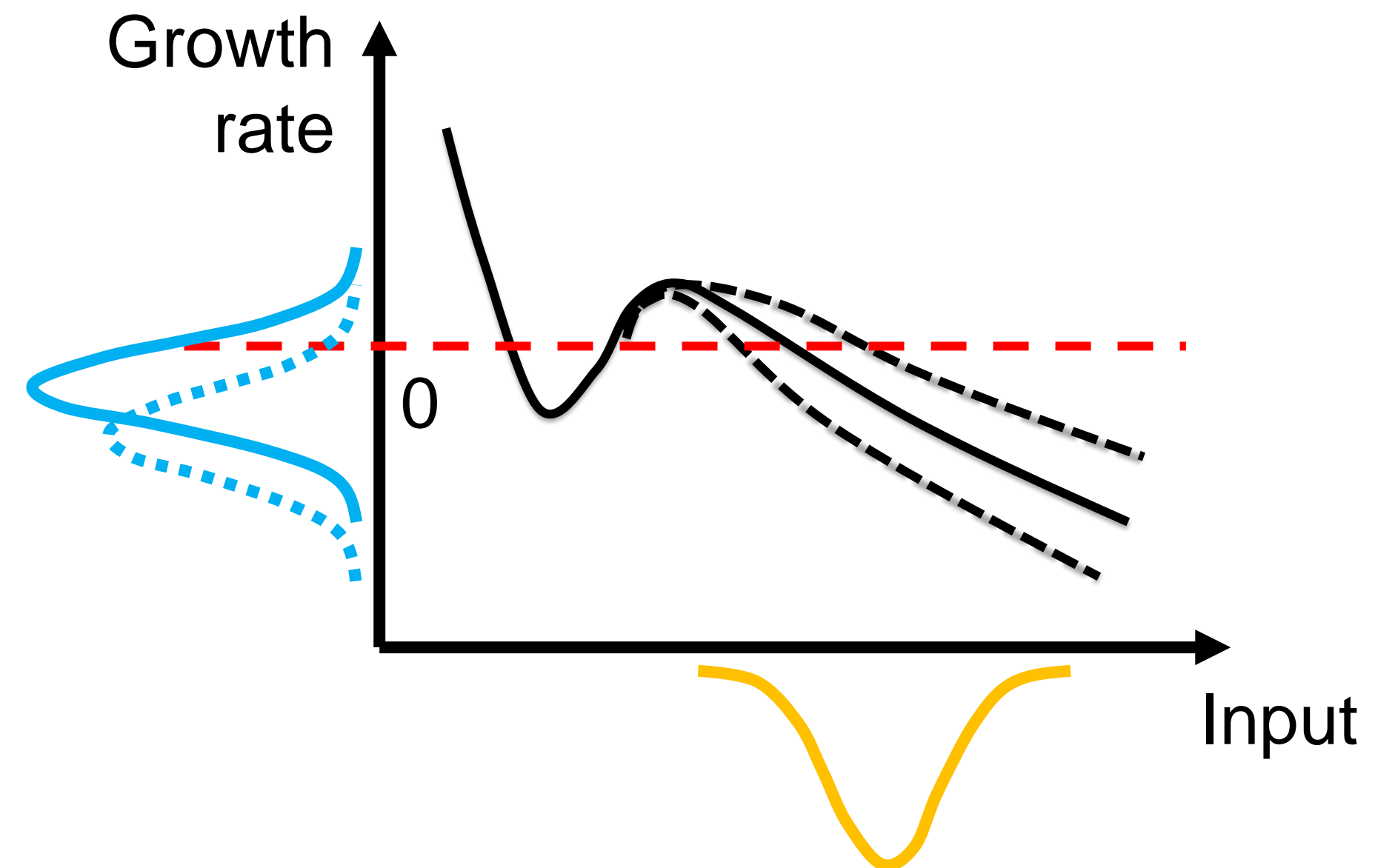


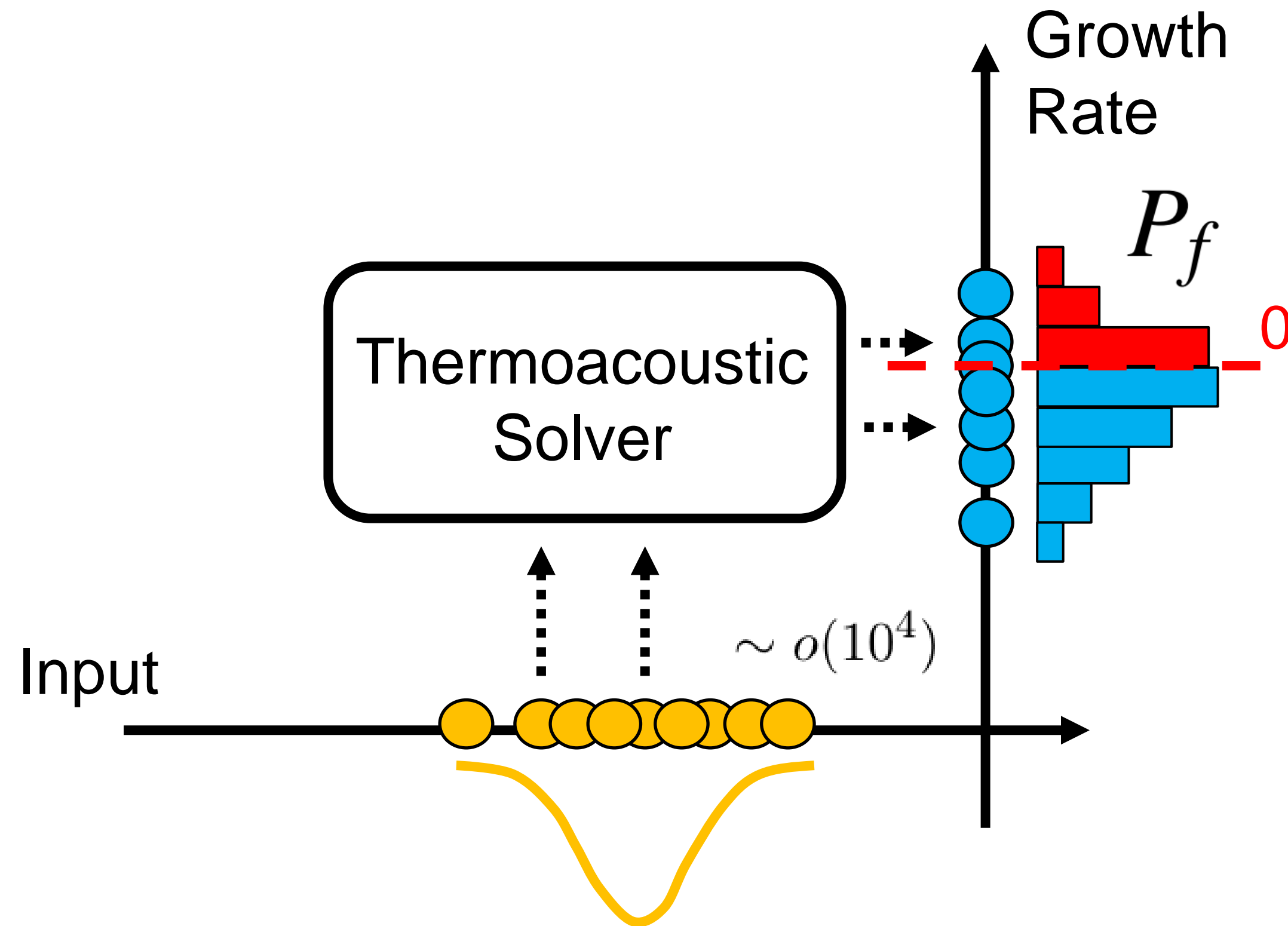
Reliable calculation of thermoacoustic instability risk using an imperfect surrogate model

S. Guo, C. Silva, W. Polifke

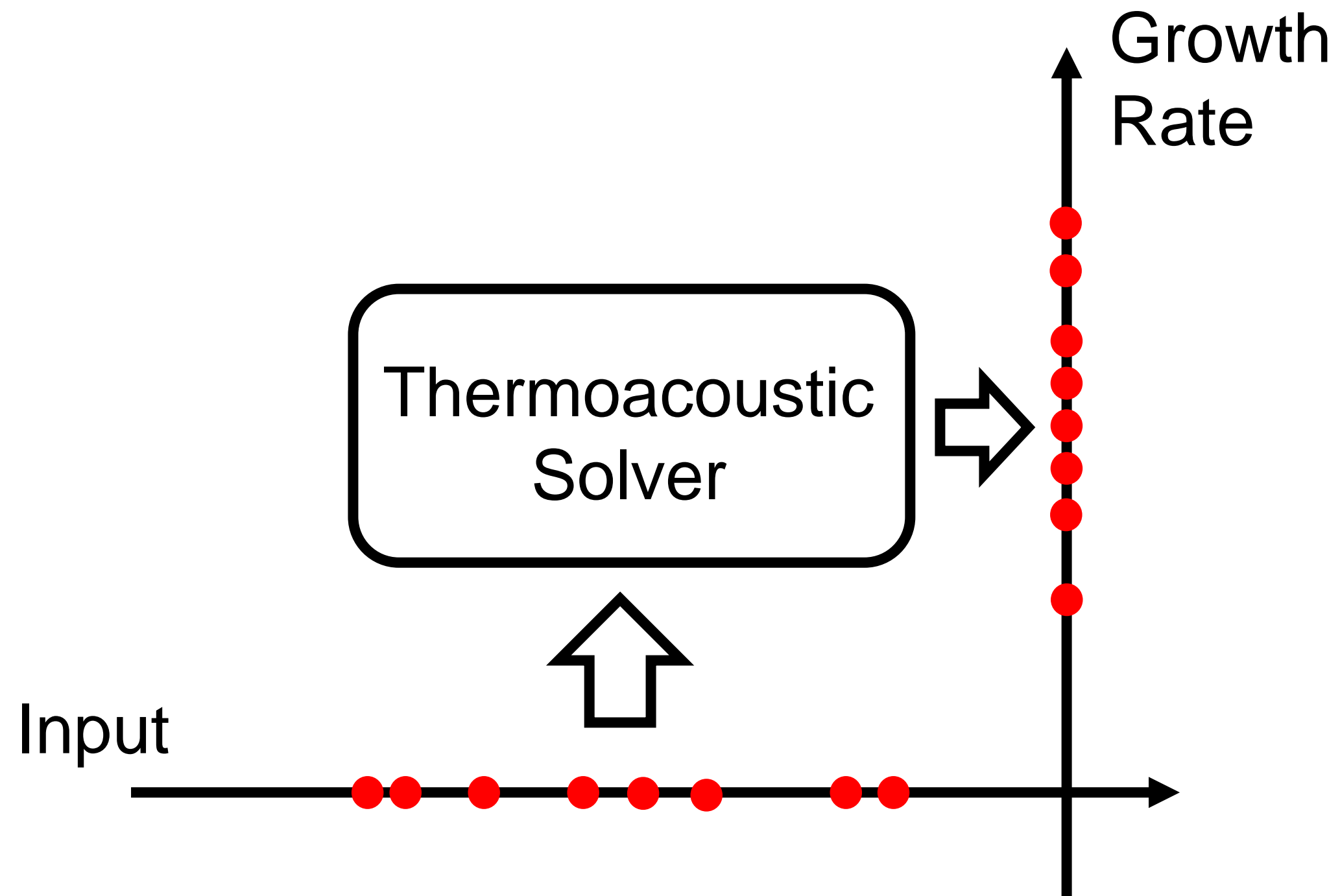


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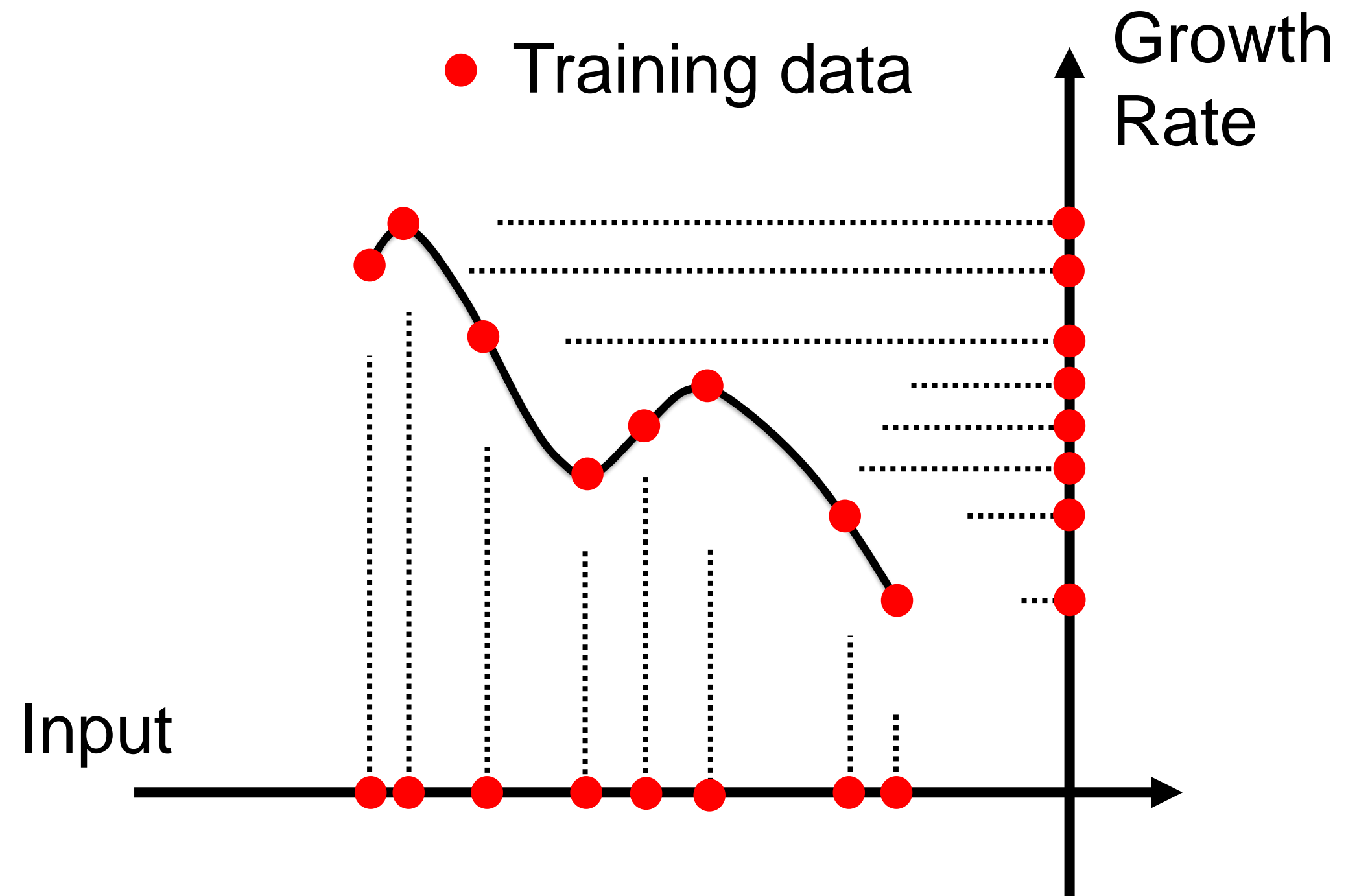
Uncertain surrogate model may lead to uncertain risk calculations



