INSTITUTE FOR EMPLOYMENT RESEARCH
The Research Institute of the Federal Employment Agency

ITS COMPLICATED: KNOW YOUR DATA AND KNOW YOUR GENERATOR

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SECTIONS

1. Introduction
2. Know your data (SD2011)
3. Know your generator
   - DataSynthesizer
   - CTGAN
   - Synthpop
4. Conclusion

Section 1: Introduction

COMPARE 3 SYNTHETIC DATA GENERATOR (SDG)

- DataSynthesizer (Bayes)
- CTGAN (GAN)
- Synthpop (CART)

Section 2: Know your data (SD2011)

REAL DATA

- Social Diagnosis 2011 (SD2011)
- Loads with Synthpop
  - `http://www.diagnoza.com/index-en.html`
  - Not entirely clear how original data is created or cleaned to create data in Synthpop
- Like real data, has ‘quirks’ or unusual values/variables
  - Includes missings
    - Informative (i.e. month married, but single)
    - Non-informative
  - Includes ‘errors’
    - `smoke` - Does not smoke is NO, but `nociga` - 20/22 cigarettes per day
  - Includes generated variables
    - `bmi,agegr`
    - Can be problematic for SDG

DATA (SD2011)

Number	Variable	Description	Type	Observations	Unique.Values	Missings	Negative.values	Generated	Quirks
1	sex	Sex	factor	5000	2	0	0		
2	age	Age of person, 2011	numeric	5000	79	0	0		
3	agegr	Age group, 2011	factor	5000	7	4	0	Yes	Yes
				...					
7	eduspec	Discipline of completed qualification	factor	5000	28	20	0		Yes
				...					
10	income	Personal monthly net income	numeric	5000	407	683	603		
11	marital	Marital status	factor	5000	7	9	0		
12	mmarr	Month of marriage	numeric	5000	13	1350	0		
13	ymarr	Year of marriage	numeric	5000	75	1320	0		
14	msepdiv	Month of separation/divorce	numeric	5000	13	4300	0		
15	ysepdiv	Year of separation/divorce	numeric	5000	51	4275	0		
				...					
22	nofriend	Number of friends	numeric	5000	44	0	41		
23	smoke	Smoking cigarettes	factor	5000	3	10	0		
24	nociga	Number of cigarettes smoked per day	numeric	5000	30	0	3737		Yes
				...					
27	workab	Working abroad in 2007-2011	factor	5000	3	438	0		
28	wkabdur	Total time spent on working abroad	numeric	5000	33	0	4875		Yes
				...					
33	height	Height of person	numeric	5000	65	35	0		
34	weight	Weight of person	numeric	5000	91	53	0		
35	bmi	Body mass index (weight/(height^2)*10000	numeric	5000	1396	59	0	Yes	Yes

Section 3a): Know your generator (DataSynthesizer)

TASKS

- Run default model - correlated attribute mode
- Hyperparameters
  - ϵ DP: 0 (default 0.1)
  - Bayesian network ($\mathcal{N}$) parents: 1, 2, or 3 (default is ‘greedy’)

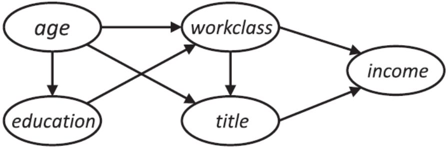
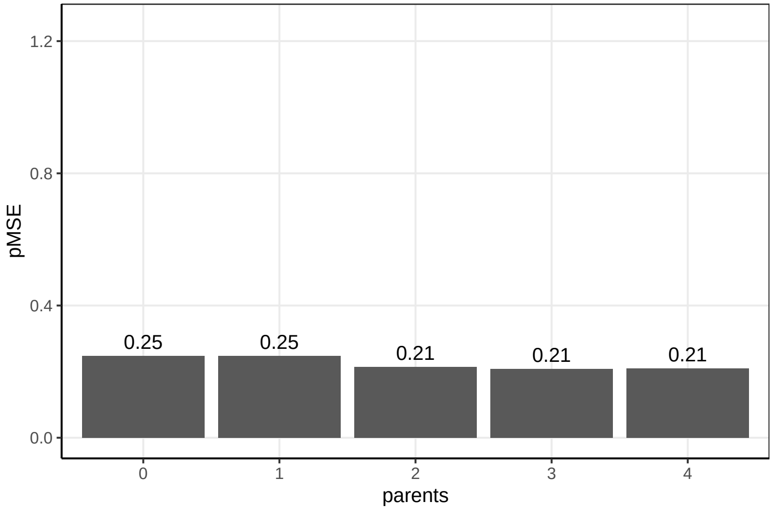


