

# Additional Experiments

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This section is intended to briefly show and explain additional experiments that have been made on several public datasets, in order to show the general validity of our framework. The characteristics of the events logs are presented in Table I, while the results obtained on those datasets are shown in Table II.

## A. Bank Account Closure

We show here the application of our framework to the other two activities that are of interest for the bank, *Autorization Required* and *Pending Request for Acquittance of Heirs*.

In Figure 1 are shown the explanations related to the *Authorization Requested* prediction. Here, most of the times the LSTM is predicting that the activity will not be performed, and this is correct since the authorization to proceed further is usually requested to a director in the early stages of the process, rather than at the end. In particular, activities performed by the resource BOC or by resources with role Back-office are all performed after *Authorization Requested*, and this is of course also true when these activities have been performed in previous steps. Instead, when a customer does not want to change the bank but wants just to close one of its bank accounts among different ones he owns (labeled as *Closure\_Reason=2 - Keep bank account. Same dip*), most of the times a director's authorization need to be requested; on the contrary, when a customer decides to change the bank and close definitively its bank account (labeled by *Closure\_type=Client Recess* and by *Closure\_Reason=1 - Client lost*), then a director's authorization is not needed.

## B. BPIC 2012

Figure 3 shows the application for the remaining time prediction in the bpi12 dataset. The biggest value is represented by *event!=A\_PREACCEPTED*, meaning that this activity is particularly important for the model. As a matter of fact, when this activity is performed (event=A\_PREACCEPTED can be seen in the heatmap as well), the offer has an higher chance to be accepted by the customer, leading to a process that is longer compared to when the offer is declined (when event=A\_DECLINED a smaller remaining time is expected). Looking at the history of *event!=A\_PREACCEPTED*, the first two indexes (#0 and #-1) are mainly found at the beginning of the case, meaning that not until this activity is performed, there are good chances that the offer will be rejected (*A\_DECLINED*), causing a smaller remaining time

prediction; on the contrary, bigger indexes (#-2, #-3, #-4, #-5) mean that we are currently in the acceptance process (that is also indicated by the activities *O\_SENT*, *O\_CREATED*, and *O\_SELECTED*) and a smaller remaining time is predicted. Finally, states of the work item belonging to the application seems to be not relevant for the prediction.

The financial institute aims also to identify in advance if a loan will be declined (represented by the activity *A\_DECLINED*). The heatmap related to *A\_DECLINED* prediction (6) shows as before that the activity *A\_PREACCEPTED* being performed or not is the most influential. We already mentioned that when the offer is declined the process is shorter and not until *A\_PREACCEPTED* is being performed (as can be seen in the first row of the heatmap), there are higher chances that the offer is going to be declined; on the contrary, when *A\_PREACCEPTED* is performed or when it has been performed in the past (as can be seen in the long tail of the heatmap), then the offer is predicted to not be declined. In general when information for the application have been filled (labeled as *W\_Completeren aanvraag*), *A\_DECLINED* is predicted to not happen (shown in the boxes with #-1 or lower index), but when information have just been filled (as it can be seen in the box with the #0 index) there is still a little chance that the offer is going to be declined. Finally, when the amount of the requested loan is low (labeled as *Low value of AMOUNT\_REQ* there is less probability that the loan will be declined by the institute (-2996) compared to when the requested amount is high (labeled as *High value of AMOUNT\_REQ*).

