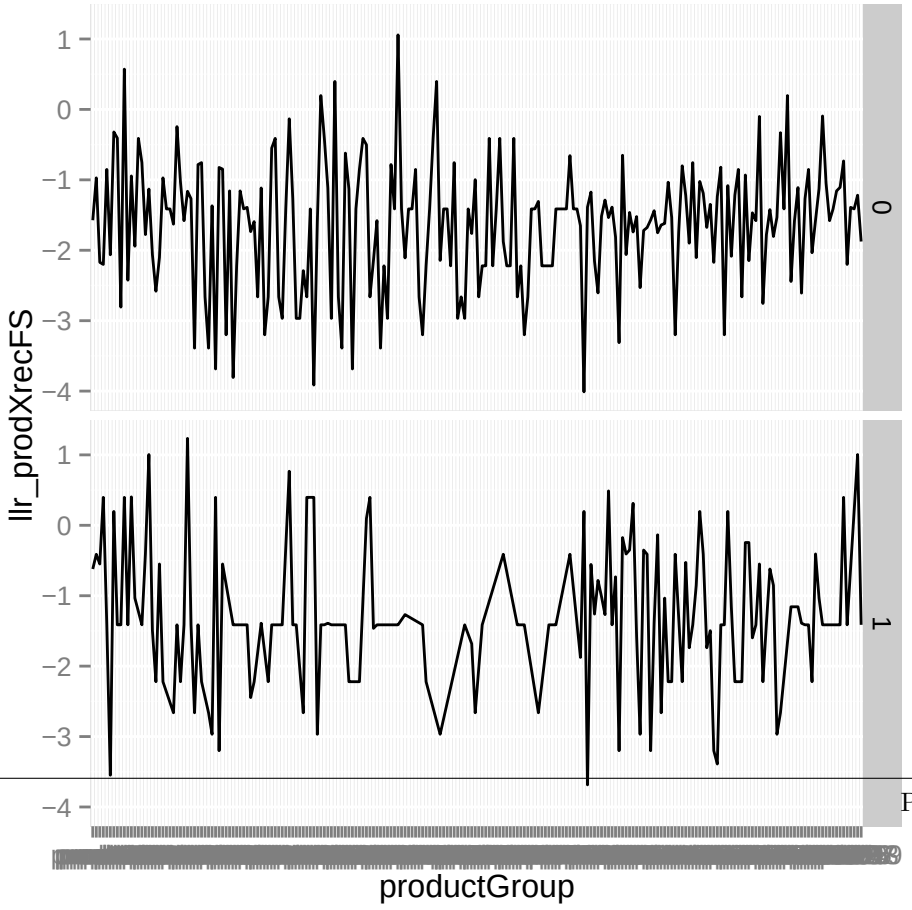


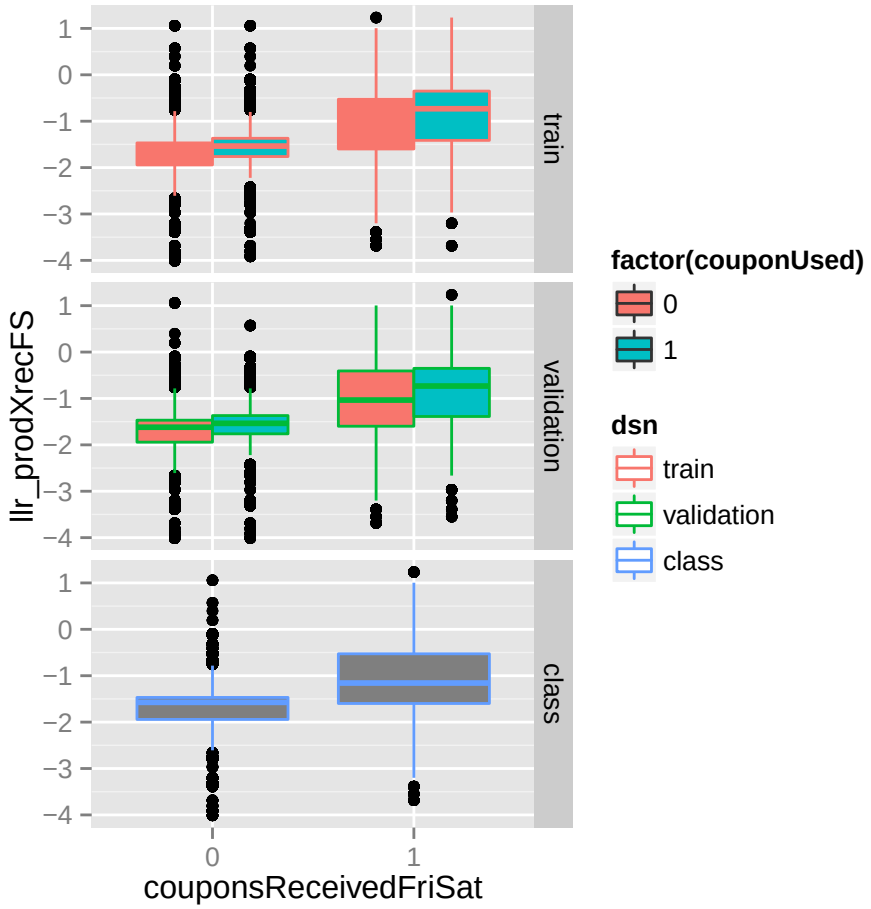
couponsReceivedFriSat (as `llr_prodXrecFS`)

```
# couponsReceivedFriSat
llr = compute_ll_2w(as.character(H$productGroup), as.character(H$couponsReceivedFriSat), H$couponUsed, a
    as.character(TVC$couponsReceivedFriSat))
llr_prodXrecFS = data.frame(productGroup = TVC$productGroup, couponsReceivedFriSat = TVC$couponsReceivec
    arrange(productGroup)

ggplot(data = llr_prodXrecFS, aes(x = productGroup, y = couponsReceivedFriSat, size = llr_prodXrecFS), a
qplot(productGroup, llr_prodXrecFS, data = llr_prodXrecFS, geom = "line", group = couponsReceivedFriSat
    .)

TVC %>% left_join(llr_prodXrecFS, by = c("productGroup", "couponsReceivedFriSat")) %>% select(orderID, p
    couponsReceivedFriSat, llr_prodXrecFS, couponUsed) %>% ggplot(aes(x = couponsReceivedFriSat, y = lll
    color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_prodXrecFS = TVC %>% left_join(llr_prodXrecFS, by = c("productGroup", "couponsReceivedFriSat")) %>%
    dsn, llr_prodXrecFS)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_prodXrecFS %>% filter(dsn == "train") %>% select(-dsn)
val = llr_prodXrecFS %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_prodXrecFS %>% filter(dsn == "class") %>% select(-dsn)

llr_prodXrecFS = list(T = trn, V = val, C = cls)

saveRDS(llr_prodXrecFS, "../features/feature_files/llr_prodXrecFS.rds")
```


couponsReceivedFriSat
1
0
productGroup
llr_prodXrecFS
−4
−3
−2
−1
0
1

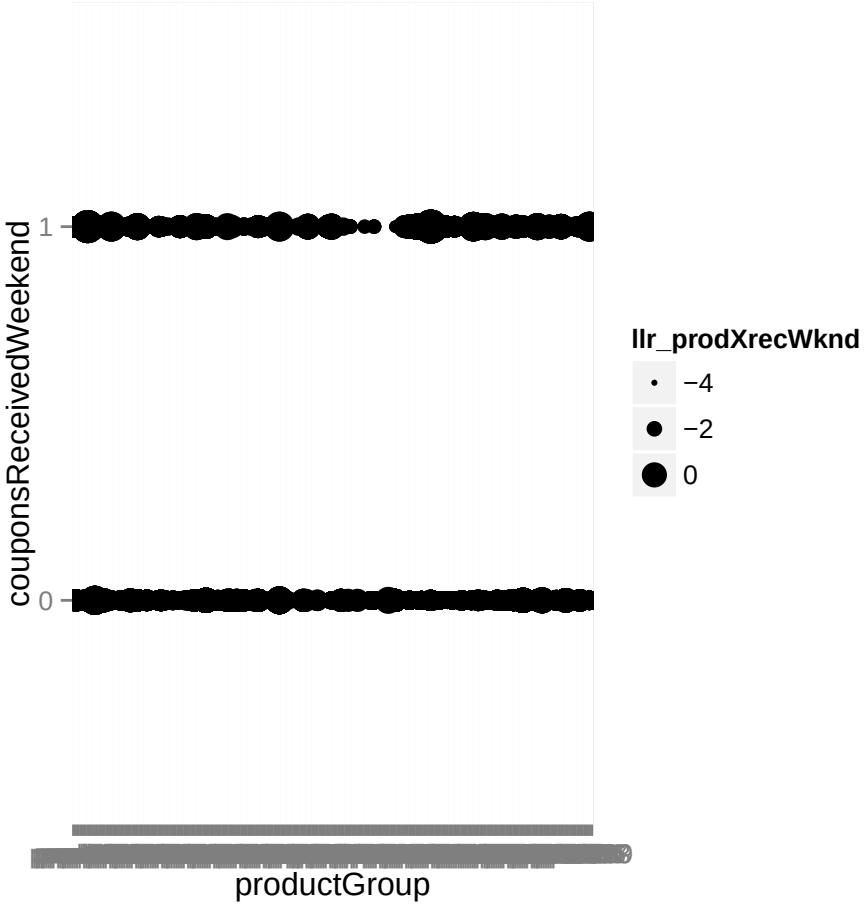

llr_prodXrecFS
1
0
−1
−2
−3
−4
0
1
productGroup

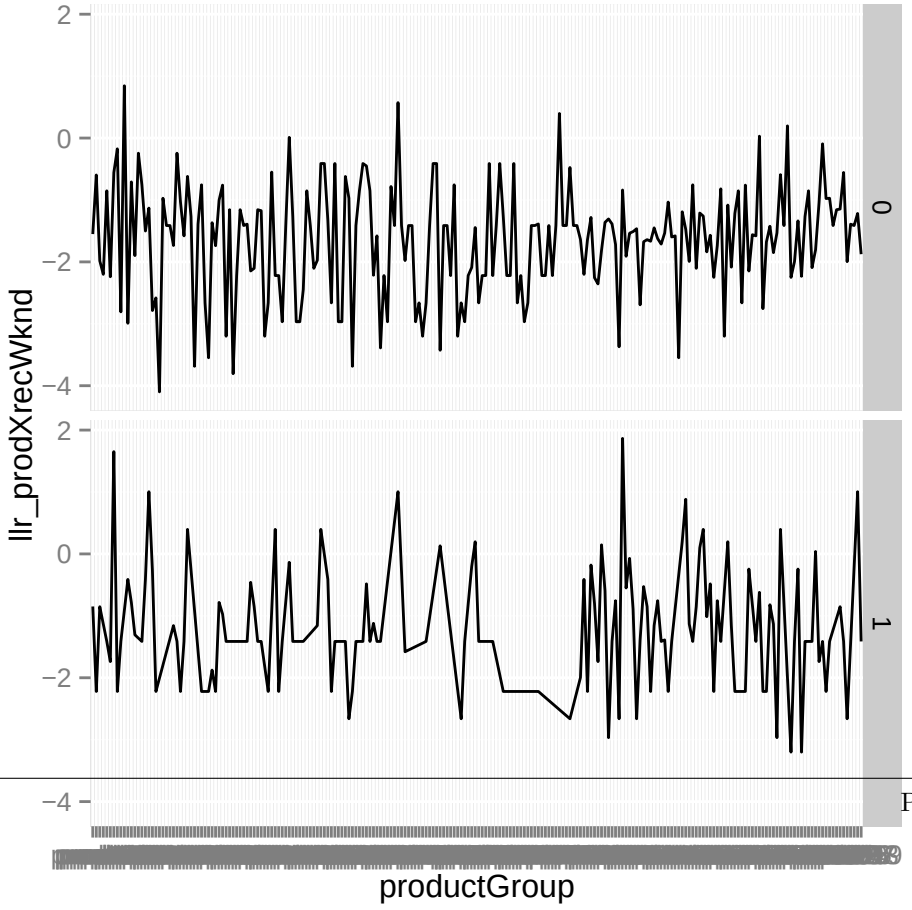


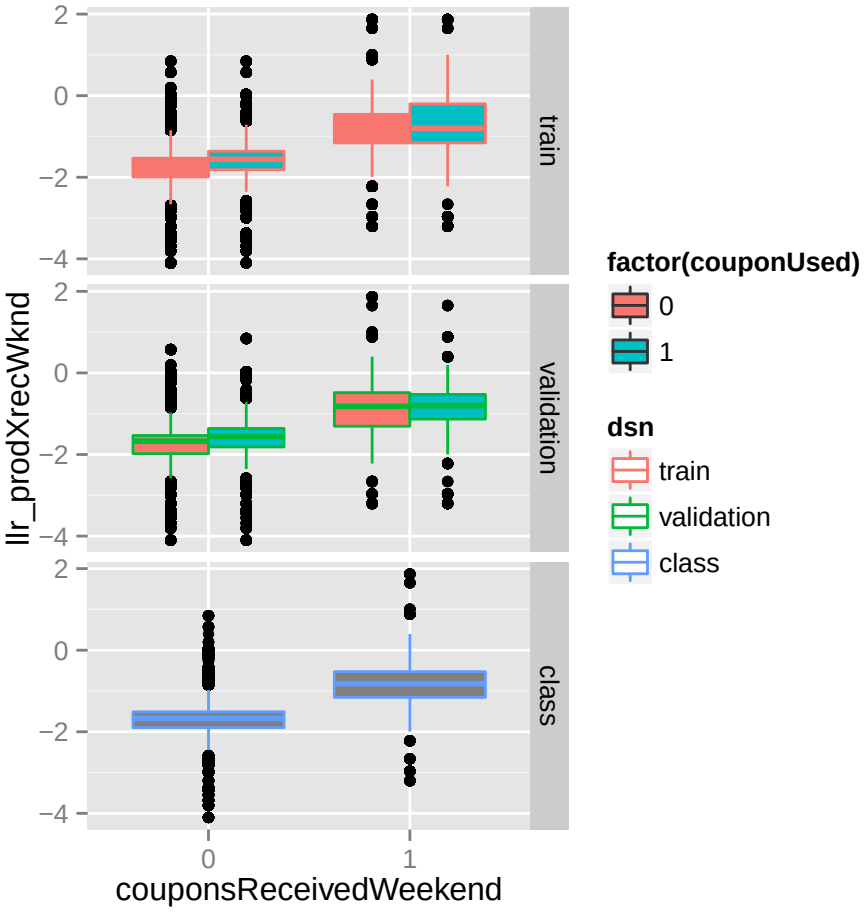
couponsReceivedWeekend (as `llr_prodXrecWknd`)

```
# couponsReceivedWeekend
llr = compute_ll_2w(as.character(H$productGroup), as.character(H$couponsReceivedWeekend), H$couponUsed,
    as.character(TVC$couponsReceivedWeekend))
llr_prodXrecWknd = data.frame(productGroup = TVC$productGroup, couponsReceivedWeekend = TVC$couponsRece
    arrange(productGroup)

ggplot(data = llr_prodXrecWknd, aes(x = productGroup, y = couponsReceivedWeekend, size = llr_prodXrecWk
    geom_point()
qplot(productGroup, llr_prodXrecWknd, data = llr_prodXrecWknd, geom = "line", group = couponsReceivedWe
    .)

TVC %>% left_join(llr_prodXrecWknd, by = c("productGroup", "couponsReceivedWeekend")) %>% select(orderI
    dsn, couponsReceivedWeekend, llr_prodXrecWknd, couponUsed) %>% ggplot(aes(x = couponsReceivedWeeken
    fill = factor(couponUsed), color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_prodXrecWknd = TVC %>% left_join(llr_prodXrecWknd, by = c("productGroup", "couponsReceivedWeekend")
    dsn, llr_prodXrecWknd)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_prodXrecWknd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_prodXrecWknd %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_prodXrecWknd %>% filter(dsn == "class") %>% select(-dsn)

llr_prodXrecWknd = list(T = trn, V = val, C = cls)

saveRDS(llr_prodXrecWknd, "../features/feature_files/llr_prodXrecWknd.rds")
```


