tidymodels

rsample

recipes

parsnip

TUNE

yardstick

Tidymodels

```r
library(tidymodels)
```

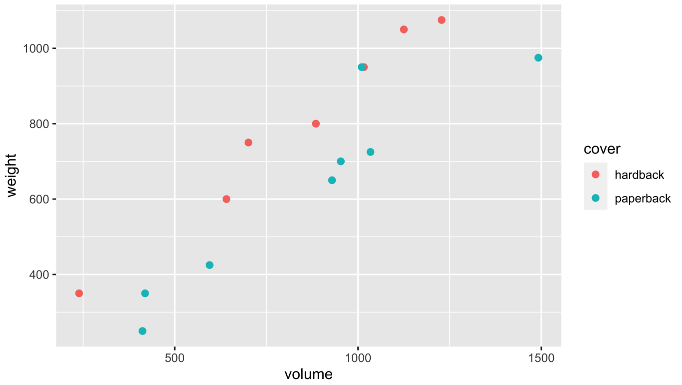
```
## Registered S3 method overwritten by 'tune':
##   method                   from
##   required_pkgs.model_spec parsnip

## ── Attaching packages ────────────────────── tidymodels 0.1.4 ──

## ✓ broom        0.7.10     ✓ rsample      0.1.0
## ✓ dials        0.0.10     ✓ tune         0.1.6
## ✓ infer        1.0.0      ✓ workflows    0.2.4
## ✓ modeldata    0.1.1      ✓ workflowsets 0.1.0
## ✓ parsnip      0.1.7      ✓ yardstick    0.0.8
## ✓ recipes      0.1.17

## ── Conflicts ───────────────────────── tidymodels_conflicts() ──
## x scales::discard()   masks purrr::discard()
## x dplyr::filter()     masks stats::filter()
## x recipes::fixed()    masks stringr::fixed()
## x dplyr::lag()        masks stats::lag()
## x rsample::populate() masks Rcpp::populate()
## x yardstick::spec()   masks readr::spec()
## x recipes::step()     masks stats::step()
## • Dig deeper into tidy modeling with R at https://www.tmwr.org
```

Book data

```r
(books = DAAG::allbacks %>%
  as_tibble() %>%
  select(-area) %>%
  mutate(
    cover = forcats::fct_recode(
      cover,
      "hardback" = "hb",
      "paperback" = "pb"
    )
  )
)
```

```
## # A tibble: 15 × 3
##    volume weight cover
##     <dbl>  <dbl> <fct>
##  1    885    800 hardback
##  2   1016    950 hardback
##  3   1125   1050 hardback
##  4    239    350 hardback
##  5    701    750 hardback
##  6    641    600 hardback
##  7   1228   1075 hardback
##  8    412    250 paperback
```

```r
ggplot(books, aes(x=volume, y=weight, color = cov
  geom_point(size=2)
```



Building a tidymodel

```
linear_reg()
```

```
## Linear Regression Model Specification (regression)
##
## Computational engine: lm
```

Building a tidymodel

```r
linear_reg() %>%
  set_engine("lm")
```

```
## Linear Regression Model Specification (regression)
##
## Computational engine: lm
```

Building a tidymodel

```r
linear_reg() %>%
  set_engine("lm") %>%
  fit(weight ~ volume * cover, data = books)
```

```
## parsnip model object
##
## Fit time:  10ms
##
## Call:
## stats::lm(formula = weight ~ volume * cover, da
##
## Coefficients:
##          (Intercept)                 volume
##            161.58654                0.76159
##        coverpaperback  volume:coverpaperback
##           -120.21407               -0.07573
```

```r
lm(weight ~ volume * cover, data = books)
```

```
##
## Call:
## lm(formula = weight ~ volume * cover, data = books)
##
## Coefficients:
##          (Intercept)                 volume
##            161.58654                0.76159
##        coverpaperback  volume:coverpaperback
##           -120.21407               -0.07573
```

