MATHEMATICS OF JOB HUNTING, RE-TRAINING AND TAX REVENUE PRODUCTION

Robert T. Chisholm, B.Sc. Hons.(Eng.),
Ottawa,
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Summary

A probability and statistics-based approach to finding the probable time needed to get a job is demonstrated. This is based on an individual's records of the number of employers approached, the time required prior to getting previous jobs and the confidence level considered satisfactory. Two ways to project the time required for job hunting activities in bad market conditions, relative to an individual's previous experience, are shown.

An attempt is made to gauge the implications of unequal success probabilities for individuals in different situations, within a group of 800 applicants for one job. The figure of 800 comes from Paul Swinwood, President of the Software Human Resources Council, and is not the worst that has been seen. In the example considered, someone in a top sub-group of 50 applicants who are working might require 13 weeks to get a job, while even the best unemployed people might require 2 ½ years. The estimates depend, among other things, on the numbers in the sub-groupings used to classify the 800 people and the success probability assigned to each sub-group; the sum of the success probabilities for all the sub-groups must equal 1. The estimates ignore waiting times for employers to respond and waiting times for decisions on contract awards to employers by their clients. In some cases these factors are dominant.

Additional examples of actual ratios of job seekers to positions open are quoted.

Typical financial planning scenarios are examined in terms of controllability and dependencies on uncertainties about the outcomes of job search-related activities. The genesis of the feelings of being ''in control'' or having no control at all are examined, in terms of being ''solvable'' versus essentially un-solvable mathematical problems.

Finally, the phenomenon of entrapment in under-employment is analysed, in terms of its implications for the tax base. The example considered is a software developer trapped in menial work such as general labouring.

Major improvements in general knowledge, attitudes and conditions are required to deal with the Canadian problem.

CONTENTS

1. INTRODUCTION

In this paper, the author analyses the problem mathematically in an attempt to answer questions such as:-

1. When looking for a job, how long will it take?
2. How many job applications will be needed?
3. To what extent might the chance of being hired be affected by being categorised in a certain way by hiring managers?
4. What are the full implications of large numbers of applicants – typically 800 – for each job?
5. What is the optimum way to manage time, when looking for a job?
6. Should successful people be concerned in any way about the above?
7. What are the consequences for tax revenue production of under-employment and exclusion from re-training for high tech workers?

It will also serve to make clear to successful people what is really going on around them. The same factors are involved as for people who just happen to be unlucky in the job market, only the numbers are different.

The mathematical realities involve probability and statistics based on previous job hunting experience and the state of the job market at the time of deciding, or being forced, to look for another job. For instance, previous experience indicating not more than 20 applications needed to get a job does not mean a confidence level of 100% that this will apply in the future.

Persons who have been habitually successful may reach the dangerous conclusion that certain other persons are no good merely because they have not been lucky (where "not lucky" = persistently dis-favoured, not necessarily for legitimate reasons). This is the consequence of a job market in which there are always hundreds of applicants for every job opening.

It will also be shown that there is no real answer, for job seekers, to question 5, because it involves knowing the un-knowable.

This last point is particularly important in Ottawa, having regard to the hi tech slump which started in about March 2001 and to the cover-up involving "Not in the Labour Force" which, by hiding from view the numbers of jobs needed to make tax payers out of everybody who wants to work, tends to keep real unemployment (as opposed to the so-called "official" unemployment rate) artificially high.

This paper contains discussion of societal attitudes, employer attitudes and personal attitudes, to the extent necessary to give the context of the mathematical arguments.

Ontario high school Grade 12 mathematics, and no more, is required in order to use the methods in this paper. The Normal Probability Distribution table in Appendix 2 appears in many other places – for instance, in the McGraw-Hill Ryerson book "Mathematics of Data Management" used in Ontario high schools in Grade 12 .

2. BASIC CALCULATIONS

In this section we will look at several kinds of calculation. Worked examples are included.

- 2.1 Probability of landing a job within **n** applications if the probability of any one application being successful is **1/N**
- 2.2 Systematic evaluation of your own previous experience: the Normal Distribution, Mean, Standard Deviation and Z-score.
- 2.3 Number of job applications:-
  - 2.3.5. Expected number of applications
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  - 2.3.7. Least possible number of applications
  - 2.3.8. Worst possible number of applications.
- 2.4. Time required to get a job.
- 2.5. Alternative method – finding the time to get a job.
- 3.6. Effects of waiting time, $\mathbf{t_w}$ and the ‘‘pink elephant’’ problem
- 3.7. Probability Groups in a Job Applicant Population.

2.1. Probability of landing a job within “n” applications if the probability of any one application being successful is 1/N

It can be shown that this is given by:-

$$P_S = 1- \{(N-1)/N\}^n$$ **- equation (2),**

where P_S = probability of success

Alternatively, if we are interested in the number of job applications for a given success probability,

$$n = \log(1- P_S) / \log\{(N-1)/N\}$$ **- equation (2a)**

The derivation of these equations is given in **Appendix 1 (p.20).**

Remarks on the above

The number of applications that a job seeker will make, when searching for a job, will be governed by what he / she considers necessary in the circumstances then prevailing. This means that they will continue to apply for jobs before the results of previous applications – success or failure – are known. Thus it will usually happen that if, say, 100 applications are sent out, the first, 10th, 51st etc. may turn out to be the one that is eventually successful.

