cbbdata

```r
# persistent log-in
cbbdata::cbd_login()
```

```
API Key set!
```

```r
library(cbbdata)
library(tidyverse)
library(tidymodels)
library(caret)
```

```r
duke_data <- cbd_torvik_game_factors() %>%
  filter(team == 'Duke')
```

```r
duke_unc_game <- cbd_torvik_season_prediction('Duke',2024) %>%
  filter(opp == 'North Carolina', game_location == 'A')
duke_unc_game
```

```
        date team            opp game_location    tempo      ppp  pts  win_per
1 2024-02-03 Duke North Carolina             A 71.05691 1.037392 73.7 22.89543
  did_win simulate_date year
1   FALSE    2024-02-03 2024
```

```r
unc_duke_game <- cbd_torvik_season_prediction('North Carolina',2024) %>%
  filter(opp == 'Duke', game_location == 'H')
unc_duke_game
```

```
        date           team  opp game_location    tempo      ppp  pts  win_per
1 2024-02-03 North Carolina Duke             H 71.05691 1.152916 81.9 77.10457
  did_win simulate_date year
1    TRUE    2024-02-03 2024
```

```
#result <- rbinom(100, 1, 0.2346)
#hist(result)
```

```
home_games <- list("20150218","20160305","20170209","20180303","20190220","20200307","2021
away_games <- list("20150307","20160217","20170304","20180208","20190309","20200208","2021
home_predictions <- cbd_torvik_game_prediction('Duke','North Carolina', "20150218")
for (x in home_games){
  this_pred = cbd_torvik_game_prediction('Duke','North Carolina', x)
  home_predictions = full_join(home_predictions, this_pred)
}
```

```
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
```

```
away_predictions <- cbd_torvik_game_prediction('North Carolina', 'Duke', "20150307")
for (x in away_games){
  this_pred = cbd_torvik_game_prediction('North Carolina','Duke', x)
  away_predictions = full_join(away_predictions, this_pred)
}
```

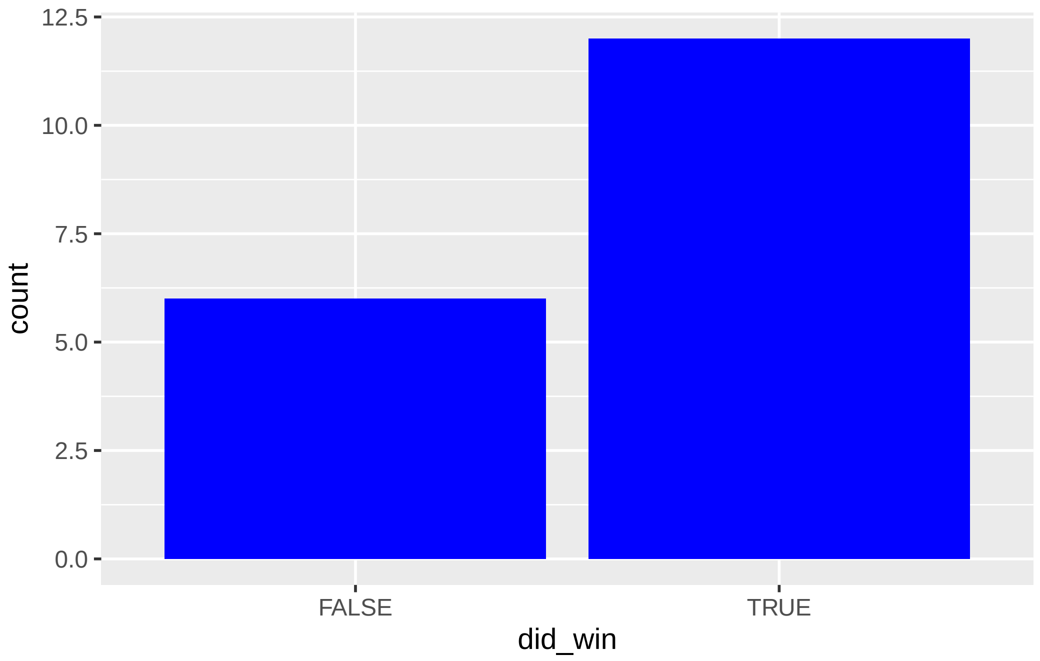
```
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
```

```r
full_predictions <- full_join(home_predictions, away_predictions)
