Modelling solid tumour growth:

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The main aim of this course is to show how mathematical techniques can be used to investigate and provide insight into the mechanisms that regulate different aspects of solid tumour growth. The models we study will include: systems of coupled differential equations that describe vascular tumour growth (when the tumour is connected by the host's blood supply and has an effectively limitless supply of nutrients); moving boundary problems that describe avascular tumour growth (when the tumour lacks its own blood supply and relies on nutrient diffusion to sustain its growth); and, probabilistic models of angiogenesis (the process by which an avascular tumour becomes vascularised by stimulating the formation of a new blood supply from neighbouring vessels). Whilst the models and analytical techniques employed will apply to tumours, the methods are sufficiently general in nature that they will be applicable in other areas of mathematical biology and applied mathematics.

LECTURE 1: *Preliminaries.* Introduction to the background biology. Simple time-dependent models of avascular and vascular tumour growth.

LECTURE 2: *Avascular Tumour Growth I.* Modelling the growth of tumour spheroids and the action of chemotherapeutic agents. Moving boundary value problems and diffusion-limited growth.

LECTURE 3: *Avascular Tumour Growth II.* Symmetry-breaking as a mechanism for invasion. Linear stability analysis.

LECTURE 4: *Angiogenesis.* Alternative modelling approaches: discrete or continuous and deterministic of stochastic. Anti-angiogenic therapies.

LECTURE 5: *Summary and future directions:* The state of the art and future applications, including existing and emerging therapies and modelling vascular tumour growth.

Reading:

J.A. Adam & N. Bellomo, A survey of models for Tumor-Immune system Dynamics. Basel, Birkhauser (1997).

H.P. Greenspan, Models for the growth of solid tumours by diffusion. *Stud. Appl. Math.* **51** (1972), 317-340.

H.M. Byrne & M.A.J.Chaplain Mathematical models for tumour angiogenesis – numerical simulations and non-linear wave solutions. *Bull. Math. Biol.* **57** (1995), 461-486.