Introduction to Machine Learning

Image recognition in Python and Tensorflow

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Introduction

Esten H. Leonardsen
(UiO and Biometrical AS)
Interests:
- Talking about esoteric theory
- Making deep learning tutorials

Martin Hovin
(Biometrical AS)
Interests:
- Installing tensorflow
- Debugging Estens code

Introduction

Theory session:

- What is a statistical learning model?
- What is a loss function?
- How do we train a statistical learning model?
- How does a (deep) neural network work?
- What operations does a convolutional neural network use?
- What is transfer learning?
- What is overfitting?
- How do we combat it?

Practical session:

1. Set up a Python-environment containing Tensorflow
2. Use a pretrained convolutional neural network to predict
3. Fit a flower classifier using transfer learning
4. Improve the flower classifier

Introduction

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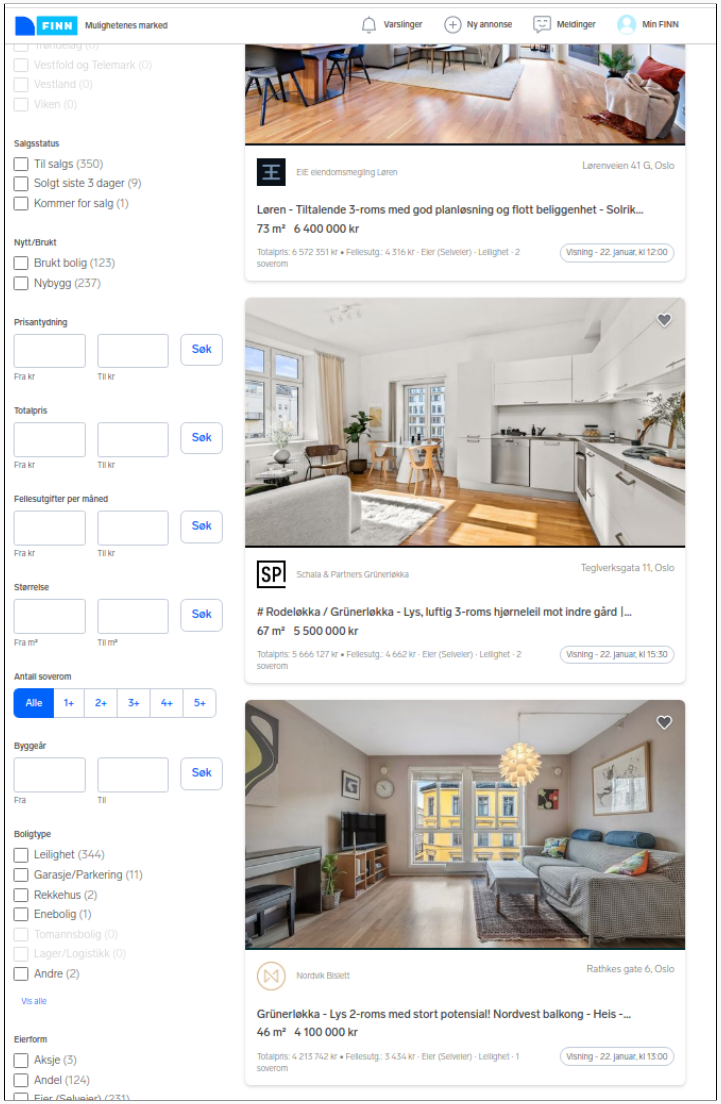
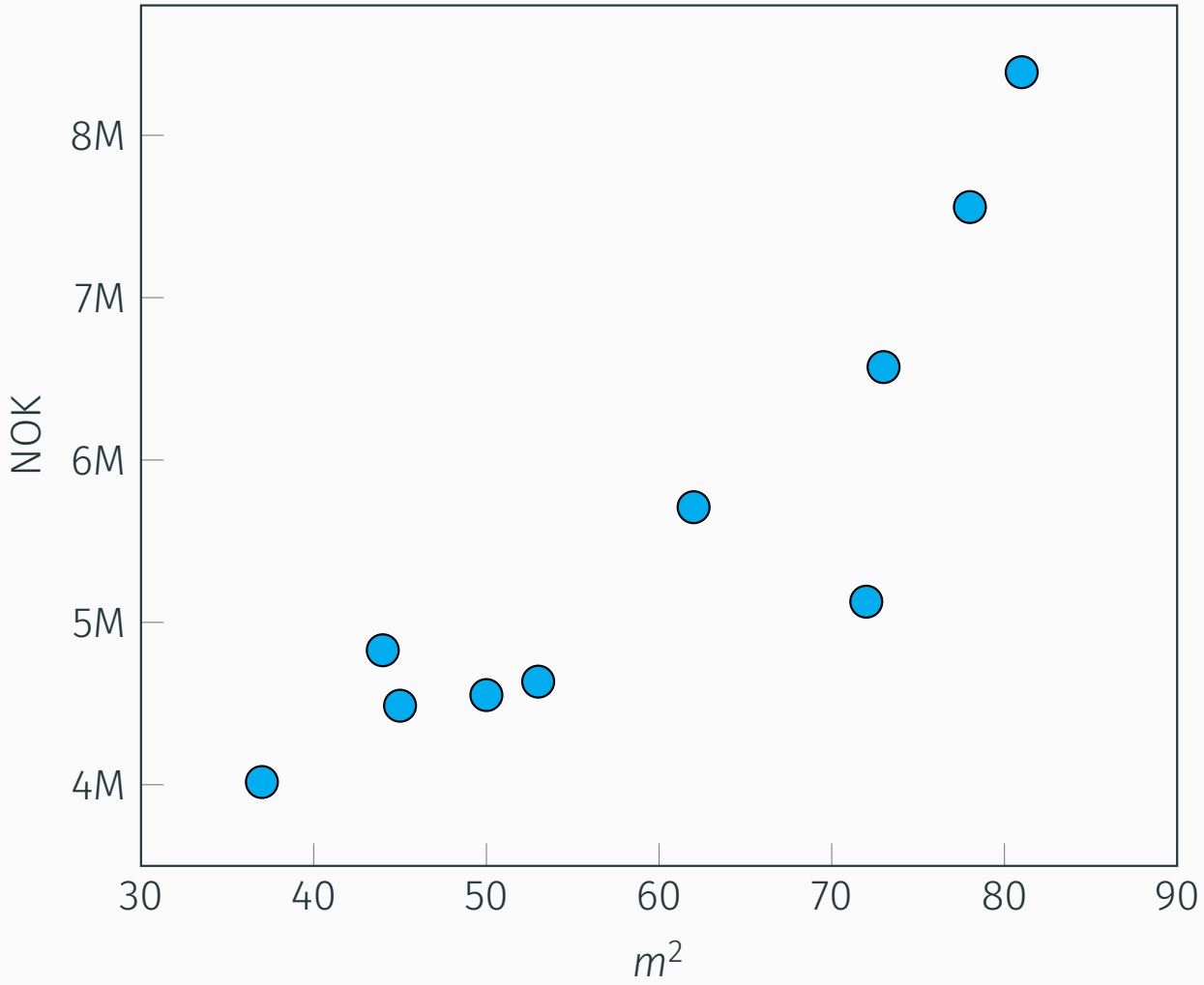
Statistical learning models



