on 4

.00 out of

Consider a 2x2 economy characterized by the following input coefficients:

0,3	0,4
0,2	0,5

, where sectors are in columns.

Assume further that the first sector uses 2 units of oil (a primary resource) per unit of output, while the second sector uses 0.5 units. The current price of crude oil is 100 HUF, the price of both products is 1,000 HUF, and the value added is 300 HUF and 50 HUF for the first and second sectors, respectively.
The price of oil increases by 45.8%, and it is known that domestic value added remains unchanged in absolute terms.

What will be the price of the first product after the price increase?

Answer: 1186.5926 ✔

The correct answer is: 1186.59

on 5

.00 out of

What will the inflation rate be if the weights of the goods in the inflation index are 40/50/10 for the first product, the second product, and oil, respectively?

Answer: 21.7971 ✔

The correct answer is: 21.80

Of course. Here is a step-by-step solution to both problems using matrices and vectors as requested.

Problem 4: Calculating the New Price of the First Product

This problem can be solved using the Leontief price model. The model states that the price of a product must cover the cost of its inputs (both intermediate and primary) plus the value added.

1. Define the Vectors and Matrices

From the problem description, we can define the following:

- **Input-Output Matrix (A):** This matrix shows the amount of input from sector *i* (row) needed to produce one unit of output in sector *j* (column).

```
A = | 0.3  0.4 |
    | 0.2  0.5 |
```

- **Initial Price Vector (P):** The initial prices of the two products.
  `P = [1000, 1000]`
- **Oil Input Coefficients (a_oil):** A vector representing the units of oil needed per unit of output for each sector.
  `a_oil = [2, 0.5]`
- **Initial Oil Price (P_oil):**
  `P_oil = 100` HUF
- **Value Added Vector (v):** The value added per unit of output for each sector.
  `v = [300, 50]`

2. The Leontief Price Equation

The price equation for an economy is:

`p = Aᵀp + c`

Where:

- **p** is the column vector of product prices.
- **A^T** is the transpose of the input-output matrix.
- **c** is the column vector of costs per unit of output, excluding intermediate inputs. This vector is the sum of primary input costs and value added.

Let's calculate the initial cost vector `c_initial`:

```
c = (a_oil)ᵀ * P_oil + vᵀ
c_initial = [2, 0.5]ᵀ * 100 + [300, 50]ᵀ
c_initial = [200, 50]ᵀ + [300, 50]ᵀ = [500, 100]ᵀ
```

We can verify that the initial prices are correct: `p = (I - Aᵀ)⁻¹ * c`
Let's first calculate `(I - Aᵀ)`:

```
I - Aᵀ = | 1  0 | - | 0.3  0.2 | = | 0.7  -0.2 |
          | 0  1 |   | 0.4  0.5 |   | -0.4  0.5 |
```

The inverse, `(I - Aᵀ)⁻¹`, is `(1/det) * adj(matrix)`:

```
det = (0.7 * 0.5) - (-0.2 * -0.4) = 0.35 - 0.08 = 0.27
(I - Aᵀ)⁻¹ = (1/0.27) * | 0.5  0.2 |
                        | 0.4  0.7 |

p_initial = (1/0.27) * | 0.5  0.2 | * | 500 | = (1/0.27) * | 250 + 20 | = (1/0.27) * | 270 | = | 1000 |
                       | 0.4  0.7 |   | 100 |              | 200 + 70 |              | 270 |   | 1000 |
```

The initial state is consistent.

3. Calculate the New Prices (p')

The price of oil increases by 45.8%, and the value added remains constant.

- **New Oil Price (P'_oil):**
  `P'_oil = 100 * (1 + 0.458) = 145.8` HUF
- **New Cost Vector (c'):** The value added `v` is unchanged.

  ```
  c' = (a_oil)ᵀ * P'_oil + vᵀ
  c' = [2, 0.5]ᵀ * 145.8 + [300, 50]ᵀ
  c' = [291.6, 72.9]ᵀ + [300, 50]ᵀ = [591.6, 122.9]ᵀ
  ```

Now, we solve for the new price vector `p'`:

```
p' = (I - Aᵀ)⁻¹ * c'
p' = (1/0.27) * | 0.5  0.2 | * | 591.6 |
                | 0.4  0.7 |   | 122.9 |
```

First, perform the matrix-vector multiplication:

```
| (0.5 * 591.6) + (0.2 * 122.9) | = | 295.8 + 24.58 | = | 320.38 |
| (0.4 * 591.6) + (0.7 * 122.9) |   | 236.64 + 86.03 |   | 322.67 |
```

Now, multiply by `1/0.27`:

```
p' = (1/0.27) * | 320.38 | = | 320.38 / 0.27 | = | 1186.5926 |
                | 322.67 |   | 322.67 / 0.27 |   | 1195.0741 |
```

The new price vector is `p' = [1186.59, 1195.07]`.

Answer for Question 4: The price of the first product after the price increase is **1186.59** HUF.

Problem 5: Calculating the Inflation Rate

The inflation rate is the weighted average of the price changes for the goods in the index.

1. Define the Weights and Prices

- **Weights Vector (w):** For the first product, second product, and oil.
  `w = [0.4, 0.5, 0.1]`
- **Initial Price Vector (P_basket_initial):**
  `P_basket_initial = [P1, P2, P_oil] = [1000, 1000, 100]`
- **New Price Vector (P_basket_new):**
  `P_basket_new = [P1', P2', P'_oil] = [1186.59, 1195.07, 145.8]`

2. Calculate Individual Price Changes

First, we calculate the percentage price change for each item in the basket.

- **% Change in P1:** `(1186.59 / 1000 - 1) * 100 = 18.659%`
- **% Change in P2:** `(1195.07 / 1000 - 1) * 100 = 19.507%`
- **% Change in P_oil:** `(145.8 / 100 - 1) * 100 = 45.8%`

3. Calculate the Weighted Average Inflation Rate

The overall inflation rate is the dot product of the weights vector and the vector of percentage changes.

```
Inflation Rate = w · [%ΔP1, %ΔP2, %ΔP_oil]ᵀ
Inflation Rate = (0.4 * 18.659) + (0.5 * 19.507) + (0.1 * 45.8)
Inflation Rate = 7.4636 + 9.7535 + 4.58
Inflation Rate = 21.7971 %
```

Answer for Question 5: The inflation rate is **21.80%**.