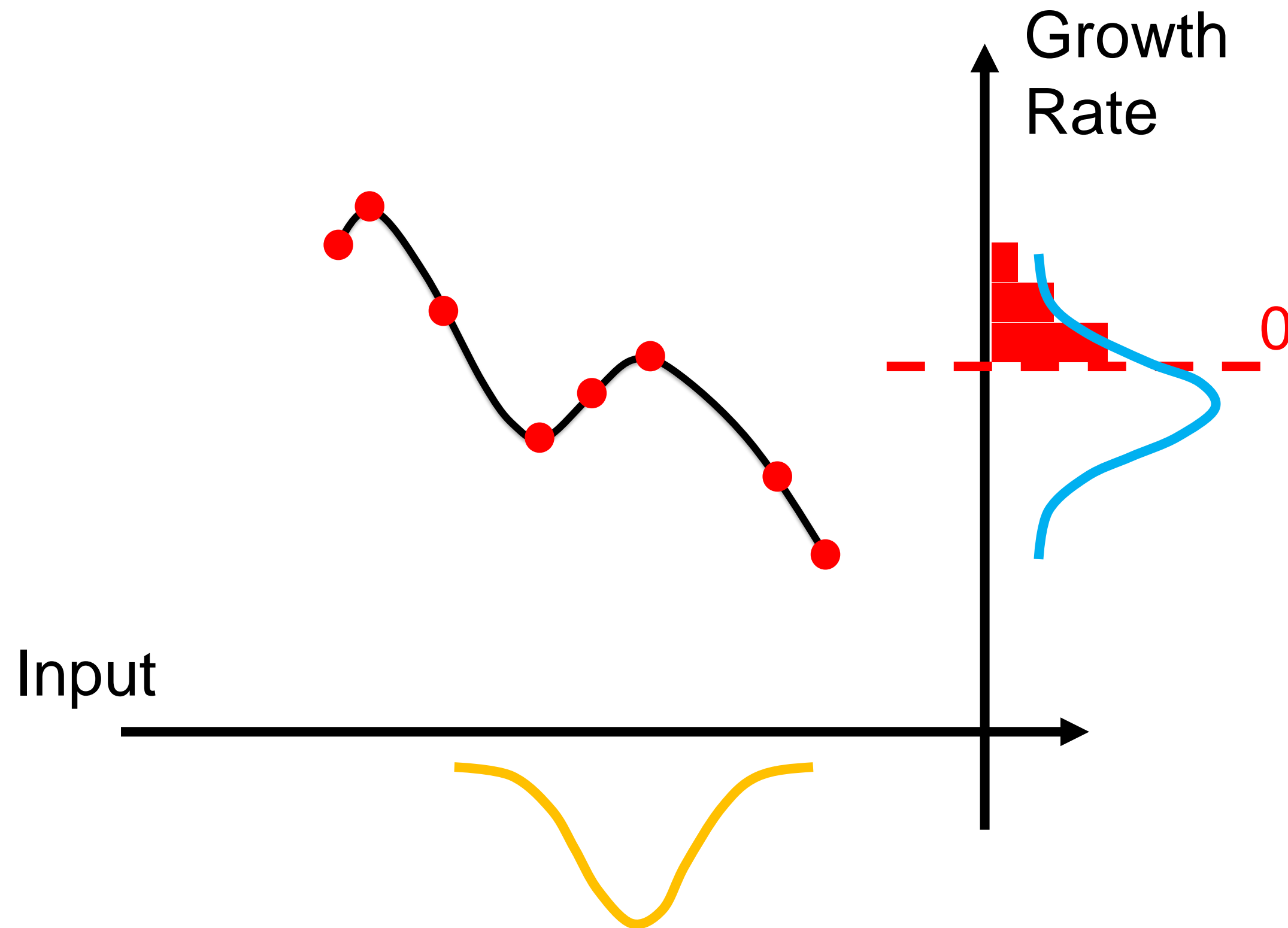
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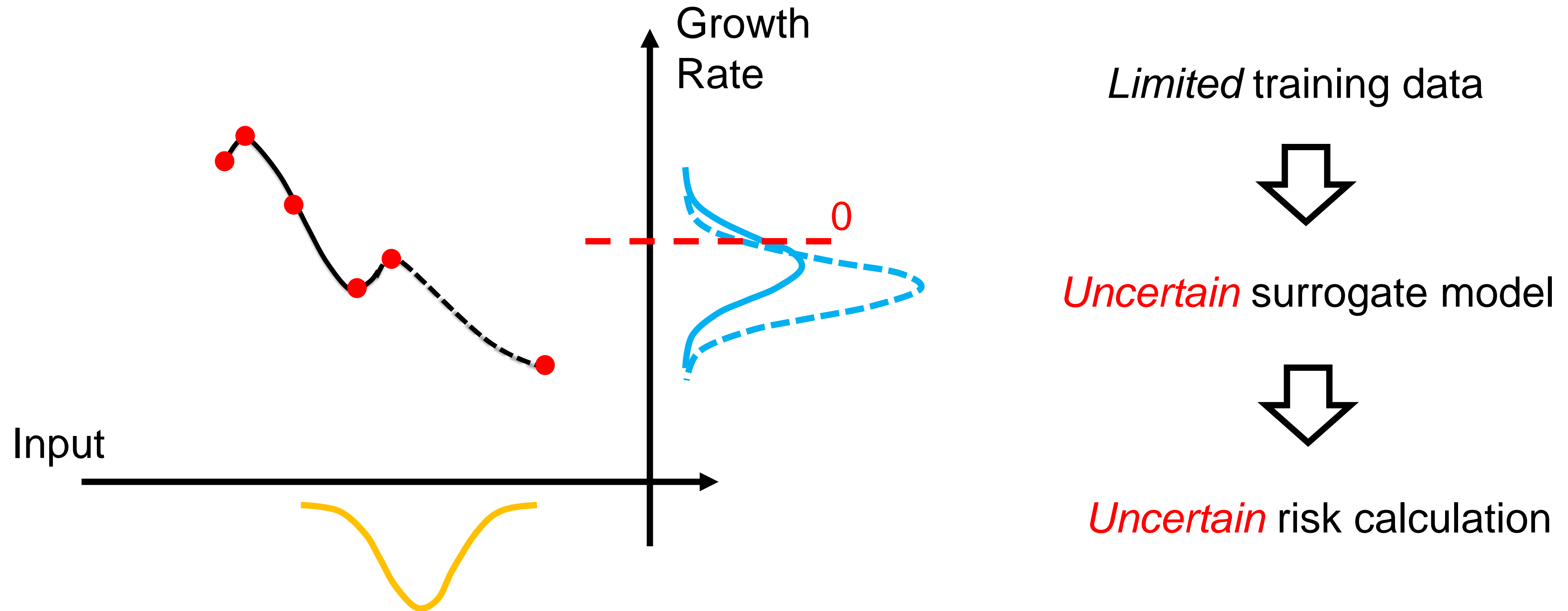
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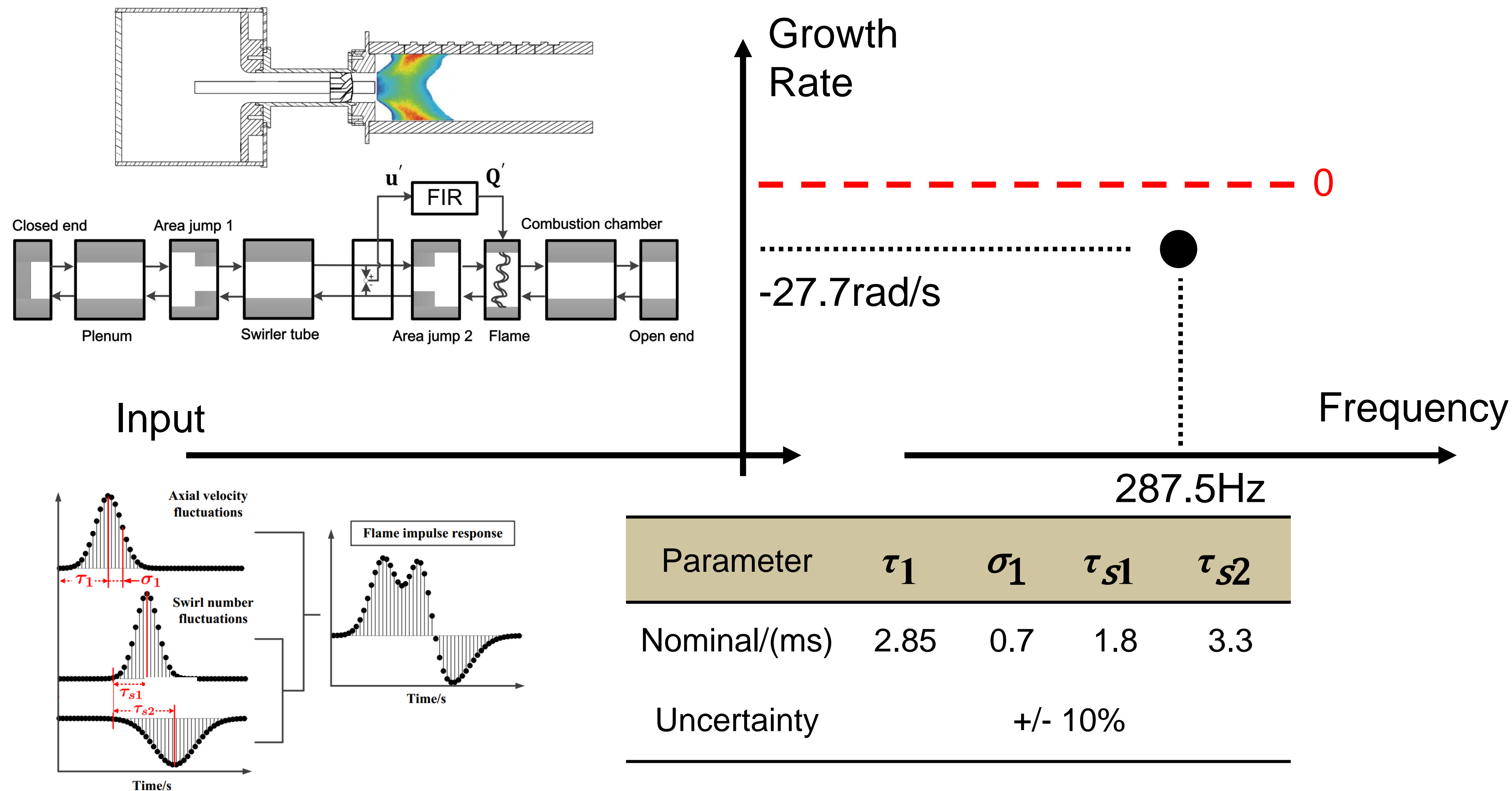
Uncertain surrogate model may lead to uncertain risk calculations



