EDA: Voter Turnout and Race Competitiveness

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Intro

In this exploratory data analysis (EDA), we will take a first look at our elections data. Our research question of interest is whether more competitive elections are associated with greater voter turnout in British Columbia. To answer this, we will be using open data from Elections BC. Scripts for downloading these data are provided in the `src/` directory.

Load the data

Let's start by loading the data. We are using two open data sources: the provincial voting results, and the provincial voter participation. We will load these in here and name them `pvr` and `pvp`, respectively.

```
# Load packages
library(tidyverse)

# Set defaults and seeds
theme_set(ggthemes::theme_fivethirtyeight() +
              theme(axis.title = element_text()))
set.seed(1)
```

```
# Read-in the elections results data
f1 <- here::here("data", "raw", "provincial_voting_results.csv")
pvr <- janitor::clean_names(read_csv(f1))
```

```
## Parsed with column specification:
## cols(
##   EVENT_NAME = col_character(),
##   EVENT_YEAR = col_double(),
##   ED_ABBREVIATION = col_character(),
##   ED_NAME = col_character(),
##   VA_CODE = col_character(),
##   EDVA_CODE = col_character(),
##   ADVANCE_VOTING_LOCATION = col_character(),
##   ADDRESS_STANDARD_ID = col_double(),
##   VOTING_OPPORTUNITY = col_character(),
##   CANDIDATE = col_character(),
##   ELECTED = col_character(),
##   AFFILIATION = col_character(),
##   VOTES_CONSIDERED = col_double(),
##   VOTE_CATEGORY = col_character(),
##   COMBINED_INDICATOR = col_character(),
##   RESULTS_REPORTED_UNDER = col_character()
## )
```

```
# Read-in the voter participation data
f2 <- here::here("data", "raw", "provincial_voter_participation_by_age_group.csv")
pvp <- janitor::clean_names(read_csv(f2))
```

```
## Parsed with column specification:
## cols(
##   EVENT_NAME = col_character(),
##   EVENT_YEAR = col_double(),
##   ED_ABBREVIATION = col_character(),
##   ED_NAME = col_character(),
##   AGE_GROUP = col_character(),
##   PARTICIPATION = col_number(),
##   REGISTERED_VOTERS = col_number(),
##   EVENT_DATE_TEXT = col_character()
## )
```

Let's take a look a sample of rows from our voter participation dataset by creating an exploratory data table:

```
sample_n(pvp, 10) %>%
  knitr::kable()
```

event_name	event_year	ed_abbreviation	ed_name	age_group	participation	registered_voters	event_date_text
General Election 2009	2009	SWH	Surrey-Whalley	25-34	1937	5789	05/12/2009
General Election 2009	2009	CWV	Cowichan Valley	75+	3311	4550	05/12/2009
General Election 2017	2017	SKN	Stikine	75+	785	1092	05/09/2017
General Election 2009	2009	RCE	Richmond East	65-74	2182	3568	05/12/2009
General Election 2013	2013	RCS	Richmond-Steveston	75+	2320	4015	05/14/2013
General Election 2005	2005	VKE	Vancouver-Kensington	25-34	3308	6615	05/17/2005
General Election 2005	2005	OKV	Okanagan-Vernon	45-54	5843	9212	05/17/2005
General Election 2013	2013	BNN	Burnaby North	75+	3086	3956	05/14/2013
General Election 2009	2009	BNE	Burnaby-Edmonds	25-34	2155	6158	05/12/2009
General Election 2013	2013	FLA	Fort Langley-Aldergrove	65-74	4223	5536	05/14/2013

Let's do the same for our election results data. Here, we only show a sub-selection of the columns.

```
pvr %>%
  sample_n(10) %>%
  select(ed_name, event_year, event_name, affiliation, vote_category,
         votes_considered) %>%
  knitr::kable()
```

ed_name	event_year	event_name	affiliation	vote_category	votes_considered
Vernon-Monashee	2009	General Election 2009	BC Liberal Party	Valid	0
Port Coquitlam	2009	General Election 2009	BC NDP	Valid	71
Kamloops-South Thompson	2017	General Election 2017	BC NDP	Valid	73
Vancouver-Mount Pleasant	2013	General Election 2013	BC Liberal Party	Valid	39
Kelowna-Mission	2005	General Election 2005	NA	Rejected	0
Abbotsford-Mount Lehman	2005	General Election 2005	BC Liberal Party	Valid	164
West Kootenay-Boundary	2005	General Election 2005	NA	Valid	0
Saanich South	2009	General Election 2009	BC Green Party	Valid	10
Shuswap	2009	General Election 2009	Conservative	Valid	8
Vancouver-Mount Pleasant	2005	General Election 2005	BC Marijuana Party	Valid	2