```

```
Joining with `by = join_by(team, date, location, tempo, ppp, pts, win_per,
did_win)`
```

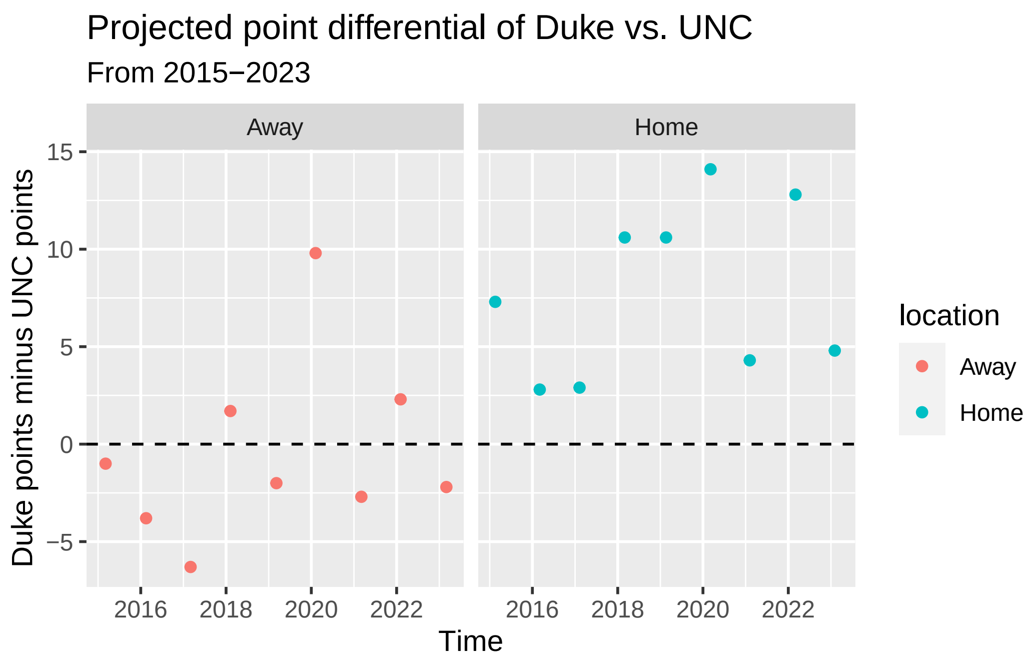
```r
full_predictions %>%
  filter(team == 'Duke') %>%
  ggplot(aes(x = did_win)) +
  geom_histogram(stat = "count", fill = "Blue")
```

```
Warning in geom_histogram(stat = "count", fill = "Blue"): Ignoring unknown
parameters: `binwidth`, `bins`, and `pad`
```

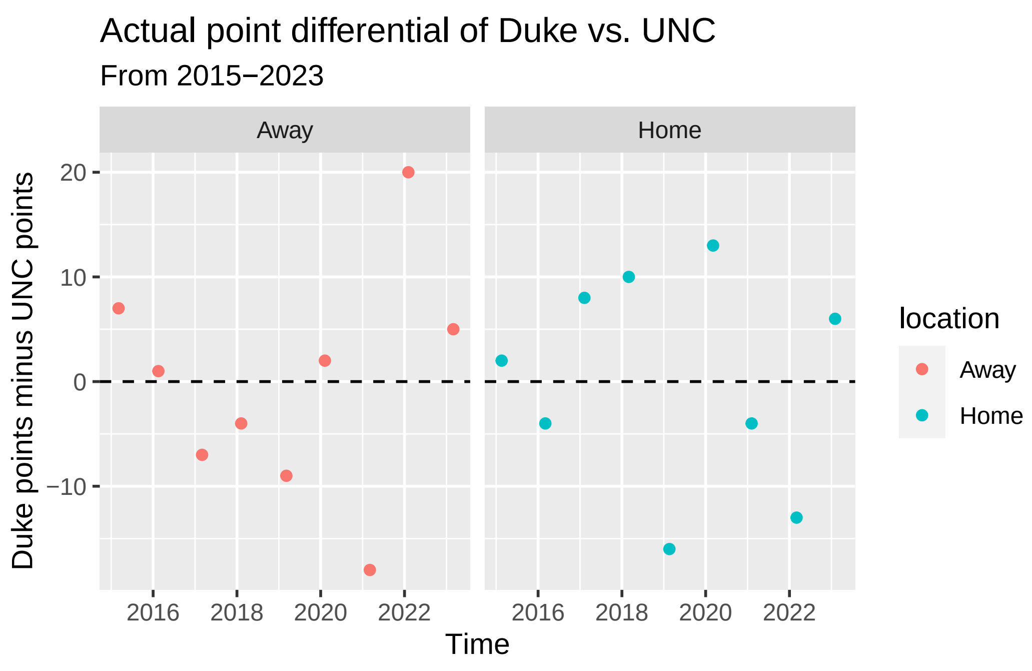


```
date <- c("02/17/2015","03/06/2015","02/16/2016","03/04/2016","02/08/2017","03/03/2017","0
date <- as.Date(date, format = "%m/%d/%Y")
winner <- c("Duke","Duke","Duke","North Carolina","Duke","North Carolina","North Carolina"
diff <- c(2,7,1,-4,8,-7,-4,10,-16,-9,2,13,-4,-18,20,-13,6,5)
duke_home <- c("Home","Away","Away","Home","Home","Away","Away","Home","Home","Away","Away
real_results <- data.frame(date,winner,diff,duke_home)
```

```
full_predictions <- full_predictions %>%
  mutate(duke_home = case_when(team == "Duke" & location == "H"  ~ "Home",
                               team == "North Carolina" & location == "A" ~ "Home",
                               TRUE ~ "Away"),
         duke_pts = if_else(team == "Duke", pts, 0),
         unc_pts = if_else(team == "North Carolina",pts,0))

full_predictions <- full_predictions %>%
  group_by(date) %>%
  mutate(diff = max(duke_pts) - max(unc_pts))


full_predictions %>%
  filter(team == "Duke") %>%
  ggplot(aes(x = date, y = diff, color = duke_home)) +
  geom_point() +
  geom_hline(yintercept =  0, linetype = 2) +
  facet_wrap(~ duke_home) +
  labs(title = "Projected point differential of Duke vs. UNC",
       subtitle = "From 2015-2023",
       y = "Duke points minus UNC points",
       x = "Time",
       color = "location")
```



```
real_results %>%
  ggplot(aes(x = date, y = diff, color = duke_home)) +
  geom_point() +
  geom_hline(yintercept =  0, linetype = 2) +
