



Yet Another DIF test

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IRT Workshop 2010



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Motivation

In an analysis [...] where no anchor is introduced and the groups are simply analyzed separately, no conclusions about which items may or may not show DIF are possible.



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1. What do we have?

- “Same” items, different persons.
- *Relative* difficulties of items *in* each group:

$$R_{ij}^{(g)} = \delta_{ig} - \delta_{jg}$$

- DIF means: $\mathbf{R}^{(1)} \neq \mathbf{R}^{(2)}$.
- Groups are manifest.



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2. A simple test

- $\mathbf{R}^{(1)} \perp\!\!\!\perp \mathbf{R}^{(2)}$:

$$\text{Var} \left(R_{ij}^{(1)} - R_{ij}^{(2)} \right) = \text{Var} \left(R_{ij}^{(1)} \right) + \text{Var} \left(R_{ij}^{(2)} \right)$$

where

$$\text{Var} \left(R_{ij}^{(g)} \right) = \text{Var}(\hat{\delta}_{i,g}) + \text{Var}(\hat{\delta}_{j,g}) - 2\text{Cov}(\hat{\delta}_{i,g}, \hat{\delta}_{j,g})$$

- $\mathbf{D} = (D_{ij}) = (R_{ij}^{(1)} - R_{ij}^{(2)}) / \text{Var} \left(R_{ij}^{(1)} - R_{ij}^{(2)} \right)$
- Each entry asymptotically standard normal.

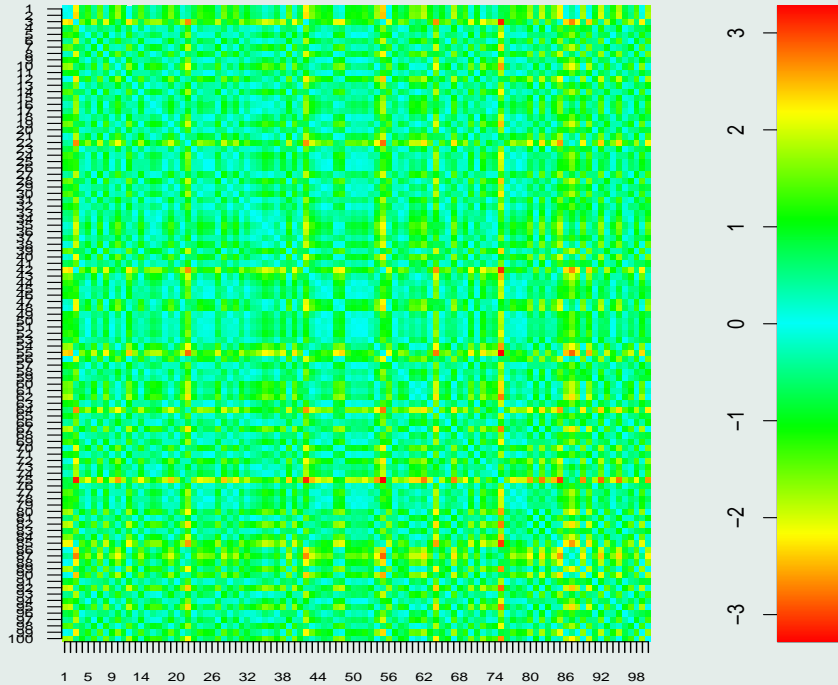


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3. Does it work?

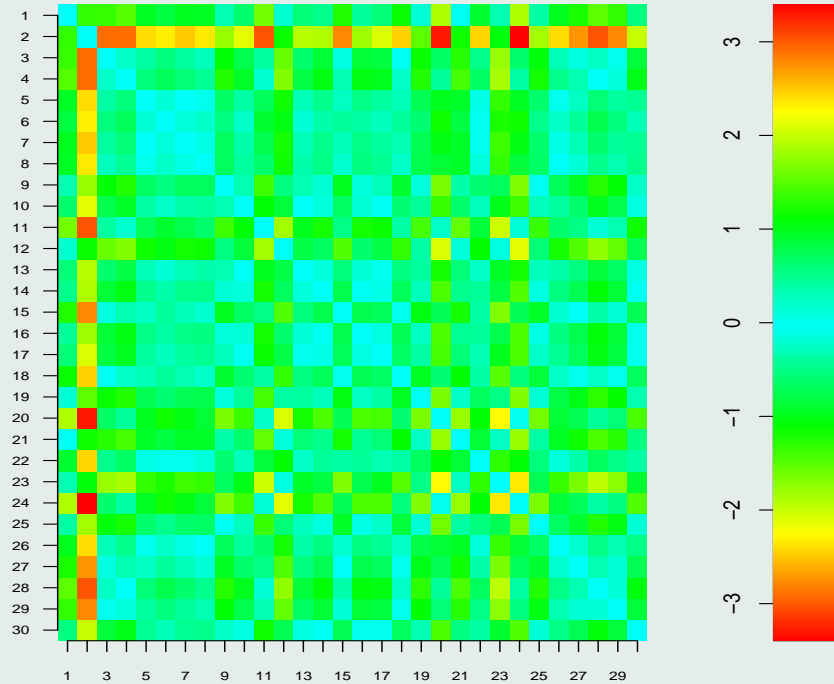
No DIF: $n=1000$ % $> 1.96 \approx 0.05$



