Financial Risk Modeling and Banking Regulation

Credit Risk – Regulator's Point of View

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Agenda

- Introduction and Observations
- Open Issues:
  - Developing tests for model accuracy when:
    - the assumption of independent events is violated
    - there are too many observations

Introduction

- Current practices in credit-risk modeling
  - PD estimation
  - PD validation
- Wholesale Products
  - Large/middle-market corporate credits
    - limited data
    - few events
    - heterogeneous pool

Introduction

- Retail Products
  - Mortgages, credit cards, auto loans
    - unlimited data
    - many events
    - homogeneous pool
  - Develop models and validation procedures that:
    - rely on large samples
    - independent default probabilities

Issue I: Independent Events

- Does independence hold?
  - Systemic risk factors
    - Defaults are correlated
  - As a result, must adjusted for dependence

Issue I: Independent Events

- Objective: Validate that the models:
  - discriminate (rank-order)
  - accurately predict (calibrate)
- Many tools available to assess a model's ability to discriminate, e.g,.,
  - KS
  - Accuracy Ratio
  - ROC

Issue I: Independent Events

- Tests of model accuracy
  - Binomial test
  - Hosmer-Lemeshow test
- Accuracy tests tend to reject models that
  - discriminate well
  - consistent with the expectations of the LOB

Issue I: Independent Events

- Do the accuracy tests tend to reject good models "too" often
- Tests require the assumption of independence
  - Conditional (PIT)
  - Unconditional (TTC)
    - Vasicek Test: incorporates the asset correlation (ρ) into the calculation of the CI.

$$v_{.95} = \Phi[\ (\Phi^{-1}(PD_i) + \rho^{1/2}\,(\Phi^{-1}(.95)) / (1- \rho)^{1/2}\ ]$$

- Examples

Example 1: Development

				PD		Confidence Intervals			Outside			
Deciles	# Accts	Defaults	Non-defaults	Actual	Predicted	stdv	lower	upper	Interval	H-L test	Vasicek	KS
1	403878	45	403833	0.0001105	0.0000616	0.0000123	0.0000369	0.0000863	y	15.70	0.00062	9.84
2	396209	57	396152	0.0001445	0.0001183	0.0000173	0.0000838	0.0001529	n	2.29	0.00108	19.40
3	400475	55	400419	0.0001381	0.0001792	0.0000211	0.0001369	0.0002215	n	3.78	0.00154	29.08
4	399338	83	399254	0.0002089	0.0002640	0.0000257	0.0002126	0.0003155	y	4.60	0.00214	38.54
5	398475	146	398330	0.0003652	0.0003866	0.0000311	0.0003243	0.0004489	n	0.47	0.00294	47.57
6	401552	202	401350	0.0005025	0.0005581	0.0000373	0.0004836	0.0006326	n	2.22	0.00400	56.30
7	399037	316	398721	0.0007925	0.0008541	0.0000462	0.0007616	0.0009466	n	1.77	0.00567	64.21
8	401105	516	400589	0.0012867	0.0014009	0.0000591	0.0012827	0.0015190	n	3.74	0.00848	70.83
9	400802	1046	399756	0.0026092	0.0027177	0.0000822	0.0025532	0.0028821	n	1.74	0.01435	73.91
10	399129	12578	386551	0.0315146	0.0311303	0.0002749	0.0305805	0.0316801	n	1.95	0.07705	0.00
	4000000	15044	3984956	0.0037611	0.0037655					38.26		
										0.0000		

