

Rugby – the conversion kick

Mathematical Investigation – teacher notes

Hopefully the task sheet for this investigation provides much of the detail required and should be read first. The below are some thoughts that may be of assistance to teachers and should be read in conjunction with it.

Try-scoring position – some context-based information.

Depending on the sporting interests of the students who do this task, there are some practical concerns that students may want to consider when thinking about the best distance from which to attempt a conversion kick.

- A successful kick needs to go over the crossbar, which is 3 metres above the ground.
- Once kicker approaches the ball to kick it, the opposition team, who are behind the goal line, can ‘charge’ the kicker and attempt to block or disrupt the kick.

These are two reasons why kickers do not kick from close to the goal line, even if it maximises angle of view.

On the other hand, the kick needs to be from a “kickable” distance. An “optimal position” that is 35 metres from the goal line and close to the touch line (in the common situation when the try is scored close to the corner of the pitch) means that the kicker needs to kick a stationary ball well over 50 metres, which would challenge the accurate range of many.

The mathematical of optimising angle of view does not concern itself with these sporting questions, but many students will.

Assigning students their try scoring distances

To minimise the above issues, students can/should be assigned to try scoring distances in the 10 to 25 metre range. Using increments of 0.2 metres provides plenty of scope for individual responses. The spreadsheet provided considers distances from 0 to 36 metres in 0.2 metres increments for completeness’ sake.

For try positions greater than 2 metres from the goal post, there is a very ‘clean’, approximately linear, relationship between try distance and optimal kicking position. If students focus around 10 to 25 (spread across that range depending on class size) they will, collectively, get a good picture of what is going on.

Methods and precision

The spreadsheet provided calculates the optimal kicking position to the nearest 10 cm, for try scoring distances from 0 to 36 metres. This should be useful for marking/checking student work. A result with this sort of precision is equivalent to a student using trial and error or tabulation methods and is probably precise enough for this context.

It is hoped that students might pursue methods, such as the ones in the “teacher edition” video like refining tables or, better yet, graphing a function, that yield more precise results, “just because we can”. This may be a way of differentiating between levels of student success.

The exact answer?

Optimisation problems such as this can be tackled using the differential calculus taught to students in the last years of secondary school. Such approaches are not the intention of this task, though it could be modified for such a use, depending on the scope of the calculus course studied.

In the writer’s opinion, middle school students should be discouraged from parroting mathematics found on the internet of which they have little understanding. Instead, the task could be revisited when they have studied some of the ideas that allow for an exact solution to be obtained.

Reasonableness and limitations

Questions of reasonableness and the limitations of results are a rich dimension to a “real life” piece of mathematics such as this. Their inclusion or otherwise may depend on the context within which this task is used i.e. what behaviours/ideas have been taught and are being assessed.

One point likely to be worth raising in terms of reasonableness is the need for accuracy. Is it reasonable for a rugby player to choose a kicking position accurate to within 10 cm? 1 cm? 1 mm? How much difference does a “near enough” position have on angle of view?

A limitation is the physical demands of kicking. What is the optimal position is too close to other players? Too far for the player’s kicking skill?

Other factors like the condition of the pitch, the wind etc may also be seen as relevant by students.

The task sheet is provided in Word format to allow teachers to modify it to suit their individual circumstances.

Play on ...

