**Background information**

SONY, as a world-famous electronic device company, is trying to set up an online shopping platform at Edinburgh. Edinburgh is a city at Scotland, UK. This city is well-known as its rich history and developed economic, there are lots of young people work and study here. So, Edinburgh is an ideal city to launch SONY’s online shopping platform.

As the developing of the online shopping platform, efficient and safe delivery play an important role of successful. There are many elements in delivery, one of the most important elements is choosing the suitable location of warehouse. A good location of warehouse not only can make sure a short time of delivery to consumer, but also can reduce delivery cost and time, increase the overall efficiency.

However, choosing the suitable location warehouse should take account of many factors, such as the traffic convince, labor force, fixed cost of setting up a warehouse. Also we need to consider from SONY’s perspective, basically all the products are electronic devices, such as smart phone, camera, headphone and television…it has various type of products with different sizes.

So, this problem can be converted to a math programming issue, there are many variables need to take account such as whether set up a pick up point, also some constraints such as the total investment, the demand should be meet…

This problem should be solved by 2 models, the first model is the minimize the total cost of the delivery. The second model is the minimize the time of the delivery process.

1. 他说我们的问题框架需要修改,因为现在去修改亚马逊的delivery station不现实, 所以我跟他说修改为 start-up e-commerce company ,然后现在进驻爱丁堡市场, 选取市面上available的warehouse(通过zoopla等出售房产的网站获取数据[地点+价格])

2. 我们第二个问题, 他说要加入更多realistic的细节:

比如我们运的货物是什么?是smart phone吗?

那我们基于smart phone的重量数据, 我们可以得到每种vehicle的capacity, (比如货车一次运1000台手机).

因此我说我们可以是专门卖手机的e-commerce company.他说OK.

但是我们还需要加入更多细节到problem description里面

JD 进驻爱丁堡市场，与Amazon竞争。想要复刻

**Background Description**

We are tasked with optimizing the setup of pick-up points to efficiently serve various demand areas. Our primary objectives are to minimize the costs associated with establishing and operating these pick-up points, and to minimize the transportation time for delivering goods to these areas. This dual focus aims to enhance operational efficiency while ensuring customer satisfaction by reliably meeting their demands in a timely manner.

Critical considerations in this endeavor include the costs of transporting goods from pick-up points to demand areas, the fixed costs of establishing these points, the capacity constraints of each location, and an overarching investment budget that must not be exceeded. Furthermore, we aim to balance these economic objectives with the operational goal of reducing delivery times, thereby maintaining a high level of customer satisfaction and reflecting the efficiency in fulfilling the demand.

The **challenge** lies in formulating an optimization model that effectively balances these dual objectives, possibly through multi-objective optimization techniques such as weighted objectives or hierarchical optimization. This model will inform the strategic decision-making process for determining the optimal number and locations of pick-up points, taking into account both cost-effectiveness and timeliness within the given constraints.

**Model 1 - Cost Minimization Model (MILP)**

**Objective:** Minimize the total cost, including fixed and transportation costs.

**Decision Variables:**

: The flow of goods from pick-up point i to demand area j (continuous variable).

: Binary variable indicating whether a pick-up point is established at location i.

K -> 产品类别,k=1 是手机1,k=2是冰箱1

**Objective Function:**

where is the transportation cost from pick-up point to demand area, and Fi is the fixed cost of establishing a pick-up point at location.

**Constraints:**

**每个区的需求量不一样-> 根据人口 *NHS / POSTCODE***

***Z <= investment1***

**Table: RENT*i*房租成本**

**Capacity Constraint:**

**Demand Satisfaction Constraint:**

**Pickup Point Number Limit:**

**Investment Constraint:**

# Model 2 - Transportation Time Minimization Model (MIP) [Based on the optimized solution of Model 1]

**Objective:**

Minimize the total transportation time using different types of vehicles for goods delivery.

**Decision Variables:**

: The number of **trucks** purchased at the th delivery station.

: The number of **motorcycles** purchased at theth delivery station.

: The number of **bicycles** purchased at theth delivery station.

**Objective Function:**

-> potential delivery station 的编号

-> demand zone 编号

: The flow of goods(货物件数) from pick-up point i to demand area j (continuous variable).

: Binary variable indicating **whether** a pick-up point is established at location i.

: j 地的月需求

: i地到j 地的距离

: The number of **trucks** purchased at the th delivery station.

: The number of motorcycles purchased at theth delivery station.

: The number of bicycles purchased at theth delivery station.

model1 的成本约束

model2 的成本约束

I 到 J 地的单位货运成本

在i地建立仓库的固定成本

i地的月总租金

K -> 产品类别,k=1 是手机1,k=2是冰箱1

Distance ij:

**Distance 考虑来回**

**每个产品的重量/体积, -> 每种载具能载多少这种产品**

**维护成本 -> 细分到月**

**? <=每种载具最大运货体积**

**? <=每种载具最大运货重量**

**Table 3 X 2 载具的最大运货体积, 最大运货重量**

**雇佣driver成本 -> 细分到月**

**Constraints:**

**Cargo Flow Constraint:**

**Cargo weight Constraint:**

A->B,K=1有3台,K=2有5台

如何引入k代表货物类型,来约束Cap

**Daily Max Departures for Each Vehicle Type:**

Trucks:

Motorcycles:

Bicycles:

**Vehicle Purchase Constraints:**

Trucks:

Motorcycles:

Bicycles: