Intelligence

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INTRODUCTION: This project analyzes a data set of 582 high school students who speak Portugese. Students took both a Portugese and a Mathematics course over the year and their quarterly and final grades are displayed, alongside various lifestyle statistics that the students were polled on. The question I seek to answer is whether intelligence is general (i.e. a higher math score would correlate with a higher Portugese score) or whether intelligence is more sectionalized (i.e. a higher math score would not necessarily be correlated with a higher Portugese score).

```
library(tidyverse)
```

```
## -- Attaching packages ---------------------------- tidyverse 1.2.1 --
```

```
## v ggplot2 3.1.0       v purrr   0.3.0
## v tibble  2.0.1       v dplyr   0.8.0.1
## v tidyr   0.8.2       v stringr 1.3.1
## v readr   1.3.1       v forcats 0.3.0
```

```
## -- Conflicts ------------------------------- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(dplyr)
library(ggplot2)

#load data
data_math <- read.table("~/Desktop/student/student-mat.csv",sep=";",header=TRUE)
data_por <- read.table("~/Desktop/student/student-por.csv",sep=";",header=TRUE)
data <- merge(data_math,data_por,by=c("school","sex","age","address","famsize","Pstatus","Medu","Fedu",

#examine data
head(data)
```

```
##   school sex age address famsize Pstatus Medu Fedu     Mjob     Fjob
## 1     GP   F  15       R     GT3       T    1    1  at_home    other
## 2     GP   F  15       R     GT3       T    1    1    other    other
## 3     GP   F  15       R     GT3       T    2    2  at_home    other
## 4     GP   F  15       R     GT3       T    2    4 services   health
## 5     GP   F  15       R     GT3       T    3    3 services services
## 6     GP   F  