Statistical learning models

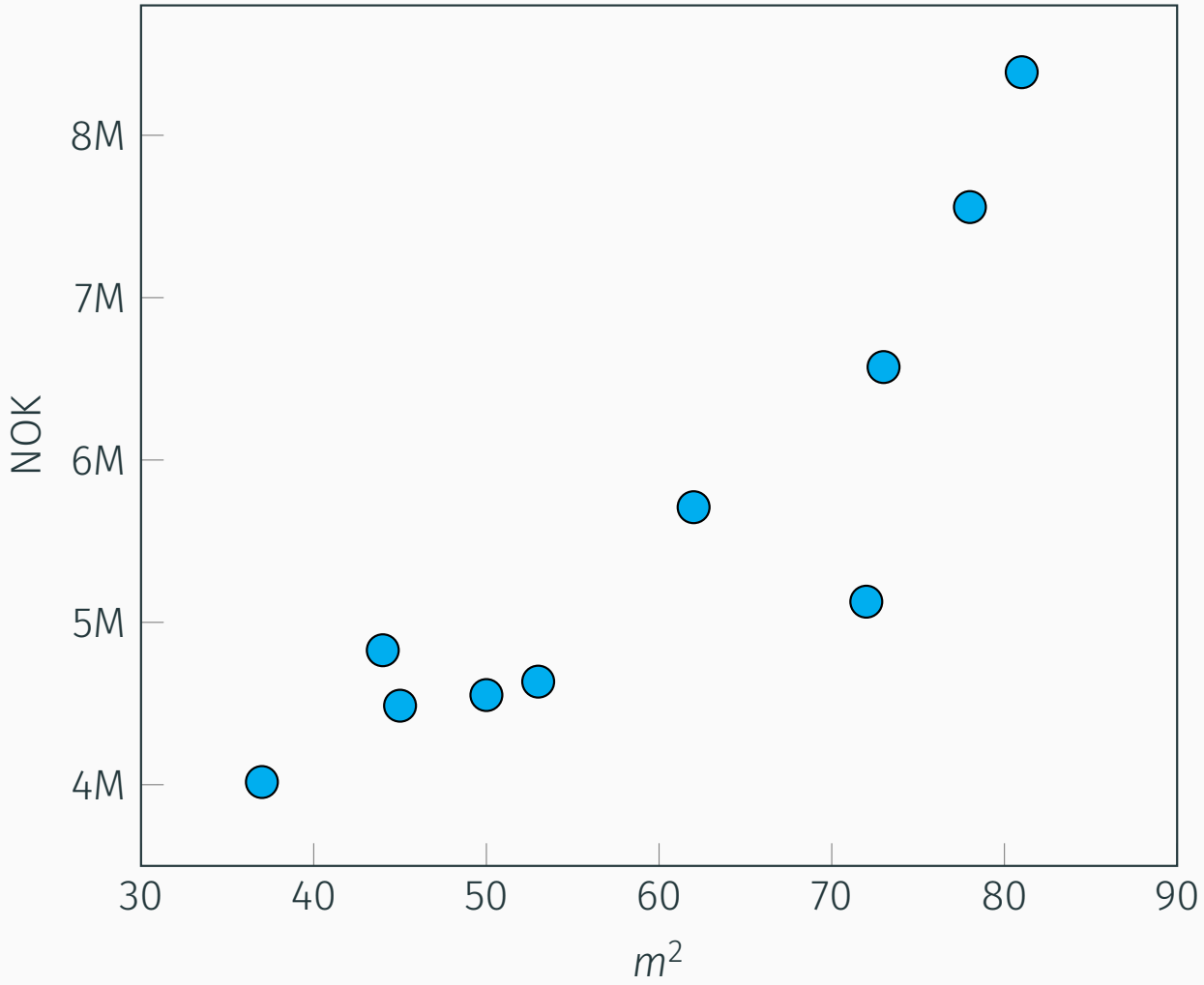
m^2	Price
72	5.127.379
50	4.552.170
45	4.486.654
62	5.709.276
53	4.634.912
81	8.388.570
44	4.828.170
78	7.557.770
37	4.016.520
73	6.572.351

