Probability Experiment Checklist

Start with writing a question to be answered.

- Take your time with this, as the whole assessment will depend on it.
- It must a probability question.
- Make it relate to a **single** trial – do not ask ones that relate to many trials.
- Don't make your question relate to unlikely results, as they require more trials to appear in decent numbers.
- Ideally make the question be about a range of results so that your answer is not just a single probability.

What is the probability that tossing four coins will give at least 2 heads?

When I toss four coins, what is the most likely result?

Make a hypothesis – a reasoned guess – about the likely result.

Back that hypothesis up with a bit of reasoning, not a fully calculated probability.

I think that that the probability of at least two heads will be around 75% because there are three different ways this can happen (2, 3 or 4 heads) and the ones around 2 and 3 will be more likely than getting 4 heads or 4 tails.

My hypothesis is that the most likely result is 2 heads and 2 tails, because there are more ways to get this than the other results (e.g. HHTT, HTHT, HTTH etc).

Write down how you plan to get the experimental probability, in detail.

- The number of trials you plan to make.
- How you conduct your experiment.
- How you ensure the experiment is free from bias and properly random.

I will conduct fifty trials, each time tossing the coins onto a flat dry surface

To ensure properly random tosses, I will not look at the coins when I pick them up so I cannot know which way they are facing, and will make sure each toss is high into the air.

Write down how you are going to record the results of your trials.

- Explain how the recording is to be done.
- Make sure the table is clearly labelled, so someone can just pick it up and realise immediately what you have done. That includes labelling sub-totals and totals.
- Don't just record a simple tally of Yes/No results, as that makes it more or less impossible to discuss later on anything at a higher level.

I will record my results as they are scored, with a column for the actual result of the number of heads after each trial.

In a tally chart alongside each possible outcome – 0, 1, 2, 3 or 4 heads – I will note the result of each set of tosses.

Draw a graphical representation of your results. This is compulsory.

- Generally a bar chart or histogram is most appropriate.
- Label it clearly, both with a title and units on the axes (frequency on y, outcomes on x).
- Don't hesitate to do more than one graph, if relevant.
- The more information the graph contains, the better – in general a probability distribution is better than just Yes/No results.
- All graphs should try and use the same scales to make for easy comparison.

My graph compares the theoretical expected outcomes to my experimental ones

I have graphed a second run alongside to show the differences.

Answer the question you posed at the start

- The answer needs to explain that it is an experimental estimate of the actual probability.
- Make sure your answer includes a probability that answers your **actual** first question.

My experiment gave a probability that four coins will give at least 2 head of 64%.

I found that the most likely result when you toss four coins is to get two heads, with a probability of 38%.

Briefly explain what your answer means.

This is an experimental estimate of the actual probability.

Each time the experiment is run you will get different results due to random variation.

The more trials that are run, the closer the experimental result will tend to be to the actual probability.

If you can, discuss what the theoretical probability is.

- Clearly explain your working, not just give a result.
- Compare it to your experimental result.

The above table of possible results, each equally likely, shows that the probability of getting at least two heads in four tosses is 11 out of 16 = 68.75 %.

The difference between the experiment result of 64% and the theoretical expected of 69% is due to the inevitable random variation, especially for an experiment of not many trials like mine.

I would expect that if I ran the experiment many times, the experimental probability would tend to average out to 68.75%.

If you can, discuss how to alter the context of the original situation.

- Could the situation be modified – what is the effect of the initial conditions?
- If it is a game or betting situation – is it fair? How can it be made fair?

If you can, discuss a probability **distribution** in the results (or sub results).

- Compare experimental to theoretical for distributions as well.
- Graphs are often more clear than muddling through wordy explanations.

> *My results show in the histogram that 2 heads is the most likely result, and that it drops off on either side for 1 and 3 heads, with no heads and 4 heads being much less common.*
>
> *This is what we would predict from the theoretical probability distribution, which we can see from its histogram has a symmetrical pattern with a peak at two heads of 54.5%.*

Run another set of trials, if you have time.

- Explain that this gives another estimate of probability.
- Repeated trials increase confidence in the results, but never give a final answer.

> *My second experiment gave a probability that four coins will give at least 2 head of 70%.*
>
> *The real result is therefore likely to be around my two results of 64% and 70%.*
>
> *Again the probability distribution shows the same basic shape, allowing for random variation, of a peak at 2 heads dropping down on either side.*

In general:

- You conduct trials to answer a question. Answering that question is the most important thing in the assessment.
- **Results are always probabilities**. Don't discuss the number of wins/losses in relation to the number of trials – calculate it as a %. More trials will usually give more accurate results, but a probability does not depend directly on the number of trials.
- Give exact numbers wherever possible.
- Show all your calculations.
- This is not an English essay, but even simple steps should be explained.