Faculty Engagement EDA

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1. Import and Check Structure

Goals:

- Import data
- Find important variables
- Check if cleaning needs to be done

Preliminary thoughts:

- `course_year`, `cem_unique`, `cour_st_dt`, `cour_end_dt` appear redundant or unnecessary
- rename `sln`, `term_session` to `class_nbr`, `session_code` for consistency
- insert '|' between subject and catalog number in `course` for consistency
- `acad_career` is a student-level variable and may not make sense to use at this granularity
- This includes graduate courses, which for now I'll just get rid of

Things to inspect:

- what is the difference between `acad_group` and `acad_org`?
  - `acad_group` is kind of like college but not exactly? full data has weird cross tabs
  - `acad_org` appears to be the department
- what is the distribution of enrollment totals?
- any courses from campuses outside the normal group? (Poly, West, Tempe, DT, ASUO)
- how complete is the feedback data?

Update before moving on:

- Drops:
  - Graduate courses and missing courses
  - `course_year`, `cem_unique`, `cour_st_dt`, and `cour_end_dt` variables
  - Rename `sln` and `term_session`
  - Recreate `course` based on previous work

```
forum <- forum %>%
  filter(course != '-' & as.numeric(str_sub(course, 4, 6)) < 500) %>%
  select(-c(cour_st_dt, cour_end_dt, cem_unique)) %>%
  rename(session_code = term_session) %>%
  mutate(subject = str_sub(course, 1, 3),
         catalog_nbr = str_sub(course, 4, 6),
         course = paste(subject, catalog_nbr, sep = '|'),
         enrl_total = pass_ct + wdwn_ct + fail_ct)
```

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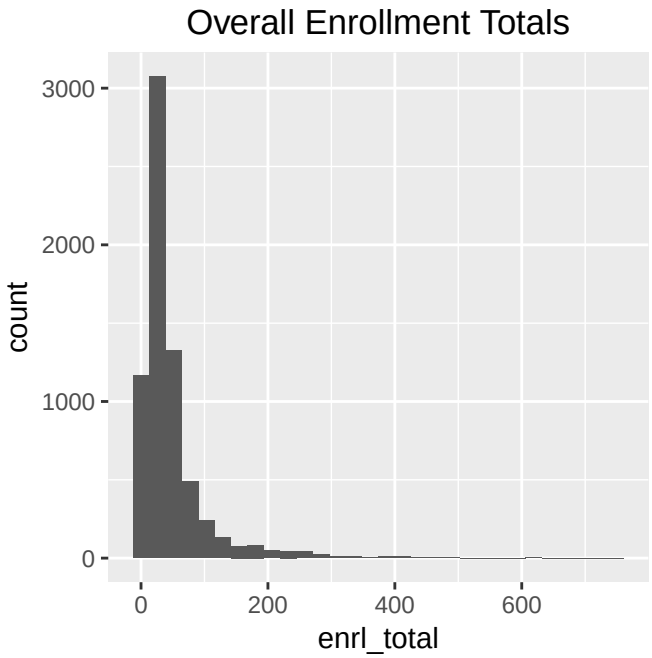
2. Further inspection

What's the distribution of enrollment totals?

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



Okay, so a handful of courses with super high enrollment are throwing off this graph, so let's figure out what these courses are and redo the graph without them to get a better understanding of the majority. We're not really interested in how many students are in these courses, just what the courses are

```
## # A tibble: 22 x 2
## # Groups: course [22]
##    course  enrl_total
##    <chr>        <dbl>
##  1 ENG|102        748
##  2 SOC|352        553
##  3 ASB|300        484
##  4 BIO|112        476
##  5 CDE|312        459
##  6 SOC|101        456
##  7 ASB|100        427
##  8 SOC|424        412
##  9 MCO|194        403
## 10 FIN|380        402
## # ... with 12 more rows
```

