Standard Setting Study for the Level 1 (LPIC-1) Certification Exams

From November 2002 to February 2003, concurrently while the beta exam data was being collected, the standard setting study was begun for Level 1 exams (Exams 101 and 102-passing both are required for LPIC-1 certification). A number of subject matter experts (SMEs), in this case experienced Linux system administrators, were contacted and encouraged to participate in the study. Eleven different SME's expressed interest in participating in the study, and in the end, seven Linux systems administrators completed the standard setting study and rated all the items.

A modified Angoff method was used to devise the performance standards for the exams. Because it was not feasible to complete a face-to-face meeting, the standard setting study was completed mostly through electronic communications, with additional phone consultations when needed. Given that the SMEs area of expertise is within the IT field, they felt particularly comfortable completing the study through electronic communication.

Initially, the SMEs were provided with written information and instructions about the standard setting study. Attempts were made to complete a conference call with all SMEs to discuss the concept of the minimally qualified candidate (MQC), but because of time conflicts, participants were unable to have that discussion together. In lieu of a conference call, after staff discussed the definition of the MQC with the SMEs and others, a written description of the minimally qualified candidate was distributed as well statistical information about the exam (and item) difficulty. Participants who had questions about the MQC concept or the Angoff process had individual discussions with LPI staff to clarify any issues.

To practice using the rating method, the SME's were emailed instructions and the item text (without the correct answer) for a set of ten sample items. They completed their ratings and the ratings were analyzed to evaluate whether the SMEs were "on the same page" and in close enough agreement in reference to their definition of the MQC as implied by their ratings. In this review, one person was identified as having rather "strict" ratings that were generally higher than the other SMEs. He was provided information about his ratings and after discussion with LPI staff, came to a better understanding of the purpose and process. At a later time, this particular SME was not able to complete all the item ratings due to personal reasons and later left the study.

Beginning in November 2002 , the Level 1 items (410 items total) were emailed to the SMEs and they were to complete their ratings on their own as their time permitted. So as to not overwhelm the SMEs with too many items at one time and to allow them ample time to thoughtfully complete the ratings, the items were provided in two packets, approximately five weeks apart.

The SMEs were asked to make their best estimate about the chances of the MQC getting each item correct as a probability, and also were encouraged to write in comments about the item for future item revisions. Average Angoff ratings were calculated for each item.
To determine the minimum passing scores (cutscore), the mean of the average item Angoff ratings was obtained for only the set of items on each of the exams. Thus, only the average ratings from the items on a particular exam were utilized to develop the cutscore for that exam. Three equivalent forms (A, B and Paper) were created for the 101 level exam and for the 102 level exam. Additionally, each 101 level form had a Debian and an RMP module from which an examinee can chose. In total, nine forms were created. For the 101 level exam, the forms are listed below and each form has 65 items:

101A_deb
101A_rpm
101B_deb
101B_rpm
101P_deb (paper form)
101P_rpm (paper form)

For the 102 level exam, these three forms were created each with 73 items: 102A, 102B and 102P (paper form).

Since all item analyses and equating projects are completed using IRT (Rasch) methods, the average items ratings were then translated into their equivalent logit measures. Measurement error was then accounted for in favor of the candidate, so that one standard error (about .3 logits for each of the forms) of the logit measure was subtracted from the original cutscore logit measure. This final logit cutscore was then translated to a raw score to arrive at the final raw cutscore, which is utilized in the scoring algorithm at the test sites. Table 1 below lists each exam form, its average Angoff rating, its equivalent logit measure and the minimum logit measures and raw scores to pass the each exam.

Table 1 - Final Cutscore for Each Exam Form

Exam	Average Angoff rating	Logit Measure	Cutscore Logit Measure (Logit Measure - 1SE)	Minimum Raw Score to Pass
101a_rpm	.74	1.14	.83	44
101a_deb	.74	1.14	.83	44
101b_rpm	.74	1.08	.78	44
101b_deb	.74	1.09	.79	44
101p_rpm	.75	1.12	.82	44
101p_deb	.75	1.12	.82	44
102a	.74	1.24	.95	49
102b	.73	1.21	.91	49
102p	.76	1.38	1.08	51

Since scaled scores are the desired reporting format, the equivalent logit measures for each possible raw score was converted to scaled scores for each of the nine forms. Since the Debian and RPM modules were created to be of approximately the same difficulty (and statistically were the same), the scaled score conversions for the 101 Debian and RPM modules were the same, so only six unique tables were created (three for Form 101, three for Form 102). The logit measures were converted to scaled scores using the scaling formula y=ax+b. The minimum passing scaled score was predetermined to be 500 with a standard deviation of 100 for all exams. The conversion tables for the six exams follow.