## C. BPIC 2012-W

Figure 7 shows the application for the remaining time prediction in the bpi12-W dataset, that is the dataset derived from bpi12 challenge, containing only the states of the work items belonging to the application. Here the largest and most important values are represented by the activity attribute; please note that here *Activity* and *concept:name* refer to the same thing (and this is also correctly understood by the model, which gives them the same importance), so for simplicity we will address them as activity. In particular, *W\_Completeren aanvraag* and *W\_Nabellen offertes* (labeled respectively as *concept:name=W\_Completeren aanvraag* and *concept:name=W\_Nabellen offertes*) are always performed in the initial part of cases, and, hence, when they are currently

performed (index #0) an higher remaining time is predicted. Instead, when these two activities have been performed in the past it means that either they are still performed because of internal inefficiencies that cause reworks or other activities are currently performed; in any case the process is not anymore in its early stages and hence a smaller remaining time is predicted (this can be noticed in the heatmap in the long tails of those two attributes). As a matter of fact, when these two activities are not currently performed (labeled as *concept:name!=W\_Completeren aanvraag* and *concept:name!=W\_Nabellen offertes*) it's even more influencial in predicting a smaller remaining time, because those inefficient reworks have already been done. According to the same logic, *W\_Validatoren aanvraag* and *W\_Nabellen incomplete dossiers* are performed in the final part of cases and when it happen (labeled as *concept:name=W\_Validatoren aanvraag* and *concept:name=W\_Nabellen incomplete dossiers*) a smaller remaining time is correctly predicted.

D. BPIC 2013

TABLE I: Event logs statistics

Event Log	# traces	# activities	mean events/trace	median events/trace	mean duration	median duration
<b>Bank Account Closure</b>	32429	15	5.5	7	15.5 days	7.7 days
<b>BPIC 2012</b>	12369	23	14	8	7.9 days	0.6 days
<b>BPIC 2012 - W</b>	9658	6	7.5	6	11.4 days	8.5 days
<b>BPIC 2013</b>	7554	13	8.7	6	12.1 days	7.6 days
<b>HelpDesk 2017</b>	4580	14	4.7	4	40.9 days	39.9 days

TABLE II: Event logs and summary statistics

	Remaining time MAE (days)	Activity occurrence prediction (AUROC / APR / F1)			Cost prediction MAE (Euro)
<b>Bank Account Closure</b>	4.37	Authorization Requested 1 / 0.99 / 0.99	BO Adjustment Requested 0.86 / 0.69 / 0.65	Pending Request for acquittance of heirs 0.99 / 0.87 / 0.90	0.95
<b>BPIC 2012</b>	6.66	A_ACCEPTED 0.92 / 0.66 / 0.60	A_CANCELLED 0.74 / 0.52 / 0.37	A_DECLINED 0.77 / 0.55 / 0.51	-
<b>BPIC 2012 - W</b>	7.84	-	-	-	-
<b>BPIC 2013</b>	11.82	Wait - User 0.50 / 0.43 / 0.45	2nd / 3rd line 0.90 / 0.90 / 0.81	-	-
<b>HelpDesk 2017</b>	5.96	-	-	-	-

