$$\frac{A + t + \text{endurance}}{1 - A}$$

MANE 3332.05

LECTURE 28

Agenda

- Quiz Announcement
- Regression Review
- Final Exam Review
- Chapter 9, Case 3 2-sided Quiz (assigned 12/4/2025, due 12/9/2025)
- Chapter 9, Case 3 Lower Quiz (assigned 12/4/2025, due 12/9/2025)
- Chapter 9, Case 3 Upper Quiz (assigned 12/4/2025, due 12/9/2025)
- Attendance
- Questions?

Handouts

- Lecture 28 Handouts
- Lecture 28 Handouts - marked
- Regression Review Handout

Class Schedule

Week	Tuesday Lecture	Thursday Lecture
15	**12/9** - Review Session	**12/11** - Study Day (no class)

The final exam for MANE 3332.05 is **Thursday December 18, 2025 at 1:15 PM - 3:00 PM**.

Dr. Timmer's Schedule

Dr. Timmer will be part of a team conducting an ABET visit December 13 - 17, 2025.

- There will be little to no contact with Dr. Timmer during this time period
- Please try to complete all course business with Dr. Timmer before December 13

Quizzes with 2 names ch 9 C 2 upper

Quiz Announcement

Ch 9 C2 upper C1

- This announcement applies to all Quizzes in Part Two (Linear Combinations through Chapter 9, Case 3 Upper Quiz)
- Will go into effect on Wednesday December 10, 2025
- All Part Two Quizzes
  - You will be allowed two attempts (but you do not have to use your second attempt)
  - The **highest** score will be recorded
  - All Part Two Quizzes will be available until the Final Exam begins (12/18/2025, 10:00 am)

1:00 pm

Practice Problems

- Remember that all Practice Problems will be available until the Final Exam begins (12/18/2025, ~~10:00 am~~ 1:00pm)
- The highest score will be recorded

