Motivation: Parameter Estimation

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Machine Learning

▸ ML's goals: **predict** the world, and **optimise** outcomes

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- In ML, we use data to improve understanding
- To express our understanding, we use **probability**

<div align="center">

Machine Learning and Statistics
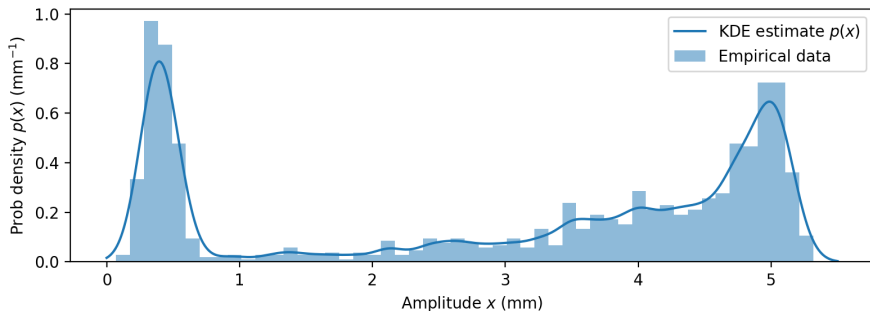are **almost the same**

</div>

Example: The shaking desk

Figure: xkcd #228

- Why is it shaking?
- How can I stop it?
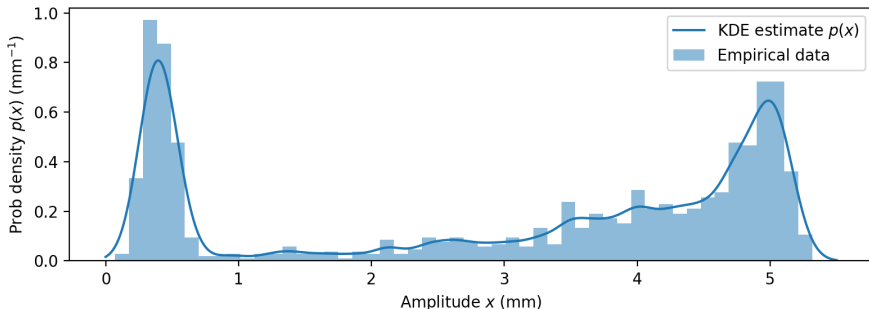- How much will it shake?

The shaking desk: Gathering data

Measure amplitude at various fixed points during the day.
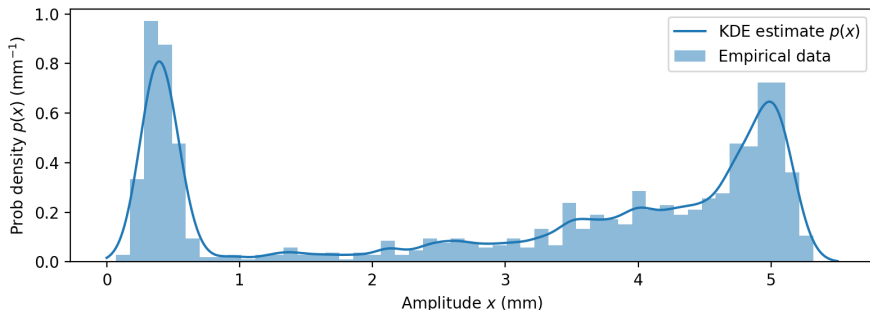
The shaking desk: Gathering data

Measure amplitude at various fixed points during the day.

‣ Can we predict whether the shaking will happen?
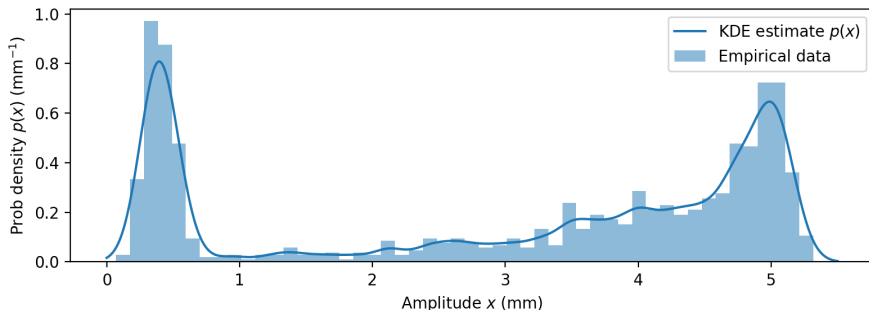
The shaking desk: Gathering data

Measure amplitude at various fixed points during the day.