Statistical learning models



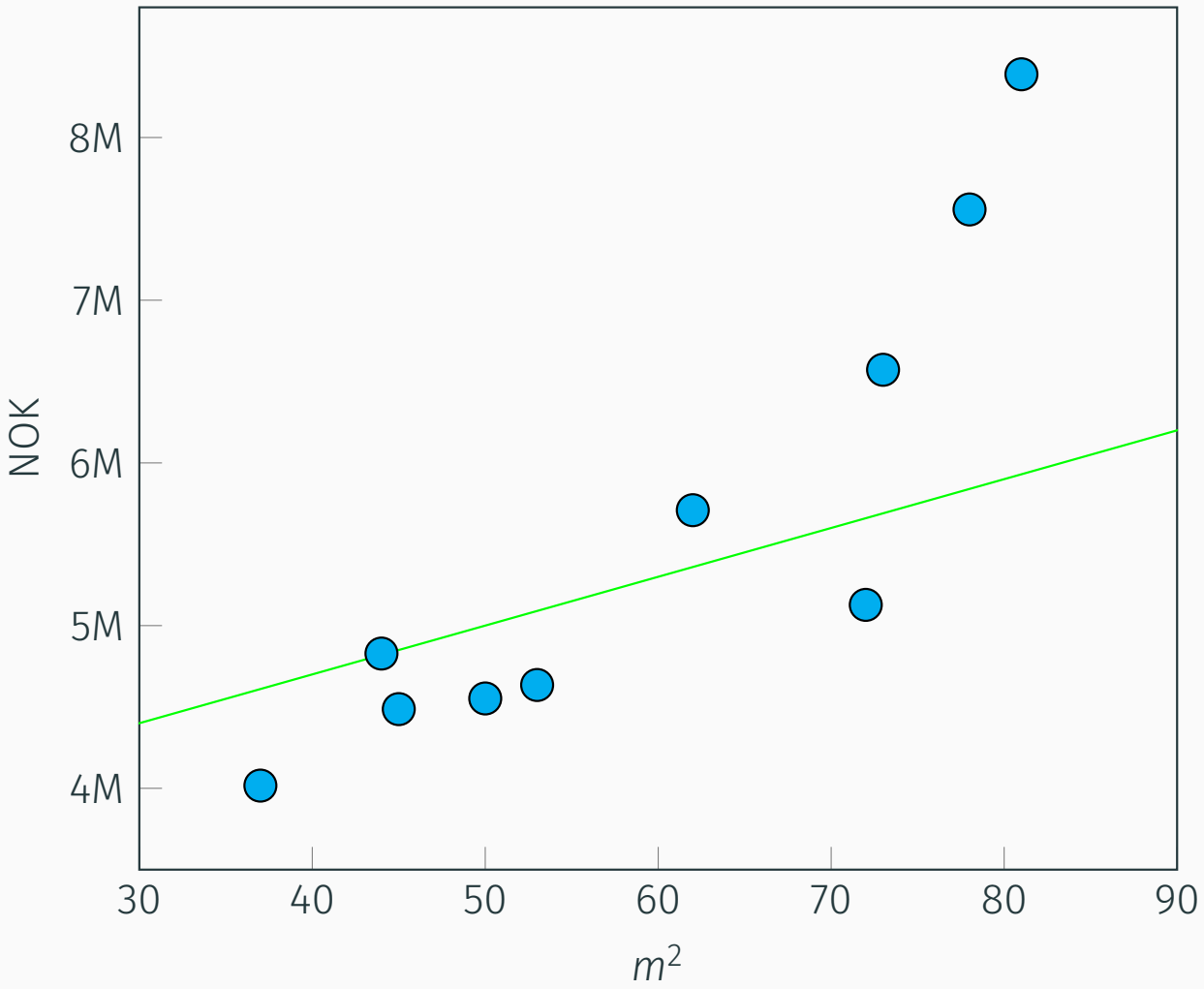
$$\hat{y} = f(x)$$

Statistical learning models



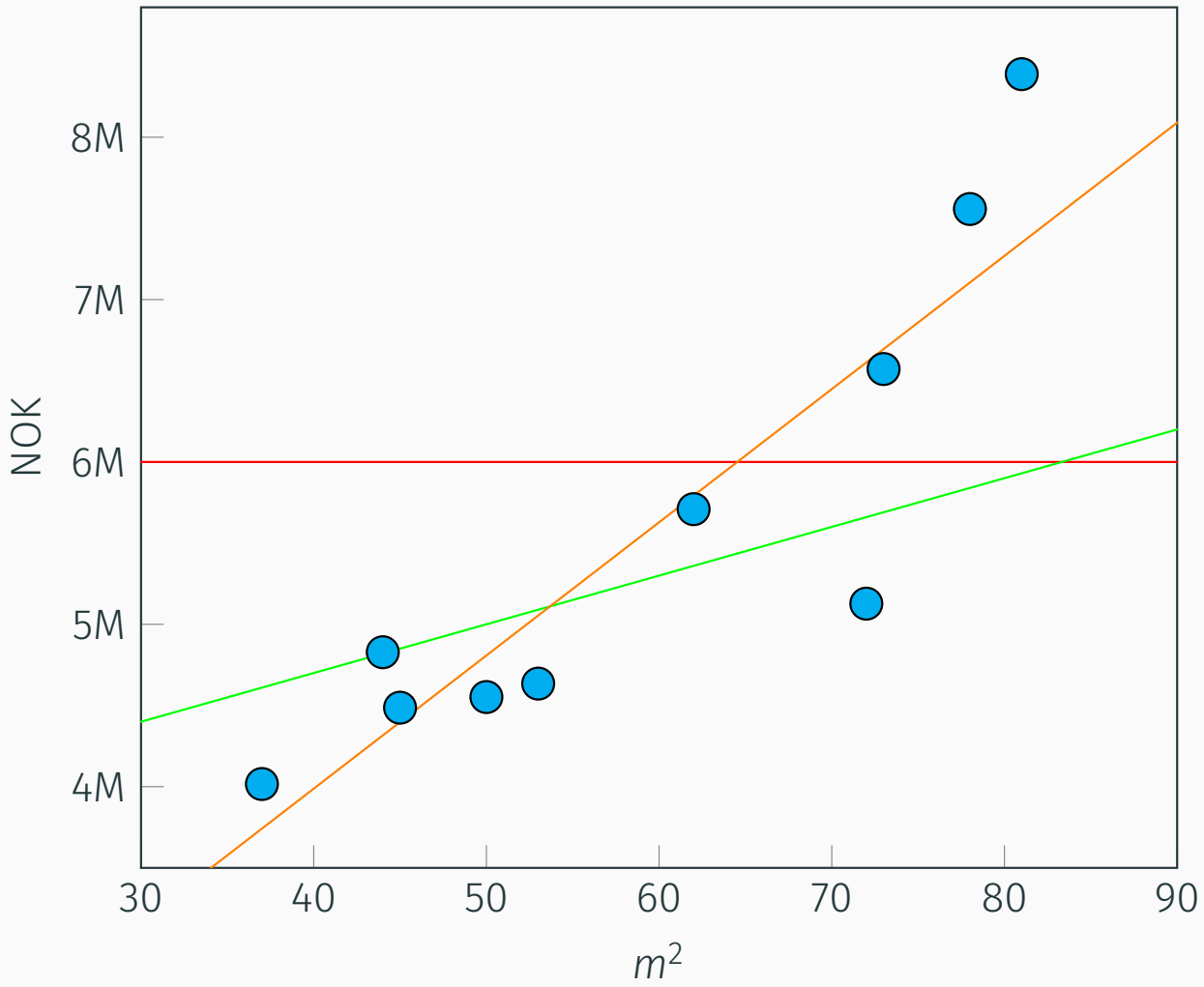
$$\hat{y} = Wx + b$$

Statistical learning models