101A Conversion Table			
RAW SCORE	LOGIT	exact scaled score	*adjusted scale scores*
0	-5.9	-208	200
1	-4.68	-80	200
2	-3.96	-4	200
3	-3.52	42	200
4	-3.21	75	200
5	-2.95	102	200
6	-2.74	124	200
7	-2.56	143	200
8	-2.39	161	200
9	-2.25	176	200
10	-2.11	191	200
11	-1.98	204	200
12	-1.87	216	220
13	-1.76	227	230
14	-1.65	239	240
15	-1.55	249	250
16	-1.45	260	260
17	-1.36	269	270
18	-1.27	279	280
19	-1.18	288	290
20	-1.1	297	300
21	-1.01	306	310
22	-0.93	315	310
23	-0.85	323	320
24	-0.77	332	330
25	-0.69	340	340
26	-0.62	347	350
27	-0.54	356	360
28	-0.47	363	360
29	-0.39	372	370
30	-0.32	379	380
31	-0.24	387	390
32	-0.17	395	390
33	-0.09	403	400
34	-0.02	411	410
35	0.06	419	420
36	0.14	427	430
37	0.21	435	430
38	0.29	443	440
39	0.37	452	450
40	0.45	460	460
41	0.53	468	470
42	0.61	477	480
43	0.69	485	490
44	**0.78**	**495**	**500**
45	0.86	503	500
46	0.95	513	510
47	1.04	522	520
48	1.14	533	530
49	1.24	543	540
50	1.34	554	550
51	1.44	564	560
52	1.55	576	580
53	1.67	588	590
54	1.79	601	600
55	1.92	615	610
56	2.06	629	630
57	2.22	646	650
58	2.39	664	660
59	2.58	684	680
60	2.79	706	710
61	3.05	734	730
62	3.37	767	770
63	3.81	814	810
64	4.54	891	890
65	5.77	1020	890

Minimum pass=.83 logits (SE=.29)

101B Conversion Table			
RAW SCORE	LOGIT	exact scaled score	*adjusted scale scores*
0	-5.81	-201	200
1	-4.58	-70	200
2	-3.87	5	200
3	-3.44	51	200
4	-3.12	85	200
5	-2.87	112	200
6	-2.67	133	200
7	-2.49	152	200
8	-2.33	169	200
9	-2.18	185	200
10	-2.05	199	200
11	-1.93	212	210
12	-1.81	224	220
13	-1.7	236	240
14	-1.6	247	250
15	-1.5	257	260
16	-1.41	267	270
17	-1.32	277	280
18	-1.23	286	290
19	-1.15	295	290
20	-1.06	304	300
21	-0.98	313	310
22	-0.9	321	320
23	-0.83	329	330
24	-0.75	337	340
25	-0.67	346	350
26	-0.6	353	350
27	-0.53	361	360
28	-0.45	369	370
29	-0.38	377	380
30	-0.31	384	380
31	-0.24	391	390
32	-0.16	400	400
33	-0.09	407	410
34	-0.02	415	410
35	0.05	422	420
36	0.13	431	430
37	0.2	438	440
38	0.27	446	450
39	0.35	454	450
40	0.42	462	460
41	0.5	470	470
42	0.58	479	480
43	0.66	487	490
44	**0.74**	**496**	**500**
45	0.82	504	500
46	0.91	514	510
47	0.99	522	520
48	1.08	532	530
49	1.18	543	540
50	1.27	552	550
51	1.38	564	560
52	1.48	574	570
53	1.59	586	590
54	1.71	599	600
55	1.84	613	610
56	1.98	628	630
57	2.13	644	640
58	2.29	661	660
59	2.48	681	680
60	2.69	703	700
61	2.95	731	730
62	3.27	765	760
63	3.7	811	810
64	4.43	888	890
65	5.65	1018	890