The job seeker will generally stop sending out applications only when success has occurred with one of the earlier ones, not just based on an early indication of *possible* success. Thus equations 2 and 2(a) may give pessimistic predictions in practice – but on the other hand, this is the only realistic approach.

2.2. Systematic evaluation of your own previous experience: the Normal Distribution , Mean, Standard Deviation, Z-score.

In this analysis, we look at your previous job hunting experience – based on your general approach and circumstances – and look at the question of how many applications you might need to do.

We assume that you have records of how many job applications you sent out, when you applied for the jobs you had in the past and the one you have now.

To do this, we use a standard statistical method involving average, standard deviation and assuming a normal distribution for the historical numbers of job applications.

Obviously, you could do exactly the same analysis for the times involved, assuming that you have the appropriate records, and use this to predict the time you might need to find your next job. We will look at some examples later.

For instance, you might have held 5 jobs including the one you have now, as follows:-

Job no.	**No. of applications made before getting it, X_i**
1	**10**
2	**15**
3	**5**
4	**20**
5	**12**

Based on this you would conclude, from previous experience, that the probability that you won't need to make more than 20 applications when applying for your next job is 93.57%.

The calculations are shown in **Example 1 (p.26).**

This, again, might seem quite good enough for you – because, your approach has worked for **YOU** in the past, therefore why should you not have faith in it?

However, this level of confidence in the future is justified if and only if future market conditions are the same or better than what was previously experienced.

If market conditions in the future are worse, you might for instance use this 93.57% confidence level as a benchmark - for instance, "...if I don't think I can get a job in a certain field after not more than 20 applications with a confidence level of 93.57% or better, I'm not going to bother with it any more because conditions are unsatisfactory for investing the required time and effort...", or some such.

You might then use such a method to decide whether certain other fields of work are worth investigating, based on whatever information you have about whether the job market in them is better or worse than what you have previously experienced.

Obviously each person will make his / her own decision concerning acceptable confidence levels and number of applications, based on his / her own previous experience of what is or is not satisfactory. It's all a question of what has worked for YOU!

2.3. Number of job applications:-

2.3.1. Expected number of applications

For **Example 1 (p.26)** above, this is just the average, in this case 12.4 applications to get a job. This is comparable to the single 6-sided dice throwing problem where, for a large number of throws, the expected value (average) is 21/6, or 3.5

2.3.2. Probable number of applications

That depends on your assessment of what is an acceptable confidence level. For **Example 1 (p.26)** above, the probable number of applications is 20 or less with a confidence level of 93.75%. Obviously, in the same way, you could find the number of applications you would need to make for a higher confidence level. It's just a question of what confidence level you are satisfied with, based on previous experience.

2.3.3. Least possible number of applications

This is obvious.

2.3.4. Worst possible number of applications.

Equally obviously, the number of applications needed for a confidence level of 100% is infinity. This is where anyone can come un-stuck due to bad luck, especially when combined with a sudden onset of bad market conditions in his / her current field of work and mis-leading or non-existent information concerning probabilities of success in others.

2.4. Time required to get a job

We could do exactly the same kind of analysis as in sections 2 and 3 above, given the total time spent on initial applications, interviews etc. before getting each of the jobs we had.

Just to get a rough initial idea of what to expect, look at **Example 1 (p.26)** above again. If we spent a total of 4 hours on each and every job application, we would find an average of 49.6 hours of work – initial application, follow up, interview etc. - needed to get a job, and not more than 80 hours with a confidence level of 93.57%.

Of course, some would get no further than the initial application (the no response / "black hole" situation), others might go all the way but still fail, etc.

For **Example 1 (p.26)** above, we might get something like what is shown in **Example 2 (p.28)** Here, we find an average number of hours of 52.2 for job hunting activities for the 5 jobs, a maximum of 85 hours and a probability of 95.67% that 85 hours won't be exceeded in the future.

In practice, time is more important than the number of applications because we are interested in how long we can survive without the income from a job, compared with the time required to find one. This is of obvious importance for the following reasons:-

1. Financial planning and avoidance of bankruptcy and/or homelessness for the people involved.
2. Loss to the tax base due to someone who is out of work being prevented from contributing
3. Decisions about whether to try looking for different kinds of work and/or undertake re-training.
4. Excessive time without income can, in the worst case, lead to bankruptcy and/or homelessness plus various pejorative and ill-informed perceptions by the general public, employers, peers, friends, politicians, the legal profession and government officials, which serve merely to exacerbate the problem by increasing the difficulty of becoming a tax payer again. Hence such attitudes, whilst commonplace and popular, are counter-productive.

2.5. Alternative method – time to get a job.

If you have a general idea of the total time spent on all the activities connected with getting a job, but no detailed records for every stage with every employer approached, you might proceed as explained below.