Presentation overview

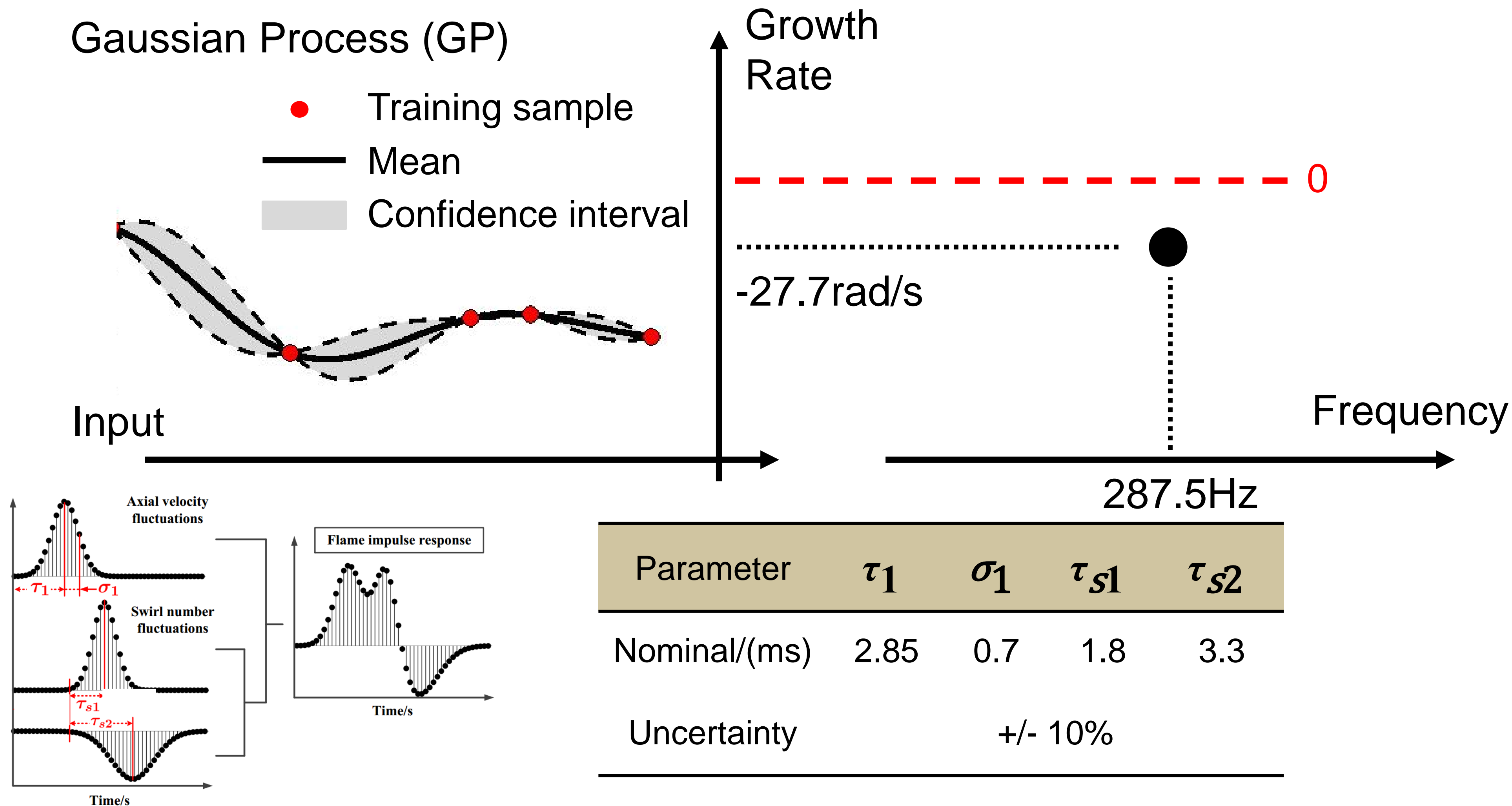
- Motivation
- Case study settings
- ***Quantifying*** the variation of risk calculation
- ***Reducing*** the variation of risk calculation
- Conclusions

Network model, flame impulse response and Gaussian process



[1] Komarek, T., Polifke, W., 2010, *J Eng Gas Turbines Power*.

Network model, flame impulse response and Gaussian process

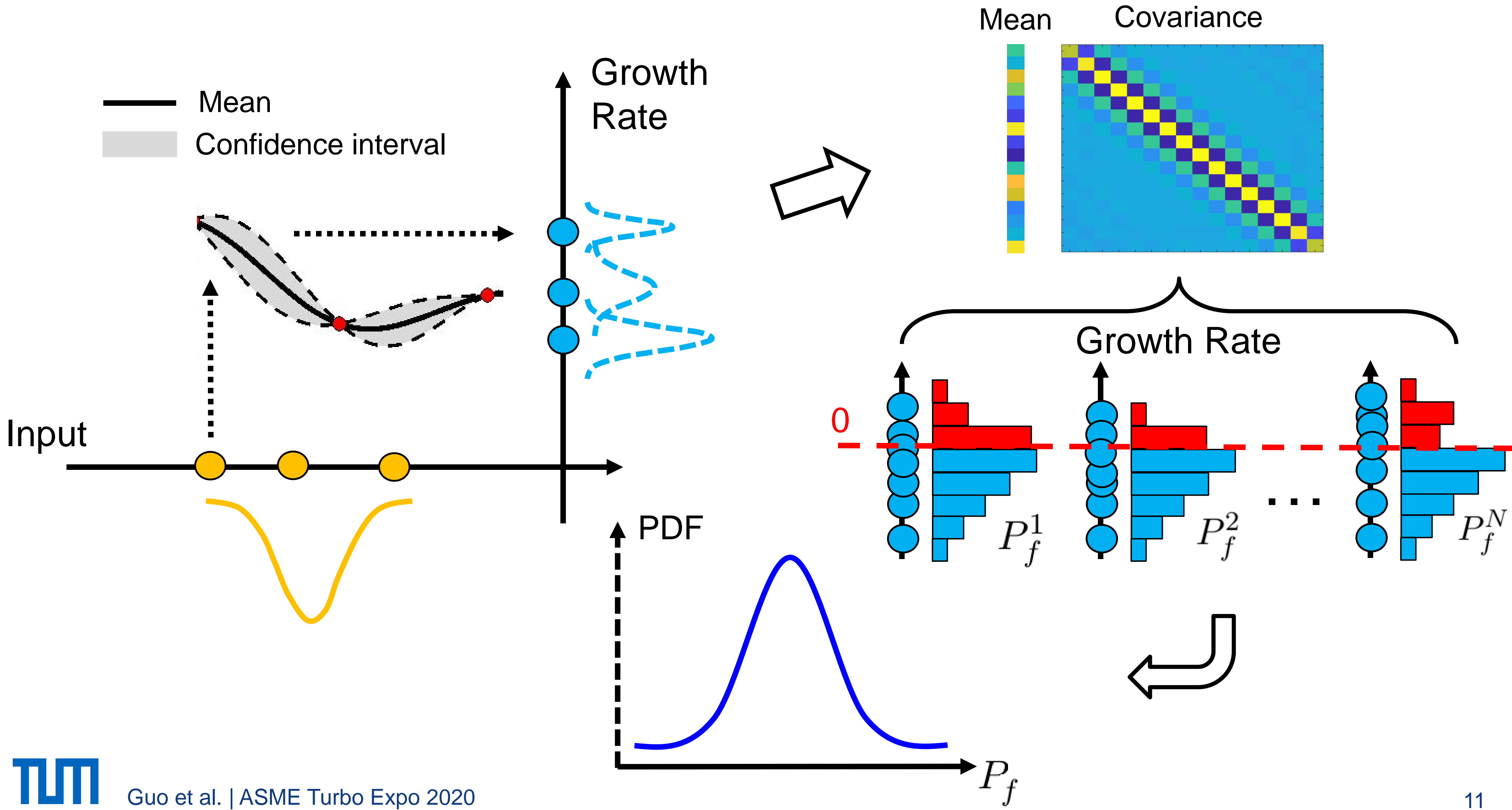


[1] Komarek, T., Polifke, W., 2010, *J Eng Gas Turbines Power*.

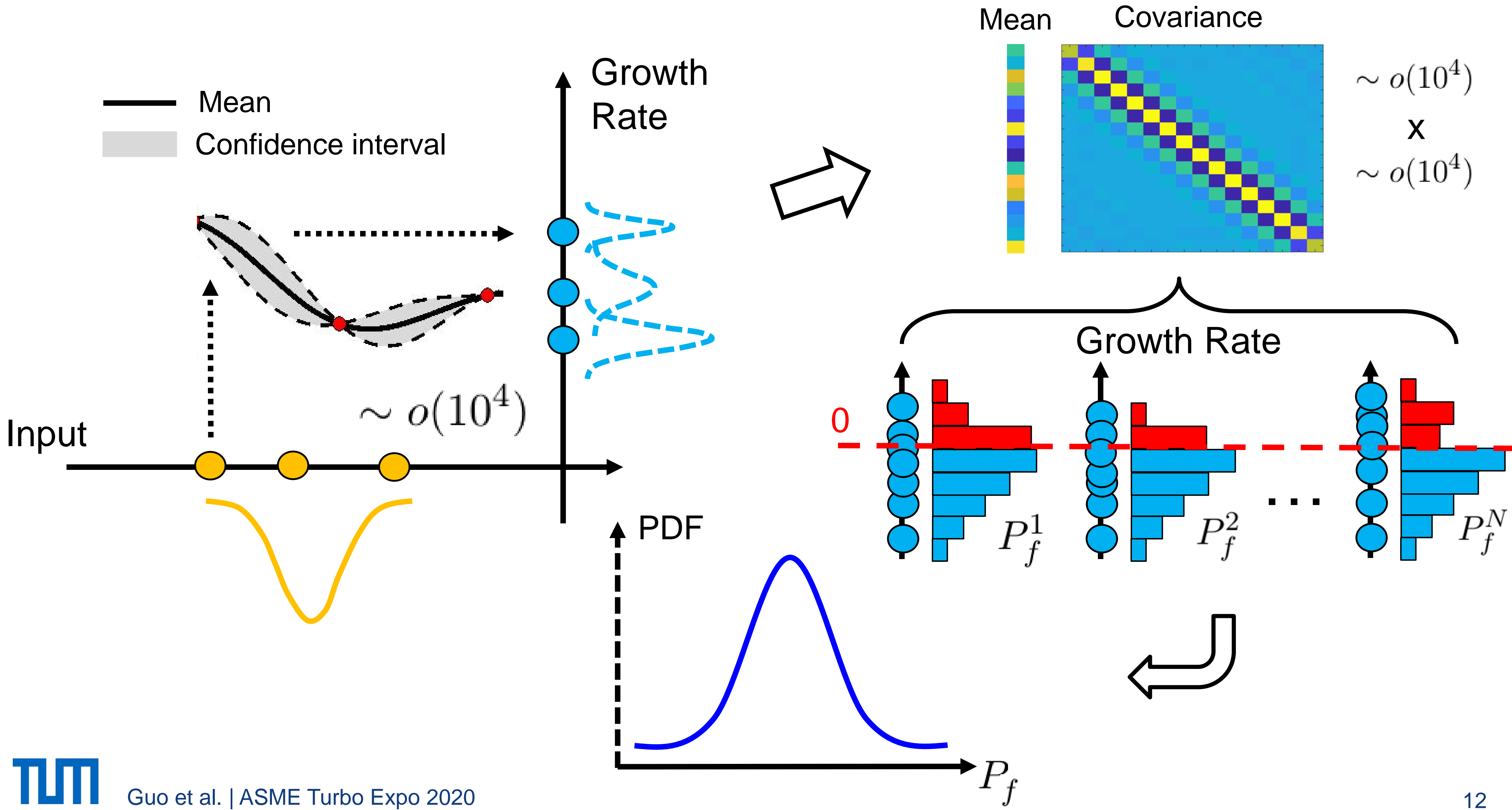
Presentation overview

- Motivation
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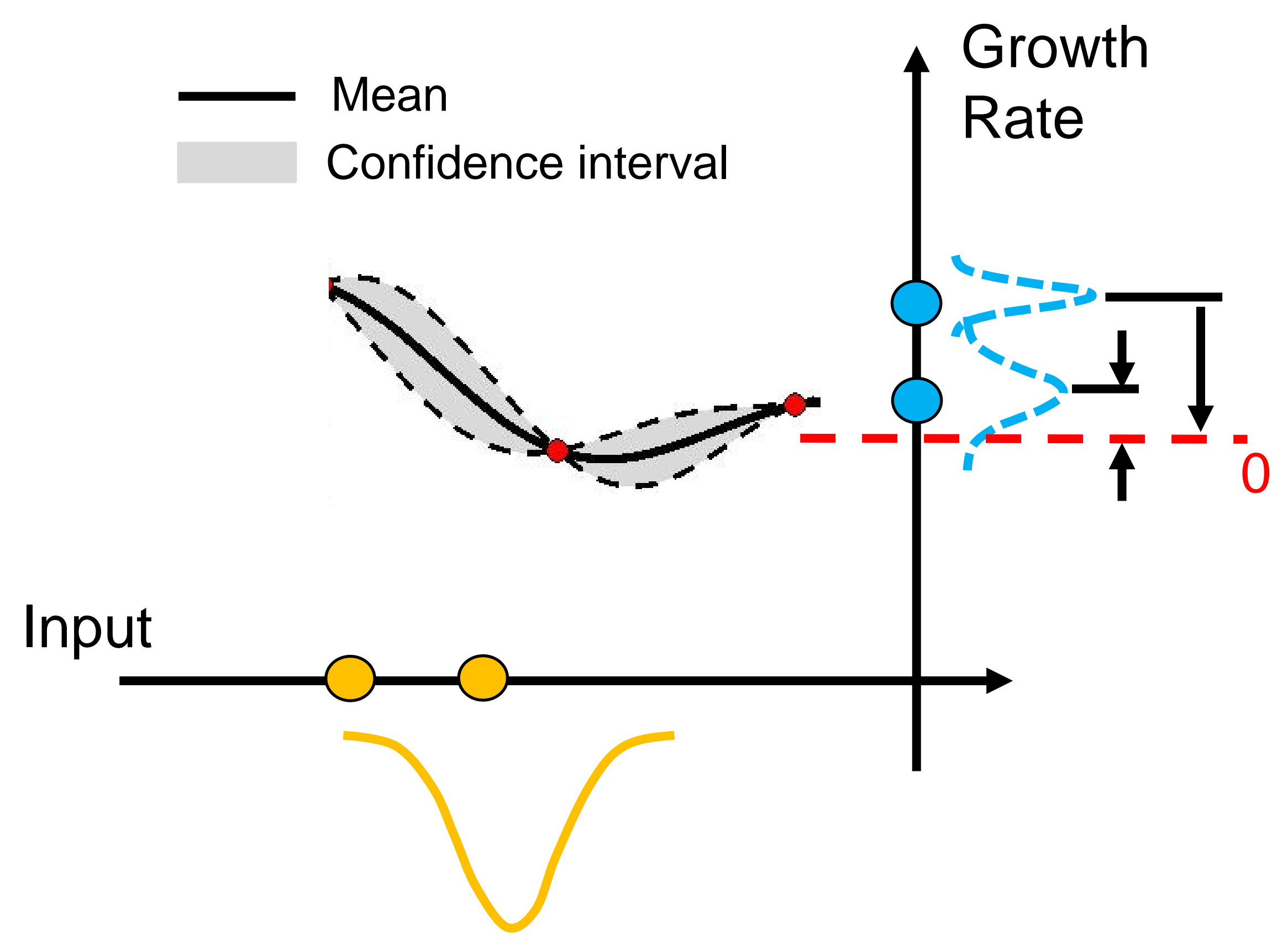
The growth rate prediction uncertainty yielded by GP permits the quantification of risk variations



