Improving-Dodgers-Attendance

February 1, 2025

[1]:

```
## Chris Kellogg

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##
## Using Data to Improve MLB Attendance
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##
## In this assignment, you will be using data on the Los Angeles Dodgers Major
## League Baseball (MLB) team located here: dodgers.csv.
##
## Use this data to make a recommendation to management on how to improve
## attendance. Tell a story with your analysis and clearly explain the steps
## you take to arrive at your conclusion.
##
## This is an open-ended question, and there is no one right answer. You are
## welcome to do additional research and/or use domain knowledge to assist
## your analysis, but clearly state any assumptions you make.
##
```

[2]:

```
##
## load necessary packages
##

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

[3]:

```
##
## read the Dodgers data
##

## read the data into a "golden record" copy
df_pristine = pd.read_csv('dodgers-2022.csv')
```

```
# preview the "golden record"
df_pristine
```

[3]:

```
   month  day  attend day_of_week opponent  temp   skies day_night cap shirt  \
0    APR   10   56000     Tuesday  Pirates    67  Clear        Day  NO    NO
1    APR   11   29729   Wednesday  Pirates    58  Cloudy      Night  NO    NO
2    APR   12   28328    Thursday  Pirates    57  Cloudy      Night  NO    NO
3    APR   13   31601      Friday   Padres    54  Cloudy      Night  NO    NO
4    APR   14   46549    Saturday   Padres    57  Cloudy      Night  NO    NO
..   …  …     …         …      …   …     …       …  ..   …
76   SEP   29   40724    Saturday  Rockies    84  Cloudy      Night  NO    NO
77   SEP   30   35607      Sunday  Rockies    95  Clear        Day  NO    NO
78   OCT    1   33624      Monday   Giants    86  Clear      Night  NO    NO
79   OCT    2   42473     Tuesday   Giants    83  Clear      Night  NO    NO
80   OCT    3   34014   Wednesday   Giants    82  Cloudy      Night  NO    NO

   fireworks bobblehead
0          NO         NO
1          NO         NO
2          NO         NO
3         YES         NO
4          NO         NO
..       …        …
76         NO         NO
77         NO         NO
78         NO         NO
79         NO         NO
80         NO         NO

[81 rows x 12 columns]
```

The first note we should make is that this file seems to be misnamed.
These dates and attendance numbers are from the Dodgers' 2012 season.

[4]:

```
##
## make a working copy
##

# make a working copy of the data (just in case)
df = df_pristine.copy()

# turn the YES/NO promo strings into a 0/1 flag
df.cap = df.apply(
    lambda row: 1 if row.cap == 'YES' else 0,
    axis=1
)
df.shirt = df.apply(
    lambda row: 1 if row.shirt == 'YES' else 0,
    axis=1
)
df.fireworks = df.apply(
    lambda row: 1 if row.fireworks == 'YES' else 0,
    axis=1
)
df.bobblehead = df.apply(
    lambda row: 1 if row.bobblehead == 'YES' else 0,
    axis=1
)

# add a column to indicate if any promotional was active that day
df['is_promo'] = df[['cap','shirt','fireworks','bobblehead',]].max(axis=1)

# add a column to indicate if any promotional was active that day
df['promo'] = df.apply(
    lambda row: 'promo' if row.is_promo == 1 else 'no promo',
    axis=1
)

# turn the day_night string into a 0/1 flag
df['is_night_game'] = df.apply(
    lambda row: 1 if row.day_night == 'Night' else 0,
    axis=1
)

