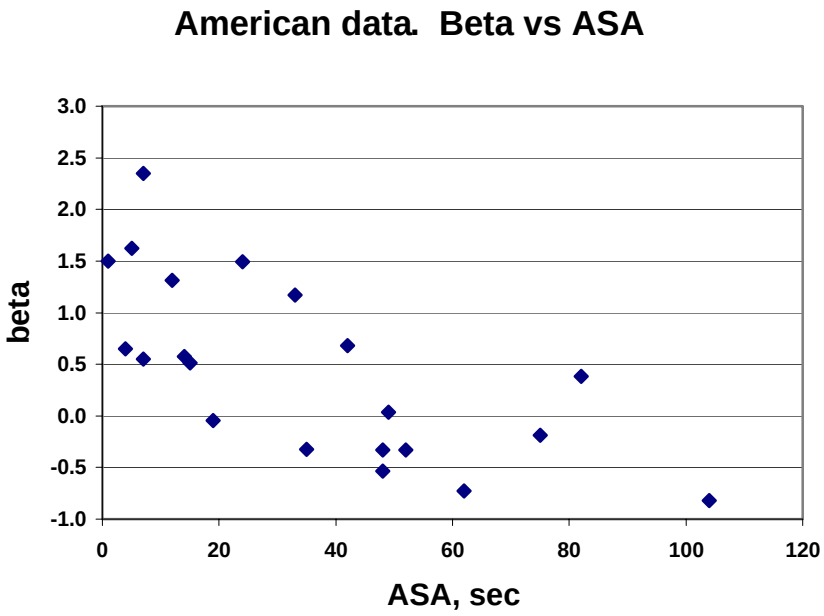
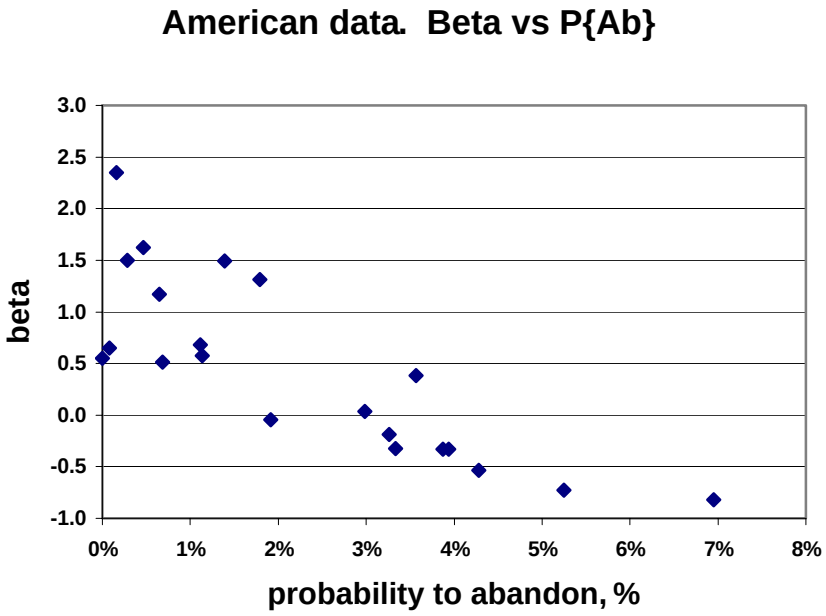
Empirical Service Grade (Beta)





Abandonment Important Practically

One of 2 Customer-Centric performance measures (2^{nd} = Redials)

- Lost business (now)
- Poor service level (future losses)
- 1-800 costs decrease (out-of-pocket vs. alternative)
- Self-selection: the “fittest” survive and wait less
- Must account for (carefully) in models and measures
  - Otherwise wrong picture of reality
  - Misleading performance measures, hence staffing
  - Unstable models (vs. Robustness)