  facet_wrap(~ duke_home) +
  labs(title = "Actual point differential of Duke vs. UNC",
       subtitle = "From 2015-2023",
       y = "Duke points minus UNC points",
       x = "Time",
       color = "location")
```



```
acc_2023 <- full_join(cbd_torvik_season_prediction("Duke", 2023,"20230101"),duke_data, by
  select(-location, -avg_marg) %>%
  filter(! is.na(pts_scored), opp_conf == "ACC", !is.na(team.x))

acc_2022 <- full_join(cbd_torvik_season_prediction("Duke", 2022,"20220101"),duke_data, by
  select(-location, -avg_marg) %>%
  filter(! is.na(pts_scored), opp_conf == "ACC", !is.na(team.x))

test <- full_join(acc_2023,acc_2022)
```

```
Joining with `by = join_by(date, team.x, opp.x, game_location, tempo.x, ppp,
pts, win_per, did_win, simulate_date, year.x, type, team.y, conf, opp.y,
opp_conf, loc, result, pts_scored, pts_allowed, adj_o, adj_d, off_ppp, off_efg,
off_to, off_or, off_ftr, def_ppp, def_efg, def_to, def_or, def_ftr, game_score,
season, tempo.y, game_id, coach, opp_coach, year.y)`
```

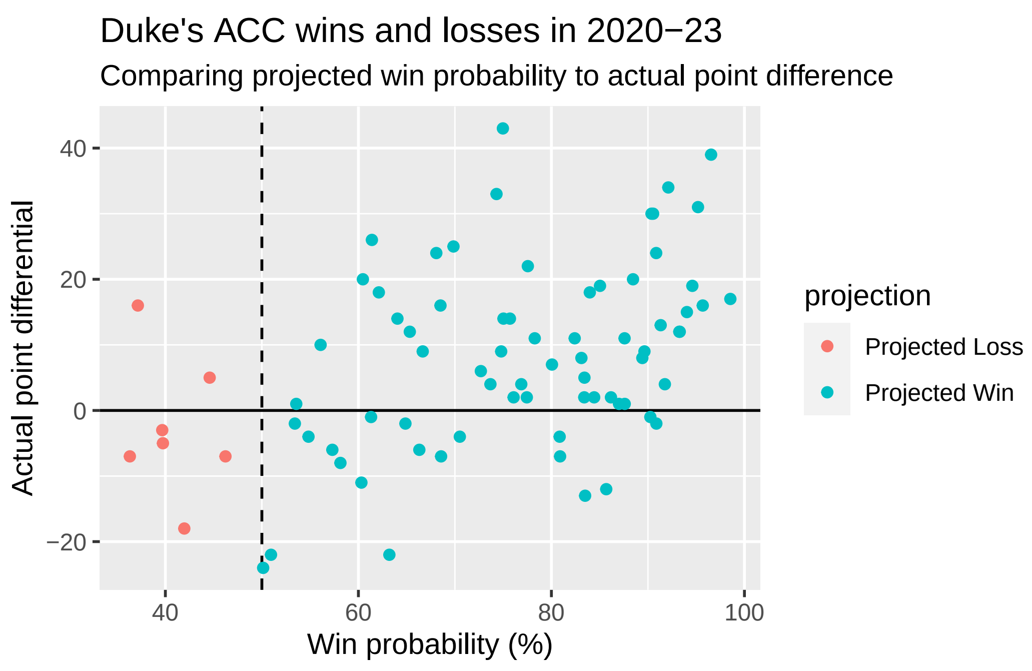
```
acc_2021 <- full_join(cbd_torvik_season_prediction("Duke", 2021,"20210101"),duke_data, by
  select(-location, -avg_marg) %>%
  filter(! is.na(pts_scored), opp_conf == "ACC", !is.na(team.x))

test <- full_join(test,acc_2021)
```

```
Joining with `by = join_by(date, team.x, opp.x, game_location, tempo.x, ppp,
pts, win_per, did_win, simulate_date, year.x, type, team.y, conf, opp.y,
opp_conf, loc, result, pts_scored, pts_allowed, adj_o, adj_d, off_ppp, off_efg,
off_to, off_or, off_ftr, def_ppp, def_efg, def_to, def_or, def_ftr, game_score,
season, tempo.y, game_id, coach, opp_coach, year.y)`
```

```
acc_2020 <- full_join(cbd_torvik_season_prediction("Duke", 2020,"20200101"),duke_data, by
  select(-location, -avg_marg) %>%
  filter(! is.na(pts_scored), opp_conf == "ACC", !is.na(team.x))

test <- full_join(test,acc_2020)
```

```