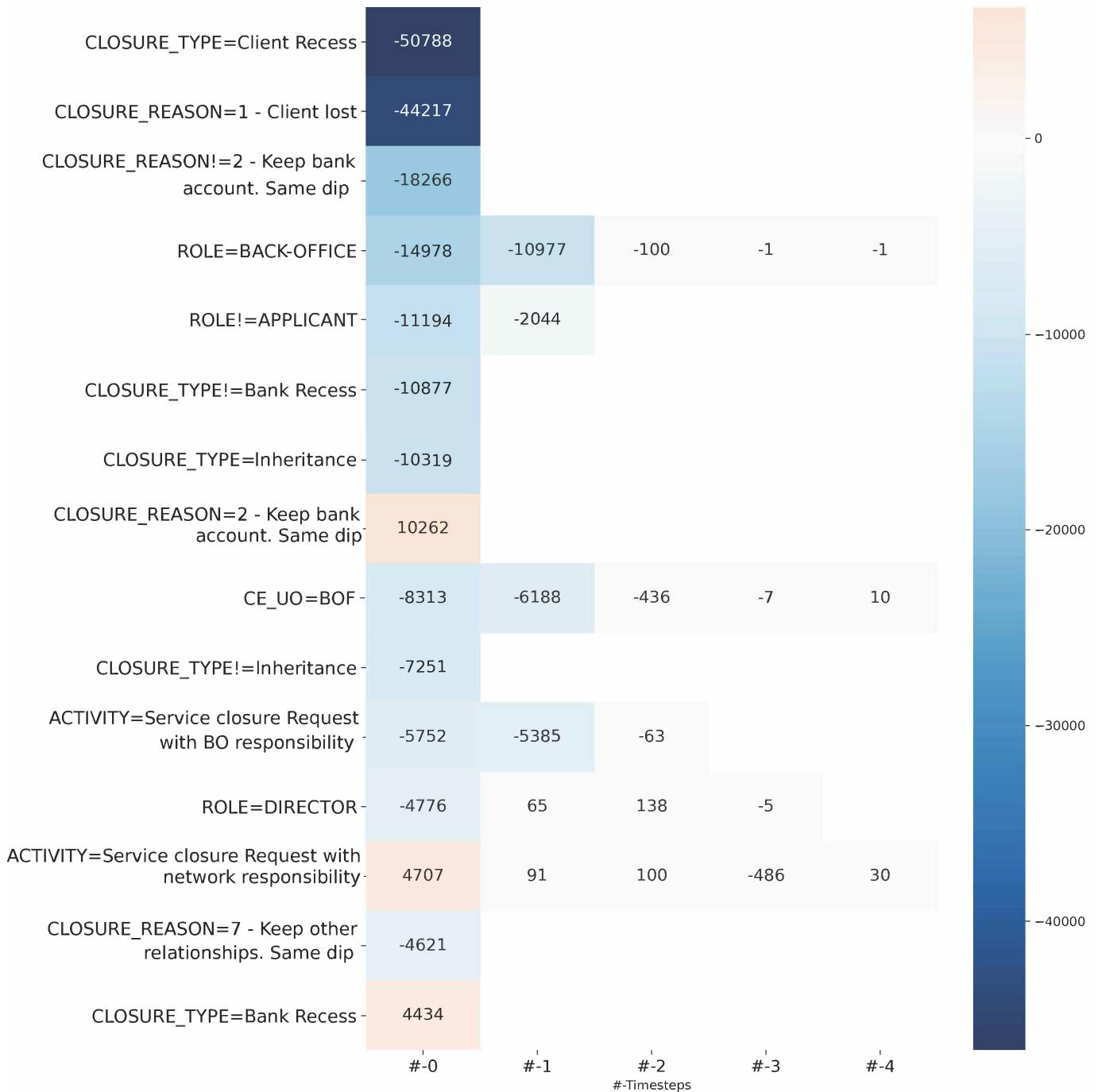


Fig. 1: Offline explanations for *Authorization Requested* prediction (Bank Account Closure)

