**QUESTION ONE**

The data that you gathered over the weekend is the historical actual real data related to your ability to successfully flip a bottle containing varying amounts of water. Complete the following table.

(6 marks)

**Table 1 Historical Data Summary**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Total Number  of Flips | Total Number  SUCCESSFUL flips | Decimal Value of SUCCESSFUL Flips |
| QUARTER FULL BOTTLE | 100 |  |  |
| HALF FULL BOTTLE | 100 |  |  |
| THREE QUARTER FULL BOTTLE | 100 |  |  |

For each group of ten flips, you recorded the NUMBER of successful flips out of ten. This could be easily converted to a decimal. For example, 1 successful flip out of ten is represented as 0,1.

a) For the QUARTER FULL bottle, plot the number of successful flips (as a decimal) against the flip numbers on the following graph. (Plot each value with an *x* and join up with a ruler).

(5 marks)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  | **Probability of a QUARTER FULL Bottle Landing Upright** | | | | | | | | | | | | | | | | |  |
| Actual Probability that Bottle Landed Upright. | **1.0** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.9** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.8** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.7** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.6** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.5** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.4** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.3** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.2** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.1** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  | 1st | | 2nd | | 3rd | | 4th | | 5th | | 6th | | 7th | | 8th | | 9th | | 10th | |  |  |
|  |  |  |  | Group of 10 flips | | | | | | | | | | | | | | | | | | | |  |  |

b) For the HALF FULL bottle, plot the number of successful flips (as a decimal) against the flip numbers on the following graph. (Plot each value with an *x* and join up with a ruler).

(5 marks)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  | **Probability of a HALF FULL Bottle Landing Upright** | | | | | | | | | | | | | | | | |  |
| Actual Probability that Bottle Landed Upright. | **1.0** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.9** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.8** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.7** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.6** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.5** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.4** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.3** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.2** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.1** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  |  |  |  | 1st | | 2nd | | 3rd | | 4th | | 5th | | 6th | | 7th | | 8th | | 9th | | 10th | |  |  |
|  |  |  |  | Group of 10 flips | | | | | | | | | | | | | | | | | | | |  |  |

c) For the THREE QUARTER FULL bottle, plot the number of successful flips (as a decimal) against the flip numbers on the following graph. (Plot each value with an *x* and join up with a ruler).

(5 marks)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  | **Probability of a THREE QUARTER FULL Bottle Landing Upright** | | | | | | | | | | | | | | | | |  |
| Actual Probability that Bottle Landed Upright. | **1.0** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.9** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.8** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.7** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.6** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.5** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.4** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.3** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.2** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.1** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  |  |  |  | 1st | | 2nd | | 3rd | | 4th | | 5th | | 6th | | 7th | | 8th | | 9th | | 10th | |  |  |
|  |  |  |  | Group of 10 flips | | | | | | | | | | | | | | | | | | | |  |  |

d) For each of the three graphs above, inspect to see if there is an obvious trend line and if so, draw it in on each graph and label it clearly. If there is no obvious trend line, tick the appropriate box in the table below.

(3 marks)

|  |  |  |
| --- | --- | --- |
|  | OBVIOUS TREND LINE  Indicated on Graph | NO OBVIOUS TREND LINE |
| QUARTER FULL BOTTLE |  |  |
| HALF FULL BOTTLE |  |  |
| THREE QUARTER FULL BOTTLE |  |  |

e) Comment on the shapes of the three graphs above. Use some or all of the following words or phrases in each statement. {symmetrical, bias, trend line, experience, improve with time, sample size}

i) QUARTER FULL BOTTLE

(2 marks)

ii) HALF FULL BOTTLE

(2 marks)

iii) THREE QUARTER FULL BOTTLE

(2 marks)

**QUESTION TWO**

a) Using the data contained in Table 1 Historical Data Summary, plot the performance of your bottle on the following graph. (Plot each value with an *x* and join up with a ruler).

(5 marks)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **Relationship Between Amount Bottle Filled and Success Landing Upright** | | | | | |
| Actual Probability that Bottle Landed Upright. | **1.0** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **0.9** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **0.8** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **0.7** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **0.6** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **0.5** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **0.4** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **0.3** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **0.2** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **0.1** |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  | 25% | | 50% | | 75% | |  |
|  |  |  | Amount Bottle is Filled | | | | | | |  |

b) Sketch and label the trend line on the graph.

(2 marks)

c) Using the trend line in the graph, show on the graph and write below the predicted probability for a 37.5% filled bottle which is flipped to land upright.

(3 marks)

d) Is this an accurate estimate of the probability that a 37.5% filled bottle will land upright? Give your answer (YES/NO) and give reasons for your answer.

(3 marks)

e) Could the estimate of the probability that a 37.5% filled bottle will land upright be made more accurate? Give your answer (YES/NO) and give reasons for your answer.

(3 marks)

**QUESTION THREE**

If you were using the same bottle that you used at home and filled it 87.5% with water.

a) Using the trend line in the graph from QUESTION TWO, show on the graph and write below the predicted probability that this 87.5% filled bottle will land upright when it is flipped 10 times.

(4 marks)

b) In your own word explain why you think this the case.

(3 marks)

c) Similarly using the same bottle that you used at home, if you were to tip out some of the water so that it is full. Using the trend line in the graph from QUESTION TWO, show on the graph and write below the predicted probability that this 12.5% filled bottle will land upright when it is flipped 10 times.

(4 marks)

d) In your own word explain why you think this the case.

(3 marks)