couponsReceivedWeekend
1
0
productGroup
llr_prodXrecWknd
−4
−2
0

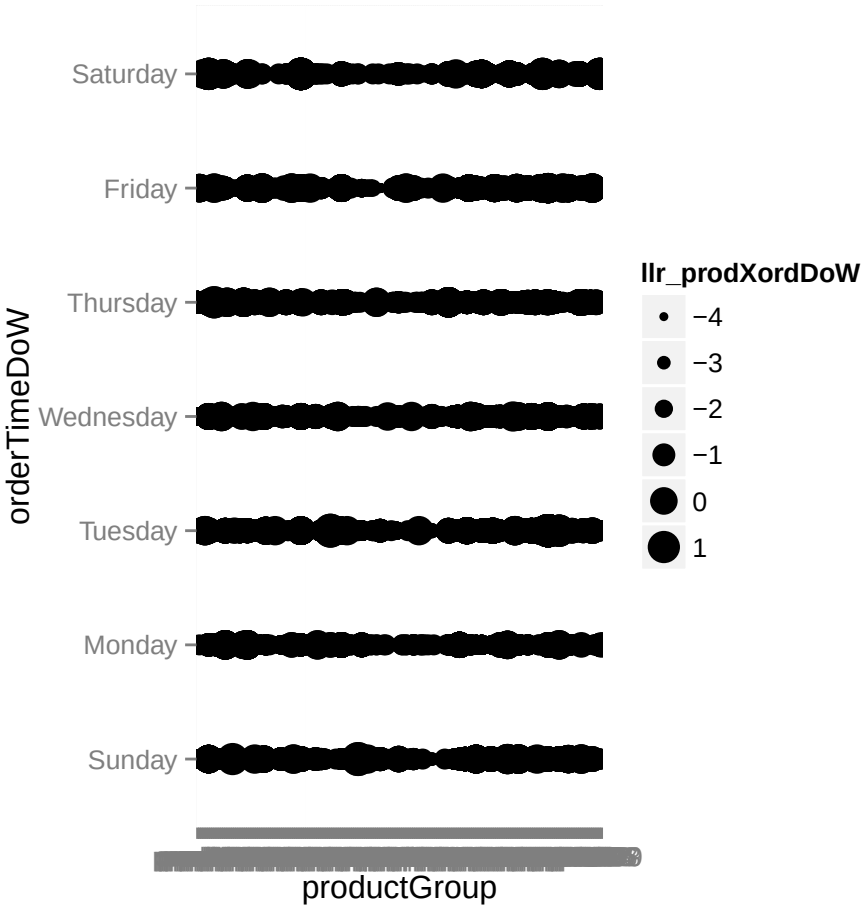

llr_prodXrecWknd
2
0
−2
−4
0
1
productGroup

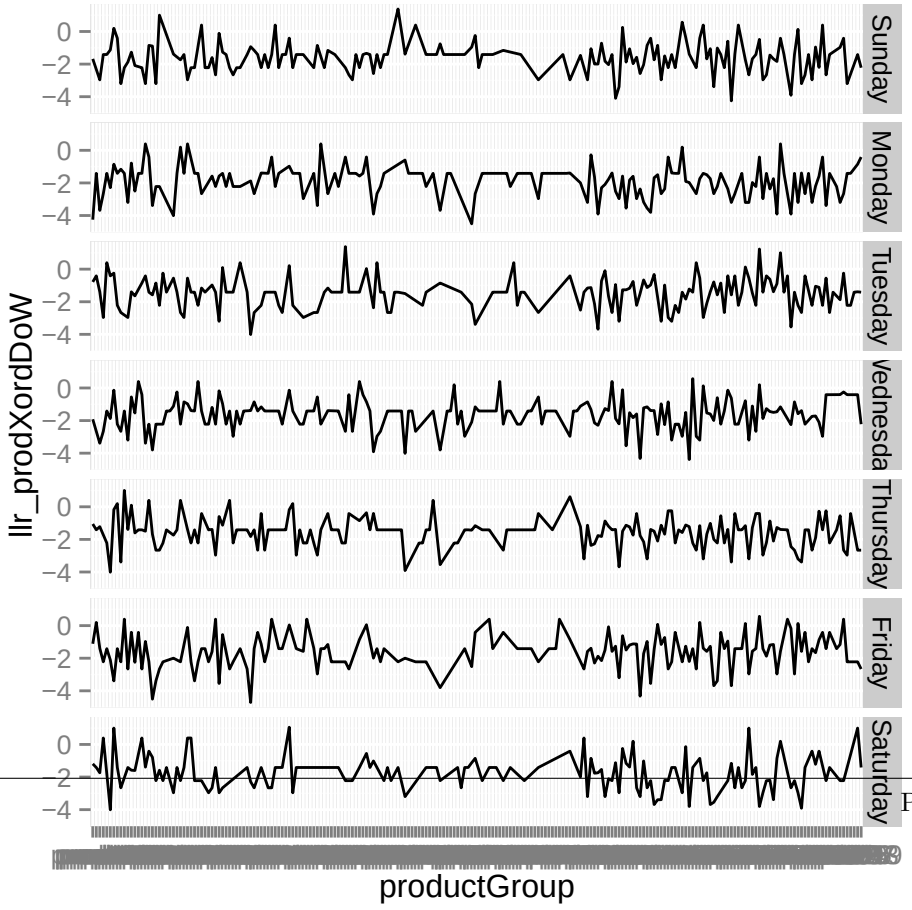


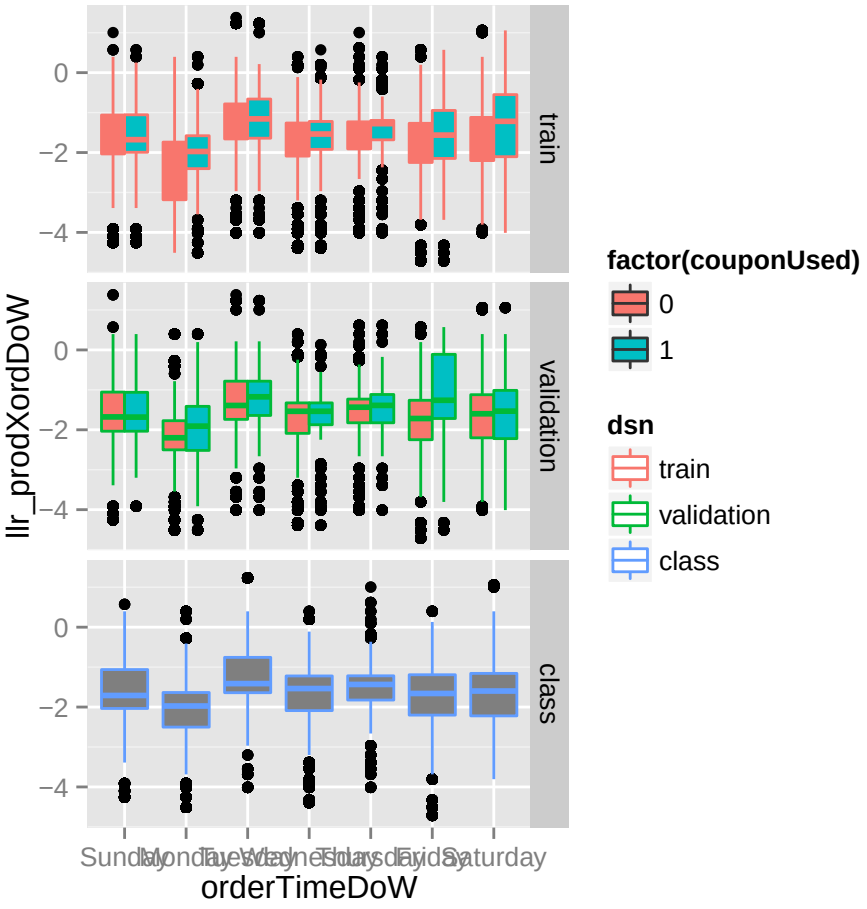
orderTimeDoW (as `llr_prodXordDoW`)

```
# orderTimeDoW
llr = compute_ll_2w(as.character(H$productGroup), as.character(H$orderTimeDoW), H$couponUsed, as.charac
    as.character(TVC$orderTimeDoW))
llr_prodXordDoW = data.frame(productGroup = TVC$productGroup, orderTimeDoW = TVC$orderTimeDoW, llr_prod
    arrange(productGroup)

ggplot(data = llr_prodXordDoW, aes(x = productGroup, y = orderTimeDoW, size = llr_prodXordDoW), alpha =
qplot(productGroup, llr_prodXordDoW, data = llr_prodXordDoW, geom = "line", group = orderTimeDoW, facet
    .)

TVC %>% left_join(llr_prodXordDoW, by = c("productGroup", "orderTimeDoW")) %>% select(orderID, productG
    llr_prodXordDoW, couponUsed) %>% ggplot(aes(x = orderTimeDoW, y = llr_prodXordDoW, fill = factor(co
    geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_prodXordDoW = TVC %>% left_join(llr_prodXordDoW, by = c("productGroup", "orderTimeDoW")) %>% select

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_prodXordDoW %>% filter(dsn == "train") %>% select(-dsn)
val = llr_prodXordDoW %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_prodXordDoW %>% filter(dsn == "class") %>% select(-dsn)

llr_prodXordDoW = list(T = trn, V = val, C = cls)

saveRDS(llr_prodXordDoW, "../features/feature_files/llr_prodXordDoW.rds")
```


Saturday
Friday
Thursday
Wednesday
Tuesday
Monday
Sunday
orderTimeDoW
productGroup
llr_prodXordDoW
−4
−3
−2
−1
0
1

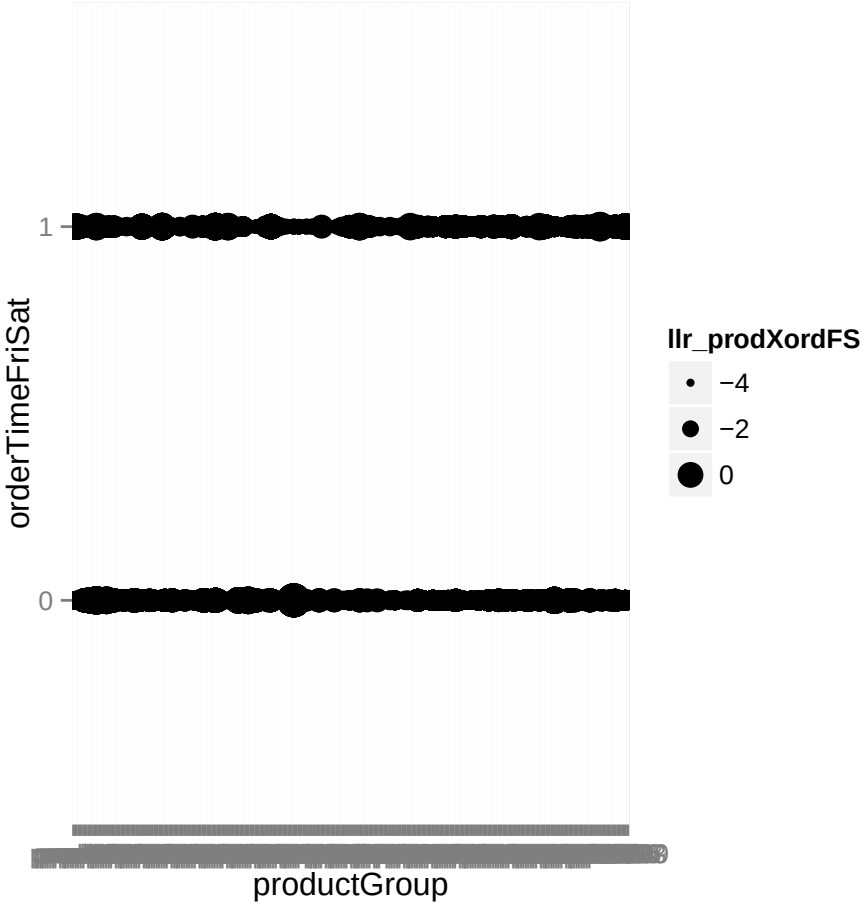

llr_prodXordDoW
0
−2
−4
Sunday
Monday
Tuesday
Wednesda
Thursday
Friday
Saturday
productGroup

