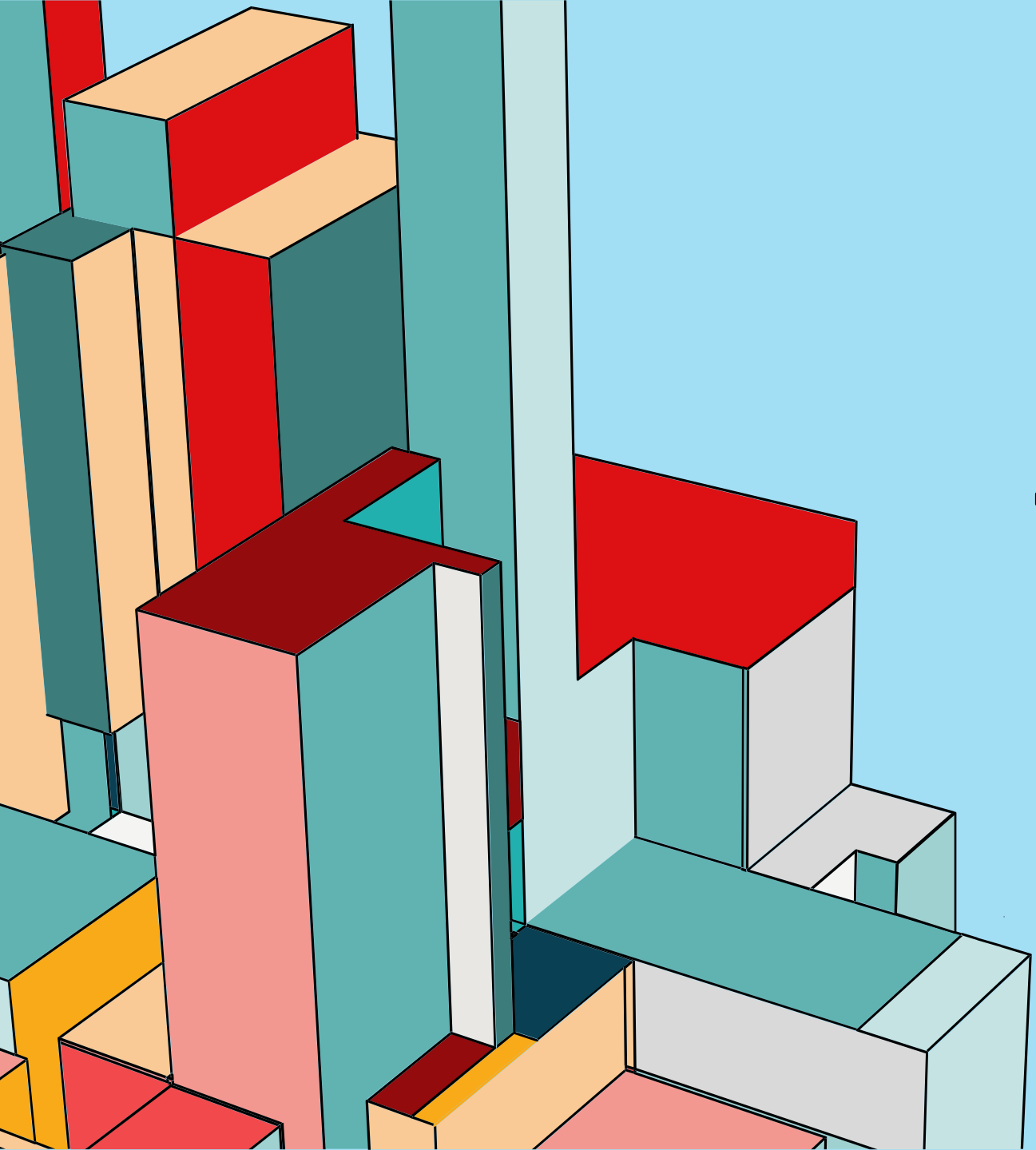
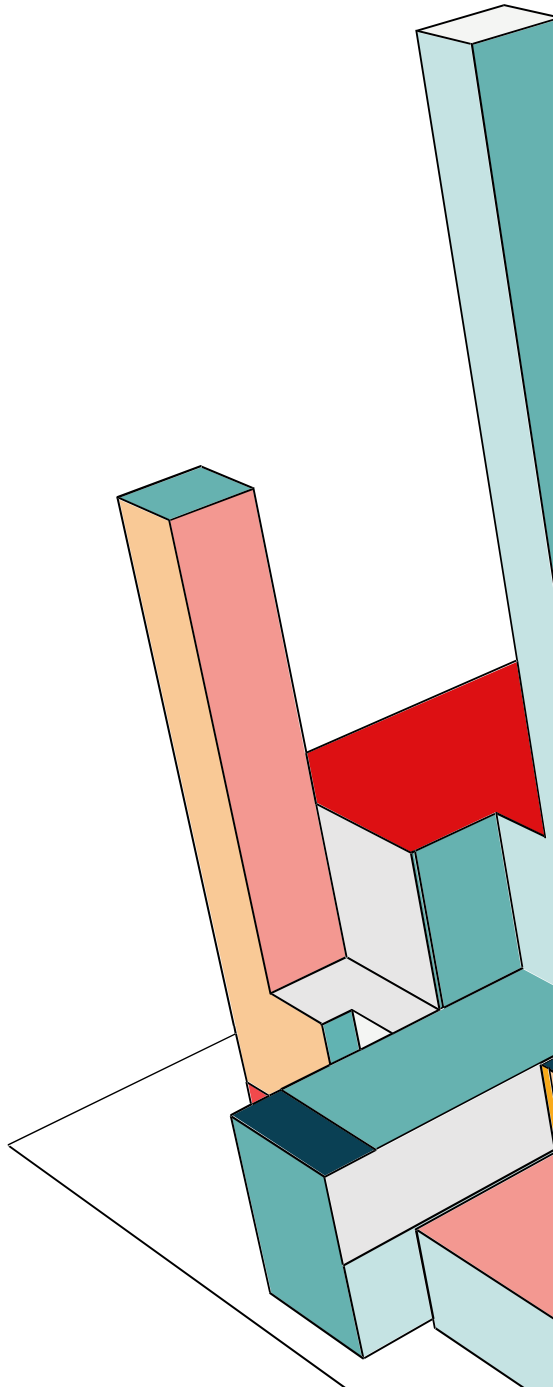


T.H.E CASE COMPETITION

By Benjamin Taraba and Patrick Obal

POWER OF POP

- Pop concerts and festivals attract hundreds of thousands of fans to host cities.
- The economic impact doesn’t stop in the stands, though; local businesses in cities see an increase in demand from this surge in visitors.

