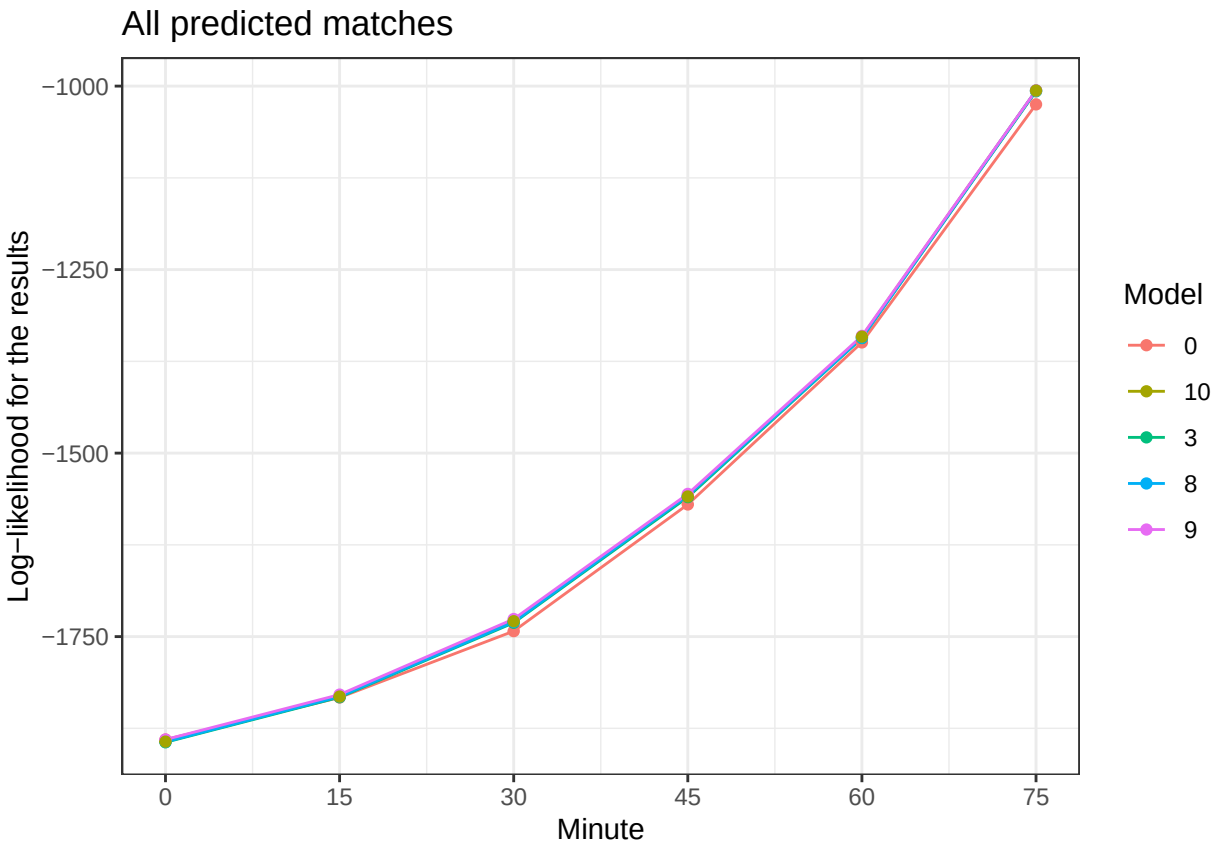
Log-likelihood instead of geometric mean

```
library(dplyr)
library(ggplot2)
library(tidyr)
library(knitr)

load("data/HDA_dc.RData")
load("data/first_matches.RData")

HDA = HDA_dc %>%
  anti_join(first_matches)

nrow(HDA)
```

```
## [1] 1858
```

```
HDA[,c(9:158)][which(HDA[,c(9:158)] == 0, arr.ind = TRUE)] = 10^-5
```

```
results = tibble(GeoMean = apply(HDA[,c(99:128)], 2, function(x) sum(log(x))),
                 Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                 Model = factor(c(rep("0", 6),
                                  rep("3", 6),
                                  rep("8", 6),
                                  rep("9", 6),
                                  rep("10", 6))))
results %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
  theme_bw() +
  ggtitle("All predicted matches") +
  ylab("Log-likelihood for the results")
```

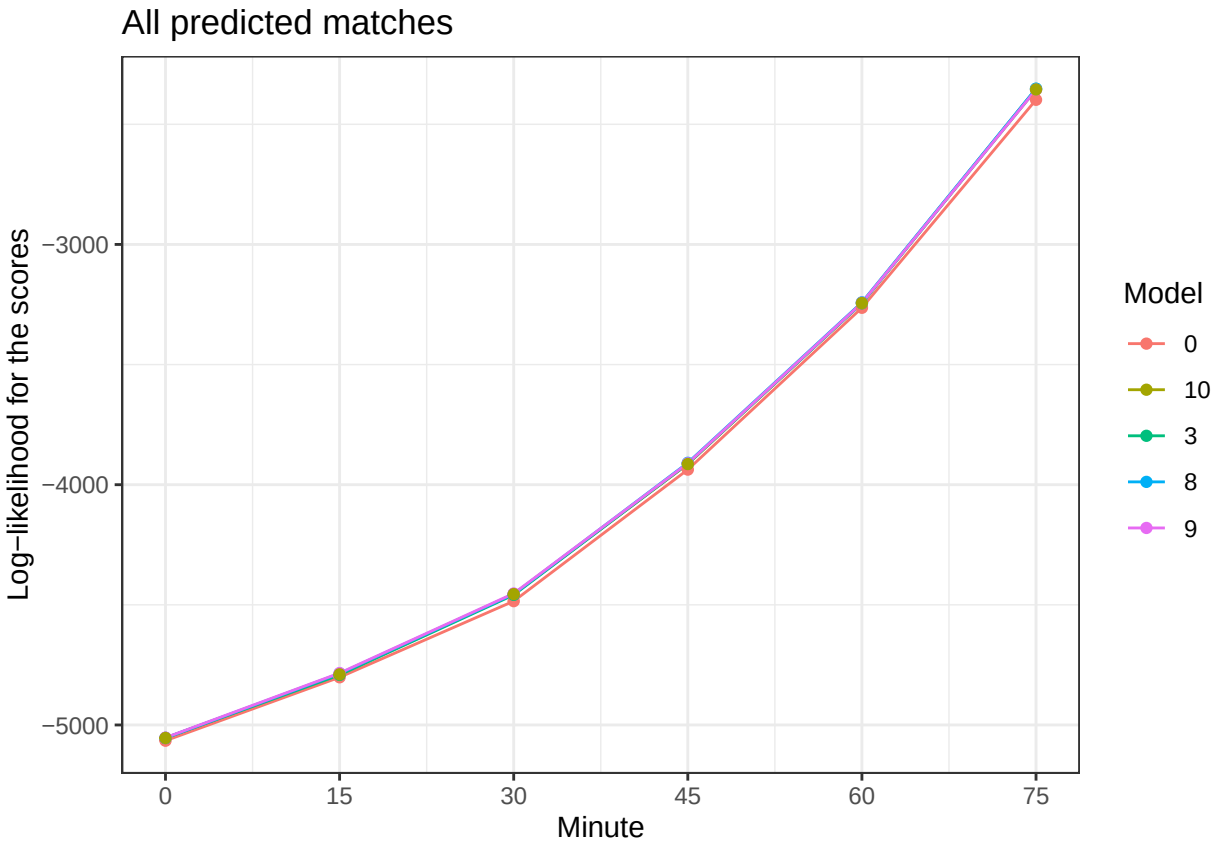



```
results %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-1890.224	-1833.017	-1742.580	-1569.958	-1349.180	-1024.889
3	-1894.012	-1832.541	-1731.142	-1560.000	-1343.261	-1006.988
8	-1893.354	-1831.652	-1730.029	-1557.920	-1342.842	-1006.088
9	-1890.257	-1829.038	-1726.062	-1555.640	-1340.360	-1005.756
10	-1893.121	-1831.689	-1729.083	-1559.126	-1341.357	-1006.080

```
scores = tibble(GeoMean = apply(HDA[,c(129:158)], 2, function(x) sum(log(x))),
                Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                Model = factor(c(rep("0", 6),
                                 rep("3", 6),
                                 rep("8", 6),
                                 rep("9", 6),
                                 rep("10", 6))))
scores %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
```

```
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
  theme_bw() +
  ggtitle("All predicted matches") +
  ylab("Log-likelihood for the scores")
```




```
scores %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-5065.544	-4801.531	-4484.667	-3937.140	-3263.705	-2397.947
3	-5054.111	-4791.688	-4458.603	-3912.463	-3244.909	-2352.378
8	-5054.016	-4785.797	-4455.128	-3908.892	-3241.158	-2352.016
9	-5052.707	-4783.969	-4452.737	-3911.148	-3243.164	-2355.706
10	-5054.064	-4789.236	-4455.453	-3913.991	-3243.887	-2355.322

```
load("~/GitHub/soccer-live-predictions/soccer-live-predictions/scrape/data/reds.RData")

matches = reds %>%
  filter(Season > 2015, Half == 1) %>%
  select(Season, Match)
```

```
HDA_reds = HDA %>%
  inner_join(matches)
```

```
## Joining, by = c("Season", "Match")
```