# preview the master data
df
```

[4]:

```
   month  day  attend day_of_week opponent  temp   skies day_night  cap  \
0    APR   10   56000     Tuesday  Pirates    67  Clear        Day    0
1    APR   11   29729   Wednesday  Pirates    58  Cloudy     Night    0
2    APR   12   28328    Thursday  Pirates    57  Cloudy     Night    0
3    APR   13   31601      Friday   Padres    54  Cloudy     Night    0
4    APR   14   46549    Saturday   Padres    57  Cloudy     Night    0
..   …   …     …         …      …    …     …        …  …
76   SEP   29   40724    Saturday  Rockies    84  Cloudy     Night    0
77   SEP   30   35607      Sunday  Rockies    95  Clear        Day    0
78   OCT    1   33624      Monday   Giants    86  Clear      Night    0
79   OCT    2   42473     Tuesday   Giants    83  Clear      Night    0
80   OCT    3   34014   Wednesday   Giants    82  Cloudy     Night    0

    shirt  fireworks  bobblehead  is_promo     promo  is_night_game
0       0          0           0         0  no promo              0
1       0          0           0         0  no promo              1
2       0          0           0         0  no promo              1
```

```
3       0           1           0         1     promo               1
4       0           0           0         0  no promo               1
..    …         …         …       …       …            …
76      0           0           0         0  no promo               1
77      0           0           0         0  no promo               0
78      0           0           0         0  no promo               1
79      0           0           0         0  no promo               1
80      0           0           0         0  no promo               1

[81 rows x 15 columns]
```

[5]:

```
##
## First, let's take a couple subsets of the most-attended games. Maybe
## we'll find that there's something glaringly obvious that they all
## have in common, and we can knock off early.
##

# grab just the top 20 games by attendance
df_top_20 = df.sort_values(['attend'], ascending=False).head(20)

# grab just the top 20 games by attendance
df_top_40 = df.sort_values(['attend'], ascending=False).head(40)

# preview the top 20 games, by attendance
df_top_20
```

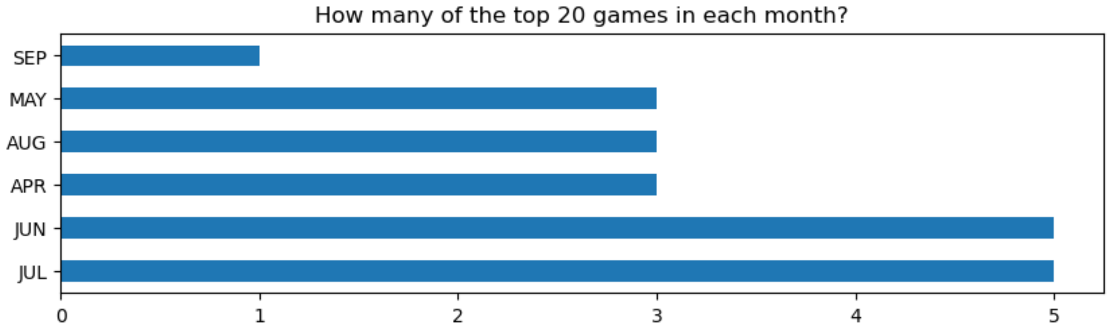
[5]:

```
   month  day  attend day_of_week    opponent  temp   skies day_night  cap  \
0    APR   10   56000     Tuesday     Pirates    67  Clear        Day    0
59   AUG   21   56000     Tuesday      Giants    75  Clear      Night    0
39   JUL    1   55359      Sunday        Mets    75  Clear      Night    0
31   JUN   12   55279     Tuesday      Angels    66  Cloudy     Night    0
56   AUG    7   55024     Tuesday     Rockies    80  Clear      Night    0
64   AUG   30   54621    Thursday      Snakes    80  Clear      Night    0
10   APR   28   54242    Saturday   Nationals    71  Clear      Night    0
44   JUL   14   54014    Saturday      Padres    75  Clear      Night    0
42   JUL    4   53570   Wednesday        Reds    70  Clear      Night    0
35   JUN   17   53504      Sunday   White Sox    74  Clear        Day    0
47   JUL   17   53498     Tuesday    Phillies    70  Clear      Night    0
50   JUL   31   52832     Tuesday      Snakes    75  Cloudy     Night    0
27   MAY   29   51137     Tuesday     Brewers    74  Clear      Night    0
70   SEP    5   50560   Wednesday      Padres    77  Cloudy     Night    0
30   JUN   11   50559      Monday      Angels    68  Clear      Night    0
37   JUN   29   49763      Friday        Mets    72  Clear      Night    0
17   MAY   13   49124      Sunday     Rockies    70  Clear        Day    0
36   JUN   28   49006    Thursday        Mets    75  Clear      Night    0
11   APR   29   48753      Sunday   Nationals    74  Clear        Day    0
19   MAY   15   47077     Tuesday      Snakes    70  Clear      Night    0
```