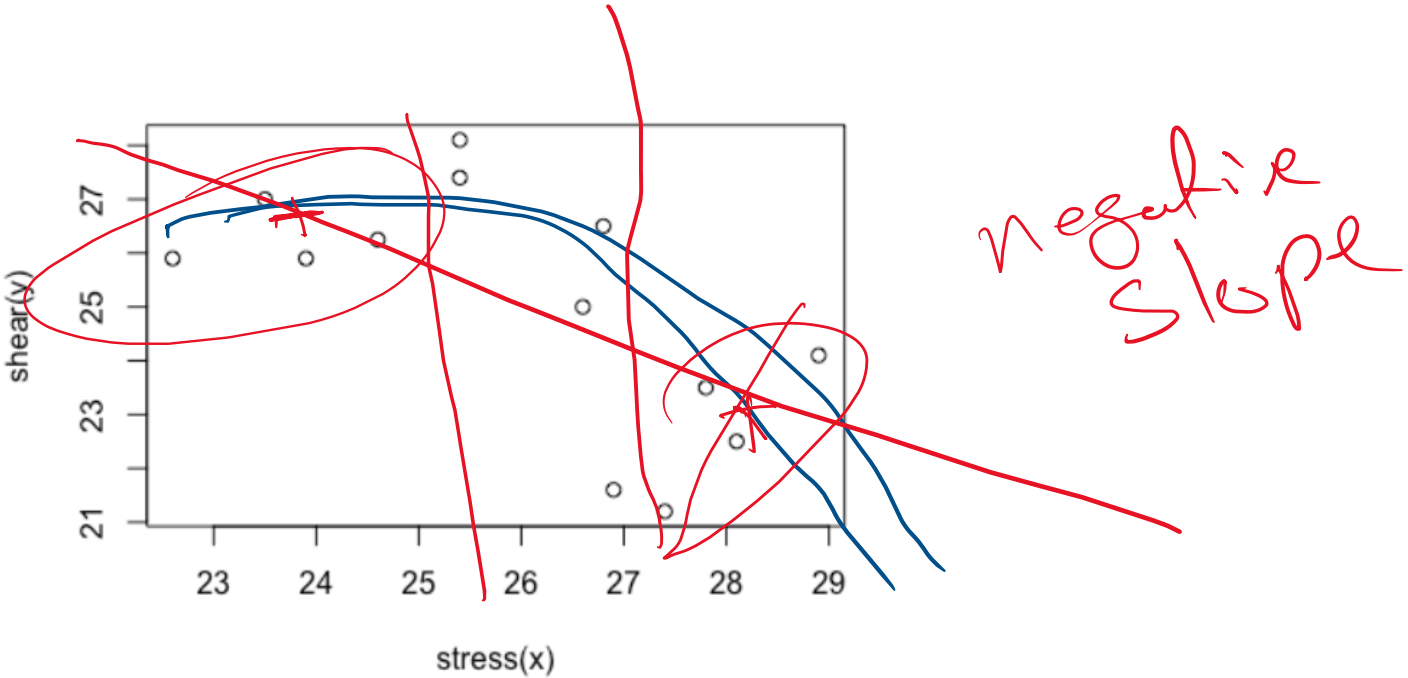
Regression Review

- Work Handout

Question 1 - Slope

Consider the scatterplot shown below. Which statement most accurately describes the slope shown?

1. The slope is positive
2. The slope is negative
3. The slope is approximately zero
4. Cannot determine from information provided



Question 2 - Y-intercept

What is the value of y-intercept (β_0)?

1. 44.022
2. -0.732
3. 7.063
4. 0.271
5. The correct answer is not provided

$\hat{\beta}_0 = 44.022$

```
slr <- lm(y~x,data=df)
summary(slr)

##
## Call:
## lm(formula = y ~ x, data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.7658 -0.9534  0.1796  1.2322  2.6703
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   44.022      7.063   6.233 6.41e-05 ***
## x             -0.732      0.271  -2.701   0.0206 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.813 on 11 degrees of freedom
## Multiple R-squared:  0.3987, Adjusted R-squared:  0.344
## F-statistic: 7.293 on 1 and 11 DF,  p-value: 0.02064
```

Question 3 - Slope

What is the value of the slope (β_1)?

1. 44.022
2. -0.732
3. 7.063
4. 0.271
5. The correct answer is not provided

$\hat{\beta}_1 = -.732$

```
slr <- lm(y~x,data=df)
summary(slr)

##
## Call:
## lm(formula = y ~ x, data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.7658 -0.9534  0.1796  1.2322  2.6703
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   44.022      7.063   6.233 6.41e-05 ***
## x             -0.732      0.271  -2.701   0.0206 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.813 on 11 degrees of freedom
## Multiple R-squared:  0.3987, Adjusted R-squared:  0.344
## F-statistic: 7.293 on 1 and 11 DF,  p-value: 0.02064
```

Question 4 - Fitted Value

What is the predicted value of shear (y) when stress(x)=25?

1. -61.517
2. 13.838
3. 25.722
4. The correct answer is not provided

```
slr <- lm(y~x,data=df)
summary(slr)
```

```
##
## Call:
## lm(formula = y ~ x, data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.7658 -0.9534  0.1796  1.2322  2.6703
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   44.022      7.063   6.233 6.41e-05 ***
## x             -0.732      0.271  -2.701   0.0206 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.813 on 11 degrees of freedom
## Multiple R-squared:  0.3987, Adjusted R-squared:  0.344
## F-statistic: 7.293 on 1 and 11 DF,  p-value: 0.02064
```

What is the value of the residual when stress(x)=25.6 and strain(y)=24.9?

1. -0.1952
2. 0.1952
3. 0.3828
4. The correct answer is not provided

$$e = y - \hat{y}$$
$$= y - (\hat{\beta}_0 + \hat{\beta}_1 x)$$
$$= 24.9 - (44.022 - .732(25.6))$$
$$= -0.3828$$

```
slr <- lm(y~x,data=df)
summary(slr)

##
## Call:
## lm(formula = y ~ x, data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.7658 -0.9534  0.1796  1.2322  2.6703
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   44.022      7.063   6.233 6.41e-05 ***
## x             -0.732      0.271  -2.701   0.0206 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.813 on 11 degrees of freedom
## Multiple R-squared:  0.3987, Adjusted R-squared:  0.344
## F-statistic: 7.293 on 1 and 11 DF,  p-value: 0.02064
```

Question 6 - Hypothesis Test on y-intercept

What is the correct decision for the hypothesis test that $H_0: \beta_0 = 0$ versus $H_1: \beta_0 \neq 0$, using $\alpha = 0.01$?

