A Portfolio Approach for Multiple-Site Use in a Random Utility Model of Recreation Demand

Zhe Chen
George Parsons
Chris Leggett
Joe Herriges
Nancy Bockstael
Kevin Boyle

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Motivation

- Principal Purpose:
  - Valuation of site closure in the context of multiple-site trips
- Single-destination Trips vs. Multiple-destination Trip
  - Conventional travel cost model – single-purpose, single-site trips
  - Setting is parks out west where multiple-site trips is the normal

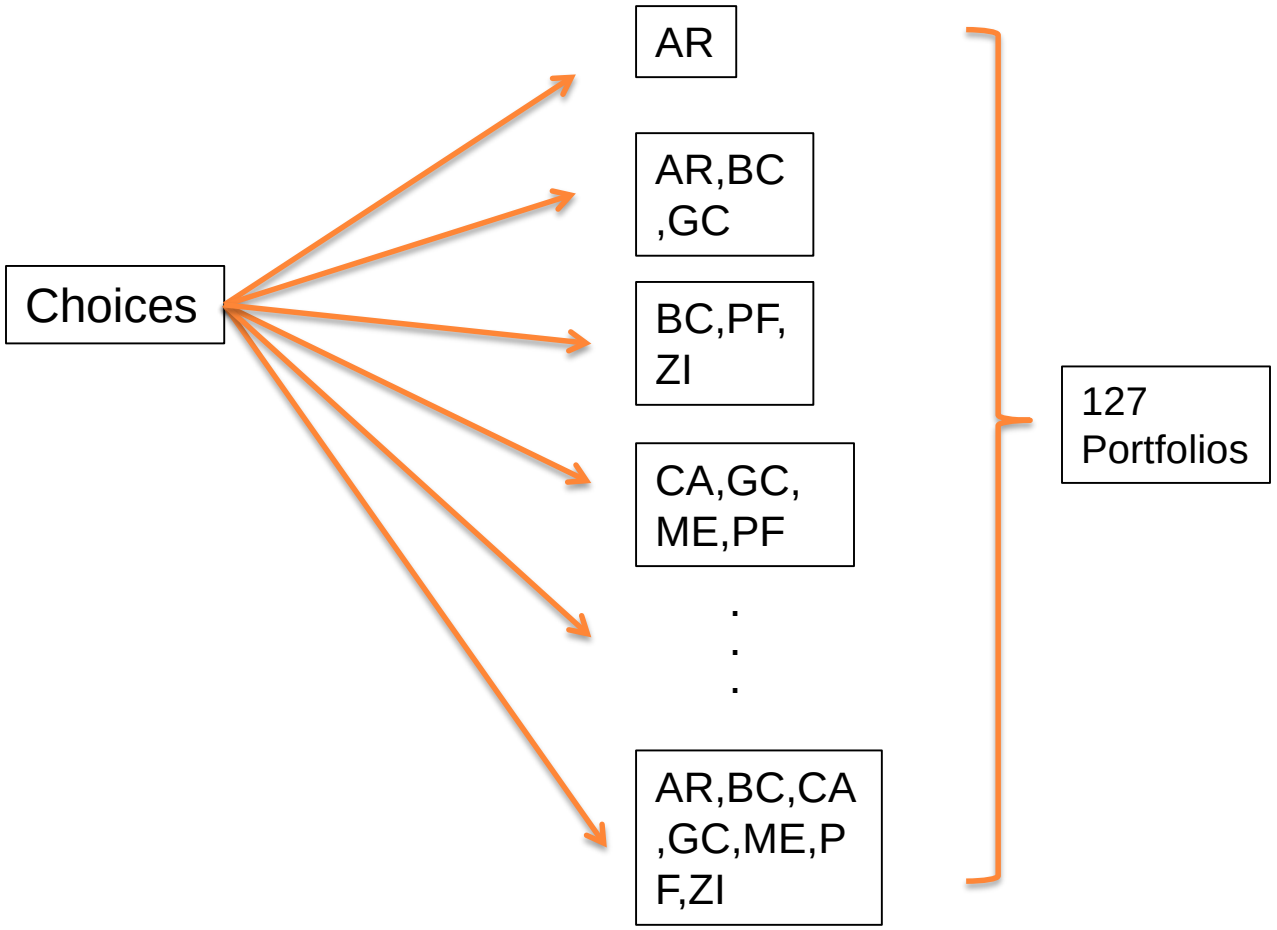
Study Setting

- 7 National parks in 4 states (UT, CO, NM, AZ) :
  - ✓ Arches
  - ✓ Bryce Canyon
  - ✓ Canyonlands
  - ✓ Grand Canyon
  - ✓ Mesa Verde
  - ✓ Petrified Forest
  - ✓ Zion
  - ✓ + Others


