A Framework for Generating Data to Simulate Application Scoring

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Contents

- Artificial Data
  - Motivation
- Methodology
  - Data Generation
  - Label Application
- Population Drift
- Conclusion

Data Sources

- Benchmark studies
  - West (2000) 302 citations
  - Baesens et al. (2003) 190 citations
- Proposed method
- Concerns
  - Superior performance
  - Data

UCI Datasets

- UCI Machine Learning Repository
  - Allows comparison of techniques
  - Over-reliance
    - Overfitting (Drummond, 2006)
    - Data bias (Keogh & Kasetty, 2003)
      - *"the conscious or unconscious use of a particular set of testing data to confirm a desired finding."*
  - Ignore conditions
  - Not representative (Saitta & Neri, 1998)
    - Size and distribution
    - Characteristics

Real World Datasets

- Real Data
  - Gold standard
    - *"Close engagement with the data, owners of the data, and problems of the data is vital"*. (Hand, 2010)
  - Benefits of data sharing
  - Data sharing culture (Fischer & Zigmond, 2010)
  - Negative career impact
  - Limited resources
  - Property rights and Legal issues

Artificial Data

- Manipulation of various parameters used in the evaluation process
  - Design specific experiments,
  - Under certain conditions of interest in a relatively precise manner (Scott & Wilkins, 1999; Japkowicz and Shah, 2011).
- Advance some research proposed direction in tool development

Data Sources

- Irish mortgage market in 2007
- Sources
  - Demographic data from the Central Statistics Office (CSO), Ireland (2010)
  - Housing statistics published by the Department of Environment, Heritage and Local Government (Irish Gov.) (2008)
  - Central Bank of Ireland technical report (McCarthy and Quinn, 2010)
  - Moody's research report on why Irish borrowers default (2010)
  - Credit risk expert

Methodology

Generate Instances – Borrower Features

Feature	Value	Source
First-Time-Buyer	1,0	Irish Gov.
Age Group	18-25, 26-30, 31-35,...46-55	Irish Gov.
Income Group	30-40k, 40k-60k, 60k-80k,…	Irish Gov. / Moody's
Employment Sector	Health, Hospitality, Construction…	CSO
Occupation	Manager, Employee, Trade…	Irish Gov.
Household Compos.	1 Adult, No Children < 18;…	CSO
Education	Primary,…,3rd Level Higher Degree	CSO
Expenses-to-Income	Ratio	CSO

Generate Instances – Loan Features

Feature	Value	Source
Location	Dublin, Cork, Galway,…	Fitches
New Home	1,0	Irish Gov.
Loan Value	50k-100k, 100k-150k,…450k-900k	Irish Gov. / Moody's
LTV	45%,55%,60%,…,97.5%,100%	Irish Gov.
Loan Term	20, 25, 30, 35, 40	Irish Gov.
Loan Rate	Fixed, Variable, Tracker	Irish Gov.
House Value	Loan Value * LTV	Irish Gov. / Moody's
MRTI	Ratio	-

Generate Instances – Prior Probabilities

Location	Prior Probability
Dublin	32%
Cork	15%
Galway	7%
Limerick	4%
Waterford	3%
Other	39%

New Home	Prior Probability
1	46%
0	54%

Generate Instances – Conditional Prior Probabilities

FTB	Location	New Home	Conditional Prior Probability
1	Dublin	1	0.41
0	Dublin	1	0.59
1	Dublin	0	0.30
0	Dublin	0	0.70
1	Cork	1	0.38
…	…	…	…

Methodology

Calculate Risk Score - Feature Risk

- Assess risk of feature
  - assign one of 7 monotonic levels

Feature	Value	Feature Score
Location	Dublin	2
FTB	1	6
Age	26-30	5
Education	3rd Level Non-Degree	3
Employment Sector	Construction	6
…	…	…

Calculate Risk Score - Feature Risk

- Assess risk of feature
  - assign one of 7 monotonic levels

Feature	Value	Feature Score
Location	Dublin	2
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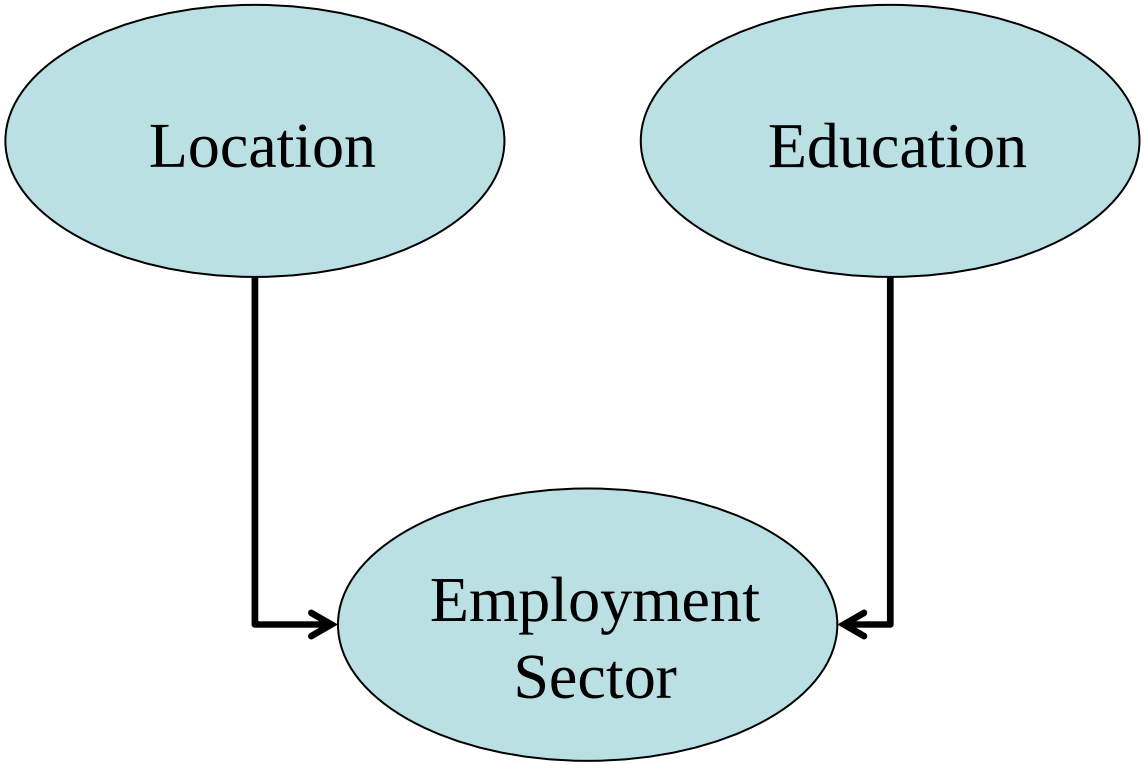
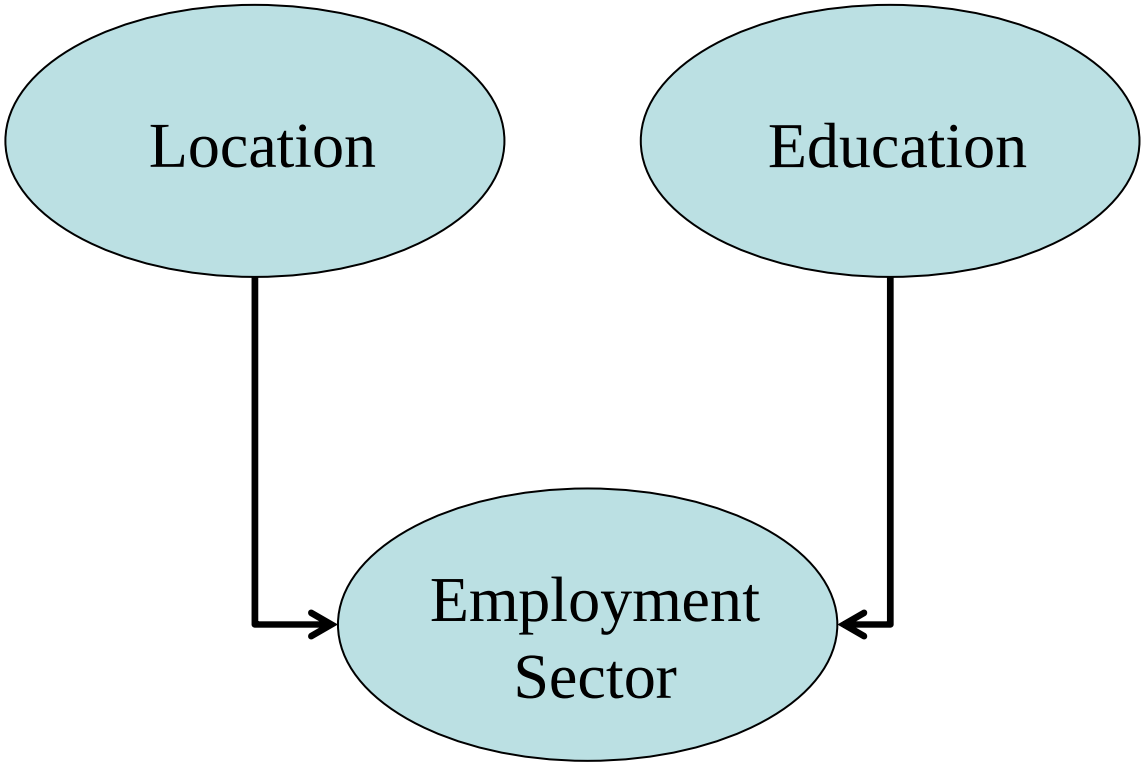
Calculate Risk Score - Interactions

