BTYD Modelling with Stan

Mick Cooney mcooney@describedata.com

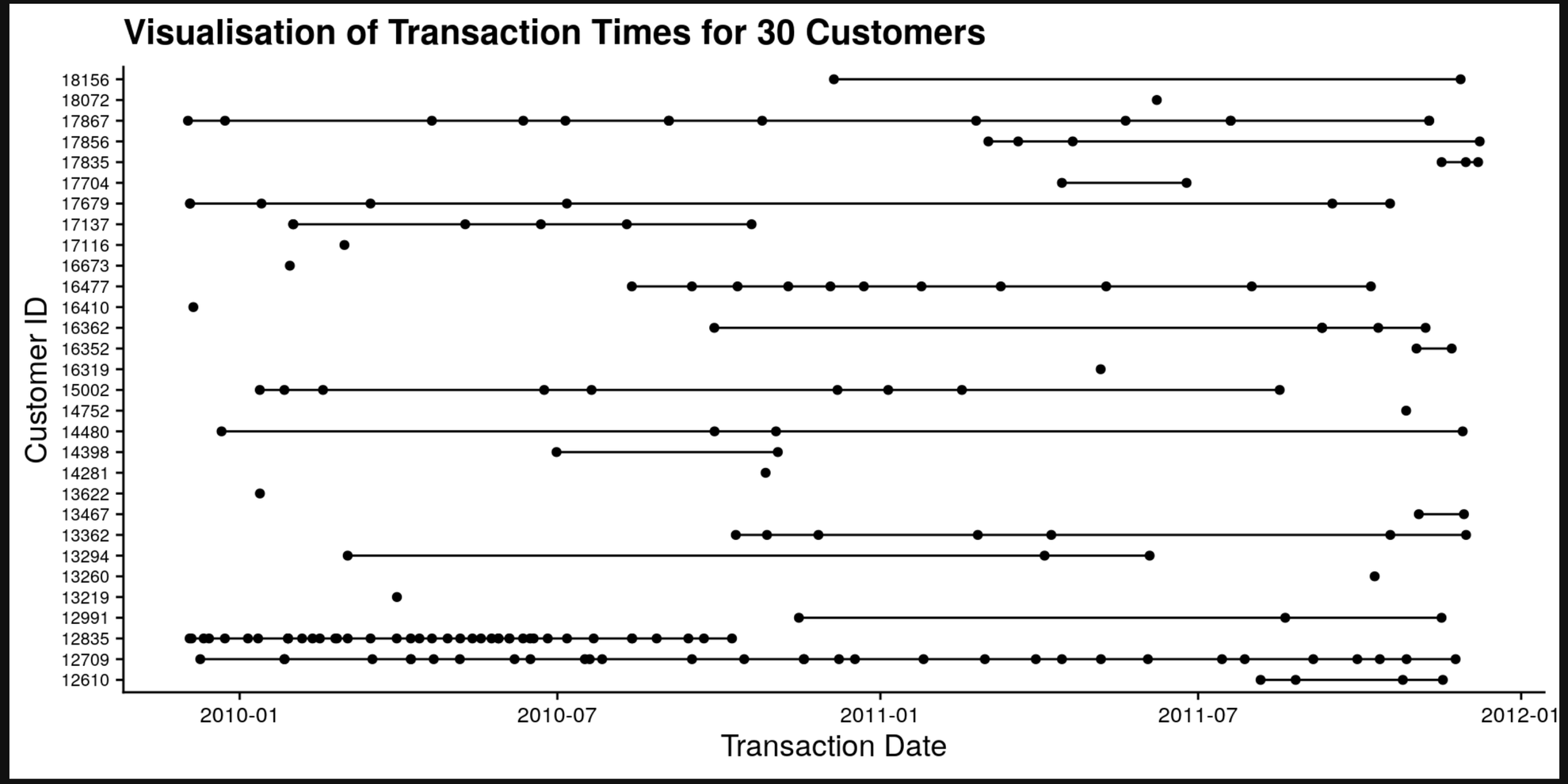
Customer Lifetime Value

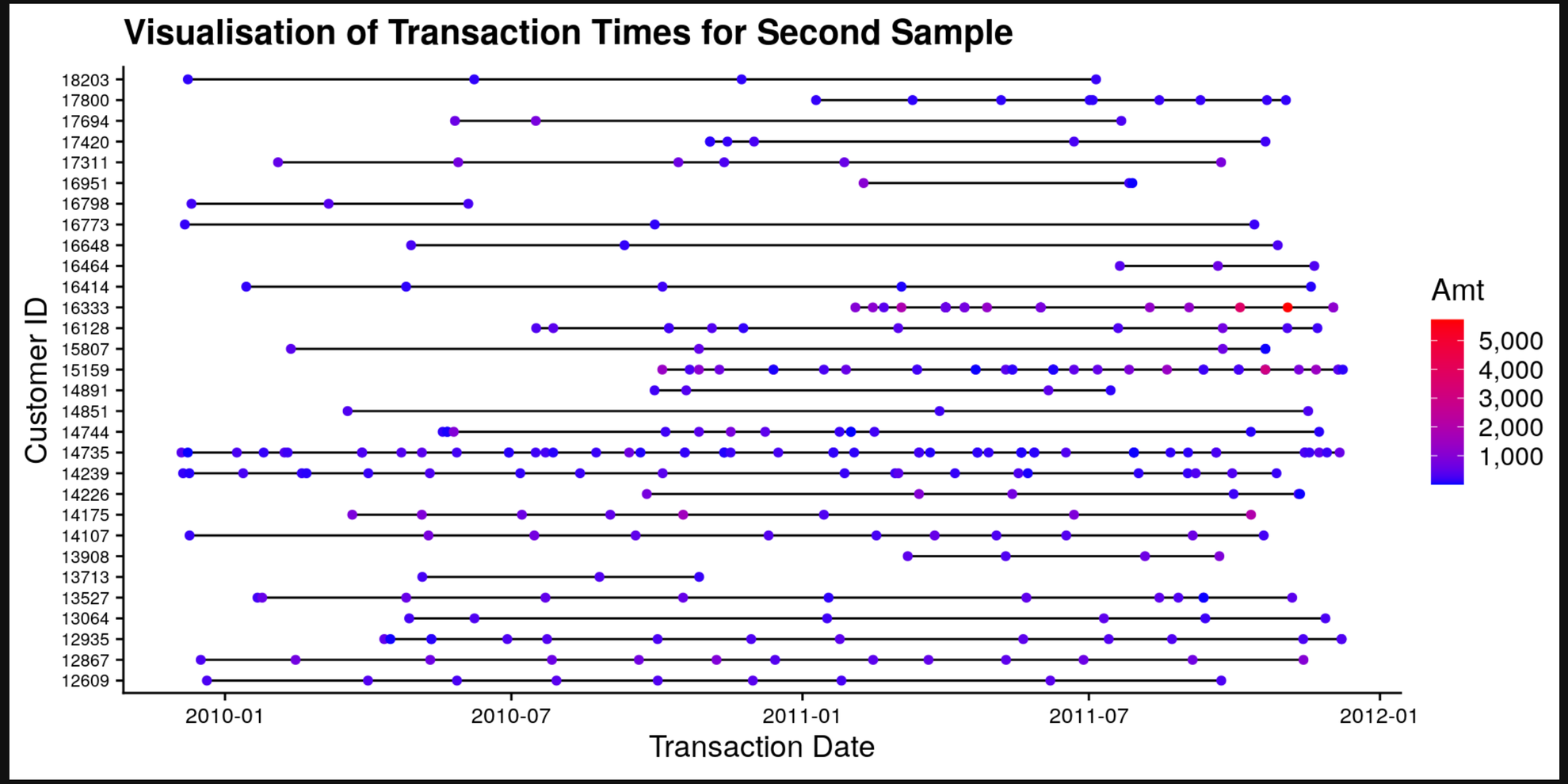
Non-Contractual Transactions

Retail

Transaction Data

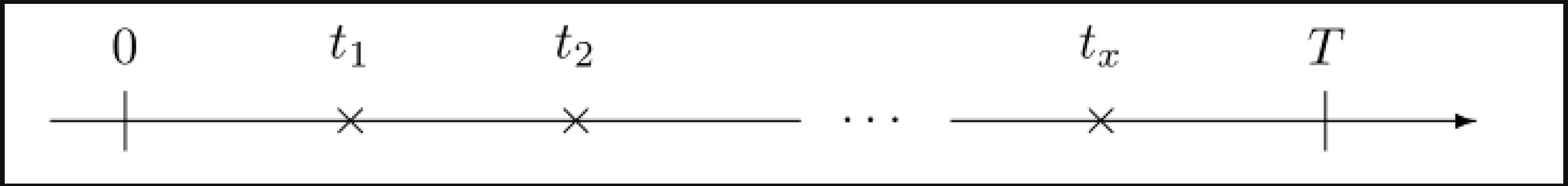
```
                  # A tibble: 5 × 4
  tnx_timestamp       customer_id invoice_id tnx_amount
  <dttm>              <chr>       <chr>            <dbl>
1 2009-12-01 07:45:00 13085       489434            505.
2 2009-12-01 07:45:59 13085       489435            146.
3 2009-12-01 09:05:59 13078       489436            630.
4 2009-12-01 09:08:00 15362       489437            311.
5 2009-12-01 09:23:59 18102       489438           2286.
```


Visualisation of Transaction Times for 30 Customers
Customer ID
18156
18072
17867
17856
17835
17704
17679
17137
17116
16673
16477
16410
16362
16352
16319
15002
14752
14480
14398
14281
13622
13467
13362
13294
13260
13219
12991
12835
12709
12610
2010-01
2010-07
2011-01
2011-07
2012-01
Transaction Date


Visualisation of Transaction Times for Second Sample
Customer ID
18203
17800
17694
17420
17311
16951
16798
16773
16648
16464
16414
16333
16128
15807
15159
14891
14851
14744
14735
14239
14226
14175
14107
13908
13713
13527
13064
12935
12867
12609
2010-01
2010-07
2011-01
2011-07
2012-01
Transaction Date
Amt
5,000
4,000
3,000
2,000
1,000

