ST 516: Final Project

Due by 11:55pm, Thursday, December 12

Problem Statement:

You are working for a manufacturer of optical fiber and a new design is being introduced. One of the most important attributes of a fiber is optical signal attenuation, which we want to minimize.

Your project team wants to run a process experiment to determine the best combination of settings for the fiber drawing process as well as a few other characteristics to minimize attenuation. They have identified the following factors to investigate:

- Fiber draw speed (ranges from 20-30 m/sec)
- Furnace temperature (ranges from 1800-2200 C^0)
- Draw tension (ranges from 0.5 to 1.0N)
- Germanium concentration (ranges from 0.01 to 0.05)
- Fiber design 1 or 2 (index of refraction profile)
- Draw tower 1 or 2 (one of two manufacturing lines able to make the fiber)
- Raw material supplier 1 or 2 (one of two potential glass material suppliers)
- Coating type 1 or 2 (one of two coatings compatible with the designs)

The project has two objectives:

1. Identify any significant main effects and interactions on attenuation from the list of identified factors
2. Build a model to predict attenuation from the significant factors, and generate a list of optimal settings/characteristics based on that model.

You department has budgeted $25,000 for the experimental runs, which cost $1,000 per run. It is possible to get addition money for the project if needed, but that may result in negative feedback on your annual performance review (i.e., lost points on your grade). Also, the manufacturing engineering department has told you they can run up to 16 experimental runs per day.

For the project, it is advised that you follow an iterative process, i.e., design an initial experiment, run the experiment, analyze the data, then continue with a follow-up experiment (or two) depending on the initial results. Once you have agreed on the design for the current phase, you can send an email to Rahul or me and we will provide simulated response results from the experimental runs you specify. Please allow 24 hours for a reply (it may not take that long, but shorter response time is not guaranteed). No requests for experimental runs will be accepted after Tuesday, Dec 10 at 11:55pm.

General Instructions:

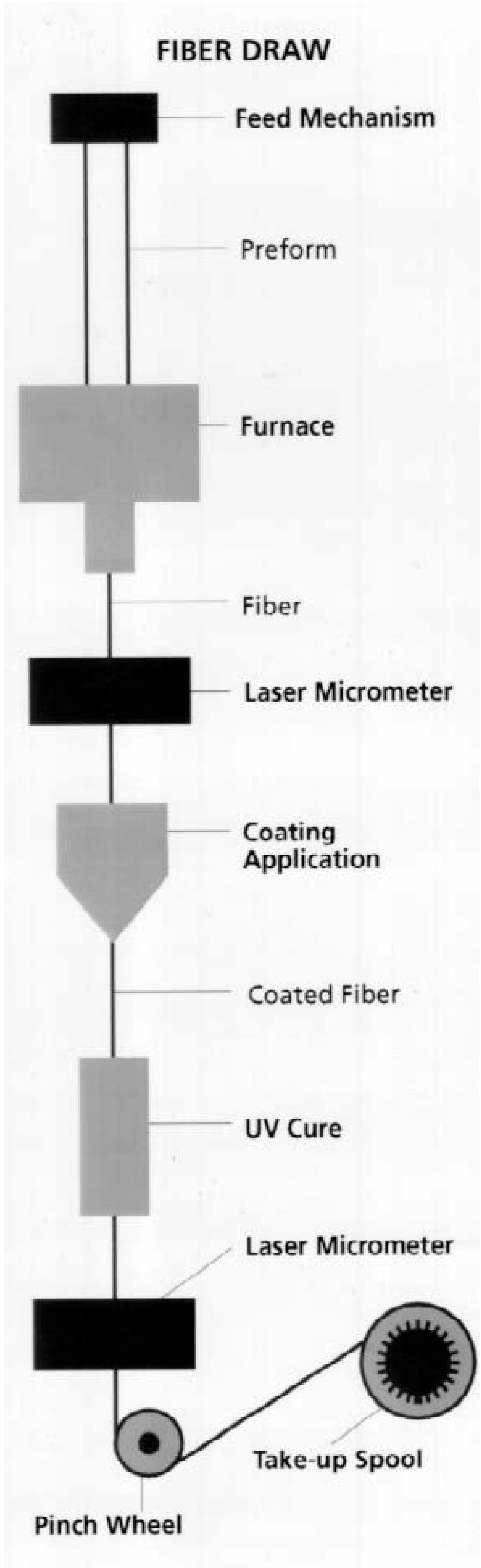
- You will work in teams of four or five. You should sign up for your teams on the Google Sheets link provided on Moodle.
- Your team will submit one written report no more than 10 pages in length in the following format:
  - Executive summary
  - Introduction (explain a little about the process, what you are trying to learn from the experiment and why)
  - Experimental design (include all aspects of your initial and any follow-up designs, including response variables, factors and settings/levels, any possible nuisance factors and how you will deal with them)
  - Analysis and Results (describe your models or analysis techniques, and where appropriate, results of (a) diagnostics, (b) ANOVA, (c) effects tests, and (d) regression models, including any diagrams that will be helpful in illustrating your findings)
  - Recommendations (restate your final model and recommend settings to achieve minimum average attenuation; also include any limitations of the model if any and/or any further experimentation you recommend if any)
- One team member should submit a final report and accompanying R code using the following format
  - Report: pdf named in the format 'lastname_firstname_Proj2.pdf'
  - JMP files: JMP files named 'lastname_firstname_Proj2_xxx.jmp'
  - Code (if needed): R script named 'lastname_firstname_Proj2.r'.

A very brief description of the optical fiber drawing process:

A solid optical fiber glass preform is transferred to a vertical fiber drawing system. The machines that make up a typical vertical drawing system can be two stories high and are able to produce continuous fibers up to 300 kilometers (186 miles) long. This system consists of a furnace to melt the end of the preform, sensors to monitor the diameter of the fiber being pulled from the preform, and coating devices to apply protective layers over the outer cladding.

The preform first passes through a furnace, where it is heated to about 3600 degrees Fahrenheit (about 2000 degrees Celsius). Next, a drop of molten glass called a "gob" forms at the end of the preform, much like a droplet of water that collects at the bottom of a leaky faucet. The gob then falls away, and the single optical fiber inside is drawn out of the preform through compression on the preform from a feed mechanism at the top of the draw tower and tension provided from a take-up mechanism at the bottom of the draw tower.

See figure on next page
Read more: http://www.madehow.com/Volume-1/Optical-Fiber.html#ixzz64zoxmdW2


FIBER DRAW
Feed Mechanism
Preform
Furnace
Fiber
Laser Micrometer
Coating Application
Coated Fiber
UV Cure
Laser Micrometer
Take-up Spool
Pinch Wheel