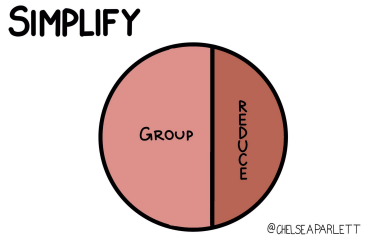
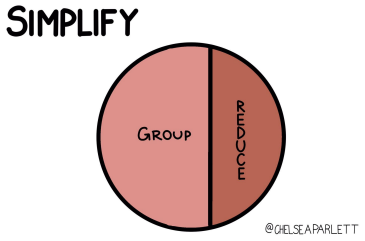


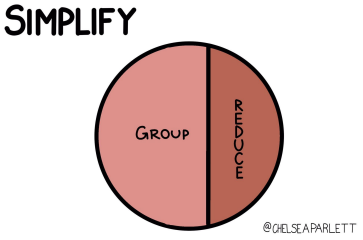
K-Means and Expectation Maximization

Chelsea Parlett-Pelleriti

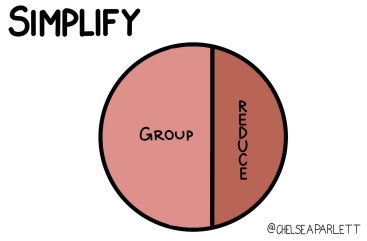
Unsupervised Machine Learning



Clustering



K-Means



1. Choose **k** random points to be cluster centers
2. For each data point, assign it to the cluster whose center is closest
3. Using these assignments, recalculate the centers
4. Repeat 2 and 3 until either:
    a. Cluster membership does not change
    b. Centers change only a tiny amount

K-Means

1. Choose **k** random points to be cluster centers
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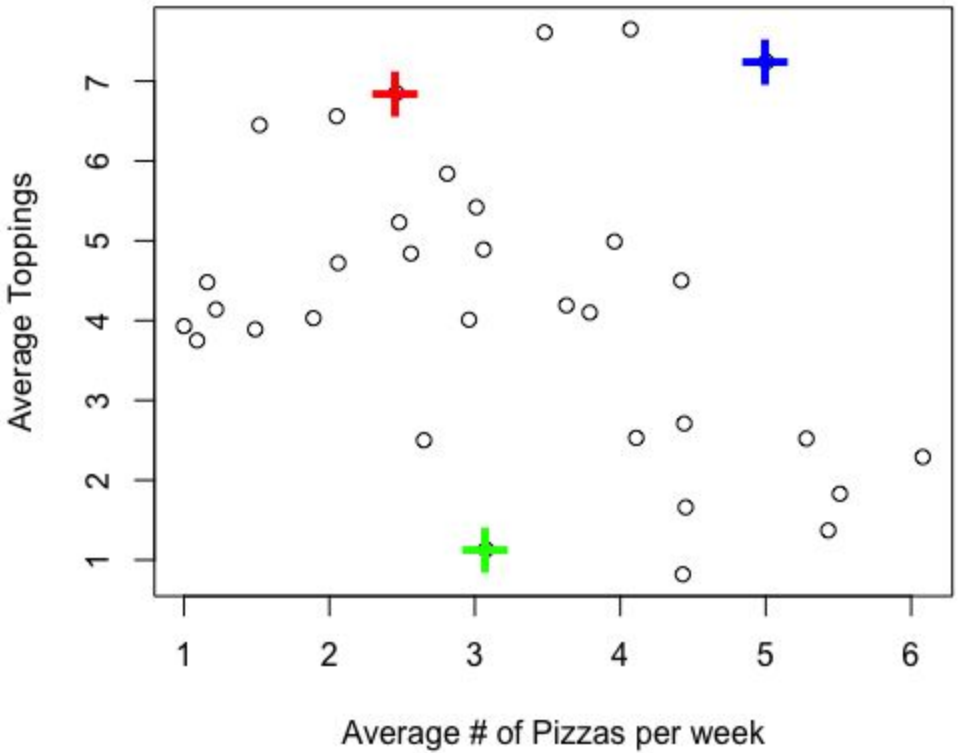
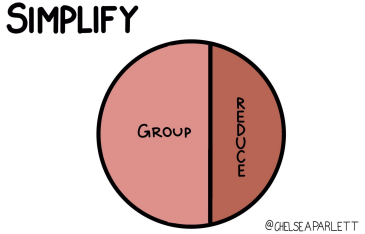


1



K-Means

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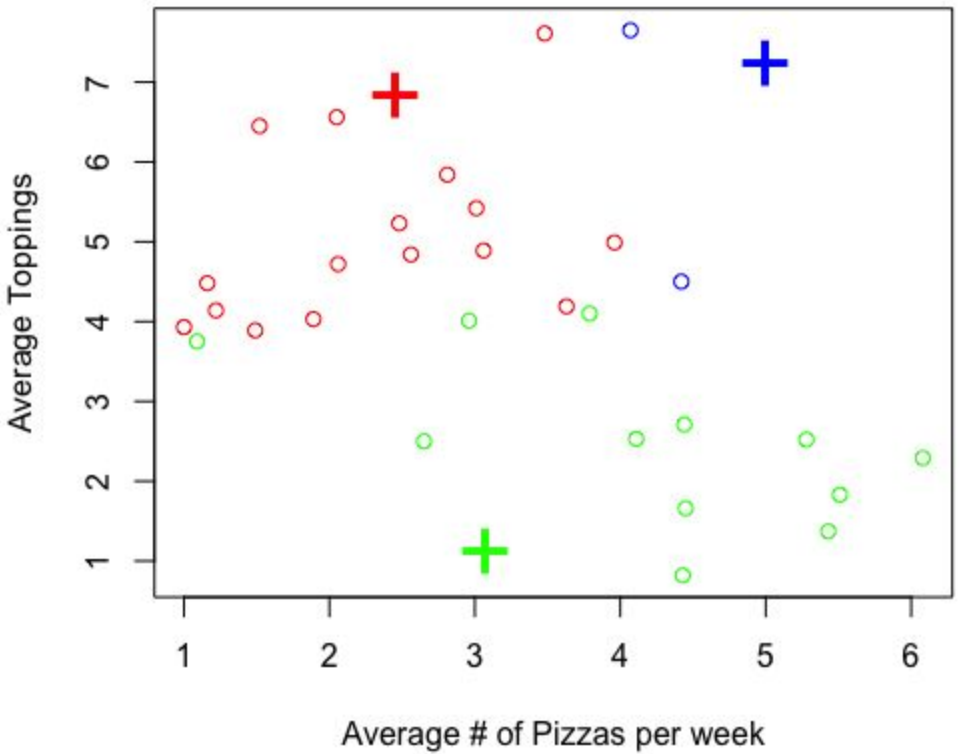