Tidy model objects

```r
summary(lm(weight ~ volume * cover, data = books))
```

```
##
## Call:
## lm(formula = weight ~ volume * cover, data = books)
##
## Residuals:
##     Min      1Q Median      3Q     Max
## -89.67 -32.07 -21.82  17.94 215.91
##
## Coefficients:
##                        Estimate Std. Error t value
## (Intercept)           161.58654   86.51918   1.868
## volume                  0.76159    0.09718   7.837
## coverpaperback       -120.21407  115.65899  -1.039
## volume:coverpaperback  -0.07573    0.12802  -0.592
##                       Pr(>|t|)
## (Intercept)             0.0887 .
## volume                7.94e-06 ***
## coverpaperback          0.3209
## volume:coverpaperback   0.5661
## ---
## Signif. codes:
## 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 80.41 on 11 degrees of freedom
## Multiple R-squared:  0.9297,    Adjusted R-squared:  0.9105
## F-statistic:  48.5 on 3 and 11 DF,  p-value: 1.245e-06
```

```r
lm_tm = linear_reg() %>%
  set_engine("lm") %>%
  fit(weight ~ volume * cover, data = books)
```

```r
summary(lm_tm)
```

```
##         Length Class      Mode
## lvl      0     -none-     NULL
## spec     5     linear_reg list
## fit     13     lm         list
## preproc  1     -none-     list
## elapsed  5     proc_time  numeric
```

```r
broom::tidy(lm_tm)
```

```
## # A tibble: 4 × 5
##   term                  estimate std.error statistic p.value
##   <chr>                    <dbl>     <dbl>     <dbl>   <dbl>
## 1 (Intercept)            1.62e+2   86.5         1.87 8.87e-2
## 2 volume                 7.62e-1    0.0972      7.84 7.94e-6
```

Tidy model statistics

```
broom::glance(lm(weight ~ volume * cover, data = books))
```

```
## # A tibble: 1 × 12
##   r.squared adj.r.squared sigma statistic    p.value    df
##       <dbl>         <dbl> <dbl>     <dbl>      <dbl> <dbl>
## 1     0.930         0.911  80.4      48.5 0.00000124     3
## # … with 6 more variables: logLik <dbl>, AIC <dbl>,
## #   BIC <dbl>, deviance <dbl>, df.residual <int>,
## #   nobs <int>
```

```
broom::glance(lm_tm)
```

```
## # A tibble: 1 × 12
##   r.squared adj.r.squared sigma statistic    p.value    df
##       <dbl>         <dbl> <dbl>     <dbl>      <dbl> <dbl>
## 1     0.930         0.911  80.4      48.5 0.00000124     3
## # … with 6 more variables: logLik <dbl>, AIC <dbl>,
## #   BIC <dbl>, deviance <dbl>, df.residual <int>,
## #   nobs <int>
```

Tidy model prediction

```
broom::augment(lm_tm, new_data = books)
```

```
## # A tibble: 15 × 5
##    volume weight cover      .pred .resid
##     <dbl>  <dbl> <fct>      <dbl>  <dbl>
##  1    885    800 hardback    836. -35.6
##  2   1016    950 hardback    935.  14.6
##  3   1125   1050 hardback   1018.  31.6
##  4    239    350 hardback    344.   6.39
##  5    701    750 hardback    695.  54.5
##  6    641    600 hardback    650. -49.8
##  7   1228   1075 hardback   1097. -21.8
##  8    412    250 paperback   324. -73.9
##  9    953    700 paperback   695.   5.00
## 10    929    650 paperback   679. -28.5
## 11   1492    975 paperback  1065. -89.7
## 12    419    350 paperback   329.  21.3
## 13   1010    950 paperback   734. 216.
## 14    595    425 paperback   449. -24.5
## 15   1034    725 paperback   751. -25.6
```

Putting it together

```
lm_tm %>%
  augment(
    new_data = tidyr::expand_grid(
      volume = seq(0, 1500, by=5),
      cover = c("hardback", "paperback") %>% as.factor()
    )
  ) %>%
  rename(weight = .pred) %>%
  ggplot(aes(x = volume, y = weight, color = cover, group = cover)) +
    geom_line() +
    geom_point(data = books)
```

Why do we care?

```r
show_engines("linear_reg")
```

```
## # A tibble: 5 × 2
##   engine mode      
##   <chr>  <chr>     
## 1 lm     regression
## 2 glmnet regression
## 3 stan   regression
## 4 spark  regression
## 5 keras  regression
```

```r
(bayes_tm = linear_reg() %>%
  set_engine(
    "stan",
    prior_intercept = rstanarm::student_t(df = 1),
    prior = rstanarm::student_t(df = 1),
    seed = 1234
  )
)
```

```
## Linear Regression Model Specification (regression)
## 
## Engine-Specific Arguments:
##   prior_intercept = rstanarm::student_t(df = 1)
##   prior = rstanarm::student_t(df = 1)
##   seed = 1234
## 
## Computational engine: stan
```

