



THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato



MASSEY
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Human Habitat Modelling – identifying the preferred urban setting in NZ

Pathways Conference, Wellington Nov 2016

Lars Brabyn and Natalie Jackson

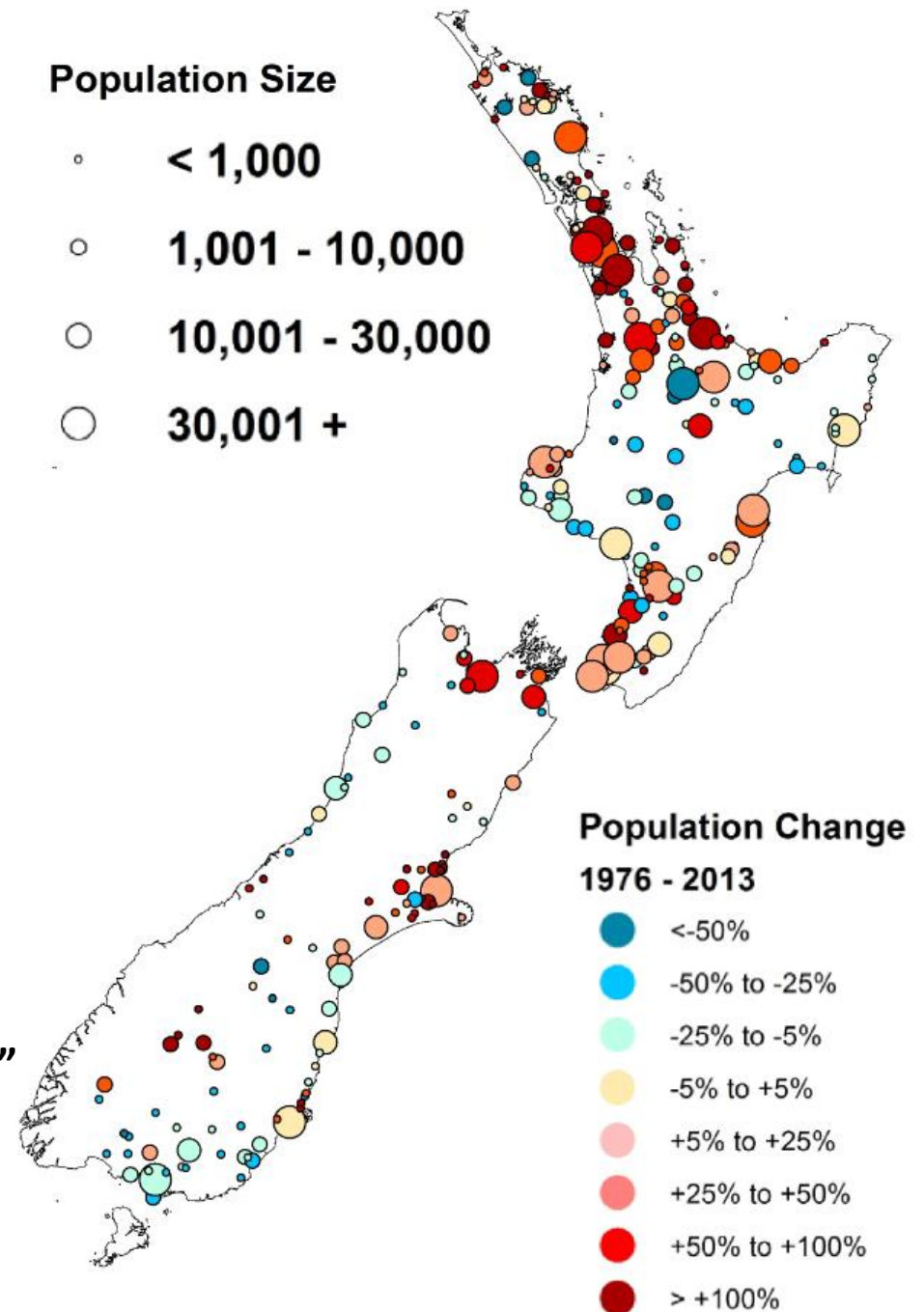


CaDDANZ

Capturing the Diversity Dividend
of Aotearoa/New Zealand

Population change by urban areas 1976-2013

This research is part of a Marsden project with the title: “The sub-national mechanisms of the ending of population growth. Towards a theory of depopulation”



Percent Change of the 10 Fastest Growing Urban Places.

Rolleston	544.9
Arrowtown	381.2
Snells Beach	349.5
Mangawhai Heads	317.6
Wanaka	300.0
Queenstown	243.3
Athenree	223.8
Pauanui Beach	195.2
Woodend	170.6
Rural Centre Waikuku	167.3

Percent Change of the 10 Fastest Declining Urban Places

Murupara	-38.8
Kaingaroa Forest	-39.2
Turangi	-41.0
Patea	-42.4
Rural Centre Waitoa	-46.5
Rural Centre Ohai	-50.8
Waioruru	-54.8
Otematata	-55.4
Rural Centre Ohura	-60.7
Twizel Community	-76.0

**If only the 39 urban places in 1981 with a
population greater than 10,000 are examined**

**Percent Change of the 10 Fastest
Growing Urban Places.**

Tauranga	96.4
Kapiti	83.7
Southern Auckland Zone	68.1
Northern Auckland Zone	67.7
Pukekohe	67.0
Western Auckland Zone	62.8
Cambridge Zone	51.2
Taupo	47.1
Central Auckland Zone	41.4
Hamilton Zone	41.2

**Percent Change of the 10
Least Growing Urban Places.**

Gisborne	1.0
Masterton	0.3
Wanganui	-1.1
Hawera	-7.0
Timaru	-8.2
Oamaru	-10.6
Greymouth	-11.8
Invercargill	-13.0
Gore	-19.2
Tokoroa	-31.0

Main Ultimate (rather than Proximate) Drivers of Net Migration

Employment

Surrounding Land-use and Resources, including Tourism Resources

Access to Local Markets - Critical Population Mass

Access to Distant Markets – Ports and Airports

Lifestyle

Friends, Family, Cultural Peer Groups

Climate

Natural Aesthetics – coast, lakes, mountains, nature

Cultural Opportunities / Services

Essential Services

Health facilities – hospitals

Education

Transport – local buses, and airports

Demography

Population Age Structure

Natural Change - birth and deaths

Age

Other Potential Drivers

War (not relevant in NZ)

Natural Hazards – earthquakes and floods

Cost of living – house prices

Safety – crime

Drivers	Surrogate Indices
Surrounding Land-use and Resources	Area of Landcover productive landcover classess in surrounding region (50km radius)
Access to Local Markets	Travel time to different size population centres
Access to Distant Markets – Ports and Airports	Travel time to ports and airports
Friends, Family, Cultural Peer Groups	Travel time to different size population centres; Population of Urban area
Climate	Mean wind speed, temperature, and solar radiation
Natural Aesthetics – coast, lakes, mountains, nature	Length of coatline, area of different landscape classes in in surrounding region (50km radius)
Cultural Opportunities / Services	Travel time to different size population centres; Population of Urban area
Health facilities – hospitals	Travel time to different size hospitals
Education	Travel time to tertiary education services
Transport – local buses, and airports	Travel time to airports; Population of Urban area
Population Age Structure	Population age ratios - work entry age/work exit age
Natural Change - birth and deaths	Population of people aged between 20-40, and 65+

Population	TotalCount
	Entry15_24Percent
	Exit55_65Percent
	Retire65PlusPercent
	PrimeWork20_65Percent
Employment (Markets and Resources)	Port_1_Time_hrs_
	Port_2_Time_hrs_
	Airport_1_Time_hrs_
	Airport_2_Time_hrs_
	Urban_50km_
	High_Producing_50km_
	Low_Producing_50km_
	Natural_50km_
	TravelTime_HrstoPopgt20k
	TravelTime_HrstoPopgt50k
	TravelTime_HrstoPopgt100k
	TravelTime_HrstoPopgt200k