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A little DIF: $\forall i \neq 2: R_{2i}^{(2)} \neq R_{2i}^{(1)}$

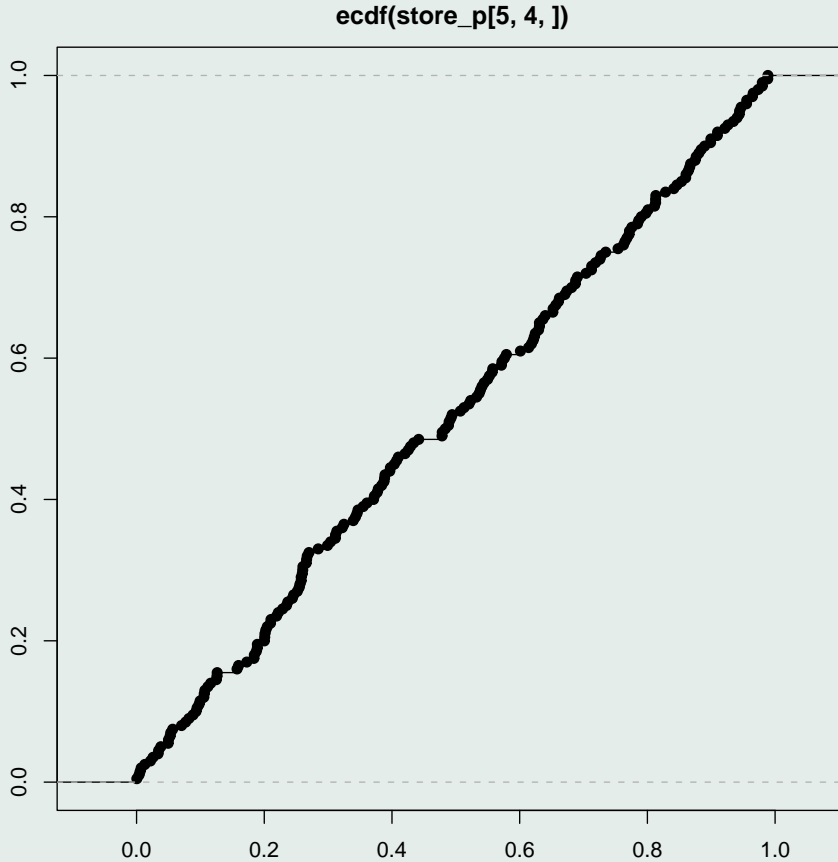


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Statistical properties

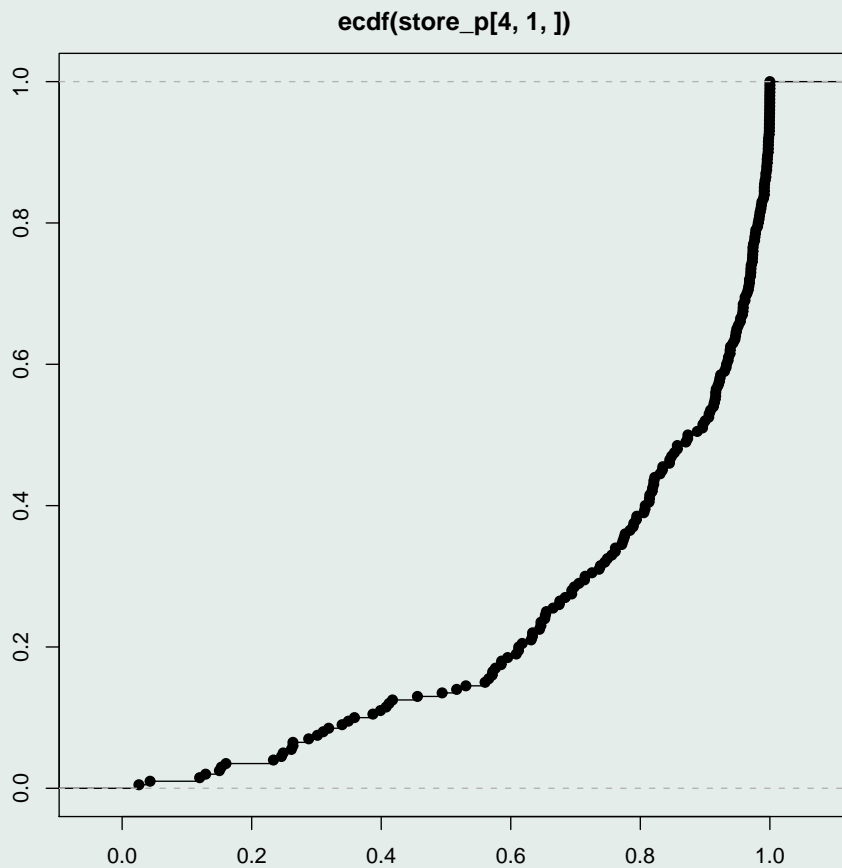
$$D_{5,4} = 0$$



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$$D_{4,1} \neq 0$$

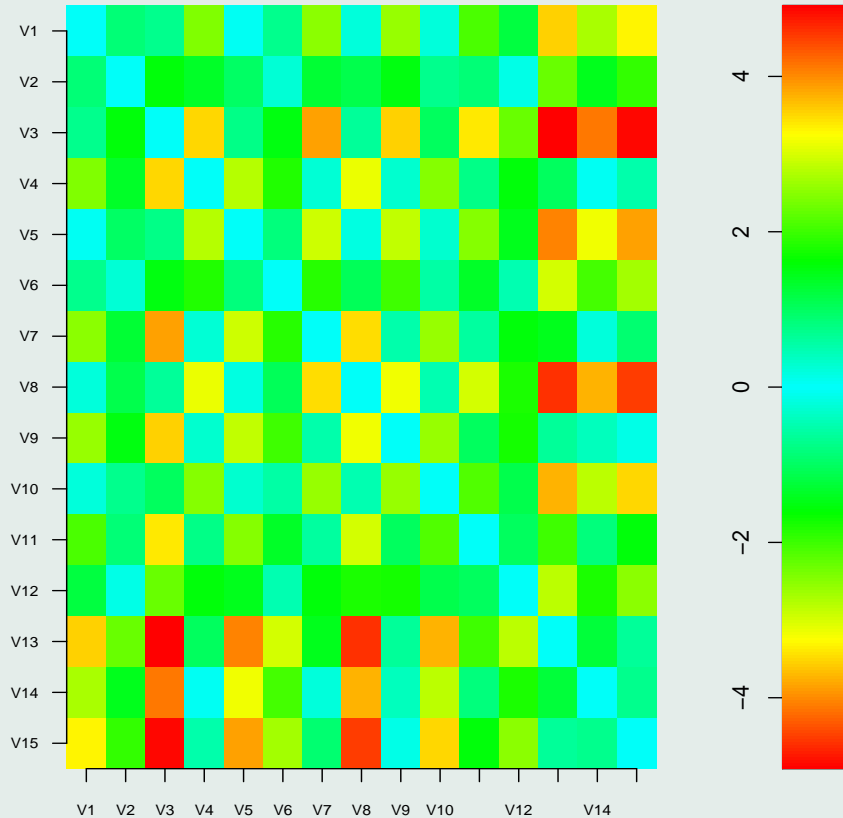