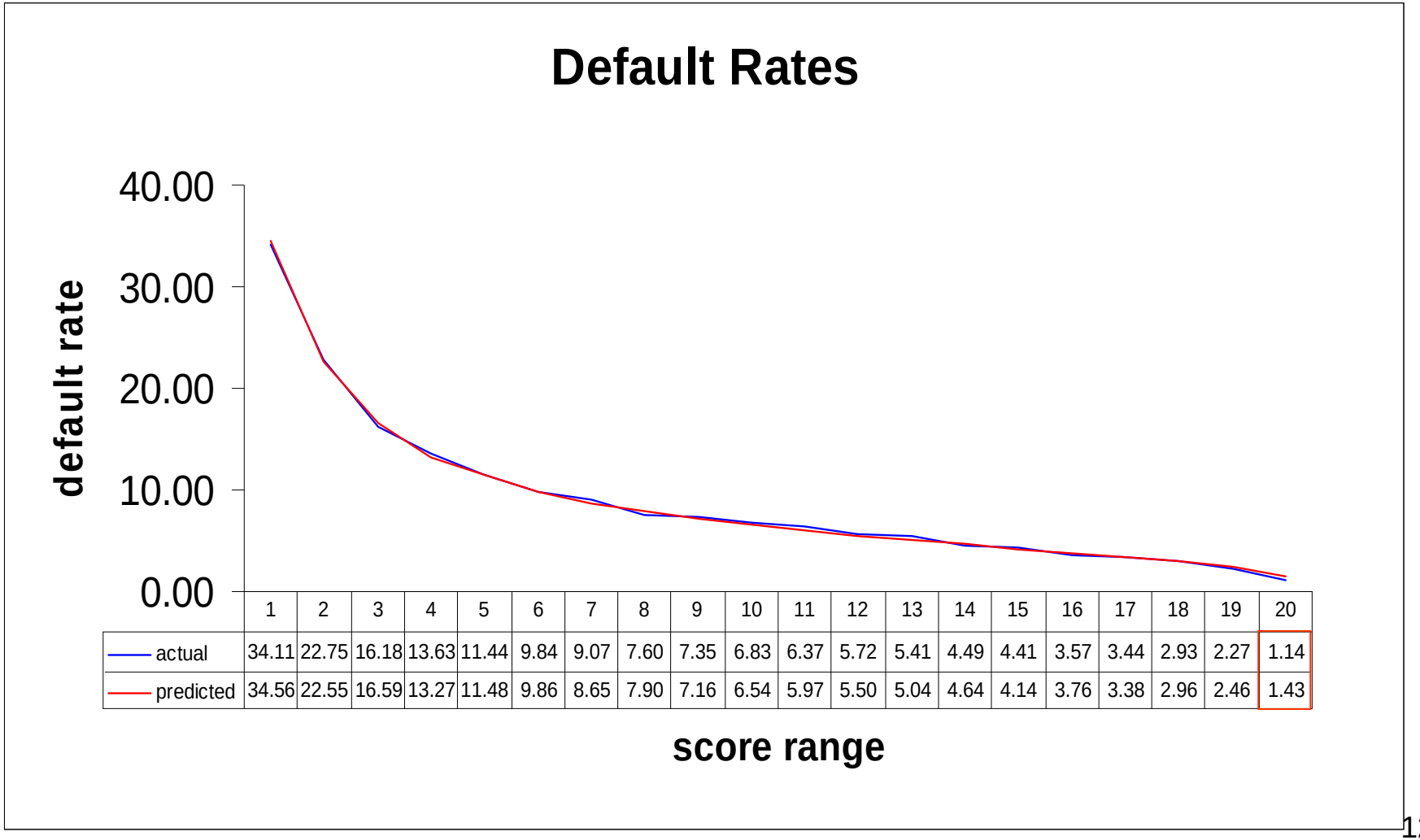
Example 1: Validation (out-of-time)

				PD		Confidence Intervals			Outside			
Deciles	# Accts	Defaults	Non-defaults	Actual	Predicted	stdv	lower	upper	Interval	H-L test	Vasicek	KS
1	149528	16	149513	0.0001057	0.0000503	0.0000183	0.0000136	0.0000870	y	9.13	0.00052	9.75
2	151553	35	151518	0.0002282	0.0000936	0.0000249	0.0000439	0.0001433	y	29.32	0.00089	19.33
3	149010	32	148978	0.0002122	0.0001367	0.0000303	0.0000761	0.0001973	y	6.21	0.00123	28.79
4	149977	41	149935	0.0002767	0.0002018	0.0000367	0.0001284	0.0002752	y	4.17	0.00170	38.16
5	150027	54	149973	0.0003622	0.0002998	0.0000447	0.0002104	0.0003892	n	1.95	0.00238	47.31
6	152718	86	152632	0.0005628	0.0004261	0.0000528	0.0003205	0.0005317	y	6.70	0.00319	56.14
7	146849	144	146705	0.0009822	0.0006339	0.0000657	0.0005025	0.0007652	y	28.13	0.00444	63.61
8	150190	246	149944	0.0016379	0.0010571	0.0000839	0.0008894	0.0012248	y	47.98	0.00675	69.66
9	150264	433	149832	0.0028797	0.0022162	0.0001213	0.0019736	0.0024588	y	29.92	0.01223	72.66
10	149883	5072	144811	0.0338404	0.0325656	0.0004585	0.0316487	0.0334825	y	7.73	0.07914	0.00
	1500000	6159	1493841	0.0041059	0.0037655					171.23		
										0.0000		

Issue II: Too Many Observations

- Measurement can be so precise that even a small, non-relevant difference in point estimates can be considered statistically significant.

