1. **Heating vectors (Set 1)**

**ACS 2006-2010**

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**Mixing weights**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Mean** | **SD** | **2.5%** | **97.5%** |
| p.1 | 0.2043 | 0.0175 | 0.1712 | 0.2404 |
| p.2 | 0.1054 | 0.0140 | 0.0774 | 0.1322 |
| p.3 | 0.1126 | 0.0392 | 0.0000 | 0.1666 |
| p.4 | 0.1003 | 0.0132 | 0.0754 | 0.1266 |
| p.5 | 0.1380 | 0.0136 | 0.1098 | 0.1636 |
| p.6 | 0.1005 | 0.0146 | 0.0721 | 0.1315 |
| p.7 | 0.0530 | 0.0107 | 0.0345 | 0.0741 |
| p.8 | 0.0284 | 0.0227 | 0.0000 | 0.0829 |
| p.9 | 0.1573 | 0.0319 | 0.1044 | 0.2212 |

A graph with different colored rectangular shapes

Description automatically generated

|  | **cluster1 (N=324)** | **cluster2 (N=167)** | **cluster3 (N=152)** | **cluster4 (N=145)** | **cluster5 (N=209)** | **cluster6 (N=135)** | **cluster7 (N=73)** | **cluster8 (N=28)** | **cluster9 (N=245)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Average Assignment Probability (ECR Algorithm)** |  |  |  |  |  |  |  |  |  |
| Mean (SD) | 0.841 (0.174) | 0.828 (0.170) | 0.704 (0.130) | 0.815 (0.176) | 0.891 (0.161) | 0.817 (0.156) | 0.744 (0.153) | 0.566 (0.0796) | 0.785 (0.191) |
| Median [Min, Max] | 0.914 [0.185, 0.994] | 0.890 [0.309, 0.995] | 0.706 [0.410, 0.919] | 0.871 [0.442, 0.996] | 0.972 [0.290, 0.996] | 0.845 [0.434, 0.998] | 0.774 [0.372, 0.979] | 0.572 [0.345, 0.673] | 0.815 [0.176, 0.992] |

**ACS 2011-2015**

A screenshot of a computer

Description automatically generated

\*No observations in cluster 7

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Mean** | **SD** | **2.5%** | **97.5%** |
| p.1 | 0.1292183 | 0.0175580 | 0.1037124 | 0.1893165 |
| p.2 | 0.1035116 | 0.0112210 | 0.0823009 | 0.1255278 |
| p.3 | 0.1984312 | 0.0178423 | 0.1662735 | 0.2365589 |
| p.4 | 0.2639759 | 0.0151615 | 0.2333685 | 0.2933483 |
| p.5 | 0.1124291 | 0.0156044 | 0.0857048 | 0.1462296 |
| p.6 | 0.0715279 | 0.0220546 | 0.0000000 | 0.1154052 |
| p.7 | 0.0108511 | 0.0183613 | 0.0000000 | 0.0562619 |
| p.8 | 0.0397064 | 0.0108644 | 0.0225403 | 0.0666677 |
| p.9 | 0.0703486 | 0.0209471 | 0.0000000 | 0.0957974 |

A graph with different colored squares

Description automatically generated

|  | **cluster1 (N=181)** | **cluster2 (N=156)** | **cluster3 (N=315)** | **cluster4 (N=406)** | **cluster5 (N=165)** | **cluster6 (N=96)** | **cluster8 (N=45)** | **cluster9 (N=114)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Average Assignment Probability (ECR Algorithm)** |  |  |  |  |  |  |  |  |
| Mean (SD) | 0.955 (0.0839) | 0.866 (0.159) | 0.857 (0.174) | 0.924 (0.128) | 0.807 (0.164) | 0.657 (0.150) | 0.807 (0.164) | 0.794 (0.147) |
| Median [Min, Max] | 0.985 [0.468, 0.999] | 0.946 [0.361, 0.998] | 0.923 [0.247, 0.994] | 0.975 [0.240, 0.998] | 0.830 [0.383, 0.995] | 0.662 [0.363, 0.953] | 0.830 [0.383, 0.997] | 0.853 [0.316, 0.927] |