Consider **Example 2 (p.25)** again.

Suppose you knew just the total hours spent on job hunting activities, before landing each of your previous jobs, not including waiting time. In this example, the total would be 261 hours for 5 jobs, 62 job applications and an average of 12.4 applications per job.

Here we assume that the average job hunting activity time per employer approached is the same, no matter the market conditions.

Based on this simplifying assumption, in **Example 2A (p.30)** the probability of any one application being successful has deteriorated from the figure of **1/12.4** in **Example 2** **(p.28)** to **1/800**, we find that **2510** job applications (as opposed to **20** before) and **10,116** hours of effort are needed for the same success probability. This is actually a pessimistic estimate compared with what you would find if you had access to detailed records of time spent on all your past job search activities.

On the other hand the result, while less accurate, is still useful.

2.6. Effects of waiting time, t_w and the ''pink elephant'' problem

Waiting time arises from the following :-

1. Delay by the employer in responding to the initial application
2. Delay by the employer during the pre-interview follow-up phase – e.g. responding to questions from the job applicant
3. As for (2) but during post-interview follow-up.
4. Waiting for contract award decisions by the employers' clients.

Usually, time spent waiting for responses from one employer can be used effectively to process applications to others. The analysis in previous sections assumes that all such ''waiting time'' is in fact so used.

In the worst type of case, however, any or all of these can extend the overall time far beyond when you commenced the last job application, assuming that the last one happens to be the one that is eventually successful. This is particularly true for item 4 which can involve years of additional delays. In the worst case, the waiting time $\mathbf{t_w}$ must be added to the predicted delay time $\mathbf{t_d}$ to give the overall time $\mathbf{T_o}$, so that :-

$$\mathbf{T_o = t_d + t_w}$$

This may not be important for someone who is working but looking for a better job, but can be critical for anyone who is out of work, particularly where many situations involving item 4, running concurrently, degenerate into ''indefinite'' waiting periods ending with no contract awards to the employers in question. This gives rise to the ''perennial pink elephant'' problem, where waiting periods for projects to come through and the uncertainties involved become the dominant factors.

2.7. Probability Groups in a Job Applicant Population.

Suppose there are 800 applicants for a job. Some other examples reported of actual numbers are given in **APPENDIX 3**. It does not follow that the probability of success is the same for everybody, for obvious reasons. It is instructive to try to break down the 800 applicants into most-favoured sub-groups and least favoured sub-groups, for instance as follows:-

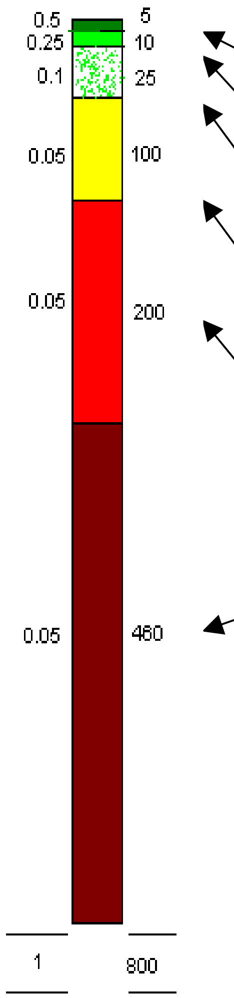


CHART 1

In **CHART 1** at left, the different sub-groups are as follows:-

1. Most favoured applicants – usually already working in the field. The top 5 people, with a 50% chance of one of them getting the job. Persistently favoured and lucky.
2. Next 10 people - next most favoured applicants – usually working, possibly in a different field, with a 25% chance of one of them getting the job.
3. Next 25 - good applicants – usually working, possibly less experienced than groups 1 and 2, with a 10% chance of one of them getting the job.
4. Next 100 – most favoured applicants – unemployed, but not for long.
5. Next 200 – good applicants – unemployed.
6. Next (lowest) 460 – "Not in the Labour Force" - long term unemployed, persistently dis-favoured.

Obviously the group of 800 job applicants can be broken down in many ways, with different probabilities of success assigned to each.

Irrespective of how the group is sub-divided and the probabilities assumed for each sub-group, one of the 800 will get the job, therefore the sum of the probabilities for the different sub-groups must equal 1.

For sub-group **1**: 5 applicants for 0.5 jobs equals 10 applicants for 1 job, hence a 1 in 10 chance that any one job application will succeed.

At the other extreme, for sub-group **6**: 460 applicants for 0.05 jobs equals 9,200 applicants for 1 job, hence a 1 in 9,200 chance that any one job application will succeed.

If nothing else, this chart should prompt successful people to enquire about what is really going on and why, and doing something about it, as opposed to following the tradition-based routine of looking down their noses at those who are merely unlucky as a result of finding themselves in the wrong place at the wrong time, finding themselves dealing with the wrong sort of people, faced with poor success probabilities due to poor previous work history caused by past bad luck, or a combination of these.

