The effect of Tilburg gold on your health

Presentation Zorginstituut: Combining causal inference and machine learning in practice

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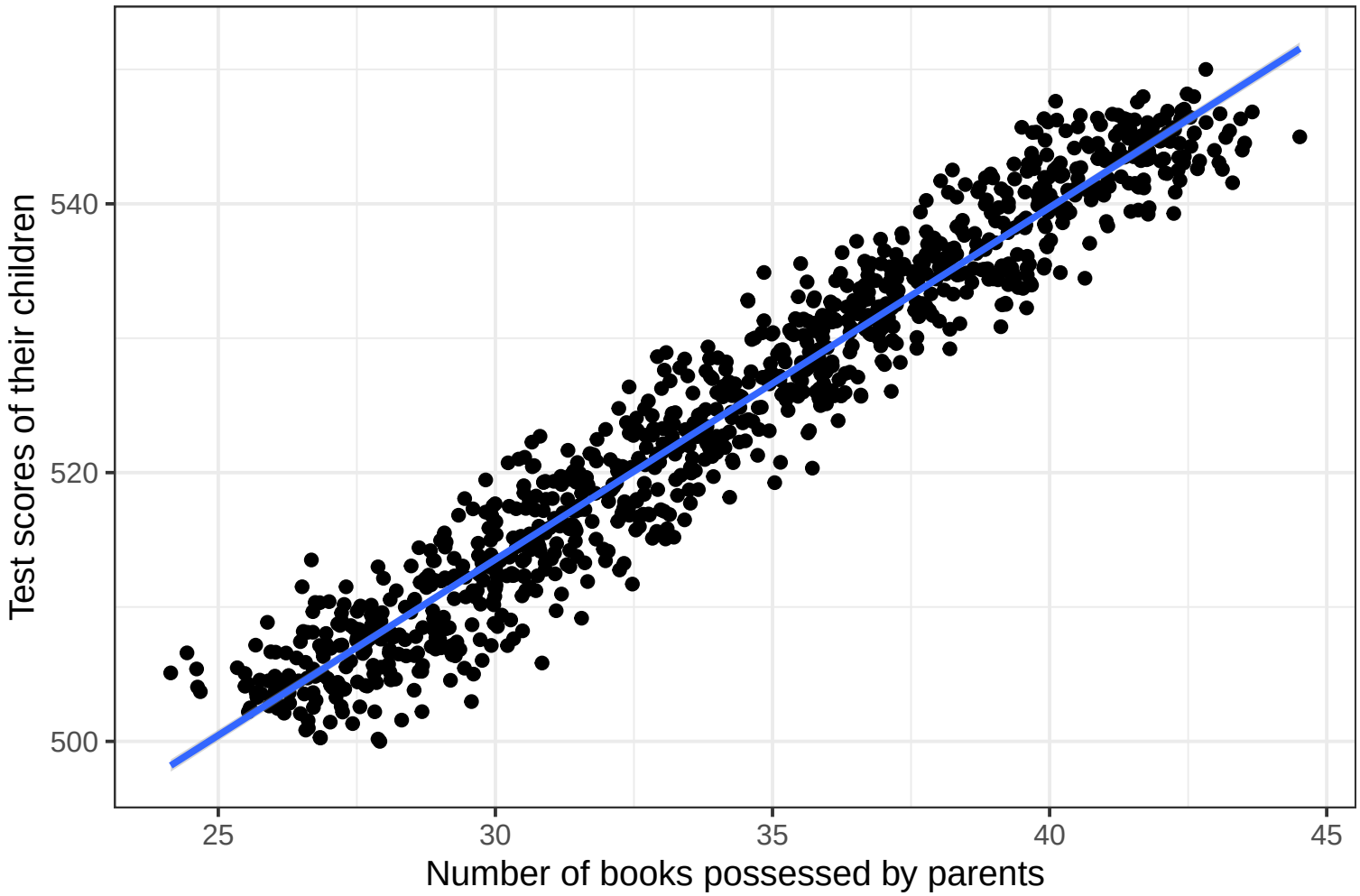
Introduction