But Abandonment also Interesting Theoretically

- Queueing Science
  (Paradigm: experiment, measure, model, validate)
- Research: OR + Psychology + Marketing
  (Modelling: steady-state, transient, equilibrium)
- Wide Scope of Applications: in addition to Phone,
  - VRU/IVR: opt-out-rates
  - Internet: business-drivers (60% and more)

QED Relevance: One of 12 Call Centers

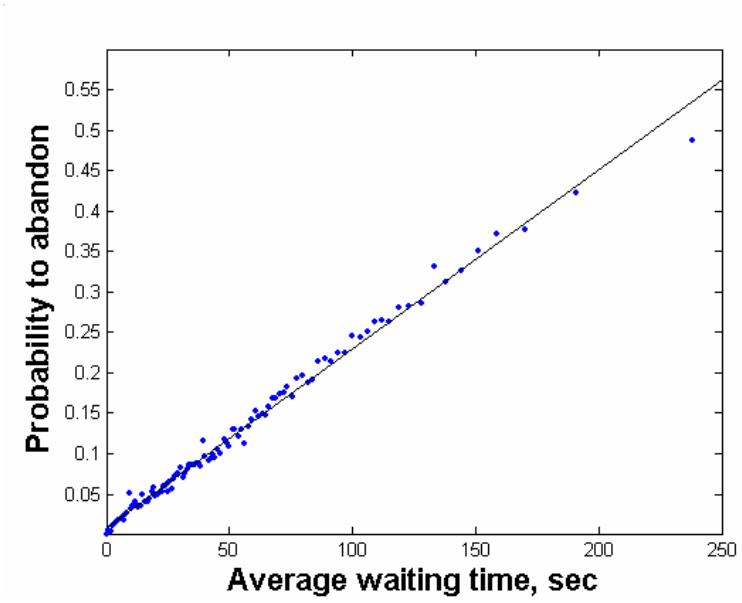
6/13/00 - Tue

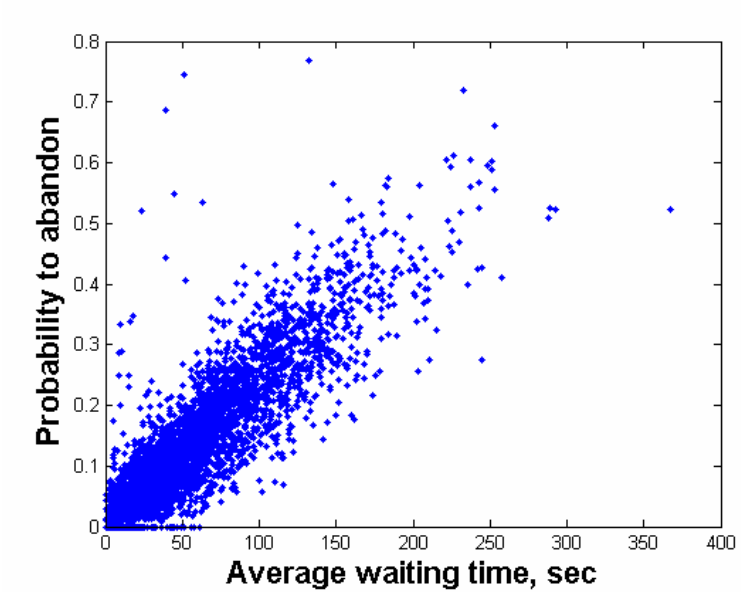
Time	Recvd	Answ	Abn %	ASA	AHT	Occ %	On Prod%	On Prod FTE	Sch Open FTE	Sch Avail %
Total	**20,577**	**19,860**	**~3.0%**	**30**	**307**	**95.1%**	**85.4%**	**222.7**	**234.6**	**95.0%**
8:00	332	308	7.2%	27	302	87.1%	79.5%	59.3	66.9	88.5%
8:30	653	615	5.8%	58	293	96.1%	81.1%	104.1	111.7	93.2%
9:00	866	796	8.1%	63	308	97.1%	84.7%	140.4	145.3	96.6%
9:30	1,152	1,138	1.2%	2l	303	90.8%	81.6%	211.1	221.3	95.4%
10:00	1,330	1.286	3.3%	22	307	98.4%	84.3%	223.1	229.0	97.4%
10:30	**1,364**	**1,338**	**1.9%**	**33**	**296**	**99.0%**	84.1%	**222.5**	227.9	97.6%
11:00	1,380	1,280	7.2%	34	306	98.2%	84.0%	222.0	223.9	99.2%
