Catan-Exploration

2025-12-16

Catan Exploration

by Ryan Fernandes

Import Data

```
data <- read.csv("catan-results.csv")
data$X <- NULL
```

Check data format

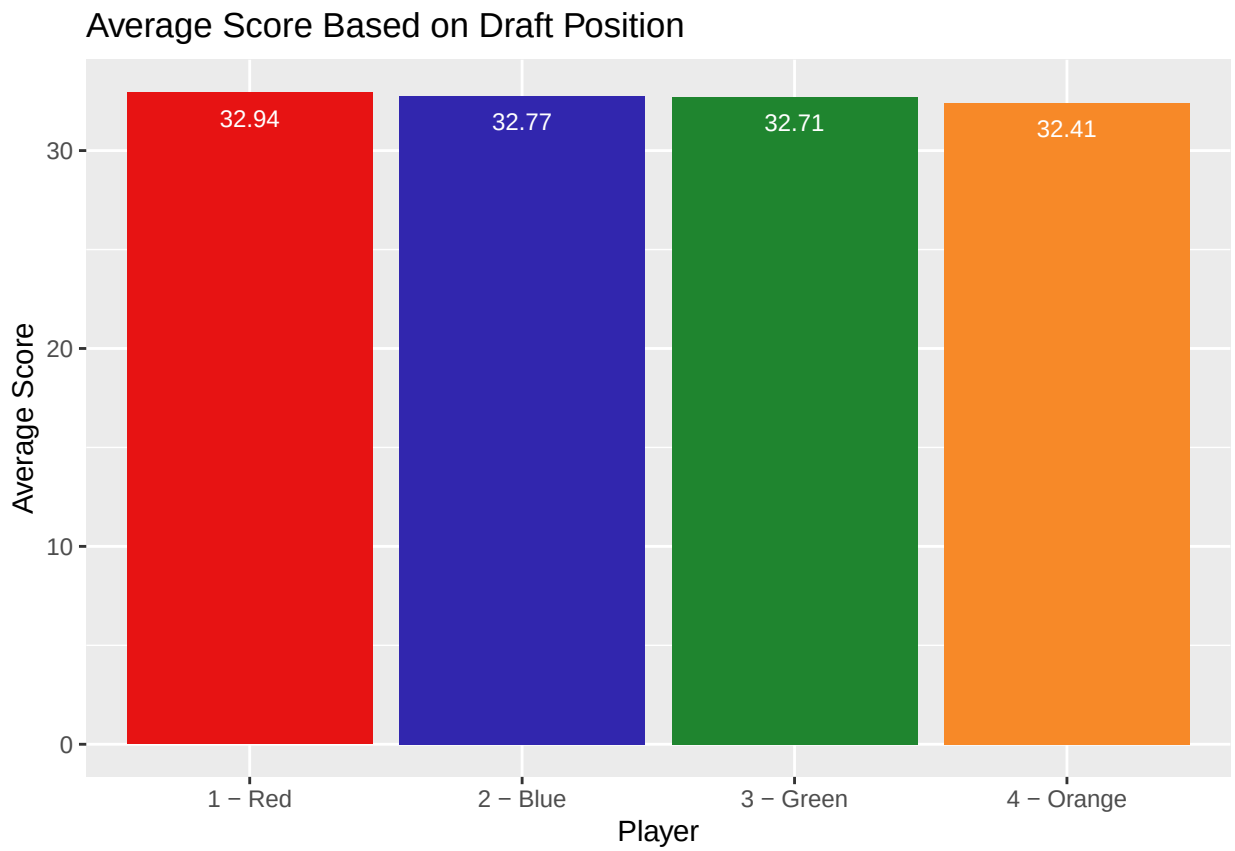
```
head(data, 2)
```

```
##        ts1      ts2      ts3   ts4        tu1        tu2       tu3         tu4
## 1 30.33333 30.58333 30.75000 30.50 -0.2777778 0.05555556 0.2777778 -0.05555556
## 2 29.08333 30.00000 30.16667 28.75 -0.5555556 0.66666667 0.8888889 -1.00000000
##          tm1        tm2       tm3       tm4 s1 s2 s3 s4 s5 s6 s7 s8 str1 str2
## 1 -0.4166667 -0.1666667 0.1666667 -0.250000 38 47 44 36 42 50 40 52    2    2
## 2 -1.0833333 -0.1666667 0.1666667 -1.416667 37 40 45 35 33 48 52 42    2    2
##   str3 str4 pr1 pr2 pr3 pr4 pr5 pr6 pr7 pr8 dl r1 r2 r3 r4 r5 r6 r7 r8 wood1
## 1    0    2   3   2   4   2   2   4   1   1 13 42 57 52 39 49 63 46 67     6
## 2    2    0   3   1   4   3   2   4   1   2  0 41 46 54 37 34 60 67 49     0
##   wood2 wood3 wood4 brick1 brick2 brick3 brick4 sheep1 sheep2 sheep3 sheep4
## 1     4     2     0      0      0      8      3      0      4      3      8
## 2     6     5     1      1      0      0      2      7      0      4      4
##   wheat1 wheat2 wheat3 wheat4 ore1 ore2 ore3 ore4 pros1 pros2 pros3 pros4 pip1
## 1      7      9      2      7    7    4    4    3    18    25    27    28   20
## 2      8     10      5     13    4    6    5    0    23    12    28    25   20
##   pip2 pip3 pip4       pf1       pf2       pf3 pf4
## 1   21   19   21 11.666667  6.666667 10.000000   5
## 2   22   19   20  6.666667 10.000000  8.333333   5
```

Plots

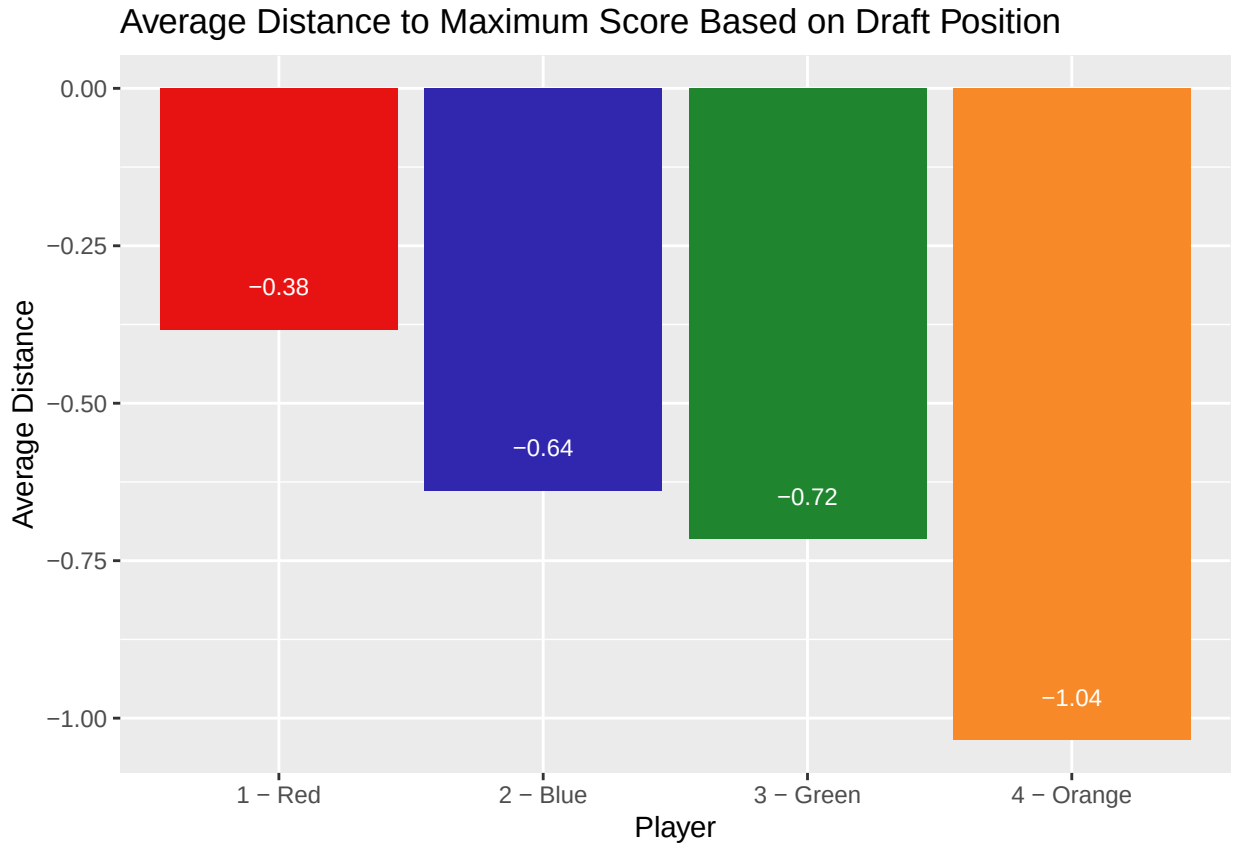
```
data |>
  summarize(
    "1 - Red" = mean(ts1),
    "2 - Blue" = mean(ts2),
    "3 - Green" = mean(ts3),
    "4 - Orange" = mean(ts4)
  ) |>
  pivot_longer(
    cols = everything(),
    names_to = "player",
    values_to = "mean"
```

```
  ) |>
  ggplot(aes(x = player, y = mean, fill = player)) +
  geom_col() +
  geom_text(
    aes(label = round(mean, 2)),
    vjust = 2,
    size = 3.25,
    color = "white",
  ) +
  scale_fill_manual(values = c(
    "1 - Red" = "#e71313",
    "2 - Blue" = "#3126ae",
    "3 - Green" = "#1f852f",
    "4 - Orange" = "#f78928"
  )) +
  labs(
    x = "Player",
    y = "Average Score",
    title = "Average Score Based on Draft Position"
  ) +
  guides(fill = "none")
```