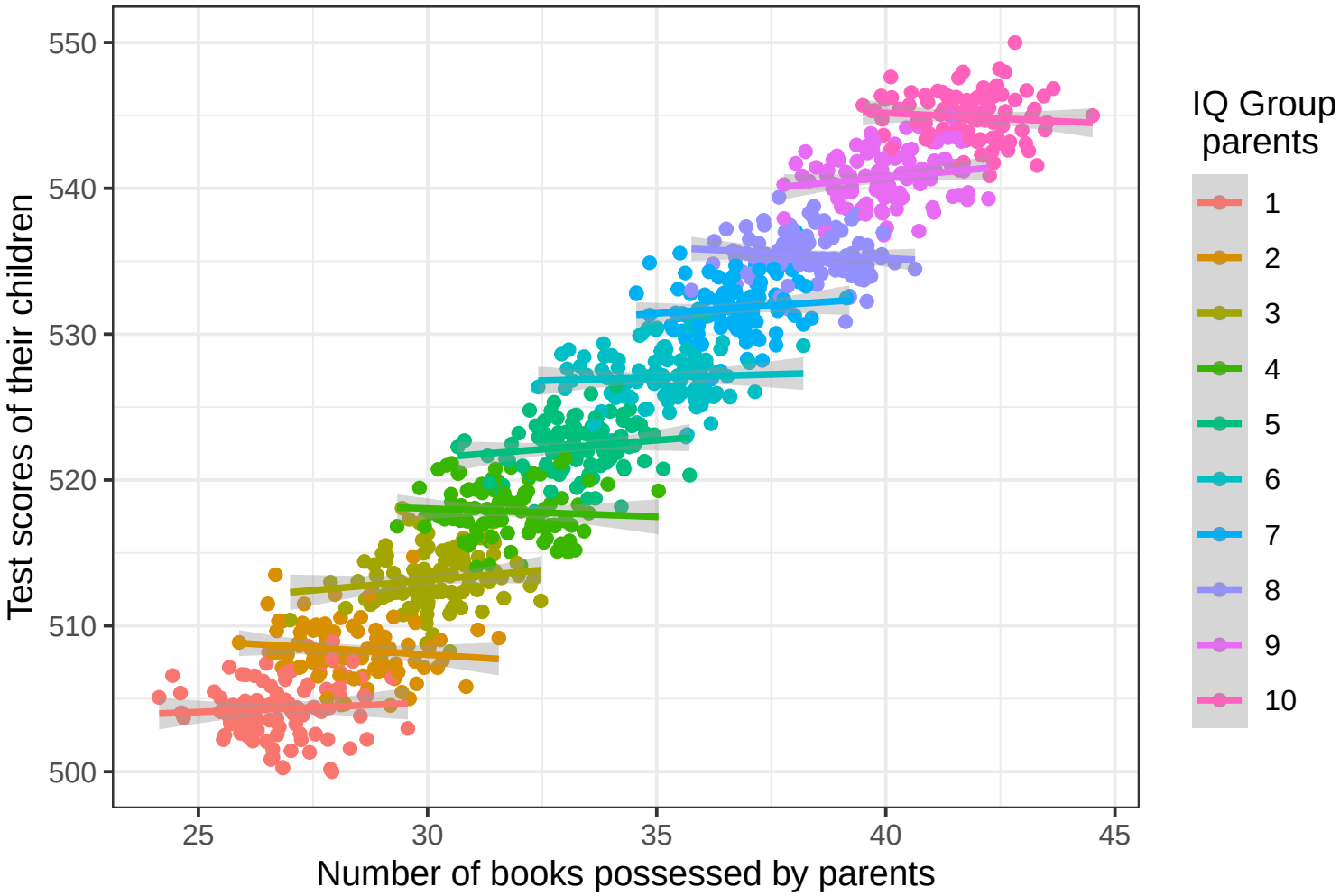
Example of a dataset dataset

X_1	X_2	X_3	X_i	I	Y0	Y1
Male	9	14	1	0	67	NA
Female	60	36	0	1	NA	113
Female	7	2	1	1	NA	54
...	...	...	...	...	...	...