11:30	1,272	1,247	2.0%	44	298	94.6%	82.8%	218.0	233.2	93.5%
12:00	1,179	1,177	0.2%	1	306	91.6%	88.6%	218.3	222.5	98.1%
12:30	**1,174**	**1,160**	**1.2%**	**10**	**302**	**95.5%**	93.6%	**203.8**	209.8	97.1%
13:00	**1,018**	**999**	**1.9%**	**9**	**314**	**95.4%**	91.2%	**182.9**	187.0	97.8%
13:30	1,061	961	9.4%	67	306	100.0%	88.9%	163.4	182.5	89.5%
14:00	1,173	1,082	7.8%	78	313	99.5%	85.7%	188.9	213.0	88.7%
14:30	**1,212**	**1,179**	**2.7%**	**23**	**304**	**96.6%**	86.0%	**206.1**	220.9	93.3%
15:00	1,137	1,122	1.3%	15	320	96.9%	83.5%	205.8	222.1	92.7%
15:30	1,169	1,137	2.7%	17	311	97.1%	84.6%	202.2	207.0	97.7%
16:00	1,107	1,059	4.3%	46	315	99.2%	79.4%	187.1	192.9	97.0%
16:30	914	892	2.4%	22	307	95.2%	81.8%	160.0	172.3	92.8%
17:00	615	615	0.0%	2	328	83.0%	93.6%	135.0	146.2	92.3%
17:30	420	420	0.0%	0	328	73.8%	95.4%	103.5	116.1	89.2%
18:00	49	49	0.0%	14	180	84.2%	89.1%	5.8	1.4	416.2%

Empirically-Based Theory

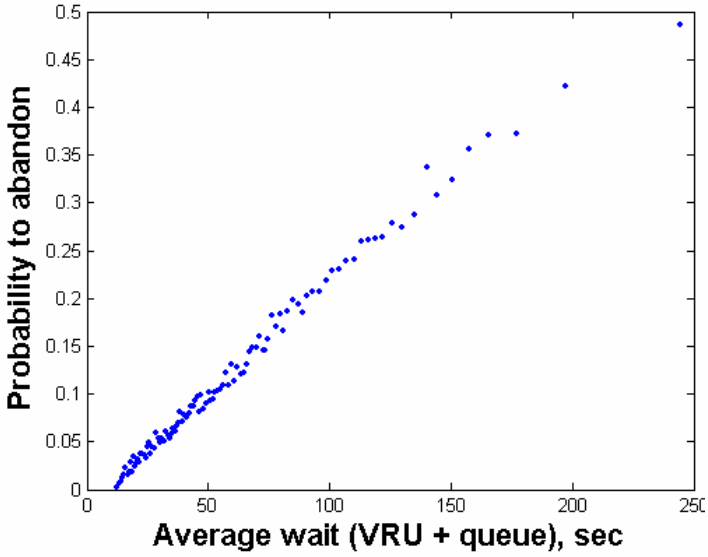
Linear pattern observed: P{Abandon} = $C \bullet$ E[Wait]

Theory: Average Patience = 1/C in Erlang-A, else?