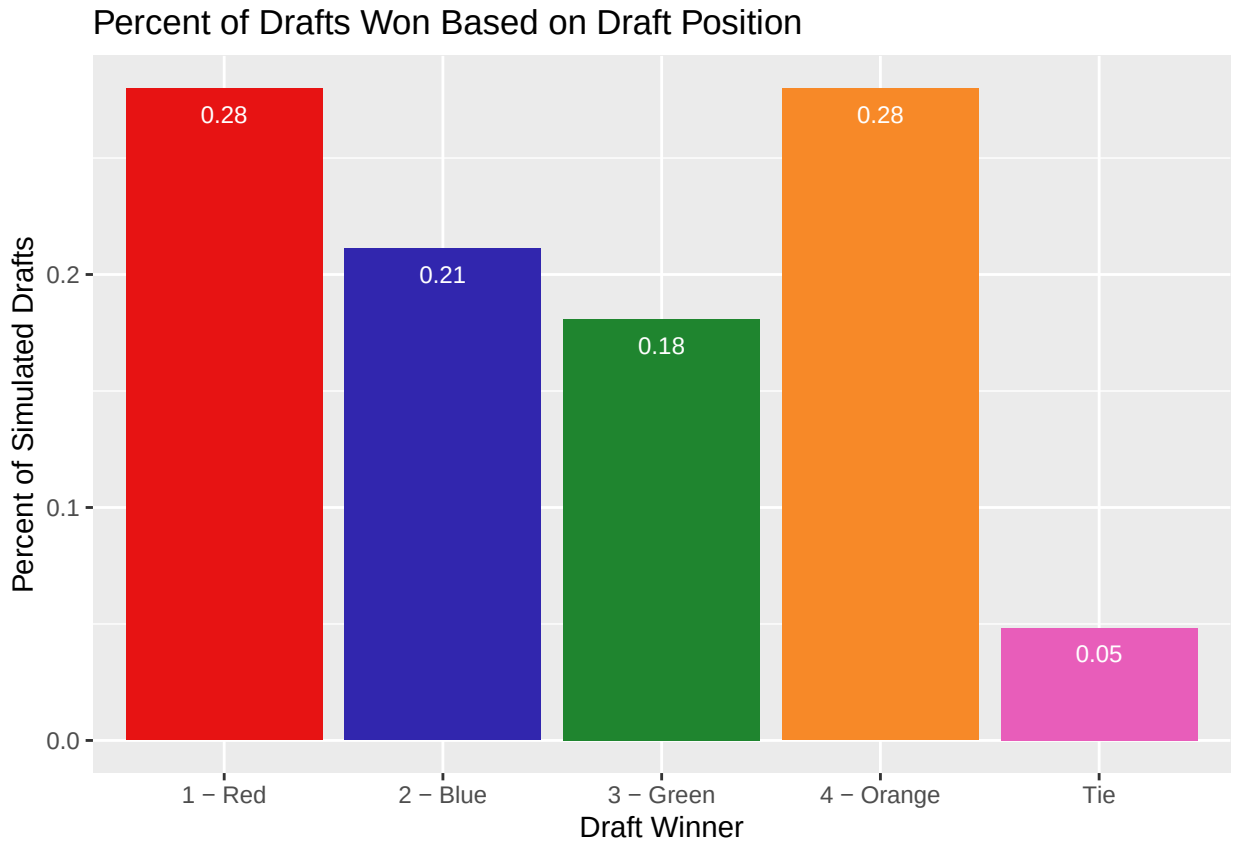

```
data |>
  summarize(
    "1 - Red" = mean(tm1),
    "2 - Blue" = mean(tm2),
```

```
  "3 - Green" = mean(tm3),
  "4 - Orange" = mean(tm4)
) |>
pivot_longer(
  cols = everything(),
  names_to = "player",
  values_to = "mean"
) |>
ggplot(aes(x = player, y = mean, fill = player)) +
geom_col() +
geom_text(
  aes(label = round(mean, 2)),
  vjust = -2,
  size = 3.25,
  color = "white",
) +
scale_fill_manual(values = c(
  "1 - Red" = "#e71313",
  "2 - Blue" = "#3126ae",
  "3 - Green" = "#1f852f",
  "4 - Orange" = "#f78928"
)) +
labs(
  x = "Player",
  y = "Average Distance",
  title = "Average Distance to Maximum Score Based on Draft Position"
) +
guides(fill = "none")
```



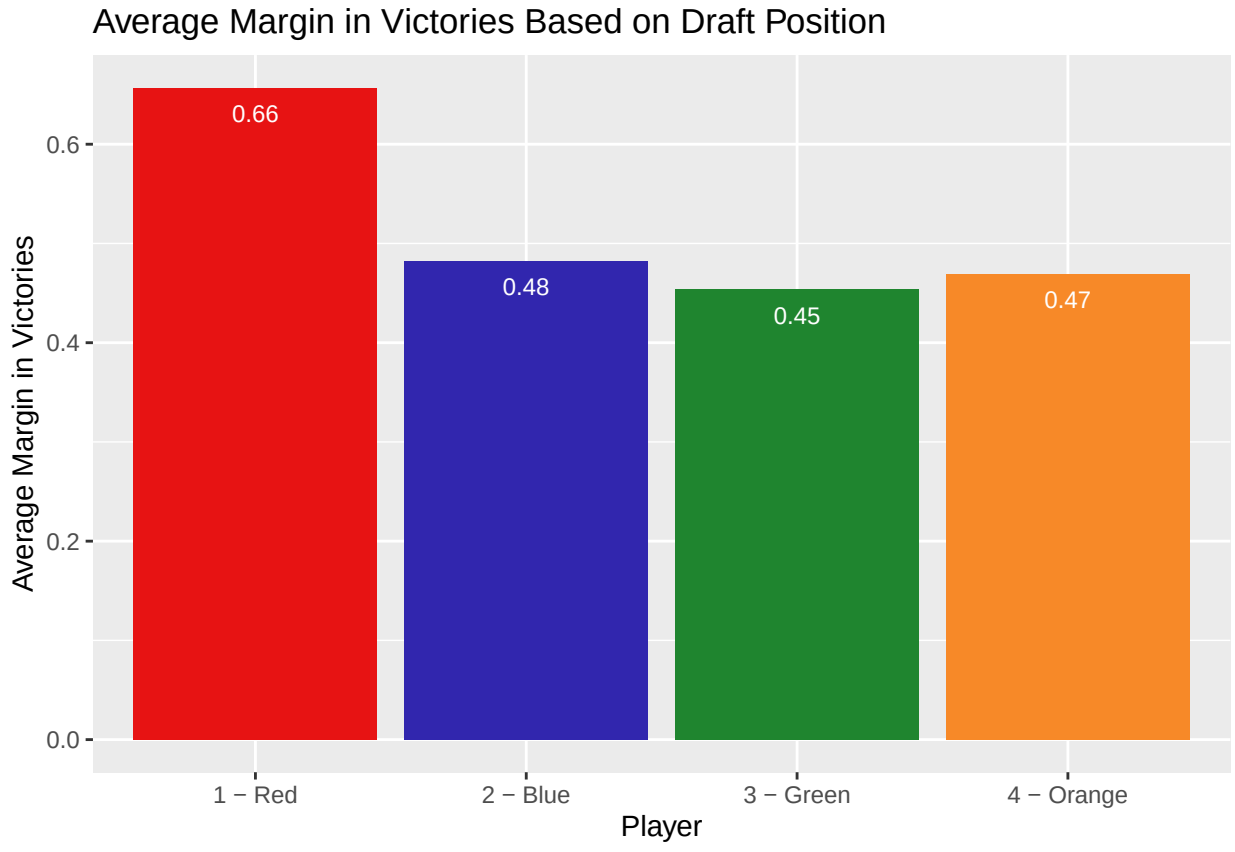

```
data |>
  mutate(
    "p1_win" = as.integer(tm1 > 0),
    "p2_win" = as.integer(tm2 > 0),
    "p3_win" = as.integer(tm3 > 0),
    "p4_win" = as.integer(tm1 > 0),
    "tie" = as.integer(1 - p1_win - p2_win - p3_win - p4_win)
  ) |>
  summarize(
    "1 - Red" = mean(p1_win),
    "2 - Blue" = mean(p2_win),
    "3 - Green" = mean(p3_win),
    "4 - Orange" = mean(p4_win),
    "Tie" = mean(tie)
  ) |>
  pivot_longer(
    cols = everything(),
    names_to = "player",
    values_to = "percent"
  ) |>
  ggplot(aes(x = player, y = percent, fill = player)) +
  geom_col() +
  geom_text(
    aes(label = round(percent, 2)),
    vjust = 2,
    size = 3.25,
```

```
    color = "white",
  ) +
  scale_fill_manual(values = c(
    "1 - Red" = "#e71313",
    "2 - Blue" = "#3126ae",
    "3 - Green" = "#1f852f",
    "4 - Orange" = "#f78928",
    "Tie" = "#e85dba"
  )) +
  labs(
    x = "Draft Winner",
    y = "Percent of Simulated Drafts",
    title = "Percent of Drafts Won Based on Draft Position"
  ) +
  guides(fill = "none")
```