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4. Real Data Example

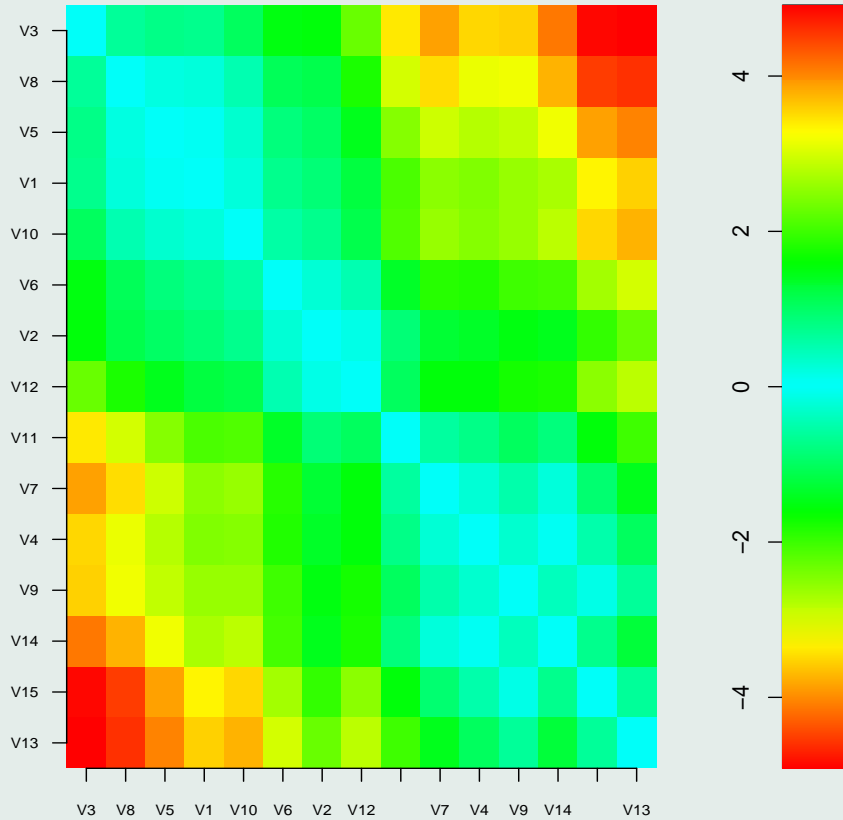
$\% < 0.05 = 0.22, R1c = 334.687; df = 97$



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Patterns (compare to 4)



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5. What do we get?

- The test tells us which item-*pairs* have DIF.

$\{3, 8, 5\}$ with $\{14, 15, 13\}$.