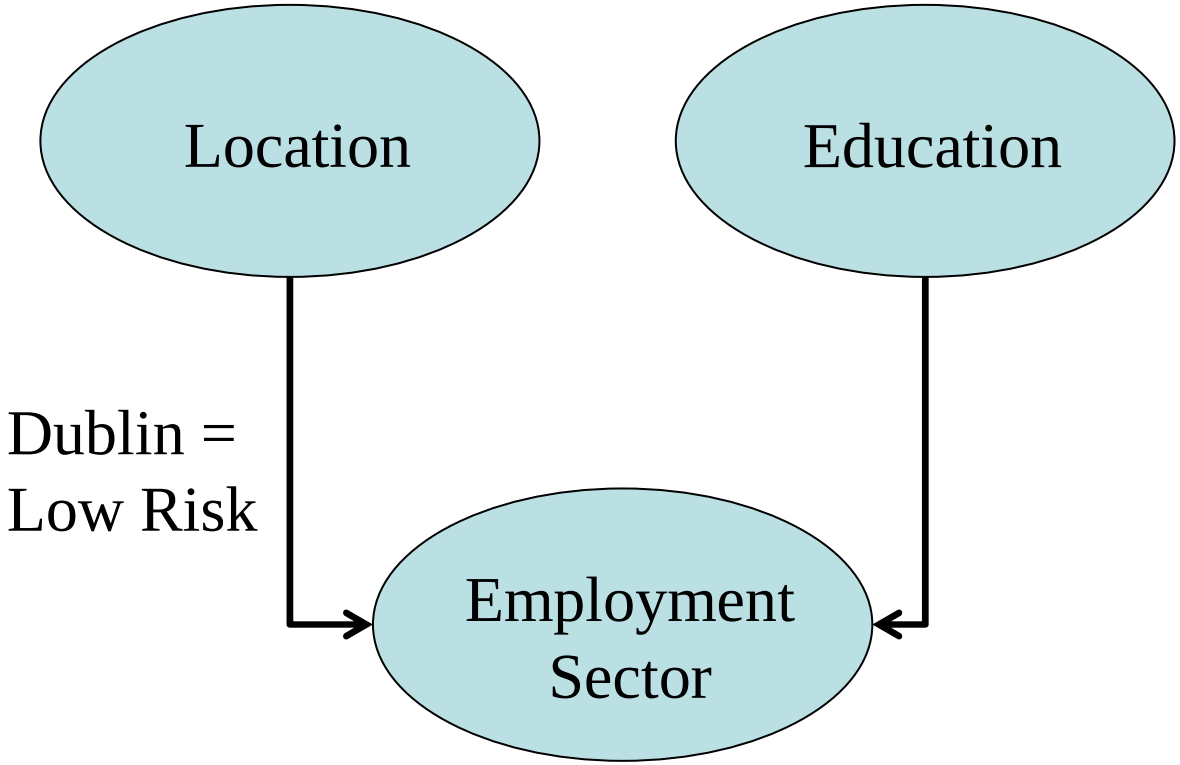


Calculate Risk Score - Interactions



Construction = High Risk
(5,6,7)