In this example, those in sub-group **1** would do 10 applications for each job they get, on average, resulting in slightly better times than indicated in **Example 1 (p.26)** and **Example 2 (p.28)** above, where the average was 12.4 applications prior to landing a job. You might say that these people would not have much reason to worry about the time they would need to find a job, if they lose one or if it ends simply because they have finished a contract. They would probably be happy and completely oblivious to the position of people in sub-group **6**, whom they might just dismiss as “no good”, or some such.

The people in sub-group **6**, however, only get favoured with one job for every 9,200 applications, as opposed to 12.4. This means they have to spend 742 times the hours on researching companies, doing job applications and pre-interview follow-up for each interview and each job offer they can accept – obviously hopeless, in terms of the time required.

But what if the situation is like the one in **CHART 2** below? In this case half (400) of the 800 applicants are working. The ones in the top sub-group of 50 would probably be complaining and the others who are working would be complaining more. If they meet any of the people in the bottom three groups (amber, red and dark red), they might just say “...well, it’s tough to get a job for everybody – so who the hell are YOU to be complaining? There’s so much of this going on that you can’t POSSIBLY do anything about it....”

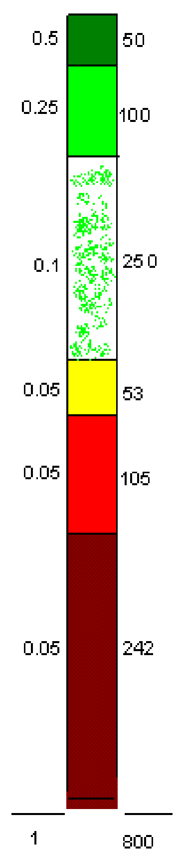


CHART 2

The people in the bottom three sub-groups are only slightly better off than before.

3. TIME MANAGEMENT, FINANCIAL CONTROL AND ATTITUDES: THE JOB HUNTER'S CHALLENGE OR CONUNDRUM

3.4 GENERAL.

The purpose of having a job is to:-

(a) generate income on which to live and control personal finances.

(b) generate revenue for the tax base, to help pay for essential government services.

Without income, or income after a known time delay, there is no basis for satisfactory control of personal finances and no production of revenue for the tax base.

In this section we see how and why some people can "know" that they are competent, secure, efficient, paying their share of taxes for government services and in control of their affairs. These same people may have never considered the issues of probability and chance and how these work to prevent other people from having any control of their affairs at all, to the point of becoming bankrupt and homeless, so as to force them into having an appearance of being "incompetent" and being "parasites" because they produce no tax revenue. This gives rise to the emotional phenomenon involving some successful people being "cocky", at the expense of others forced into failure through no fault of their own.

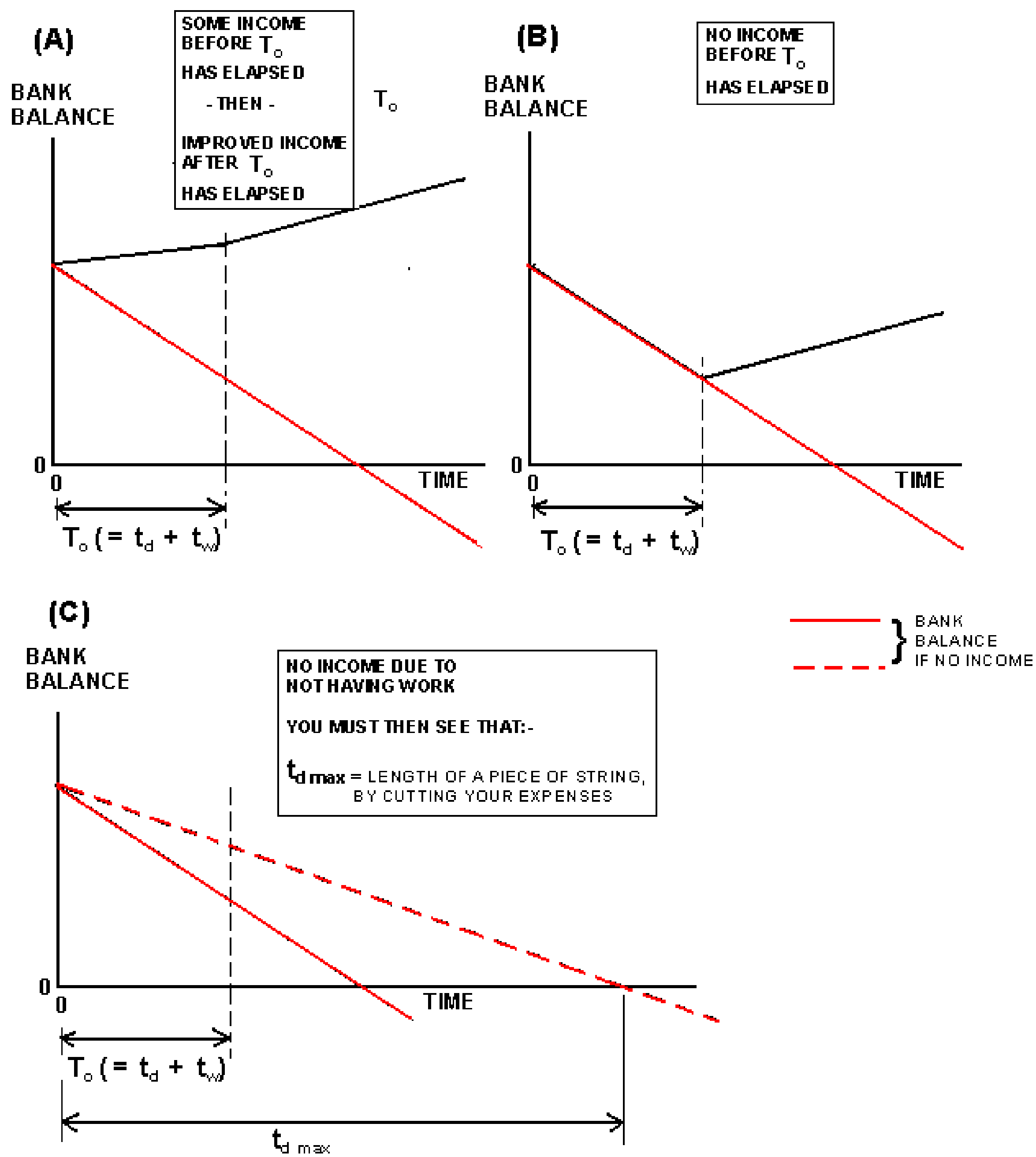
We see how, for others, it is virtually impossible, so that they feel totally out of control because nothing ever works (Sodd's Law), even though the underlying principles involving probabilities and chance are the same.