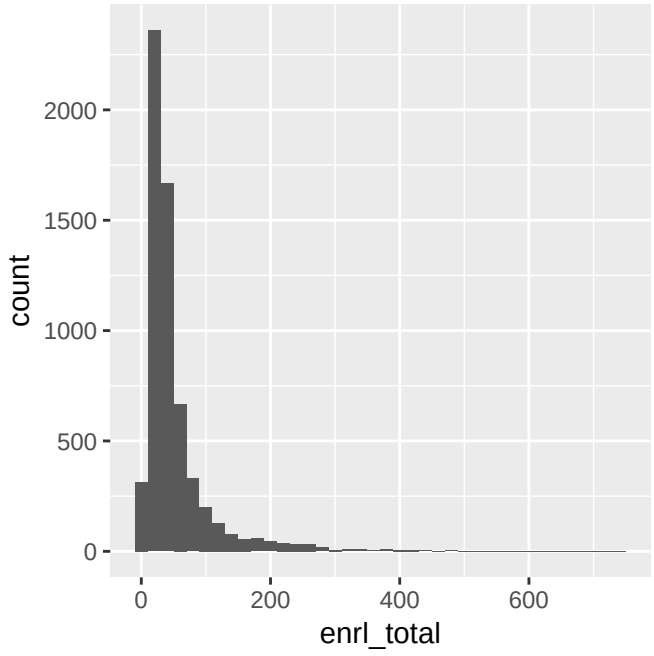
These are all intro freshman courses, so everything looks to be as expected there. Now let's check out low enrollment courses:

```
## # A tibble: 152 x 1
## # Groups: course [152]
##    course
##    <chr>
##  1 ACC|320
```

```
##  2 ACC|310
##  3 ACC|241
##  4 AGB|250
##  5 AGB|294
##  6 ARS|250
##  7 ARS|480
##  8 ART|206
##  9 ASM|201
## 10 ASU|101
## # ... with 142 more rows
```

These courses are going to be a pain in the butt to filter through because a lot of them appear to be topic courses or internships (courses with catalog_nbr of 384, 394, or 494 are generally specially designed courses). It would probably be a good idea to merge `descr` and `descr2` from the peoplesoft tables to give us more info.

For now, let's just get rid of any courses with less than 5 students because **a.)** it isn't that many courses and **b.)** we know that some of those are irregularly taught courses that are probably irrelevant to the analysis



Before we move on, I'm going to assume that this super-low enrollment courses will actually turn out to be irrelevant for the study, so I will drop them entirely from the data set. To recap, the cumulative list of drops I've made is:

- Graduate courses and missing courses
- Courses with less than 5 students enrolled

```
forum <- forum %>% filter(enrl_total >= 5)
```

Campus/Location Variable

___ THIS SECTION IS NOW UNNECESSARY DUE TO CHANGES IN THE DATA ___

In the full data ASUO is designated as a unique location and observations having "ASUONLINE" `location` values should (for the most part) only have "ONLNE" as their `campus`. In other words, online students have their own campus that is different from Tempe, Poly, etc.

For some reason, this data seems to have a variety of values for campus despite the fact that there should only be one campus in the data. I don't know what the cause of this is and it could definitely be the case that I'm interpreting something wrong on the full_data end. To illustrate, here's a cross-tab of location and campus in the forum data:

I won't do anything with this for now because it really isn't that big of a deal, but whatever is causing this needs to be understood