```
    shirt  fireworks  bobblehead  is_promo     promo  is_night_game
0       0          0           0         0  no promo              0
59      0          0           1         1     promo              1
39      0          0           1         1     promo              1
31      0          0           1         1     promo              1
56      0          0           1         1     promo              1
64      0          0           1         1     promo              1
10      0          0           1         1     promo              1
44      0          0           1         1     promo              1
42      0          1           0         1     promo              1
35      0          0           0         0  no promo              0
47      0          0           0         0  no promo              1
50      0          0           1         1     promo              1
27      0          0           1         1     promo              1
70      0          0           0         0  no promo              1
30      1          0           0         1     promo              1
37      0          1           0         1     promo              1
17      0          0           0         0  no promo              0
36      0          0           1         1     promo              1
11      1          0           0         1     promo              0
19      0          0           1         1     promo              1
```

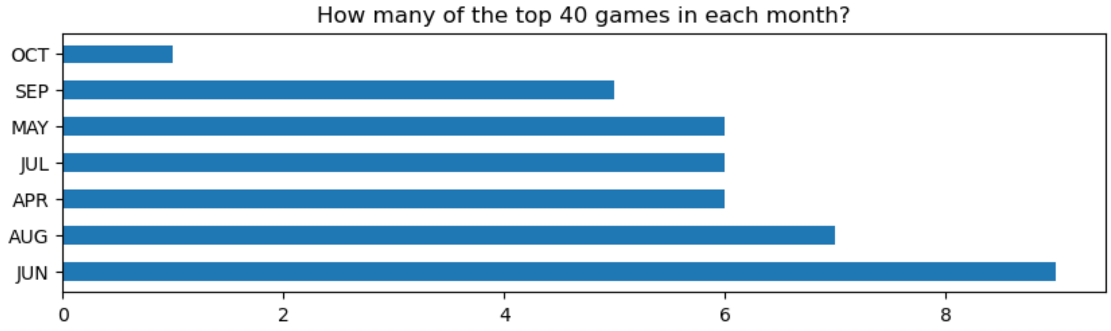
[6]:

```python
##
## let's look at what month the games are played in
##

# get distribution of the top 20 dates by month
top_20_by_month = df_top_20.month.value_counts()

# plot the top 20 dates by month
fig = plt.figure(figsize=(10, 2.5))
plt.barh(top_20_by_month.index, top_20_by_month, height=0.5)
plt.title('How many of the top 20 games in each month?')
plt.show()
```



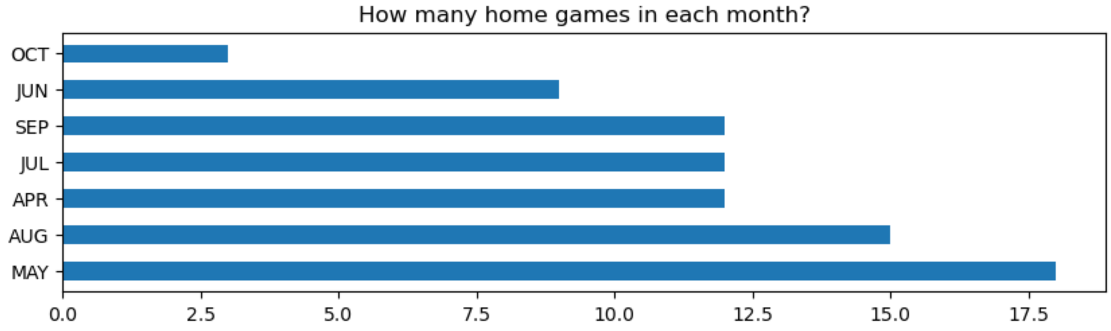
[7]:

```python
# get distribution of the top 40 dates by month
top_40_by_month = df_top_40.month.value_counts()

# plot the top 40 dates by month
fig = plt.figure(figsize=(10, 2.5))
plt.barh(top_40_by_month.index, top_40_by_month, height=0.5)
plt.title('How many of the top 40 games in each month?')
plt.show()
```



[8]:

```python
# get distribution of all home dates by month
all_by_month = df.month.value_counts()

# plot all home dates by month
fig = plt.figure(figsize=(10, 2.5))
plt.barh(all_by_month.index, all_by_month, height=0.5)
plt.title('How many home games in each month?')
plt.show()
```



Well, there's something interesting. The Dodgers only played 9 home games in June, and all 9 of them are in the top 40 (which is the top half of the 81 home dates. And more than half of those

June games were in the top 20 in attendance! Let's just take a quick peek at all the June games (sorted by attendance, highest to lowest) and see if there's anything interesting to note.

[9]:

```
# distribution of all the June dates
df_jun = df.query('month == "JUN"').sort_values(['attend'], ascending=False)

df_jun
```

[9]:

```
   month  day  attend day_of_week   opponent  temp   skies day_night  cap  \
31   JUN   12   55279     Tuesday     Angels    66  Cloudy     Night    0
35   JUN   17   53504      Sunday  White Sox    74  Clear        Day    0
30   JUN   11   50559      Monday     Angels    68  Clear      Night    0
37   JUN   29   49763      Friday       Mets    72  Clear      Night    0
36   JUN   28   49006    Thursday       Mets    75  Clear      Night    0
34   JUN   16   45210    Saturday  White Sox    68  Clear      Night    0
38   JUN   30   44217    Saturday       Mets    78  Clear        Day    0
32   JUN   13   43494   Wednesday     Angels    67  Clear      Night    0
33   JUN   15   40432      Friday  White Sox    67  Clear      Night    0

    shirt  fireworks  bobblehead  is_promo     promo  is_night_game
31      0          0           1         1     promo              1
35      0          0           0         0  no promo              0
30      1          0           0         1     promo              1
37      0          1           0         1     promo              1
36      0          0           1         1     promo              1
34      0          0           0         0  no promo              1
38      0          0           0         0  no promo              0
32      0          0           0         0  no promo              1
33      0          1           0         1     promo              1
```

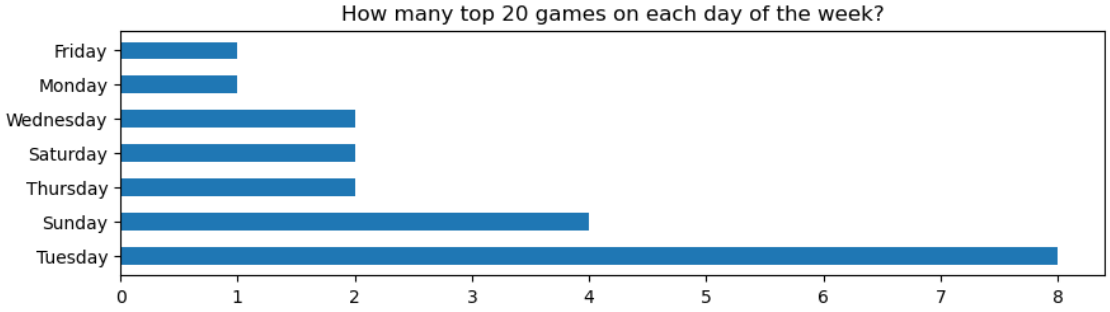
[10]:

```
# check the mean temperatures
print (
    'Mean temperature of:' + '\n' +
    'all games -- ' + str(round(df.temp.mean(),2)) + '\n' +
    'top 40 games -- ' + str(round(df_top_40.temp.mean(),2)) + '\n' +
    'top 20 games -- ' + str(round(df_top_20.temp.mean(),2)) + '\n' +
    'June games -- ' + str(round(df_jun.temp.mean(),2))
)
```

```
Mean temperature of:
all games -- 73.15
top 40 games -- 73.45
top 20 games -- 72.9
June games -- 70.56
```

None of the teams that the Dodgers played in June 2012 were playoff teams that year. It was several degrees cooler in June, but most of the games were at night, so that's not a huge surprise. While we really can't recommend to the Dodgers that they should drive attendance by playing all their games in June, it probably would be a good idea to explore the possibility of having one or two more series in June (like they did in May and August). I'm sure every team would prefer more June and July home games, when school is out, but it's worth noting.

