

Deloitte.

Unemployment models

The probability of unemployment



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Introduction

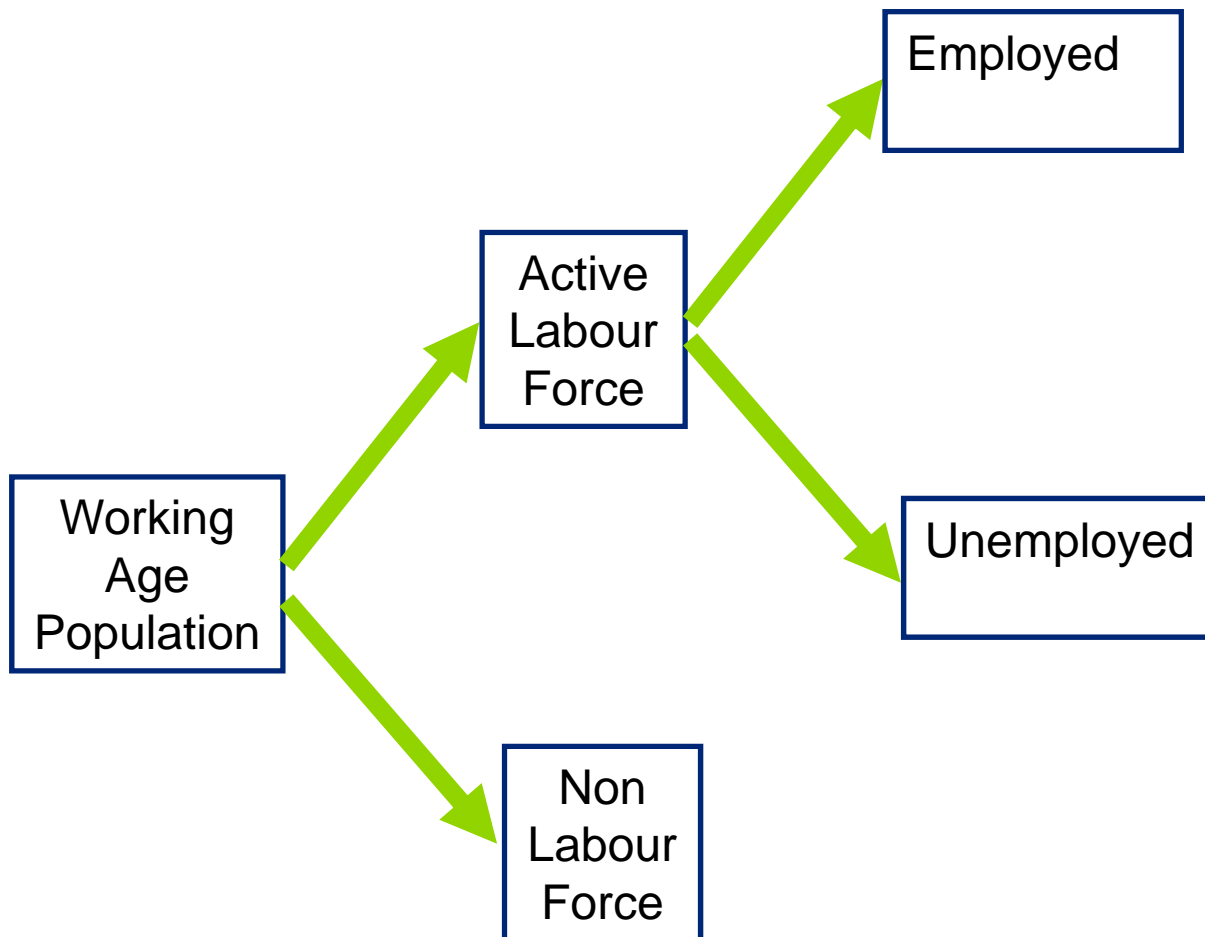
$P [\text{unemployment} \mid \text{employment}] = ?$

$P [\text{employment} \mid \text{unemployment}] = ?$

Unchartered water?