**ACS 2015-2019**

**A screenshot of a computer program

Description automatically generated**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Mean** | **SD** | **2.5%** | **97.5%** |
| p.1 | 0.2946242 | 0.0138141 | 0.2684068 | 0.3216439 |
| p.2 | 0.1032780 | 0.0133154 | 0.0781711 | 0.1286903 |
| p.3 | 0.0373058 | 0.0276428 | 0.0000000 | 0.0873315 |
| p.4 | 0.1129444 | 0.0142592 | 0.0857370 | 0.1430624 |
| p.5 | 0.1080820 | 0.0404868 | 0.0073321 | 0.1969131 |
| p.6 | 0.2419764 | 0.0241896 | 0.1995722 | 0.2896869 |
| p.7 | 0.1017891 | 0.0437053 | 0.0350052 | 0.2070201 |

A graph showing different colored squares

Description automatically generated

|  | **cluster1 (N=448)** | **cluster2 (N=154)** | **cluster3 (N=39)** | **cluster4 (N=171)** | **cluster5 (N=167)** | **cluster6 (N=379)** | **cluster7 (N=120)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Average Assignment Probability (ECR Algorithm)** |  |  |  |  |  |  |  |
| Mean (SD) | 0.949 (0.131) | 0.856 (0.187) | 0.519 (0.102) | 0.822 (0.186) | 0.773 (0.0984) | 0.877 (0.161) | 0.798 (0.131) |
| Median [Min, Max] | 0.998 [0.237, 1.00] | 0.963 [0.329, 0.998] | 0.505 [0.349, 0.732] | 0.896 [0.288, 0.997] | 0.823 [0.383, 0.855] | 0.949 [0.222, 0.990] | 0.866 [0.400, 0.911] |

1. **Heating vectors (Set 2)**

**ACS 2006-2010**

A screenshot of a computer

Description automatically generated

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Mean** | **SD** | **2.5%** | **97.5%** |
| p.1 | 0.2040 | 0.0174 | 0.1630 | 0.2347 |
| p.2 | 0.0996 | 0.0157 | 0.0714 | 0.1310 |
| p.3 | 0.0996 | 0.0128 | 0.0756 | 0.1253 |
| p.4 | 0.0537 | 0.0107 | 0.0345 | 0.0752 |
| p.5 | 0.1188 | 0.0300 | 0.0596 | 0.1742 |
| p.6 | 0.1069 | 0.0133 | 0.0808 | 0.1322 |
| p.7 | 0.1579 | 0.0339 | 0.1027 | 0.2259 |
| p.8 | 0.1376 | 0.0128 | 0.1122 | 0.1626 |
| p.9 | 0.0219 | 0.0180 | 0.0000 | 0.0568 |

A graph with different colored rectangular shapes

Description automatically generated

|  | **cluster1 (N=331)** | **cluster2 (N=131)** | **cluster3 (N=144)** | **cluster4 (N=72)** | **cluster5 (N=162)** | **cluster6 (N=167)** | **cluster7 (N=241)** | **cluster8 (N=209)** | **cluster9 (N=21)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Average Assignment Probability (ECR Algorithm)** |  |  |  |  |  |  |  |  |  |
| Mean (SD) | 0.831 (0.187) | 0.823 (0.148) | 0.811 (0.177) | 0.755 (0.149) | 0.717 (0.158) | 0.834 (0.169) | 0.793 (0.177) | 0.896 (0.165) | 0.536 (0.0635) |
| Median [Min, Max] | 0.899 [0.198, 0.994] | 0.853 [0.431, 0.998] | 0.858 [0.436, 0.996] | 0.782 [0.372, 0.978] | 0.722 [0.257, 0.984] | 0.898 [0.320, 0.994] | 0.816 [0.234, 0.994] | 0.980 [0.294, 0.999] | 0.554 [0.398, 0.621] |

**ACS 2011-2015**

A screenshot of a computer

Description automatically generated

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Mean** | **SD** | **2.5%** | **97.5%** |
| p.1 | 0.0662 | 0.0255 | 0.0000 | 0.0956 |
| p.2 | 0.1053 | 0.0108 | 0.0847 | 0.1276 |
| p.3 | 0.0396 | 0.0095 | 0.0238 | 0.0591 |
| p.4 | 0.0752 | 0.0145 | 0.0474 | 0.1031 |
| p.5 | 0.1164 | 0.0157 | 0.0886 | 0.1499 |
| p.6 | 0.1322 | 0.0226 | 0.1042 | 0.1943 |
| p.7 | 0.2657 | 0.0155 | 0.2377 | 0.2990 |
| p.8 | 0.1994 | 0.0163 | 0.1681 | 0.2313 |