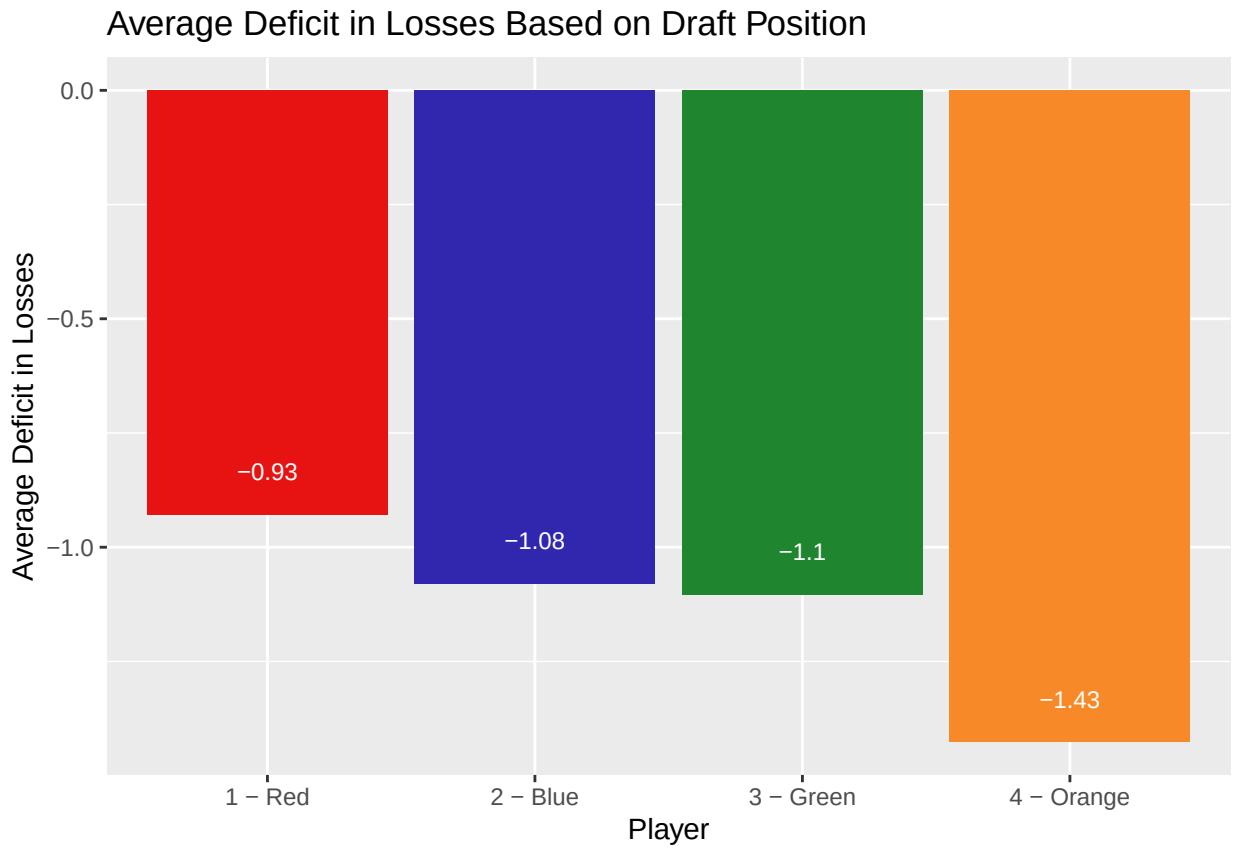

```
data |>
  summarize(
    "1 - Red" = mean(tm1[tm1 > 0]),
    "2 - Blue" = mean(tm2[tm2 > 0]),
    "3 - Green" = mean(tm3[tm3 > 0]),
    "4 - Orange" = mean(tm4[tm4 > 0])
  ) |>
  pivot_longer(
    cols = everything(),
    names_to = "player",
```

```
    values_to = "mean"
  ) |>
  ggplot(aes(x = player, y = mean, fill = player)) +
  geom_col() +
  geom_text(
    aes(label = round(mean, 2)),
    vjust = 2,
    size = 3.25,
    color = "white",
  ) +
  scale_fill_manual(values = c(
    "1 - Red" = "#e71313",
    "2 - Blue" = "#3126ae",
    "3 - Green" = "#1f852f",
    "4 - Orange" = "#f78928"
  )) +
  labs(
    x = "Player",
    y = "Average Margin in Victories",
    title = "Average Margin in Victories Based on Draft Position"
  ) +
  guides(fill = "none")
```



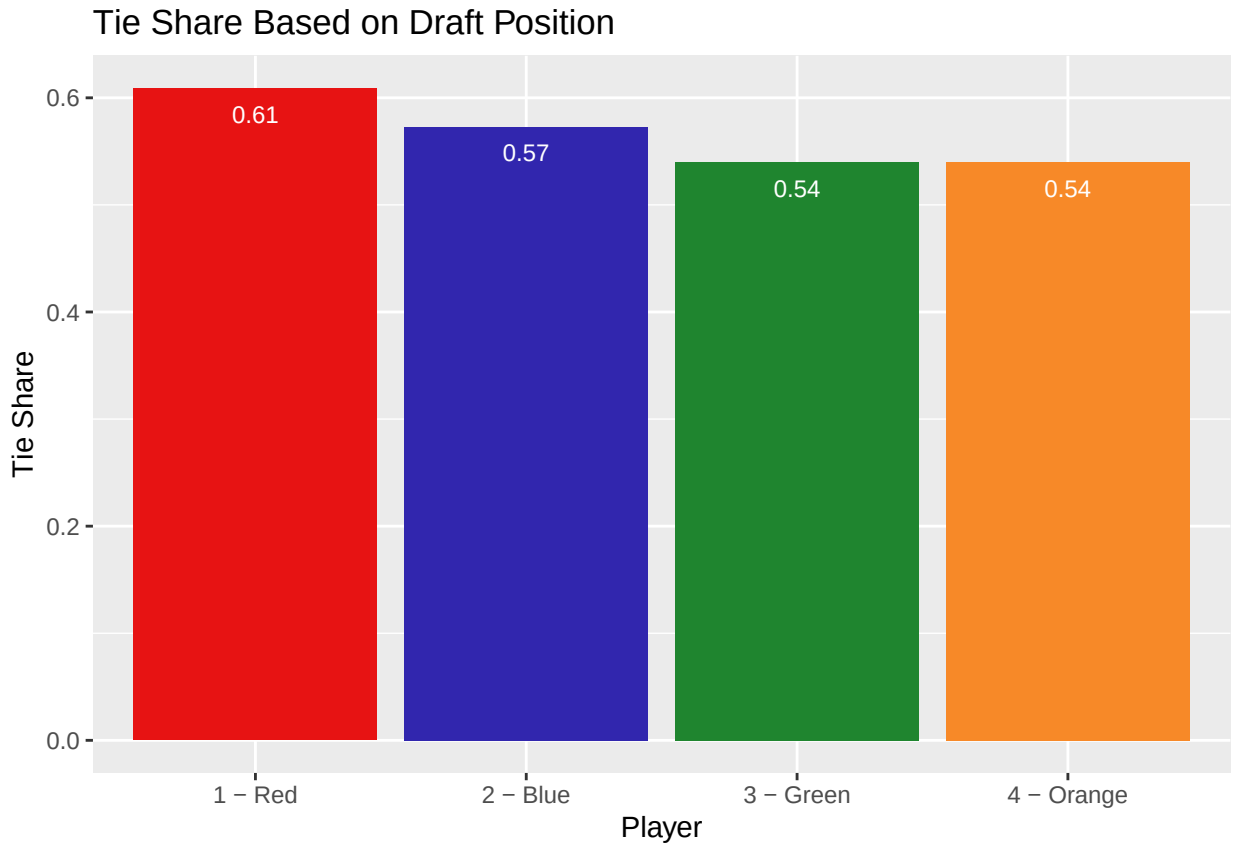

```
data |>
  summarize(
    "1 - Red" = mean(tm1[tm1 < 0]),
```

```
  "2 - Blue" = mean(tm2[tm2 < 0]),
  "3 - Green" = mean(tm3[tm3 < 0]),
  "4 - Orange" = mean(tm4[tm4 < 0])
) |>
pivot_longer(
  cols = everything(),
  names_to = "player",
  values_to = "mean"
) |>
ggplot(aes(x = player, y = mean, fill = player)) +
geom_col() +
geom_text(
  aes(label = round(mean, 2)),
  vjust = -2,
  size = 3.25,
  color = "white",
) +
scale_fill_manual(values = c(
  "1 - Red" = "#e71313",
  "2 - Blue" = "#3126ae",
  "3 - Green" = "#1f852f",
  "4 - Orange" = "#f78928"
)) +
labs(
  x = "Player",
  y = "Average Deficit in Losses",
  title = "Average Deficit in Losses Based on Draft Position"
) +
guides(fill = "none")
```



