SCOIL CHONGLAIS

Teaching and Learning Plan- scatter graphs

Lesson Plan :

**Target students :** Ordinary level 5th year Maths group

**Topic**: Statistics **Scatter graphs**

**Prior knowledge** : Drawing axes and plotting points, and representing one set of data on a graph

**Duration** : 3 x 35 minutes class periods

**Aim**:

Relationship between two variables

* Students will be able to understand the concept of correlation and examine the relationship between variables if one exists.

**Objectives** :

* To introduce students to the concept of plotting two sets of data on the one graph (paired data).
* To show students how to draw a scatter graph
* To teach students how to interpret the graph
* To examine the different types of correlation (positive, negative, weak, strong)
* To allow students understand that a change in one variable does not necessarily cause a change in the other variable.(correlation is not causation )

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| **Sub-topics** | **Foundation Level** | **Ordinary Level (also includes FL)** | **Higher Level (also includes OL,FL)** | |
| **Representing data graphically** | bar chart, pie chart, trend graph, histogram**, scatter** **graph**, stem plots and the use of spread sheets | frequency polygon, frequency curve, cumulative frequency polygon, stem plots (back to back), cumulative frequency curve (ogive); choice of suitable representation of data for a particular purpose; use of spreadsheets |  | |
| **Representing data numerically** | concept of dispersion/spread; average (mean, mode, median, weighted mean); standard deviation of an ungrouped array of not more than 10 numbers | standard deviation, range, quartiles and inter-quartile range, percentiles, ranking; **concept of correlation/association (positive, negative, strong, weak, etc.); use of spreadsheets** | | limitations of mean and standard deviation; choice of average  correlation coefficient (by calculator); line of best fit (by eye and calculator) | |
| **Sub-topics** | Foundation Level | Ordinary Level (also includes FL) | | Higher Level (also includes OL,FL) | |
| **Analysing and interpreting data** | drawing conclusions from graphical and numerical summaries of data; recognising assumptions  **relevance of sample size:** | **correlation vs. causality**; concept of hypothesis testing; Tukey quick test (tail count test)  decision making | |  | |
| **Being a statistically aware consumer and citizen** | recognising everyday examples of the use of statistics in relevant applications | evaluating reliability and quality of data and data sources: critically evaluating claims and inferences made on the basis of statistics | |  | |

**Learning outcomes** :

At the end of this lesson students will be able to :

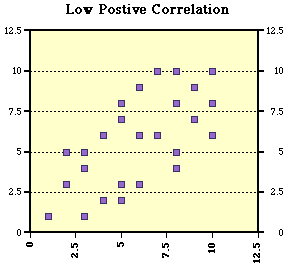
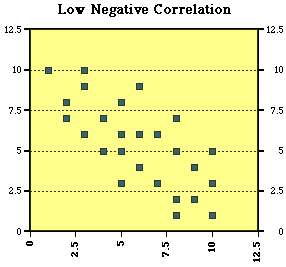
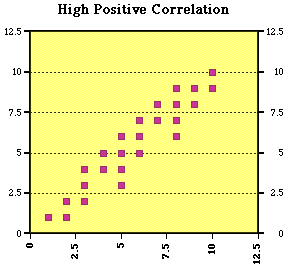
* Scale and Truncate axes
* Label axes
* Plot points
* Draw a line of best fit
* Identify the type of correlation that exists (strong positive, weak positive, strong negative, weak negative)
* Understand that correlation does not necessarily mean causation

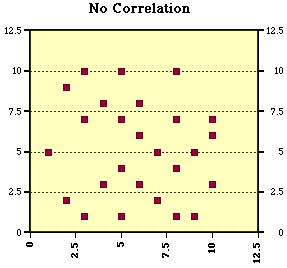
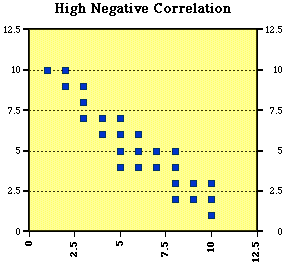
**Key terms** :

* Scatter plot
* Line of best fit
* Correlation ( positive, negative, strong, weak)
* Correlation is not necessarily causation
* Paired data

