Institute for Healthcare Improvement

QI Essentials Toolkit:

Scatter Diagram

A scatter diagram — also known as a "scatter plot" — is a graphic representation of the relationship between two variables. Teams use scatter diagrams to help them identify cause-and-effect relationships between two variables. For example, after brainstorming multiple causes and effects using a fishbone (cause and effect) diagram, your team might use a scatter diagram to determine whether a particular cause and effect are related.

A scatter diagram graphs one variable on the X-axis and the other variable on the Y-axis. If the two variables are related, the data points will fall along a diagonal line or curve — that is, values for variable X will be associated with values for variable Y. This could show either a positive correlation (values for both variables increase or decrease) or a negative correlation (values for one variable increase while those for the other decrease).

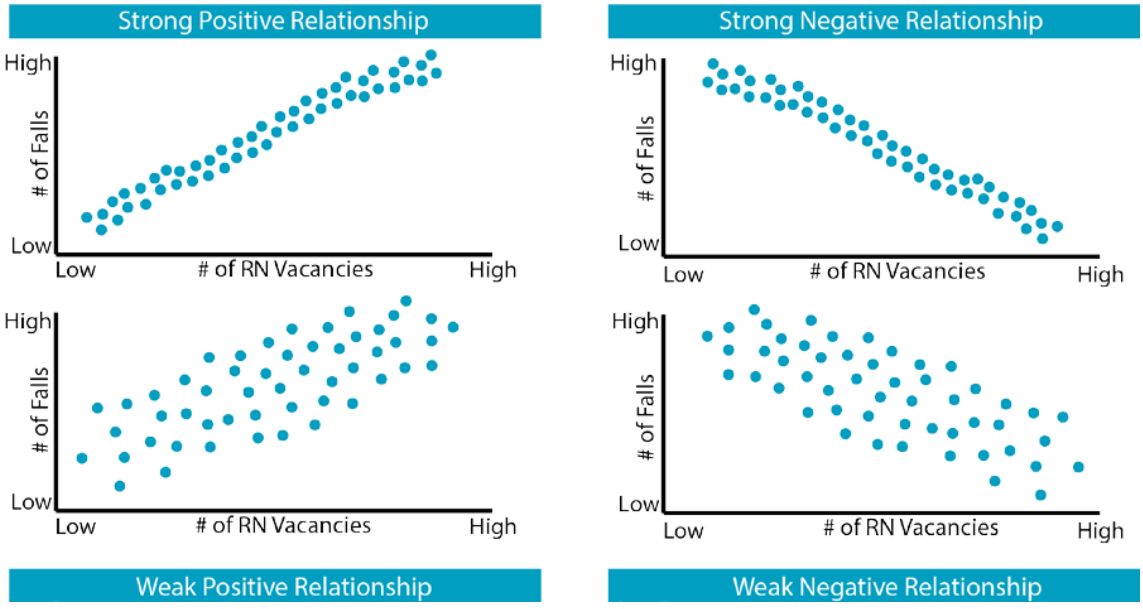
Note: A scatter diagram shows a correlation between two variables; it does not prove causation.

IHI's QI Essentials Toolkit includes the tools and templates you need to launch and manage a successful improvement project. Each of the nine tools in the toolkit includes a short description, instructions, an example, and a blank template. NOTE: Before filling out the template, first save the file on your computer. Then open and use that version of the tool. Otherwise, your changes will not be saved.

- Cause and Effect Diagram
- Driver Diagram
- Failure Modes and Effects Analysis (FMEA)
- Flowchart
- Histogram
- Pareto Chart
- PDSA Worksheet
- Project Planning Form
- Run Chart & Control Chart
- **Scatter Diagram**

Instructions

1) Gather the data for your two variables. On the data collection sheet, put each data pair in their respective columns. Ensure the data remain paired.
2) Decide which factor you will plot on which axis. Put the suspected cause on the horizontal (X) axis, and the suspected effect on the vertical (Y) axis.
3) Draw and label the axes clearly.
    - Make the axes roughly the same length, creating a square plotting area.
    - Label each axis with increasing values from left to right, and from bottom to top.
    - Label each axis to match the full range of values for that factor. In other words, make the lowest numerical label slightly less than the lowest data value, and the highest label slightly greater than the highest value. The data should fill the whole plotting area.
4) Plot the X and Y data pairs on the diagram; place a point on the graph where the two values intersect.
5) Include a title at the top of the diagram and provide necessary annotations to describe what it shows.
6) Study the pattern that the plotted data points create to identify what you have learned and decide on your next steps. If there is an association between the two variables, the pattern will resemble an elliptical shape or a straight line.
    - If the points for both values are increasing (line slants from lower left to upper right): The correlation is positive.
    - If one variable increases while the other decreases (line slants from upper left to lower right): The correlation is negative.
    - If the points form a circular shape: There is little or no correlation.

