Selecting Service Repair Technicians for the Appliance Store

Reliability Assessment

For several years now, the service department of a local appliance store has selected service repair technicians using the following procedure.

1. Applicants complete a standard application blank. Applicants who do not meet the minimum requirements are screened out at this stage. Those applicants who pass the application blank screening proceed through all of the remaining steps.
2. Applicants are given an initial screening interview by one of the HR department interviewers.
3. Applicants take a paper-and-pencil mechanical ability test.
4. Applicants are given an interview by a supervisor and a senior service repair technician.

The appliance store recently hired a new human resource manager to replace the previous one who had retired. The new HR manager was surprised to find that the store had never validated any of its selection procedures. Fortunately, no applicant had ever filed a claim of discrimination against the store, but the new HR manager was uncomfortable about the store's potential legal liability.

To satisfy his curiosity (and hopefully increase his feeling of comfort), the HR manager decided to make a few analyses of the currently used selection procedures, so he made a list of the information/data he would need to accomplish his objective. Needed information?

a. Application blank scores
b. Interview scores from the initial screening interview in HR
c. Scores on the mechanical ability test
d. Interview scores from the supervisor and senior service repair technician

The HR manager then began digging into the personnel files to find the data he needed. The following paragraphs describe what he found.

He was not able to find any score associated with the application blank. Thus he could not calculate any reliability coefficient on the initial screening procedures.

Since the initial screening interview was done by only one HR interviewer (and each applicant interview was conducted only once), it was not possible to assess interrater reliability (the logical choice for assessing interview judgments).

The mechanical ability test scores provided an unexpected gold mine. Not only were the scores carefully recorded, but there were also two sets of scores for the same applicants in the files from two years ago. Further investigation revealed an explanation for this coincidence. Apparently, a temporary secretary working at the time had misplaced the results from the first administration of the test. Since the store needed a service repair technician to replace one who had been terminated, it was necessary to readminister the same test to the same

applicants. Unfortunately, all of the applicants could not be assembled to retake the test until six weeks later. The temporary secretary was roundly criticized for her mistake and was replaced shortly thereafter. Her mistake at the time inadvertently made it possible to assess test-retest reliability in addition to internal consistency reliability.

While it was not possible to assess the reliability of the initial screening interview, the second interview provided the opportunity to assess interrater reliability, since two independent raters (the supervisor and the senior service repair technician) assessed each of the applicants.

After assembling the data, the HR manager then put them all into the following table to use for his calculations:

Applicant	Initial HR Interview Rating	Interview Rating Supervisor	Interview Rating Technician	Mechanical Ability Test	
				Time1	Time2
a	7	5	6	72	79
b	6	8	5	66	63
c	4	7	6	84	88
d	5	4	3	42	39
e	8	6	5	71	67
f	9	7	6	90	94
g	7	9	8	92	91
h	8	7	8	85	89
I	6	6	6	70	73
j	8	5	6	69	71
k	7	4	6	50	55
l	4	6	3	64	67
m	9	7	8	79	84
n	3	3	5	42	44
o	7	5	4	65	68

Step 1

Using the Pearson product-moment correlation formula, correlate the scores obtained from Time 1 with the scores obtained from Time 2 on the Mechanical Ability Test.

For the record, here are the formulas: The simplified version of the Pearson product-moment correlation formula involves calculating Z scores for each test score.

$$Z = \frac{(X_i - \text{mean})}{\text{standard deviation}} \qquad r = \frac{\sum (Z_x Z_y)}{N}$$

Of course it is infinitely easier to calculate this in a spreadsheet. After completing the calculations, answer the following questions:

1. ***What is the reliability coefficient?*** _____

2. ***For selection purposes, is this adequate reliability for the measure? Why or why not?***

Step 2

Next assess the internal consistency reliability of the Mechanical Ability Test. There are several methods that we could use, but for this analysis we will calculate a split-half reliability coefficient. The sum of the odd-numbered test items and the sum of the even-numbered test items are reported in the following table for each applicant. Using the same correlation procedures as in the previous step, calculate the correlation between the odd items and the even items on the test.