15       R     GT3       T    3    4 services   health
##       reason nursery internet guardian.x traveltime.x studytime.x
## 1       home     yes      yes     mother            2           4
## 2 reputation      no      yes     mother            1           2
## 3 reputation     yes       no     mother            1           1
## 4     course     yes      yes     mother            1           3
## 5 reputation     yes      yes      other            2           3
## 6     course     yes      yes     mother            1           3
##   failures.x schoolsup.x famsup.x paid.x activities.x higher.x romantic.x
## 1          1         yes      yes    yes          yes      yes         no
## 2          2         yes      yes     no           no      yes        yes
## 3          0         yes      yes    yes          yes      yes         no
```

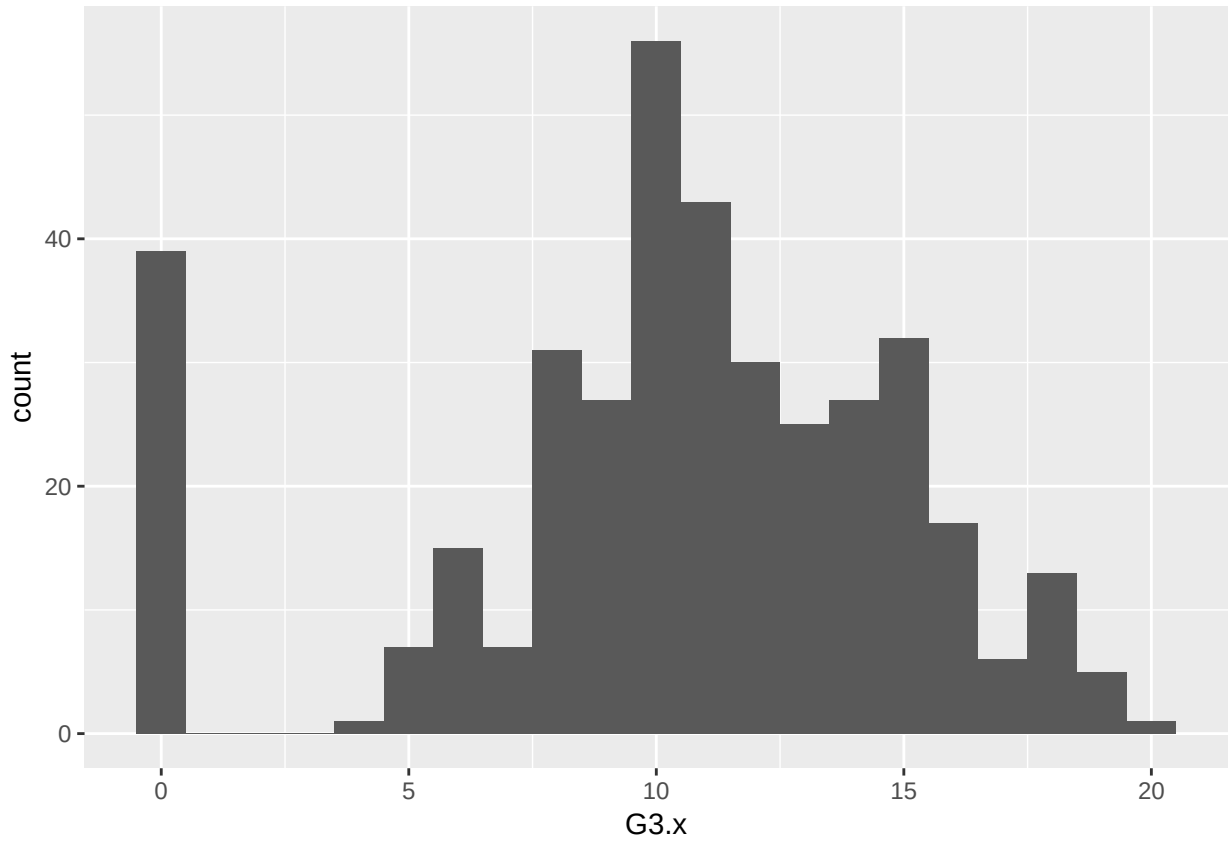
```
## 4          0         yes      yes    yes          yes      yes         no
## 5          2          no      yes    yes          yes      yes        yes
## 6          0         yes      yes    yes          yes      yes         no
##   famrel.x freetime.x goout.x Dalc.x Walc.x health.x absences.x G1.x G2.x
## 1        3          1       2      1      1        1          2    7   10
## 2        3          3       4      2      4        5          2    8    6
## 3        4          3       1      1      1        2          8   14   13
## 4        4          3       2      1      1        5          2   10    9
## 5        4          2       1      2      3        3          8   10   10
## 6        4          3       2      1      1        5          2   12   12
##   G3.x guardian.y traveltime.y studytime.y failures.y schoolsup.y famsup.y
## 1   10     mother            2           4          0         