

Predict the Number of Enterprises in New Zealand

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The goal of this example is to have a first glance on New Zealand (NZ) industries, and especially, to predict the number of enterprises in “Agriculture, Forestry, Fishing Sector” and “Construction Sector”. The data was downloaded in May 2017 from Statistics New Zealand (<https://www.stats.govt.nz/>)

(http://www.stats.govt.nz/browse_for_stats/economic_indicators/NationalAccounts.aspx

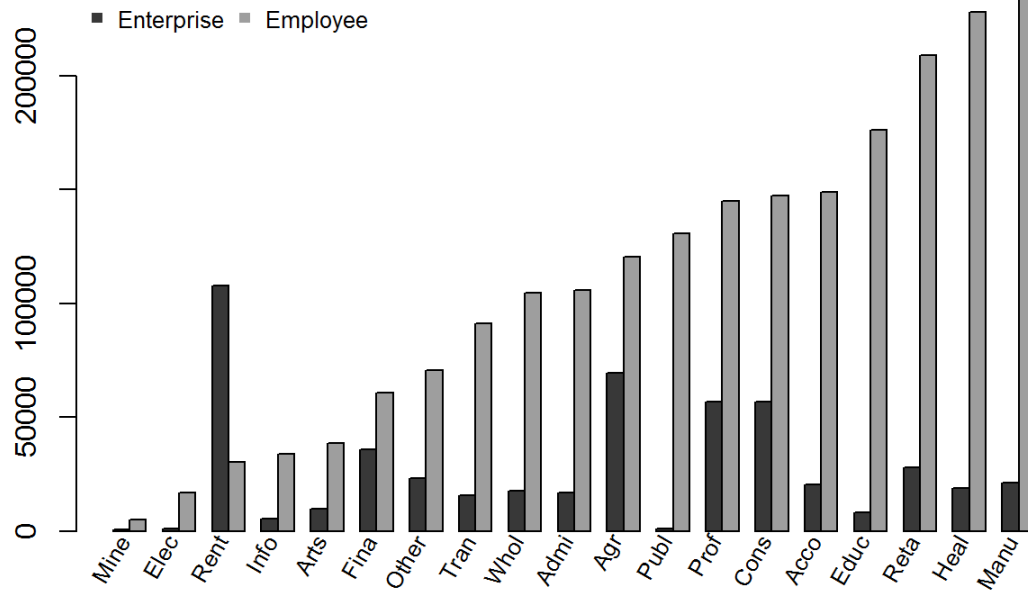
(http://www.stats.govt.nz/browse_for_stats/economic_indicators/NationalAccounts.aspx) Please read the terms before you use them). The following table explains the abbreviation of variables we used throughout this example.

Variable	Description	Variable	Description
Agr	Agriculture, Forestry, Fishing	Mine	Mining
Manu	Manufacturing	Elec	Electricity, Gas, Water, Waste Services
Cons	Construction	Whol	Wholesale Trade
Reta	Retail Trade	Acco	Accommodation and Food Services
Tran	Transport, Postal, Warehousing	Info	Info. Media, Telecommunications
Fina	Financial, Insurance Services	Rent	Rental, Hiring, Real Estate
Prof	Professional, Scientific, Technical	Admi	Administrative, Support
Publ	Public Administration, Safety	Educ	Education and Training
Heal	Health Care, Social Assistance	Arts	Arts, Recreation Services
Other	Other Services		

