TO: Todd Rent, Chief Examiner
              Civil Service Commission

FROM: Human Resources Staff

RE: Establish a Passing Score for the Firefighter Written Exam

DATE: August 26, 2015

A. Summary

City of Urbana Human Resources staff recommends a passing score of 75.44% for the written exam. This would result in passing a group of 55 applicants on to the next step of the process with no adverse or disparate impact.

A. Background

The position was open for applications from March 16 – June 5, 2015 and Human Resources received 140 applications for the position. Of those candidates, 139 met the minimum qualifications and were invited to test.

	#	%
Male	134	96%
Female	5	4%

	#	%
Non-Minority	122	88%
Minority	17	12%

C. Written Exam

Three tests were offered: Saturday, June 27 at the Alice Campbell Alumni Center; Tuesday, July 28 at the Illinois Law Enforcement Alarm System (ILEAS) and Saturday, August 1 at the Urbana Civic Center. In all, 115 applicants tested for the position.

	#	% of Test Group
Male	110	96%
Female	5	4%

	#	% of Test Group
Non-Minority	100	87%
Minority	15	13%

D. Passing Score

Staff recommends a passing score of 75.44% for the exam, which would allow 55 applicants to be placed on the preliminary eligibility register list, providing they have passed the physical testing component. At this passing score, adverse and/or disparate impact is not observed (additional data is attached in Appendix A).

Mean score: 73.40

Median score: 74.84

Standard Deviation: 8.746

75.44% Pass Rate				
	#	% of Total Tested	% of Like Group Tested	% of Register
Male	**53**	46% (53/115)	48% (53/110)	96% (53/55)
Female	**2**	2% (2/115)	40% (2/5)	4% (2/55)
	#	% of Total Tested	% of Like Group Tested	% of Register
Non-Minority	**50**	43% (50/115)	50% (50/100)	91% (50/55)
Minority	**5**	4% (5/115)	33% (5/15)	9% (5/55)

At this passing score, a total of 60 applicants would not pass the exam, which represents a 52% failure rate.

	#	% of Total Tested	% of Like Group Tested		#	% of Total Tested	% of Like Group Tested
Male	57	50% (57/115)	52% (57/110)	**Non-Minority**	50	43% (50/115)	50% (50/100)
Female	3	3% (3/115)	60% (3/5)	**Minority**	10	9% (10/115)	67% (10/15)

Disparate Impact Analysis

(an On-Line Internet based application)

<u>Appendix A</u>

Instructions: Please fill out the information into the form below. Once you have entered your data below, you may select the types of analysis to be conducted by checking the appropriate boxes. Then press the compute button at the bottom of the form to view the results.

Select the type of employment decision: [Selection ▼]
Enter a title for your report: [Firefighter Written Exam 2015 - 75.4%]

Number of Male		Number of Non-Minority		Number of Younger		Number of Non-Disabled	
110	Applicants	100	Applicants		Applicants		Applicants
53	Selected	50	Selected		Selected		Selected
Number of Female		Number of Minority		Number of Older		Number of Disabled	
5	Applicants	15	Applicants		Applicants		Applicants
2	Selected	5	Selected		Selected		Selected

☑ -Adverse Impact
☑ -Chi-Square
☑ -Standard Deviation
☑ -Confidence Intervals
☑ Probability Distribution

Select the Statistical Tests you wish to execute by checking or unchecking the boxes on the left. Then press the 'Compute' button below.

[Compute]

Display: ☑ Description of Statistic ☑ Interpretation of Results

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Firefighter Written Exam 2015 - 75.4%

Adverse-Impact Report

Adverse Impact **and the "four-fifths rule." - A selection rate for any race, sex, or ethnic group which is less than four-fifths (4/5ths) (or eighty percent) of the rate for the group with the highest rate will generally be regarded by the Federal enforcement agencies as evidence of adverse impact. *Uniform Guidelines on Employee Selection Procedures***

Rate of Females Applicants Selected	Rate of Males Applicants Selected	Adverse Impact Ratio for Females	Adverse Impact Ratio for Males
(2/ 5) = 0.4	(53/ 110) = 0.4818	(0.4/ 0.4818)= 0.83	(0.4818/ 0.4)= 1.2

Adverse impact as defined by the 4/5ths rule was not found in the above data.

Rate of Minorities Applicants Selected	Rate of Non-Minorities Applicants Selected	Adverse Impact Ratio for Minorities	Adverse Impact Ratio for Non-Minorities
(5/ 15) = 0.3333	(50/ 100) = 0.5	(0.3333/ 0.5)= 0.67	(0.5/ 0.3333)= 1.5

The Adverse Impact Ratio for Minorities is less than 0.80.
Minorities Applicants are Selected at a rate less than 80% (4/5ths) of the rate that Non-Minorities Applicants are Selected.