Let's create some EDA profile reports. These will be created as PDFs in the eda directory, and will include marginal plots, basic descriptive statistics, and information about missing data. We'll use the dataMaid package for this.

```
# Create PDF profile reports
dataMaid::makeDataReport(pvr, file = here::here("eda", "profile_pvr.Rmd"),
                         replace = TRUE)
dataMaid::makeDataReport(pvp, file = here::here("eda", "profile_pvp.Rmd"),
                         replace = TRUE)
```

Data Cleaning and Transformation

The data is relatively clean, but too granular for our research question. Let's start by aggregating the voter participation so that each row (unit of analysis) represents an Electoral District (ED) for a given electoral event. We'll add a new column for the turnout by dividing the number of electors who participated by the total number of registered voters:

```
# Aggregate participation by event and electoral district
pvp_agg <- pvp %>%
    group_by(event_name, ed_name) %>%
    summarise(across(participation:registered_voters, sum),
              .groups = "drop") %>%
    mutate(turnout = participation / registered_voters)
```

We can also aggregate the voting results data. As we do this, we will also compute some variables for each ED and electoral event, such as competitiveness. We operationalized the latter as the point difference in vote share between the runner-up and the winner. For example, if in a given district, a party wins with 42% of the votes, and the runner up has 30%, this would be a 12-point difference.

Finally, we will also join-in our voter turnout data.

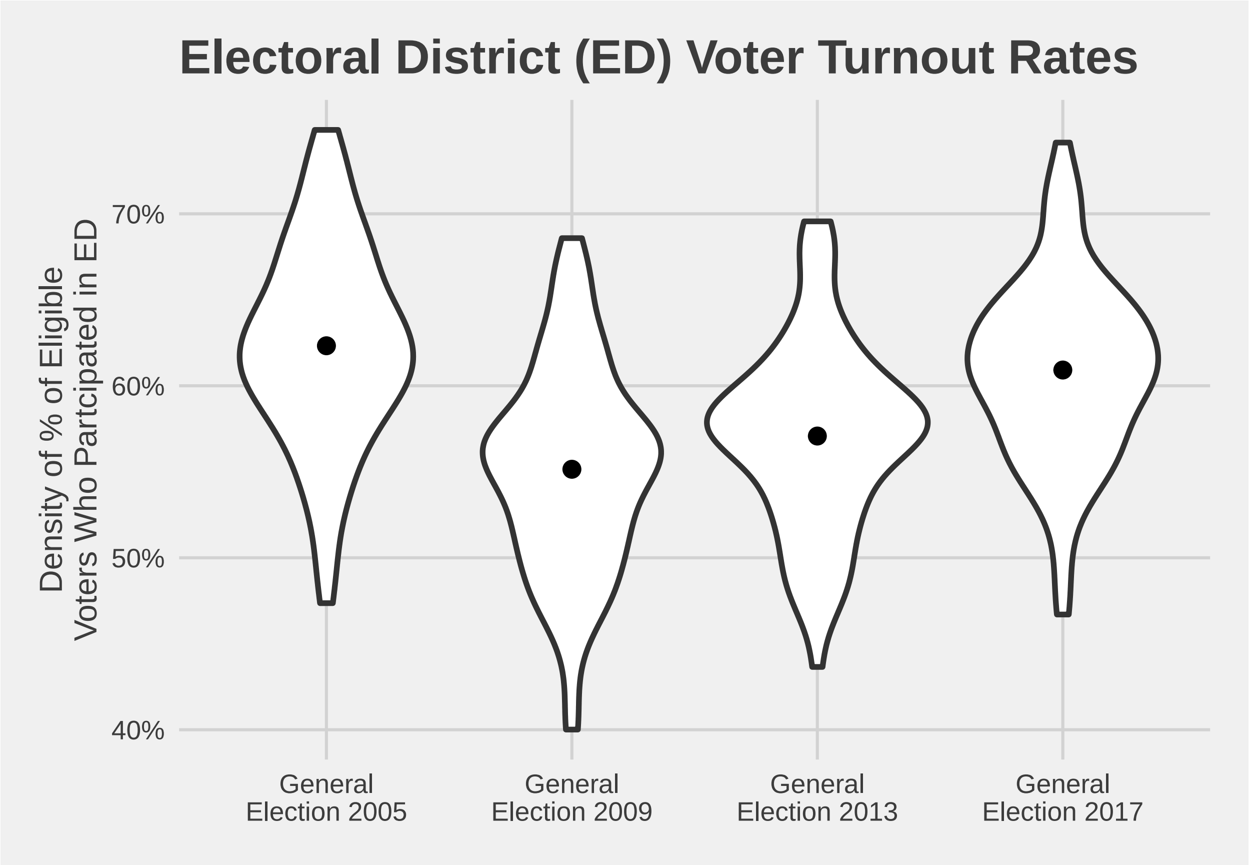
```
# Aggregate election results by event and electoral district.
pvr_agg <- pvr %>%
```

```r
    filter(vote_category == "Valid") %>%
    group_by(event_name, ed_name, affiliation) %>%
    summarise(votes = sum(votes_considered),
              .groups = "drop_last") %>%
    arrange(event_name, ed_name, desc(votes)) %>%
    mutate(vote_share = votes / sum(votes),
           rank = row_number(),
           vote_trail = votes - first(votes) ,
           share_trail = vote_share - first(vote_share),
           vote_diff = nth(vote_trail, 2),
           competitiveness = nth(share_trail, 2),
           winning_party = nth(affiliation, 1)) %>%
    nest(candidates = c(affiliation, votes, vote_share, vote_trail,
                        share_trail, rank)) %>%
    ungroup %>%
    left_join(pvp_agg, by = c("event_name", "ed_name"))
```

