‘NEXT’ events

A cooperative game theoretical view to festivals.

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Introduction

- Festival is a very common device to supply cultural goods (in particular for living performance artistic disciplines).
- Aggregate data are rare, but festivals may sum up to a large amount of the total supply of living performances. (Summerfest gather more than 800.000 for 11 days, at Milwaukee, Wisconsin and up to 700 rock bands are presented on a yearly basis).
- Many artists became famous during festivals (Avignon is a must for French speaking actors, while Woodstock revealed Santana, Hendrix, the Who, Joe Cocker and many more).

The real life case study the "NEXT festival"

- Some facts about NEXT festival
  1. Contemporary Theater, dance and performance festival taking place on a yearly basis in Northern France and Southern Belgium (both Flemish and French-speaking parts),
  2. The 2012 edition proposed 47 shows in 9 different places from 18/11 to 3/12 incl.,
  3. A total amount of 10.890 tickets were sold. The average audience is 221 people and the average ratio audience/capacity is 84% (13 shows were sold out),
  4. The festival is subsidized by EC *via* the INTERREG program.
  5. This program aims at enhancing mobility and collaboration across as well as inside euro-regions.

The available data

- We used the full program (schedule, show presentations, prices, languages, transportation facilities).
- We observe shows/artists and theaters characteristics (location, capacity, notoriety) and audiences.
- A total of 476 individual surveys have been collected in queues and at bar (during breaks). Attenders were asked about individual characteristics, cultural consumption and practice, price of ticket, knowledge of show/artist/theaters/festivals, transportation choice.[1]
- Surveys were designed to be conducted within minutes and consist in a total of 26 questions with multiple directed choices.
- Surveys have been collected by students. Luc conducted surveys on one special occasion (a controversial show which violent Christian activists tried to interrupt). We ran out of conductors for two other 'small' shows.
- Finally, we thank Benoît Geers and Hélène Debacker from the NEXT festival for answering many additional questions.

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Figure: Map of the Festival

(1:Budascoop, 2: Espace Pasolini, 3: Rose des Vents, 4: Maison de la culture de Tournai, 5: Maison Folie de Wazemmes, 6: Phenix, 7: Schouwburg, 8: Théatre du Nord, 9: Transfo)

Figure: programme of the festival

performance or artist name	dates (from 18/11. to 3/12)	Place	type	price (full, in €)
M. A. Demey /J. van Dormael	18,19,20	Tournai	Dance	20
T. Castellucci /D. Dell	19	Schowburg	Dance	9
M. Depauw	19	Budascoop	Theater	14
N. Penino	19,20,22,23	Budascoop	Theater	9
B. Lachambre	22	Phenix	Dance	14
C. De Smedt	21, 22	Espace Pasolini	Dance	9
D. Veronese	22 to 26	Théâtre du Nord	Theater	20
F. Jaïbi /J. Baccar	23	Phenix	Theater	14
O. Dubois	23,24	Rose des Vents	Dance	14
A.C. Vandalem	24,25	Tournai	Theater	20
Gob Squad	25,27	Budascoop	Theater	14
I. Van Hove	26,27	Schouwburg	Theater	20
N. Lucas /H. Heisig	28	Espace Pasolini	Dance	9
L. Rodrigues	29	Phenix	Dance	14
R. Castellucci	29 30	Rose des Vents	Theater	20
C. Loemij /M. Lorimer	30	Schouwburg	Dance	9
E. Joris	1 to 3	Wazemmes	Theater	9
Berlin	30 to 3	Transfo	Theater	14
T. Castellucci /D. Dell	1,2	Budascoop	Dance	9
W. Vandekeybus	2,3	Rose des Vents	Dance	20
O. Normand /Y. Barelli	2	Espace Pasolini	Dance	14
Syndrome Collective	2	Schouwburg	Theater	0 (free event)

Figure: Collected spillover transmission between theaters (ρ_i)

dest. / org.	Budascoop	Espace Pasolini	La Rose des vents	Maison de la culture de Tournai	Maison Folie de Wazemmes	Phenix	Schouwburg	Théâtre du Nord	Transfo
Budascoop	0.18	0.06	0.11	0.14	0.09	0.09	0.15	0.10	0.09
Espace Pasolini	0.08	0.17	0.14	0.10	0.12	0.17	0.06	0.12	0.04
La Rose des vents	0.04	0.04	0.22	0.13	0.19	0.13	0.05	0.19	0.01
Maison de la culture de Tournai	0.05	0.06	0.17	0.23	0.14	0.11	0.09	0.13	0.02
Maison Folie de Wazemmes	0.10	0.06	0.16	0.10	0.22	0.08	0.08	0.15	0.04
Phenix	0.07	0.10	0.16	0.11	0.12	0.20	0.04	0.16	0.01
Schouwburg	0.17	0.06	0.11	0.11	0.09	0.10	0.20	0.10	0.06
Théâtre du Nord	0.02	0.05	0.19	0.14	0.21	0.13	0.03	0.22	0.02
Transfo	0.15	0.06	0.12	0.13	0.08	0.08	0.16	0.10	0.13

