Computational Management Science 1
Final

registration number: ....
(Do not write your name on the test - just the 7 digit student id number.)

1. (6 points) Writing Code

    (a) (3 points, ≤5 minutes) Functions
    Write a function `productsum(first_iterable, second_iterable)` in Python that takes
    a two sequences of numbers with any length. The function must calculate the product
    of the elements of each of the sequences and return the sum of the two products. [e.g.
    `productsum((1, 3, 4, 1), (9, 2, 3))` ⟹ 12+54=66;
    `productsum([3, 5], [2, 4])` ⟹ 23]. Add a proper docstring to receive full points.

    (b) (3 points, ≤5 minutes) Classes and Data Structures
    Implement a simple data structure in Python. The data structure must be capable of
    storing a table with named rows and columns. Write a **minimalistic** class. You don't
    need to implement any functionality, not even the functions to access / index the data.
    The class must be initialized with row and column labels and all values must be set
    to 0.0. [e.g. `a_table = Table(['row1', 'row2'], ['col1', 'col2', 'col3'])`].
    Don't forget to write docstrings in order to receive full points.

2. (6 points, ≤10 minutes) Correct Mistakes
   The following code contains 6 syntax errors/ typos. Clearly mark and correct the mistakes.
   (*hint: you don't need to understand what the function does to correct the mistakes as there are no
   logical errors; assume that all required classes are available → just look for syntax errors*)

```python
class SortationCenter(OptimizationObject):
    """Sortation center representation for transportation problems.""
    def __init__(self, sortation_center: dict, fulfillment_centers dict,
                 customers: dict):
        self.name = sortation_center[name]
        self.unit_costs = {fulfillment_centers[fc['from']]: fc['cost']
                           for fc in sortation_center['unit_cost'}
        self.shipping_costs {customers[cust['to']: cust['cost']
                             for cust in sortation_center['shipping_cost']}
```

3. (6 points, ≤10 minutes) Data Analysis Tools

   (a) Name (in total) two advantages and / or disadvantages of pandas over common spreadsheet programs (2p).

   (b) Also name (in total) two advantages and / or disadvantages of pandas over other professional data analysis tools (2p).

   (c) Finally, name one thing you like about this course and one thing that should be improved in the future (be honest!) (2p).

4. (12 points) Reading and Understanding Code
   What do the following code snippets print to stdout? Write exactly what the output of
   each snippet is if **the snippet is the only content of a Python file**. If the output is an error
   message, it is enough to write "ERROR". If there is no output, write "None"

   (a) Simple calculation

   ```python
   print(3 * 2 * 2 ** 3)
   ```

   (b) Pandas

   ```python
   from pandas import DataFrame
   df = DataFrame([[20, 'name1'], [15, 'name2']])
   print(df[1][1])
   ```

   (c) Numpy

   ```python
   import numpy as np
   m = np.arange(4).reshape(2,2)
   print(m[1,1])
   ```

   (d) Math

   ```python
   import math
   l = [5, 3, 2]
   print(math.pi(l[0], l[1]))
   ```

   (e) Lists

   ```python
   l1 = [5, 3]
   l2 = [3, 5]
   l1.append(l2)
   print(sum(l1))
   ```

   (f) Sorting

   ```python
   l = [2, 4, 3]
   print(sorted(l))
   ```

5. (5 points, ≤5 minutes) PuLP

    (a) (3 points)
        Name three advantages and / or disadvantages of PuLP over proprietary, designated
        modelling languages.

    (b) (2 points)
        List at least two tricks to apply when running out of memory (RAM) when using PuLP
        and a MILP solver directly from within the same Python program.

6. (6 points), ≤5 minutes) Pandas
   Assume pandas is imported into your namespace as `pd`.

    (a) (1.5 points)
        Initialize a pandas series with the values (4, 2, 3, 5, 7) which use the labels ['Sue', 'Pat',
        'Chris', 'John', 'Stu']. The series must be stored in a variable named `s`.

    (b) (1.5 points)
        Generate basic statistic figures over the values in `s` and print them.

    (c) (1.5 points)
        Read a compressed csv file into a pandas data frame. The file is called 'pv_data.csv.bz2',
        directly starts with the column names and has ',' to separate the columns. The data
        frame must be stored in a variable called `df`.

    (d) (1.5 points)
        Print the last couple of lines of `df` to `stdout`.

7. (7 points) Tools

    (a) (3 points)
        What is git and what can it do for you? Name some of the key features. Give examples
        of file types that work well with git and examples of file types that are not ideal.

    (b) (3 points)
        Name the three types of UI and give a pro and a contra for each approach.

    (c) (1 points)
        Is `math` part of the Python standard library? What about numpy?