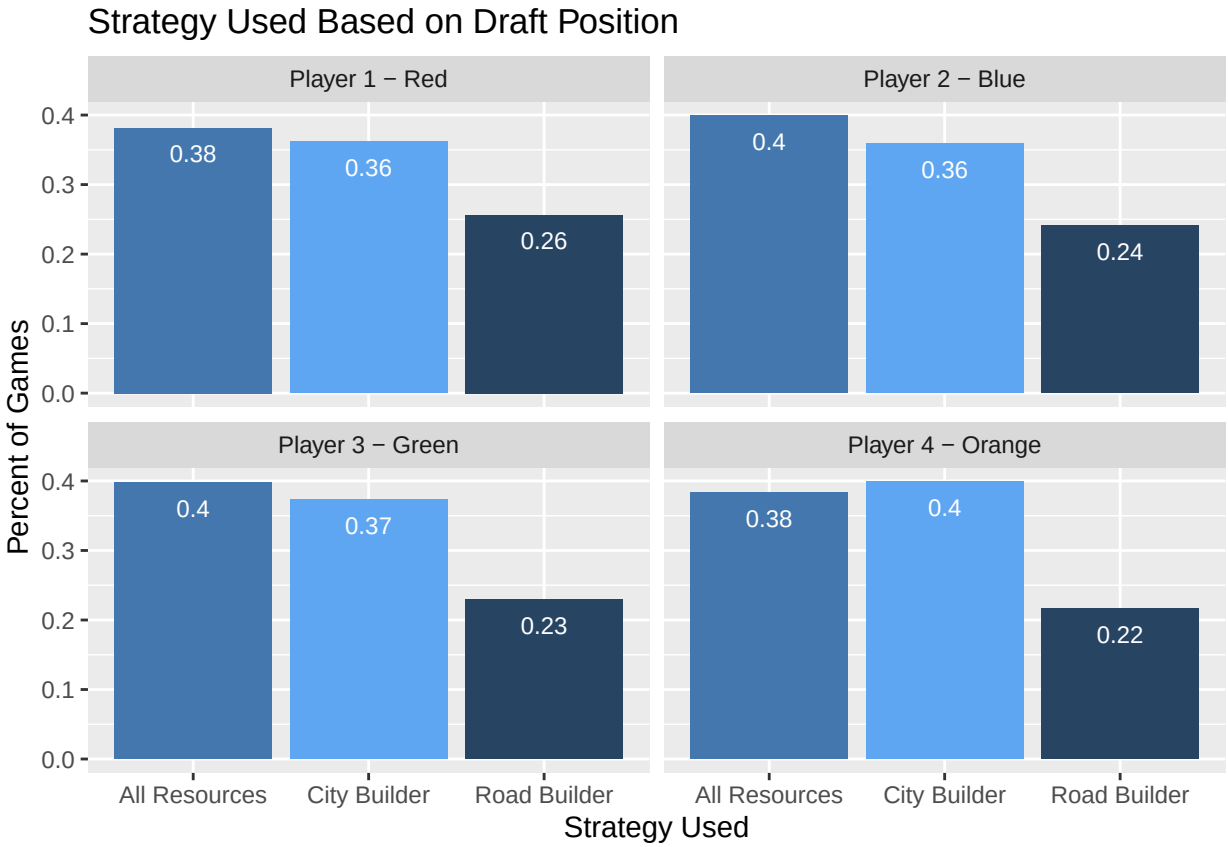

```
data |>
  mutate(
    "tie" = as.integer((tm1 == 0) | (tm2 == 0) | (tm3 == 0) | (tm4 == 0)),
    "p1_tie" = as.integer(tm1 == 0),
    "p2_tie" = as.integer(tm2 == 0),
    "p3_tie" = as.integer(tm3 == 0),
    "p4_tie" = as.integer(tm4 == 0),
  ) |>
  filter(
    tie == 1
  ) |>
  summarize(
    "1 - Red" = mean(p1_tie),
    "2 - Blue" = mean(p2_tie),
    "3 - Green" = mean(p3_tie),
    "4 - Orange" = mean(p3_tie)
  ) |>
  pivot_longer(
    cols = everything(),
    names_to = "player",
    values_to = "mean"
  ) |>
  ggplot(aes(x = player, y = mean, fill = player)) +
  geom_col() +
  geom_text(
    aes(label = round(mean, 2)),
```

```
    vjust = 2,
    size = 3.25,
    color = "white",
  ) +
  scale_fill_manual(values = c(
    "1 - Red" = "#e71313",
    "2 - Blue" = "#3126ae",
    "3 - Green" = "#1f852f",
    "4 - Orange" = "#f78928"
  )) +
  labs(
    x = "Player",
    y = "Tie Share",
    title = "Tie Share Based on Draft Position"
  ) +
  guides(fill = "none")
```



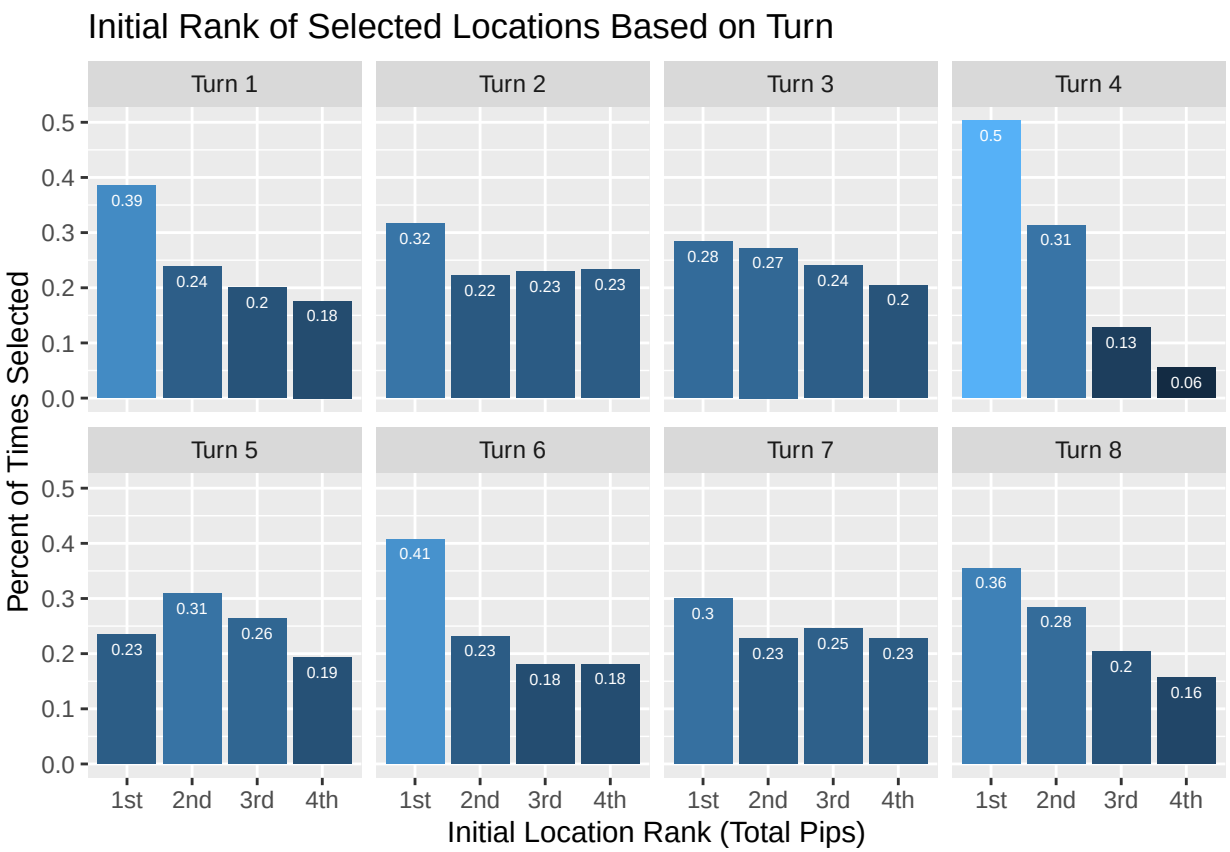

```
data |>
  pivot_longer(
    cols = c(str1, str2, str3, str4),
    names_to = "player",
    values_to = "strategy"
  ) |>
  group_by(player) |>
  summarize(
    "All Resources" = mean(strategy == 0),
```

```
  "Road Builder" = mean(strategy == 1),
  "City Builder" = mean(strategy == 2)
) |>
pivot_longer(
  cols = c("All Resources", "Road Builder", "City Builder"),
  names_to = "strategy",
  values_to = "percent"
) |>
mutate(
  player_names = recode(
    player,
    "str1" = "Player 1 - Red",
    "str2" = "Player 2 - Blue",
    "str3" = "Player 3 - Green",
    "str4" = "Player 4 - Orange"
  )
) |>
ggplot(aes(x = strategy, y = percent, fill = strategy)) +
geom_col() +
geom_text(
  aes(label = round(percent, 2)),
  vjust = 2,
  size = 3.25,
  color = "white",
) +
scale_fill_manual(values = c(
  "All Resources" = "#4477ad",
  "Road Builder" = "#274463",
  "City Builder" = "#5ea6f2"
)) +
labs(
  x = "Strategy Used",
  y = "Percent of Games",
  title = "Strategy Used Based on Draft Position"
) +
guides(fill = "none") +
facet_wrap(
  facets = c("player_names")
)
```