Natural Amenity	Natural_50km_
	Solar_Rad
	Temp
	Wind
	Rainfall
	Percent_Water_View
	CoastlineLengthWithin50km
	MountainsWithin50km
	HillsAndHighHillsWithin50km
Cultural Opportunities	TravelTime_HrstoPopgt20k
	TravelTime_HrstoPopgt50k
	TravelTime_HrstoPopgt100k
	TravelTime_HrstoPopgt200k
Essential Services	Medical_1_Time_hrs_
	Medical_2_Time_hrs_
	Tertiary_1_Time_hrs_
	Tertiary_2_Time_hrs_
	Varability Explained

Pearson Correlation Matrix is a helpful start to understanding relationships

	Net Mig. 76-86	Net Mig. 86-96	Net Mig. 96-06	Net Mig. 06-13	Net Mig. 76-13	Population - all	Entry Age 15-24 yrs	Exit Age 55-64 yrs	Retire Age 65 + yrs	Working Age 20-64 yrs	Travel Time to Pop. > 20k	Travel Time to Pop. > 50k	Travel Time to Pop. > 100k	Travel Time to Pop. > 200k	Travel Time to Large Port	Travel Time to a Port	Travel Time to an Int. Airport	Travel Time to an Airport	Urban Area within 50km	High Producing Land	Low Producing Land	Natural Land	Solar Radiation	Temperature	Wind	Rainfall	Water View	Coastline	Mountains	Hills	Major Hospital	Hospital	University	Tertiary Education
Row Labels																																		
Net Mig. 76-86	1.00	0.62	0.36	0.39	0.75	-0.05	-0.25	0.43	0.36	0.09	0.03	-0.07	-0.10	-0.19	-0.11	-0.04	-0.21	-0.08	0.18	-0.16	-0.06	-0.05	0.24	0.00	0.01	0.02	0.39	0.29	0.05	-0.27	-0.06	0.12	-0.06	-0.02
Net Mig. 86-96	0.62	1.00	0.47	0.43	0.75	0.03	-0.29	0.38	0.41	0.15	-0.01	-0.10	-0.21	-0.29	-0.10	-0.06	-0.29	-0.15	0.27	-0.19	-0.14	-0.12	0.21	0.00	0.04	-0.02	0.48	0.36	-0.04	-0.31	-0.13	0.05	-0.13	-0.04
Net Mig. 96-06	0.36	0.47	1.00	0.54	0.78	0.08	-0.13	0.19	0.17	0.23	-0.06	-0.14	-0.18	-0.26	-0.01	-0.14	-0.29	-0.15	0.34	-0.04	-0.07	-0.06	0.14	0.01	-0.05	-0.08	0.10	0.29	0.06	-0.30	-0.11	-0.05	-0.13	-0.13
Net Mig. 06-13	0.39	0.43	0.54	1.00	0.67	0.02	-0.22	0.21	0.36	0.02	-0.16	-0.26	-0.29	-0.32	0.12	-0.31	-0.29	-0.28	0.29	0.09	-0.07	-0.19	-0.02	-0.01	0.06	-0.26	0.13	0.13	0.05	-0.39	-0.18	-0.15	-0.28	-0.25
Net Mig. 76-13	0.75	0.75	0.78	0.67	1.00	-0.01	-0.28	0.39	0.36	0.13	-0.03	-0.13	-0.20	-0.27	-0.06	-0.11	-0.31	-0.17	0.29	-0.11	-0.06	-0.08	0.20	0.00	0.00	-0.08	0.32	0.32	0.04	-0.32	-0.12	0.05	-0.15	-0.10
Population - all	-0.05	0.03	0.08	0.02	-0.01	1.00	0.22	-0.17	-0.07	0.15	-0.26	-0.27	-0.24	-0.22	-0.11	-0.24	-0.14	-0.21	0.45	0.03	-0.11	-0.14	0.09	0.08	0.07	-0.04	0.05	0.23	-0.11	-0.08	-0.23	-0.31	-0.23	-0.29
Entry Age 15-24 yrs	-0.25	-0.29	-0.13	-0.22	-0.28	0.22	1.00	-0.60	-0.53	0.31	0.00	0.02	0.07	0.08	0.08	0.01	0.08	-0.01	0.02	0.04	0.09	0.14	-0.10	0.02	0.02	0.16	-0.26	-0.17	-0.01	0.02	0.05	-0.05	0.03	-0.01
Exit Age 55-64 yrs	0.43	0.38	0.19	0.21	0.39	-0.17	-0.60	1.00	0.65	-0.03	0.08	0.06	-0.04	-0.07	0.00	0.02	-0.10	0.01	-0.07	-0.14	-0.09	-0.12	0.05	-0.02	0.04	-0.10	0.44	0.17	0.00	-0.16	0.00	0.16	-0.01	0.09
Retire Age 65 + yrs	0.36	0.41	0.17	0.36	0.36	-0.07	-0.53	0.65	1.00	-0.40	-0.05	-0.06	-0.16	-0.13	0.04	-0.12	-0.11	-0.13	-0.05	0.06	-0.16	-0.22	-0.04	0.00	0.01	-0.15	0.30	0.12	-0.09	-0.12	-0.12	0.02	-0.17	-0.06
Working Age 20-64 yrs	0.09	0.15	0.23	0.02	0.13	0.15	0.31	-0.03	-0.40	1.00	0.23	0.15	0.08	0.05	0.30	0.06	0.02	0.00	0.11	-0.27	0.06	0.30	-0.17	-0.01	0.09	0.17	0.14	0.01	0.24	-0.29	0.19	0.15	0.09	0.15
Travel Time to Pop. > 20k	0.03	-0.01	-0.06	-0.16	-0.03	-0.26	0.00	0.08	-0.05	0.23	1.00	0.72	0.43	0.29	0.29	0.71	0.05	0.38	-0.40	-0.51	0.05	0.60	-0.19	-0.08	-0.12	0.49	0.14	-0.15	0.42	-0.20	0.51	0.79	0.48	0.61
Travel Time to Pop. > 50k	-0.07	-0.10	-0.14	-0.26	-0.13	-0.27	0.02	0.06	-0.06	0.15	0.72	1.00	0.60	0.52	0.35	0.79	0.26	0.60	-0.51	-0.44	0.13	0.47	-0.23	0.02	0.04	0.32	0.13	-0.04	0.32	-0.10	0.58	0.64	0.69	0.61
Travel Time to Pop. > 100k	-0.10	-0.21	-0.18	-0.29	-0.20	-0.24	0.07	-0.04	-0.16	0.08	0.43	0.60	1.00	0.66	0.18	0.52	0.48	0.84	-0.57	-0.42	0.07	0.45	0.03	-0.01	0.14	0.30	0.04	-0.18	0.41	-0.07	0.83	0.36	0.89	0.44
Travel Time to Pop. > 200k	-0.19	-0.29	-0.26	-0.32	-0.27	-0.22	0.08	-0.07	-0.13	0.05	0.29	0.52	0.66	1.00	0.51	0.26	0.66	0.53	-0.59	-0.20	0.21	0.29	-0.44	-0.05	0.11	0.02	0.01	-0.34	0.31	0.08	0.65	0.32	0.68	0.26
