MERIA Scenario "Job advertisement"

Measures of central tendency

Target knowledge	Determine, distinguish between and make decisions on measures of central tendency (arithmetic mean, mode, median).
Broader goals	Analysing data. Drawing histograms and other graphical representations (plots), as well as calculating statistical measures on paper or using ICT. Understanding the issues and misconceptions that arise in statistics. Inquiry skills: making and evaluating decisions based on arguments, comparing different ways of reasoning, interpretation of data and formulation of conclusions. Interdisciplinary skills: students can connect statistical problems to everyday situations and situations in economy. They learn to appreciate the use of mathematical reasoning in decision making.
Prerequisite mathematical knowledge	Calculating arithmetic mean. Familiarity with the notion of average. Basic skills in the use of ICT: manipulating Excel spreadsheets or similar (e. g. Google Sheets or OpenOffice); knowing how to use basic commands to compute sums and averages; representing data graphically (histograms, scatter plots, box plots …)
Grade	Age 15 - 18, grade 9 - 12 (whenever the arithmetic mean is introduced)
Time	45 minutes (could be extended to 90 minutes)
Required material	Computer, appropriate software (Excel, Google Sheets, OpenOffice, GeoGebra …). Data set, referred to in the following as the 'payroll'. The data set is appended to the scenario as an Job_advertisement_data.xlsx file.

Observations from implementation
The context of observations (grade, institution, country, etc.):

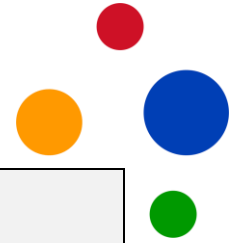
Problem:

Companies advertise for new employees. To give prospective applicants an idea of the income possibilities in the company ('boast about the company') the advertisement informs the applicants of the average monthly pay. In the material you have the payrolls of these three companies.

In which company would you seek employment? Explain and give mathematical reasons for your decision.

Consider the following: Which salary divides the employees into two groups of the same size? Which salary would be the best representative of the payroll?

Phase	Teacher's actions incl. instructions	Students' actions and reactions	Observations from implementation
Devolution (didactical) 5 min	The teacher presents the problem to the students and gives them a link to the *Excel* sheet with data (3 payrolls). (S)he suggests using technology (data analysing and graphing tools) to help them with reaching a decision. The teacher organizes students in groups of two or three.	Students listen and ask questions.	
Action (adidactical) 20 minutes	The teacher circulates and observes, helping just in case of some technical difficulties (not with the use of the program). (S)he notes the different strategies the students choose.	Students discuss in their groups what technology they will use, what "mathematics" they will use, and how to organize work.	
Formulation (adidactical) 5 minutes	The teacher asks the students to organize their process and formulate decisions.	Students organize and summarize their work.	
Validation (didactical / adidactical) 10 minutes	The teacher chooses some students to shortly present their solutions – decisions. Groups with different strategies should be chosen.	Students give short explanations of what they were doing. Other students listen and discuss.	
Institutionalisation (didactical) 5 minutes	Summarize students' work and generalize: How to choose the number that best represents the data set. The teacher defines the measures of the central tendency - the	Students listen and ask questions.	



	arithmetic mean, the median and the mode, and how they are determined. (S)he summarizes the influence of data on the arithmetic mean, median (and mode), advantages and disadvantages of each measure. Be clear that this situation does not have one answer, but the result should be the different information that each of the measures provides.		

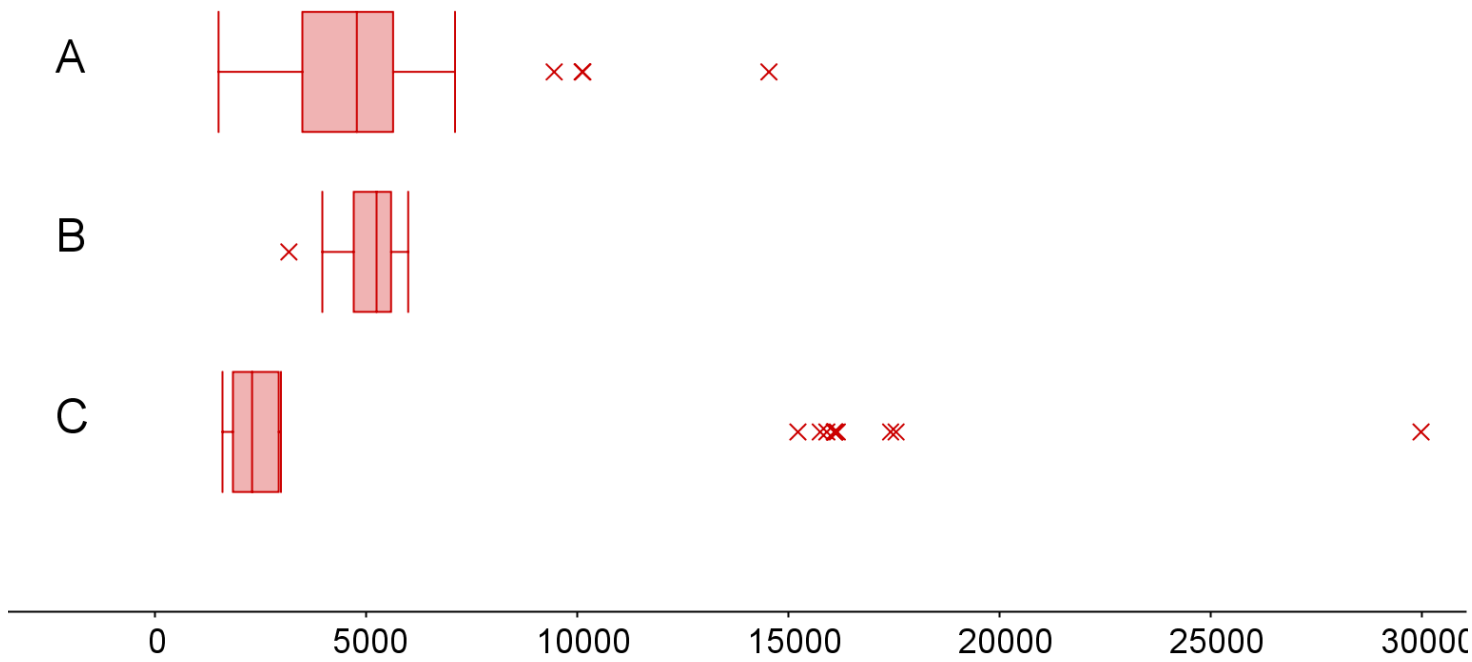
Possible ways for students to realize target knowledge

