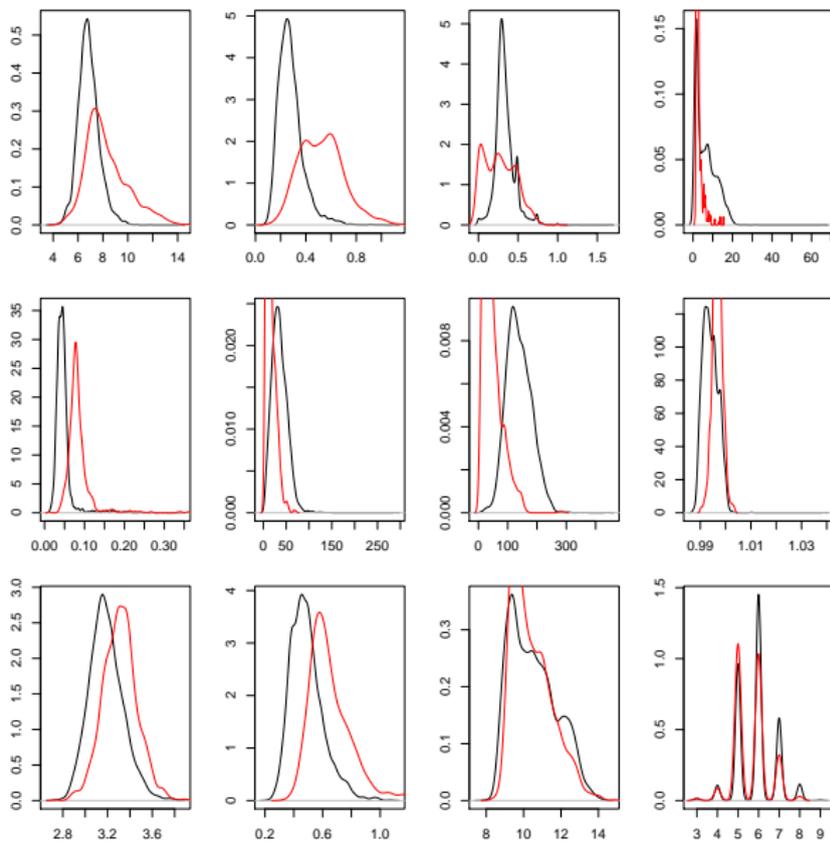
# Semi-Supervised Domain Adaptation with Non-Parametric Copulas


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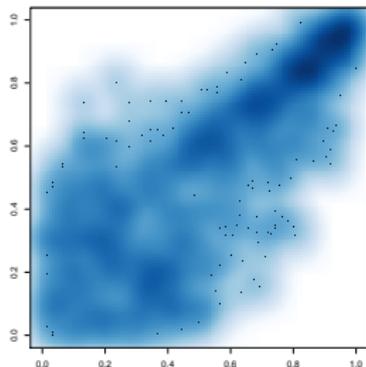
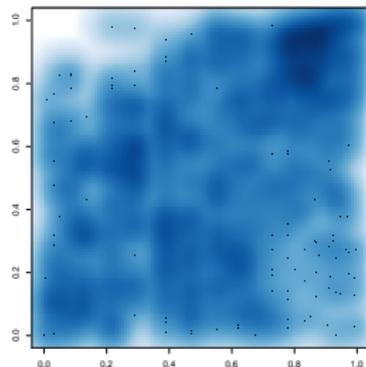


# Marginal Distributions for the Wine Quality Problem

# Some Pair-wise Interactions for the Wine Quality Problem

Interaction between `residual_sugar` and `density`:

White Wine

Red Wine

This plotted interactions are formally called copulas.

# Vine Distributions for Domain Adaptation

$$p(\mathbf{x}) = \prod_{i=1}^{d} p_i(x_i) \prod_{i=1}^{d-1} \prod_{e(j,k)\in E_i} c_{jk|D(e)}(P_{j|D(e)}(x_{j|D(e)}), P_{k|D(e)}(x_{k|D(e)}))$$

This models allow to:

1. Independently **explore changes** in each factor accross domains.
2. Use unlabeled data to improve the estimation of the factors that do not depend on the target variable.

In this work, we propose the **non-parametric regular vine distribution**.

| Dataset | Wine | Sarcos | Rocks-Mines | Hill-Valleys | Axis-Slice | Isolet |
|---|---|---|---|---|---|---|
| No. of variables | 12 | 21 | 60 | 100 | 386 | 617 |
| **GP-Source** | $0.86 \pm 0.02$ | $1.80 \pm 0.04$ | $0.90 \pm 0.01$ | $1.00 \pm 0.00$ | $1.52 \pm 0.02$ | $1.59 \pm 0.02$ |
| **GP-All** | $0.83 \pm 0.03$ | $1.69 \pm 0.04$ | $1.10 \pm 0.08$ | $0.87 \pm 0.06$ | $1.27 \pm 0.07$ | $1.58 \pm 0.02$ |
| **Daume** | $0.97 \pm 0.03$ | $0.88 \pm 0.02$ | $0.72 \pm 0.09$ | $0.99 \pm 0.03$ | $0.95 \pm 0.02$ | $0.99 \pm 0.00$ |
| **SSL-Daume** | $0.82 \pm 0.05$ | $0.74 \pm 0.08$ | $0.59 \pm 0.07$ | $0.82 \pm 0.07$ | $0.65 \pm 0.04$ | $0.64 \pm 0.02$ |
| **ATGP** | $0.86 \pm 0.08$ | $0.79 \pm 0.07$ | $\mathbf{0.56 \pm 0.10}$ | $0.15 \pm 0.07$ | $1.00 \pm 0.01$ | $1.00 \pm 0.00$ |
| **KMM** | $1.03 \pm 0.01$ | $1.00 \pm 0.00$ | $1.00 \pm 0.00$ | $1.00 \pm 0.00$ | $1.00 \pm 0.00$ | $1.00 \pm 0.00$ |
| **KuLSIF** | $0.91 \pm 0.08$ | $1.67 \pm 0.06$ | $0.65 \pm 0.10$ | $0.80 \pm 0.11$ | $0.98 \pm 0.07$ | $0.58 \pm 0.02$ |
| **NPRV** | $\mathbf{0.73 \pm 0.07}$ | $\mathbf{0.61 \pm 0.10}$ | $0.72 \pm 0.13$ | $\mathbf{0.15 \pm 0.07}$ | $0.38 \pm 0.07$ | $0.46 \pm 0.09$ |
| **UNPRV** | $0.76 \pm 0.06$ | $0.62 \pm 0.13$ | $0.72 \pm 0.15$ | $0.19 \pm 0.09$ | $\mathbf{0.37 \pm 0.07}$ | $\mathbf{0.42 \pm 0.04}$ |