2019-01-27 - LCA data modeling Seth-Josh

1. Loading, setting up

```r
library(tidyverse)
library(poLCA)
library(readxl)
```

Getting data from Google Sheets

```r
library(googlesheets)
library(readr)

g <- gs_title("Observations_segment_Units_1-7_2013-14-with-duplicates-identified")
d <- gs_read(g, col_types =
                 readr::cols(
  `ClassObservation::Observer` = col_character(),
  `ClassObservation::ObsNickname` = col_double(),
  `Teacher::TeacherID` = col_double(),
  `Teacher::First Name` = col_character(),
  `Teacher::Last Name` = col_character(),
  `Teacher::Condition` = col_character(),
  `ClassObservation::Unit` = col_double(),
  `ClassObservation::Date` = col_datetime(format = ""),
  Notes = col_character(),
  ObsNN = col_double(),
  SegNum = col_double(),
  `Segment::StartStamp` = col_datetime(format = ""),
  `Segment::EndStamp` = col_datetime(format = ""),
  fWhole = col_double(),
  fGroups = col_double(),
  fSeat = col_double(),
  sInvented = col_double(),
  sConceptual = col_double(),
  sProcedural = col_double(),
  sEngagement = col_character(),
  tInitSelect = col_double(),
  tCompare = col_double(),
  tDiscussQ = col_double(),
  tPressExplain = col_double(),
  tConnectOthers = col_double(),
  tConnectBigIdeas = col_double(),
  tConventional = col_double(),
  tProcedural = col_double(),
  iPrecision = col_double(),
  iCenter = col_double(),
  iDIsplay = col_double(),
```

```r
    iOther = col_double(),
    iOrder = col_double(),
    iScale = col_double(),
    iGrouping = col_double(),
    iShape = col_double(),
    iShow = col_double(),
    iHide = col_double(),
    iMode = col_double(),
    iMedian = col_double(),
    iMean = col_double(),
    iRange = col_double(),
    iCenterClump = col_double(),
    iDeviation = col_double(),
    iReplicability = col_double(),
    iGeneralizability = col_double(),
    iLinkVisDist = col_double(),
    iLinkImagDist = col_double(),
    ITheoreticalProb = col_double(),
    IEmpiricalProb = col_double(),
    IOdds = col_logical(),
    ISampleSize = col_double(),
    ISamplingDistrib = col_double(),
    ICenterStats = col_double(),
    IVariabilityStats = col_double(),
    `Segment::iIntelligibility` = col_double(),
    `Segment::iModelFit` = col_double(),
    `Segment::iDistribution` = col_double(),
    `Segment::iRandomComponents` = col_double(),
    `Segment::iNonRandomComponents` = col_double(),
    `Segment::iMedianDistr` = col_double(),
    `Segment::iIQRDistr` = col_logical(),
    `Segment::iNewMedian` = col_double(),
    `Segment::iNewIQR` = col_logical(),
    `Segment::iRegions` = col_double(),
    `Segment::iQuantRegions` = col_double(),
    number_of_segments = col_double(),
    `Duplicate Condition` = col_character()
))

d <- dplyr::rename(d, condition = `Teacher::Condition`)

d <- d %>%
    mutate(condition = ifelse(str_detect(condition, "1"), 1,
                        ifelse(str_detect(condition, "2") | condition == 0, 0, NA)))

library(readxl)
u <- read_xlsx("Observations_summary_Units_1-7_2012-13-mod.xlsx")
g1 <- gs_title("Observations_segment_Units_1-7_2012-13-with-duplicates-identified")
d1 <- gs_read(g1)
d1 <- unite(d1, Teacher, `Teacher::First Name`, `Teacher::Last Name`, sep = " ")
d1 <- d1 %>% left_join(u, by = "Teacher")
d1 <- rename(d1, condition = Group)
```

```r
add_one <- function(x) {
    x + 1
}

ds <- d %>%
    dplyr::select(sInvented, sProcedural, sConceptual, tInitSelect, tCompare, tDiscussQ, tConnectBigIdea
    map_df(replace_na, 0) %>%
    modify_if(is.numeric, add_one)

ds1 <- d1 %>%
    dplyr::select(sInvented, sProcedural, sConceptual, tInitSelect, tCompare, tDiscussQ, tConnectBigIdea
    map_df(replace_na, 0) %>%
    modify_if(is.numeric, add_one)

dd <- bind_rows(ds, ds1)

dds <- filter(dd, `Duplicate Condition` != "D" & `Duplicate Condition` != "d")
```