IDAHO
Pocatello
Snake
Bear
Boise
Lake
Logan
Brigham City
Ogden
Great Salt Lake
GREAT SALT LAKE DESERT
Salt Lake City
Tooele
Orem
Utah Lake
Provo
Kings Peak 13,528 ft.
Vernal
Flaming Gorge Reservoir
Green
Wells
Wendover
Nephi
Price
Ely
Wheeler Peak 13,063 ft.
Sevier Lake
UTAH
Richfield
ARCHES NAT'L PARK
Moab
Delano Peak 12,173 ft.
CANYONLANS NATIONAL PARK
Cedar City
BRYCE CANYON NATIONAL PARK
ZION NATIONAL PARK
St. George
Lake Powell
Page
Las Vegas
Lake Mead
Virgin
GRAND CANYON NATIONAL PARK
Grand Canyon
PAINTED DESERT
Little Colorado
Humphreys Peak 12,633 ft.
Kingman
Williams
Flagstaff
PETRIFIED FOREST NATIONAL PARK
Winslow
Needles
Lake Havasu City
Prescott
Snowflake
Verde
Colorado
ARIZONA
Blythe
Salt
Scottsdale
Mesa
Phoenix
Globe
Gila
Casa Grande
Safford
Centro
Yuma
Ajo
SONORAN DESERT
Tucson
Sierra Vista
Nogales
Douglas
Gulf of California
MEXICO
ROCKY MOUNTAINS
WYOMING
Casper
Cheyenne
Flaming Gorge Reservoir
NEBRASKA
North Platte
South Platte
Fort Collins
Sterling
Greeley
Fort Morgan
Steamboat Springs
ROCKY MTN. NATIONAL PARK
Boulder
Loveland Pass 11,990 ft.
Denver
Glenwood Springs
COLORADO
Grand Junction
Mount Elbert 14,433 ft.
Pikes Peak 14,110 ft.
Colorado Springs
Gunnison
Montrose
Canon City
Pueblo
Lamar
Uncompahgre Peak 14,309 ft.
Arkansas
Blanca Peak 14,345 ft.
SAN JUAN MOUNTAINS
Alamosa
SANGRE DE CRISTO MTS.
Trinidad
Cortez
MESA VERDE NATIONAL PARK
Durango
Raton
OKLA.
Raton Pass 7,835 ft.
Farmington
Wheeler Peak 13,161 ft.
Taos
Los Alamos
Santa Fe
Las Vegas
Canadian
Amarillo
Gallup
Tucumcari
Grants
Albuquerque
NEW MEXICO
TEXAS
Clovis
Portales
LLANO ESTACADO
Lubbock
Socorro
Rio Grande
BLACK RANGE
SACRAMENTO MOUNTAINS
Pecos
Roswell
Truth or Consequences
Artesia
Hobbs
Alamogordo
Silver City
Carlsbad
Las Cruces
CARLSBAD CAVERNS NATIONAL PARK
Deming
El Paso
Ciudad Juárez

Portfolio Approach

- Treat trip-choice as a portfolio choice – 127 portfolios



AR – Arches
BC – Bryce Canyon
CA – Canyonlands
GC – Grand Canyon
MV – Mesa Verde
PF – Petrified Forest
ZI – Zion

Portfolio Approach

- RUM-Based Model
  - 127 Alternatives or Portfolios
  - Parks represented by dummies
- No site characteristics
- Trip cost
  - No fixed cost of entering and exiting the region
  - Min travel cost to reach all sites in the portfolio

