Information:

1) Demand points + Demand

2) Reference points (Potential Bases)

3) Distance matrix

Demand point / Bases

[ ]

4) Actual Bases locations

5) Actual available Amb. location

6) Call location

- Demand points
- Calls
- Available Ambulances
- Bases

i → demand point

d_i → demand at point i

$\sum_i d_i$ → total demand

$E = \{(j,i) : j \in W, i \in V\}$ where (j,i) is travel time from site j to demand point i.

$G = (V \cup W, E)$. V = demand points; W = ambulance location sites.

x_j integer $(j \in W)$ (9)

→ the num of ambulances at site $j \in W$

$y_i, z_i \in \{0,1\}$ $(i \in V)$ (8)

y and z are ~~var~~ booleans related to demand points.

$x_j \leq P_j$ $(j \in W)$ each site has at most P_j ambs. (7)

$\sum_{j \in W} x_j = P$. use all ambulances (6)

$z_i \leq y_i$ $(i \in V)$ a demand cannot be covered twice if it isn't covered once. (5)

$\sum_{j \in W_i^{r1}} x_j \geq y_i + z_i$ $(i \in V)$ (4)

at least 2 ambulances are required for double cov.

$\sum_{i \in V} d_i^s y_i \geq \alpha \sum_{i \in V} d_i^s$ $(s \in S)$ (3)

a fraction α of all demand is covered within r_1 in each scenario

$\sum_{j \in W_i^{r2}} x_j \geq 1$ $(i \in V)$ (2)

all demand is covered within ~~r_1~~ r_2

max: $\sum_{s \in S} p^s \sum_{i \in V} w_i^s d_i^s z_i$ (1)

weighted sum of demand points covered at least twice within

(1) potential base locations: spots for ambulances
(2) call demand & priority
(3) demand scenarios demand variations on time & day.
(4) demand points
(5) average travel time

[4] calculated by hierarchical clustering to select 100 demand points. by Euclidean distance & Ward's minimum variance.

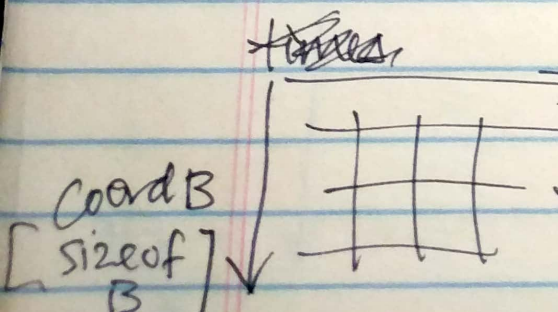
= How to run the clustering in Python? =

[5] Average travel time reported by a Google Maps query.

(id, long, latt, date, day, time, priority) 10513
latt, long — of the location of request. entries.

(latt, long) 969 entries
(bases)

(☆) Cluster by ~~average~~ demands
(2) from each "base" to demand points, calculate average time.

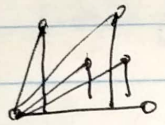


That's what the demand points is for.

for each demand point, count # of nearby points.
sort points by descending order
pick top 100 points as representative

suppose cl have all the demand points clustered already. Now what?

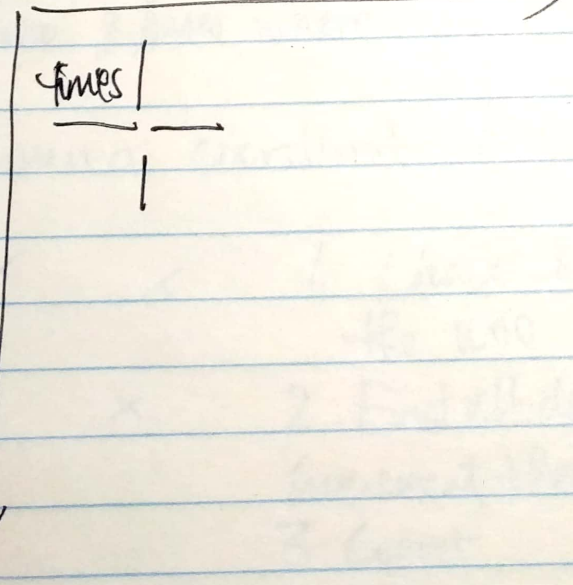
Find ~~a b~~ a set of 8 ambulances that fits within the 100 demand points.



