

National Foundation for Educational Research

Developing a Single Model for Statistical Neighbour Benchmarking

May 2007



Aims of research

- Create new set of statistical neighbours
- Appropriate for ECM outcomes
- Build on existing models (Ofsted, IPF)
- Create easy to use tool for LAs

Strands of Research

- Literature review and data mapping
- Consultation with stakeholders
 - Bulletin board, telephone interviews
- Creating statistical neighbours
 - Ensuring relevance to ECM outcomes
- Displaying statistical neighbours

Main findings from consultation

- Important to explain rationale behind new model
- Exploring 'reciprocity' between statistical neighbours
- Model should use a variety of variables relating to socio-economic and demographic characteristics
- Model needs to evolve

Performance assessment

Quantitative indicators provide a common method of performance assessment

Within Every Child Matters:

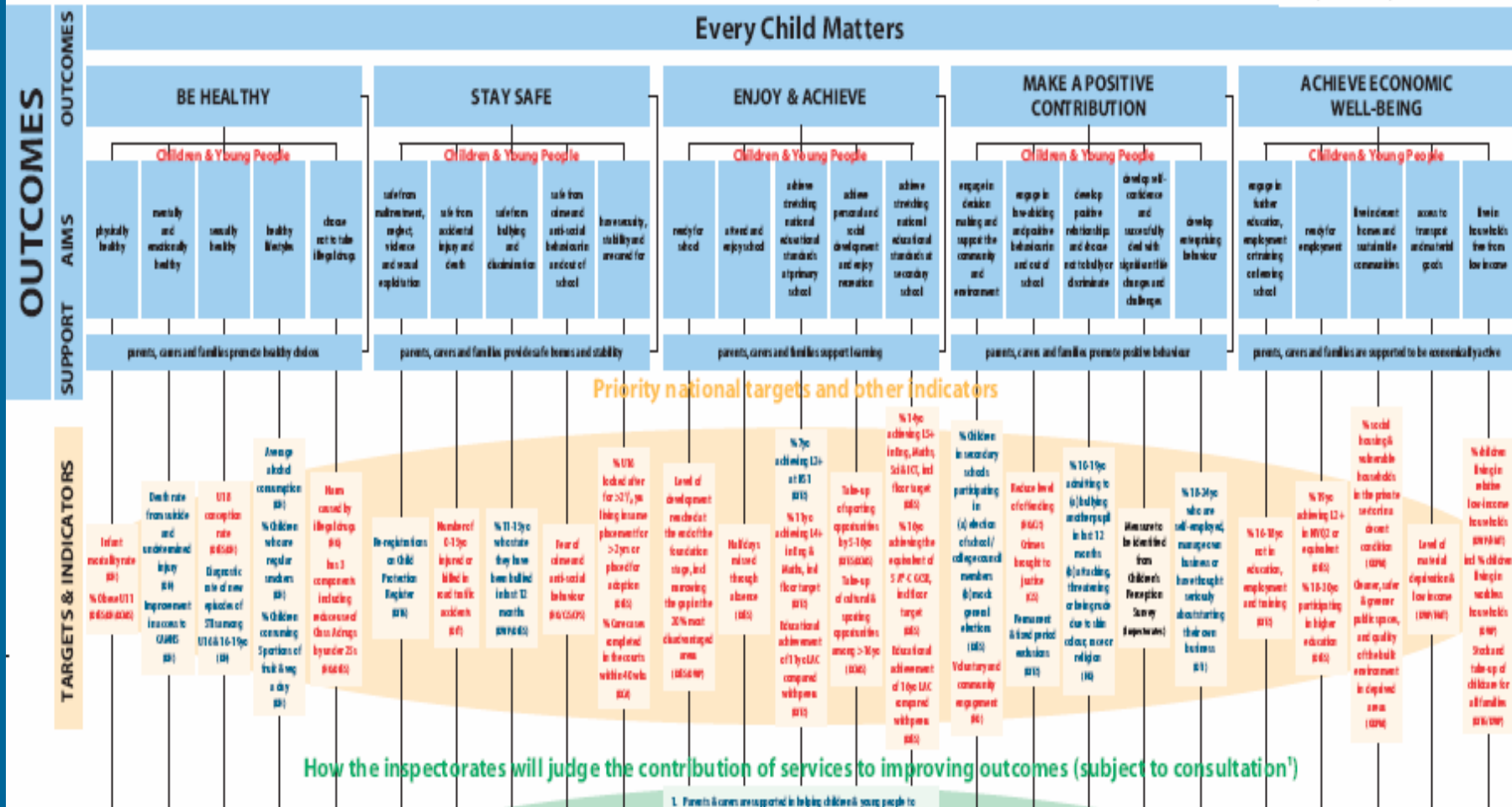
- be healthy → teenage pregnancy, obesity
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- enjoy & achieve → test results, absence
- make a positive contribution → youth offending
- achieve economic well-being → further education as well as many other indicators.

Performance assessment

There are 26 PSA targets in total and 13 other key indicators. For the PSA on stability of looked after children the associated performance indicators are also shown under Enjoy & Achieve

OUTCOMES FRAMEWORK

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Performance assessment

How do we adjust for context?

<i>Local Authority</i>	<i>% achieving 5 A*-C (2005)</i>	<i>% children in income deprived households</i>
<i>Windsor & Maidenhead</i>	<i>59%</i>	<i>9%</i>
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<i>National Figure</i>	<i>56%</i>	

What are statistical neighbours?

Each local authority has other similar authorities designated as its statistical neighbours.

- Compare performance with neighbours
- Adjusts for context

For example:

Results at the end of Key Stage 1 are good and have consistently been above national averages and those of statistical neighbours, although for reading and writing rates of improvement are below statistical neighbours.

(Bedfordshire APA 2005)

New statistical neighbour model

- Empirical basis for model
 - Relevance to ECM outcomes
- Breadth of data explored
- Comparisons with previous statistical neighbour models

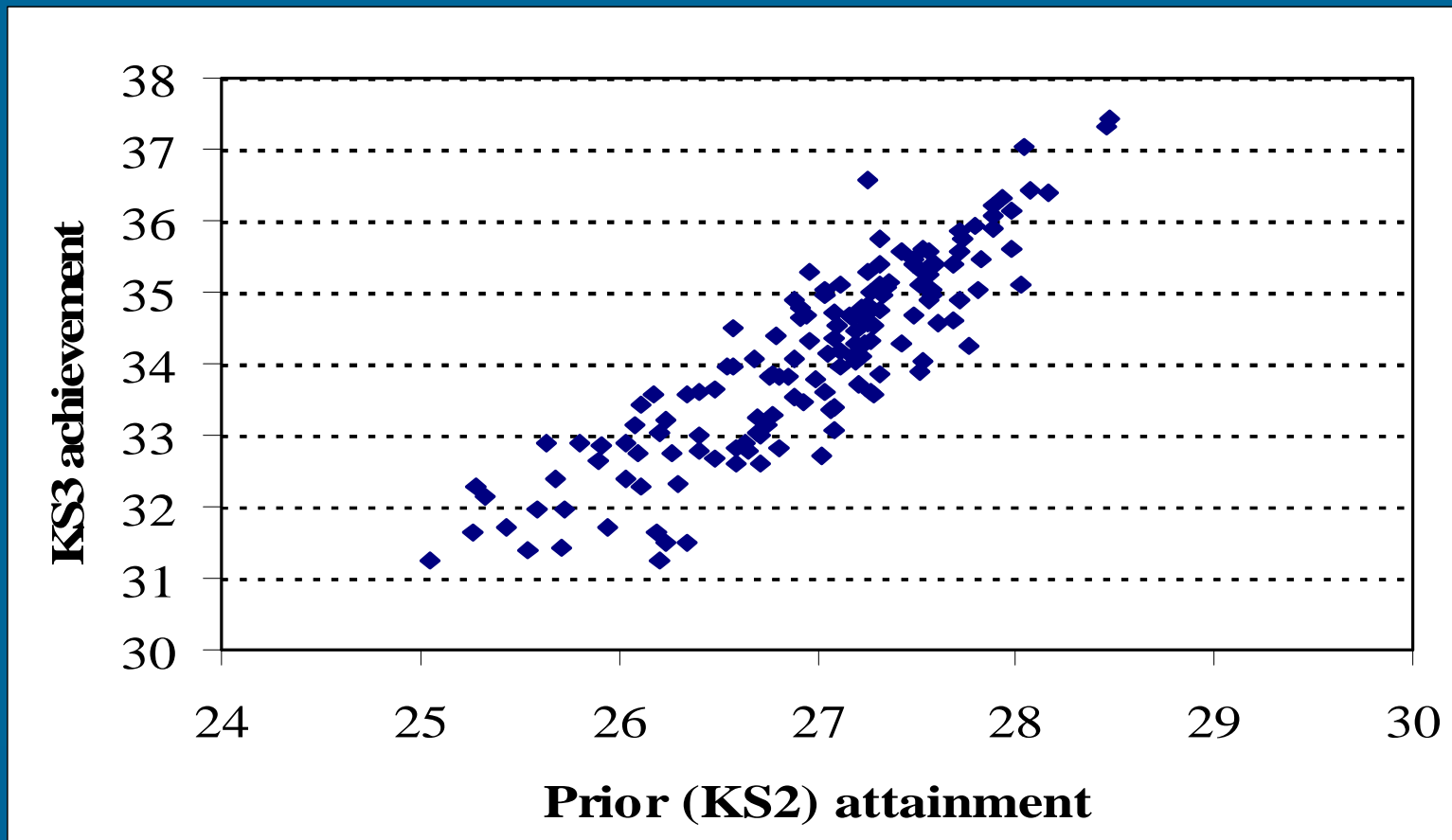
Empirical principles

- Choose model features to maximise predictive performance
 - Ø Background variables
 - Ø Number of statistical neighbours
 - Ø Variable weighting