Travel Time to Large Port	-0.11	-0.10	-0.01	0.12	-0.06	-0.11	0.08	0.00	0.04	0.30	0.29	0.35	0.18	0.51	1.00	-0.05	0.33	0.01	-0.30	-0.06	0.17	0.20	-0.86	-0.06	0.06	-0.29	-0.06	-0.39	0.48	-0.36	0.39	0.19	0.17	0.08
Travel Time to a Port	-0.04	-0.06	-0.14	-0.31	-0.11	-0.24	0.01	0.02	-0.12	0.06	0.71	0.79	0.52	0.26	-0.05	1.00	0.18	0.51	-0.44	-0.37	0.10	0.44	0.08	0.03	0.04	0.43	0.09	-0.01	0.19	0.15	0.37	0.62	0.53	0.58
Travel Time to an Int. Airport	-0.21	-0.29	-0.29	-0.29	-0.31	-0.14	0.08	-0.10	-0.11	0.02	0.05	0.26	0.48	0.66	0.33	0.18	1.00	0.24	-0.46	-0.07	0.02	0.20	-0.39	-0.04	0.29	-0.06	-0.11	-0.37	0.23	0.16	0.36	0.09	0.35	0.08
Travel Time to an Airport	-0.08	-0.15	-0.15	-0.28	-0.17	-0.21	-0.01	0.01	-0.13	0.00	0.38	0.60	0.84	0.53	0.01	0.51	0.24	1.00	-0.48	-0.55	0.10	0.36	0.21	0.02	0.01	0.41	0.16	0.06	0.23	0.00	0.77	0.28	0.94	0.41
Urban Area within 50km	0.18	0.27	0.34	0.29	0.29	0.45	0.02	-0.07	-0.05	0.11	-0.40	-0.51	-0.57	-0.59	-0.30	-0.44	-0.46	-0.48	1.00	0.20	-0.23	-0.35	0.25	0.00	-0.03	-0.09	0.02	0.49	-0.29	-0.21	-0.49	-0.40	-0.54	-0.30
High Producing Land	-0.16	-0.19	-0.04	0.09	-0.11	0.03	0.04	-0.14	0.06	-0.27	-0.51	-0.44	-0.42	-0.20	-0.06	-0.37	-0.07	-0.55	0.20	1.00	-0.16	-0.51	-0.18	-0.01	-0.06	-0.39	-0.43	-0.17	-0.39	0.28	-0.54	-0.45	-0.59	-0.30
Low Producing Land	-0.06	-0.14	-0.07	-0.07	-0.06	-0.11	0.09	-0.09	-0.16	0.06	0.05	0.13	0.07	0.21	0.17	0.10	0.02	0.10	-0.23	-0.16	1.00	0.29	0.00	-0.02	-0.34	-0.30	-0.05	-0.32	0.42	0.28	0.16	0.23	0.19	0.02
Natural Land	-0.05	-0.12	-0.06	-0.19	-0.08	-0.14	0.14	-0.12	-0.22	0.30	0.60	0.47	0.45	0.29	0.20	0.44	0.20	0.36	-0.35	-0.51	0.29	1.00	-0.03	-0.03	-0.27	-0.37	-0.03	-0.27	0.72	0.07	0.59	0.56	0.51	0.39
Solar Radiation	0.24	0.21	0.14	-0.02	0.20	0.09	-0.10	0.05	-0.04	-0.17	-0.19	-0.23	0.03	-0.44	-0.86	0.08	-0.39	0.21	0.25	-0.18	0.00	-0.03	1.00	0.06	-0.10	0.22	0.16	0.43	-0.16	0.12	-0.11	-0.04	0.09	0.04
Temperature	0.00	0.00	0.01	-0.01	0.00	0.08	0.02	-0.02	0.00	-0.01	-0.08	0.02	-0.01	-0.05	-0.06	0.03	-0.04	0.02	0.00	-0.01	-0.02	-0.03	0.06	1.00	0.03	0.04	0.02	0.08	-0.05	0.02	-0.09	-0.09	-0.01	-0.08
Wind	0.01	0.04	-0.05	0.06	0.00	0.07	0.02	0.04	0.01	0.09	-0.12	0.04	0.14	0.11	0.06	0.04	0.29	0.01	-0.03	-0.06	-0.34	-0.27	-0.10	0.03	1.00	0.00	0.15	0.13	-0.17	-0.27	0.03	-0.14	0.00	-0.02
Rainfall	0.02	-0.02	-0.08	-0.26	-0.08	-0.04	0.16	-0.10	-0.15	0.17	0.49	0.32	0.30	0.02	-0.29	0.43	-0.06	0.41	-0.09	-0.39	-0.30	0.37	0.22	0.04	0.00	1.00	0.07	0.17	-0.14	-0.02	0.32	0.17	0.37	0.28
Water View	0.39	0.48	0.10	0.13	0.32	0.05	-0.26	0.44	0.30	0.14	0.14	0.13	0.04	0.01	-0.06	0.09	-0.11	0.16	0.02	-0.43	-0.05	-0.03	0.16	0.02	0.15	0.07	1.00	0.29	0.01	-0.22	0.10	0.19	0.16	0.10
Coastline	0.29	0.36	0.29	0.13	0.32	0.23	-0.17	0.17	0.12	0.01	-0.15	-0.04	-0.18	-0.34	-0.39	-0.01	-0.37	0.06	0.49	-0.17	-0.32	-0.27	0.43	0.08	0.13	0.17	0.29	1.00	-0.36	-0.15	-0.22	-0.11	-0.09	0.04
Mountains	0.05	-0.04	0.06	0.05	0.04	-0.11	-0.01	0.00	-0.09	0.24	0.42	0.32	0.41	0.31	0.48	0.19	0.23	0.23	-0.29	-0.39	0.42	0.72	-0.16	-0.05	-0.17	-0.14	0.01	-0.36	1.00	-0.24	0.57	0.43	0.43	0.20
Hills	-0.27	-0.31	-0.30	-0.39	-0.32	-0.08	0.02	-0.16	-0.12	-0.29	-0.20	-0.10	-0.07	0.08	-0.36	0.15	0.16	0.00	-0.21	0.28	0.28	0.07	0.12	0.02	-0.27	-0.02	-0.22	-0.15	-0.24	1.00	-0.23	-0.02	-0.06	0.01
Major Hospital	-0.06	-0.13	-0.11	-0.18	-0.12	-0.23	0.05	0.00	-0.12	0.19	0.51	0.58	0.83	0.65	0.39	0.37	0.36	0.77	-0.49	-0.54	0.16	0.59	-0.11	-0.09	0.03	0.32	0.10	-0.22	0.57	-0.23	1.00	0.40	0.89	0.35
Hospital	0.12	0.05	-0.05	-0.15	0.05	-0.31	-0.05	0.16	0.02	0.15	0.79	0.64	0.36	0.32	0.19	0.62	0.09	0.28	-0.40	-0.45	0.23	0.56	-0.04	-0.09	-0.14	0.17	0.19	-0.11	0.43	-0.02	0.40	1.00	0.42	0.73
University	-0.06	-0.13	-0.13	-0.28	-0.15	-0.23	0.03	-0.01	-0.17	0.09	0.48	0.69	0.89	0.68	0.17	0.53	0.35	0.94	-0.54	-0.59	0.19	0.51	0.09	-0.01	0.00	0.37	0.16	-0.09	0.43	-0.06	0.89	0.42	1.00	0.42
Tertiary Education	-0.02	-0.04	-0.13	-0.25	-0.10	-0.29	-0.01	0.09	-0.06	0.15	0.61	0.61	0.44	0.26	0.08	0.58	0.08	0.41	-0.30	-0.30	0.02	0.39	0.04	-0.08	-0.02	0.28	0.10	0.04	0.20	0.01	0.35	0.73	0.42	1.00

