Selection Between Conditional and Unconditional Models of Recreation Demand

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Overview

- Discuss basic issues between conditional and unconditional models
- Present the models to be examined
- Discuss methods of distinguishing models
- Present the results
- Conclusions

Basic Issues

- Vastly different underlying assumptions
  – Linear indirect utility v.s. linear exponential demand
- Both are widely employed
- Problems with econometric tests to differentiate them
  – Non-nested tests only differentiate data to model fit – not the theoretical acceptability of underlying modelling assumptions

What to do?

- Early work (Diamond, Feather and Parsons) tried to link conditional and unconditional models
  - Proven wrong (Shonkwiler and Shaw and others)
- Specialized analyses can easily choose amongst the models when designed a survey and collecting primary data
- In other situations what are the tradeoffs?
- How can one measure the tradeoffs quantitatively?

What to do indeed!

- Grab some data
- Pick some models
  - Random Utility Models
    - Conditional logit
    - Multinomial Dirichlet RUM
  - Pooled Count Demand Models
    - Poisson
    - negative binomial

Conditional Models

- Random Utility Modeling
- Generally assumes linear indirect utility
- Conditional models take the intensity of use by an individual as given - no need for individual characteristics (intensive margin)
- Provides efficiency gains in econometric analysis from conditioning on individuals
- While increasing quality may draw "new" participants there is no way to predict who they may be (extensive margin)
- *Powerful if the presumption is that the world is getting worse – problematic if new participants may come*

Random Utility Models

- Conditional modeling strategy
- Econometric efficiency is maximized
- Multinomial Dirichlet newer model with more flexibility
- Others could be used (MNL for one)

$$P\left(Y_J = y_j \middle| y\right) = \frac{y!}{y_1!y_2!\ldots y_J!}\pi_1^{y_1}\pi_2^{y_2}\ldots\pi_J^{y_{J1}}$$

$$p\left(y \middle| \alpha,\theta,\Upsilon\right) = \frac{\Upsilon!\Gamma(\alpha)/\Gamma(\Upsilon+\alpha)}{\prod\left\{y_j!\Gamma\left(\alpha\theta_j\right)\right\}}\prod\Gamma\left(y_i + \alpha\theta_j\right)$$

Unconditional models

- Demand based models – Typically count models
- Models assume linear exponential demand
- Models predict increases or decreases in demand
- Requires information on individual characteristics – no efficiency gains from conditioning on individuals
- Good at predicting welfare changes from increasing or decreasing quality (either intensive or extensive margins)
- *Suitable for a range of possible policy scenarios*

Count Models

- Treat individual trips as integers
- Non-negative distributions
- Quite popular
- Well suited to commonly obtainable public data
- Use Poisson and Negative Binomial

$$P(Y = y) = \frac{e^{-\lambda}\lambda^{y}}{y!}$$

$$P(Y = y) = \frac{\Gamma(\alpha^{-1} + y)}{\Gamma(\alpha^{-1})\Gamma(y+1)}\left(\frac{\alpha^{-1}}{\alpha^{-1}+\lambda}\right)^{\alpha^{-1}}\left(\frac{\lambda}{\alpha^{-1}+\lambda}\right)^{y}$$

Data

- Backcountry hiking permit data in the Paysaten Wilderness
- Paysaten Wilderness has twenty four trails
- Ecosystems mapped onto trails
- Other site characteristics added
- Distance calculated based on postal code to trailhead
- Demographics at the postal code level

US Map

Washington

NORTH
CASCADES
NATIONAL
PARK
OKANOGAN
N.F.
WENATCHEE
N.F.
Winthrop
Tonasket
Okanogan
Chelan
Entiat
Seattle
Leavenworth
Wenatchee
Cle Elum
Olympia
Ellensburg
Spokane
Naches
Yakima
WASHINGTON
Pasco
Vancouver
5
20
97
21
25
2
90
410
12
82

Paysaten Wilderness

Paysaten Wilderness

Paysaten Wilderness

Data to Question Fit

- Data is anonymous – only home postal code is reported
- Models are estimated on a representative individual from a postal code
- Demographic information is taken from the US National Census – the average person
- *Good fit to the question because this is the kind of situation where the trade-offs between econometric efficiency and transferability of the functions is an important decision*

Methodology

- First, fit the four models
- Examine traditional measures of model adequacy
- Examine the differences in welfare measures across the site characteristics