Simple example

Example to demonstrate principle

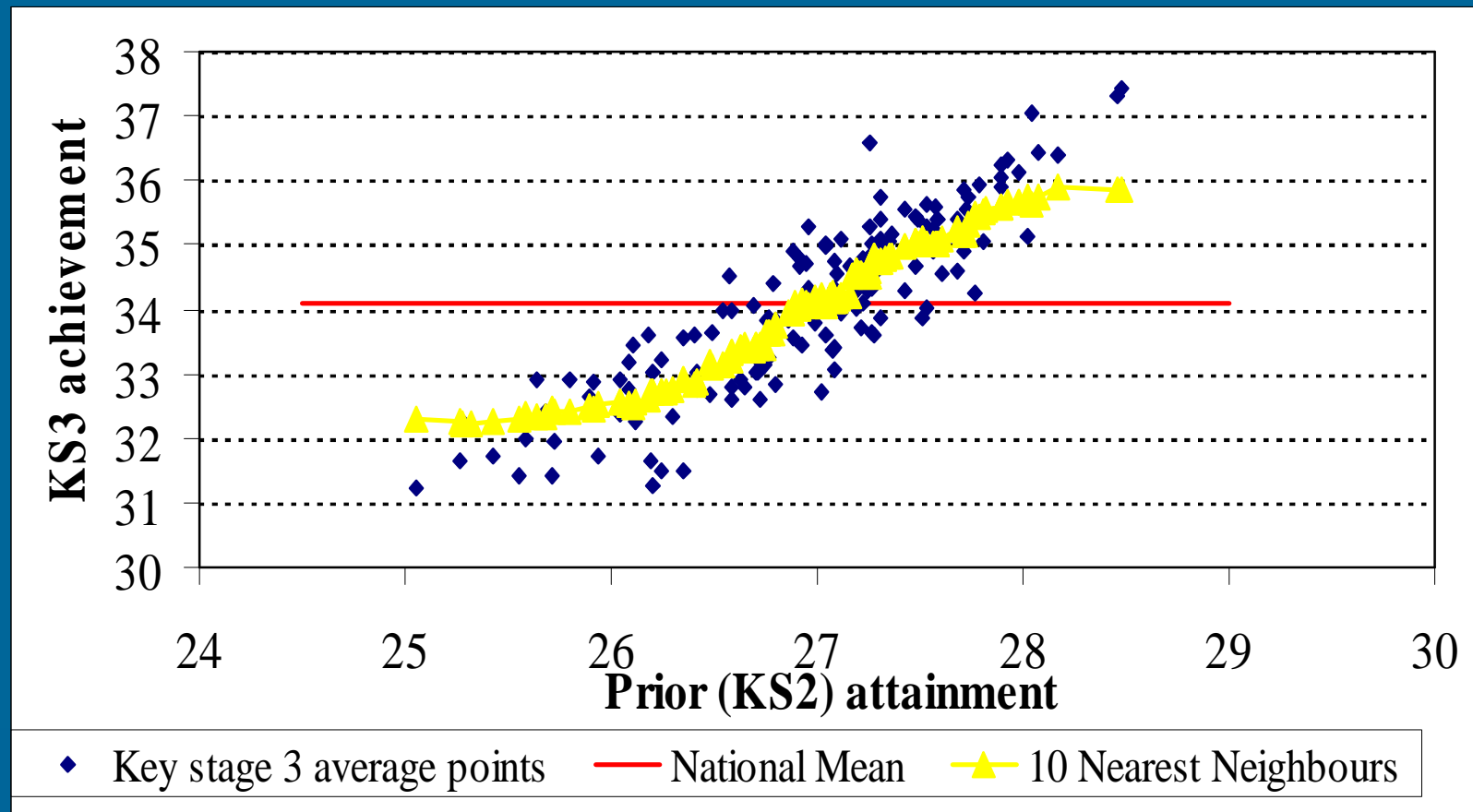
- 1 outcome (average key stage 3 score 2004)
- 1 background variable (prior attainment of cohort)



Simple example

Compare to:

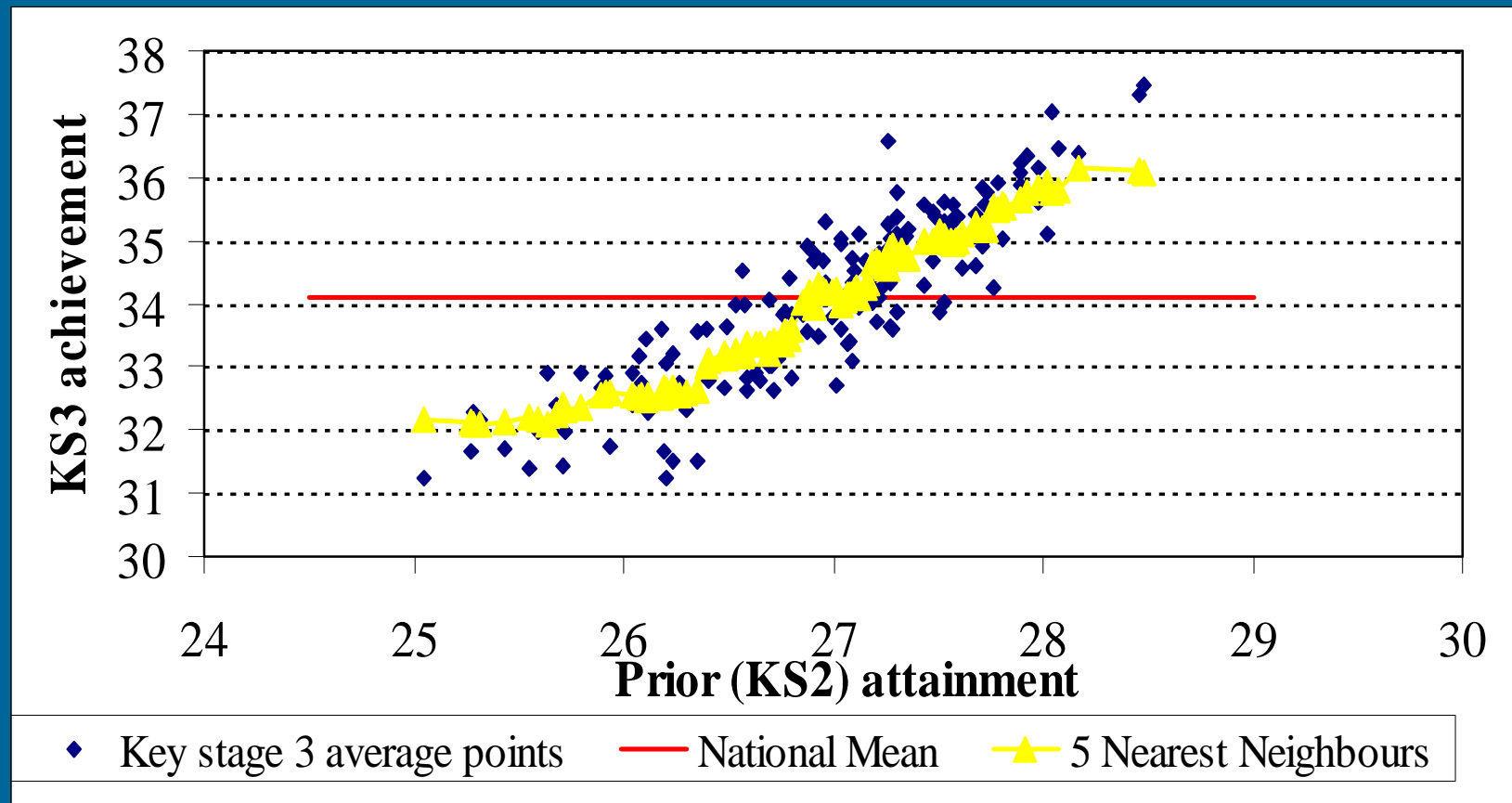
- National mean
- Average for statistical neighbours (10)