3. Choosing the number of classes/profiles

Using latent class analysis through the **poLCA** R package.

```r
f <- cbind(sInvented, sProcedural, sConceptual, tInitSelect, tCompare, tDiscussQ, tConnectBigIdeas, tCo

od <- map(1:9, poLCA, formula = f, data = dds, maxiter = 5000, verbose = FALSE, graphs = FALSE) %>%
    map_df(broom::glance)
```
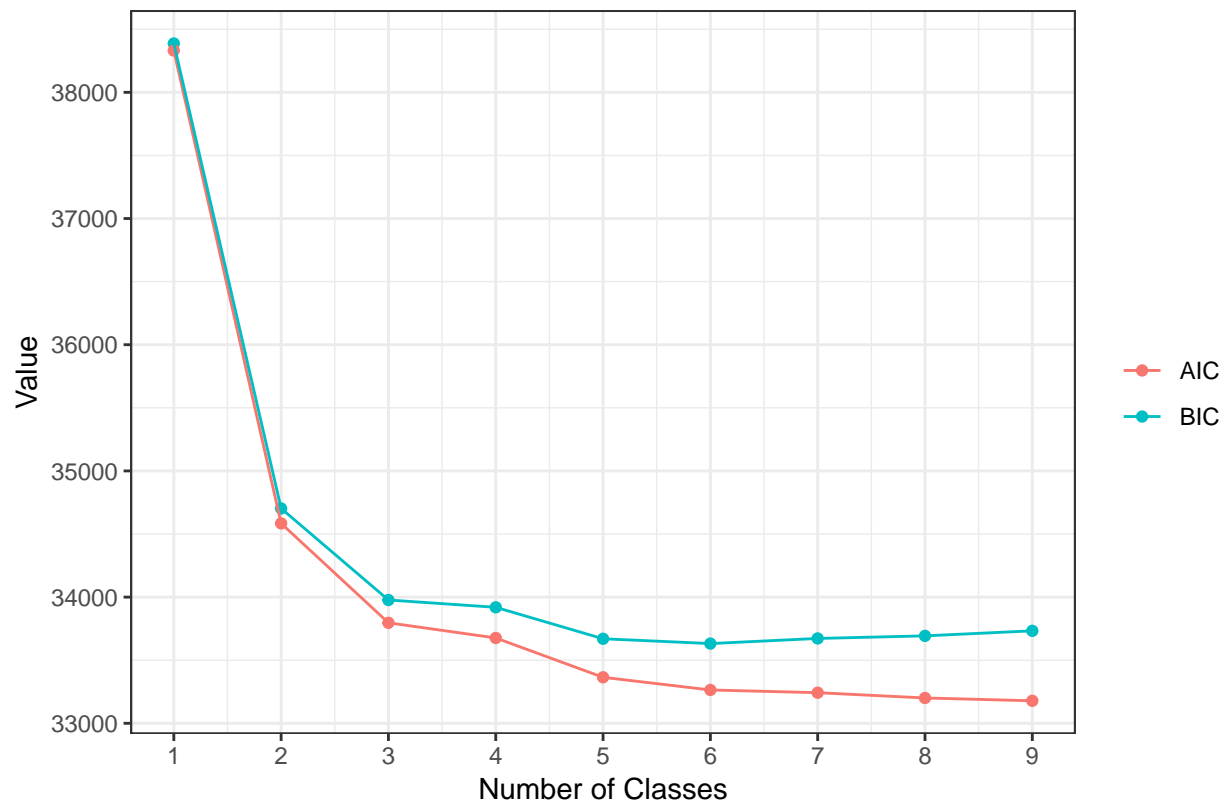
```r
od %>%
    mutate(n_classes = 1:9) %>%
    gather(key, val, BIC, AIC) %>%
    ggplot(aes(x = n_classes, y = val, color = key, group = key)) +
    geom_point() +
    geom_line() +
    scale_x_continuous(breaks = 1:9, labels = 1:9) +
    theme_bw() +
    labs(caption = "Lower values of the AIC & BIC suggest preferred model(s); generally, BIC is more con
    xlab("Number of Classes") +
    ylab("Value") +
    scale_color_discrete("")
```

wer values of the AIC & BIC suggest preferred model(s); generally, BIC is more conservative than AIC

Based on these fit statistics, a three or four class solution seems to exhibit the best fit, though a three-class solution may also be suitable; for comparison, a two-class solution is also explored.