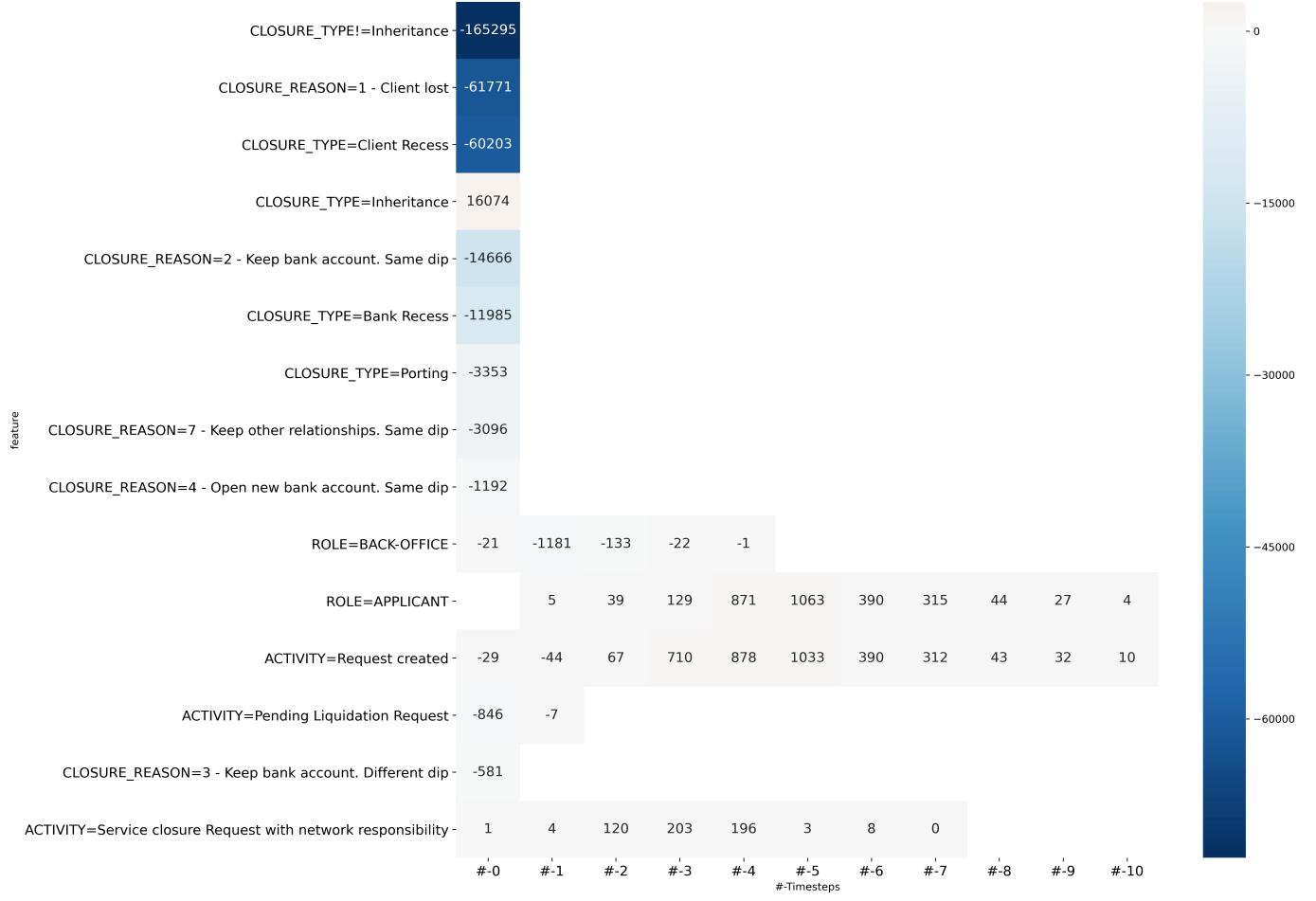


Fig. 2: Offline explanations for *Pending Request for acquittance of heirs* prediction (Bank Account Closure)