Fitting with `rstanarm`

```
(bayes_tm = bayes_tm %>%
  fit(weight ~ volume * cover, data = books)
)
```

```
## Warning: There were 19 divergent transitions after warmup. See
## http://mc-stan.org/misc/warnings.html#divergent-transitions-after-warmup
## to find out why this is a problem and how to eliminate them.
```

```
## Warning: Examine the pairs() plot to diagnose sampling problems
```

```
## parsnip model object
##
## Fit time:  911ms
## stan_glm
##  family:       gaussian [identity]
##  formula:      weight ~ volume * cover
##  observations: 15
##  predictors:   4
## ------
##                        Median MAD_SD
## (Intercept)            98.2   58.8
## volume                  0.8    0.1
## coverpaperback         -0.3    3.5
## volume:coverpaperback  -0.2    0.1
##
## Auxiliary parameter(s):
##       Median MAD_SD
## sigma 84.9   17.8
##
## ------
## * For help interpreting the printed output see ?print.stanreg
```

See `?details_linear_reg_stan` for details within `parsnip`

What was actually run?

```
linear_reg() %>%
  set_engine(
    "stan",
    prior_intercept = rstanarm::student_t(df = 1),
    prior = rstanarm::student_t(df = 1),
    seed = 1234
  ) %>%
  translate()
```

```
## Linear Regression Model Specification (regression)
##
## Engine-Specific Arguments:
##   prior_intercept = rstanarm::student_t(df = 1)
##   prior = rstanarm::student_t(df = 1)
##   seed = 1234
##
## Computational engine: stan
##
## Model fit template:
## rstanarm::stan_glm(formula = missing_arg(), data = missing_arg(),
##     weights = missing_arg(), prior_intercept = rstanarm::student_t(df = 1),
##     prior = rstanarm::student_t(df = 1), seed = 1234, family = stats::gaussian,
##     refresh = 0)
```

Back to broom

```r
broom::tidy(bayes_tm)
```

```
## Error in warn_on_stanreg(x): The supplied model object seems to be outputted from the rstanarm package. Tidi
```

```r
broom.mixed::tidy(bayes_tm)
```

```
## # A tibble: 4 × 3
##   term                 estimate std.error
##   <chr>                   <dbl>     <dbl>
## 1 (Intercept)            98.2     58.8
## 2 volume                  0.829    0.0733
## 3 coverpaperback         -0.285    3.53
## 4 volume:coverpaperback  -0.197    0.0510
```

```r
broom.mixed::glance(bayes_tm)
```

```
## # A tibble: 1 × 4
##   algorithm   pss  nobs sigma
##   <chr>     <dbl> <int> <dbl>
## 1 sampling   4000    15  84.9
```

Augment

```
augment(bayes_tm, new_data=books)
```

```
## # A tibble: 15 × 5
##    volume weight cover     .pred  .resid
##     <dbl>  <dbl> <fct>     <dbl>   <dbl>
##  1    885    800 hardback   829.  -29.2 
##  2   1016    950 hardback   938.   12.3 
##  3   1125   1050 hardback  1028.   22.1 
##  4    239    350 hardback   294.   55.5 
##  5    701    750 hardback   677.   73.1 
##  6    641    600 hardback   627.  -27.3 
##  7   1228   1075 hardback  1113.  -38.2 
##  8    412    250 paperback  355. -105.  
##  9    953    700 paperback  696.    4.16
## 10    929    650 paperback  681.  -30.7 
## 11   1492    975 paperback 1036.  -60.8 
## 12    419    350 paperback  359.   -9.05
## 13   1010    950 paperback  732.  218.  
## 14    595    425 paperback  470.  -45.1 
## 15   1034    725 paperback  747.  -21.9
```

Predictions

```
bayes_tm %>%
  augment(
    new_data = tidyr::expand_grid(
      volume = seq(0, 1500, by=5),
      cover = c("hardback", "paperback") %>% as.factor()
    )
  ) %>%
  rename(weight = .pred) %>%
  ggplot(aes(x = volume, y = weight, color = cover, group = cover)) +
    geom_line() +
    geom_point(data = books)
```