- We see clusters of items which are potential anchors.

E.g., $\{7, 4, 9, 14, 13\}$.



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6. Discussion

- Some items do, others do *not* keep their distances.
- What would regular DIF tests do? (E.g.,)

What is DIF?

Purification $\stackrel{?}{=}$ bad statistics (see)

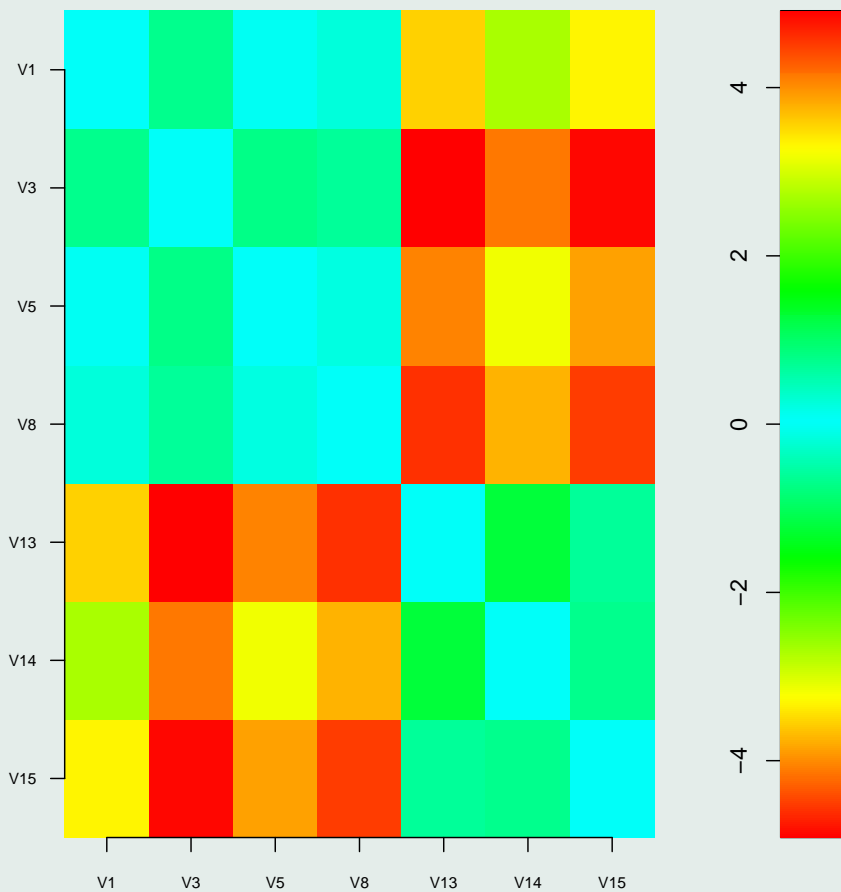
- Which anchor? \Leftrightarrow Which result?



