

Performance of linking researchers to theses

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15 August, 2023

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This script makes some plots of the advisor links and saves the most plausible links to a table in the database.

```
# parameters for selecting links
min_score_advisors <- 0.7 # minimum score from dedupe
```

Overview

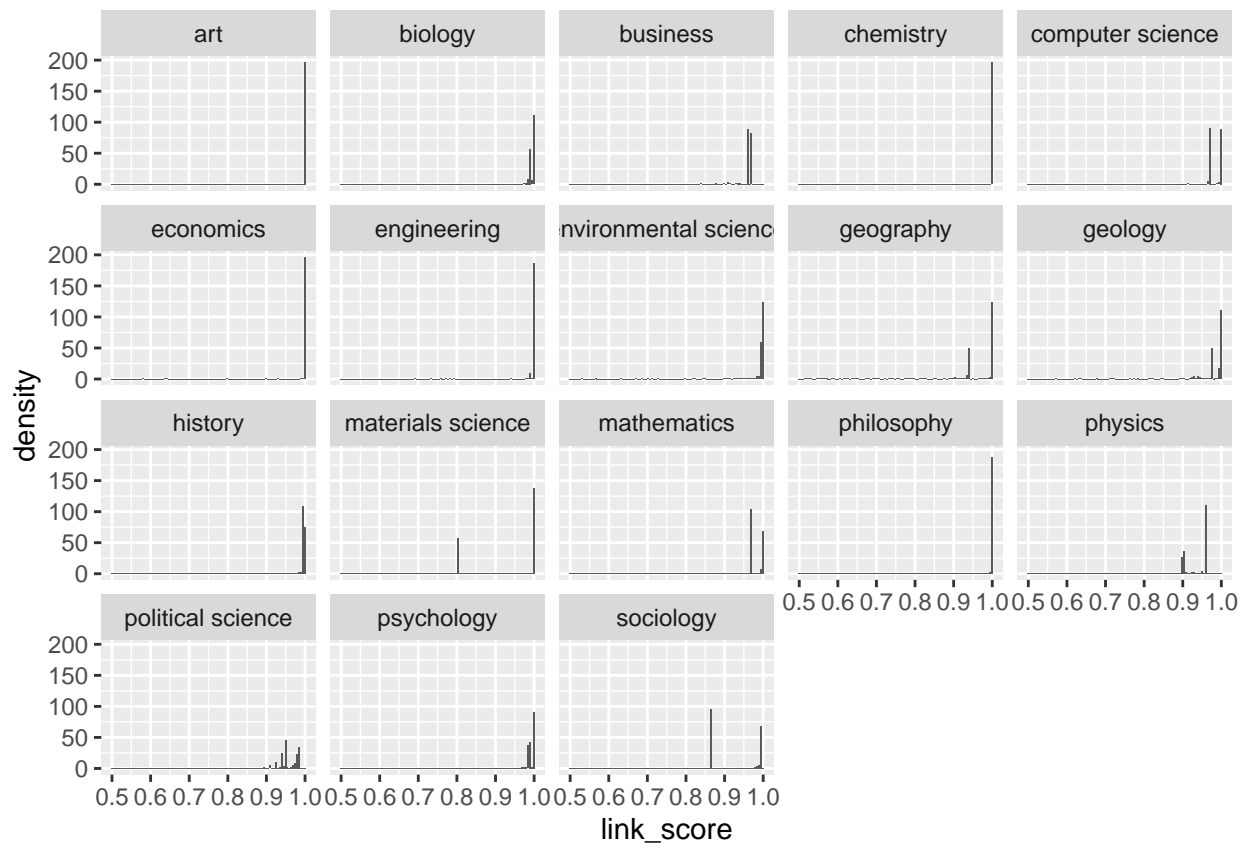
```
linked_advisors <- collect(linked_advisors)
theses <- collect(theses)
linking_info <- collect(linking_info)
pq_fields_mag <- collect(pq_fields_mag)
```