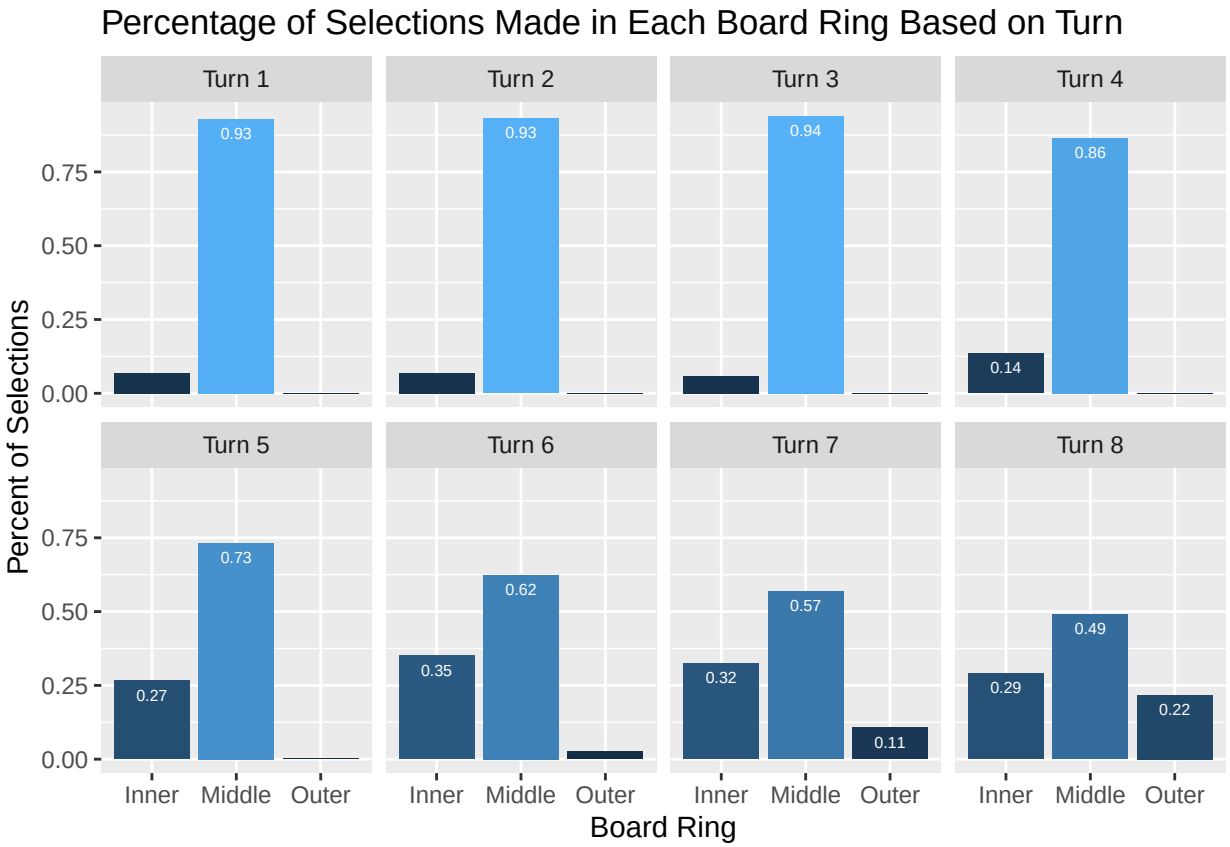

```
data |>
  pivot_longer(
    cols = c(pr1, pr2, pr3, pr4, pr5, pr6, pr7, pr8),
    names_to = "turn_name",
    values_to = "pip_rank"
  ) |>
  mutate(
    turn = recode(
      turn_name,
      "pr1" = "Turn 1",
      "pr2" = "Turn 2",
      "pr3" = "Turn 3",
      "pr4" = "Turn 4",
      "pr5" = "Turn 5",
      "pr6" = "Turn 6",
      "pr7" = "Turn 7",
      "pr8" = "Turn 8"
    )
  ) |>
  group_by(
    turn
  ) |>
  summarize(
    "1st" = mean(pip_rank == 1),
    "2nd" = mean(pip_rank == 2),
    "3rd" = mean(pip_rank == 3),
```

```
    "4th" = mean(pip_rank == 4)
  ) |>
  pivot_longer(
    cols = c("1st", "2nd", "3rd", "4th"),
    names_to = "rank",
    values_to = "mean"
  ) |>
  ggplot(aes(x = rank, y = mean, fill = mean)) +
  geom_col() +
  geom_text(
    aes(label = round(mean, 2)),
    vjust = 1.75,
    size = 2.25,
    color = "white",
  ) +
  labs(
    x = "Initial Location Rank (Total Pips)",
    y = "Percent of Times Selected",
    title = "Initial Rank of Selected Locations Based on Turn"
  ) +
  guides(fill = "none") +
  facet_wrap(
    facets = c("turn"),
    ncol = 4
  )
```