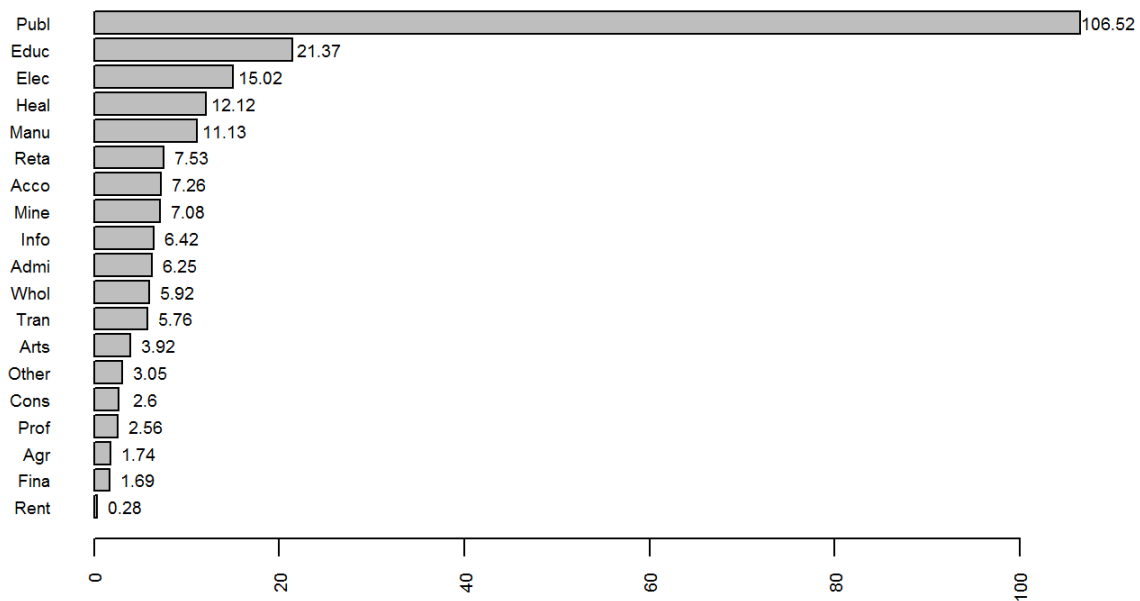
I. Overview on NZ industries

There are 19 industry sectors in NZ. In this section we are interested in the fast growing industries and those industries with a great number of employees. The *employee density*¹ of industries are explored as well.

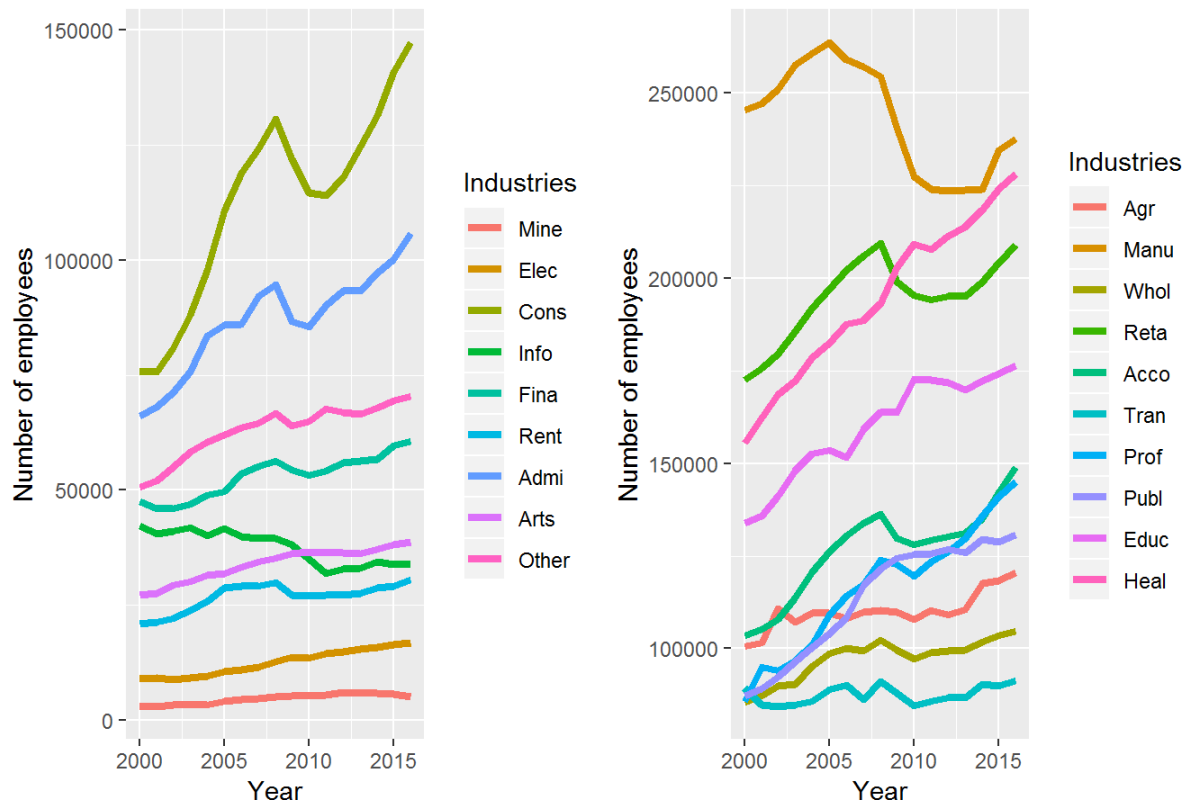
The number of enterprises and employees in 2016