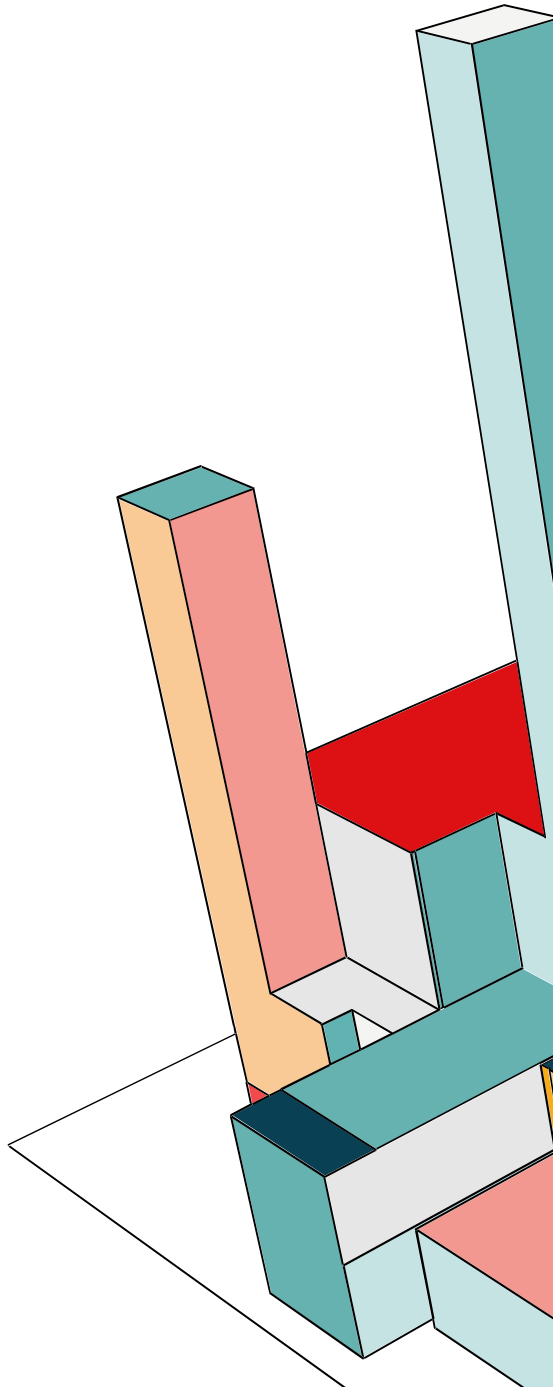


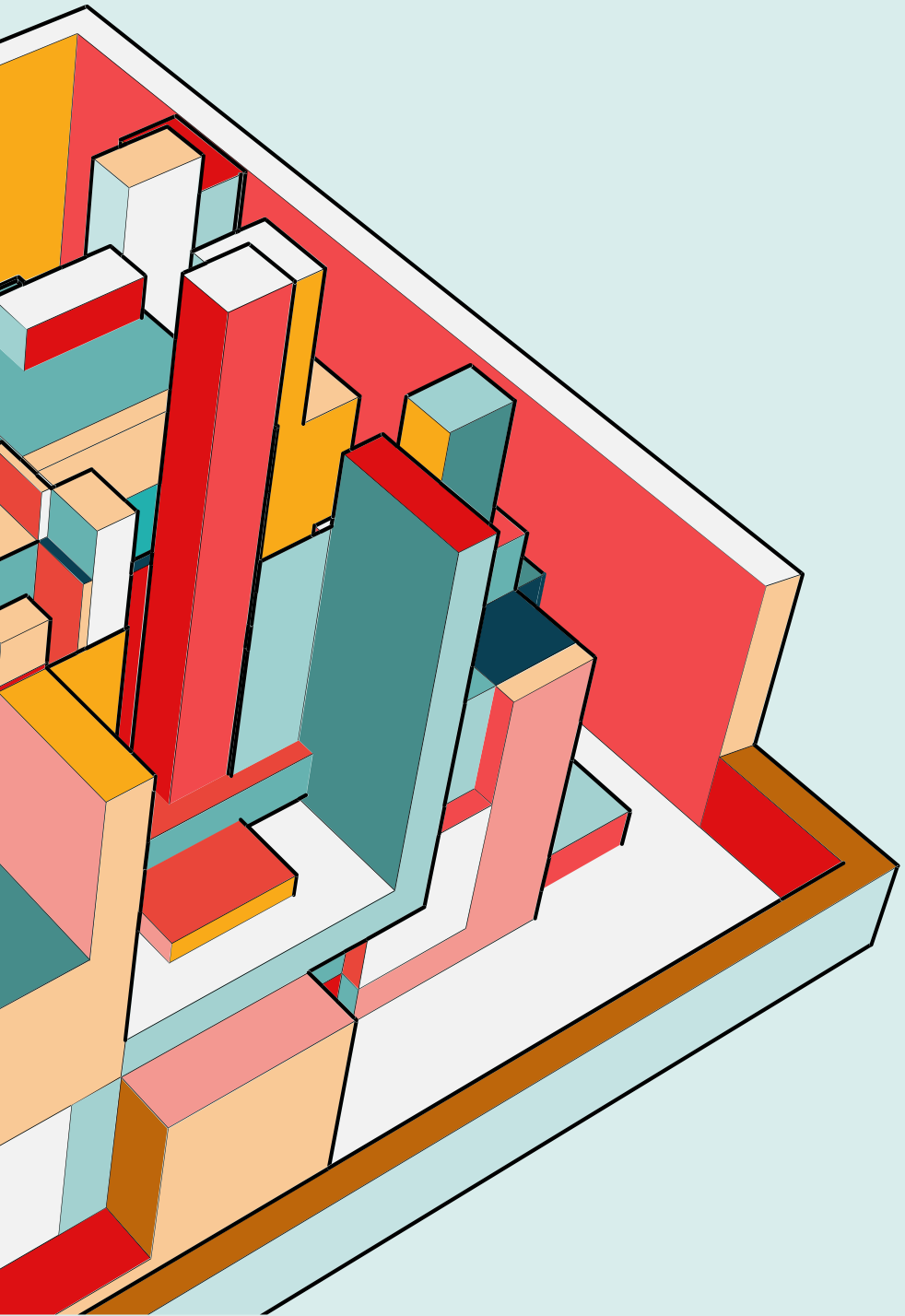
WHAT IS THE ECONOMIC IMPACT OF HOSTING A POP STAR EVENT ON THE HOTEL INDUSTRY?

WHY DOES THIS MATTER?

Why studying this economic impact is important:

- Local Business – optimize pricing strategies, understand demand, and needed staff.
- Politicians/Taxpayers – Materialize how public funds generate tangible returns and justify future infrastructure projects.
- Workers – Benefit from an increase in new jobs driven by a stronger local economy.





FINDINGS

- Cities vary greatly, with an average increase in hotel revenue of $4.85M per event day.
- Seasonality has no significant effect on event revenue.
- Events do not significantly affect hotel classes differently.

WHAT ARE OUR VARIABLES AND BASELINE?

- Season: (Summer, Spring, Fall, Winter)
- Dow: (Monday, Tuesday, Wednesday, etc.)
- Event: Is there an event on this date and location? (0 = No, 1 = Yes)
- Near Events: Is there an event in 5± days? (-1 = No, 0 = Event Today, 1 = One Day Away, … 5 = Five Days Away)

Baseline = Summer, Friday, No Event, No events in 5± Days

DO EVENTS INCREASE HOTEL ECONOMICS?

```
Call:
lm(formula = dat$Rooms_Revenue ~ Season + Event_This_Date + XEvent_in5Days +
    Near_Event + Day_Of_Week, data = dat)

Residuals:
      Min        1Q    Median        3Q       Max
-19343039  -6840150  -1774423   4351109  49787481

Coefficients: (1 not defined because of singularities)
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       20559729     500117  41.110  < 2e-16 ***
SeasonFall         2956337     445569   6.635 3.73e-11 ***
SeasonSpring       -224922     443059  -0.508 0.611725
SeasonWinter      -3631787     449207  -8.085 8.39e-16 ***
Event_This_Date1  20300649    5310513   3.823 0.000134 ***
XEvent_in5Days    -6294907    1865701  -3.374 0.000749 ***
Near_Event0             NA         NA      NA       NA
Near_Event1       19868712    5226472   3.802 0.000146 ***
Near_Event2       19532971    5223917   3.739 0.000187 ***
Near_Event3       19722229    5227165   3.773 0.000164 ***
Near_Event4       15866620    4172639   3.803 0.000146 ***
Near_Event5        9063797    2636351   3.438 0.000593 ***
Day_Of_WeekMonday -5216438     583720  -8.937  < 2e-16 ***
Day_Of_WeekSaturday  1729192   581697   2.973 0.002972 **
Day_Of_WeekSunday -6106375     581737 -10.497  < 2e-16 ***
Day_Of_WeekThursday -3598173   583681  -6.165 7.84e-10 ***
Day_Of_WeekTuesday -3369575    585847  -5.752 9.57e-09 ***
Day_Of_WeekWednesday -3147209  585006  -5.380 7.93e-08 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 9395000 on 3633 degrees of freedom
Multiple R-squared:  0.1274,    Adjusted R-squared:  0.1236
F-statistic: 33.16 on 16 and 3633 DF,  p-value: < 2.2e-16
```

- Originally conducted a multiple linear regression to find how revenue impact of events.
- Found that each event day was associated with an increase of ≈ $20.3M in revenue with an additional ≈ $8.4M from the 5± days around the event.

TRANSITION FROM MULTIPLE LINEAR REGRESSION MODEL

We weren't very satisfied with our linear model:

- Low adjusted R^2 at 12.36%
- When applied to individual cities, it struggled to create significant results
  - Likely due to lack of quantity events and clusters of events.
- We believed that cities varied too much to have equal baselines.
- Transitioned to a Linear Mixed-Effects Model.
  - Allowed us to isolate the event impact from each city’s baseline.

