

Liver Cancer Survival Probabilities

The five year survival rate for liver cancer is around 20%¹. Clinicians with patients with liver cancer sometimes have to decide whether to include patients in phase I trials of new treatments. These trials are limited to those patients whose survival rates fall below some percentage after some median. Both the percentage and median are based on biological factors and are modeled using an exponentially decaying function. The model you will be working with does a patient-specific prediction regarding the value of 6 covariates: [albumin baseline levels, LDH baseline level, dNLR, ECOG, number of metastatic sites, and liver affectation]². It calculates specific survival probabilities for a patient before enrolment in a phase I trial.

This project will consist of three parts. In the first section, you will be given a set of discrete data consisting of survival probabilities at certain times (in months). You will then be asked to cubic spline the data to determine survival probabilities at times between the available data. In the second part, you will be asked to fit data to an exponential model. Lastly, you will read the article and write a 2–5 sentence reflection on the article. More details on section I and II follow below.

Each group will be given several sets of data in which the 6 covariates listed above differ. One group of data will be cubic splined, and the other will be fitted to a exponential decay model. The functional form of the model will be provided with the data. The code used for cubic splining and fitting the data must be written by the group. You may use any parts of code supplied during the course lectures or given in the text, but you may not use code from any other source. The deliverables for this project are:

- (1) The **MatLab** code for each section.
- (2) A PowerPoint presentation in which results are presented. All results should include any associated estimates of the goodness of fits, etc.
- (3) A short narrative reflecting on
 - (i) What were the key concepts you learned from this project
 - (ii) What were the most difficult obstacles to overcome
 - (iii) What parts of the project were most completely addressed, which were not, and why you felt that.
 - (iv) What more would you like to learn about this topic.
 - (v) A 2–5 sentence reflection on the article on cancer health disparities

The following rubric will be used to assess your presentation

Content :

4. **Expert** Clear articulation and use of all the key concepts, synthesis of all results, conclusion supported by results
3. **Proficient** A general sense and use of key concepts, synthesis of key results, conclusion supported by results
2. **Almost Proficient** Some key results or synthesis omitted, conclusion not entirely supported by results
1. **Developing** Most of the key results not included, little to no synthesis, conclusion not supported by results

Communication and Organization :

4. **Expert** Oral presentation had clear organization, and each part was effectively and concisely delivered
3. **Proficient** Oral presentation had clear organization, was easy to follow, and included relevant information
2. **Almost Proficient** Oral presentation had some organization but was somewhat difficult to follow (e.g., too detailed, too general, missing important sections)
1. **Developing** Oral presentation was disorganized or unclear

Visuals :

4. **Expert** Tables/graphs summarize data and/or conclusions, figures and images explained and described well, axes labeled and units listed.
3. **Proficient** Most figures and images explained and described well,
2. **Almost Proficient** Visuals were of uneven quality; Labels and legends somewhat unclear, relation to conclusions not clear or not drawn from figures
1. **Developing** Visuals were confusing, unprofessional, and/or not clearly relevant

Part I—Cubic Spline:

In the Projects→LiverProject folder on *D2L* you will find several data files. The names of the files will begin with either **GP0x.Spline** or **GP0x.Fit**, where x is a number. For the spline part of this project you are to use one file each from the GP01, GP02, and GP03 spline files. You are free to choose any from those groups you wish. After you have read in the data files and cubic splined the data, you are to use the spline to give survival probability at 4, 7, 11, and 20 months. What can you infer from your analysis?

Part II–Fitting

In the same data folder you will find three data sets called `GP01_Fit_data`, `GP02_Fit_data`, `GP03_Fit_data`. You are to fit each of these data sets to an exponential function of the form

$$y = a \exp(bx)$$

where a , and b are parameters you are looking for. You are also to find the variance in the best fit parameters. Notice that the function is **NOT** linear and so the techniques we introduced in class cannot be used directly. However there is a straightforward way to make the function linear. Please contact me to confirm you have done the transformation correctly. You should generate plots showing both the data and its best fit graph. Note that because the parameters will have error bars associated with them, it's probably best to plot the *range* of possibilities. Code, which you may have to modify, will be provided to generate appropriate graphs.

References:

¹ Howlader N, Noone AM, Krapcho M, et al (eds). SEER Cancer Statistics Review, 1975-2016, National Cancer Institute, Bethesda, MD, https://seer.cancer.gov/csr/1975_2016/, and

National Cancer Institute. Physician Data Query (PDQ). Adult Primary Liver Cancer Treatment. www.cancer.gov/types/liver/hp/adult-liver-treatment-pdq

²Onaca N, Davis GL, Jennings LW, Goldstein RM, Klintmalm GB. Improved results of transplantation for hepatocellular carcinoma: A report from the International Registry of Hepatic Tumors in Liver Transplantation. *Liver Transpl.* 2009;15(6):574-580, and

Matos I, Villacampa G, Hierro C, Martin-Liberal J, Berché R, Pedrola A, Braña I, Azaro A, Vieito M, Saavedra O, Gardezabal I, Hernando-Calvo A, Alonso G, Galvao V, Ochoa de Olza M, Ros J, Viaplana C, Muñoz-Couselo E, Elez E, Rodon J, Saura C, Macarulla T, Oaknin A, Carles J, Felip E, Tabernero J, Dienstmann R, Garralda E. Phase I prognostic online (PIPO): A web tool to improve patient selection for oncology early phase clinical trials. *Eur J Cancer.* 2021 Aug 9; 155:168-178. doi: 10.1016/j.ejca.2021.05.040. Epub ahead of print. PMID: 34385069.