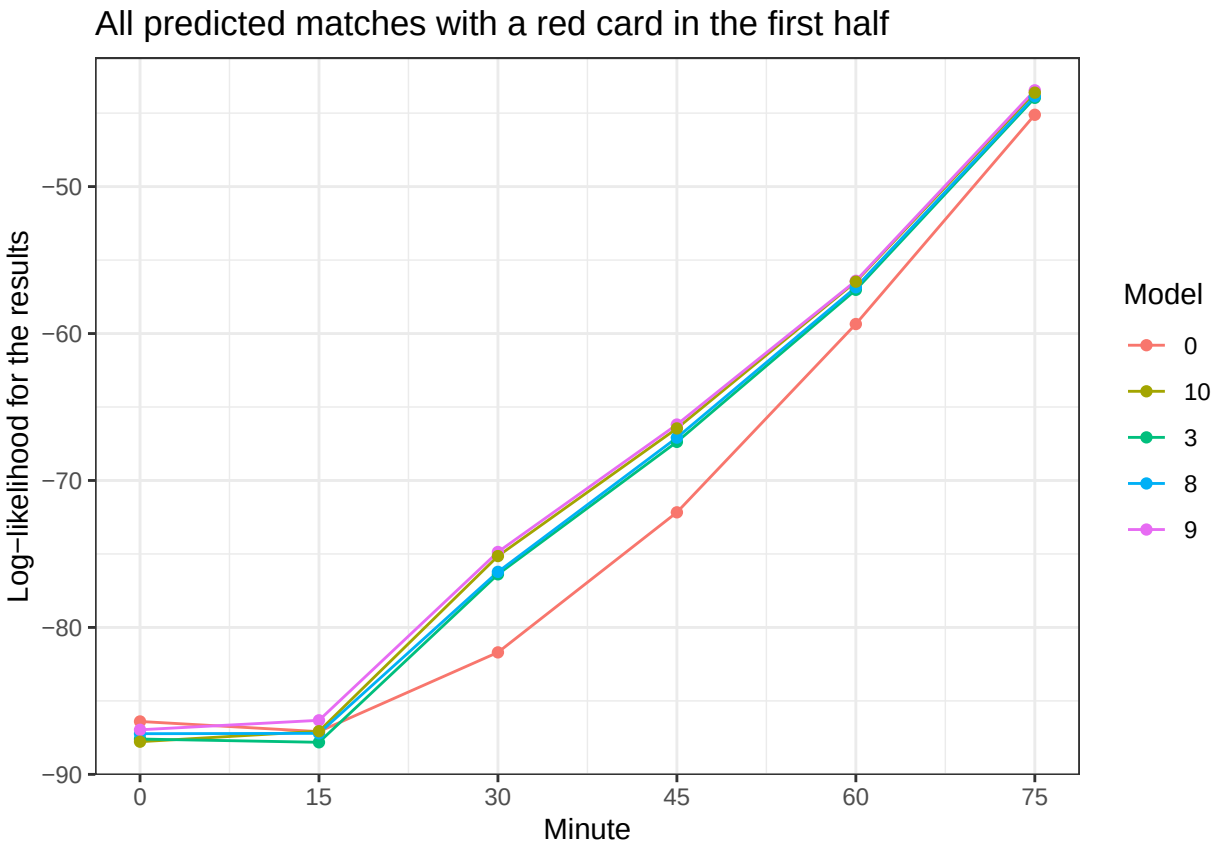
```
HDA_no_reds = HDA %>%
  anti_join(matches)
```

```
## Joining, by = c("Season", "Match")
```

```
nrow(HDA_reds)
```

```
## [1] 82
```

```
results_reds = tibble(GeoMean = apply(HDA_reds[,c(99:128)], 2, function(x) sum(log(x))),
                      Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                      Model = factor(c(rep("0", 6),
                                       rep("3", 6),
                                       rep("8", 6),
                                       rep("9", 6),
                                       rep("10", 6))))
results_reds %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
  theme_bw() +
  ggtitle("All predicted matches with a red card in the first half") +
  ylab("Log-likelihood for the results")
```

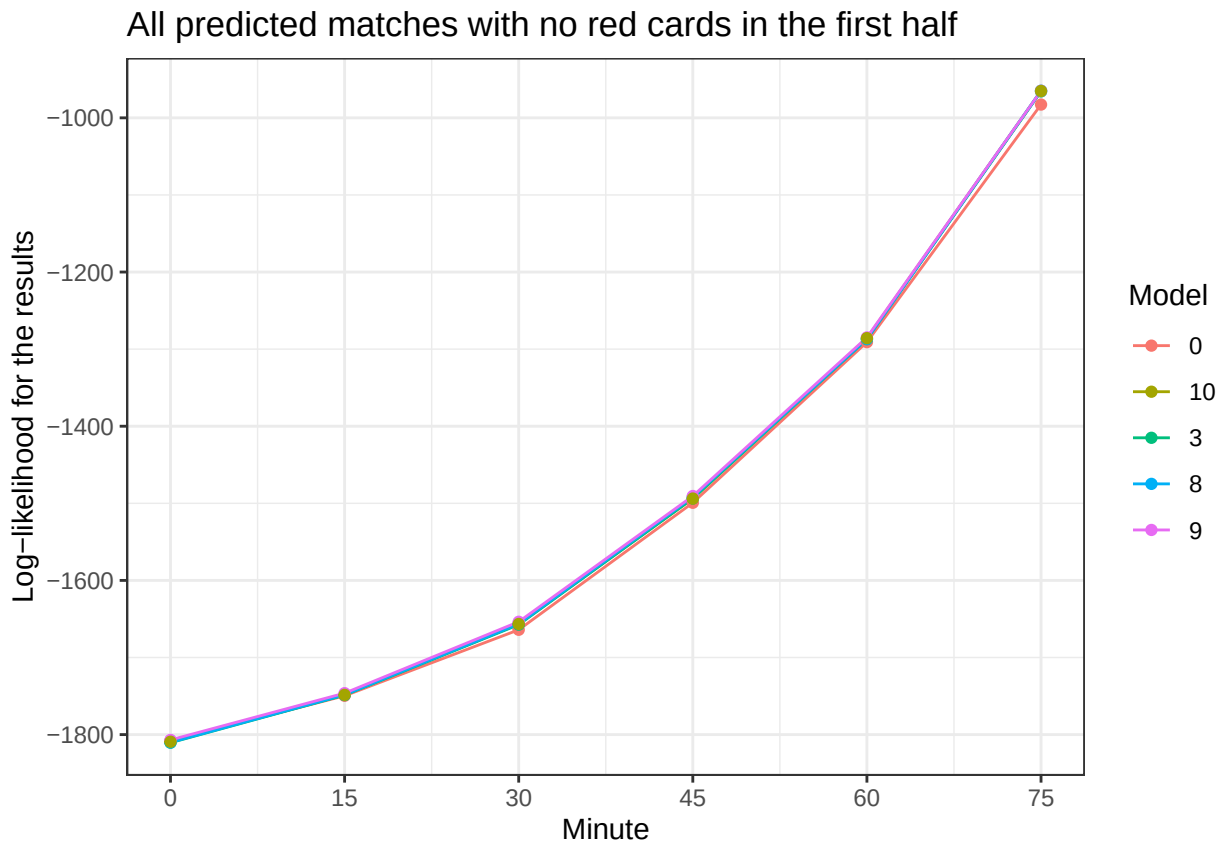



```
results_reds %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-86.39889	-87.09036	-81.69770	-72.16749	-59.35294	-45.11280
3	-87.59528	-87.81794	-76.38645	-67.37333	-57.02580	-43.95818
8	-87.23302	-87.20829	-76.21890	-67.08395	-56.85356	-43.85348
9	-86.96523	-86.32152	-74.86546	-66.19342	-56.41242	-43.44915
10	-87.77694	-87.06382	-75.14452	-66.45706	-56.46960	-43.60584

```
results_no_reds = tibble(GeoMean = apply(HDA_no_reds[,c(99:128)], 2, function(x) sum(log(x))),
                         Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                         Model = factor(c(rep("0", 6),
                                          rep("3", 6),
                                          rep("8", 6),
                                          rep("9", 6),
                                          rep("10", 6))))
results_no_reds %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
```