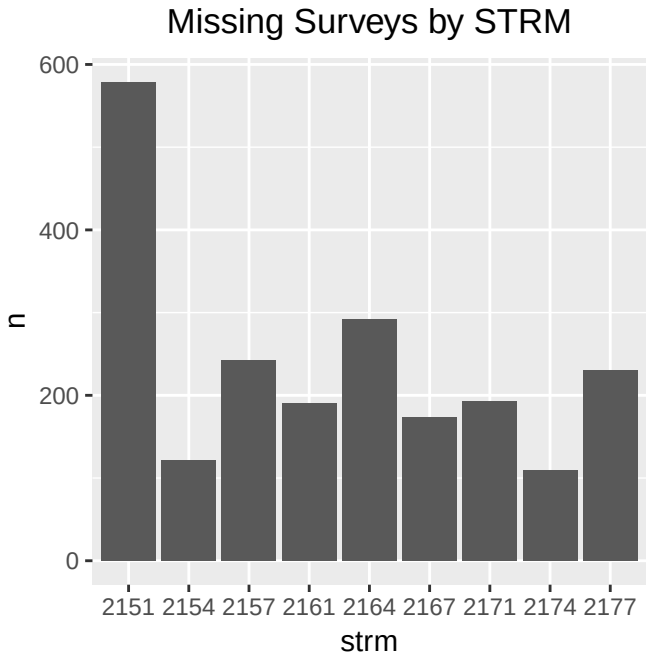
Feedback Data Completeness

When I initially glanced at the data, it seemed like there were a ton of missing values for the variables around student-course reviews. Let's check first if there were any missing values for `num_evals_expected`. We shouldn't have any, hopefully.

```
## [1] 2131
```

Okay, so about 2100 courses have missing values for `num_evals_expected`. It is not included here but these courses also have missing `responserate`, so I will just assume that these guys are also missing the average response for each of the questions.

Let's investigate a little more into these courses - is it limited to a specific time frame? course? department? (for the moment we assume that `acad_org` is the department; still working on confirming this)

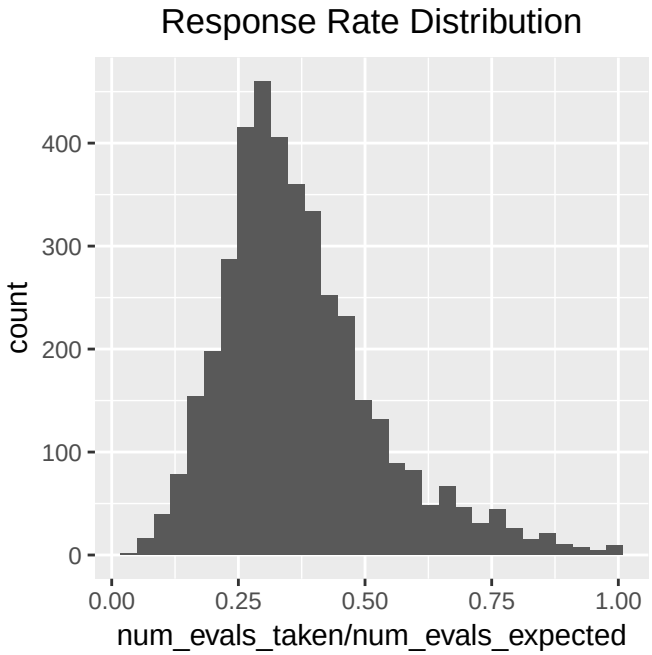


It is probably reasonable to assume that the missing values from earliers terms are just flat out missing from the warehouse, but I'm not sure what is going on with the more recent terms. For now, we'll just drop the course-sections with missing `expectedsurveys` and move on to checking out `responserate`. Just as a quick recap, the current list of drops is:

- graduate courses or missing courses (~2100)
- courses with less than 5 students (~700)
- courses with missing surveys (~2100)

Onto the graphing:

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



This looks pretty good, no reason for concern. Since most of this looks fine, let's just move on to some feature engineering before we get to modeling

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3. Faculty Posts

We want to investigate the distribution of the faculty postings. In particular, we look at `num_fac_ta_posts`, `total_len_fac_ta_posts`, and `num_fac_ta`