Joining with `by = join_by(date, team.x, opp.x, game_location, tempo.x, ppp,
pts, win_per, did_win, simulate_date, year.x, type, team.y, conf, opp.y,
opp_conf, loc, result, pts_scored, pts_allowed, adj_o, adj_d, off_ppp, off_efg,
off_to, off_or, off_ftr, def_ppp, def_efg, def_to, def_or, def_ftr, game_score,
season, tempo.y, game_id, coach, opp_coach, year.y)`
```

```
test <- test %>%
  mutate(diff = pts_scored - pts_allowed,
         projection = case_when(win_per > 50  ~ "Projected Win",
                  win_per <50 ~ "Projected Loss",
                   TRUE ~ "Too close to call")) %>%
  filter(!is.na(win_per))

test %>%
  ggplot(aes(x = win_per, y = diff, color = projection)) +
  geom_hline(yintercept =  0, linetype = 1) +
  geom_vline(xintercept = 50, linetype = 2) +
  geom_point() +
  #geom_rect(xmin = 45, xmax = 55, ymin = -1000, ymax = 1000, alpha = 0, color = "White",l
  labs(title = "Duke's ACC wins and losses in 2020-23",
       subtitle = "Comparing projected win probability to actual point difference",
       x = "Win probability (%)",
       y = "Actual point differential")
```



```
unc_data <- cbd_torvik_game_factors() %>%
  filter(team == 'North Carolina')

acc_2023_unc <- full_join(cbd_torvik_season_prediction("North Carolina", 2023, date = "202
  select(-location, -avg_marg) %>%
  filter(! is.na(pts_scored), opp_conf == "ACC", !is.na(team.x))

acc_2022_unc <- full_join(cbd_torvik_season_prediction("North Carolina", 2022, "20220101")
  select(-location, -avg_marg) %>%
  filter(! is.na(pts_scored), opp_conf == "ACC", !is.na(team.x))

test_unc <- full_join(acc_2023_unc,acc_2022_unc)
```

```
Joining with `by = join_by(date, team.x, opp.x, game_location, tempo.x, ppp,
pts, win_per, did_win, simulate_date, year.x, type, team.y, conf, opp.y,
opp_conf, loc, result, pts_scored, pts_allowed, adj_o, adj_d, off_ppp, off_efg,
off_to, off_or, off_ftr, def_ppp, def_efg, def_to, def_or, def_ftr, game_score,