Linking scores

- conditioning on link score > 0.7 is fine

```
linked_advisors %>%
  left_join(linking_info, by = "iteration_id") %>%
  ggplot(aes(x = link_score)) +
  geom_histogram(bins = 100, aes(y = ..density..)) +
  facet_wrap(~field)
```

```
## Warning: The dot-dot notation (`..density..`) was deprecated in ggplot2 3.4.0.
## i Please use `after_stat(density)` instead.
```



Link performance by graduation year

- fraction of listed advisors where the link_score is above the threshold
- the mean link score for advisors where dedupe finds a link (link_score is not NA)
- NOTE: the field here is assigned based on the first reported in the dissertation, and the crosswalked to the MAG field
 - in the figure above, we used the field from iteration_id, but this only works for advisors that dedupe suggests to be a link

```
keep_fields <- select_fields
# c("biology", "chemistry", "computer science",
#   "economics", "engineering", "environmental science",
#   "geography", "geology", "mathematics", "physics",
#   "political science", "psychology", "sociology")

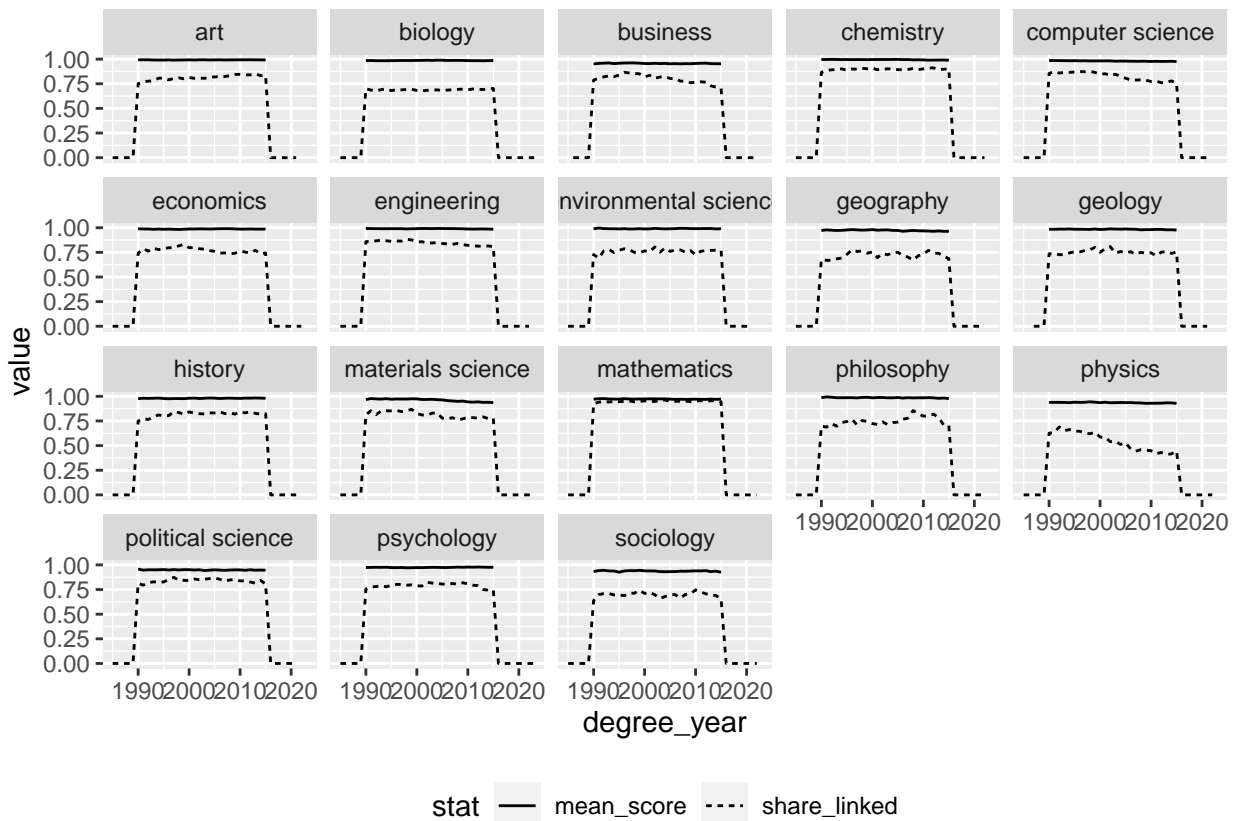
score_by_year <- theses %>%
  filter(degree_year >= 1985) %>%
  left_join(linked_advisors,
            by = "relationship_id") %>%
  left_join(pq_fields_mag, by = "goid") %>%
  filter(field %in% keep_fields)
```

```
## Warning in left_join(., linked_advisors, by = "relationship_id"): Each row in `x` is expected to match
## i Row 401 of `x` matches multiple rows.
## i If multiple matches are expected, set `multiple = "all"` to silence this
## warning.
```

```
# %>%
#   left_join(linking_info,
#             by = "iteration_id")

score_by_year %>%
  mutate(link_score_adj = ifelse(is.na(link_score), -1, link_score)) %>%
  group_by(degree_year, field) %>%
  summarise(mean_score = mean(link_score, na.rm = TRUE),
            #p50_score = quantile(link_score, probs = 0.5),
            share_linked = mean(link_score_adj > min_score_advisors),
            .groups = "drop") %>%
  pivot_longer(cols = all_of(c("mean_score", "share_linked")),
               names_to = "stat") %>%
  ggplot(aes(x = degree_year, y = value)) +
  geom_line(aes(linetype = stat)) +
  facet_wrap(~field) +
  theme(legend.position = "bottom")
```