Cross validation and Feature engineering

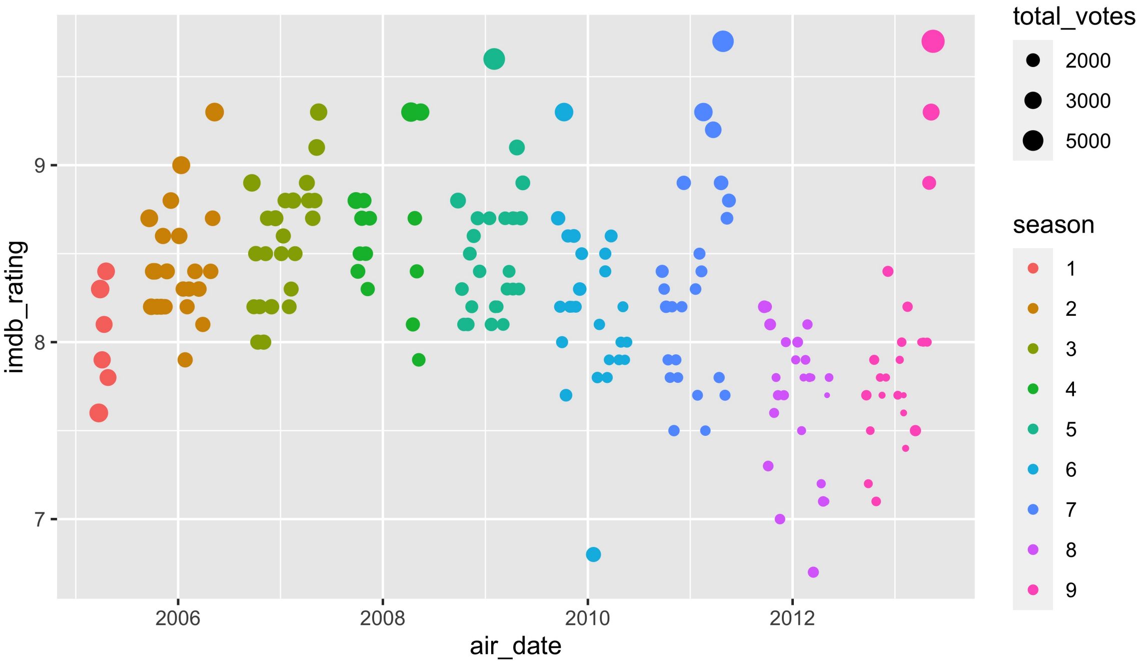
The Office & IMDB

```r
(office_ratings = read_csv("data/office_ratings.csv"))
```

```
## # A tibble: 188 × 6
##    season episode title   imdb_rating total_votes air_date
##     <dbl>   <dbl> <chr>         <dbl>       <dbl> <date>
##  1      1       1 Pilot           7.6        3706 2005-03-24
##  2      1       2 Divers…         8.3        3566 2005-03-29
##  3      1       3 Health…         7.9        2983 2005-04-05
##  4      1       4 The Al…         8.1        2886 2005-04-12
##  5      1       5 Basket…         8.4        3179 2005-04-19
##  6      1       6 Hot Gi…         7.8        2852 2005-04-26
##  7      2       1 The Du…         8.7        3213 2005-09-20
##  8      2       2 Sexual…         8.2        2736 2005-09-27
##  9      2       3 Office…         8.4        2742 2005-10-04
## 10      2       4 The Fi…         8.4        2713 2005-10-11
## # … with 178 more rows
```

These data are from data.world, by way of TidyTuesday.

Rating vs Air Date



Test-train split

```r
set.seed(123)
(office_split = initial_split(office_ratings, pro
```

```
## <Analysis/Assess/Total>
## <150/38/188>
```

```r
(office_train = training(office_split))
```

```
## # A tibble: 150 × 6
##     season episode title   imdb_rating total_vot
##      <dbl>   <dbl> <chr>         <dbl>     <db
##  1       8      18 Last D…         7.8        14
##  2       9      14 Vandal…         7.6        14
##  3       2       8 Perfor…         8.2        24
##  4       9       5 Here C…         7.1        15
##  5       3      22 Beach …         9.1        27
##  6       7       1 Nepoti…         8.4        18
##  7       3      15 Phylli…         8.3        22
##  8       9      21 Livin'…         8.9        20
##  9       9      18 Promos          8          14
```

```r
(office_test = testing(office_split))
```

```
## # A tibble: 38 × 6
##     season episode title   imdb_rating total_votes ai
##      <dbl>   <dbl> <chr>         <dbl>       <dbl> <d
##  1       1       2 Divers…         8.3        3566 20
##  2       2       4 The Fi…         8.4        2713 20
##  3       2       9 E-Mail…         8.4        2527 20
##  4       2      12 The In…         9          3282 20
##  5       2      22 Casino…         9.3        3644 20
##  6       3       5 Initia…         8.2        2254 20
##  7       3      16 Busine…         8.8        2622 20
##  8       3      17 Cockta…         8.5        2264 20
##  9       4       6 Branch…         8.5        2185 20
```