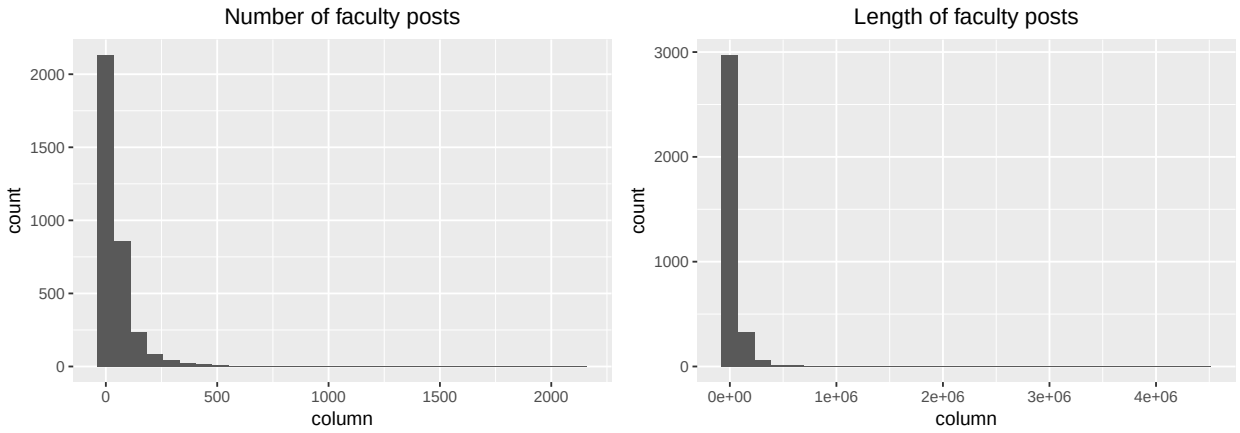
```
## # A tibble: 8 x 2
##   num_fac_ta     n
##        <dbl> <int>
## 1       0      590
## 2       1.00  2844
## 3       2.00   377
## 4       3.00    99
## 5       4.00    33
## 6       5.00    19
## 7       6.00    13
## 8       7.00    12
```

So it turns out that there are a lot of courses that don't have any faculty. We need to drop those courses for now until we have an answer as to why this is the case

```
forum <- filter(forum, num_fac_ta > 0)
```

Now that that is out of the way, let's look at at the distributions for the other two variables of interest:

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



There are some huge outliers that are throwing off the graphs. To condense this slightly, let's drop anything above the 95th quantile for the faculty post length. This is done assuming that the reason for these crazy high totals is because an instructor might post fat blocks of text describing an assignment. These observations are less valuable because they are less of a representation of faculty engagement and more of how the instructor uses the blackboard shell.

We leave in observations with really high faculty post counts because that is likely indicative of instructors who reply to a lot and post often, which is exactly what we want to identify.

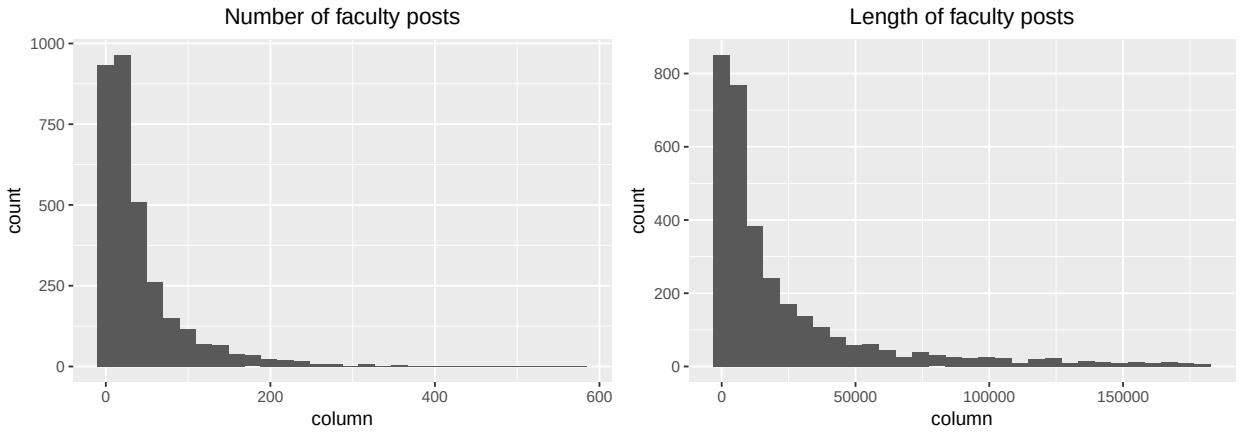
```
forum <- forum %>%
  filter(total_len_fac_ta_posts <= quantile(total_len_fac_ta_posts, .95))

plotHist <- function(data, column, title){
  data %>%
    ggplot(aes(column)) +
    geom_histogram() +
    ggtitle(title) +
    theme(plot.title = element_text(hjust = .5))
}

num <- plotHist(forum, forum$num_fac_ta_posts, "Number of faculty posts")
len <- plotHist(forum, forum$total_len_fac_ta_posts, "Length of faculty posts")

grid.arrange(num, len, nrow = 1)
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
rm(num, len)
```