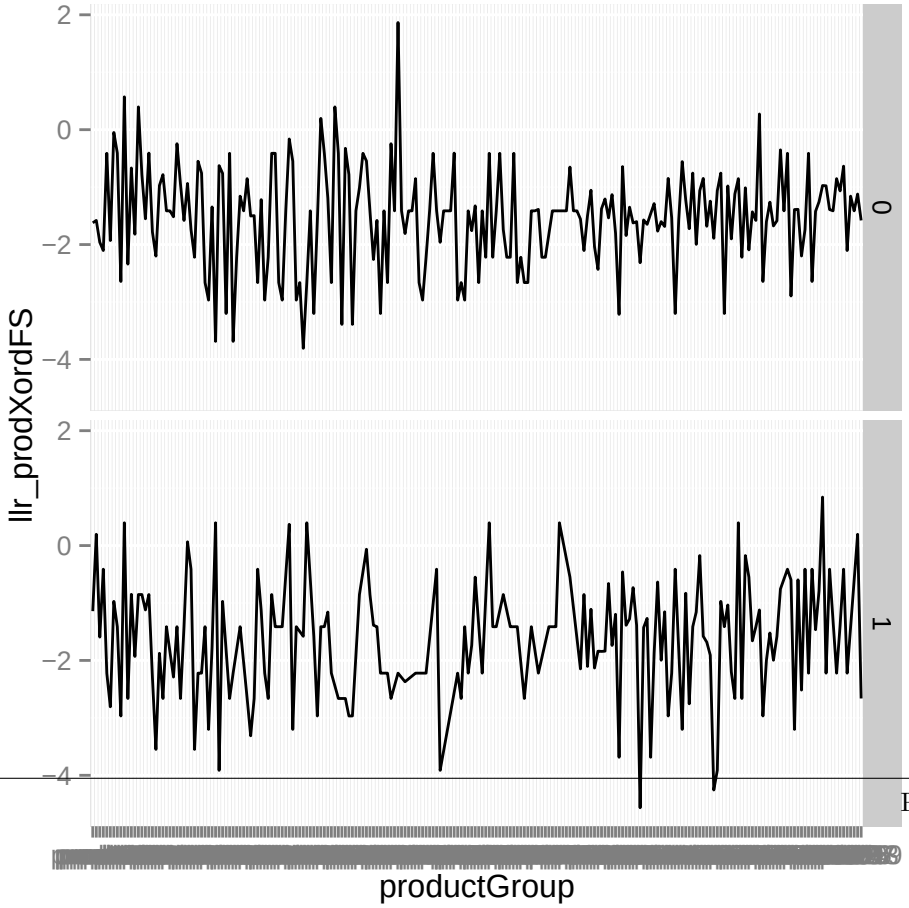


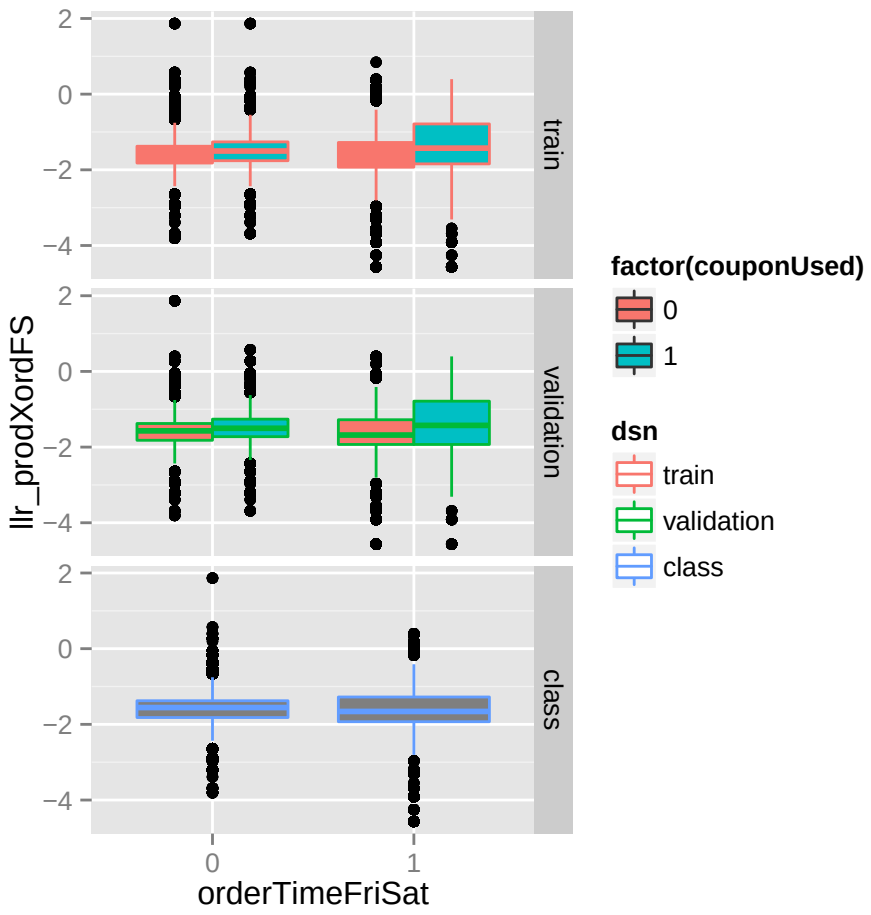
orderTimeFriSat (as `llr_prodXordFS`)

```
# orderTimeFriSat
llr = compute_ll_2w(as.character(H$productGroup), as.character(H$orderTimeFriSat), H$couponUsed, as.cha
    as.character(TVC$orderTimeFriSat))
llr_prodXordFS = data.frame(productGroup = TVC$productGroup, orderTimeFriSat = TVC$orderTimeFriSat, llr
    arrange(productGroup)

ggplot(data = llr_prodXordFS, aes(x = productGroup, y = orderTimeFriSat, size = llr_prodXordFS), alpha =
qplot(productGroup, llr_prodXordFS, data = llr_prodXordFS, geom = "line", group = orderTimeFriSat, face
    .)

TVC %>% left_join(llr_prodXordFS, by = c("productGroup", "orderTimeFriSat")) %>% select(orderID, produc
    llr_prodXordFS, couponUsed) %>% ggplot(aes(x = orderTimeFriSat, y = llr_prodXordFS, fill = factor(co
    geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_prodXordFS = TVC %>% left_join(llr_prodXordFS, by = c("productGroup", "orderTimeFriSat")) %>% selec

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_prodXordFS %>% filter(dsn == "train") %>% select(-dsn)
val = llr_prodXordFS %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_prodXordFS %>% filter(dsn == "class") %>% select(-dsn)

llr_prodXordFS = list(T = trn, V = val, C = cls)

saveRDS(llr_prodXordFS, "../features/feature_files/llr_prodXordFS.rds")
```


1
0
orderTimeFriSat
llr_prodXordFS
−4
−2
0
productGroup

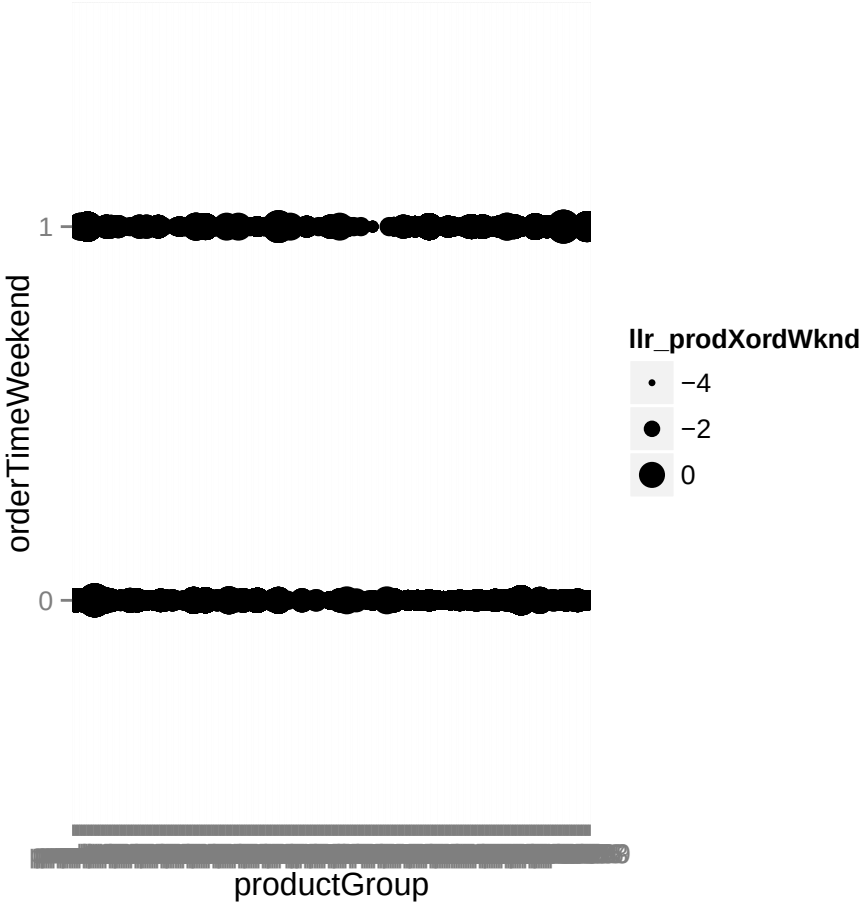

2
0
−2
−4
llr_prodXordFS
0
1
productGroup

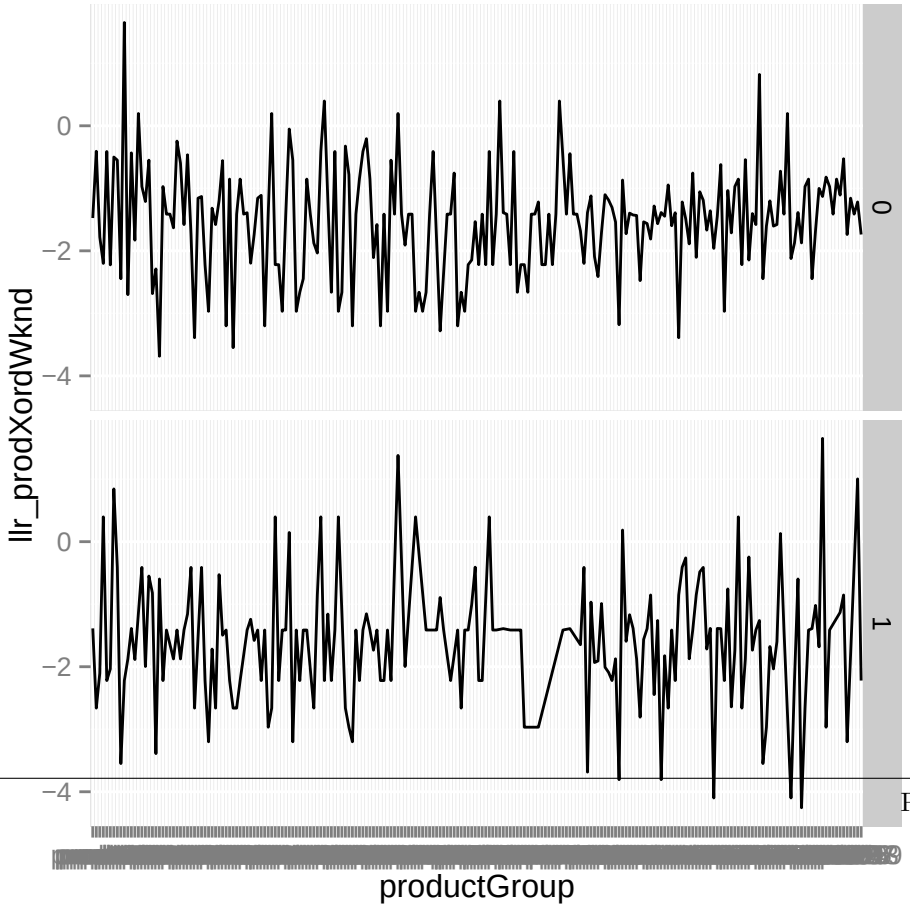


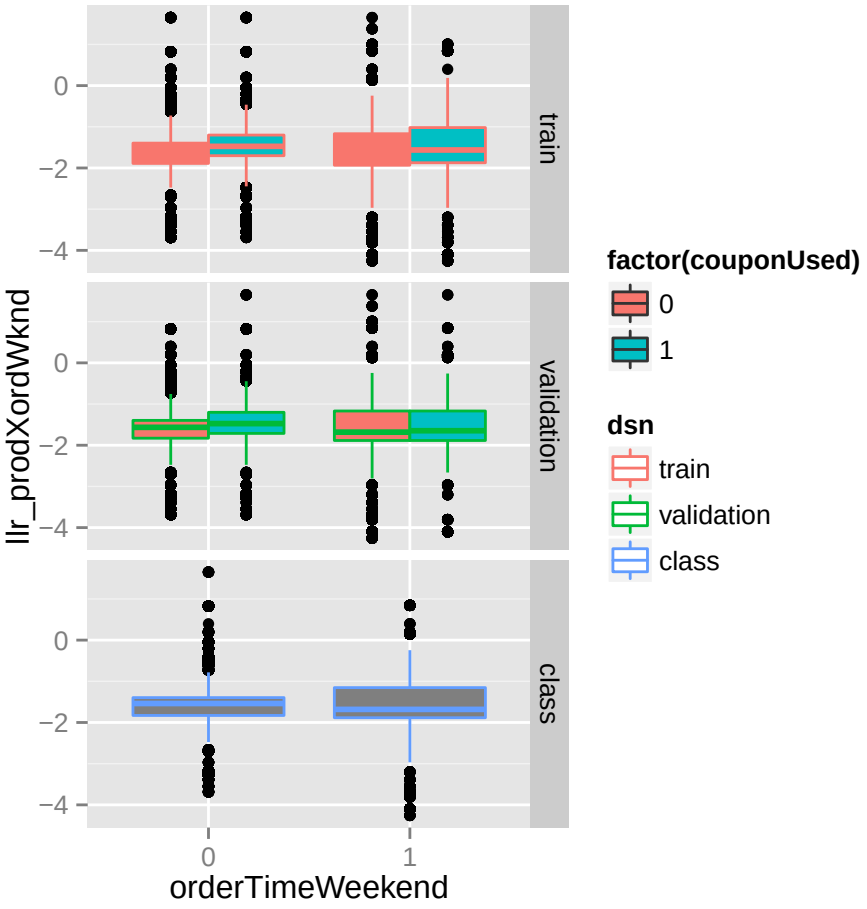
orderTimeWeekend (as `llr_prodXordWknd`)

```
# orderTimeWeekend
llr = compute_ll_2w(as.character(H$productGroup), as.character(H$orderTimeWeekend), H$couponUsed, as.cha
    as.character(TVC$orderTimeWeekend))
llr_prodXordWknd = data.frame(productGroup = TVC$productGroup, orderTimeWeekend = TVC$orderTimeWeekend,
    arrange(productGroup)

ggplot(data = llr_prodXordWknd, aes(x = productGroup, y = orderTimeWeekend, size = llr_prodXordWknd), al
qplot(productGroup, llr_prodXordWknd, data = llr_prodXordWknd, geom = "line", group = orderTimeWeekend,
    .)

TVC %>% left_join(llr_prodXordWknd, by = c("productGroup", "orderTimeWeekend")) %>% select(orderID, proc
    llr_prodXordWknd, couponUsed) %>% ggplot(aes(x = orderTimeWeekend, y = llr_prodXordWknd, fill = fact
    color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_prodXordWknd = TVC %>% left_join(llr_prodXordWknd, by = c("productGroup", "orderTimeWeekend")) %>% s
    llr_prodXordWknd)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_prodXordWknd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_prodXordWknd %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_prodXordWknd %>% filter(dsn == "class") %>% select(-dsn)

llr_prodXordWknd = list(T = trn, V = val, C = cls)

saveRDS(llr_prodXordWknd, "../features/feature_files/llr_prodXordWknd.rds")
```