season, tempo.y, game_id, coach, opp_coach, year.y)`
```

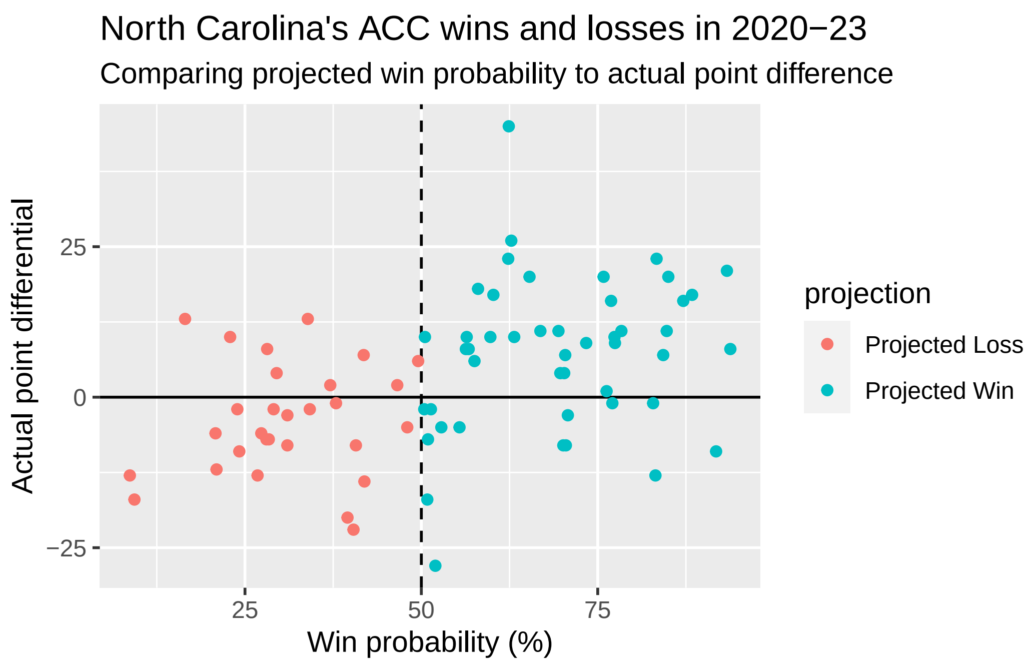
```r
acc_2021_unc <- full_join(cbd_torvik_season_prediction("North Carolina", 2021, "20210101")
  select(-location, -avg_marg) %>%
  filter(! is.na(pts_scored), opp_conf == "ACC", !is.na(team.x))

test_unc <- full_join(test_unc,acc_2021_unc)
```

```
Joining with `by = join_by(date, team.x, opp.x, game_location, tempo.x, ppp,
pts, win_per, did_win, simulate_date, year.x, type, team.y, conf, opp.y,
opp_conf, loc, result, pts_scored, pts_allowed, adj_o, adj_d, off_ppp, off_efg,
off_to, off_or, off_ftr, def_ppp, def_efg, def_to, def_or, def_ftr, game_score,
season, tempo.y, game_id, coach, opp_coach, year.y)`
```

```r
acc_2020_unc <- full_join(cbd_torvik_season_prediction("North Carolina", 2020, "20200101")
  select(-location, -avg_marg) %>%
  filter(! is.na(pts_scored), opp_conf == "ACC", !is.na(team.x))

test_unc <- full_join(test_unc,acc_2020_unc)
```

```
Joining with `by = join_by(date, team.x, opp.x, game_location, tempo.x, ppp,
pts, win_per, did_win, simulate_date, year.x, type, team.y, conf, opp.y,
opp_conf, loc, result, pts_scored, pts_allowed, adj_o, adj_d, off_ppp, off_efg,
off_to, off_or, off_ftr, def_ppp, def_efg, def_to, def_or, def_ftr, game_score,
season, tempo.y, game_id, coach, opp_coach, year.y)`
```

```r
test_unc <- test_unc %>%
  mutate(diff = pts_scored - pts_allowed,
         projection = case_when(win_per > 50  ~ "Projected Win",
                  win_per <50 ~ "Projected Loss",
                   TRUE ~ "Too close to call")) %>%
  filter(!is.na(win_per), team.x == "North Carolina")

test_unc %>%
  ggplot(aes(x = win_per, y = diff, color = projection)) +
  #facet_wrap(~year.y) +
  geom_hline(yintercept =  0, linetype = 1) +
  geom_vline(xintercept = 50, linetype = 2) +
  geom_point() +
  #geom_rect(xmin = 45, xmax = 55, ymin = -1000, ymax = 1000, alpha = 0, color = "White",l