4. Examining 2, 3, 4, and 5 class solutions

```
f <- cbind(sInvented, sProcedural, sConceptual, tInitSelect, tCompare, tDiscussQ, tConnectBigIdeas, tCon

m2 <- poLCA(f, dds, nclass = 2, maxiter = 5000, graphs = TRUE)
```
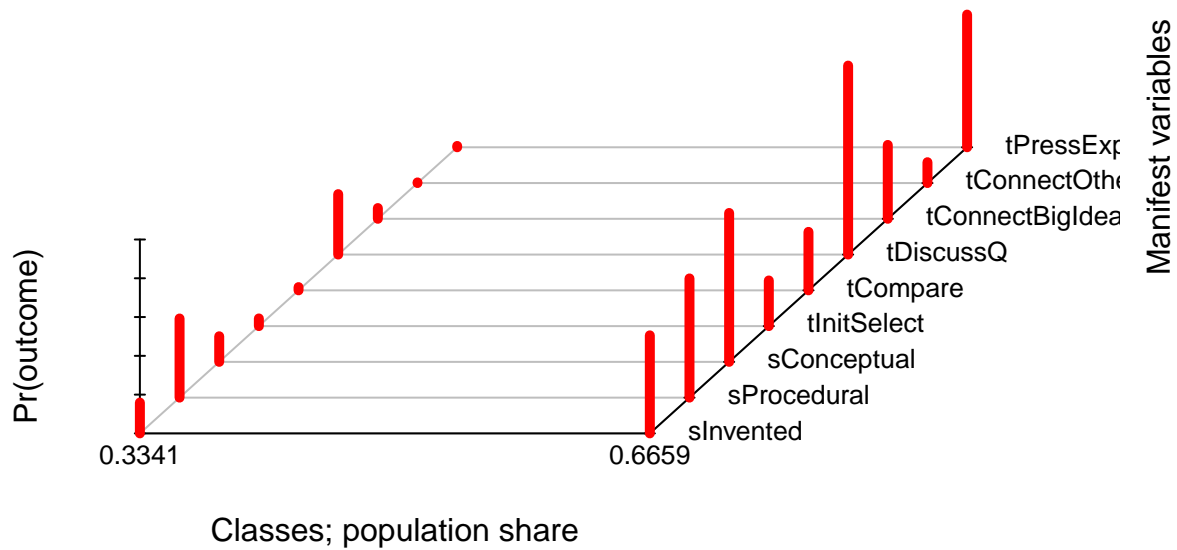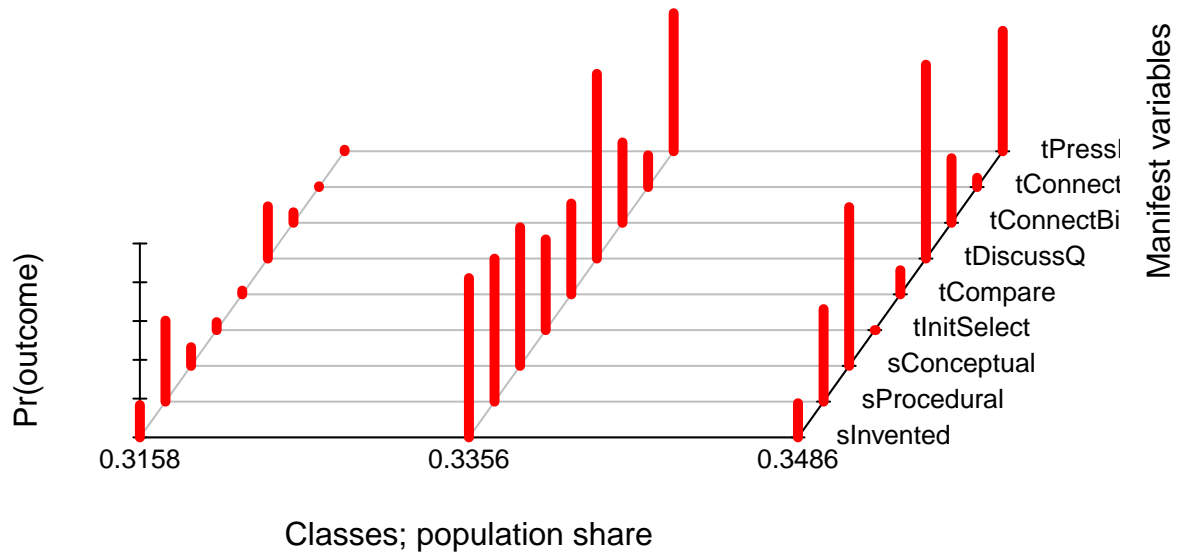
```
## Conditional item response (column) probabilities,
##  by outcome variable, for each class (row)
##
## $sInvented
##            Pr(1)  Pr(2)
## class 1:  0.8410 0.1590
## class 2:  0.4943 0.5057
##
## $sProcedural
##            Pr(1)  Pr(2)
## class 1:  0.5919 0.4081
## class 2:  0.3853 0.6147
##
## $sConceptual
##            Pr(1)  Pr(2)
## class 1:  0.8679 0.1321
## class 2:  0.2320 0.7680
##
## $tInitSelect
##            Pr(1)  Pr(2)
## class 1:  0.9605 0.0395
## class 2:  0.7645 0.2355
##
## $tCompare
##            Pr(1)  Pr(2)
## class 1:  0.9833 0.0167
```

```
## class 2:   0.6983 0.3017
##
## $tDiscussQ
##             Pr(1)  Pr(2)
## class 1:   0.6882 0.3118
## class 2:   0.0252 0.9748
##
## $tConnectBigIdeas
##             Pr(1)  Pr(2)
## class 1:   0.9444 0.0556
## class 2:   0.6189 0.3811
##
## $tConnectOthers
##             Pr(1)  Pr(2)
## class 1:   0.9967 0.0033
## class 2:   0.8924 0.1076
##
## $tPressExplain
##             Pr(1)  Pr(2)
## class 1:   0.9930 0.0070
## class 2:   0.3157 0.6843
##
## Estimated class population shares
##   0.3341 0.6659
##
## Predicted class memberships (by modal posterior prob.)
##   0.3213 0.6787
##
## ============================================================
## Fit for 2 latent classes:
## ============================================================
## number of observations: 3753
## number of estimated parameters: 19
## residual degrees of freedom: 492
## maximum log-likelihood: -17273.09
##
## AIC(2): 34584.18
## BIC(2): 34702.56
## G^2(2): 2000.883 (Likelihood ratio/deviance statistic)
## X^2(2): 5120.786 (Chi-square goodness of fit)
##
```

```r
m3 <- poLCA(f, dds, nclass = 3, maxiter = 5000, graphs = TRUE)
```

```
## Conditional item response (column) probabilities,
##  by outcome variable, for each class (row)
##
## $sInvented
##           Pr(1)  Pr(2)
## class 1:  0.8332 0.1668
## class 2:  0.1784 0.8216
## class 3:  0.8238 0.1762
##
## $sProcedural
##           Pr(1)  Pr(2)
## class 1:  0.5823 0.4177
## class 2:  0.2626 0.7374
## class 3:  0.5229 0.4771
##
## $sConceptual
##           Pr(1)  Pr(2)
## class 1:  0.9038 0.0962
## class 2:  0.2855 0.7145
## class 3:  0.1813 0.8187
##
## $tInitSelect
##           Pr(1)  Pr(2)
## class 1:  0.9587 0.0413
## class 2:  0.5323 0.4677
## class 3:  1.0000 0.0000
```

```
## 
## $tCompare
##           Pr(1)  Pr(2)
## class 1:  0.9809 0.0191
## class 2:  0.5317 0.4683
## class 3:  0.8758 0.1242
## 
## $tDiscussQ
##           Pr(1)  Pr(2)
## class 1:  0.7309 0.2691
## class 2:  0.0474 0.9526
## class 3:  0.0000 1.0000
## 
## $tConnectBigIdeas
##           Pr(1)  Pr(2)
## class 1:  0.9457 0.0543
## class 2:  0.5858 0.4142
## class 3:  0.6668 0.3332
## 
## $tConnectOthers
##           Pr(1)  Pr(2)
## class 1:  0.9962 0.0038
## class 2:  0.8364 0.1636
## class 3:  0.9523 0.0477
## 
## $tPressExplain
##           Pr(1)  Pr(2)
## class 1:  0.9921 0.0079
## class 2:  0.2878 0.7122
## class 3:  0.3788 0.6212
## 
## Estimated class population shares
##   0.3158 0.3356 0.3486
## 
## Predicted class memberships (by modal posterior prob.)
##   0.3176 0.3288 0.3536
## 
## =============================================================
## Fit for 3 latent classes:
## =============================================================
## number of observations: 3753
## number of estimated parameters: 29
## residual degrees of freedom: 482
## maximum log-likelihood: -16869.22
## 
## AIC(3): 33796.45
## BIC(3): 33977.13
## G^2(3): 1193.151 (Likelihood ratio/deviance statistic)
## X^2(3): 2276.576 (Chi-square goodness of fit)
## 
```

```
m4 <- poLCA(f, dds, nclass = 4, maxiter = 10000, graphs = TRUE)
```



```
## Conditional item response (column) probabilities,
##  by outcome variable, for each class (row)
##
## $sInvented
##           Pr(1)  Pr(2)
## class 1:  0.8716 0.1284
## class 2:  0.0818 0.9182
## class 3:  0.2874 0.7126
## class 4:  0.8761 0.1239
##
## $sProcedural
##           Pr(1)  Pr(2)
## class 1:  0.5310 0.4690
## class 2:  0.2120 0.7880
## class 3:  0.3553 0.6447
## class 4:  0.6039 0.3961
##
## $sConceptual
##           Pr(1)  Pr(2)
## class 1:  0.1874 0.8126
## class 2:  0.3986 0.6014
## class 3:  0.1331 0.8669
## class 4:  0.9144 0.0856
```

```
##
## $tInitSelect
##            Pr(1)  Pr(2)
## class 1:  0.9903 0.0097
## class 2:  0.6033 0.3967
## class 3:  0.5053 0.4947
## class 4:  0.9720 0.0280
##
## $tCompare
##            Pr(1)  Pr(2)
## class 1:  0.8842 0.1158
## class 2:  0.7255 0.2745
## class 3:  0.2609 0.7391
## class 4:  0.9814 0.0186
##
## $tDiscussQ
##            Pr(1)  Pr(2)
## class 1:  0.0025 0.9975
## class 2:  0.0959 0.9041
## class 3:  0.0066 0.9934
## class 4:  0.7540 0.2460
##
## $tConnectBigIdeas
##            Pr(1)  Pr(2)
## class 1:  0.6602 0.3398
## class 2:  0.8569 0.1431
## class 3:  0.1879 0.8121
## class 4:  0.9428 0.0572
##
## $tConnectOthers
##            Pr(1)  Pr(2)
## class 1:  0.9552 0.0448
## class 2:  0.9493 0.0507
## class 3:  0.6622 0.3378
## class 4:  0.9959 0.0041
##
## $tPressExplain
##            Pr(1)  Pr(2)
## class 1:  0.3876 0.6124
## class 2:  0.4128 0.5872
## class 3:  0.1523 0.8477
## class 4:  0.9956 0.0044
##
## Estimated class population shares
##  0.338 0.2353 0.1316 0.295
##
## Predicted class memberships (by modal posterior prob.)
##  0.3429 0.2443 0.1164 0.2963
##
## ============================================================
## Fit for 4 latent classes:
## ============================================================
## number of observations: 3753
## number of estimated parameters: 39
```

```
## residual degrees of freedom: 472
## maximum log-likelihood: -16688.75
##
## AIC(4): 33455.5
## BIC(4): 33698.49
## G^2(4): 832.2073 (Likelihood ratio/deviance statistic)
## X^2(4): 1870.21 (Chi-square goodness of fit)
##
```

```
m5 <- poLCA(f, dds, nclass = 5, maxiter = 10000, graphs = TRUE)
```
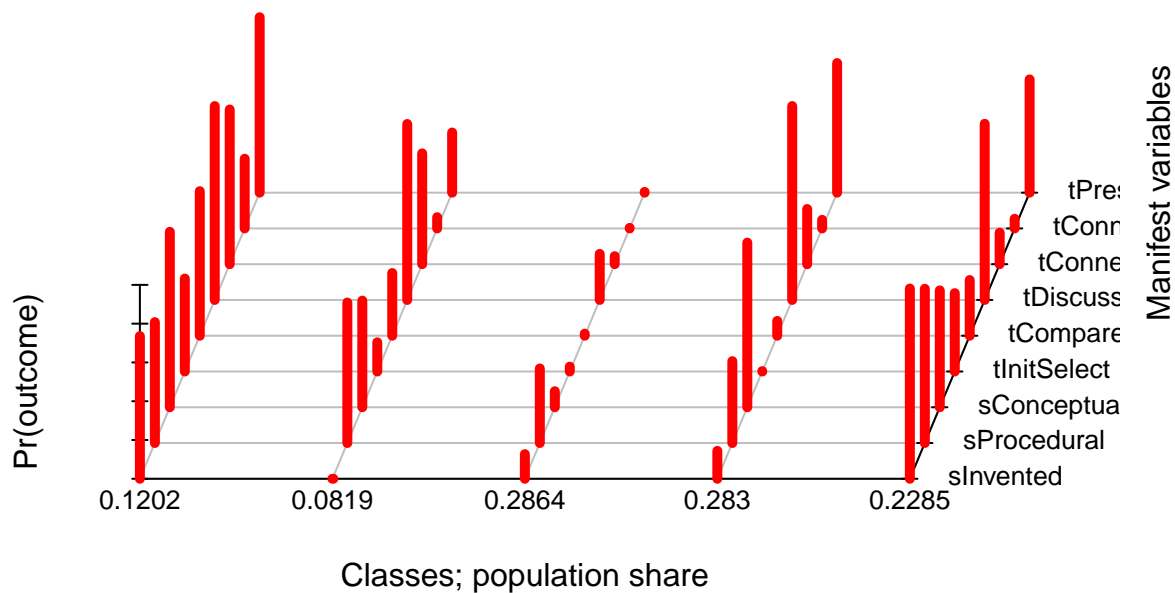


```
## Conditional item response (column) probabilities,
##  by outcome variable, for each class (row)
##
## $sInvented
##           Pr(1)  Pr(2)
## class 1:  0.2641 0.7359
## class 2:  1.0000 0.0000
## class 3:  0.8729 0.1271
## class 4:  0.8560 0.1440
## class 5:  0.0189 0.9811
##
## $sProcedural
##           Pr(1)  Pr(2)
## class 1:  0.3765 0.6235
```