Calculate Risk Score - Interactions



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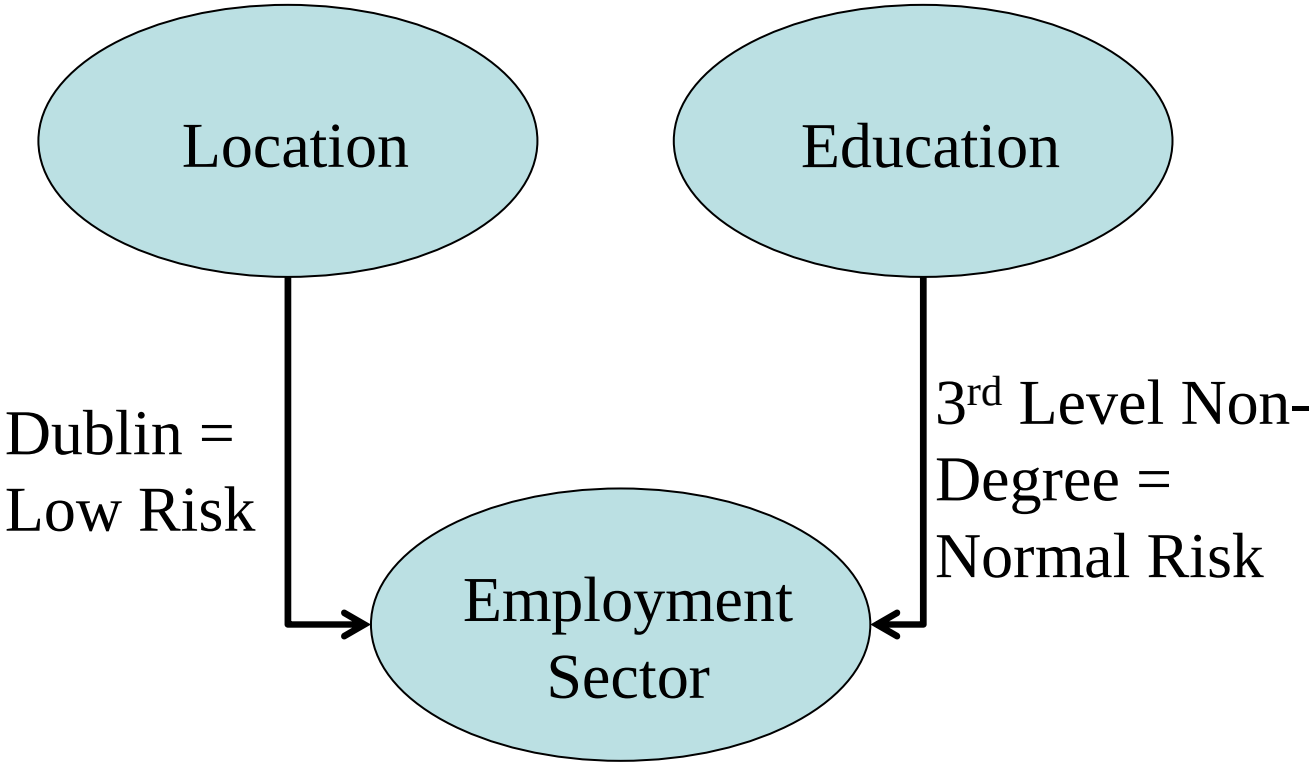

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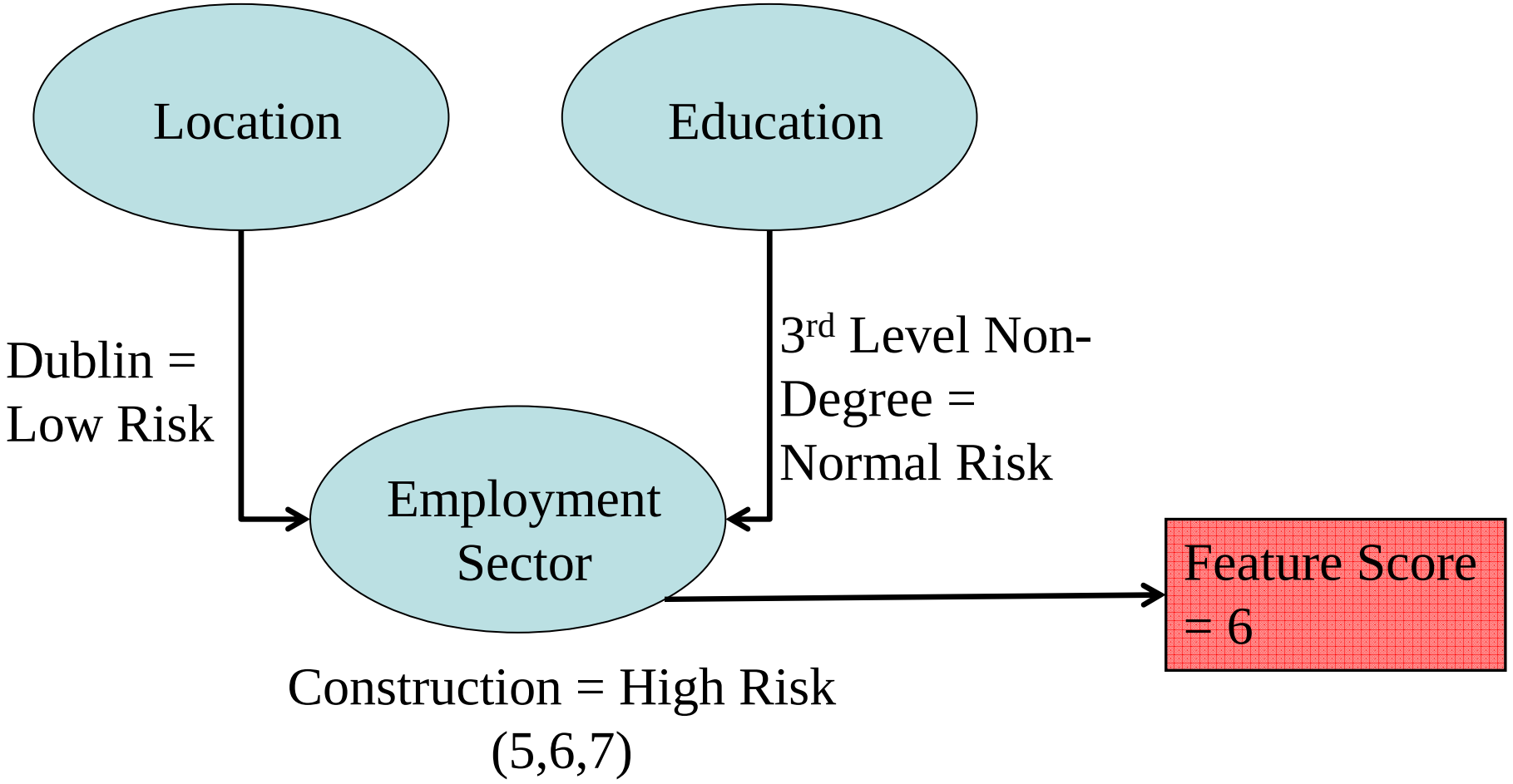
Calculate Risk Score - Interactions



Calculate Risk Score

-

- Accumulate Feature Scores
- Add noise

Feature	Value	Feature Score
Location	Dublin	3
FTB	1	6
Age	26-30	5
Education	3rd Level Non-Degree	3
Employment Sector	Construction	6
…	…	…
Risk Score	-	**76**

Methodology

Apply Labels

Risk Score	Label
90.15	Bad
90.00	Bad
89.70	Bad
88.60	Bad
87.00	Bad
86.50	Good
86.40	Good
86.5	Good
86.5	Good
…	Good
22.50	Good
21.70	Good