Simple example

Compare to:

- National mean
- Average for statistical neighbours (5)



Empirical principles

- Performance of model measured by:

(Average squared error of model)

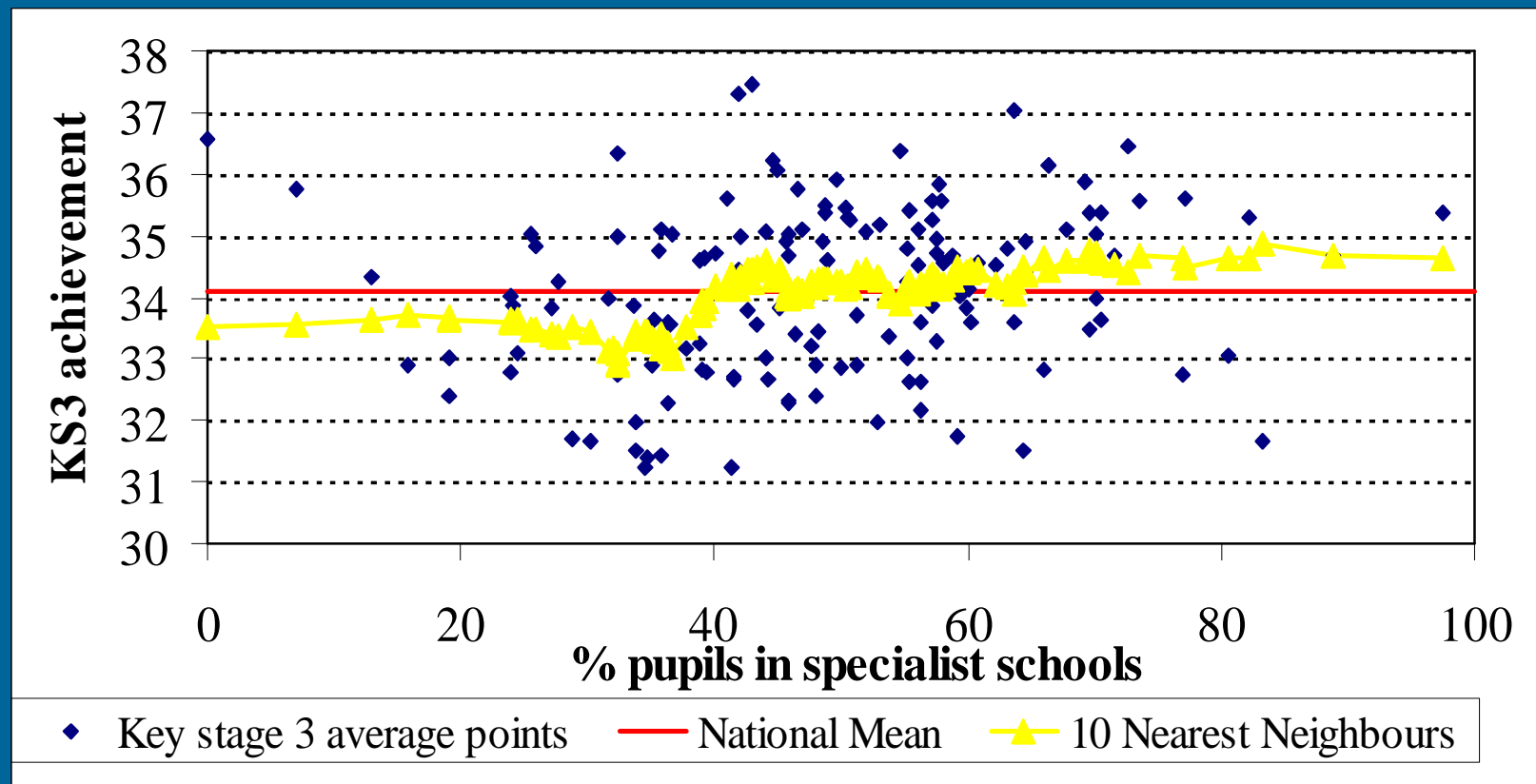
(Average squared error of national mean)

<i>Model (simple example)</i>	<i>Criterion</i>
<i>5 neighbours</i>	<i>0.256</i>
<i>10 neighbours</i>	<i>0.234</i>
<i>National mean</i>	<i>1.000</i>

Simple example

Nearest neighbour models can be less accurate than national mean

- 1 background variable (% pupils in specialist schools)
- Criterion = 1.09



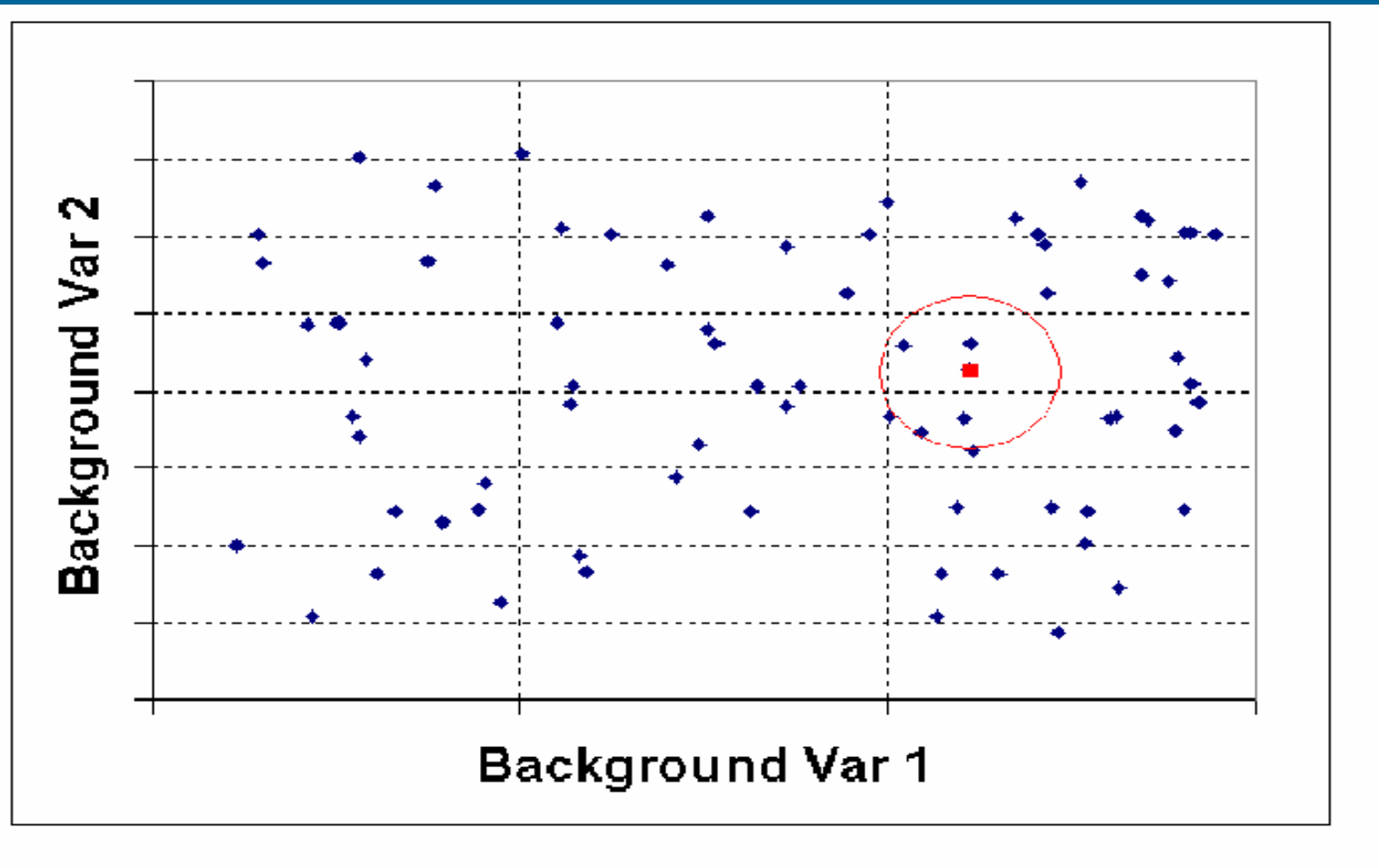
Empirical principles

New model based on same technique
except:

- Multiple outcomes
- Multiple background variables (weighting)