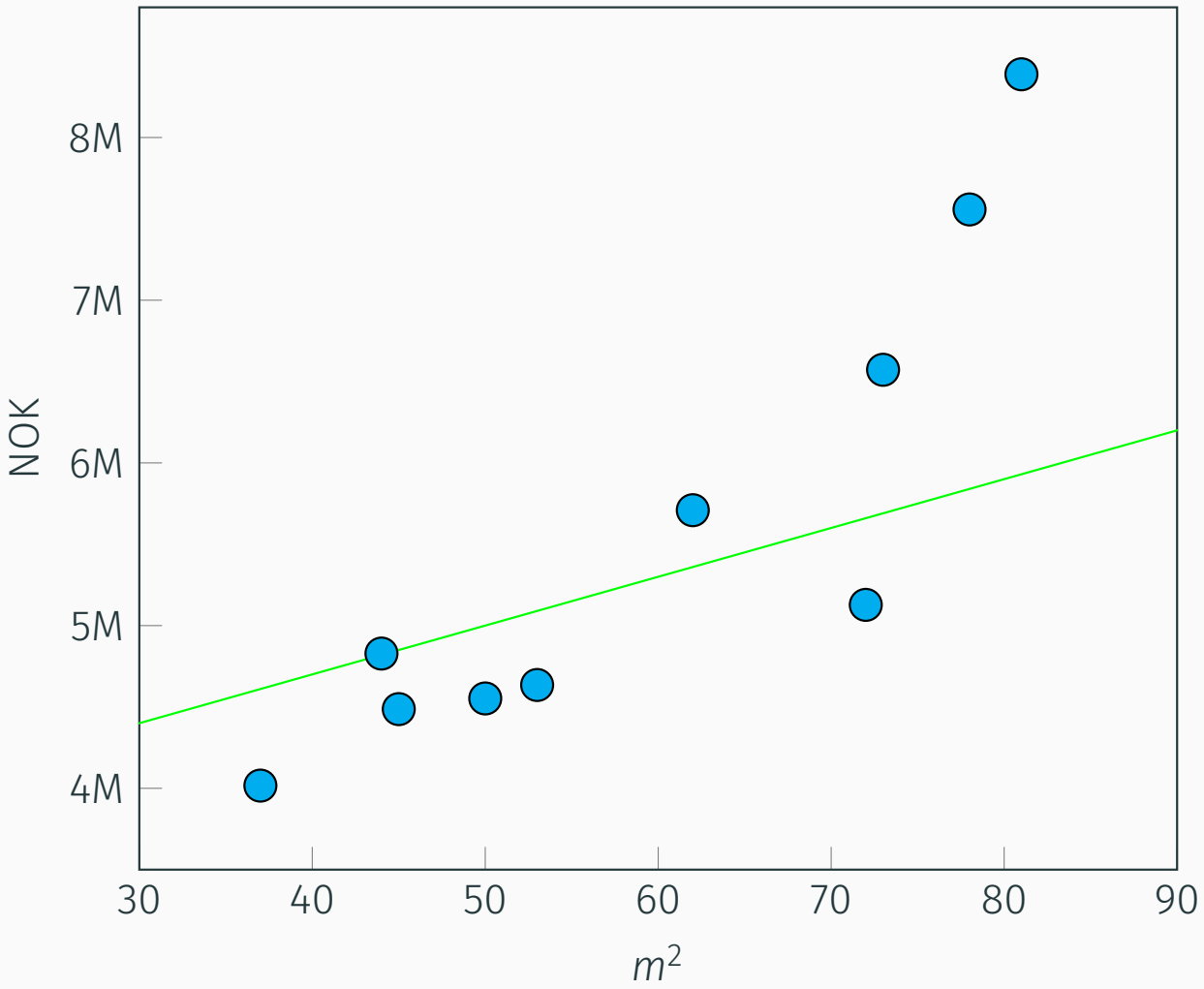
$\hat{y} = 30000x + 3500000$

Statistical learning models



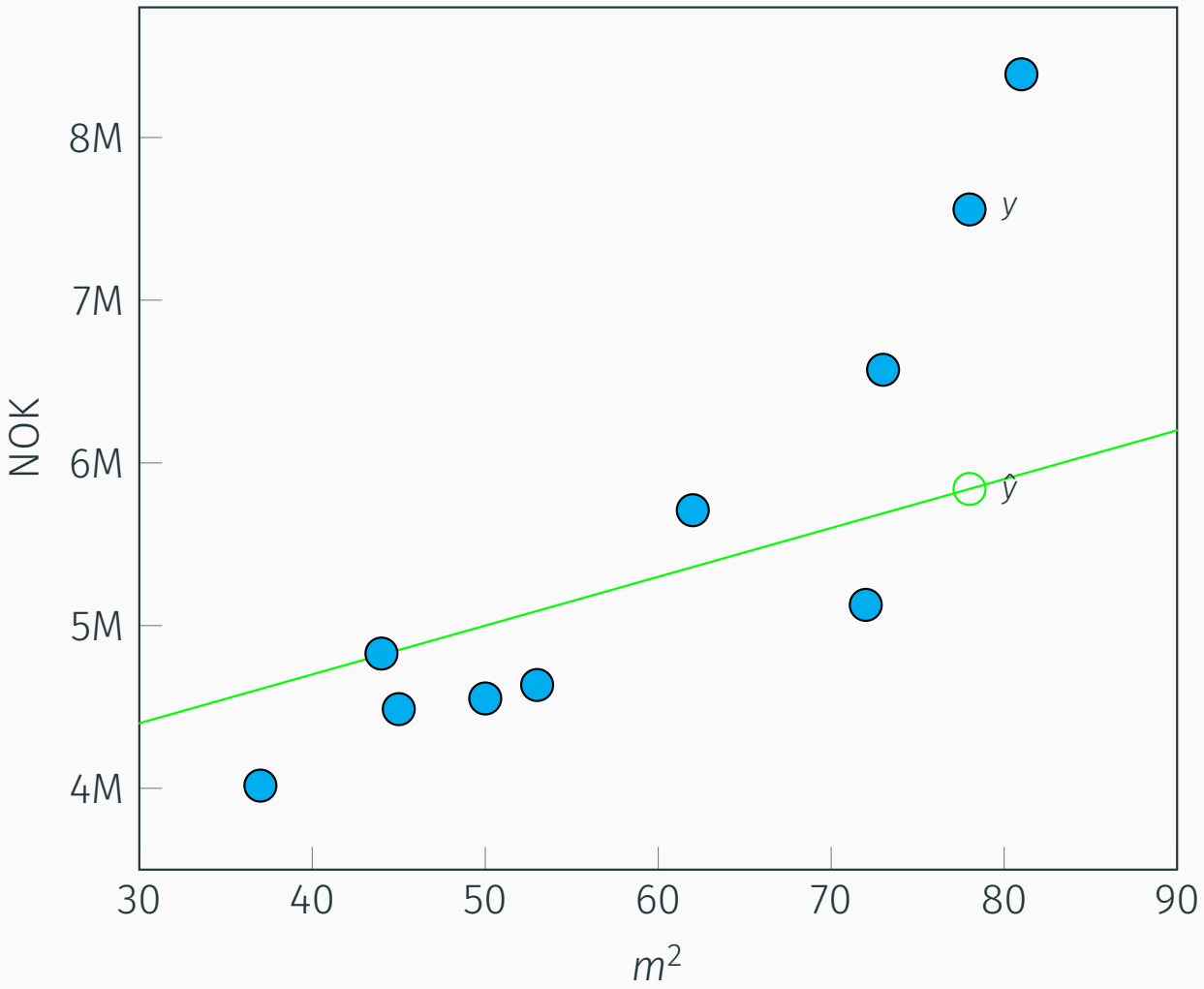
$\hat{y} = 0x + 6000000$ $\hat{y} = 30000x + 3500000$ $\hat{y} = 82031x + 706495$