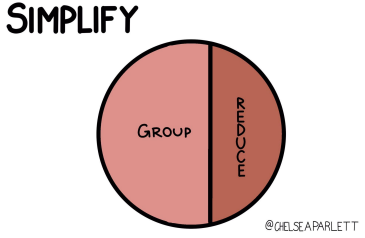

2

K-Means

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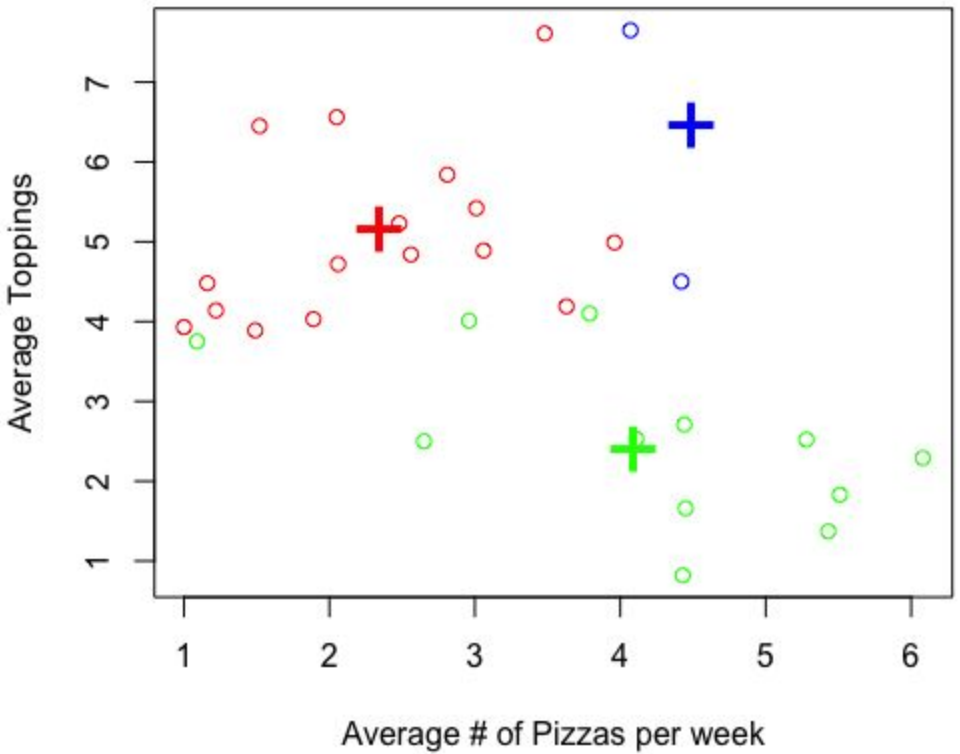

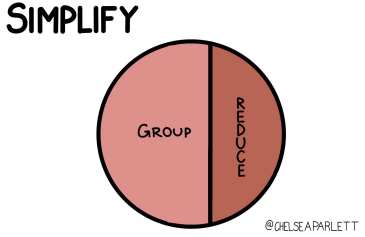

3

K-Means

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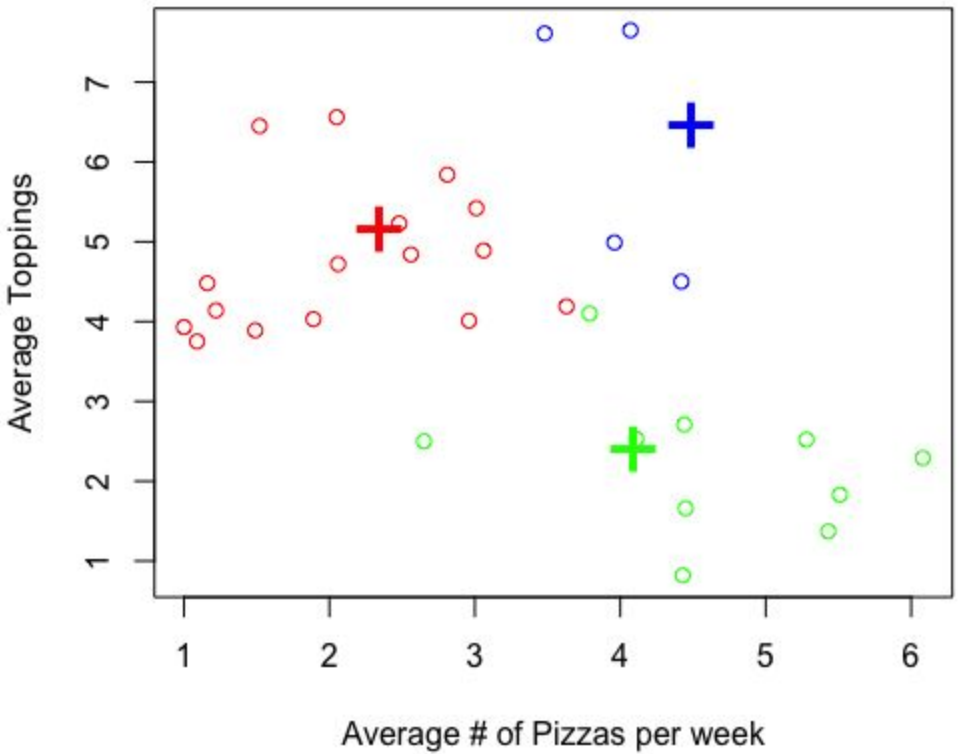