1
0
orderTimeWeekend
llr_prodXordWknd
−4
−2
0
productGroup

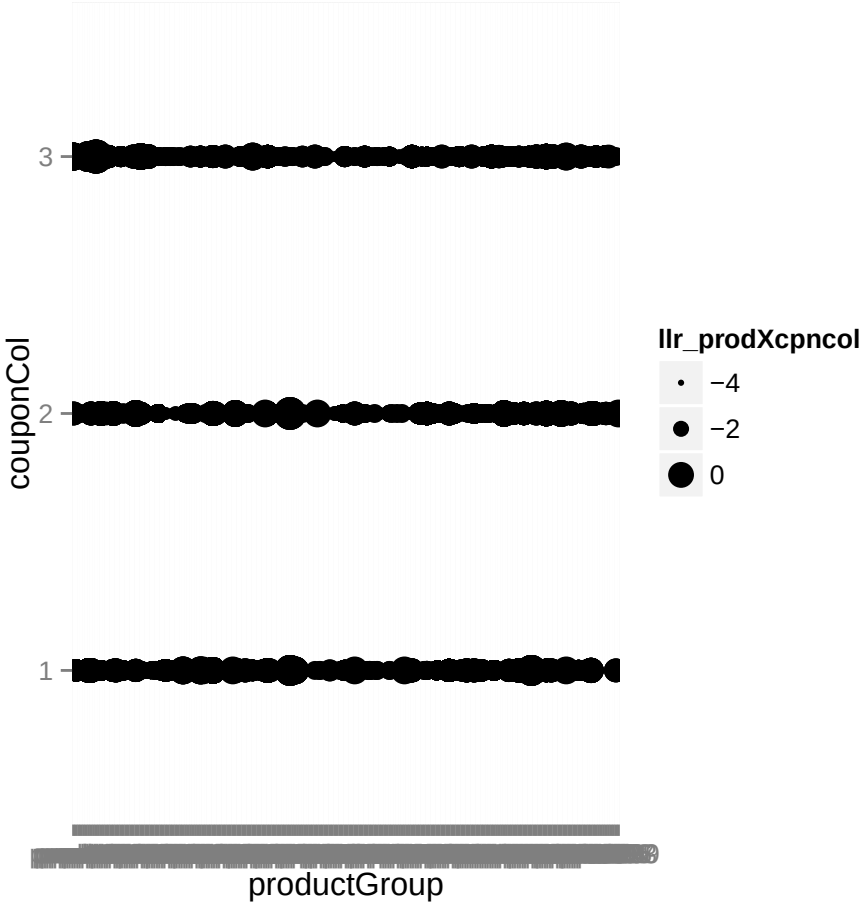

0
−2
−4
llr_prodXordWknd
0
1
productGroup

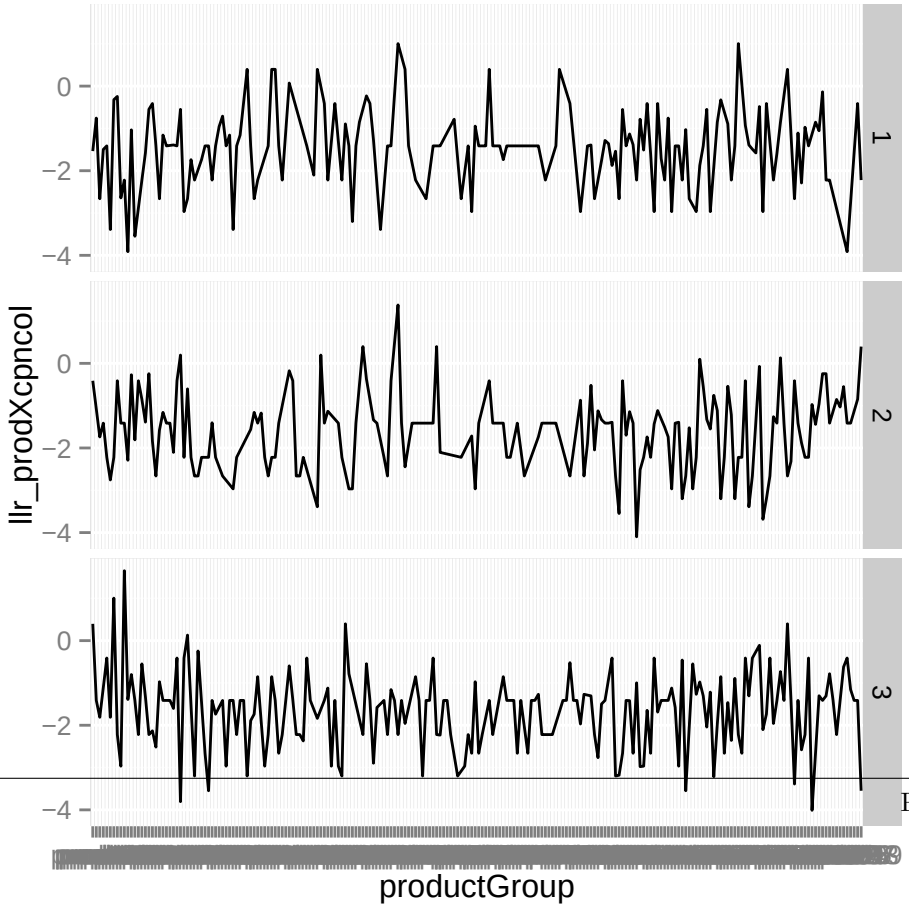


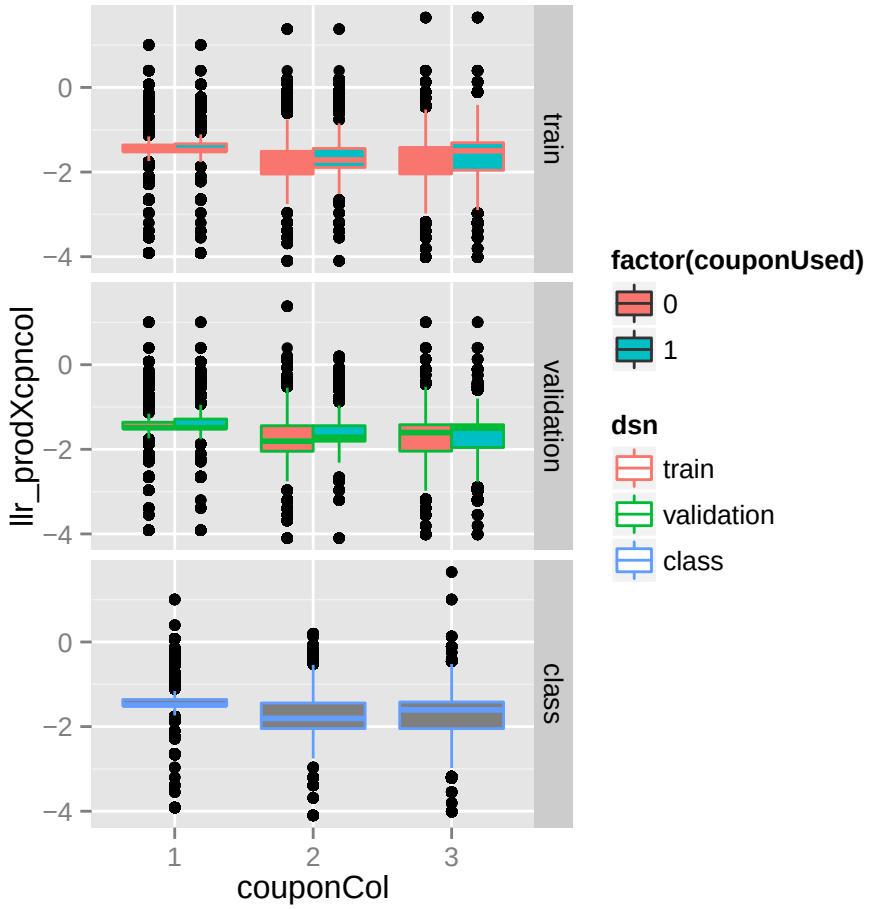
couponCol (as `llr_prodXcpncol`)

```
# couponCol
llr = compute_ll_2w(as.character(H$productGroup), as.character(H$couponCol), H$couponUsed, as.character
    as.character(TVC$couponCol))
llr_prodXcpncol = data.frame(productGroup = TVC$productGroup, couponCol = TVC$couponCol, llr_prodXcpncol

ggplot(data = llr_prodXcpncol, aes(x = productGroup, y = couponCol, size = llr_prodXcpncol), alpha = 0.
qplot(productGroup, llr_prodXcpncol, data = llr_prodXcpncol, geom = "line", group = couponCol, facets =

TVC %>% left_join(llr_prodXcpncol, by = c("productGroup", "couponCol")) %>% select(orderID, productGroup
    llr_prodXcpncol, couponUsed) %>% ggplot(aes(x = couponCol, y = llr_prodXcpncol, fill = factor(coupon
    geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_prodXcpncol = TVC %>% left_join(llr_prodXcpncol, by = c("productGroup", "couponCol")) %>% select(ord

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_prodXcpncol %>% filter(dsn == "train") %>% select(-dsn)
val = llr_prodXcpncol %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_prodXcpncol %>% filter(dsn == "class") %>% select(-dsn)

llr_prodXcpncol = list(T = trn, V = val, C = cls)

saveRDS(llr_prodXcpncol, "../features/feature_files/llr_prodXcpncol.rds")
```