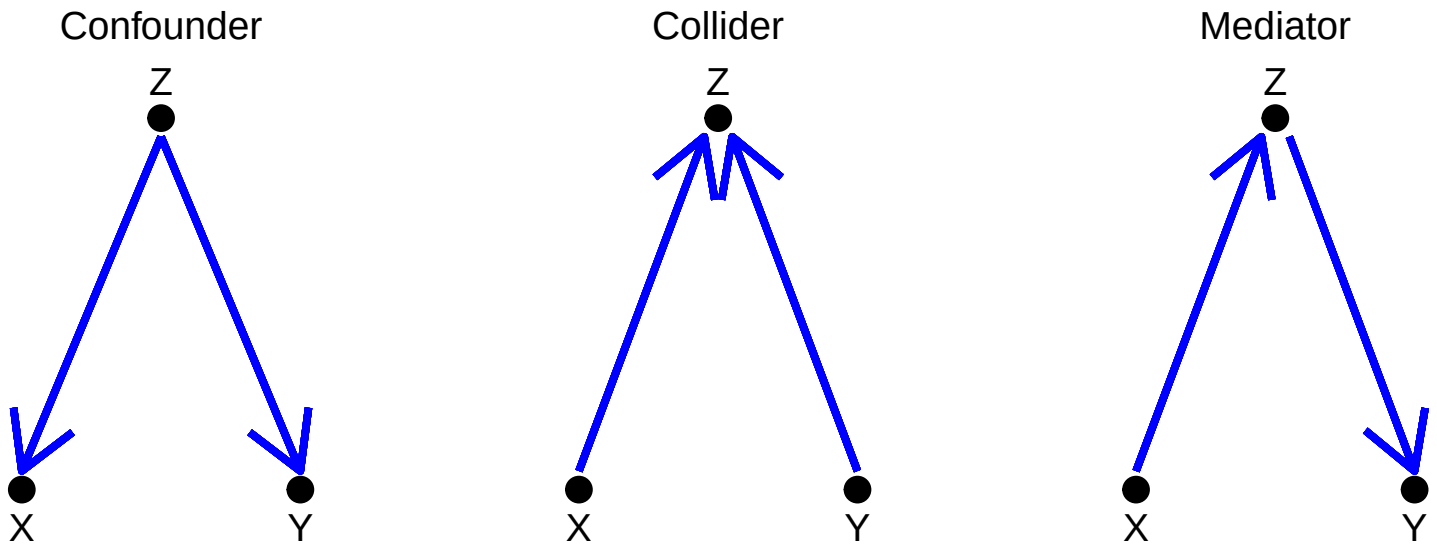
Prediction versus understanding



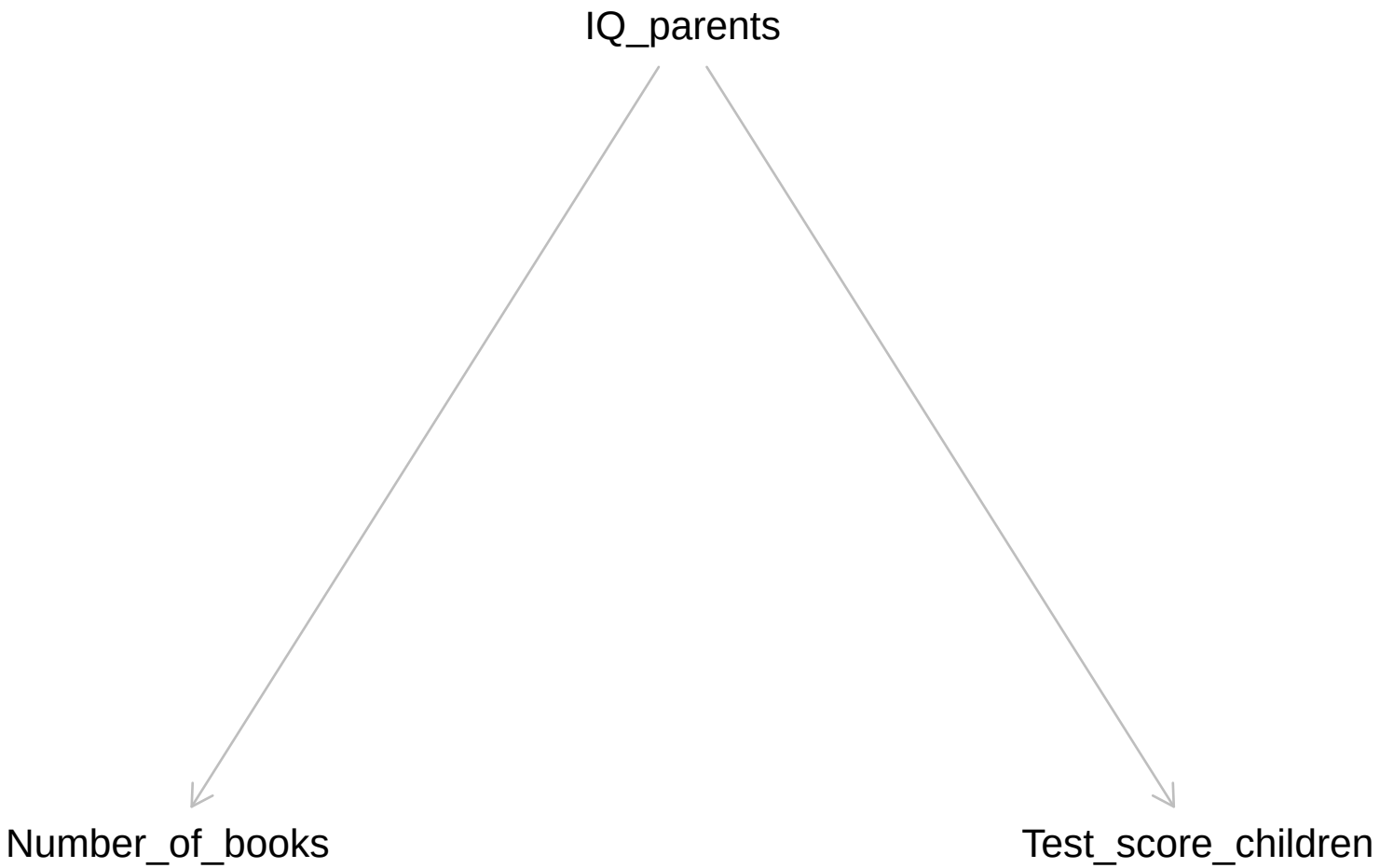
Voorspellen versus begrijpen