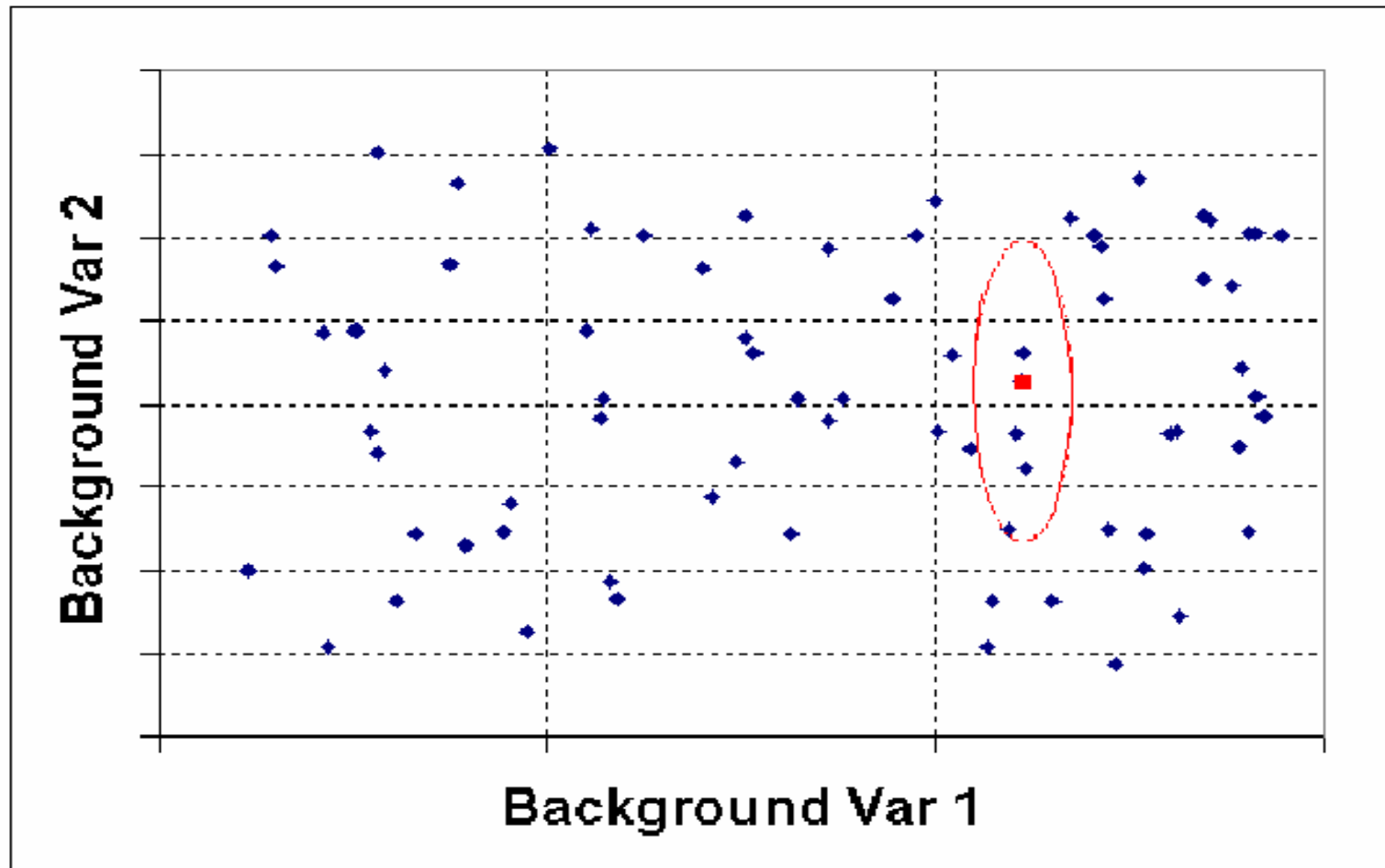
Weighting variables

Background variables equally important



Weighting variables

Variable 1 more important



Breadth of information

Sixty-three initial background variables chosen from:

- 2001 Census
- Annual population surveys between 2001 and 2005
- Labour force survey four quarterly averages – June 2004 to May 2005
- Annual survey of hours and earnings 2005
- The ODPM indices of multiple deprivation
- The local authority data matrix
- DVLA information on vehicle numbers and ages
- CIPFA information on availability of services

How to create the neighbours 1

The methodology began with variable selection.

- **Regression analysis of performance indicators on the proposed background variables.**
 - Ø Identify background variables not related to outcomes
 - Ø Identify outcomes not related to background variables
- **Analysis of correlations between background variables.**
 - Ø Remove closely related measures

How to create the neighbours 1a

Performance indicators used in regression analysis

- Infant mortality rate
- Under 18 conception rate
- Re-registrations on the Child Protection Register
- % of children who have been looked after for more than two and a half years and of those, have been in the same placement for at least two years or placed for adoption
- Child casualties in road accidents
- Achievement at each key stage
- School absence
- Permanent and fixed exclusions
- Police records
- Post-16 progression to further education and training

Compare models

Variables in common with OFSTED

Variable used in Ofsted model	Kept/Replaced/Discarded
% of households where HOH is in Registrar Generals Group IV or V	Replaced with % dependent children in households where household reference person is in any routine occupation.
% of households with dependent children and no car	Replaced with % dependent children in households with 2 or more cars.
% of pupils in maintained schools eligible for free school meals	Variable kept in new model.
% of households in dwellings with 7 or more rooms	Replaced with % dependent children living in households with occupancy rating of +2 or more.
% of households with 3 or more children	Variable kept in new model.

Compare models

More variables in common with OFSTED

Variable used in Ofsted model	Kept/Replaced/Discarded
% of households with more than 1.5 persons per room	Replaced with % dependent children living in overcrowded households.
% of adults with higher educational qualifications	Variable kept in new model.
Ethnicity information (% of people of white, black, Indian, Pakistani, Bangladeshi, other Asian ethnicity)	Black ethnicity split into Caribbean, African and other. Mixed ethnicity included in new model. White ethnicity dropped as a separate category since information on other ethnic groups defines this.
% of population in rural areas or urban settlements of less than 20,000	Replaced with % of the population living in villages, hamlets or isolated settlements.

Compare models

Variables not in common with OFSTED

Variable used in Ofsted model	Kept/Replaced/Discarded
% of households with dependent children, moved in the previous 12 months	Discarded from model due to weak relationship with outcomes.
Population density	Discarded from model due to weak relationship with outcomes.
Population growth/decline: % change	Discarded from model due to weak relationship with outcomes.
Number of pupils in state maintained schools	Discarded from model due to weak relationship with outcomes.

Compare models

Variables not in common with OFSTED

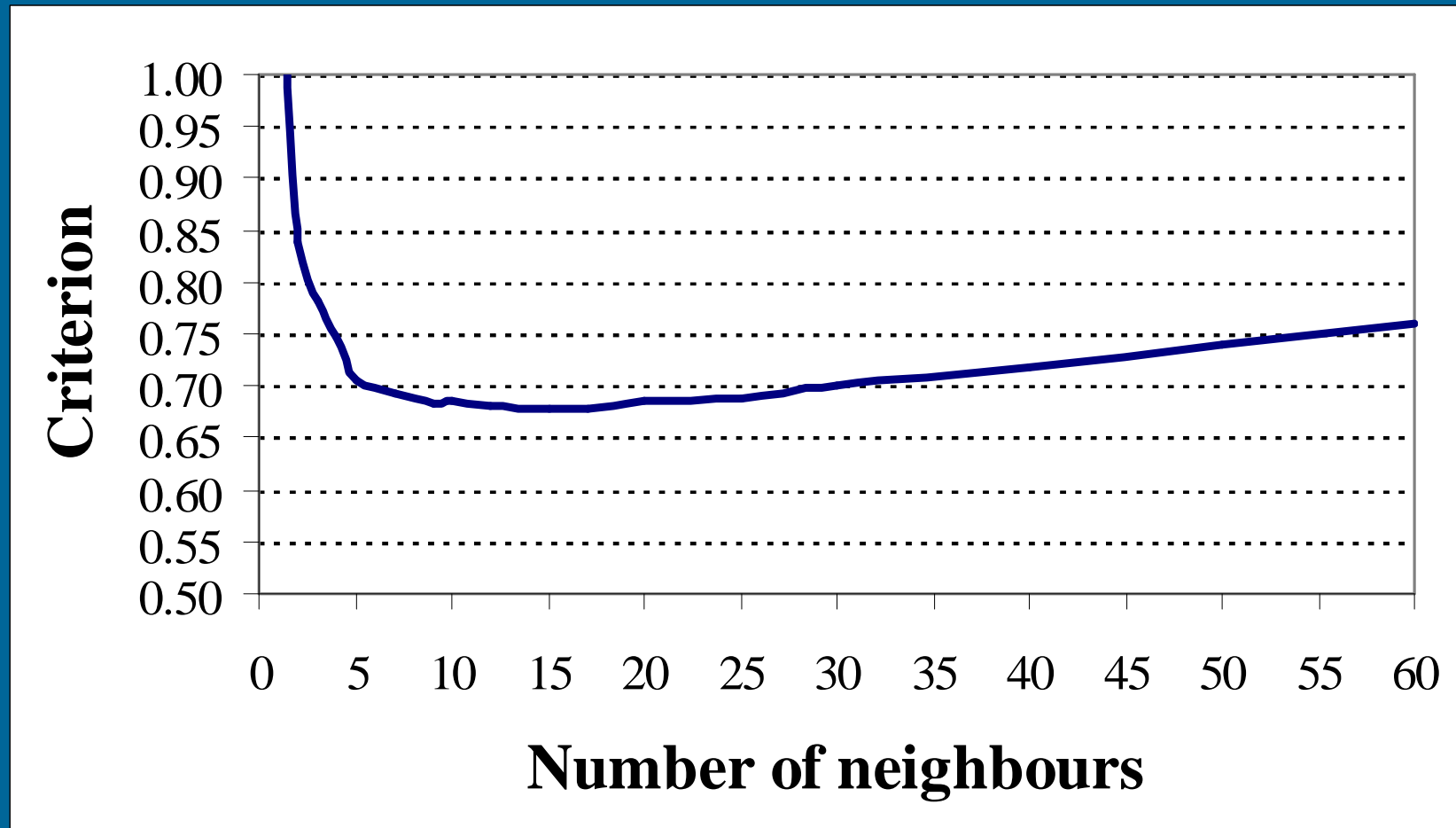
- % of dependent children in households where household reference person is any professional or managerial occupation
- Mean gross weekly pay
- % of vehicles that are 3 years old or less
- % of dependent children in one adult households
- % of people in good health
- % of households owned outright or owned with a mortgage