yes      yes
## 2    5     mother            1           2          0         yes      yes
## 3   13     mother            1           1          0         yes      yes
## 4    8     mother            1           3          0         yes      yes
## 5   10      other            2           3          0          no      yes
## 6   11     mother            1           3          0         yes      yes
##   paid.y activities.y higher.y romantic.y famrel.y freetime.y goout.y
## 1    yes          yes      yes         no        3          1       2
## 2     no           no      yes        yes        3          3       4
## 3     no          yes      yes         no        4          3       1
## 4     no          yes      yes         no        4          3       2
## 5    yes          yes      yes        yes        4          2       1
## 6     no          yes      yes         no        4          3       2
##   Dalc.y Walc.y health.y absences.y G1.y G2.y G3.y
## 1      1      1        1          4   13   13   13
## 2      2      4        5          2   13   11   11
## 3      1      1        2          8   14   13   12
## 4      1      1        5          2   10   11   10
## 5      2      3        3          2   13   13   13
## 6      1      1        5          2   11   12   12
```

```
dim(data)
```

```
## [1] 382  53
```

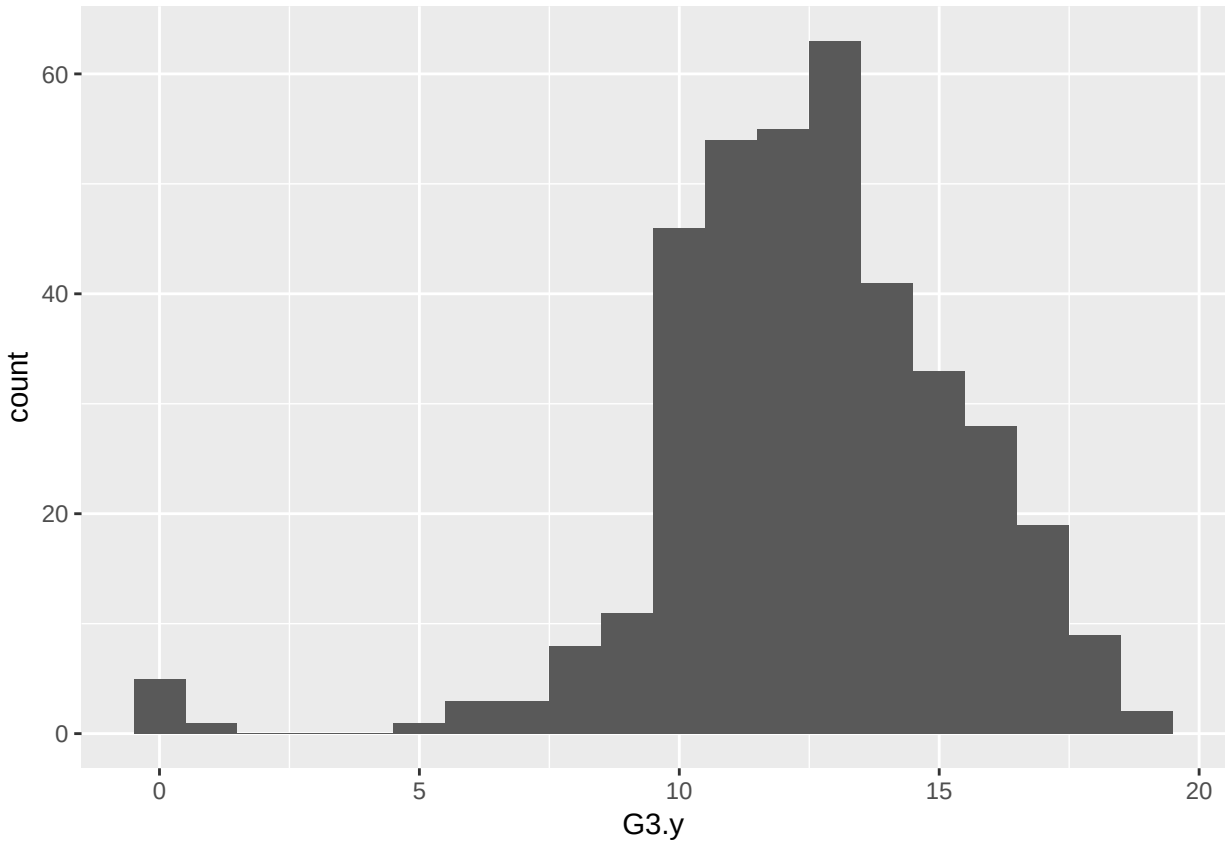
```
ggplot(data, aes(x=G3.x)) + geom_bar(binwidth = 1)
```

```
## Warning: `geom_bar()` no longer has a `binwidth` parameter. Please use
## `geom_histogram()` instead.
```




```
ggplot(data, aes(x=G3.y)) + geom_bar(binwidth = 1)
```

```
## Warning: `geom_bar()` no longer has a `binwidth` parameter. Please use
## `geom_histogram()` instead.
```



Math scores are generally lower than Portugese scores, with more failures as well.