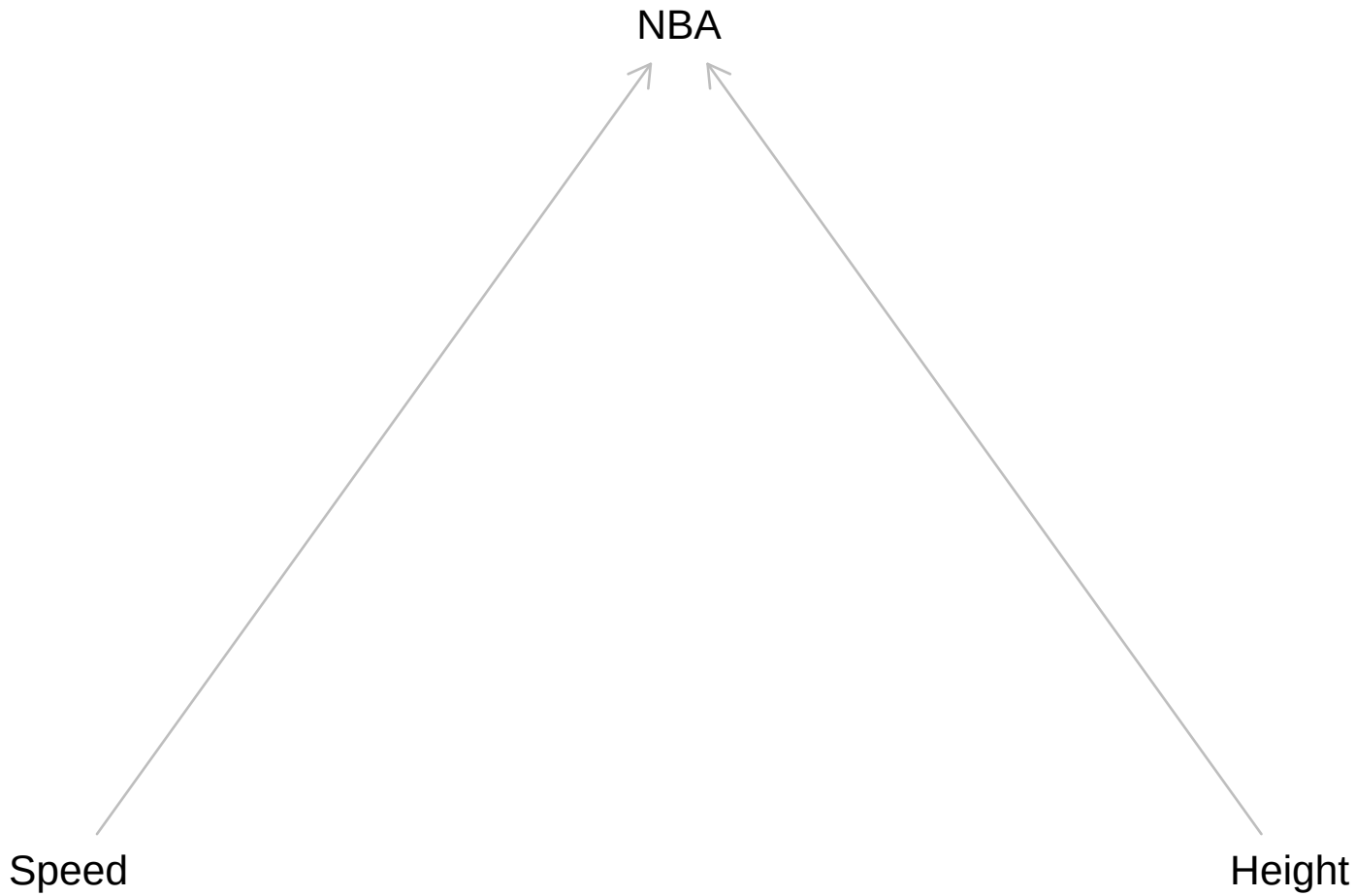
DAG building blocks



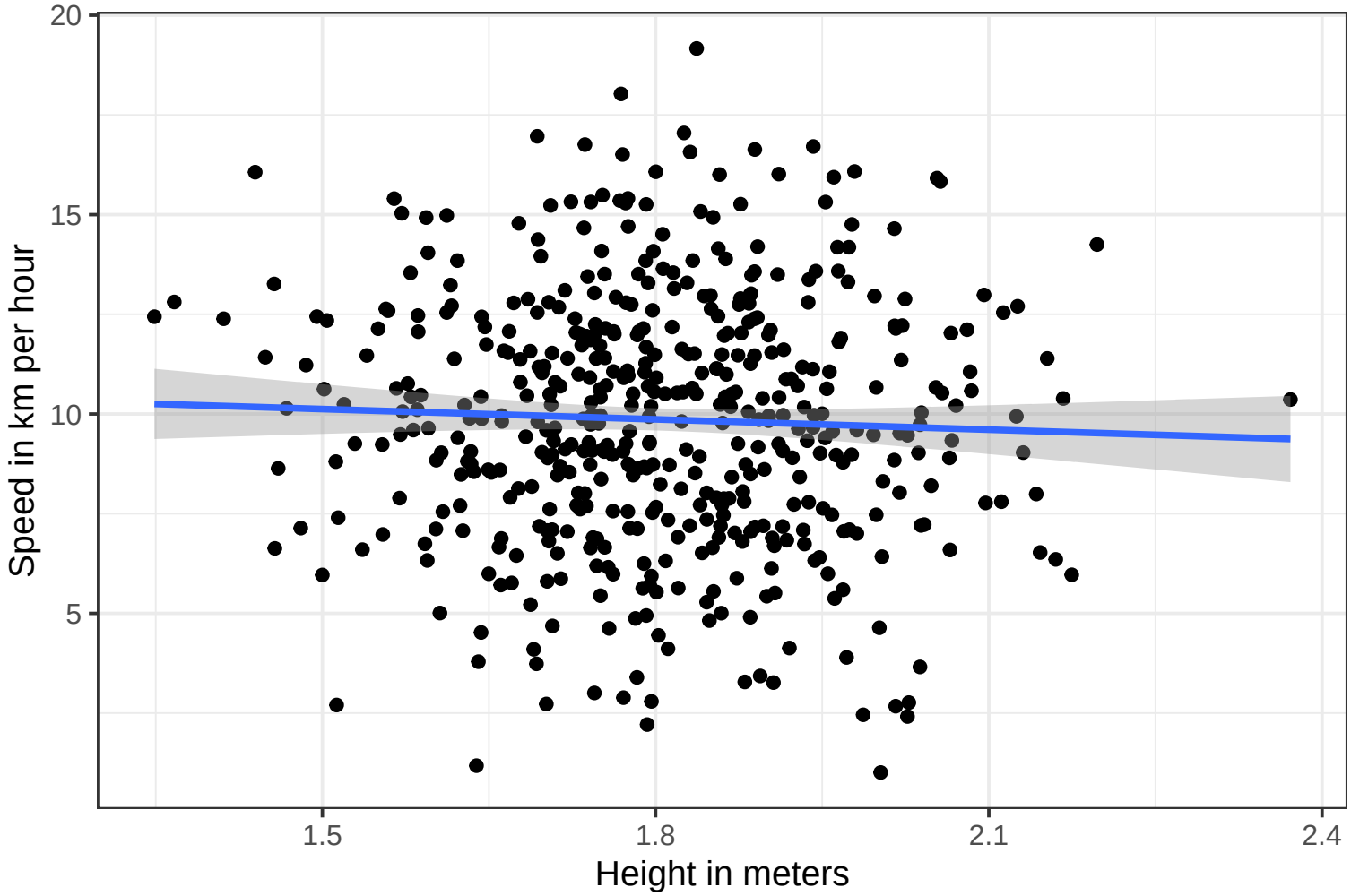
Confounder



Collider



Does height causes speed?