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```
## class 2:   0.2755 0.7245
## class 3:   0.6155 0.3845
## class 4:   0.5777 0.4223
## class 5:   0.2045 0.7955
##
## $sConceptual
##            Pr(1)  Pr(2)
## class 1:   0.0951 0.9049
## class 2:   0.4501 0.5499
## class 3:   0.9173 0.0827
## class 4:   0.1509 0.8491
## class 5:   0.3972 0.6028
##
## $tInitSelect
##            Pr(1)  Pr(2)
## class 1:   0.5206 0.4794
## class 2:   0.8496 0.1504
## class 3:   0.9751 0.0249
## class 4:   0.9981 0.0019
## class 5:   0.5958 0.4042
##
## $tCompare
##            Pr(1)  Pr(2)
## class 1:   0.2543 0.7457
## class 2:   0.6766 0.3234
## class 3:   0.9892 0.0108
## class 4:   0.9236 0.0764
## class 5:   0.7127 0.2873
##
## $tDiscussQ
##            Pr(1)  Pr(2)
## class 1:   0.0000 1.0000
## class 2:   0.0924 0.9076
## class 3:   0.7623 0.2377
## class 4:   0.0000 1.0000
## class 5:   0.0913 0.9087
##
## $tConnectBigIdeas
##            Pr(1)  Pr(2)
## class 1:   0.2020 0.7980
## class 2:   0.4285 0.5715
## class 3:   0.9587 0.0413
## class 4:   0.7152 0.2848
## class 5:   0.8375 0.1625
##
## $tConnectOthers
##            Pr(1)  Pr(2)
## class 1:   0.6404 0.3596
## class 2:   0.9421 0.0579
## class 3:   0.9971 0.0029
## class 4:   0.9557 0.0443
## class 5:   0.9501 0.0499
##
## $tPressExplain
```