3
2
1
couponCol
llr_prodXcpncol
−4
−2
0
productGroup


0
−2
−4
1
2
3
llr_prodXcpncol
productGroup

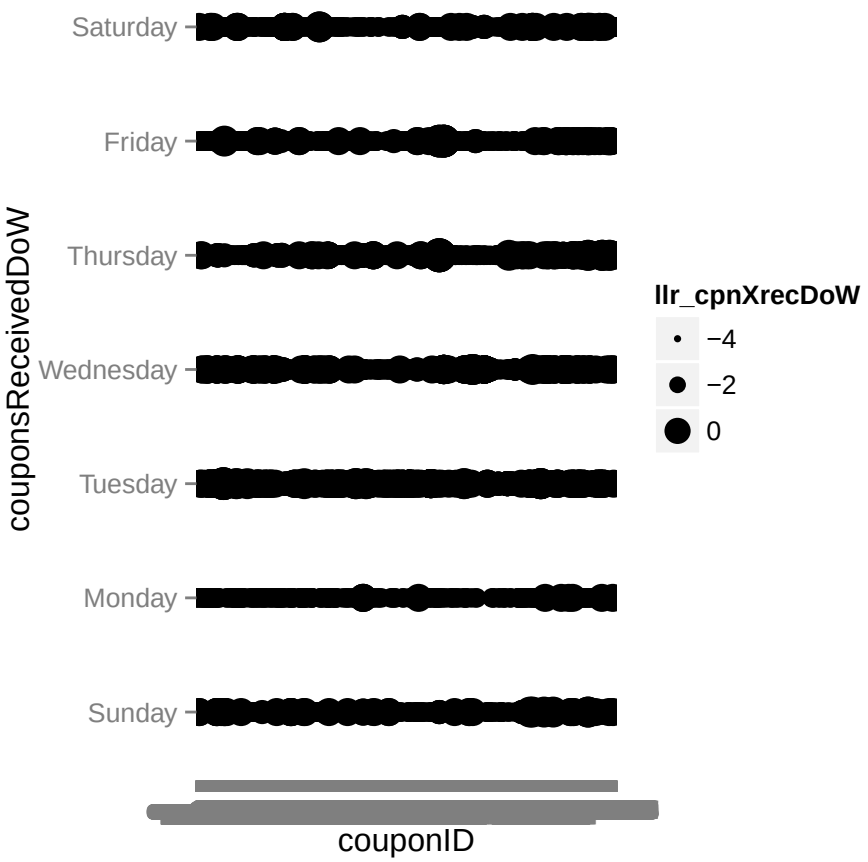


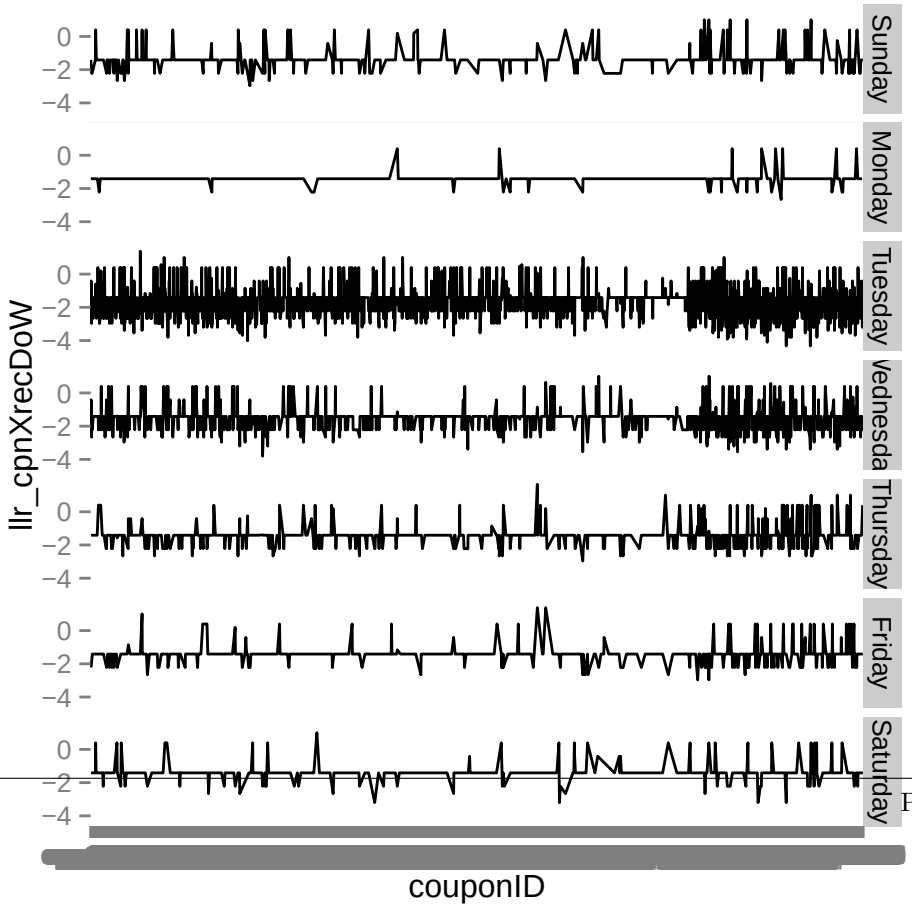
0.4.6 couponID and

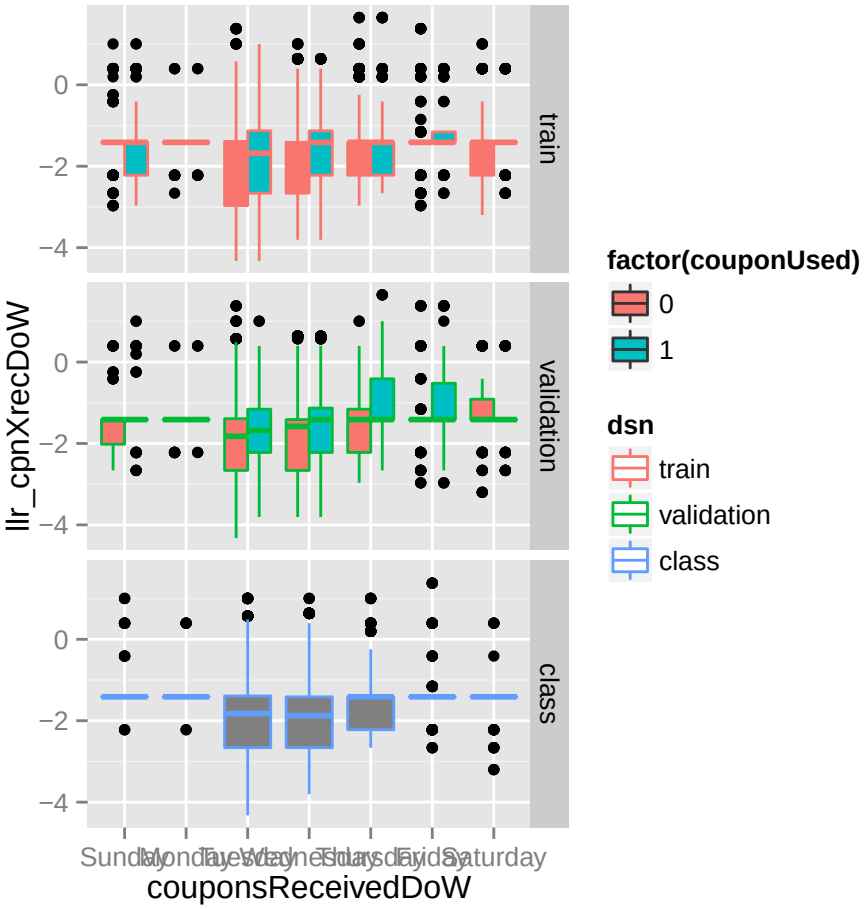
couponsReceivedDoW (as `llr_cpnXrecDoW`)

```
# couponsReceivedDoW
llr = compute_ll_2w(as.character(H$couponID), as.character(H$couponsReceivedDoW), H$couponUsed, as.chara
    as.character(TVC$couponsReceivedDoW))
llr_cpnXrecDoW = data.frame(couponID = TVC$couponID, couponsReceivedDoW = TVC$couponsReceivedDoW, llr_cp
    arrange(couponID)

ggplot(data = llr_cpnXrecDoW, aes(x = couponID, y = couponsReceivedDoW, size = llr_cpnXrecDoW), alpha =
qplot(couponID, llr_cpnXrecDoW, data = llr_cpnXrecDoW, geom = "line", group = couponsReceivedDoW, facets
    .)

TVC %>% left_join(llr_cpnXrecDoW, by = c("couponID", "couponsReceivedDoW")) %>% select(orderID, couponI
    llr_cpnXrecDoW, couponUsed) %>% ggplot(aes(x = couponsReceivedDoW, y = llr_cpnXrecDoW, fill = facto
    geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_cpnXrecDoW = TVC %>% left_join(llr_cpnXrecDoW, by = c("couponID", "couponsReceivedDoW")) %>% select

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_cpnXrecDoW %>% filter(dsn == "train") %>% select(-dsn)
val = llr_cpnXrecDoW %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_cpnXrecDoW %>% filter(dsn == "class") %>% select(-dsn)

llr_cpnXrecDoW = list(T = trn, V = val, C = cls)

saveRDS(llr_cpnXrecDoW, "../features/feature_files/llr_cpnXrecDoW.rds")
```


Saturday
Friday
Thursday
Wednesday
Tuesday
Monday
Sunday
couponsReceivedDoW
couponID
llr_cpnXrecDoW
−4
−2
0

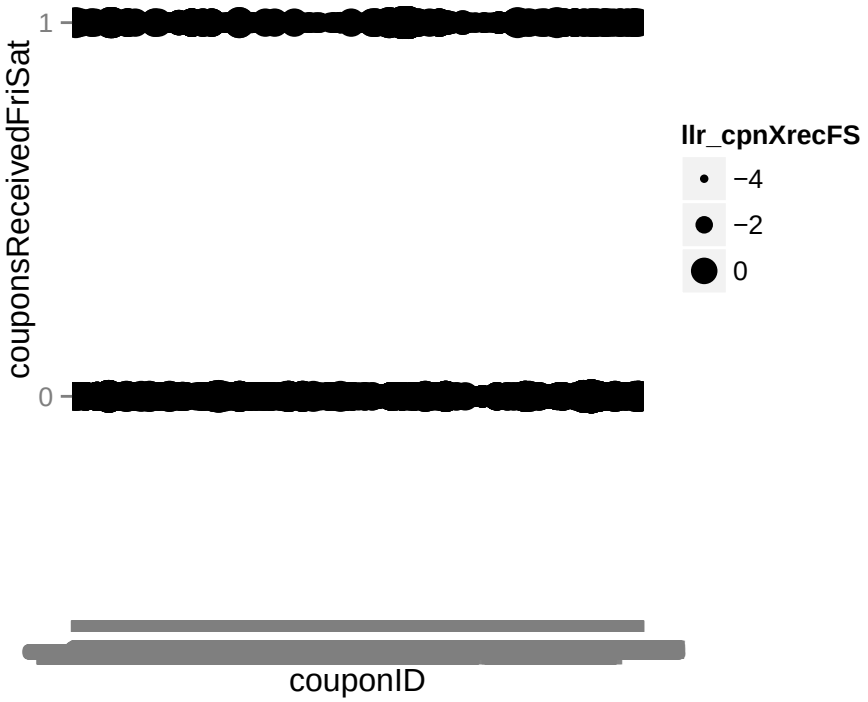

Sunday
Monday
Tuesday
Wednesda
Thursday
Friday
Saturday
0
−2
−4
llr_cpnXrecDoW
couponID

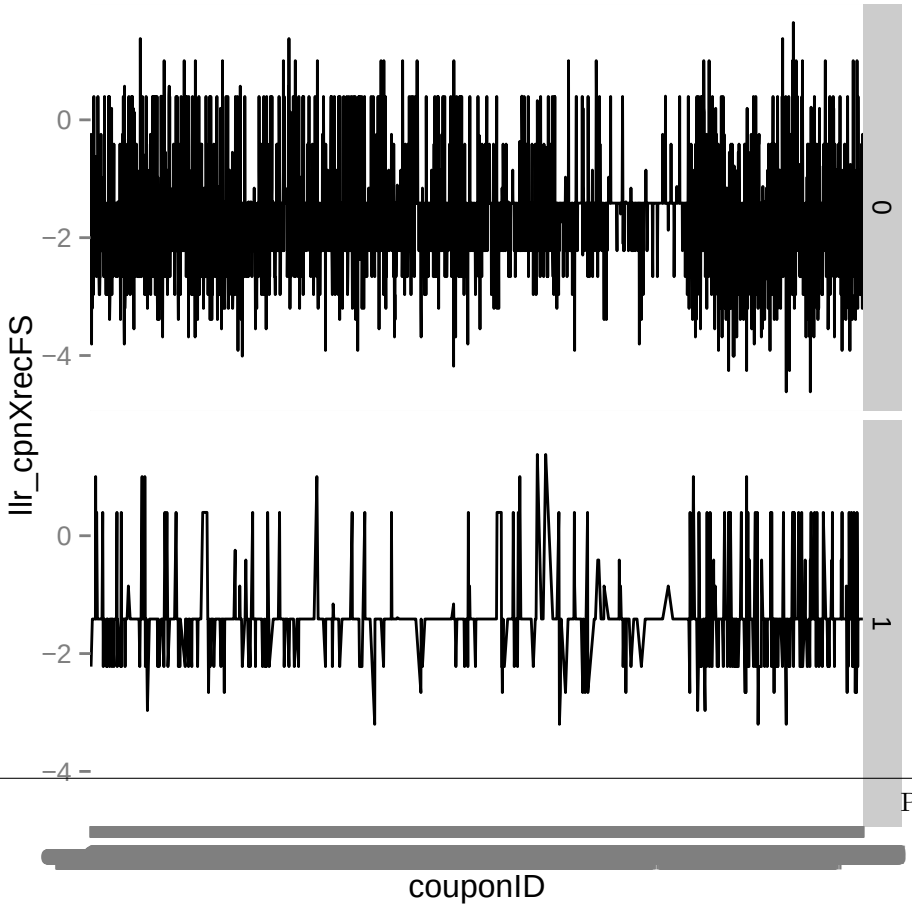


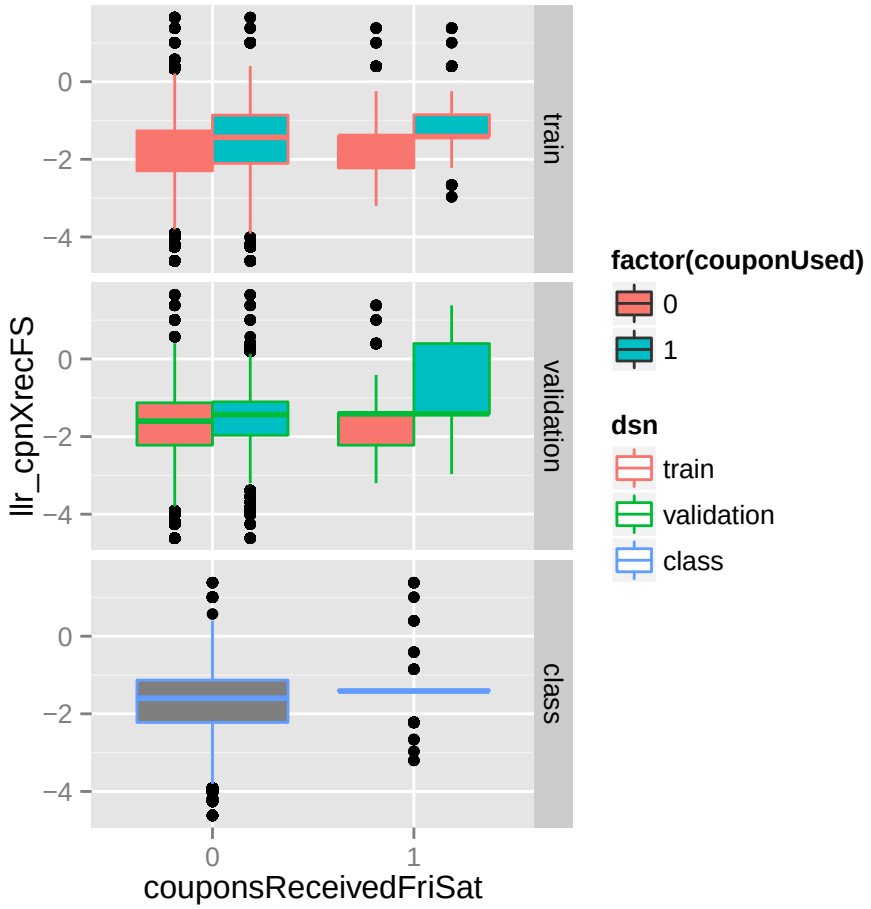
couponsReceivedFriSat (as `llr_cpnXrecFS`)

```
# couponsReceivedFriSat
llr = compute_ll_2w(as.character(H$couponID), as.character(H$couponsReceivedFriSat), H$couponUsed, as.cl
    as.character(TVC$couponsReceivedFriSat))
llr_cpnXrecFS = data.frame(couponID = TVC$couponID, couponsReceivedFriSat = TVC$couponsReceivedFriSat, l
    arrange(couponID)

ggplot(data = llr_cpnXrecFS, aes(x = couponID, y = couponsReceivedFriSat, size = llr_cpnXrecFS), alpha =
qplot(couponID, llr_cpnXrecFS, data = llr_cpnXrecFS, geom = "line", group = couponsReceivedFriSat, facet
    .)

TVC %>% left_join(llr_cpnXrecFS, by = c("couponID", "couponsReceivedFriSat")) %>% select(orderID, coupon
    llr_cpnXrecFS, couponUsed) %>% ggplot(aes(x = couponsReceivedFriSat, y = llr_cpnXrecFS, fill = facto
    geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_cpnXrecFS = TVC %>% left_join(llr_cpnXrecFS, by = c("couponID", "couponsReceivedFriSat")) %>% selec

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_cpnXrecFS %>% filter(dsn == "train") %>% select(-dsn)
val = llr_cpnXrecFS %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_cpnXrecFS %>% filter(dsn == "class") %>% select(-dsn)

llr_cpnXrecFS = list(T = trn, V = val, C = cls)

saveRDS(llr_cpnXrecFS, "../features/feature_files/llr_cpnXrecFS.rds")
```