```
correlation <- lm(G3.x ~ G3.y, data)
summary(correlation)
```

```
##
## Call:
## lm(formula = G3.x ~ G3.y, data = data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -12.2864  -1.5220   0.4491   2.5356  10.4153
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   0.8203     0.9205   0.891    0.373
## G3.y          0.7644     0.0716  10.676   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 4.116 on 380 degrees of freedom
## Multiple R-squared:  0.2307, Adjusted R-squared:  0.2287
## F-statistic:   114 on 1 and 380 DF,  p-value: < 2.2e-16
```

```
confint(correlation)
```

```
##                 2.5 %   97.5 %
## (Intercept) -0.9896571 2.630338
## G3.y         0.6236251 0.905189
```

We can see here that math scores and Portugese scores are clearly positively correlated. The confidence interval shows us that we are extremely confident that the correlation between math and Portugese scores is actually positive. However, the R^2 value is fairly low, showing that this may be due to factors other than a "general intelligence" (i.e. this correlation could be due to other factors). We are going to investigate this further by looking at "splitters" (students with a good score for one course and a low score for another).

```
lms <- data %>%
  filter(G3.x < 6, G3.y > 10)
dim(lms)
```

```
## [1] 26 53
```

```
head(lms)
```

```
##   school sex age address famsize Pstatus Medu Fedu     Mjob     Fjob
## 1     GP   F  15       R     GT3       T    1    1    other    other
## 2     GP   F  15       R     GT3       T    3    4 services  teacher
## 3     GP   F  15       U     GT3       T    1    1  at_home    other
## 4     GP   F  15       U     GT3       T    3    2   health services
## 5     GP   F  15       U     GT3       T    4    4 services  at_home
## 6     GP   F  16       U     GT3       T    1    3  at_home services
##       reason nursery internet guardian.x traveltime.x studytime.x
## 1 reputation      no      yes     mother            1           2
## 2     course     yes      yes     father            2           3
## 3     course      no      yes     mother            3           1
## 4       home     yes      yes     father            1           2
## 5     course     yes      yes     mother            1           3
## 6       home      no      yes     mother            1           2
##   failures.x schoolsup.x famsup.x paid.x activities.x higher.x romantic.x
## 1          2         yes      yes     no           no      yes        yes
## 2          2          no      yes     no           no      yes        yes
## 3          0          no      yes     no          yes      yes        yes
## 4          3          no      yes     no           no      yes         no
## 5          0          no      yes     no          yes      yes        yes
## 6          3          no       no     no          yes      yes        yes
##   famrel.x freetime.x goout.x Dalc.x Walc.x health.x absences.x G1.x G2.x
## 1        3          3       4      2      4        5          2    8    6
## 2        4          2       2      2      2        5          0   12    0
## 3        4          3       3      1      2        4          0    8    0
## 4        3          3       2      1      1        3          0    6    7
## 5        4          3       3      1      1        5          0   11    0
## 6        4          3       5      1      1        3          0    8    7
##   G3.x guardian.y traveltime.y studytime.y failures.y schoolsup.y famsup.y
## 1    5     mother            1           2          0         yes      yes
## 2    0     father            2           3          0          no      yes
## 3    0     mother            3           1          0          no      yes
## 4    0     father            1           2          1          no      yes
## 5    0     mother            1           3          0          no      yes
## 6    0     mother            1           2          0          no       no
##   paid.y activities.y higher.y romantic.y famrel.y freetime.y goout.y
## 1     no           no      yes        yes        3          3       4
## 2     no           no      yes        yes        4          2       2
## 3     no          yes      yes        yes        4          3       3
## 4     no           no      yes         no        3          3       2
## 5     no          yes      yes        yes        4          3       3
## 6     no          yes      yes        yes        4          3       5
```

```
##   Dalc.y Walc.y health.y absences.y G1.y G2.y G3.y
## 1      2      4        5          2   13   11   11
## 2      2      2        5          0   10   11   12
## 3      1      2        4          6   11   12   13
## 4      1      1        3          2   11   11   11
## 5      1      1        5          4   13   14   15
## 6      1      1        3          0   14   13   13
```