  labs(title = "North Carolina's ACC wins and losses in 2020-23",
       subtitle = "Comparing projected win probability to actual point difference",
       x = "Win probability (%)",
       y = "Actual point differential")
```



```
#library(caret)

conf_mat_data <- test %>%
  #filter(projection != "Too close to call") %>%
  mutate(projection_bin = fct_relevel(as.factor(if_else(projection == "Projected Win", 1,
         result_bin = fct_relevel(as.factor(if_else(result == "W", 1, 0))),"1")
conf_matrix <- confusionMatrix(data=conf_mat_data$projection_bin, reference = conf_mat_dat
```

```
Warning in confusionMatrix.default(data = conf_mat_data$projection_bin, :
Levels are not in the same order for reference and data. Refactoring data to
match.
```

```
conf_matrix
```

```
Confusion Matrix and Statistics
```

```
          Reference
Prediction  0  1
         0  5  2
         1 19 52

               Accuracy : 0.7308
                 95% CI : (0.6184, 0.825)
    No Information Rate : 0.6923
    P-Value [Acc > NIR] : 0.2732702

                  Kappa : 0.2133

 Mcnemar's Test P-Value : 0.0004803

            Sensitivity : 0.9630
            Specificity : 0.2083
         Pos Pred Value : 0.7324
         Neg Pred Value : 0.7143
             Prevalence : 0.6923
         Detection Rate : 0.6667
   Detection Prevalence : 0.9103
      Balanced Accuracy : 0.5856

       'Positive' Class : 1
```

```r
conf_mat_data_unc <- test_unc %>%
  filter(projection != "Too close to call") %>%
  mutate(projection_bin = fct_relevel(as.factor(if_else(projection == "Projected Win", 1,
         result_bin = fct_relevel(as.factor(if_else(result == "W", 1, 0))),"1")
conf_matrix_unc <- confusionMatrix(data=conf_mat_data_unc$projection_bin, reference = conf
```

```
Warning in confusionMatrix.default(data = conf_mat_data_unc$projection_bin, :
Levels are not in the same order for reference and data. Refactoring data to
match.