Warning: Removed 12 rows containing missing values (`geom_line()`).



```
score_by_year %>%
  filter(field == "biology") %>%
  filter(is.na(link_score)) %>%
  filter(degree_year < 2000) %>%
  group_by(firstname, lastname, uni_name, degree_year) %>%
  summarise(nb = n(),
            .groups = "drop") %>%
```

```
arrange(desc(nb)) %>%
head(10)
```

```
## # A tibble: 10 x 5
##   firstname lastname uni_name      degree1    nb
##   <chr>      <chr>   <chr>      <int> <int>
## 1 john a      gerlt    university of maryland college park    1994    6
## 2 mingdaw     tsai     ohio state university                1997    5
## 3 naba k      gupta    university of nebraska lincoln        1997    5
## 4 paul f      cook     university of north texas             1993    5
## 5 chawnshang chang  university of wisconsin madison        1996    4
## 6 david b     wake     university of california berkeley     1993    4
## 7 david j     chapman  university of california los angeles   1988    4
## 8 eric n      olson    university of texas graduate school of bio~ 1995    4
## 9 heinrich    roder    university of pennsylvania            1995    4
## 10 henry r     bose     university of texas at austin          1997    4
## # ... with abbreviated variable name 1: degree_year
```

```
# score_by_year %>% filter(lastname == "dasgupta" & firstname == "asim" & !is.na(iteration_id)) # never
# score_by_year %>% filter(lastname == "freeling" & firstname == "michael") # never linked
```

```
# scale this up? check all the main fields of the authors with such names? -- tedious
```

Notes

- Reasons for why advisor not linked
 - they are not sampled for linking either in the mag or proquest data
 - * most plausibly because they are assigned to different fields
 - institution names do not overlap
 - dedupe does not find a link even though it should
 - * but how can it explain the time trend?
- Comparing fields in MAG and ProQuest dissertations
 - General
 - * not linking an advisor in biology does not mean do not link them in chemistry if the thesis is also classified in chemistry
 - * in the data above, this happens if biology is listed at position 0
 - Biology
 - * main field biology: dasgupta, freeling
 - * at least one of the dissertations of freeling are sampled for the linking
 - Sociology
 - * different main field: ishisaka, coulton (medicine), howell (geography), mindel (psychology)
 - * not in MAG, but findable on google: khleif, gullerud
 - * not in MAG, not findable on google: liff
- Next steps
 - widen the sampled field in MAG
 - re-train and re-check