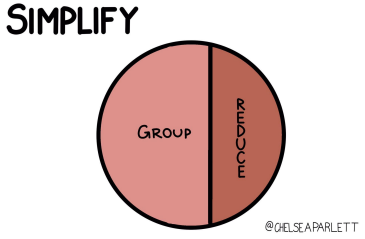

2

K-Means

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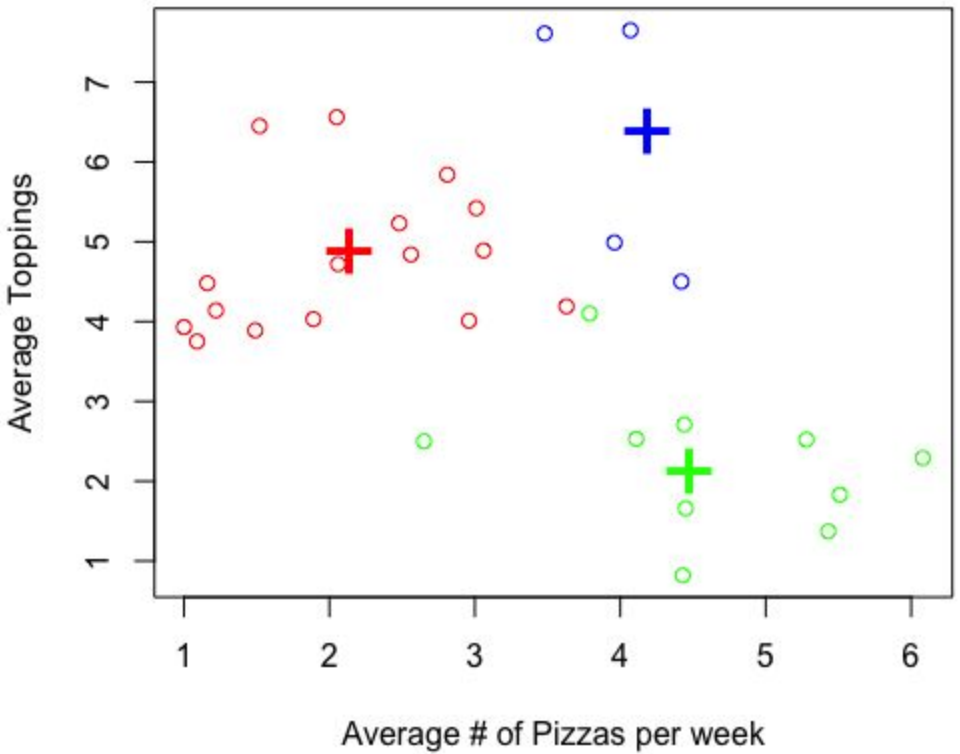

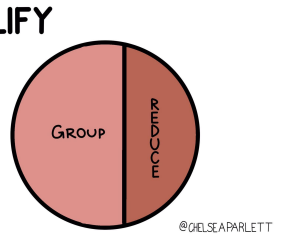

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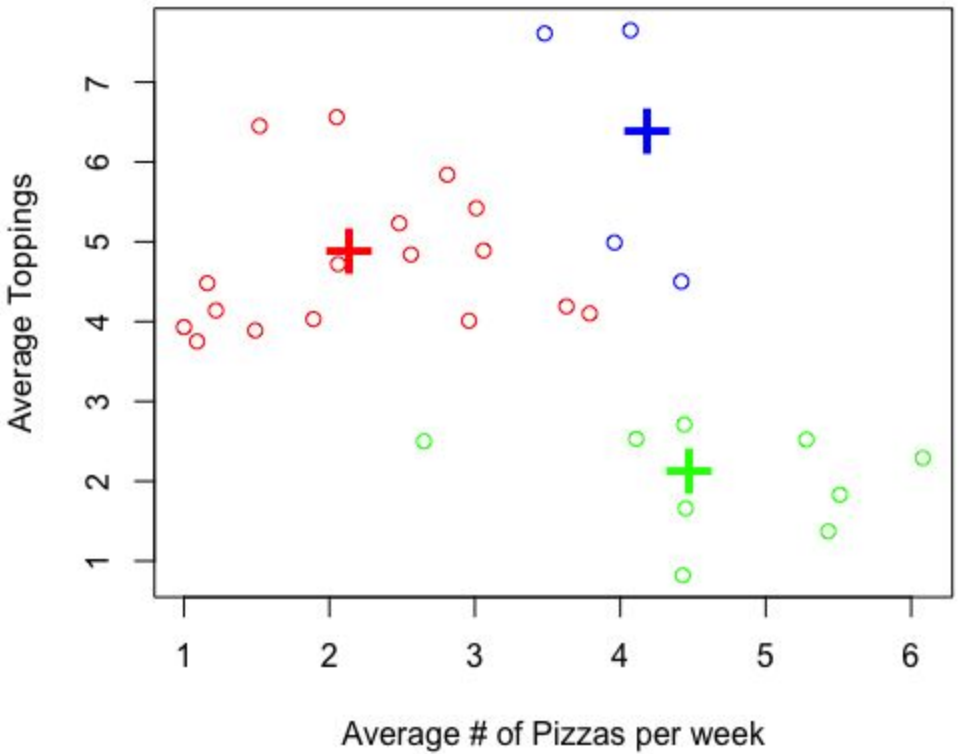