Now that cl have a list of surrounding estimated locations for demand points, cl can estimate time between base and demand points.

times.csv

100 demand points



969 bases

x_j = num Amb per base
P = total ambulances

all demand points must be covered by r=10, and we want to maximize r=14

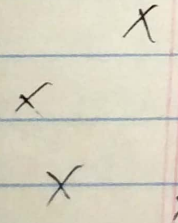
① find the travel time between each base chosen by k-means, and the k-means of the demand.
a) 8 chosen bases or 11 (doesn't matter) that satisfies $r_i \leq 10$ for all demand points given by the cluster.

10·60
= 600

for each demand point, if a base is $r \leq 10$, increment it's coverage.

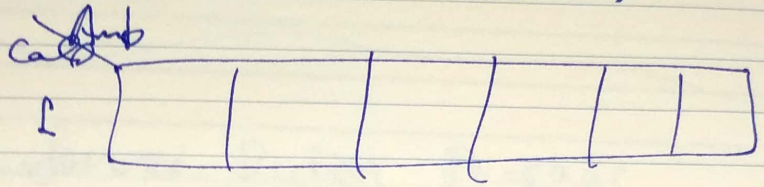
10000 demand pts
1000 bases.
choose 8 bases where all clusters are satisfied.

given a coordinate, find closest nearby coord.



1. Choose 8 ambulance locations out of the 1000
2. Find all demand points near them. increment their coverage.
3. Count

1) Calculate travel time
from each nearby ambulance
to call locations



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2) Evaluate coverage

primary
secondary | Given radius

or calculate

primary radius
secondary radius | ⋮

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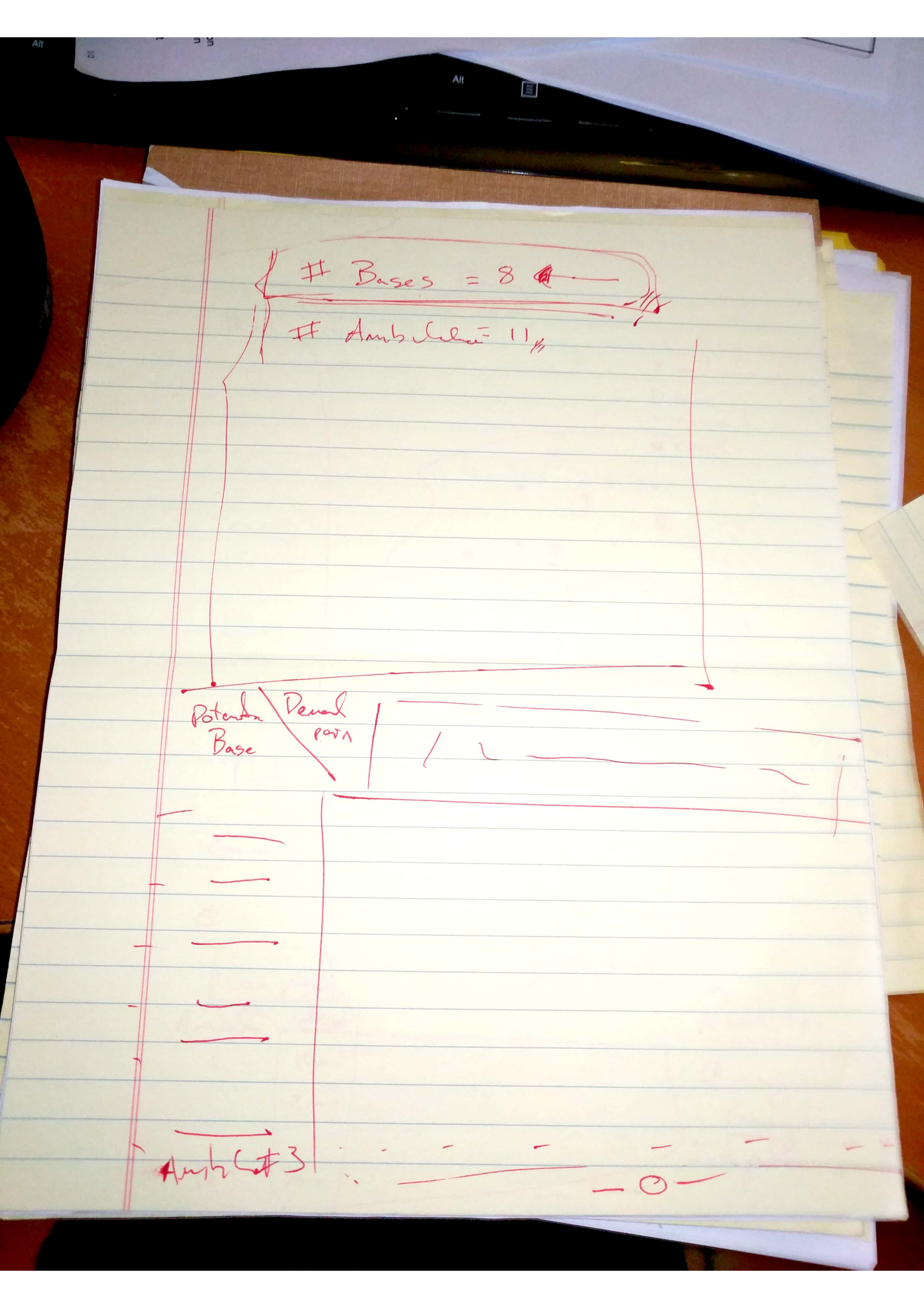
3) to do = then what?