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LRT DIF items



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Bad Statistics?

- Regular DIF test item j :

$$H_0: \text{No DIF } \mathbf{R}^{(1)} = \mathbf{R}^{(2)}$$

$$H_1: \forall i \neq j : R_{ir}^{(1)} = R_{ir}^{(2)}, R_{jr}^{(1)} \neq R_{jr}^{(2)}$$

- What if H_2 is true ?

$$H_2: \forall i \neq k : R_{ir}^{(1)} = R_{ir}^{(2)}, R_{kr}^{(1)} \neq R_{kr}^{(2)}$$

H_0 rejected \Rightarrow all items have DIF

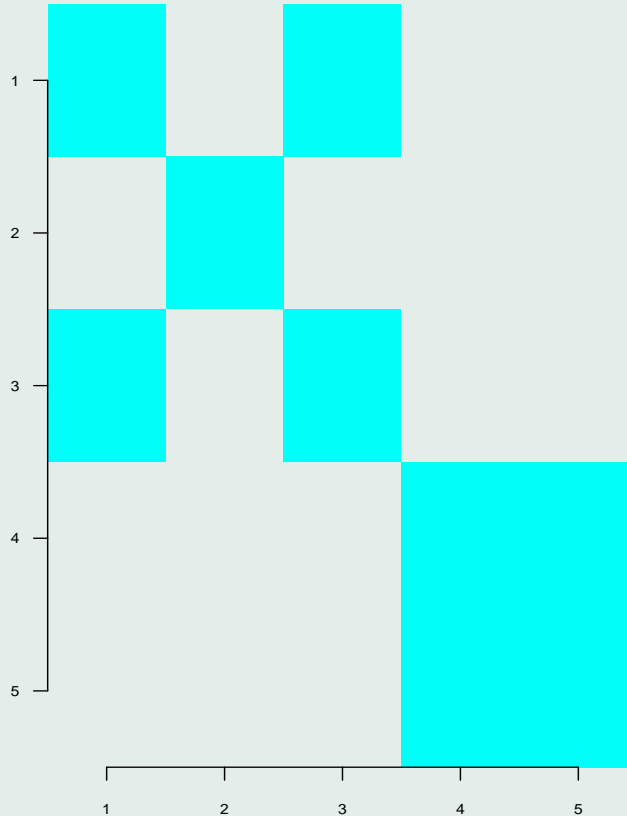
- Purification is a heuristic to “solve” this problem



