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When to go to a forest? An analysis of the seasonal demand for forest visitation in Poland.

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Outline

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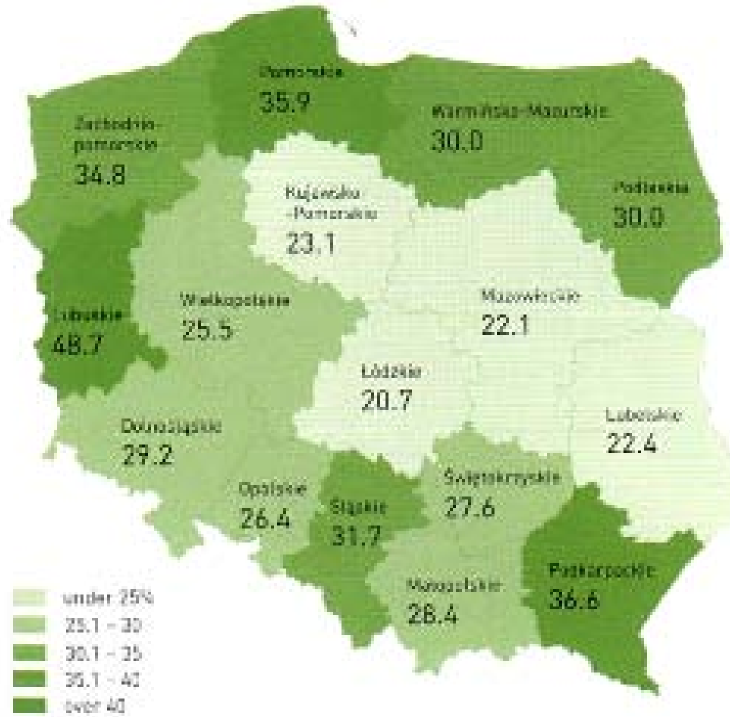
General information about forests and forestry in Poland:

- **The forest area:** 9.1 million hectares = 29% of the Polish territory (the average share of forest area in Europe is 31.1%)
- **The average age** of forests is 60years
- 67% of forests are **coniferous forest stands**
- **Forest ownership:** 82.5% state-owned forests. Almost all of these are managed by the State Forests National Forests Holding (NFH)
- **Access to forests:** unlimited and free of charge in state forests (except for some national parks and strict reserves)



The seasonal demand for forest recreation:

- Thousand of applications of the travel cost methods have been done so far, many of them consider forest recreation,

- For Europe, 38 TCM studies dealing with forest recreation , published in peer-reviewed journals have been recently identified (Giergiczny, 2009),

- As far as we know, no study has dealt with the seasonal differences in recreation demand so far.

Why analyzing the seasonal demand for the forest recreation can be important? How can these results be utilized in practice?

- In many European countries (Central, Eastern and a part of Western Europe) there are four (or even six) distinct seasons. In this case, each forest environment provides some aspects that remain constant across seasons while also providing a rich change in attributes throughout the year what can affect visitation patterns,

- In contrast to North America, European countries are densely populated leading to year-round utilization of forests at greater levels of intensity.

- Effective forest management requires to know the differences in recreation welfare values between seasons as well as the relationships between them,

- Seasonal analysis can play a prominent role to understand the long run implication of climate change on forest use and provided social benefits.

Travel cost method

The seasonal exponential demand system:

$$\ln(y_{is}) = \alpha_s - \sum_{j=s}^{4} \beta_s TC_{is} + \gamma \ m_i + \kappa \ x_i ,$$

Constrains:
- the intercepts must be positive,
- the demand curves must be downward sloping,
- there must be a single income effect in the system,

The compensated price-cross effect:

$$e_{ijk} = y_{ij} \frac{\partial y_{ik}}{\partial m_i} = \gamma \, y_{ik} \, y_{ij}$$

- The cross price effects will be symmetric (i.e. $e_{jk} = e_{kj}$) for individual *i*
- The cross price effects will not be identical across individuals who have different seasonal visitation patterns

- **On-site survey** conducted in the fall 2009 by a professional polling agency
- **4 forest sites** selected to be in close proximity (less than 30 km) to large urban areas
- State owned forests managed by the SF NFH

Name of the site	Conservation regime	Type of forest	Dominant species	Adjacent city	Forest cover in region	Location
Lasy Kozlowieckie	LP	mixed, broadleaved	pine, sessile oak	Lublin (352,000)	14%	SE
Puszcza Kozienicka	LP, PA	mixed	pine, sessile oak, oak	Radom (225,000)	25%	C
Puszcza Bukowa	LP, PA	broadleaved	beech, alder, hornbeam	Szczecin (408,000)	32%	NW
Lasy Zielonogorskie	None	coniferous, broadleaved	pine, ash, alder	Zielona Gora (118,000)	49%	SW

Note:

- **LP** - **landscape park** - protected area due to its unique environmental, historical, and cultural or landscape values in order to protect and popularize them in terms of sustainable development. They are established by local Polish governments. In 2008, there were 121 of these parks with an approximate area of 2.5 million hectares representing 8% of the Polish territory. Forests account for half of this area
- **PA** - **promotional areas** - large compact forest areas characteristic for a given region, where a pro-ecological forest policy has been implemented
- **SE, C, NW, and SW** refer to southeast, central, northwest, and southwest respectively.

