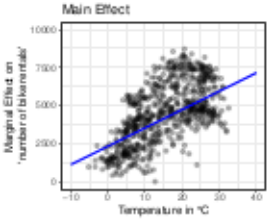
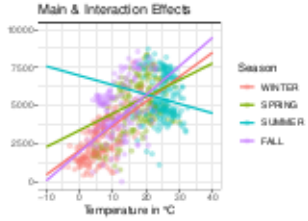
EXAMPLE: INTERACTION EFFECT

Example: Interaction between temp and season will affect marginal effect of temp





	Weights
(Intercept)	3453.9
seasonSPRING	1317.0
seasonSUMMER	4894.1
seasonFALL	-114.2
temp	160.5
hum	-37.6
windspeed	-61.9
days_since_2011	4.9
seasonSPRING:temp	-50.7
seasonSUMMER:temp	-222.0
seasonFALL:temp	27.2

EXAMPLE: INTERACTION EFFECT

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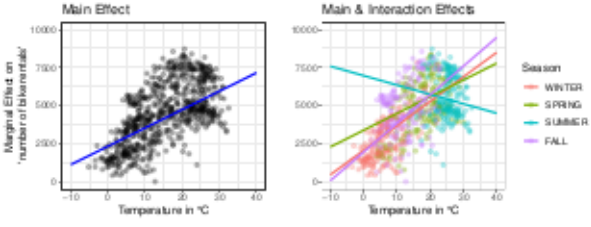

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(Intercept)	3453.9
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seasonSUMMER	4894.1
seasonFALL	-114.2
temp	160.5
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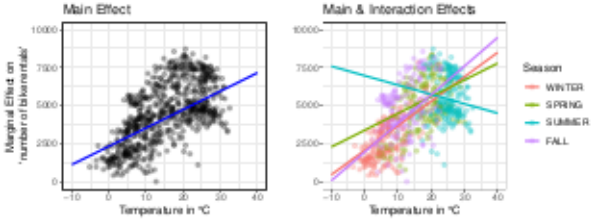
windspeed	-61.9
days_since_2011	4.9
seasonSPRING:temp	-50.7
seasonSUMMER:temp	-222.0
seasonFALL:temp	27.2

Interpretation: If temp increases by 1 °C, bike rentals

- increase by 160.5 in WINTER (reference)

EXAMPLE: INTERACTION EFFECT

Example: Interaction between temp and season will affect marginal effect of temp



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(Intercept)	3453.9
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seasonSUMMER	4894.1
seasonFALL	-114.2
temp	160.5
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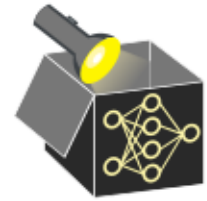
windspeed	-61.9
days_since_2011	4.9
seasonSPRING:temp	-50.7
seasonSUMMER:temp	-222.0
seasonFALL:temp	27.2

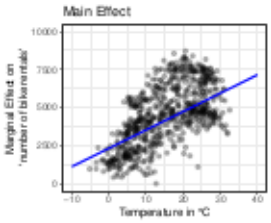
Interpretation: If temp increases by 1 °C, bike rentals

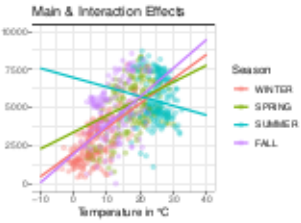
- increase by 160.5 in WINTER (reference)
- increase by 109.8 (= 160.5 - 50.7) in SPRING

EXAMPLE: INTERACTION EFFECT



Example: Interaction between temp and season will affect marginal effect of temp





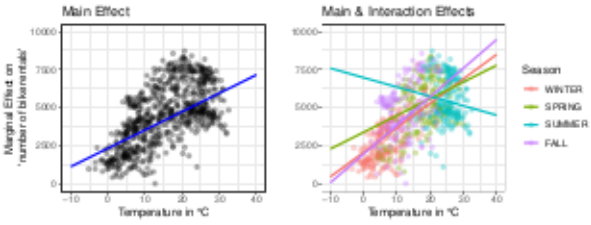
	Weights
(Intercept)	3453.9
seasonSPRING	1317.0
seasonSUMMER	4894.1
seasonFALL	-114.2
temp	160.5
hum	-37.6
windspeed	-61.9
days_since_2011	4.9
seasonSPRING:temp	-50.7
seasonSUMMER:temp	-222.0
seasonFALL:temp	27.2

Interpretation: If temp increases by 1 °C, bike rentals

- increase by 160.5 in WINTER (reference)
- increase by 109.8 (= 160.5 - 50.7) in SPRING
- decrease by -61.5 (= 160.5 - 222) in SUMMER

EXAMPLE: INTERACTION EFFECT

Example: Interaction between temp and season will affect marginal effect of temp



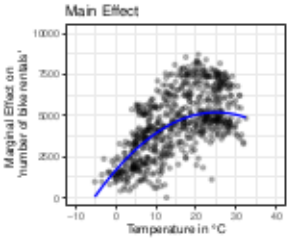
	Weights
(Intercept)	3453.9
seasonSPRING	1317.0
seasonSUMMER	4894.1
seasonFALL	-114.2
temp	160.5
hum	-37.6
windspeed	-61.9
days_since_2011	4.9
seasonSPRING:temp	-50.7
seasonSUMMER:temp	-222.0
seasonFALL:temp	27.2

