INTRODUCTION

This report aims to calculate the bias in an award distribution event. The selection of the winning project is the final step in the process. The intermediate steps are listed below:

1) Project Selection
2) Speaker Invitation
3) Jury Member selection
4) Awards selection

The procedure adopted to arrive at the bias in the entire process is by calculating the probabilities of the individual processes using binomial probability distribution. The report introduces the concept of binomial probability distribution in the next section. In the following sections, the report highlights the calculation of the binomial probability associated with each event with the data provided for the events.

UNDERSTANDING THE BINOMIAL PROBABILITY DISTRIBUTION

The binomial probability mass function is represented as shown below.

$$P[\, k \mid r, p] = {}^{r}C_{k}\,(p)^{k}(1-p)^{r-k}$$

Here ${}^{r}C_{k}$, denotes the number of ways in which k objects can be selected from r objects. It can be further expanded in the factorial format as represented below:

$${}^{r}C_{k} = \frac{r!}{k!(r-k)!}$$

The binomial probability mass function can be interpreted as "*the probability of selecting 'k' items from a pool of 'r' items where the probability of selecting 'k' type of items is 'p'.*" For example, calculating the probability of selecting 7 girls from a class of 100 students where there are 37 girls and 63 boys will be done as follows:

- ➔ Probability of selecting a girl from the class: 37/100 = 0.37
- ➔ Thus the binomial probability mass function would look like: P[7 | 100, 0.37]

Similarly, in the same example, the probability of selecting 7 boys would be:

- ➔ P[7 | 100, 0.63] because the probability of selecting a boy from the same class is 63/100 or 0.63 .

The way in which the binomial probability mass function differs from the ordinary probability calculation is that the former takes into account all possible ways of selecting an item from the pool. In the context of the previous example, the binomial probability mass function will take into account all possible combination of 7 girls from the pool of 37 girls.

SOLVING THE AWARD PROBLEM

In the frame of the given problem of awards, it has to be noted that events 1,2 and 3 have the probability of selecting a woman as 0.5. This is because the outcome of selecting a person can result in selecting either a man or a woman. In the final event of selecting the winner for the award, the probability is not 0.5. This is attributed to the fact that, in the pool of 12 projects shortlisted for the awards, 8 are led by women and 4 are led by men. Thus, the probability of selecting a woman is 8/12 or 2/3 and the corresponding probability of selecting a man is 4/12 or 1/3. These adjusted probabilities are used to calculate the binomial probabilities associated with the fourth event.

FIRST EVENT

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Project Selection Bias:

Total Projects: 12
Projects Led by Women: 8
Projects Led by Men: 4
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This can be rephrased as “selecting 8 women in a group of 12 where the probability of selecting a woman is 0.5” The probability in this case is 0.5 because the outcome of selecting a person can go only one of two ways: select a man or select a woman. We will denote the result in orange colour for future reference and mark the result as (1)

$$P[\,8 \mid 12, 0.5\,] = {}^{12}C_8(0.5)^8(1-0.5)^4 = {}^{12}C_8(0.5)^{12}$$

$$= \frac{12!}{8!4!} \times \frac{1}{2^{12}} = \frac{495}{2^{12}} = \frac{495}{4096} = 0.12085$$

$$= 12.085\%$$

(1)

SECOND EVENT

Speaker Invitation Bias:

Total Speakers: 3
Female Speakers: 3
Male Speakers: 0

This event can be rephrased as "the probability of selecting 3 women in a group of 3 where the probability of selecting a woman is 0.5". The probability of selecting a woman is 0.5 since the selected person will be either a male or a female. This is because the speakers are chosen independently from the audience.

$$P[\,3 \mid 3, 0.5\,] = {}^{3}C_3(0.5)^3(1-0.5)^0 = {}^{3}C_3(0.5)^3$$

$$= 1 \times \frac{1}{2^3} = \frac{1}{2^3} = \frac{1}{8} = 0.125 = 12.5\%$$

(2)

THIRD EVENT

Jury Member Bias:

Total Jury Members: 7
Female Jury Members: 6
Male Jury Members: 1

This event indicates that from a pool of 7 members, 6 have to be female. This is represented as follows:

$$P[\,6 \mid 7, 0.5\,] = {}^{7}C_6(0.5)^6(1-0.5)^1 = {}^{7}C_6(0.5)^7$$

$$= 7 \times \frac{1}{2^7} = \frac{7}{2^7} = \frac{7}{128} = 0.05469 = 5.47\%$$

(3)

FOURTH EVENT

Award Winners Bias:

Total Awards: 4
Awards to Women: 4
Awards to Men: 0

Probability of selecting 4 women in a group is calculated below. The probability in this case would be 2/3 or 0.66 as the number of women in the pool of 12 people is 8.

$$P[\,4 \mid 4, 0.66\,] = {}^{4}C_4(0.66)^4(1-0.66)^0 = {}^{4}C_4(0.66)^4$$

$$= 1 \times \left(\frac{2}{3}\right)^4 = \frac{16}{81} = 0.19753 = 19.75\%$$

(4)

CALCULATING THE FINAL PROBABILITY

The final probability for bias is arrived at by multiplying the values obtained from (1) to (4).

P[8 | 12, 0.5] × P[3 | 3, 0.5] × P[6 | 7, 0.5] × P[4 | 4, 0.5]

= 12.085% × 12.5% × 5.47% × 19.75%

= 0.016 %

Thus the probability of this event occurring is 0.016%

It may be concluded that the gender bias in the event was 100 – 0.016 = **99.984%**