- Default rate, e.g. 2.5%
- Swap Good -> Bad

Apply Labels

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Comparison

Dataset	TNR	TPR	Average Class Accuracy
Australia	0.876	0.876	0.876
German	0.717	0.720	0.719
Artificial Dataset	0.808	0.926	0.867

Population Drift

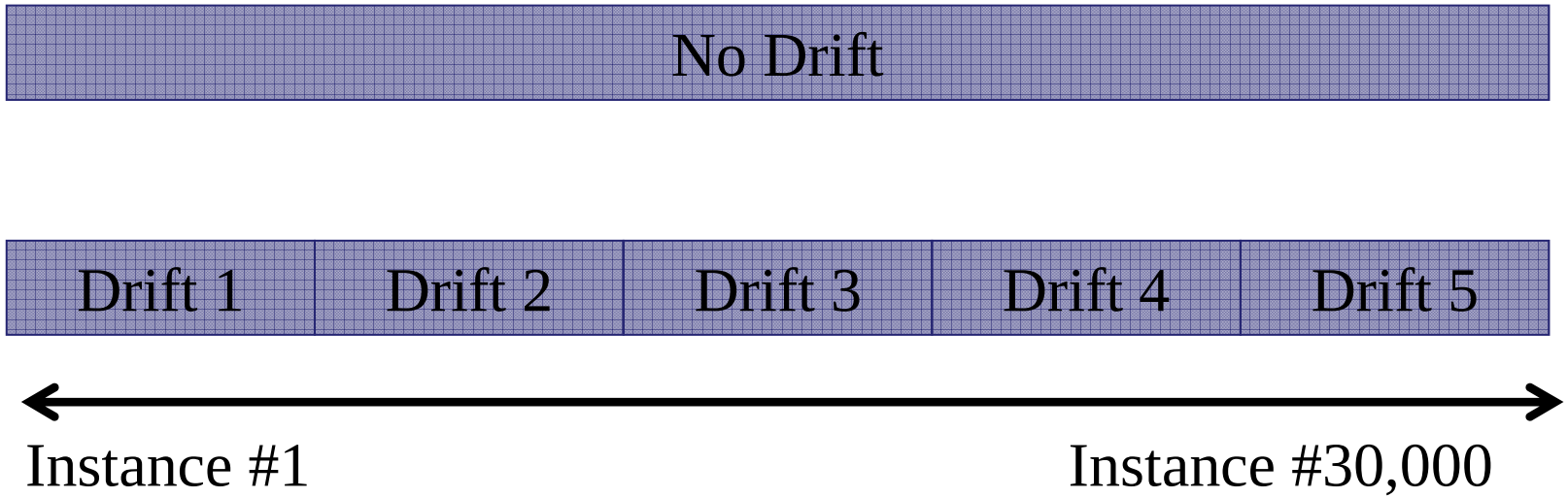
- Demographic change
- Marketing campaigns (own/competitor)
- Errors in coding, data capture, human input
- Adaptive customer behaviour
- Variability of the economic environment
- Performance window

Population Drift

- Training data
  - 2000 instances
  - Remove unrealistic: 1912 instances
  - Default rate 2.5% (48 instances)
  - Noise with 0.5 standard deviation
  - Record cut-off risk score
  - Swap rate 0.33% (6 instances)
  - 70:30

Population Drift

- Test data



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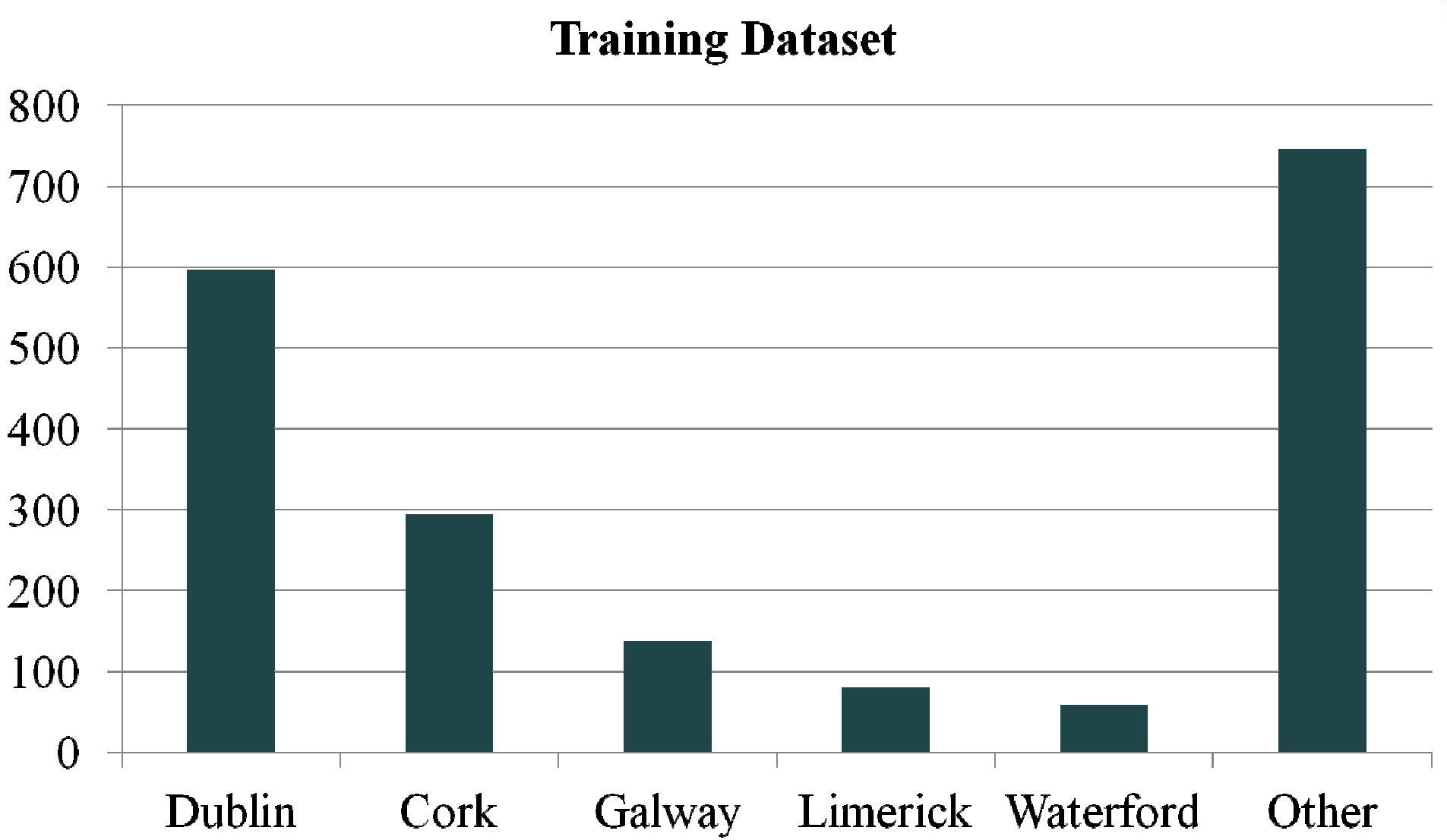