**Resources** : Perspex ruler, graph paper, Census at School data

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| **Students’ Learning Activities and**  **Teacher’s key questions** | **Expected Reactions/responses of**  **Students** | **Teacher support and actions in response to student reactions and things to remember** | **Points of Evaluation** |
| Teacher poses the question |  |  |  |
| How do we represent paired data on one graph | Students may suggest a trend graph | Teacher suggests that there is a new type of graph we could use called a scatter graph |  |
| Students are invited to examine the data from Census at School and suggest what data that may have a possible link or relationship with each other | Expect students to come up with the link between height and foot length and/or  Height and arm span | Give out Census at School Data. |  |
| Pose a question to get students thinking where there is no link eg Is there any relationship between your height and the length of time you can hold your breath for? | Students will probably be unsure | Having now provided students with examples of paired data explain the term correlation  “Correlation means to check the strength of the relationship between two sets of data” |  |
| **Activity** |  | Get students to work in groups of two |  |
| Let us now test the relationship between height and arm span  Ask students does it matter and invite answers | Students will respond  Which set of data goes on which axis? | .  Tell students it does not matter |  |
| Groups now draw the graph.  What is the range of data in each set? | Students may have problems with scaling and truncating the axes  Continuous data may need to be rounded  Interpreting the data and plotting the points  Do we join the dots? | Teacher should inform groups that you do not join the dots | Did students plot the points without joining them – ie draw a scatter graph |
| Now ask the students what do they notice about the dots?  Is there any trend? | Some mention the are all scattered  Sloping up to the right | Remind students what the graph is called – scatter graph (hence the name) | Do students understand why it is called a scatter graph? |
| Ask could we draw a straight line anywhere to show this trend | Students will not know how to draw the line | Hint to students that there should be approximately the same number of dots above and below the line  Helpful hint: Draw an **oval shape** around the points. Use your major axis of the oval shape as your **Line of Best Fit** | Did students draw the line of best fit? |
| Teacher asks students if this line is increasing or decreasing  Is it a positive or negative slope  As x increases does y increase?  As y increases does y increase? | Students say that it is increasing or sloping up  Some will say it has positive slope | At this point teacher explains this is **positive correlation** because the **line is sloping upwards**. If the line is **sloping downwards** then it is **negative correlation**. |  |
| Now ask the students what do they notice about the positioning of the dots | Some will notice they are scattered closely together | Explain that it if the dots are close to the line this shows a **strong** **relationship** and if the dots are not well scattered about the line this indicates if there is a **weak relationship** |  |
| Teacher asks the question –  Is there correlation between the two sets of data? | Expect some students to ask what is correlation | Explain correlation again  “correlation is about assessing the strength of the relationship between pairs of data” |  |
| Now pose the question again:  Is there is any correlation between the height and arm span? | Students will say yes because the line is sloping upwards. Some may respond that as one variable is increasing the other is increasing |  | Can students identify if there is correlation |
| Can you describe the type of correlation? | Students say positive. |  |  |
| Is this correlation weak or strong? | Students say strong because the dots are close to the line of best fit |  |  |
|  |  |  |
| Teacher/student discussion  **Correlation versus causation**  Teacher introduces this by asking  Does smoking damage your health?  Does speeding cause accidents?  Does height determine arm span?  Does height affect shoe size? | Students respond yes to first two instances but will probably be unsure about height and arm span and height and shoe size | Teacher now explains that just because there is correlation (relationship) one does not always automatically cause the other. Hence  **Correlation is not necessarily causation**.  Consider the findings that in summer time there is an increase in swimming accidents and also in ice cream sales...does one cause the other?  Continue the discussion and emphasise that the reason we said yes in some of the given examples was because there has been sufficient evidence over a long period of time.  Further to the discussion emphasise that **correlation depends on the sample size, need a large sample to really establish if there is correlation.** |  |





**Question 2**

**The following is data provided by computer students when surveyed about their laptop usage and the battery life remaining.**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **BatteryLife**  **(minutes)** | **180** | **162** | **156** | **142** | **133** | **120** | **110** | **125** | **112** | **125** | **118** | **100** | **80** | **65** | **40** | **25** | **18** |
| **Usage**  **(minutes)** | **2** | **18** | **14** | **28** | **45** | **56** | **70** | **83** | **91** | **100** | **115** | **134** | **150** | **163** | **167** | **174** | **179** |

**Draw a scatter graph and identify the type of correlation if it exists.**

**Question 3**

**The following data is the response to a survey which asked ten people about the number of years they spent in education and their annual earnings**

**.**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Income €** | **125,000** | **40,000** | **41,000** | **35,000** | **50,000** | **60,000** | **24,000** | **29,000** | **100,000** | **35,000** |
| **Years in Education** | **19** | **16** | **18** | **14** | **16** | **17** | **12** | **12** | **20** | **16** |

**Draw a scatter graph and identify the type of correlation if it exists.**

**Question 4**

**The data provided shows details of car prices in a Dublin garage. Draw a scatter graph to illustrate the data**

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Year of Manufacture** | **2004** | **2007** | **2001** | **2006** | **2002** | **2005** | **2008** |
| **Market Price €** | **9950** | **17495** | **4550** | **159500** | **4950** | **13750** | **19950** |

**Is there correlation? If so what type?**

**Question 5**

**Is there correlation between height and foot size?**

**From the Census at School data select two sets of data and draw a scatter graph**

**Identify the type of correlation if it exists.**

**Question 6**

**Is there correlation between height and holding your breath?**

**Using Census at School data select and draw a scatter graph.**

**Identify the type of correlation if it exists.**

**Project Work**

**Activity 1**

**Students are asked to get data from Census at School on students in Africa. Examine any two sets of data and produce a scatter graph.**

**Then give a three/four minute presentation to class presenting their findings.**

**Activity 2**

**Ask students to source data from newspapers etc on subjects of interest eg sport, television and then prepare scatter graphs**

**Activity 3**

**Another source of data can be found at the following website** **which will provide data to graph** **scatter plots of year of the Olympics versus womens running times in the 800m.**

<http://www.databaseolympics.com/>