```
lps <- data %>%
  filter(G3.x > 10, G3.y < 6)
dim(lps)
```

```
## [1]  2 53
```

```
head(lps)
```

```
##   school sex age address famsize Pstatus Medu Fedu  Mjob     Fjob reason
## 1     GP   M  16       U     GT3       T    3    3 other services course
## 2     MS   F  18       R     GT3       T    4    4 other  teacher  other
##   nursery internet guardian.x traveltime.x studytime.x failures.x
## 1     yes      yes     father            1           2          1
## 2      no      yes     father            3           2          0
##   schoolsup.x famsup.x paid.x activities.x higher.x romantic.x famrel.x
## 1          no      yes    yes           no      yes        yes        4
## 2          no      yes    yes           no      yes        yes        3
##   freetime.x goout.x Dalc.x Walc.x health.x absences.x G1.x G2.x G3.x
## 1          5       5      4      4        5          4   10   12   12
## 2          2       2      4      2        5         10   14   12   11
##   guardian.y traveltime.y studytime.y failures.y schoolsup.y famsup.y
## 1     father            1           2          1          no      yes
## 2     father            3           2          0          no      yes
##   paid.y activities.y higher.y romantic.y famrel.y freetime.y goout.y
## 1     no           no      yes        yes        4          5       5
## 2     no           no      yes        yes        3          2       2
##   Dalc.y Walc.y health.y absences.y G1.y G2.y G3.y
## 1      4      4        5          0   10   10    1
## 2      4      2        5          0    7    5    0
```

There are only 2 students with a high math score and a low Portugese score. Both of these students failed to take the final, leaving them with failing scores for the class. One student was doing strongly before the final, but other other was actually what we would define as a splitter based off of his quarterly grades. However, this is only the case for 1/382 students and his/her result cannot be extrapolated. What is more interesting to look at is the low math splitters, of which there are 26.

```
failcorr_por <- lm(G3.y ~ failures.y, data)
summary(failcorr_por)
```

```
##
## Call:
## lm(formula = G3.y ~ failures.y, data = data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -12.7944  -1.7944   0.2056   2.1984   6.2056
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)  12.7944     0.1470   87.03  < 2e-16 ***
## failures.y   -1.9713     0.2765   -7.13  5.1e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.77 on 380 degrees of freedom
## Multiple R-squared:  0.118,  Adjusted R-squared:  0.1157
## F-statistic: 50.83 on 1 and 380 DF,  p-value: 5.1e-12
```

```
failcorr_lms_por <- lm(G3.y ~ failures.y, lms)
summary(failcorr_lms_por)
```

```
##
## Call:
## lm(formula = G3.y ~ failures.y, data = lms)
##
## Residuals:
##    Min     1Q Median     3Q    Max
##  -1.72  -0.72   0.14   1.03   2.28
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   12.720      0.280  45.429   <2e-16 ***
## failures.y    -1.720      1.428  -1.205     0.24
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.4 on 24 degrees of freedom
## Multiple R-squared:  0.05702,    Adjusted R-squared:  0.01773
## F-statistic: 1.451 on 1 and 24 DF,  p-value: 0.2401
```

```
failcorr_math <- lm(G3.x ~ failures.x, data)
summary(failcorr_math)
```

```
##
## Call:
## lm(formula = G3.x ~ failures.x, data = data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -11.0983  -2.0983  -0.0983   2.9017   9.3481
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  11.0983     0.2391  46.425  < 2e-16 ***
## failures.x   -2.4464     0.3048  -8.027 1.26e-14 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 4.34 on 380 degrees of freedom
## Multiple R-squared:  0.145,  Adjusted R-squared:  0.1427
## F-statistic: 64.43 on 1 and 380 DF,  p-value: 1.264e-14
```

```
failcorr_lms_math <- lm(G3.x ~ failures.x, lms)
summary(failcorr_lms_math)
```

```
##
## Call:
## lm(formula = G3.x ~ failures.x, data = lms)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -0.6759 -0.4276 -0.3034 -0.3034  4.6966
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   0.3034     0.3201   0.948    0.353
## failures.x    0.1241     0.2614   0.475    0.639
##
## Residual standard error: 1.38 on 24 degrees of freedom
## Multiple R-squared:  0.00931,    Adjusted R-squared:  -0.03197
## F-statistic: 0.2255 on 1 and 24 DF,  p-value: 0.6391
```

```
print(lms)
```

```