LINEAR MIXED-EFFECTS MODEL FOR REVENUE

Large baseline variety between cities:

- Baseline hotel revenue standard deviation ≈ 7.92 M

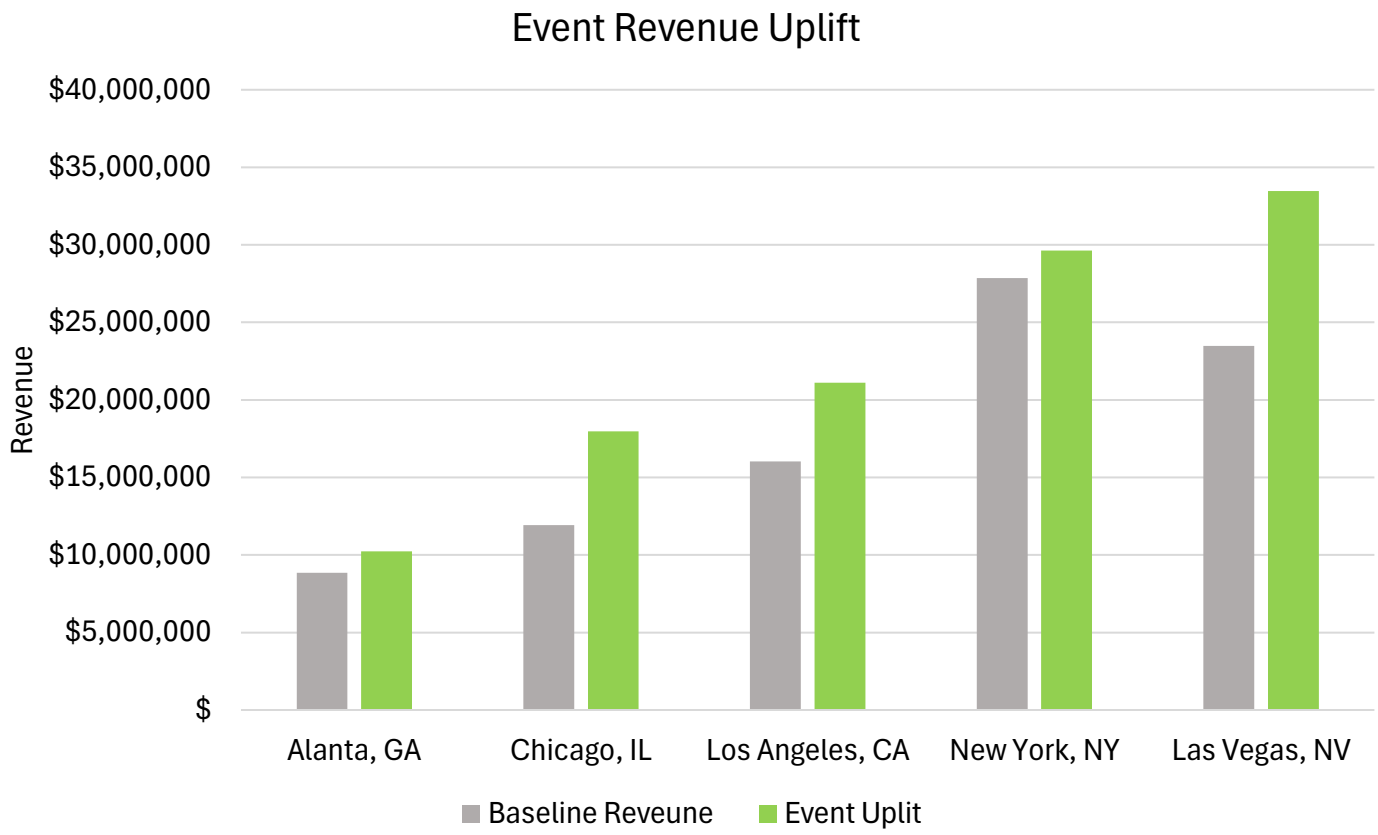
- Intercept (Normal No Event Revenue across all cities) ≈17.36M, t-value 4.97

- Event Days (Revenue Increase across all cities) ≈ $4.85M, t-value 4.97

```
Random effects:
 Groups         Name              Variance  Std.Dev. Corr
 Markets_Market (Intercept)       6.277e+13 7922788
                Event_This_Date1  1.759e+13 4194396  0.16
 Residual                         5.017e+13 7082964
Number of obs: 3650, groups:  Markets_Market, 5
```

LINEAR MIXED-EFFECTS MODEL REVENUE

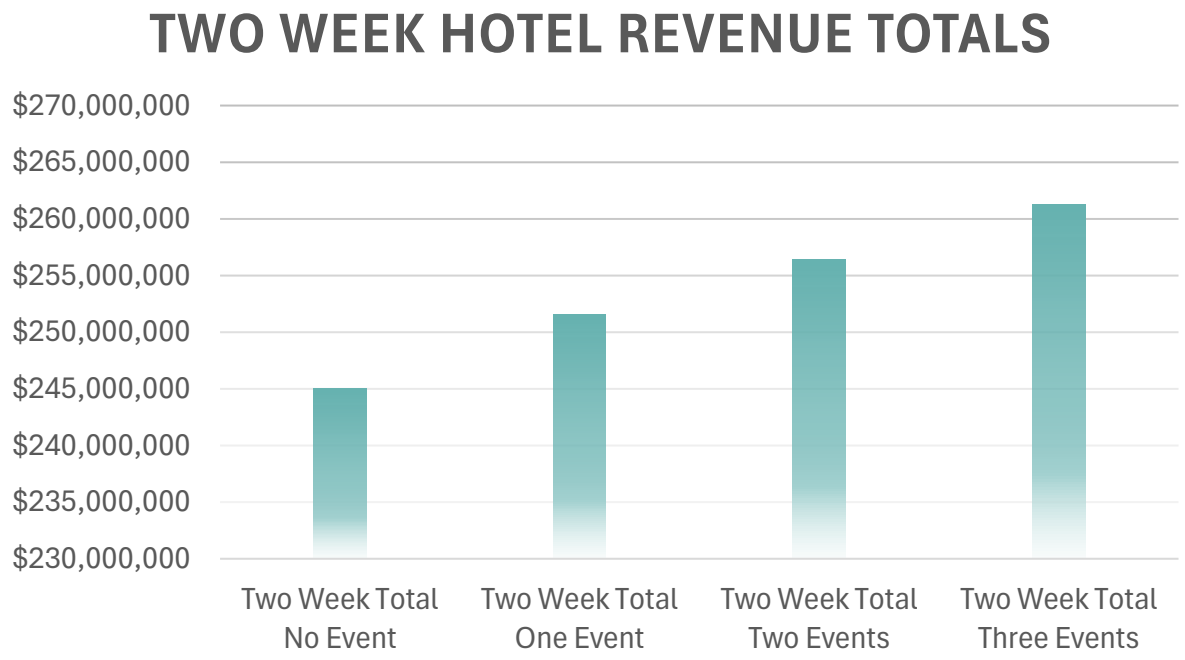
City	Baseline Revenue	Event
Atlanta	≈ $8.85M	≈ $1.38M
Chicago	≈ $11.93M	≈ $6.05M
Las Vegas	≈ $23.49M	≈ $9.98M
Los Angeles	≈ $16.04M	≈ $5.06M
New York	≈ $27.85M	≈ $1.79M



LINEAR MIXED-EFFECTS MODEL REVENUE EFFECT OF SURROUNDING DAYS

Intercept	≈ $17.5M	t-value ≈ 4.96
5± days around the event	≈ $1.7M	t-value ≈ 2.63

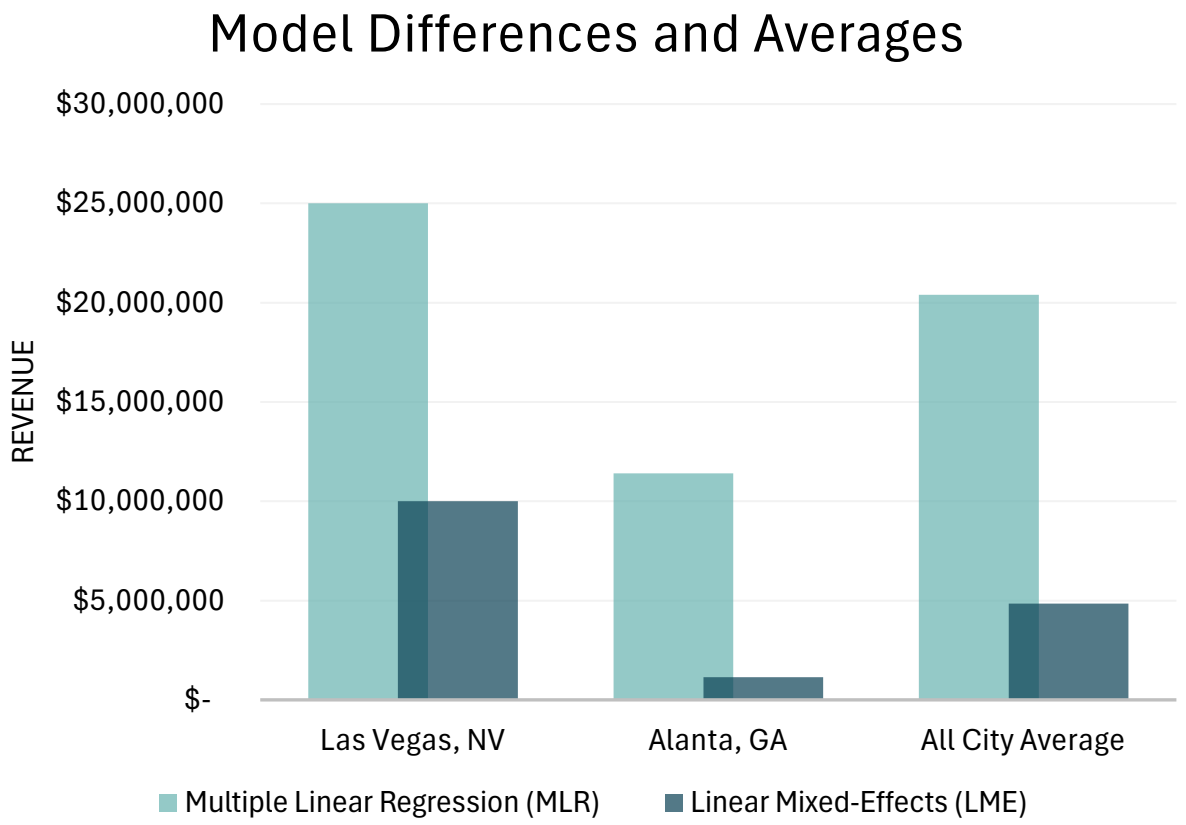
City	5± days around the event
Atlanta, GA	$2,396,875
Chicago, IL	$1,821,899
Las Vegas, NV	$1,054,268
Los Angeles, CA	$1,800,420
New York, NY	$1,979,314

