InterStats

January 5, 2022

[ ]:

```
library(tidyverse)
library(xtable)
library(ggplot2)
library(ggpubr)
library(ggrepel)
library(gridExtra)
library(rstatix)
library(survival)
library(survminer)
library(vcd)
library(finalfit)
library(gtsummary)
```

Read data

[2]:

```
surveys1 <- read_csv("Datasets/effec1.quest.compil.csv", locale = locale("fr"),␣
 ↪show_col_types = FALSE)
surveys2 <- read_csv("Datasets/effec2.quest.compil.csv", locale = locale("fr"),␣
 ↪show_col_types = FALSE)
surveys3 <- read_csv("Datasets/effec3.quest.compil.csv", locale = locale("fr"),␣
 ↪show_col_types = FALSE)
usages1 <- distinct(read_csv("Datasets/usages.effec1.csv", locale =␣
 ↪locale("fr"), show_col_types = FALSE))
usages2 <- distinct(read_csv("Datasets/usages.effec2.csv", locale =␣
 ↪locale("fr"), show_col_types = FALSE))
usages3 <- distinct(read_csv("Datasets/usages.effec3.csv", locale =␣
 ↪locale("fr"), show_col_types = FALSE))
```

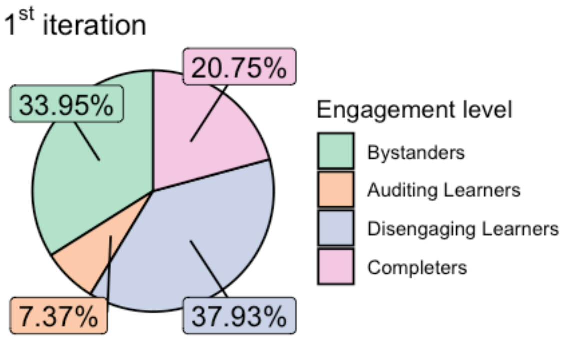
1 Observation of learners' engagement

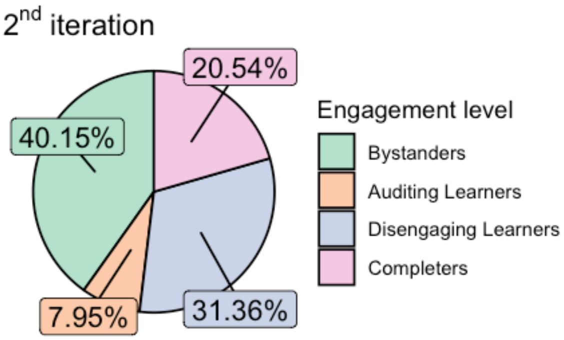
[3]:

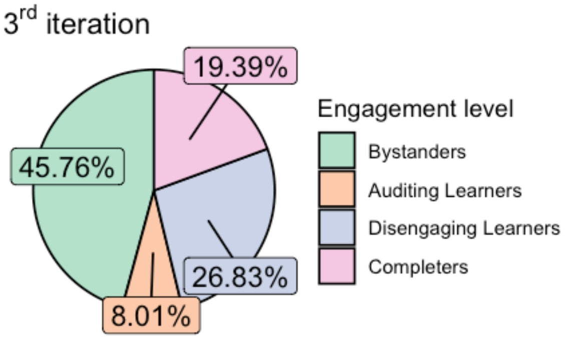
```
# Fix Exam.bin on usages1
usages1 <- usages1 %>% mutate(Exam.bin = case_when(last.quizz == 5 & last.video␣
 ↪> 30 ~ 1,
                                                   TRUE ~ 0))


usages1 <- usages1 %>%
           mutate(EngagementLevel = case_when(Exam.bin == 1 & Assignment.bin ==␣
 ↪1 ~ 3, # Completers
                                              last.quizz > 0 | Assignment.bin␣
 ↪== 1 ~ 2, # Disengaging Learners
                                              last.video / 35 > 0.1 ~ 1, #␣
 ↪Auditing Learners
                                              TRUE ~ 0)) # Bystanders

usages2 <- usages2 %>%
           mutate(EngagementLevel = case_when(Exam.bin == 1 & Assignment.bin ==␣
 ↪1 ~ 3, # Completers
                                              last.quizz > 0 | Assignment.bin␣
 ↪== 1 ~ 2, # Disengaging Learners
                                              last.video / 35 > 0.1 ~ 1, #␣
 ↪Auditing Learners
                                              TRUE ~ 0)) # Bystanders

usages3 <- usages3 %>%
           mutate(EngagementLevel = case_when(Exam.bin == 1 & Assignment.bin ==␣
 ↪1 ~ 3, # Completers
                                              last.quizz > 0 | Assignment.bin␣
 ↪== 1 ~ 2, # Disengaging Learners
                                              last.video / 35 > 0.1 ~ 1, #␣
 ↪Auditing Learners
                                              TRUE ~ 0)) # Bystanders
```