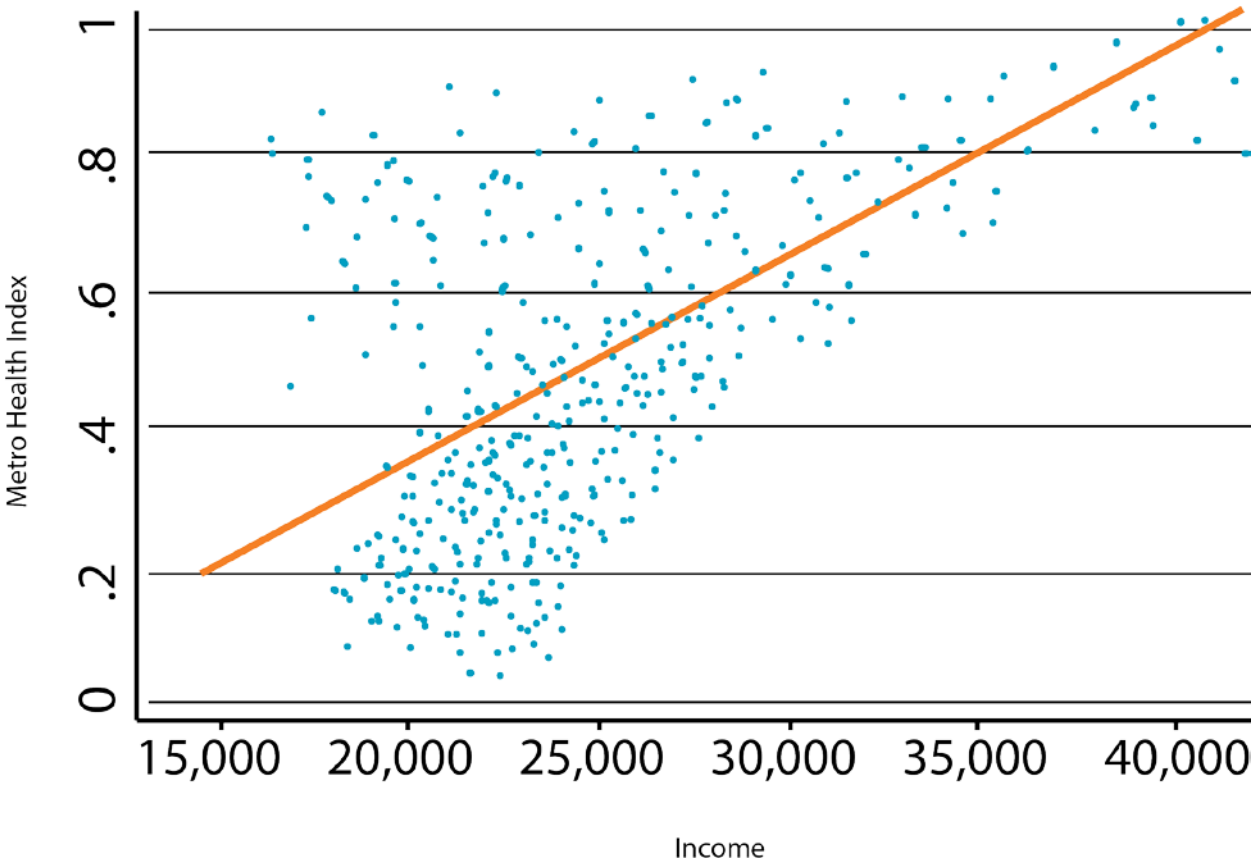


Example: Scatter Diagram

This example scatter diagram shows the relationship between median income (X-axis) and Metro Health Index, a measure of people who smoke or are obese (Y-axis). The researcher wanted to see if there was correlation between income and health outcomes.

Indeed, the scatter diagram indicates that cities with a lower median income tend to have a lower Metro Health Index (indicating much higher levels of smoking and obesity). As the income level increases, so does the Metro Health Index. The scatter diagram shows a strong **positive correlation** between income and Metro Health Index.

Correlation Between Median Income (in US $) and Metro Health Index



Source: Florida R. "Why Some Cities Are Healthier Than Others." *The Atlantic CityLab*. January 5, 2012. http://www.citylab.com/design/2012/01/why-some-cities-are-healthier-others/365/

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Template: Data Collection Sheet

Variable 1	Variable 2

Template: Scatter Diagram