Row Labels	Net Mig. 76-86	Net Mig. 86-96	Net Mig. 96-06	Net Mig. 06-13	Net Mig. 76-13
Population - all	-0.05	0.03	0.08	0.02	-0.01
Entry Age 15-24 yrs	-0.25	-0.29	-0.13	-0.22	-0.28
Exit Age 55-64 yrs	0.43	0.38	0.19	0.21	0.39
Retire Age 65 + yrs	0.36	0.41	0.17	0.36	0.36
Working Age 20-64 yrs	0.09	0.15	0.23	0.02	0.13
Travel Time to Pop. > 20k	0.03	-0.01	-0.06	-0.16	-0.03
Travel Time to Pop. > 50k	-0.07	-0.10	-0.14	-0.26	-0.13
Travel Time to Pop. > 100k	-0.10	-0.21	-0.18	-0.29	-0.20
Travel Time to Pop. > 200k	-0.19	-0.29	-0.26	-0.32	-0.27

		Net Mig. 76-86	Net Mig. 86-96	Net Mig. 96-06	Net Mig. 06-13	Net Mig. 76-13
	Row Labels					
Employment (Markets and Resources)	Travel Time to Large Port	-0.11	-0.10	-0.01	0.12	-0.06
	Travel Time to a Port	-0.04	-0.06	-0.14	-0.31	-0.11
	Travel Time to an Int. Airport	-0.21	-0.29	-0.29	-0.29	-0.31
	Travel Time to an Airport	-0.08	-0.15	-0.15	-0.28	-0.17
	Urban Area within 50km	0.18	0.27	0.34	0.29	0.29
	High Producing Land	-0.16	-0.19	-0.04	0.09	-0.11
	Low Producing Land	-0.06	-0.14	-0.07	-0.07	-0.06
Natural Amenity	Natural Land	-0.05	-0.12	-0.06	-0.19	-0.08
	Solar Radiation	0.24	0.21	0.14	-0.02	0.20
	Temperature	0.00	0.00	0.01	-0.01	0.00
	Wind	0.01	0.04	-0.05	0.06	0.00
	Rainfall	0.02	-0.02	-0.08	-0.26	-0.08
	Water View	0.39	0.48	0.10	0.13	0.32
	Coastline	0.29	0.36	0.29	0.13	0.32
	Mountains	0.05	-0.04	0.06	0.05	0.04
	Hills	-0.27	-0.31	-0.30	-0.39	-0.32
Essential Services	Major Hospital	-0.06	-0.13	-0.11	-0.18	-0.12
	Hospital	0.12	0.05	-0.05	-0.15	0.05
	University	-0.06	-0.13	-0.13	-0.28	-0.15
	Tertiary Education	-0.02	-0.04	-0.13	-0.25	-0.10

Need to be careful with collinearity

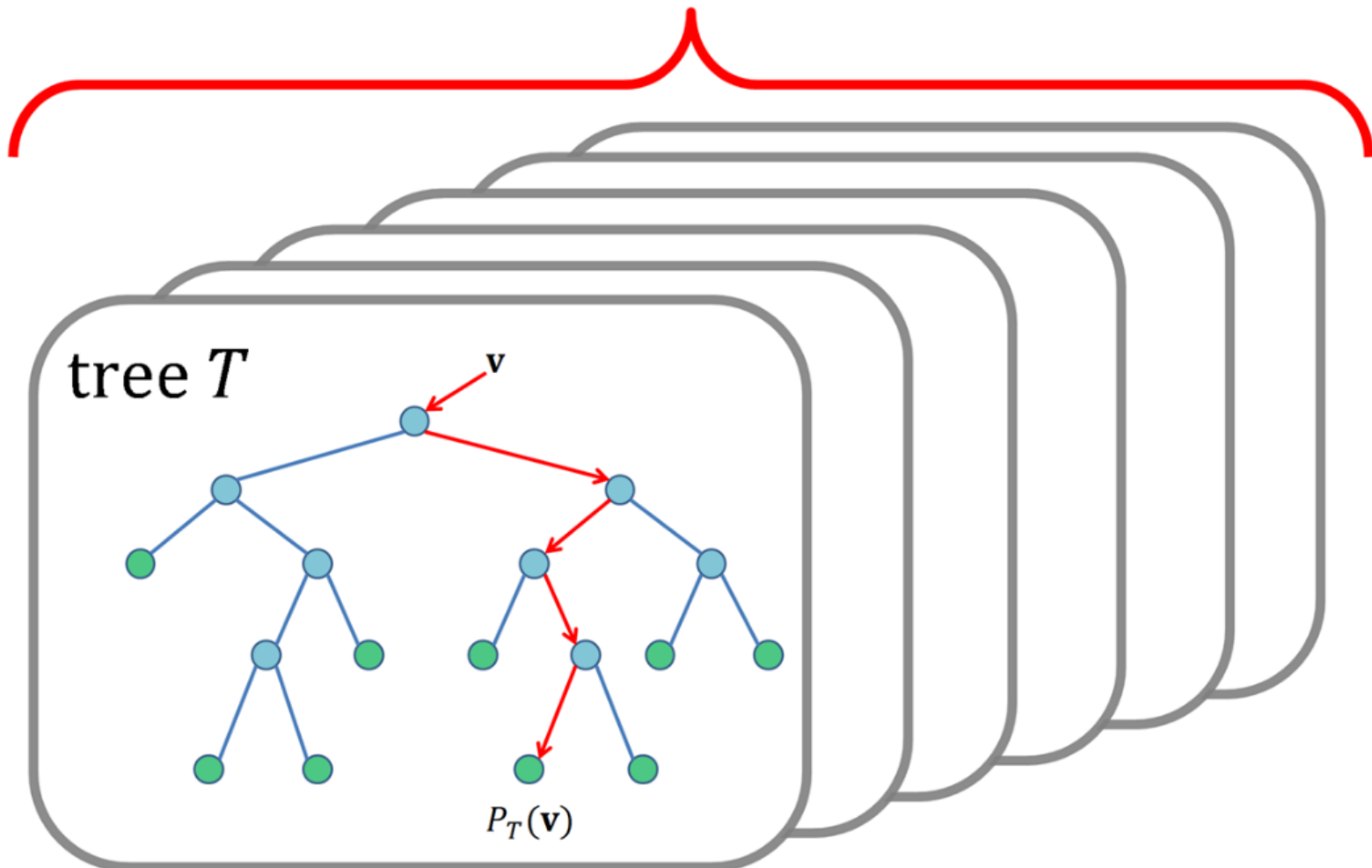
Row Labels	Urban Area within 50km	High Producing Land	Low Producing Land	Natural Land	Solar Radiation
Travel Time to Pop. > 200k	-0.59	-0.20	0.21	0.29	-0.44
Travel Time to Large Port	-0.30	-0.06	0.17	0.20	-0.86
Travel Time to a Port	-0.44	-0.37	0.10	0.44	0.08
Travel Time to an Int. Airport	-0.46	-0.07	0.02	0.20	-0.39
Travel Time to an Airport	-0.48	-0.55	0.10	0.36	0.21
Urban Area within 50km	1.00	0.20	-0.23	-0.35	0.25
High Producing Land	0.20	1.00	-0.16	-0.51	-0.18
Low Producing Land	-0.23	-0.16	1.00	0.29	0.00
Natural Land	-0.35	-0.51	0.29	1.00	-0.03
Solar Radiation	0.25	-0.18	0.00	-0.03	1.00

Also need to be careful that outliers don't overly distort the model.

Multivariate Regression Models can be highly unstable making it difficult to make conclusions