```
##             Pr(1)  Pr(2)
## class 1:   0.0952 0.9048
## class 2:   0.6897 0.3103
## class 3:   0.9959 0.0041
## class 4:   0.3315 0.6685
## class 5:   0.4159 0.5841
##
## Estimated class population shares
##  0.1202 0.0819 0.2864 0.283 0.2285
##
## Predicted class memberships (by modal posterior prob.)
##  0.1106 0.0512 0.2928 0.3014 0.2441
##
## ============================================================
## Fit for 5 latent classes:
## ============================================================
## number of observations: 3753
## number of estimated parameters: 49
## residual degrees of freedom: 462
## maximum log-likelihood: -16643.4
##
## AIC(5): 33384.8
## BIC(5): 33690.09
## G^2(5): 741.5037 (Likelihood ratio/deviance statistic)
## X^2(5): 1361.074 (Chi-square goodness of fit)
##
```

5. Examining predictors of the 4-class solution

```r
f <- cbind(sInvented, sProcedural, sConceptual, tInitSelect, tCompare, tDiscussQ, tConnectBigIdeas, tCo

m2 <- poLCA(f, dds, nclass = 2, maxiter = 10000, graphs = TRUE)
```
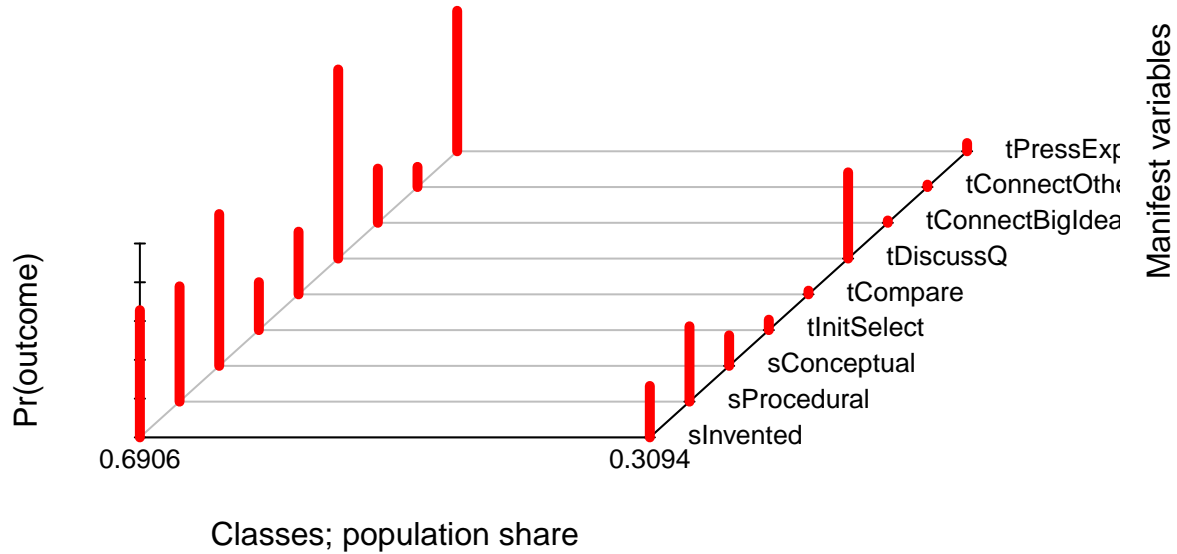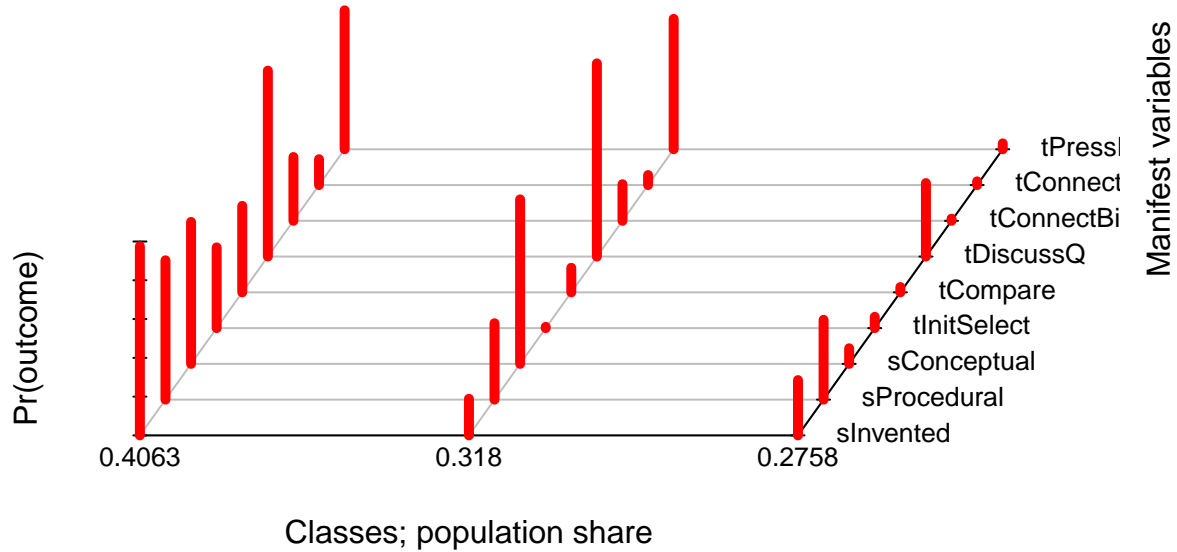
```
## Conditional item response (column) probabilities,
##  by outcome variable, for each class (row)
##
## $sInvented
##          Pr(1)  Pr(2)
## class 1:  0.3440 0.6560
## class 2:  0.7348 0.2652
##
## $sProcedural
##          Pr(1)  Pr(2)
## class 1:  0.4054 0.5946
## class 2:  0.6116 0.3884
##
## $sConceptual
##          Pr(1)  Pr(2)
## class 1:  0.2170 0.7830
## class 2:  0.8428 0.1572
##
## $tInitSelect
##          Pr(1)  Pr(2)
## class 1:  0.7529 0.2471
## class 2:  0.9463 0.0537
##
## $tCompare
##          Pr(1)  Pr(2)
## class 1:  0.6768 0.3232
```