##    school sex age address famsize Pstatus Medu Fedu     Mjob     Fjob
## 1      GP   F  15       R     GT3       T    1    1    other    other
## 2      GP   F  15       R     GT3       T    3    4 services  teacher
## 3      GP   F  15       U     GT3       T    1    1  at_home    other
## 4      GP   F  15       U     GT3       T    3    2   health services
## 5      GP   F  15       U     GT3       T    4    4 services  at_home
## 6      GP   F  16       U     GT3       T    1    3  at_home services
## 7      GP   F  16       U     GT3       T    2    2    other    other
## 8      GP   F  16       U     GT3       T    3    4  at_home    other
## 9      GP   F  17       U     GT3       A    2    2  at_home  at_home
## 10     GP   F  17       U     GT3       T    1    1  at_home    other
## 11     GP   F  17       U     GT3       T    3    2    other    other
## 12     GP   F  17       U     LE3       T    2    2 services services
## 13     GP   F  18       R     GT3       T    2    2  at_home    other
## 14     GP   F  18       U     GT3       T    2    1    other    other
## 15     GP   F  18       U     GT3       T    2    1 services    other
## 16     GP   F  18       U     GT3       T    2    2  at_home services
## 17     GP   F  18       U     GT3       T    3    3 services services
## 18     GP   F  18       U     LE3       T    2    2    other    other
## 19     GP   F  19       U     GT3       T    4    4   health    other
## 20     GP   M  15       R     GT3       T    3    4  at_home  teacher
## 21     GP   M  15       U     GT3       T    4    3  teacher services
## 22     GP   M  16       U     GT3       T    4    4  teacher  teacher
## 23     GP   M  16       U     LE3       T    4    3  teacher    other
## 24     GP   M  18       U     GT3       T    4    4  teacher services
## 25     GP   M  18       U     GT3       T    4    4  teacher services
## 26     GP   M  19       U     GT3       T    3    2 services  at_home
##        reason nursery internet guardian.x traveltime.x studytime.x
## 1  reputation      no      yes     mother            1           2
## 2      course     yes      yes     father            2           3
## 3      course      no      yes     mother            3           1
## 4        home     yes      yes     father            1           2
## 5      course     yes      yes     mother            1           3
## 6        home      no      yes     mother            1           2
## 7        home      no      yes     mother            1           2
## 8      course     yes      yes     mother            1           2
```

```
## 9        home     yes      yes     father            1           2
## 10 reputation     yes       no     mother            1           3
## 11       home     yes      yes     mother            1           2
## 12     course     yes      yes     father            1           4
## 13     course     yes       no     mother            2           4
## 14     course      no      yes      other            2           3
## 15     course     yes      yes     mother            2           2
## 16       home     yes      yes     mother            1           3
## 17       home     yes      yes     mother            1           2
## 18       home      no      yes      other            1           2
## 19 reputation     yes      yes      other            2           2
## 20     course     yes       no     mother            4           2
## 21     course     yes      yes     father            2           4
## 22     course     yes      yes     mother            1           1
## 23     course      no      yes     mother            1           1
## 24       home     yes      yes     father            1           2
## 25       home     yes      yes     father            1           2
## 26       home     yes      yes     mother            1           1
##    failures.x schoolsup.x famsup.x paid.x activities.x higher.x romantic.x
## 1           2         yes      yes     no           no      yes        yes
## 2           2          no      yes     no           no      yes        yes
## 3           0          no      yes     no          yes      yes        yes
## 4           3          no      yes     no           no      yes         no
## 5           0          no      yes     no          yes      yes        yes
## 6           3          no       no     no          yes      yes        yes
## 7           0          no      yes    yes           no      yes         no
## 8           0          no      yes     no           no      yes         no
## 9           1          no      yes     no           no      yes        yes
## 10          1          no      yes     no          yes      yes        yes
## 11          0          no      yes    yes           no      yes        yes
## 12          0          no       no    yes          yes      yes        yes
## 13          0          no       no     no          yes      yes         no
## 14          0          no      yes    yes           no      yes        yes
## 15          0          no      yes    yes          yes      yes         no
## 16          0          no      yes    yes          yes      yes        yes
## 17          0          no       no     no          yes      