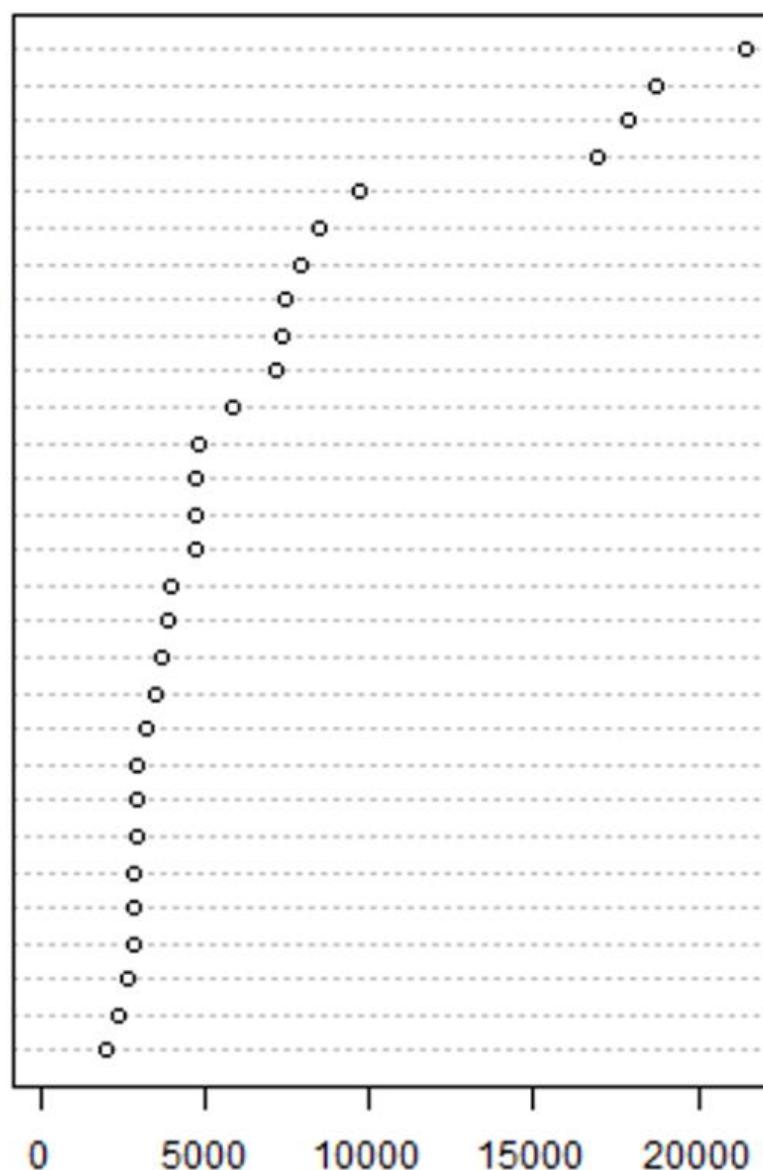
Use of Random Forest in R

Decision Forest



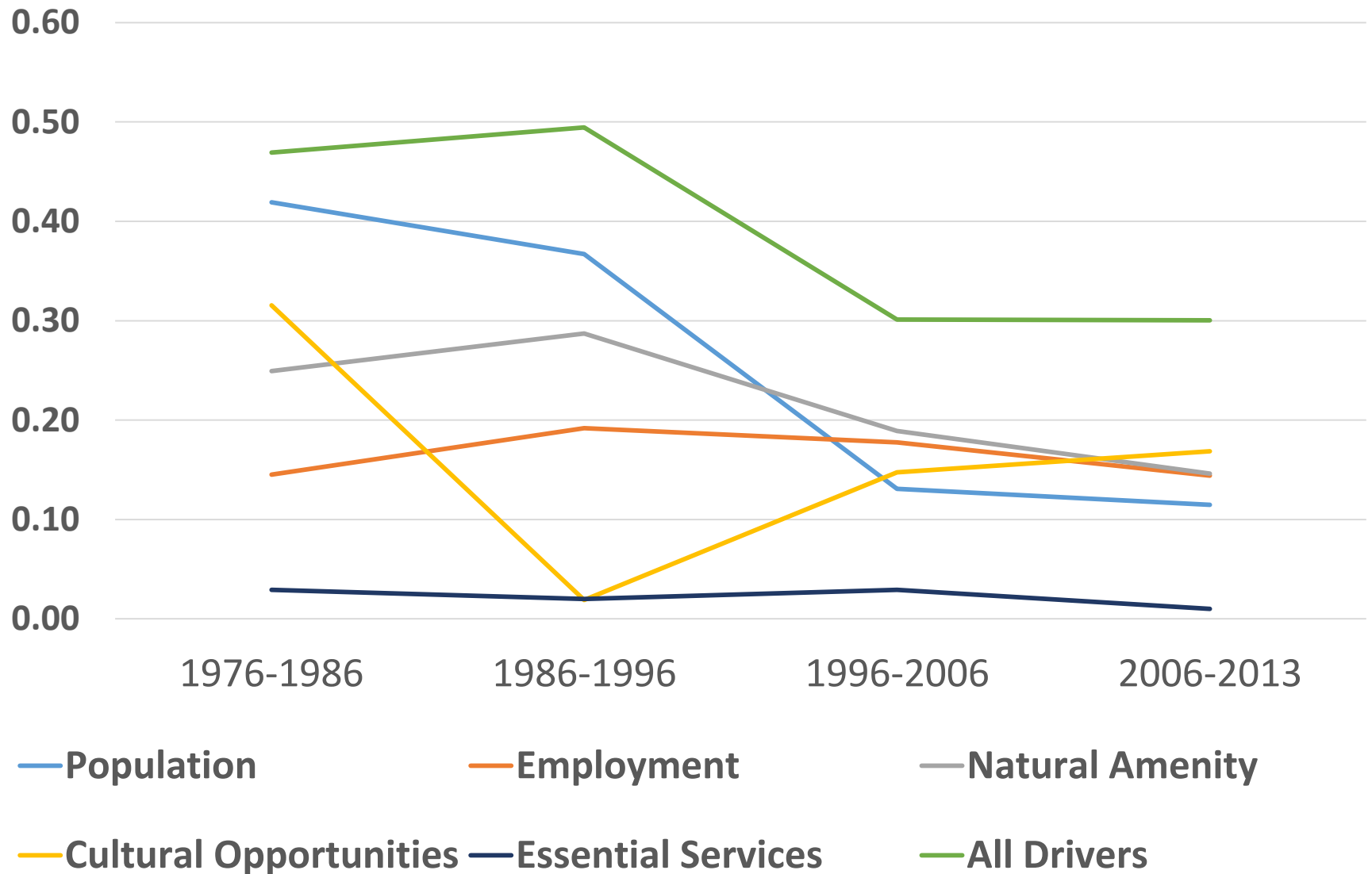
Average Importance plot

Exit55_65Percent1976
 Entry15_24Percent1976
 TotalCount1976
 Retire65PlusPercent1976
 Natural_50km_1976
 Percent_Water_View
 Solar_Rad
 PrimeWork20_65Percent1976
 HillsAndHighHillsWithin50km
 CoastlineLengthWithin50km
 Airport_1_Time_hrs_1976
 TravelTime_HrstoPopgt200k
 Medical_2_Time_hrs_1976
 Low_Producing_50km_1976
 MountainsWithin50km
 Rainfall
 Temp
 Port_1_Time_hrs_1976
 High_Producing_50km_1976
 Tertiary_2_Time_hrs_1976
 Medical_1_Time_hrs_1976
 Wind
 Urban_50km_1976
 Airport_2_Time_hrs_1976
 TravelTime_HrstoPopgt100k
 TravelTime_HrstoPopgt20k
 Tertiary_1_Time_hrs_1976
 TravelTime_HrstoPopgt50k
 Port_2_Time_hrs_1976



	1976_1986	1986_1996	1996_2006	2006_2013
Top 10 explanatory drivers listed by order of importance	Exit Age 55-64 yrs	Entry Age 15-24 yrs	Access to an Int. Airport	Retire Age 65 + yrs
	Entry Age 15-24 yrs	Exit Age 55-64 yrs	Mountains	Hills
	Population - all	Retire Age 65 + yrs	Retire Age 65 + yrs	Entry Age 15-24 yrs
	Retire Age 65 + yrs	Water View	Population - all	Access to Pop. > 200k
	Natural Land	Mountains	Hospital	Exit Age 55-64 yrs
	Water View	Hills	Access to Pop. > 200k	Access to an Int. Airport
	Solar Radiation	Temperature	Hills	Population - all
	Working Age 20-64 yrs	Working Age 20-64 yrs	Urban Area within 50km	Urban Area within 50km
	Hills	Coastline	Working Age 20-64 yrs	Access to Pop. > 100k
	Coastline	Solar Radiation	Entry Age 15-24 yrs	Tertiary Education
Varability explained by model using all 29 variables	0.47	0.49	0.30	0.30