- Initial sample size from 4 sites: 1128 interviews
- Restricted to observations where a forest was **a single/the most important purpose** of the trip & to **one day** trips: 740 interviews

Forest	Lasy Kozlowieckie	Puszcza Kozienicka	Puszcza Bukowa	Lasy Zielonogorskie	All forests
Variable	**Mean (Sd)**	**Mean (Sd)**	**Mean (Sd)**	**Mean (Sd)**	**Mean (Sd)**
One-way distance traveled (km)	18 (12)	7 (10)	18 (18)	13 (19)	14 (15)
One-way travel time (min)	27 (14)	17 (16)	31 (26)	29 (27)	25 (22)
Time spend on site (min)	112 (57)	105 (67)	115 (81)	94 (50)	108 (67)

Forest	Lasy Kozlowieckie	Puszcza Kozienicka	Puszcza Bukowa	Lasy Zielonogorskie	All forests
Variable	**Mean (Sd)**	**Mean (Sd)**	**Mean (Sd)**	**Mean (Sd)**	**Mean (Sd)**
Sex (female=0; male=1)	0.54 (0.50)	0.46 (0.50)	0.39 (0.49)	0.36 (0.48)	0.45 (0.50)
Age	37.84 (12.85)	40.69 (17.56)	39.48 (15.42)	41.71 (17.60)	39.80 (15.93)
Education (in years)	13.10 (2.37)	11.75 (2.56)	12.75 (2.54)	13.26 (3.00)	12.62 (2.62)
Number of household members	3.00 (1.22)	3.49 (1.42)	2.91 (1.29)	2.71 (1.20)	3.08 (1.33)
Net monthly household income	2965.47 (1482.25)	3002.63 (2160.09)	3915.32 (2358.26)	2788.89 (1818.64)	3224.88 (2054.94)
Net monthly individual income	1652.24 (698.27)	1154.82 (981.08)	1514.95 (1242.79)	1445.06 (890.38)	1433.95 (1003.48)

Frequency of the forest visits	Shares (%)			
"I am here for the first time"	11.77			
"A few times a year or more often"	67.79			
	Summer	**Fall**	**Winter**	**Spring**
- "I do not go to the forest during this season "	4.80	0.00	**41.40**	15.00
- "Once at this season"	14.80	16.20	19.60	19.00
- "Once a month"	**24.80**	**30.20**	16.80	**23.20**
- "Once per two weeks"	17.80	18.40	8.20	14.20
- "Once per week"	17.60	17.60	7.60	13.00
- "On average twice per week",	8.00	9.80	3.20	6.40
- "Every day or almost every day"	11.20	6.80	2.20	6.20
- "I do not know/it is difficult to say"	1.00	1.00	1.00	3.00
"Once a year"	13.53			
"Once every a few years"	6.90			

Base models:

- a count model => a model with the Poisson distribution
- a continuous model => a model with the exponential distribution

Description of the used models

Right truncated Poisson (RTP)	Right truncated exponential (RTE)	Description
RTP I	RTE I	No division per seasons
RTP II	RTE II	Seasonal models with the income as one of explanatory variables
RTP III	RTE III	Seasonal models without the income

Poisson	Acronyms
Right truncated at *a*	RTP II, RTP III for summer, winter and spring
$$P(Y \mid Y \le a) = \frac{\frac{e^{-\lambda}\lambda^{y}}{y!}}{\Pr(Y \le a)} = \frac{\lambda^{y}}{y!}\left(\sum_{y=0}^{a}\frac{\lambda^{j}}{y!}\right)^{-1}$$	
Right truncated at *a* and left truncated at zero adjusted for endogenous stratification	RTP I, and RTP II, RTP III for fall
$$P(Y_i \mid 1 \le Y_i \le a) = \frac{\frac{e^{-\lambda}\lambda^{y}}{y!}\cdot\frac{y}{\lambda}}{\Pr(Y_i \le a)} = \frac{\lambda^{y-1}}{(y-1)!}\left(\sum_{j=1}^{a}\frac{\lambda^{j}}{y!}\right)^{-1}$$	

Exponential	Acronyms
Right truncated at *a*	RTE II, RTE III for summer, winter and spring
$$P(Y \mid Y \le a) = \frac{\frac{e^{-\frac{y}{\lambda}}}{\lambda}}{\Pr(Y_i \le a)} = \frac{\frac{e^{-\frac{y}{\lambda}}}{\lambda}}{(1 - e^{-\frac{a}{\lambda}})}$$	
Right truncated at *a* and left truncated at one, adjusted for endogenous stratification	RTE I, and RTE II, RTE III for fall
$$P(Y \mid 1 \le Y_i \le a) = \frac{\frac{\frac{y}{\lambda^2} e^{-\frac{y}{\lambda}}}{(\frac{1}{\lambda} + 1) e^{-\frac{1}{\lambda}}}}{\Pr(Y \le a)} = \frac{\frac{y}{\lambda}\left(1 - e^{-\frac{a}{\lambda}}\right)}{\left(1 + \frac{1}{\lambda}\right)(e^{-\frac{a}{\lambda}})}$$	