Table 1. Econometric Parameter Results

	Conditional Logit		Multinomial Dirichlet		Poisson		Negative Binomial	
Model Attributes								
Constant					-23.7721	***	-35.4542	***
					3.4224		6.3569	
Travel Distance	-0.055	***	-0.0489	***	-0.06	*	-0.01	
	(0.0134)		0.0103		0.03		0.02	
Forest Ecosystems								
Douglas Fir	-0.1387	**	-0.1334	***	-0.0661		-0.0927	*
	0.0648		0.0442		0.0545		0.0551	
Englman Spruce	0.1203	***	0.1094	**	0.1014	***	0.1295	**
	0.0557		0.0464		0.0648		0.0525	
Hemlock	0.0001		0.0003		-0.0003		-0.0003	
	0.0002		0.0002		0.0002		0.0002	
Lodgepole	0.0001		0.0002		0.0001		0	
	0.0001		0.0001		0.0001		0.0001	
Silver Fir	0.1094		0.1328		-0.1069		0.0203	
	0.1651		0.1312		0.1447		0.1262	
Other Site Attributes								
Horse Facilties	1.1286	***	1.2677	***	0.649	***	0.8675	***
	0.3334		0.2305		0.1954		0.2367	
Rock and Ice	-0.0021	***	-0.0015	***	-0.0019	***	-0.0023	***
	0.0008		0.0006		0.0007		0.0007	
Dirt Roads	0.0561	**	0.067	***	0.0529	**	0.0545	**
	0.0241		0.0191		0.0236		0.0222	
Demographic Variables								
Income					0		0	
					0		0	
Gender					0.4105	***	0.6026	***
					0.0681		0.1202	
Age					-0.009		-0.0199	
					0.015		0.0203	
Education					0.1407		0.2822	*
					0.0897		0.1587	
Log(population)					-0.1461	***	-0.0261	
					0.1382		0.0335	
Alpha			0.886	***				
			0.1651					
Overdispersion Parameter							23.6442	***
							2.3108	
Log Likelihood	-1649.1976		-815.45265		-2031.85		-1126.81	

Welfare Calculations

- RUM
  - Uses standard per unit welfare calculations by trail
- Count Demand
  - Based on choosing a trail and increasing the quantity of an attribute by one unit and assessing the change in consumer surplus that results from the change in trips

Average Welfare Measures by Modelling Strategy across 24 trails

	Conditional Logit	Multinomial Dirichlet	Poisson	Negative Binomial
Douglas Fir	-$6.76	-$8.94	-$14.30	-$10.82
Dirt Road	$3.01	$4.96	$12.14	$6.84
Englemann Spruce	$6.67	$8.27	$23.88	$16.89
Hemlock	$0.01	$0.02	-$0.07	-$0.04
Lodgepole	$0.00	$0.01	$0.01	$0.00
Silver Fir	$6.03	$10.16	-$22.67	$2.51
Rock/Ice	-$0.11	-$0.11	-$0.42	-$0.28
Horse Facility	$109.18	$182.64	$204.30	$168.76

