Estimating the Cost-Effectiveness Threshold for Cancer Care in Alberta:

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What is the threshold?

- The **'threshold'** is used in **economic evaluations** to determine if a **health technology** is **'cost-effective'**
- Two ways to use the threshold:
  1. Compare the technology to the threshold
     - Cost-effective if ICER lies *below* the threshold:
       $$\Delta C / \Delta E < \lambda$$
     - Cost-effective if net health benefit (NHB) is *positive*:
       $$\Delta E - \Delta C / \lambda > 0$$
     - Cost-effective if net monetary benefit (NMB) is *positive*:
       $$\Delta E . \lambda - \Delta C < 0$$
  2. Use threshold to estimate value based price

Why a Threshold?

- Threshold critical to assess cost-effectiveness
  - Constraints on growth in health expenditure
- Advantages of explicit basis for threshold
  - Transparent and accountable
  - Appropriate signals of value for investments to meet future health needs

How a Threshold?

1. Infer a threshold from past decisions
2. Estimate value of what gets displaced
3. Estimate the relationship between changes in expenditure and outcomes
   - Martin et al. and Claxton et al.

Data for all individuals with a cancer ICD since 2005

- Available data during the follow-up period (8 years from 2005 – 2013) for 283,239 individuals.
- Dataset contains variables for event status (dead or censored), time-to-event, demographics, costs and 1982 ICD variables.
- Costs include, emergency department, inpatient, specialist, general practice and urgent care center costs.

The Model

- Dependent variable
  - Time to Death
- Explanatory variable
  - Average annual cost since diagnosis
- Control variables
  - Age
  - Sex
  - Total number of ICDs
  - Number of distinct ICDs
  - Low survival
  - Material deprivation quintile
  - Social deprivation quintile
  - 1982 ICDs

- Accelerated failure time (AFT) models
- Three distributional assumptions
  - Weibull
  - Log-Logistic
  - Logistic
- Models trained for randomly selected patients and validated for another randomly selected set
- Model Diagnostics
  - BIC, RMSE and ROC

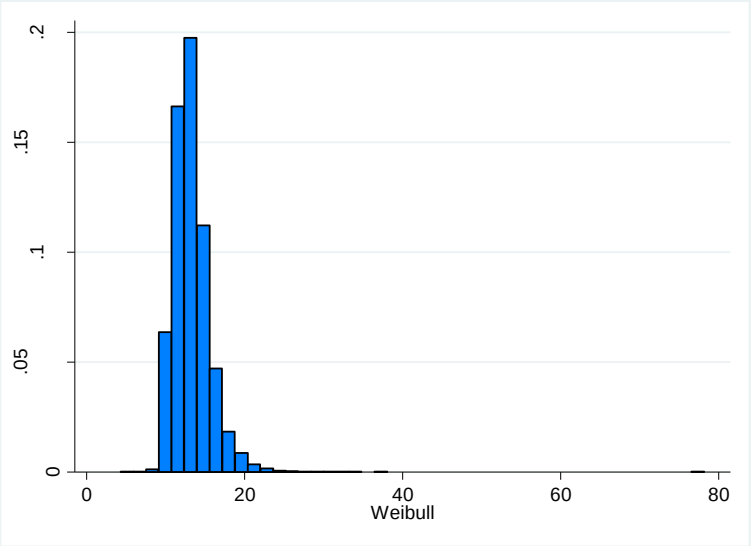
Predicting HRQoL

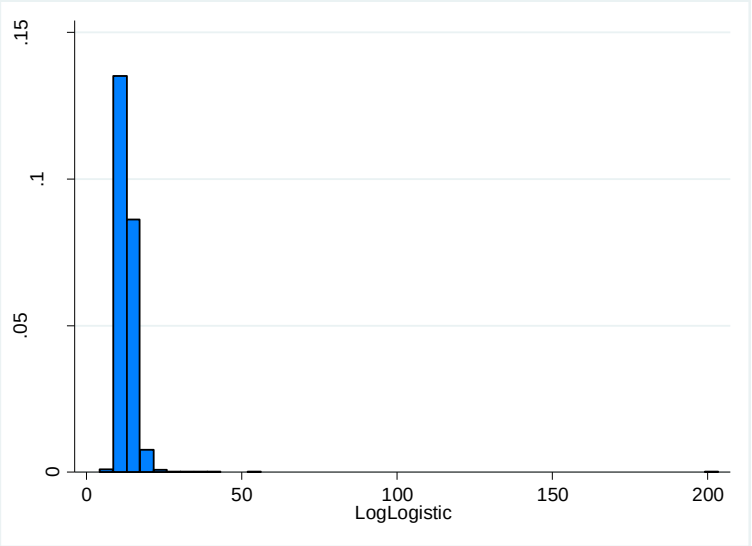
- Use an algorithm that predicts UK EQ-5D from ICD9
  - Sullivan et al. 2011
  - Convert ICD9 to ICD10
  - For unavailable variables
    - Assume national averages: race, income, education level
    - Disregard: non-cancer diagnoses
  - Predict HRQoL per patient
- Average HRQoL = **0.654**
- Claxton et al = 0.66 + 3% improvement