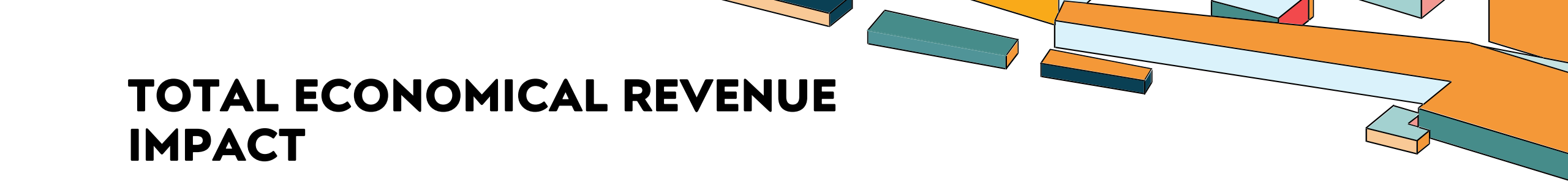


WHY SUCH A DIFFERENCE BETWEEN MODELS?

The difference between revenue estimates in MLR and LME models is because:

- MLR assumes that all cities experience the same event effects.
- Large differences in baseline revenue strongly swings the average of other cities.
- LME uses partial pooling, shrinking large differences toward the group average.





TOTAL ECONOMICAL REVENUE IMPACT

- I = Total economical impact of event.
- d = How long an event is in days.
- e = Impact of event days (Average ≈ 4.85M).
- a = Impact of days around event (Average ≈ 1.77M).

$$I = \left(d \cdot e_{city}\right) + a_{city}$$

$$Average\ I = (d \cdot 4{,}851{,}474) + 1{,}770{,}555$$

TOTAL ECONOMICAL REVENUE IMPACT

$$Atlanta\ I = (d \cdot 1{,}382{,}866) + 2{,}296{,}875$$

$$Chicago\ I = (d \cdot 6{,}045{,}452) + 1{,}821{,}899$$

$$Las\ Vegas\ I = (d \cdot 9{,}975{,}644) + 1{,}054{,}268$$

$$Los\ Angeles\ I = (d \cdot 5{,}061{,}058) + 1{,}800{,}420$$

$$New\ York\ I = (d \cdot 1{,}791{,}332) + 1{,}879{,}314$$

SEASONALITY AND DAY TRENDS

- Gave each day a season by month.
- Winter (Dec-Feb), Spring (Mar-May), Summer (Jun-Aug), Fall (Sep-Nov).
- Also assigned each date its respective day of the week (Monday, Tuesday, etc.).

INTERACTION SEASON & DAY OF THE WEEK

Created an interaction linear model for demand.

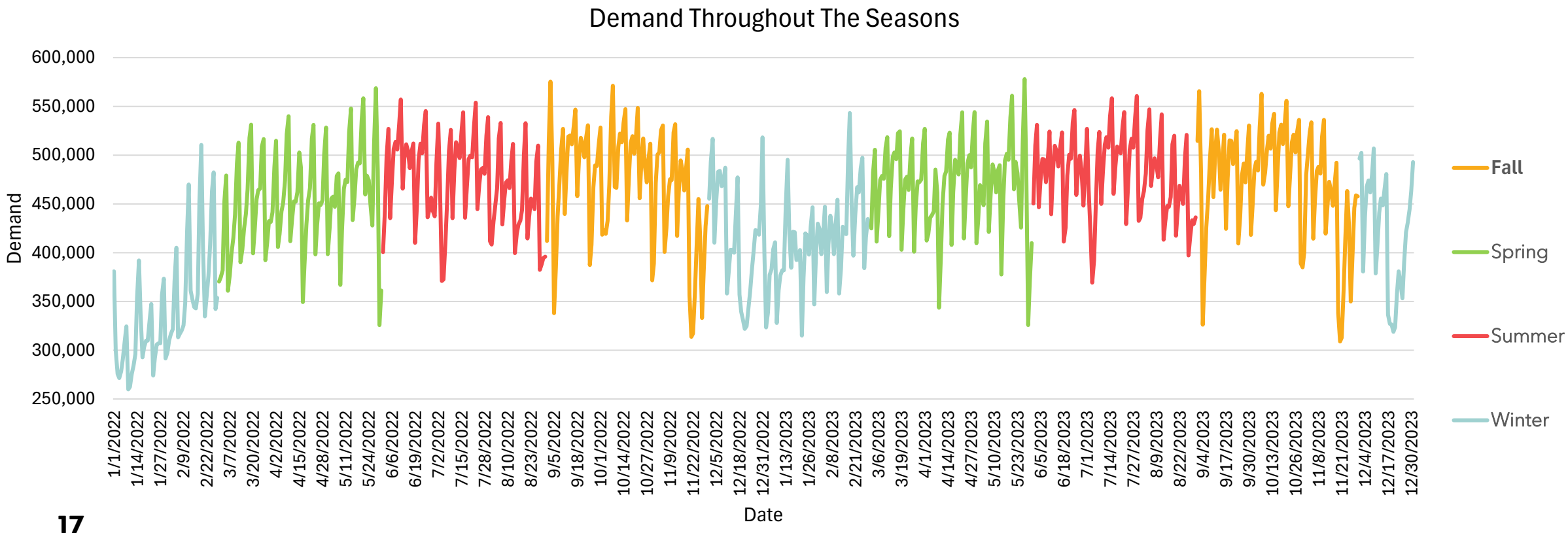
Season * Event + DoW * Event

- Some seasons and certain days of the week do affect a hotel's revenue.
- No significant reaction between event and either season or day of the week.