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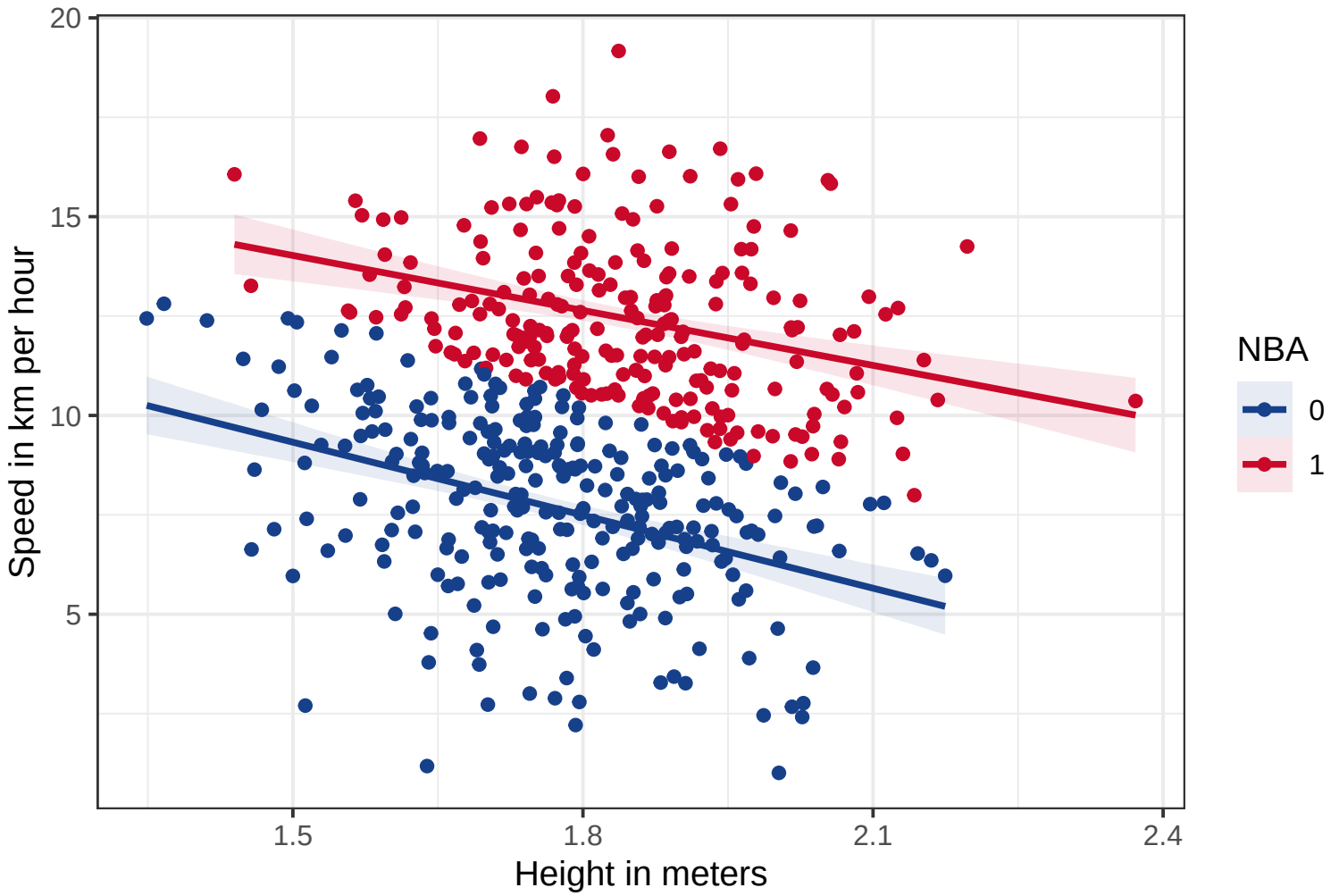
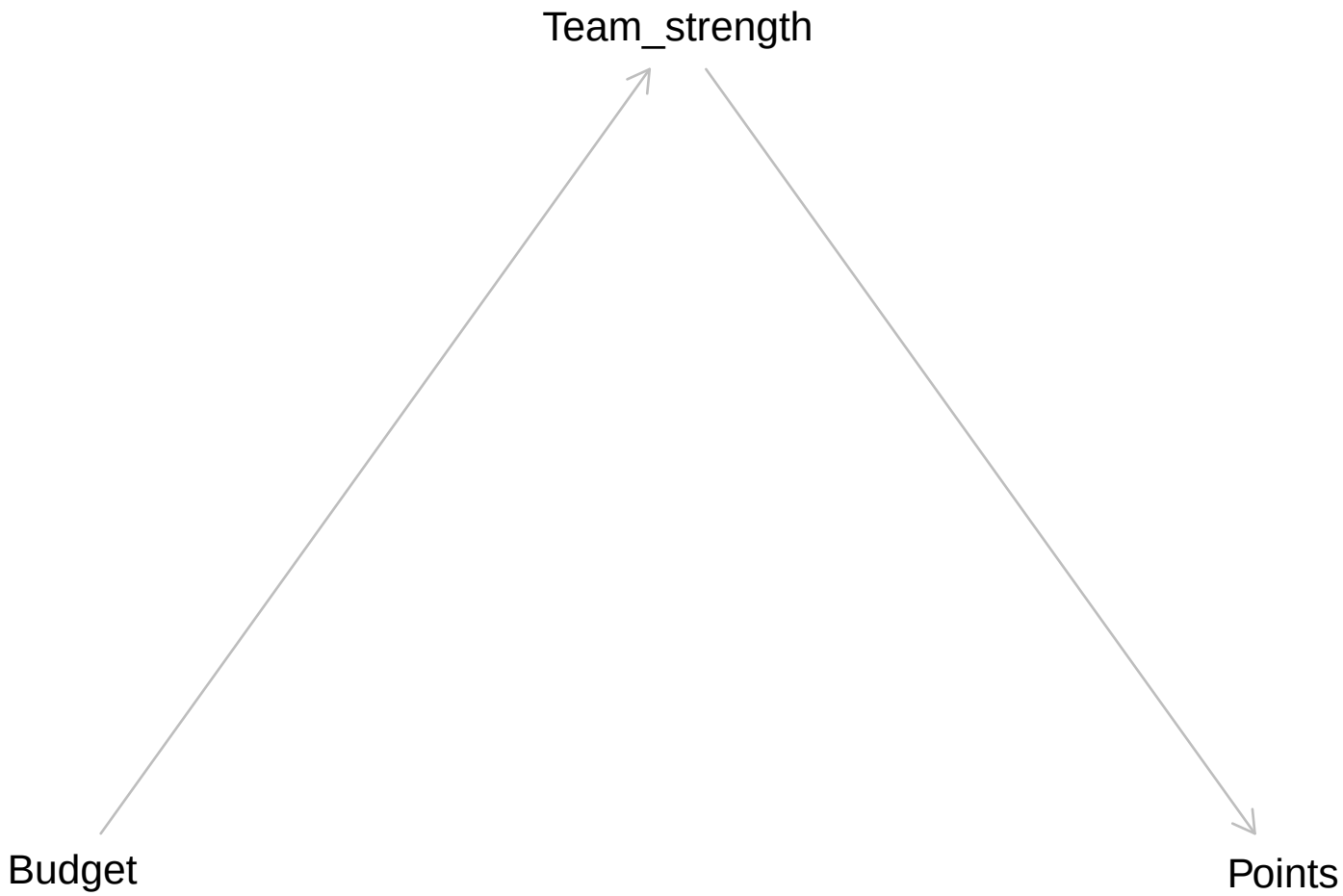
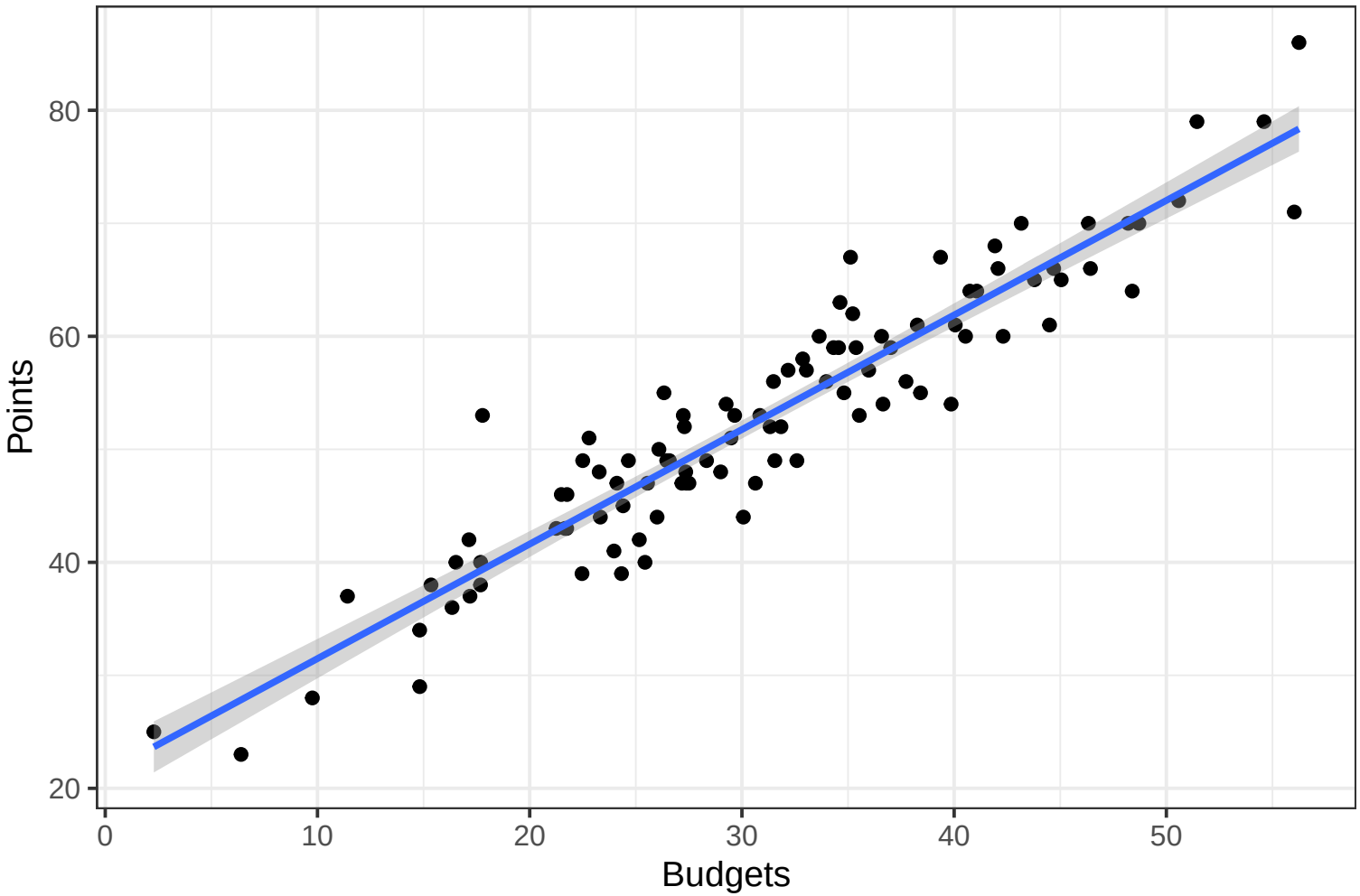
Does height causes speed?