Buy Till You Die

Statistical distributions of transactions



P/NBD Models

$$x \sim \text{Poisson}(\lambda)$$
$$\tau \sim \text{Exponential}(\mu)$$

$$\lambda \sim \text{Gamma}(\alpha, r)$$
$$\mu \sim \text{Gamma}(s, \beta)$$

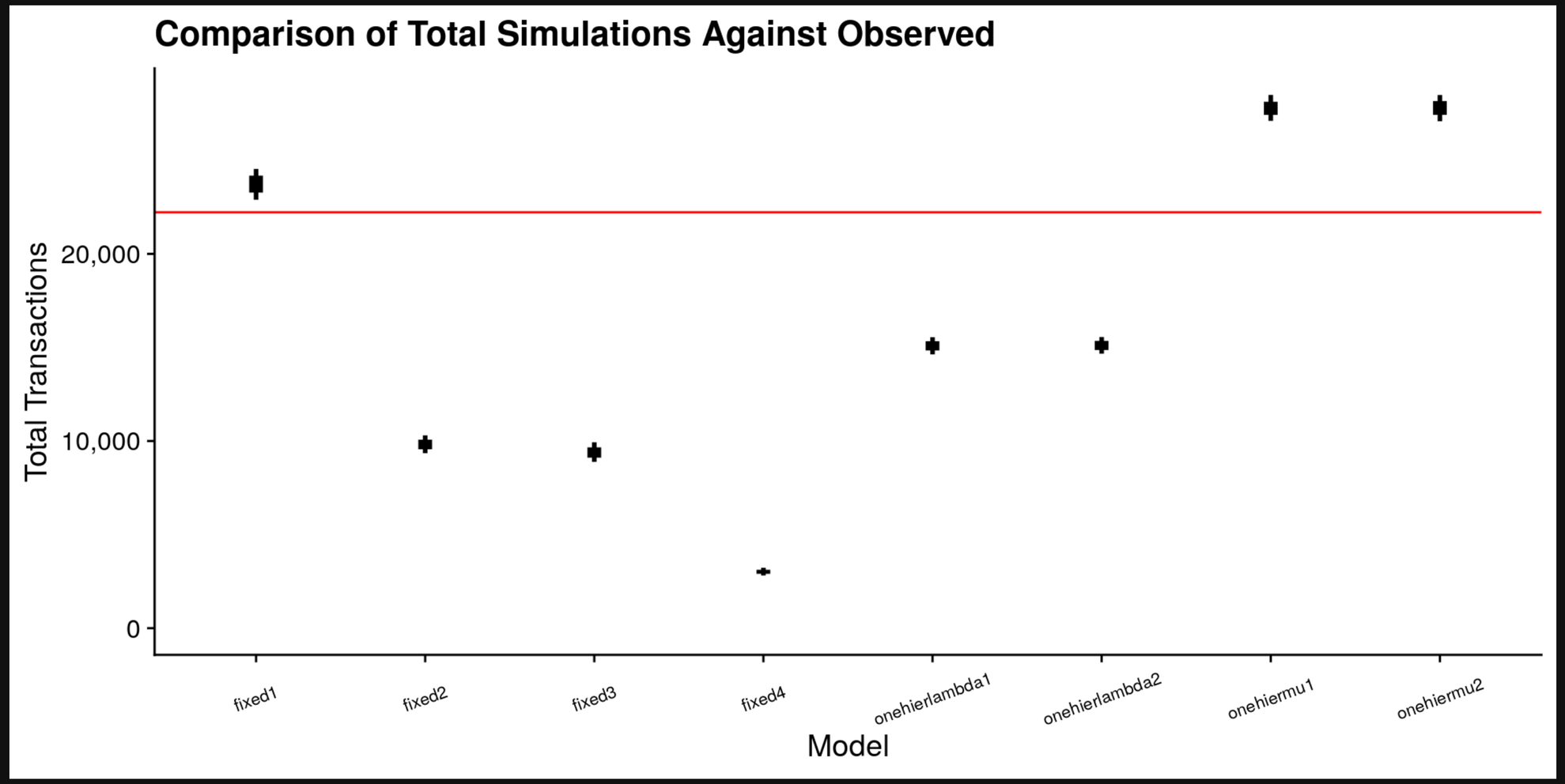
Data: (x, t_x, T)