Variable	RTP			RTE		
	I	II	III	I	II	III
Constant	**1.9252*** **			**1.6430***		
Round-way distance	**-0.0418*** **			**-0.0275*** **		
Constant 		**2.3580*** **	**2.3070*** **		**3.4081*** **	**3.3600*** **
Round-way distance		**-0.0483*** **	**-0.0477*** **		**-0.0415*** **	**-0.0413*** **
Constant 		**1.9083*** **	**1.8598*** **		1.1474	**1.1250***
Round-way distance		**-0.0340*** **	**-0.0335*** **		**-0.0230*** **	**-0.0229*** **
Constant 		1.0328	**0.9840***		0.8330	0.8074
Round-way distance		**-0.0424*** **	**-0.0418*** **		**-0.0301*** **	**-0.0299*** **
Constant 		**1.8787*** **	**1.8284*** **		**2.0976** **	**2.0645*** **
Round-way distance		**-0.0497*** **	**-0.0490*** **		**-0.0365*** **	**-0.0363*** **
Sex (male=1)	0.0784	0.0818	0.1045	0.1658	0.2462	0.2422
Age	**0.0092***	**0.0103***	**0.0106***	**0.0115** **	**0.0116** **	**0.0112***
Net individual income (1000 PLN)	0.0447	0.0490		-0.0208	-0.0160	
Education (years)	0.0318	0.0347	0.0412	0.0133	0.0154	0.0144
Number of household members	-0.0645	-0.0720	-0.0771	-0.0604	-0.0264	-0.0277
Puszcza Kozienicka	-0.0308	-0.0283		0.2501	-0.0669	
Puszcza Bukowa	0.2391	0.2656	0.2989	**0.5799** **	**0.4991** **	**0.5259*** **
Lasy Zielonogorskie	0.0740	0.0855	0.0989	0.5534	0.6709	0.7143
Log likelihood	**-13729.7387**	**-12591.6663**	**-12605.7456**	**-4989.7742**	**-4720.7611**	**-4721.3254**

Likelihood ratio test results

Comparison	Test statistic	Significance
RTP I vs RTP II	2276.1442	Prob> $\chi^2_{0.1}(6)=10.645$
RTP III vs RTP II	28.1586	Prob> $\chi^2_{0.1}(2)=4.605$
RTE I vs RTE II	538.0262	Prob> $\chi^2_{0.1}(6)=10.645$
RTE III vs RTE II	1.1286	Prob> $\chi^2_{0.1}(2)=4.605$

Vuong test results for 0.05 significance level

Comparison	First stage		Second stage	
	Multivariate χ^2 Critical Value	Vuong test statistic	Vuong test statistic	p-value
RTP II vs. RTE II	134,274.66	479,950.91	-7.319586	0.00000
RTP III vs. RTE III	98,866.93	365,158.78	-9.14876	0.00000

CS per person per visit in km	RTP			RTE		
	I	II	III	I	II	III
Summer	23.93 (0.37)	20.70 (0.38)	20.97 (0.36)	36.33 (0.42)	24.09 (0.24)	**24.24 (0.23)**
Fall	23.93 (0.37)	29.40 (0.59)	29.88 (0.54)	36.33 (0.42)	43.49 (0.63)	**43.75 (0.60)**
Winter	23.93 (0.37)	23.58 (0.51)	23.93 (0.46)	36.33 (0.42)	33.21 (0.56)	**33.47 (0.56)**
Spring	23.93 (0.37)	20.11 (0.31)	20.41 (0.27)	36.33 (0.42)	27.42 (0.30)	**27.57 (0.29)**

CS per person per visit in monetary terms	PLN	Euro	USD
Summer	8.73	**2.03**	3.12
Fall	15.75	**3.66**	5.63
Winter	12.05	**2.80**	4.30
Spring	9.93	**2.31**	3.54

The compensated price-cross effect between seasons:

$$\gamma = 0 \Rightarrow e_{ijk} = \gamma \, y_{ik} \, y_{ij} = 0$$

- There is considerable seasonal variation in the value of a trip to analyzed Polish forests. The most valuable trips are those taken in the fall. It could be connected with the aesthetical aspect of the forest during this season („the Polish golden autumn”) as well as with popular recreation activity available only during this season – mushroom picking.

- The compensated cross-price effect between seasons equals zero suggesting that changes in the visitation patterns during one season will not affect the number of trips in the rest of the year. Future work is required to investigate robustness of these results.

- If the visitation pattern is characterized by the high average number of trips, TCM models with non-negative continuous distributions can perform better than count data models.

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http://www.polforex.wne.uw.edu.pl/index.php?en=true

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