Transfer Learning with Copulas

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Transfer Learning, Copulas... How?

- **Motivation:** Related natural systems may have similar dependencies between their inputs.

- *Transfer Learning* methods use previously gained knowledge to improve future learning procesess.

- *Copulas* describe the full dependence structure between the marginal distributions of a multivariate model.

- **Idea:** Learn a common copula model for a set of tasks.
  Let the marginals vary freely.
  Use this copula to predict new points.

Empirical validation with real-world data

- *Source* task data, $\mathcal{D}_s = \{(x_i^{(s)}, y_i^{(s)})\}_{i=1}^{1000}$
- *Target* task data, $\mathcal{D}_t = \{(x_i^{(t)}, y_i^{(t)})\}_{i=1}^{10}$
- Copula $\hat{c}$ is fitted with $PIT(\mathcal{D}_s) \cup PIT(\mathcal{D}_t)$*
- Estimation using: $\hat{p}(y_t|x_t) = \hat{p}(y_t)\hat{c}(\hat{P}(x_t), \hat{P}(y_t))$
- SVM Regression is outperformed:

Abalone	Avg. Test Error
G. Copula	0.011±0.023
K. Copula	**0.007±0.001**
SVM$_t$	0.015±0.004
SVM$_{s+t}$	1.108±0.139

- **Semi-supervised learning** is easy with Copulas!

* Non-parametrically, using kernel density estimations.