MMC/Mammoth-2022 Problem

2201: A Space Odyssey

By the beginning of the 23rd century, mankind has settled Mars, the Moon and other bodies of the solar system. Under the direction of a heuristically programmed algorithmic computer HAL13, the *Humankind Post* global system is delivering cargoes between numerous colonies and space stations.

Alice, Bob, Charlie, David, and Erin live on a remote research base on Mars. One fine day, a transport Humankind Post ship arrives at the base with cargo that was clearly destined for some other addressees. But HAL13 denies the error, denies the arrival of the transport and the very existence of this ship. Since it is impossible to return the shipment, the researchers decide to split the goods among themselves.

To this end, they compiled a complete list of cargoes, and each of them, independently of the others, estimated the subjective value of each cargo (i.e., the value of the cargo for them personally), expressing it in the currency of humankind – astrocredits (acr.):

No.	Cargo	Alice's value, acr.	Bob's value, acr.	Charlie's value, acr.	David's value, acr.	Erin's value, acr.
1	Handyman toolset	30	70	60	45	45
2	Box of survival food packs	20	22	25	23	15
3	Length of silk cloth	110	70	50	90	80
4	Computer memory banks	50	100	50	90	20
5	Electronic thermometer (lab grade)	200	310	200	320	300
6	Pet dog-butterfly hybrid (in cryostasis)	180	50	-50	0	200
7	Tableware set	7	6	5	5	6
8	Space suit	200	700	450	550	550
9	Space bow-tie	3	10	3	4	1
10	Rolled-up 300" flat TV	75	50	90	50	40
11	Table cutlery set	4	4	1	1	3
12	Summer shoes	15	5	7	5	10
13	Holodeck access key card	10	110	110	30	40
14	Box of rare paper books	120	80	90	150	170
15	Sundew-pumpkin seeds	5	3	15	30	100
16	Scanning quark microscope	200	800	600	1100	1000
17	Web videostreaming gear	150	50	300	100	100
18	Knit sweater	20	20	20	20	20
19	Adjustable-wavelength projector	5	8	7	20	35
20	Albanian keyboard	9	10	15	2	5
21	Foldable real estate (high tax)	50	75	-30	-50	-40
22	Bottle of spice melange	50	25	95	100	50
23	Automatic chicken counter	20	75	20	70	90
24	Antique uPhone 17 (good condition)	200	300	340	125	150
25	Lightsaber (out of order)	50	100	220	110	70
26	High-school student correction tool	200	250	150	400	500
27	Unsuspicious mechanical parts	3	30	5	7	5
28	Suspicious mechanical parts	3	45	50	70	45
29	"We were known as BTS" memoirs (books)	70	40	100	10	120
30	Luke's birth certificate	30	5	25	10	5

Remark 1: The negative values of some cargoes are explained by the fact that the values of these cargoes for some researchers is low, but these objects incur maintenance costs.

Tasks:

1) Distribute all the cargoes between Alice and Bob, giving the items to whoever likes them most. Will such a distribution of goods be fair?

2) Create a set of criteria for a fair distribution of goods. All researchers involved in cargo distribution are assumed to have equal rights.

3) The five researchers can both compete with one another, or cooperate in achieving some collective goals. How will the criteria for the fair distribution of goods change if one takes into account the social interactions between the settlers?

4) The researchers have evaluated each cargo separately. However, the subjective value of goods may change depending on what other goods the person possesses or does not possess. Examine the list of cargoes and suggest modifications to their values depending on the possession of other cargoes.

5) Distribute all cargoes according to the principles you suggested among the members of each of the following groups (i.e., create four independent cargo distributions):

      a) Alice and Bob,

      b) Alice and Charlie,

      c) Alice, Bob, and Charlie,

      d) Alice, Bob, Charlie, David, and Erin.

Demonstrate how the distributions you obtained comply or do not comply with your principles of fairness.

Remark 2: The cargoes are indivisible, i.e., each cargo can only be given to one researcher.

Remark 3: The cargo table is duplicated in the form of Excel tables (in Russian and English) and in the form of two CSV files (in Russian and English); in the CSV files, the field separator is the character ";" (semicolon). The CSV files are UTF-8 encoded text files.