Linan Midds H= Zw. x: WERPH? 7 X Y YERM Bas = arguin { 55 = } = arguin { (\$ - X\$) (\$ - X\$)} => XTX is not invertele => bols is injosible to corpore so A=OLS brenks
Scalar casan down Hoerl & Kermand (1970) use XTX + ) Ip should f XTX. > #0. XTX+XI is along investible. Pt: Note XTX = VOV-1 diagonalizaria  $0 = \begin{cases} \lambda_1 \\ \lambda_2 \\ \lambda_3 \\ \lambda_4 \\ \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_4 + \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_2 + \lambda_3 \\ \lambda_3 + \lambda_4 \\ \lambda_4 + \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_4 + \lambda_5 \\ \lambda_4 + \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_2 + \lambda_3 \\ \lambda_3 + \lambda_4 \\ \lambda_4 + \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_2 + \lambda_3 \\ \lambda_4 + \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_2 + \lambda_3 \\ \lambda_3 + \lambda_4 \\ \lambda_4 + \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_2 + \lambda_3 \\ \lambda_3 + \lambda_4 \\ \lambda_4 + \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_2 + \lambda_3 \\ \lambda_3 + \lambda_4 \\ \lambda_4 + \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_2 + \lambda_3 \\ \lambda_3 + \lambda_4 \\ \lambda_4 + \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_2 + \lambda_3 \\ \lambda_3 + \lambda_4 \\ \lambda_4 + \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_2 + \lambda_3 \\ \lambda_3 + \lambda_4 \\ \lambda_4 + \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_2 + \lambda_4 \\ \lambda_3 + \lambda_4 \\ \lambda_4 + \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_3 + \lambda_4 \\ \lambda_4 + \lambda_5 \\ \lambda_4 + \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_2 + \lambda_4 \\ \lambda_3 + \lambda_4 \\ \lambda_4 + \lambda_5 \\ \lambda_4 + \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_2 + \lambda_4 \\ \lambda_3 + \lambda_4 \\ \lambda_4 + \lambda_5 \\ \lambda_4 + \lambda_5 \end{cases}$   $\begin{cases} \lambda_1 + \lambda_2 \\ \lambda_2 + \lambda_4 \\ \lambda_3 + \lambda_4 \\ \lambda_4 + \lambda_5 \\ \lambda_5 + \lambda_5 \\$  $X_{\perp}X + y_{\perp} = \wedge 0 \wedge_{-1} + y_{\perp} = \wedge 0 \wedge_{-1} + y_{\perp} \wedge \wedge_{-1} = \wedge 0 \wedge_{-1} + \wedge (x_{\perp}) \wedge_{-1}$  $\lambda_{\perp} x + \lambda I = \Lambda \left( D + \gamma I \right) \Lambda_{-1} \implies \left( \chi_{\perp} x + \gamma I \right)_{-1} = \Lambda \left( D + \gamma I \right)_{-1} \Lambda_{-1}$ Bridge = (XTX+XI) XT & > Ewin / >>0. Consider A:  $\vec{b} = \text{Prymin} \left\{ 55E + \lambda ||\vec{w}||^2 \right\}$   $\vec{w} \in \mathbb{R}^{p+1}$ LZ Legularization  $(\vec{y} - \vec{x} \vec{w})^{\mathsf{T}} (\vec{y} - \vec{X} \vec{w}) + \vec{\lambda} \vec{v}^{\mathsf{T}} \vec{w} = \vec{y}^{\mathsf{T}} \vec{y} - 2 \vec{v}^{\mathsf{T}} \vec{X}^{\mathsf{T}} \vec{y} + \vec{v}^{\mathsf{T}} \vec{X}^{\mathsf{T}} \vec{x} \vec{w} + \vec{v}^{\mathsf{T}} (\vec{x} \vec{x}) \vec{w}$  $= \vec{\nabla}^{T} \vec{y} - \vec{Z} \vec{w}^{T} \vec{X}^{T} \vec{y} + \vec{w}^{T} \left( \vec{X}^{T} \vec{X} + \lambda \vec{I} \right) \vec{w} \qquad \frac{\vec{Q}}{\vec{Q} \vec{w}} \left[ \vec{\chi} \right] = -\vec{Z} \vec{X}^{T} \vec{y} + \vec{Z} \left( \vec{X} \vec{X} + \lambda \vec{I} \right) \vec{w}$ Set  $0 \Rightarrow (X^TX + \lambda I)\vec{w} = X^T\vec{y} \Rightarrow \vec{b}_{filty} = \vec{w} = (X^TX + \lambda I)^{-1}X^T\vec{y}$ . Much 341 likelihant \$\frac{7}{1}\times N(\times\bar{\beta}, \sigma^2 I), (3; \frac{12}{2}) = \frac{7}{3}map A:  $\overline{b}_{lomo} = qrymin \begin{cases} 55E + \lambda ||\overline{\omega}||_1 \end{cases}$   $\sim L1$  penalizal repression hor closed form  $\lambda \lesssim |v_i|$   $\sim L1$  regularization  $\sim L1$ March 341/621 Sine likelihout, By il Laplace (0, T) = Broom = Busso Lasso sets many chann of  $\vec{b}$  to be = 0. For those honors enough, you consider these variable "Selected". Lasso does "variable selection". Occum's Rizorizur" (simplifies the model). What if I was to combine ridge & lasso? A:  $\vec{b}_{en} = \operatorname{prop}_{nh} \left\{ 55E + \left\langle \left\langle \left\langle \left| | \vec{v} | \right|, + (1 - \kappa) | | \vec{w} | \right|^{2} \right\rangle \right\}$ "classic ret" algoritm. Missingers PH Missing vilnes (NA) Ih R. y = by def. there cannot be missigned it y. R's he discoul hill fail. If shoe is missing value in X, P(mi | Xi, migs , X-i, miss , X-i, ebs , ) MCAR-missy copletely at random does hot simplify } Very diffile Strategies to Fix X to be used in A's I Listuise Deletion - drop all observatos that have any missing values, Why is this bad? I Inpute (predict) missing values, Bhild a prediction madel for x; s. Then fill it missing when with predictions. my Reasonmula Imputation Procedure: missForest. ① Fill in all missing value with  $(\bar{x})$  the respective column averages).
① Fit  $\bar{x}$ ,  $\sim RF(\bar{x}_{-1})$  all other variables
where  $\bar{x}$ , was present its original D. Then set missing when if \$\frac{1}{2}, to be prediction from the RF. (2) Fit \$\frac{1}{2} \sim RF(\frac{1}{2}-z) \( \lambda \rightarrow \rightarrow \lambda \rightarrow \rightarrow \lambda \rightarrow \lambda \rightarrow \lambda \rightarrow \lambda \righta (p+1) Repent Steps 1-p 44il Conveyence is imported whis don't change Significaty from itension-itension. Reals: a D nich ho missigness. Ohe more gland recommunition. XI,XZ hox Suple condim  $\mathcal{E}(x_{ij}-\overline{x}_{i})(x_{iz}-\overline{x}_{i})$ You in jugice du 10 Q17 × V12 = Sigling error (Xi1-X1)2 S(Xi2-X2)2 1 /12 x 1 but Q12 = 0, R/R=0 these silvin me called "Sparious Correlation"