Homework 4

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```
# data prep
df_house = data.frame(
  contact = c(rep(c("low", "high"), times = c(3, 3))),
  type = c(rep(c("tower", "apartment", "house"), length.out = 3)),
  sat.low = c(65, 130, 67, 34, 141, 130),
  sat.medium = c(54, 76, 48, 47, 116, 105),
  sat.high = c(100, 111, 62, 100, 191, 104)
)
```

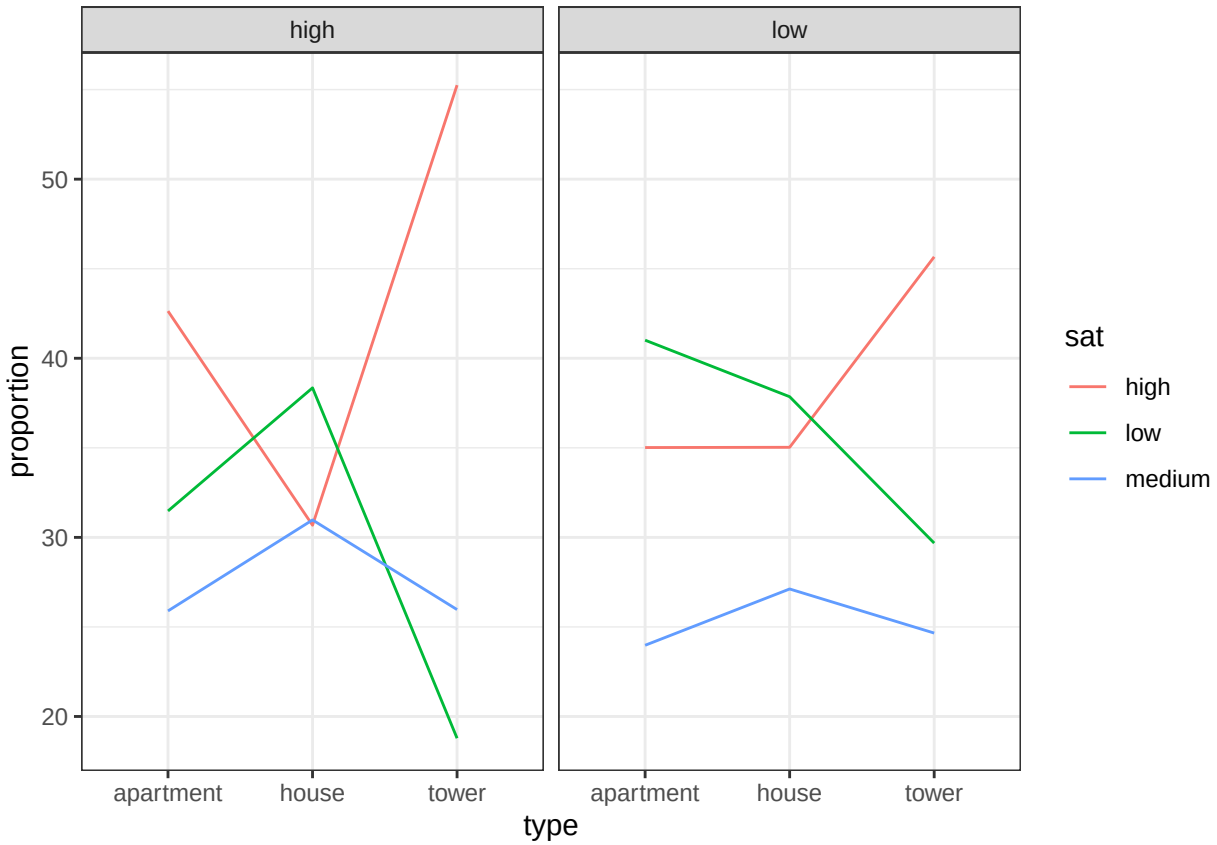
1