Update, 4/11/22

Biology

- c brent theurer (authorid 2005171991), c channa reddy (authorid 2263585539): not in advisor sample b/c of the constraint on the length of the first name. can we fix this?
- john a gerlt: similar; is in mag with j a or ja gerlt
- daniel rittschof: his author id is 2242600877 and his name there is dan rittschof

- mingdaw tsai (authorid 2159629249), naba k gupta (authorid 2298396241), paul f cook (authorid 2107503814), eric n olson (2029316736) are all in the advisor sample from mag
 - do their affiliation-years exactly match in MAG? all except olson, who has a special affiliation

Physics

- h angus macleod (2169098584): first initial
- g michael morris (2232988940): first initial
- cyrus duncan cantrell: hard to find in MAG, if non-existent. <https://news.utdallas.edu/faculty-staff/engineering-school-visionary-dr-cyrus-cantrell-mou/>
- robert l byer: only late in mag, but exists as “r l byer” (authorid 2047849238)
- clifford m will (2150132651): could be linked but is not
- c fred moore (2317232422): first initial.

Political science

- chester a newland (2142560737): could be matched, but year-uni are 3 years apart
- orion f white (2116764412): could be matched
- a lucille brewer: could not find. hard to find.
- christopher bellavita: could not find
- m margaret conway (2104998712): first initial
- mitchell a seligson (608794441): could be matched
- bernard grofman (402009535): could be matched
- chester a newland (2142560737): could be matched

validate: does this also hold for economics?

- there, the top 10 non-matched advisors all have only first initials

Possible reasons for the non-linking

- algorithm
 - blocking: predicates are (SimplePredicate: (commonSixGram, lastname), SimplePredicate: (commonFourGram, middlename)). In contrast, for the settings file 1985-2022, the predicates are (SimplePredicate: (suffixArray, lastname),). For chemistry, they are (SimplePredicate: (sameSevenCharStartPredicate, lastname),)
 - * why do we use another training data set again here?
 - logistic regression
 - they are false negatives. compared to chemistry, it seems weird to have such a high false negative rate (this assumes that all the advisors we do currently not find are actually in the data)
- training
- the features are wrong. – No, they are correct.
- the comparator is wrong. but then why does it work for other fields?
- any reason should ideally also explain why it works for chemistry but not for biology
- How can we fix the algorithm?
- we could relax the feature “same firstname”/“same lastname”, particularly for advisors where the affiliation is a good and precise feature
- in some fields it seems important to have people with first initials.

Here is some python code to look at the learned settings, based on

- <https://github.com/dedupeio/rlr/blob/master/rlr/lr.py> (new dedupe does not use this anymore I think)
- <https://github.com/dedupeio/dedupe/blob/5742efc7fc696c06d3327e038541532e584551a8/dedupe/api.py>