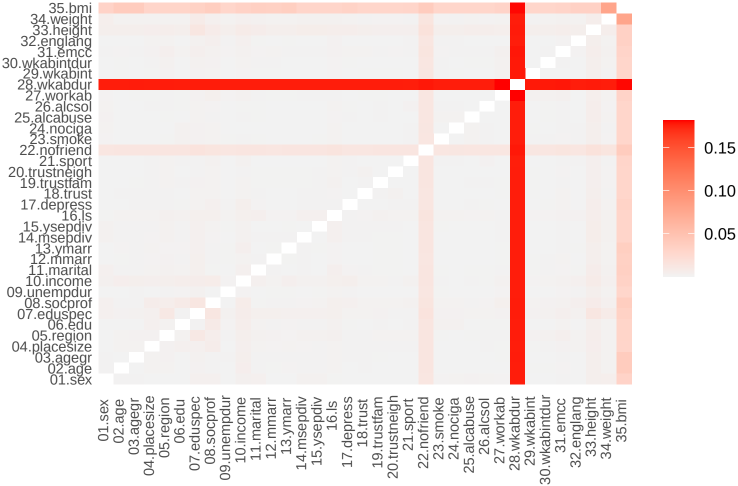
Fig. 1. A Bayesian network $\mathcal{N}_1$ over five attributes.

- In Fig. 1, $\mathcal{N} = 2$, but not known in reality

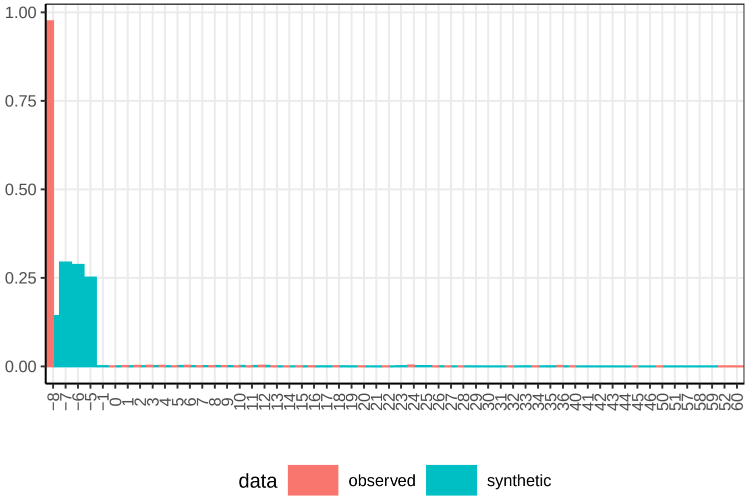
SD2011 - PMSE



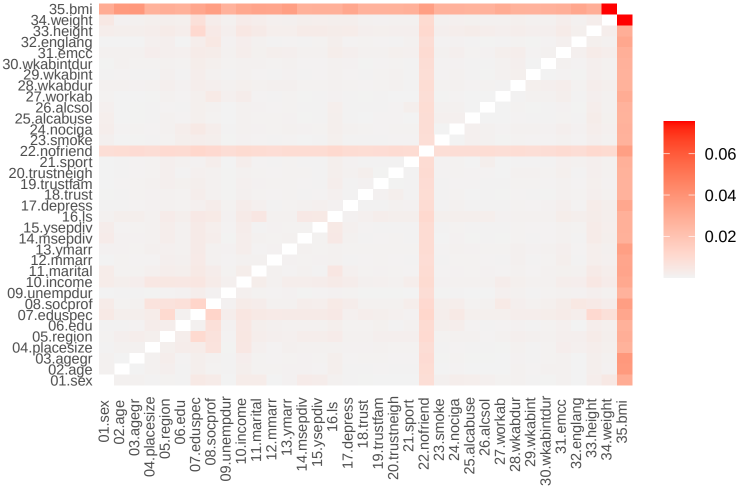
DATASYNTHESIZER - SD2011(A)