Unemployment data

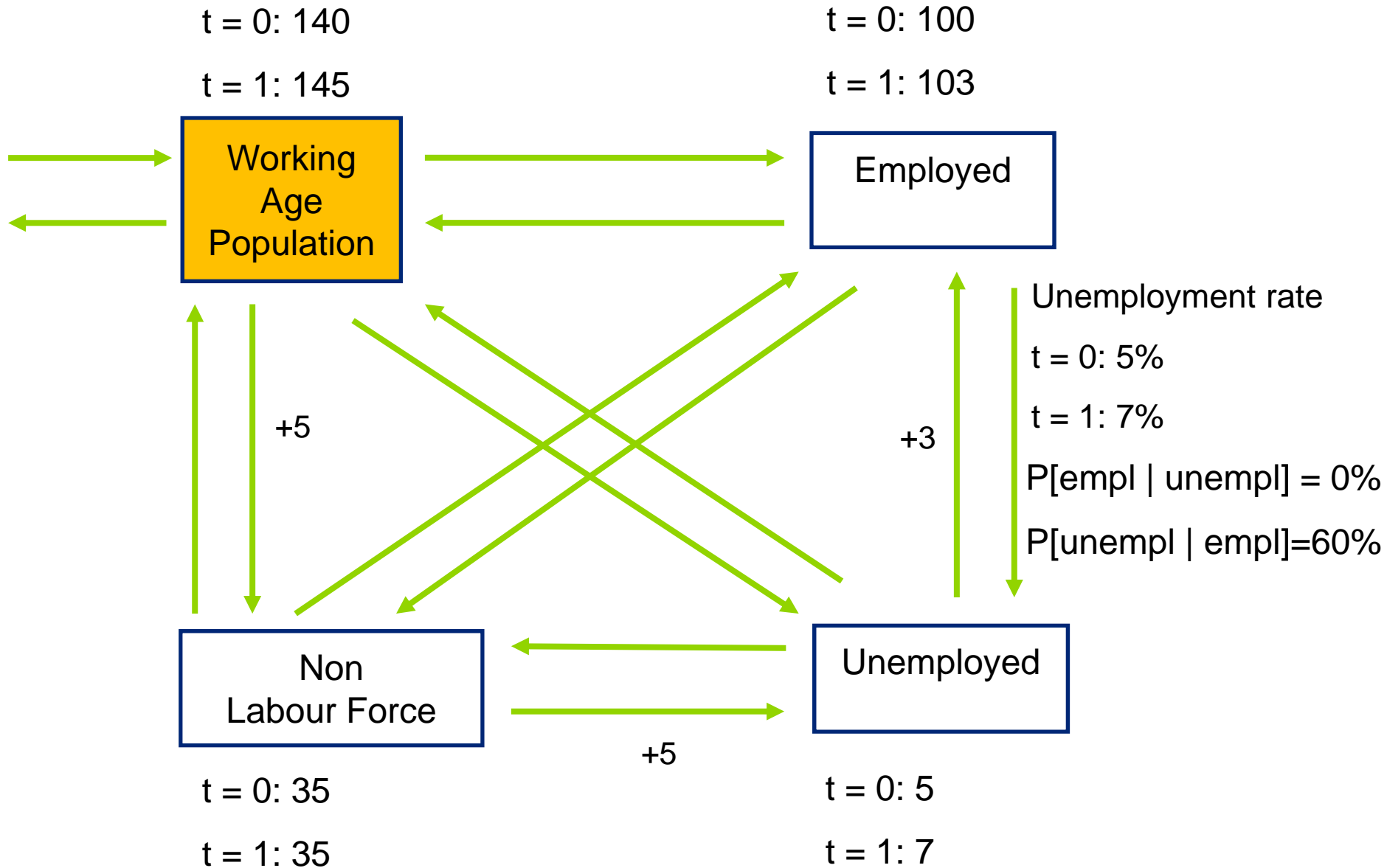
Statistics New Zealand: Labour Force Household Survey Unemployment data
(Quarterly – 20 yrs history. Segmented for region, age, qualification and gender)