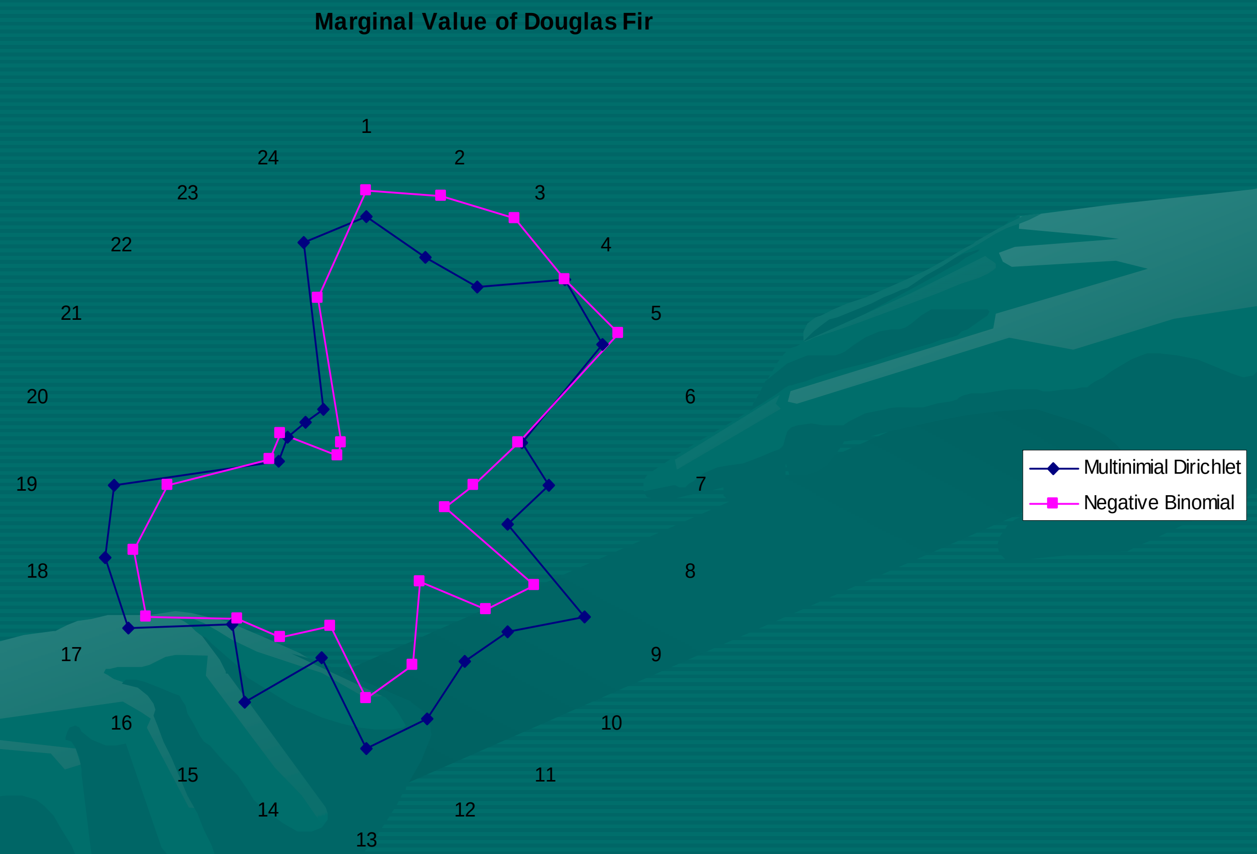
Some Preliminaries

- Trails 1, 2, 3, and 4 receive almost no visitors because you must either take a boat to the trailhead or take a long trek outside the park to get there
- Trails 6 through 10 and 20 through 23 are popular

“Consistent fits”

- Trail attributes that are zero-one or small amounts **OR** parameters are small
- No major differences between modeling strategies

Douglas Fir



Marginal Value of Douglas Fir
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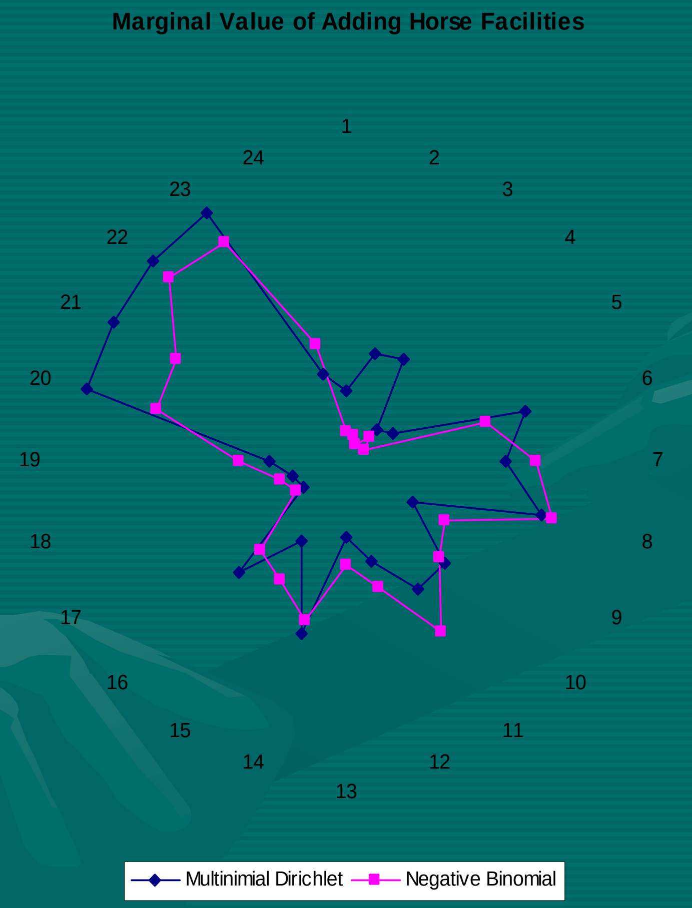
23
24
Multinimial Dirichlet
Negative Binomial