```
[11]: ##
      ## let's look at what day of week the games are played on
      ##

      # get distribution of all home dates by month
      top_20_by_day = df_top_20.day_of_week.value_counts()

      # plot all home dates by month
      fig = plt.figure(figsize=(10, 2.5))
      plt.barh(top_20_by_day.index, top_20_by_day, height=0.5)
      plt.title('How many top 20 games on each day of the week?')
      plt.show()
```



Wow. Eight (or about 40%) of the top 20 dates are Tuesdays. I wouldn't have guessed that Tuesdays would be that popular, so I went looking for something to help me put it in perspective. According to a research project I found online (Puzzanghera), the weekend games (Friday, Saturday, and Sunday) are consistently the most well-attended games, and Tuesdays have, league-wide, the lowest mean attendance. We should investigate what makes Tuesdays at Dodger stadium so popular.

Reference Puzzanghera, S. (n.d.). Game Attendance in Major League Baseball. https://rstudio-pubs-static.s3.amazonaws.com/609595_749e7aa53bd54c35b0fb480388d3cb57.html

```
[12]: # dataset of all the Tuesdays
      df_tuesday = df \
          .query('day_of_week == "Tuesday"') \
          .sort_values(['attend'], ascending=False)

      df_tuesday
```

```
[12]:    month  day  attend day_of_week  opponent  temp   skies day_night  cap  \
      0    APR   10   56000     Tuesday   Pirates    67  Clear         Day    0
      59   AUG   21   56000     Tuesday    Giants    75  Clear       Night    0
      31   JUN   12   55279     Tuesday    Angels    66  Cloudy      Night    0
```

```
56   AUG   7  55024    Tuesday   Rockies   80  Clear     Night    0
47   JUL  17  53498    Tuesday  Phillies   70  Clear     Night    0
50   JUL  31  52832    Tuesday    Snakes   75  Cloudy    Night    0
27   MAY  29  51137    Tuesday   Brewers   74  Clear     Night    0
19   MAY  15  47077    Tuesday    Snakes   70  Clear     Night    0
7    APR  24  44014    Tuesday    Braves   63  Cloudy    Night    0
79   OCT   2  42473    Tuesday    Giants   83  Clear     Night    0
69   SEP   4  40619    Tuesday    Padres   78  Clear     Night    0
41   JUL   3  33884    Tuesday      Reds   70  Cloudy    Night    1
13   MAY   8  32799    Tuesday    Giants   75  Clear     Night    0

    shirt  fireworks  bobblehead  is_promo     promo  is_night_game
0       0          0           0         0  no promo              0
59      0          0           1         1     promo              1
31      0          0           1         1     promo              1
56      0          0           1         1     promo              1
47      0          0           0         0  no promo              1
50      0          0           1         1     promo              1
27      0          0           1         1     promo              1
19      0          0           1         1     promo              1
7       0          0           0         0  no promo              1
79      0          0           0         0  no promo              1
69      1          0           0         1     promo              1
41      0          0           0         1     promo              1
13      0          0           0         0  no promo              1
```

Hey! Six of the 13 Tuesdays at Dodger Stadium in 2012 were bobblehead give-aways, and they were (probably not by chance) 6 of the 8 best attended Tuesdays. April 10 was the home opener for the Dodgers in 2012, in a year when the team was changing ownership and the new owners had spent BIG in free agency, so it should come as no real surprise that it was a sellout, even with no promo. Maybe we should see if Tuesdays had a disproportionate number of promotional events.

[13]:

```
# check ratios of promos
print (
    'Percentage of dates that are promos:' + '\n' +
    'all games -- ' +
    str(len(df.query('is_promo==1'))) + ' / ' +
    str(len(df)) + ' = ' +
    str(round(len(df.query('is_promo==1'))/len(df),2)) + '\n' +
    'top 20 games -- ' +
    str(len(df_top_20.query('is_promo==1'))) + ' / ' +
    str(len(df_top_20)) + ' = ' +
    str(round(len(df_top_20.query('is_promo==1'))/len(df_top_20),2)) + '\n' +
    'top 40 games -- ' +
    str(len(df_top_40.query('is_promo==1'))) + ' / ' +
    str(len(df_top_40)) + ' = ' +
    str(round(len(df_top_40.query('is_promo==1'))/len(df_top_40),2)) + '\n' +
    'Tuesdays -- ' +
    str(len(df_tuesday.query('is_promo==1'))) + ' / ' +
    str(len(df_tuesday)) + ' = ' +
    str(round(len(df_tuesday.query('is_promo==1'))/len(df_tuesday),2))
)
```

```
Percentage of dates that are promos:
all games -- 30 / 81 = 0.37
top 20 games -- 15 / 20 = 0.75
top 40 games -- 22 / 40 = 0.55
Tuesdays -- 8 / 13 = 0.62
```

Here's something meaty to investigate. Not only do Tuesdays have a heavier dose of promos than the overall schedule, but 75% the top 20 games in attendance were promotionals! Let's look for the correlation between promos and attendance.

[14]:

```
df[['attend','is_promo','cap','shirt','fireworks','bobblehead']].
  ↪corr()[['attend']]
```

[14]:

```
               attend
attend       1.000000
is_promo     0.448887
cap         -0.055002
shirt        0.133269
fireworks    0.002094
bobblehead   0.581895
```

The correlation between attendance and promos (especially bobbleheads) is notable. It also looks like most of the top 20 games were night games. Let's take a peek at that.

[15]:

```
# check ratios of promos
print (
    'Percentage of dates that are night games:' + '\n' +
    'all games -- ' +
    str(len(df.query('is_night_game==1'))) + ' / ' +
    str(len(df)) + ' = ' +
    str(round(len(df.query('is_night_game==1'))/len(df),2)) + '\n' +
    'top 20 games -- ' +
    str(len(df_top_20.query('is_night_game==1'))) + ' / ' +
    str(len(df_top_20)) + ' = ' +
    str(round(len(df_top_20.query('is_night_game==1'))/len(df_top_20),2)) +␣
  ↪'\n' +
    'top 40 games -- ' +
    str(len(df_top_40.query('is_night_game==1'))) + ' / ' +
    str(len(df_top_40)) + ' = ' +
    str(round(len(df_top_40.query('is_night_game==1'))/len(df_top_40),2))
)
```