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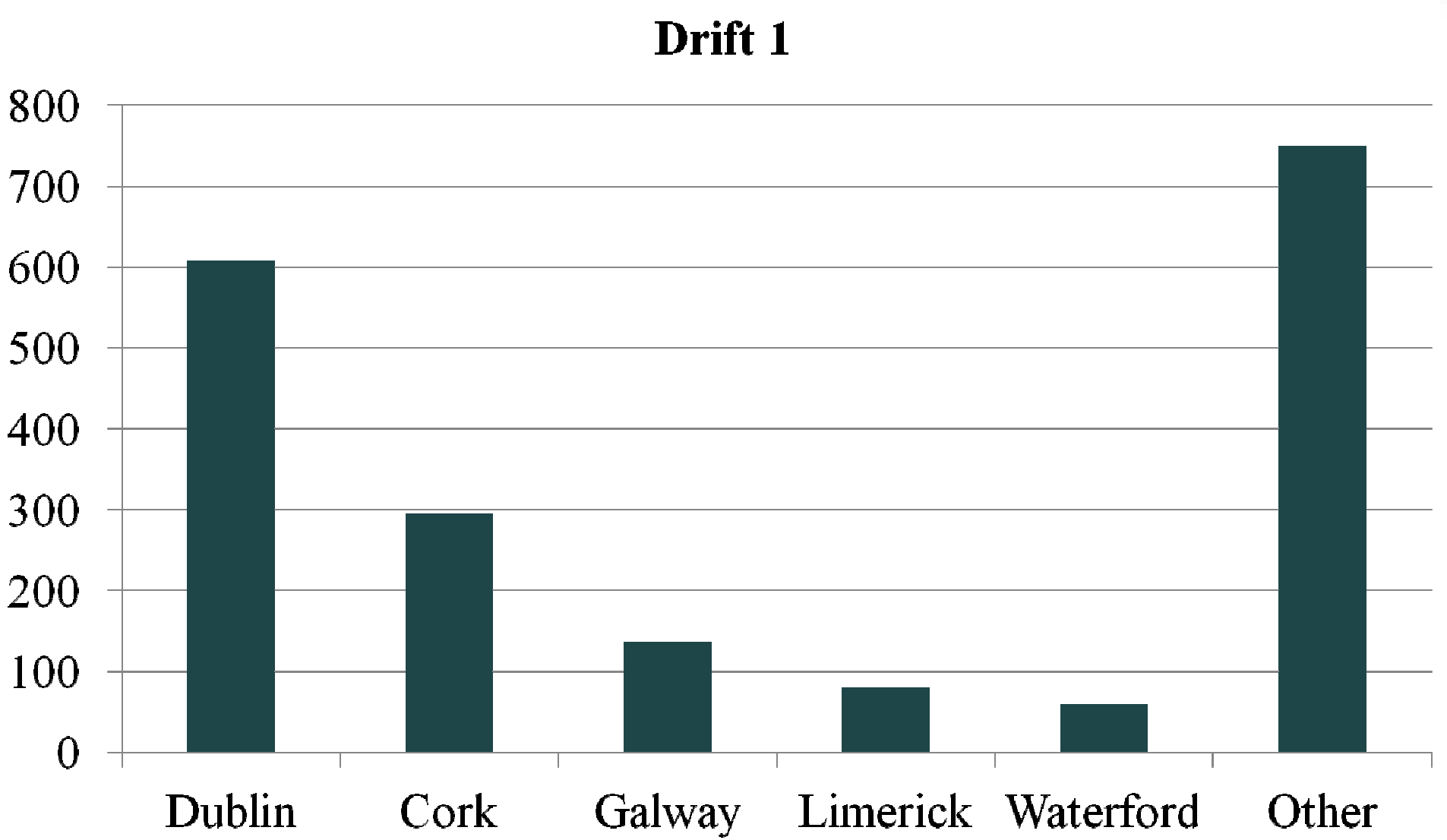

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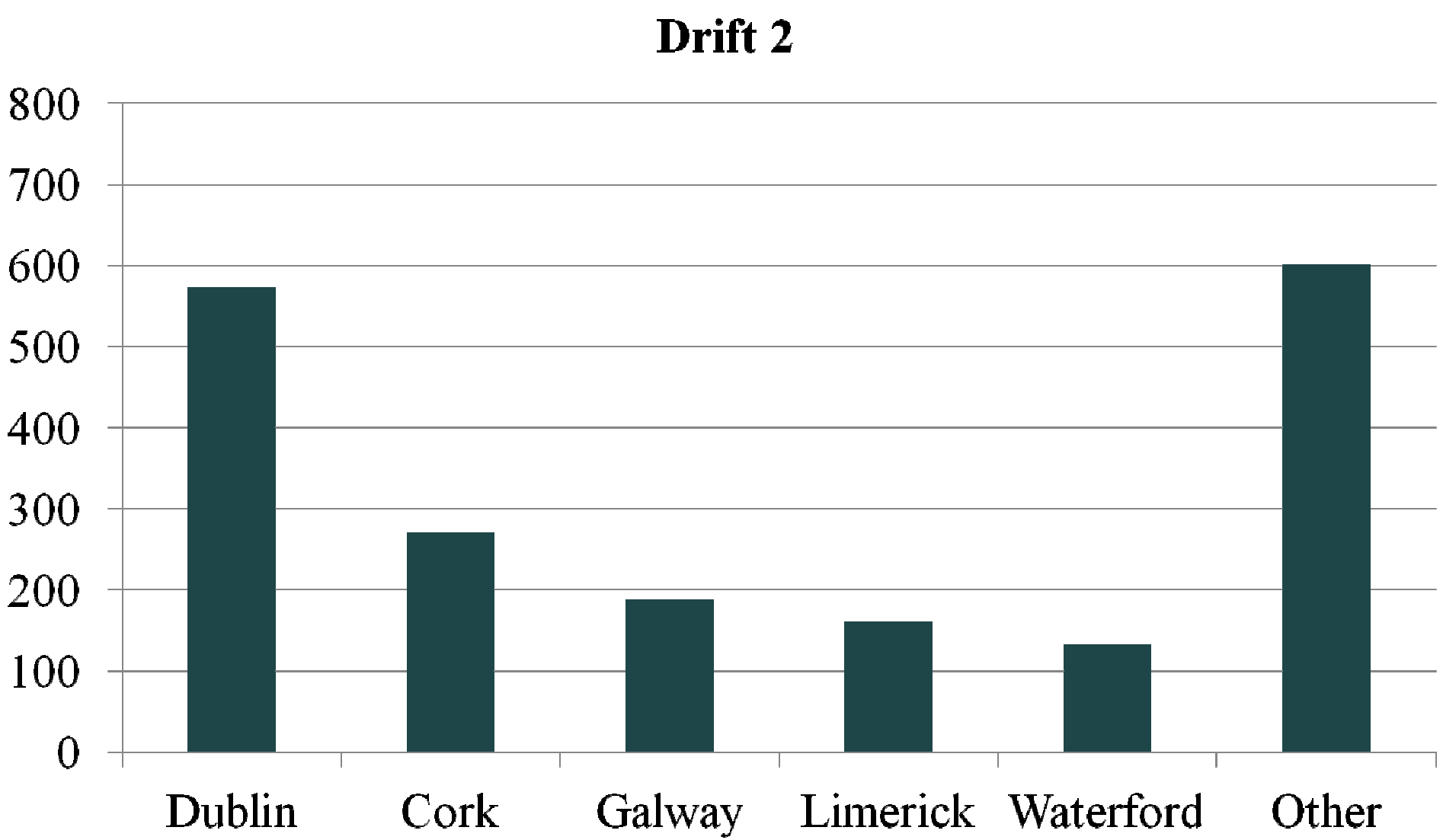