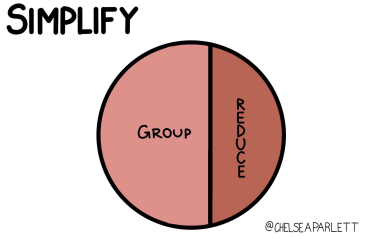

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K-Means

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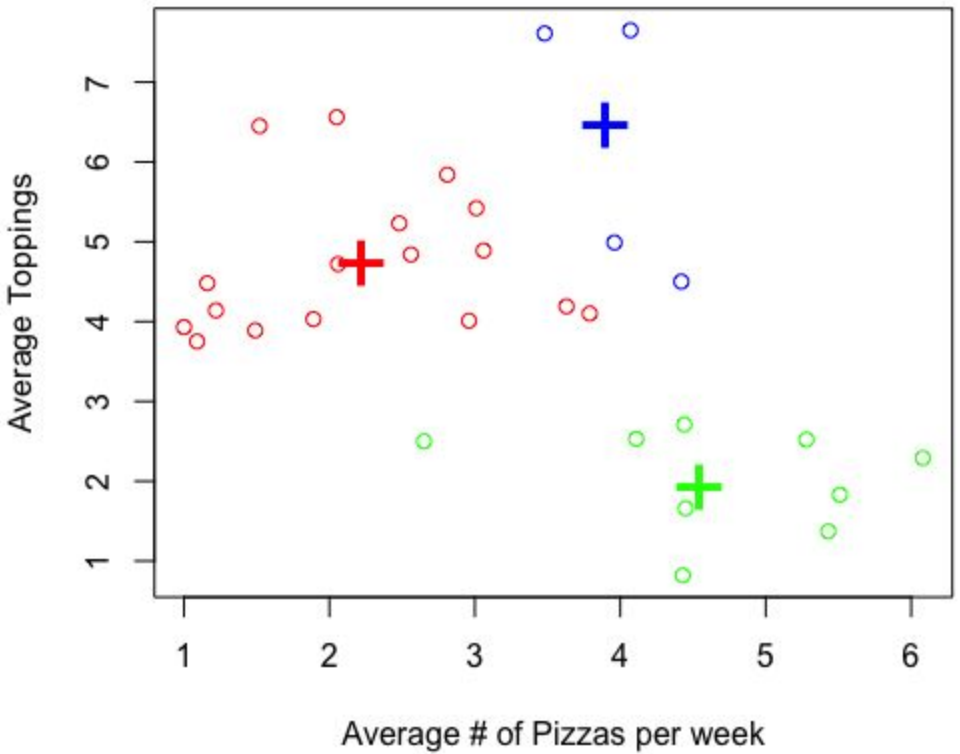

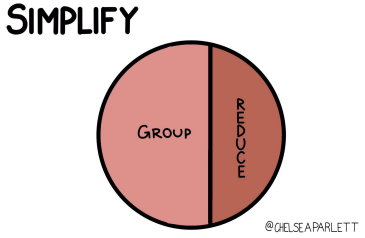

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K-Means

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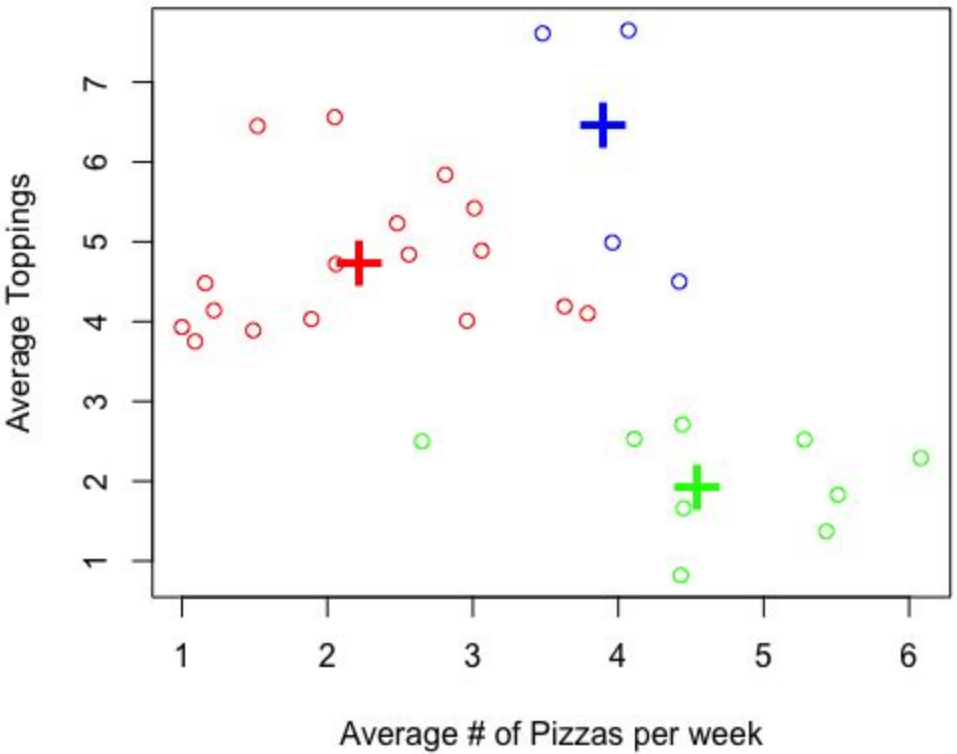