- Note: The predicates are similar for all three fields I looked at. I do not know how the weights correspond to the logit regression coefficients

```
sf_biology = "/mnt/ssd/DedupeFiles/advisors/settings_biology_1985_2022_institutionTrue_fieldofstudy_catFalse_fieldofstudy_cat"
sf_chemistry = "/mnt/ssd/DedupeFiles/advisors/settings_chemistry_1985_2022_institutionTrue_fieldofstudy_catFalse_fieldofstudy_cat"
sf_cs = "/mnt/ssd/DedupeFiles/advisors/settings_computer_science_1985_2022_institutionTrue_fieldofstudy_catFalse_fieldofstudy_cat"

with open(sf_biology, "rb") as sf:
    linker_biology = dedupe.StaticRecordLink(sf)

with open(sf_chemistry, "rb") as sf:
    linker_chemistry = dedupe.StaticRecordLink(sf)

with open(sf_cs, "rb") as sf:
    linker_cs = dedupe.StaticRecordLink(sf)

linker_biology.predicates
linker_chemistry.predicates
linker_cs.predicates

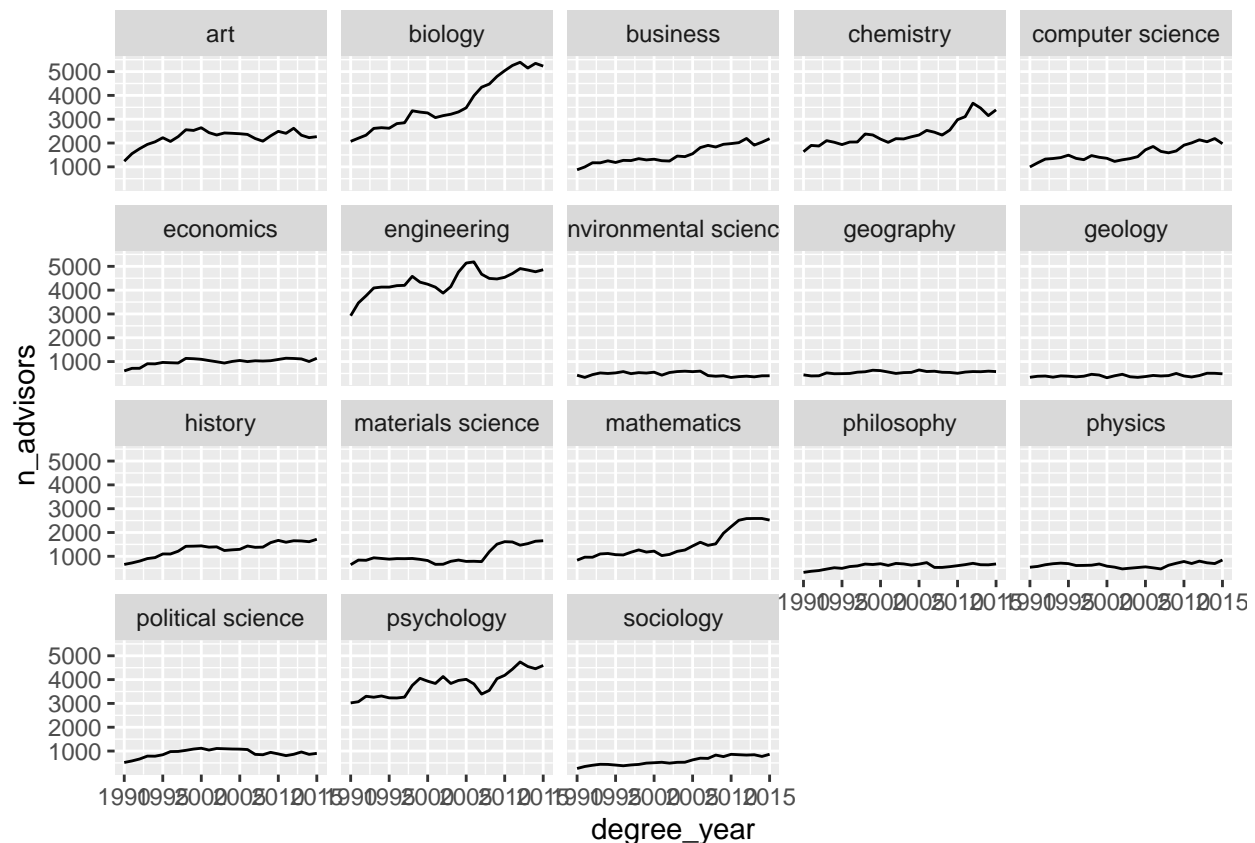
linker_biology.classifier.weights
linker_chemistry.classifier.weights
linker_cs.classifier.weights
```

sf_biology = "/mnt/ssd/DedupeFiles/advisors/settings_biology_1985_2022_institutionTrue_fieldofstudy_catFalse_fieldofstudy_cat"

Number of linked advisors

- not sure this is still relevant?

```
score_by_year %>%
  filter(!is.na(link_score)
         & field %in% keep_fields) %>%
  group_by(degree_year, field) %>%
  summarise(n_advisors = n(),
            .groups = "drop") %>%
  ggplot(aes(x = degree_year, y = n_advisors)) +
  geom_line() +
  facet_wrap(~field)
```



old comments

- for instance, a student of michael j lambert (authorid 2120159045; relationship id 303670971_0 in proquest) from pre-1990 is link score of 0.02, but should be a clear link