Variability Explained for Different Driver Groups



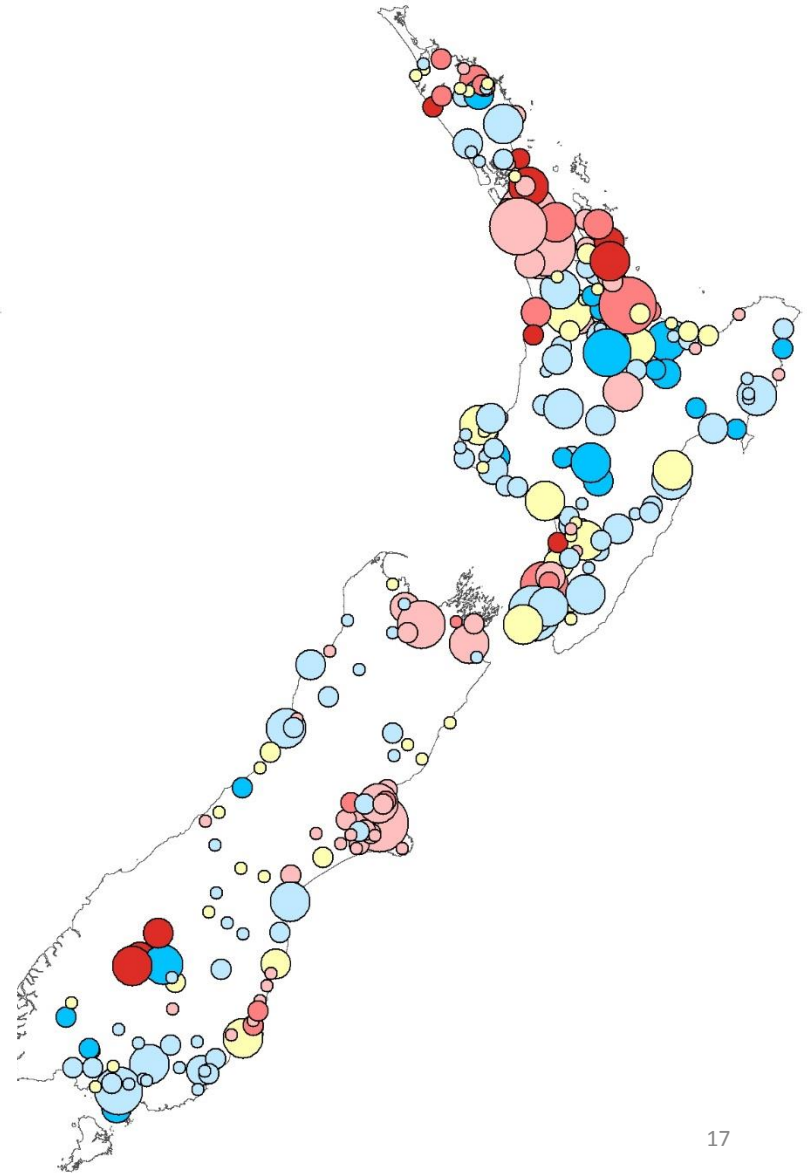
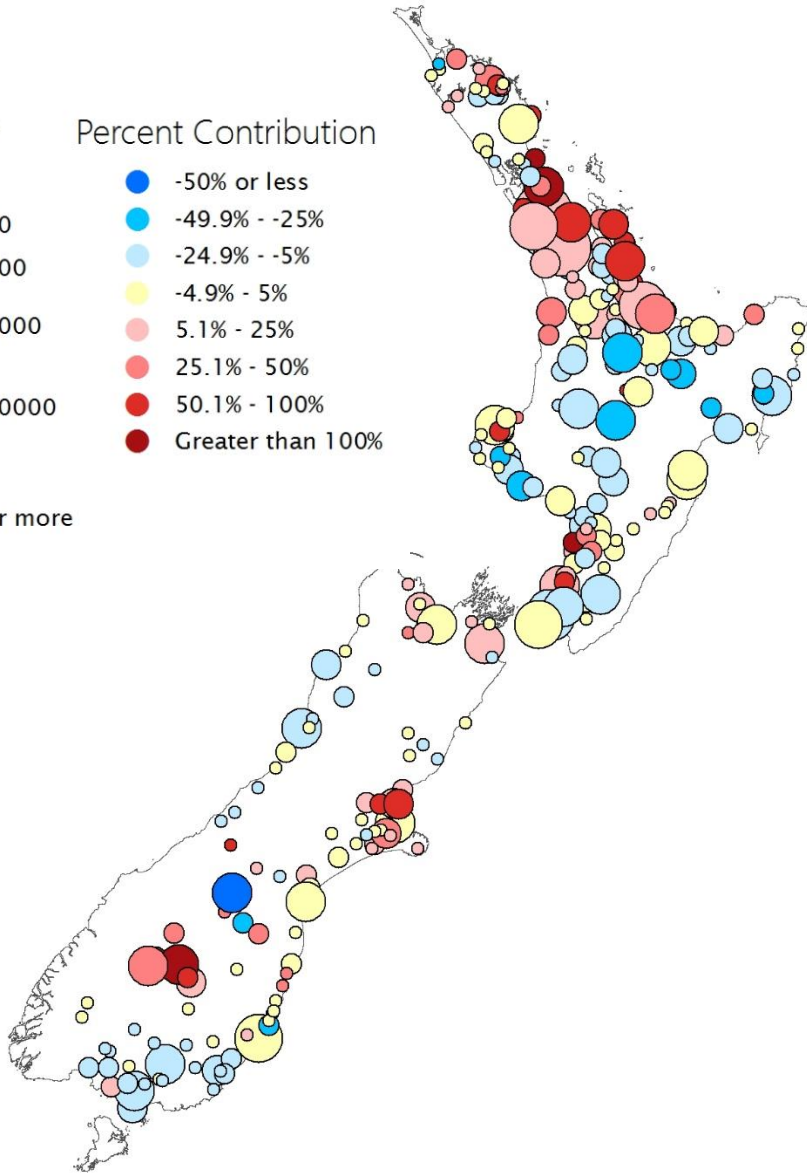
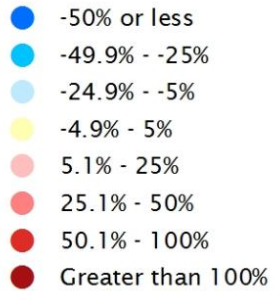
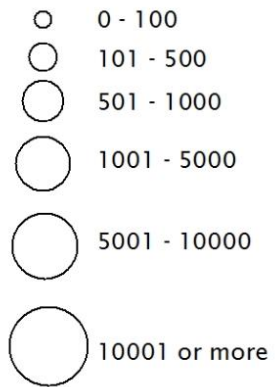
Net Migration