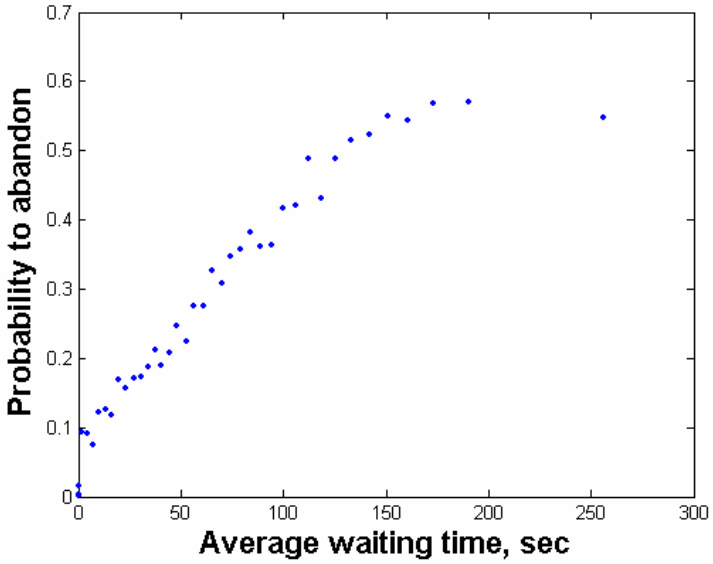




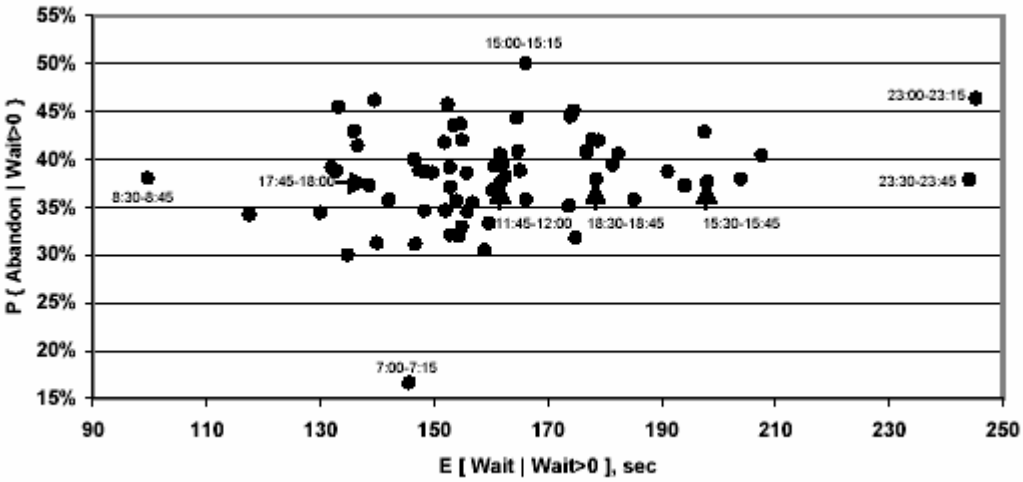
Human behavior



Delayed Abandons (IVR)



Balking (New Customers)



Learning (Internet Customers)

Understanding (Im)Patience

- **Observing** (Im)Patience: Heterogeneity.

  Under a single roof, the fraction

  abandoning varies from 6% to 40%,

  depending on the type of service/customer .

- **Describing** (Im)Patience Dynamically:

  Irritation proportional to Hazard Rate (Palm);

- **Managing** (Im)Patience:

  VIP vs. Regulars: who is more "Patient"?