Compare number of links across iterations within fields

```
fields_iter_compare <- c("economics", "chemistry")
min_score <- 0.8

keep_iter_ids <- tbl(con, "linking_info_advisors") %>%
  filter(field %in% fields_iter_compare) %>%
  filter(testing == 0) %>%
  collect() %>%
  group_by(field, train_name) %>%
  arrange(iteration_id) %>%
  mutate(nb = n(),
         id = row_number()) %>%
  ungroup() %>%
  filter(id == nb) %>%
  select(iteration_id, field, train_name)

linked_ids_to_compare <- tbl(con, "linked_ids_advisors") %>%
  inner_join(
    tbl(con, "linking_info_advisors") %>%
      filter(field %in% fields_iter_compare),
    by = "iteration_id"
```

```

) %>%
inner_join(
  tbl(con, "pq_advisors") %>%
    select(relationship_id, goid),
  by = "relationship_id"
) %>%
inner_join(
  tbl(con, "pq_authors") %>%
    select(goid, degree_year),
  by = "goid"
) %>%
collect() %>%
filter(iteration_id %in% keep_iter_ids$iteration_id)

```

Number of graduates with at least 1 advisor

```

d_sum <- linked_ids_to_compare %>%
  filter(link_score >= min_score) %>%
  group_by(train_name, field, degree_year) %>%
  summarise(n_advisors = n(),
            n_graduates = n_distinct(goid),
            .groups = "drop") %>%
  pivot_longer(cols = starts_with("n_"), names_to = "variable")

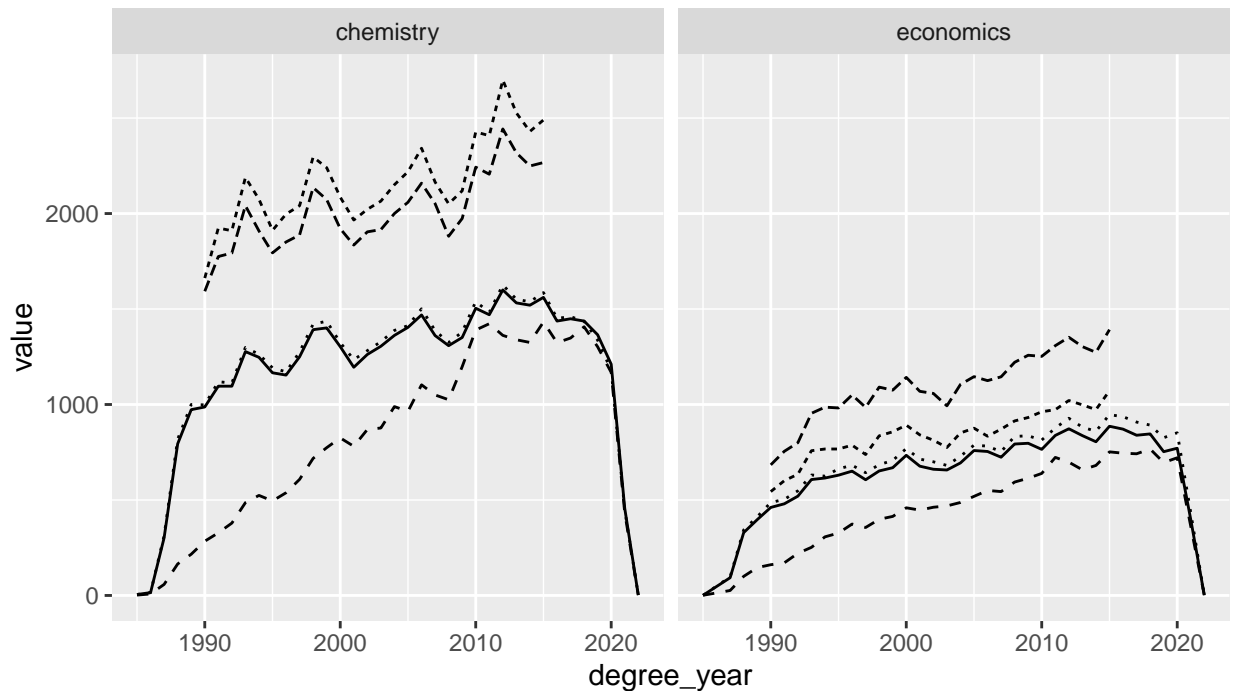
plotvars <- c("n_graduates")

map(.x = plotvars,
  .f = ~d_sum %>%
    filter(variable == .x) %>%
    ggplot(aes(x = degree_year, y = value)) +
    geom_line(aes(linetype = train_name)) +
    facet_wrap(~field) +
    theme(legend.position = "bottom") +
    labs(title = paste0("Count: ", .x))
)