- Can we predict whether the shaking will happen? ▶▶ No.
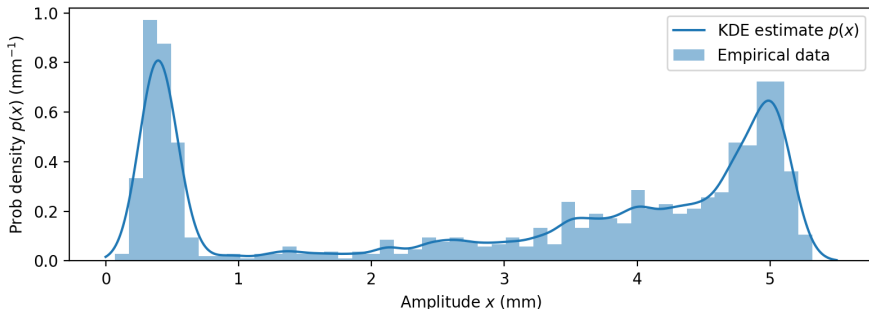
The shaking desk: Gathering data

Measure amplitude at various fixed points during the day.

- ▸ Can we predict whether the shaking will happen? ▶▶ No.
- ▸ Does this give **some** information about our world?
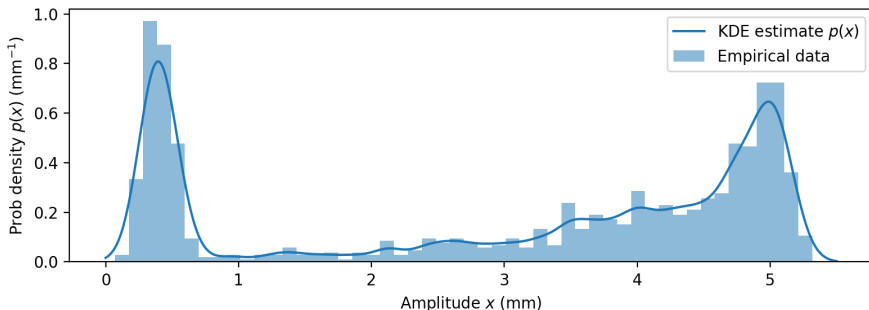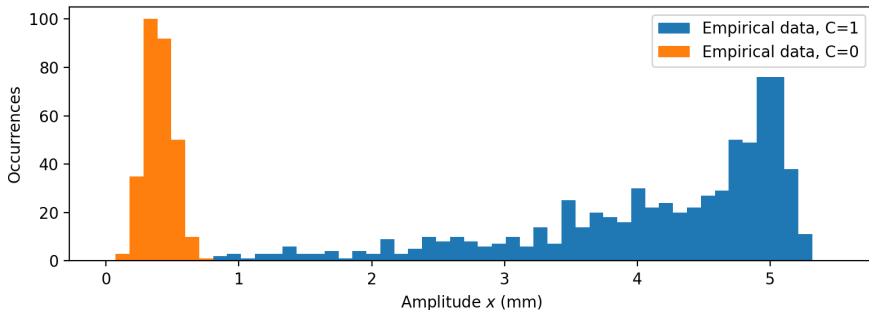
The shaking desk: Gathering data

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- ▸ Can we predict whether the shaking will happen? ▸▸ No.
- ▸ Does this give **some** information about our world? ▸▸ Yes!

The shaking desk: Gathering data

Measure amplitude at various fixed points during the day.

- ▸ Can we predict whether the shaking will happen? ▶▶ No.
- ▸ Does this give **some** information about our world? ▶▶ Yes!
- ▸ We can at least predict: Unlikely to be small amplitude.

The shaking desk: Gathering data

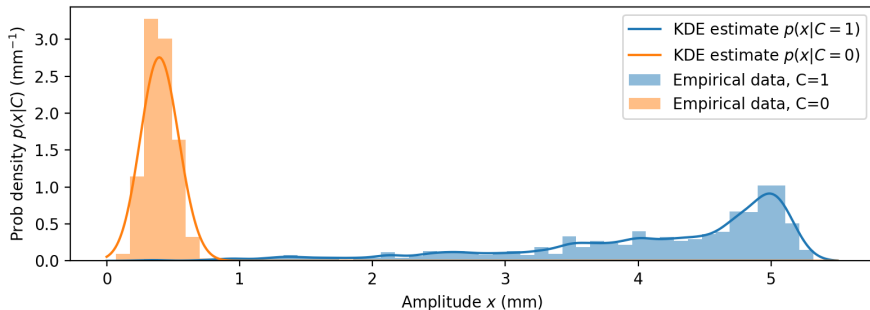More data: Also measure whether your colleague is present (C).

With this data...

- It seems that $C = 1$ indicates larger shaking
- Given C, we can now predict with more certainty!

The shaking desk: Gathering data

More data: Also measure whether your colleague is present (*C*).

With this data...