Feature engineering with dplyr

```
office_train %>%
  mutate(
    season = as_factor(season),
    month = lubridate::month(air_date),
    wday = lubridate::wday(air_date),
    top10_votes = as.integer(total_votes > quantile(total_votes, 0.9))
  )
```

```
## # A tibble: 150 × 9
##    season episode title                imdb_rating total_votes air_date   month  wday top10_votes
##    <fct>    <dbl> <chr>                      <dbl>       <dbl> <date>     <dbl> <dbl>       <int>
##  1 8           18 Last Day in Florida          7.8        1429 2012-03-08     3     5           0
##  2 9           14 Vandalism                    7.6        1402 2013-01-31     1     5           0
##  3 2            8 Performance Review           8.2        2416 2005-11-15    11     3           0
##  4 9            5 Here Comes Treble            7.1        1515 2012-10-25    10     5           0
##  5 3           22 Beach Games                  9.1        2783 2007-05-10     5     5           0
##  6 7            1 Nepotism                     8.4        1897 2010-09-23     9     5           0
##  7 3           15 Phyllis' Wedding             8.3        2283 2007-02-08     2     5           0
##  8 9           21 Livin' the Dream             8.9        2041 2013-05-02     5     5           0
##  9 9           18 Promos                       8          1445 2013-04-04     4     5           0
## 10 8           12 Pool Party                   8          1612 2012-01-19     1     5           0
## # … with 140 more rows
```

Better living through recipes

```r
(r = recipe(imdb_rating ~ ., data = office_train)
```

```
## Recipe
##
## Inputs:
##
##       role #variables
##    outcome          1
##  predictor          5
```

```r
summary(r)
```

```
## # A tibble: 6 × 4
##   variable    type    role      source
##   <chr>       <chr>   <chr>     <chr>
## 1 season      numeric predictor original
## 2 episode     numeric predictor original
## 3 title       nominal predictor original
## 4 total_votes numeric predictor original
## 5 air_date    date    predictor original
## 6 imdb_rating numeric outcome   original
```

Recipe roles

```r
(r = recipe(imdb_rating ~ ., data = office_train)
  update_role(title, new_role = "ID")
)
```

```
## Recipe
##
## Inputs:
##
##        role #variables
##          ID          1
##     outcome          1
##   predictor          4
```

```r
summary(r)
```

```
## # A tibble: 6 × 4
##   variable    type    role      source
##   <chr>       <chr>   <chr>     <chr>
## 1 season      numeric predictor original
## 2 episode     numeric predictor original
## 3 title       nominal ID        original
## 4 total_votes numeric predictor original
## 5 air_date    date    predictor original
## 6 imdb_rating numeric outcome   original
```

Adding features (month & day of week)

```r
(r = recipe(imdb_rating ~ ., data = office_train)
  update_role(title, new_role = "ID") %>%
  step_date(air_date, features = c("dow", "month"
)
```

```
## Recipe
##
## Inputs:
##
##       role #variables
##         ID          1
##    outcome          1
##  predictor          4
##
## Operations:
##
## Date features from air_date
```

```r
summary(r)
```

```
## # A tibble: 6 × 4
##   variable    type    role      source
##   <chr>       <chr>   <chr>     <chr>
## 1 season      numeric predictor original
## 2 episode     numeric predictor original
## 3 title       nominal ID        original
## 4 total_votes numeric predictor original
## 5 air_date    date    predictor original
## 6 imdb_rating numeric outcome   original
```

Adding Holidays

```r
(r = recipe(imdb_rating ~ ., data = office_train) %>%
  update_role(title, new_role = "ID") %>%
  step_date(air_date, features = c("dow", "month")) %>%
  step_holiday(
    air_date,
    holidays = c("USThanksgivingDay", "USChristmasDay", "USNewYearsDay", "USIndependenceDay"),
    keep_original_cols = FALSE
  )
)
```

```
## Recipe
##
## Inputs:
##
##       role #variables
##         ID          1
##    outcome          1
##  predictor          4
##
## Operations:
##
## Date features from air_date
## Holiday features from air_date
```