Chi-Square Report

Observed Expected	Selected	Not Selected	Row Totals
Males	53 52.6087	57 57.3913	110
Females	2 2.3913	3 2.6087	5
Column Total	55	60	115

Chi-Square = 0.1283
The value of the statistic is less than 3.841. This indicates that there is a 95 percent chance that these results have been obtained absent any form of bias. Therefore, you may conclude that these results fall within normal random variations and are not the result of bias.

Observed Expected	Selected	Not Selected	Row Totals
Non-Minorities	50 47.8261	50 52.1739	100
Minorities	5 7.1739	10 7.8261	15
Column Total	55	60	115

Chi-Square = 1.452
The value of the statistic is less than 3.841. This indicates that there is a 95 percent chance that these results have been obtained absent any form of bias. Therefore, you may conclude that these results fall within normal random variations and are not the result of bias.

Standard-Deviation Report

The difference between the proportion of the protected class Selected and the proportion of all Applicants Selected has a normal distribution with a mean and standard deviation. The statistic is shown below:

```
         (r / n) - p

   -----------------------------

   sqrt(p * (1-p) / n) * sqrt(1-q)
```

Analysis of proportion of Females Selected **where:**

- **r = number of Females Selected.**
- **n = number of Selected (Females and Males).**
- **p = proportion of Applicants that are Females.**
- **q = proportion of Applicants Selected.**

	Selected	Not Selected	Row Totals
Males	53	57	110
Females	2	3	5
Column Total	55	60	115

r = 2
n = 55
p = 5 / 115 = 0.043
q = (2 + 53) / (5 + 110) = 0.478

Standard Deviation Statistic = -0.358

These results show that the proportion of Females Selected is -0.358 standard deviations below the proportion of Applicants Selected. A result of less than 2 standard deviations is generally considered non-significant.

Analysis of proportion of Minorities Selected **where:**

- **r = number of Minorities Selected.**
- **n = number of Selected (Minorities and Non-Minorities).**
- **p = proportion of Applicants that are Minorities.**
- **q = proportion of Applicants Selected.**

	Selected	Not Selected	Row Totals
Non-Minorities	50	50	100
Minorities	5	10	15
Column Total	55	60	115

r = 5
n = 55
p = 15 / 115 = 0.13
q = (5 + 50) / (15 + 100) = 0.478

Standard Deviation Statistic = -1.205

These results show that the proportion of Minorities Selected is -1.205 standard deviations below the proportion of Applicants Selected. A result of less than 2 standard deviations is generally considered non-significant.

Confidence Interval Report

The proportion of the protected class Selected has an expected value that would fall within a specified confidence interval. The statistic is shown below:
Observed value = (r / n)
Expected value = p

Standard Deviation = sqrt(p * (1-p) / n) * sqrt(1-q)

Confidence Interval:
Lower Bound = p - 1.96 * Std Dev
Upper Bound = p + 1.96 * Std Dev

Analysis of proportion of Females Applicants Selected **where:**

- **r = number of Females Selected.**
- **n = number of Applicants Selected.**
- **p = proportion of Females among those Selected.**
- **q = proportion of Applicants Selected.**

r = 2
n = 55

p = (5/(5+110))=0.043
q = ((2 + 53)/(5 + 110))=0.478
(r/n)=2/55=0.0364

The lower bound of the confidence interval is: 0.043 -(1.96* 0.02)= 0.0045
The upper bound of the confidence interval is: 0.043 +(1.96* 0.02)= 0.0824

Confidence Interval = 0.0045 to 0.0824

These results show that the proportion of Females Females (r/n=0.0364) is contained in the confidence interval. Therefore a finding of disparate impact is not supported by this data.

Analysis of proportion of Minorities Applicants Selected **where:**

- **r = number of Minorities Selected.**
- **n = number of Applicants Selected.**
- **p = proportion of Minorities among those Selected.**
- **q = proportion of Applicants Selected.**

r = 5
n = 55
p = (15/(15+100))=0.13
q = ((5 + 50)/(15 + 100))=0.478
(r/n)=5/55=0.0909

The lower bound of the confidence interval is: 0.13 -(1.96* 0.033)= 0.0661
The upper bound of the confidence interval is: 0.13 +(1.96* 0.033)= 0.1947

Confidence Interval = 0.0661 to 0.1947

These results show that the proportion of Minorities Minorities (r/n=0.0909) is contained in the confidence interval. Therefore a finding of disparate impact is not supported by this data.