1976 to 1986

1986 to 1996

Net Number

Percent Contribution



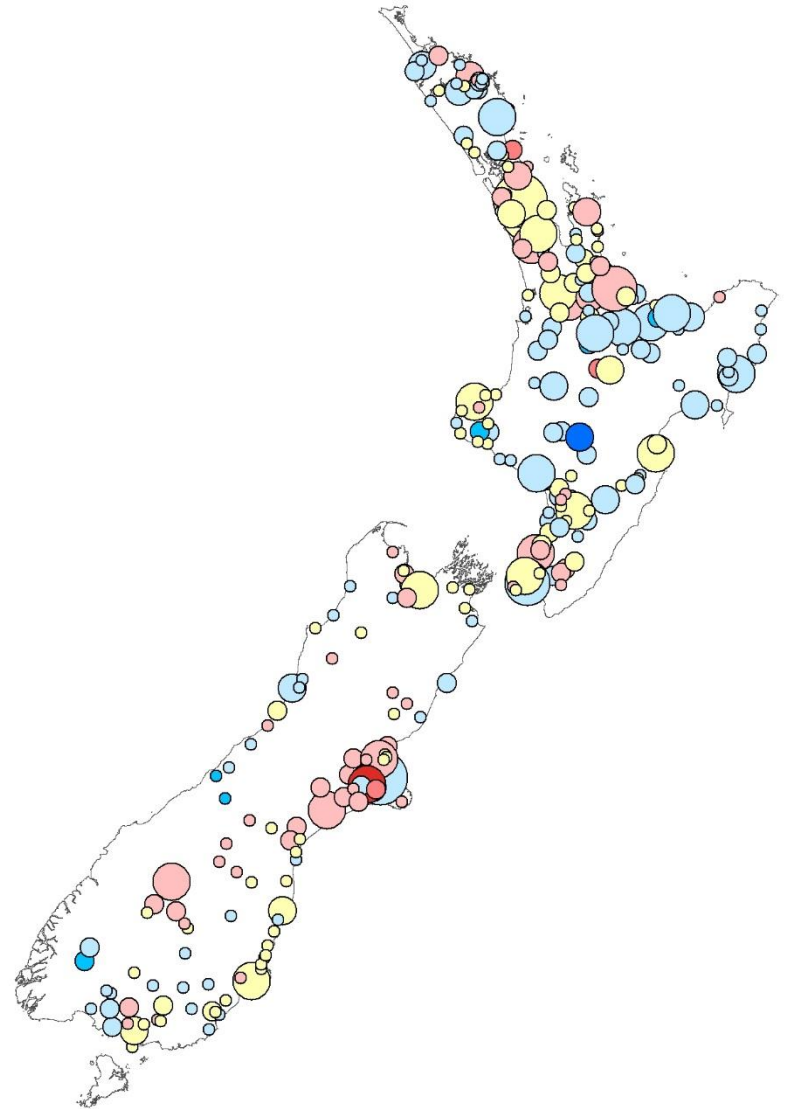
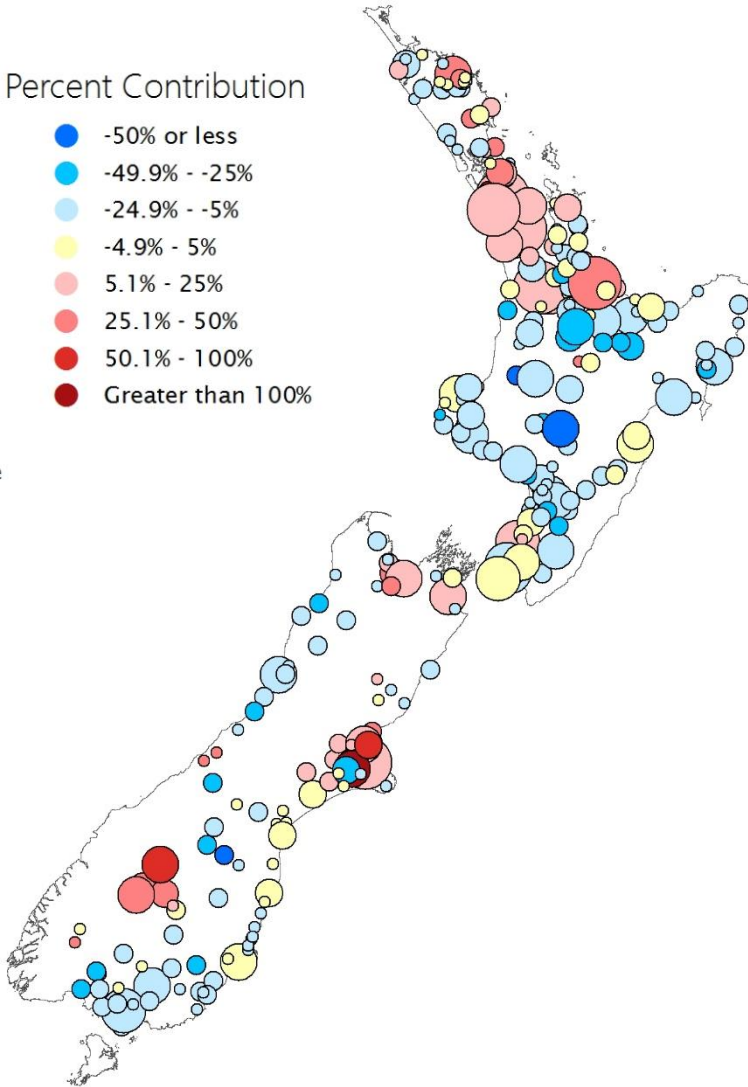
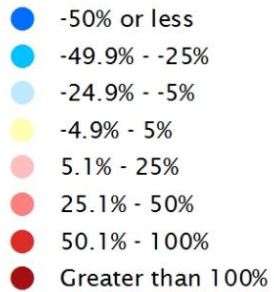
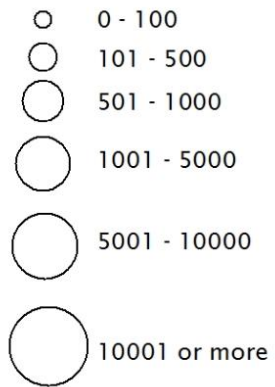
Net Migration

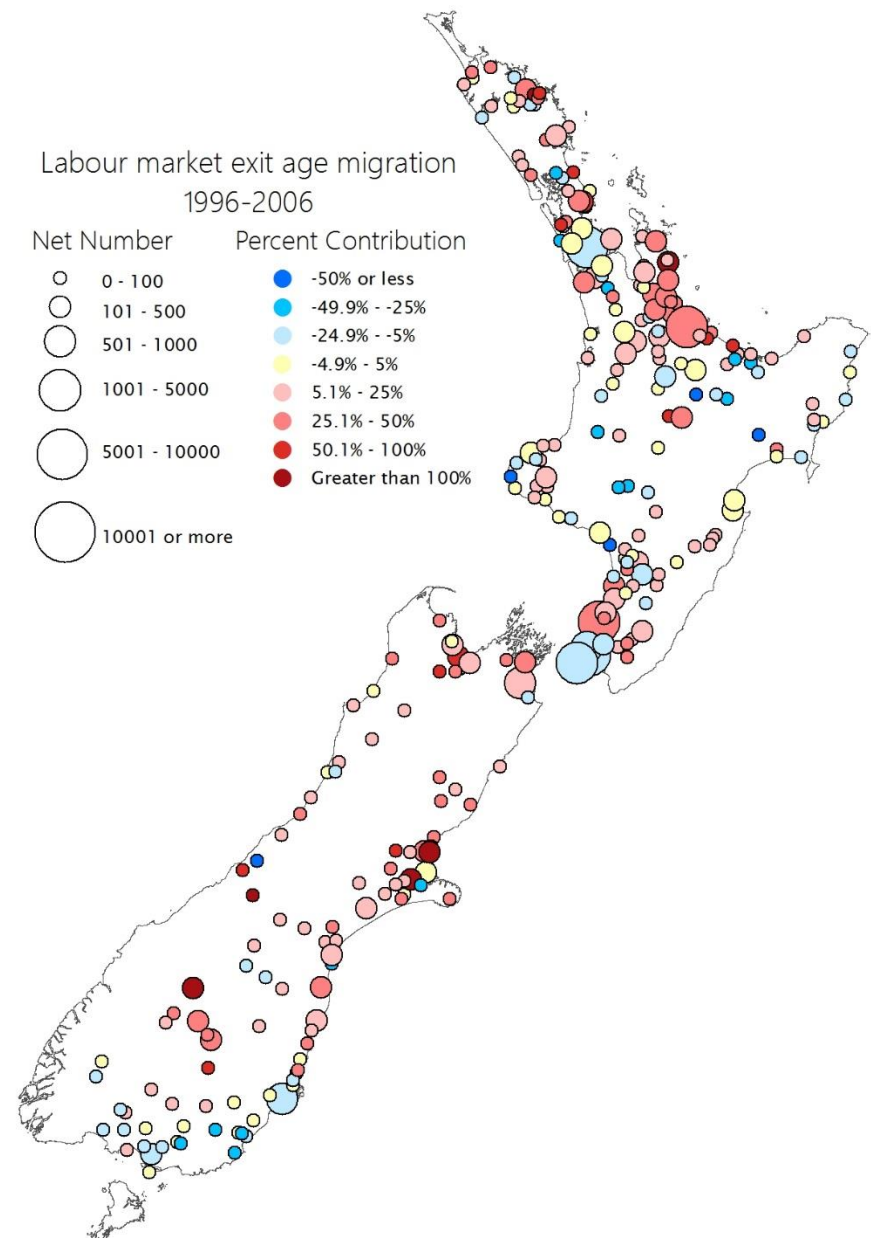
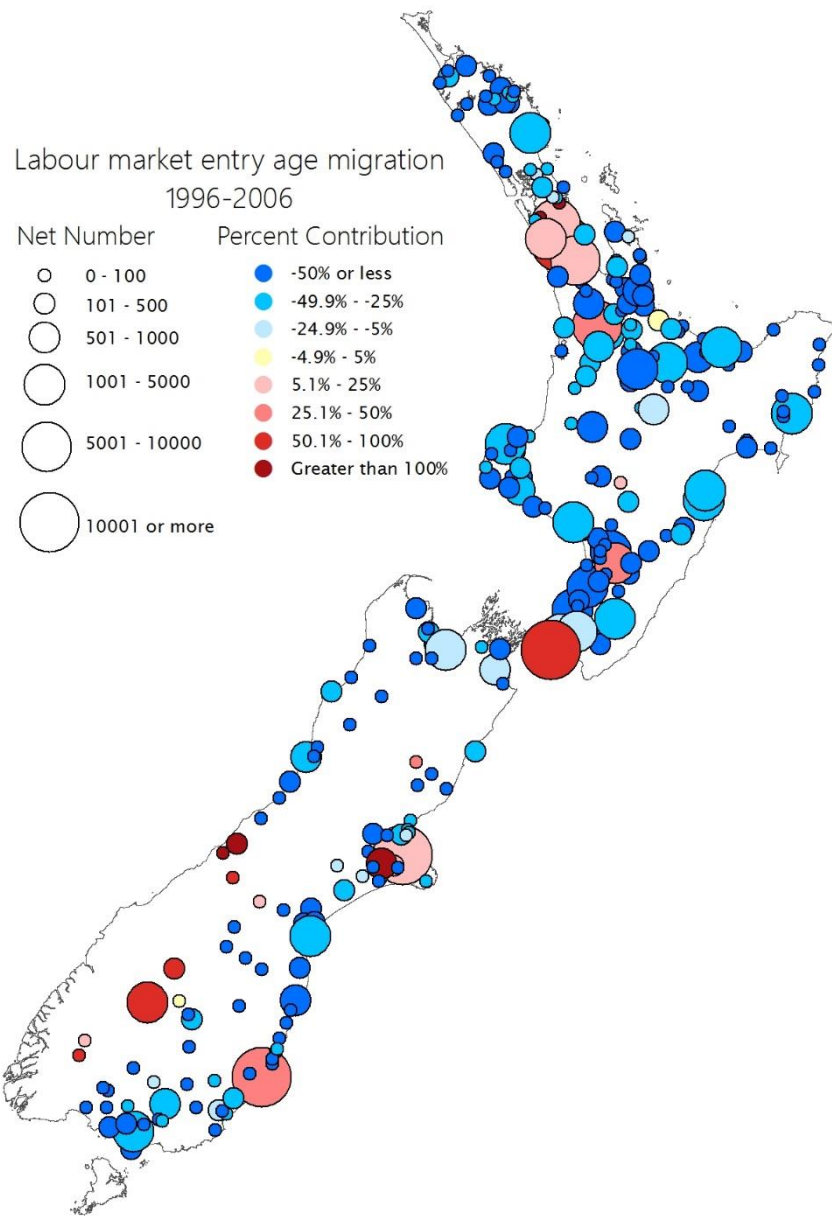
1996 to 2006