The employees densities in 2016

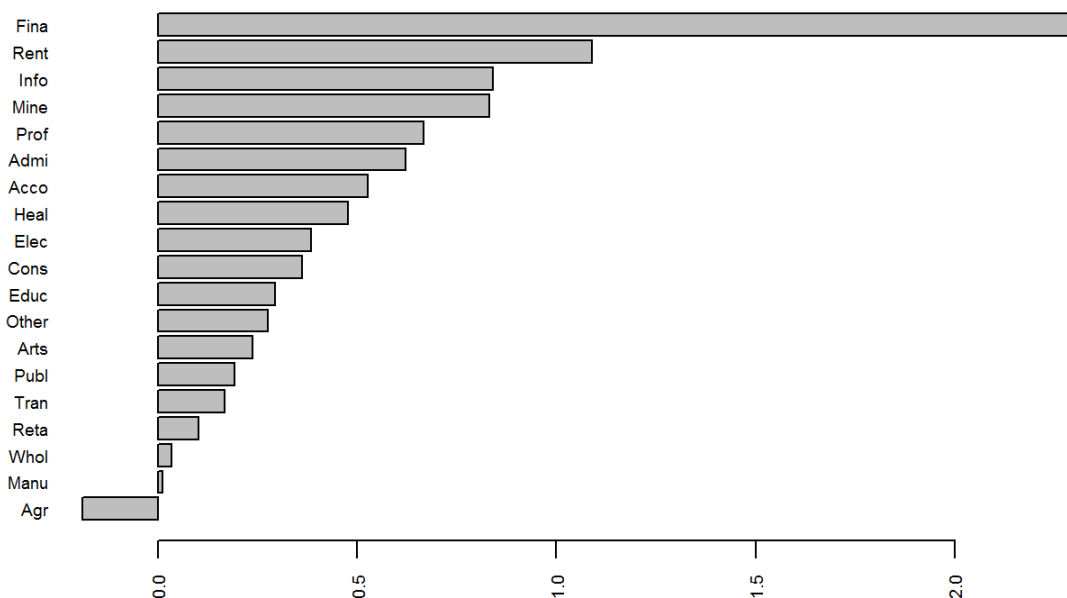


The following graph implies that “Cons” sector has an overall rapid increased number of employees.



The following graphs presents the *relative growth speed*² of industry numbers in 2016. “Agr” is the only sector with a negative growth speed relative to 2000.

Growth speed (relative to 2000) of the enterprise numbers in 2016



To check the correlation between industries, we print out all correlations. Most industries have strong correlations to others, while “Manu” and “Whol” have relative weak relationship with others.

	Agr	Mine	Manu	Elec	Cons	Whol	Reta	Acco	Tran
Agr	1.00	-0.95	0.22	-0.97	-0.82	-0.20	-0.77	-0.95	-0.74