couponsReceivedFriSat
1
0
couponID
llr_cpnXrecFS
−4
−2
0

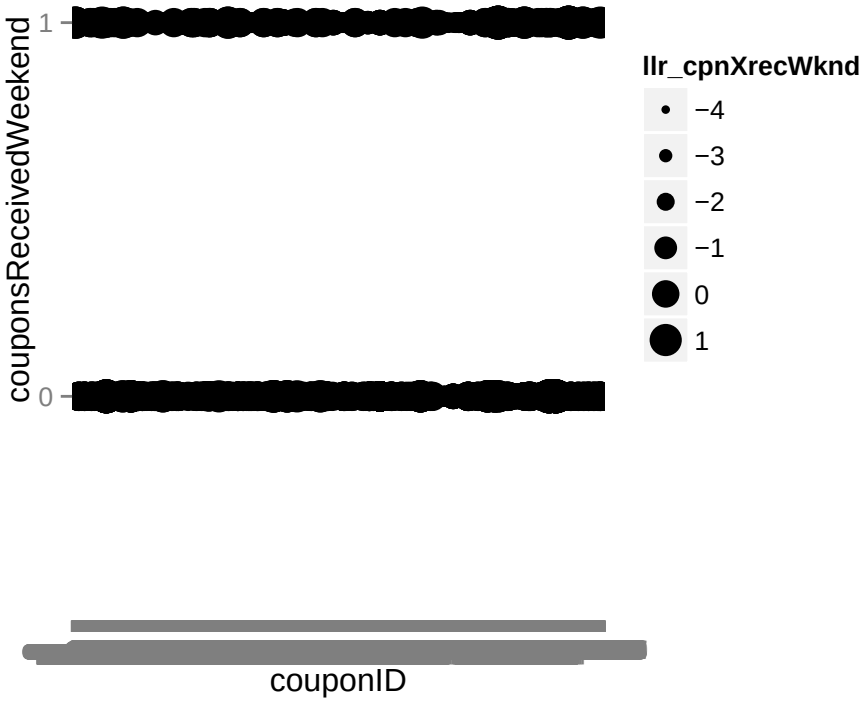

llr_cpnXrecFS
0
−2
−4
0
0
−2
−4
1
couponID

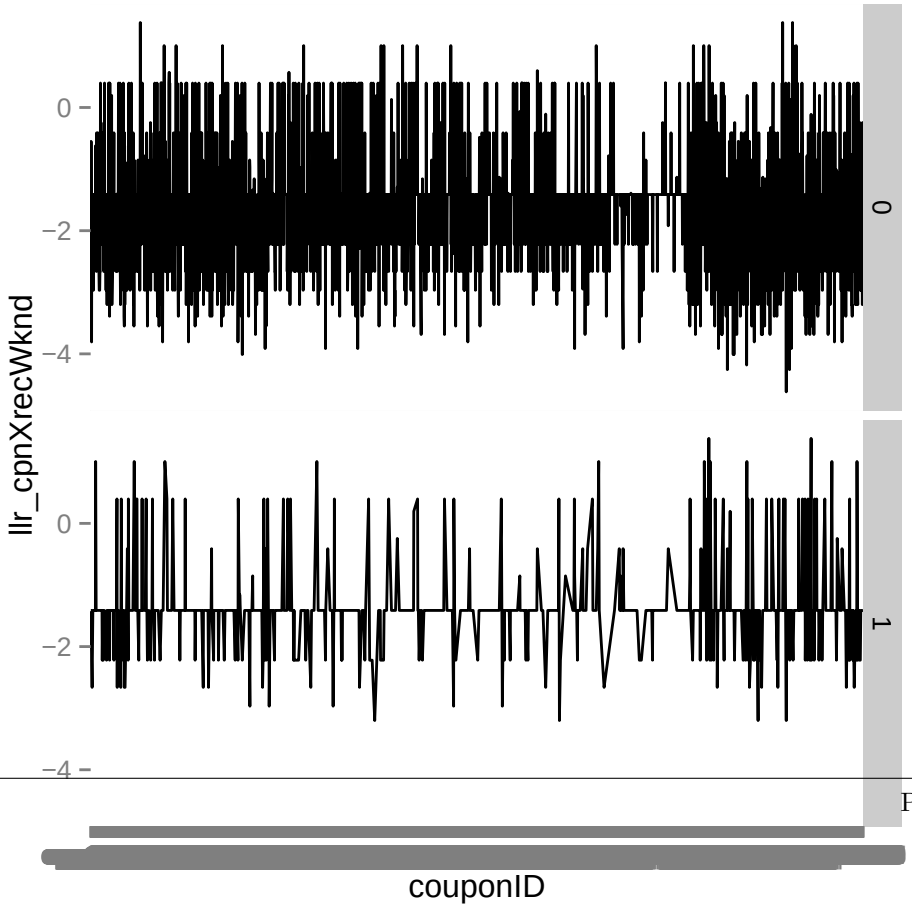


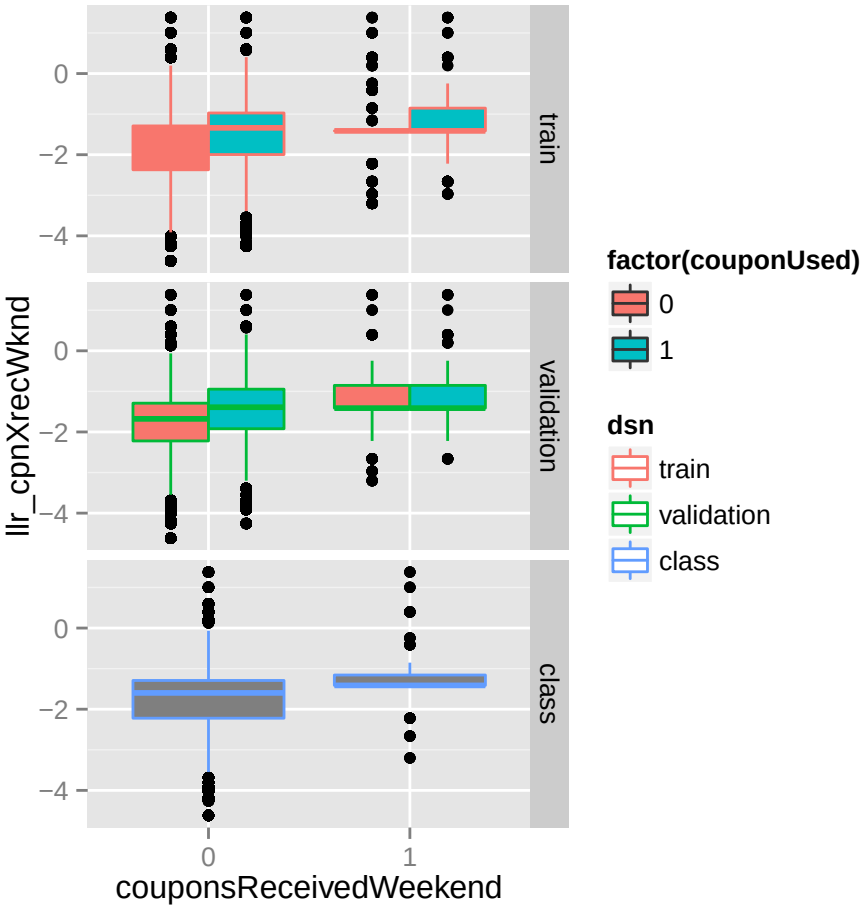
couponsReceivedWeekend (as `llr_cpnXrecWknd`)

```
# couponsReceivedWeekend
llr = compute_ll_2w(as.character(H$couponID), as.character(H$couponsReceivedWeekend), H$couponUsed, as.c
    as.character(TVC$couponsReceivedWeekend))
llr_cpnXrecWknd = data.frame(couponID = TVC$couponID, couponsReceivedWeekend = TVC$couponsReceivedWeeken
    arrange(couponID)

ggplot(data = llr_cpnXrecWknd, aes(x = couponID, y = couponsReceivedWeekend, size = llr_cpnXrecWknd), al
qplot(couponID, llr_cpnXrecWknd, data = llr_cpnXrecWknd, geom = "line", group = couponsReceivedWeekend,
    .)

TVC %>% left_join(llr_cpnXrecWknd, by = c("couponID", "couponsReceivedWeekend")) %>% select(orderID, cou
    llr_cpnXrecWknd, couponUsed) %>% ggplot(aes(x = couponsReceivedWeekend, y = llr_cpnXrecWknd, fill =
    color = dsn)) + geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_cpnXrecWknd = TVC %>% left_join(llr_cpnXrecWknd, by = c("couponID", "couponsReceivedWeekend")) %>% s
    llr_cpnXrecWknd)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_cpnXrecWknd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_cpnXrecWknd %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_cpnXrecWknd %>% filter(dsn == "class") %>% select(-dsn)

llr_cpnXrecWknd = list(T = trn, V = val, C = cls)

saveRDS(llr_cpnXrecWknd, "../features/feature_files/llr_cpnXrecWknd.rds")
```


couponsReceivedWeekend
1
0
couponID
llr_cpnXrecWknd
−4
−3
−2
−1
0
1


llr_cpnXrecWknd
0
−2
−4
0
−2
−4
0
1
couponID



orderTimeDoW (as `llr_cpnXordDoW`)

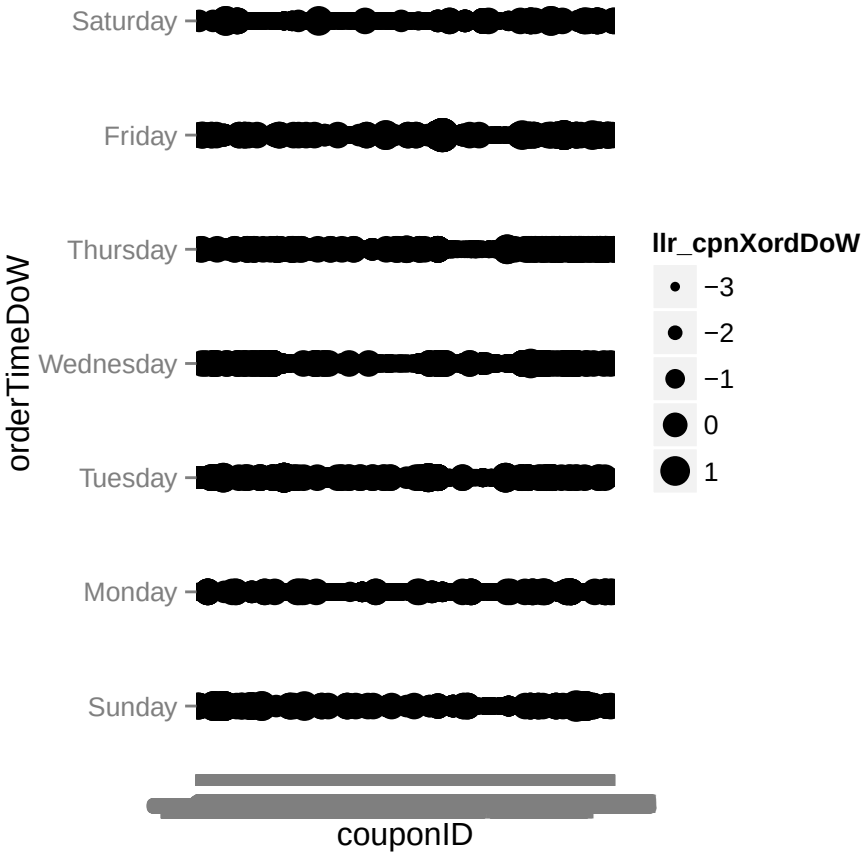
```
# orderTimeDoW
llr = compute_ll_2w(as.character(H$couponID), as.character(H$orderTimeDoW), H$couponUsed, as.character(
llr_cpnXordDoW = data.frame(couponID = TVC$couponID, orderTimeDoW = TVC$orderTimeDoW, llr_cpnXordDoW = l

ggplot(data = llr_cpnXordDoW, aes(x = couponID, y = orderTimeDoW, size = llr_cpnXordDoW), alpha = 0.1) +
qplot(couponID, llr_cpnXordDoW, data = llr_cpnXordDoW, geom = "line", group = orderTimeDoW, facets = ord

TVC %>% left_join(llr_cpnXordDoW, by = c("couponID", "orderTimeDoW")) %>% select(orderID, couponID, dsn
    couponUsed) %>% ggplot(aes(x = orderTimeDoW, y = llr_cpnXordDoW, fill = factor(couponUsed), color =
    facet_grid(dsn ~ .)
```

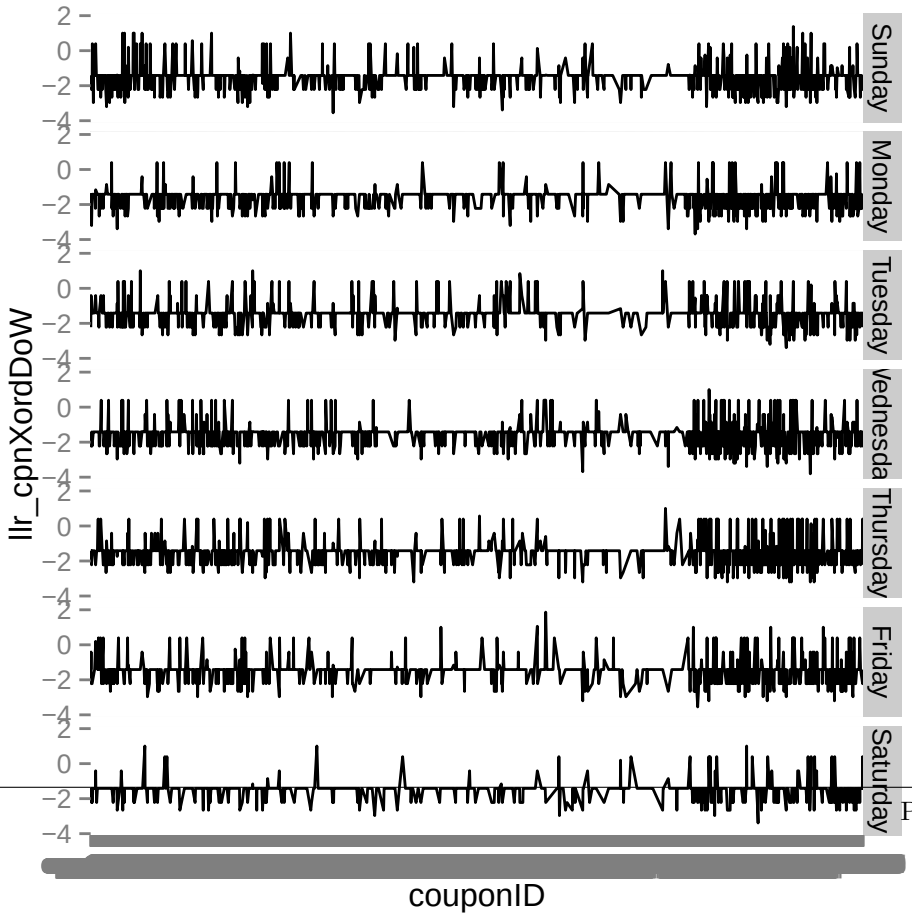
```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

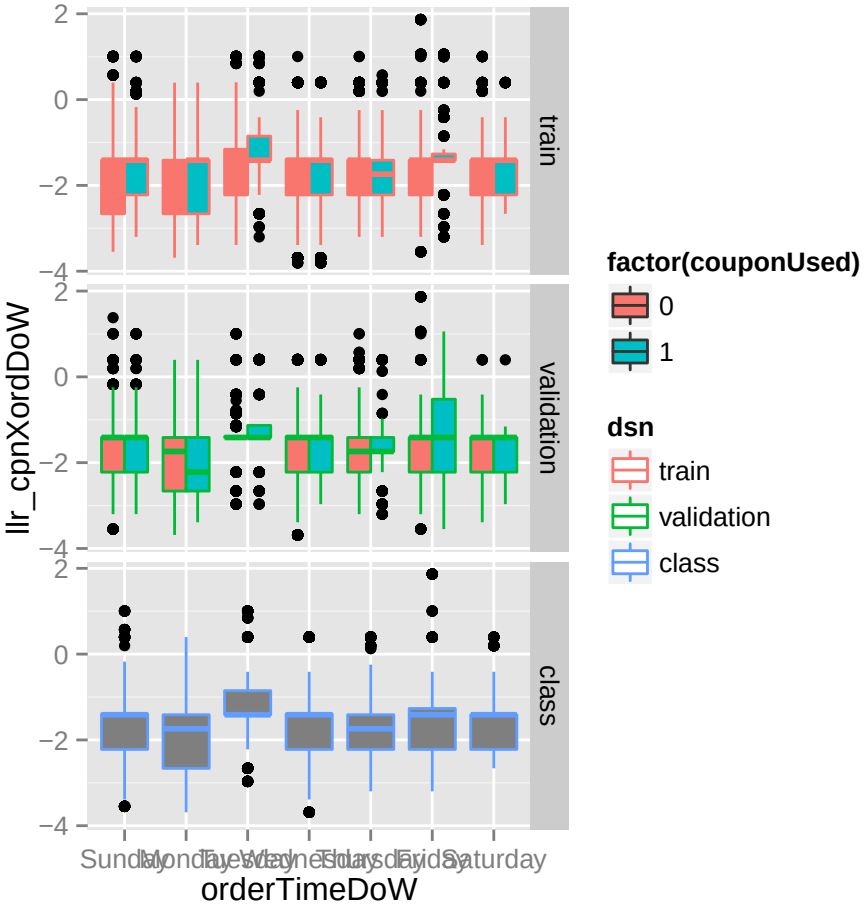
```
llr_cpnXordDoW = TVC %>% left_join(llr_cpnXordDoW, by = c("couponID", "orderTimeDoW")) %>% select(order
```