Interpretation: If temp increases by 1 °C, bike rentals

- increase by 160.5 in WINTER (reference)
- increase by 109.8 (= 160.5 - 50.7) in SPRING
- decrease by -61.5 (= 160.5 - 222) in SUMMER
- increase by 187.7 (= 160.5 + 27.2) in FALL

EXAMPLE: QUADRATIC EFFECT

Example: Adding quadratic effect for temp

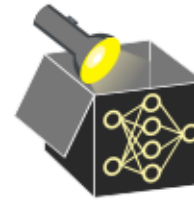


	Weights
(Intercept)	3094.1
seasonSPRING	619.2
seasonSUMMER	284.6
seasonFALL	123.1
hum	-36.4
windspeed	-65.7
days_since_2011	4.7
temp	280.2
$temp^2$	-5.6

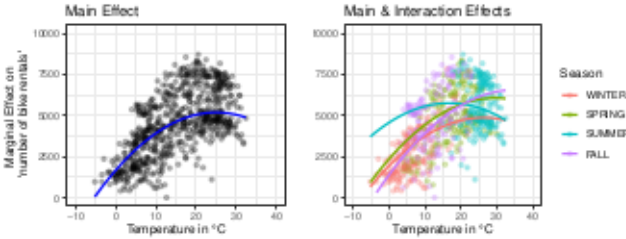
Interpretation: Not linear anymore!

- temp depends on two weights:
  $280.2 \cdot x_{temp} - 5.6 \cdot x_{temp}^2$

EXAMPLE: QUADRATIC EFFECT



Example: Adding quadratic effect for temp (left) and interaction with season (right)



	Weights
(Intercept)	3802.1
seasonSPRING	-1345.1
seasonSUMMER	-6006.3
seasonFALL	-681.4
hum	-38.9
windspeed	-64.1
days_since_2011	4.8
temp	39.1
$temp^2$	8.6
seasonSPRING:temp	407.4
seasonSPRING:$temp^2$	-18.7
seasonSUMMER:temp	801.1
seasonSUMMER:$temp^2$	-27.2
seasonFALL:temp	217.4
seasonFALL:$temp^2$	-11.3

Interpretation: Not linear anymore!

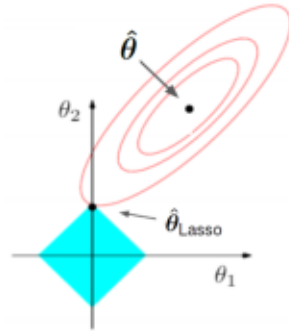
- temp depends on multiple weights due to season:
  - $\rightsquigarrow$ WINTER: $39.1 \cdot x_{temp} + 8.6 \cdot x_{temp}^2$
  - $\rightsquigarrow$ SPRING: $(39.1+407.4) \cdot x_{temp} + (8.6-18.7) \cdot x_{temp}^2$
  - $\rightsquigarrow$ SUMMER: $(39.1+801.1) \cdot x_{temp} + (8.6-27.2) \cdot x_{temp}^2$
  - $\rightsquigarrow$ FALL: $(39.1+217.4) \cdot x_{temp} + (8.6-11.3) \cdot x_{temp}^2$

REGULARIZATION VIA LASSO

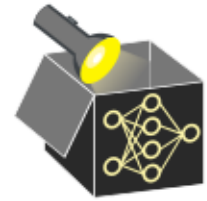
Tibshirani (1996)

- LASSO adds an L_1-norm penalization term ($\lambda||\theta||_1$) to least squares optimization problem
  - ⇝ Shrinks some feature weights to zero (feature selection)
  - ⇝ Sparser models (fewer features): more interpretable
- Penalization parameter λ must be chosen (e.g., by CV)

$$min_\theta \Bigg(\underbrace{\frac{1}{n} \sum_{i=1}^{n} (y^{(i)} - \mathbf{x}^{(i)\top} \theta)^2}_{\text{Least square estimate for LM}} + \lambda ||\theta||_1 \Bigg)$$

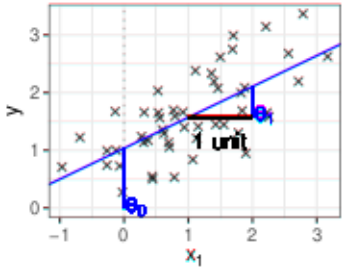


REGULARIZATION VIA LASSO ▸ Tibshirani (1996)



Example (interpretation of weights analogous to LM):

- LASSO with main effects and interaction temp with season
- λ is chosen $\rightsquigarrow$ 6 selected features ($\neq 0$)
- LASSO shrinks weights of single categories separately (due to dummy encoding)
  $\rightsquigarrow$ No feature selection of whole categorical features (only w.r.t. category levels)
  $\rightsquigarrow$ Solution: group LASSO ▸ Yuan and Lin (2006)



	Weights
(Intercept)	3135.2
seasonSPRING	767.4
seasonSUMMER	0.0
seasonFALL	0.0
temp	116.7
hum	-28.9
windspeed	-50.5
days_since_2011	4.8
seasonSPRING:temp	0.0
seasonSUMMER:temp	0.0
seasonFALL:temp	30.2