Math 430 Formula Sheet for Exam 1

$$\overline{x} = \frac{1}{n}\sum x_i$$

$$s^2 = \frac{1}{n-1}\sum(x_i - \overline{x})^2$$

$$r = \frac{1}{n-1}\sum\left(\frac{x_i - \overline{x}}{s_x}\right)\left(\frac{y_i - \overline{y}}{s_y}\right)$$

$$R^2 = \frac{SSreg}{SST} = 1 - \frac{RSS}{SST}$$

$$SXY = \sum(x_i - \overline{x})(y_i - \overline{y})$$

$$SXX = \sum(x_i - \overline{x})^2$$

$$Y_i = \beta_0 + \beta_1 x_i + e_i,\ e_i \sim \mathcal{N}(0, \sigma^2)$$

$$\widehat{\beta}_0 = \overline{y} - \widehat{\beta}_1\overline{x}$$

$$\widehat{\beta}_1 = \frac{SXY}{SXX}$$

$$\widehat{e}_i = y_i - \widehat{y}_i$$

$$S^2 = \frac{RSS}{n-2} = \frac{1}{n-2}\sum \widehat{e}_i^2$$

$$h_{ii} = \frac{1}{n} + \frac{(x_i - \overline{x})^2}{SXX}$$

$$h_{ii} = 4/n$$

$$r_i = \frac{\widehat{e}_i}{S\sqrt{1 - h_i i}}$$

$$D_i = \frac{\sum(\widehat{y}_{j(i)} - \widehat{y}_j)^2}{2S^2} = \frac{r_i^2}{2}\frac{h_{ii}}{1 - h_{ii}}$$

$$D_i > \frac{4}{n-2}$$

$$\mathbf{Y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{e},\ \mathbf{e} \sim \mathcal{N}(\mathbf{0}, \sigma^2\boldsymbol{I})$$

$$\widehat{\boldsymbol{\beta}} = (\boldsymbol{X'X})^{-1}\boldsymbol{X'}\mathbf{Y}$$

$$\mathrm{Var}(\widehat{\boldsymbol{\beta}}|\boldsymbol{X}) = S^2(\boldsymbol{X'X})^{-1}$$

$$S^2 = \frac{RSS}{n-p-1}$$

Distributions and test statistics:

$$T_i = \frac{\widehat{\beta}_i - \beta_i^0}{se(\widehat{\beta})} \sim t_{n-p-1}$$

$$F = \frac{SSreg/p}{RSS/(n-p-1)} \sim F_{p,\,n-p-1}$$

Confidence intervals: statistic $\pm\, t^* \cdot se$

Standard errors:

$$se(\widehat{\beta}_0) = S\sqrt{\frac{1}{n} + \frac{\overline{x}^2}{SXX}}$$

$$se(\widehat{\beta}_1) = \frac{S}{\sqrt{SXX}}$$

$$se(\mu_y) = S\sqrt{\frac{1}{n} + \frac{(x^* - \overline{x})^2}{SXX}}$$

$$se(\widehat{y}) = S\sqrt{1 + \frac{1}{n} + \frac{(x^* - \overline{x})^2}{SXX}}$$

ANOVA table skeleton:

Source	d.f.	Sums of squares
Regression	p	$\sum(\widehat{y}_i - \overline{y})^2$
Residual	$n-p-1$	$\sum(y_i - \widehat{y}_i)^2$
Total	$n-1$	$\sum(y_i - \overline{y})^2$