```
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
  theme_bw() +
  ggtitle("All predicted matches with no red cards in the first half") +
  ylab("Log-likelihood for the results")
```

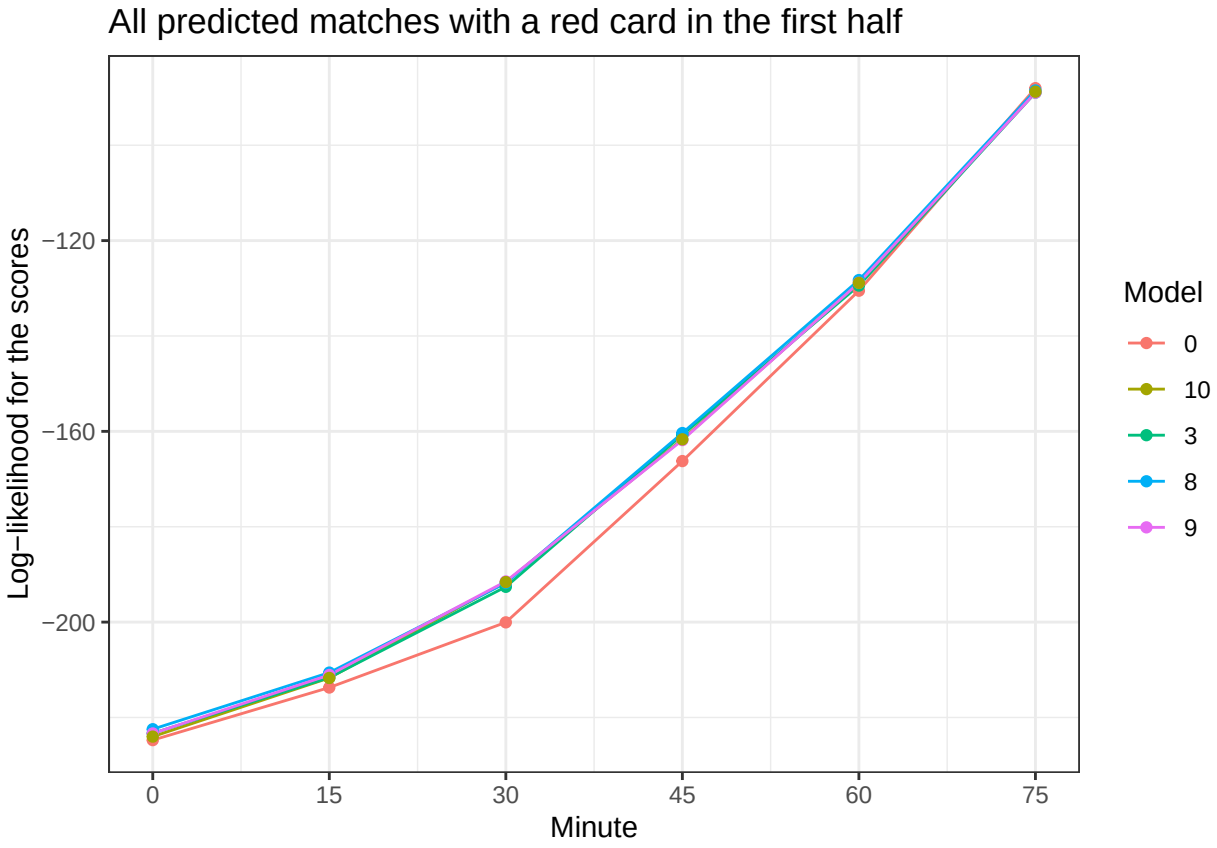



```
results_no_reds %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-1807.660	-1749.691	-1664.040	-1499.304	-1290.946	-982.7744
3	-1810.527	-1748.707	-1657.398	-1493.712	-1287.072	-965.6765
8	-1810.107	-1748.328	-1656.430	-1491.948	-1286.857	-964.8476
9	-1806.915	-1746.257	-1653.648	-1490.539	-1284.802	-964.9718
10	-1809.251	-1748.425	-1656.499	-1493.808	-1285.769	-965.1557

```
scores_reds = tibble(GeoMean = apply(HDA_reds[,c(129:158)], 2, function(x) sum(log(x))),
                     Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                     Model = factor(c(rep("0", 6),
                                      rep("3", 6),
                                      rep("8", 6),
                                      rep("9", 6),
```

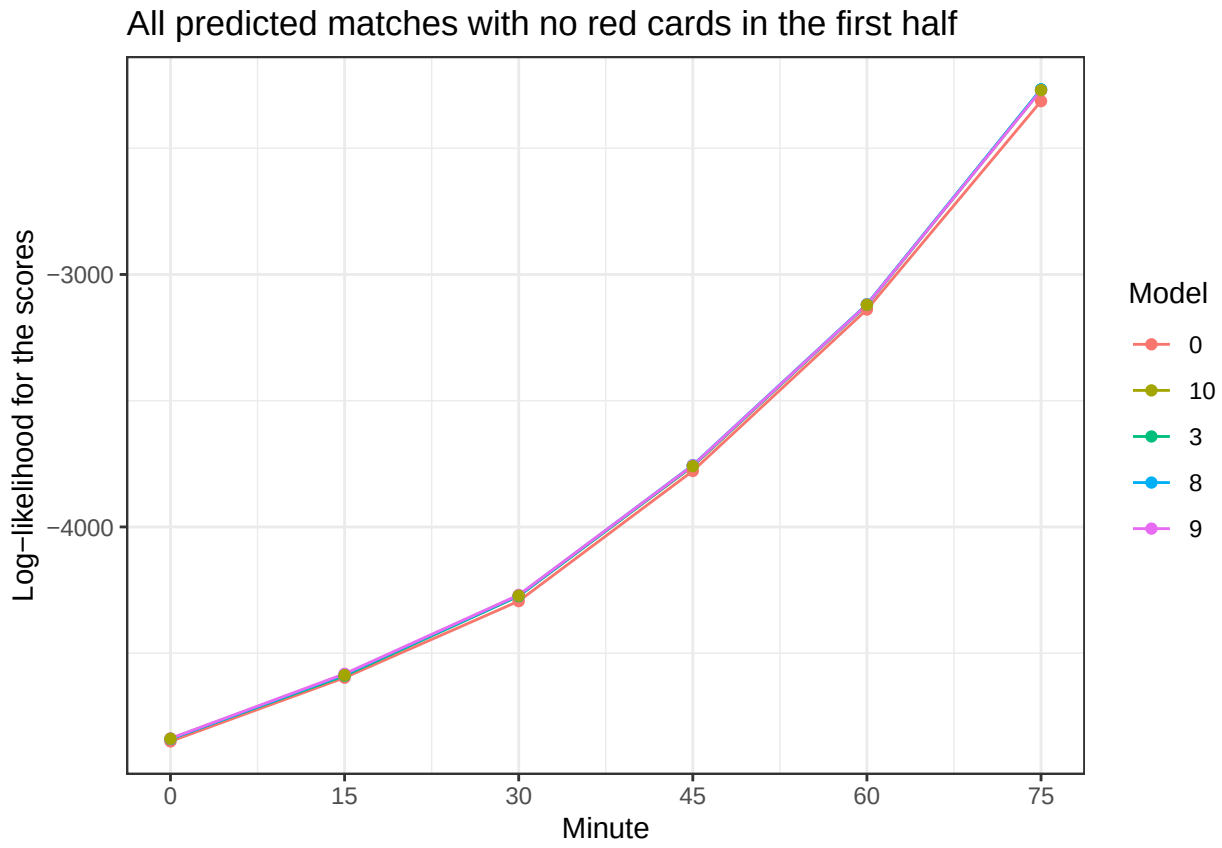
```
                                        rep("10", 6))))
scores_reds %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
  theme_bw() +
  ggtitle("All predicted matches with a red card in the first half") +
  ylab("Log-likelihood for the scores")
```




```
scores_reds %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-224.7456	-213.7180	-200.0498	-166.2344	-130.5081	-88.03192
3	-223.3140	-211.6420	-192.6009	-160.7275	-129.4250	-88.96801
8	-222.4576	-210.5889	-191.7961	-160.3531	-128.2738	-88.51502
9	-223.3485	-211.0858	-191.4733	-161.8324	-128.8539	-88.97006
10	-224.0104	-211.7078	-191.6004	-161.6698	-128.8700	-88.78007

```
scores_no_reds = tibble(GeoMean = apply(HDA_no_reds[,c(129:158)], 2, function(x) sum(log(x))),
                        Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                        Model = factor(c(rep("0", 6),
                                         rep("3", 6),
                                         rep("8", 6),
                                         rep("9", 6),
                                         rep("10", 6))))
scores_no_reds %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
  theme_bw() +
  ggtitle("All predicted matches with no red cards in the first half") +
  ylab("Log-likelihood for the scores")
```