1. Fail to reject H_0
2. Reject H_0
3. Cannot determine from the information provided.

$\alpha = .01$

p-value = 6.41×10^{-5}

```
slr <- lm(y~x,data=df)
summary(slr)

##
## Call:
## lm(formula = y ~ x, data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.7658 -0.9534  0.1796  1.2322  2.6703
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   44.022      7.063   6.233 6.41e-05 ***
## x             -0.732      0.271  -2.701   0.0206 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.813 on 11 degrees of freedom
## Multiple R-squared:  0.3987, Adjusted R-squared:  0.344
## F-statistic: 7.293 on 1 and 11 DF,  p-value: 0.02064
```

p-value

Q: is p-value < α ?

? yes, Reject H_0

Question 7 - Hypothesis Test on Slope Term

What is the correct decision for the hypothesis test that $H_0: \beta_1 = 0$ versus $H_1: \beta_1 \neq 0$, using $\alpha = 0.01$?

1. Fail to reject H_0
2. Reject H_0
3. Cannot determine from the information provided.

```
slr <- lm(y~x,data=df)
summary(slr)

##
## Call:
## lm(formula = y ~ x, data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.7658 -0.9534  0.1796  1.2322  2.6703
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   44.022      7.063   6.233 6.41e-05 ***
## x             -0.732      0.271  -2.701   0.0206 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.813 on 11 degrees of freedom
## Multiple R-squared:  0.3987, Adjusted R-squared:  0.344
## F-statistic: 7.293 on 1 and 11 DF,  p-value: 0.02064
```

$\alpha = .01$

p-value = .0206

Q. is p-value < α ?

No, fail to reject H_0

Question 8 - Lack of Fit Test

What is the correct decision for the hypothesis test H_0: there is no lack of fit versus H_1: there is lack of fit, using $\alpha = 0.01$?

1. Fail to reject H_0
2. Reject H_0
3. Cannot determine from the information provided

$\alpha = .01$

p-value = .20078

```
library(EnvStats)

##
## Attaching package: 'EnvStats'

## The following objects are masked from 'package:stats':
##
##     predict, predict.lm

anovaPE(slr)

##              Df Sum Sq Mean Sq F value  Pr(>F)
## x             1 23.965 23.9649  97.816 0.06415 .
## Lack of Fit  10 35.902  3.5902  14.654 0.20078
## Pure Error    1  0.245  0.2450
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Is p-value < α ? no, fail to reject H_0

p-value

Final Exam

- Thursday December 18, 2025, 1:15 pm - 3:00 pm
- EENGR 1.242 (regular classroom)
- Format is identical to the Midterm Exam
- Closed book
- One four by six inch notecard allowed (Handwritten front and back)
- Bring a calculator
- Answer sheet provided
- Final Exam tables provided
- No sample final exam provided
- The final exam will not be returned. You can make an appointment to view your final.

Final Exam Topics

- Covers chapters 5, 6, 7, 8, 9, and 11
  - Chapter 5 - Covariance, Correlation and Linear Combinations
  - Chapter 6 - Descriptive Statistics
  - Chapter 7 - Central Limit Theorem, and Properties of Estimators
  - Chapter 8 - Confidence Intervals (Cases 1- 3)
  - Chapter 9 - Hypothesis Testing for Single Sample (Cases 1 - 3)
  - Chapter 11 - Simple Linear Regression (see Regression Review)
- Lectures (Days) 14 - 28

Final Exam Topics, continued

- Practice Problems/Online Quizzes
  - Linear Combinations
  - Chapter 8, Case 1
  - Chapter 8, Case 2
  - Chapter8, Case 3
  - Chapter 9, Case 1 Two-sided
  - Chapter 9, Case 1 Lower
  - Chapter 9, Case 1 Upper
  - Chapter 9, Case 2 Two-sided
  - Chapter 9, Case 2 Lower
  - Chapter 9, Case 2 Upper
  - Chapter 9, Case 3 Two-sided
  - Chapter 9, Case 3 Lower
  - Chapter 9, Case 3 Upper

Final Exam Content

- If I did it in class, you should be able to do it
- Look at classroom examples, practice problems/online quizzes, and regression review
- Review notes that I said should be added to your formula sheet
- Review all marked notes for problems worked by hand
- Approximately 85 to 90 percent of the exam will be application questions like practice problems
- Approximately 10 to 15 percent of the exam will be conceptual questions