VARIABLE: WKABDUR (WORK ABROAD DURATION)

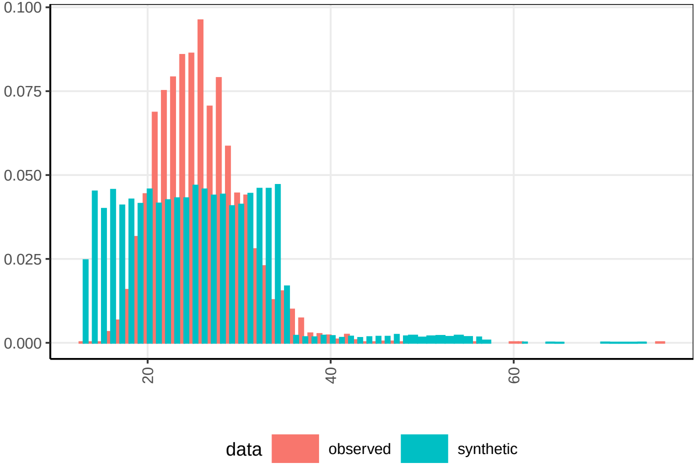


DATASYNTHESIZER - SD2011(B)

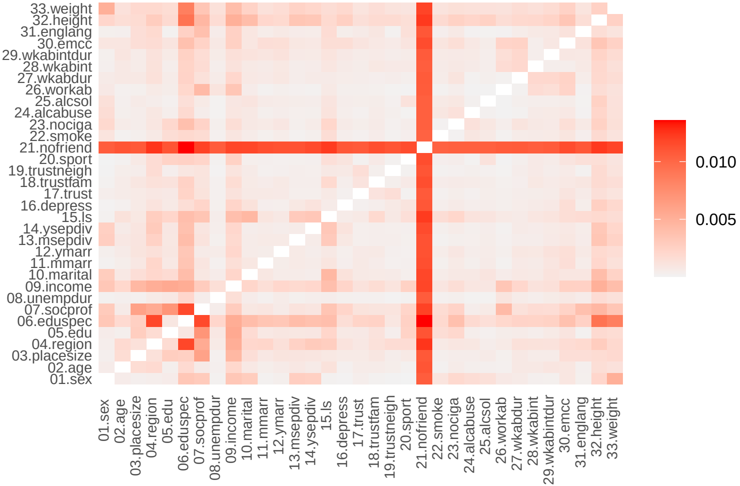


VARIABLE: BMI

Figure 1: BMI $<$ 20 is underweight/malnourished

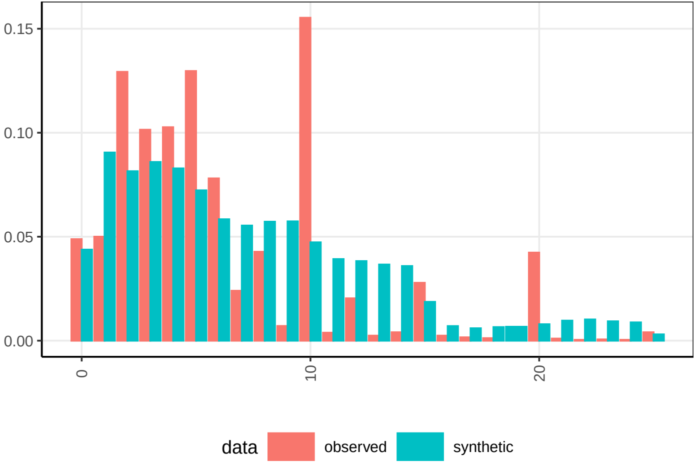


DATASYNTHESIZER - SD2011(C)