```

```r
conf_matrix_unc
```

```
Confusion Matrix and Statistics
```

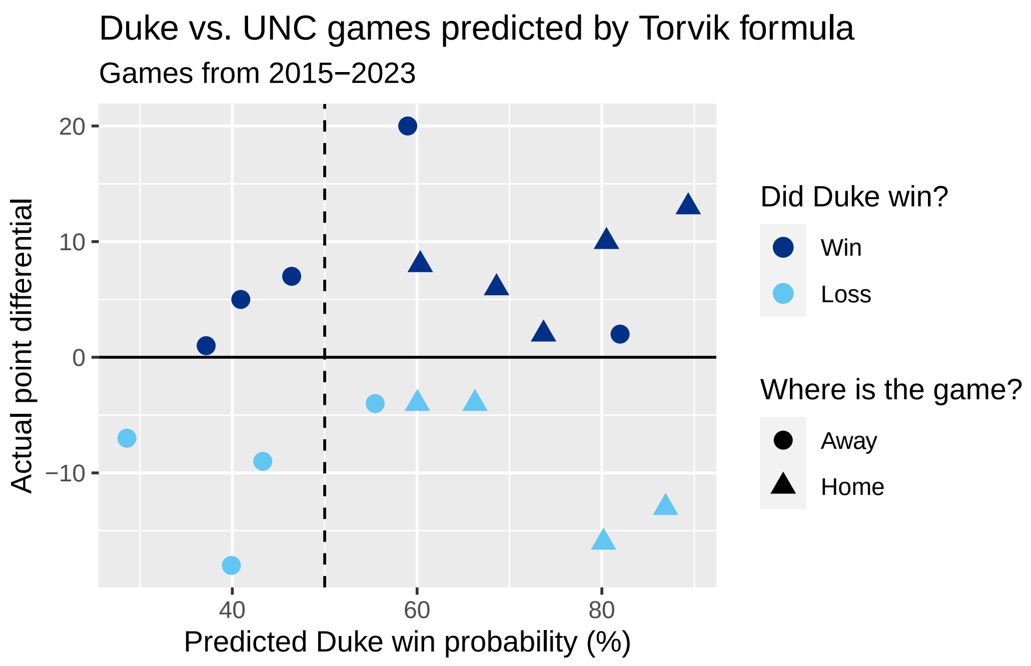
```
          Reference
Prediction  0  1
         0 20  9
         1 14 33

               Accuracy : 0.6974
                 95% CI : (0.5813, 0.7975)
    No Information Rate : 0.5526
    P-Value [Acc > NIR] : 0.007009

                  Kappa : 0.3793

 Mcnemar's Test P-Value : 0.404248

            Sensitivity : 0.7857
            Specificity : 0.5882
         Pos Pred Value : 0.7021
         Neg Pred Value : 0.6897
             Prevalence : 0.5526
         Detection Rate : 0.4342
   Detection Prevalence : 0.6184
      Balanced Accuracy : 0.6870

       'Positive' Class : 1
```

```
real_results <- real_results %>%
  mutate(bin_win = as.factor(if_else(diff > 0, 1,0)))

full_predictions <- full_predictions %>%
  mutate(bin_win = as.factor(if_else(diff > 0, 1,0)))

filtered_predictions <- full_predictions %>%
  filter(team == "Duke")

confusionMatrix(data=filtered_predictions$bin_win, reference = real_results$bin_win, posit
```

```
Warning in confusionMatrix.default(data = filtered_predictions$bin_win, :
Levels are not in the same order for reference and data. Refactoring data to
match.
```

```
Confusion Matrix and Statistics

          Reference
Prediction 0 1
         0 3 3
         1 5 7

               Accuracy : 0.5556
                 95% CI : (0.3076, 0.7847)
    No Information Rate : 0.5556
    P-Value [Acc > NIR] : 0.5966

                  Kappa : 0.0769

 Mcnemar's Test P-Value : 0.7237

            Sensitivity : 0.7000
            Specificity : 0.3750
         Pos Pred Value : 0.5833
         Neg Pred Value : 0.5000
             Prevalence : 0.5556
         Detection Rate : 0.3889
   Detection Prevalence : 0.6667
      Balanced Accuracy : 0.5375

       'Positive' Class : 1
```

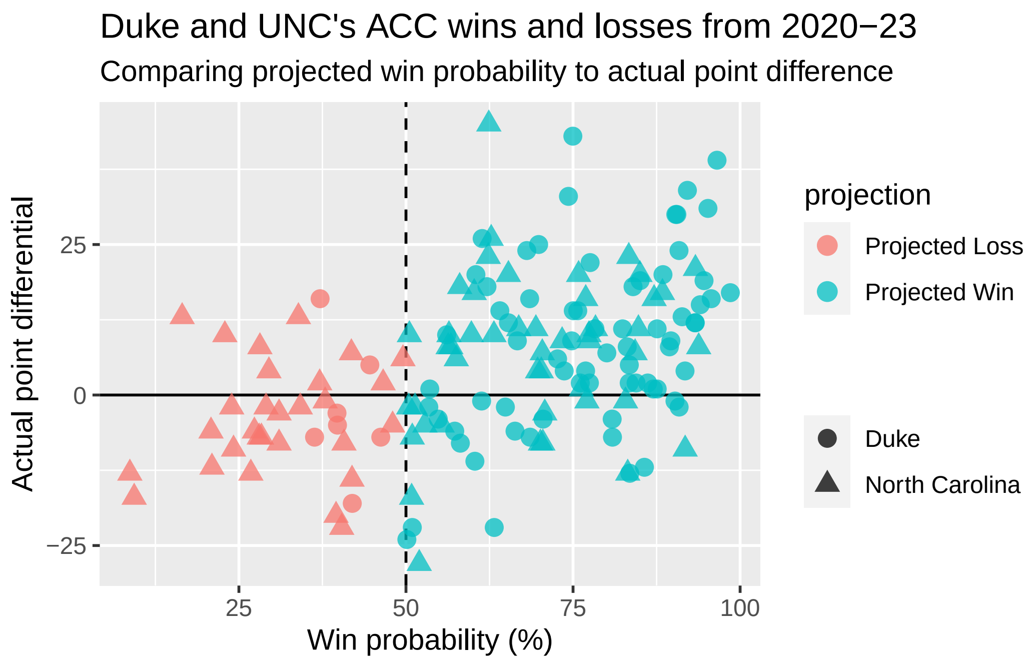
```r
joined_pred_real <- full_join(real_results,full_predictions, by = join_by(date))

joined_pred_real %>%
  mutate(win_cat = fct_relevel(if_else(bin_win.x == 1, "Win", "Loss"),"Win")) %>%
  filter(team == "Duke") %>%
  ggplot(aes(x=win_per,y=diff.x,color = win_cat, shape = duke_home.x)) +
  geom_point(size = 3) +
  scale_color_manual(values = c("#003087","#62C6F2")) +
  geom_hline(yintercept = 0, linetype = 1) +
  geom_vline(xintercept = 50, linetype = 2) +
