

Course Preview: Data Analysis for Social Scientists

Answers

This course preview is meant to give prospective learners the opportunity to get a taste of the content and exercises that will be covered in the course. While there are no prerequisites for this online course, it is recommended that learners have some familiarity with economics or statistics. Each question below is tied to concepts that will appear in this course, all of which it would be good to feel comfortable with. If you are new to these subjects, or eager to refresh your memory, please do consult the available resources below, and be prepared to refer to these resources over the course of the class. Try to first answer these questions without consulting the resources, but fear not if you do consult them - being an agile user of outside resources will help you succeed in this course.

A score of 60% or above in this course preview indicates that you are ready to take this course, while a score below 60% indicates that you should further review some concepts in the attached materials before commencing the course.

Useful Resources:

- *Useful online courses:*
 - Fundamentals of calculus: [Khan Academy: Calculus Tutorials](#)
 - Overview of advanced calculus: [MIT Open Courseware: Multivariate Calculus](#)
 - Fundamentals of probability: [Harvard University on edX: Fat Chance - Probability from the Ground Up](#)
- *Useful textbooks:*
 - [All of Statistics: A Concise Course in Statistics](#) by Larry Wasserman (any edition)
 - [An Introduction to Mathematical Statistics and Its Applications](#) by Richard Larsen and Marris Marx (any edition)

1. **Algebra:** Solve for x (1 point).

$$|-3x - 4| = 5$$

Solution:

$$\begin{aligned} -3x - 4 &= 5 \\ -3x &= 9 \\ x &= -3 \end{aligned}$$

$$\begin{aligned} -3x - 4 &= -5 \\ -3x &= -1 \\ x &= \frac{1}{3} \end{aligned}$$

$$x = \left\{ -3, \frac{1}{3} \right\}$$

2. **Integrals:** Compute the following integral (2.5 points).

$$\int_0^3 \int_0^2 xy^2 dx dy$$

Solution:

$$\begin{aligned} \int_0^3 \int_0^2 xy^2 dx dy &= \int_0^3 \left(\frac{x^2}{2} y^2 \Big|_{x=0}^{x=2} \right) dy \\ &= \int_0^3 \left(\left[\frac{2^2}{2} - \frac{0^2}{2} \right] y^2 \right) dy \\ &= \int_0^3 2y^2 dy \\ &= \frac{2y^3}{3} \Big|_{y=0}^{y=3} \\ &= \frac{2 * 3^3}{3} - \frac{2 * 0^3}{3} \\ &= 18 \end{aligned}$$

3. **Derivatives:** Compute the following derivative (2.5 points).

$$\frac{d}{dx} [x^3 \ln(x) + e^{3x}]$$

Solution:

$$\frac{d}{dx} [x^3 \ln(x) + e^{3x}] = \frac{d}{dx} [x^3 \ln(x)] + \frac{d}{dx} [e^{3x}]$$

Recalling product rule,

$$\begin{aligned}\frac{d}{dx} [x^3 \ln(x)] &= \frac{d}{dx} [x^3] \ln(x) + x^3 \frac{d}{dx} [\ln(x)] \\ &= 3x^2 \ln(x) + \frac{x^3}{x} \\ &= 3x^2 \ln(x) + x^2\end{aligned}$$

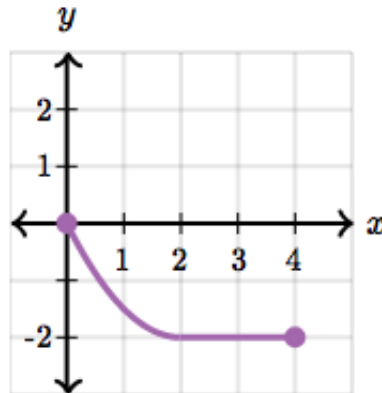
Using chain rule,

$$\begin{aligned}\frac{d}{dx} [e^{3x}] &= \frac{de^u}{du} \frac{du}{dx} \text{ where } u = 3x \\ &= 3e^{3x}\end{aligned}$$

Thus,

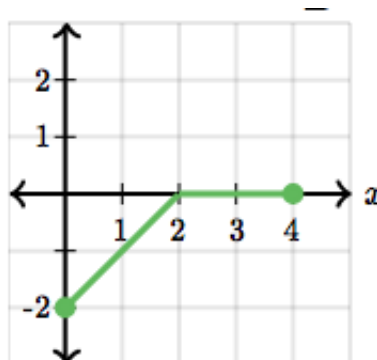
$$\begin{aligned}\frac{d}{dx} [x^3 \ln(x) + e^{3x}] &= 3x^2 \ln(x) + \frac{x^3}{x} + 3e^{3x} \\ &= 3x^2 \ln(x) + x^2 + 3e^{3x}\end{aligned}$$

4. **Graphing Derivatives:** This is a graph of function $f(x)$:



What is the graph of its derivative, $f'(x)$?

Solution (2 points):



Note: Question taken from Khan Academy.

5. **Probability:** Two dice are rolled. Find the probability that the sum is equal to 4.

Solution (2 points):

The sample space consists of 36 outcomes: $\{(1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (2, 1), \dots, (6, 6)\}$. There are 3 outcomes that result in a sum of 4: $\{(1, 3), (2, 2), (3, 1)\}$. Therefore, the probability that the sum of the faces is 4 is equal to $\frac{3}{36} = \frac{1}{12}$.

$$P(\text{sum of two dice is equal to 4}) = \frac{1}{12}$$