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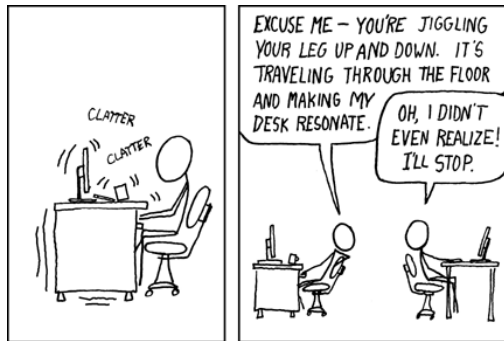- Given C, we can now predict with more certainty!

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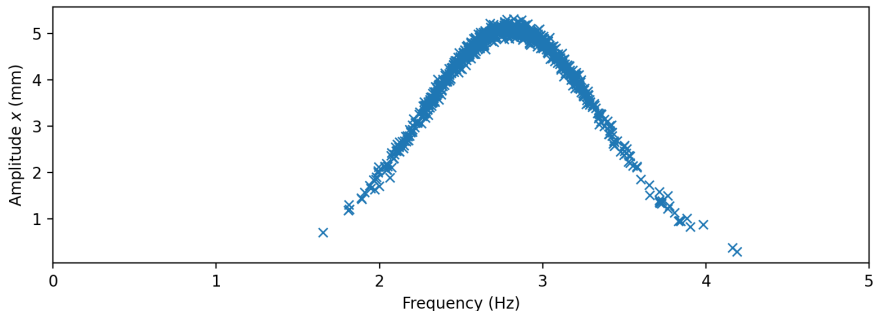

Figure: xkcd #228

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- How can I stop it?
- How much will it shake?

The shaking desk: Gathering more data

More data: Also measure whether your colleague is present (*C*).

With this data...

▸ We should be able to predict the amplitude very accurately!

▸ Uncertainty reduces, predictions improve.

Example: The shaking desk
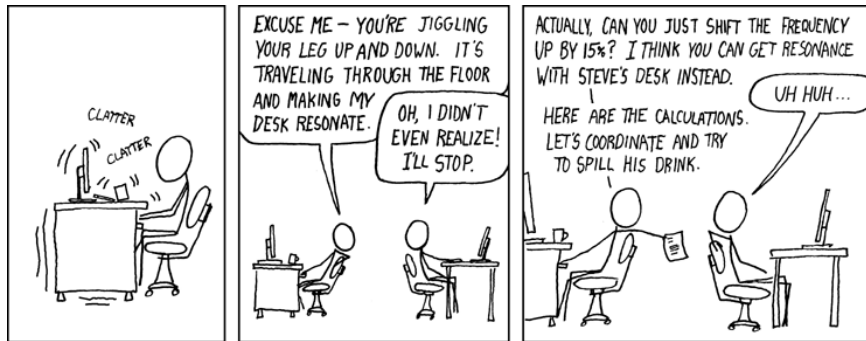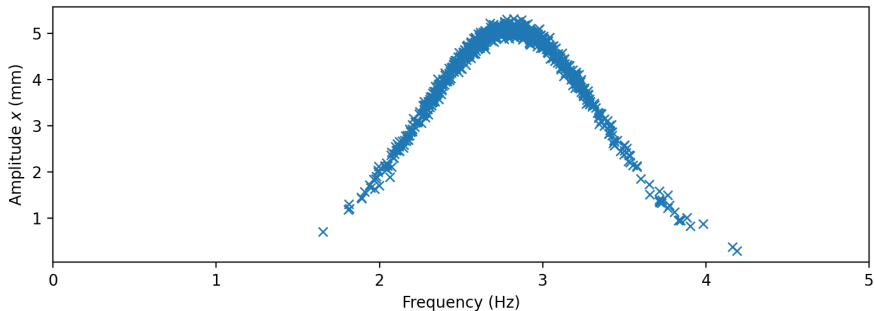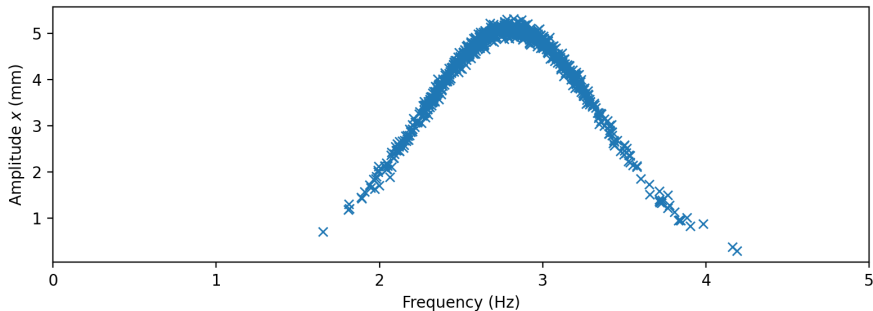

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Curve Fitting

Curve fitting problem!

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Regression