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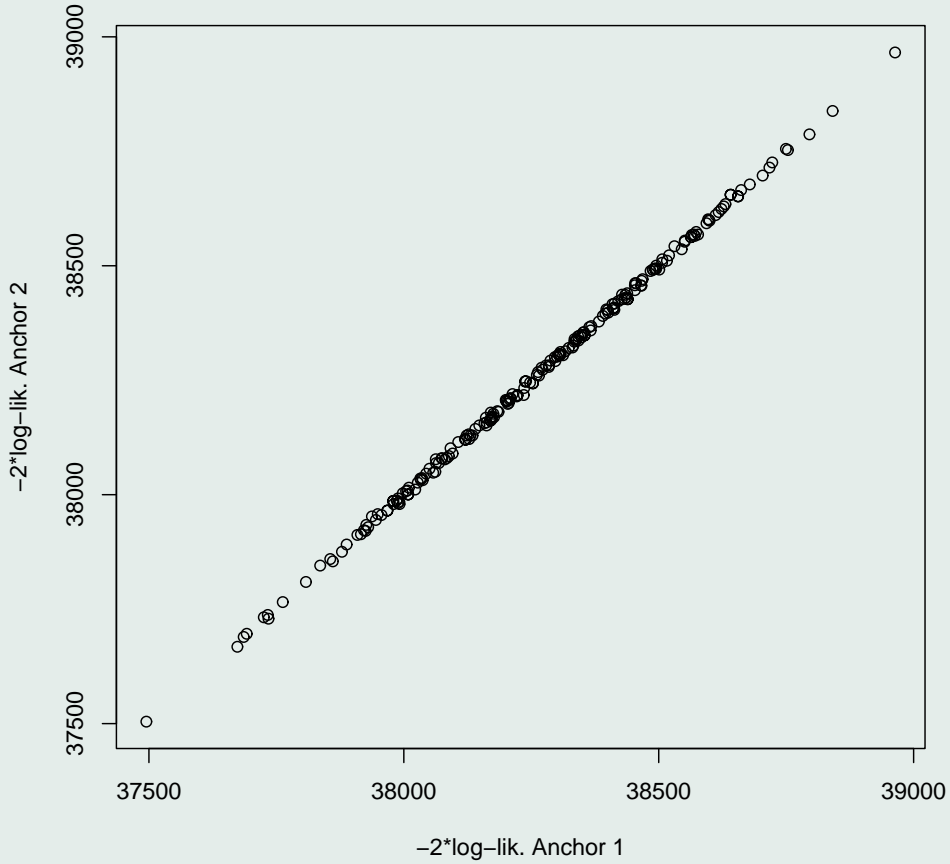
Which Anchor? Cont.



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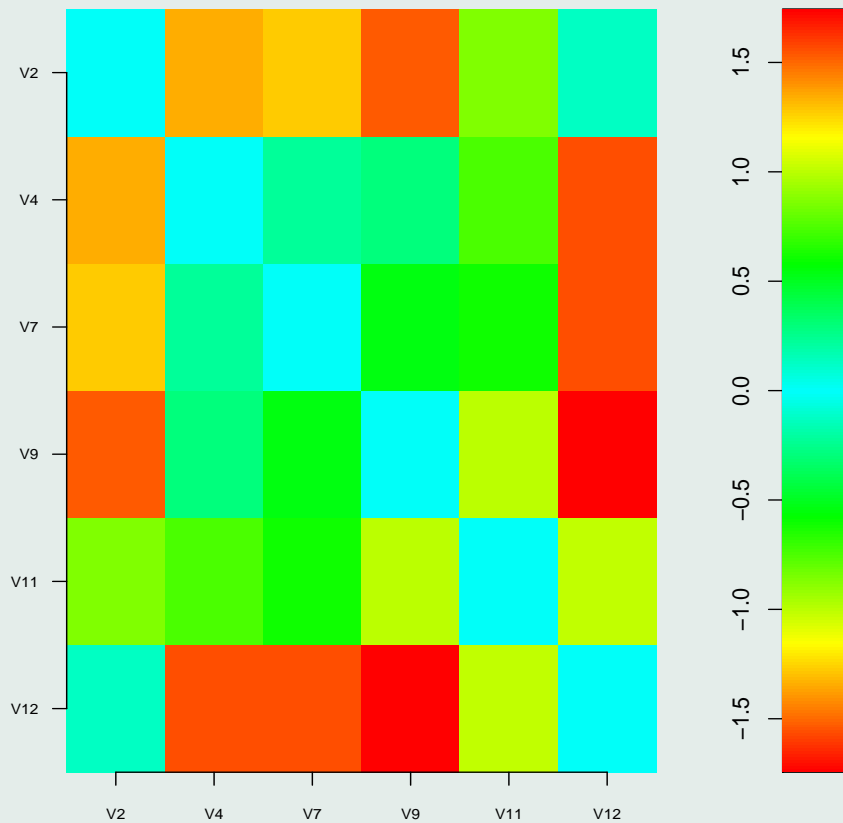
Anchor1>Anchor2 = 0.5