```
## class 2:  0.9811 0.0189
##
## $tDiscussQ
##             Pr(1)  Pr(2)
## class 1:  0.0248 0.9752
## class 2:  0.5553 0.4447
##
## $tConnectBigIdeas
##             Pr(1)  Pr(2)
## class 1:  0.7205 0.2795
## class 2:  0.9880 0.0120
##
## $tConnectOthers
##             Pr(1)  Pr(2)
## class 1:  0.8959 0.1041
## class 2:  0.9875 0.0125
##
## $tPressExplain
##             Pr(1)  Pr(2)
## class 1:  0.2754 0.7246
## class 2:  0.9573 0.0427
##
## Estimated class population shares
##   0.6906 0.3094
##
## Predicted class memberships (by modal posterior prob.)
##   0.6797 0.3203
##
## =============================================================
## Fit for 2 latent classes:
## =============================================================
## 2 / 1
##             Coefficient  Std. error  t value  Pr(>|t|)
## (Intercept)     4.51625     0.60846    7.422         0
## condition      -2.74023     0.30631   -8.946         0
## =============================================================
## number of observations: 2323
## number of estimated parameters: 20
## residual degrees of freedom: 491
## maximum log-likelihood: -10622.53
##
## AIC(2): 21285.06
## BIC(2): 21400.07
## X^2(2): 4744.149 (Chi-square goodness of fit)
##
```

```r
m3 <- poLCA(f, dds, nclass = 3, maxiter = 10000, graphs = TRUE)
```

```
## Conditional item response (column) probabilities,
##  by outcome variable, for each class (row)
##
## $sInvented
##           Pr(1)  Pr(2)
## class 1:  0.0242 0.9758
## class 2:  0.8112 0.1888
## class 3:  0.7150 0.2850
##
## $sProcedural
##           Pr(1)  Pr(2)
## class 1:  0.2814 0.7186
## class 2:  0.6060 0.3940
## class 3:  0.5882 0.4118
##
## $sConceptual
##           Pr(1)  Pr(2)
## class 1:  0.2679 0.7321
## class 2:  0.1517 0.8483
## class 3:  0.9196 0.0804
##
## $tInitSelect
##           Pr(1)  Pr(2)
## class 1:  0.5838 0.4162
## class 2:  0.9934 0.0066
## class 3:  0.9417 0.0583
```

```
##
## $tCompare
##             Pr(1)  Pr(2)
## class 1:  0.5540 0.4460
## class 2:  0.8733 0.1267
## class 3:  0.9726 0.0274
##
## $tDiscussQ
##             Pr(1)  Pr(2)
## class 1:  0.0410 0.9590
## class 2:  0.0036 0.9964
## class 3:  0.6208 0.3792
##
## $tConnectBigIdeas
##             Pr(1)  Pr(2)
## class 1:  0.6710 0.3290
## class 2:  0.8113 0.1887
## class 3:  0.9890 0.0110
##
## $tConnectOthers
##             Pr(1)  Pr(2)
## class 1:  0.8668 0.1332
## class 2:  0.9484 0.0516
## class 3:  0.9810 0.0190
##
## $tPressExplain
##             Pr(1)  Pr(2)
## class 1:  0.2833 0.7167
## class 2:  0.3271 0.6729
## class 3:  0.9695 0.0305
##
## Estimated class population shares
##  0.4063 0.318 0.2758
##
## Predicted class memberships (by modal posterior prob.)
##  0.4219 0.2953 0.2828
##
## =============================================================
## Fit for 3 latent classes:
## =============================================================
## 2 / 1
##             Coefficient  Std. error  t value  Pr(>|t|)
## (Intercept)    48.22836     0.28080  171.754         0
## condition     -24.25275     0.14955 -162.169         0
## =============================================================
## 3 / 1
##             Coefficient  Std. error  t value  Pr(>|t|)
## (Intercept)    51.64564     0.28194  183.179         0
## condition     -26.11146     0.14430 -180.948         0
## =============================================================
## number of observations: 2323
## number of estimated parameters: 31
## residual degrees of freedom: 480
## maximum log-likelihood: -10285.11
```

```
## 
## AIC(3): 20632.22
## BIC(3): 20810.49
## X^2(3): 2337.87 (Chi-square goodness of fit)
## 
## ALERT: estimation algorithm automatically restarted with new initial values
## 
```

