

LESSON 3. PROBABILITY DISTRIBUTIONS

3.1. Probability

- Probability experiment, outcome and sample space
- Classical and empirical probability
- Law of large numbers

3.2. Random variables

3.3. Probability distributions and cumulative probability distributions

3.4. Types of probability distributions

- Discrete
- Continuous

3.5. Some distributions used in inferential statistics

Lesson 3: Assignments

- Find the sample space for the gender of the children if a family has three children. Use B for boy and G for girl.**
 - So, we will define as followed.
 - B = Boys
 - G = Girls
- If a family has three children, find the probability that all the children are girls.**
 - So, because we have 3 children, we can then say that the probability for having 3 girls are $\frac{3}{3}$.
- If the probability that a person lives in an industrialized country of the world is $\frac{1}{5}$, find the probability that a person does not live in an industrialized country.**
 - The probability would also be 20% or $\frac{1}{5}$, because the same chance for (a) person or one person who does not live in a industrialized country would be the same for the one who does live in an industrialized country.
- The table below contains information on the number of daily emergency service calls received by the volunteer ambulance service of Happytown for the last 50 days: 22 days of which 2 emergency calls were received, 9 days of which 3 emergency calls were received, 8 days of which no emergency calls were received, etc.**

Number of Service Calls per Day (X)	Number of Days (f)
0	8
1	10
2	22
3	9
4	1
Total	50

What is the probability that 2 or more emergency calls are received on a day?

- The probability is $\frac{5}{31}$, because we can see that 2 emergency calls and 9 emergency calls **were** received, during these 22 days.

- Determine which of the following distributions is a cumulative probability distribution.**

i)

X	1	2	3	4	5
P(X≤x)	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{9}{20}$	$\frac{6}{8}$	$\frac{20}{20}$

ii)

X	22	33	44	55	66	77
P(X≤x)	-0.4	0.2	0.4	0.7	0.8	1

iii)

X	0	3	5	6
P(X≤x)	0.25	0.25	0.25	0.25

iv)

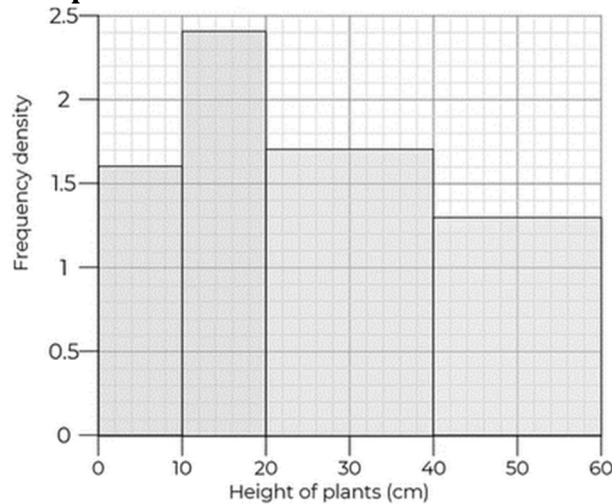
X	0	2	4	6
P(X≤x)	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{6}$	$\frac{4}{16}$

- The picture (i) shown above is a clear example of cumulative probability.

6. The grades of a group of 1000 students in an exam are normally distributed with a mean of 70 and a standard deviation of 10. Approximately, how many students have grades greater than 80?

- a) 680 students
- b) 840 students
- c) **160 students**
- d) 50 students
- e) 320 students

7. We visited a field with plants. We measured the height of each plant and built the histogram below. We then chose one plant at random. What is the probability that the plant is under 30 cm tall?



- In this case we can see that the x-axis shows the height of the plants. Because there is a reference towards the height under 30 cm, then the 30 cm itself should also be included. Because there are 7 different heights, from 0-60, then we can say that the probability for the plants to be under 30 cm tall is $4/7 = 0,57 \times 100 = 57\%$.

8. M&M sweets are of varying colors and the different colors occur in different proportions. The table below gives the probability that a randomly chosen M&M has each color, but the value for orange candies is missing.

Color	Brown	Red	Yellow	Green	Orange
Probability	0.2	0.3	0.2	0.1	?

You draw an M&M at random from a packet. What is the probability that you get either a green one or an orange one?

Because there are 5 different colors, and there is a talk about “either” the green or the orange. Then we can see that the probability is $1/5 = 0,333 \times 33,3\%$.

9. What percent of cases are likely to be between 85 and 93 in a normal distribution with mean 87 and variance 4?

- a. 83.85%
- b. 30.72%
- c. 49.87%
- d. 69.02%
- e. none of these

10. A survey found that one out of five Americans say he or she has visited a doctor in any given month. If 10 people are selected at random, find the probability that exactly 3 will have visited a doctor last month.

- The probability for exactly 3 is $2/10$, because we can see that we have 10 people and there is a talk about he or she. Because we are talking about male and female, we can say that it is 2 people. Therefore, it is $2/10 = 0,2 * 100 = 20\%$.

11. Suppose a loaded die has the following model:

Face	1	2	3	4	5	6
Probability	0.3	0.1	0.1	0.1	0.1	0.3

If this die is thrown and the top face shows an odd number,

- a. What is the probability that the die shows a four?
- If it is a uneven number, then it is $0,1/6 = 0,016$.
- b. What is the probability that the die shows a 1?
- It is the same because it is also $1/6$.

Two sample dependent

Two sample independent

Three sample or more (Anova-one way)

One Sample Variance

One Sample Mean

Descriptive statistics

Hypothesis testing: Comparison of mean of one sample.

Hypothesis testing: Comparison of standard deviation of one sample.

Hypothesis testing: Comparison of means of two independent samples.

Hypothesis testing: Comparison of means of two dependent samples.

ANOVA

Something, we haven't learned.

Hypothesis testing: Comparison of standard deviations of two independent samples.