Hitting Capacity:

Implications for the Valuation of Outdoor Recreation

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Sellouts are Pervasive

- Sellouts are pervasive in recreational activities.
  - Government run campgrounds in the United States: Online booking.
  - Free beaches where parking is limited.
- And other activities, too…
  - Primary health care provider panel may be full.
  - Classes at a university fill up: Pick a different general education requirement.
  - Reservations at a restaurant.
  - People at a movie seeing *Angry Birds* instead of *Finding Dory*

Incentives

- **Sellouts** are different than **crowding** – crowding is a well-studied **feature** (McConnell 1977).
- Sellouts alter the choice set. They are not an attribute of the choice.
- Are choice sets observable?
  - Yes – if they are explicitly provided in the data.
  - No – in aggregate data.

Literature

- Examples of Logit Models applied to Fisheries: Haab, et.al. (2012), Carson, Hanemann, and Wegge (2009)… *many others*
- Incomplete choice availability violates a major assumption of the standard or even more complicated random utility models (RUM's), used in many recreational studies.
- Inventory stockout problem well-studied – understanding consumer demand main objective.
  - Conlon and Mortimer (2013) use (frequentist) adjustment directly in the utility function; computationally expensive.
  - Musalem, et.al. (2010) use Bayesian adjustment for shampoo sales.

Small Vending Machine Example

- Let's say there is a small vending machine with plain and seltzer water.
- People like the bubbles; their utility is $U_{ij} = (\beta_1 + \beta_2 \text{bubbles}_i)(\text{mL}_i) - price_i + \varepsilon_{ij}$.
- If there are 10 of each, but 20 people order water bottles before you were able to document the sellout, you have no idea who bought what. Model is unidentified.

Screenshot of Fisherman's Landing Google Map Integration
Fisherman's Landing is one of many popular CPFV destination in San Diego.


FISHERMAN'S LANDING

HOME FISH COUNTS BOOK ONLINE TRIP TYPES CHARTER BOATS LONG RANGE MEDIA CONTACT US ETA

Fisherman's Landing
Secure Online Reservations - Book Online

If you know or suspect that your trip will be fishing California Waters,
please get your California fishing license HERE in advance.

To make your reservation please click on the green button next to the trip you would like to go on.
Then follow the instructions to complete your reservation now.
We gladly accept the credit cards below:

VISA MasterCard DISCOVER NETWORK AMERICAN EXPRESS

Search by Boat: Select Boats Search by Trip Type: Select Trip Type

	Boat	Trip Type	Departure Date & Time	Return Date & Time	Load	Price	Open Spots Comments	
			Monday, June 27, 2016					
CALL	Dolphin	PM Half Day	Mon 06-27-2016 1:00 PM	Mon 06-27-2016 6:30 PM	75	$31	CALL $31 Mondays! Half-day local fishing targeting calico-bass, rockfish, sand-bass, lingcod and halibut. Licence and Rental are additional.	My Account
	Condor	1.5 Day	Mon 06-27-2016 9:00 PM	Wed 06-29-2016 7:00 AM	37	$335 inc. Permits	CALL This trip is a Definite Go! Offshore/Freelance. Targeting tuna and yellowtail. Price includes Mexican	My Account

Screenshot of Fisherman's Landing booking service (took on June 27).

Empirical Application

- **What is the willingness to pay for highly migratory species ("HMS"; "tuna"; "5 prized species") recreation catch in San Diego?**
  - Albacore tuna, Bluefin tuna, Dolphinfish, Yellowfin Tuna, and Yellowtail
  - Unequal marginal willingness to pay between the recreational and commercial fishery (fish price) is inefficient. These species are a scarce resource.
- **Do sellouts impact the estimation?**

Industry Review

- Consumer passenger fishing vessel (CPFV) – “party boats” – support recreational fishing trips off the coast of California.
- “Party boat” industry in Southern California – 2013: 500,000 angler days; 1500 jobs (Hilger 2014).
- Industry divides trips into trip types based on the length of the trip (½ day, ¾ day, full day, overnight, 1½ day, 2 day)
  - Our focus is on 1-2 day trips in San Diego County
- Trip type helps determine the type of fish targeted.

Data

- *Skipper's Log Book*
  - Fish catch.
  - Passenger load.
  - Date
  - Vessel
- Price data is from archived vessel websites.

Simulation

- We run a standard conditional logit model simulation with 6 vessels and ~100,000 people.
  - Utility $U_{bit} = v'_{bit}\beta + \varepsilon_{bit}$, individual probability $\frac{exp(v'_{bit}\beta)}{\sum_{b=1}^{B} exp(v'_{bit}\beta)}$.
- The correct Willingness to Pay is $3.00
- Capacities are constrained to (20,15,10,100,100,100) spots each time period, with $N(70,15^2)$ customers.
- Vessel 1 is typically preferred, although allowed to vary.
- Share of vessels without constraints would be (54%,28%,12%,4%,1%,<1%) but with capacity constraints it is (25%,16%,8%,30%,14%,6%).
- Estimating with infinite capacity: WTP = $3.01.
- Estimating with limited capacity and not accounting for sellouts: WTP = $1.91.

Application Overview

- Three step process:
  - First, estimate the probability that each trip sells out.
    - Vessel Fixed Effects, Number of People in the Market
  - Second, take out the vessel from an individual's choice set with that probability (if person did not select).
  - Third, estimate the RUM with the new choice set.