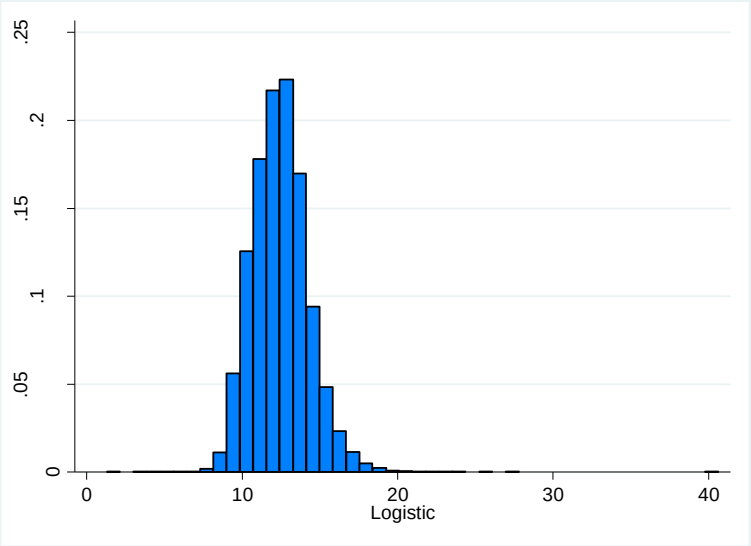
Population Characteristics

	One cancer ICD		Two cancer ICDs in Year	
	Training Set	Validation Set	Training Set	Validation Set
Sample Size	150,000	133,239	44,797	22,399
Proportion Male	50.5%	50.3%	48.5%	48.0%
Average Age	57.7	57.7	59.1	59.0
Average Year of Diagnosis	2007.8	2007.8	2009.5	2009.5
Average total costs	$36,094	$35,807	$47,115	$46,972
Average annual costs	$12,395	$12,238	$17,852	$17,945
Died	35.0%	35.0%	54.8%	54.9%

Model Selection







	Weibull	Log-logistic	Logistic
BIC	84568	84483	84857
AUC	0.8602	0.8682	0.8677
RMSE	1.8583	1.5491	1.4316

Regression Results

Parameter	*1 ICD* Value	SE	*2 ICDs* Value	SE
Intercept	13.3847	0.1330	13.0053	0.0998
Sex	-0.1469	0.0248	-0.1105	0.0239
Age	-0.0440	0.0009	-0.0339	0.0009
Total ICD	-0.0848	0.0012	-0.0654	0.0011
Distinct ICD	0.0312	0.0023	0.0284	0.0022
Low Survival	1.0122	0.0302	1.0095	0.0295
Avg. Cost	0.1198	0.0118	0.0299	0.0180
MDQ	-0.0004	0.0071	0.0150	0.0070
SDQ	0.0040	0.0074	-0.0092	0.0073

Draft ICER Results

1 Cancer ICD

Model	LE	Avg Cost	Elasticity	ICER /LYG	Utility	+ 3%	ICER /QALY
Logistic	12.1	$12,395	0.00119	$8,611	0.654	0.674	$12,775

2 Cancer ICDs in a Year

Model	LE	Avg Cost	Elasticity	ICER /LYG	Utility	+ 3%	ICER /QALY
Logistic	12.5	$ 17,852	0.000297	$48,231	0.654	0.674	$71,552

Conclusions

- Routinely collected administrative data allows us to estimate marginal productivity by ICD chapter
- Including ICDs seems to control sufficiently to avoid endogeneity
- Marginal productivity differs by population