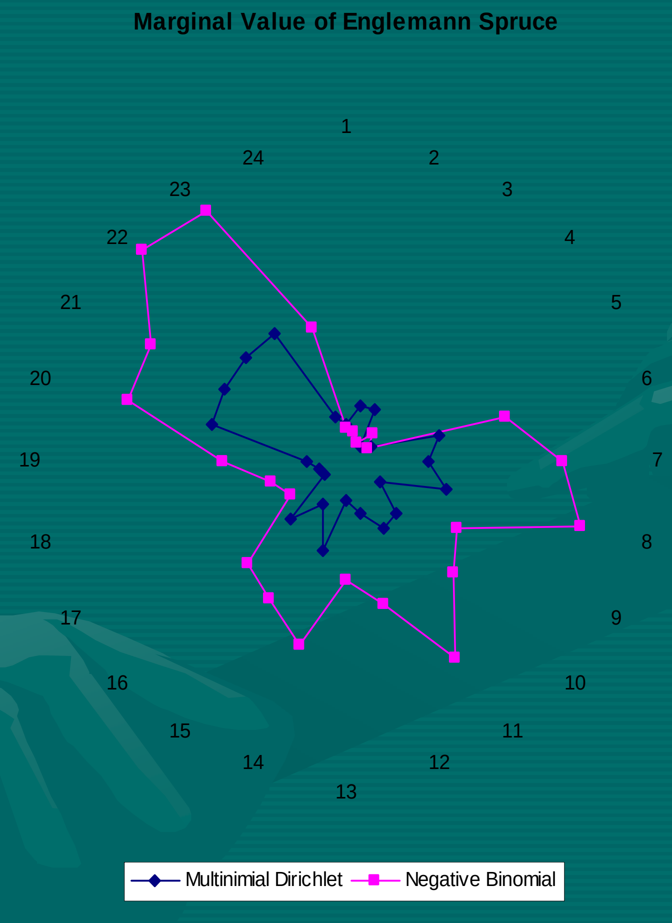
Horse Facilities



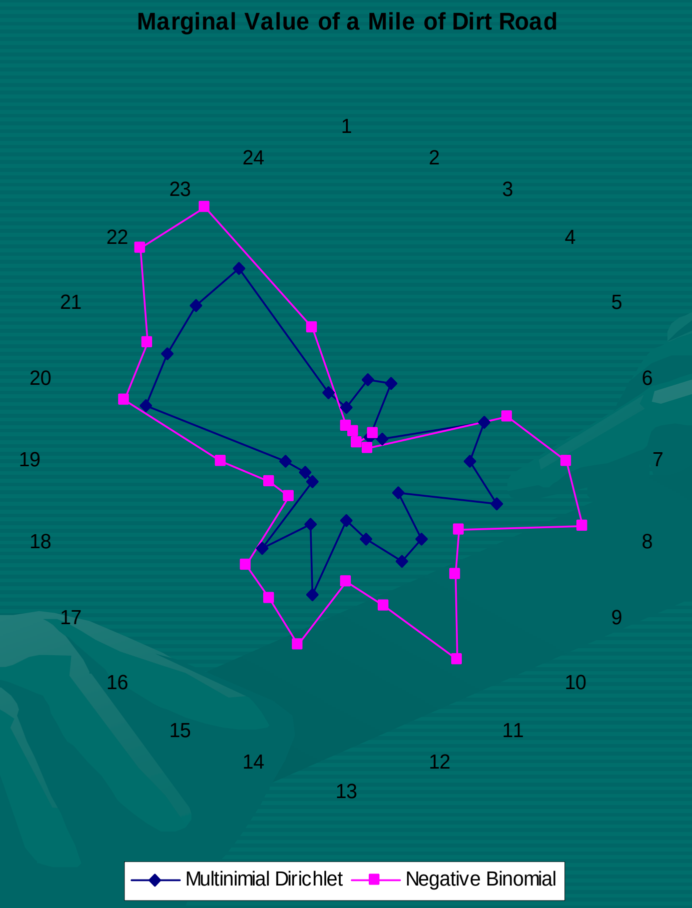
Count Models Welfare Large

- Trail attributes that have large quantities **OR** large parameters
- Linear exponential demand causes large shifts in demand in response to small changes in quantity