Seasons as factors

```r
(r = recipe(imdb_rating ~ ., data = office_train) %>%
  update_role(title, new_role = "ID") %>%
  step_date(air_date, features = c("dow", "month")) %>%
  step_holiday(
    air_date,
    holidays = c("USThanksgivingDay", "USChristmasDay", "USNewYearsDay", "USIndependenceDay"),
    keep_original_cols = FALSE
  ) %>%
  step_num2factor(season, levels = as.character(1:9))
)
```

```
## Recipe
##
## Inputs:
##
##       role #variables
##         ID          1
##    outcome          1
##  predictor          4
##
## Operations:
##
## Date features from air_date
## Holiday features from air_date
```

Dummy coding

```r
(r = recipe(imdb_rating ~ ., data = office_train) %>%
  update_role(title, new_role = "ID") %>%
  step_date(air_date, features = c("dow", "month")) %>%
  step_holiday(
    air_date,
    holidays = c("USThanksgivingDay", "USChristmasDay", "USNewYearsDay", "USIndependenceDay"),
    keep_original_cols = FALSE
  ) %>%
  step_num2factor(season, levels = as.character(1:9)) %>%
  step_dummy(all_nominal_predictors())
)
```

```
## Recipe
##
## Inputs:
##
##       role #variables
##         ID          1
##    outcome          1
##  predictor          4
##
## Operations:
##
## Date features from air_date
```

Why no `top10_votes`?

There does not appear to be a `step_*()` function that implements the quantile calculation necessary for the `top10_votes` feature above, custom recipe steps can be created see this for an relevant example.

Preparing a recipe

```r
prep(r)
```

```
## Recipe
##
## Inputs:
##
##       role #variables
##         ID          1
##    outcome          1
##  predictor          4
##
## Training data contained 150 data points and no missing data.
##
## Operations:
##
## Date features from air_date [trained]
## Holiday features from air_date [trained]
## Factor variables from season [trained]
## Dummy variables from season, air_date_dow, air_date_month [trained]
```

Baking a recipe

```
prep(r) %>%
  bake(new_data = office_train)
```

```
## # A tibble: 150 × 33
##    episode title     total_votes imdb_rating air_date_USThanksg… air_date_USChris… air_date_USNewYe…
##      <dbl> <fct>           <dbl>       <dbl>               <dbl>             <dbl>             <dbl>
##  1      18 Last Day…        1429         7.8                   0                 0                 0
##  2      14 Vandalism        1402         7.6                   0                 0                 0
##  3       8 Performa…        2416         8.2                   0                 0                 0
##  4       5 Here Com…        1515         7.1                   0                 0                 0
##  5      22 Beach Ga…        2783         9.1                   0                 0                 0
##  6       1 Nepotism         1897         8.4                   0                 0                 0
##  7      15 Phyllis'…        2283         8.3                   0                 0                 0
##  8      21 Livin' t…        2041         8.9                   0                 0                 0
##  9      18 Promos           1445         8                     0                 0                 0
## 10      12 Pool Par…        1612         8                     0                 0                 0
## # … with 140 more rows, and 26 more variables: air_date_USIndependenceDay <dbl>, season_X2 <dbl>,
## #   season_X3 <dbl>, season_X4 <dbl>, season_X5 <dbl>, season_X6 <dbl>, season_X7 <dbl>,
## #   season_X8 <dbl>, season_X9 <dbl>, air_date_dow_Mon <dbl>, air_date_dow_Tue <dbl>,
## #   air_date_dow_Wed <dbl>, air_date_dow_Thu <dbl>, air_date_dow_Fri <dbl>, air_date_dow_Sat <dbl>,
## #   air_date_month_Feb <dbl>, air_date_month_Mar <dbl>, air_date_month_Apr <dbl>,
## #   air_date_month_May <dbl>, air_date_month_Jun <dbl>, air_date_month_Jul <dbl>,
## #   air_date_month_Aug <dbl>, air_date_month_Sep <dbl>, air_date_month_Oct <dbl>, …
```