yes         no
## 18          0          no       no     no          yes      yes        yes
## 19          0          no      yes    yes          yes      yes         no
## 20          0          no      yes     no           no      yes        yes
## 21          0         yes      yes     no           no      yes         no
## 22          0          no      yes     no           no       no        yes
## 23          0          no       no     no          yes      yes         no
## 24          1          no      yes     no          yes      yes         no
## 25          1          no      yes     no          yes      yes         no
## 26          3          no      yes     no           no       no        yes
##    famrel.x freetime.x goout.x Dalc.x Walc.x health.x absences.x G1.x G2.x
## 1         3          3       4      2      4        5          2    8    6
## 2         4          2       2      2      2        5          0   12    0
## 3         4          3       3      1      2        4          0    8    0
## 4         3          3       2      1      1        3          0    6    7
## 5         4          3       3      1      1        5          0   11    0
## 6         4          3       5      1      1        3          0    8    7
## 7         5          1       5      1      1        4          0    6    7
## 8         2          4       3      1      2        3         12    5    5
```

```
## 9         3          3       1      1      2        4          0    9    8
## 10        4          3       4      1      1        5          0    6    5
## 11        4          3       2      2      3        2          0    7    8
## 12        3          4       1      1      1        2          0   10    9
## 13        4          4       4      1      1        4          0   10    9
## 14        4          4       4      1      1        3          0    7    0
## 15        5          3       3      1      2        1          0    8    8
## 16        4          3       3      1      1        3          0    9   10
## 17        5          3       4      1      1        4          0    7    0
## 18        4          3       3      1      1        2          0    8    8
## 19        2          3       4      2      3        2          0   10    9
## 20        5          3       3      1      1        5          0    9    0
## 21        2          2       2      1      1        3          0    7    9
## 22        3          3       2      2      1        5          0    7    6
## 23        5          4       5      1      1        3          0    6    0
## 24        4          3       3      2      2        2          0   10   10
## 25        4          3       3      2      2        2          0   10   10
## 26        4          5       4      1      1        4          0    5    0
##    G3.x guardian.y traveltime.y studytime.y failures.y schoolsup.y
## 1     5     mother            1           2          0         yes
## 2     0     father            2           3          0          no
## 3     0     mother            3           1          0          no
## 4     0     father            1           2          1          no
## 5     0     mother            1           3          0          no
## 6     0     mother            1           2          0          no
## 7     0     mother            1           2          0          no
## 8     5     mother            1           2          0          no
## 9     0     father            1           2          0          no
## 10    0     mother            1           3          0          no
## 11    0     mother            1           2          0          no
## 12    0     father            1           4          0          no
## 13    0     mother            2           4          0          no
## 14    0      other            2           3          0          no
## 15    0     mother            2           2          0          no
## 16    0     mother            1           3          0          no
## 17    0     mother            1           2          0          no
## 18    0      other            1           2          0          no
## 19    0      other            2           2          0          no
## 20    0     mother            4           2          0          no
## 21    0     father            2           4          0         yes
## 22    0     father            1           2          0          no
## 23    0     mother            1           1          0          no
## 24    0     father            1           2          0          no
## 25    0     mother            2           1          0          no
## 26    0     mother            1           1          0          no
##    famsup.y paid.y activities.y higher.y romantic.y famrel.y freetime.y
## 1       yes     no           no      yes        yes        3          3
## 2       yes     no           no      yes        yes        4          2
## 3       yes     no          yes      yes        yes        4          3
## 4       yes     no           no      yes         no        3          3
## 5       yes     no          yes      yes        yes        4          3
## 6        no     no          yes      yes        yes        4          3
## 7       yes     no           no      yes         no        5          1
## 8       yes     no           no      yes         no        2          4
```