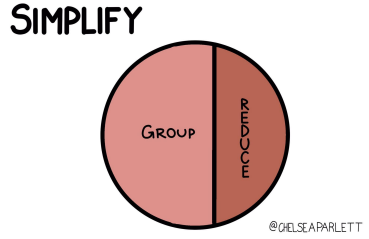

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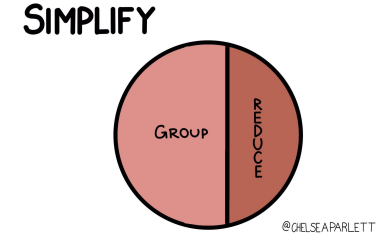
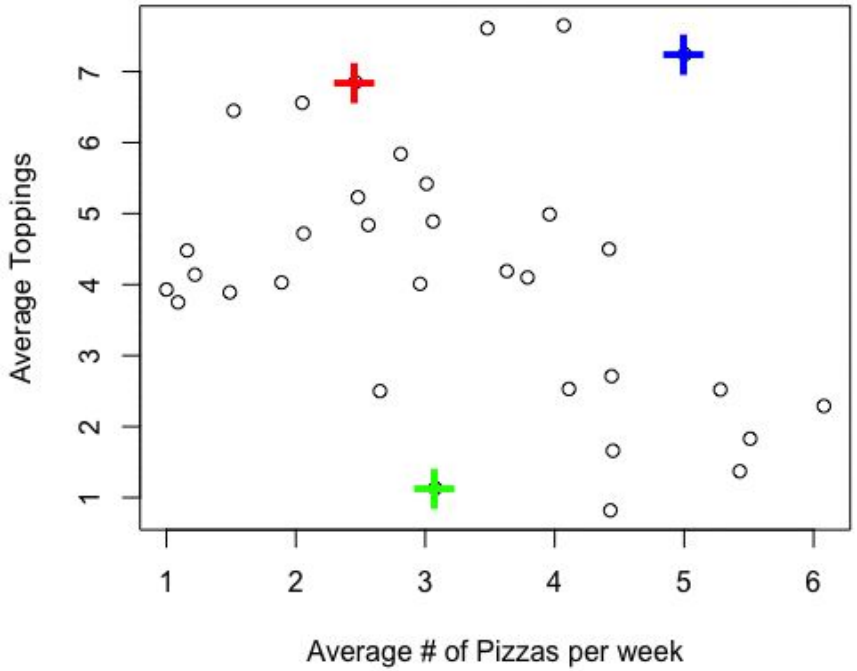
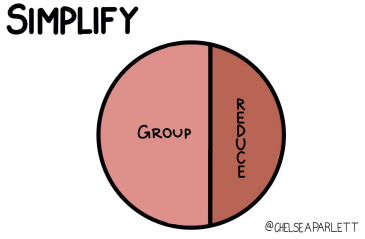




K-Means

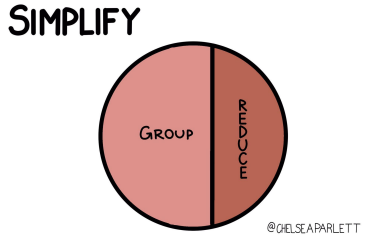


Assumptions

Spherical Clusters

Roughly the same # in each cluster

Evaluating Unsupervised Models

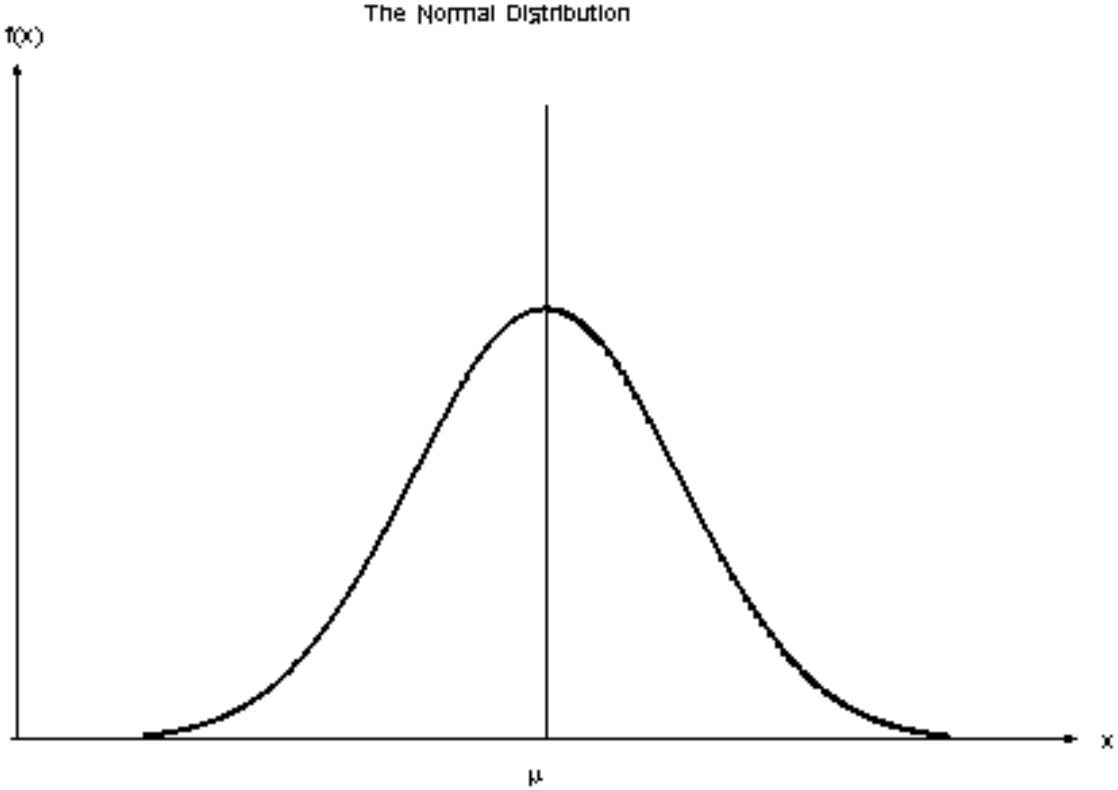


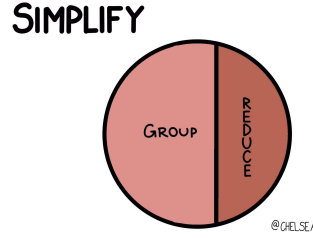
Cohesion:

Separation:

$$s(i) = \frac{b(i) - a(i)}{\max\{a(i), b(i)\}}$$

Normal (Gaussian) Distribution

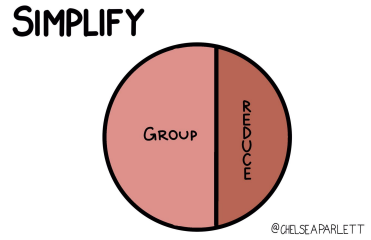


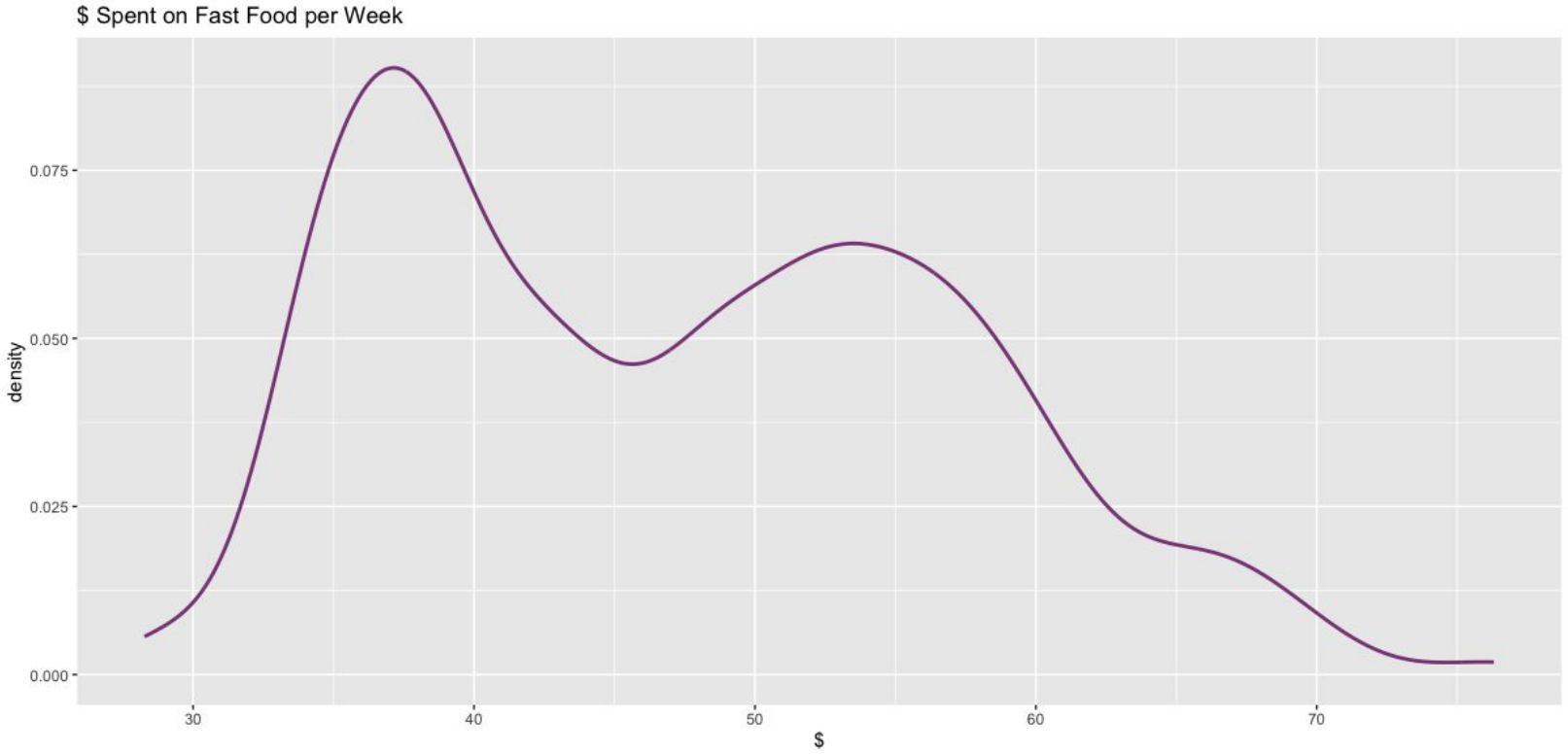


$$y = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

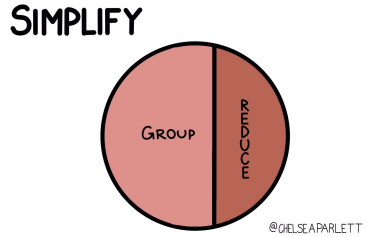
$\mu =$ Mean
$\sigma =$ Standard Deviation
$\pi \approx 3.14159\cdots$
$e \approx 2.71828\cdots$