[4]:

```
df1 <- usages1 %>% group_by(EngagementLevel) %>% tally(name = "value") %>%
          mutate(csum = rev(cumsum(rev(value))),
         pos = if_else(is.na(value/2 + lead(csum, 1)), value/2, value/2 +␣
 ↪lead(csum, 1)))

plot1 <- ggplot(df1, aes(x = "" , y = value, fill = factor(EngagementLevel))) +
  geom_col(width = 1, color = 1) +
  coord_polar(theta = "y") +
  geom_label_repel(data = df1,
                   aes(y = pos, label = paste0(round(value / sum(value) * 100,
                                              digits = 2), "%")),
                   size = 4.5, nudge_x = 1, show.legend = FALSE) +
  scale_fill_brewer(palette = "Pastel2", name = "Engagement level",
                    labels = c('Bystanders', 'Auditing Learners',
                    'Disengaging Learners', 'Completers')) +

  theme_void() + labs(title = expression('1'^st*' iteration'))

df2 <- usages2 %>% group_by(EngagementLevel) %>% tally(name = "value") %>%
          mutate(csum = rev(cumsum(rev(value))),
         pos = if_else(is.na(value/2 + lead(csum, 1)), value/2, value/2 +␣
 ↪lead(csum, 1)))

plot2 <- ggplot(df2, aes(x = "" , y = value, fill = factor(EngagementLevel))) +
  geom_col(width = 1, color = 1) +
  coord_polar(theta = "y") +
  geom_label_repel(data = df2,
                   aes(y = pos, label = paste0(round(value / sum(value) * 100,
                                                    digits = 2), "%")),
                   size = 4.5, nudge_x = 1, show.legend = FALSE) +
  scale_fill_brewer(palette = "Pastel2", name = "Engagement level",
                    labels = c('Bystanders', 'Auditing Learners',
                    'Disengaging Learners', 'Completers')) +

  theme_void() + labs(title = expression('2'^nd*' iteration'))

df3 <- usages3 %>% group_by(EngagementLevel) %>% tally(name = "value") %>%
          mutate(csum = rev(cumsum(rev(value))),
         pos = if_else(is.na(value/2 + lead(csum, 1)), value/2, value/2 +␣
 ↪lead(csum, 1)))

plot3 <- ggplot(df3, aes(x = "" , y = value, fill = factor(EngagementLevel))) +
  geom_col(width = 1, color = 1) +
  coord_polar(theta = "y") +
  geom_label_repel(data = df3,
                   aes(y = pos, label = paste0(round(value / sum(value) * 100,
                                                    digits = 2), "%")),
                   size = 4.5, nudge_x = 1, show.legend = FALSE) +
  scale_fill_brewer(palette = "Pastel2", name = "Engagement level",
                    labels = c('Bystanders', 'Auditing Learners',
                    'Disengaging Learners', 'Completers')) +

  theme_void() + labs(title = expression('3'^rd*' iteration'))

g <- arrangeGrob(plot1, plot2, plot3, ncol = 2, layout_matrix=rbind(c(1,1,2,2),␣
 ↪c(NA, 3, 3, NA)))
grid.arrange(plot1, plot2, plot3, ncol = 2, layout_matrix=rbind(c(1,1,2,2),␣
 ↪c(NA, 3, 3, NA)))
```







2 Inferential Statistics

Prepare data to apply hypothesis tests

[ ]:

```
# Merge data
iter1 <- distinct(left_join(surveys1, usages1, by='Student_ID'))
iter2 <- distinct(left_join(surveys2, usages2, by='Student_ID'))
iter3 <- distinct(left_join(surveys3, usages3, by='Student_ID'))
iter3 <- iter3 %>% mutate_at(c('Curiosity.MOOC', 'Rencontres'), as.numeric)
df <- iter1 %>% full_join(iter2) %>% full_join(iter3)
```

[6]:

```
df <- df %>% mutate(Country_HDI = case_when(Country_HDI == "TH" ~ "Very High",
                                            Country_HDI == "H" | Country_HDI ==␣
 ↪"M" ~ "Intermediate",
                                            Country_HDI == "B" ~ "Low"))
df$Country_HDI <- factor(df$Country_HDI, levels = c("Very High",␣
 ↪"Intermediate", "Low"))

df <- df %>% mutate(Gender = case_when(Gender == "un homme" ~ "Male",
                                       Gender == "une femme" ~"Female"))
df$Gender <- factor(df$Gender, levels = c("Male", "Female"))
df$Exam.bin <- factor(df$Exam.bin)
```

2.1 Gender and Viewed videos

[7]:

```
df.t_test <- df %>% drop_na(c(Gender, last.video))
df.t_test %>%
  group_by(Gender) %>%
  get_summary_stats(last.video, type = "mean_sd")
```

A tibble: 2 × 5

Gender <fct>	variable <chr>	n <dbl>	mean <dbl>	sd <dbl>
Male	last.video	6103	20.843	13.458
Female	last.video	2990	20.773	13.912

[8]:

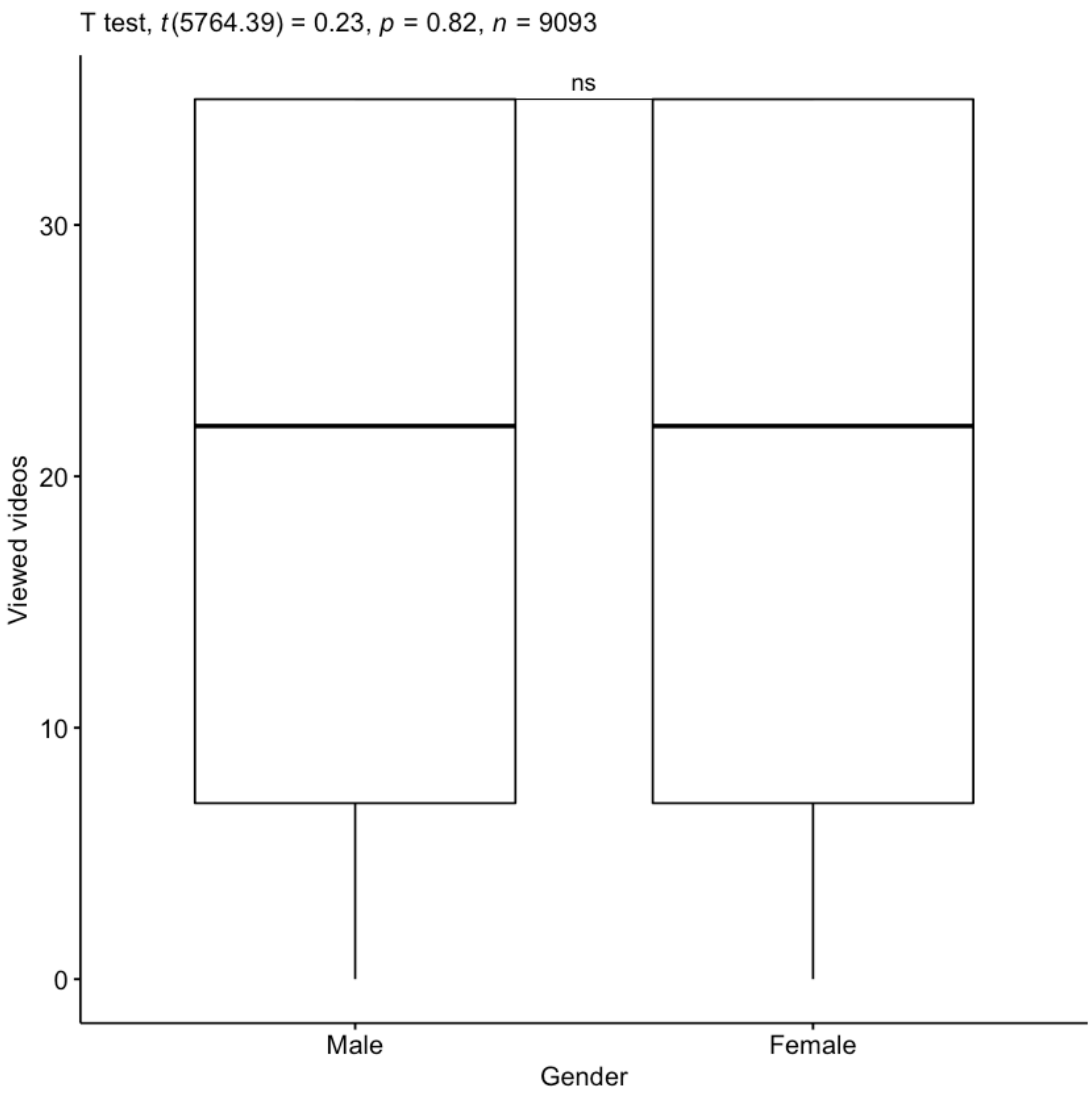
```
# Independent sample t-test
stat.test <- df.t_test %>%
             t_test(last.video ~ Gender)
stat.test
```

A rstatix_test: 1 × 8

	.y. <chr>	group1 <chr>	group2 <chr>	n1 <int>	n2 <int>	statistic <dbl>	df <dbl>	p <dbl>
1	last.video	Male	Female	6103	2990	0.2292759	5764.39	0.819

[9]:

```
# Create a box-plot
bxp <- ggboxplot(
  df.t_test, x = "Gender", y = "last.video",
  ylab = "Viewed videos", xlab = "Gender")

# Add p-value and significance levels
stat.test <- stat.test %>% add_xy_position(x = "Gender") %>%
             add_significance()
bxp +
  stat_pvalue_manual(stat.test, tip.length = 0) +
  labs(subtitle = get_test_label(stat.test, detailed = TRUE))
```



2.2 Country's HDI and Viewed videos

[10]:

```
df.anova <- df %>% drop_na(c(Country_HDI, last.video))
df.anova %>%
  group_by(Country_HDI) %>%
  get_summary_stats(last.video, type = "mean_sd")
```

A tibble: 3 × 5

Country_HDI	variable	n	mean	sd
<fct>	<chr>	<dbl>	<dbl>	<dbl>
Very High	last.video	7264	21.665	13.580
Intermediate	last.video	667	18.099	13.846
Low	last.video	1032	16.633	12.638

[11]:

```
# Levene test
levene <- df.anova %>% levene_test(last.video ~ Country_HDI)
levene
```

