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| --- | --- | --- | --- | --- | --- | --- |
| **Type of event** | **Meaning** | **Examples** | **Probability Notation** | **Methods**(When events occur in no particular order) | **Method**(when there is an order) | **Formulas** |
| **Two Way Table** | **Venn Diagram** | **Tree Diagram** |
| **An event** | Is a subset of the sample space | A: Failing the test | $$P(A)$$ |

|  |  |  |  |
| --- | --- | --- | --- |
|  | A | A’ | Totals |
| B |  |  |  |
| B’ |  |  |  |
| Totals |  |  |  |

 | AA’BB’BB’P(A)P(A’)P(B|A)P(B’|A)P(B|A’)P(B’|A’) |  | Theoretical Probability:$$P\left(A\right)=\frac{No. in event }{No. in sample space}$$Experimental Probability:$$P\left(A\right)=\frac{No. of favourable outcomes }{No. of trials}$$ |
| “What might happen” |
| **Complementary events** | If A is an event, then not A (A’) is the complementary event | A: Failing the testA’: Not failing the test | $P(A)$ and $P(A’)$ |

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| --- | --- | --- | --- |
|  | A | A’ | Totals |
| B |  |  |  |
| B’ |  |  |  |
| Totals |  |  |  |

 | A’ | AA’BB’BB’P(A)P(A’)P(B|A)P(B’|A)P(B|A’)P(B’|A’) | $$P\left(A\right)+P\left(A^{'}\right)=1$$$$P(A’)=1-P(A)$$ |
| “Not A” |
| **Mutually exclusive events** | Two events that cannot occur in the same trial | A: Passing the test with high alcoholB: Passing the test with low alcohol | No notation |

|  |  |  |  |
| --- | --- | --- | --- |
|  | A | A’ | Totals |
| B |  |  |  |
| B’ |  |  |  |
| Totals |  |  |  |

 |  | AA’BB’BB’P(A)P(A’)P(B|A)P(B’|A)P(B|A’)P(B’|A’) | Two events are mutually exclusive iff$$P(A∩B)=0$$OR$$P\left(A∪B\right)=P\left(A\right)+P(B)$$ |
| “Can’t both happen at once” |
| **Independent events** | The occurrence of A has no effect on the probability of B occurring | A: Passing the testB: Born in April | No notation | Get P(A), P(B) and $\left(A∩B\right)$ from table then use formula.OR use meaning “being born in April will not affect the chance that you will pass the test” | Get P(A), P(B) and $\left(A∩B\right)$ from venn diagram then use formula.OR use meaning “being born in April will not affect the chance that you will pass the test” | Get P(A), P(B) and $\left(A∩B\right) $from tree diagram then use formula.Hint: $(P(B)=P(A∩B)+P(A’∩B)$OR use meaning “being born in April will not affect the chance that you will pass the test” | Two events are independent iff$$P\left(A∩B\right)=P\left(A\right)×P\left(B\right)$$OR$$P\left(A|B\right)=P\left(A\right)$$ |
| “One does not affect the chance of the other” |

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| **Type of event** | **Meaning** | **Examples** | **Probability Notation** | **Methods**(When events occur in no particular order) | **Method**(when there is an order) | **Formulas** |
| **Two Way Table** | **Venn Diagram** | **Tree Diagram** |
| **Intersection of events** | Represents ***both*** events occuring | Passing the test **and** having high alcohol | $$P(A∩B)$$ |

|  |  |  |  |
| --- | --- | --- | --- |
|  | A | A’ | Totals  |
| B |  |  |  |
| B’ |  |  |  |
| Totals  |  |  |  |

 |  | Multiply along branchesP(AnB)AA’BB’BB’P(A)P(A’)P(B|A)P(B’|A)P(B|A’)P(B’|A’) | For independent events$$P\left(A∩B\right)=P\left(A\right)×P\left(B\right)$$ |
| “AND” |
| **Union of events** | Represents A ***or*** B occurring (or both) | Passing the test ***or*** having high alcohol level | $$P(A∪B)$$ |

|  |  |  |  |
| --- | --- | --- | --- |
|  | A | A’ | Totals  |
| B |  |  |  |
| B’ |  |  |  |
| Totals  |  |  |  |

 |  | Add between branchesP(A’nB)P(AnB’)AA’BB’BB’P(A)P(A’)P(B|A)P(B’|A)P(B|A’)P(B’|A’)P(AnB) | $$\*P\left(A∪B\right)=P\left(A\right)+P\left(B\right)-P(A∩B)$$For mutually exclusive events:$$P\left(A∪B\right)=P\left(A\right)+P\left(B\right)$$ |
| “OR” |
| **Conditional event** | Represents an event **given** that another has occurred | Failing the test **given that** you have high alcohol level | $$P(A|B)$$ |