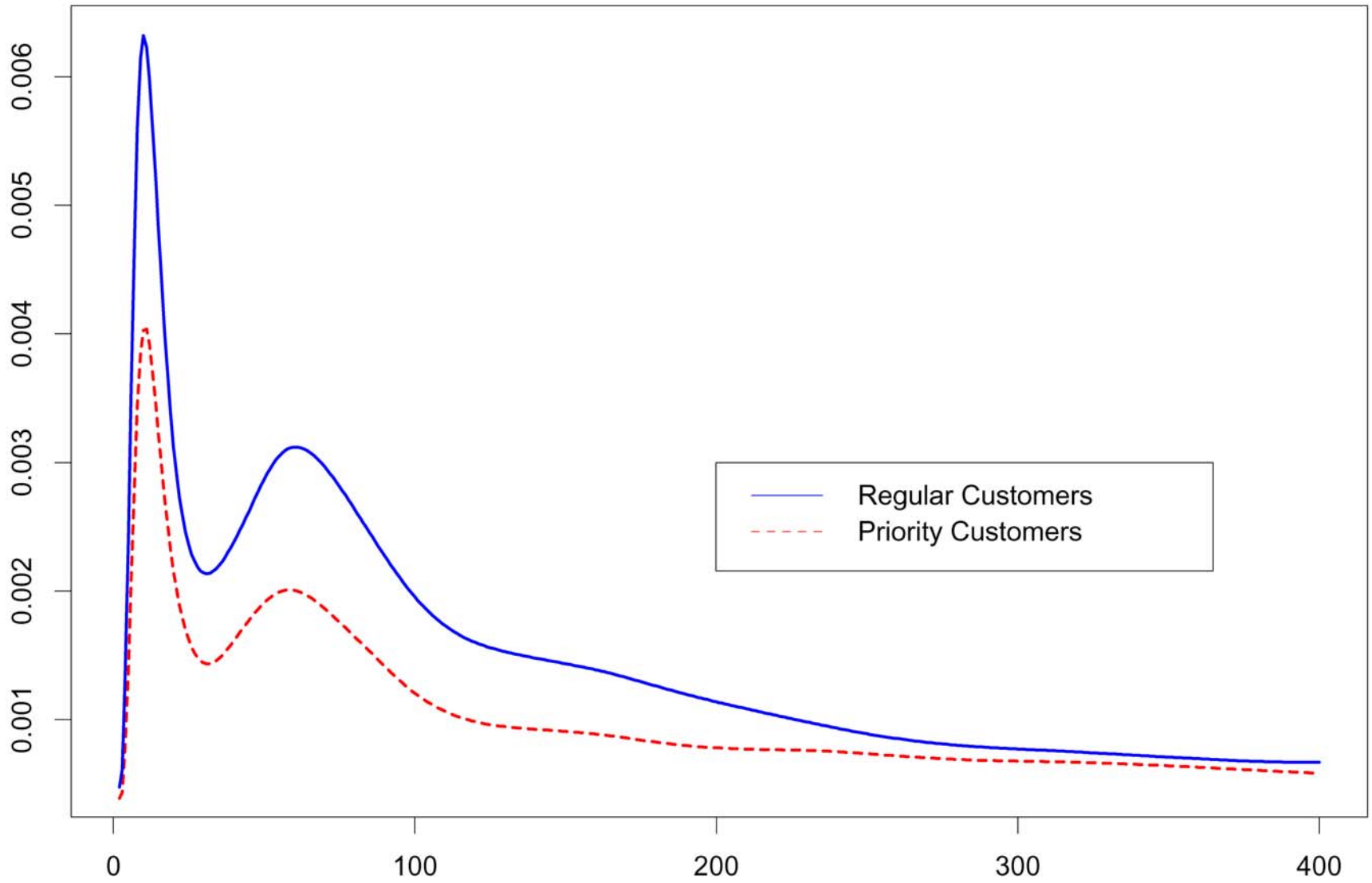
  What are we actually measuring?