- Arithmetic mean and median:
  - Some students might immediately know what to do so they start graphically representing data using familiar technology and using data analysis tools for calculating the arithmetic mean and median for each payroll. They will compare the lists and notice how outliers (big data) affect the mean, and consequently reach the decision which company to choose.

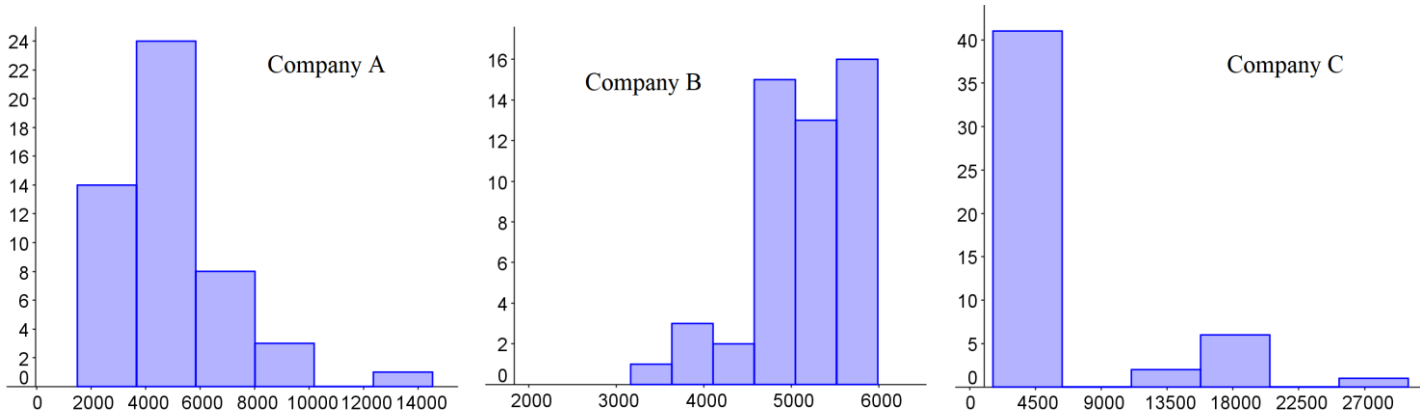
	Company A	*Company B*	*Company C*
Mean	4939.98	5138.04	4992.6
Median	4774.5	5241	2293.5
Range	13038	2826	28394
Minimum	1500	3165	1593
Maximum	14538	5991	29987

  - Some students will observe tables, sort the data and discover how to find the middle data (median) on their own. They will notice that in tables with sorted data, especially in payroll C, there are some outliers (in relation to the rest of the data set) and investigate what happens with arithmetic mean and median with and without them. Consequently, they will learn the advantages and disadvantages of each measure.

- Some students will only graphically represent data and make conclusions from graphs. These students might use box and whisker plots where they can read out all the information they need (arithmetic mean and median) and make a decision. In addition, the outliers are easy to spot in box plots and they will conclude how they affect the arithmetic mean and the median.



- Some students will draw histograms and notice the outliers. From the histograms, they will notice the influence of the outliers on the averages.



- As for the mode, in order for students to be able to determine it, they can be encouraged by the teacher to round the data or group them into classes. Then they could represent the new data graphically in some form, which includes frequency classes (e.g. histogram). After that, they will compute mode for each payroll (or read the value of it from e.g. histogram) and enhance their previous decision regardless of which method they used to determine the arithmetic mean and the median.