EM


SIMPLIFY
GROUP
REDUCE
@CHELSEAPARLETT


$ Spent on Fast Food per Week
density
0.075
0.050
0.025
0.000
30
40
50
60
70
$

EM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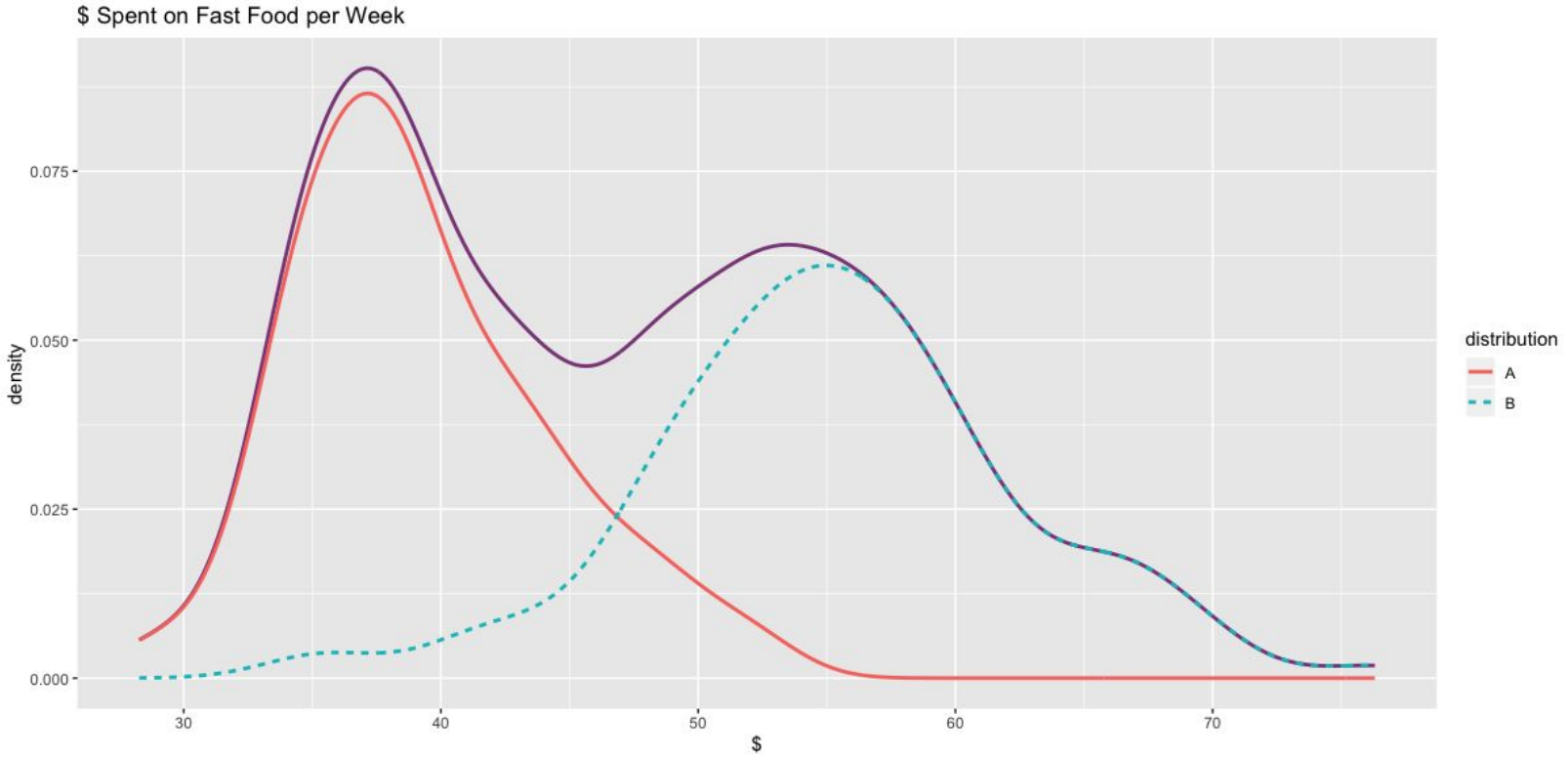
$ Spent on Fast Food per Week
density
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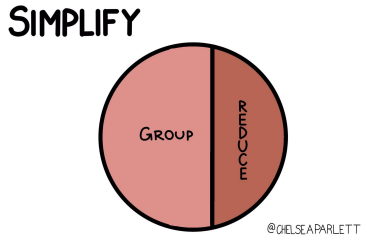
EM