2006 to 2013

Net Number

Percent Contribution



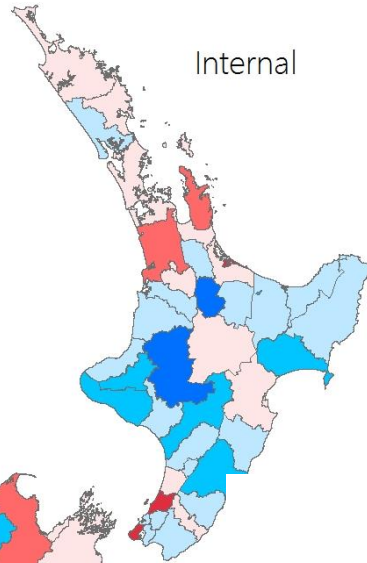
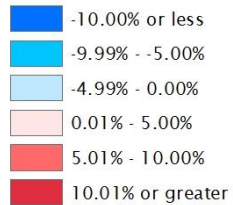


The Choice of Spatial Unit for Analysis is Important

Urban Areas are “Natural Boundary Units” while TAs are artificial boundaries
People can identify with urban towns and cities as a units

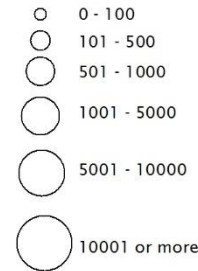
Net Migration 1996-2001

Percent Contribution

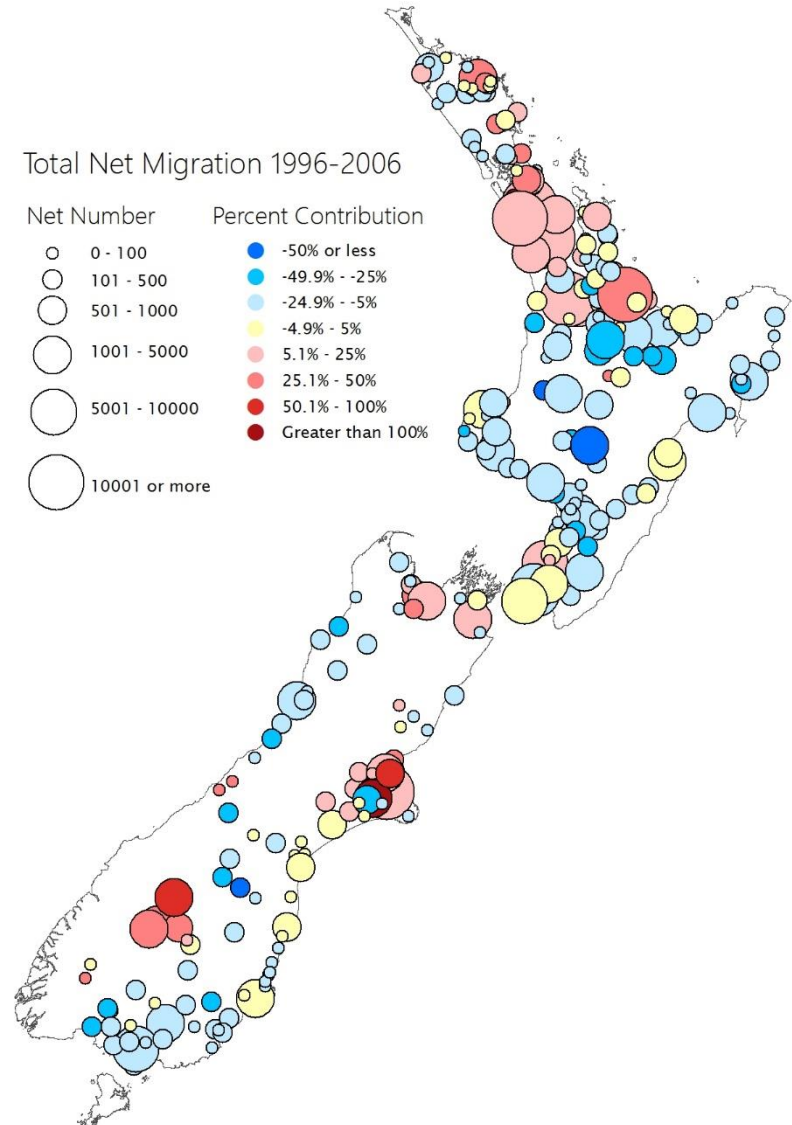
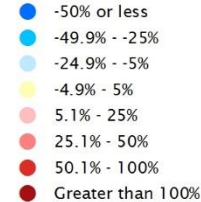


Total Net Migration 1996-2006

Net Number



Percent Contribution



Net migration for urban places is difficult to model with a high degree of certainty, but is a fascinating challenge, and we are making progress.

Thankyou

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