Loss functions



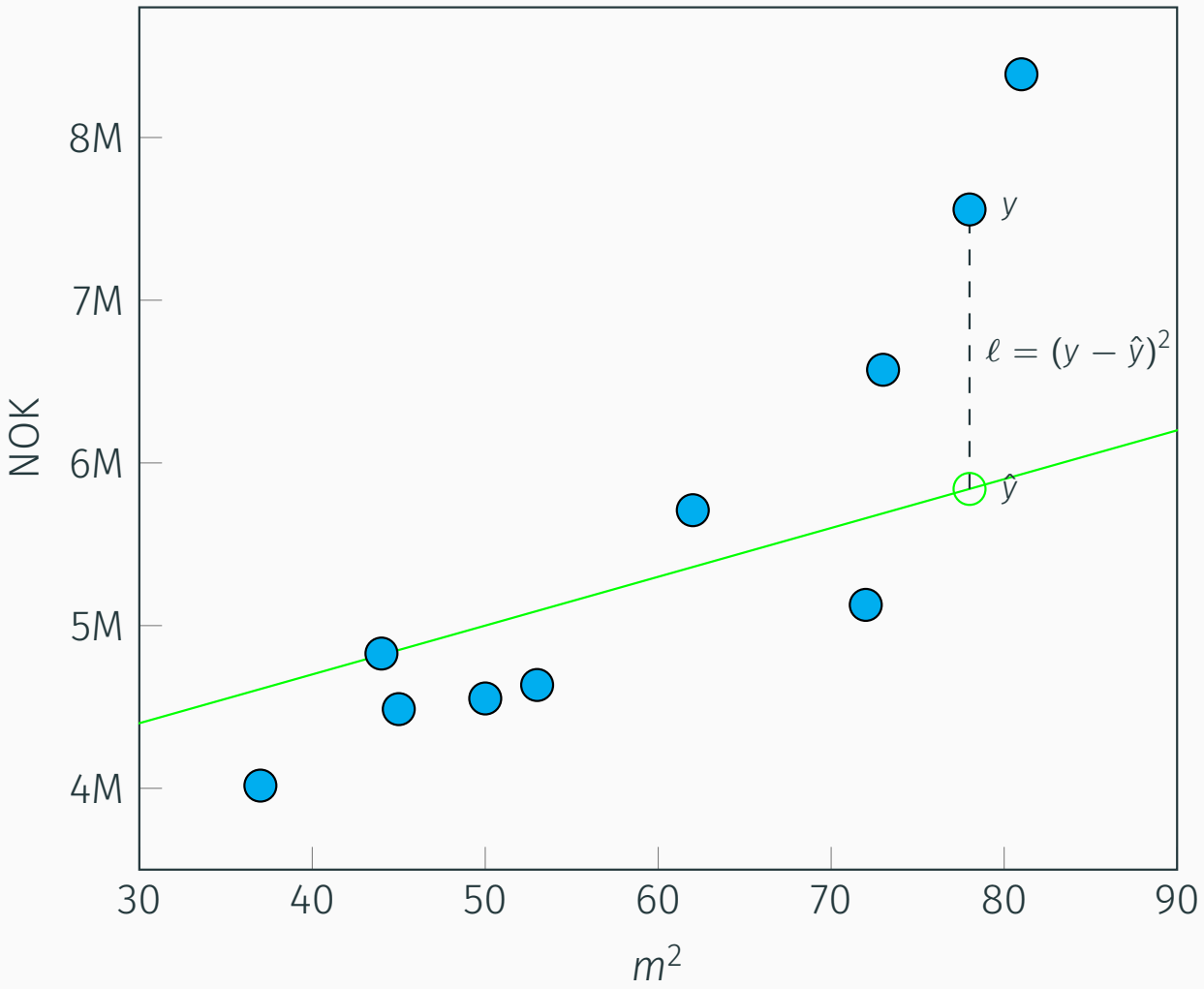
$\hat{y} = 30000x + 3500000$

Loss functions



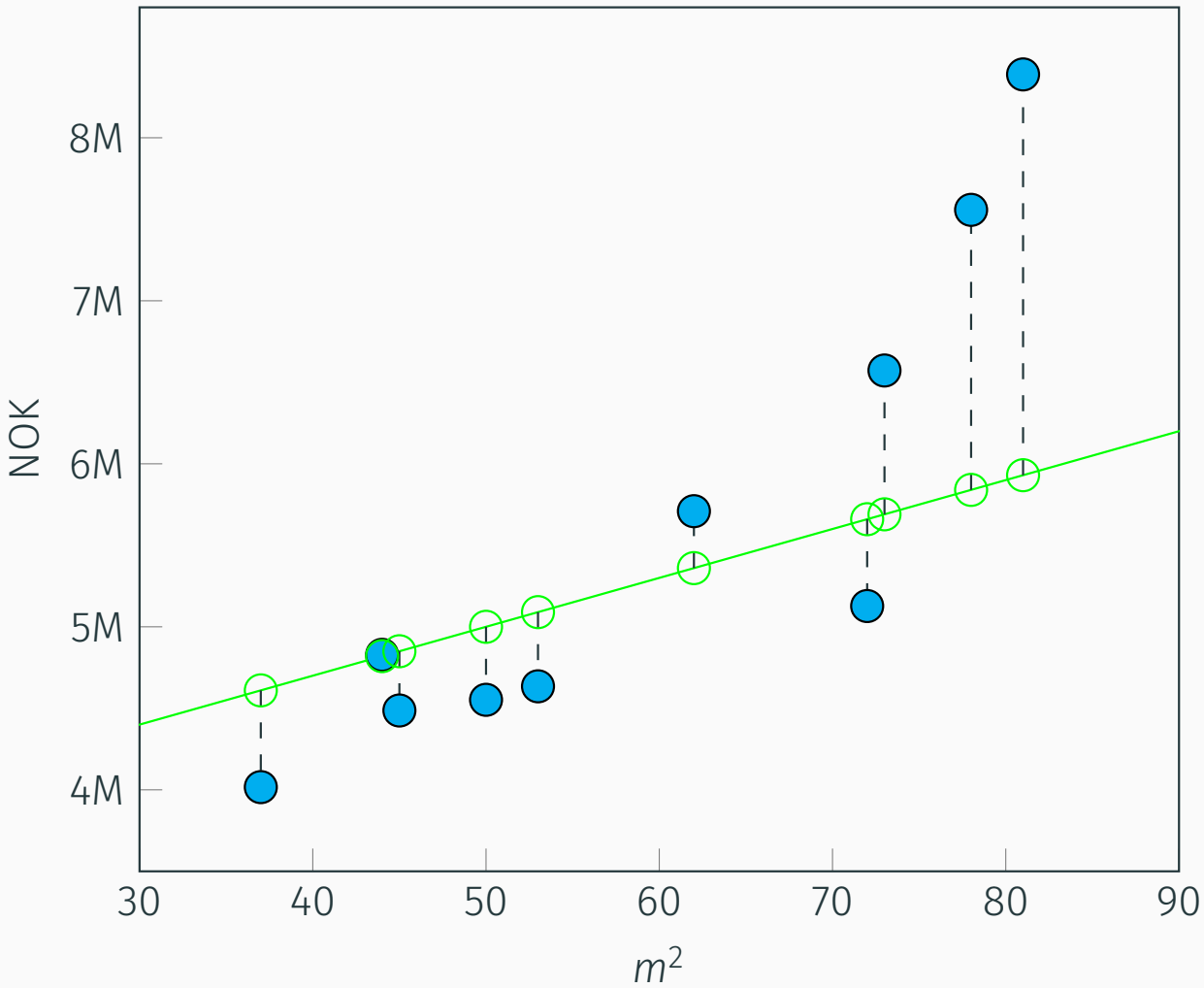
$$\hat{y} = 30000x + 3500000$$

Loss functions



$\hat{y} = 30000x + 3500000$

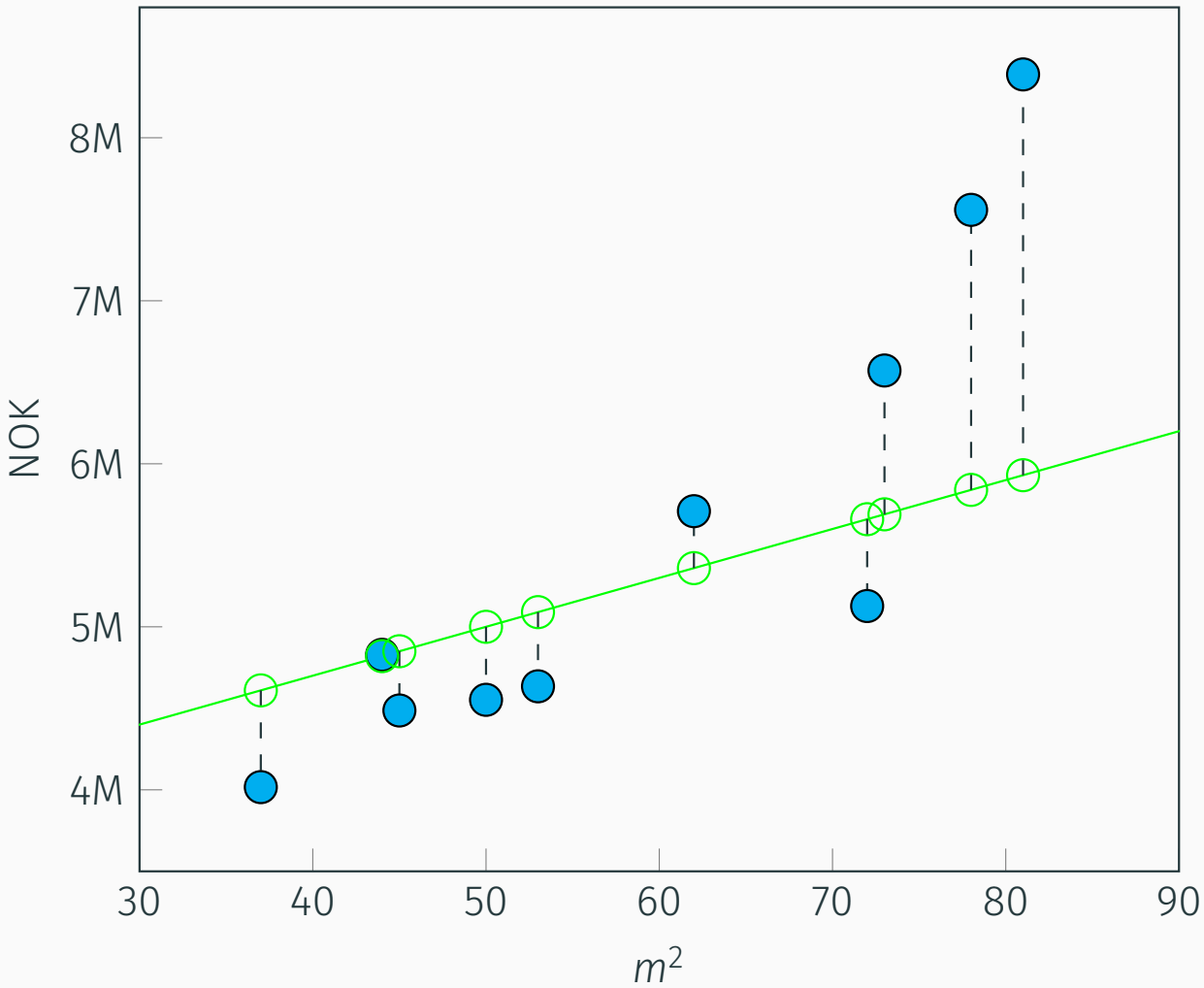
Loss functions



$$\hat{y} = 30000x + 3500000$$

$$\ell = \sum (y - \hat{y})^2$$

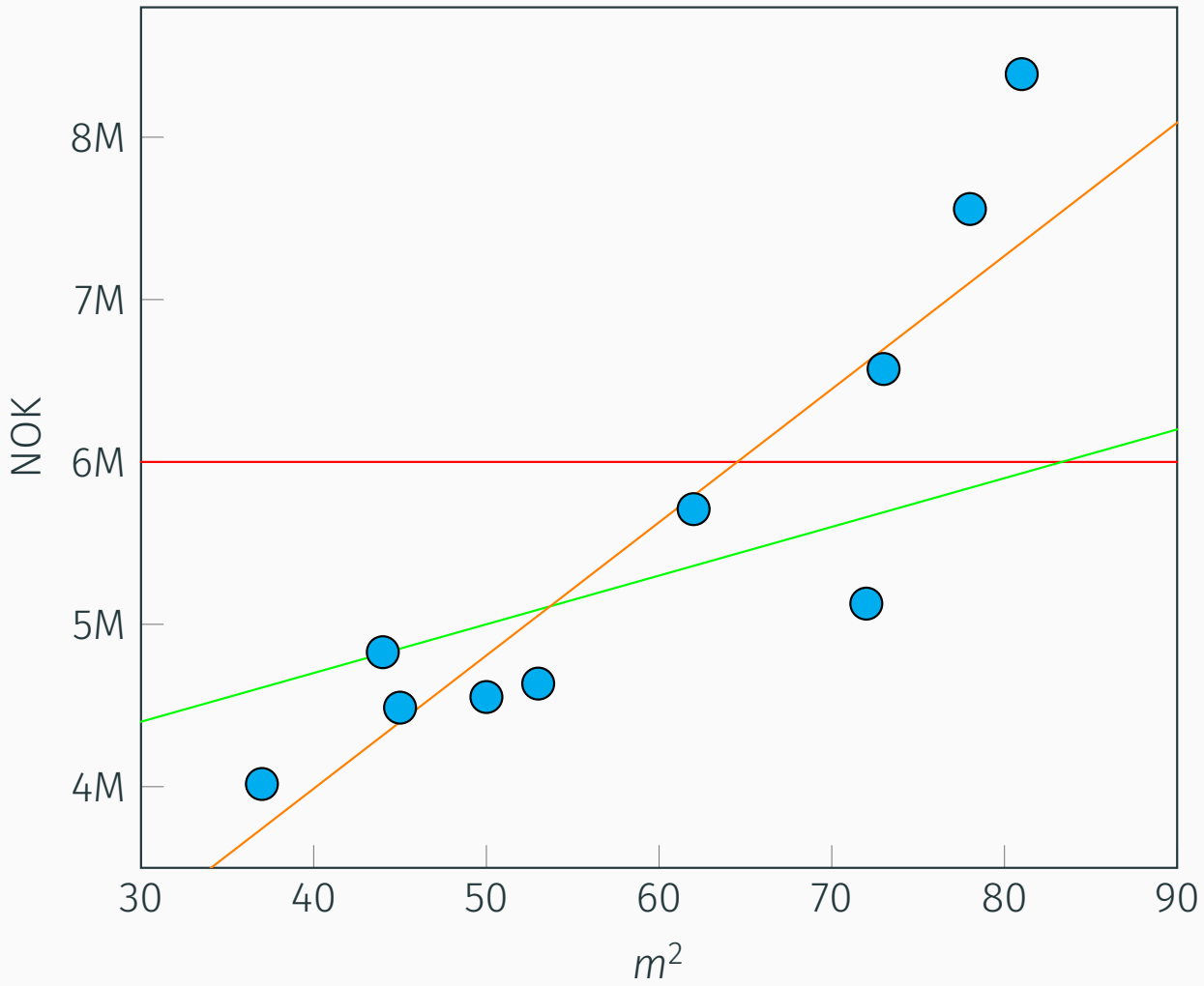
Loss functions



$$\hat{y} = 30000x + 3500000$$