```
# calculate row-wise percentages
df_house$sat.low_per <- (df_house$sat.low / rowSums(df_house[, c("sat.low", "sat.medium", "sat.high")]))
df_house$sat.medium_per <- (df_house$sat.medium / rowSums(df_house[, c("sat.low", "sat.medium", "sat.hig
df_house$sat.high_per <- (df_house$sat.high / rowSums(df_house[, c("sat.low", "sat.medium", "sat.high")]

# table of percentages
df_house[-(3:5)]
```

```
##   contact      type sat.low_per sat.medium_per sat.high_per
## 1     low     tower    29.68037       24.65753     45.66210
## 2     low apartment    41.00946       23.97476     35.01577
## 3     low     house    37.85311       27.11864     35.02825
## 4    high     tower    18.78453       25.96685     55.24862
## 5    high apartment    31.47321       25.89286     42.63393
## 6    high     house    38.34808       30.97345     30.67847
```

```
# plot
df_house |>
  dplyr::select(contact, type, sat.low_per, sat.medium_per, sat.high_per) |>
  pivot_longer(cols = starts_with("sat."),
               names_to = "sat",
               values_to = "proportion") |>
  mutate(sat = str_remove(sat, "sat\\.") |>  str_remove("_per")) |>
# plot
  ggplot(aes(x = type, y = proportion, group = sat, color = sat)) +
  geom_line() +
  facet_grid(~contact) +
  theme_bw()
```



2

```
# fit a nominal logistic regression model
house.mult <- multinom(cbind(sat.low, sat.medium, sat.high) ~ factor(contact) + factor(type), data = df
```

```
summary(house.mult)
```

```
## Call:
## multinom(formula = cbind(sat.low, sat.medium, sat.high) ~ factor(contact) +
##     factor(type), data = df_house)
##
## Coefficients:
##             (Intercept) factor(contact)low factor(type)house factor(type)tower
## sat.medium  -0.2180364         -0.2959832        0.06967922         0.4067631
## sat.high     0.2474047         -0.3282264       -0.30402275         0.6415948
##
## Std. Errors:
##             (Intercept) factor(contact)low factor(type)house factor(type)tower
## sat.medium  0.10930968          0.1301046         0.1437749         0.1713009
## sat.high    0.09783068          0.1181870         0.1351693         0.1500774
##
## Residual Deviance: 3605.48
## AIC: 3621.48
```

```r
# goodness of fit
pihat = predict(house.mult,type = 'probs')
pihat
```

```
##     sat.low sat.medium  sat.high
## 1 0.2739485  0.2460866 0.4799649
## 2 0.3967554  0.2372941 0.3659505
## 3 0.4306997  0.2761849 0.2931154
## 4 0.2154984  0.2602598 0.5242418
## 5 0.3241708  0.2606645 0.4151647
## 6 0.3562423  0.3071247 0.3366329
```

```r
m = rowSums(df_house[, 3:5])

# pearson residuals
res.pearson = (df_house[, 3:5] - pihat*m) / sqrt(pihat*m)
res.pearson
```

```
##      sat.low  sat.medium   sat.high
## 1  0.6462082  0.01458006 -0.4986448
## 2  0.3770510  0.08967620 -0.4648120
## 3 -1.0575683 -0.12653898  1.4047956
## 4 -0.8014220 -0.01559243  0.5248140
## 5 -0.3508834 -0.07196683  0.3670803
## 6  0.8402535  0.08670506 -0.9471979
```

```r
# Generalized Pearson Chisq Stat
G.stat = sum(res.pearson^2)
G.stat
```

```
## [1] 6.932341
```

```r
pval = 1 - pchisq(G.stat, df = (6 - 4)*(3 - 1))
pval # fit is good, do not reject the model
```

```
## [1] 0.1395072
```

```r
# deviance
D.stat = sum(2*df_house[, 3:5]*log(df_house[, 3:5] / (m*pihat)))
D.stat
```

```
## [1] 6.893028
```

3

```r
# fit a ordinal logistic regression model
```

4

```
# Pearson residuals
```