```
## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara
```

```
trn = llr_cpnXordDoW %>% filter(dsn == "train") %>% select(-dsn)
val = llr_cpnXordDoW %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_cpnXordDoW %>% filter(dsn == "class") %>% select(-dsn)

llr_cpnXordDoW = list(T = trn, V = val, C = cls)

saveRDS(llr_cpnXordDoW, "../features/feature_files/llr_cpnXordDoW.rds")
```


Saturday
Friday
Thursday
Wednesday
Tuesday
Monday
Sunday
orderTimeDoW
couponID
llr_cpnXordDoW
−3
−2
−1
0
1

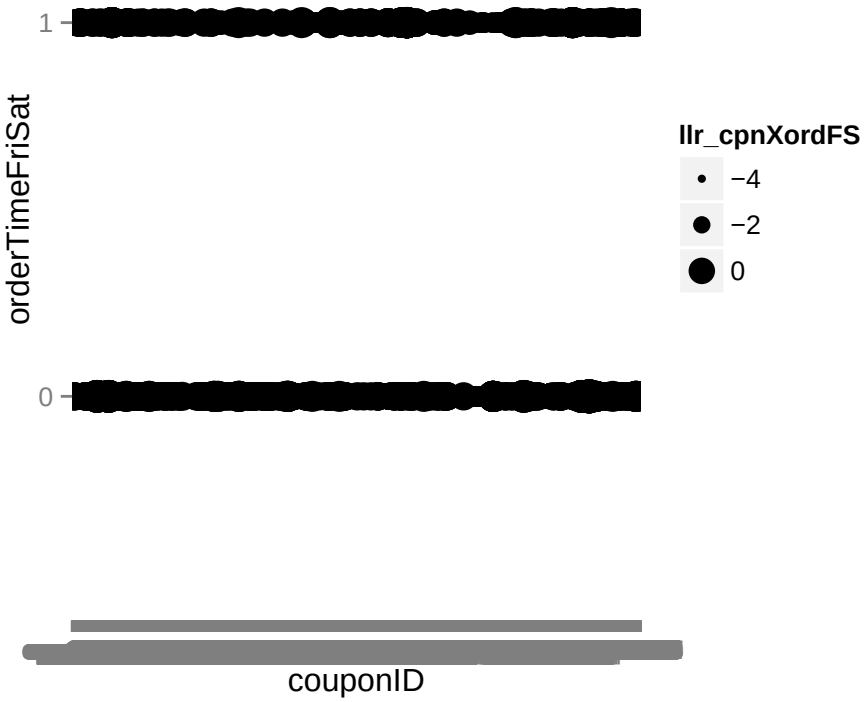

Sunday
Monday
Tuesday
Wednesda
Thursday
Friday
Saturday
llr_cpnXordDoW
2
0
−2
−4
couponID

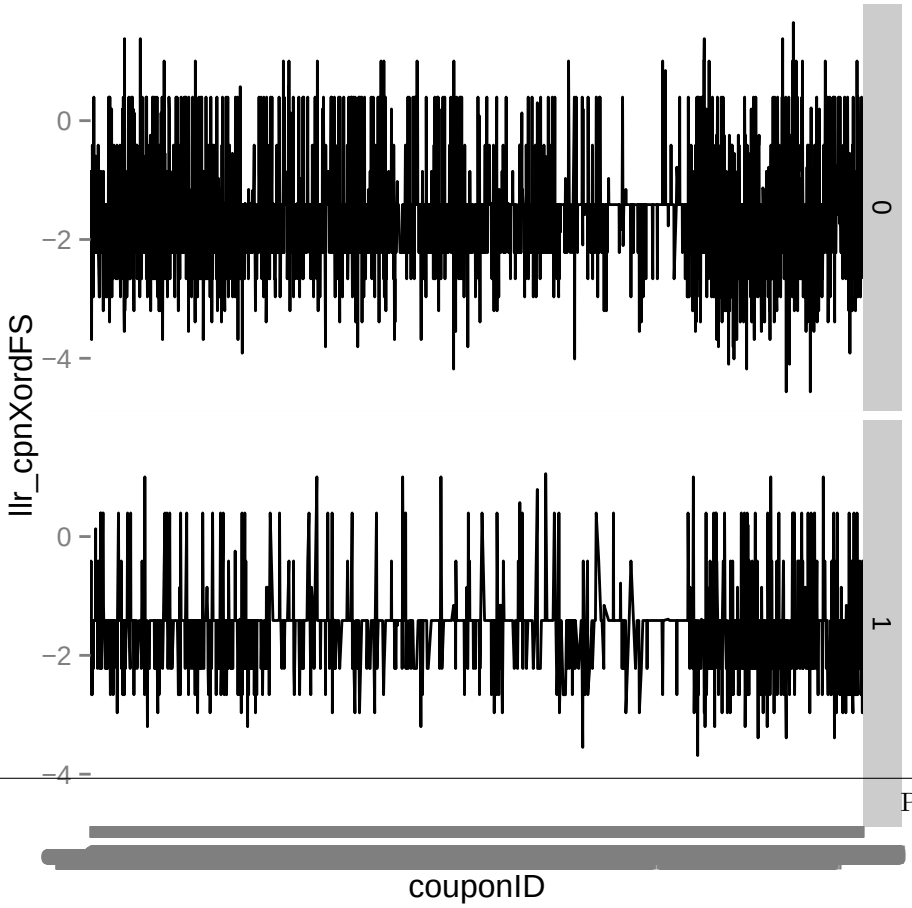


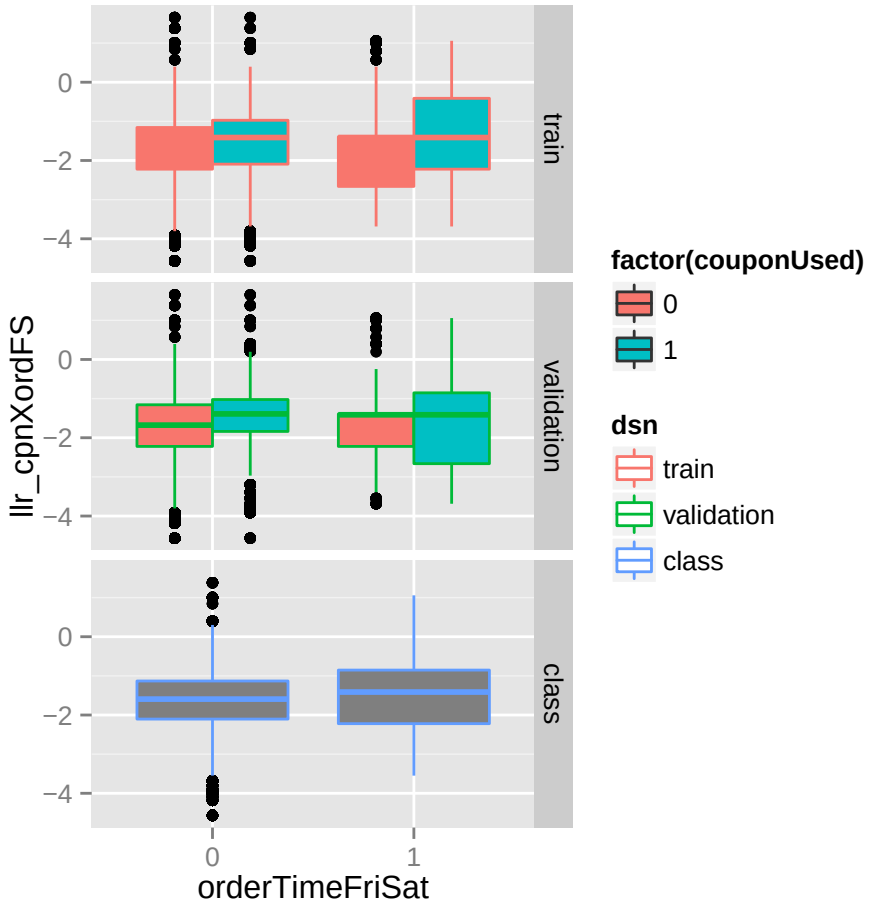
orderTimeFriSat (as `llr_cpnXordFS`)

```
# orderTimeFriSat
llr = compute_ll_2w(as.character(H$couponID), as.character(H$orderTimeFriSat), H$couponUsed, as.charact
    as.character(TVC$orderTimeFriSat))
llr_cpnXordFS = data.frame(couponID = TVC$couponID, orderTimeFriSat = TVC$orderTimeFriSat, llr_cpnXordF

ggplot(data = llr_cpnXordFS, aes(x = couponID, y = orderTimeFriSat, size = llr_cpnXordFS), alpha = 0.1)
qplot(couponID, llr_cpnXordFS, data = llr_cpnXordFS, geom = "line", group = orderTimeFriSat, facets = o
    .)

TVC %>% left_join(llr_cpnXordFS, by = c("couponID", "orderTimeFriSat")) %>% select(orderID, couponID, d
    llr_cpnXordFS, couponUsed) %>% ggplot(aes(x = orderTimeFriSat, y = llr_cpnXordFS, fill = factor(cou
    geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_cpnXordFS = TVC %>% left_join(llr_cpnXordFS, by = c("couponID", "orderTimeFriSat")) %>% select(orde

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_cpnXordFS %>% filter(dsn == "train") %>% select(-dsn)
val = llr_cpnXordFS %>% filter(dsn == "validation") %>% select(-dsn)
cls = llr_cpnXordFS %>% filter(dsn == "class") %>% select(-dsn)
```

```
llr_cpnXordFS = list(T = trn, V = val, C = cls)

