

# Scheduling of Movies at *Lincoln Plaza Cinema Theaters*

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# Introduction

Gathered and adapted information from Lincoln Plaza on:

- a. Hours of theater: 11am - 1am
- b. Number of movies (substituted names with letters (A,...F))
- c. Number of auditoriums available (numbered them 1,...,6)
- d. Duration of every movie (in minutes) - represents *processing time*
- e. Added weight constraint to scheduling problem (out of 10), and based it on number of times a specific movie is shown in the theater per day - represents *demand of movie*
- f. Added release times to movies - makes our model more realistic, as it might not be profitable to schedule a movie before a particular time of day
- g. Added a constant of 29 minute setup time between the showings

# Goal

Given a set of *weighted* movies with specific processing times, a number of available auditoriums, and release times; schedule the movie showings optimally so as to maximize the number of showings given their respective weights and release constraints.

# Maximization Problem

Max  $\sum W_j X_j$

s.t.

$\sum P_{ji} X_j + \sum C_{ji} X_j \leq 840$

min, for all  $i$  and  $j$

$C_{ji} = 29$  min, for all  $i$   
and  $j$

$X_j > 0$  for all  $j$

$i \in [1, 2, 3, 4, 5, 6]$

$j \in [1, 2, 3, 4, 5, 6]$

Where

$X_j$  # of showings of movie  $j$

$W_j$  weight associated with  
movie  $j$

$P_{ji}$  Processing time of movie  $j$  at  
theater  $i$

$C_{ji}$  cleaning (buffer time) after  
every movie  $j$  shown (it is a  
constant – can also be thought  
of as setup time)

# Data

<b>j</b>	<b>Pj (min)</b>	<b>Wj</b>	<b>Rj</b>
A	89	5	12:00 pm
B	110	6	11:00 am
C	111	5	12:30 pm
D	122	10	11:00 am
E	97	5	12:00 pm
F	110	1	01:00 pm

# Algorithms Tested

1. Decreasing order of  $W_j/P_j$  given release dates
2. Modified version of list scheduling algorithm
3. Trial & Error

# Potential Solution #1

After taking into consideration the release dates we:

- Place each movie in each auditorium in decreasing order of  $W_i/P_i$  values, given release times.
- Since  $W_i/P_i$  does not change, after the first movie showings, which are constrained by the release dates, the order remains the same until the last movie that will be shown is constrained by the closing time of the theater.
- In that case the selection is made based on the remaining times in each theater and the movies whose duration is equal or smaller than the remaining times in each theater.

# Potential Solution #1 Schedule

1	B 11:00-12: 50	F 13:19-15: 09	F 15:38-17: 28	F 17:57-19: 47	F 20:16-22: 00	F 22:35-00: 25
2	D 11:00-13: 02	C 13:31-15: 22	C 15:51-17: 42	C 18:31-20: 22	C 20:51-22: 42	E 23:11-00:38
3	E 12:00-13: 37	E 14:06-15: 33	E 16:02-17: 29	E 17:58-19: 25	E 19:54-21:23	E 21:52-23- 19
4	A 12:00-13: 29	A 13:58-15- 27	A 15:56-17: 25	A 17:54-19: 23	A 19:52-21:21	A 21:50-23: 18
5	C 12:30-13: 21	B 13:50-15: 40	B 16:09-17: 59	B 18:28-20: 18	B 20:47-22: 37	B 23:06-00: 56
6	F 13:00-15: 20	D 15:49-17: 51	D 18:20-20: 22	D 20:51-22: 53	E 23:23-00: 50	

# Potential Solution # 1

Wj/Pj:

A	B	C	D	E	F
23.6	23.17	28	15.1	25.2	139

Number of times each movie is showed when the schedule above is applied:

A:6      B:6      C:5      D:4      E:7      F:6

Value of the objective function:  $(6*5)+(6*6)+(5*5)+(4*10)+(7*5)+(6*1) = \mathbf{172}$

# Potential Solution #2

After taking into consideration the release dates we created modified list scheduling algorithm based on them, in which:

- The weight of each movie determines the number of repetitions for that movie
- Greater weight with same release dates gets priority
- We do not even consider changing movies in one screen if they still haven't achieved their weight number of showings

# Potential Solution #2 Schedule

1	D (11:00-13:02)	D (13:02-15:04)	D (15:04-17:06)	D (17:06-19:08)	D (19:08-21:10)	
2	B (11:00-12:50)	B (12:50-14:40)	B (14:40-16:30)	B (16:30-18:20)	B (18:20-20:10)	B (20:10-22:00)
3	A (13:02-14:31)	A (14:31-18:29)	A (18:29-18:27)	A (18:27-20:25)	A (20:25-22:23)	D (22:23-00:54)
4	E (12:00-13:37)	E (14:06-15:33)	E (16:02-17:29)	E (17:58-19:25)	E (19:54-21:23)	E (21:52-23:19)
5	C (12:50-13:41)	C (13:41-15:32)	C (15:32-17:23)	C (17:23-19:14)	C (19:14-21:05)	D (21:05-23:07)
6	F (13:02-15:22)	D (15:51-17:53)	D (18:22-20:24)	D (20:53-22:55)	A (23:25-00:52)	

# Potential Solution #2

Number of times each movie is shown:

A:5 B:6 C:5 D:10 E:6 F:1

Value of the objective function:  $(5*5)+(6*6)+$   
 $(5*5)+(10*10)+(6*5)+(1*1) = \mathbf{217}$