Englemann Spruce



Dirt Roads



Marginal Value of a Mile of Dirt Road
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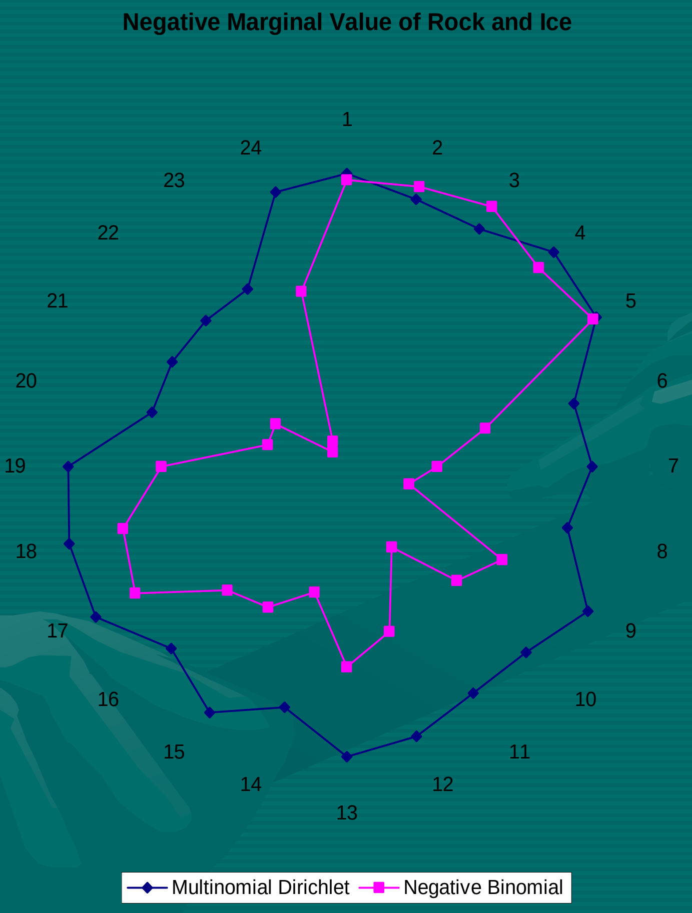
24
Multinimial Dirichlet
Negative Binomial

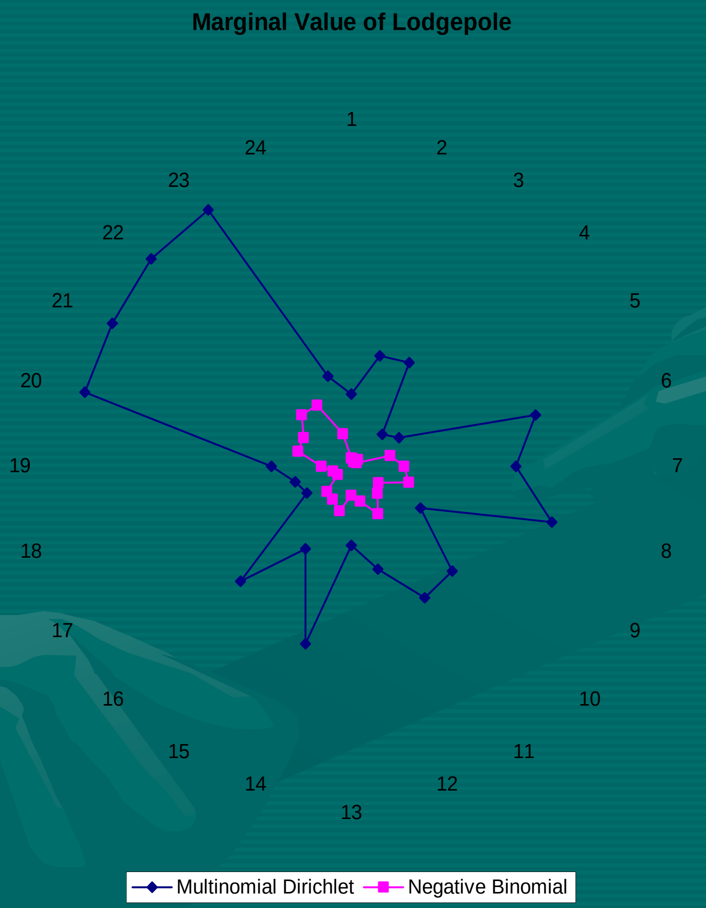
RUM Models generate large welfare

- Trail attributes with small quantities OR small parameters
- Linear utility expands these effects beyond what a non-linear (concave) function will estimate

Rock and Ice Fields



Lodgepole


Marginal Value of Lodgepole
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Multinomial Dirichlet
Negative Binomial

What's going on?

- In the demand framework the change in marginal value is driven by change in trips
  - Since the functional form of demand is trips=exp(xb) the impact of a one unit increase in x_i depends on the value of all other x's
- In the RUM the change in marginal value is independent of trips
- The welfare from demand models is systematically different from RUM models ceteris paribas

More about what's going on

- Curvature matters when the base and/or the delta (parameter*marginal increase in attribute) is high
  - Affects both RUM and linear exponential demand
  - Systematic study would put "bounds" on welfare measures

Conclusion

- The underlying assumptions of these models drives the relative welfare results in predictable ways
- Causes me to think a little more about such things during survey design in my choice experiments and other studies
- No particularly good way to choose
- *It is only one study, but we can learn more*……..