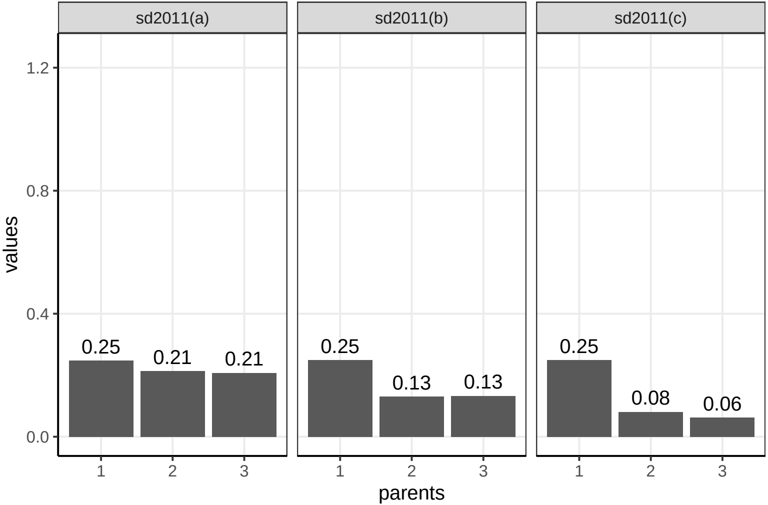


VARIABLE: NOFRIEND

Figure 2: Doesn't capture rounding/discontinuity



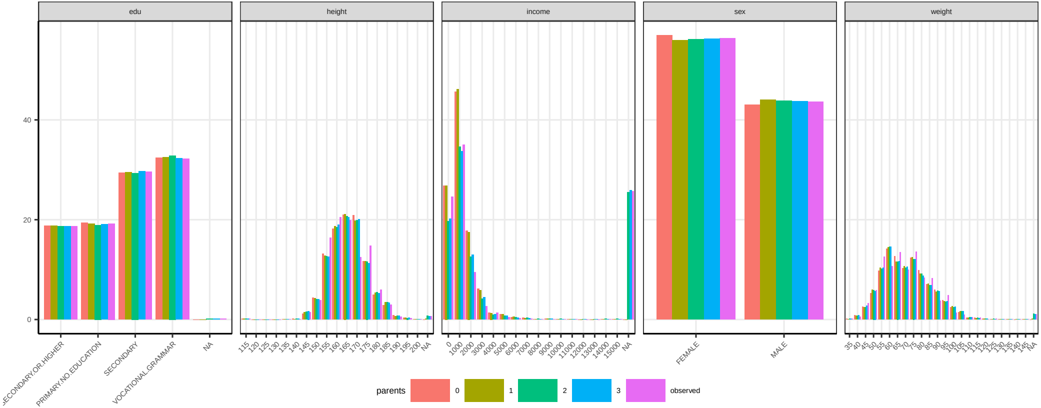
SD2011 - PMSE



sd2011(a)
sd2011(b)
sd2011(c)
values
1.2
0.8
0.4
0.0
0.25
0.21
0.21
0.25
0.13
0.13
0.25
0.08
0.06
1
2
3
parents

DATASYNTHESIZER: SELECTED VARIABLES

Figure 3: No missings if parents < 2



Section 3b): Know your generator (CTGAN)

TUNING CTGAN

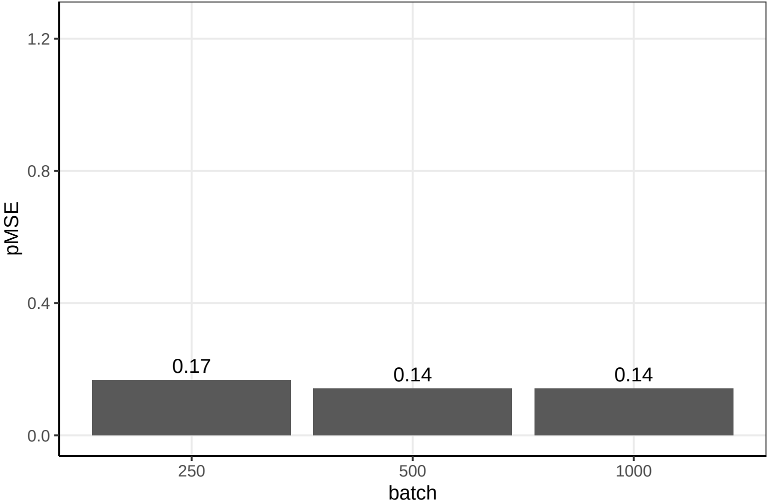
- Batch size (constant steps)
- Epochs (constant batch size)
- Dimensions (2 hyperparameters)
  - embedding_dim (int): Size of the random sample passed to the Generator. Defaults to 128.
  - dimensionality - 2 hyperparameters, but same value for each
    - discriminator_dim (tuple or list of ints): Size of the output samples for each one of the Discriminator Layers. A Linear Layer will be created for each one of the values provided. Defaults to (256, 256).
    - generator_dim (tuple or list of ints): Size of the output samples for each one of the Residuals. A Resiudal Layer will be created for each one of the values provided. Defaults to (256, 256).