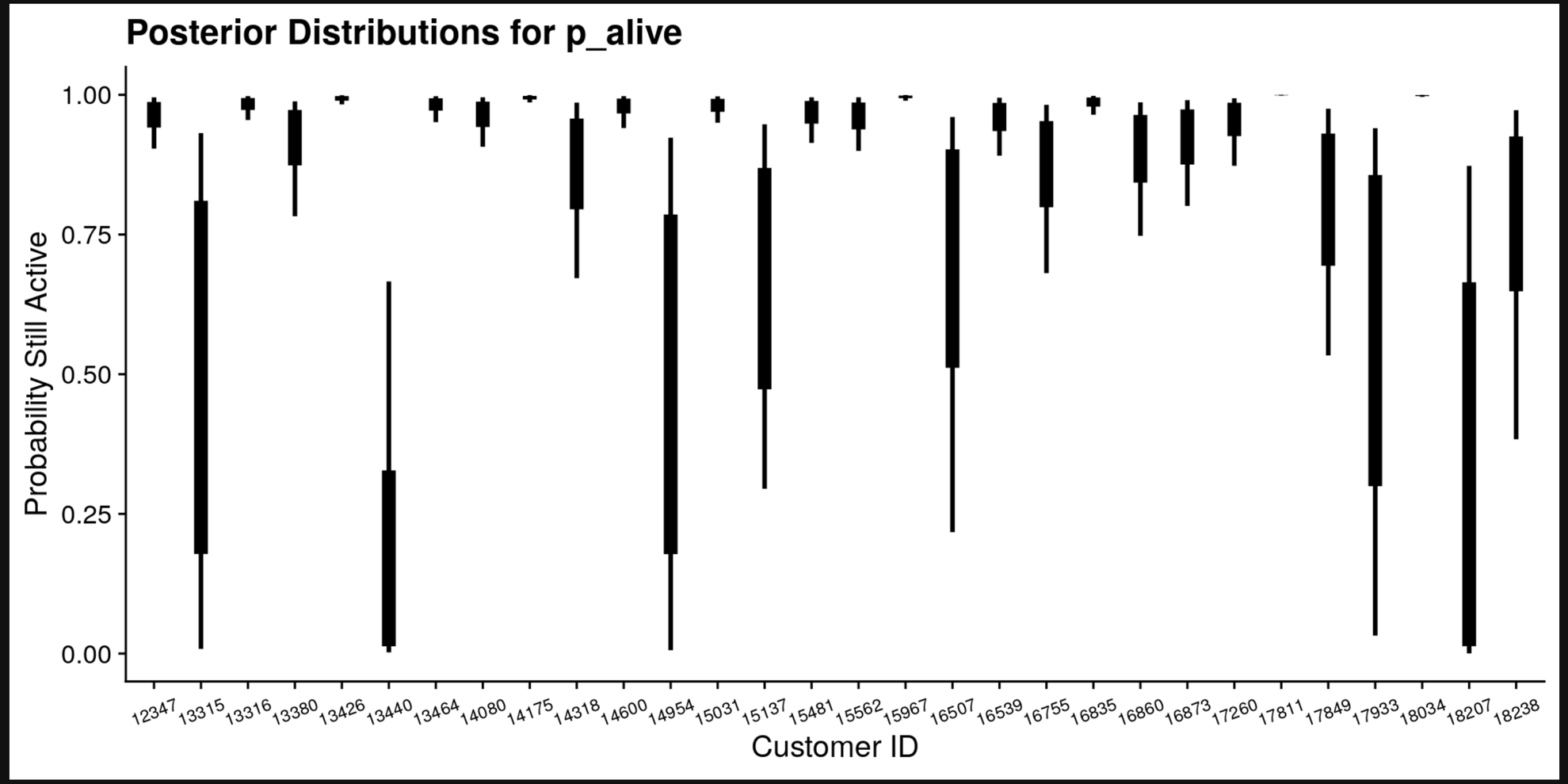
$x =$ count of transactions

$t_x =$ time from birth to last transaction

$T =$ time from birth to observation time

Bayesian Modelling


Comparison of Total Simulations Against Observed
Total Transactions
20,000
10,000
0
fixed1
fixed2
fixed3
fixed4
onehierlambda1
onehierlambda2
onehiermu1
onehiermu2
Model


Posterior Distributions for p_alive
Probability Still Active
1.00
0.75
0.50
0.25
0.00
12347
13315
13316
13380
13426
13440
13464
14080
14175
14318
14600
14954
15031
15137
15481
15562
15967
16507
16539
16755
16835
16860
16873
17260
17811
17849
17933
18034
18207
18238
Customer ID

Thank You!

Slides for Talk

Detailed Work