```r
m4 <- poLCA(f, dds, nclass = 4, maxiter = 10000, graphs = TRUE)
```
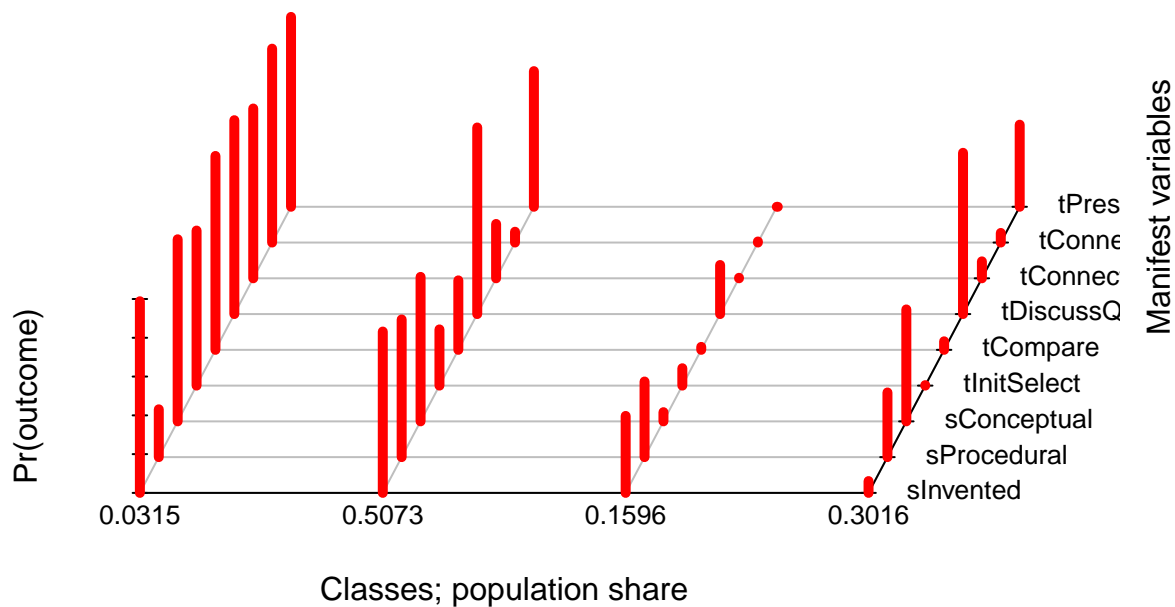


```
## Conditional item response (column) probabilities,
##  by outcome variable, for each class (row)
## 
## $sInvented
##          Pr(1)  Pr(2)
## class 1: 0.0116 0.9884
## class 2: 0.1678 0.8322
## class 3: 0.6029 0.3971
## class 4: 0.9389 0.0611
## 
## $sProcedural
##          Pr(1)  Pr(2)
## class 1: 0.7533 0.2467
## class 2: 0.2900 0.7100
## class 3: 0.6100 0.3900
```

```
## class 4:  0.6666 0.3334
##
## $sConceptual
##            Pr(1)  Pr(2)
## class 1:  0.0608 0.9392
## class 2:  0.2548 0.7452
## class 3:  0.9525 0.0475
## class 4:  0.4227 0.5773
##
## $tInitSelect
##            Pr(1)  Pr(2)
## class 1:  0.2003 0.7997
## class 2:  0.7102 0.2898
## class 3:  0.9104 0.0896
## class 4:  0.9976 0.0024
##
## $tCompare
##            Pr(1)  Pr(2)
## class 1:  0.0000 1.0000
## class 2:  0.6417 0.3583
## class 3:  0.9846 0.0154
## class 4:  0.9560 0.0440
##
## $tDiscussQ
##            Pr(1)  Pr(2)
## class 1:  0.0000 1.0000
## class 2:  0.0376 0.9624
## class 3:  0.7468 0.2532
## class 4:  0.1682 0.8318
##
## $tConnectBigIdeas
##            Pr(1)  Pr(2)
## class 1:  0.1242 0.8758
## class 2:  0.7195 0.2805
## class 3:  0.9972 0.0028
## class 4:  0.9125 0.0875
##
## $tConnectOthers
##            Pr(1)  Pr(2)
## class 1:  0.0000 1.0000
## class 2:  0.9441 0.0559
## class 3:  0.9945 0.0055
## class 4:  0.9503 0.0497
##
## $tPressExplain
##            Pr(1)  Pr(2)
## class 1:  0.0206 0.9794
## class 2:  0.3002 0.6998
## class 3:  1.0000 0.0000
## class 4:  0.5766 0.4234
##
## Estimated class population shares
##  0.0315 0.5073 0.1596 0.3016
##
```

```
## Predicted class memberships (by modal posterior prob.)
##   0.0327 0.4981 0.1369 0.3323
##
## ============================================================
## Fit for 4 latent classes:
## ============================================================
## 2 / 1
##              Coefficient  Std. error   t value  Pr(>|t|)
## (Intercept)     -0.75367     0.02725   -27.662         0
## condition        1.76600     0.05449    32.409         0
## ============================================================
## 3 / 1
##              Coefficient  Std. error   t value  Pr(>|t|)
## (Intercept)    -22.43114     0.03044  -736.972         0
## condition       12.02646     0.06087   197.564         0
## ============================================================
## 4 / 1
##              Coefficient  Std. error   t value  Pr(>|t|)
## (Intercept)     28.08426     0.03009   933.385         0
## condition      -13.01907     0.06018  -216.342         0
## ============================================================
## number of observations: 2323
## number of estimated parameters: 42
## residual degrees of freedom: 469
## maximum log-likelihood: -10395.01
##
## AIC(4): 20874.03
## BIC(4): 21115.55
## X^2(4): 1377.956 (Chi-square goodness of fit)
##
## ALERT: estimation algorithm automatically restarted with new initial values
##
```