saveRDS(llr_cpnXordFS, "../features/feature_files/llr_cpnXordFS.rds")
```


1
0
orderTimeFriSat
llr_cpnXordFS
−4
−2
0
couponID

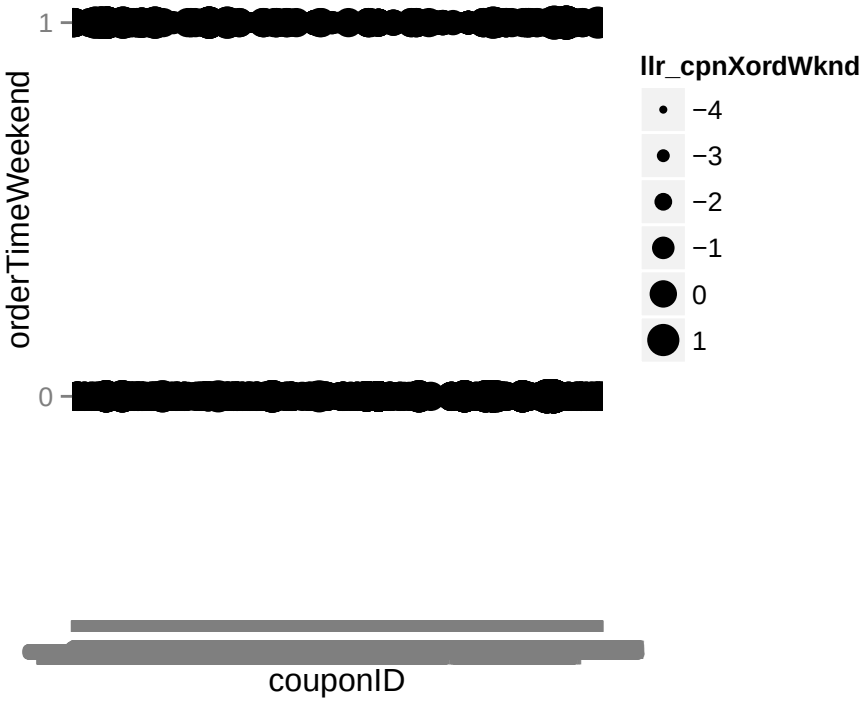

0
−2
−4
0
−2
−4
llr_cpnXordFS
0
1
couponID

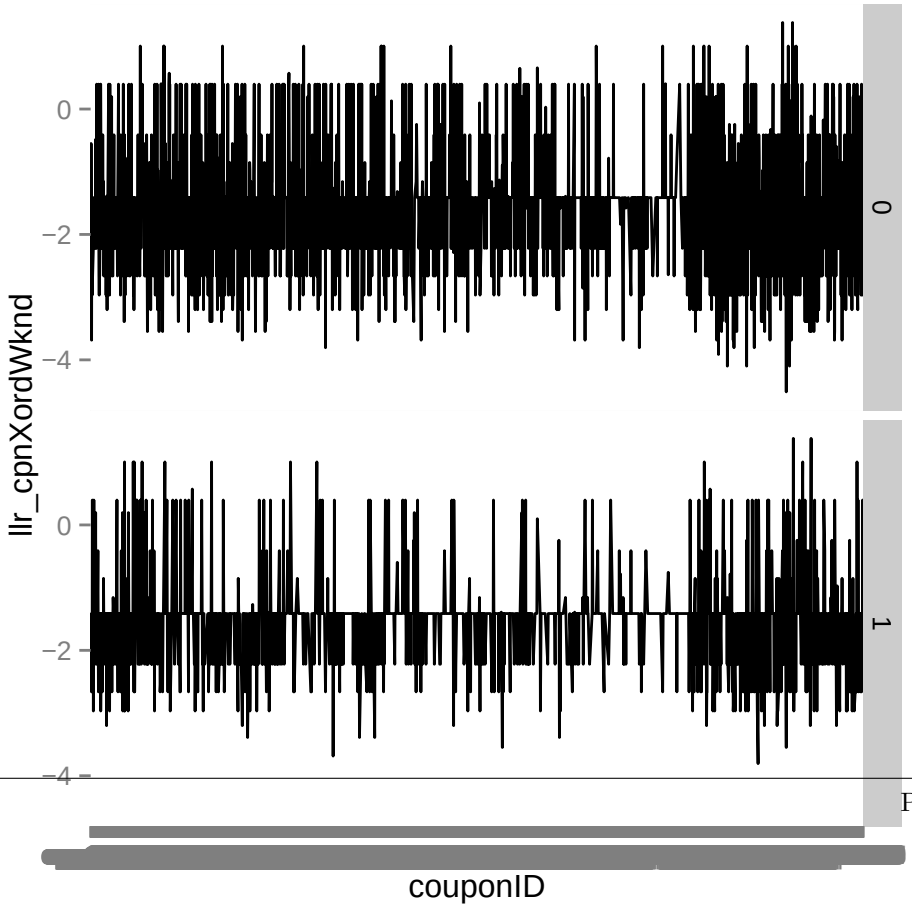


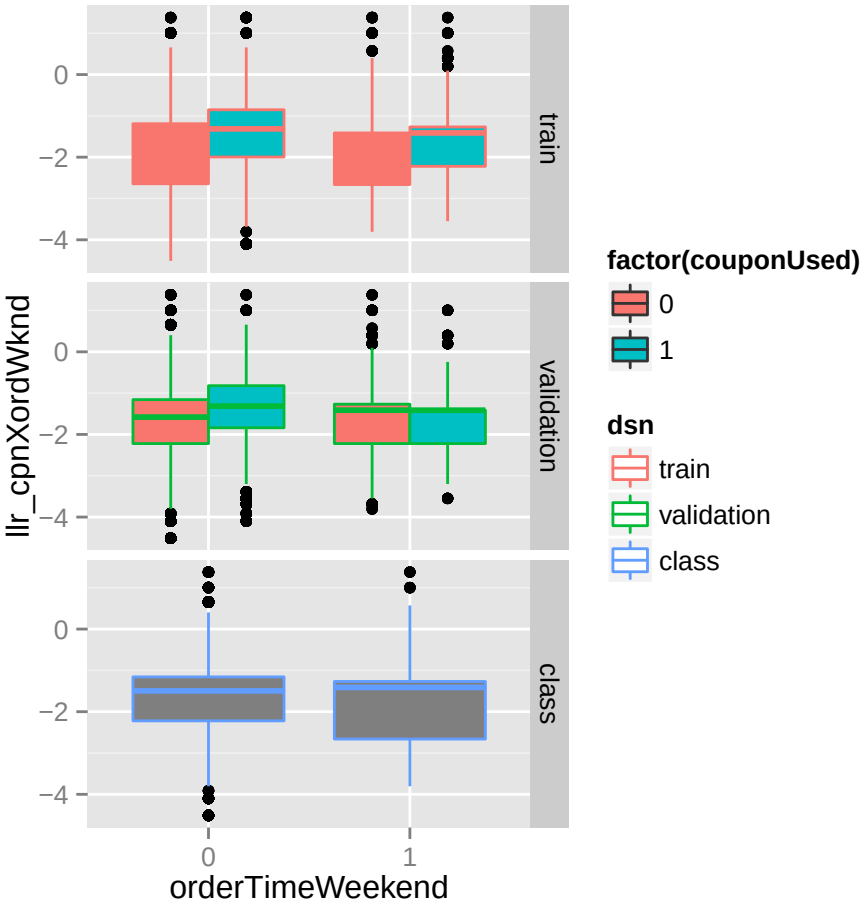
orderTimeWeekend (as `llr_cpnXordWknd`)

```
# orderTimeWeekend
llr = compute_ll_2w(as.character(H$couponID), as.character(H$orderTimeWeekend), H$couponUsed, as.charac
    as.character(TVC$orderTimeWeekend))
llr_cpnXordWknd = data.frame(couponID = TVC$couponID, orderTimeWeekend = TVC$orderTimeWeekend, llr_cpnX
    arrange(couponID)

ggplot(data = llr_cpnXordWknd, aes(x = couponID, y = orderTimeWeekend, size = llr_cpnXordWknd), alpha =
qplot(couponID, llr_cpnXordWknd, data = llr_cpnXordWknd, geom = "line", group = orderTimeWeekend, facet
    .)

TVC %>% left_join(llr_cpnXordWknd, by = c("couponID", "orderTimeWeekend")) %>% select(orderID, couponID
    llr_cpnXordWknd, couponUsed) %>% ggplot(aes(x = orderTimeWeekend, y = llr_cpnXordWknd, fill = facto
    geom_boxplot() + facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_cpnXordWknd = TVC %>% left_join(llr_cpnXordWknd, by = c("couponID", "orderTimeWeekend")) %>% select

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_cpnXordWknd %>% filter(dsn == "train") %>% select(-dsn)
val = llr_cpnXordWknd %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_cpnXordWknd %>% filter(dsn == "class") %>% select(-dsn)

llr_cpnXordWknd = list(T = trn, V = val, C = cls)

saveRDS(llr_cpnXordWknd, "../features/feature_files/llr_cpnXordWknd.rds")
```


1
0
orderTimeWeekend
llr_cpnXordWknd
−4
−3
−2
−1
0
1
couponID

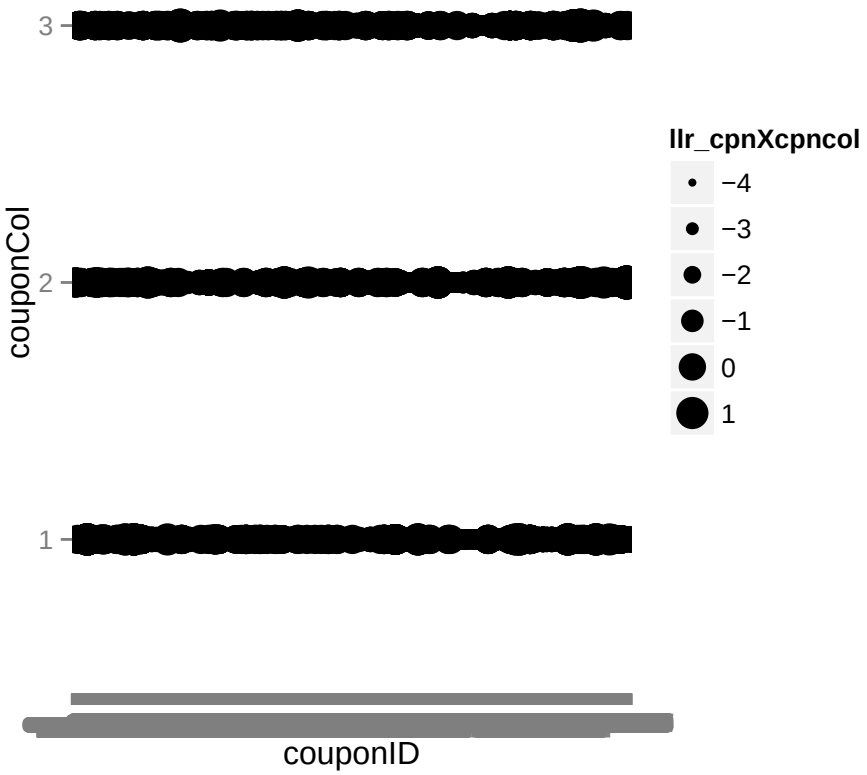

0
−2
−4
0
−2
−4
llr_cpnXordWknd
0
1
couponID

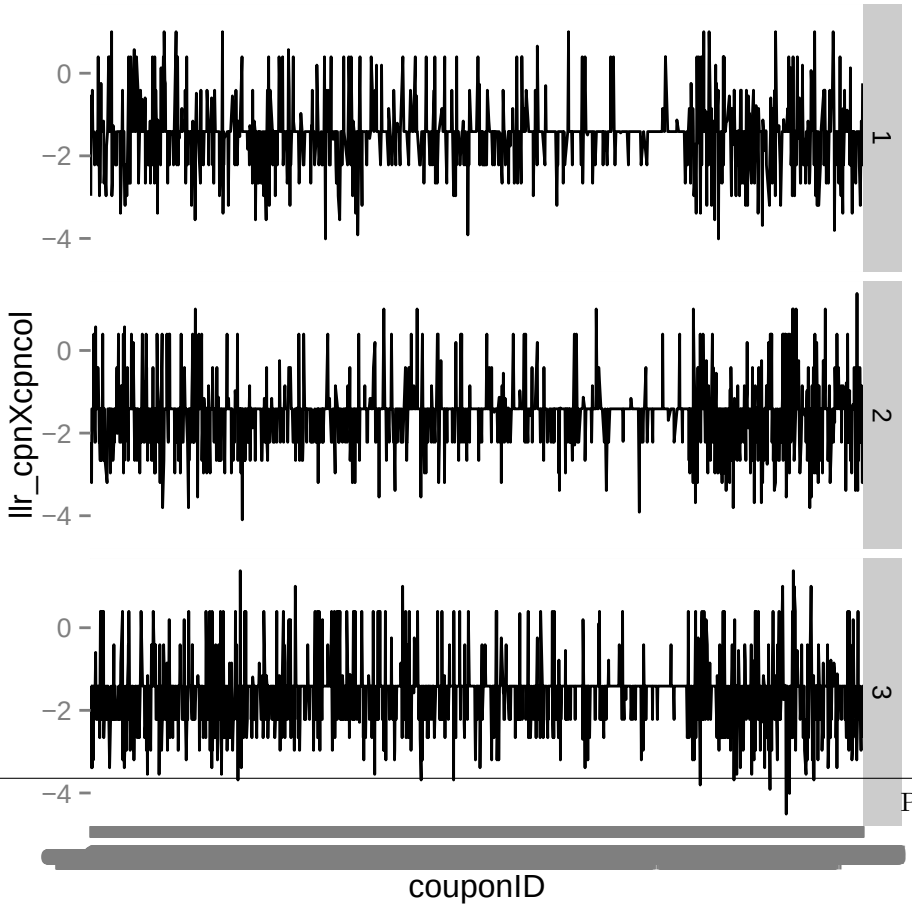


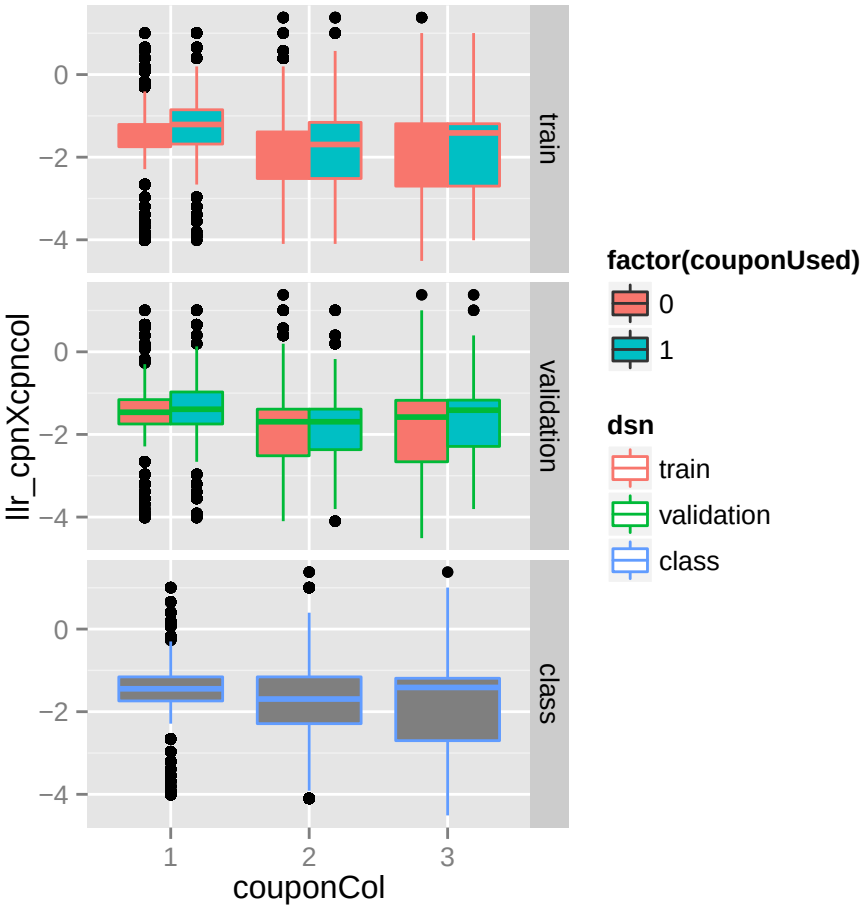
couponCol (as `llr_cpnXcpncol`)

```
# couponCol
llr = compute_ll_2w(as.character(H$couponID), as.character(H$couponCol), H$couponUsed, as.character(TVC
llr_cpnXcpncol = data.frame(couponID = TVC$couponID, couponCol = TVC$couponCol, llr_cpnXcpncol = llr) %

ggplot(data = llr_cpnXcpncol, aes(x = couponID, y = couponCol, size = llr_cpnXcpncol), alpha = 0.1) + g
qplot(couponID, llr_cpnXcpncol, data = llr_cpnXcpncol, geom = "line", group = couponCol, facets = coupo

TVC %>% left_join(llr_cpnXcpncol, by = c("couponID", "couponCol")) %>% select(orderID, couponID, dsn, c
    couponUsed) %>% ggplot(aes(x = couponCol, y = llr_cpnXcpncol, fill = factor(couponUsed), color = ds
    facet_grid(dsn ~ .)

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

llr_cpnXcpncol = TVC %>% left_join(llr_cpnXcpncol, by = c("couponID", "couponCol")) %>% select(orderID,

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

## Warning in left_join_impl(x, y, by$x, by$y): joining factor and character vector, coercing into chara

trn = llr_cpnXcpncol %>% filter(dsn == "train") %>% select(-dsn)
val = llr_cpnXcpncol %>% filter(dsn == "validation") %>% select(-dsn)
```

```
cls = llr_cpnXcpncol %>% filter(dsn == "class") %>% select(-dsn)

llr_cpnXcpncol = list(T = trn, V = val, C = cls)

saveRDS(llr_cpnXcpncol, "../features/feature_files/llr_cpnXcpncol.rds")
```


3
2
1
couponCol
couponID
llr_cpnXcpncol
−4
−3
−2
−1
0
1


0
−2
−4
llr_cpnXcpncol
1
2
3
couponID


train
validation
class
llr_cpnXcpncol
0
−2
−4
1
2
3
couponCol
factor(couponUsed)
0
1
dsn
train
validation
class