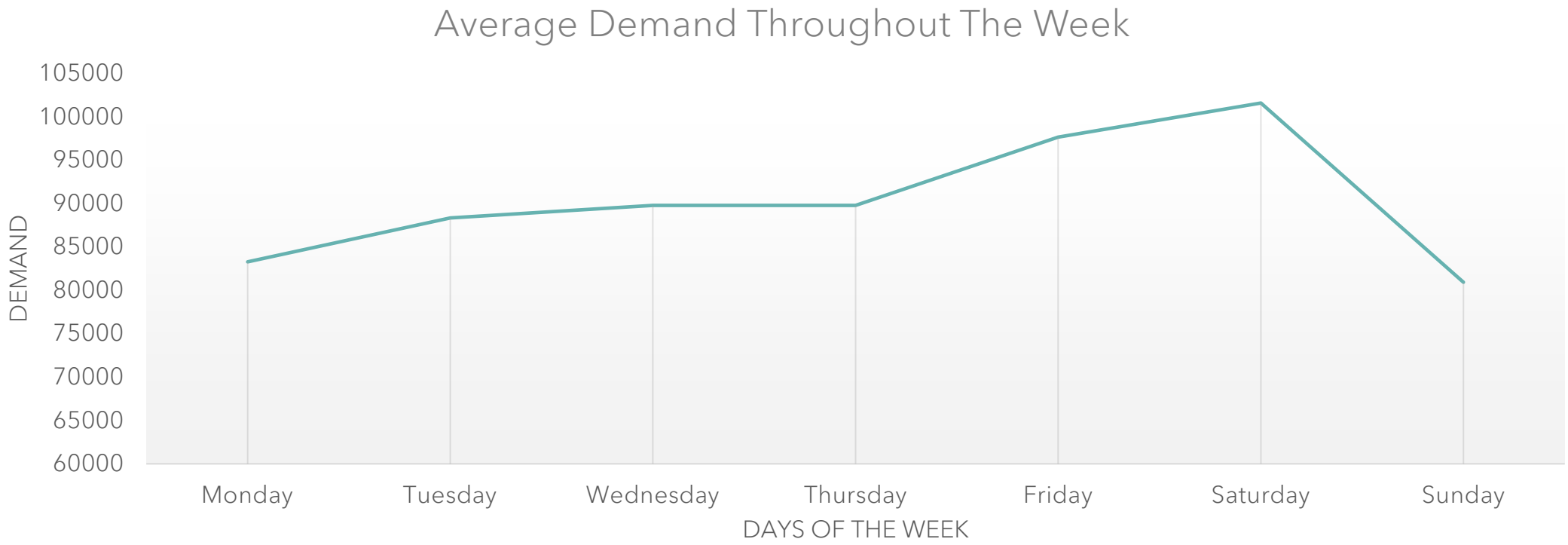
```
Call:
lm(formula = Rooms_Demand ~ Season * Event_This_Date + Day_Of_Week *
    Event_This_Date + Near_Event + XEvent_in5Days, data = dat)

Residuals:
   Min     1Q Median     3Q    Max
-47661 -15711  -5474  10918  75308

Coefficients: (2 not defined because of singularities)
                                      Estimate Std. Error t value Pr(>|t|)
(Intercept)                          102385.9     1203.2  85.096  < 2e-16 ***
SeasonFall                             -721.1     1070.4  -0.674  0.50057
SeasonSpring                          -2668.7     1067.7  -2.500  0.01248 *
SeasonWinter                         -16810.5     1077.7 -15.599  < 2e-16 ***
Event_This_Date1                      29881.6    16404.9   1.822  0.06861 .
Day_Of_WeekMonday                    -14238.5     1402.8 -10.150  < 2e-16 ***
Day_Of_WeekSaturday                    4154.1     1406.0   2.954  0.00315 **
Day_Of_WeekSunday                    -16450.2     1403.1 -11.724  < 2e-16 ***
Day_Of_WeekThursday                   -8085.2     1405.2  -5.754 9.46e-09 ***
Day_Of_WeekTuesday                    -9317.3     1408.0  -6.618 4.19e-11 ***
Day_Of_WeekWednesday                  -8093.0     1405.7  -5.757 9.26e-09 ***
Near_Event0                               NA         NA      NA       NA
Near_Event1                           31436.1    13363.9   2.352  0.01871 *
Near_Event2                           31215.2    13359.5   2.337  0.01952 *
Near_Event3                           31427.5    13366.0   2.351  0.01876 *
Near_Event4                           25689.5    10614.7   2.420  0.01556 *
Near_Event5                           14425.0     6562.1   2.198  0.02800 *
XEvent_in5Days                        -9924.9     4813.3  -2.062  0.03928 *
SeasonFall:Event_This_Date1           34611.5    17451.7   1.983  0.04741 *
SeasonSpring:Event_This_Date1          9558.0     9342.1   1.023  0.30632
SeasonWinter:Event_This_Date1             NA         NA      NA       NA
Event_This_Date1:Day_Of_WeekMonday   -24451.5    24307.6  -1.006  0.31452
Event_This_Date1:Day_Of_WeekSaturday  -2803.7    10549.6  -0.266  0.79044
Event_This_Date1:Day_Of_WeekSunday    -7007.8    12217.9  -0.574  0.56630
Event_This_Date1:Day_Of_WeekThursday  10650.6    14094.6   0.756  0.44991
Event_This_Date1:Day_Of_WeekTuesday  -26351.7    24307.7  -1.084  0.27840
Event_This_Date1:Day_Of_WeekWednesday -27015.0   24308.7  -1.111  0.26650
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 22490 on 3625 degrees of freedom
Multiple R-squared:  0.1634,    Adjusted R-squared:  0.1578
F-statistic:  29.5 on 24 and 3625 DF,  p-value: < 2.2e-16
```

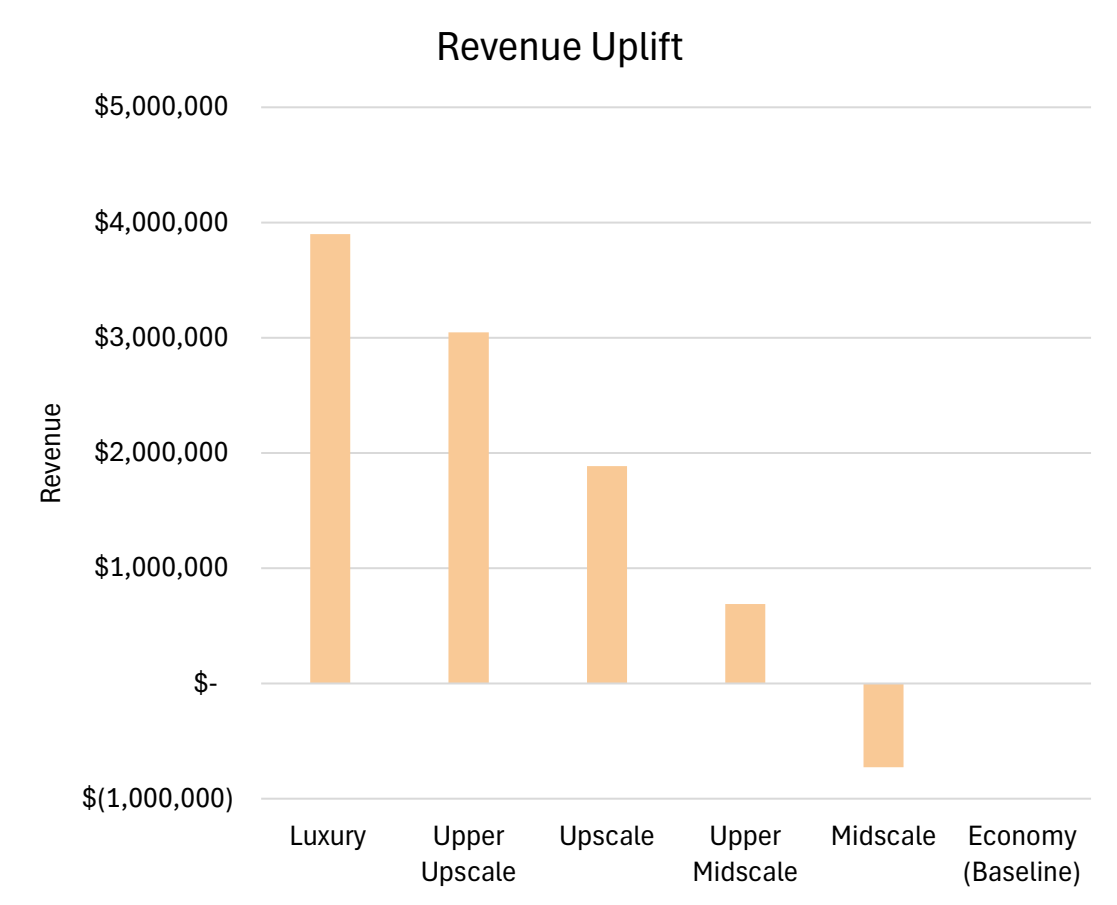
SEASON AND DAY OF THE WEEK

Its still important for hotels to understand seasonality and weekly trends to better prepare staff.



DAYS OF THE WEEK





HOW DOES AN EVENT AFFECT DIFFERENT HOTEL CLASSES' REVENUE?

- Created an interaction multiple linear regression model for revenue.
- Significant interaction was between events and hotel classes while testing revenue.
- Events significantly affect different hotel classes' revenue.

MULTIPLE LINEAR REGRESSION THREE-WAY INTERACTION

- Three-way Interaction with Markets * Event * Hotel Class
- Very little significant data with events.
- The main effect of the event was not statistically significant, with a t-value of 0.09.
- Even with a large adjusted R^2 of 76.78% we felt data was bias.
- Transitioned to Linear Mixed-Effects Model.