```
scores_no_reds %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

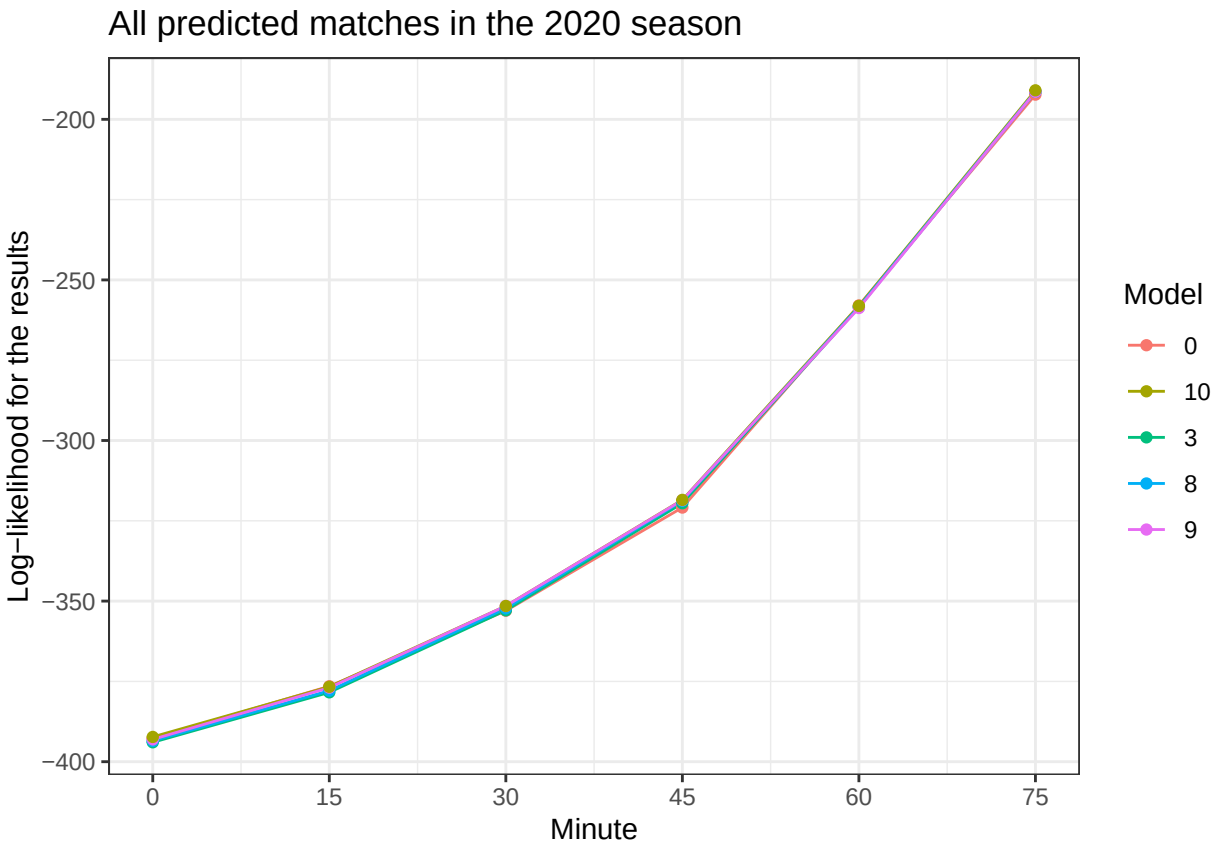
Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-4849.605	-4597.244	-4293.983	-3778.223	-3138.816	-2313.432
3	-4839.652	-4589.291	-4274.195	-3758.295	-3120.482	-2266.970

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
8	-4840.318	-4584.447	-4271.615	-3755.137	-3117.845	-2267.033
9	-4837.799	-4581.799	-4269.475	-3756.197	-3119.328	-2270.364
10	-4838.793	-4586.715	-4272.100	-3759.172	-3120.094	-2270.100

```
HDA_2020 = HDA %>%
  filter(Season == 2020)

nrow(HDA_2020)
```

```
## [1] 376
```

```
results_2020 = tibble(GeoMean = apply(HDA_2020[,c(99:128)], 2, function(x) sum(log(x))),
                      Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                      Model = factor(c(rep("0", 6),
                                       rep("3", 6),
                                       rep("8", 6),
                                       rep("9", 6),
                                       rep("10", 6))))
results_2020 %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
  theme_bw() +
  ggtitle("All predicted matches in the 2020 season") +
  ylab("Log-likelihood for the results")
```

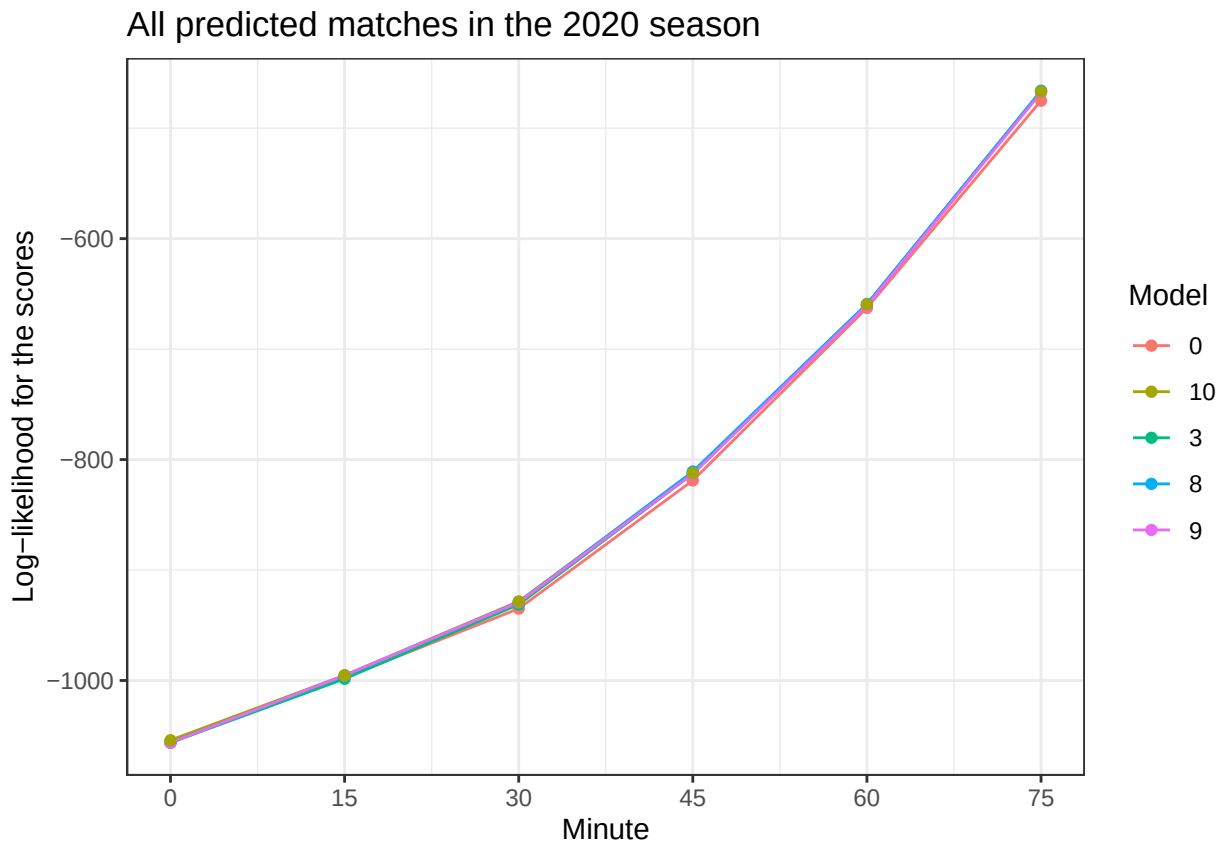



```
results_2020 %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-392.7460	-376.5228	-353.0018	-320.8718	-257.9516	-192.3059
3	-393.9627	-378.4038	-352.8693	-319.5201	-258.4795	-191.4411
8	-393.5374	-377.8929	-352.2666	-318.8197	-258.4200	-191.4105
9	-393.0544	-376.9445	-351.5204	-318.5744	-258.7481	-191.4479
10	-392.2937	-376.6835	-351.5231	-318.4946	-258.0962	-190.9748

```
scores_2020 = tibble(GeoMean = apply(HDA_2020[,c(129:158)], 2, function(x) sum(log(x))),
                     Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                     Model = factor(c(rep("0", 6),
                                      rep("3", 6),
                                      rep("8", 6),
                                      rep("9", 6),
                                      rep("10", 6))))
scores_2020 %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
```

```
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
  theme_bw() +
  ggtitle("All predicted matches in the 2020 season") +
  ylab("Log-likelihood for the scores")
```




```
scores_2020 %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-1055.491	-997.3345	-934.9641	-818.9256	-662.7450	-475.1056
3	-1056.274	-998.4839	-931.1766	-812.8399	-659.9563	-466.1074
8	-1056.283	-995.7604	-929.2553	-810.8645	-659.0949	-466.5382
9	-1056.337	-995.3463	-929.2395	-812.9336	-660.6809	-467.7761
10	-1054.089	-995.2960	-928.4206	-812.0833	-659.5676	-466.9066

```
load("~/GitHub/soccer-live-predictions/soccer-live-predictions/scrape/data/results.RData")
load("~/GitHub/soccer-live-predictions/soccer-live-predictions/scrape/data/goals.RData")
```

```
at_45 = results %>%
  select(Season, Match) %>%
```

```
  filter(Season > 2015)
```

```
home_score_at_45 <- function(season, match) {
  goals %>%
    filter(Season == season,
           Match == match,
           Team == 1,
           Half == 1) %>%
    nrow()
}

away_score_at_45 <- function(season, match) {
  goals %>%
    filter(Season == season,
           Match == match,
           Team == 2,
           Half == 1) %>%
    nrow()
}
```

```
at_45 = at_45 %>%
  rowwise() %>%
  mutate(Home_Score = home_score_at_45(Season, Match),
         Away_Score = away_score_at_45(Season, Match),
         abs_dif = abs(Home_Score - Away_Score))
```

```
tmp_00 = at_45 %>%
  filter(abs_dif == 0) %>%
  select(Season, Match)

HDA_00 = HDA %>%
  inner_join(tmp_00)
```