Issue II: Illustrative Example

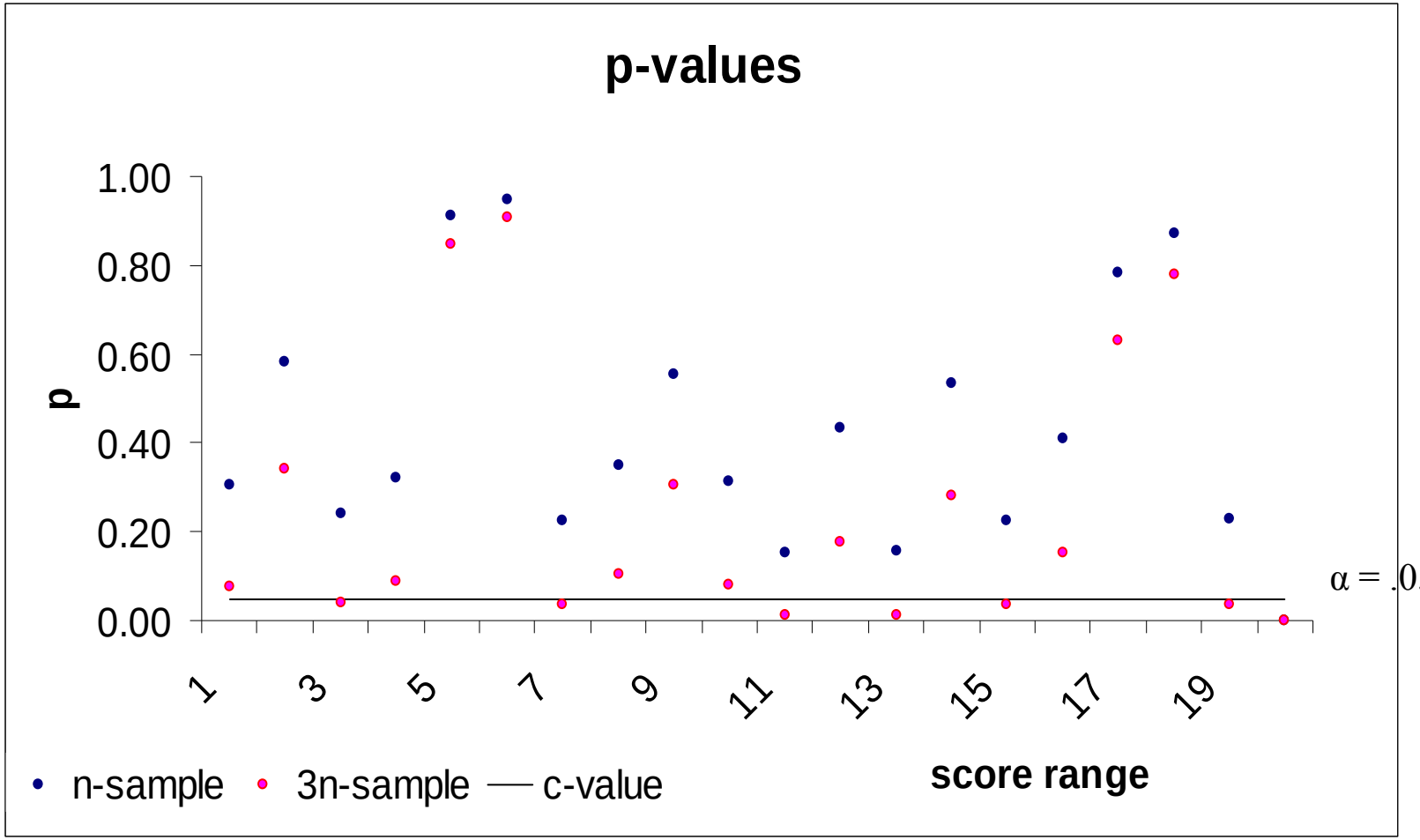


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
actual	34.11	22.75	16.18	13.63	11.44	9.84	9.07	7.60	7.35	6.83	6.37	5.72	5.41	4.49	4.41	3.57	3.44	2.93	2.27	1.14
predicted	34.56	22.55	16.59	13.27	11.48	9.86	8.65	7.90	7.16	6.54	5.97	5.50	5.04	4.64	4.14	3.76	3.38	2.96	2.46	1.43

Issue II: Illustrative Example

Seg	Default	Non-Default	Total	Default Rate Actual	Default Rate Predicted	p-values (cv - 5%)	HL
1	4027	7780	11807	34.11	34.56	0.3039	1.0572
2	2992	10158	13150	22.75	22.55	0.5832	0.3011
3	1847	9568	11415	16.18	16.59	0.2390	1.3867
4	1184	7505	8689	13.63	13.27	0.3226	0.9787
5	878	6795	7673	11.44	11.48	0.9125	0.0121
6	1007	9223	10230	9.84	9.86	0.9459	0.0046
7	598	5996	6594	9.07	8.65	0.2250	1.4722
8	536	6512	7048	7.60	7.90	0.3506	0.8713
9	474	5973	6447	7.35	7.16	0.5541	0.3500
10	507	6913	7420	6.83	6.54	0.3124	1.0205
11	459	6752	7211	6.37	5.97	0.1516	2.0568
12	373	6150	6523	5.72	5.50	0.4357	0.6076
13	380	6647	7027	5.41	5.04	0.1562	2.0109
14	339	7214	7553	4.49	4.64	0.5354	0.3842
15	355	7698	8053	4.41	4.14	0.2238	1.4799
16	244	6584	6828	3.57	3.76	0.4094	0.6806
17	239	6712	6951	3.44	3.38	0.7819	0.0767
18	246	8145	8391	2.93	2.96	0.8712	0.0263
19	217	9360	9577	2.27	2.46	0.2296	1.4432
20	208	17978	18186	1.14	1.43	0.0010	10.8227
						HL stat	27.0433
						p-value	0.0782

