

ROUND 1: PROBABILITY AND STATISTICS

1. OBJECTIVES

- To develop fluency in probability and statistics.
- To develop mathematical reasoning.

2. DESCRIPTION & RATIONALE

Probability and statistics are necessarily taught for exam purposes as a series of processes. These techniques were developed and are used by professionals to find models to capture the variability in (normally very large) data sets and tools to model variables which have a random element. The two parts of this round consist of a dice game in which students make probabilistic judgements and an activity in which they need to identify models for data sets.

1. The Game of Hedgehog. The game involves rolling a single die. If you roll 2, 3, 4, 5 you score that many points. If you roll 1, your turn ends. If you roll a 6 your turn ends but you lose all the points you scored in that turn. Or you can choose to pass, ending the turn without rolling. The first to score 20 points wins. Teams will line up facing each other with one team assigned to start. Players in the team play in turn with no communication (verbal or non-verbal) allowed either rolling the die or passing. A judge will keep score. When one team has scored the final scores are recorded. Points will be awarded according to the scores with a bonus for winning (one third of the points for winning and two thirds divided in the ratio of the scores).
2. Data – Chart – Analysis. At the end of the Hedgehog round, teams will be handed an envelope containing a set of 18 cards and an answer sheet. 6 will contain details of data sets, 6 will show statistical charts and 6 will contain a summary analysis. Just before the start of the algebra round they will need to hand in their completed answer sheet for marking, so they can work on this at any time. When team members are not involved in the Gridlines and 24@Game rounds they could be doing this. They will need to organise the cards into sets with a best match of data + chart + analysis and write the card letters in 6 sets onto the answer sheet. The student workbook contains a sample set of cards to give an idea of the sorts of sets that could be used.

3. SCHOOL ACTIVITIES

In Class

The game of Hedgehog can be easily played in class. The important thing is to consider strategy. This is a modified version of the classic 'Game of Pig'. There are

online simulators which let you see the probabilities at given points of the game to consider your strategy. For example: <http://cs.gettysburg.edu/projects/pig/pigggame.html>

Once students have an idea of the strategy, they can move onto the game of Hedgehog. Then they can modify the variables in the game to see how this affects their strategy. Change the penalty for rolling a 6. Change the target score. Change the rules e.g. 1 and 2 end your turn without penalty. Of course, they cannot control random events and so the strategy has to be framed in terms of probabilities and the language of better/worse, more/less likely.

Data-Chart-Analysis will be drawn from reporting about real world events or situations. In the students guide the charts are taken from a Channel 4 article summarising analysis on climate change data. The full report is here: www.channel4.com/news/factcheck/climate-change-in-ten-graphs. The issue is how the data can be used to make the inference that is given in the analysis and how the chart is useful in illuminating this. This is complementary to the more direct method of taking small data sets, calculating statistics and drawing charts, common in exams and textbooks. But we hope gives a helpful broader view. Taking interesting data sets from any source and asking what sorts of statements you could make using this data and how you could you illustrate this effectively for different purposes e.g. social media, TV news, academic paper. This link takes you directly to download an EU book of illustrated statistics that you can use to explore: <https://bit.ly/3EhgV8R>.

Catch-Up

The catch-up tracker lists worksheets to practise the skills.

Clubs and Tournament

Once students are familiar with playing the Game of Hedgehog one versus one, they should play in teams. In previous tournament activities we have found that taking turns in a group's strategy consistently is very hard and certainly needs practice.

In clubs, students can move on to the two dice game, which takes rather longer. The strategy is more subtle and will be very helpful in developing Hedgehog strategy. Also, for one versus one, it is a much better game.

Two Dice Rules

Players take turns: throw the two dice together. Add the total. Throw again and add the total to what you had before. Keep going as many times as you like adding the total at each throw to your turn total. Winner is first to 100. BUT:

- a. If one (but not both) of the dice you throw is a 6 your turn ends and nothing is added to the score for that turn.
- b. If you throw a double 6 your turn ends and your score goes back to zero.

As with the algebra round, the Chart-Data-Analysis round cannot be practised directly. Instead we recommend that students find other reports and articles online on issues of

interest where data has been used to draw conclusions and illustrated with charts and to look at the relationships between the three components. We hope they will find this interesting to do.

4. MATERIALS

1. We supply a bag of 10 ordinary dice and one large foam di in the school resource kit.
2. In the student guide: a sample set of Data-Chart-Analysis cards for practice and familiarisation.

5. AT THE COUNT ON US SECONDARY CHALLENGE

Teams will be called out in groups of six. They will play 4 games playing each other team at least once and starting two of these games. Thus, there will be three games happening at the same time, each with its own judge. After each set of games is finished, teams will be moved to different positions to play different teams. Play needs to be near continuous, so each player plays as soon as the previous player has made their roll. If the judge determines any undue delay or indeed any verbal or non-verbal communication between players, they will first issue a warning and on a repeat occasion will award the game to the other team scored as 50-0.

The Data-Chart-Analysis envelope will be handed out as soon as all teams have completed the Hedgehog round. Answer sheets must be ready for collection immediately when called as soon as the algebra round is announced.