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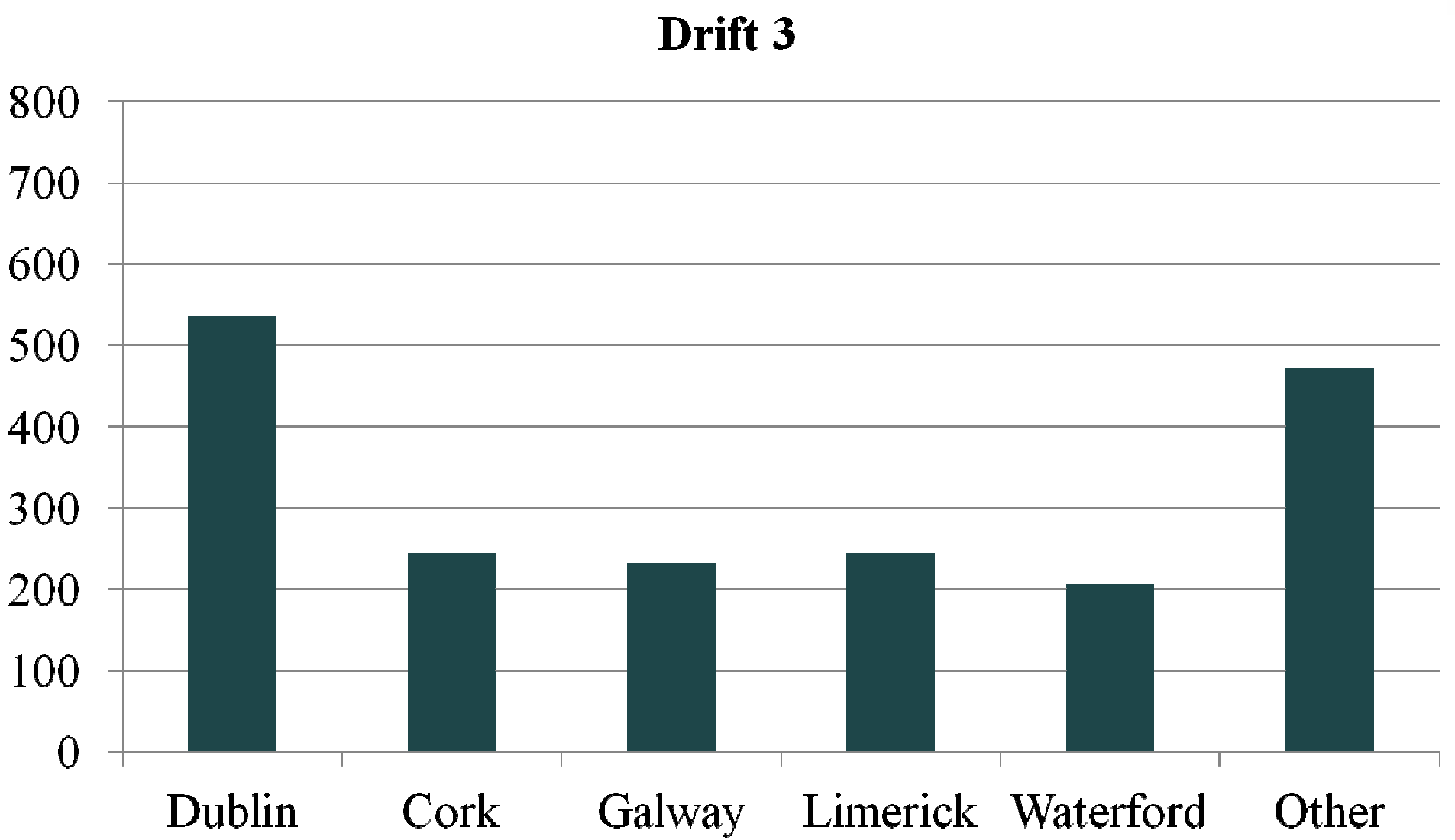