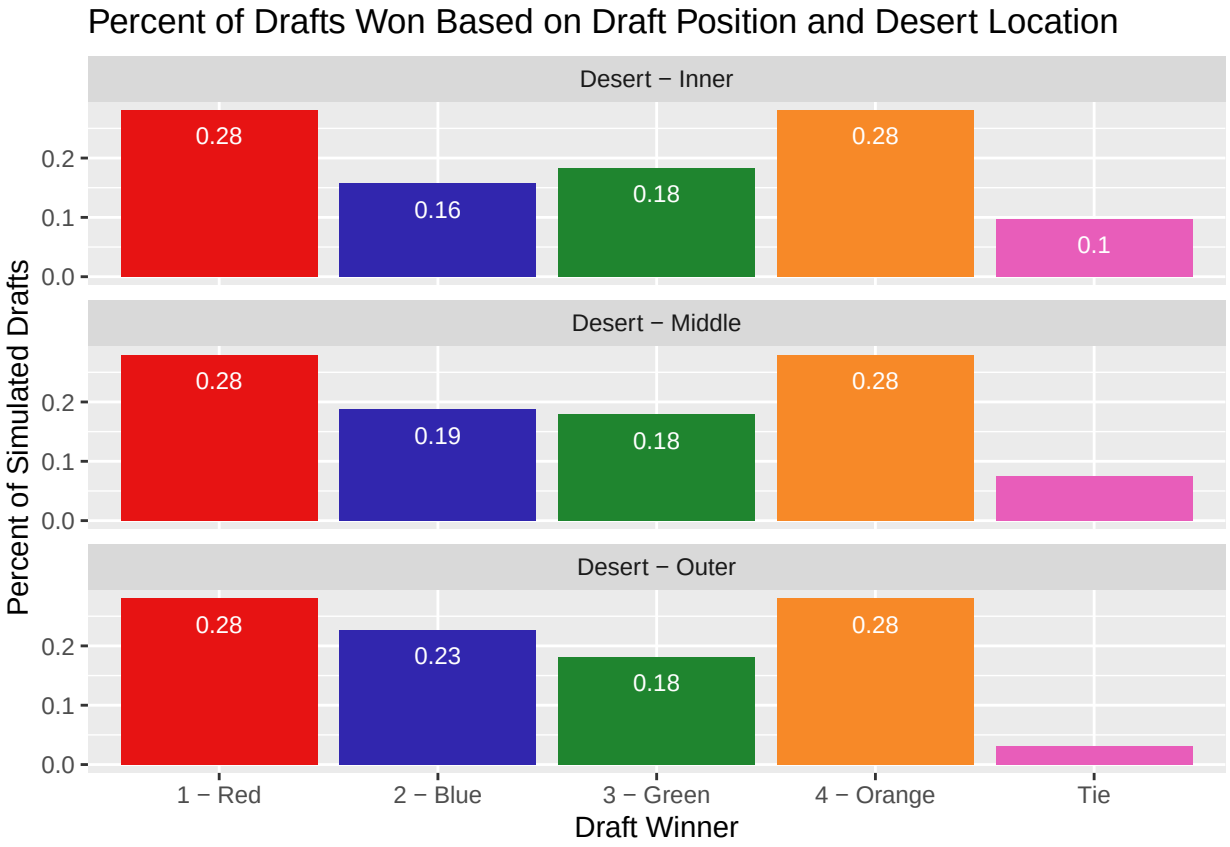
```r
data |>
  pivot_longer(
    cols = c(s1, s2, s3, s4, s5, s6, s7, s8),
    names_to = "turn_name",
    values_to = "vertex"
  ) |>
  mutate(
    turn = recode(
      turn_name,
      "s1" = "Turn 1",
      "s2" = "Turn 2",
      "s3" = "Turn 3",
      "s4" = "Turn 4",
      "s5" = "Turn 5",
      "s6" = "Turn 6",
      "s7" = "Turn 7",
      "s8" = "Turn 8"
    ),
    ring_idx = case_when(
      vertex <= 29 ~ 0,
      vertex > 29 & vertex <= 47 ~ 1,
      vertex > 47 ~ 2
    )
  ) |>
  group_by(
    turn
  ) |>
  summarize(
    "Outer" = mean(ring_idx == 0),
    "Middle" = mean(ring_idx == 1),
    "Inner" = mean(ring_idx == 2)
  ) |>
  pivot_longer(
    cols = c("Outer", "Middle", "Inner"),
    names_to = "ring",
    values_to = "mean"
  ) |>
  ggplot(aes(x = ring, y = mean, fill = mean)) +
  geom_col() +
  geom_text(
    aes(label = ifelse(mean > 0.10, round(mean, 2), "")),
    vjust = 1.75,
    size = 2.25,
    color = "white",
  ) +
  labs(
    x = "Board Ring",
    y = "Percent of Selections",
    title = "Percentage of Selections Made in Each Board Ring Based on Turn"
  ) +
  guides(fill = "none") +
  facet_wrap(
    facets = c("turn"),
```

```
    ncol = 4
  )
```



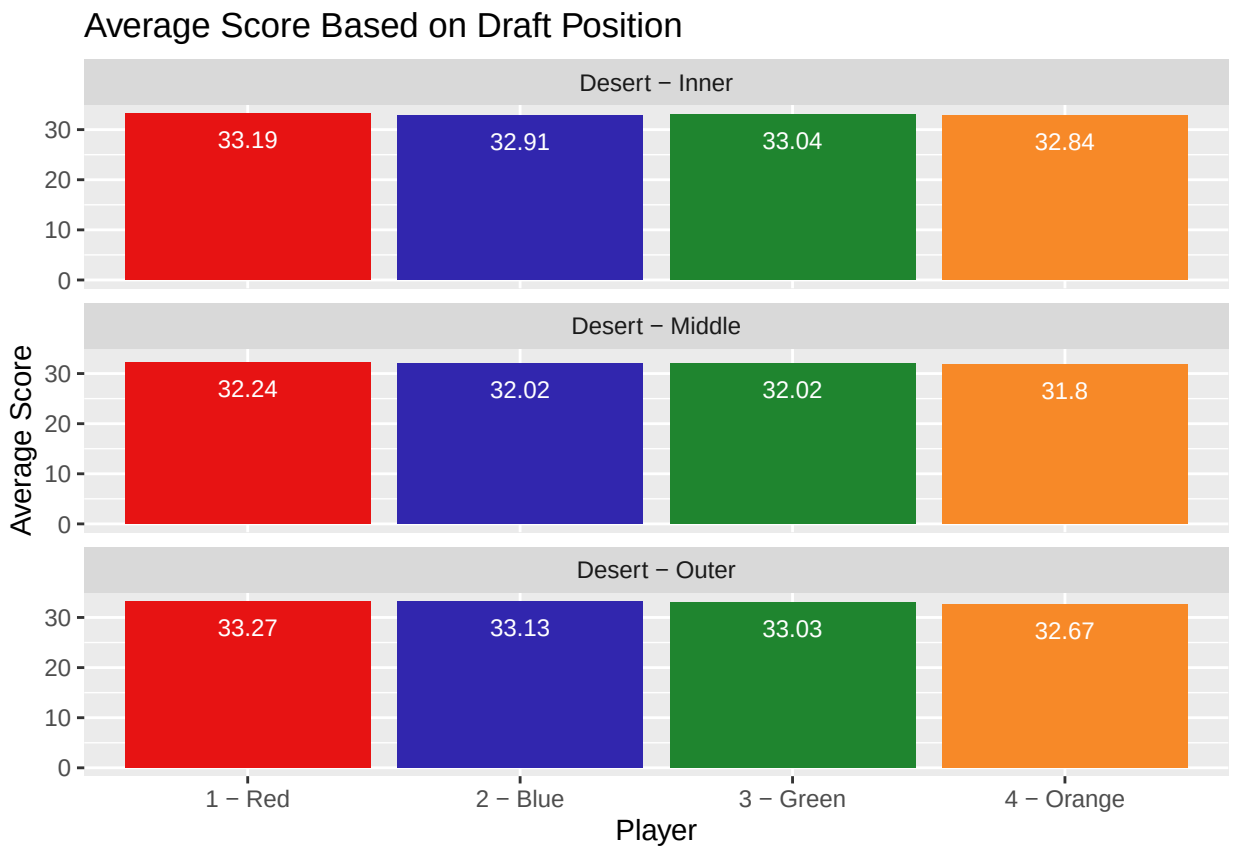

```
data |>
  mutate(
    "p1_win" = as.integer(tm1 > 0),
    "p2_win" = as.integer(tm2 > 0),
    "p3_win" = as.integer(tm3 > 0),
    "p4_win" = as.integer(tm1 > 0),
    "tie" = as.integer(1 - p1_win - p2_win - p3_win - p4_win),
    "desert_ring" = case_when(
      dl <= 11 ~ "Desert - Outer",
      dl > 11 & dl <= 17 ~ "Desert - Middle",
      dl > 17 ~ "Desert - Inner"
    )
  ) |>
  group_by(desert_ring) |>
  summarize(
    "1 - Red" = mean(p1_win),
    "2 - Blue" = mean(p2_win),
    "3 - Green" = mean(p3_win),
    "4 - Orange" = mean(p4_win),
    "Tie" = mean(tie)
  ) |>
  pivot_longer(
    cols = c("1 - Red", "2 - Blue", "3 - Green", "4 - Orange", "Tie"),
```

```
  names_to = "player",
  values_to = "percent"
) |>
ggplot(aes(x = player, y = percent, fill = player)) +
geom_col() +
geom_text(
  aes(label = ifelse(percent >= 0.09, round(percent, 2), "")),
  vjust = 2,
  size = 3.25,
  color = "white",
) +
scale_fill_manual(values = c(
  "1 - Red" = "#e71313",
  "2 - Blue" = "#3126ae",
  "3 - Green" = "#1f852f",
  "4 - Orange" = "#f78928",
  "Tie" = "#e85dba"
)) +
labs(
  x = "Draft Winner",
  y = "Percent of Simulated Drafts",
  title = "Percent of Drafts Won Based on Draft Position and Desert Location"
) +
guides(fill = "none") +
facet_wrap(
  facets = c("desert_ring"),
  ncol = 1
)
```




```
data |>
  mutate(
    "desert_ring" = case_when(
      dl <= 11 ~ "Desert - Outer",
      dl > 11 & dl <= 17 ~ "Desert - Middle",
      dl > 17 ~ "Desert - Inner"
    )
  ) |>
  group_by(desert_ring) |>
  summarize(
    "1 - Red" = mean(ts1),
    "2 - Blue" = mean(ts2),
    "3 - Green" = mean(ts3),
    "4 - Orange" = mean(ts4)
  ) |>
  pivot_longer(
    cols = c("1 - Red", "2 - Blue", "3 - Green", "4 - Orange"),
    names_to = "player",
    values_to = "mean"
  ) |>
  ggplot(aes(x = player, y = mean, fill = player)) +
  geom_col() +
  geom_text(
    aes(label = round(mean, 2)),
    vjust = 2,
    size = 3.25,
```

```
    color = "white",
  ) +
  scale_fill_manual(values = c(
    "1 - Red" = "#e71313",
    "2 - Blue" = "#3126ae",
    "3 - Green" = "#1f852f",
    "4 - Orange" = "#f78928"
  )) +
  labs(
    x = "Player",
    y = "Average Score",
    title = "Average Score Based on Draft Position"
  ) +
  guides(fill = "none") +
  facet_wrap(
    facets = c("desert_ring"),
    ncol = 1
  )
```