Probability Distribution Report

| Number Females Selected	Number Males Selected	Rate of Females Applicants Selected	Rate of Males Applicants Selected	Adverse Impact Ratio of Females	Adverse Impact against Females ?	Probability	Cumulative Probability
0	55	(0/5)	(55/110)	0	YES	0.035585	0.035585
1	54	(1/5)	(54/110)	0.4074	YES	0.17475	0.210335
Selected-> 2	53	(2/5)	(53/110)	0.8302	NO	0.331105	0.54144
3	52	(3/5)	(52/110)	1.2692	NO	0.302561	0.844001
4	51	(4/5)	(51/110)	1.7255	NO	0.133332	0.977334
5	50	(5/5)	(50/110)	2.2	NO	0.022666	1

Given that 55 were Selected from a pool of 110 Males and 5 Females it was possible to have Selected from 0 to 5 Females.

Adverse Impact would be found if you Selected 1 or fewer Females.

The probability of Adverse Impact occurring even if the employment decisions were random (i.e. unbiased) is 0.2103 (the sum of the probabilities of having Selected 1 or fewer Females).

Since the probability of Adverse Impact occurring even if the employment decisions were random (i.e. unbiased) is greater than 10%, an observed Adverse Impact may be not significant since the probability is greater than 1 in 10 that Adverse Impact would have occurred due to chance.

Probability Distribution of the variable: Number of Females Selected.


0 1 2 3 4 5
Number of female Applicants
Selected
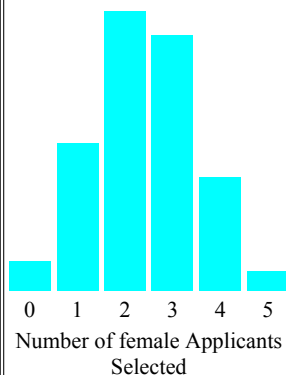
The probability distribution of having Selected from 0 to 5 Females is displayed above. As can be seen, the most likely event (highest probability) to have occurred by chance (or decisions not affected by any form of bias) is to have Selected 2 female Applicants. This represents the mean of the probability distribution. Approximately half of the probability distribution is above this point and approximately half is below this point. The total area contained in the probability distribution is equal to 1. Thus, probabilities for each number of female Applicants Selected are a fraction of the total probability distribution. The larger areas of the distribution represent higher probabilities of occurance. Adding the individual probabilities up to a certain point enable you to compute the probability of having Selected that many or fewer female Applicants. Adding the individual probabilities from a certain point and higher enable you to compute the probability of having Selected that many or more female Applicants.

The characteristics of the probability distribution--its mean and standard deviation--are a function of the number of female and male Applicants and the number of Applicants to be Selected. Though it is possible to have Selected from 0 to 5 female Applicants, the individual probabilities of having Selected each number of female Applicants can be computed and accumulated. As noted before, these individual probabilities are a function of the number of female and male Applicants and the number of Applicants to be Selected.

Using the distribution above, a 90 percent confidence interval on the variable 'Number of Females Selected' would have a lower bound of 1 and an upper bound of 4.

The significance of having Selected 2 or fewer Females is graphically displayed below.
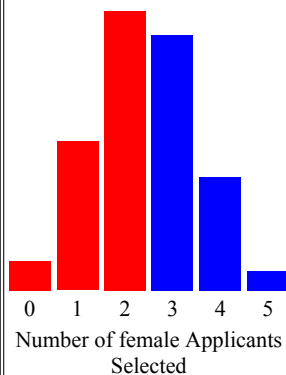
Number of female Applicants
Selected

As noted earlier, Adverse Impact, according to the 4/5ths rule, would be found if you Selected 1 *or fewer* female Applicants.

You have Selected 2 female Applicants. The probability of having Selected 2 *or fewer* Females is equal to the cumulative probability for having Selected 2 Females Applicants. The cumulative probability of having Selected 2 female Applicants is 0.5414 and is graphically displayed, in red, above.

Since the probability is greater than 10%, we are unable to reject the hypothesis that the decisions occurred due to chance. Therefore, we must conclude that it is entirely possible that having Selected 2 or fewer female Applicants is an event that occurred due to chance and not from discriminatory actions by the employer.

| Number Minorities Selected	Number Non-Minorities Selected	Rate of Minorities Applicants Selected	Rate of Non-Minorities Applicants Selected	Adverse Impact Ratio of Minorities	Adverse Impact against Minorities ?	Probability	Cumulative Probability
0	55	(0/15)	(55/100)	0	YES	0.000022	0.000022
1	54	(1/15)	(54/100)	0.1235	YES	0.000398	0.00042
2	53	(2/15)	(53/100)	0.2516	YES	0.003201	0.003621
3	52	(3/15)	(52/100)	0.3846	YES	0.015317	0.018938
4	51	(4/15)	(51/100)	0.5229	YES	0.048764	0.067703
Selected-> 5	50	(5/15)	(50/100)	0.6667	YES	0.109427	0.17713
6	49	(6/15)	(49/100)	0.8163	NO	0.178803	0.355932
7	48	(7/15)	(48/100)	0.9722	NO	0.216626	0.572559
8	47	(8/15)	(47/100)	1.1348	NO	0.19619	0.768748
9	46	(9/15)	(46/100)	1.3043	NO	0.132812	0.90156
10	45	(10/15)	(45/100)	1.4815	NO	0.066647	0.968207
11	44	(11/15)	(44/100)	1.6667	NO	0.024344	0.992551
12	43	(12/15)	(43/100)	1.8605	NO	0.006264	0.998814
13	42	(13/15)	(42/100)	2.0635	NO	0.001072	0.999886
14	41	(14/15)	(41/100)	2.2764	NO	0.000109	0.999995
15	40	(15/15)	(40/100)	2.5	NO	0.000005	1

