A self-study computer version of 3034
Frank Quinn, 5/6/94

This memo sketches some of the issues involved in an aggressive program to develop a largely self-study computer version of 3034. It is not a proposal to undertake such a program. Essentially it is an offer to develop a proposal, and a preview of what might be in it, if the undertaking seems appropriate.

The issues discussed are: the need (why we would even consider such a thing); instructional goals; why 3034; a little more detail on the model; a timetable; and some drawbacks.

The Need
From the memo from Carlisle to Bates 4/6/94 on Phase II plans:

"... The resources allocated to your college are allocated to the college - not to specific programs or departments. This includes the special instructor positions recently allocated to the Math Department. In Phase II, the critical issue is student learning - not class size."

And later under "Breaking the Mold":

"An expectation has been set in Virginia that higher education would find ways to use instructional technology to 'break the mold' of credit for classroom contact."

Bates, in his meeting with the department May 3, said that he would not "terminate the experiment" without giving it a chance to be evaluated. But he was not willing to specify what sort of data would justify a further commitment to small math classes. Further his "nontermination" does not seem to preclude steady erosion, since we have already lost three instructorships. And finally he emphasized that Phase II was demanded by realities and would not go away with Carlisle. The realistic conclusion is that Math is not exempt from the need to do more with less, we just have a little more breathing room than other departments.

Instructional goals
The administration is reluctant to be explicit about this, but "break the mold of credit for classroom contact" and "the critical issue is student learning - not class size" should make it clear that there is a bottom line. The bottom line is productivity: we must do the job using (on average) less faculty time per student credit. We must find ways to get students to learn (and give them credit) either on their own, or in larger classes.

In math we have had experience with large classes, and generally found them unsatisfactory. The alternative seems to be courses with large self-study components. These have been tried elsewhere in the past, without much success. They have not been tried here, nor with the latest technology. Developing effective self-study courses is hard and requires a conscious commitment and a lot of resources. But it is widely identified as an important part of the future of instruction: "a guide by the side, not a sage on the stage" is a motto for the movement.

We can put this as a question: should a (partially) self-study calculus sequence be an goal in the current reform developments? This would be a major undertaking, but if successful would fully justify the investment. Again, it should be borne in mind that the alternative (and the default) is a return to large classes.

Why 3034?
Calculus is in the midst of an upheaval which will take years to stabilize. Even if self-study were a goal it would take years to seriously address it, let alone widely implement it. It would be very valuable to have a pilot project to help decide if this is a realistic goal; what resources would be needed; and what time frames might be feasible.
A pilot project would also be useful in dealing with the administration. First, it would show that we are seriously addressing the issues. Hard quantative information about resources and time needed would also be a strong basis for a request for resources. In our case the request would be that the Dean not take further positions, so we can maintain modest class sizes until more efficient practices come online.

A successful pilot project would also help establish Va. Tech as a major player in the reform movement.

The "Proofs" course 3034 seems a good candidate for a pilot project. It is a single-semester course with low enrollment, has qualitative rather than quantitative goals, and is completely under the control of the department. It is time to overhaul the course anyway, to acknowledge the existence of computers, and commitments have already been made to begin this overhaul. And finally we have the expertese to do it: the course was developed and the text was written here.

More about the model
Exactly what should be meant by a "course with a large self-study component" can only emerge from experimentation. However it is clear the idea has many potential drawbacks, so some constraints should be mentioned. First, this approach to education will not work for all students, so traditional sections of the course should still be available. Second, there must still be some contact with instructors and other students--we should not completely discard the benefits of a residential University with a living faculty. Third, there must be ways to ensure students move through the material at an appropriate pace, and evaluate their progress.

Here is a first guess at a model which might meet these concerns. The course could continue to be organized in sections of 20--25 students. The students would primarily learn from an interactive multimedia text, perhaps a Mathematica notebook. The class would meet once a week to discuss problems, ask questions, and take quizzes. Help would be available at other times by email, and work to be graded would be submitted by email or on disk.

There is now an emphasis on teaching students to "write", and this undertaking can be very appropriately addressed in this class. Some of the homework problems could be written up as "technical reports". These could be given to other students to critique, returned for revision, and checked by the instructor. Larger problems might be undertaken as group projects. This would not only give the students contact with each other, it would emphasize the importance of learning to communicate with each other, not just the instructor.

Careful design of the material to be graded should allow at least a doubling of the students accomodated by such a model: two sections each met once a week, instead of a single section met three times a week. Eventually a tripling might be possible.

A Timetable
The following is an aggressive approach, designed to yield results in a relatively short time. There are drawbacks to this, which will be discussed below.

Late May 1994 A faculty meeting to discuss the possibility, and determine if there is serious resistence to the experiment.

Summer 1994 Fletcher and Quinn begin development of computer-based course material. A detailed proposal for the course is developed, and the feasibility of marketing it as a basic Mathematica programming course is determined. (There are two points to this last: it would be a valuable resource for the University, particularly Engineering, and it would increase enrollment. The current enrollment is not large enough to sustain a real trial of the partial self-study format.)
Fall 1994  Fletcher teaches one section with computer; further development of materials by Fletcher and Quinn; and depending on the outcome of the feasibility studies, changes in course descriptions and restrictions are begun. (Offer as credit toward a minor; advertise to client departments as a “conceptual” programming course; obtain any necessary approvals to offer most sections as partial self-study, all beginning Fall 1995.)

Winter 1995  At least two, and possibly all sections taught with computer materials (though still in traditional format). Self-study materials field-tested, feedback from other instructors.

Summer 1995  Computer materials used in summer school. First draft of self-study text completed.

Fall 1995  Self-study sections offered. Materials evaluated and further developed, etc.

Winter 1996  We finally get the first data on the feasibility of self-study math courses.

**Drawbacks**
The first are political. If there is serious opposition in the department to the basic idea, then it cannot succeed. If it is seen as a power play to “take over the course” then it is unlikely to succeed. Decisive and risky action will have to be taken by the departmental administration.

Some bases are left uncovered. In this timetable the steps to increase enrollment in the course are taken before the course itself is completely developed and tested. An awkward situation could develop if enrollment does increase but something goes wrong with the course. The first defence against this will be a careful study of the full proposal presented at the beginning of fall 1994. Even if this seems credible there will be risk. This risk can be reduced by delaying the enrollment boost or new course implementation by a year, but this also delays the data we hope to obtain.

Even with this schedule it will be nearly two years before any data at all is available on the feasibility of this model for “breaking the mold of contact-for-credit”. And even if we commit resources to development in the calculus before the pilot project comes online, it will be 3--4 years before anything can be done there. If there is a greater sense of urgency it might be compressed: the basic electronic course developed in fall 1994, and the first self-study section offered in winter 1995. The feasibility of doing this would have to be assessed in the proposal developed over the summer.