```

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


Count: n_graduates



name — christoph_baseline_update christoph_degree0 --- combined - - flavio_baseline flavio.

Fraction of theses with at least 1 supervisor linked to MAG

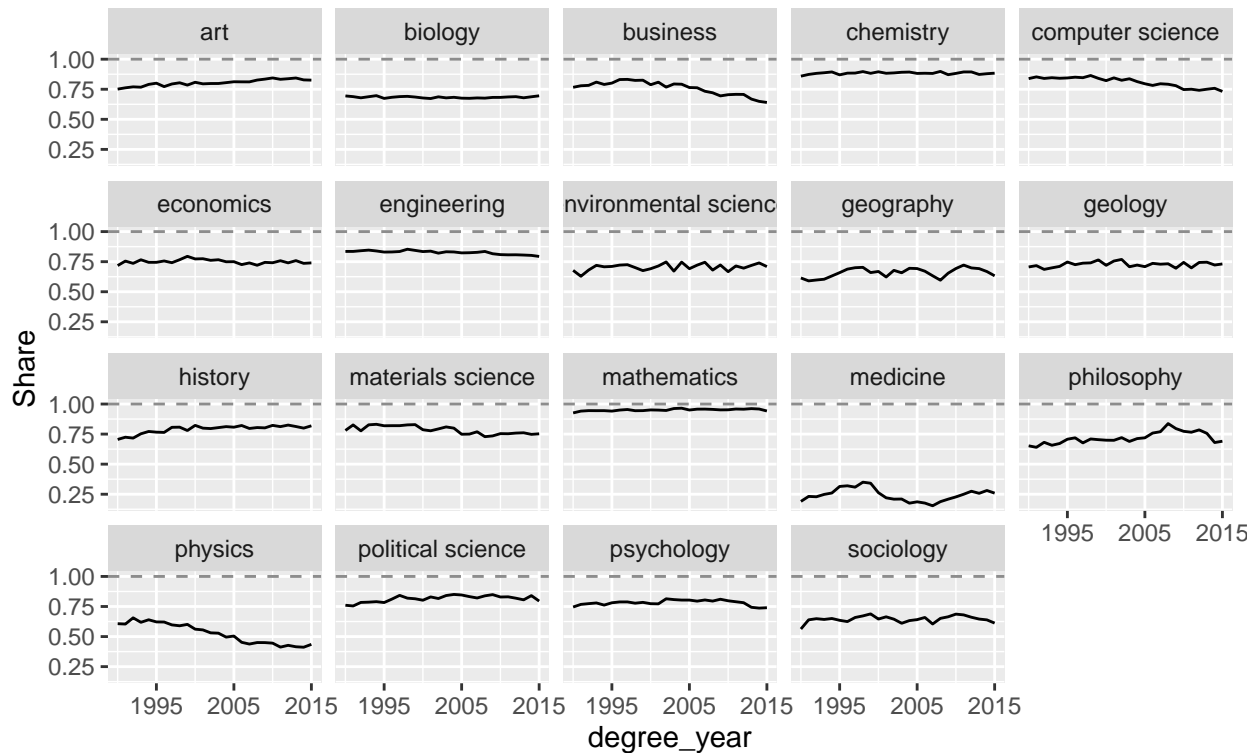
```
s_thesis_advisor_link <- theses %>%
  filter(degree_year %in% 1990:2015) %>%
  left_join(linked_advisors %>%
    filter(link_score > min_score_advisors) %>%
    select(relationship_id) %>%
    mutate(linked = 1),
    by = "relationship_id") %>%
  mutate(linked = ifelse(is.na(linked), 0, linked)) %>%
  group_by(goid) %>%
  mutate(any_link = max(linked)) %>%
  ungroup() %>%
  filter(!duplicated(goid)) %>%
  group_by(degree_year, any_link, fieldname0_mag) %>%
  summarise(n_theses = n(),
    .groups = "drop") %>%
  group_by(degree_year, fieldname0_mag) %>%
  mutate(s = n_theses / sum(n_theses)) %>%
  ungroup() %>%
  filter(any_link == 1)
```

```
## Warning in left_join(., linked_advisors %>% filter(link_score > min_score_advisors) %>% : Each row in
## i Row 1 of `x` matches multiple rows.
## i If multiple matches are expected, set `multiple = "all"` to silence this
## warning.
```

```
s_thesis_advisor_link %>%
  ggplot(aes(x = degree_year, y = s)) +
  geom_line() +
  facet_wrap(~fieldname0_mag) +
  scale_x_continuous(breaks = c(1995, 2005, 2015)) +
  geom_hline(yintercept = 1, color = "grey55", linetype = "dashed") +
  labs(y = "Share", title = "Share of US theses with >=1 supervisor linked to MAG",
       subtitle = "Where >= 1 supervisor reported; by first indicated field0 of thesis.")
```