  labs(title = "Duke vs. UNC games predicted by Torvik formula",
       subtitle = "Games from 2015-2023",
       x = "Predicted Duke win probability (%)",
       y = "Actual point differential",
       color = "Did Duke win?",
       shape = "Where is the game?")
```



```
both_teams <- full_join(test,test_unc)
```

```
Joining with `by = join_by(date, team.x, opp.x, game_location, tempo.x, ppp,
pts, win_per, did_win, simulate_date, year.x, type, team.y, conf, opp.y,
opp_conf, loc, result, pts_scored, pts_allowed, adj_o, adj_d, off_ppp, off_efg,
off_to, off_or, off_ftr, def_ppp, def_efg, def_to, def_or, def_ftr, game_score,
season, tempo.y, game_id, coach, opp_coach, year.y, diff, projection)`
```

```
both_teams %>%
  ggplot(aes(x = win_per, y = diff, color = projection, shape = team.x)) +
  geom_hline(yintercept =  0, linetype = 1) +
  geom_vline(xintercept = 50, linetype = 2) +
  geom_point(size = 3, alpha = 0.75) +
  labs(title = "Duke and UNC's ACC wins and losses from 2020-23",
       subtitle = "Comparing projected win probability to actual point difference",
       shape = "",
       x = "Win probability (%)",
         y = "Actual point differential")
```



```
conf_mat_data_combo <- both_teams %>%
  mutate(projection_bin = fct_relevel(as.factor(if_else(projection == "Projected Win", 1,
         result_bin = fct_relevel(as.factor(if_else(result == "W", 1, 0))),"1")
conf_matrix_combo <- confusionMatrix(data=conf_mat_data_combo$projection_bin, reference =
```

```
Warning in confusionMatrix.default(data = conf_mat_data_combo$projection_bin, :
Levels are not in the same order for reference and data. Refactoring data to
match.
```

```
conf_matrix_combo
```

```
Confusion Matrix and Statistics

          Reference
Prediction  0  1
         0 25 11
         1 33 85
```

```
               Accuracy : 0.7143
                 95% CI : (0.636, 0.7841)
    No Information Rate : 0.6234
    P-Value [Acc > NIR] : 0.011316

                  Kappa : 0.3421

 Mcnemar's Test P-Value : 0.001546

            Sensitivity : 0.8854
            Specificity : 0.4310
         Pos Pred Value : 0.7203
         Neg Pred Value : 0.6944
             Prevalence : 0.6234
         Detection Rate : 0.5519
   Detection Prevalence : 0.7662
      Balanced Accuracy : 0.6582

       'Positive' Class : 1
```