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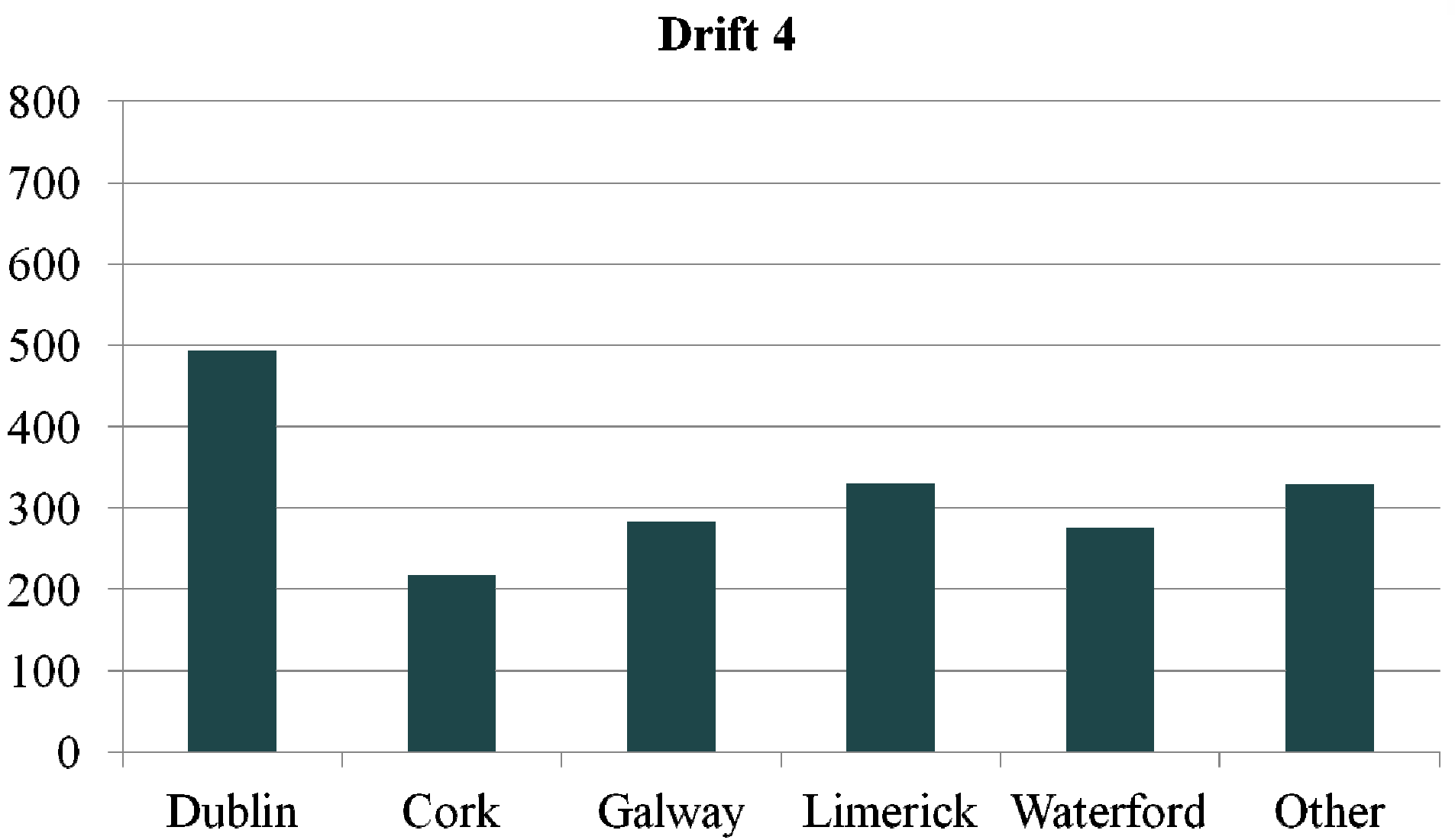

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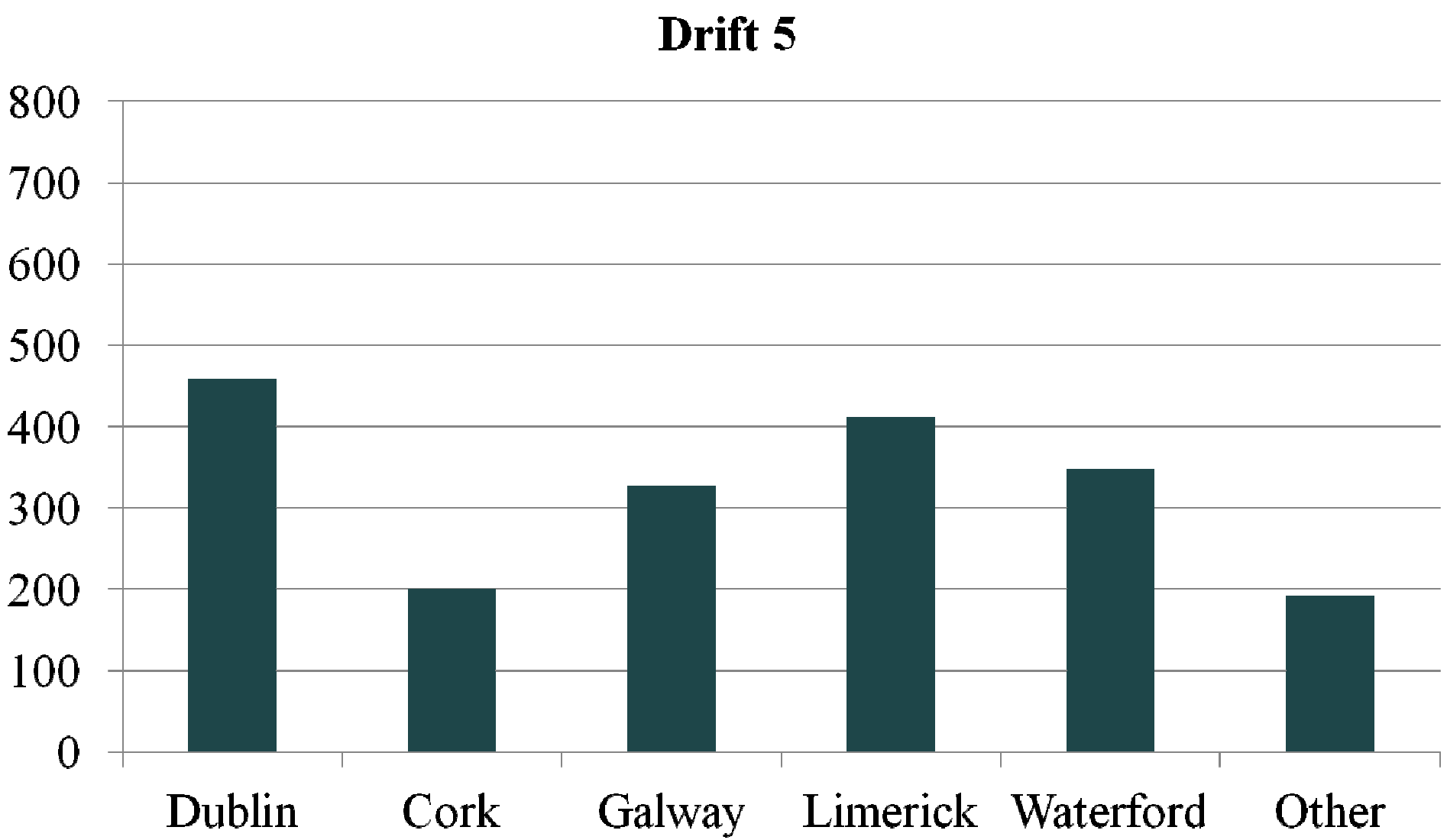

