

# **Week 6:**

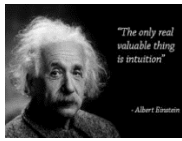
## **(1) Regularization (Penalized or Shrinkage Models)**

## **(2) Dimension Reduction Models**

$XI(\times)$  – X's are not independent (are correlated)

# Regularization (Penalized or Shrinkage Models)

$XI(\mathbf{x})$  – X's are not independent (are correlated)



# Penalized Methods: Intuition

- In the **variable selection** methods covered above, the main **decisions** are about **including** and **removing** certain variables based on F tests and test **MSE** values
- Removing a variable from a model is **equivalent** to forcing its  $\beta$  coefficient to **0**
- In contrast, **“penalized”** (or **“shrinkage”**) methods fit a model with **all P predictors**, but **shrink** (or **“regularize”**) the coefficient estimates **towards 0**, but not necessarily 0.

# Ridge and LASSO Regressions

- Most common penalized methods: **Ridge** and **LASSO** regressions
- So, **all predictors** that matter for **business reasons** are **included**, but predictors are shrunk (i.e., penalized) so that **small coefficients** have a very **low weight** in the prediction, but not removed.
- Shrinking coefficient estimates **increases** the **bias** of the model, but it has been shown to **reduce variance** and lead to better **predictive performance** than other methods like stepwise regression.
- This is particularly **true** for models with **high dimensionality**
- How much **shrinkage** can be controlled with a “**tuning**” parameter  $\lambda$



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