Minimum pass=.78 logits (SE=.29)

101 Paper Conversion Table			
RAW SCORE	LOGIT	exact scaled score	*adjusted scale scores*
0	-5.85	-120	200
1	-4.63	-7	200
2	-3.91	60	200
3	-3.47	101	200
4	-3.16	130	200
5	-2.91	153	200
6	-2.69	173	200
7	-2.51	190	200
8	-2.35	205	210
9	-2.2	219	220
10	-2.07	231	230
11	-1.94	243	240
12	-1.82	254	250
13	-1.71	265	260
14	-1.61	274	270
15	-1.51	283	280
16	-1.41	293	290
17	-1.32	301	300
18	-1.23	309	310
19	-1.14	318	320
20	-1.06	325	330
21	-0.98	333	330
22	-0.89	341	340
23	-0.81	348	350
24	-0.74	355	350
25	-0.66	362	360
26	-0.58	370	370
27	-0.51	376	380
28	-0.43	384	380
29	-0.36	390	390
30	-0.29	397	400
31	-0.21	404	400
32	-0.14	411	410
33	-0.07	417	420
34	0.01	425	420
35	0.08	431	430
36	0.16	439	440
37	0.23	445	450
38	0.31	453	450
39	0.38	459	460
40	0.46	467	470
41	0.54	474	470
42	0.61	480	480
43	0.69	488	490
44	**0.78**	**496**	**500**
45	0.86	504	500
46	0.95	512	510
47	1.03	520	520
48	1.12	528	530
49	1.22	537	540
50	1.32	547	550
51	1.42	556	560
52	1.52	565	570
53	1.64	576	580
54	1.75	587	590
55	1.88	599	600
56	2.02	612	610
57	2.17	626	630
58	2.33	640	640
59	2.51	657	660
60	2.73	678	680
61	2.98	701	700
62	3.3	731	730
63	3.73	771	770
64	4.45	838	840
65	5.68	952	890

Minimum pass=.82 logits (SE .29)

102A Conversion Table			
RAW SCORE	LOGIT MEASURE	exact scaled score	*adjusted scale scores*
0	-6.18	-310	200
1	-4.94	-169	200
2	-4.2	-85	200
3	-3.75	-34	200
4	-3.43	2	200
5	-3.16	33	200
6	-2.94	58	200
7	-2.75	80	200
8	-2.58	99	200
9	-2.43	116	200
10	-2.28	133	200
11	-2.15	148	200
12	-2.03	161	200
13	-1.92	174	200
14	-1.81	186	200
15	-1.7	199	200
16	-1.6	210	210
17	-1.51	220	220
18	-1.41	232	230
19	-1.32	242	240
20	-1.24	251	250
21	-1.15	261	260
22	-1.07	270	270
23	-0.99	280	280
24	-0.91	289	290
25	-0.83	298	300
26	-0.76	306	310
27	-0.68	315	310
28	-0.61	323	320
29	-0.53	332	330
30	-0.46	340	340
31	-0.39	348	350
32	-0.32	356	360
33	-0.25	364	360
34	-0.17	373	370
35	-0.1	381	380
36	-0.03	389	390
37	0.04	397	400
38	0.11	405	400
39	0.18	413	410
40	0.25	420	420
41	0.32	428	430
42	0.39	436	440
43	0.46	444	440
44	0.54	453	450
45	0.61	461	460
46	0.69	470	470
47	0.76	478	480
48	0.84	488	490
49	**0.92**	**497**	**500**
50	0.99	505	500
51	1.08	515	510
52	1.16	524	520
53	1.24	533	530
54	1.33	543	540
55	1.42	553	550
56	1.51	564	560
57	1.61	575	580
58	1.71	586	590
59	1.81	598	600
60	1.92	610	610
61	2.04	624	620
62	2.16	638	640
63	2.29	652	650
64	2.43	668	670
65	2.58	685	690
66	2.75	705	700
67	2.94	726	730
68	3.15	750	750
69	3.41	780	780
70	3.74	817	820
71	4.18	867	870
72	4.91	950	890
73	6.14	1090	890

Minimum pass=.95 logits (SE=.28)