LINEAR MIXED-EFFECT INTERACTION FOR HOTEL CLASS & MARKETS

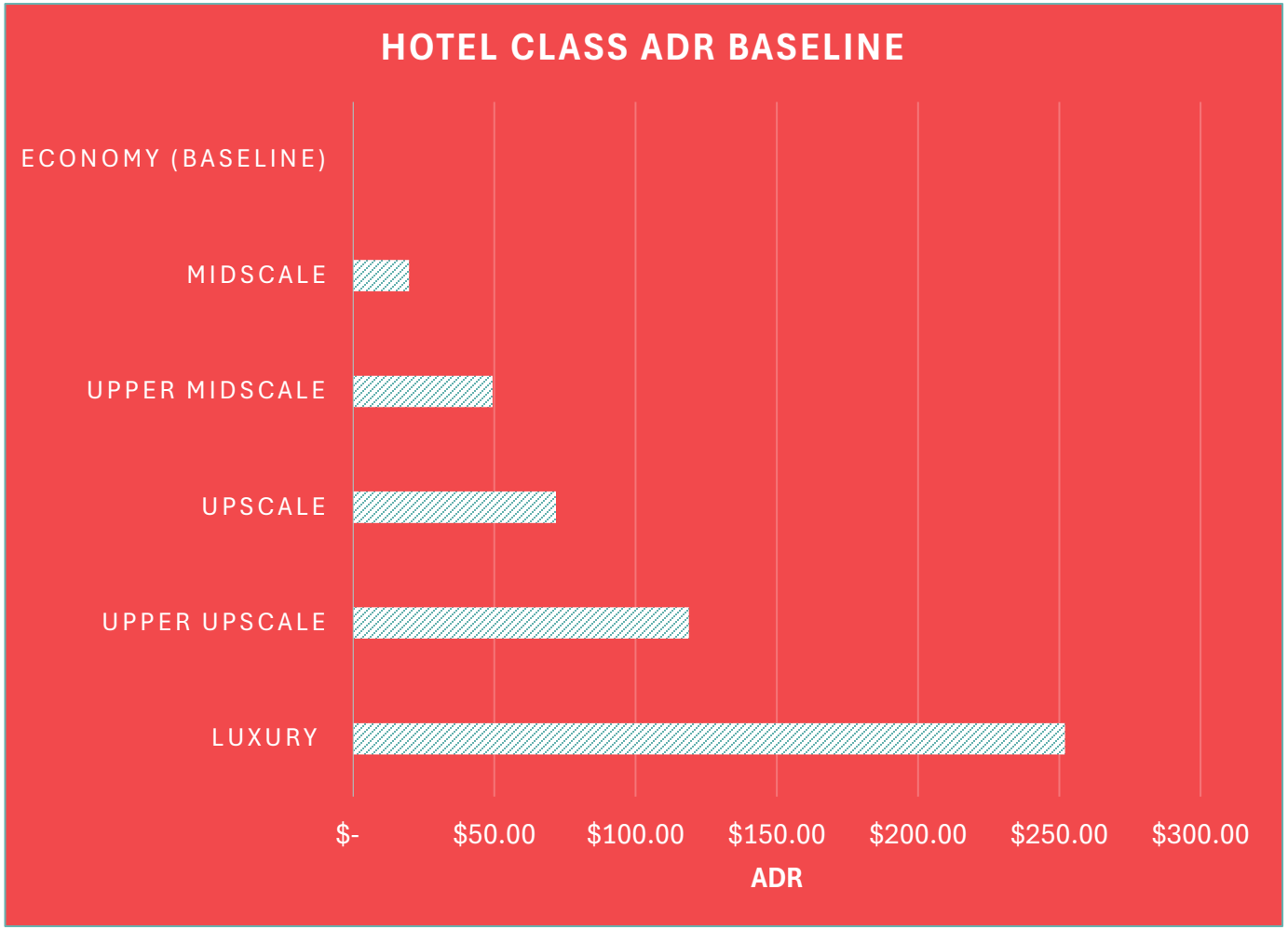
- Linear mixed effect model of event and hotel class effect while accounting for market differences.
- Large variance between cities
  - Variance = 200
  - Standard Deviation = 44.73
  - Different cities have different baseline ADR levels.
- The interaction between events and hotel classes is insignificant.

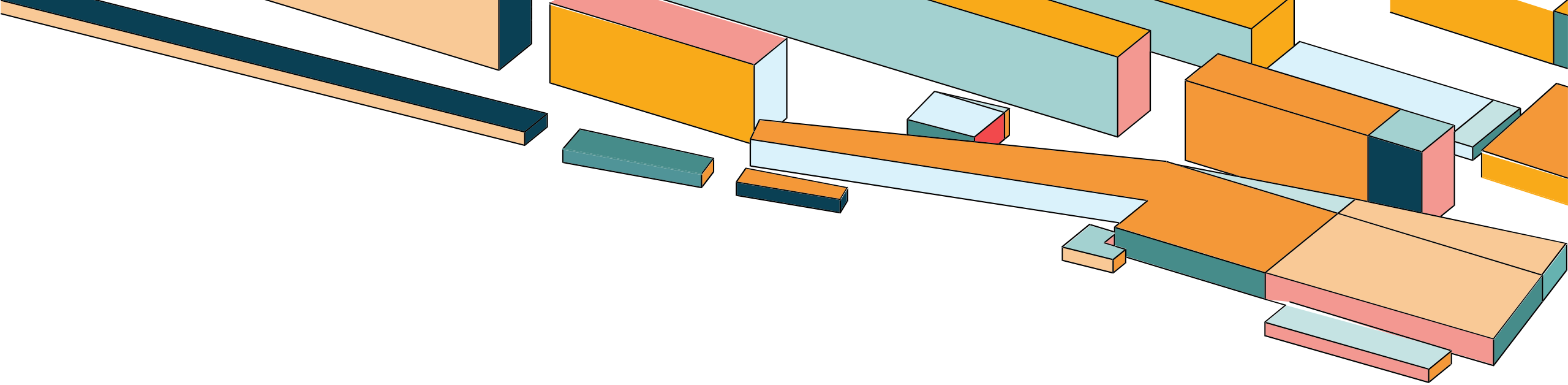
LINEAR MIXED-EFFECT INTERACTION FOR HOTEL CLASS & MARKETS

- The interaction between events and hotel classes is insignificant, with a t-value of:
- Luxury ≈ 1.81
- Upper Upscale ≈ 0.56
- Upscale ≈ 0.26
- Upper Midscale ≈ 0.38
- Midscale ≈ .18

HOTEL CLASS ADR BASELINES

- Differences in ADR from the economy class baseline
- Luxury +$251.99
- Upper Upscale +$118.84
- Upscale +$71.79
- Upper Midscale +$49.33
- Midscale +$19.73





HOW ARE FESTIVALS AND CONCERTS ECONOMICALLY DIFFERENT?

MULTIPLE LINEAR REGRESSION OF FESTIVAL EFFECT ON ADR

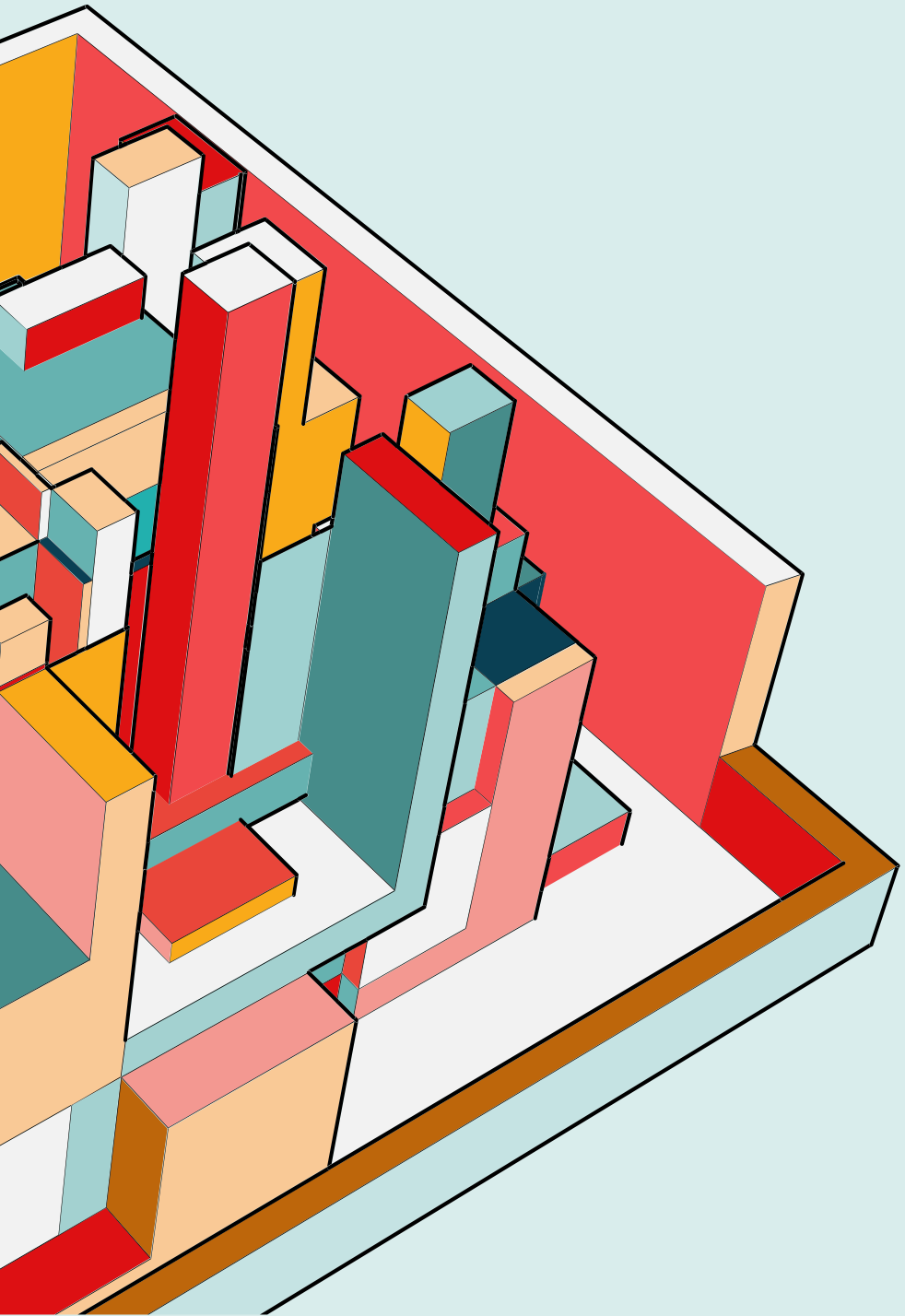
- Festival days significantly increase ADR by $29.43.
- Single artist events significantly raise ADR by $22.33.
- That is a $7.1 ADR increase for festivals over single artist events.

```
Call:
lm(formula = Rooms_ADR ~ Season + Day_Avg_Attendance + `Classes - Class` +
    mdat$Festival, data = mdat)

Residuals:
    Min      1Q  Median      3Q     Max
-191.85  -33.76  -11.40   23.80  639.49

Coefficients:
                                    Estimate Std. Error t value Pr(>|t|)
(Intercept)                        9.241e+01  1.293e+00  71.493  < 2e-16 ***
SeasonFall                         1.809e+01  1.202e+00  15.050  < 2e-16 ***
SeasonSpring                      -2.523e+00  1.196e+00  -2.109  0.03494 *
SeasonWinter                      -1.557e+01  1.204e+00 -12.934  < 2e-16 ***
Day_Avg_Attendance                -3.292e-06  1.347e-04  -0.024  0.98049
`Classes - Class`Luxury Class      2.553e+02  1.477e+00 172.888  < 2e-16 ***
`Classes - Class`Midscale Class    2.294e+01  1.477e+00  15.535  < 2e-16 ***
`Classes - Class`Upper Midscale Class  5.251e+01  1.477e+00  35.555  < 2e-16 ***
`Classes - Class`Upper Upscale Class   1.220e+02  1.477e+00  82.630  < 2e-16 ***
`Classes - Class`Upscale Class     7.495e+01  1.477e+00  50.748  < 2e-16 ***
mdat$Festival0                     2.233e+01  8.684e+00   2.572  0.01012 *
mdat$Festival1                     2.943e+01  1.062e+01   2.770  0.00561 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 62.34 on 21719 degrees of freedom
  (169 observations deleted due to missingness)
Multiple R-squared:  0.651,     Adjusted R-squared:  0.6508
F-statistic:  3683 on 11 and 21719 DF,  p-value: < 2.2e-16
```