Fig. 3: Offline explanations for BPI12 remaining time prediction



Fig. 4: Offline explanations for BPI12 A\_ACCEPTED prediction



Fig. 5: Offline explanations for BPI12 A\_CANCELLED prediction

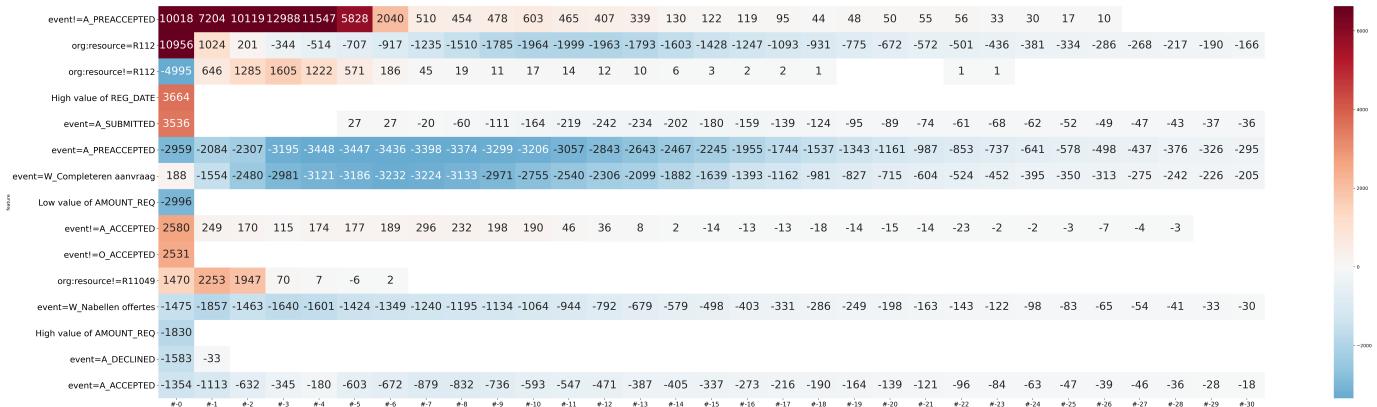


