Math 239 01
Prof. Doug Baldwin

Problem Set 6 — Induction

Complete by **Monday, March 25**
Grade by **Wednesday, March 27**

Purpose

This problem set develops your ability to write inductive proofs. When you finish this problem set you should be able to ...

- Prove theorems using weak induction

- Prove theorems using strong induction

- Evaluate whether proofs by induction are valid

- Write induction proofs as formal proofs.

Background

Our textbook discusses proof by induction in chapter 4, particularly sections 4.1 and 4.2. We discussed (or will discuss) this material in class between March 11 and 25.

Activity

Solve the following problems. All proofs must be written according to conventions for formal proofs, including typeface rules (e.g., italic variables, emphasized labels for theorems and proofs, etc.).

Question 1. Exercise 15d in section 4.1 of Sundstrom's text (essentially, formulate and prove a conjecture about what the nth derivative of e^{ax} is in terms of a, n, and e^{ax}, where a is a real constant).

Question 2. Exercise 4d in section 4.2 of Sundstrom's text (state and prove a proposition about the product $(1 - \frac{1}{4})(1 - \frac{1}{9})\ldots(1 - \frac{1}{n^2})$; see the textbook for more information; you may find it helpful to look at exercises 4a and 4b, although you aren't required to).

Question 3. A variation on exercise 9 in section 4.2 of Sundstrom's text: prove that each natural number greater than or equal to 6 can be written as a sum of at least 2 natural numbers, each of which is either 2 or 5. See the textbook for examples of exactly what the claim means.

Note that I can imagine both an inductive and a non-inductive proof of this theorem. I specifically want you to produce an inductive proof. Producing a non-inductive proof in addition would be a way to go beyond my minimum expectations on this problem set.

Question 4. Exercise 18c in section 4.1 of Sundstrom's text (critique a proof that all dogs are the same breed). This is another "evaluation of proofs" exercise, such as you saw in problem set 4.

Follow-Up

I will grade this exercise in a face-to-face meeting with you. During this meeting I will look at your solution, ask you any questions I have about it, answer questions you have, etc. Please bring a written solution to the exercise to your meeting, as that will speed the process along.

Sign up for a meeting via Google calendar. Please make the meeting 15 minutes long, and schedule it to finish before the end of the "Grade By" date above.