MULTIPLE LINEAR REGRESSION OF FESTIVAL EFFECT ON DEMAND

```
Call:
lm(formula = Rooms_Demand ~ Season + +Day_Avg_Attendance + `Classes - Class` +
    mdat$Festival, data = mdat)

Residuals:
     Min       1Q   Median       3Q      Max
-15022.7  -4078.2   -412.9   3135.6  29564.9

Coefficients:
                                  Estimate Std. Error t value Pr(>|t|)
(Intercept)                      1.692e+04  1.354e+02 124.976  < 2e-16 ***
SeasonFall                      -1.441e+02  1.259e+02  -1.145 0.252202
SeasonSpring                    -5.983e+02  1.253e+02  -4.775 1.81e-06 ***
SeasonWinter                    -2.953e+03  1.261e+02 -23.429  < 2e-16 ***
Day_Avg_Attendance               5.225e-02  1.410e-02   3.705 0.000212 ***
`Classes - Class`Luxury Class   -1.335e+03  1.547e+02  -8.633  < 2e-16 ***
`Classes - Class`Midscale Class -9.405e+03  1.547e+02 -60.805  < 2e-16 ***
`Classes - Class`Upper Midscale Class -1.385e+03  1.547e+02  -8.952  < 2e-16 ***
`Classes - Class`Upper Upscale Class   4.171e+03  1.547e+02  26.968  < 2e-16 ***
`Classes - Class`Upscale Class         2.572e+03  1.547e+02  16.628  < 2e-16 ***
mdat$Festival0                  -1.786e+03  9.094e+02  -1.964 0.049549 *
mdat$Festival1                  -1.200e+03  1.113e+03  -1.078 0.280933
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 6528 on 21719 degrees of freedom
  (169 observations deleted due to missingness)
Multiple R-squared:  0.3212,    Adjusted R-squared:  0.3209
F-statistic: 934.4 on 11 and 21719 DF,  p-value: < 2.2e-16
```

- Festivals were not significant when looking at room demand.
- Our data used both large and small festivals.
- Average day attendance is significant and increases demand by 0.05 per attendee.
- Traditional festivals will have an impact on demand.

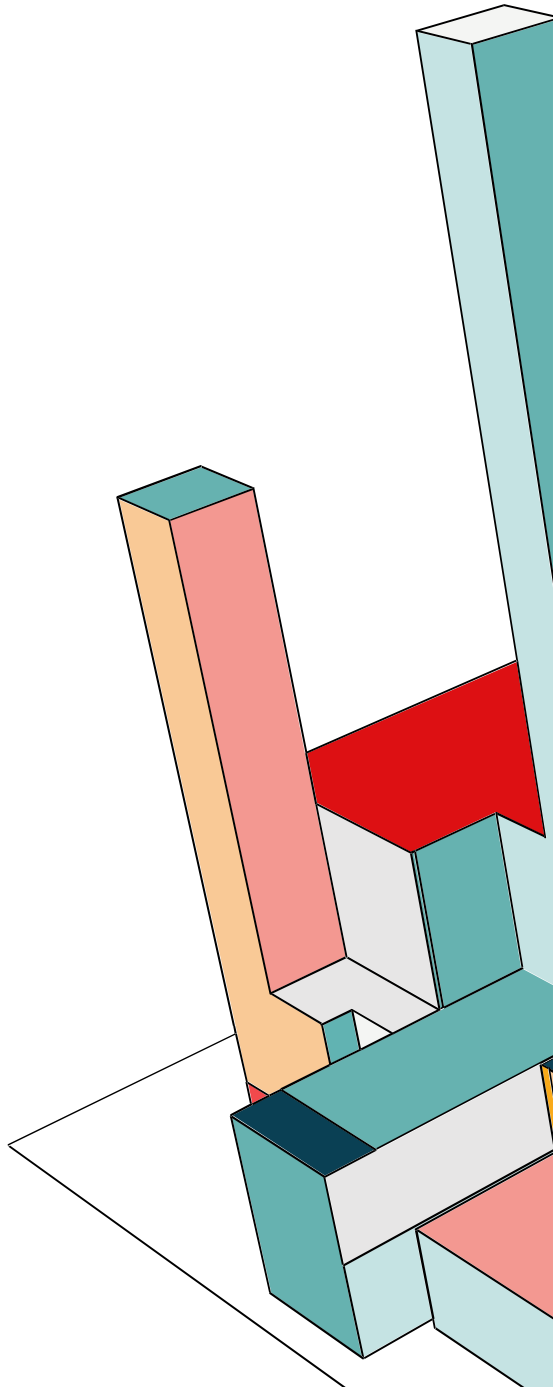


IMPLICATIONS AND RECOMMENDATIONS

IMPLICATIONS AND RECOMMENDATIONS

Hotels

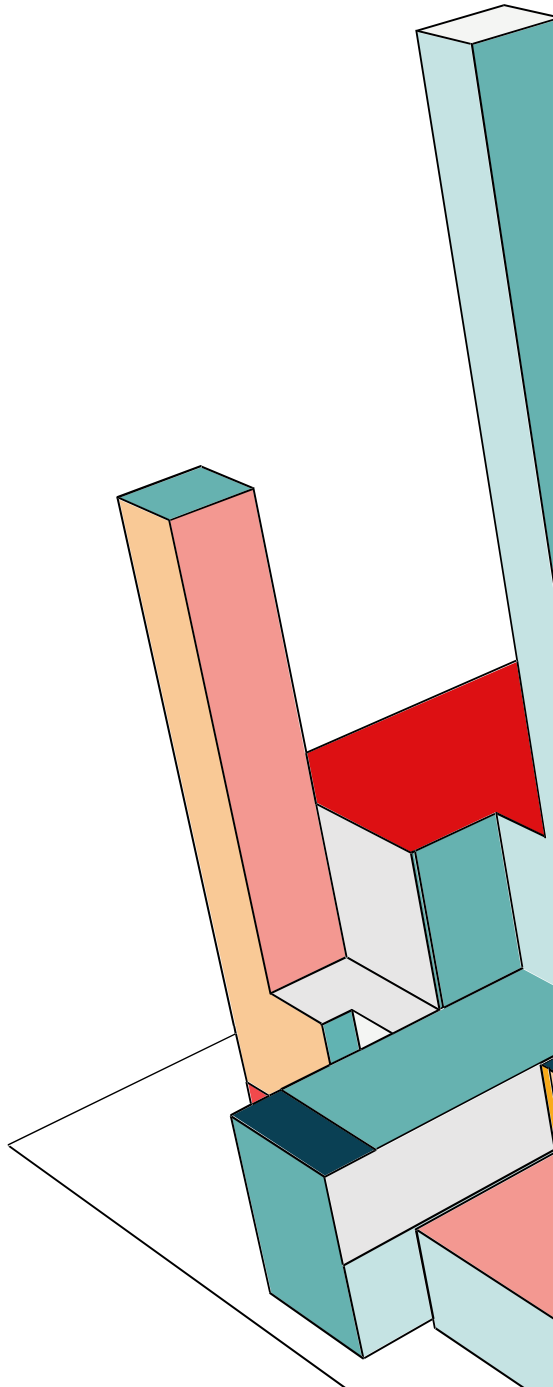
- Implement dynamic pricing during and around pop star events.
- Increase staffing to prepare for increased demand.
- Many visitors may stay for extended days around the event. They offer deals for those who may stay longer, especially if it is on the slow side of the week (Sunday & Monday).