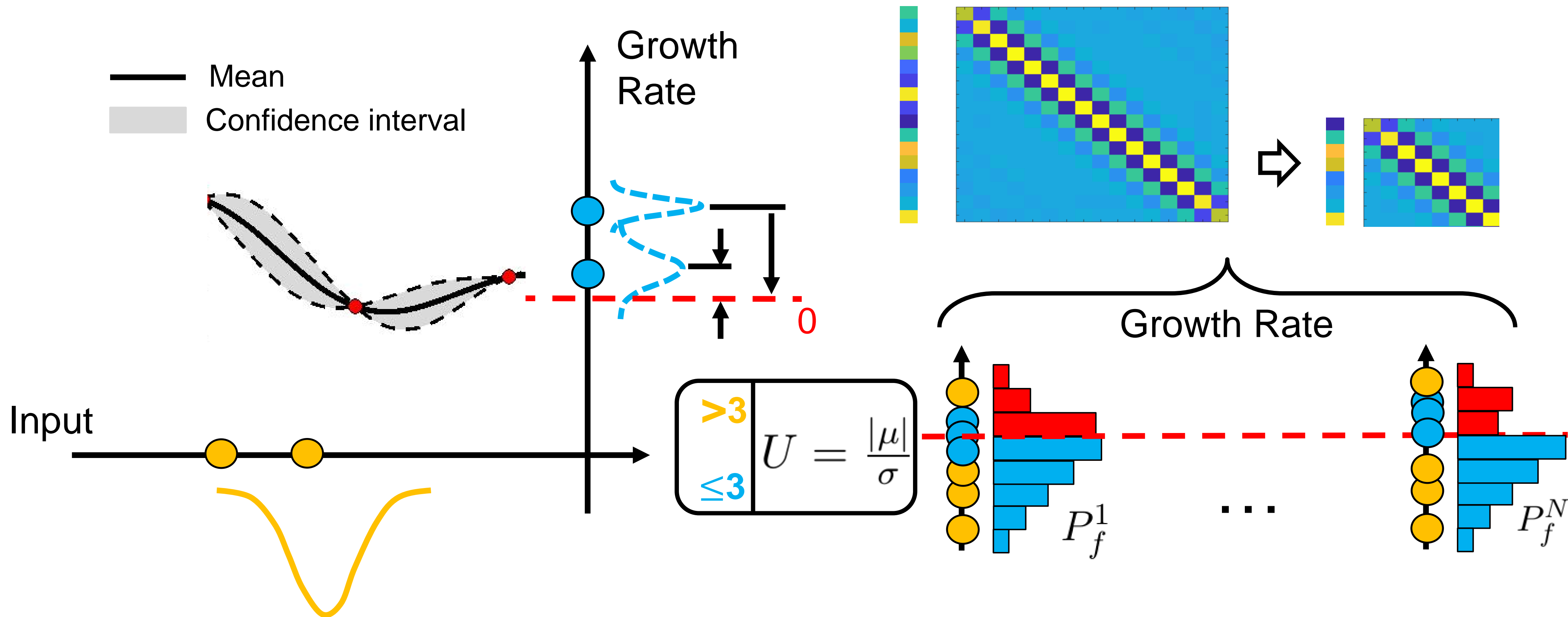
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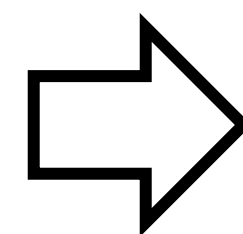
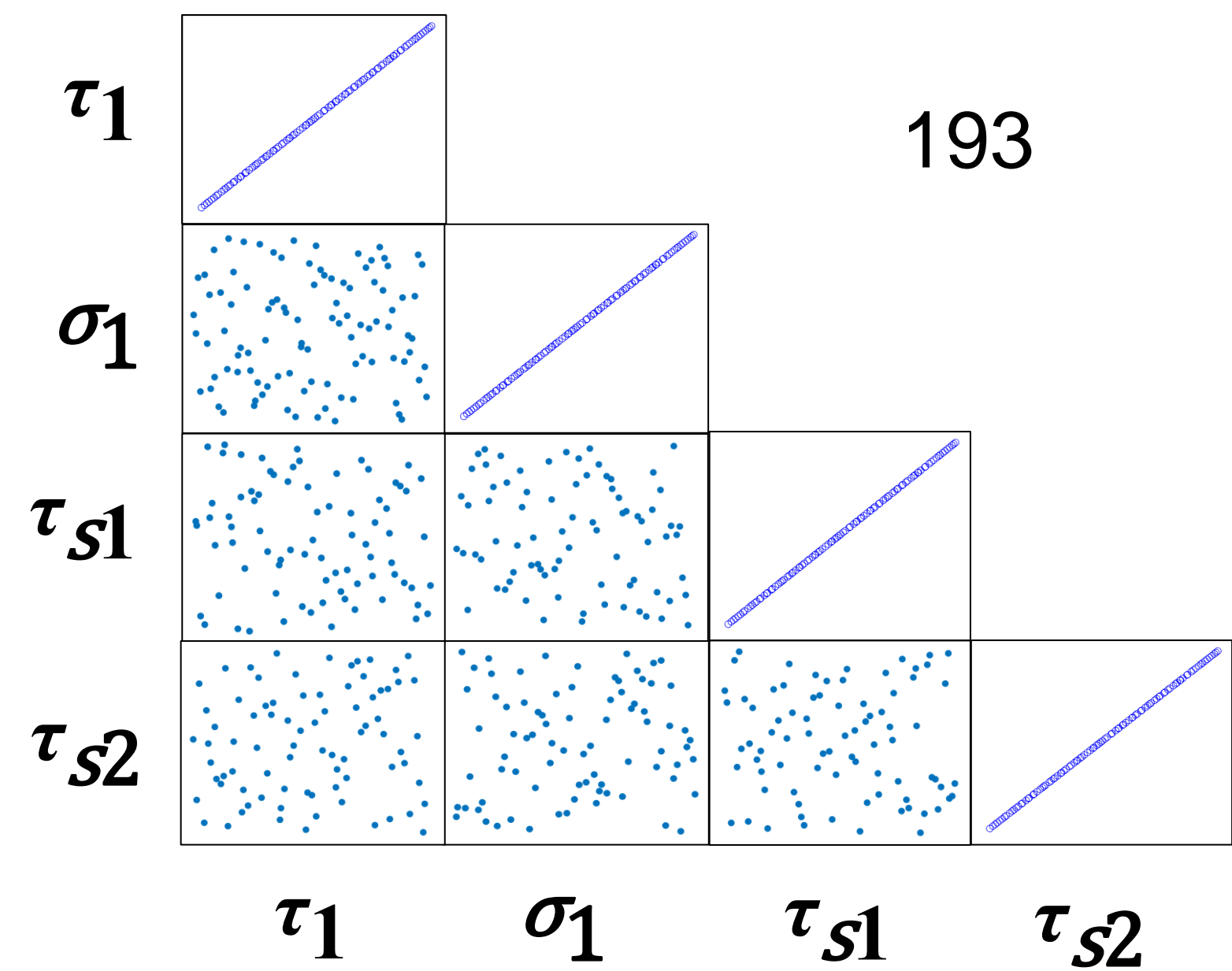
Only outputs close to stability margin worth considering in quantifying risk variations



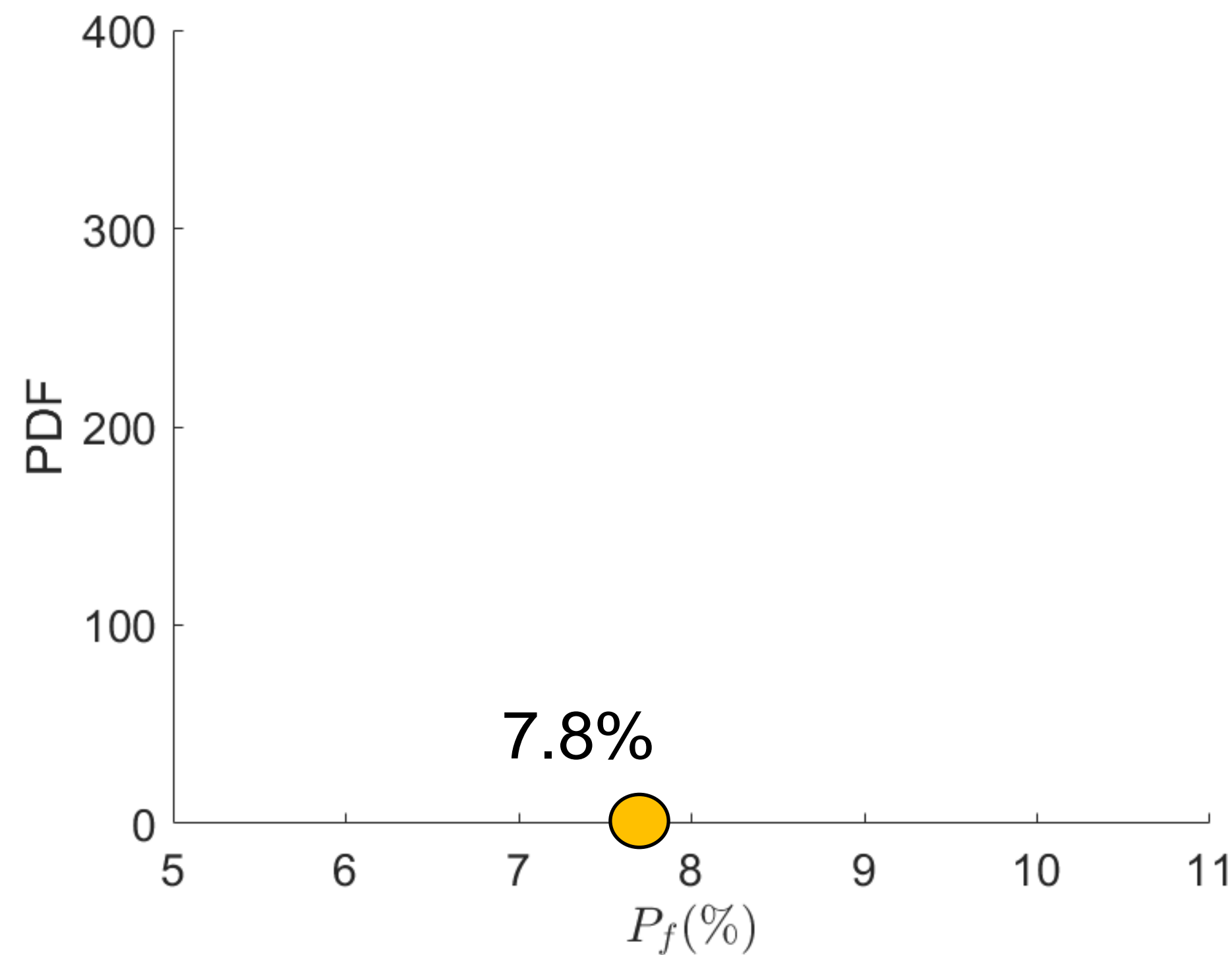
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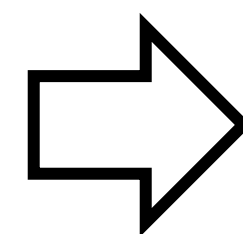
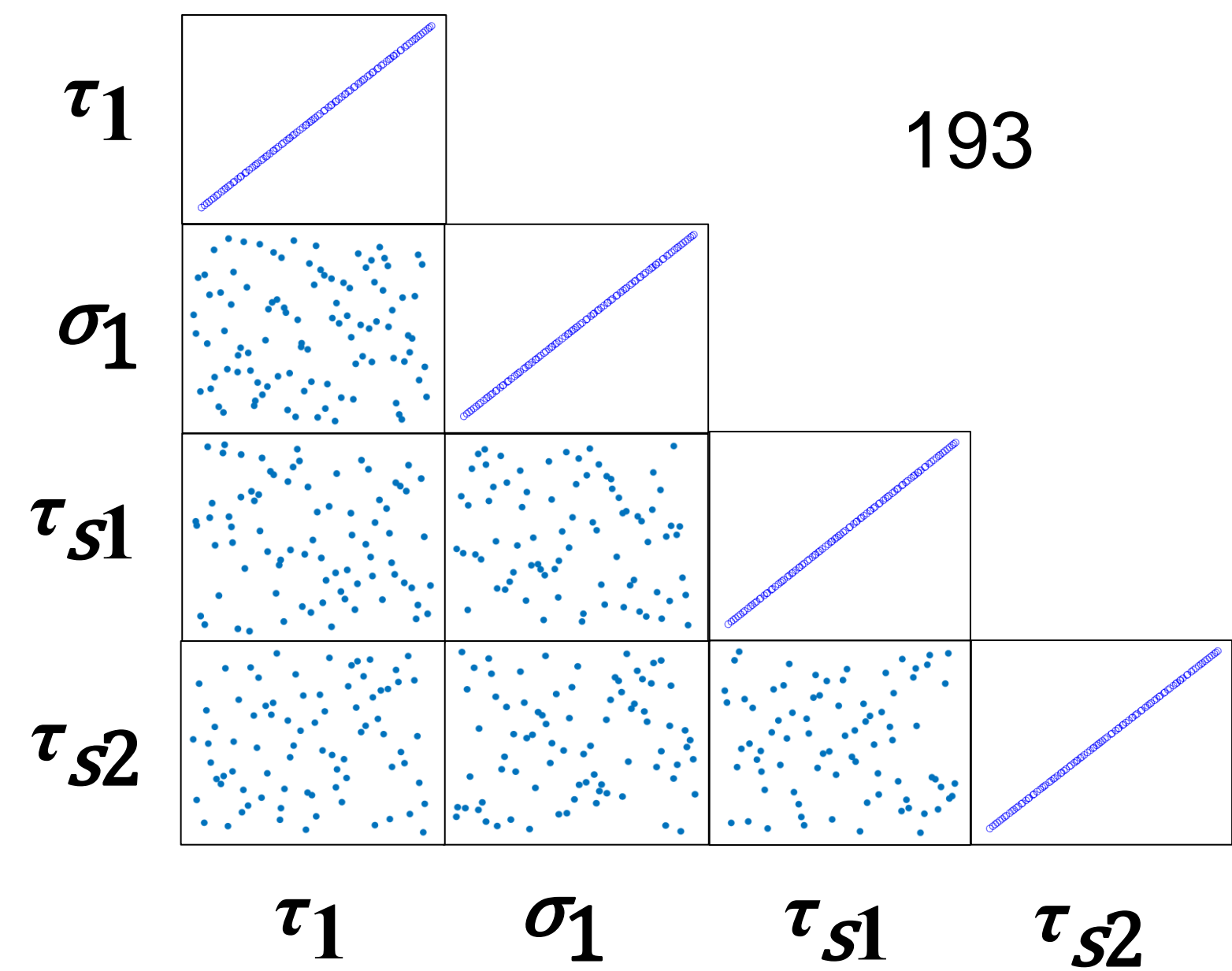
Taking GP uncertainty into account yields a more robust risk calculation