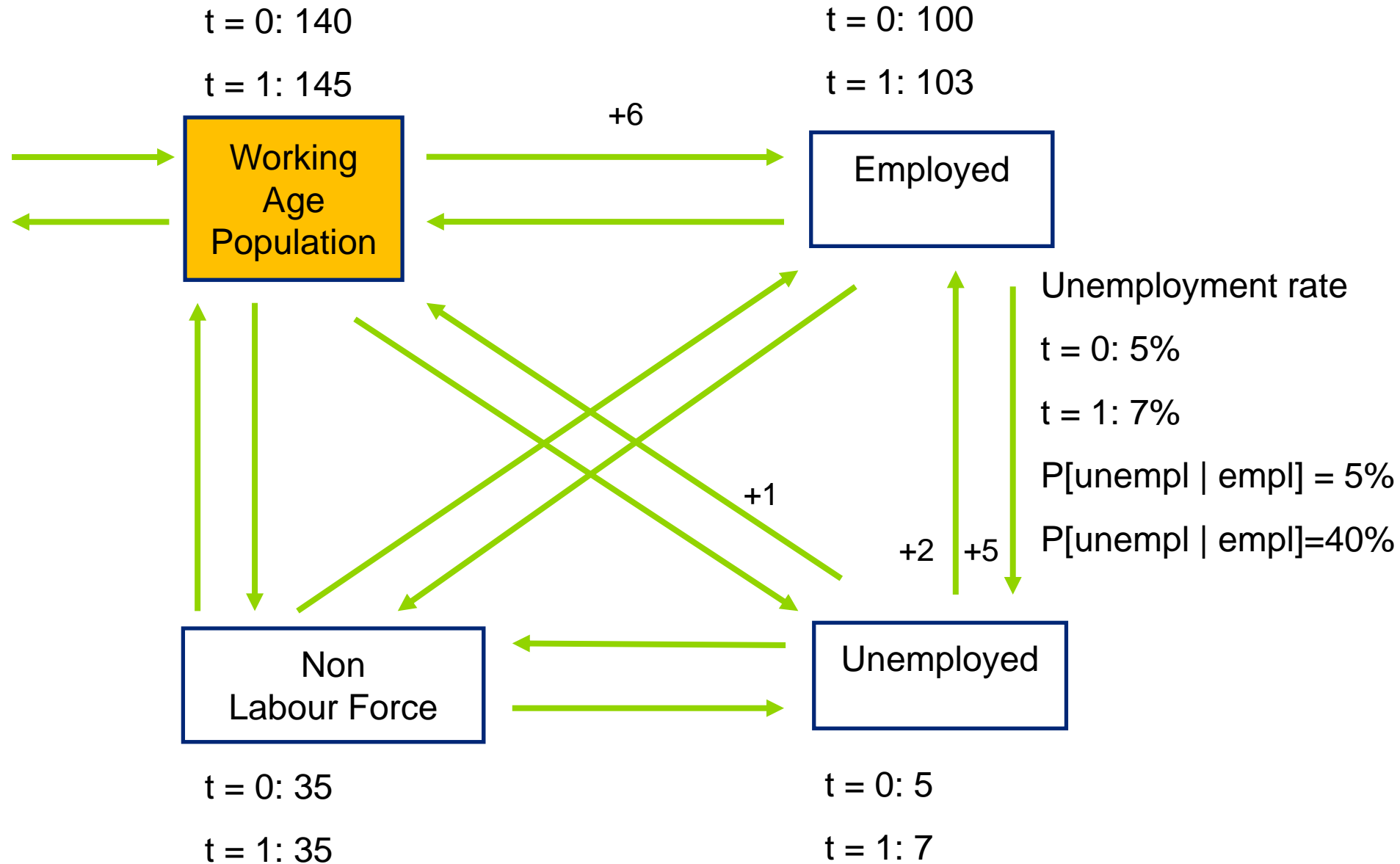
Unemployment rate =
$$\frac{\text{Unemployed}}{\text{Labour Force}}$$

Participation Rate =
$$\frac{\text{Labour Force}}{\text{Working Age Population}}$$