Informative features?

```
prep(r) %>%
  bake(new_data = office_train) %>%
  map_int(~ length(unique(.x)))
```

```
##                  episode                         title                 total_votes
##                       26                           150                         142
##              imdb_rating air_date_USThanksgivingDay     air_date_USChristmasDay
##                       26                             1                           1
##      air_date_USNewYearsDay air_date_USIndependenceDay                  season_X2
##                        1                             1                           2
##                season_X3                     season_X4                   season_X5
##                        2                             2                           2
##                season_X6                     season_X7                   season_X8
##                        2                             2                           2
##                season_X9               air_date_dow_Mon            air_date_dow_Tue
##                        2                             1                           2
##         air_date_dow_Wed               air_date_dow_Thu            air_date_dow_Fri
##                        1                             2                           1
##         air_date_dow_Sat             air_date_month_Feb          air_date_month_Mar
##                        1                             2                           2
##       air_date_month_Apr             air_date_month_May          air_date_month_Jun
##                        2                             2                           1
##       air_date_month_Jul             air_date_month_Aug          air_date_month_Sep
##                        1                             1                           2
```

Removing zero variance predictors

```r
r = recipe(imdb_rating ~ ., data = office_train) %>%
  update_role(title, new_role = "ID") %>%
  step_date(air_date, features = c("dow", "month")) %>%
  step_holiday(
    air_date,
    holidays = c("USThanksgivingDay", "USChristmasDay", "USNewYearsDay", "USIndependenceDay"),
    keep_original_cols = FALSE
  ) %>%
  step_num2factor(season, levels = as.character(1:9)) %>%
  step_dummy(all_nominal_predictors()) %>%
  step_zv(all_predictors())

prep(r) %>%
  bake(new_data = office_train)
```

```
## # A tibble: 150 × 22
##    episode title total_votes imdb_rating season_X2 season_X3 season_X4 season_X5 season_X6 season_X7
##      <dbl> <fct>       <dbl>       <dbl>     <dbl>     <dbl>     <dbl>     <dbl>     <dbl>     <dbl>
##  1      18 Last…        1429         7.8         0         0         0         0         0         0
##  2      14 Vand…        1402         7.6         0         0         0         0         0         0
##  3       8 Perf…        2416         8.2         1         0         0         0         0         0
##  4       5 Here…        1515         7.1         0         0         0         0         0         0
##  5      22 Beac…        2783         9.1         0         1         0         0         0         0
##  6       1 Nepo…        1897         8.4         0         0         0         0         0         1
##  7      15 Phyl…        2283         8.3         0         1         0         0         0         0
##  8      21 Livi…        2041         8.9         0         0         0         0         0         0
##  9      18 Prom…        1445         8           0         0         0         0         0         0
## 10      12 Pool…        1612         8           0         0         0         0         0         0
## # … with 140 more rows, and 12 more variables: season_X8 <dbl>, season_X9 <dbl>,
## #   air_date_dow_Tue <dbl>, air_date_dow_Thu <dbl>, air_date_month_Feb <dbl>,
```

Really putting it all together

```
(office_work = workflow() %>%
  add_recipe(r) %>%
  add_model(
    linear_reg() %>%
    set_engine("lm")
  )
)
```

```
## ══ Workflow ════════════════════════════════
## Preprocessor: Recipe
## Model: linear_reg()
##
## ── Preprocessor ────────────────────────────
## 5 Recipe Steps
##
## • step_date()
## • step_holiday()
## • step_num2factor()
## • step_dummy()
## • step_zv()
##
## ── Model ───────────────────────────────────
## Linear Regression Model Specification (regressi
```

Workflow fit

```
(office_fit = office_work %>%
  fit(data = office_train))
```

```
## ══ Workflow [trained] ══════════════════════════════════════════════════════════
## Preprocessor: Recipe
## Model: linear_reg()
##
## ── Preprocessor ────────────────────────────────────────────────────────────────
## 5 Recipe Steps
##
## • step_date()
## • step_holiday()
## • step_num2factor()
## • step_dummy()
## • step_zv()
##
## ── Model ───────────────────────────────────────────────────────────────────────
##
## Call:
## stats::lm(formula = ..y ~ ., data = data)
##
## Coefficients:
##        (Intercept)             episode         total_votes           season_X2           season_X3
##          6.2557856          -0.0081872           0.0003838           0.8389817           1.1277917
##          season_X4           season_X5           season_X6           season_X7           season_X8
##          1.1519446           1.1767757           1.0899544           1.0671645           0.5024513
##          season_X9     air_date_dow_Tue    air_date_dow_Thu  air_date_month_Feb  air_date_month_Mar
##          0.6981099           0.4945405           0.3699592          -0.0089843          -0.0194673
## air_date_month_Apr  air_date_month_May  air_date_month_Sep  air_date_month_Oct  air_date_month_Nov
##          0.0895888           0.2105803          -0.0776988          -0.2059183          -0.1895729
```