Analysis

Now, let's plot our dependent variable: voter turnout. It appears that we have data on this at the electoral district for the General Elections held in 2005, 2009, 2013, and 2017 (but not sufficient amounts of data for by-elections).

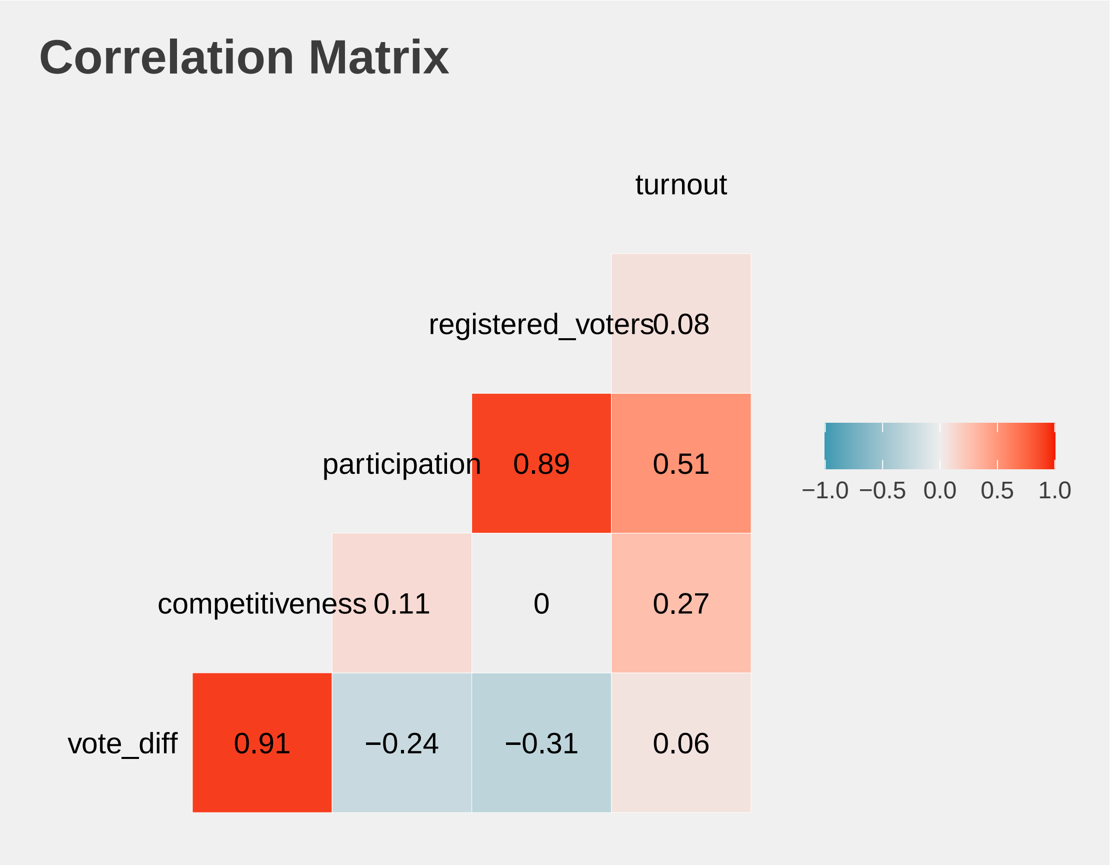
```r
# Violin plots of voter turnout
pvp_agg %>%
    ggplot(aes(y = turnout, x = factor(str_wrap(event_name, 15)))) +
    geom_violin(size = 1) +
    scale_y_continuous(labels = scales::percent_format(1)) +
    labs(title = "Electoral District (ED) Voter Turnout Rates",
         y = "Density of % of Eligible\nVoters Who Partcipated in ED",
         x = NULL) +
    stat_summary(fun = mean)
```



Turnout seems to vary quite a bit from one election to another. That might be something to keep in mind for subsequent analyses, as we may want to control for this factor.