Unemployment multi state model – Example 1



Unemployment multi state model – Example 2

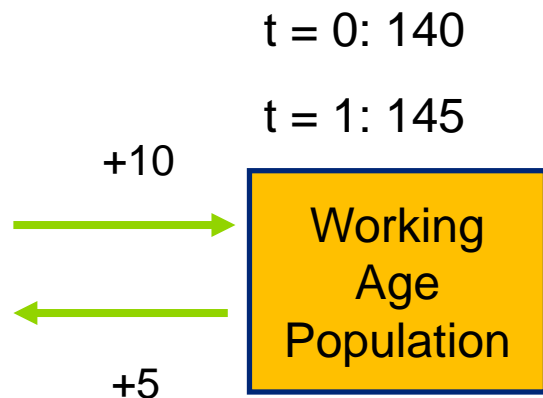


Unemployment multi state model - Assumptions

8 interlinked equations and 16 variables (of which 4 are known) form the multi state model to estimate historical probabilities.

5 assumptions to solve the model:

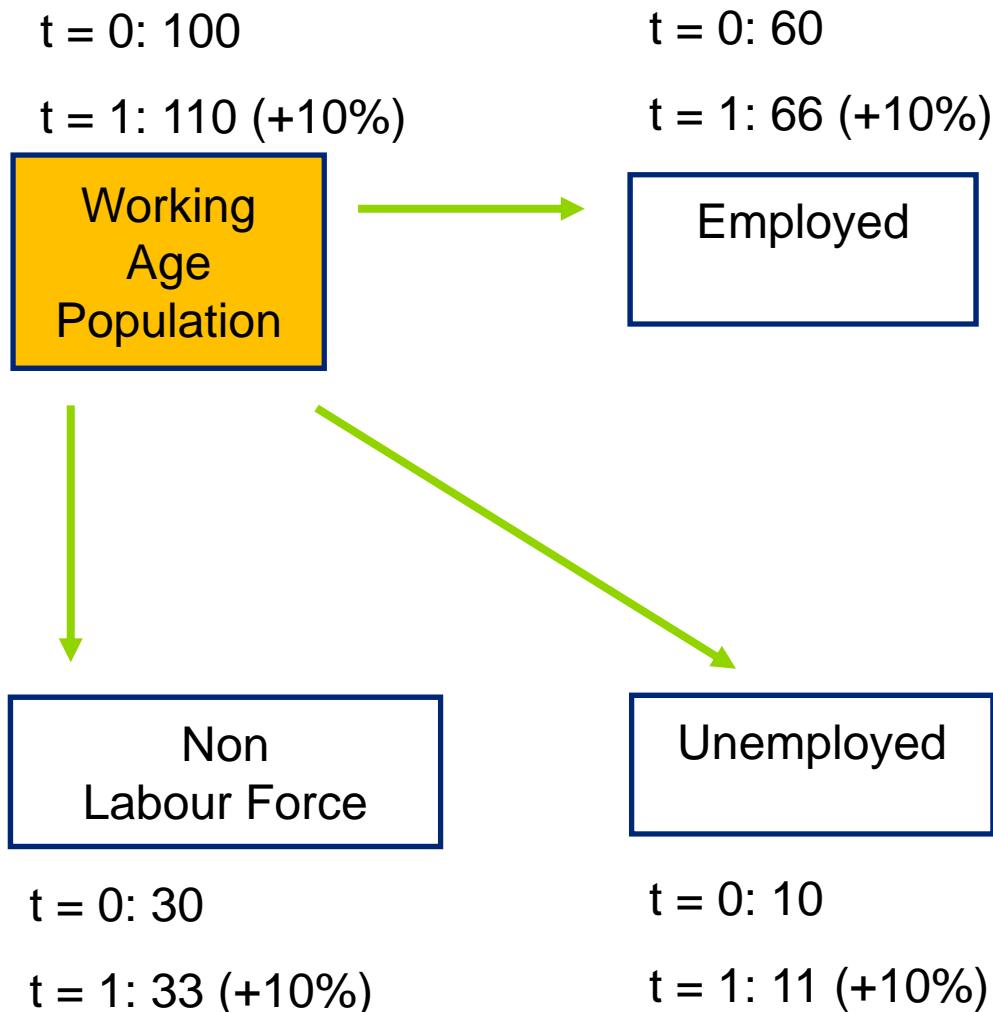
Number of people leaving the working age population = estimated mortality + net migration