```
Percentage of dates that are night games:
```

```
all games -- 66 / 81 = 0.81
top 20 games -- 16 / 20 = 0.8
top 40 games -- 33 / 40 = 0.82
```

It turns out that most of the top 20 games were night games because most of ALL the game were night games! In fact, the percentage of night games among the top dates and the overall schedule is pretty consistent. Are they typically more heavily attended than day games?

[16]:

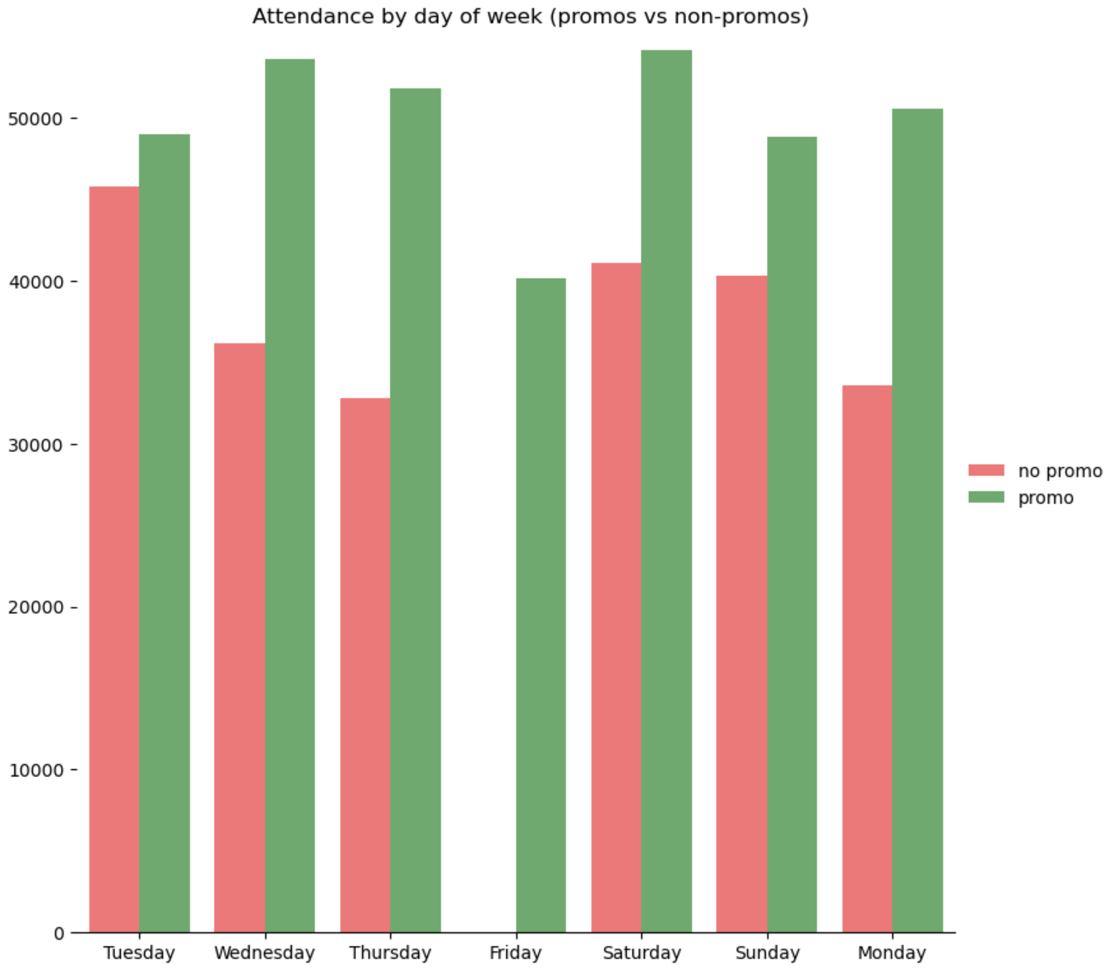
```python
# check means of day/night games
print (
    'Mean attendance at night games:' + '\n' +
    'all night games -- ' +
    str(int(df.query('is_night_game==1').attend.mean())) + '\n' +
    'all day games -- ' +
    str(int(df.query('is_night_game==0').attend.mean()))
)
```

```
Mean attendance at night games:
all night games -- 40868
all day games -- 41793
```

The difference in mean attendance between day games and night games is only about 2% overall. Because there are other considerations (mostly based around team travel and player health/convenience) around choosing whether to play at night, we probably don't want to make a recommendation of scheduling more day games for such a small difference. Let's take one last look at what the mean attendance difference looks on promo dates vs regular dates.

[17]:

```python
##
## plot attendance by day of week, separated by promos
##

fig = sns.catplot(
    data = df,
    kind = 'bar',
    x = 'day_of_week',
    y = 'attend',
    hue = 'promo',
    errorbar = None,
    palette = ['red','green'],
    alpha = .6,
    height = 8
)
fig.despine(left=True)
fig.set_axis_labels('', '')
fig.legend.set_title('')
fig.fig.suptitle('Attendance by day of week (promos vs non-promos)')

plt.show()
```



This difference is stark. It's evident that people love promotions, and we saw earlier that they really seem to like the bobbleheads.

Recommendation:

The easiest way to increase attendance at Dodger stadium is to offer more promotional giveaways, especially bobbleheads.