How to create the neighbours 2

- **Calculating the appropriate number of statistical neighbours**
 - Ø Base calculation on model assigning equal weight to each variable
- **Assigning weights**
 - Ø Choose weights to optimise criterion
 - Ø Compare final model to existing models

How to create the neighbours 2

How many neighbours?



How to create the neighbours 2

Calculate best set of weights.

Starting with equal weights model

1. Calculate criterion for current model
2. Randomly generate new set of weights
3. Calculate criterion for new weights
4. If new criterion is lower than current criterion then new model becomes current model
5. Return to step 2

Model Outcomes

How does this model compare with other models?

Statistical neighbour model	Value of criterion
Final Model	0.63
Equal Weights Model	0.68
Ofsted's Statistical Neighbours	0.72
Institute of Public Finance comparator councils (CSCI)	0.71
Comparison to national means	1.00
Families of LAs (forced reciprocity)	0.71

Individual Model Outcomes

How does this model compare with other models?

	<i>Value of criterion for each model</i>			
<i>Outcome (Data used in analysis)</i>	<i>New model</i>	<i>Ofsted</i>	<i>CSCI</i>	<i>IDACI</i>
Infant mortality rate	0.74	0.87	0.87	0.90
U18 Conception rate	0.39	0.50	0.56	0.54
% achieving L4 in KS2 Maths	0.46	0.57	0.60	0.73
% achieving 5 A*-C	0.56	0.57	0.66	0.69
Absence rate at primary school	0.40	0.53	0.42	0.45
Fixed exclusions	0.85	1.00	0.98	1.06

Differences to previous models

How does this model compare with OFSTED's previous model?

Number of similar neighbours	Number of LAs with this number in common in each model
0	1
1	3
2	9
3	28
4	31
5	34
6	29
7	10
8	5
9	0
10	0

Differences to previous models

How does this model compare with CSCI's previous model?

Number of similar neighbours	Number of LAs with this number in common in each model
0	3
1	9
2	6
3	15
4	16
5	19
6	22
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Reciprocity

How often does a LA's neighbour have that LA as a neighbour themselves?

Number of reciprocal neighbours	Number of LAs with this number of reciprocal neighbours
0	2
1	7
2	4
3	18
4	14
5	11
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Neighbour Outcomes

Demonstrated that model works well for following outcomes:

- Infant mortality rate
- Under 18 conception rate
- Number of 0-15 year olds injured or killed in road traffic accidents
- Half days of school missed through absence
- % of 7 year olds achieving level 2 or above key stage 1
- % of 11 year olds achieving level 4 or above in key stage 2 English & Maths

Neighbour Outcomes

- % of 14 year olds achieving level 5 or above in key stage 3 English, Maths & Science
- % of 16 year olds achieving the equivalent of 5 A*-Cs at GCSE
- % of pupils who had one or more episodes of fixed period exclusion from school
- % of 10-17 year olds living in the local police force area who had been given a final warning / reprimand / caution
- % of 16-18 year olds not in education, employment or training.

Neighbour Outcomes

Model does not work well for the following outcomes:

- Re-registration on the Child Protection Register
- % of children who have been looked after for more than two and a half years and of those, have been in the same placement for at least two years or placed for adoption.
- % of pupils permanently excluded from school.

Neighbour Outcomes

Reasonable to assume model is appropriate for:

- All outcomes tested in model
- All outcomes based on large numbers of children in LA

Take care with:

- Outcomes based on small subsections of population
- Outcomes unlikely to be related to population demographics