  (Im)Patience-Index = "How long **expect** to wait"

  relative to

  "How long **willing** to wait"

- Estimating (Im)Patience: Censored Sampling.
- Modelling (Im)Patience: Equilibrium Models


Hazard Rate: Empirical (Im)Patience
0.001
0.002
0.003
0.004
0.005
0.006
0
100
200
300
400
Regular Customers
Priority Customers

Common Performance

BCMS SKILL REPORT
Switch Name: FDC/HAMPDEN
Skill: 37
Skill Name: !BA AUTH1

Date: 7:00 pm WED MAR 10, 1999

Acceptable Service Level: 30

DAY	ACD CALLS	AVG SPEED ANS	ABAND CALLS	AVG ABAND TIME	AVG TALK TIME	TOTAL AFTER CALL	FLOW IN	FLOW OUT	TOTAL AUX/ OTHER	AVG STAFF	% IN SERV LEVL
3/04/99	637	0:19	219	0:26	1:57	92:05	0	0	4310:06	8.7	66
3/05/99	849	0:06	135	0:06	1:35	179:58	0	0	4299:43	11.3	85
3/06/99	1330	0:11	363	0:13	1:42	280:22	0	0	5592:29	13.2	73
3/07/99	1213	0:12	358	0:18	1:46	226:20	0	0	4830:15	11.5	72
3/08/99	631	0:26	382	0:33	1:57	150:50	0	0	3743:04	7.9	49
3/09/99	570	0:40	487	0:43	1:52	148:41	0	0	3979:04	6.7	38
3/10/99	512	0:29	292	0:28	1:41	243:06	0	0	3046:00	7.9	50
SUMMARY	5742	0:18	2236	0:26	1:46	1321:22	0	0	****:**	9.6	63

Arrivals Abandons 40 %

Switch Name: FDC/HAMPDEN
Skill: 46
Skill Name: !BA AUTHORIZATION

Date: 7:00 pm WED MAR 10, 1999

Acceptable Service Level: 30

DAY	ACD CALLS	AVG SPEED ANS	ABAND CALLS	AVG ABAND TIME	AVG TALK TIME	TOTAL AFTER CALL	FLOW IN	FLOW OUT	TOTAL AUX/ OTHER	AVG STAFF	% IN SERV LEVL
3/04/99	1185	0:22	479	0:31	2:08	190:16	0	0	4213:22	8.4	61
3/05/99	1805	0:05	.308	0:04	1:38	337:20	0	0	4299:43	11.3	84
3/06/99	2437	0:12	642	0:12	1:51	444:03	0	0	5592:29	13.2	73
3/07/99	2260	0:13	558	0:14	1:46	326:33	0	0	4830:14	11.5	74
3/08/99	1260	0:35	676	0:28	2:06	308:19	0	0	3743:04	7.9	48
3/09/99	1126	0:40	653	0:34	2:10	250:40	0	0	3979:04	6.7	44
3/10/99	890	0:30	472	0:32	2:16	162:13	0	0	3046:00	7.9	51
SUMMARY	10963	0:19	3788	0:22	1:55	2019:24	0	0	****:**	9.6	65

30 %

BCMS SKILL REPORT
Switch Name: FDC/HAMPDEN
Skill: 33
Skill Name: GA Authorization

Date: 7:01 pm WED MAR 10, 1999

Acceptable Service Level: 30

DAY	ACD CALLS	AVG SPEED ANS	ABAND CALLS	AVG ABAND TIME	AVG TALK TIME	TOTAL AFTER CALL	FLOW IN	FLOW OUT	TOTAL AUX/ OTHER	AVG STAFF	% IN SERV LEVL
3/04/99	1248	0:27	61	0:42	1:57	330:04	0	0	4390:04	9.5	72
3/05/99	1521	0:14	37	0:20	1:58	353:48	0	0	6035:35	13.0	85
3/06/99	2388	0:20	130	0:34	2:10	550:16	0	0	6369:58	14.4	76
3/07/99	1748	0:14	66	0:30	2:08	432:16	0	0	4616:11	11.7	82
3/08/99	925	0:18	50	1:00	1:53	191:06	0	0	3835:19	8.4	81
3/09/99	856	0:26	57	0:53	1:54	125:16	0	0	4388:02	8.1	73
3/10/99	959	1:15	125	1:55	1:48	186:44	0	0	4198:39	8.9	53
SUMMARY	9645	0:25	526	0:57	2:02	2169:30	0	0	****:**	10.6	76

6%

BCMS SKILL REPORT
Switch Name: FDC/HAMPDEN

Date: 7:02 pm WED MAR 10, 1999

PATIENCE INDEX

- How to Define? Measure? Manage?