Let's look at some of the other correlations between numeric variables. We are particularly interested in `turnout`:

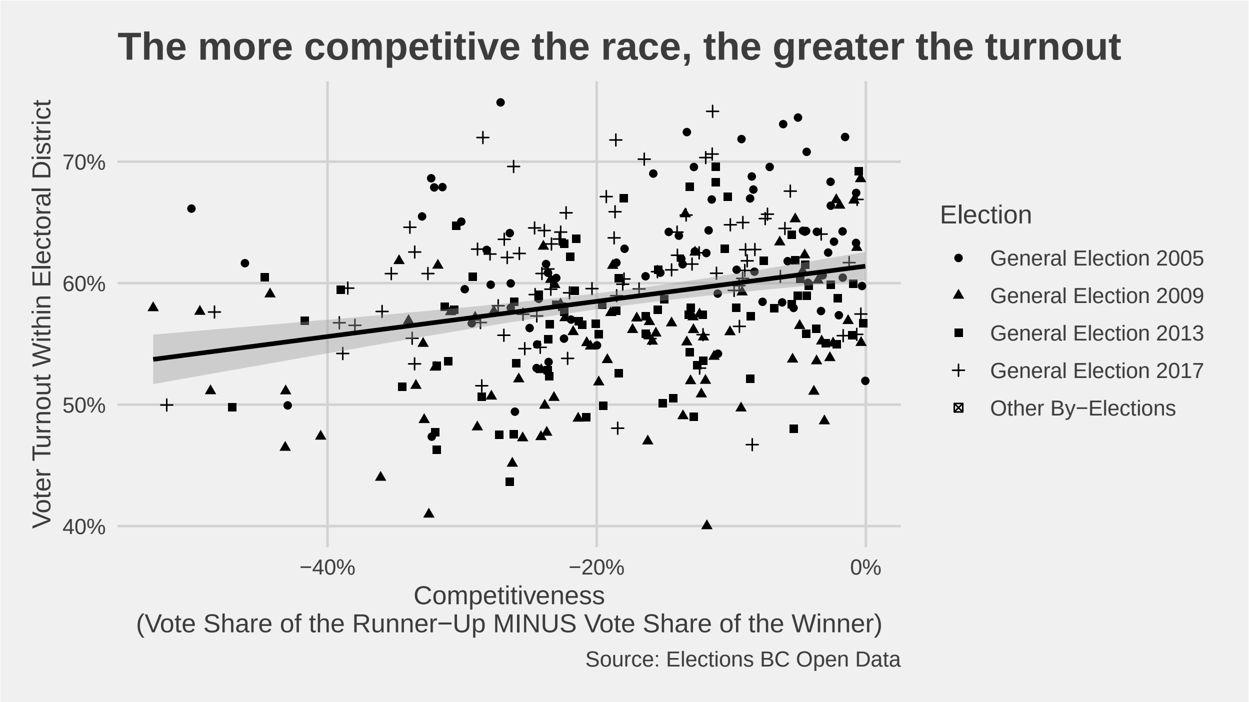
```
pvr_agg %>%
  select(where(is.numeric)) %>%
  GGally::ggcorr(label = TRUE, label_round = 2) +
  labs(title = "Correlation Matrix")
```



We see that there is 0.27 correlation between `turnout` and `competitiveness`. In subsequent analysis, we will test if this correlation is just spurious or statistically significant.

Let's plot these two variables against one another in a scatter plot, and add a trendline:

```r
# Scatter plot relating the voter turnout to the competitiveness of a race
pvr_agg %>%
    drop_na(competitiveness) %>%
    mutate(across(event_name, fct_lump, n = 4,
                  other_level = "Other By-Elections")) %>%
    ggplot(aes(x = competitiveness, y = turnout)) +
    geom_point(aes(shape = event_name)) +
    geom_smooth(method = "lm", formula = y ~ x, colour = "black") +
    scale_y_continuous(labels = scales::percent_format(1)) +
    scale_x_continuous(labels = scales::percent_format(1)) +
    labs(title = "The more competitive the race, the greater the turnout",
         caption = "Source: Elections BC Open Data",
         y = "Voter Turnout Within Electoral District",
         x = "Competitiveness\n(Vote Share of the Runner-Up MINUS Vote Share of the Winner)",
         shape = "Election") +
    theme(legend.position = "right", legend.direction = "vertical")
```



As hypothesized, the more competitive a race is, the greater the associated turnout. This is reflected visually in the positive sloping trendline.

Conclusion

This exploratory data analysis has given us some nice visuals that support our hypothesis. In subsequent analyses, we will test this more formally using regression and/or other statistical tests.