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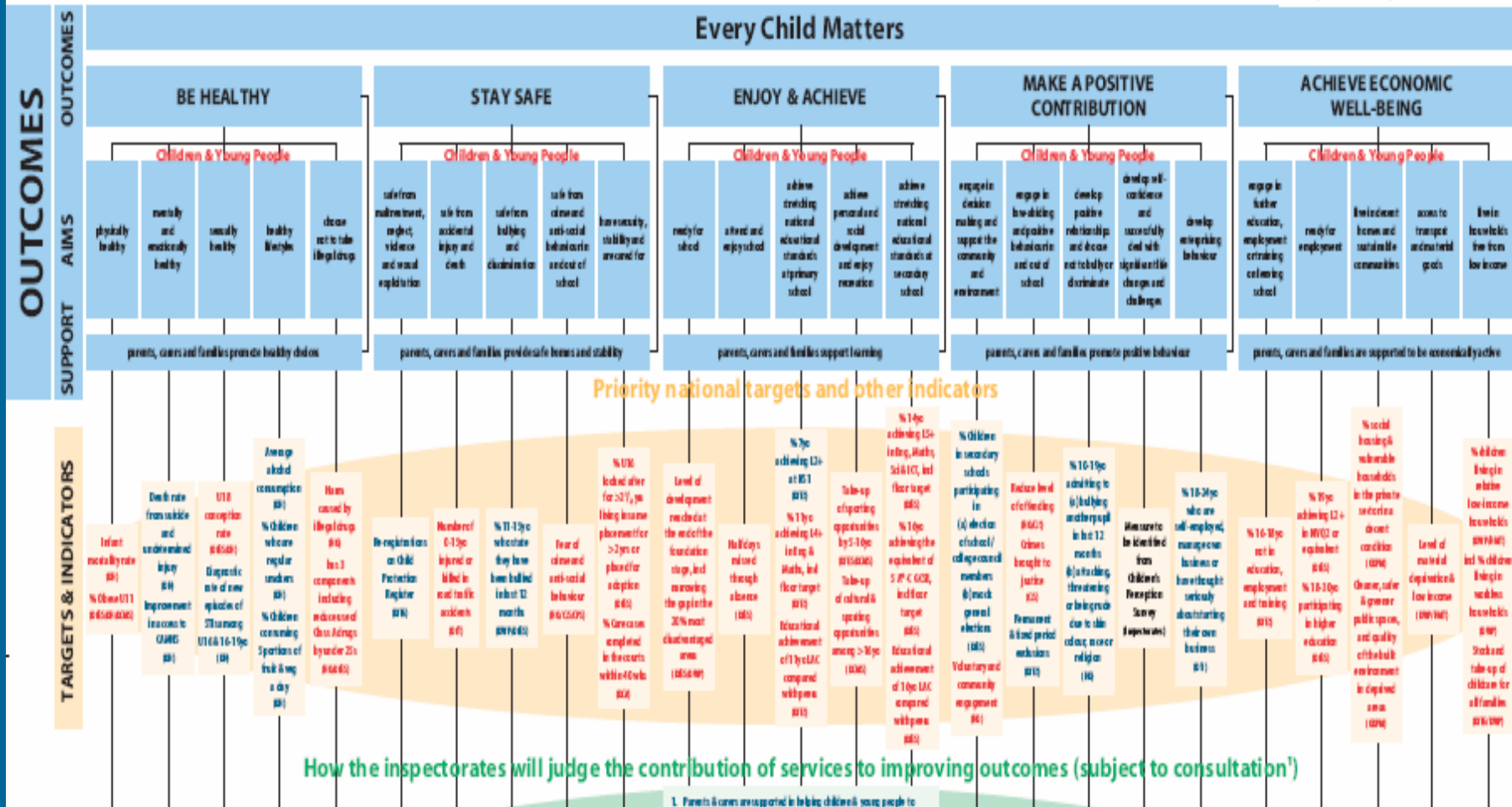
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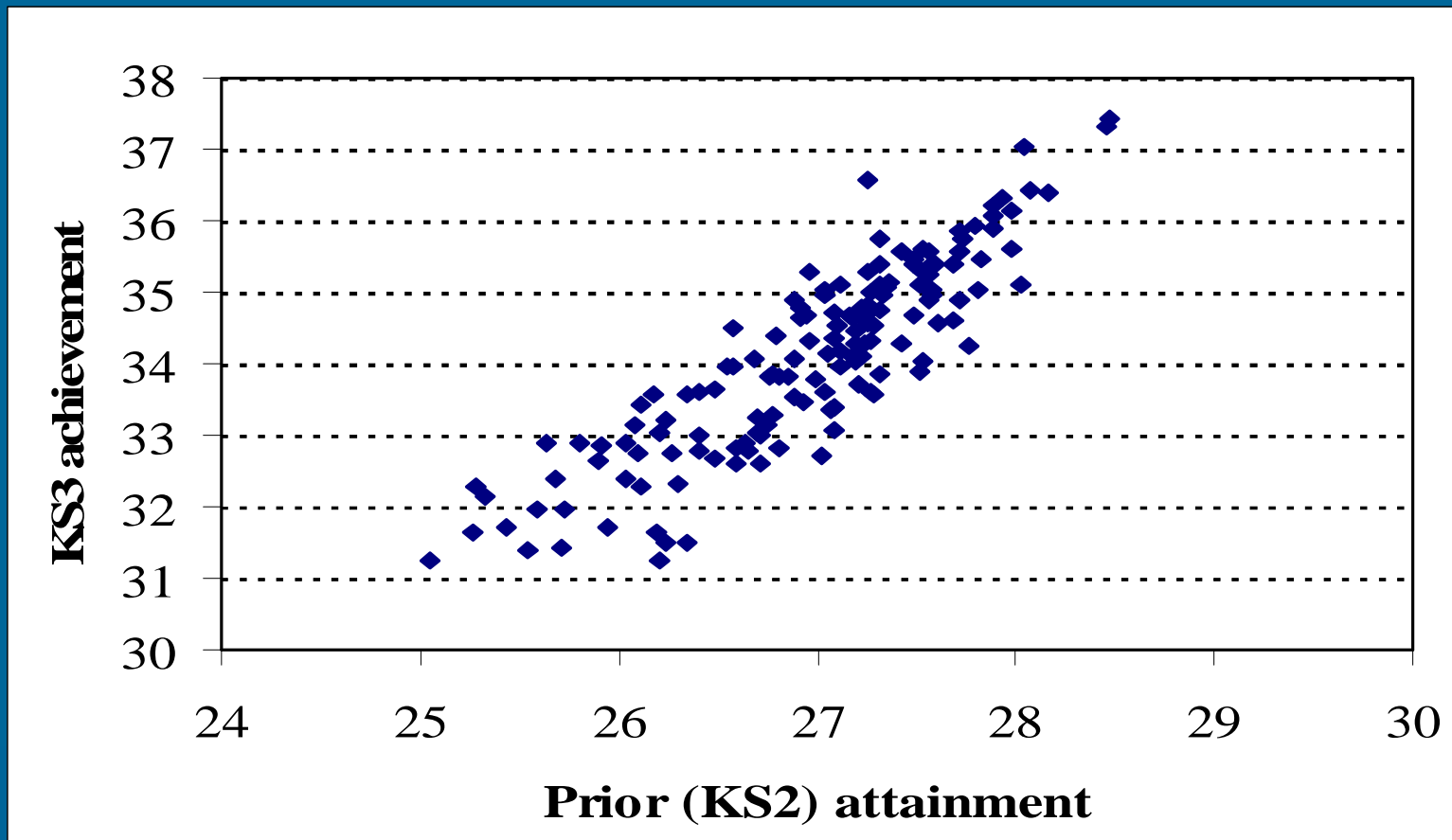
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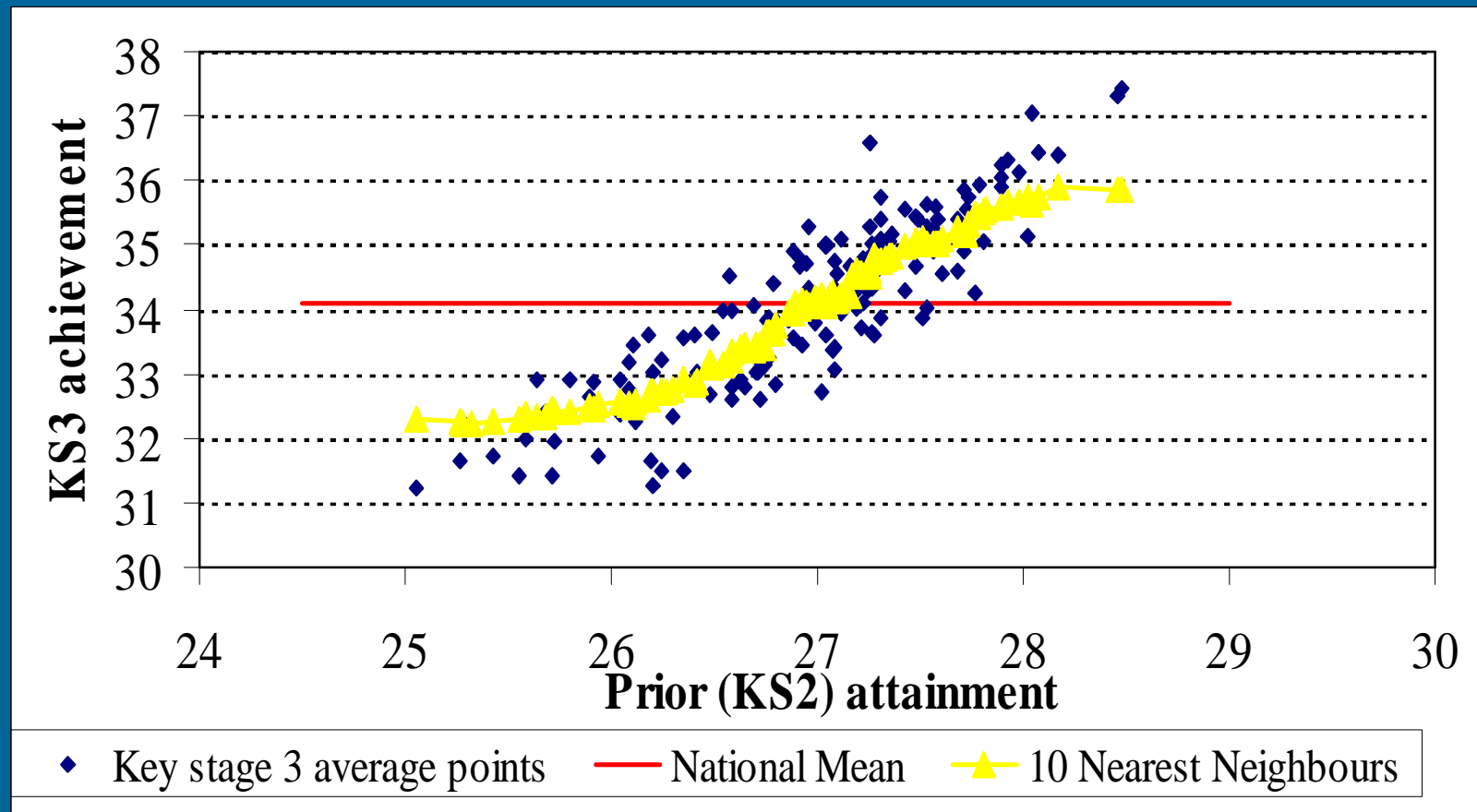