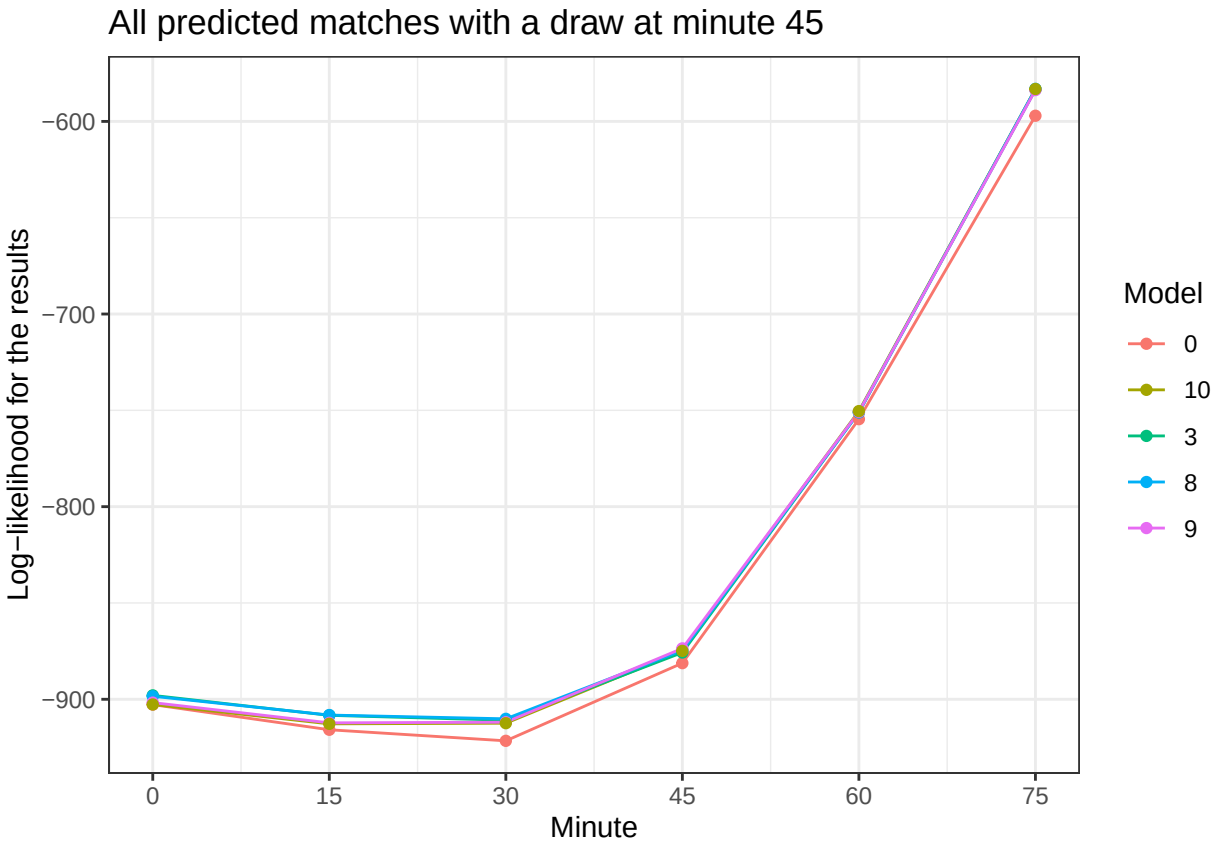
```
## Joining, by = c("Season", "Match")
```

```
nrow(HDA_00)
```

```
## [1] 838
```

```
results_00 = tibble(GeoMean = apply(HDA_00[,c(99:128)], 2, function(x) sum(log(x))),
                    Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                    Model = factor(c(rep("0", 6),
                                     rep("3", 6),
                                     rep("8", 6),
                                     rep("9", 6),
                                     rep("10", 6))))
results_00 %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
```

```
  theme_bw() +
  ggtitle("All predicted matches with a draw at minute 45") +
  ylab("Log-likelihood for the results")
```

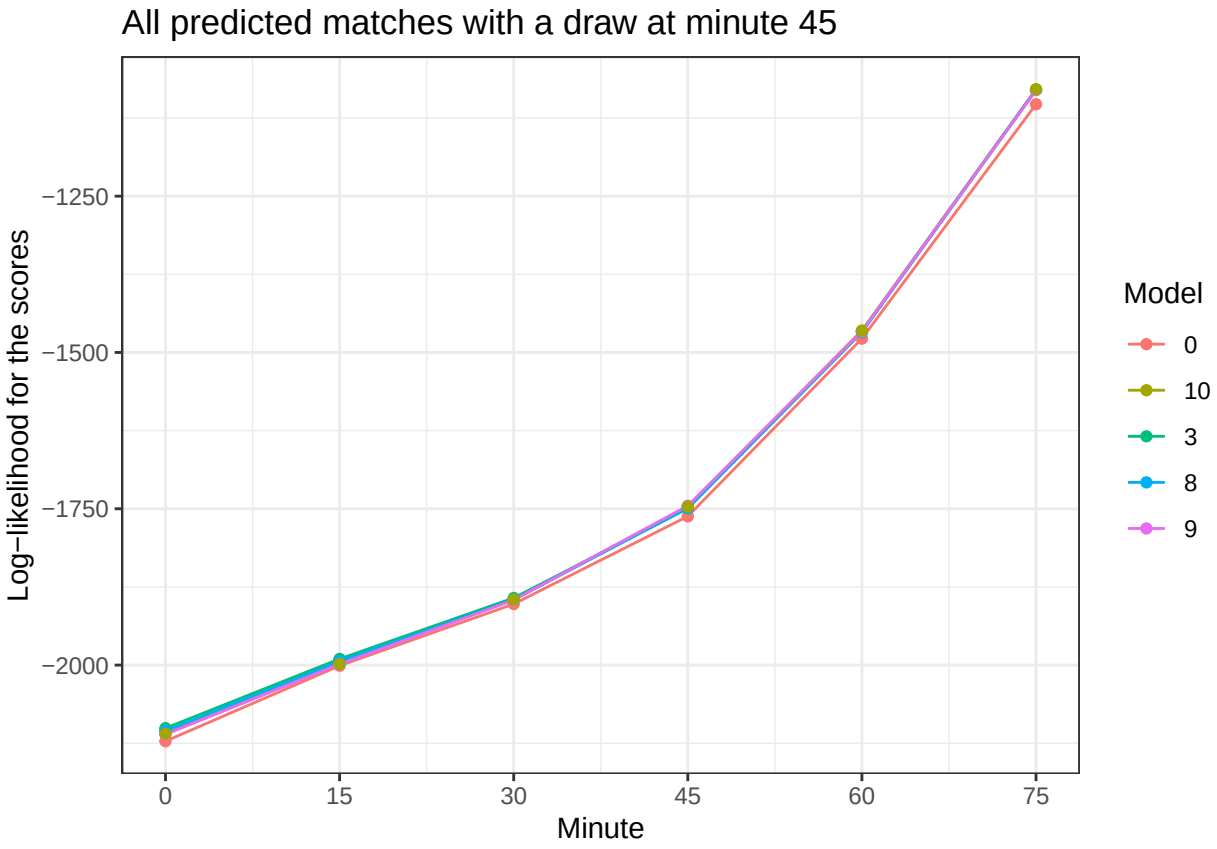



```
results_00 %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-902.7658	-915.8245	-921.5725	-881.2268	-754.5750	-597.0676
3	-897.9724	-908.3310	-910.8699	-875.7226	-750.9649	-583.4323
8	-898.4187	-908.1864	-910.1448	-874.6485	-751.1038	-583.1097
9	-901.7227	-912.2404	-911.8947	-873.5828	-750.7960	-583.7294
10	-902.6936	-912.7449	-912.4151	-874.8786	-750.3941	-583.1738

```
scores_00 = tibble(GeoMean = apply(HDA_00[,c(129:158)], 2, function(x) sum(log(x))),
                   Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                   Model = factor(c(rep("0", 6),
                                    rep("3", 6),
                                    rep("8", 6),
                                    rep("9", 6),
                                    rep("10", 6))))
```

```
scores_00 %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
  theme_bw() +
  ggtitle("All predicted matches with a draw at minute 45") +
  ylab("Log-likelihood for the scores")
```




```
scores_00 %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-2121.766	-2000.989	-1902.337	-1762.070	-1477.846	-1103.107
3	-2100.886	-1990.152	-1892.697	-1749.422	-1467.630	-1080.003
8	-2105.328	-1993.885	-1895.535	-1748.613	-1466.677	-1079.860
9	-2110.787	-1998.569	-1895.848	-1745.241	-1466.134	-1080.228
10	-2109.653	-1998.141	-1895.039	-1746.498	-1464.936	-1079.073