Fig. 6: Offline explanations for BPI12 A\_DECLINED prediction



Fig. 7: Offline explanations for BPI12-W remaining time prediction

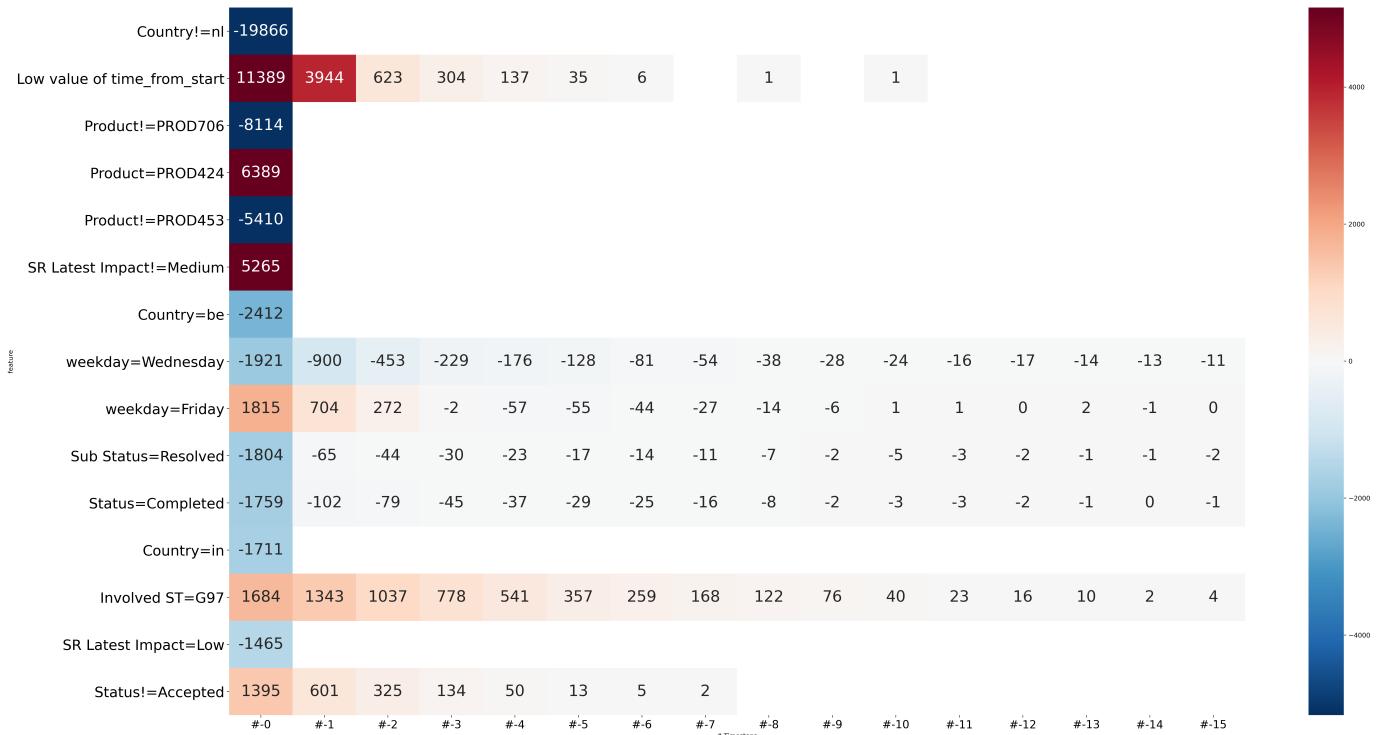


Fig. 8: Offline explanations for BPI13 remaining time prediction