**A graph with different colored rectangular shapes

Description automatically generated**

|  | **cluster1 (N=113)** | **cluster2 (N=154)** | **cluster3 (N=46)** | **cluster4 (N=91)** | **cluster5 (N=169)** | **cluster6 (N=181)** | **cluster7 (N=407)** | **cluster8 (N=317)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Average Assignment Probability (ECR Algorithm)** |  |  |  |  |  |  |  |  |
| Mean (SD) | 0.760 (0.135) | 0.881 (0.145) | 0.800 (0.175) | 0.772 (0.173) | 0.813 (0.165) | 0.957 (0.0823) | 0.925 (0.130) | 0.863 (0.163) |
| Median [Min, Max] | 0.815 [0.311, 0.879] | 0.949 [0.376, 0.998] | 0.834 [0.350, 0.998] | 0.797 [0.419, 0.997] | 0.853 [0.383, 0.995] | 0.986 [0.500, 0.999] | 0.978 [0.254, 0.998] | 0.925 [0.211, 0.994] |

**ACS 2015-2019**

A screenshot of a computer

Description automatically generated

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Mean** | **SD** | **2.5%** | **97.5%** |
| p.1 | 0.0914563 | 0.0143482 | 0.0655128 | 0.1203082 |
| p.2 | 0.2372000 | 0.0227225 | 0.1923662 | 0.2802821 |
| p.3 | 0.1153369 | 0.0153521 | 0.0867634 | 0.1443147 |
| p.4 | 0.1008468 | 0.0140745 | 0.0743414 | 0.1302943 |
| p.5 | 0.2940215 | 0.0128921 | 0.2664334 | 0.3188759 |
| p.6 | 0.1101795 | 0.0136717 | 0.0833982 | 0.1382458 |
| p.7 | 0.0509591 | 0.0222961 | 0.0128554 | 0.0961418 |

A graph with different colored squares

Description automatically generated

|  | **cluster1 (N=122)** | **cluster2 (N=371)** | **cluster3 (N=176)** | **cluster4 (N=147)** | **cluster5 (N=445)** | **cluster6 (N=166)** | **cluster7 (N=51)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Average Assignment Probability (ECR Algorithm)** |  |  |  |  |  |  |  |
| Mean (SD) | 0.860 (0.161) | 0.876 (0.160) | 0.822 (0.184) | 0.867 (0.178) | 0.952 (0.123) | 0.885 (0.133) | 0.636 (0.156) |
| Median [Min, Max] | 0.948 [0.437, 0.998] | 0.949 [0.228, 0.989] | 0.890 [0.309, 0.997] | 0.967 [0.304, 0.998] | 0.998 [0.299, 1.00] | 0.951 [0.419, 0.994] | 0.613 [0.355, 0.958] |

**Summary**

* Found a method in [Altekar(2004)](https://pubmed.ncbi.nlm.nih.gov/14960467/) to do this more efficiently by using incremental heating where the heat of the m chain is , and the parameter DeltaT is chosen s.t swaps are accepted 20%- 60% of time.
* I set DeltaT = {0.01, 0.025, 0.05, 0.1, 0.15, 0.2} 🡪 for these datasets smaller DeltaT seemed to work better (i.e., higher swap acceptance rates). The results shown above are for DeltaT = {0.01 (Set 1), 0.025 (Set 2)}
* Using Set 1 yielded swap acceptance ratios ranging from **54%-56.8%** which is pretty good. This also had shorter runtime as chains that were stuck in a local optima were able to jump to another one. However,
  + Mixing weights including zero in the credible interval
  + For ACS 2011-2015 (under Set 1), one cluster is empty.
* In terms of the above “problems”, Set 2 seems to be more stable, and the swap acceptance ratios are still good.
* Remember that some census tracts (“fuzzycts”) were not being classified to the cluster with highest posterior probability. You were right; it is a rounding issue! 🡪 should we communicate this the developers?