- Welfare
  - Closure of a site means losing all portfolios with the site

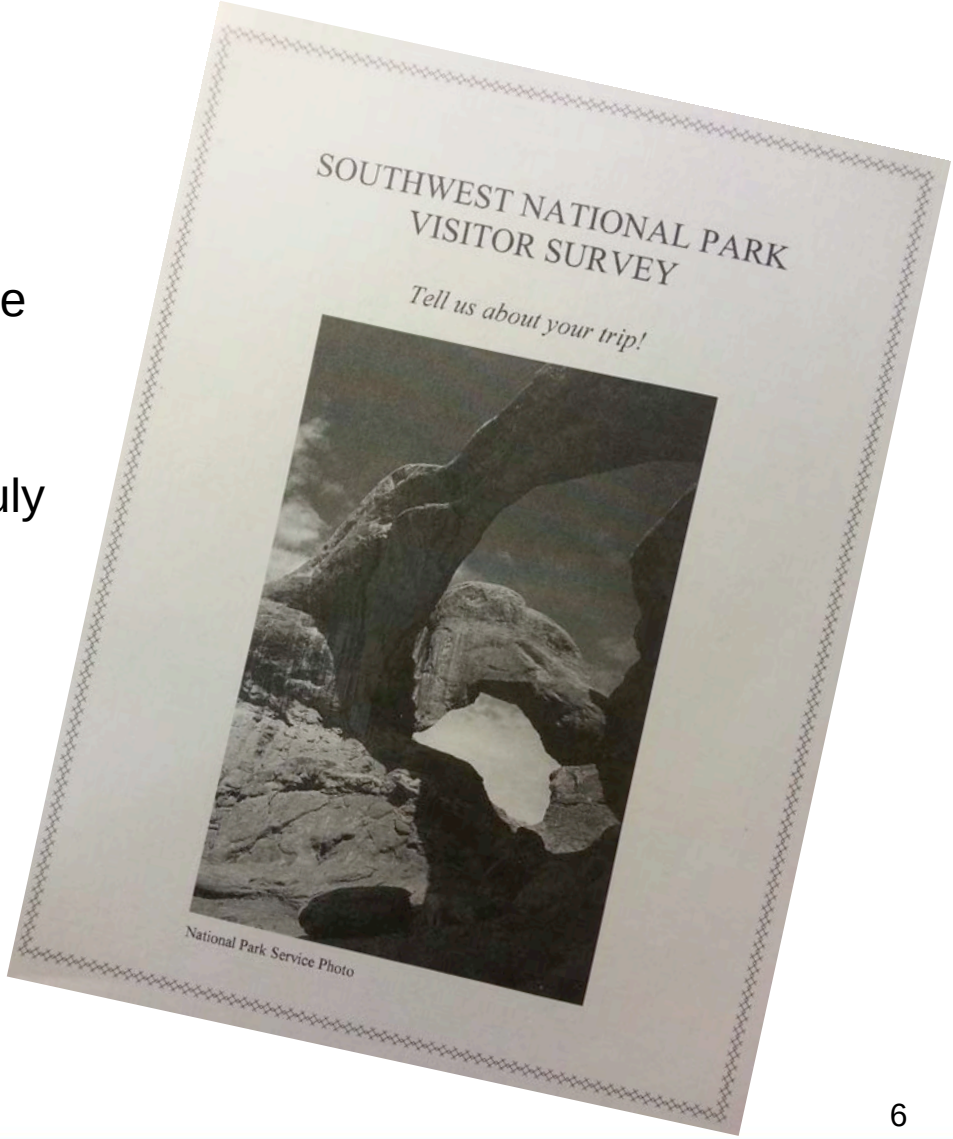
Data Collection

- Two steps data collection:

  1) On-site intercept survey → June 15 – June 23, 2002

  2) Mail survey for trip details → July and August 2002

- Choice-Based Sampling
  - Weight



Models

- Basic Model
  - → Standard Logit Model
  - → Mixed Logit Model
- ASC Model (Alternative Specific Constant Model)

Basic Model

- Portfolio Utility

$$U_{ik} = \alpha_1 time_{ik} + \alpha_2 time_{ik} * ind_i + \beta_1 ar_k + \beta_2 bc_k + \beta_3 ca_k + \beta_4 gc_k + \beta_5 mv_k + \beta_6 pf_k + \beta_7 zi_k + \varepsilon_{ik}$$

Park Dummies

$$where\ i = 1, \ldots 2934; k = 1, \ldots, 127.$$

Basic Model 1. Standard Logit Model

Table 1
7-sites Standard Logit Model

Variable	Standard Logit Model
Time	-1.698
Time * Flextime	0.106
Time * Renter	-0.082
Time * Income (in $1000)	0.001
Arches	0.905
Bryce Canyon	1.741
Canyonlands	0.595
Grand Canyon	3.493
Mesa Verde	1.131
Petrified Forest	0.272
Zion	2.169
Visited 1-5 other cities or parks	1.558
Visited 6-10 other cities or parks	-0.033[1]
Visited more than 10 other cities or parks	-1.695
Log-likelihood	-12750.141
Sample size	1349052