102B Conversion Table			
RAW SCORE	LOGIT MEASURE	exact scaled score	*adjusted scale scores*
0	-6.01	-260	200
1	-4.79	-126	200
2	-4.07	-47	200
3	-3.63	1	200
4	-3.32	35	200
5	-3.07	63	200
6	-2.86	86	200
7	-2.68	105	200
8	-2.51	124	200
9	-2.37	140	200
10	-2.23	155	200
11	-2.11	168	200
12	-1.99	181	200
13	-1.88	193	200
14	-1.78	204	200
15	-1.68	215	220
16	-1.59	225	230
17	-1.5	235	240
18	-1.41	245	250
19	-1.32	255	250
20	-1.24	264	260
21	-1.16	273	270
22	-1.08	281	280
23	-1	290	290
24	-0.93	298	300
25	-0.85	307	310
26	-0.78	314	310
27	-0.71	322	320
28	-0.63	331	330
29	-0.56	338	340
30	-0.49	346	350
31	-0.42	354	350
32	-0.35	362	360
33	-0.28	369	370
34	-0.21	377	380
35	-0.14	385	380
36	-0.07	392	390
37	0	400	400
38	0.07	408	410
39	0.14	415	420
40	0.21	423	420
41	0.28	431	430
42	0.35	438	440
43	0.42	446	450
44	0.5	455	450
45	0.57	463	460
46	0.65	471	470
47	0.72	479	480
48	0.8	488	490
49	**0.88**	**497**	**500**
50	0.96	505	510
51	1.04	514	510
52	1.13	524	520
53	1.21	533	530
54	1.3	543	540
55	1.39	553	550
56	1.49	564	560
57	1.59	575	570
58	1.69	586	590
59	1.79	597	600
60	1.91	610	610
61	2.02	622	620
62	2.15	636	640
63	2.28	651	650
64	2.42	666	670
65	2.58	684	680
66	2.75	702	700
67	2.94	723	720
68	3.16	747	750
69	3.42	776	780
70	3.74	811	810
71	4.18	859	860
72	4.91	940	890
73	6.14	1075	890

Minimum pass=.91 logits (SE=.28)

102 Paper Conversion			
RAW SCORE	LOGIT MEASURE	exact scaled score	*adiusted scale scores*
0	-6.06	-244	200
1	-4.83	-116	200
2	-4.11	-41	200
3	-3.67	5	200
4	-3.36	37	200
5	-3.1	65	200
6	-2.89	86	200
7	-2.7	106	200
8	-2.54	123	200
9	-2.39	139	200
10	-2.25	153	200
11	-2.13	166	200
12	-2.01	178	200
13	-1.9	190	200
14	-1.79	201	200
15	-1.69	211	210
16	-1.59	222	220
17	-1.5	231	230
18	-1.41	241	240
19	-1.32	250	250
20	-1.24	258	260
21	-1.16	267	270
22	-1.08	275	270
23	-1	283	280
24	-0.92	292	290
25	-0.84	300	300
26	-0.77	307	310
27	-0.69	316	320
28	-0.62	323	320
29	-0.55	330	330
30	-0.48	337	340
31	-0.41	345	340
32	-0.34	352	350
33	-0.27	359	360
34	-0.2	367	370
35	-0.13	374	370
36	-0.06	381	380
37	0.01	389	390
38	0.08	396	400
39	0.15	403	400
40	0.22	410	410
41	0.29	418	420
42	0.36	425	430
43	0.43	432	430
44	0.5	440	440
45	0.58	448	450
46	0.65	455	460
47	0.73	464	460
48	0.8	471	470
49	0.88	479	480
50	0.96	488	490
51	1.04	496	500
52	1.12	504	500
53	1.2	513	510
54	1.29	522	520
55	1.38	531	530
56	1.47	541	540
57	1.57	551	550
58	1.67	561	560
59	1.77	572	570
60	1.88	583	580
61	2	596	600
62	2.13	609	610
63	2.26	623	620
64	2.4	638	640
65	2.56	654	650
66	2.74	673	670
67	2.94	694	690
68	3.17	718	720
69	3.44	746	750
70	3.79	782	780
71	4.27	832	830
72	5.05	914	890
73	6.33	1047	890

Minimum pass=1.08 logits (SE=.29)