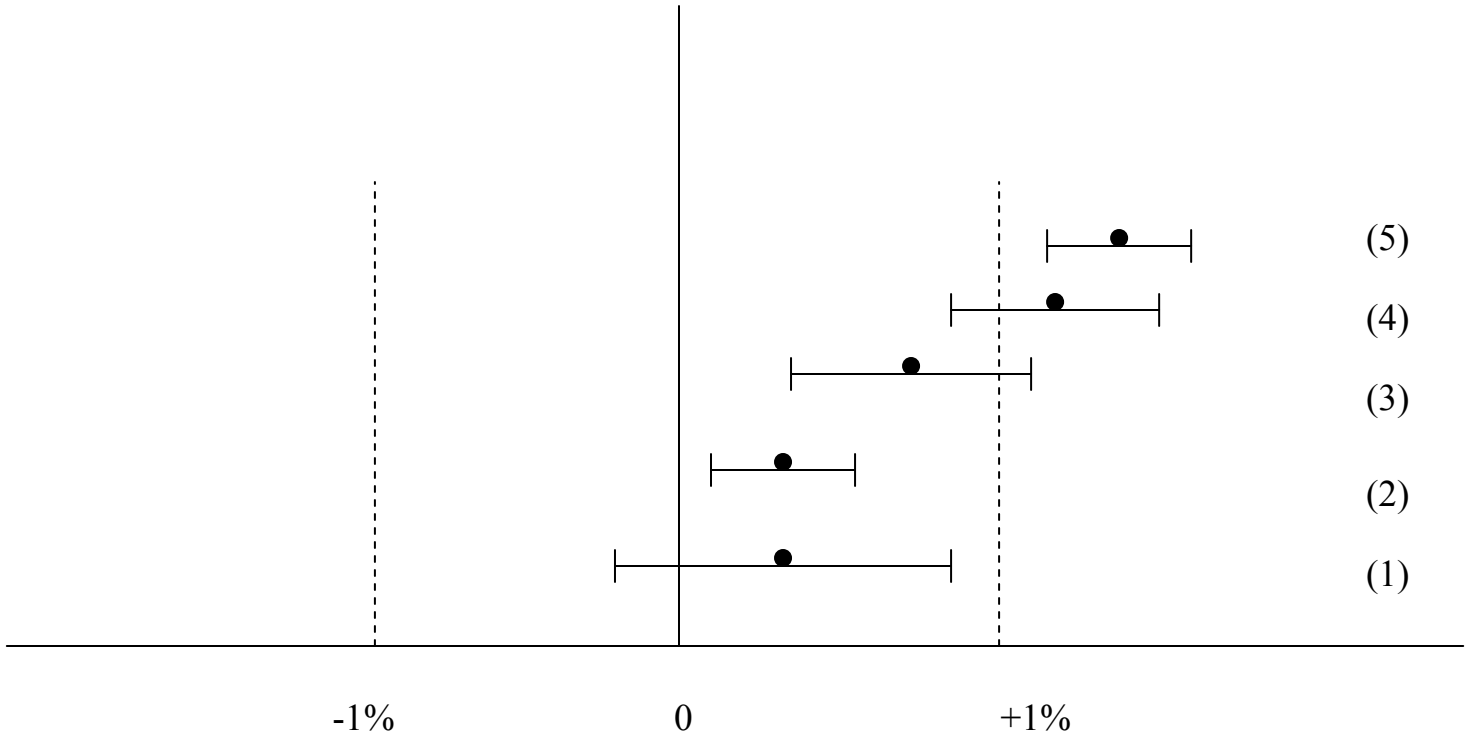
Issue II: Illustrative Example



Interval Test

- Conclusion:
  - Statistical difference: significant
  - Economic difference: insignificant
- Solutions?
  - Reduce the number observations using a sample: less powerful test
  - Redefine the test
    - Interval test
    - Focus on capital

Interval Test



Interval Test

- Restate the null as an interval defined over an economically acceptable range
  - If the $CI_{1-\alpha}$ around the point estimate is within the in interval, conclude no economically significant difference
  - May want to reformulate the interval test in terms of an acceptable economic bias in the calculation of regulatory capital