Distributions are stil ultra skewed - let's get a numeric summary real quick and keep it for later

```
summary(forum$num_fac_ta_posts)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1.00    8.00   22.00   42.06   51.00  576.00
```

```
summary(forum$total_len_fac_ta_posts)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##       0    2892    9399   23720   29017  179661
```

---

4. Missing Values

This will be a relatively short section; we just want to check out which variables have missing values and guess why that might be. More than likely we will have to go back to Mike for an explanation. Any variables with missing values will be dropped

```
sapply(forum, function(x) sum(is.na(x)))
```

```
##           myasu_course                 course                   strm
##                      0                      0                      0
##                 sln_ct             non_ol_ct            sync_st_dt
##                      0                      0                      0
##            sync_end_dt           session_code             acad_group
##                      0                      0                      0
##               acad_org                 campus          sum_enrl_total
##                      0                      0                      0
##             ocourse_ct             icourse_ct         other_course_ct
##                      0                      0                      0
##                pass_ct                fail_ct                wdwn_ct
##                      0                      0                      0
##                drop_ct                sum_gpa             num_fac_ta
##                      0                      0                      0
##             has_hallway         fac_posted_wk0         fac_posted_wk1
##                      0                      0                      0
##         fac_posted_wk2         fac_posted_wk3         fac_posted_wk4
##                      0                      0                      0
```

```
##         fac_posted_wk5         fac_posted_wk6         fac_posted_wk7
##                      0                      0                      0
##         fac_posted_wk8         fac_posted_wk9        fac_posted_wk10
##                      0                      0                      0
##        fac_posted_wk11        fac_posted_wk12        fac_posted_wk13
##                      0                      0                      0
##        fac_posted_wk14        fac_posted_wk15      num_fac_posts_wk0
##                      0                      0                      0
##      num_fac_posts_wk1      num_fac_posts_wk2      num_fac_posts_wk3
##                      0                      0                      0
##      num_fac_posts_wk4      num_fac_posts_wk5      num_fac_posts_wk6
##                      0                      0                      0
##      num_fac_posts_wk7      num_fac_posts_wk8      num_fac_posts_wk9
##                      0                      0                      0
##     num_fac_posts_wk10     num_fac_posts_wk11     num_fac_posts_wk12
##                      0                      0                      0
##     num_fac_posts_wk13     num_fac_posts_wk14     num_fac_posts_wk15
##                      0                      0                      0
##      num_stu_posts_wk0      num_stu_posts_wk1      num_stu_posts_wk2
##                      0                      0                      0
##      num_stu_posts_wk3      num_stu_posts_wk4      num_stu_posts_wk5
##                      0                      0                      0
##      num_stu_posts_wk6      num_stu_posts_wk7      num_stu_posts_wk8
##                      0                      0                      0
##      num_stu_posts_wk9     num_stu_posts_wk10     num_stu_posts_wk11
##                      0                      0                      0
##     num_stu_posts_wk12     num_stu_posts_wk13     num_stu_posts_wk14
##                      0                      0                      0
##     num_stu_posts_wk15          num_stu_posts     num_stu_with_posts
##                      0                      0                      0
##       num_fac_ta_posts total_len_fac_ta_posts     num_evals_expected
##                      0                      0                      0
##        num_evals_taken              q_success             q_prepared
##                      0                      0                      0
##        q_presentations             q_navigate             q_feedback
##                      0                      1                      0
##            q_responded              q_present                subject
##                      1                      0                      0
##            catalog_nbr             enrl_total
##                      0                      0
```

```
forum <- forum %>%
  filter_all(all_vars(!is.na(.)))
```