A tibble: 1 × 4

df1 <int>	df2 <int>	statistic <dbl>	p <dbl>
2	8960	11.85427	7.220328e-06

[12]:

```
# Welch One way ANOVA test
res.aov <- df.anova %>% welch_anova_test(last.video ~ Country_HDI)
res.aov
```

A rstatix_test: 1 × 7

	.y. <chr>	n <int>	statistic <dbl>	DFn <dbl>	DFd <dbl>	p <dbl>	method <chr>
1	last.video	8963	83.45	2	1310.252	7.7e-35	Welch ANOVA

[13]:

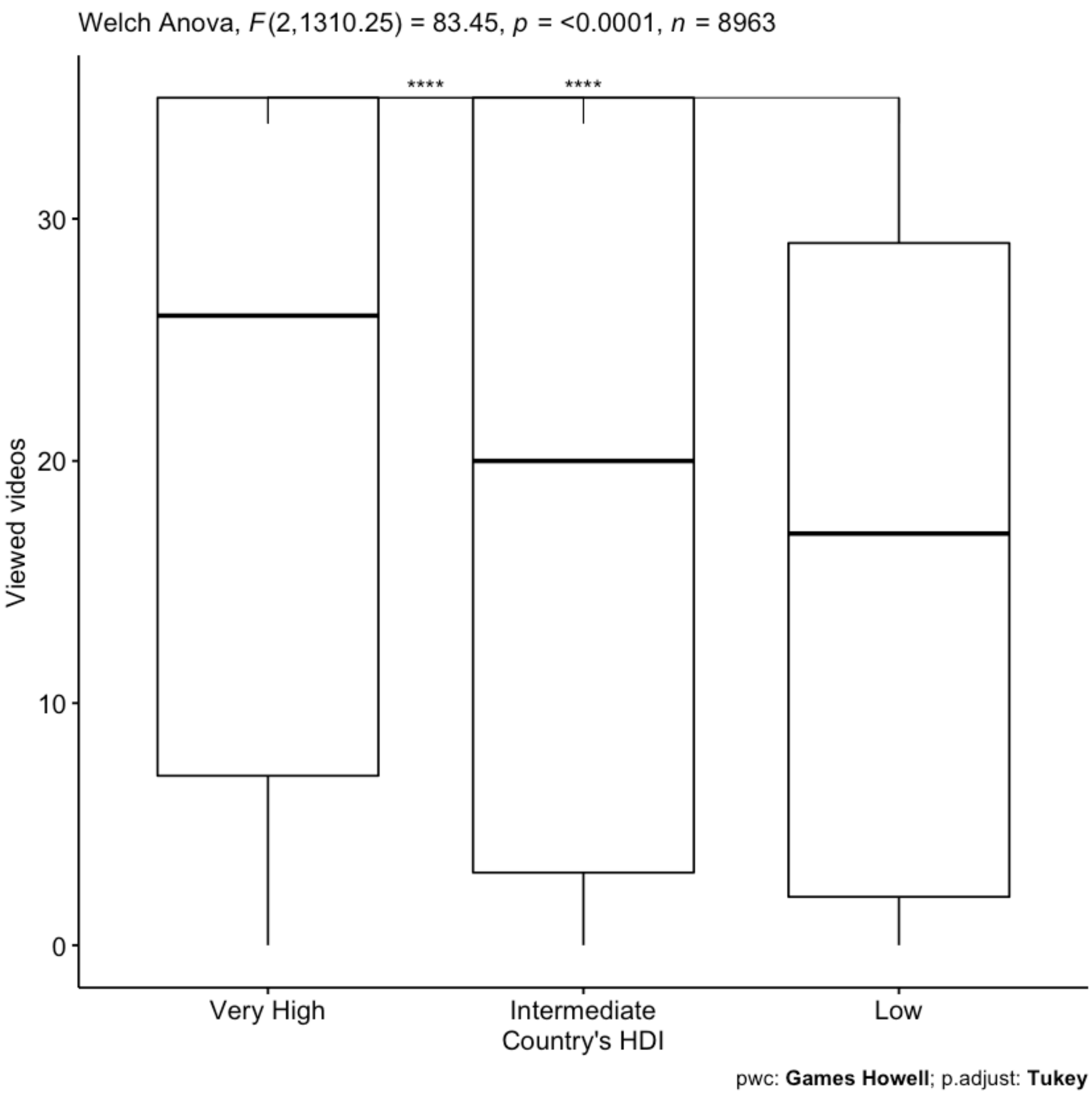
```
# Pairwise comparisons (Games-Howell)
pwc <- df.anova %>% games_howell_test(last.video ~ Country_HDI)
pwc
```

A rstatix_test: 3 × 8

	.y. <chr>	group1 <chr>	group2 <chr>	estimate <dbl>	conf.low <dbl>	conf.high <dbl>	p.adj <dbl>
1	last.video	Very High	Intermediate	-3.566385	-4.879709	-2.25306145	0.000
2	last.video	Very High	Low	-5.032584	-6.028394	-4.03677382	0.000
3	last.video	Intermediate	Low	-1.466199	-3.026445	0.09404754	0.071

[14]:

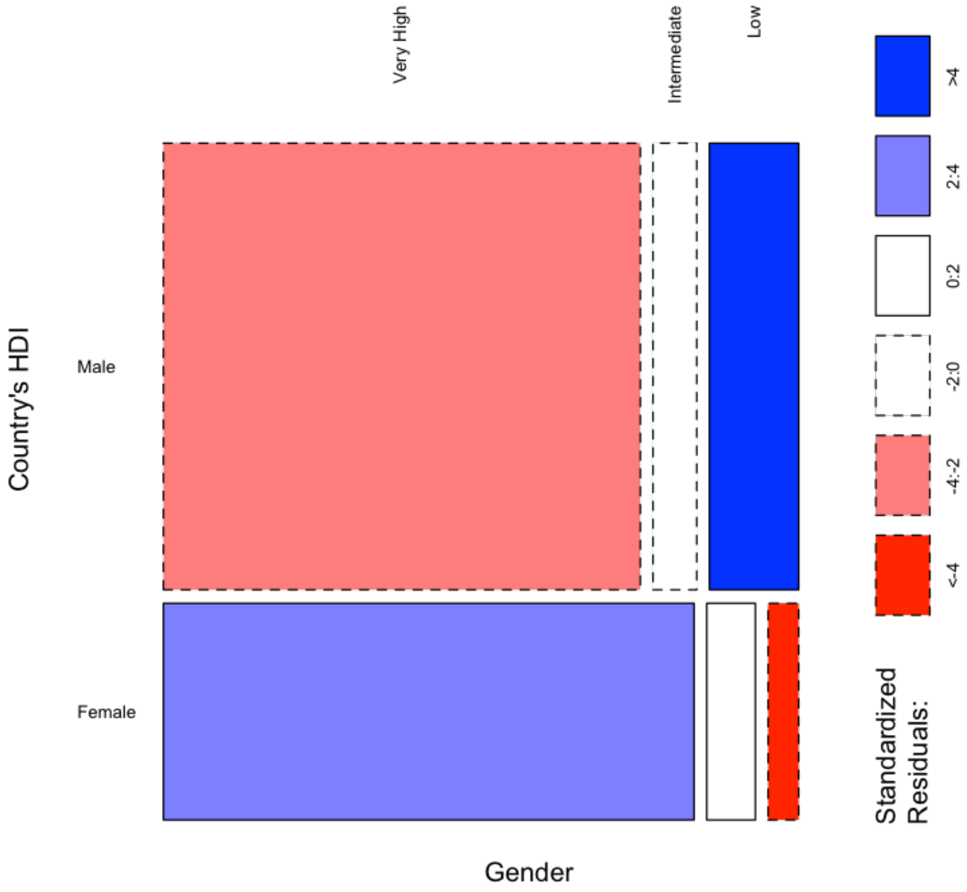
```
# Visualization: box plots with p-values
pwc <- pwc %>% add_xy_position(x = "Country_HDI")
ggboxplot(df.anova, x = "Country_HDI", y = "last.video",
          ylab = "Viewed videos", xlab = "Country's HDI") +
  stat_pvalue_manual(pwc, hide.ns = TRUE) +
  labs(
    subtitle = get_test_label(res.aov, detailed = TRUE),
    caption = get_pwc_label(pwc)
    )
```



2.3 Genders and Country's HDI groups

[15]:
```
df.chisq <- df %>% drop_na(c(Country_HDI, Gender))
```

[16]:
```
# Mosaic plot
mosaicplot( ~ Gender + Country_HDI, data = df.chisq,
           shade = TRUE, las=2, dir=c("h", "v"),
           main = NULL,
           xlab = "Gender", ylab = "Country's HDI")
```



[17]:
```
# Chi-squared test
chisq <- chisq_test(df.chisq$Gender, df.chisq$Country_HDI)
chisq
```

A rstatix_test: 1 × 6

	n <int>	statistic <dbl>	p <dbl>	df <int>	method <chr>	p.signif <chr>
1	8957	179.0476	1.32e-39	2	Chi-square test	****

2.4 Course accomplishment and viewed videos

Prepare data

[18]:

```
df <- df %>% mutate(status = case_when(last.video < 30 ~ 1,
                                        TRUE ~ 0))
```

2.4.1 Regression models

[19]:

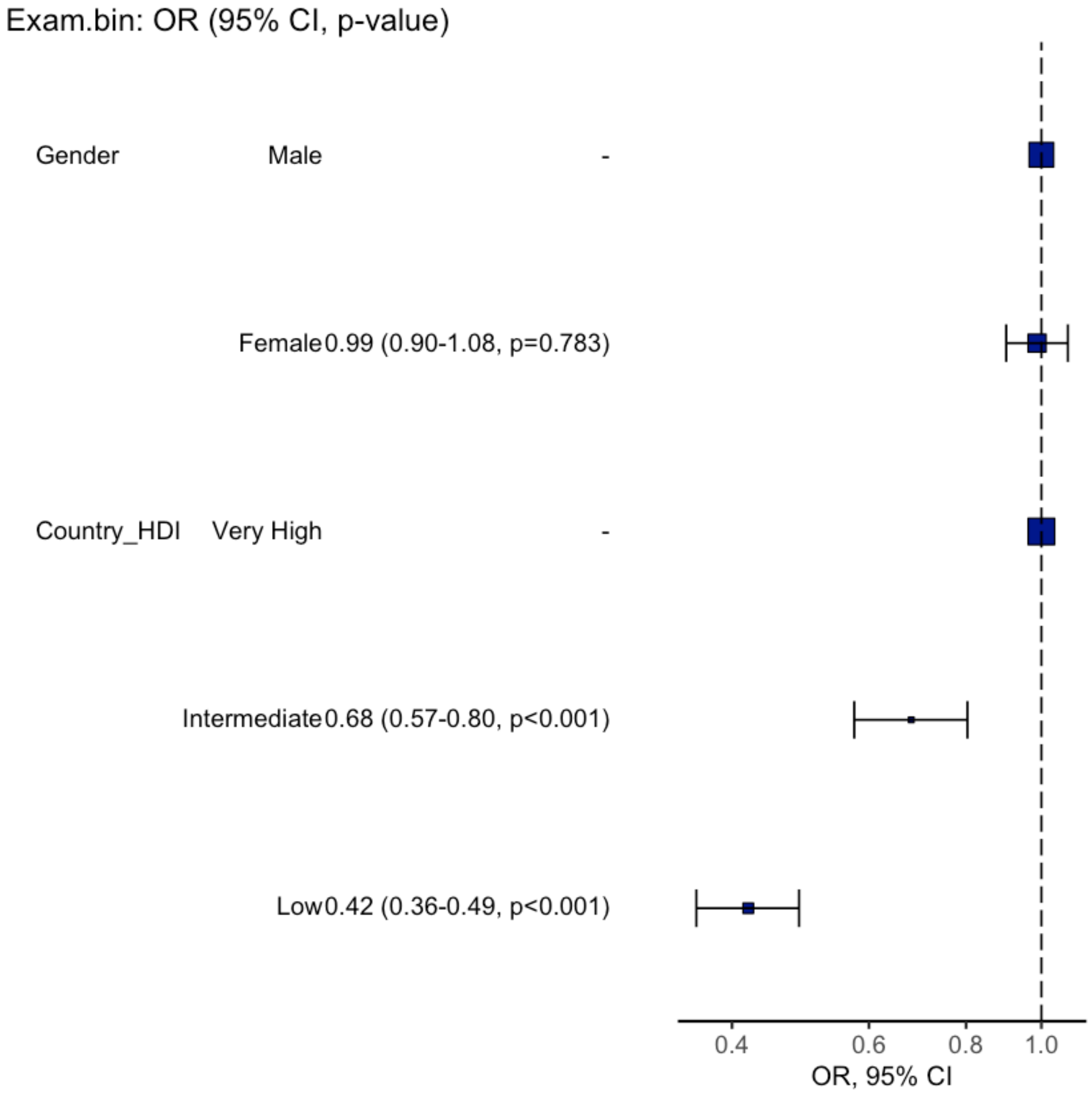
```
# Logistic regression
lr <- glm(Exam.bin ~ Country_HDI + Gender, data=df, family = "binomial")
summary(lr)
```

```
Call:
glm(formula = Exam.bin ~ Country_HDI + Gender, family = "binomial",
    data = df)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-1.0553  -1.0553  -0.9008   1.3047   1.6997

Coefficients:
                        Estimate Std. Error z value Pr(>|z|)
(Intercept)             -0.29429    0.02882 -10.213  < 2e-16 ***
Country_HDIIntermediate -0.38536    0.08550  -4.507 6.57e-06 ***
Country_HDILow          -0.86831    0.07755 -11.197  < 2e-16 ***
GenderFemale            -0.01281    0.04662  -0.275    0.783
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 12030  on 8950  degrees of freedom
Residual deviance: 11877  on 8947  degrees of freedom
  (7969 observations deleted due to missingness)
AIC: 11885

Number of Fisher Scoring iterations: 4
```

[20]:

```
# OR plot
df %>%
  or_plot("Exam.bin", c("Gender","Country_HDI"), table_text_size=4,␣
 ↪title_text_size=14,
    plot_opts=list(xlab("OR, 95% CI"), theme(axis.title =␣
 ↪element_text(size=12))))
```

```
Note: dependent includes missing data. These are dropped.

Waiting for profiling to be done…
Waiting for profiling to be done…

Waiting for profiling to be done…

Warning message:
"Removed 2 rows containing missing values (geom_errorbarh)."
```



[21]:

```r
# Poisson Regression
pr <- glm(last.video ~ Country_HDI + Gender, data=df, family = "poisson")
pr
```

```
Call:  glm(formula = last.video ~ Country_HDI + Gender, family = "poisson",
    data = df)
```

```
Coefficients:
            (Intercept)  Country_HDIIntermediate           Country_HDILow
                3.08560                 -0.18080                 -0.26909
           GenderFemale
               -0.02596

Degrees of Freedom: 8950 Total (i.e. Null);  8947 Residual
  (7969 observations deleted due to missingness)
Null Deviance:          104100
Residual Deviance: 102600        AIC: 141100
```

