**Quiz:**

Which of the following statement(s) is/are correct?

(a) Interpretation methods are *only* used ot explain the global behavior of a model.

(b) If a model-agnostic and a model-specific interpretation method are applied on the same ML model, the output of the two methods will always be the same.

(c) While feature effects methods show the influence of a feature on the target, feature importance methods focus on a feature's impact on the model performance.

(d) In IML we distinguish between global IML methods, which explain the behavior of the model over the entire feature space, and local IML methods, which only explain the prediction of individual observations.

(e) Technically, Pearson correlation is a measure of *linear* statistical dependence.

(f) All in the lecture mentioned measures for correlation and dependencies are limited to continuous random variables.

(g) A feature interaction between two features $x_j$ and $x_k$ is apparent if a change in $x_j$ influences the impact of $x_k$ on the target.

**Exercise 1:**

You received a dataset with 11 observations and two features:

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | $\sum_{i=1}^{n}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| y | -7.79 | -5.37 | -4.08 | -1.97 | 0.02 | 2.05 | 1.93 | 2.16 | 2.13 | -10.92 |
| x1 | -1.00 | -0.75 | -0.50 | -0.25 | 0.00 | 0.25 | 0.50 | 0.75 | 1.00 | 0 |
| x2 | 0.95 | 0.57 | 0.29 | -0.03 | 0.02 | 0.08 | 0.23 | 0.54 | 0.98 | 3.63 |

The last column corresponds to the sum of values of each row.

a) Compute the Pearson correlation of $x_1$ and $x_2$. The formula is:

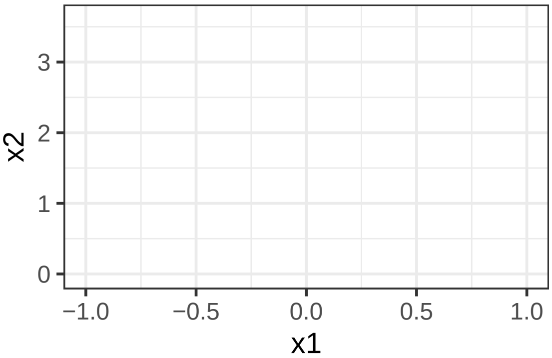
$$\rho(x_1, x_2) = \frac{\sum_{i=1}^{n}(x_1^{(i)} - \overline{x}_1)(x_2^{(i)} - \overline{x}_2)}{\sqrt{\sum_{i=1}^{n}(x_1^{(i)} - \overline{x}_1)^2}\sqrt{\sum_{i=1}^{n}(x_2^{(i)} - \overline{x}_2)^2}}$$

To speed up things, the individual differences to the means $(x_1^{(i)} - \overline{x_1}$, $x_2^{(i)} - \overline{x_2})$, are given in the following table.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| $x_1^{(i)} - \overline{x_1}$ | -1.00 | -0.75 | -0.50 | -0.25 | 0.00 | 0.25 | 0.50 | 0.75 | 1.00 |
| $x_2^{(i)} - \overline{x_2}$ | 0.55 | 0.17 | -0.11 | -0.43 | -0.38 | -0.32 | -0.17 | 0.14 | 0.58 |

Interprete the results. Based on $\rho(x_1, x_2)$, are $x_1$ and $x_2$ correlated?

b) Add points $(x_1, x_2)$ to the following figure:




Based on your drawing, do you consider the Pearson correlation coefficient a reliable measure to detect dependencies for the above use case?

**Exercise 2:**

Show, that the following holds:

$$R^2 = \rho^2.$$

*Recap:*

$$\rho = \frac{\sum_{i=1}^{n} (x^{(i)} - \bar{x}) \cdot (y^{(i)} - \bar{y})}{\sqrt{\sum_{i=1}^{n} (x^{(i)} - \bar{x})^2} \sqrt{\sum_{i=1}^{n} (y^{(i)} - \bar{y})^2}},$$
$$R^2 = 1 - \frac{SSE_{LM}}{SSE_c},$$

where

$$SSE_{LM} = \sum_{i=1}^{n} (y^{(i)} - \hat{f}_{LM}(x^{(i)}))^2,$$
$$SSE_c = \sum_{i=1}^{n} (y^{(i)} - \bar{y})^2$$

are the sum of squares due to regression and the total sum of squares, respectively.

**Exercise 3:**

Consider the following function:

$$f(\mathbf{x}) = 2x_1 + 3x_2 - x_1|x_2|.$$

Mathematically check whether interactions are present.