	Mechanical Ability Test		
Applicant	even items	odd items	Time 2 Total
a	38	41	79
b	33	30	63
c	46	42	88
d	18	21	39
e	32	35	67
f	45	49	94
g	48	43	91
h	47	42	89
I	39	34	73
j	40	31	71
k	26	29	55
l	39	28	67
m	41	43	84
n	24	20	44
o	32	36	68

After completing the calculations, answer the following questions:

1. ***What is the reliability coefficient?*** _____

2. ***For selection purposes, is this adequate reliability for the measure? Why or why not?***

Since the split-half reliability estimation procedure results in an under-estimation of the "true" reliability, it is necessary to make a statistical correction using the Spearman-Brown Prophecy formula. The formula is provided below:

$$r_{sb} = \frac{2r_o}{1+r_o}$$ where r_o = the original reliability coefficient before correction

After completing the calculations, answer the following questions:

1. ***What is the corrected reliability coefficient?*** _____

2. ***For selection purposes, is this adequate reliability for the measure? Why or why not?***

Step 3

Now calculate the interrater reliability estimate for the interview ratings. Correlate the supervisor's ratings with the senior service repair technician's ratings.

After completing the calculations, answer the following questions:

1. ***What is the reliability coefficient?*** _____

2. ***For selection purposes, is this adequate reliability for the measure? Why or why not?***

Since you have the initial HR screening interview ratings, it would also be interesting to see how those ratings compare with the second follow-up interview ratings. First, correlate the supervisor's ratings with the initial HR ratings. Then, correlate the senior service repair technician's ratings with the initial HR ratings.

After completing the calculations, answer the following questions:

1. ***Supervisor with initial HR rating reliability coefficient?*** _____

2. ***Senior service repair technician with initial HR rating reliability coefficient?***

   _____

3. ***What is the range of obtained interrater reliability coefficients?***

   _____

4. ***For selection purposes, is this adequate reliability for the measure? Why or why not?***

Step 4

The following comment was found in the notes of the previous HR manager about this group of applicants:

"Applicant F has more mechanical ability than Applicant G, since F scored higher on the test than G."

Now that you have some reliability data, you can see if that comment was reasonable. In order to do this, you need to calculate the standard error of measurement. The formula is provided below. Use the reliability coefficient you obtained from the test-retest reliability in the formula. Notice that you need to calculate the standard deviation on the mechanical ability score (use Time 2 data to calculate the standard deviation of the test).

S.E.M. = $s\sqrt{1 - r}$ where: s = standard deviation of the scores on the measure
r = the reliability coefficient for the measure

1. ***What is the standard error of measurement?*** _____

Once you have obtained the standard error of measurement, then calculate a 95% confidence interval around each of the obtained (Time 2) scores for Applicant F and Applicant G. Add 2 times the S.E.M. to the obtained score to obtain the upper limit of the confidence interval, and subtract 2 times the S.E.M. to obtain the lower limit of the confidence interval.

2. ***What is the 95% confidence interval for Applicant F's obtained score?***

   _____

3. ***What is the 95% confidence interval for Applicant G's obtained score?***

   _____

4. ***Is there overlap between the 2 confidence intervals?*** _____

5. ***Is there a 2 S.E.M. difference between Applicant F's obtain score and Applicant G's obtained score?*** _____

6. ***Was the previous HR manager justified in making his comment based on the evidence?***

applicant	initial interview rating	interview rating supervisor	interview rating technician	mechanical ability test time1	mechanical ability test time2	MAT even items	MAT odd items
a	7	5	6	72	79	38	41
b	6	8	5	66	63	33	30
c	4	7	6	84	88	46	42
d	5	4	3	42	39	18	21
e	8	6	5	71	67	32	35
f	9	7	6	90	94	45	49
g	7	9	8	92	91	48	43
h	8	7	8	85	89	47	42
I	6	6	6	70	73	39	34
j	8	5	6	69	71	40	31
k	7	4	6	50	55	26	29
l	4	6	3	64	67	39	28
m	9	7	8	79	84	41	43
n	3	3	5	42	44	24	20
o	7	5	4	65	68	32	36