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| --- | --- | --- | --- |
|  | A | A’ | Totals  |
| B |  |  |  |
| B’ |  |  |  |
| Totals  |  |  |  |

 |  | AA’BB’BB’P(A)P(A’)P(B|A)P(B’|A)P(B|A’)P(B’|A’) | $$\* P\left(B\right)=\frac{P(A∩B)}{P(B)}$$ |
| “GIVEN THAT” |
| **Relative Risk** | Compares risk between two groups – non smokers and smokers | Smokers are twice as likely to get cancer as non-smokers | No notation |

|  |  |  |  |
| --- | --- | --- | --- |
|  | C | C’ | Totals  |
| S |  |  |  |
| S’ |  |  |  |
| Totals  |  |  |  |

 |  | P(C|S’)P(C|S)SS’CC’CC’ | $$=\frac{P(event | exposed)}{P(event | not exposed)}$$$$=\frac{P(cancer | smoker)}{P(cancer | not smoker)}$$ |
| Compares conditional events |

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| **Type of event** | **Meaning** | **Examples** | **Probability Notation** | **Methods**(When events occur in no particular order) | **Method**(when there is an order) | **Formulas** |
| **Two Way Table** | **Venn Diagram** | **Tree Diagram** |
| **An event** |  |  |  |  |  |  |  |
|  |
| **Complementary events** |  |  |  |  |  |  |  |
|  |
| **Mutually exclusive events** |  |  |  |  |  |  |  |
|  |
| **Independent events** |  |  |  |  |  |  |  |
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| --- | --- | --- | --- | --- | --- | --- |
| **Type of event** | **Meaning** | **Examples** | **Probability Notation** | **Methods**(When events occur in no particular order) | **Method**(when there is an order) | **Formulas** |
| **Two Way Table** | **Venn Diagram** | **Tree Diagram** |
| **Intersection of events** |  |  |  |  |  |  |  |
|  |
| **Union of events** |  |  |  |  |  |  |  |
|  |
| **Conditional event** |  |  |  |  |  |  |  |
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| **Relative Risk** |  |  |  |  |  |  |  |
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|  | **Theoretical Probability****(Model estimates)** | **True Probability** | **Experimental Probability****(Experimental estimates)** |
| **Definition** | The probability that an event will occur based on a probability model. A theoretical probability gives an estimate of the true probability but its usefulness as an estimate depends on how well the model matches the situation being modelled. | The actual probability that an event will occur. The true probability is usually unknown and may be estimated by a theoretical probability from a probability model or by an experimental probability. | A probability that an event will occur calculated from trials of a probability activity by dividing the number of times the event occurred by the total number of trials. When an experimental probability is based on many trials the experimental probability should be a close approximation to the true probability of the event. |
| **But really** | Imagine all the possibilities and the chances of each. | What we want to know but can’t… | Data from an experiment, real life or a simulation |
| **Example 1** | Presumed to have two equally likely outcomes so a ½ chance of a boy. | The true chance a baby will be a boy or a girl. Will be close but not exactly ½. | Calculation of probability based on previous births. 2002 data in NZ gives a 0.515 chance of a boy. |
| **Example 2** | This is presumed to have six equally likely outcomes, so the theoretical probability of rolling a 6 is 1/6 (0.167) | The true chance that a particular die lands on a 6 is likely to be close but not exactly 1/6. | Rolling a dice 1000 times, gives 154 sixes. This gives an experimental probability of 0.154. |
| **Example 3** | Model using the binomial distribution with n=4 and π=theoretical or experimental estimate of P(girl). | The true chance of having a certain number of girls in a 4 child family | Get actual data from 1000 4 child families ORSimulate 4 child families using a theoretical or experimental estimate of the P(girl). |
| **Example 4** | Use of Poisson distribution with λ = 4.3 | The true chance of a certain number of earthquakes in a certain region in a month. | Number of earthquakes in a certain region per month, calculated from data collected over 10 years. |

**Probability Strategies**

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| --- | --- | --- | --- |
| **Interpret from information** | **Use a diagram** | **Translation** | **Use a formula** |
| Probability function | Probability graph | Two way table | Venn Diagram | Tree diagram | Notation to words | Words to notation | Identify and Substitute |

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| --- | --- | --- | --- | --- |
| **FREQUENCY** | **🡪**Divide by totalMultiply by total**🡨**  | **PROBABILITY / RELATIVE FREQUENCY** | **🡪**Multiply by nDivide by n**🡨** | **EXPECTED NUMBER** |
| * Count
* Number
 | * Proportion
* Between 0 and 1
 | * Number
* Prediction
 |

|  |  |  |
| --- | --- | --- |
| **RISK** | **ABSOLUTE RISK** | **RELATIVE RISK** |
| Probability | Conditional Probabilities | Compare Conditional Probabilities (divide) |
| P(injury) | P(Iinjury | not wearing seatbelt) | P(Iinjury | not wearing seatbelt)P(Iinjury | wearing seatbelt) |

**Other terms**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Random Experiment** | **Trial** | **Outcome** | **Sample Space** | **Event** | **Equally likely** |
| **Definition** |  |  |  |  |  |  |
| **But really** |  |  |  |  |  |  |
| **Notation** |  |  |  |  |  |  |
| **Example 1** |  |  |  |  |  |  |
| **Example 2** |  |  |  |  |  |  |