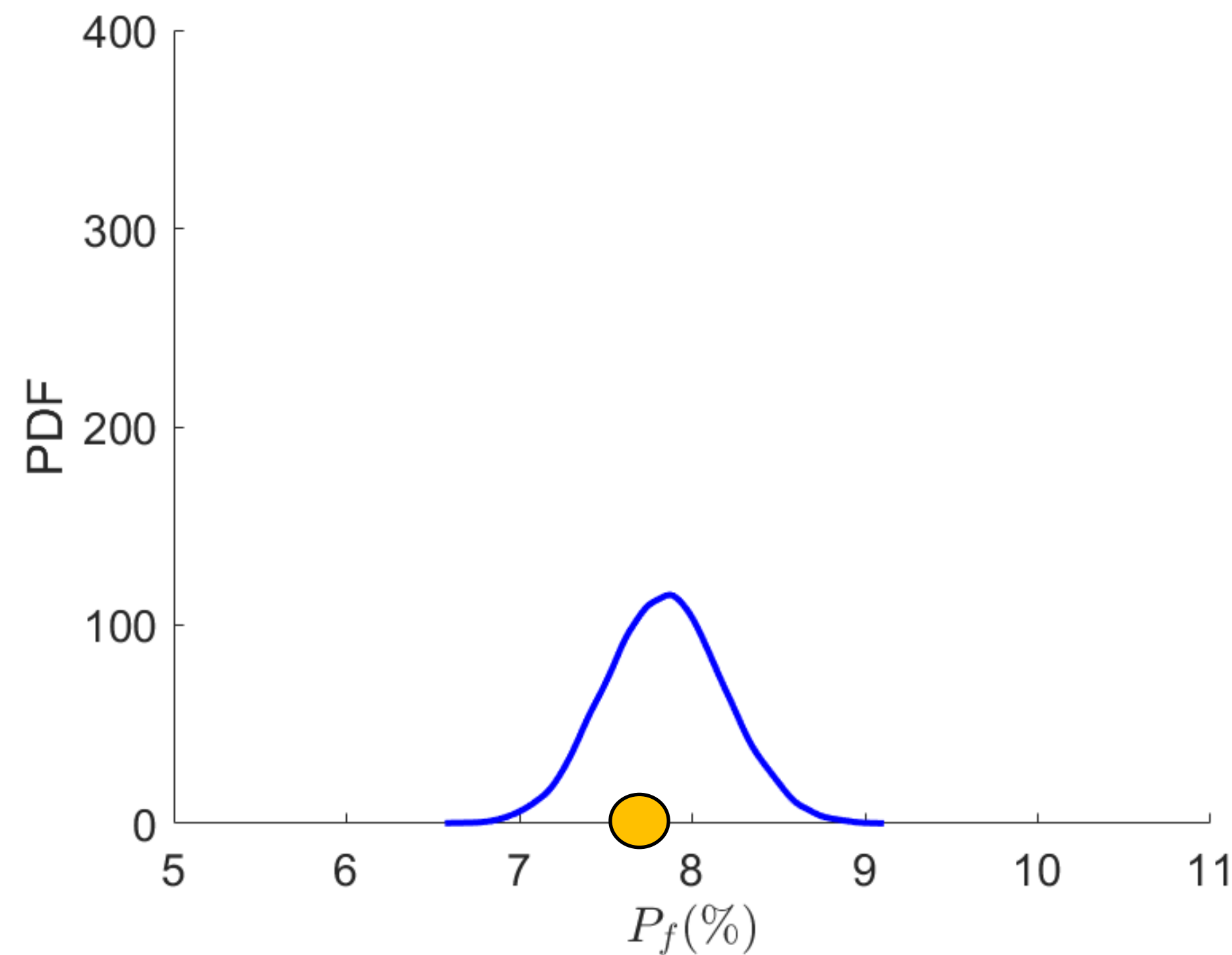
Growth Rate = $\mathcal{GP}(\tau_1, \sigma_1, \tau_{s1}, \tau_{s2})$