Fig. 9: Offline explanations for BPI13 2°/3° line prediction

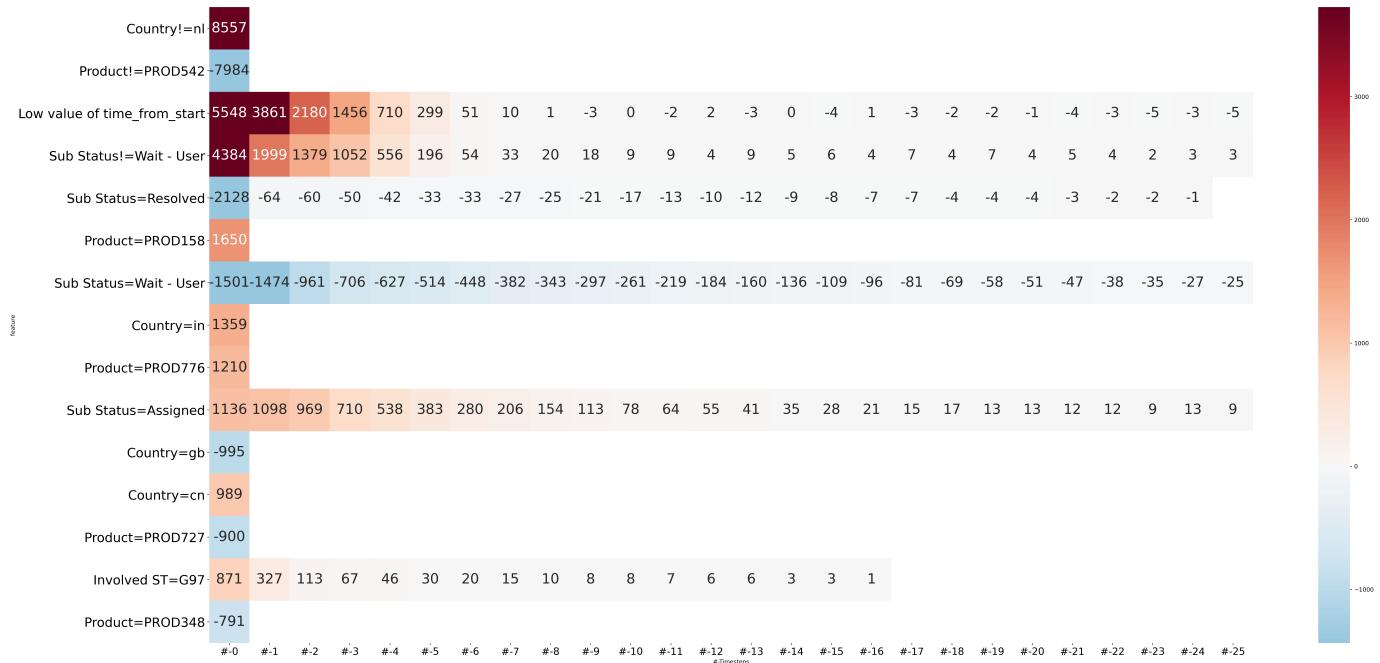


Fig. 10: Offline explanations for BPI13 wait\_user prediction

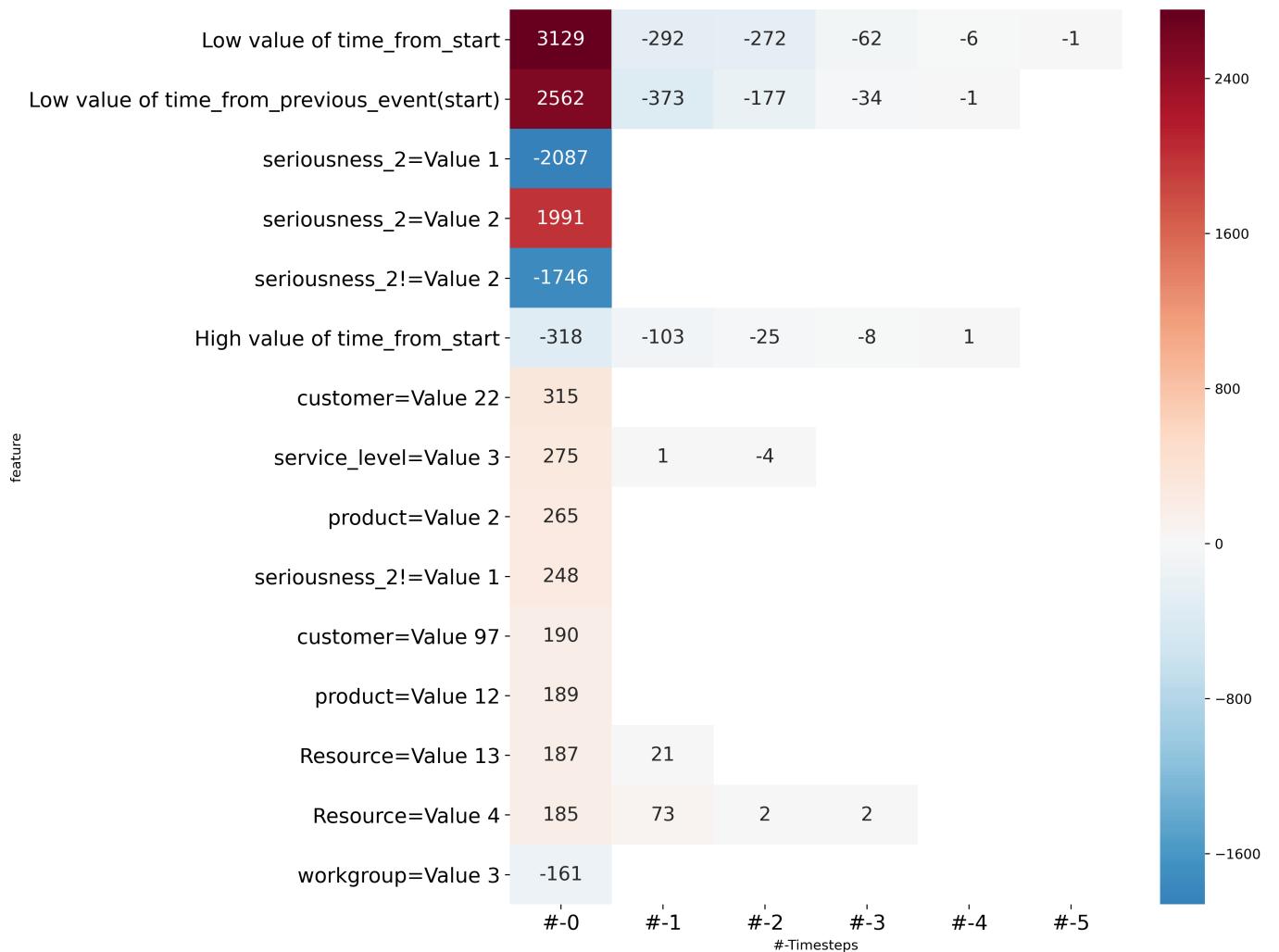


Fig. 11: Offline explanations for HelpDesk17 remaining time prediction