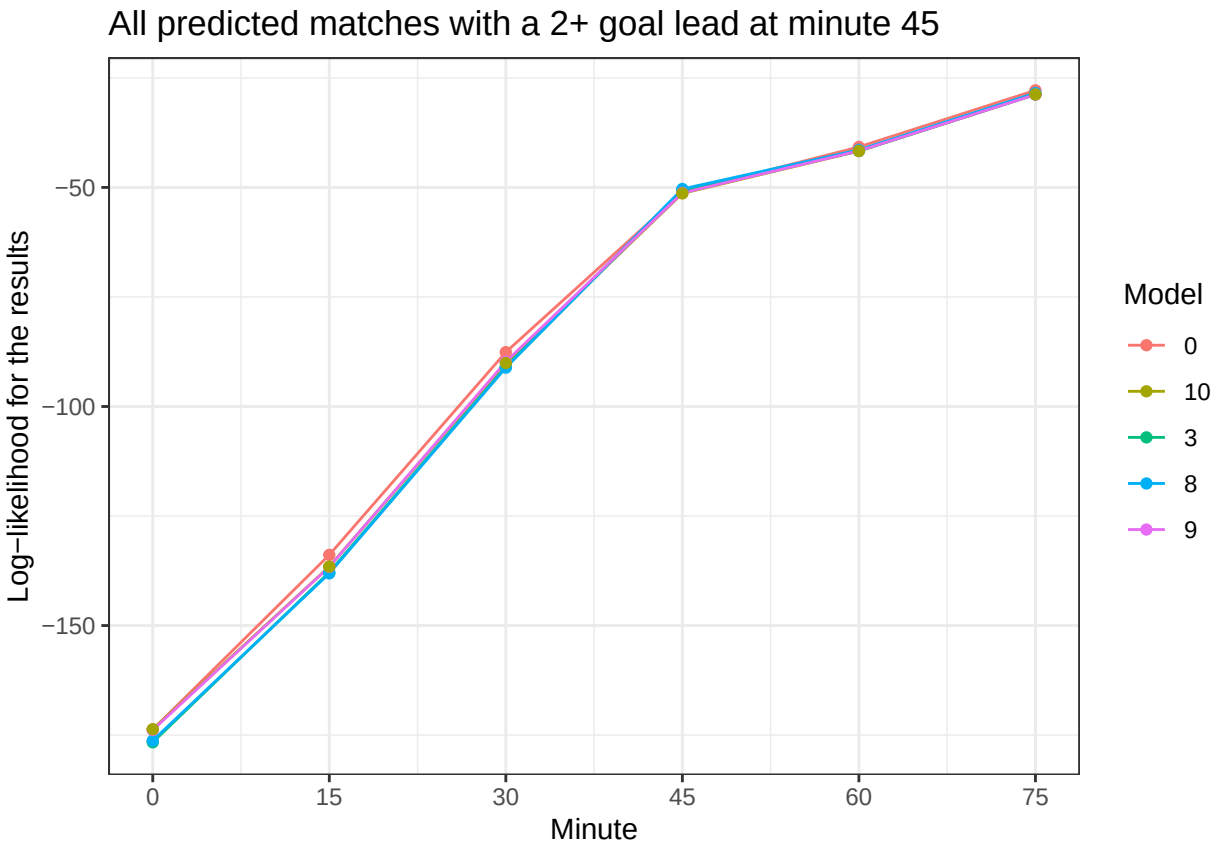
```r
tmp_20 = at_45 %>%
  filter(abs_dif >= 2) %>%
  select(Season, Match)

HDA_20 = HDA %>%
  inner_join(tmp_20)
```

```
## Joining, by = c("Season", "Match")
```

```r
nrow(HDA_20)
```

```
## [1] 211
```

```r
results_20 = tibble(GeoMean = apply(HDA_20[,c(99:128)], 2, function(x) sum(log(x))),
                    Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                    Model = factor(c(rep("0", 6),
                                     rep("3", 6),
                                     rep("8", 6),
                                     rep("9", 6),
                                     rep("10", 6))))
results_20 %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
  theme_bw() +
  ggtitle("All predicted matches with a 2+ goal lead at minute 45") +
  ylab("Log-likelihood for the results")
```

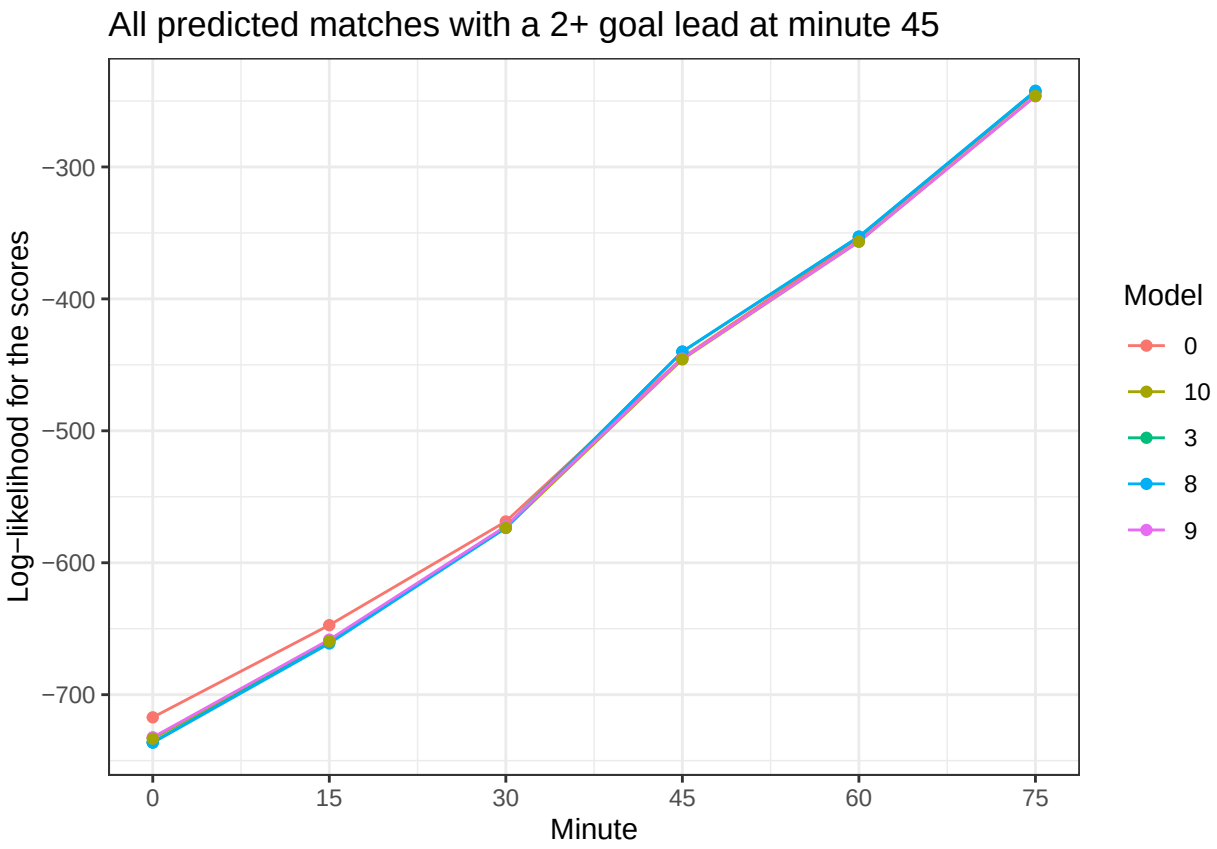



```
results_20 %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-173.7353	-133.8739	-87.59275	-51.10650	-40.75658	-27.83632
3	-176.6505	-137.8371	-90.95153	-50.64963	-41.68297	-28.76964
8	-176.2568	-138.0874	-91.13132	-50.35616	-41.42379	-28.44494
9	-173.8376	-136.6145	-89.77851	-51.24697	-41.65356	-28.80851
10	-173.6601	-136.5441	-90.08435	-51.35908	-41.68896	-28.76662

```
scores_20 = tibble(GeoMean = apply(HDA_20[,c(129:158)], 2, function(x) sum(log(x))),
                   Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                   Model = factor(c(rep("0", 6),
                                    rep("3", 6),
                                    rep("8", 6),
                                    rep("9", 6),
                                    rep("10", 6))))
scores_20 %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
```

```
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
  theme_bw() +
  ggtitle("All predicted matches with a 2+ goal lead at minute 45") +
  ylab("Log-likelihood for the scores")
```




```
scores_20 %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-717.1697	-647.2803	-568.7263	-444.6356	-353.8864	-243.2782
3	-736.0700	-659.9428	-572.8085	-440.1308	-353.0112	-242.7038
8	-736.4039	-661.1561	-573.5857	-439.8871	-352.7707	-242.2486
9	-732.3036	-658.3076	-572.3207	-445.2964	-356.6197	-246.3639
10	-733.3687	-659.5085	-573.5348	-445.8584	-356.6462	-246.1894

