

TUTORIAL

INTERPRETING THE PREDICTED SURVIVAL PLOT

The predicted survival plot is based on the Bone Metastases Ensemble Trees for Survival (BMETS) machine-learning statistical model. This model was built using a database of 397 real patients seen in Radiation Oncology consultation for symptomatic bone metastasis at the Johns Hopkins Hospital between 2007 and 2013. Each patient's chart was retrospectively reviewed to collect demographic, disease, and treatment information felt to be potentially useful in predicting survival. His or her actual survival time following consultation was documented. A random survival forests approach was then used to **predict** survival time following consultation based on patient-specific characteristics.

The plots below demonstrate the predicted survival curve within the 12 months following radiation oncology consultation for a specific case patient, shown in **orange**.

The x axis (horizontal line) shows time from consultation in months. The y axis (vertical line) shows probability of survival—listed as a percentage—where 100% means no probability of death and 0% means complete probability of death. As such, any point on the orange curve shows the percent probability of surviving to that timepoint following initial consultation.

For example, Figure 1 shows the predicted survival curve for Patient A. The model predicts that patients with demographic, disease, and treatment characteristics similar to Patient A would have a 35% chance of being alive at 3 months after consultation.

****Note: If you place your mouse cursor over the orange line during the assessment, you can see the predicted probability of survival for the case patient at any point time between 0 and 12 months following consultation.**

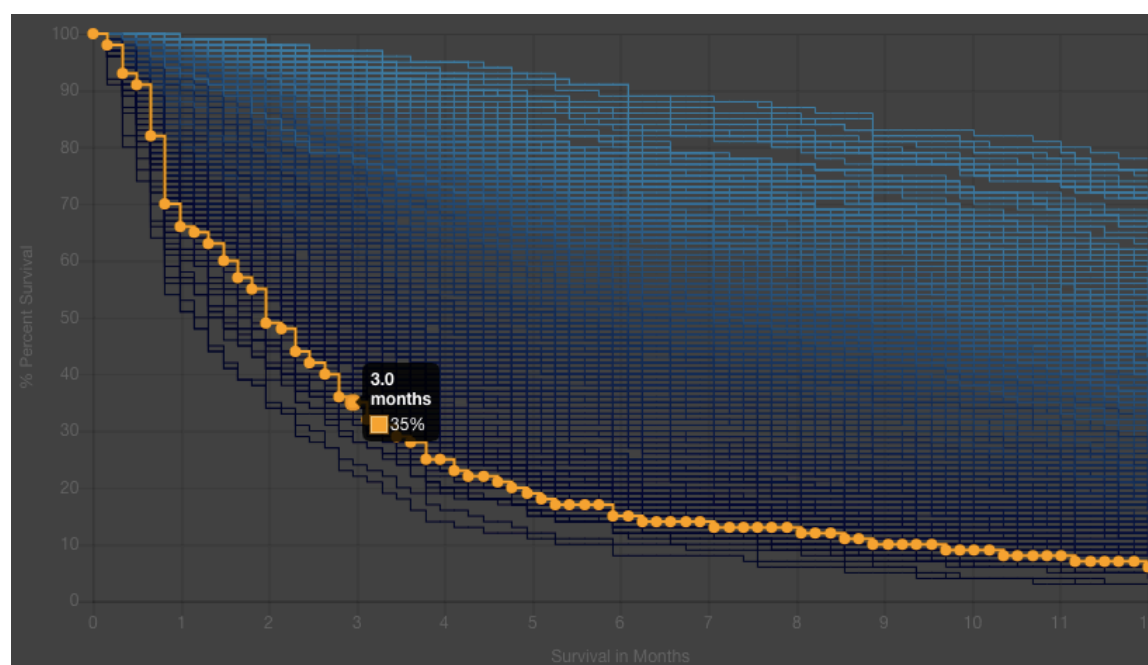


Figure 1: Patient A's probability of surviving 3 months after consultation

Another useful metric for interpreting survival curves is the predicted median survival. This corresponds to the time point at which half of patients with a given set of characteristics would still be alive. On the predicted survival plot, the time at which the y axis reads 50% corresponds to the median survival time. For example, in Figure 2, the predicted median survival time for Patient B is 6.2 months. This means that 6.2 months after consultation, we would expect that 50% of patients with similar characteristics to Patient B would be alive, while 50% would be dead.

