



# Theorem 2 (Bates, Candès, Janson and Wang, 2019, *informal version*)

If an algorithm samples **exact** knockoff for **any** distribution with only access to evaluating the distribution's unnormalized density  $\Phi$ , then almost surely,

$$\text{number of evaluations of the density} \geq 2^{|\{j: X_j \neq \tilde{X}_j\}|} - 1$$

- Make  $|\{j: X_j \neq \tilde{X}_j\}|$  small, but we will give up power

• Settle for approximate knots?

• **Four important classes of distributions**

• parametric family (e.g., Gaussian, discrete Markov chains)



Recall: need density at all points of the form  $(Z_1, Z_2, \dots, Z_p)$ ,  $Z_j$  equal to  $X_j$  or  $\tilde{X}_j$





reduced degree of freedom of  
the densities at these points

graphical structure

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- ~~• Make  $|\{j : X_j \neq \tilde{X}_j\}|$  small, but we will give up power~~
- Settle for approximate knockoffs?
- Focus on important class of distributions
  - parametric family (e.g., Gaussian, discrete Markov chains)

- **graphical structure**

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reduced degree of freedom of the densities at these points

# Graphical model and junction tree

$X_i$  independent of  $X_j$  given the remaining variables if no edge connects  $i$  and  $j$