```r
m5 <- poLCA(f, dds, nclass = 5, maxiter = 10000, graphs = TRUE)
```
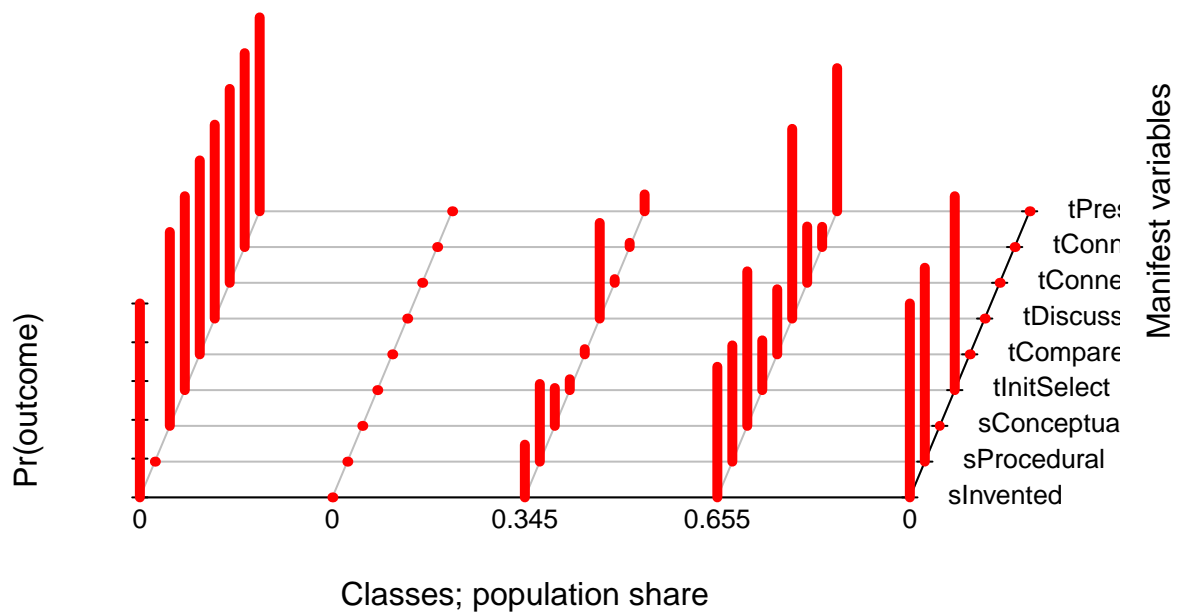
```
## Conditional item response (column) probabilities,
##  by outcome variable, for each class (row)
##
## $sInvented
##           Pr(1)  Pr(2)
## class 1:  0.0000 1.0000
## class 2:  1.0000 0.0000
## class 3:  0.7281 0.2719
## class 4:  0.3263 0.6737
## class 5:  0.0000 1.0000
##
## $sProcedural
##           Pr(1)  Pr(2)
## class 1:  1.0000 0.0000
## class 2:  1.0000 0.0000
## class 3:  0.5995 0.4005
## class 4:  0.4006 0.5994
## class 5:  0.0000 1.0000
##
## $sConceptual
##           Pr(1)  Pr(2)
## class 1:  0.0000 1.0000
## class 2:  1.0000 0.0000
## class 3:  0.8048 0.1952
## class 4:  0.2031 0.7969
## class 5:  0.9999 0.0001
```

```
## 
## $tInitSelect
##            Pr(1)  Pr(2)
## class 1:  0.0000 1.0000
## class 2:  1.0000 0.0000
## class 3:  0.9441 0.0559
## class 4:  0.7436 0.2564
## class 5:  0.0000 1.0000
## 
## $tCompare
##            Pr(1)  Pr(2)
## class 1:  0.0000 1.0000
## class 2:  1.0000 0.0000
## class 3:  0.9732 0.0268
## class 4:  0.6645 0.3355
## class 5:  1.0000 0.0000
## 
## $tDiscussQ
##            Pr(1)  Pr(2)
## class 1:  0.0000 1.0000
## class 2:  1.0000 0.0000
## class 3:  0.5068 0.4932
## class 4:  0.0216 0.9784
## class 5:  1.0000 0.0000
## 
## $tConnectBigIdeas
##            Pr(1)  Pr(2)
## class 1:  0.0000 1.0000
## class 2:  1.0000 0.0000
## class 3:  0.9810 0.0190
## class 4:  0.7097 0.2903
## class 5:  1.0000 0.0000
## 
## $tConnectOthers
##            Pr(1)  Pr(2)
## class 1:  0.0000 1.0000
## class 2:  1.0000 0.0000
## class 3:  0.9783 0.0217
## class 4:  0.8958 0.1042
## class 5:  1.0000 0.0000
## 
## $tPressExplain
##            Pr(1)  Pr(2)
## class 1:  0.0000 1.0000
## class 2:  1.0000 0.0000
## class 3:  0.9131 0.0869
## class 4:  0.2618 0.7382
## class 5:  1.0000 0.0000
## 
## Estimated class population shares
##  0 0 0.345 0.655 0
## 
## Predicted class memberships (by modal posterior prob.)
##  0.3341 0.6659
```

```
## 
## ============================================================
## Fit for 5 latent classes:
## ============================================================
## 2 / 1
##             Coefficient  Std. error      t value  Pr(>|t|)
## (Intercept)    -3.72607           0 -6305729017         0
## condition       2.22732           0  2501015009         0
## ============================================================
## 3 / 1
##             Coefficient  Std. error  t value  Pr(>|t|)
## (Intercept)    16.22522     0.00618 2624.705         0
## condition       3.00634     0.01236  243.160         0
## ============================================================
## 4 / 1
##             Coefficient  Std. error    t value  Pr(>|t|)
## (Intercept)   -16.90595     0.00618 -2734.823         0
## condition      19.98405     0.01236  1616.358         0
## ============================================================
## 5 / 1
##             Coefficient  Std. error     t value  Pr(>|t|)
## (Intercept)    -5.02072           0 -144241725         0
## condition       3.42281           0   49206840         0
## ============================================================
## number of observations: 2323
## number of estimated parameters: 53
## residual degrees of freedom: 458
## maximum log-likelihood: -10638.23
## 
## AIC(5): 21382.47
## BIC(5): 21687.25
## X^2(5): 4421.07 (Chi-square goodness of fit)
## 
## ALERT: estimation algorithm automatically restarted with new initial values
## 
```