1) Brute force (combinatorial)


Bases = 8
Ambulances = 11
Potential Base
Demand point
Ambulance #3

Existing Data

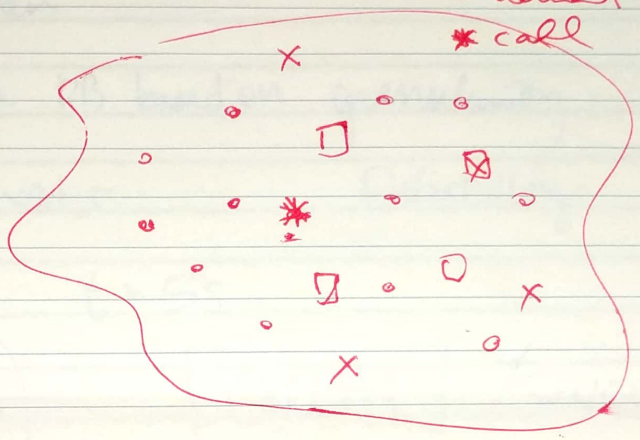
Bases | Demand points

x ambulance

D base

• demand

* call



Data needed for dynamic Deploy

Given: } Demand locations

Ambulance } positions
statuses

e.g.

Time prof

Ambulance	Load
1	10 min
:	2 min
:	
10	5 min

Real time

query

Google "

Intersection "

Realistic

Static / Dynamic given a problem case that just came in. Ambulances on route, out of base

Redefine the Problem

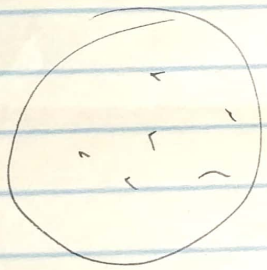
Reallocate the bases. Change num of bases?
Superset of problem

≠ Multi-layered DB based on granularity

Location exists.

Probability

t = 55.