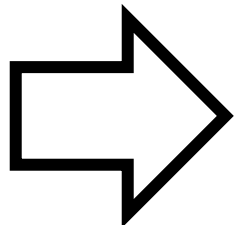
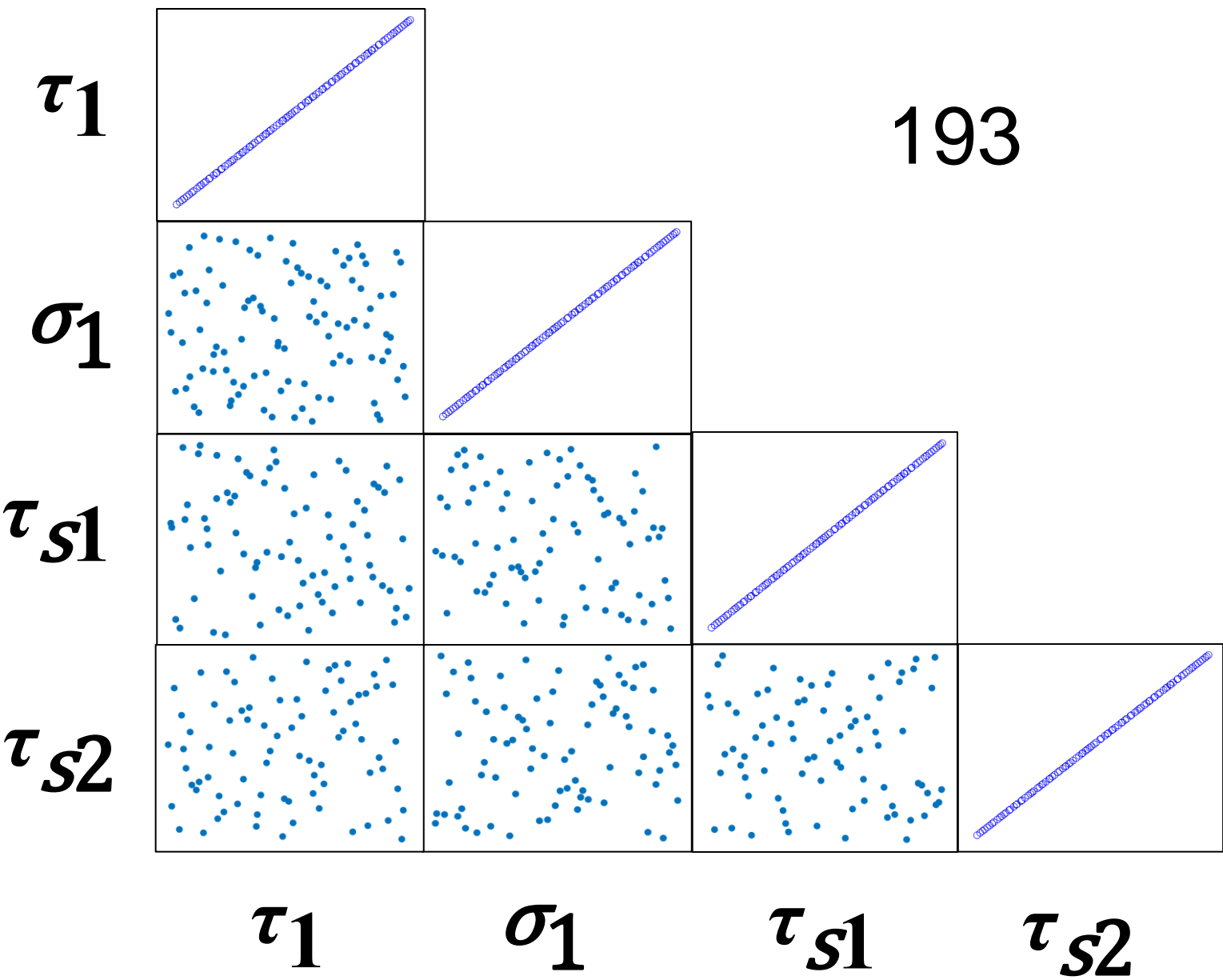
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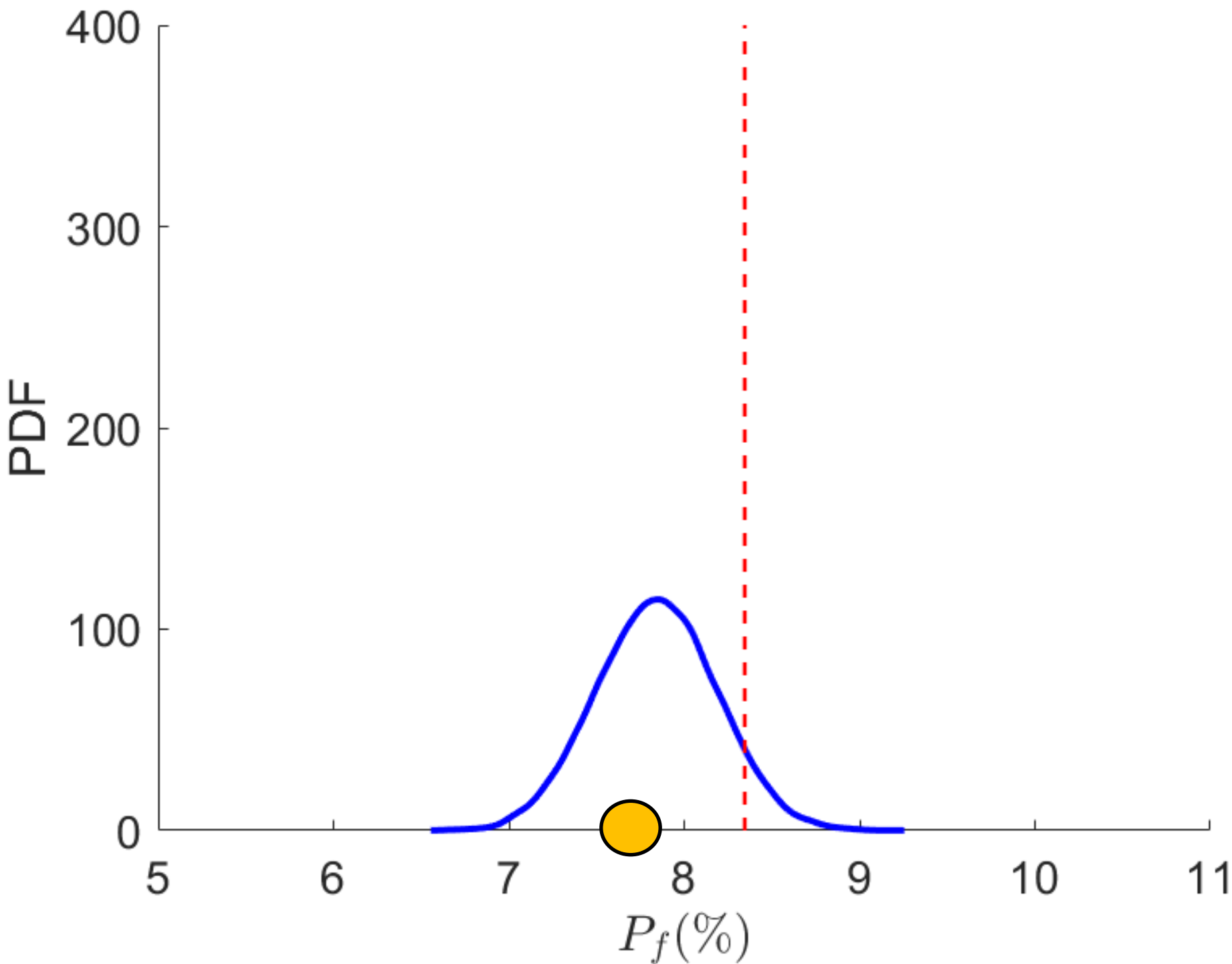
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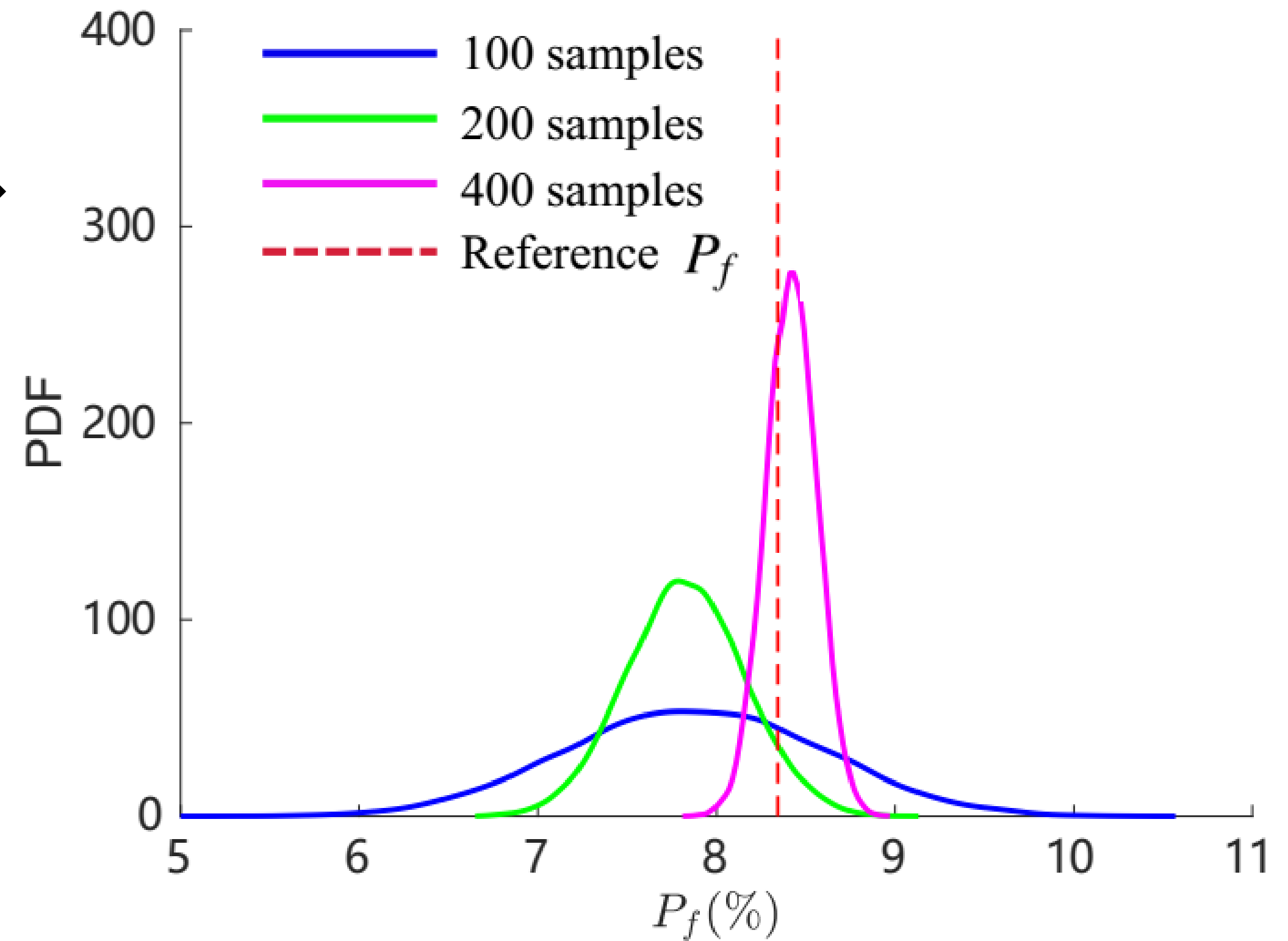
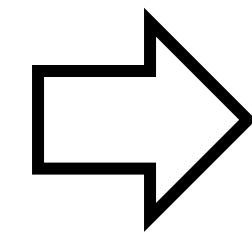
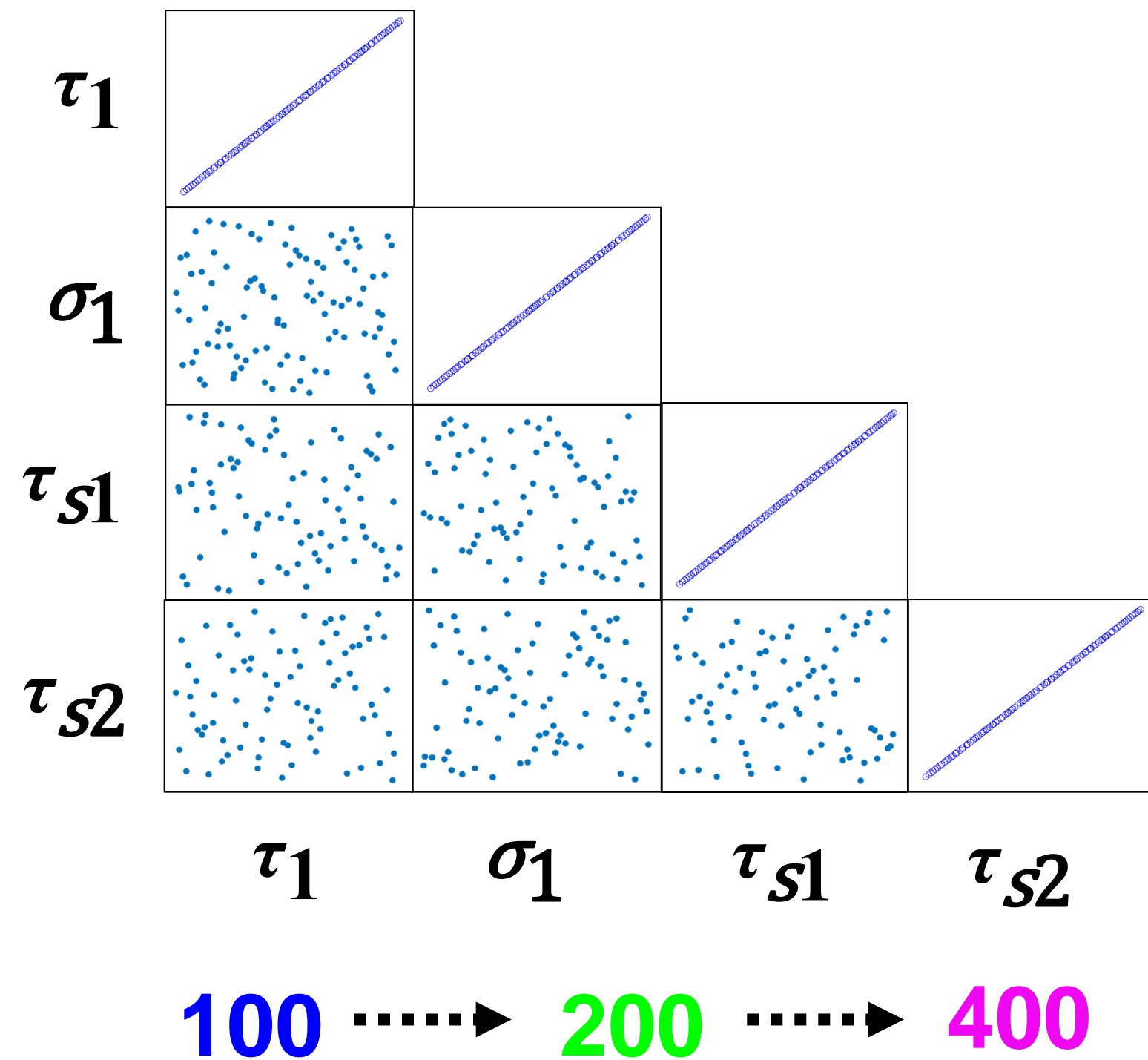
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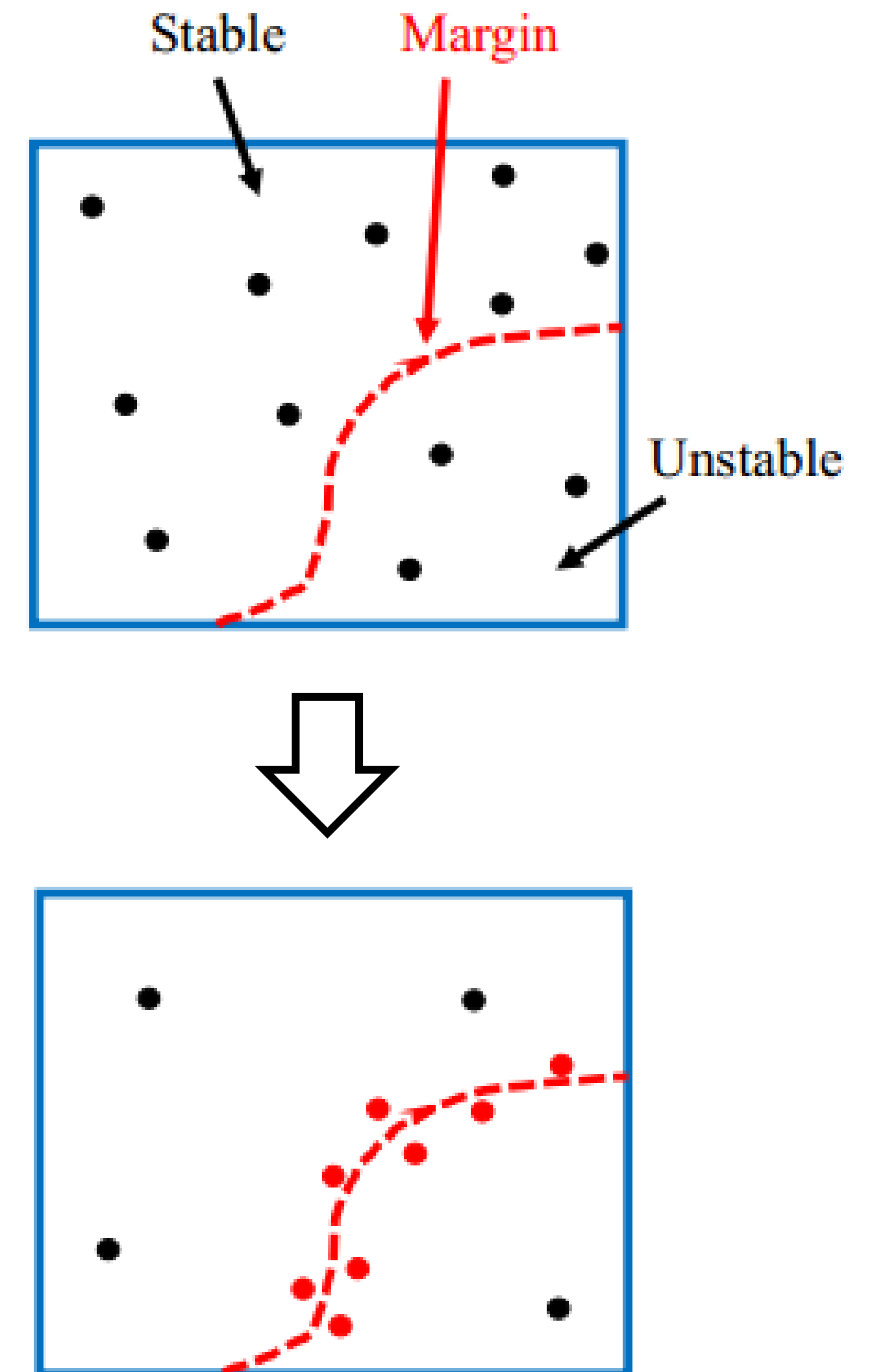
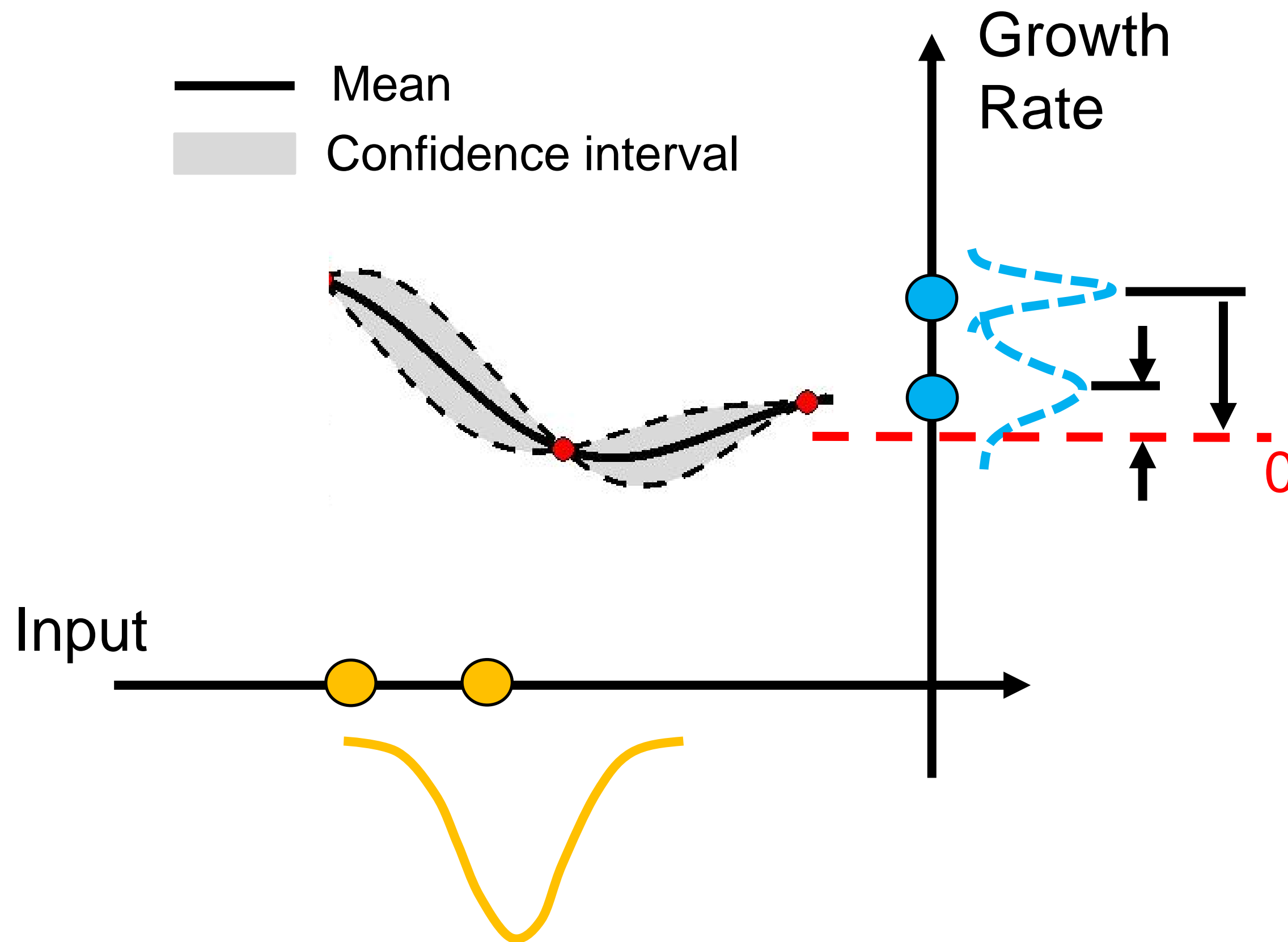
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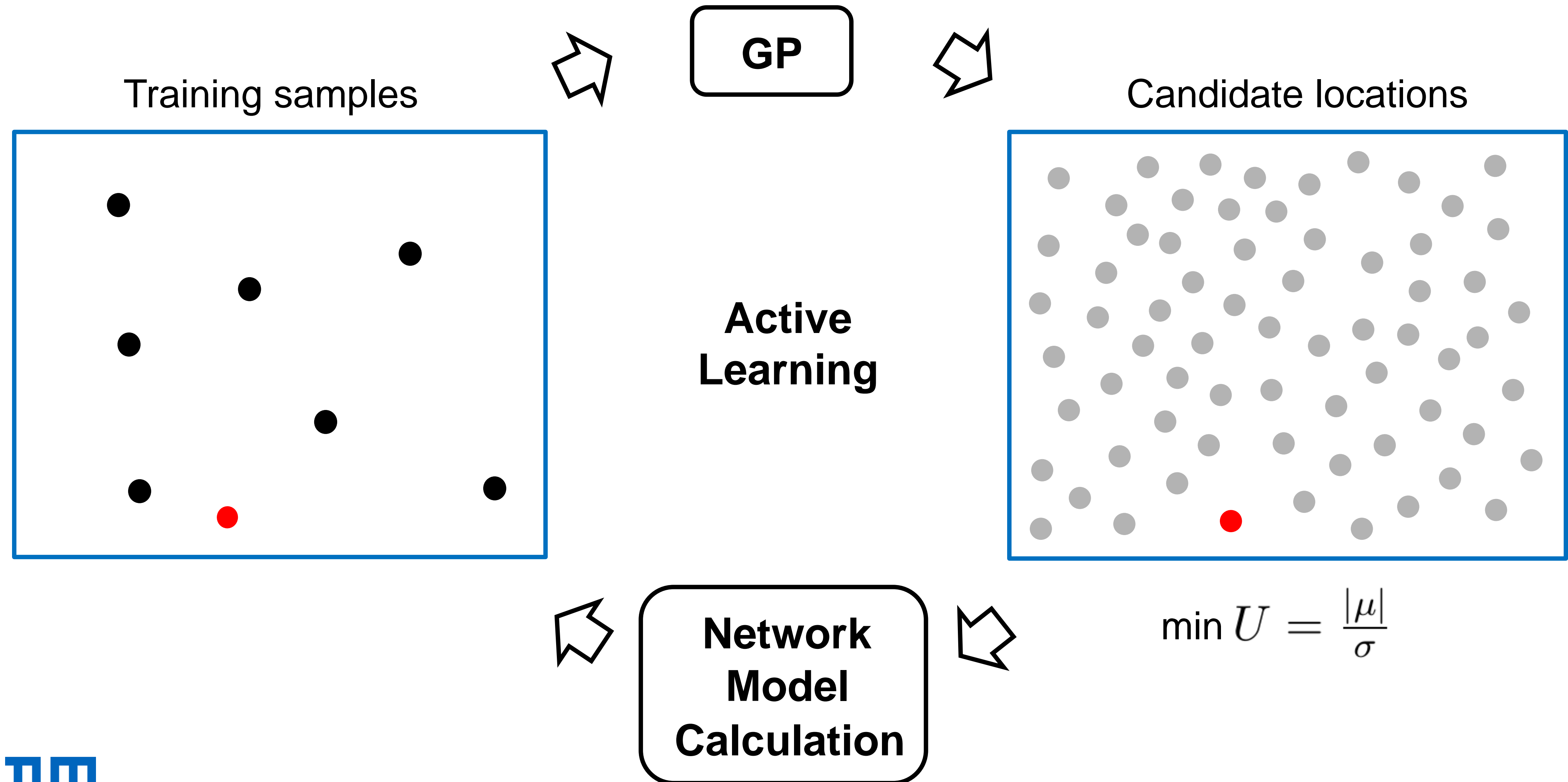
More training samples lead to more robust risk estimation