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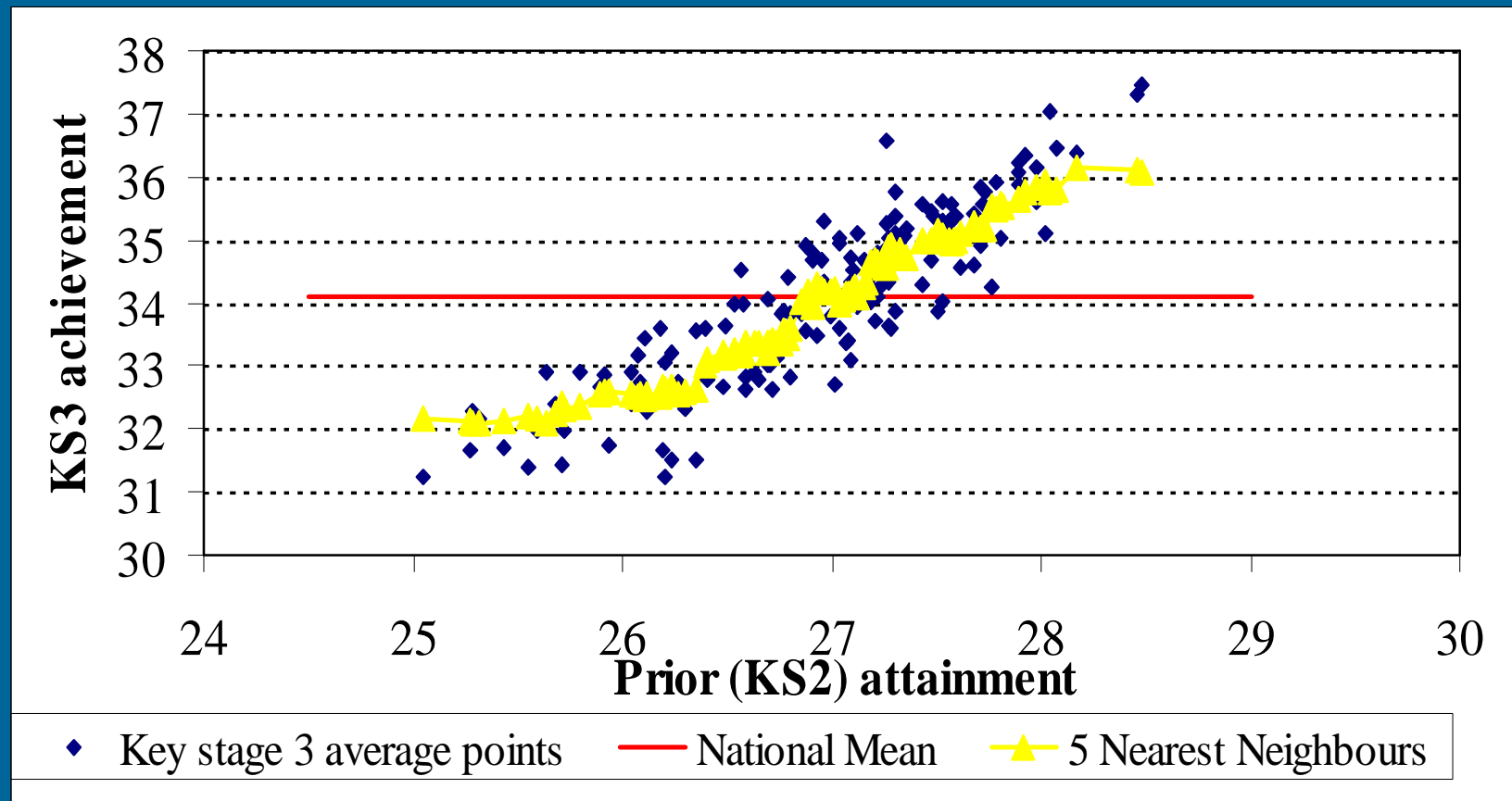
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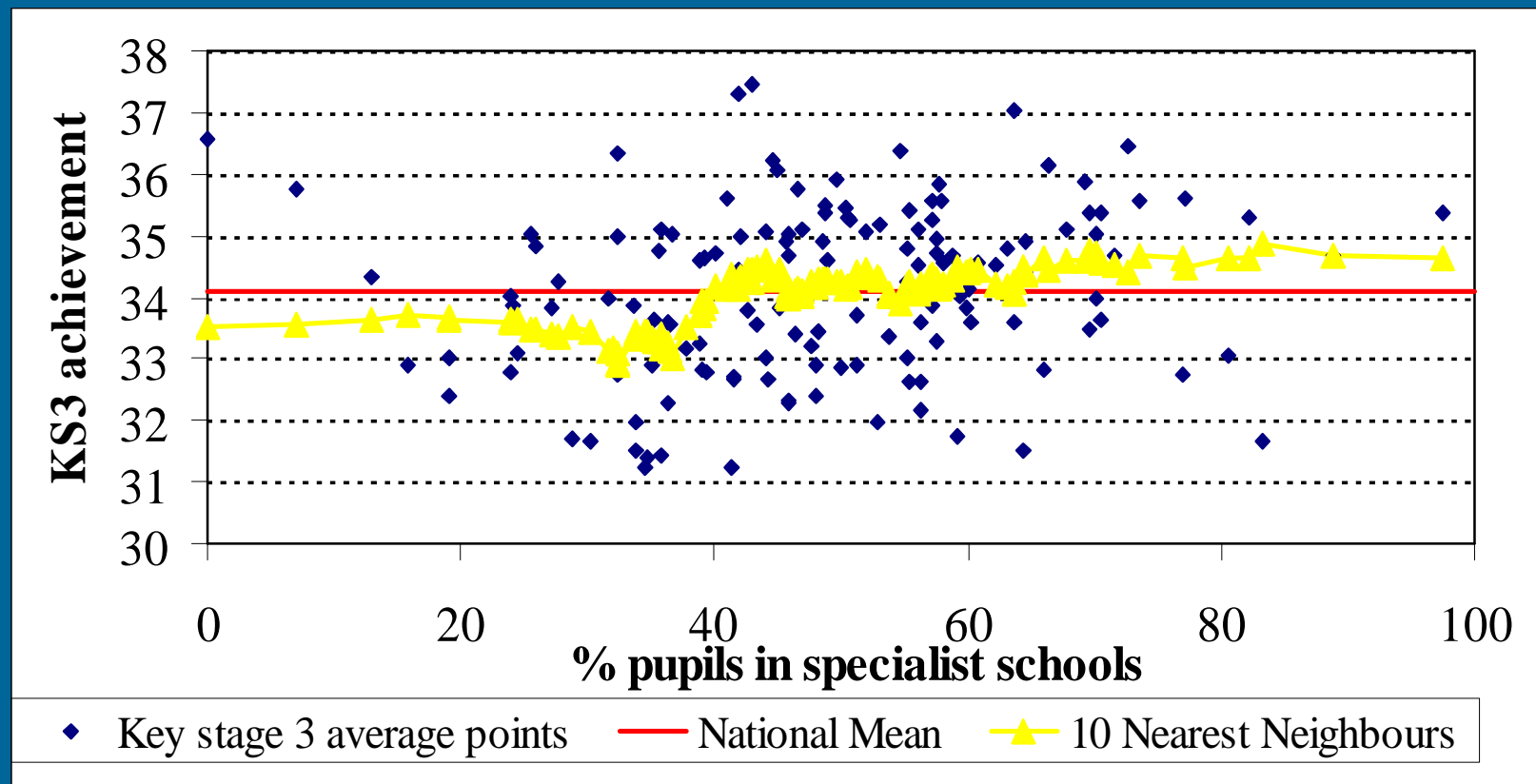
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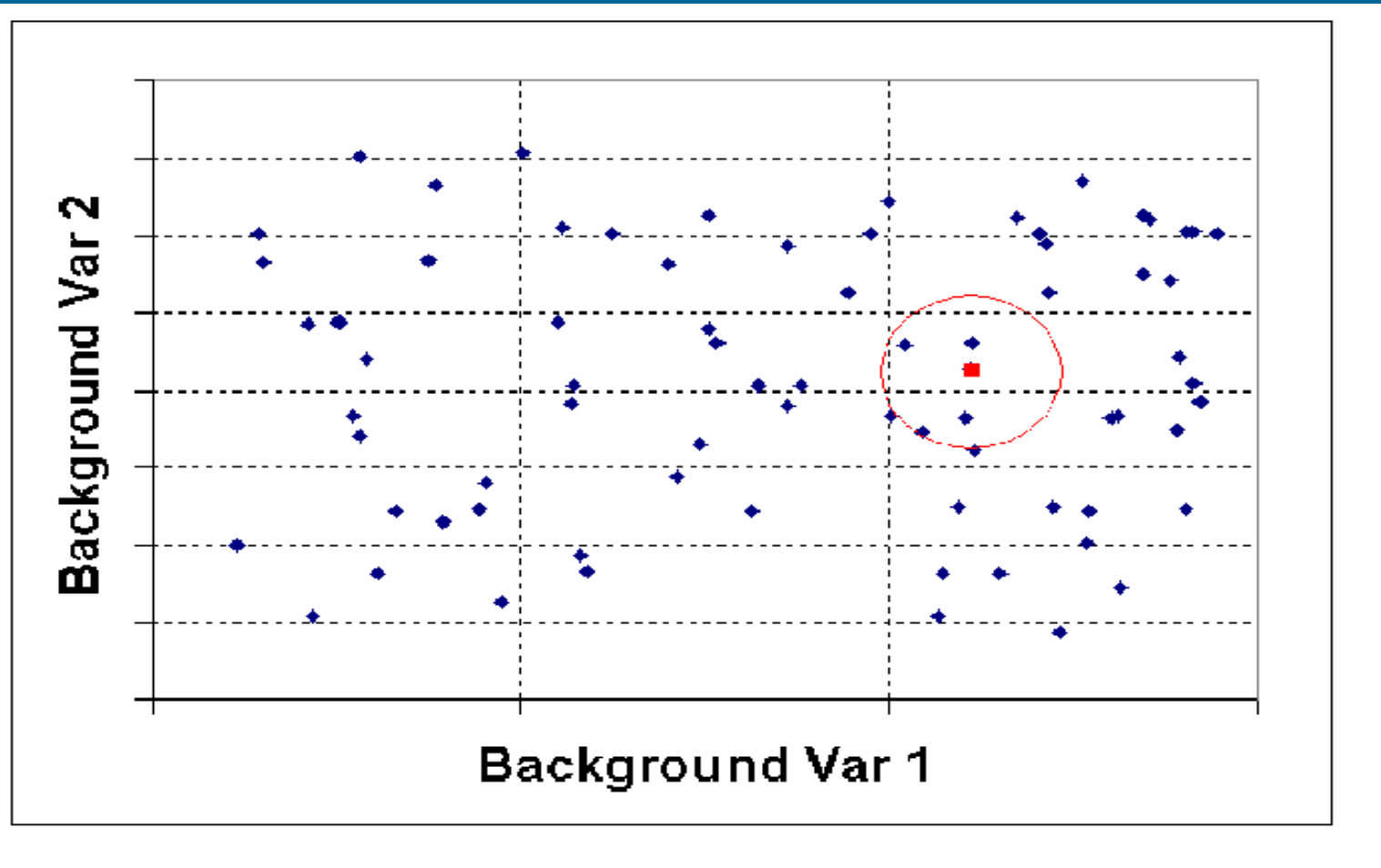