Step One

- First, run a linear probability model. $soldout_{bemrt} = 1\{\text{soldout according to algorithm}\}$. Vessel b, trip-type e, time period t, month m, and trip r. Dummy variables V, M, and E.

$$soldout_{bemrt} = \delta N_t + \alpha_1 V_b + \alpha_2 M_m + \alpha_3 E_e + \alpha_4 \text{price}_r E_e + \varepsilon_{bemrt}$$

Number of Anglers in the Market	0.000248
	(1.88)
Sq. Number of Anglers in the Market	
July Binary	-0.238**
	(-3.06)
August Binary	-0.0553
	(-1.12)
One and One Half Day Binary	-0.418
	(-0.94)
Two Day Binary	0.809
	(1.39)
Price × Overnight	-0.00163
	(-1.62)
Price × 1½ Day	0.000101
	(0.06)
Price × 2 Day	-0.0022
	(-1.66)
Constant	0.212
	(0.84)
N	557
R^2	0.277
AIC	681.9
Log Likelihood	-303.9

t-statistics in parenthesis
Vessel fixed effects included

Step Two

- Find $\tilde{p} = \widehat{soldout}_{ibemrt} - \hat{\delta}\hat{g}_i N_t$. $\hat{g}_i \sim U(0,1)$.
- Here, $\hat{\delta}$ is simulating the queue.
- Trip is eliminated from a person's choice set if person did not choose that trip with probability $\tilde{p} + \hat{\sigma}\tilde{q}$, where $\hat{\sigma}$ is the standard error of the forecast, and $\tilde{q}$ is a draw from the normal distribution.

Step Three

- Look at each vessel-trip type combination's track record last season – their proportion of "5 prized species" caught as a fraction of total fish (prob_{bet}).
- Person *i*, vessel *b*, trip-type *e*, trip *r*, time period *t*.
  - Time periods: 2 per week (Fri-Sun, Mon-Thurs)
- bl_b is beam × length of vessel *b*.

$$v_{ibert} = \sum_{\ell \in \{1,1.5,2\}} \tau_\ell \text{prop}_{\text{bet}} 1_{\ell\text{day}} + \left(\sum_{\ell \in \{1.5,2\}} \varphi_\ell 1_{\ell\text{day}} \right) + \beta_{\text{price}} p_r + \beta_{\text{h}} h_{bet} + \beta_{\text{s}} \text{bl}_{\text{b}} + \sum_{\ell \in \{1,2\}} \beta_{\text{a}} \text{age}_{\text{b}}^{\ell}$$

Interpretation of WTP Coefficient

- Quantities of interest:

$$\sum_{\iota \in \{1,1.5,2\}} \tau_{\iota} \text{prop}_{\text{bet}} 1_{\iota\text{day}}$$

- Each τ_{ι} describes the increased WTP for a trip that catches all "5 prized species" vs. a trip that does not catch any "5 prized species." A 10 percentage point increase in that particular catch would have an increased WTP of $0.1\tau_{\iota}$.

Comparison of WTP Estimates

	Restricted	Restricted	Unrestricted	Unrestricted
	Standard Model	Sell-out Model	Standard Model	Sell-out Model
Prop × Overnight	\$37	\$161	\$81	\$198
Prop × 1½ Day	\$82	\$209	-\$19	\$52
Prop × 2 Day	\$232	\$434	-\$10	\$274
WTP 1½ Day			\$122	\$166
WTP 2 Day			\$252	\$166

Table 4

One Draw of the Sell-Out Model

	RUM Coeff.	WTP	RUM Coeff.	WTP	RUM Coeff.	WTP
Price	-0.00274***		-0.00189***		-0.00200***	
	(-40.26)		(-25.31)		(-25.22)	
Pr × Overnight	-0.145***	-52.99***	0.306***	161.7***	0.397***	198.6***
	(-3.51)	(-3.53)	(6.85)	(6.44)	(8.29)	(7.87)
Pr × 1½ Day	0.568***	207.1***	0.396***	209.5***	0.0938	46.92
	(19.17)	(17.93)	(12.84)	(12.25)	(1.26)	(1.25)
Pr × 2 Day	0.927***	338.2***	0.824***	435.5***	0.559***	279.6***
	(27.38)	(28.07)	(22.76)	(22.79)	(5.42)	(5.18)
Pr N/A,	0.124***		0.235***		0.226***	
Used Avg.	(7.56)		(13.40)		(12.79)	
Beam × Length			0.00113***		0.00113***	
			(55.55)		(55.58)	
Vessel Age			0.0274***		0.0317***	
			(7.58)		(8.29)	
Vessel Age²			-0.000303***		-0.000350***	
			(-7.29)		(-8.03)	
1 ½ Day Binary					0.341***	170.4***
					(4.82)	(4.86)
2 Day Binary					0.325**	162.4***
					(3.26)	(3.37)
N	485919	485919	485919	485919	485919	485919
Pseudo R^2	0.0284		0.0548		0.0551	
AIC	115015.5		111897.9		111871.7	
Log Likelihood	-57502.7		-55941.0		-55925.9	

Test of Model

- To determine significance, confidence intervals for each 1000 draws are compared.
- To test whether model is different from standard model, we run SUR test on $(\beta_{ij}/\beta_{\text{price}}) - (\alpha_j/\alpha_{\text{price}})$ [α represents naïve regression].