We see how taking a low paid job, because nothing else can be found, may also result in long-term loss of personal financial control and long term relative loss of revenue to the tax base, caused by employer attitudes, bureaucrat attitudes, lawyer attitudes, legalistic sophistry, societal attitudes, dis-entitlement to any E.I. benefits or re-training if you quit such a job, and other circumstances preventing any chance of advancement beyond the said "low-paid" job and any improvement in tax revenue generated by the person involved.

Lastly, we see how decisions about trying to find work in different fields, and time spent re-training, affect the overall financial result.

The differences in how the problem is perceived by one person versus another are entirely due to the differences in the numbers – assuming that they are actually even determinate - which must be substituted into the simple governing equations already detailed and exemplified. The same comments apply to what is perceived as a "solution" by different people in different situations.

Three main types of situation can occur in practice, as depicted in the bank balance charts below.



In all cases, there is a time delay $\mathbf{T_o}$ between starting a job search and achieving success. The people in situation type **(A),** who are already working, usually don't have to worry about the value of $\mathbf{T_o}$, unless their employers are in difficulties liable to result in layoffs. Further, the people in situation type **(A),** invariably the most favoured, often get better jobs through promotions with their current employers. Those in situation type **(B)** are also O.K.; these people have lost a job but are able to find another long before there is any concern about financial ruin. Those in situation type **(C)** are in trouble, for obvious reasons.

In all cases, the optimization problem to be solved is two-fold:

(a) minimise $\mathbf{T_o}$

(b) maximize the bank balance slope (monthly income minus monthly living expenses) after the time delay $\mathbf{T_o}$ has elapsed.

Obviously, in all cases, minimum T_o and maximum bank balance slope also mean maximum tax revenue production, at the tax rates then prevailing. We will look at some specific examples later.

We also have to account for the fact, for people without work, that a small T_o may mean a low income subsequently, possibly meaning a negative bank balance slope; alternatively, trying for a good positive bank balance slope may lead to an unacceptably large T_o **.**

In addition to this, we also have to examine the effects of :-

(a) trying to find many different types of job simultaneously, with each type having different success probabilities but where the success probabilities are not necessarily known due to poor labour market information and other factors
(b) the effects of doing any form of re-training - in terms of improving success probabilities, reducing T_o **,** and improving the bank balance slope after T_o has elapsed.

We don't really need to examine situation type **(A)** further because these people have little to worry about.

3.2. A PERSON IN CHARGE AND IN CONTROL – SITUATION TYPE (B)

Suppose this person is exceptional even though he /she is unemployed and classed in the top sub-group of 50 applicants, out of a total of 800 applicants for a job, where there is a 50% chance that someone in this top sub-group will get the job. This is part of the situation shown in **CHART 2** above.

We will also assume that this person has the previous job hunting history already analysed in **Example 2** above, where the average number of applications before landing a job was 12.4. Times are bad now, so the average number of applications before landing a job has increased to 100.

Now 100/12.4 = 8.065.

Let's assume 8. The market is 8 times worse than previously experienced. It is reasonable to assume that the number of applications and hence the time spent on research, composing applications and pre-interview follow-up will have increased by a factor of 8, for the same number of interviews and one acceptable job offer.

The calculations are shown in **Example 3 (p.31).**

Assuming we wanted the same success probability as before, **0.9567,** we find that t_d **= 513.9** hours – **12.9** weeks based on **40 hours per week of effort – probably no great cause for concern, though the person involved might still complain about "tough times", or some such.**

Some additional points worth noting about this person:-

1. Has good contacts in his / her field and is known professionally to plenty of people, so that the business of "...who you know..." is always working for them.
2. Did not seriously consider changing to another field of work, in spite of times being bad.
3. Has a normal social life outside work
4. Does not suffer fools gladly
5. Can and will correct the actions of fools who get in his / her way.
6. Does not seriously think about re-training because he / she can rely on good experience as a selling point in getting future work.
7. Has not had serious problems with excessive values of t_w happening at the wrong time.

8. Has no reason to think about others less fortunate, or their numbers, based on lack of time, lack of relevance and lack of knowledge.

More likely, at best, you might be in sub-group **4** where your chances involve **53 people applying for 0.05 of a job, that is a 1/1060 chance of any one application being successful**. In this case the **market is 1060 / 12.4 = 85 times worse**. The calculations for this case are shown in **Example 4 (p.30).**

In this case we find that 134 weeks of effort are needed, based on 40 hours per week – over 2 ½ years – to land a job.

In both the above examples, the numbers are obviously hypothetical but will serve to give some idea of the absurd length of time needed to find work in this kind of environment.

The position of long-term unemployed (1 year plus) – categorised as "Not in the Labour Force" along with students, retirees, disabled etc . – will likely be far worse. The pretence that such people are not unemployed serves merely to hide the numbers of jobs required to make tax payers out of them, so that government policies and the policies of others then do not recognise the numbers involved. Thus by default there are never sufficient jobs, unemployment is kept artificially high, this produces absurdly low success probabilities for most people seeking work, with the additional end result of large but hidden losses in revenues produced for the tax base.

Some questions for everybody:-

- Which probability groups do YOU belong in, in a job applicant population, and to what degree are they better or worse than the average?
- To what degree can you improve the probability of success by such things as re-training for other work, and / or seeking other kinds of work?
- What reduction in the values of t_w and T_o can you achieve, by re-training for other work?
- Can anybody, particularly someone out of work, even begin to see what their chances are and how long it will be before they get work?

3.3. THE PERSISTENTLY DIS-FAVOURED JOB HUNTER– SITUATION TYPE (C)

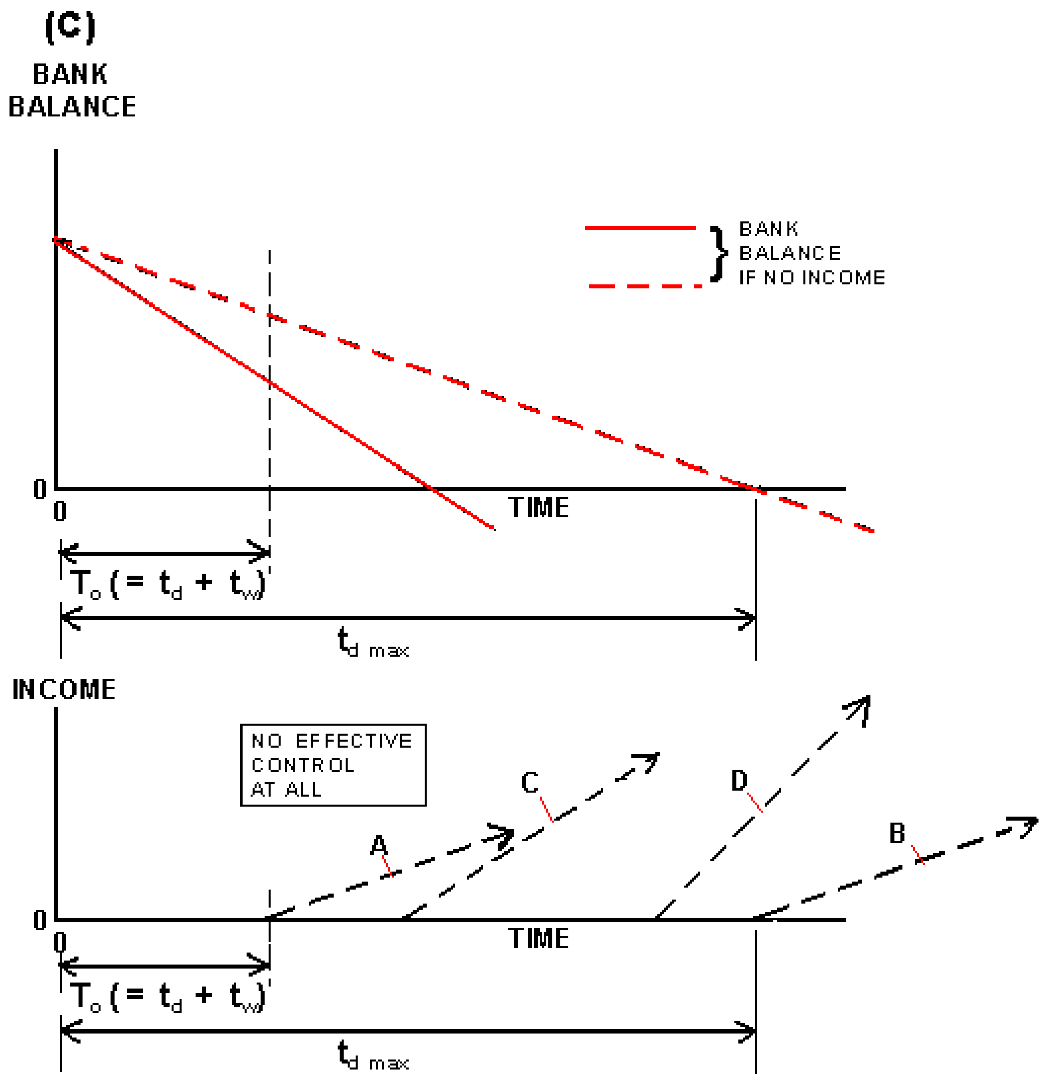
This person could be in the bottom sub-group of 242 applicants in **CHART 2** above, out of a total of 800 applicants for a job, where there is a **5% chance that someone in this bottom sub-group will get the job** and a **1/4840** chance of **any one job application being successful**. The problem of expected time to get a job is obvious, based on **Example 3 (p.31)** and **Example 4 (p.33)** which involved better success probabilities.

This person might have to deal with any or all of the following:-

1. Few or no contacts in his / her field, following a long period out of work, so that by default the business of "...who you know..." is always working against them
2. Is considering changing to some other field of work, sees some possible choices but finds job market information to be persistently unreliable; initial promises are later found to be false or mis-leading.
3. Has little or no social life.
4. Does not suffer fools gladly but constantly encounters them and they refuse to face the facts.
5. Does not trust average people because the latter are all corrupted by disinformation and stereotypes.
6. Is seriously thinking about re-training but he / she cannot rely on work being available afterwards because, due to social custom and ignorance, nobody will guarantee anything.
7. Finds that the average person does not care based on lack of time due to over-work, lack of relevance and knowledge.

8. May have run out of E.I. benefits, is classed as “ineligible” for any re-training assistance and categorised as “Not in the Labour Force”.
9. Finds that job applications are routinely ignored.
10. Finds that the average person is ignorant of the implications for the tax base.
11. Has to juggle with endless unknowns when trying to use his / her time efficiently.

Mathematically, their situation is like that shown in the bank balance and income chart below:-



Some other obvious factors are:-

1. Sooner or later they will become bankrupt and homeless, unless they are being supported by family or a working spouse who are all getting fed up and over-stressed.
2. Sooner or later they have to find work, in spite of the above.
3. Mathematically and from a financial planning standpoint, they are presented with an essentially un-solvable problem. This also prevents them saving anything for retirement.

Yet the rest of society – consisting of those with friends and colleagues who are passably well-off, working and in control of their affairs - expects them to manage their affairs properly like everybody else, notwithstanding the absence of satisfactory answers to the obvious questions involved. The rest of society has not been conditioned to analyse this kind of problem in terms of simple probability and statistics, so does not know that the same laws of cause and effect applies to it also.

In short, the rest of society doesn't know the mathematics that it needs to know concerning this problem. On the other hand, it pretends to know everything, when in fact what it is actually doing is setting an un-solvable mathematical problem for those less fortunate and then covering up the problem by means of various excuses and stereotypes.

This is like refusing to acknowledge that a car will go nowhere if there is no gas in the tank, and then blaming the car for being useless.

Apart from reducing living expenses to the minimum possible, represented by the dotted red line, in such a case the basic options are:-

1. Try for your usual kind of job until the expected $\mathbf{T_o}$ has elapsed. If that does not work then - if you are lucky – you might "quickly" get a low paid/menial job which produces just sufficient income to cover basic living expenses, represented by dotted line **A**
2. If you wait longer, you just might be lucky and get another job which pays as well as the last one, represented by dotted line **C**
3. If you do some form of re-training and get a better job as a result, you might – but only if you are lucky enough - get a situation represented by the dotted line **D**
4. If you don't do better than dotted line **B** then obviously you're liable to go bankrupt and become homeless.
5. Look into more types of work. Time spent doing this will increase $\mathbf{T_o}$ without necessarily yielding any promise of a line of work carrying better success probability. In Canada, "gut feeling" cannot be relied on because of ubiquitous unreliable or contradictory information.

Obviously there are endless possible permutations and combinations of these 5 basic options, in the course of a job search.

3.4. ENTRAPMENT IN UNDER-EMPLOYMENT AND CONSEQUENTIAL RESTRICTION OF TAX REVENUE GENERATED

For people in low-paid/menial work, this can very easily happen in Canada for any one of the following reasons, or some combination of them:-

1. Required hours of work which prevent any access to specialized libraries such as CISTI or other technical library necessary to keeping up to date, or evening courses.
2. Required un-social hours of work which interfere with control of personal domestic affairs and so compromise your reliability on the job.

Example: security guard work, which may impose a requirement to work a 1200 hrs to 2400 hrs shift.

3. Employers who are interested in cheap labour and cheapening people to the exclusion of all else, because they see this as the logical way to take advantage of job market conditions involving hundreds of applications for every position.