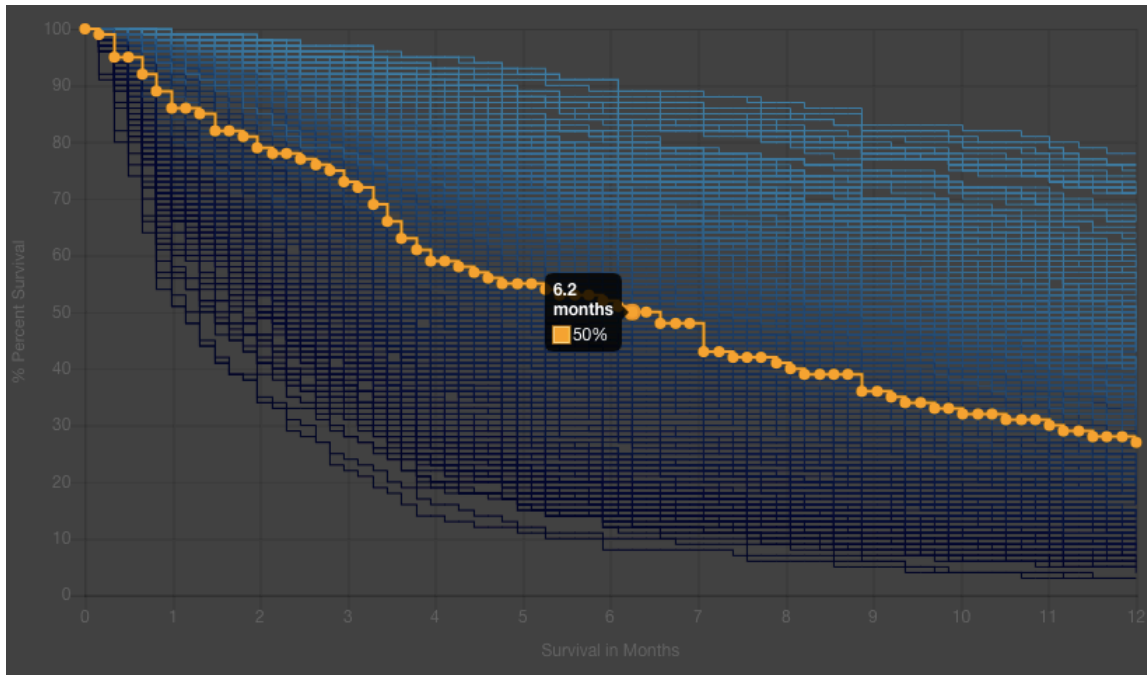


Figure 2: Patient B's predicted median survival

Plotted behind each case patient's predicted survival curve are the predicted survival curves for **every other patient** who was included in the database. These survival curves are arranged in order from shortest to longest survival time in the first 12 months, corresponding to the lowest (**dark blue**) to highest (**light blue**) percentile of survival.

The purpose of these blue curves is to demonstrate the range of survival that can be predicted by the model and to provide reference for the relative prognosis of each case patient. For example, in Figure 3, Patient C's predicted survival curve suggests a 71% chance of being alive at 12 months. Patient C's curve is among the top of all predicted survival curves for patients seen in consultation for palliative bone radiotherapy, suggesting longer survival than average.

****Note that on Patient C's curve, the survival probability does not drop to 50% over the 12 months after consultation. Thus, Patient C's predicted median survival will be listed as "12 or more months."**

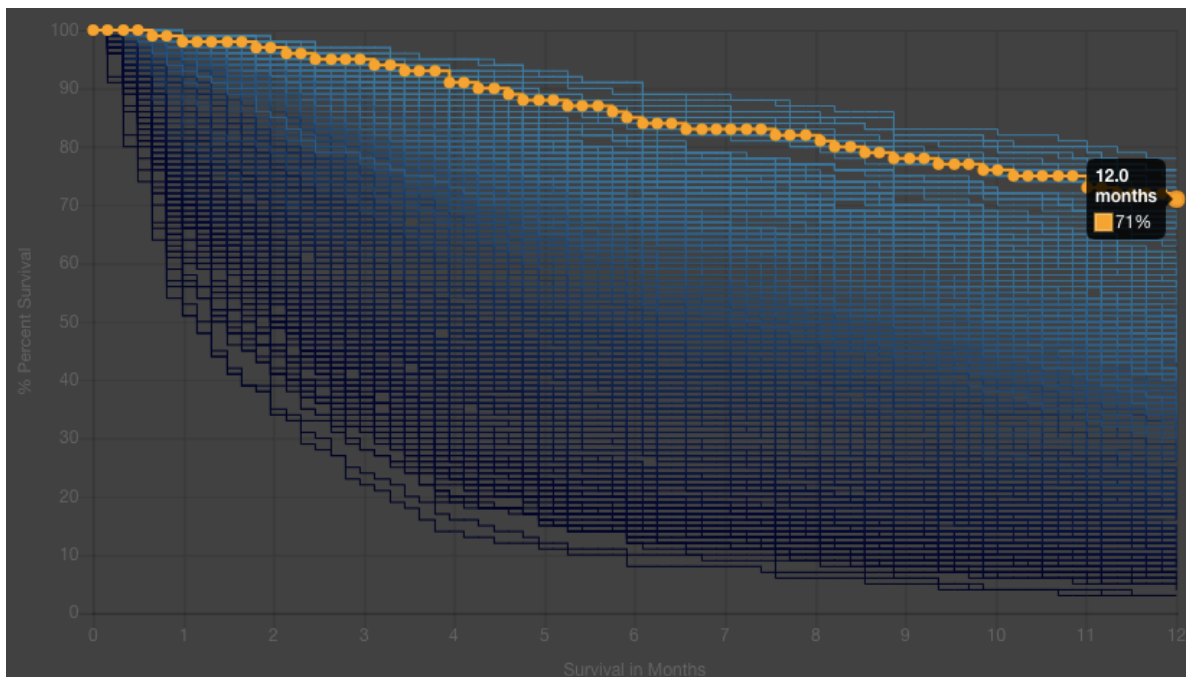


Figure 3: Patient C's predicted probability of survival 12 months after consultation

Conversely, the predicted survival curve for Patient A in Figure 1 shows a 50% chance of being alive at 2 months (corresponding to a median survival of 2 months) and nearly 0% chance of being alive at 12 months. Patient A's curve falls among the bottom of all predicted survival curves for patients seen in consultation for palliative bone radiotherapy, suggesting shorter survival than average.

The predicted survival curve for Patient B in Figure 2 shows a 50% chance of being alive at 6.2 months (corresponding to a median survival of 6.2 months) and 25% chance of being alive at 12 months. Patient B's predicted survival falls in the middle of the range among all other patients seen in consultation for palliative bone radiotherapy.

****Note that in each plot, the survival curves are displaying *predicted* values for probability of survival. The case patient's actual survival time may differ from the model's predictions. While the model is calibrated to be as accurate as possible across all patients, the predicted median survival time may underestimate or overestimate an individual patient's actual survival time.**