$$\ell = 1.10 \times 10^{13}$$

Loss functions

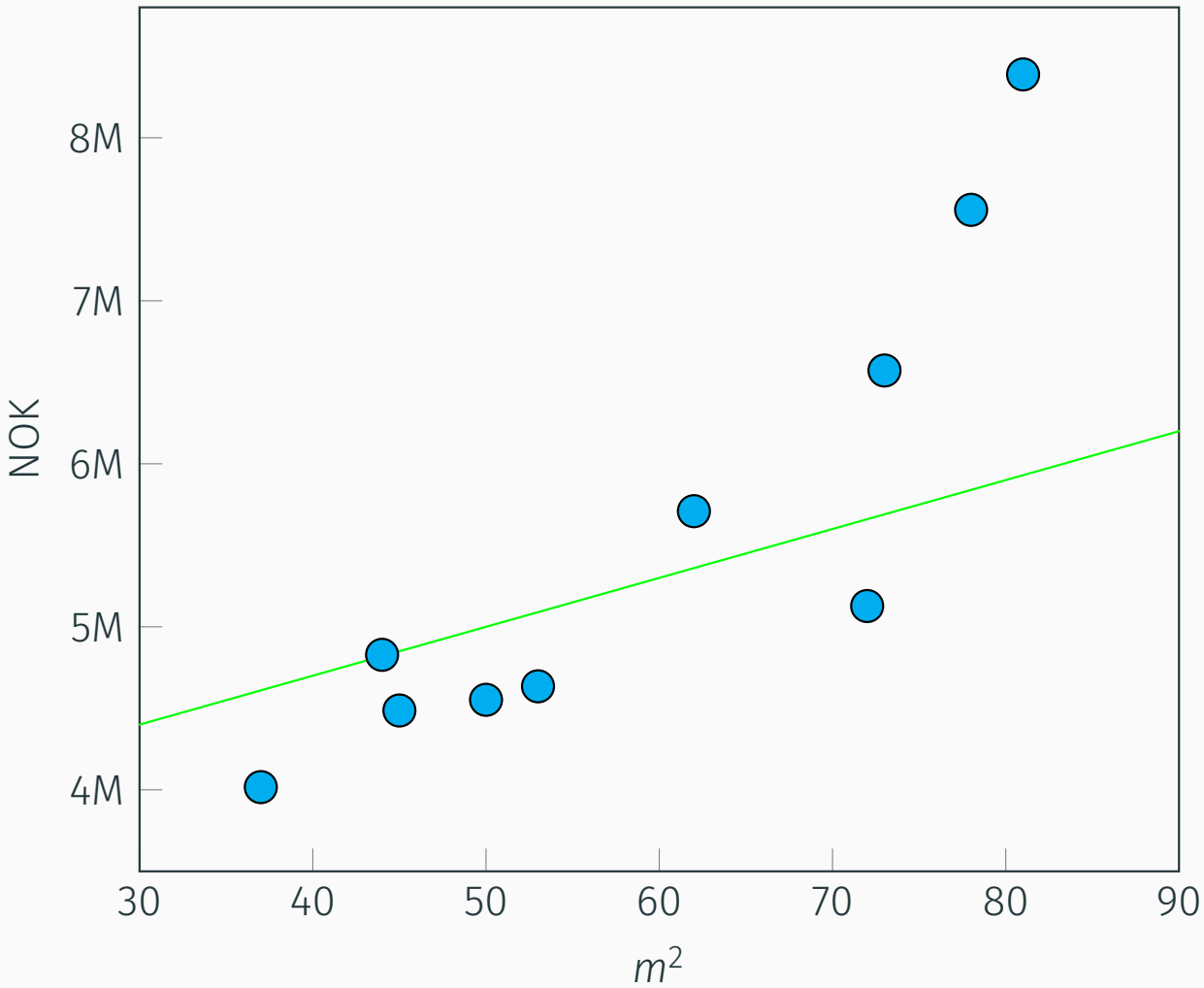


$\hat{y} = 0x + 6000000$
$\ell = 2.08 \times 10^{13}$

$\hat{y} = 30000x + 3500000$
$\ell = 1.10 \times 10^{13}$

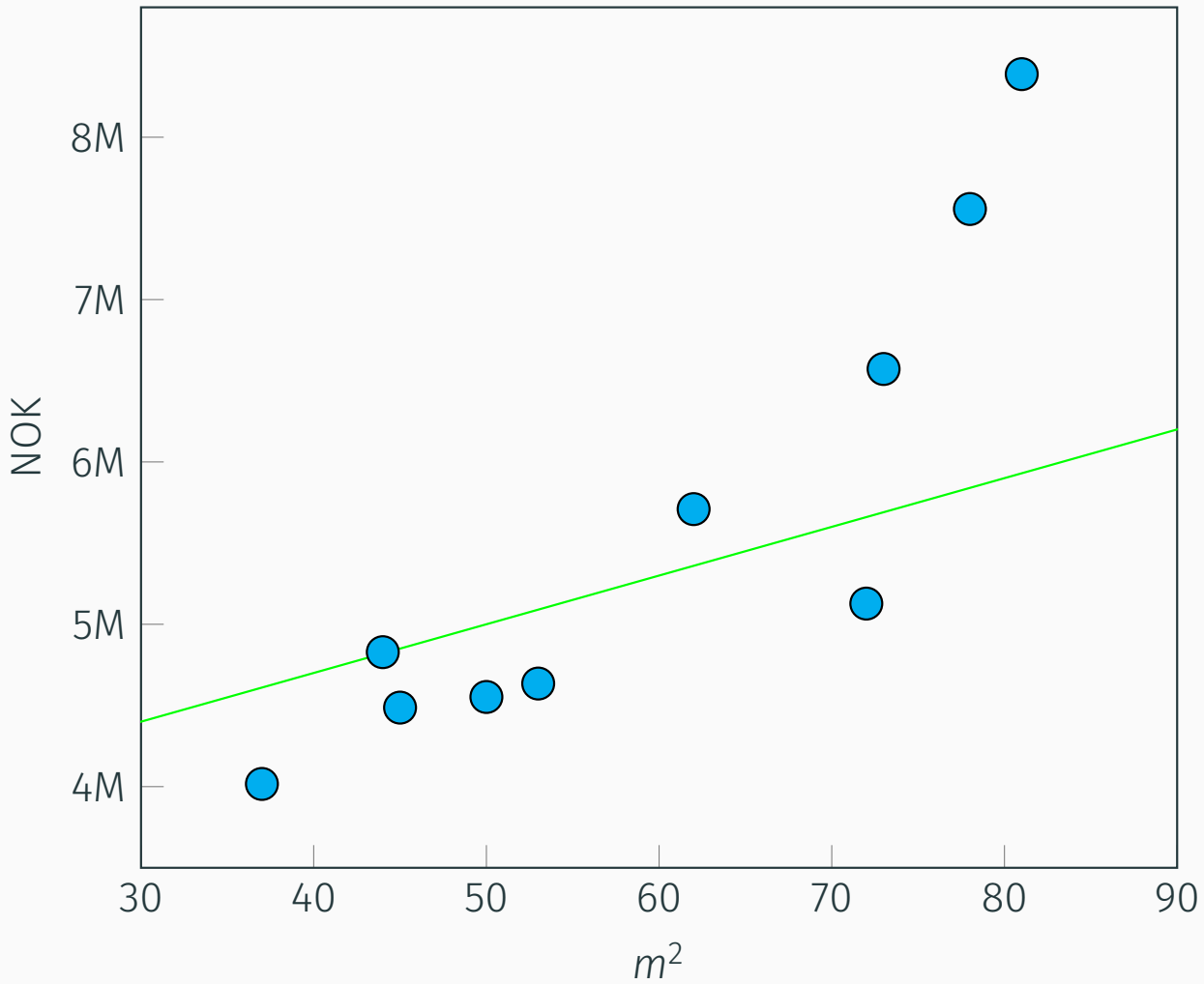
$\hat{y} = 82031x + 706495$
$\ell = 4.09 \times 10^{12}$

Loss functions



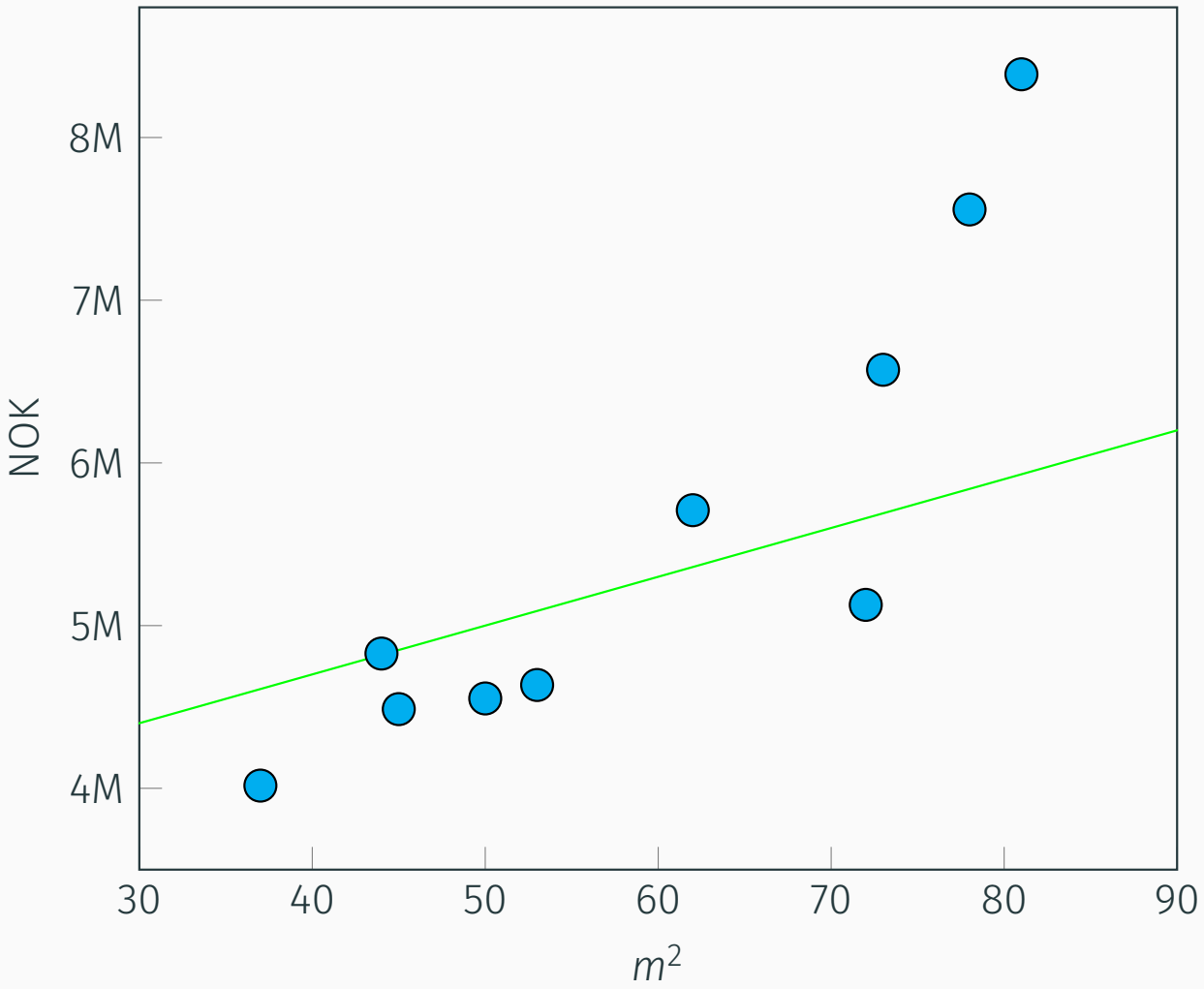
$$\hat{y} = Wx + b$$
$$\ell = \sum (y - \hat{y})^2$$

Loss functions



$$\hat{y} = Wx + b$$
$$\ell = \sum (y - \hat{y})^2$$

Loss functions



$$\ell = \sum (y - (Wx + b))^2$$

Summary

- What is a statistical learning model?
  A formula expressing a relationship between inputs and outputs
- What is a loss function?
  A function quantifying how good a set of predictions are
- How do we train a statistical learning model?
  By applying gradual updates of parameters using gradient descent
- How does a (deep) neural network work?
  Sequentially applying (non-linear) artificial neurons to transform inputs
- What operations does a convolutional neural network use?
  Alternating convolutions and pooling, to match patterns in the input
- What is transfer learning?
  Retraining an already trained model for a new problem
- What is overfitting?
  When a model learns patterns in the training data that does not hold generally
- How do we combat it?
  Rigorous testing, regularization and data augmentation