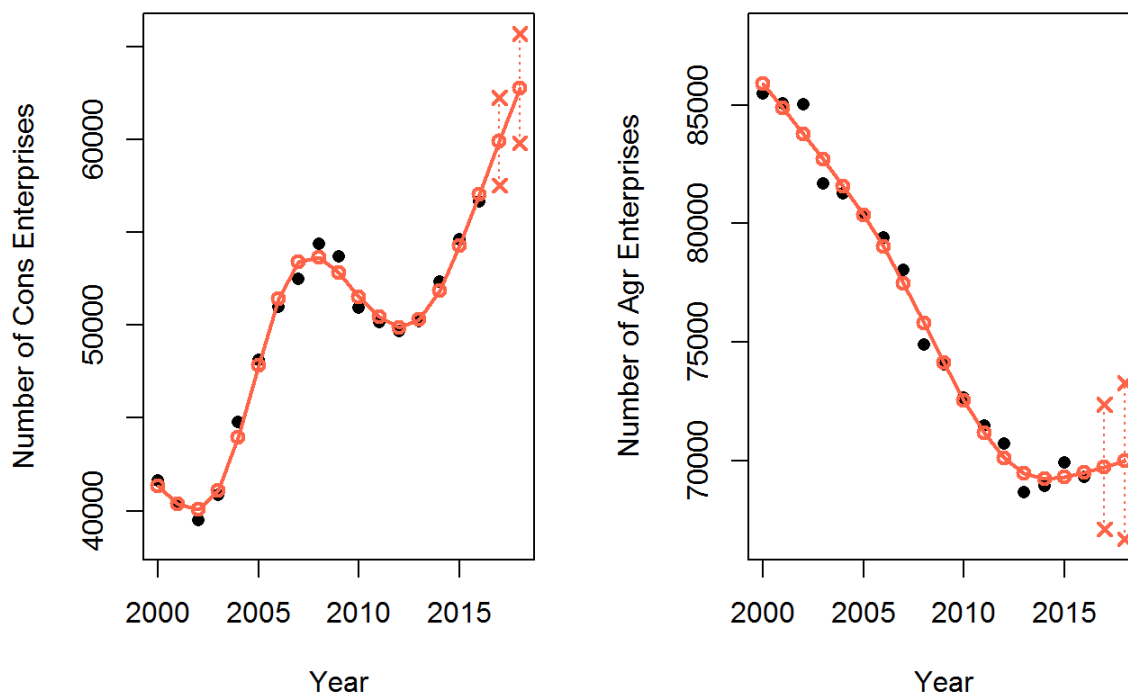
	Agr	Mine	Manu	Elec	Cons	Whol	Reta	Acco	Tran	
Mine	-0.95	1.00	-0.33	0.95	0.77	0.16	0.77	0.92	0.70	
Manu	0.22	-0.33	1.00	-0.10	0.30	0.85	0.31	0.02	0.40	
Elec	-0.97	0.95	-0.10	1.00	0.91	0.36	0.87	0.98	0.84	
Cons	-0.82	0.77	0.30	0.91	1.00	0.69	0.96	0.92	0.97	
Whol	-0.20	0.16	0.85	0.36	0.69	1.00	0.74	0.44	0.78	
Reta	-0.77	0.77	0.31	0.87	0.96	0.74	1.00	0.89	0.98	
Acco	-0.95	0.92	0.02	0.98	0.92	0.44	0.89	1.00	0.88	
Tran	-0.74	0.70	0.40	0.84	0.97	0.78	0.98	0.88	1.00	
	Agr	Mine	Manu	Elec	Cons	Whol	Reta	Acco	Tran	
Info	-0.94	0.86	0.07	0.95	0.90	0.44	0.86	0.98	0.85	
Fina	-0.97	0.93	-0.05	0.99	0.92	0.38	0.87	0.98	0.86	
Rent	-0.95	0.88	0.09	0.97	0.94	0.48	0.89	0.98	0.88	
Prof	-0.96	0.92	0.02	0.99	0.94	0.45	0.91	0.99	0.89	
Admi	-0.95	0.91	0.06	0.98	0.95	0.49	0.92	0.99	0.90	
Publ	-0.90	0.80	0.15	0.90	0.89	0.49	0.86	0.94	0.86	
Educ	-0.98	0.94	-0.11	0.98	0.86	0.32	0.84	0.99	0.81	
Heal	-0.97	0.94	-0.07	0.99	0.91	0.37	0.87	0.98	0.86	
Arts	-0.94	0.86	0.10	0.96	0.96	0.49	0.90	0.96	0.90	
Other	-0.94	0.92	0.02	0.99	0.94	0.47	0.92	0.99	0.90	
	Info	Fina	Rent	Prof	Admi	Publ	Educ	Heal	Arts	Other
Info	1.00	0.97	0.98	0.97	0.98	0.97	0.97	0.96	0.97	0.97
Fina	0.97	1.00	0.98	0.99	0.98	0.93	0.98	1.00	0.98	0.99
Rent	0.98	0.98	1.00	0.99	0.99	0.96	0.96	0.97	0.99	0.98
Prof	0.97	0.99	0.99	1.00	1.00	0.93	0.98	0.99	0.98	1.00
Admi	0.98	0.98	0.99	1.00	1.00	0.95	0.97	0.98	0.99	0.99
Publ	0.97	0.93	0.96	0.93	0.95	1.00	0.92	0.92	0.96	0.93
Educ	0.97	0.98	0.96	0.98	0.97	0.92	1.00	0.98	0.95	0.98
Heal	0.96	1.00	0.97	0.99	0.98	0.92	0.98	1.00	0.98	0.99
Arts	0.97	0.98	0.99	0.98	0.99	0.96	0.95	0.98	1.00	0.97

	Info	Fina	Rent	Prof	Admi	Publ	Educ	Heal	Arts	Other
Other	0.97	0.99	0.98	1.00	0.99	0.93	0.98	0.99	0.97	1.00

II. Enterprise number Prediction

We fit two natural cubic spline models to predict the enterprise numbers for “Cons” and “Agr” sectors. In the following graphs, black dots are true values, and red points are predicted values, and the dotted segments represent prediction intervals for 2017 and 2018. We can check the predicted values by the published data at NZ Stats (<http://nzdotstat.stats.govt.nz/wbos/index.aspx>). The specific values are listed in the table below

Sector	2017	Prediction Interval	2018	Prediction Interval
Agr	69741	(67108, 72373)	69978	(66682, 73274)
Cons	59889	(57535, 62243)	62741	(59793, 65688)



1. We call the ratio between the number of employees and the number of enterprises as the “employee density”.↵
2. In this example, the relative growth speed is calculated by (“value in 2016”-“value in 2000”)/“value in 2000”.↵