2.4.2 Survival Analysis

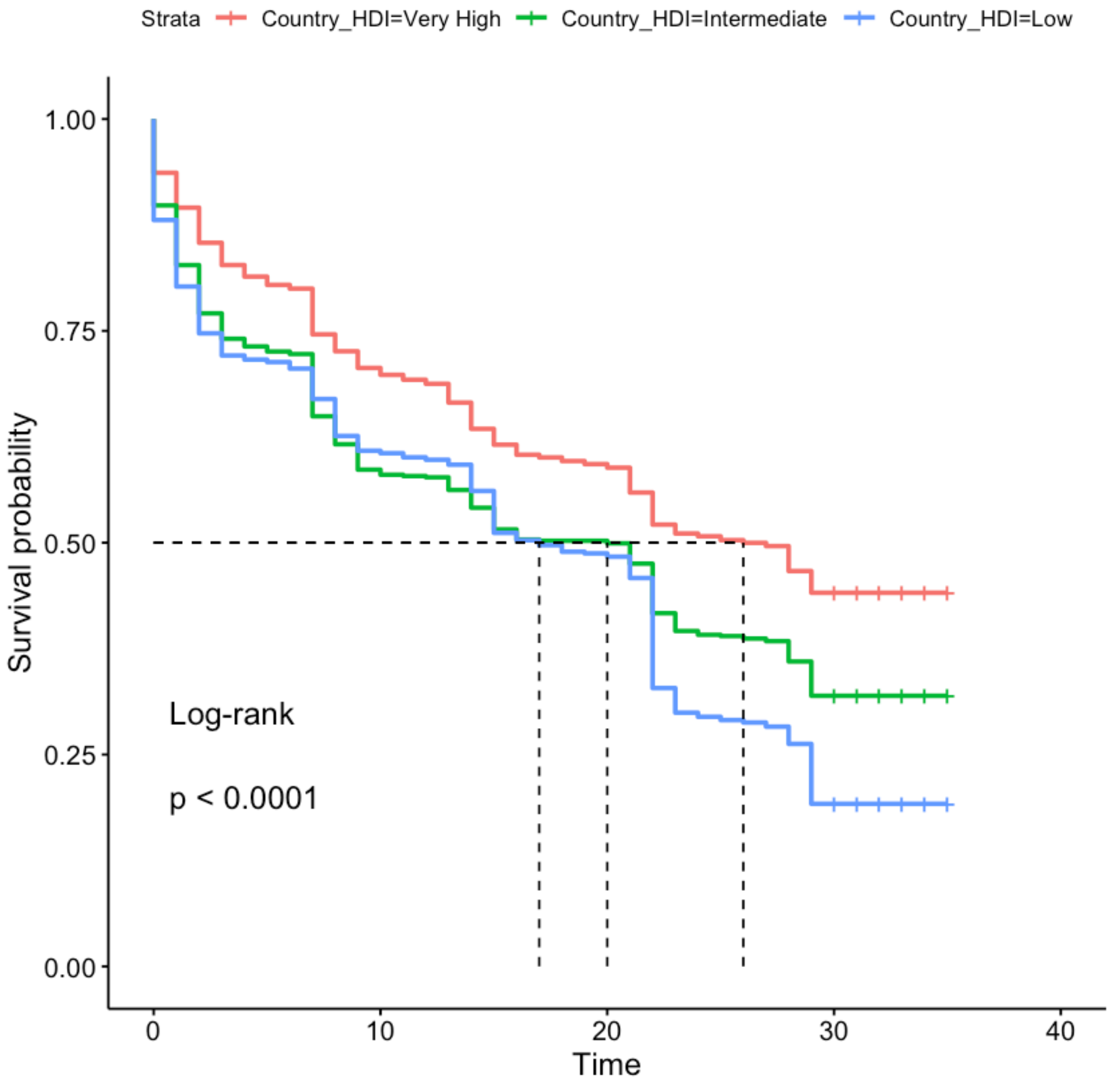
[22]:

```
# Reference: Very High + Male
surv = coxph(formula = Surv(last.video, status) ~ Country_HDI + Gender, data = df)
summary(surv)
```

```
Call:
coxph(formula = Surv(last.video, status) ~ Country_HDI + Gender,
    data = df)

  n= 8951, number of events= 5338
   (7969 observations deleted due to missingness)

                           coef exp(coef) se(coef)      z Pr(>|z|)
Country_HDIIntermediate 0.34175   1.40741  0.04955  6.897 5.32e-12 ***
Country_HDILow          0.56717   1.76327  0.03870 14.656  < 2e-16 ***
GenderFemale            0.01706   1.01720  0.02991  0.570    0.569
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

                        exp(coef) exp(-coef) lower .95 upper .95
Country_HDIIntermediate     1.407     0.7105    1.2771     1.551
Country_HDILow              1.763     0.5671    1.6345     1.902
GenderFemale                1.017     0.9831    0.9593     1.079

Concordance= 0.54  (se = 0.004 )
Likelihood ratio test= 220  on 3 df,   p=<2e-16
Wald test            = 243.6  on 3 df,   p=<2e-16
Score (logrank) test = 249.3  on 3 df,   p=<2e-16
```