```
## 9       yes     no           no      yes        yes        3          3
## 10      yes     no          yes      yes        yes        4          3
## 11      yes     no           no      yes        yes        4          3
## 12       no     no          yes      yes        yes        3          4
## 13       no     no          yes      yes         no        4          4
## 14      yes     no           no      yes        yes        4          4
## 15      yes     no          yes      yes         no        5          3
## 16      yes     no          yes      yes        yes        4          3
## 17       no     no          yes      yes         no        5          3
## 18       no     no          yes      yes        yes        4          3
## 19      yes     no          yes      yes         no        2          3
## 20      yes     no           no      yes        yes        5          3
## 21      yes     no           no      yes         no        2          2
## 22      yes     no          yes      yes         no        5          4
## 23       no     no          yes      yes         no        5          4
## 24      yes     no          yes      yes         no        4          3
## 25       no     no          yes      yes         no        3          2
## 26      yes     no           no       no        yes        4          5
##    goout.y Dalc.y Walc.y health.y absences.y G1.y G2.y G3.y
## 1        4      2      4        5          2   13   11   11
## 2        2      2      2        5          0   10   11   12
## 3        3      1      2        4          6   11   12   13
## 4        2      1      1        3          2   11   11   11
## 5        3      1      1        5          4   13   14   15
## 6        5      1      1        3          0   14   13   13
## 7        5      1      1        4          0   12   12   13
## 8        3      1      2        3         14   12   11   11
## 9        1      1      2        4         18   10   12   14
## 10       4      1      1        5         12   12   12   12
## 11       2      2      3        2          0   12   13   15
## 12       1      1      1        2          2   10   11   12
## 13       4      1      1        4          6   14   13   14
## 14       4      1      1        3         10   12   10   11
## 15       3      1      2        1          2   12   12   15
## 16       3      1      1        3          0   11   12   13
## 17       4      1      1        4          8   10   11   12
## 18       3      1      1        2          0   10    9   12
## 19       4      2      3        2          2   14   13   13
## 20       3      1      1        5          2   12   11   11
## 21       2      1      1        3          6    9   11   11
## 22       4      1      2        5          6   16   14   14
## 23       5      1      1        3          7   14   14   15
## 24       3      2      2        2          0   12   12   13
## 25       4      1      4        3          6   11   12   12
## 26       4      1      1        4          6   11    9   11
```

What's interesting to note here is that for the entire population, the number of previous classes failed is negatively correlated to both math and Portugese scores. However, low math splitters show no correlation between number of past courses failed and math/Portugese scores. This implies that these students' struggle is not with the Portugese content or study habits in general, but with this mathematics content in particular. So we have a good ~10% of this population who have generally good study habits and high scores in Portugese, but are struggling with this mathematics content.

I'd suspect that this is due to students implicitly practicing Portugese with friends/family: the low math splitters mostly showed larger family sizes and family support for their studies. The limitation of the study

time metric in this survey is that it does not differentiate between time spent on math and time spent on Portugese. Perhaps the amount of time studying and interacting with mathematics is simply less because students either a) prefer to study Portugese or b) practice Portugese implicitly. So these differences in scores potentially speak to not how "sectionally intelligent" a student is, but to how much work they put into each subject respectively.