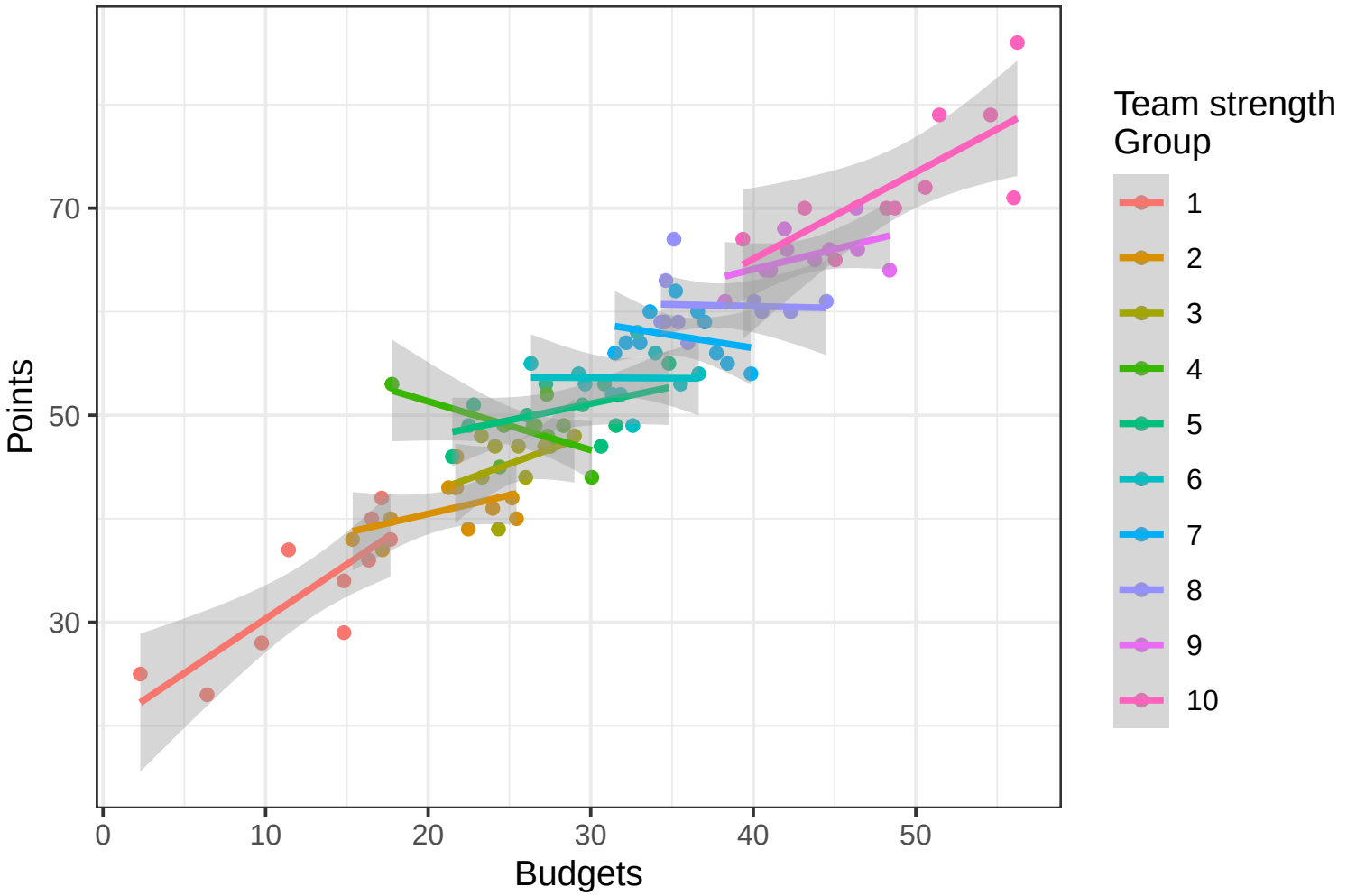
Mediator



Budgets and points



Budgets and Points



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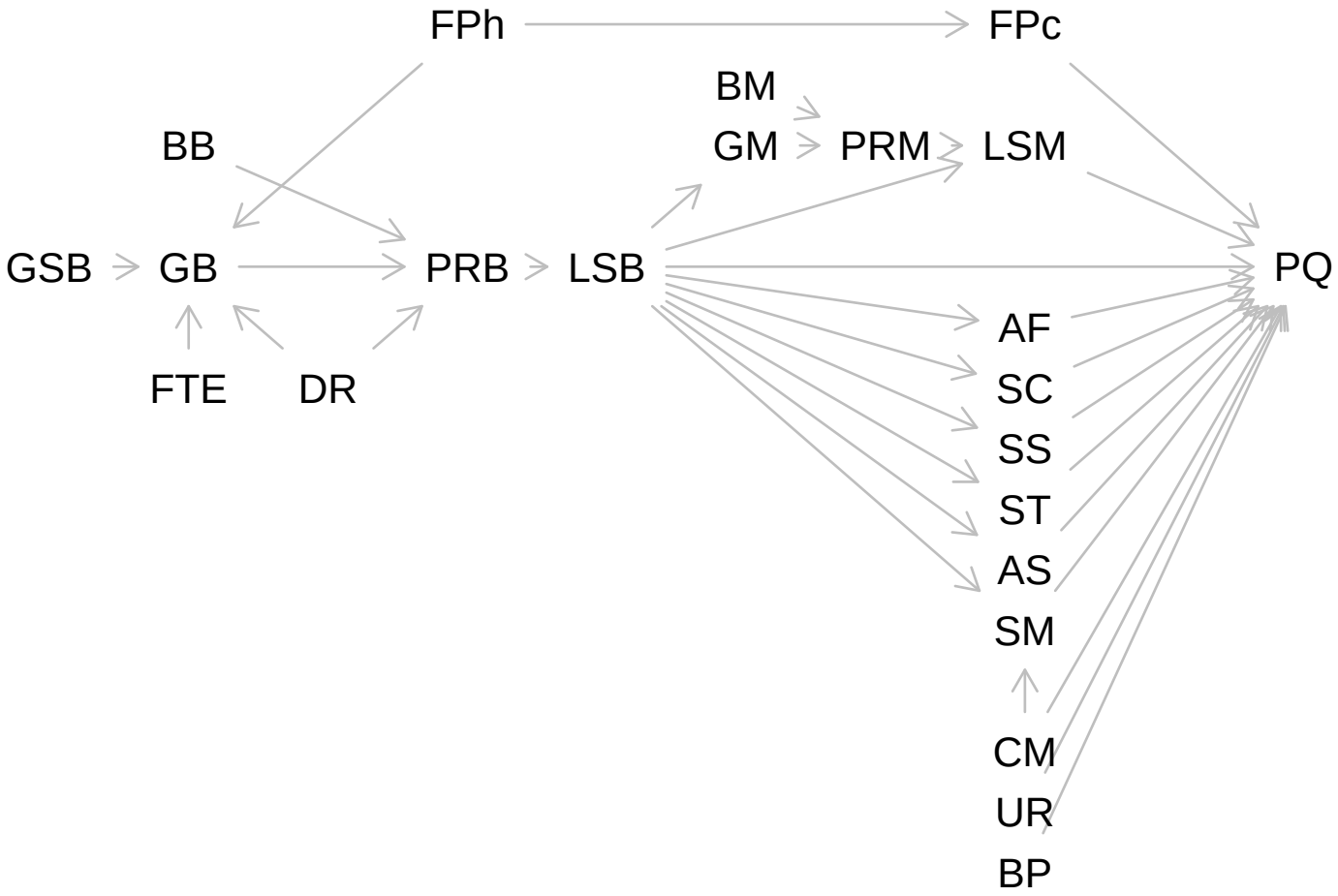
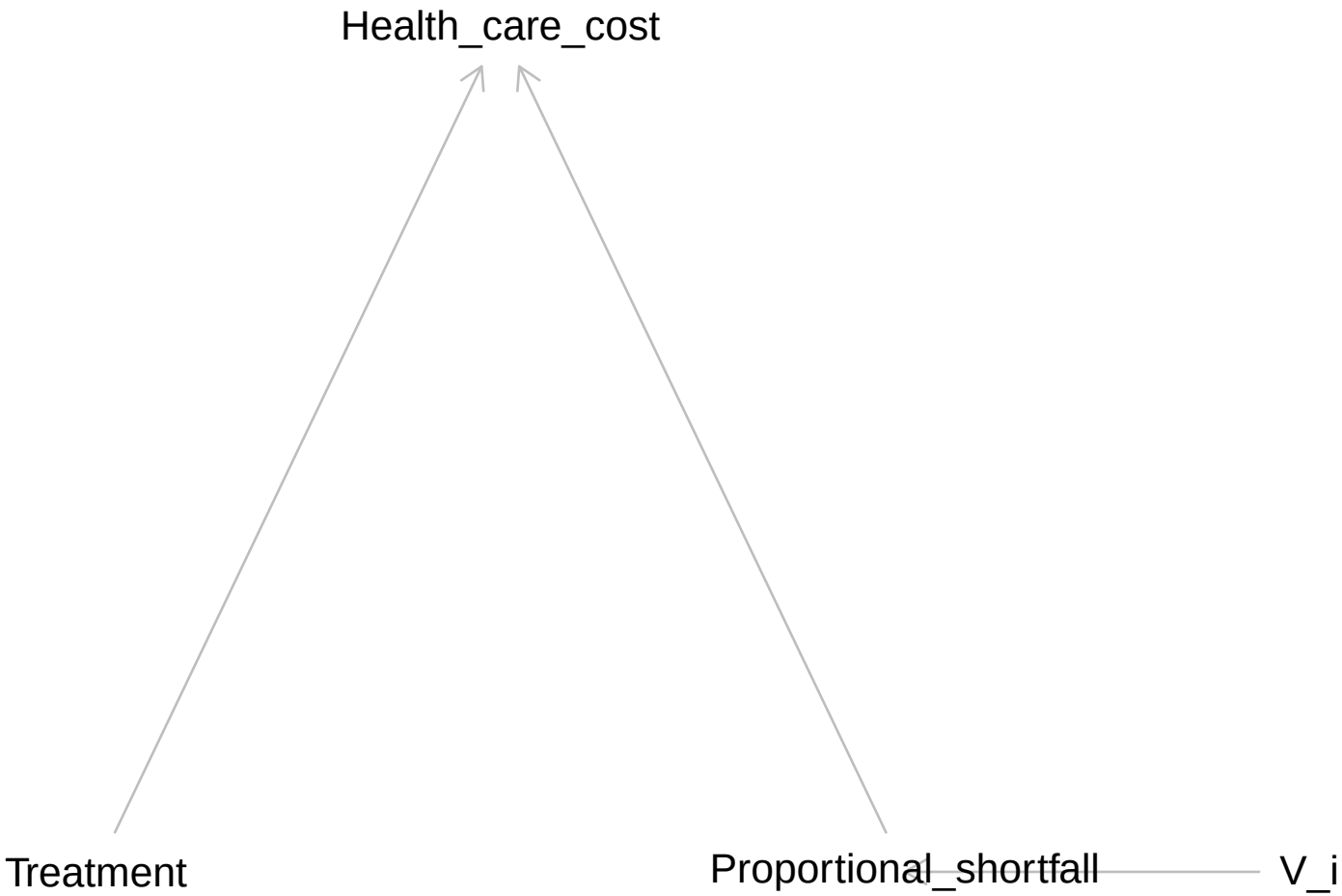
Example of a more complex DAG



Machine learning and causality



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Approach