IMPLICATIONS AND RECOMMENDATIONS

Policymakers:

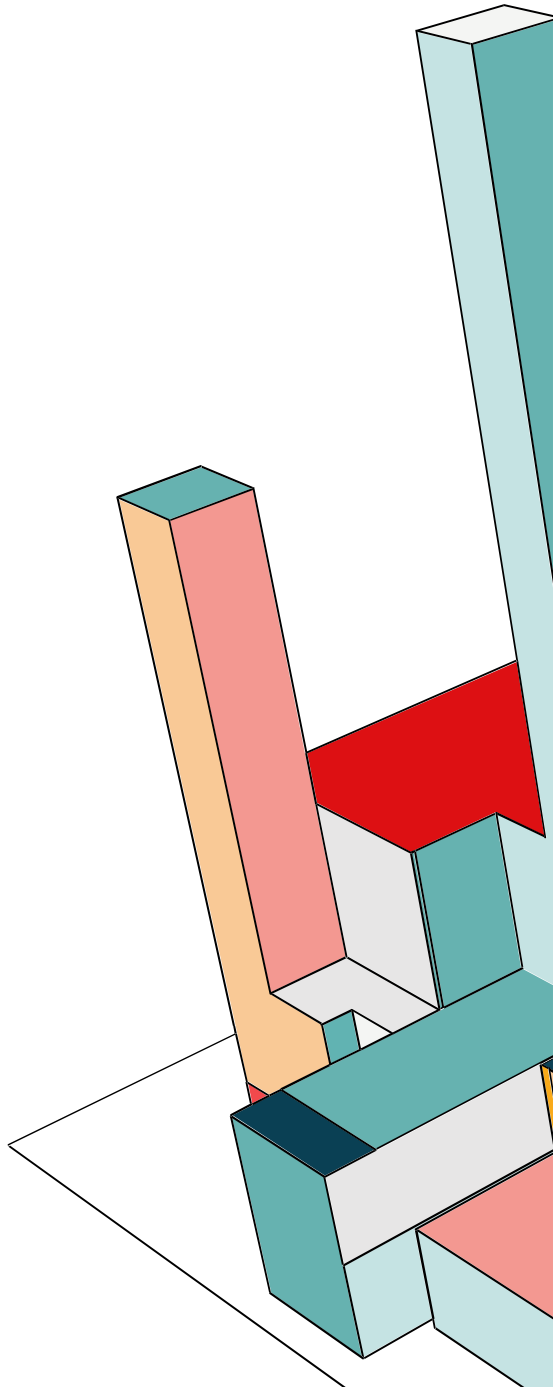
- Utilize hotel demand predictions in future urban planning and zoning decisions.
- Use city-specific data to construct support for infrastructure developments.
- Create an inviting location for festivals to locate themselves in your city.
- Encourage economic growth from events to create local employment and greater tax revenue.



IMPLICATIONS AND RECOMMENDATIONS

Event Organizers

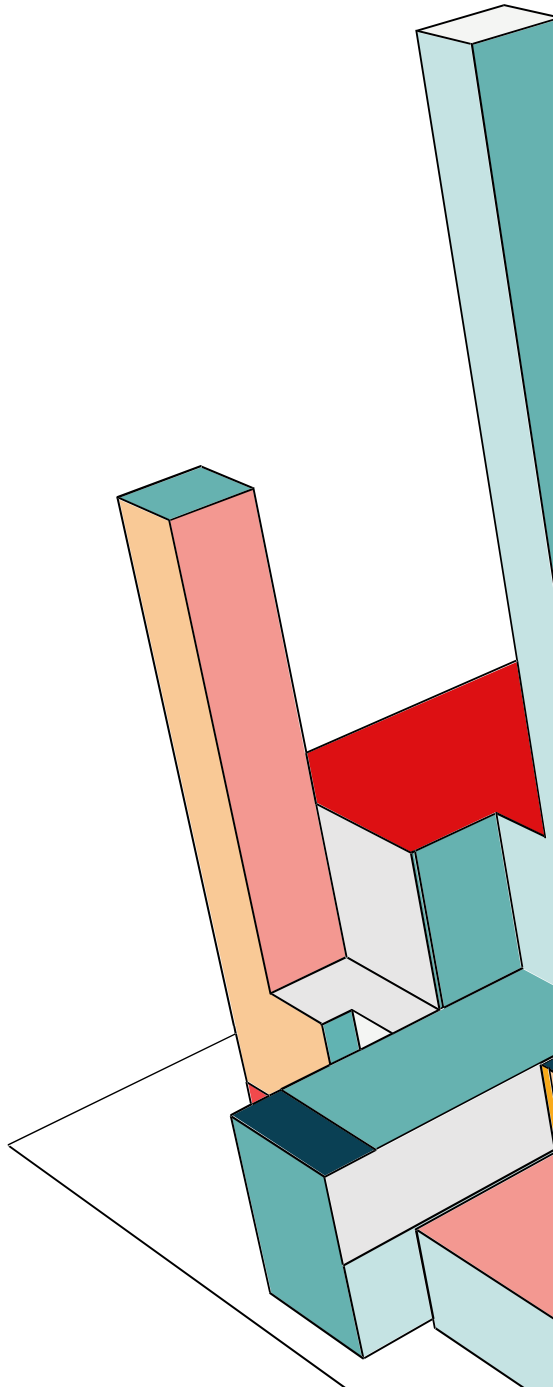
- Looking to expand your venue/festival to a new city? Look at which cities bring in the most attendance and hotel demand (Las Vegas and New York).
- Partner with hotels to plan events during slow hotel demand periods for additional revenue.

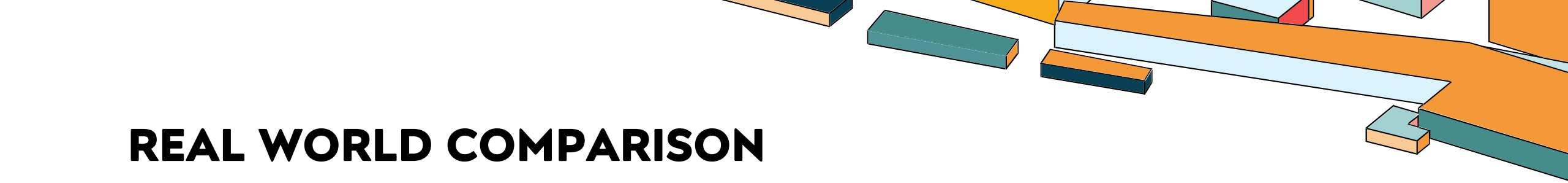


IMPLICATIONS AND RECOMMENDATIONS

Pop Stars:

- Use hotel uplift to plan tour dates in cities with strong spending.
- Present economic impact data to negotiate better deals with venues.
- Partner with cities to do a certain number of shows to boost the local economy.





REAL WORLD COMPARISON

Our Data

- Average ADR = 186.04
- Average Occupancy rate = 70.92%
- In New York, Taylor Swift caused a 28.10% ADR increase during her tour.

Real World Data

- Average USA ADR = 159.90
- Average Occupancy rate = 60.3%
- In Lisbon Hotel, ADR increased by 40% during Taylor Swifts tour.

REAL POWER OF POP

- Events boost average hotel revenue $4.85M per event day and $1.7M in surrounding days.
- While events didn’t significantly have an impact on hotel class, higher-tier hotels consistently had higher ADRs.
- Festivals generate higher ADR than single artiest events by $7.1
- Seasons and days of the week didn’t impact events.
- From Hotels to politicians, Pop Starts make a serious impact beyond your ear drums, driving significant economic growth.

THANK YOU!