Statistics	Time Till	Interpretation
360K served (80%)	2 min.	**?** must = **expect**
90K abandon (20%)	1 min.	**?** **willing** to wait

"Time willing to wait" of served is **censored** by their "wait".

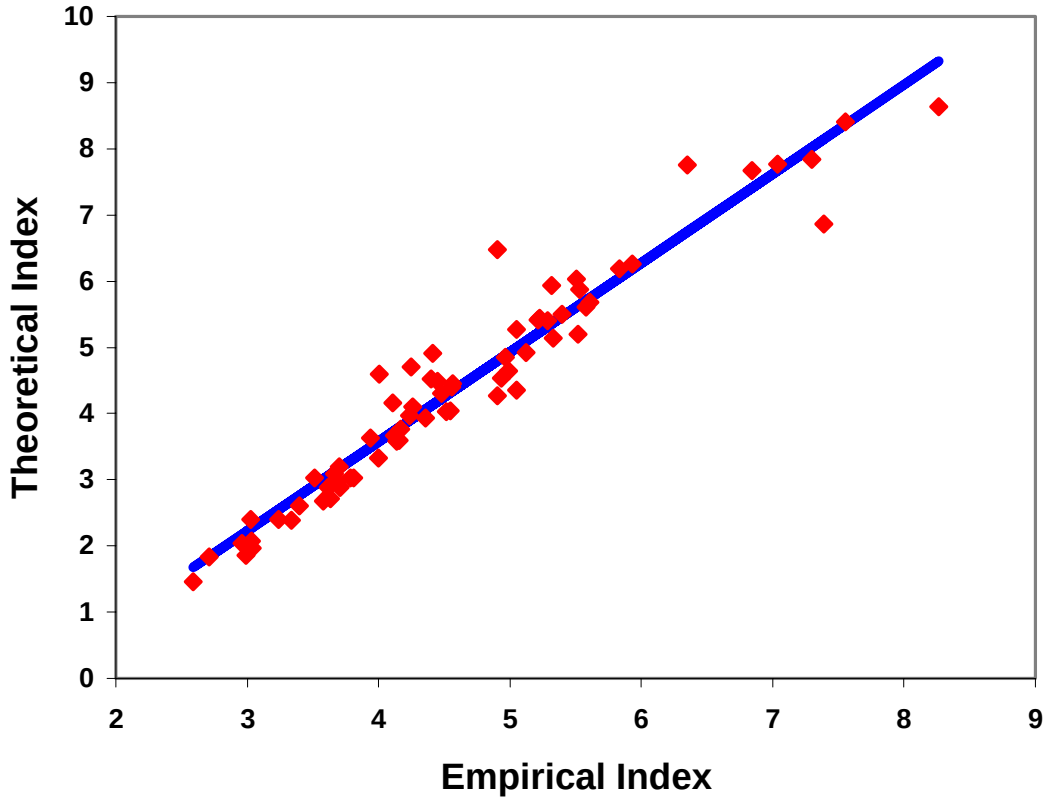
"Uncensoring" (simplified)

Willing to wait $1 + 2 \times \frac{360K}{90K} = 1 + 2 \times 4 =$ **9** min.

Expect to wait $2 + 1 \times \frac{90K}{360K} = 2 + 1 \times \frac{1}{4} =$ **2.25** min.

Patience Index $= \frac{\text{time willing}}{\text{time expect}} = 4 = \frac{\#\,\text{served/wait} > 0}{\#\,\text{abandon/wait} > 0}$

↑ definition ↑ measure

- Supported by ongoing research (Wharton).

Patience Index: Excellent Fit