Problem № 8
«Fair coin»

Team «12FM»

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The task

In many cases, disputes are resolved with a coin toss. It is presumed that this procedure gives equal chances of winning to both sides. Investigate how the chances depend on the tossing mechanism and the coin properties.

Hypothesis

Properties and the tossing mechanism of coin will affect on the probability of one side of coin prolapse.

Aim of the study

Define the dependence between the probability of one side of coin prolapse and properties and the tossing mechanism of coin.

Objectives

1.Observe the probability theory in case of coin tossing.
2.Conduct experiments, which will define the dependences and optimal amount of tossings.
3.Experimentally determine the dependence between the probability of one side of coin prolapse and the tossing mechanism, material of surface, height of tossing, denomination of the coin.
4.Infer conclusions about the probability of one side of coin prolapse depending on different tossing conditions.

Probability theory

$$P(A) = \frac{m}{n} * 100\%$$

P(A) - probability of an event A

m - number of favorable outcomes

n - total number of outcomes

Due to the fact that the total number of outcomes is 2, the probability of one of the variants prolapse equals P(A)=(1/2)*100%=50%

Theory

Description of coin tossing process.

Coin tossing – an action, usually used in everyday life and probability theory as a generator of two random signals: eagle and tails (denomination of coins).

Coin tossing — widely known way of toss-up, while which the participant:

a) tosses the coin by the snap of the thumb;

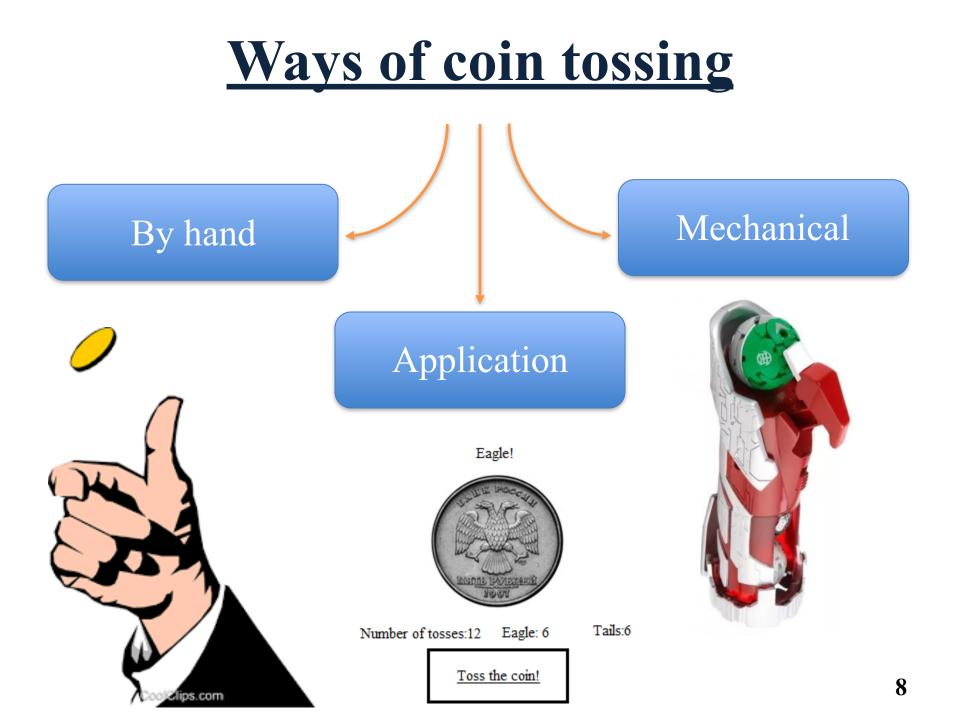**b)** catches the coin by another hand or waits until the coin falls on the ground;

c) shows the coin to other participants.

Theory

Description of coin tossing process.

There are some important aspects of coin tossing, such as: rotational movement of the coin, its uneven oscillations, as well as the probability of a rebound when it falls at the end of the trajectory.

Ways of coin tossing

By hand

Mechanical

Application

Eagle!

Number of tosses:12   Eagle: 6   Tails:6

Toss the coin!

CoolClips.com

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Experiment 1

Purpose: to determine the dependence between the probability of the eagle prolapse and the way of tossing.

Equipment: 5 ruble coin, tossing mechanism, application, hand, soft surface.

Amount of tosses: 1000

Tossing method	Probability of eagle prolapse, %
Mechanical	49
By hand	56
Application	50

Conclusion: the most accurate way to toss the coin is by an application. But further we will use mechanical as by such method we can observe different external factors.

Experiment 2

Purpose: to define the dependence between the probability of the eagle prolapse and the coin denomination(in other words, its mass and diameter).

Equipment: coins with denomination of 50 kopecks, 1, 5 and 10 rubles, tossing mechanism, soft surface.

Way of tossing: mechanical   **Amount of tosses:** 1000

Denomination	Diameter, cm	Mass, g	Probability of eagle prolapse, %
50 kopecks	1,95	2,9	49
1 ruble	2,05	3,25	50
5 rubles	2,5	6,45	52
10 rubles	2,2	5,63	49

Conclusion: the mass and diameter of the coin does not affect on the probability of eagle prolapse.

Experiment 3

Purpose: define the dependence between the probability of eagle prolapse and the type of surface.

Equipment: 5 ruble coin, soft surface (rug), solid surface(table), tossing mechanism.

Way of tossing: mechanical   **Amount of tosses:** 1000

Surface	Probability of the eagle prolapse, %
Soft	50
Solid	48

Conclusion: in both cases, probability of the eagle prolapse seek up to the 50%

Experiment 4

Purpose: to determine the dependence between the eagle prolapse probability and the height of tossing.

Equipment: 5 ruble coin, ruler, tossing mechanism, soft surface.

Way of tossing: by hand.   **Amount of tosses:** 1000

Height of tossing, cm	Probability of the eagle prolapse, %
10	96
30	78
50	49
100	51

Conclusion: the bigger the height, the closer probability to 50% is.

Experiment 5

Purpose: define the dependence between the probability of eagle prolapse and the type of coin deformation.

Equipment: two deformed 10 ruble coins, soft surface.

Way of tossing: mechanical.   **Amount of tosses:** 1000

Experiment 5

Deformation type	The probability of eagle prolapse, %
Cut	34
Hole	56

Conclusion: if the coin is deformed so that the centre of mass shifts relatively to only one axis of symmetry, the probability of eagle prolapse will seek up to 50%. In the case when the centre of mass shifts relatively to both axis of symmetry, the probability of eagle prolapse can be regulated.

Conclusions

The probability theory was observed relatively to the coin side prolapse.

In the course of experimental part we determined the dependence of the probability of coin side prolapse and the following factors: way and height of tossing, center of mass location. But it does not depend on the coin mass and diameter.

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