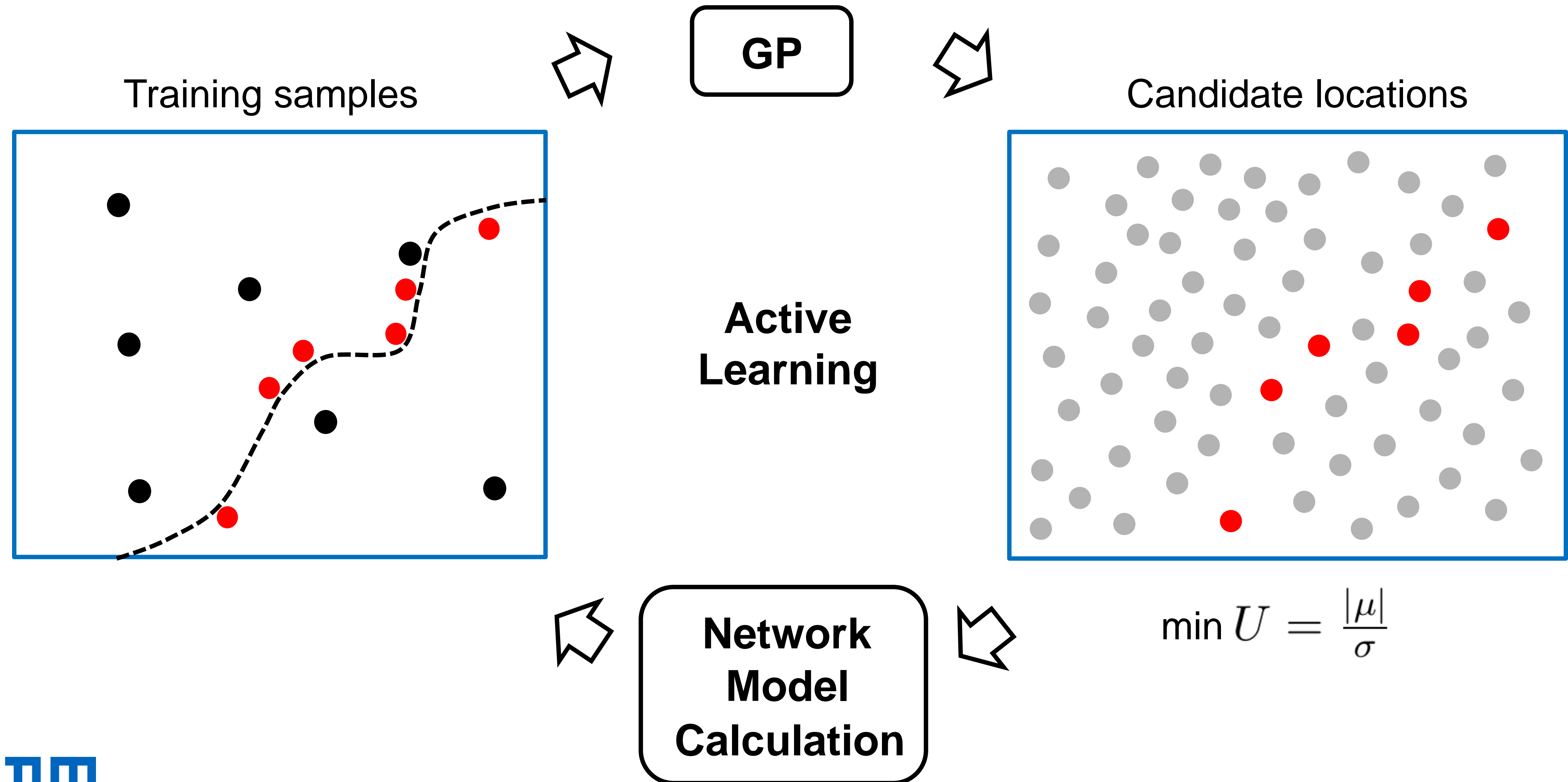
More training samples should be allocated in the vicinity of the stability margin



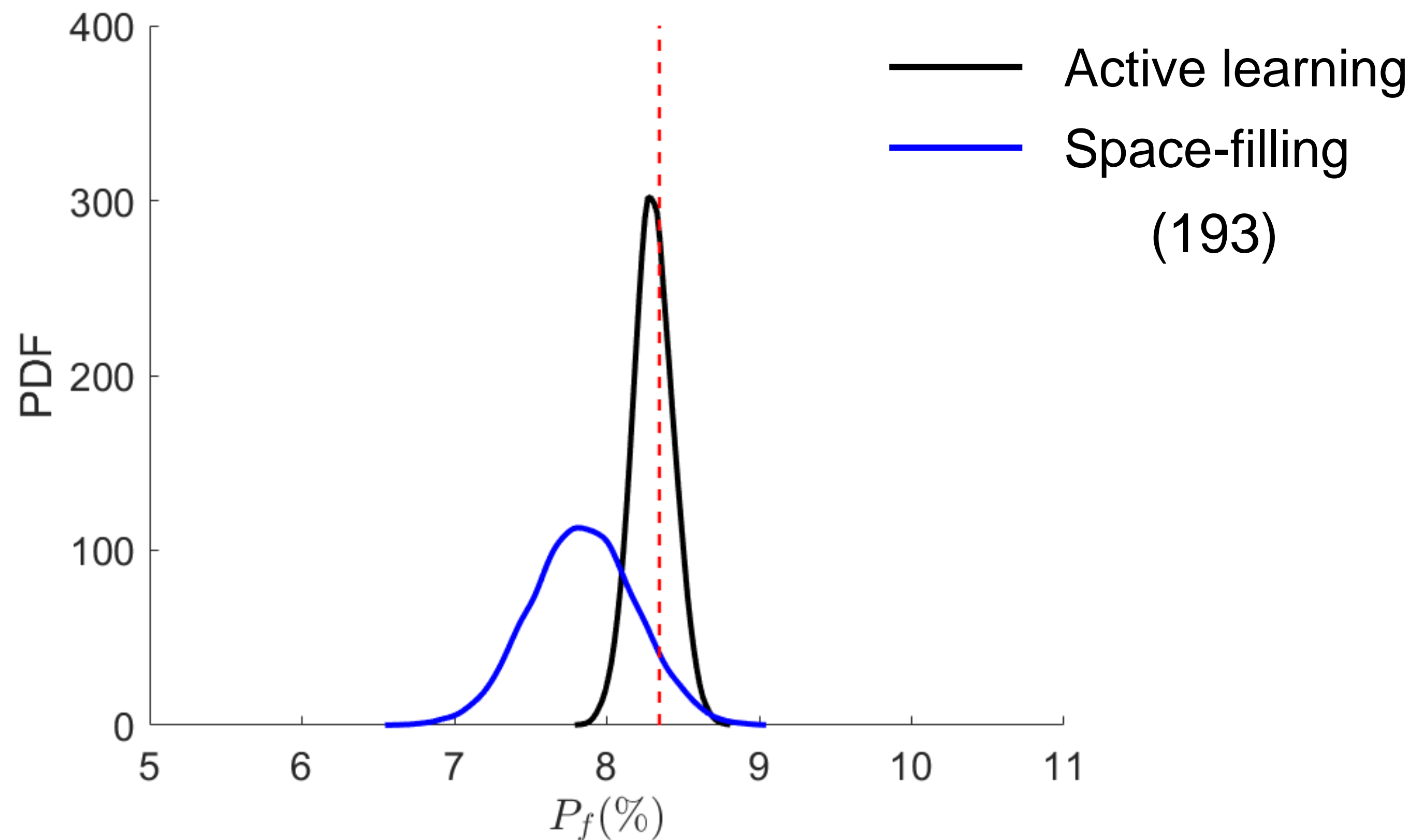
An active learning scheme is adopted to enrich the training dataset



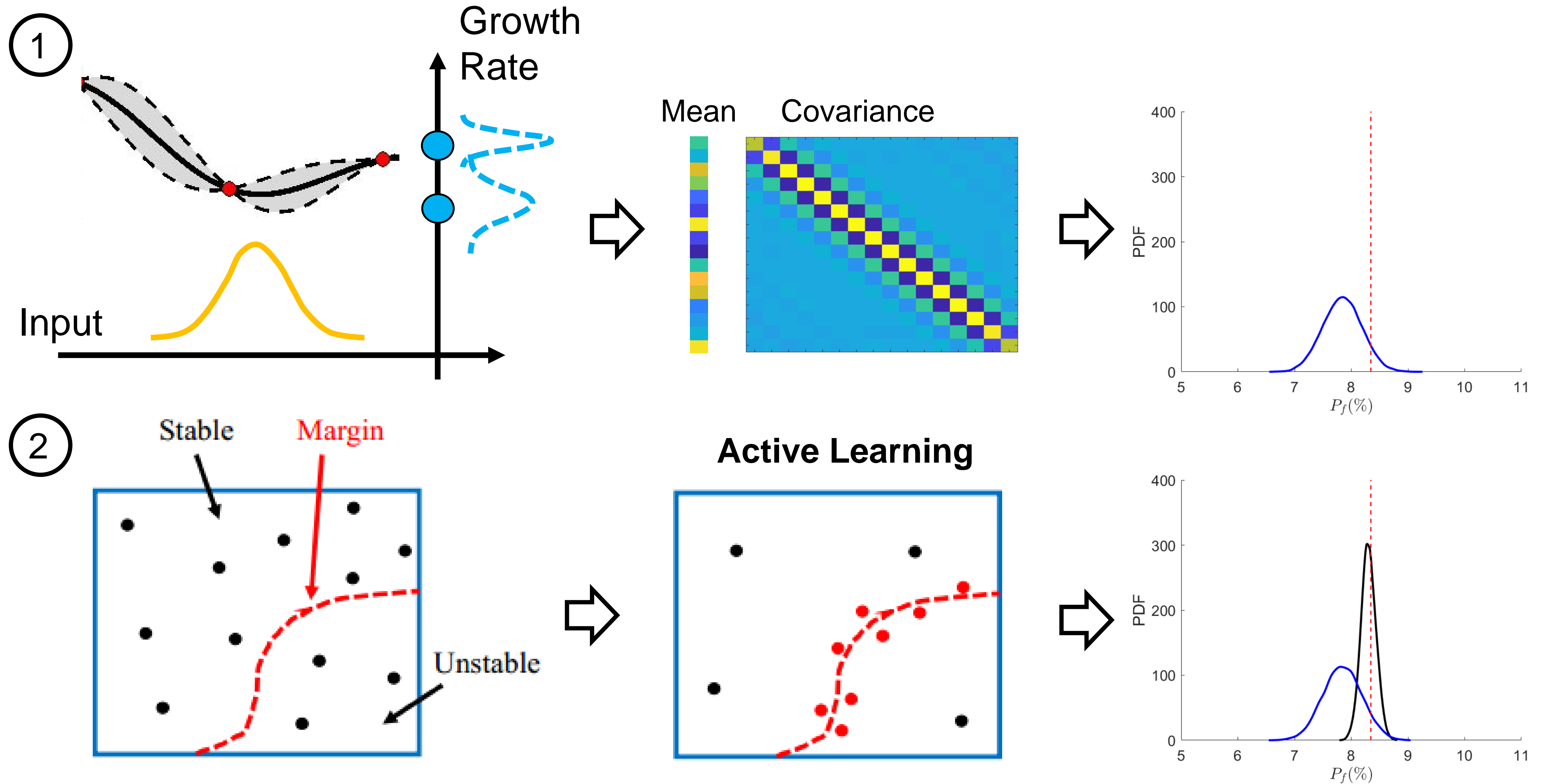
An active learning scheme is adopted to enrich the training dataset



Active learning scheme delivers a more robust risk estimation given the same number of training samples



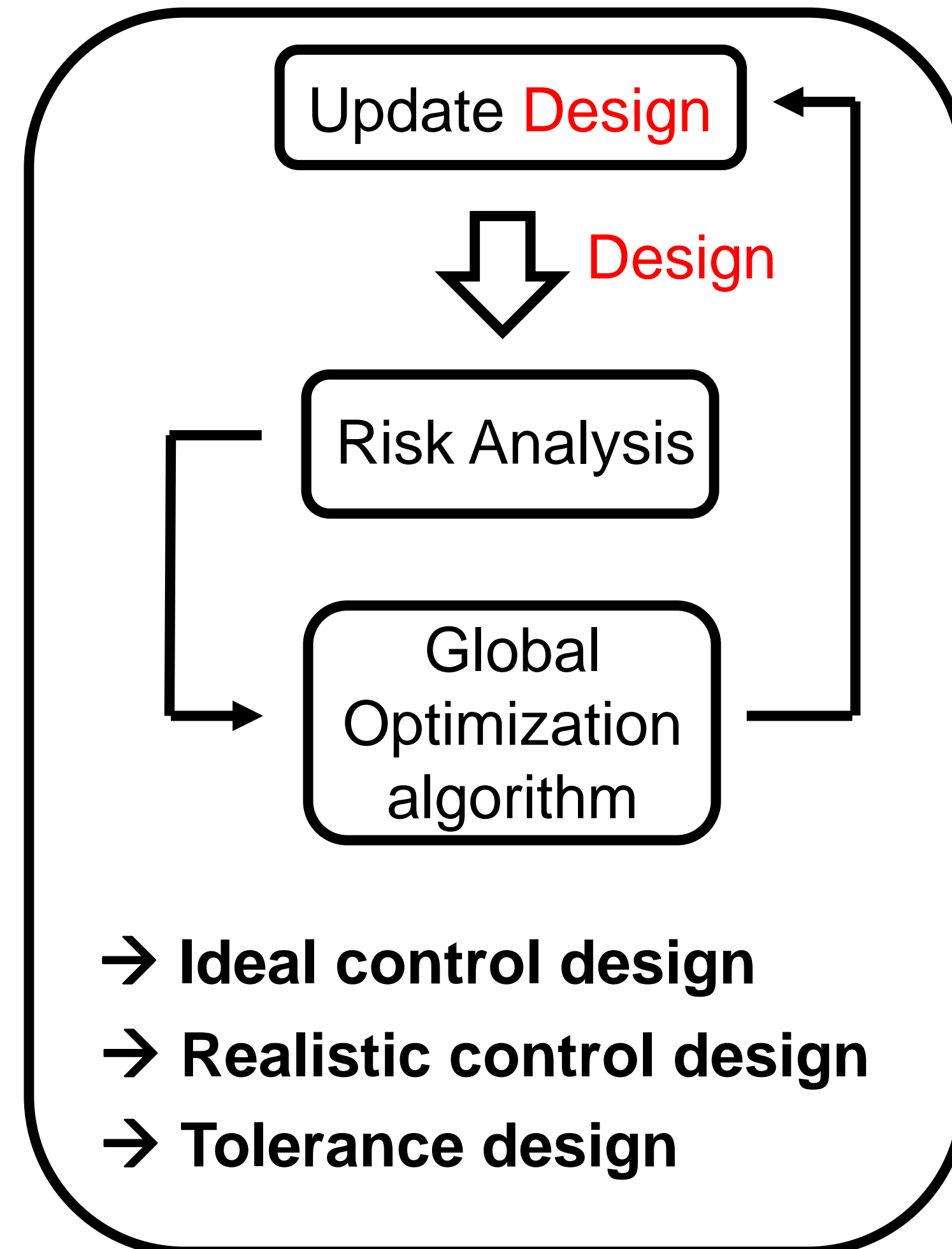
Conclusion



The current study belongs to a larger effort for mitigating the thermoacoustic instability risk

Efficient robust design for thermoacoustic instability analysis: A Gaussian Process approach

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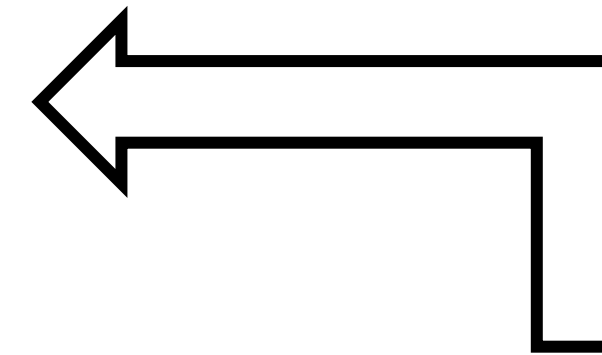
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Reliable calculation of thermoacoustic instability risk using an imperfect surrogate model

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Quantify risk calculation variation

Reduce risk calculation variation

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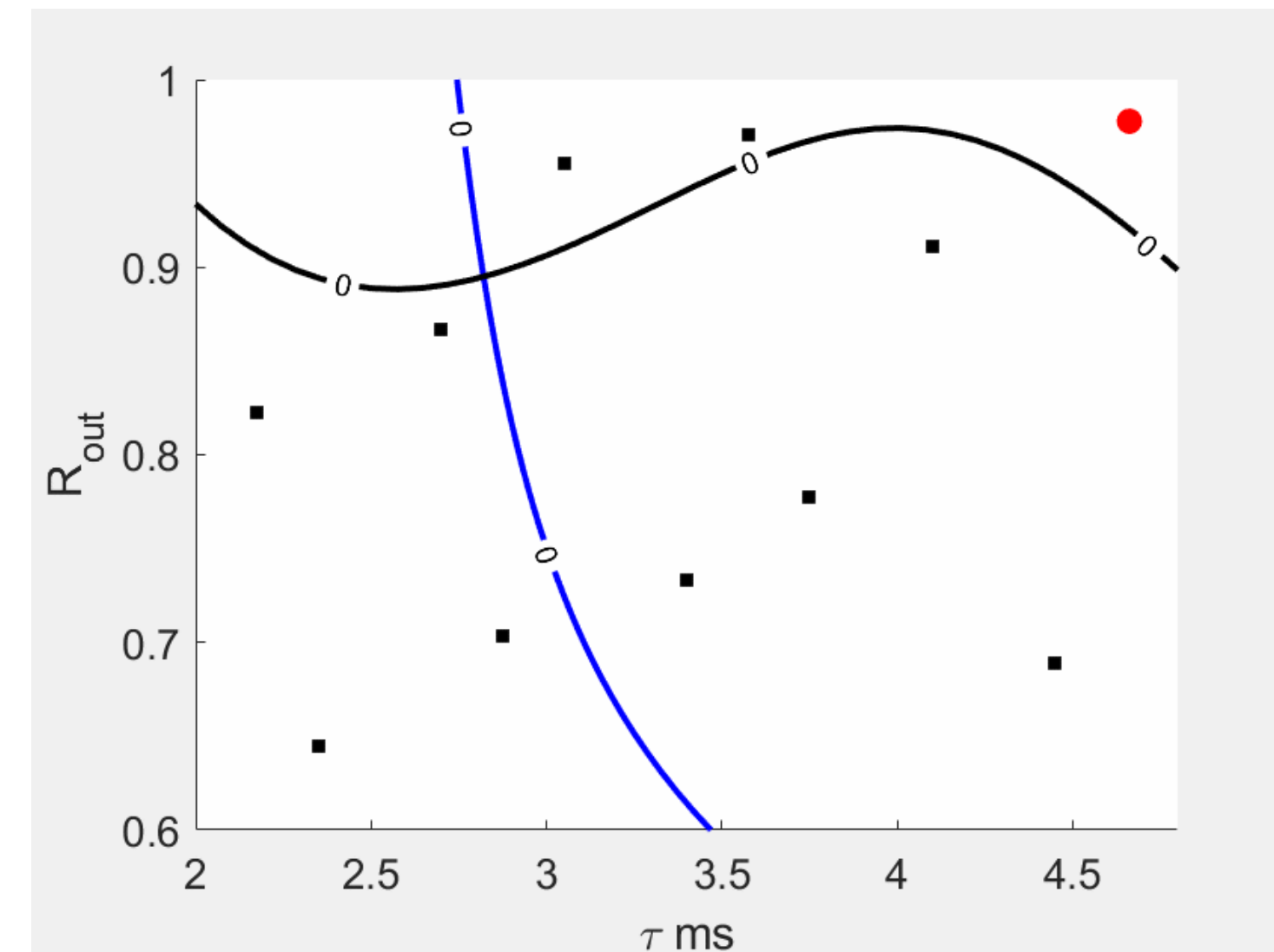
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Calculating thermoacoustic **system** instability risk using imperfect surrogate models



- Improved training scheme

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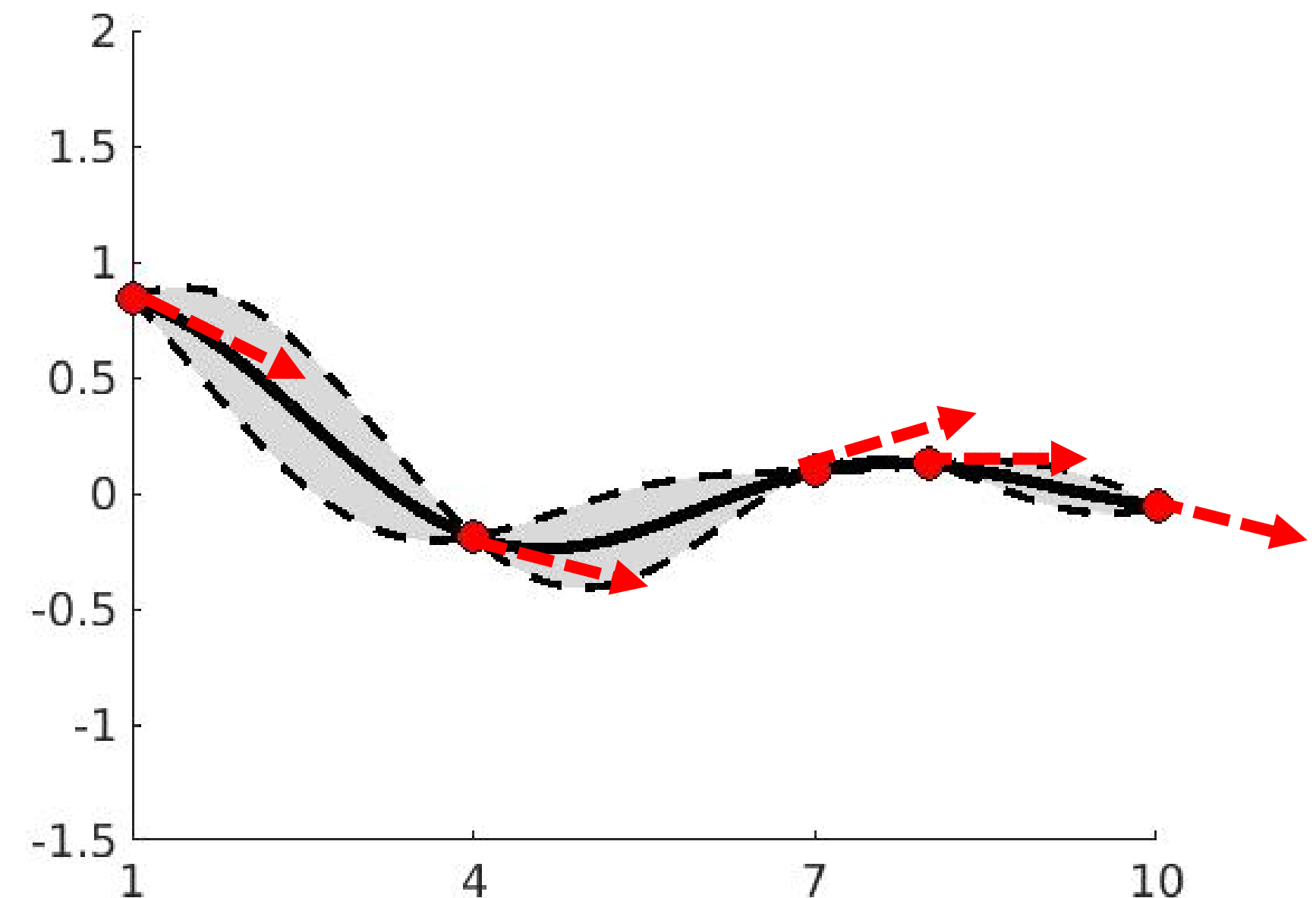
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Calculating thermoacoustic **system** instability risk using imperfect surrogate models



- Improved training scheme
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Calculating thermoacoustic **system** instability risk using imperfect surrogate models

- Improved training scheme
- Gradient-enhanced GP
- Helmholtz solver instead of network model
- More uncertain parameters and larger variational ranges

Conclusion