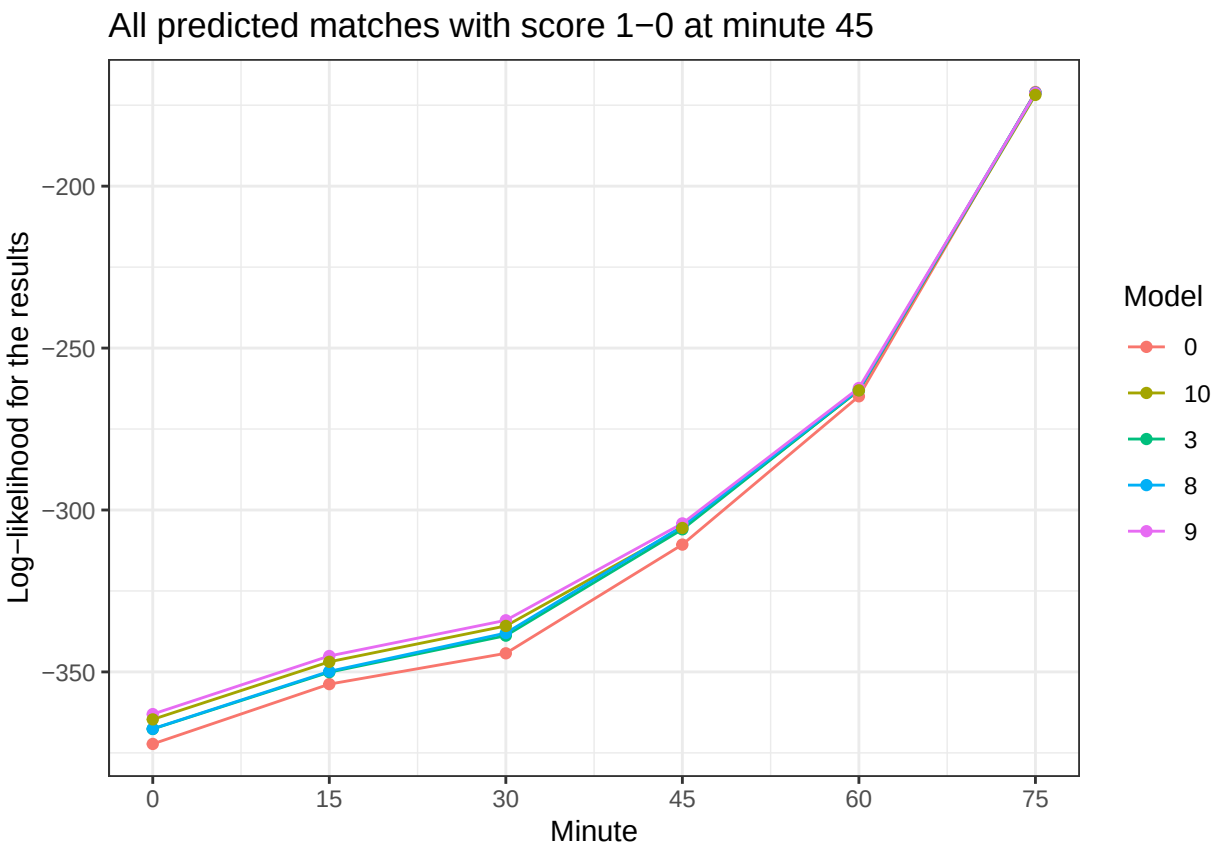
```
tmp_10 = at_45 %>%
  filter(Home_Score == 1, Away_Score == 0) %>%
  select(Season, Match)

HDA_10 = HDA %>%
  inner_join(tmp_10)
```

```
## Joining, by = c("Season", "Match")
```

```
nrow(HDA_10)
```

```
## [1] 435
```

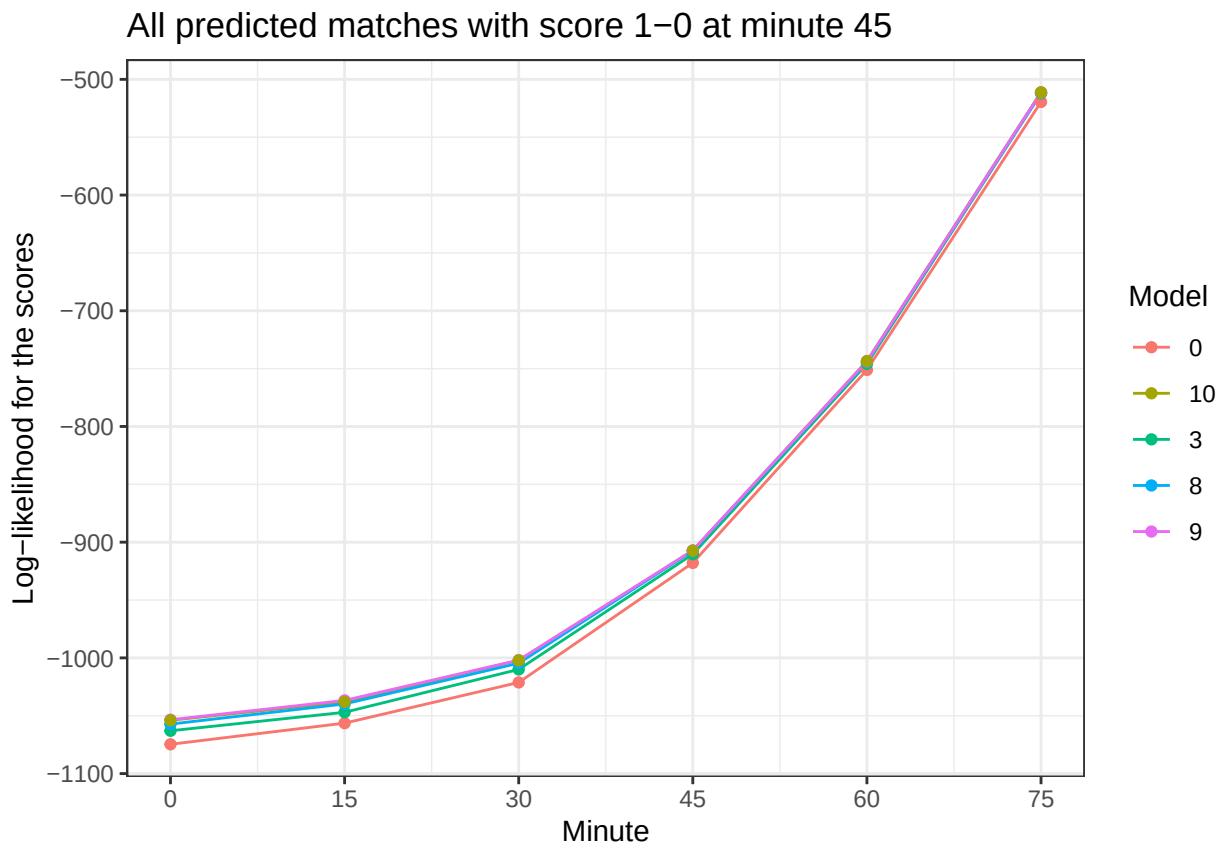
```
results_10 = tibble(GeoMean = apply(HDA_10[,c(99:128)], 2, function(x) sum(log(x))),
                    Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                    Model = factor(c(rep("0", 6),
                                     rep("3", 6),
                                     rep("8", 6),
                                     rep("9", 6),
                                     rep("10", 6))))
results_10 %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
  theme_bw() +
  ggtitle("All predicted matches with score 1-0 at minute 45") +
  ylab("Log-likelihood for the results")
```



```
results_10 %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-372.2427	-353.7677	-344.2547	-310.6817	-264.8907	-170.9251
3	-367.6256	-350.0810	-338.7987	-305.9667	-262.9895	-171.1665
8	-367.5560	-349.8253	-337.9992	-305.0230	-262.8248	-171.2397
9	-363.0284	-345.0857	-334.0576	-304.1477	-262.3258	-171.2662
10	-364.6568	-346.8744	-335.8025	-305.5645	-263.0488	-171.8220

```
scores_10 = tibble(GeoMean = apply(HDA_10[,c(129:158)], 2, function(x) sum(log(x))),
                   Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                   Model = factor(c(rep("0", 6),
                                    rep("3", 6),
                                    rep("8", 6),
                                    rep("9", 6),
                                    rep("10", 6))))
scores_10 %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
  theme_bw() +
  ggtitle("All predicted matches with score 1-0 at minute 45") +
  ylab("Log-likelihood for the scores")
```




```
scores_10 %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-1074.690	-1056.397	-1021.226	-917.8969	-751.1301	-519.5144
3	-1062.997	-1047.014	-1009.966	-910.3980	-745.8785	-512.0884
8	-1057.237	-1039.814	-1004.584	-907.4385	-744.2721	-511.6069
9	-1053.449	-1036.758	-1001.964	-907.0905	-743.6770	-511.3045
10	-1053.938	-1038.029	-1002.177	-907.3868	-743.5260	-511.2217