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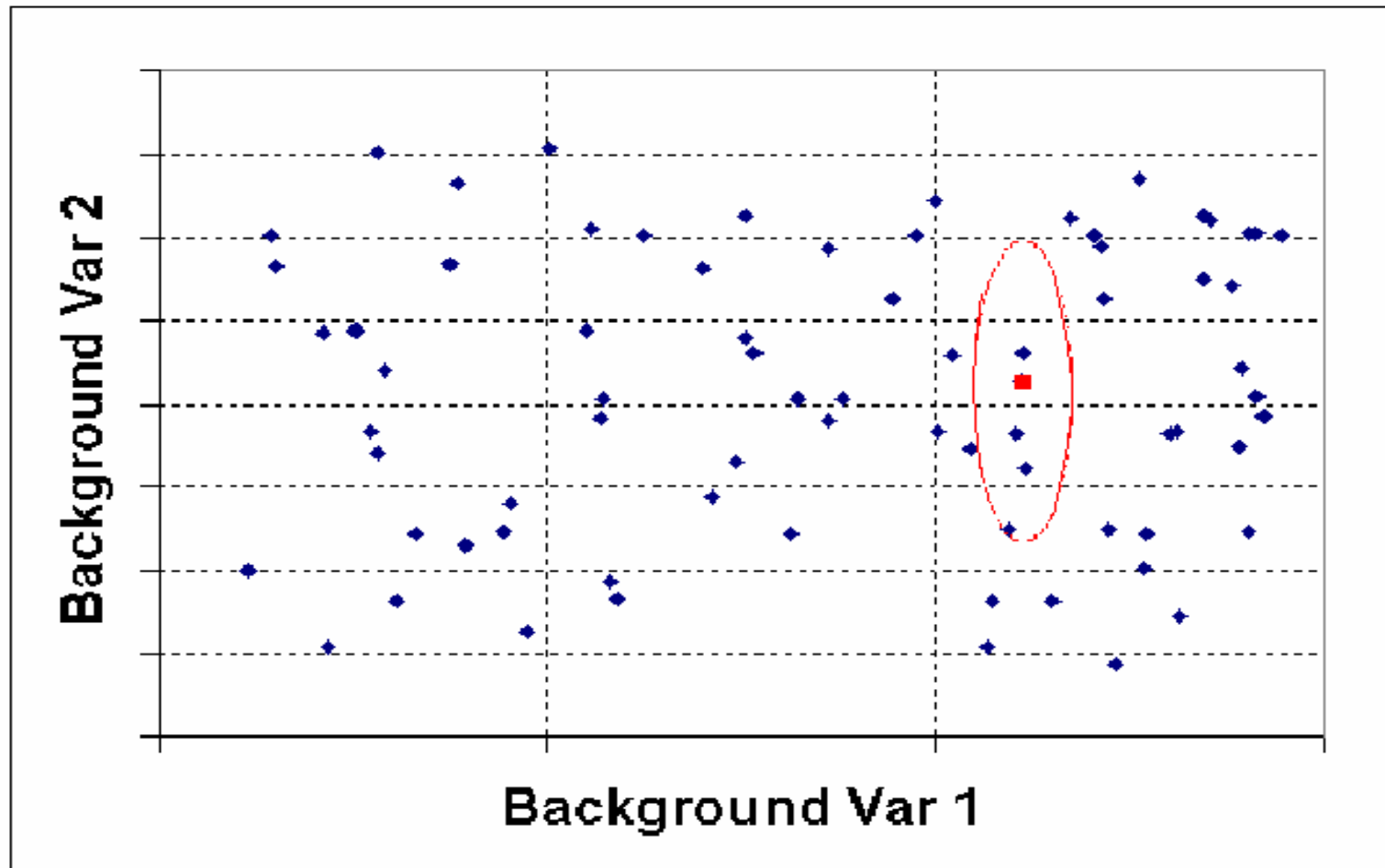
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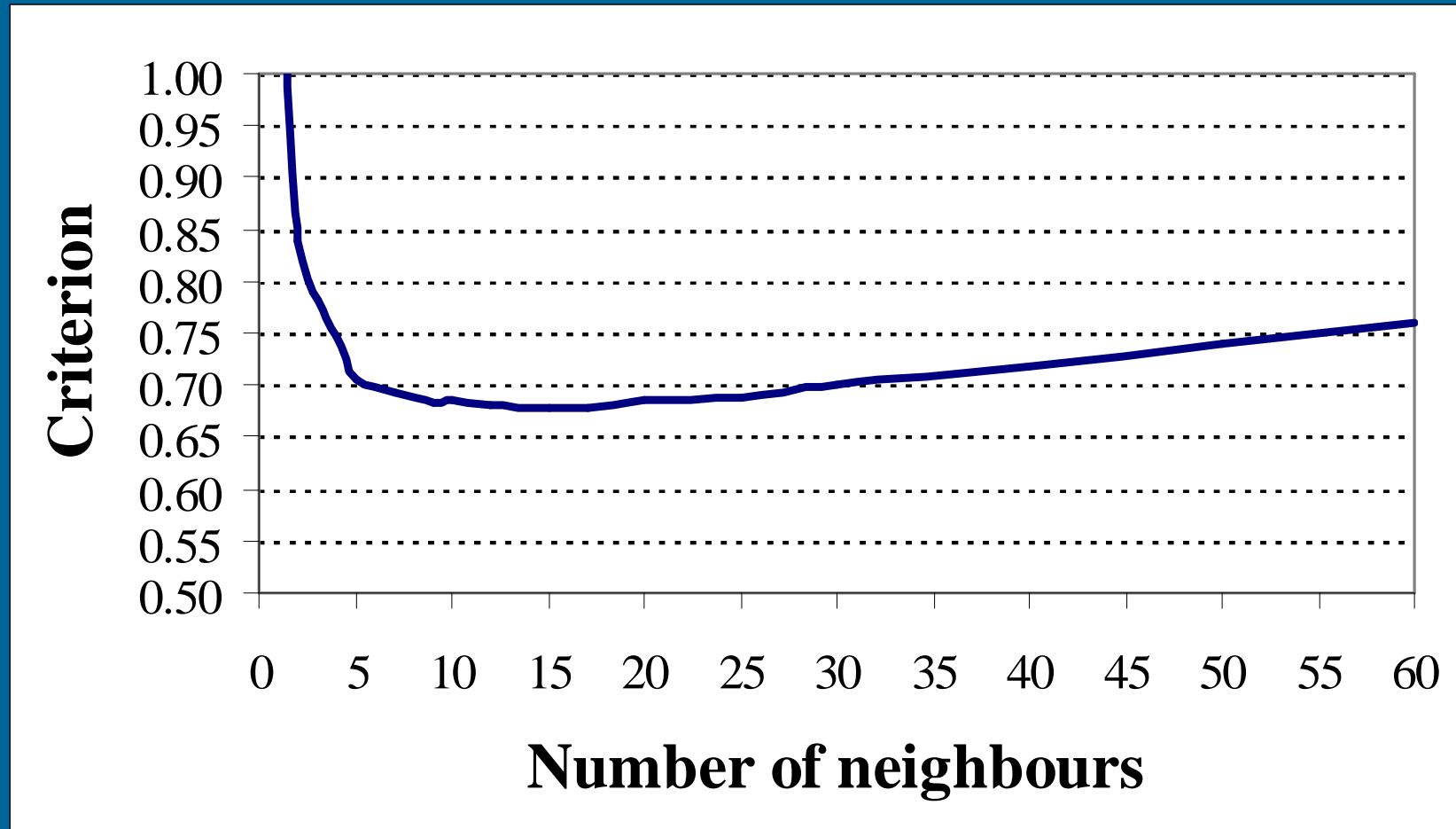
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