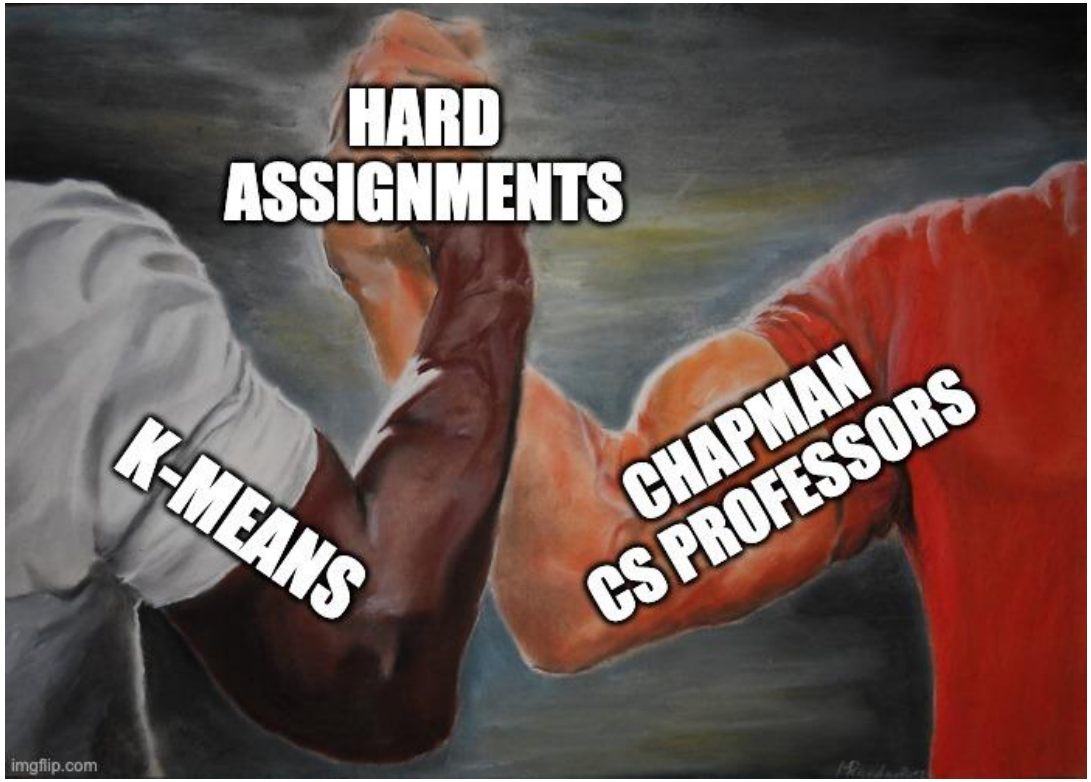
K means

- Hard Assignment
- All Variances the Same

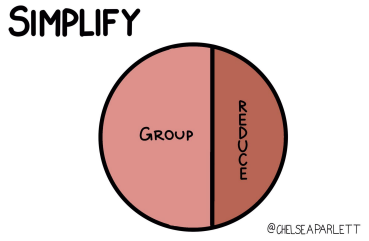
EM with mixtures of Gaussians

- Soft (probabilistic) Assignment
- Variances can be different

EM


HARD
ASSIGNMENTS
K-MEANS
CHAPMAN
CS PROFESSORS
imgflip.com

K-Means Review



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2. For each data point, assign it to the cluster whose center is closest
3. Using these assignments, recalculate the **centers**
4. Repeat 2 and 3 until either:
    a. Cluster membership does not change
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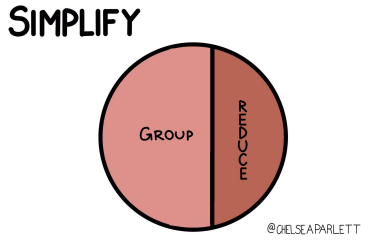
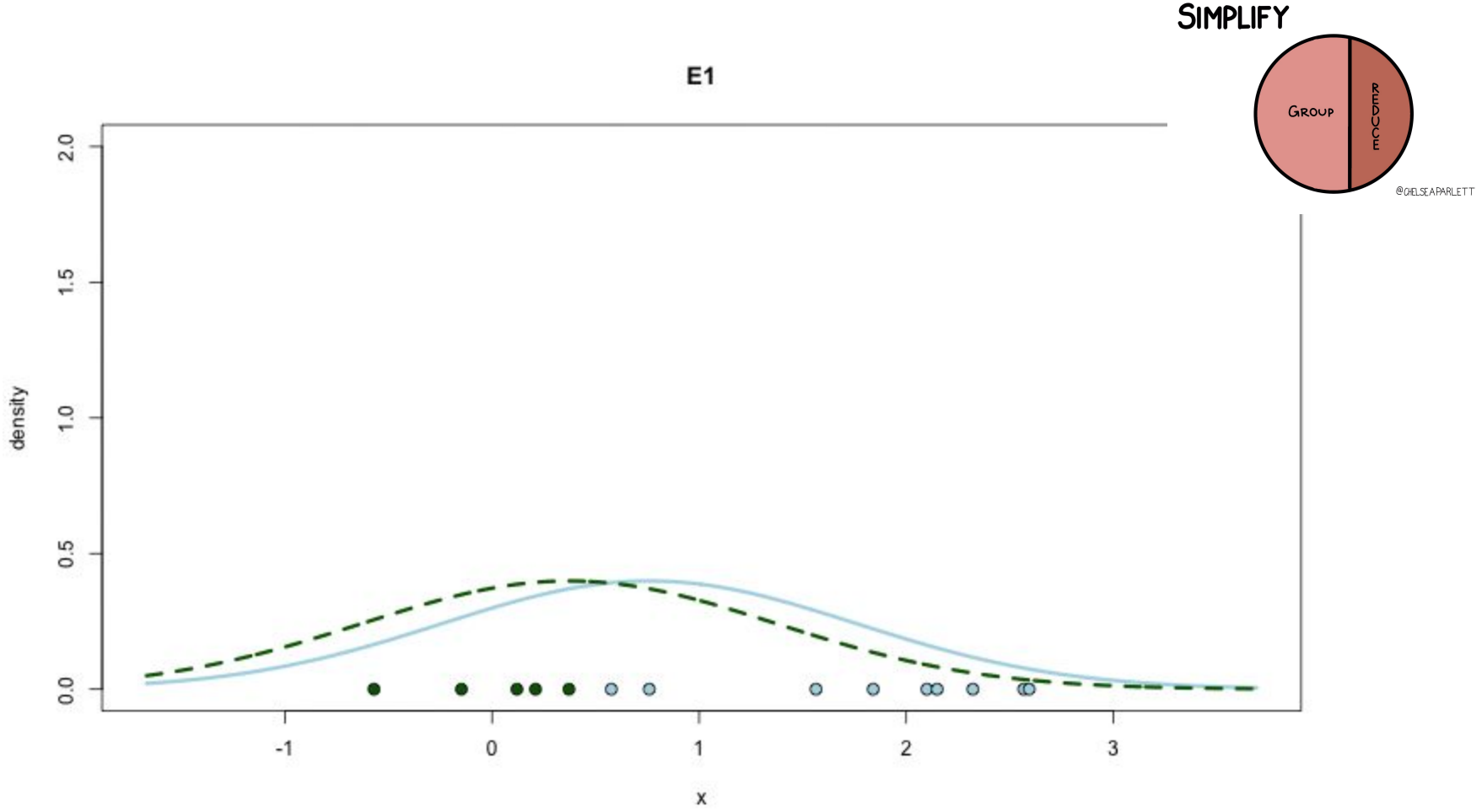
EM



1. Choose **k** random points to be cluster centers (**or estimate using k-means…etc)**
2. For each data point, assign it to the cluster whose center is closest
3. Using these assignments, recalculate the **means + variances**
4. Repeat 2 and 3 until **distributions converge.**


SIMPLIFY
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E1
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1.5
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0.5
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-1
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1
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x