For instance, the probability that a spectator interviewed at 'Espace Pasolini' will attend the next performance at 'la Rose des Vents' is about 14%. Special buses where provided by the organizers of the festival in order to enhance this "natural" mobility and to promote public transport. For two couples of performances packages were proposed which include transportation from one theater to the other in order to attend both performances on the same day. In a similar fashion, we also collected the travel times between places to the other.

An economic viewpoint

- Festivals are usually organized by merging cultural supplies from different institutions (theaters, music bands, performance companies)
- These are, from the economic viewpoint, *legal cartels*.
- Interestingly, festival organizers seldom face prosecution by antitrust authorities and many festivals are, on the contrary publicly subsidized.[2]
- This tolerance -and subsidies- may only be justified if positive externalities are at hand.
- The paper aims at
  1. providing a model for such externalities,
  2. deriving explicit cartel behavior,
  3. proposing fair sharing devices ,
  4. discussing a real-life implementation.

[2] One exception is the Lollapalooza rock festival which is currently under investigation for exclusivity clauses.

The model

- There $n \geq 1$ theaters and each one proposes a single show (assumption to be relaxed).
- Theater i faces a marginal cost $c_i \geq 0$.
- The schedule is fixed and theaters are labeled in chronological order.
- In front of theater i a queue q_i forms. Then theater i announces the price p_i to be paid for entrance and the total audience is $S_i(p_i)q_i$ where $S_i(.)$ is a survival function (that is $S_i(p_i) \in [0,1]$ and $S(0) = 1, S_i'(0) = 0, S_i'' < 0$).
- If $n > 1$ for each $i > 1$ we have

$$q_i = e_i + \rho_i S_{i-1}(p_{i-1})q_{i-1}$$

where $0 \leq \rho_i \leq 1$ measures the spillover and $e_i \geq 0$ measures the newcomers (conventionally $q_1 = e_1$).

Coalitions' behavior

- Let N be the set of all theater we define for all $T \subset N$

$$
\begin{aligned}
v(T) = \quad & \max \quad \textstyle\sum_{i \in T}(p_i - c_i)d_i \\
& \\
& wrt \quad (p_i)_{i \in T} \\
& s.t. \quad d_i = (e_i + \rho_i d_{i-1})S_i(p_i) \\
& \qquad\; d_1 = e_1 \\
& \qquad\; p_j = p_j^m = argmax_{p_j \in R^+}\ S_j(p_j)(p_j - c_j),\ \forall\, j \notin T.
\end{aligned}
$$

- The members of the coalition T maximizes the total payoff they can afford taking into account
  1. the spillover effects inside and outside of the coalition,
  2. the belief that theaters outside the coalition maximize their own payoff in a selfish way.

Related literature and theoretical results

- Although original, our model shares common features with Ambec and Sprumont (2002) and Ambec and Ehlers(2008) models of water allocations.
- Ginsburg and Zang (2001) and Béal and Solal (2010) have already applied cooperative game approaches to fair sharing problems in museum industry.
- We show that our game is convex in the Shapley sense

$$V(T \cup i) - V(T) \geq V(R \cup i) - V(R)$$

  whenever $R \subset T$ and $i \notin R \cup T$
- We propose an axiomatic approach to the Shapley sharing rule based on Myerson (1980) balanced contribution's requirement.
- We extend the model to the 'multi-events' case in which some theaters propose several shows.

Come back to the econometry of the case Next

- Full implementations of cooperative approaches are seldom since
  1. Crucial informations about the game are not available (in particular, heterogeneity of players which justifies sophisticated sharing rules is often not observed),
  2. Computation is infeasible for large sets of players,
  3. Behaviors outside the grand coalition shall note be observed.
- The paper presents a full econometric treatment to derive a value sharing for a real-life case.