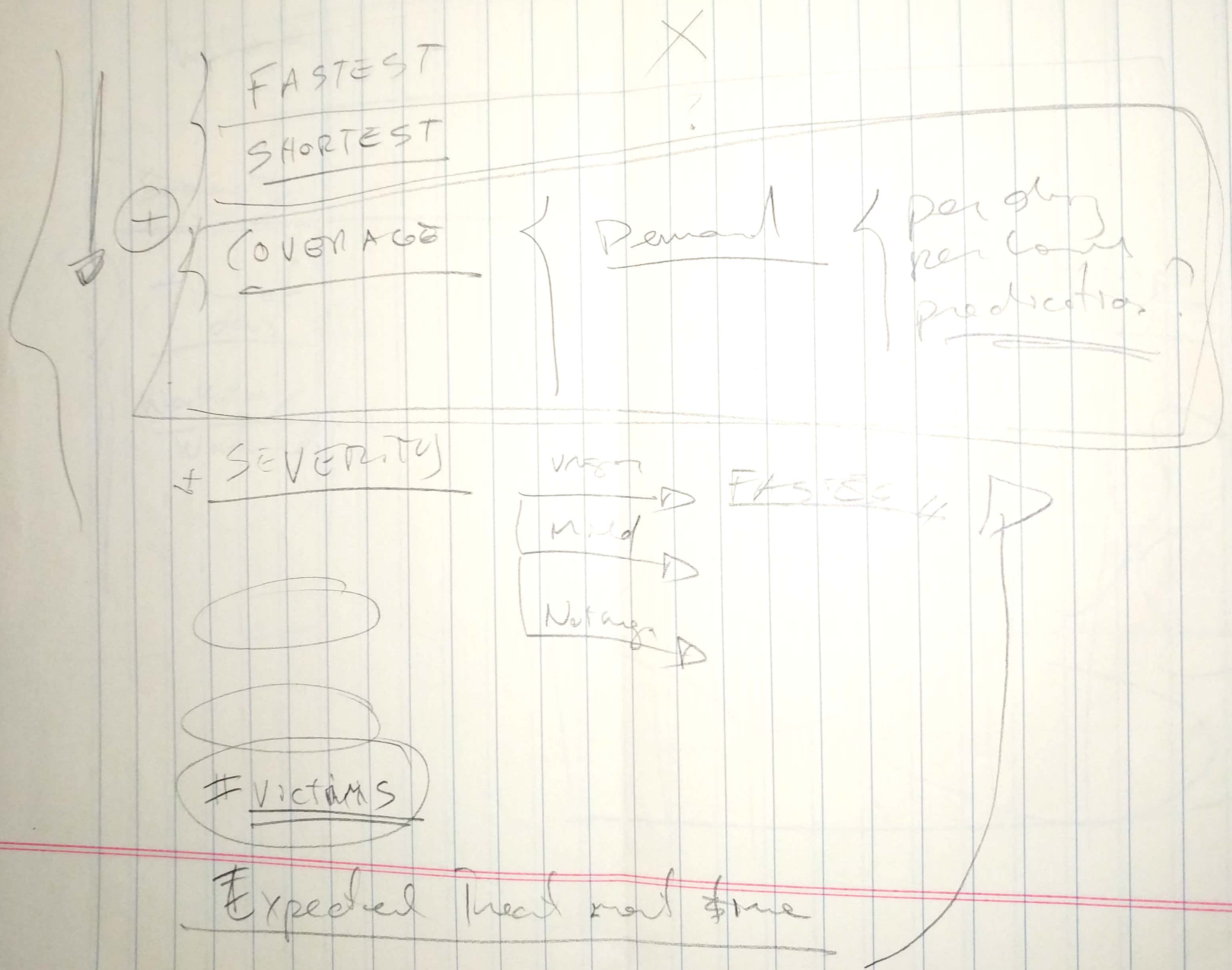


[Call #1] / Severity -

↓

[Call #2]

Base to base
In transit change destination.


FASTEST
SHORTEST
COVERAGE
Demand
prediction ?
+ SEVERITY
Mild
FASTEST
VICTIMS
Expected Treatment time

Calls

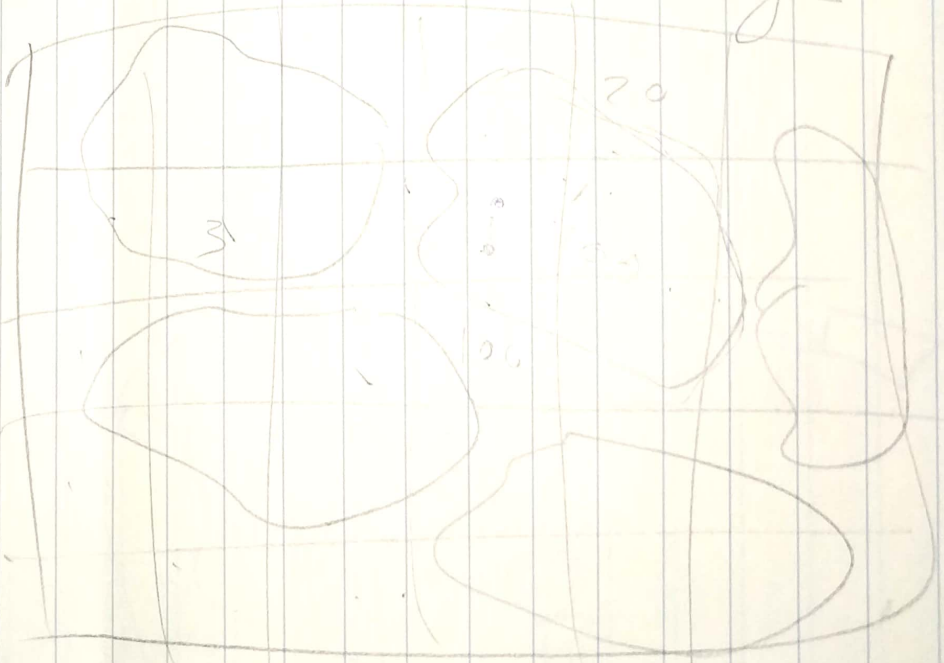
Where

Season

Time of day

Weekday / Weekend

Clustering



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What benefits or problems

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to ask: Is this really going to
become a reality?

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