Share of US theses with >=1 supervisor linked to MAG

Where >= 1 supervisor reported; by first indicated field0 of thesis.



Notes

- Idea: since supervisors tend to be established researchers and publish regularly, we should find a large fraction of supervisors reported in ProQuest in the MAG data.
- The split by field is not exact because the link may have been found using a different reported field0.
- The close to 100% is reassuring of the MAG data quality on affiliations in these fields.
- Fields of concern: physics, sociology, poli science, biology (the level, the break and the trend).

Note: the “usable” links are saved to the db in `src/dataprep/main/link/prep_linked_data.py`

Here is some sql code that I used for checking the cases of the non-linked biology advisors

```
-- 1. they are not in the sample
-- 2. they are not recognized as links: (a) the model is wrong, (b) the data are wrong (ie, dedupe is c
-- the fact that the same entities are not linked even after our improvements suggests perhaps that we
```

```

-- from older checks:
-- john a gerlt: actually registered as "j a gerlt" in MAG (authorid 93129757). dedupe links him to aut.
-- asim dasgupta: authorid 2150423063;

-- authors: 2298396241, 2171354986, 683352831, 1989754750

-- all of them are in biology
select count(distinct authorid)
from author_field0 a
inner join (
    select fieldofstudyid, normalizedname
    from fieldsofstudy
) b on (a.fieldofstudyid_lv10 = b.fieldofstudyid)
where authorid in (2298396241, 2171354986, 683352831, 1989754750)
and a.Degree = 0
and normalizedname = "biology"

-- none of them are in chinese academy of sciences
select count(*)
from author_info_linking
where authorid in (2298396241, 2171354986, 683352831, 1989754750)
and main_us_institutions_career not like "chinese academy of sciences"

-- only two have no missing information on the first field. but is this relevant? -> clearly not, as ot.
SELECT AuthorId, NormalizedName
FROM author_fields c
INNER JOIN (
    SELECT FieldOfStudyId, NormalizedName
    FROM FieldsOfStudy
) AS d USING(FieldOfStudyId)
-- ## Condition on fieldofstudy being in the level 0 id_field
INNER JOIN (
    SELECT ParentFieldOfStudyId, ChildFieldOfStudyId
    FROM crosswalk_fields
    WHERE ParentLevel = 0
    AND ParentFieldOfStudyId IN (86803240)
) AS e ON (e.ChildFieldOfStudyId = c.FieldOfStudyId)
WHERE FieldClass = 'first'
and authorid in (2298396241, 2171354986, 683352831, 1989754750)
limit 10;

-- they all start publishing before 1985
select *
from author_sample
where authorid in (2298396241, 2171354986, 683352831, 1989754750)

```