# Potential Solution #3 Schedule

1	D (11:00-13:02)		D (13:02-15:04)	D (15:04-17:06)	D (17:06-19:08)	D (19:08-21:10)	D (21:10-23:12)	
2	B (11:00-12:50)		B (12:50-14:40)	B (14:40-16:30)	B (16:30-18:20)	B (18:20-20:10)	B (20:10-22:00)	D (22:00-00:02)
3	D (11:00-13:02)	A (13:02-14:31)	A (14:31-18:29)	A (18:29-18:27)	A (18:27-20:25)	A (20:25-22:23)	D (22:23-00:54)	
4		E (12:00-13:37)	E (14:06-15:33)	E (16:02-17:29)	E (17:58-19:25)	E (19:54-21:23)	E (21:52-23:19)	
5	B (11:00-12:50)	C (12:50-13:41)	C (13:41-15:32)	C (15:32-17:23)	C (17:23-19:14)	C (19:14-21:05)	D (21:05-23:07)	B (23:07-00:57)
6	D (11:00-13:02)	F (13:02-15:22)	D (15:51-17:53)	D (18:22-20:24)	D (20:53-22:55)	A (23:25-00:52)		

# Potential Solution #3

Number of times each movie is shown:

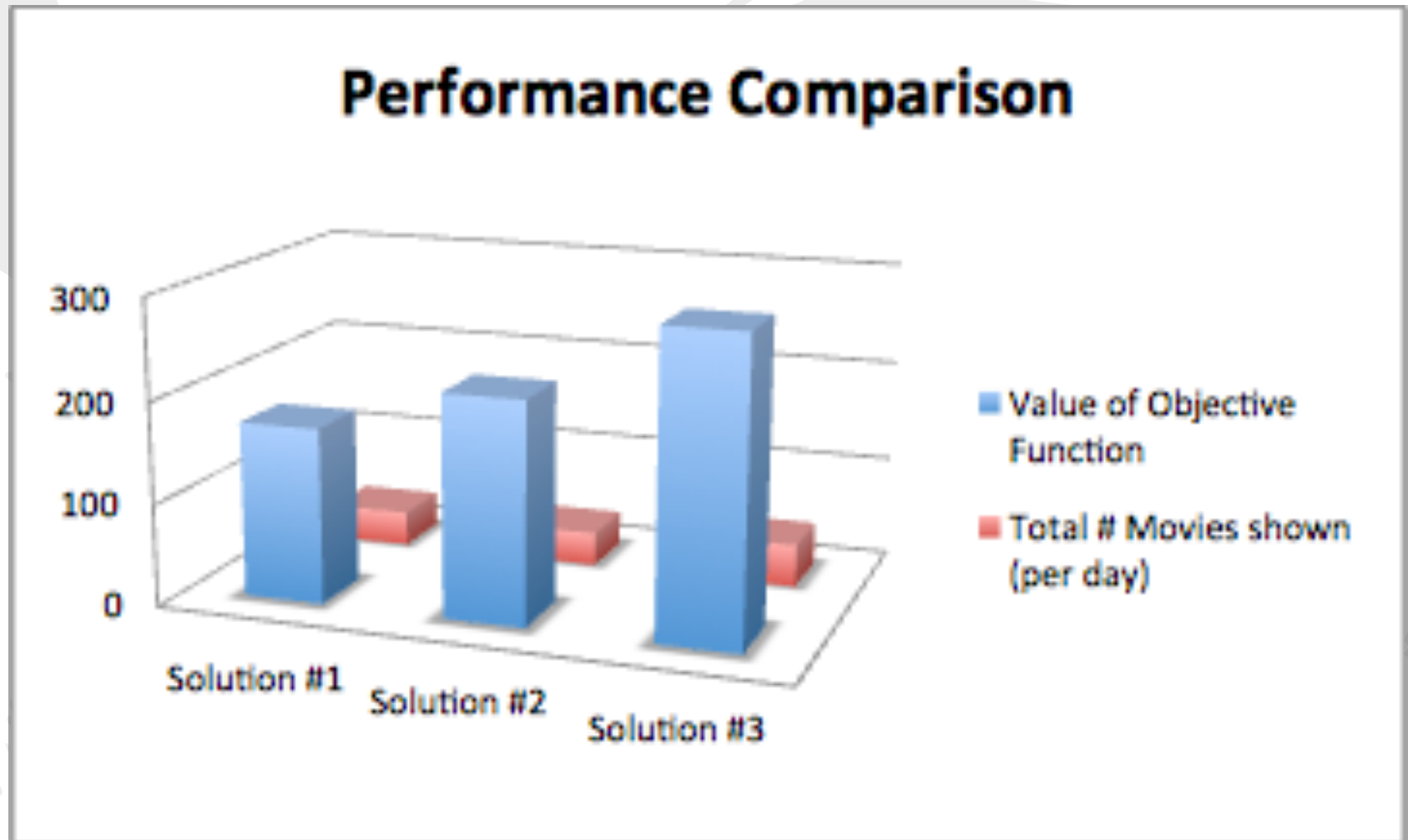
A:6    B:8    C:5    D:15    E:6    F:1

Value of objective function: **284**

# Comparing Solutions

	Solution #1	Solution #2	Solution #3
<b>Value of Objective Function</b>	172	217	284
<b>Total # Movies shown (per day)</b>	34	33	42

# Comparing Solutions



# Final Solution

According to the data that we have collected, our best option is

## **SOLUTION #3: TRIAL & ERROR**

By manually fitting the showings in auditoriums given their respective weights (demand), we maximize benefit from showing the movie - thus minimizing auditorium idle time