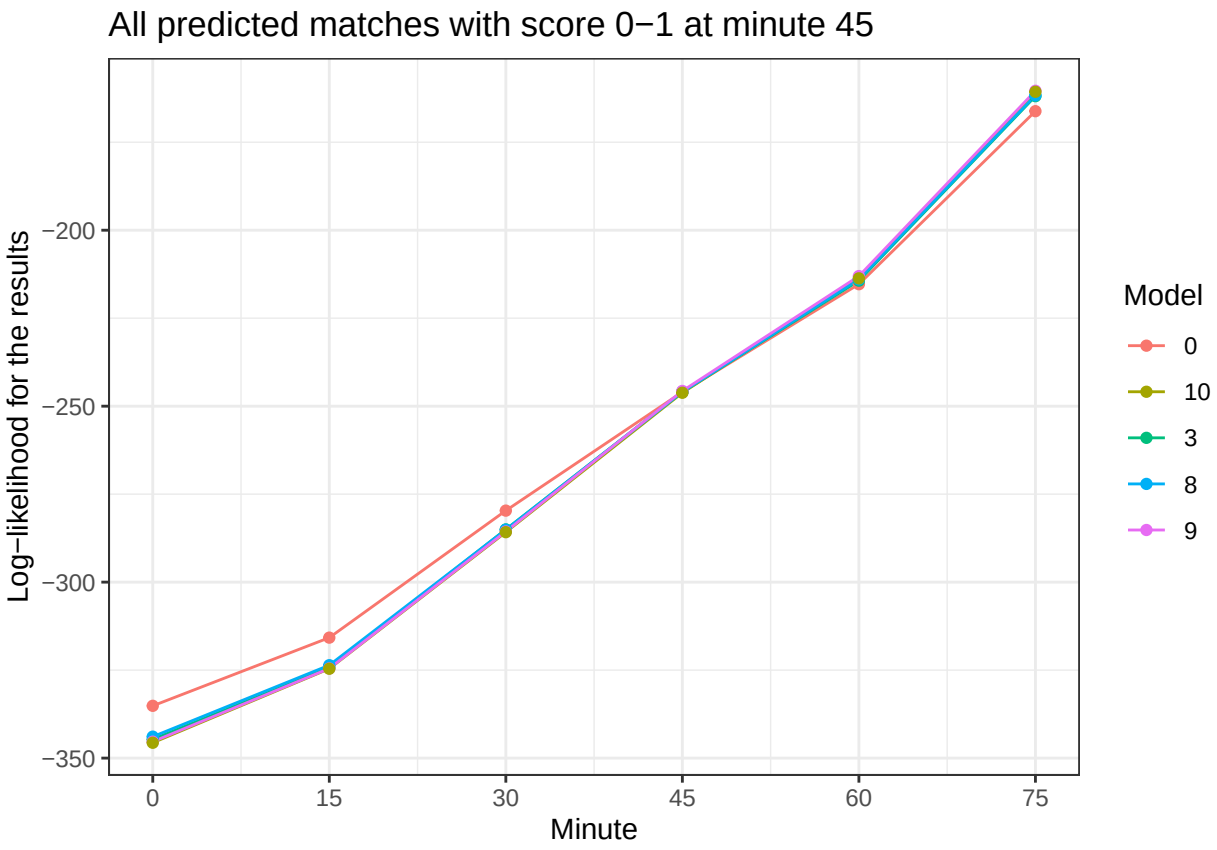
```
tmp_01 = at_45 %>%
  filter(Home_Score == 0, Away_Score == 1) %>%
  select(Season, Match)

HDA_01 = HDA %>%
  inner_join(tmp_01)
```

```
## Joining, by = c("Season", "Match")
```

```
nrow(HDA_01)
```

```
## [1] 275
```

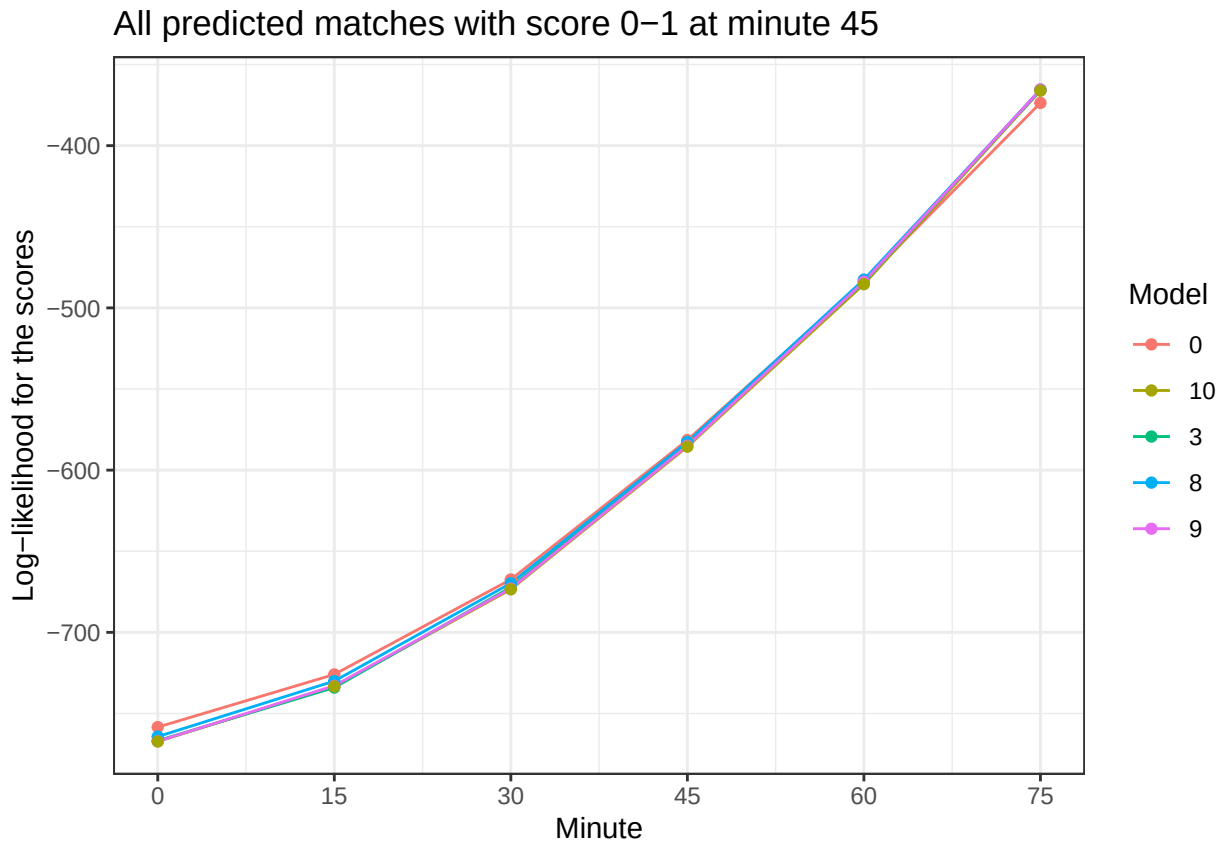
```
results_01 = tibble(GeoMean = apply(HDA_01[,c(99:128)], 2, function(x) sum(log(x))),
                    Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                    Model = factor(c(rep("0", 6),
                                     rep("3", 6),
                                     rep("8", 6),
                                     rep("9", 6),
                                     rep("10", 6))))
results_01 %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
  theme_bw() +
  ggtitle("All predicted matches with score 0-1 at minute 45") +
  ylab("Log-likelihood for the results")
```




```
results_01 %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-335.1443	-315.7691	-279.6751	-245.9715	-215.3384	-166.1779
3	-344.6697	-324.2699	-285.0199	-245.9150	-214.3330	-161.9034
8	-343.9100	-323.6013	-285.0870	-245.9352	-213.9646	-161.6828
9	-345.3362	-324.5227	-285.6121	-245.6770	-213.0394	-160.3833
10	-345.6381	-324.6014	-285.8036	-246.1892	-213.6820	-160.6602

```
scores_01 = tibble(GeoMean = apply(HDA_01[,c(129:158)], 2, function(x) sum(log(x))),
                   Minute = as.integer(rep(c(0, 15, 30, 45, 60, 75), 5)),
                   Model = factor(c(rep("0", 6),
                                    rep("3", 6),
                                    rep("8", 6),
                                    rep("9", 6),
                                    rep("10", 6))))
scores_01 %>%
  ggplot(aes(x = Minute, y = GeoMean, col = Model)) +
  geom_line() +
  geom_point() +
  scale_x_continuous(breaks = c(0, 15, 30, 45, 60, 75)) +
  theme_bw() +
  ggtitle("All predicted matches with score 0-1 at minute 45") +
  ylab("Log-likelihood for the scores")
```



```
scores_01 %>%
  pivot_wider(id_cols = "Model", values_from = "GeoMean", names_from = "Minute",
              names_prefix = "Minute ") %>%
  kable()
```

Model	Minute 0	Minute 15	Minute 30	Minute 45	Minute 60	Minute 75
0	-758.3881	-725.9194	-667.3898	-581.4862	-483.6955	-373.6684
3	-766.7444	-734.0147	-672.2180	-583.0233	-484.1150	-365.4573
8	-764.2391	-730.0189	-669.7561	-582.6695	-482.5619	-365.7556
9	-767.1044	-732.9006	-672.9539	-584.8884	-483.8653	-365.4002
10	-767.2405	-733.3057	-673.4797	-585.5545	-485.3760	-366.1233