Performance

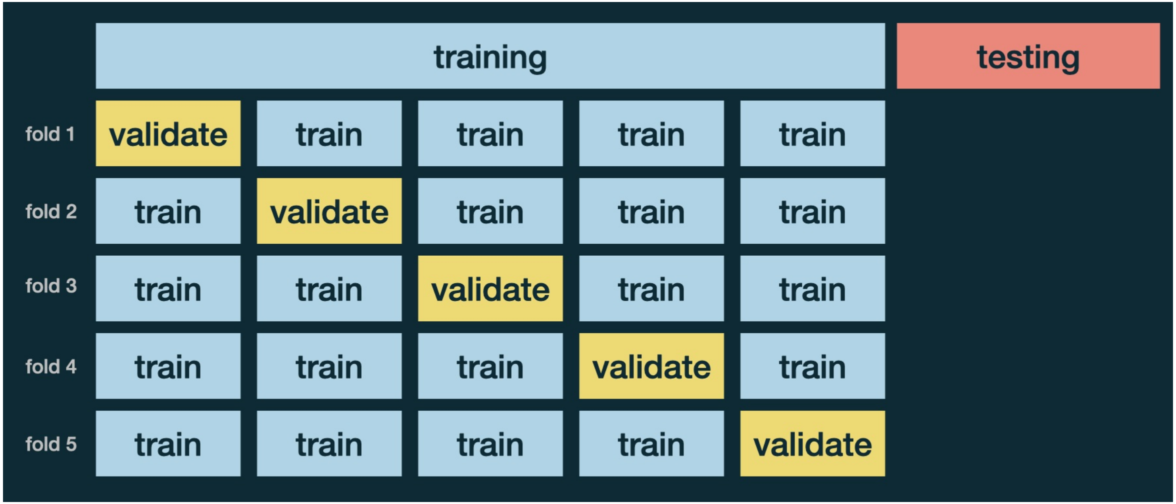
```r
office_fit %>%
  augment(office_train) %>%
  rmse(imdb_rating, .pred)
```

```
## # A tibble: 1 × 3
##   .metric .estimator .estimate
##   <chr>   <chr>          <dbl>
## 1 rmse    standard       0.305
```

```r
office_fit %>%
  augment(office_test) %>%
  rmse(imdb_rating, .pred)
```

```
## # A tibble: 1 × 3
##   .metric .estimator .estimate
##   <chr>   <chr>          <dbl>
## 1 rmse    standard       0.423
```

k-fold cross validation



Creating folds

```
set.seed(123)
(folds = vfold_cv(office_train, v=5))
```

```
## #  5-fold cross-validation
## # A tibble: 5 × 2
##   splits            id
##   <list>            <chr>
## 1 <split [120/30]> Fold1
## 2 <split [120/30]> Fold2
## 3 <split [120/30]> Fold3
## 4 <split [120/30]> Fold4
## 5 <split [120/30]> Fold5
```

```
(office_fit_folds = office_work %>%
  fit_resamples(folds)
)
```

```
## ! Fold2: preprocessor 1/1, model 1/1 (predictions): prediction from a rank-deficient fit may be misle...
```

```
## Warning: This tuning result has notes. Example notes on model fitting include:
## preprocessor 1/1, model 1/1 (predictions): prediction from a rank-deficient fit may be misleading
```

```
## # Resampling results
## # 5-fold cross-validation
```

Fold performance

```r
tune::collect_metrics(office_fit_folds)
```

```
## # A tibble: 2 × 6
##   .metric .estimator  mean     n std_err .config
##   <chr>   <chr>      <dbl> <int>   <dbl> <chr>
## 1 rmse    standard   0.421     5  0.0511 Preprocessor1_Model1
## 2 rsq     standard   0.550     5  0.0663 Preprocessor1_Model1
```

```r
tune::collect_metrics(office_fit_folds, summarize = FALSE) %>%
  filter(.metric == "rmse")
```

```
## # A tibble: 5 × 5
##   id    .metric .estimator .estimate .config
##   <chr> <chr>   <chr>          <dbl> <chr>
## 1 Fold1 rmse    standard       0.618 Preprocessor1_Model1
## 2 Fold2 rmse    standard       0.382 Preprocessor1_Model1
## 3 Fold3 rmse    standard       0.321 Preprocessor1_Model1
## 4 Fold4 rmse    standard       0.410 Preprocessor1_Model1
## 5 Fold5 rmse    standard       0.377 Preprocessor1_Model1
```

More on the `tune` package next time