Inference results : Survival functions

- To implement our cooperative approach we need for each event i: survival function $S_i(.)$, the cost c_i, the queue q_i a decomposition $q_i = e_i + r_i$ and a dispatching of r_i among ancestors of event i.
- These issues raise different problems that we address with specific inference techniques.
- We cannot assume that actual prices are optimally chosen (only four different tariffs are observed).
- If we choose $S_i(p_i) = 1 - (p_i/\alpha_i)^2$ then the monopoly price is $(c_i + \sqrt{3\alpha_i^2 + c_i^2})/3$ which must be larger than observed prices. Also optimal pricing in the festival cannot be negative, which provides a lower bound. The survival parameter α_i may then be recovered by interval regression.

Survival parameter α_i (QML estimation)

	Estimate	Std. Err	z	p-value
intercept	−25.775	0.548	−47.036	0.000
theater	1.8203	0.250	7.274	0.000
log(capacity)	9.266	0.074	124.424	0.000
log(notoriety)	0.791	0.066	12.034	0.000
competition	0.449	0.019	23.342	0.000
comp. × star	−0.107	0.007	−15.348	0.000
σ	0.329	0.006	51.488	0.000

Inference results : costs

- Assuming that the observed prices are larger than what they should be if $\rho_i = 1 \, \forall \, i$ together with the computation of the monopoly price gives us a new robust bracketing which we use to calibrate c_i.
- Summary statistics (in euros)

	Mean	Std. Err	Min.	Max
cost	6.970	2.787	3.746	13.223
markup (at full price)	7.259	2.863	2.860	12.511

- The markups are slightly larger than expected, but one should recall that the full price is charged only for the first event. A 2 euros discount is provided for every other shows.
- Also a special price of 9 (and then 7) euros is charged for less than 26 years old attenders (which means that markup for 'young audience' is zero on average). Notice that most show are not convenient for children (some of them being deliberately offensive).

Inference results : queue

- q_i may be computed using actual prices and the survival parameters, but we face another issue since 13 events appeared to be sold out.
- Notice severe capacity constraints may cause non convexity of the game.
- For sold out events the computation of the queue as the ratio of the observed attendance over the survival rate $1 - (p_i/\alpha_i)^2$ is a right-censored version of the actual queue.
- To overcome this problem, we specified a Tobit model to estimate a corrected version of the queue using as endogenous variables the factors derived form a Principal Component Analysis on the available exogenous variables.
- Largest (raw) correlations between corrected estimates of the queues and explanatory variables are as follows

explanatory variable	correlation with corrected q_i
capacity	0.878
star	0.796
staff	0.422
dance	0.421

Inference results : spillover and dispatching

- According to our model, optimal pricing (whatever the coalition considered) should not depend on the vector of newcomers $e_1, \ldots, e_n$.
- We may then use observed prices as instruments to decompose the variable q_i between spillovers and newcomers.
- The best model we came up with uses the previous factor analysis together with current and three days lagged prices.
- As a final step we need to dispatch spillover among all the possible preceeding events to recover the ρ_i parameters. To this end, we made the following additional assumptions:
  1. spillover from more than one day are negligible,
  2. nobody attends the same show twice in a row,
  3. the transition probabilities from one theater to the other conform with cross-reputation measured in surveys.
- Spillover : summary statistics (in people)

	recieved	sent
min	0	0
Q1	6.80	4.29
Q2	9.59	7.45
Q3	15.98	15.31
max	37.74	45.18

Value sharing

- We may now simulate the optimal behavior and the resulting audiences for any coalition, so that the game may be completely computed.
- We checked directly that the resulting game is convex.
- Using the Shapley sharing rule we computed relative shares for each theater and compare to three "rules of thumb".

	Relative shares (%)			
Places	Shapley	Attend.	Payoffs	Costs
Budascoop	7.53	8.70	6.12	5.07
Espace Pasolini	1.13	2.05	1.27	1.61
La Rose des vents	23.84	21.12	23.14	18.76
Maison de la culture de Tournai	20.33	20.27	23.82	25.96
Maison Folie de Wazemmes	2.01	2.82	1.49	1.57
Phenix	6.87	7.13	5.87	5.81
Schouwburg	11.39	12.71	10.41	14.20
Théâtre du Nord	22.87	20.25	23.81	23.95
Transfo	4.04	4.92	4.05	3.05
Belongs to the core	yes	no	no	no

- Despite small differences, only the Shapley sharing rule appears to belong to the core of the game (which suggests it is rather small).

Summary and further improvements

- Model for festivals as cooperative games.
- convexity of the game and axiomatization of the Shapley sharing rule (remains : 'parametric' axiomatization).
- Full derivation of the rule in a real-life example (remains : improve econometrics with the new edition data set from 2012).
- Comparison with "blind" rules and (in)stability checks using the core as a set solution.