Unemployment multi state model - Assumptions

Net Working age population inflow or outflow spreads proportionally

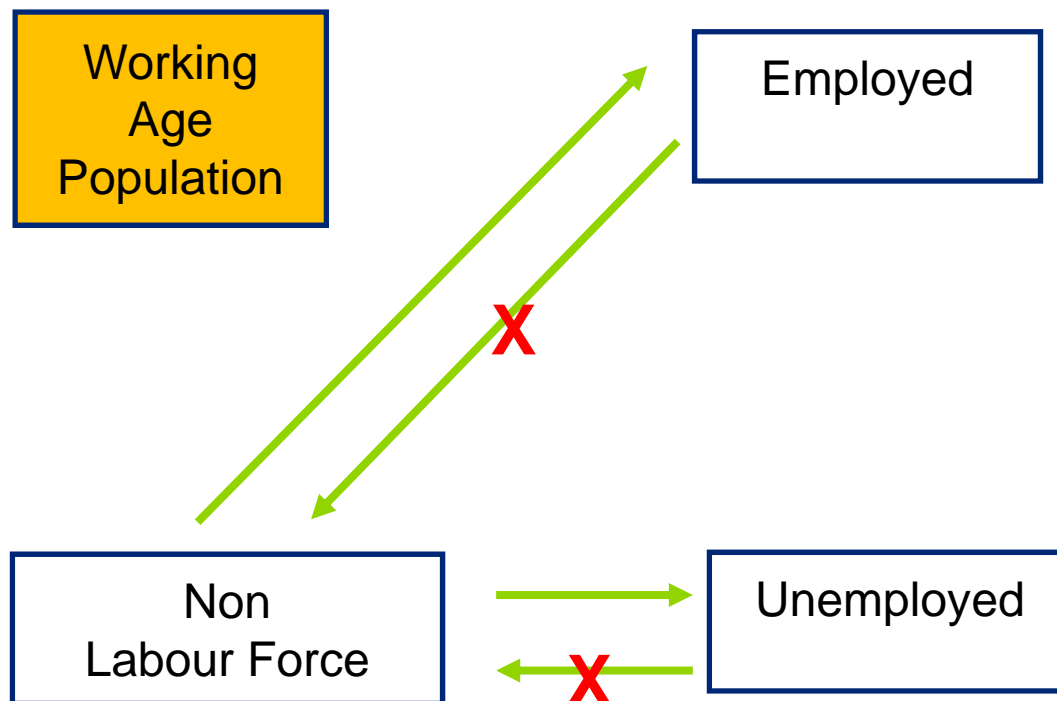
- EXAMPLE -



Unemployment multi state model - Assumptions

If the size of non labour force decreases / increases during the period then there are no / only people moving from the employment and unemployment state to the non labour force during the same period.

EXAMPLE



t = 0: 30

t = 1: 33

Unemployment multi state model - Assumptions

The number of people that move from being unemployed to employed is equal to the relative amount of people that have an observed duration of unemployment less than a quarter.

Example Data:

Duration of unemployment
Period X

Less than	Perc
1 Month	25%
1 Quarter	50%
Half year	75%
Year	90%

Working
Age
Population

Non
Labour Force

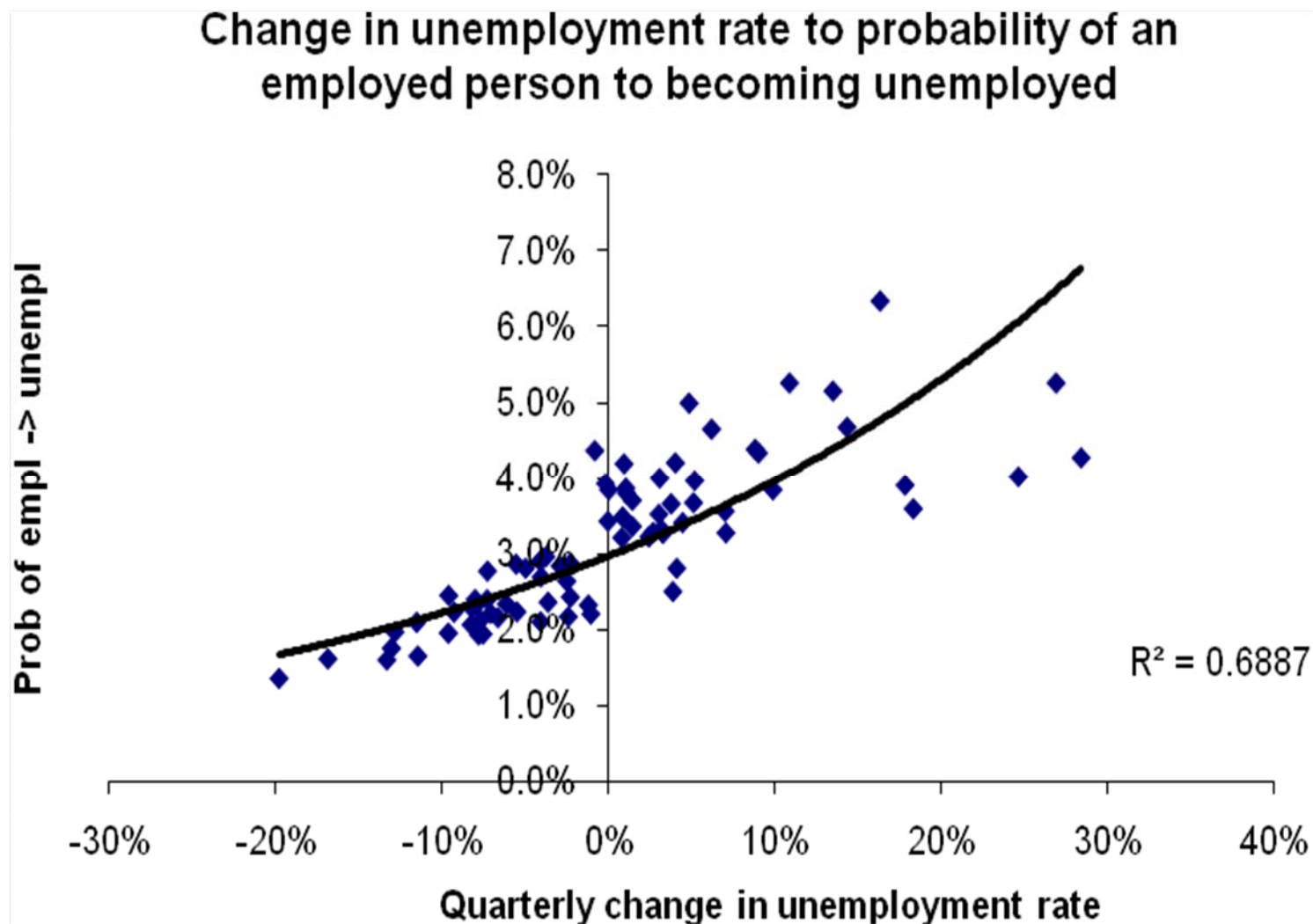
Employed

Unemployed

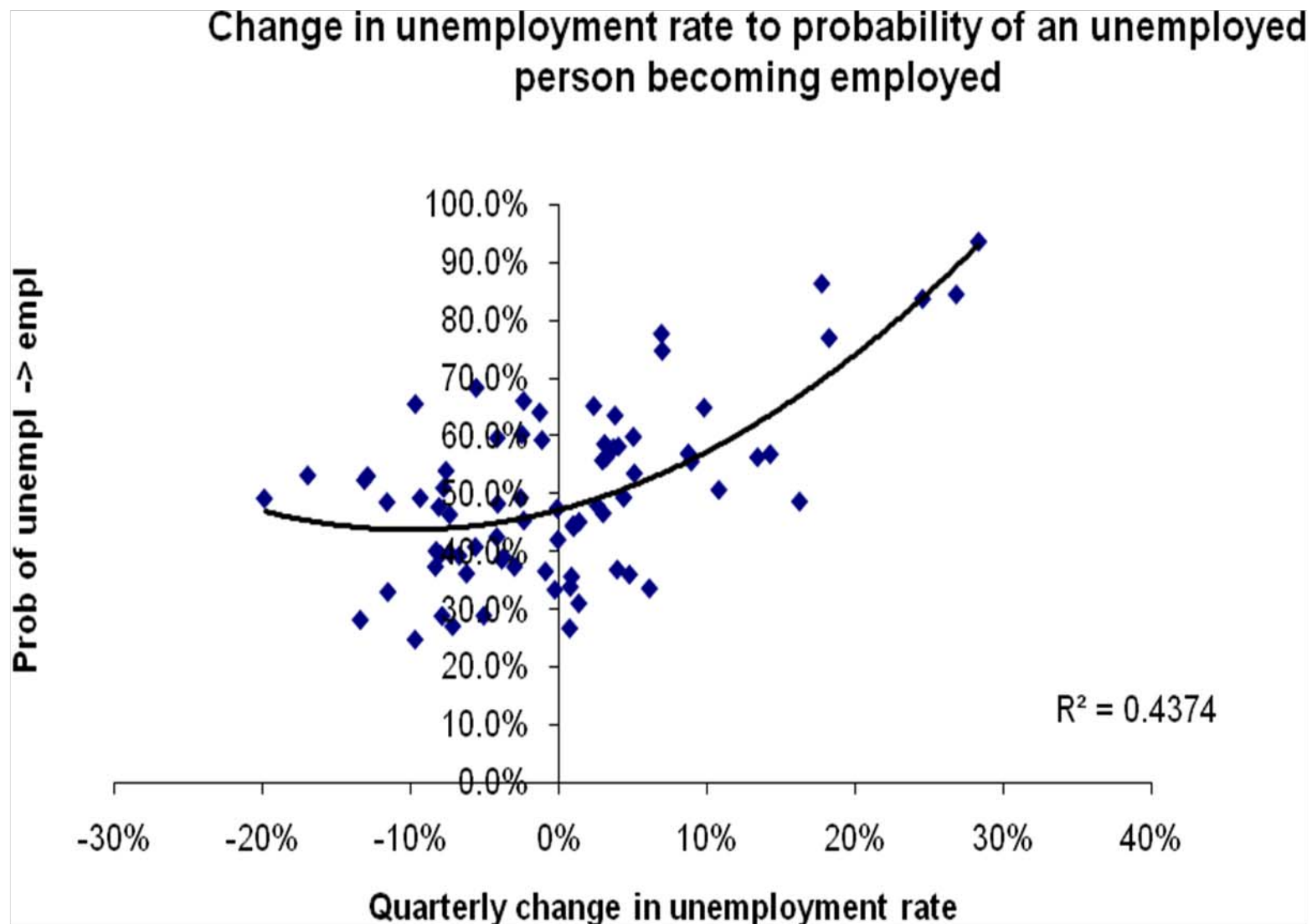


50%

Results – historical probability of unemployment



Results – historical probability of employment



Results – Segmented unemployment probabilities

Given the change in unemployment rate and the fitted curve the (un)employment probabilities can be estimated.

Is that relationship stable for different segments? Some sample testing:

	Prob of employed to unemployed		Prob of unemployed to employed	
	Mean*	Slope**	Mean	Slope
Total population	3%	9%	50%	93%
Qualification – No Qual	3%	8%	50%	64%
Sample Age – 40 to 44	2%	5%	50%	71%
Gender – Female	3%	9%	50%	81%

*The probability of (un)employment with no change in unemployment rates

** The slope (if assumed to be linear) of the fitted curve with increasing unemployment rates

Results – Segmented unemployment probabilities

The estimated (un)employment probabilities are dependent on the change in unemployment.

Correlation over the last 20 years between the change in unemployment rate for New Zealand total and:

- Gender: 90%
- Between regions, age and qualification: 40% – 70%

The volatility of changes in unemployment rate differ considerably across segments.

Estimated unemployment probabilities can be significantly different for various segments.

How can these results be used

- Financial protection products (pricing and risk modelling):
 - Estimated probability of (un)employment
 - Estimated duration of unemployment
 - Probability distribution of duration of unemployment
- Retail loans credit models
 - Probability of default
 - Loss given default
- Macroeconomic forecasting models
 - More granular information than unemployment rate