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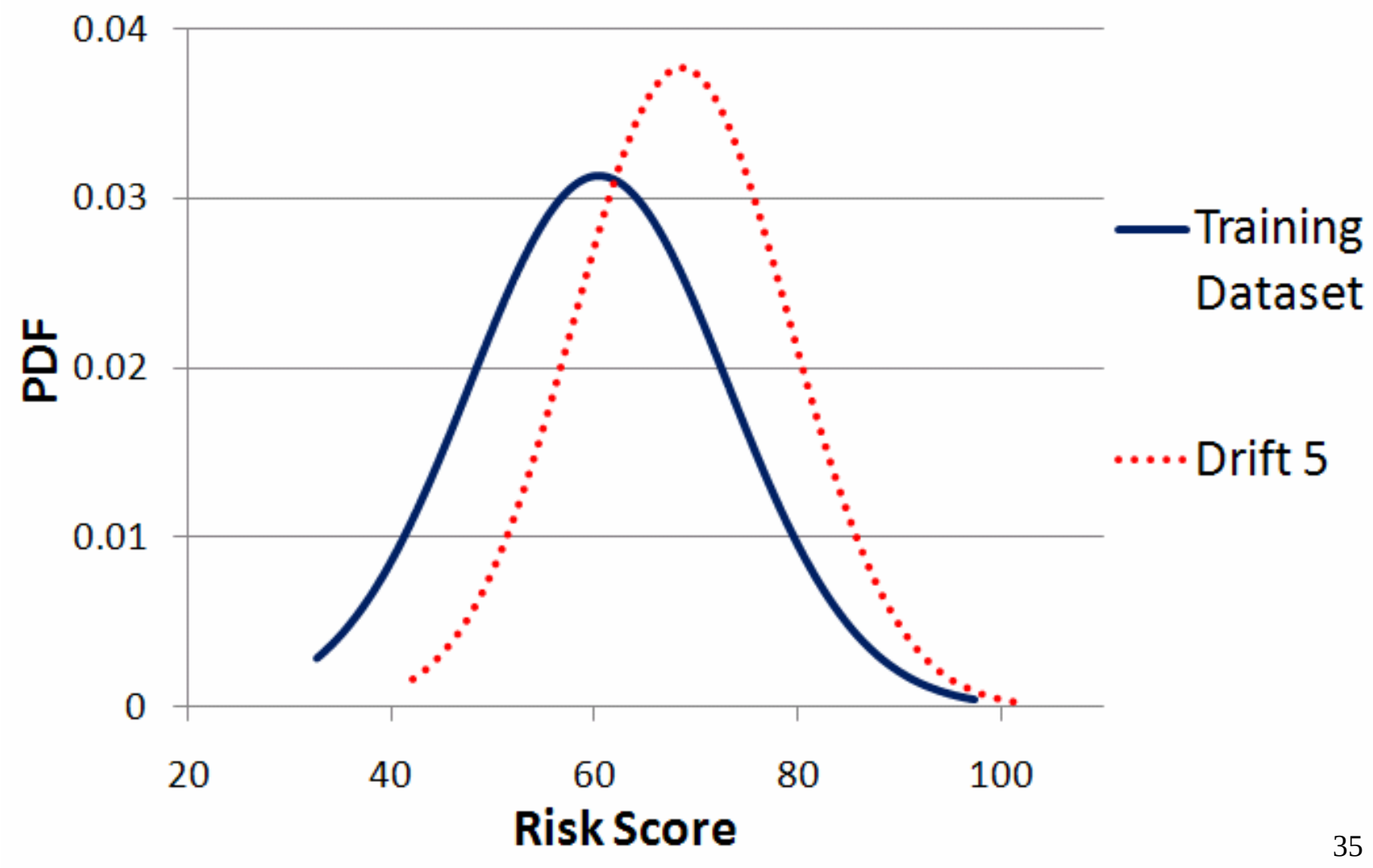

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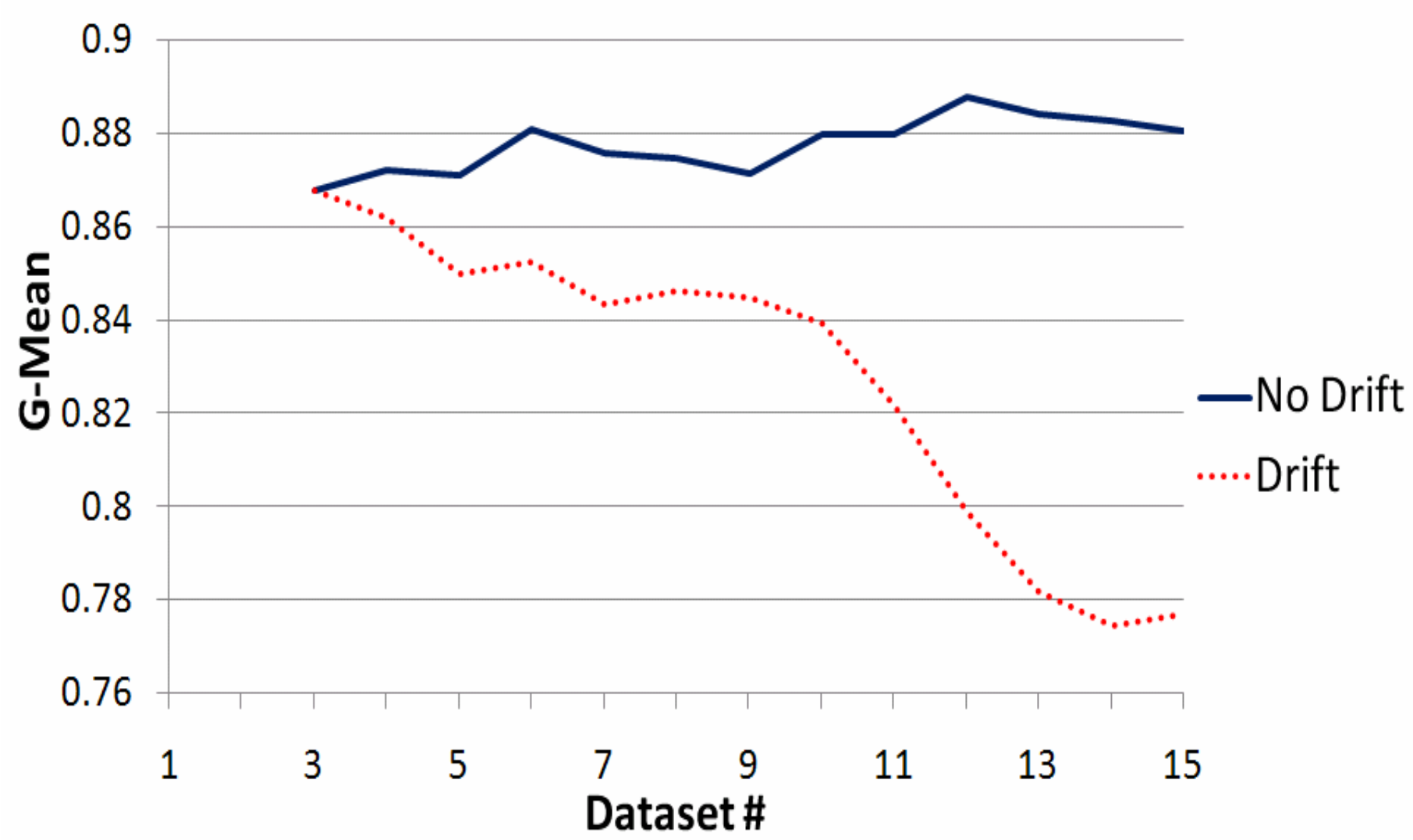

Conclusion

- Impediments to real world datasets
- UCI
- Artificial data
  - Generate
  - Label
  - Limitations
  - Direction
- Population drift
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