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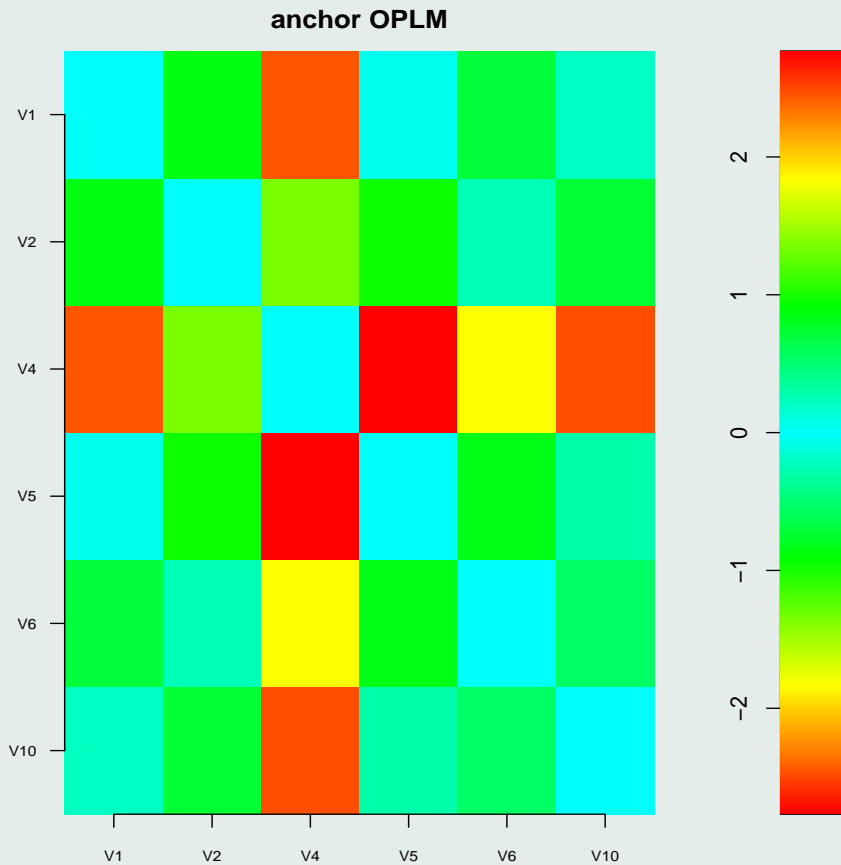
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anchor LRT



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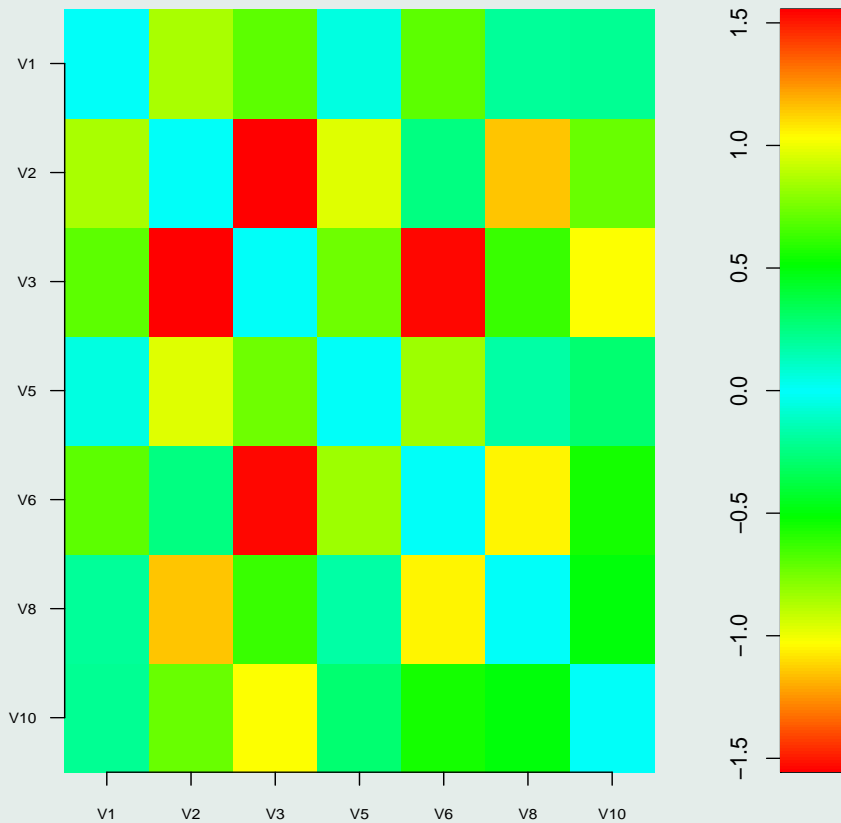
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anchor OPLM2



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