Given that 55 were Selected from a pool of 100 Non-Minorities and 15 Minorities it was possible to have Selected from 0 to 15 Minorities.

Adverse Impact would be found if you Selected 5 or fewer Minorities.

The probability of Adverse Impact occurring even if the employment decisions were random (i.e. unbiased) is 0.1771 (the sum of the probabilities of having Selected 5 or fewer Minorities).

Since the probability of Adverse Impact occurring even if the employment decisions were random (i.e. unbiased) is greater than 10%, an observed Adverse Impact may be not significant since the probability is greater than 1 in 10 that Adverse Impact would have occurred due to chance.

Probability Distribution of the variable: Number of Minorities Selected.
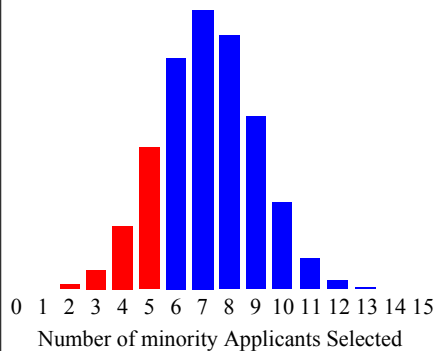

Number of minority Applicants Selected
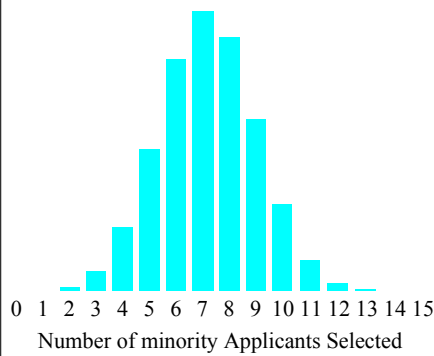
The probability distribution of having Selected from 0 to 15 Minorities is displayed above. As can be seen, the most likely event (highest probability) to have occurred by chance (or decisions not affected by any form of bias) is to have Selected 7 minority Applicants. This represents the mean of the probability distribution. Approximately half of the probability distribution is above this point and approximately half is below this point. The total area contained in the probability distribution is equal to 1. Thus, probabilities for each number of minority Applicants Selected are a fraction of the total probability distribution. The larger areas of the distribution represent higher probabilities of occurance. Adding the individual probabilities up to a certain point enable you to compute the probability of having Selected that many or fewer minority Applicants. Adding the individual probabilities from a certain point and higher enable you to compute the probability of having Selected that many or more minority Applicants.

The characteristics of the probability distribution--its mean and standard deviation--are a function of the number of minority and non-minority Applicants and the number of Applicants to be Selected. Though it is possible to have Selected from 0 to 15 minority Applicants, the individual probabilities of having Selected each number of minority Applicants can be computed and accumulated. As noted before, these individual probabilities are a function of the number of minority and non-minority Applicants and the number of Applicants to be Selected.

Using the distribution above, a 90 percent confidence interval on the variable 'Number of Minorities Selected' would have a lower bound of 4 and an upper bound of 10.

The significance of having Selected 5 or fewer Minorities is graphically displayed below.

Number of minority Applicants Selected

As noted earlier, Adverse Impact, according to the 4/5ths rule, would be found if you Selected 5 *or fewer* minority Applicants.

You have Selected 5 minority Applicants. The probability of having Selected 5 *or fewer* Minorities is equal to the cumulative probability for having Selected 5 Minorities Applicants. The cumulative probability of having Selected 5 minority Applicants is 0.1771 and is graphically displayed, in red, above.

Since the probability is greater than 10%, we are unable to reject the hypothesis that the decisions occurred due to chance. Therefore, we must conclude that it is entirely possible that having Selected 5 or fewer minority Applicants is an event that occurred due to chance and not from discriminatory actions by the employer.

View Source Code

Send questions or comments to webmaster@hr-guide.com. Thank you.

Source: http://www.hr-software.net/EmploymentStatistics/DisparateImpact.htm

Monday, August 24, 2015