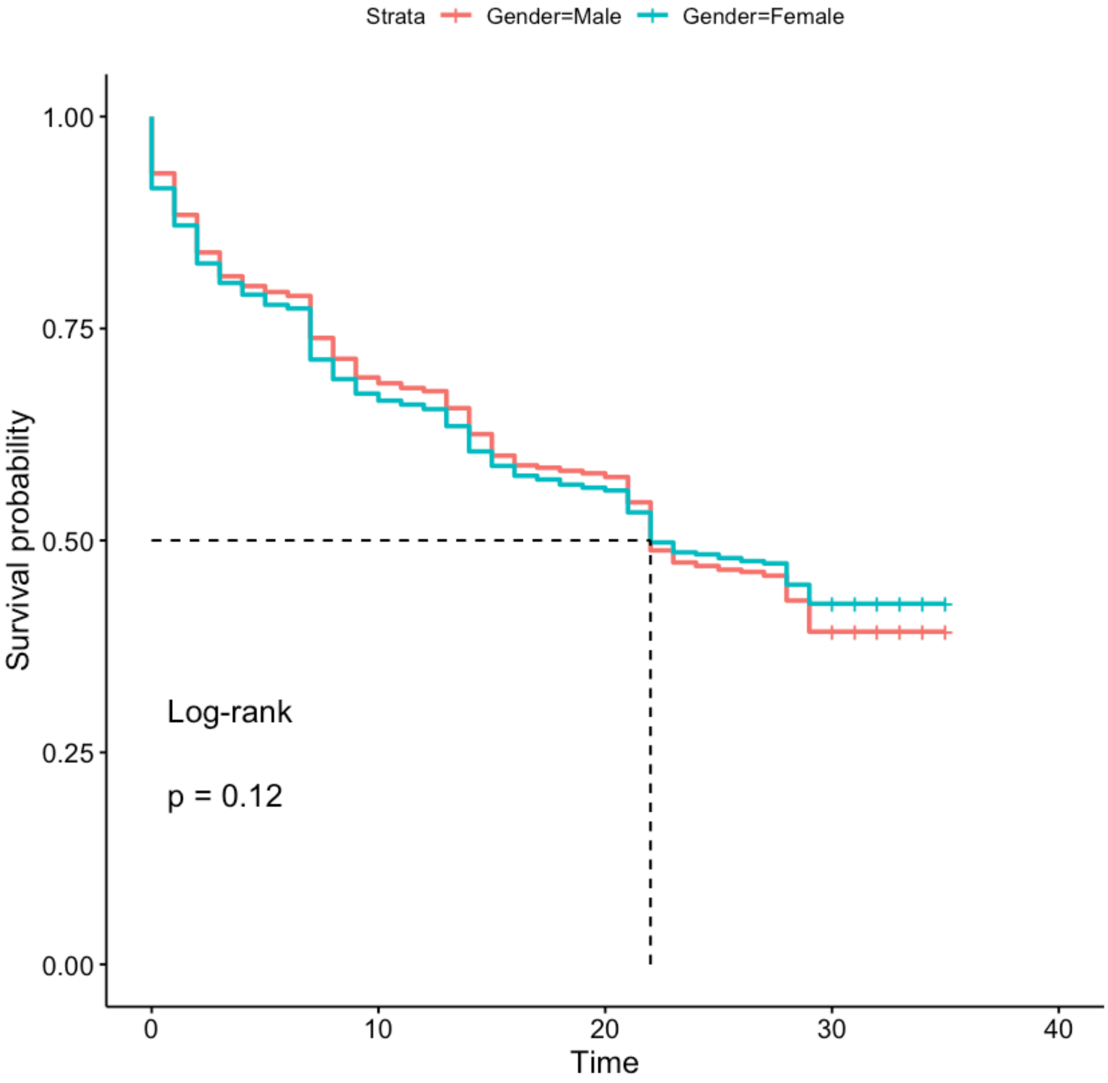
[23]:

```
# Survival plot of Country's HDI
survival_HDI <- survfit(Surv(last.video, status) ~ Country_HDI, data = df)
ggsurvplot(
  survival_HDI,
  conf.int = FALSE,
  surv.median.line = c('hv'),
  data = df,
  pval = TRUE,
  pval.method = TRUE,
  risk.table = FALSE)
```



[24]:

```
# Survival plot of Gender
survival_Group <- survfit(Surv(last.video, status) ~ Gender, data = df)
ggsurvplot(
  survival_Group,
  conf.int = FALSE,
  surv.median.line = c('hv'),
  data = df,
  pval = TRUE,
  pval.method = TRUE,
  risk.table = FALSE)
```



[25]:
```
# Merge table
t1 <- lr %>% tbl_regression(exponentiate = TRUE)
t2 <- surv %>% tbl_regression(exponentiate = TRUE)
tbl_merge <-
  tbl_merge(
    tbls = list(t1, t2),
    tab_spanner = c("**Course completion**", "**View videos to Quit**")
)
```

[26]:

```
tbl_merge %>%
  as_gt() %>%
  gt::gtsave(filename = "plots/merged_table.png")
```

[ ]:

```

```