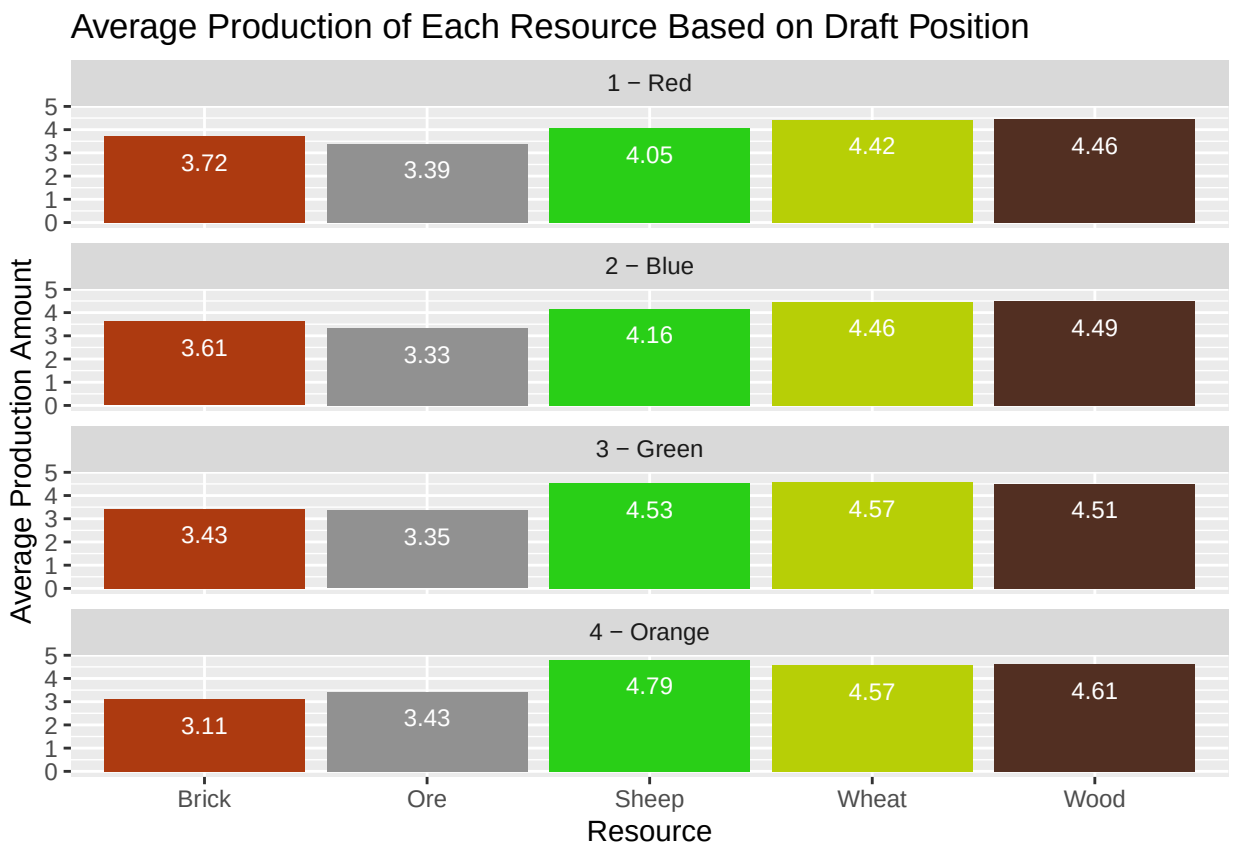



```
data |>
  pivot_longer(
    cols = c("wood1", "wood2", "wood3", "wood4"),
    names_to = "wood_player",
    values_to = "wood",
  ) |>
  mutate(
```

```
  wood_player = recode(
    wood_player,
    "wood1" = 1,
    "wood2" = 2,
    "wood3" = 3,
    "wood4" = 4
  )
) |>
pivot_longer(
  cols = c("brick1", "brick2", "brick3", "brick4"),
  names_to = "brick_player",
  values_to = "brick",
) |>
mutate(
  brick_player = recode(
    brick_player,
    "brick1" = 1,
    "brick2" = 2,
    "brick3" = 3,
    "brick4" = 4
  )
) |>
pivot_longer(
  cols = c("wheat1", "wheat2", "wheat3", "wheat4"),
  names_to = "wheat_player",
  values_to = "wheat",
) |>
mutate(
  wheat_player = recode(
    wheat_player,
    "wheat1" = 1,
    "wheat2" = 2,
    "wheat3" = 3,
    "wheat4" = 4
  )
) |>
pivot_longer(
  cols = c("sheep1", "sheep2", "sheep3", "sheep4"),
  names_to = "sheep_player",
  values_to = "sheep",
) |>
mutate(
  sheep_player = recode(
    sheep_player,
    "sheep1" = 1,
    "sheep2" = 2,
    "sheep3" = 3,
    "sheep4" = 4
  )
) |>
pivot_longer(
  cols = c("ore1", "ore2", "ore3", "ore4"),
  names_to = "ore_player",
```

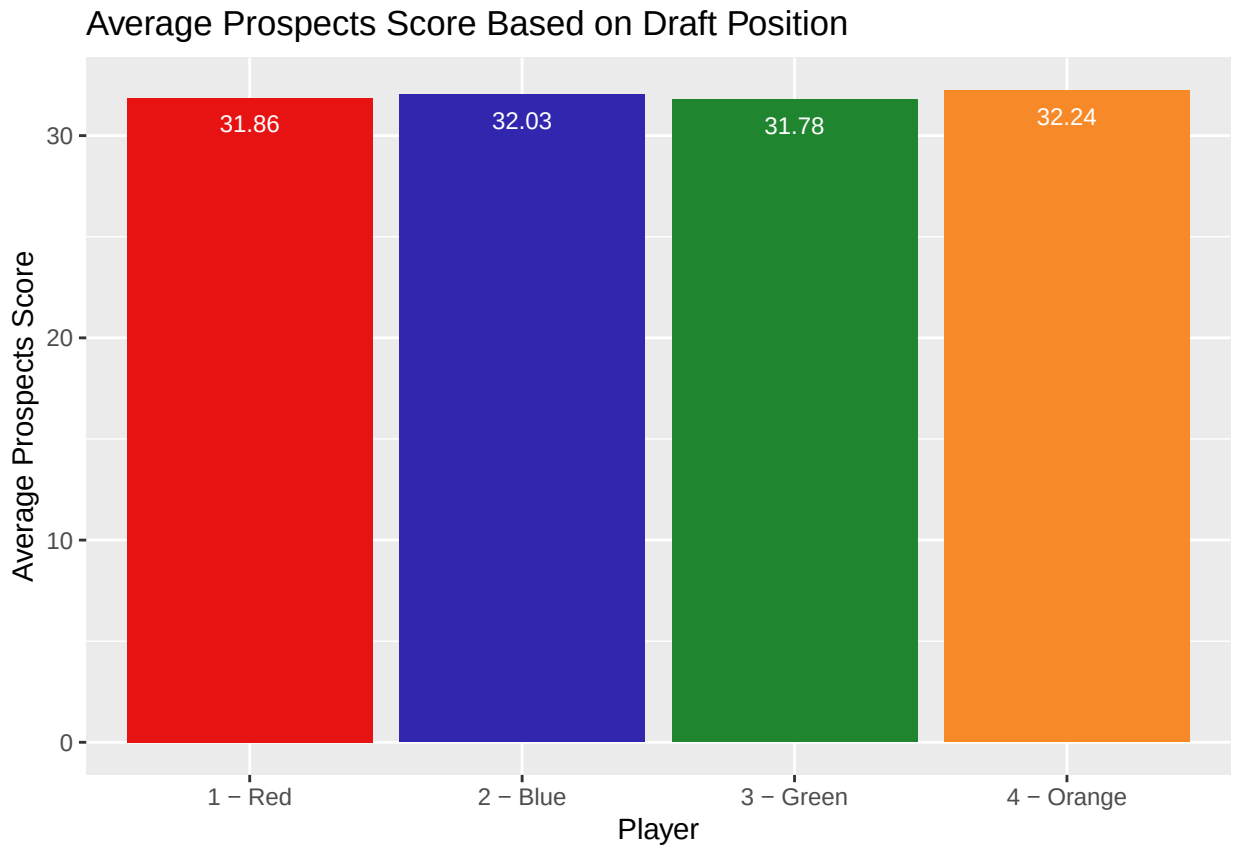
```
  values_to = "ore",
) |>
mutate(
  ore_player = recode(
    ore_player,
    "ore1" = 1,
    "ore2" = 2,
    "ore3" = 3,
    "ore4" = 4
  )
) |>
filter(
  wood_player == brick_player, brick_player == wheat_player, wheat_player == sheep_player, sheep_play
) |>
mutate(
  player = recode(
    wood_player,
    "1" = "1 - Red",
    "2" = "2 - Blue",
    "3" = "3 - Green",
    "4" = "4 - Orange"
  )
) |>
group_by(
  player
) |>
summarize(
  mean_wood = mean(wood),
  mean_brick = mean(brick),
  mean_wheat = mean(wheat),
  mean_sheep = mean(sheep),
  mean_ore = mean(ore)
) |>
pivot_longer(
  cols = c("mean_wood", "mean_brick", "mean_wheat", "mean_sheep", "mean_ore"),
  names_to = "resource_name",
  values_to = "mean"
) |>
mutate(
  resource = recode(
    resource_name,
    "mean_wood" = "Wood",
    "mean_brick" = "Brick",
    "mean_wheat" = "Wheat",
    "mean_sheep" = "Sheep",
    "mean_ore" = "Ore"
  )
) |>
ggplot(aes(x = resource, y = mean, fill = resource)) +
geom_col() +
geom_text(
  aes(label = round(mean, 2)),
  vjust = 2,
```

```
    size = 3.25,
    color = "white",
  ) +
  scale_fill_manual(values = c(
    "Wood" = "#522f22",
    "Brick" = "#ad3a10",
    "Wheat" = "#b7cf06",
    "Sheep" = "#29cf17",
    "Ore" = "#919191"
  )) +
  labs(
    x = "Resource",
    y = "Average Production Amount",
    title = "Average Production of Each Resource Based on Draft Position"
  ) +
  guides(fill = "none") +
  facet_wrap(
    facets = c("player"),
    ncol = 1
  )
```