Summary of drops so far:

- graduate courses or missing courses (~2100)
- courses with less than 5 students (~700)
- courses with missing surveys (~2100)
- 0 faculty/ta (~600)
- faculty length outliers (~200)
- missing values (~5?)

5. Feature Engineering

This section is probably just going to be condensing a couple of variables (like "faculty posted in week X") and maybe coming up with some extra dependent variables

Possible ideas:

- change num_stu_with_posts to proportion
- condense survey questions into faculty/design split
- indicator for having posted in first or last week?

What is the gpa of students who withdraw??? It should be 0

New find: the question responses are not numeric and have to be changed

I'm actually just going to drop all the C session courses cause they represent like none of the sample

```
# Grab question names
questions <-  forum %>%
  select(starts_with('q_')) %>%
  names()

# Force questions to numeric
forum <- forum %>%
  mutate_at(questions, as.numeric)

# Add new variables
forum_cleaned <- forum %>%
  mutate(prop_stu_posted = num_stu_with_posts / enrl_total,
         avg_gpa = sum_gpa / enrl_total,
         wdrw_rate = wdwn_ct / enrl_total,
         instr_score = (q_responded + q_present + q_feedback) / 3,
         design_score = (q_success + q_prepared + q_presentations + q_navigate) / 4,
         posts_per_student = num_stu_posts / enrl_total,
         posts_per_fac = num_fac_ta_posts / num_fac_ta,
         pass_rate = pass_ct / enrl_total,
         avg_fac_post_len = total_len_fac_ta_posts / num_fac_ta_posts,
         upper_division = if_else(
           as.numeric(str_sub(course, 5, 7)) >= 300, 1, 0),
         fac_posts_boc = num_fac_posts_wk0 + num_fac_posts_wk1 + num_fac_posts_wk2,
         fac_posts_eoc = num_fac_posts_wk6 + num_fac_posts_wk7 + num_fac_posts_wk8,
         pass_rate = pass_ct / enrl_total,
         response_rate = num_evals_taken / num_evals_expected) %>%
  rename(course_id = myasu_course) %>%
  select(course_id, session_code, pass_rate, avg_gpa, wdrw_rate,
         enrl_total, response_rate, has_hallway,
         fac_posts_boc, fac_posts_eoc, total_len_fac_ta_posts,
         instr_score, design_score, posts_per_fac,
         posts_per_student, avg_fac_post_len, upper_division) %>%
  filter(session_code %in% c("A", "B"))

# Do a final check on missing values
#sapply(forum_cleaned, function(x) sum(is.na(x)))
```

```
write_csv(forum_cleaned, "Data/forum_cleaned.csv")
```

Final summary of drops (we started with n = 8916)

- graduate courses or missing courses (~2100)
- courses with less than 5 students (~700)
- courses with missing surveys (~2100)
- 0 faculty/ta (~600)
- student data on these is still good in case we need/want it at some point
- faculty length outliers (~200)
- missing values (~5?)
- session C courses (~25)

Final tally: N = 3237