The variable *Proportional_Shortfall* is based on:

$$Proportional\_Shortfall = abs(scale(V1^3 + 2 * V2 + 3 * V3^2 + 4 * V4 + 5 * V5 + 6 * V6 * V7)) + \epsilon$$

1. Fit Random Forest model on the data 2. Determine the average treatment effect with generalized random forests (grf)

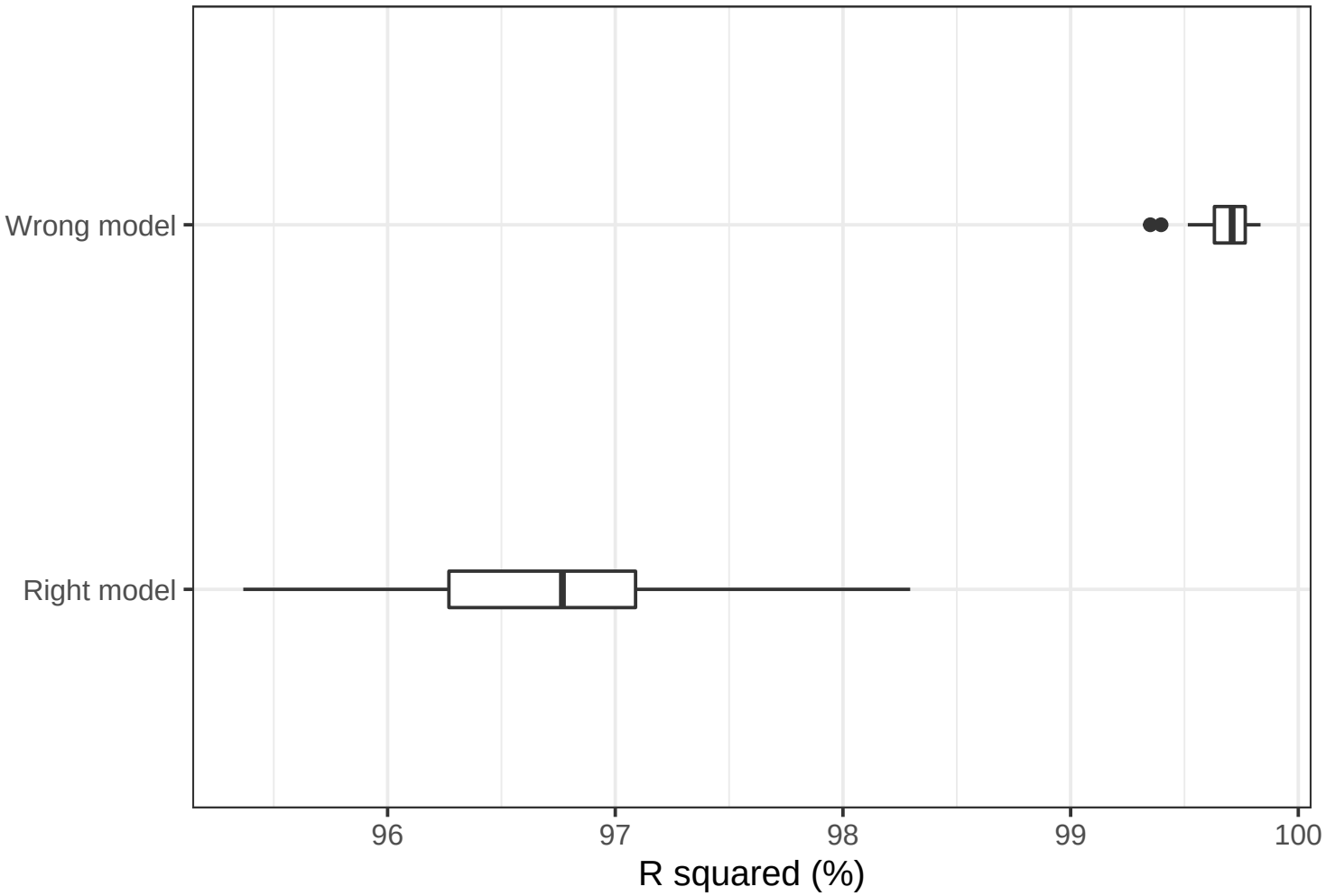
We will fit 2 models for each of these steps:

a. An analysis with all variables ("the wrong model") b. An analysis with all variables, except the collider *Health_care_cost* ("the right model")

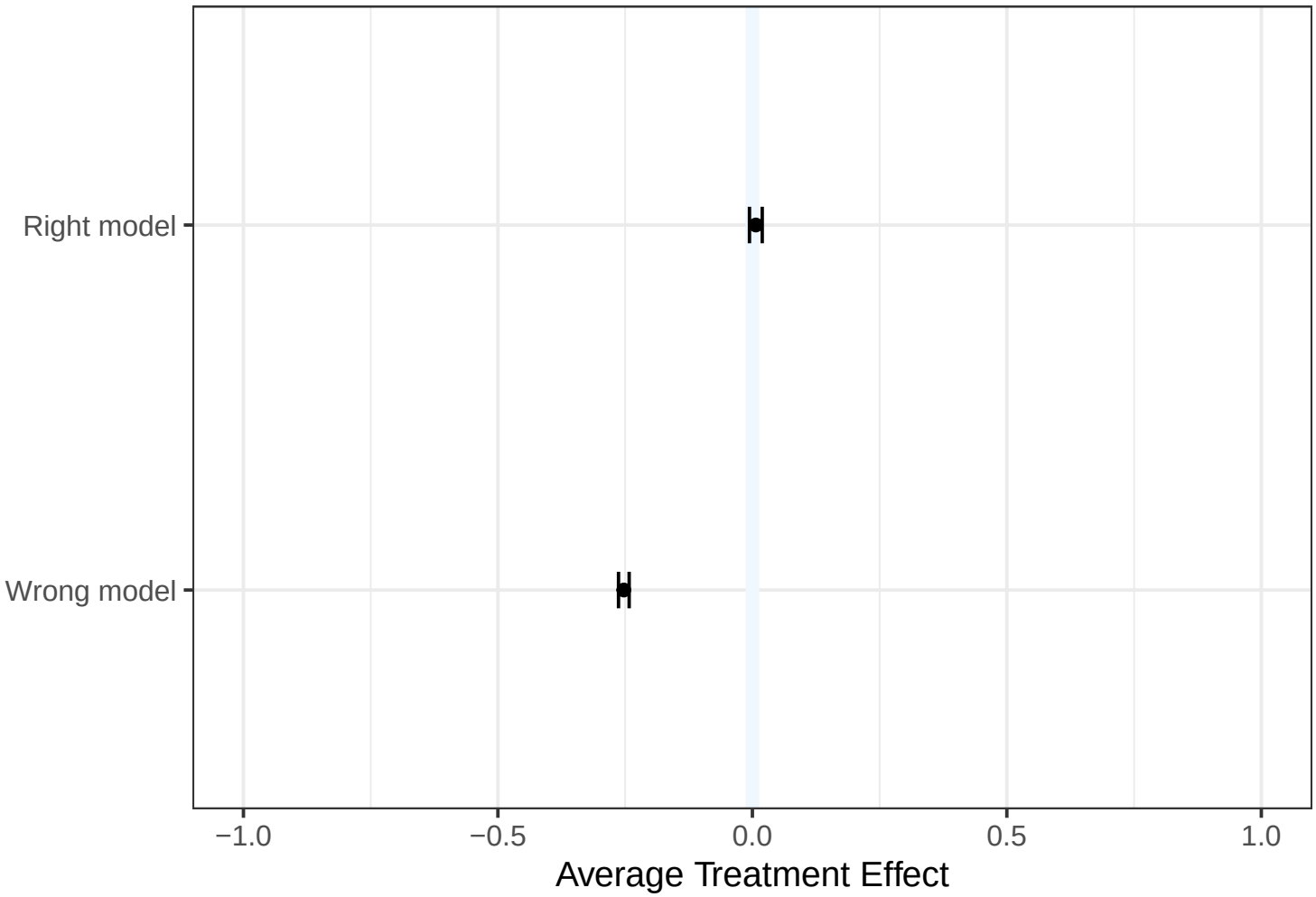
Summary statistics

Statistic	N	Mean	St. Dev.	Min	Max
Proportional Shortfall	1,000	1.114	0.859	0.003	4.778
Treatment	1,000	0.474	0.500	0	1
Health care cost	1,000	6.976	4.746	−1.578	27.557
V1	1,000	498.746	288.860	2	1,000
V2	1,000	492.975	293.667	1	1,000
V3	1,000	512.349	293.801	1	1,000
V4	1,000	489.041	288.225	1	1,000
V5	1,000	516.896	292.376	1	1,000
V6	1,000	497.232	284.475	1	1,000
V7	1,000	505.715	289.385	1	1,000
V8	1,000	501.330	276.913	3	998

Predictions Random Forest



Average treatment effect



Conclusion

- Causal models are necessary for inference
- It is tempting to use all variables in a machine learning model
- However, this could lead to misleading conclusions

Blog and code (in Dutch)

https://misjamikkers.github.io/post/causaliteit-en-machine-learning/

https://github.com/misjamikkers/Meetup_Informatieberaad