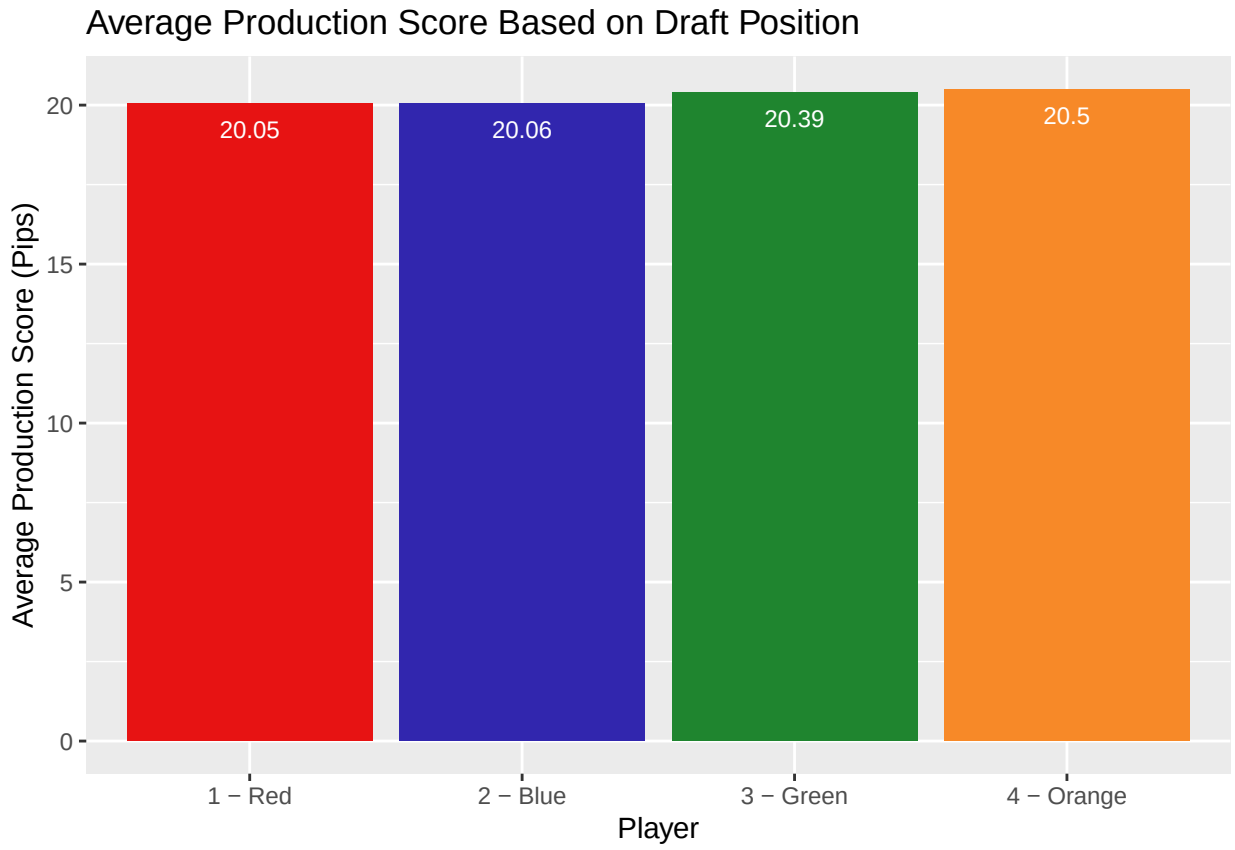

```
data |>
  summarize(
    "1 - Red" = mean(pros1),
    "2 - Blue" = mean(pros2),
    "3 - Green" = mean(pros3),
```

```
  "4 - Orange" = mean(pros4)
) |>
pivot_longer(
  cols = everything(),
  names_to = "player",
  values_to = "mean"
) |>
ggplot(aes(x = player, y = mean, fill = player)) +
geom_col() +
geom_text(
  aes(label = round(mean, 2)),
  vjust = 2,
  size = 3.25,
  color = "white",
) +
scale_fill_manual(values = c(
  "1 - Red" = "#e71313",
  "2 - Blue" = "#3126ae",
  "3 - Green" = "#1f852f",
  "4 - Orange" = "#f78928"
)) +
labs(
  x = "Player",
  y = "Average Prospects Score",
  title = "Average Prospects Score Based on Draft Position"
) +
guides(fill = "none")
```




```
data |>
  summarize(
    "1 - Red" = mean(pip1),
    "2 - Blue" = mean(pip2),
    "3 - Green" = mean(pip3),
    "4 - Orange" = mean(pip4)
  ) |>
  pivot_longer(
    cols = everything(),
    names_to = "player",
    values_to = "mean"
  ) |>
  ggplot(aes(x = player, y = mean, fill = player)) +
  geom_col() +
  geom_text(
    aes(label = round(mean, 2)),
    vjust = 2,
    size = 3.25,
    color = "white",
  ) +
  scale_fill_manual(values = c(
    "1 - Red" = "#e71313",
    "2 - Blue" = "#3126ae",
    "3 - Green" = "#1f852f",
    "4 - Orange" = "#f78928"
  )) +
```

```
  labs(
    x = "Player",
    y = "Average Production Score (Pips)",
    title = "Average Production Score Based on Draft Position"
  ) +
  guides(fill = "none")
```




```
data |>
  summarize(
    "1 - Red" = mean(pf1),
    "2 - Blue" = mean(pf2),
    "3 - Green" = mean(pf3),
    "4 - Orange" = mean(pf4)
  ) |>
  pivot_longer(
    cols = everything(),
    names_to = "player",
    values_to = "mean"
  ) |>
  ggplot(aes(x = player, y = mean, fill = player)) +
  geom_col() +
  geom_text(
    aes(label = round(mean, 2)),
    vjust = 2,
    size = 3.25,
    color = "white",
```

```
) +
scale_fill_manual(values = c(
  "1 - Red" = "#e71313",
  "2 - Blue" = "#3126ae",
  "3 - Green" = "#1f852f",
  "4 - Orange" = "#f78928"
)) +
labs(
  x = "Player",
  y = "Average Strategy Score",
  title = "Average Strategy Score Based on Draft Position"
) +
guides(fill = "none")
```