Notes: [1]Not significant at the 95% confidence level

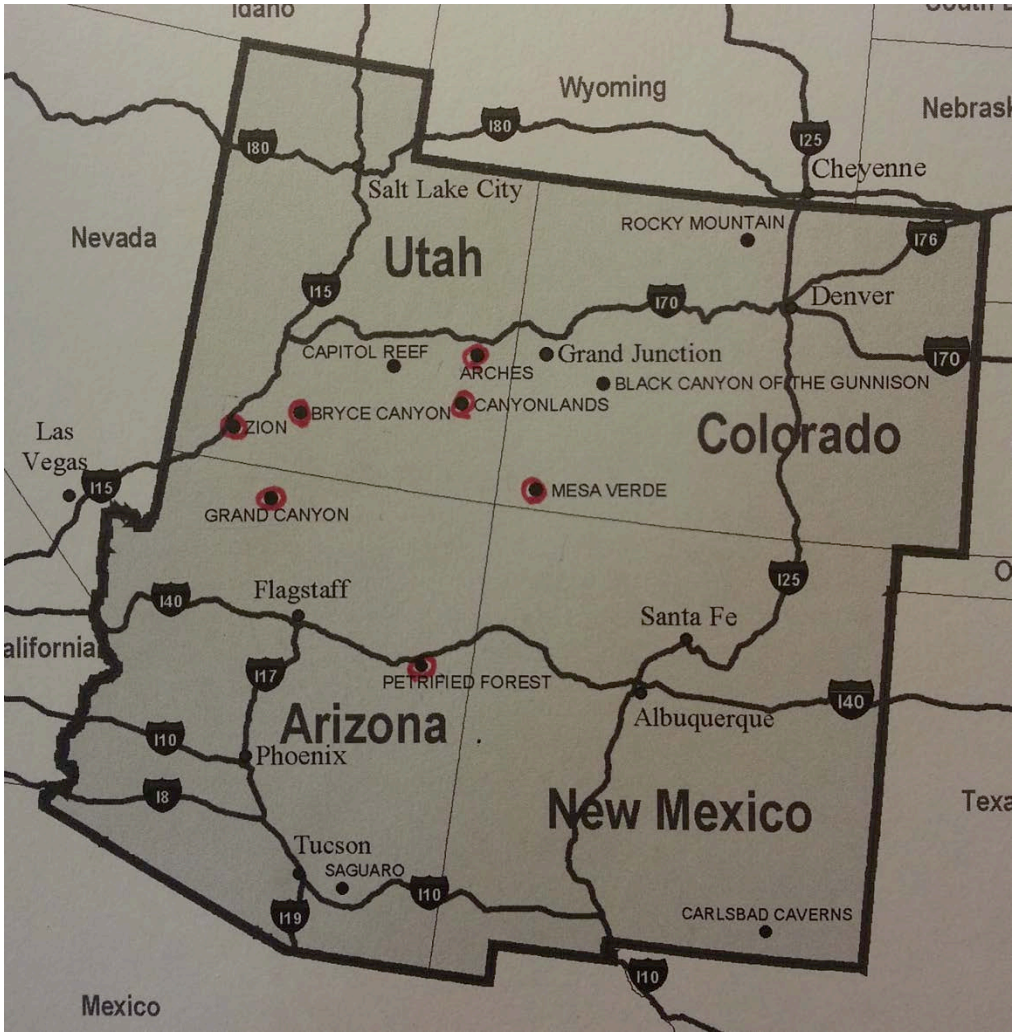
Basic Model 2

- Mixed Logit Model
  - Parks with random coefficients
  - Account for correlation among parks → Variance Covariance Matrix

Park Correlations

- Most highly correlated parks

- Arches & Canyonlands	0.974
- Bryce Canyon & Zion	0.974
- Grand Canyon & Petrified Forest	0.959
- Arches & Mesa Verde	0.713
- Grand Canyon & Mesa Verde	0.698
- Bryce Canyon & Canyonlands	0.695
- Mesa Verde & Petrified Forest	0.665



ASC Model

Table 2
127 ASC Standard Logit Model

Variable	Standard Logit Model
Time	-2.092
Time * Flextime	0.063
Time * Renter	-0.043[1]
Time * Income (in $1000)	0.001
Visited 1-5 other cities or parks	1.558
Visited 6-10 other cities or parks	-0.033[2]
Visited more than 10 other cities or parks	-1.695
ASC 1 ~ 127	0.412 ~ 33. 952
Log-likelihood	-11184.879
Sample size	1349052

Notes: [1,2] Not significant at the 95% confidence level

Welfare Analysis

- Site Closure
  - Individual parks
  - Group of parks

Comments

Table 4

Top 5 Portfolios (Portfolios with highest utility)

Portfolios	Grand Canyon	Arches	Bryce Canyon	Zion	Canyon lands	Mesa Verde	Petrified Forest	No. of Parks Visited
127	X	X	X	X	X	X	X	7
121	X	X	X	X	X	X		6
122	X	X	X	X	X		X	6
124	X	X	X	X		X	X	6
101	X	X	X	X	X			5
Total	5	5	5	5	4	3	3	

Table 6

Bottom 5 Portfolios (Portfolios with lowest utility)

Portfolios	Petrified Forest	Mesa Verde	Canyon lands	Bryce Canyon	Arches	Zion	Grand Canyon	No. of Parks Visited
46	X		X	X				3
45		X	X	X				3
51	X	X		X				3
77	X	X	X		X			4
43	X				X	X		3
Total	4	3	3	3	2	1	0	