BATCH SIZE, EPOCHS, AND STEPS

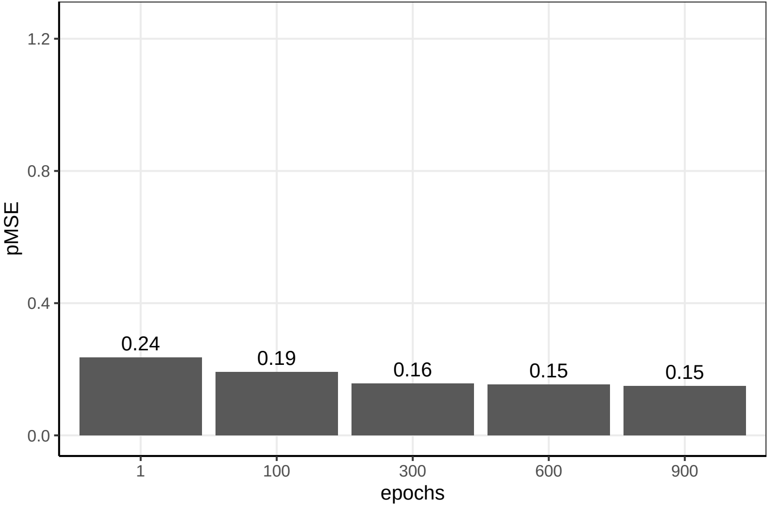
Table 1

N	Batch size	Steps per Epoch	Epochs	Actual Steps
5.000	100	50	60	3,000
5.000	250	20	150	3,000
5.000	500	10	300	3,000
5.000	1.000	5	600	3,000
5.000	500	10	100	1,000
5.000	500	10	300	3,000
5.000	500	10	600	6,000
5.000	500	10	900	9,000

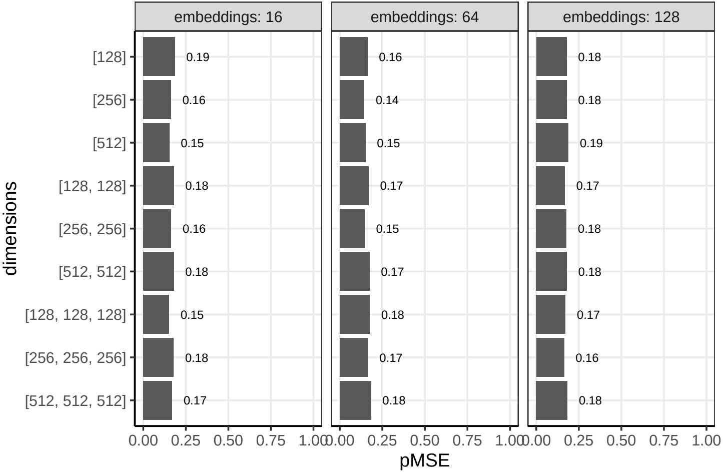
CTGAN: EFFECT OF BATCH SIZE (CONSTANT STEPS)



CTGAN: EFFECT OF EPOCHS (CONSTANT BATCH SIZE)



CTGAN: EFFECT OF DIMENSIONS



Section 3b): Know your generator (Synthpop)

Section 4: Conclusion