STEP 1

=CORREL(E5:E19,F5:F19) 0.981

STEP 2-1

0.84 =CORREL(H5:H19,I5:I19)

STEP 2-2

0.91 =(2*0.835263)/(1+0.835263)

SPEARMAN-BROWN CORRECTION

STEP 3-1

=CORREL(C5:C19,D5:D19) 0.517

STEP 3-2

0.35 =CORREL(B5:B19,C5:C19)

0.55 =CORREL(B5:B19,D5:D19)

STEP4

16.668 =STDEV(F5:F19)

0.019 =1-r=1-.981

0.1378 =SQRT(.019)

2.2976 =16.66847*.13784

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Validity Assessment

This exercise extends the analysis begun in the Reliability Assessment Exercise.

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For each of the applicants, a performance rating (1 = very poor; 9 = excellent) was found covering the period one year after being hired by this selection program.

After assembling the data, the HR manager then put them all into the following table to use for his calculations:

Applicant	Initial HR Interview Rating	Interview Rating Supervisor	Interview Rating Technician	Mechanical Ability Test Time 2	Performance
a	7	5	6	79	6
b	6	8	5	63	5
c	4	7	6	88	7
d	5	4	3	39	4
e	8	6	5	67	5
f	9	7	6	94	8
g	7	9	8	91	9
h	8	7	8	89	7
I	6	6	6	73	6
j	8	5	6	71	5
k	7	4	6	55	5
l	4	6	3	67	4
m	9	7	8	84	9
n	3	3	5	44	5
o	7	5	4	68	6

1. ***From a validation design perspective, what approach (concurrent or predictive) can the HR manager use to assess the validity of the selection program?***

2. ***What are the steps in that type of validation study?***

3. ***What potential weaknesses are inherent in this approach to validating a selection program?***

Using the Pearson product-moment correlation formula, correlate the scores obtained from each of the individual predictors with the performance rating.

4. ***What is the validity coefficient for the initial HR interview rating with job performance?*** _____

5. ***Interpret the validity data. Discuss the strength of the relationship. Would you say it is high, moderate or low?***

6. ***What is the validity coefficient for the supervisor interview rating with job performance?*** _____

7. ***Interpret the validity data. Discuss the strength of the relationship. Would you say it is high, moderate or low?***

8. ***What is the validity coefficient for the senior service repair technician interview rating with job performance?*** _____

9. ***Interpret the validity data. Discuss the strength of the relationship. Would you say it is high, moderate or low?***

10. ***What is the validity coefficient for the mechanical ability test score with job performance?*** _____

11. Interpret the validity data. Discuss the strength of the relationship. Would you say it is high, moderate or low?

12. Based on your statistical analysis of the data, which selection devices would you retain and which would you eliminate?

applicant	initial interview rating	interview rating supervisor	interview rating technician	Mechnical Apt Test time2	performance
a	7	5	6	79	6
b	6	8	5	63	5
c	4	7	6	88	7
d	5	4	3	39	4
e	8	6	5	67	5
f	9	7	6	94	8
g	7	9	8	91	9
h	8	7	8	89	7
I	6	6	6	73	6
j	8	5	6	71	5
k	7	4	6	55	5
l	4	6	3	67	4
m	9	7	8	84	9
n	3	3	5	44	5
o	7	5	4	68	6
	0.51	**0.652**	**0.812**	**0.809**	

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Decision Making

1. ***If you were to retain all of the selection devices (due to pressure from your boss, pressure from your constituents, etc.), how would you weight the various ratings in order to combine the information for an overall applicant score?***

2. ***Which selection decision-making model do you think would be most appropriate for this situation (e.g., multiple hurdles, a compensatory model, etc.)?***

3. ***Depending on the approach you recommended in #2 above, what modifications would you make to the current selection program?***

4. ***If you intercorrelate all of the predictors, you will find (unsurprisingly) that many of the relationships are statistically significant. What are the implications of this result for your selection program? What statistical procedure will help you make more informed decisions about which predictors to include and how to combine them. Explain how the statistical procedure will improve your decision making.***