4. Perceived need to "dumb-down" a resume in order to hide educational qualifications from some employers, so that there is then no possibility of advancement beyond menial work - because, if the employer is told anything, they might lay someone off for being "...too intelligent and therefore liable to move or get bored...", or some such.
5. Non-availability of any re-training if you quit such a job, because E.I. regulations dis-entitle someone from any benefits including re-training if they quit a job - "just because" they are under-employed, as opposed to being laid off. This in fact is counter-productive because it blocks any possibility of generating more tax revenue, as shown below.
6. If they stay in such a job, non-availability of any financial assistance towards the cost of courses of any kind (e.g. evening courses or online courses).

CASE 1 - EXAMPLE OF UNDER-EMPLOYMENT – $10 PER HOUR. TAX REVENUE GENERATED

Examples: general labourer, security guard.

40 hours per week, 50 weeks per year assumed

Annual income then equals $20,000

Federal tax:-
Basic personal allowance: $7,756
Hence taxable income = $12,224
Tax on this, at 16% = $12,224 x 0.16 = **$1955.84**

Ontario tax:-
Basic personal allowance: $ 7,817
Hence taxable income = $12, 183
Tax on this, at 6.05% = $12,183 x 0.0605 = **$737.07**

Hence total tax revenues produced = $ (1955.84 + 737.07) **= $2692.87**

CASE 2 - EXAMPLE OF FULL EMPLOYMENT - $30 PER HOUR. TAX REVENUE GENERATED

Examples: engineer, software developer.

Annual income then equals $60,000

Federal tax:-
Basic personal allowance: $ 7,756 as before
Hence taxable income = $52,224

Tax rates: **16% on the first $32,183** = $32,183 x 0.16 **= $5149.28**

Remaining taxable income = $(52,224 – 32,183) = $20,041

Tax on this at 22% = $20,041 x 0.22 = **$4409.02**

Hence total federal tax = $(5149.28 + 4409.02) **= $9558.30**

<u>Ontario tax:-</u>

Basic personal allowance = $7,817 as before

Hence taxable income = $52,183

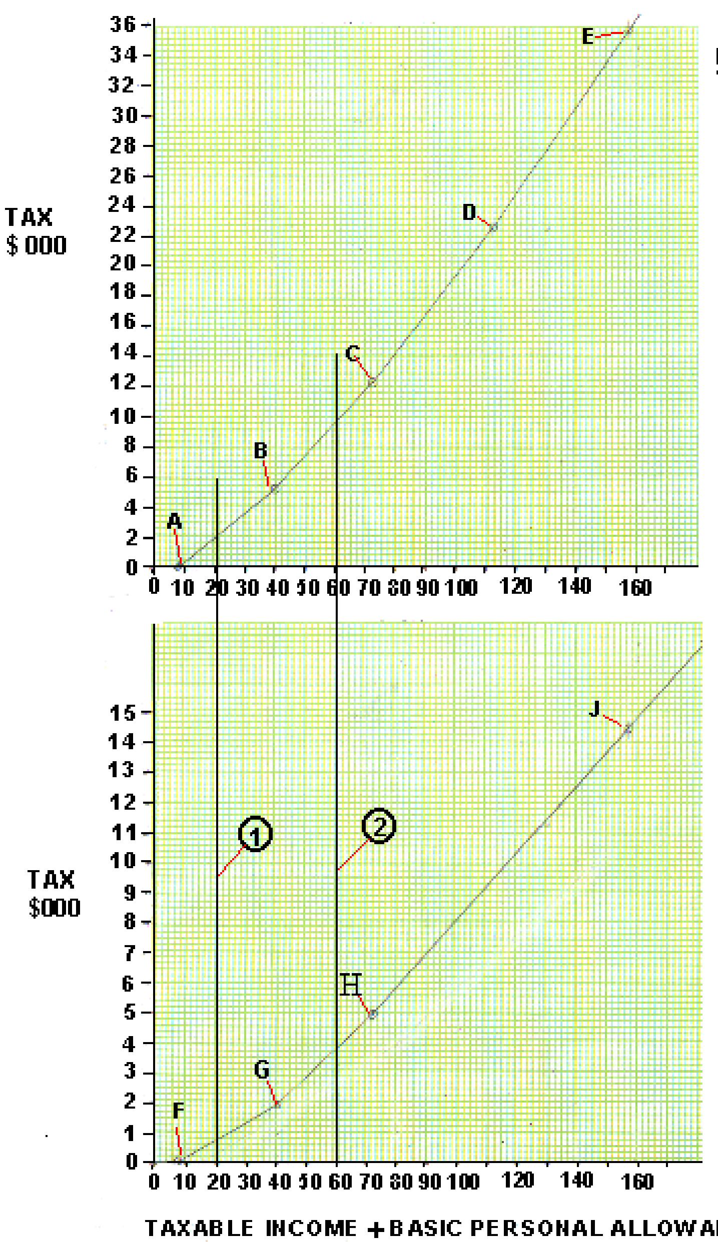
Tax rates: 6.05% on the first $32,435 = $1962.32
Hence remaining taxable income = $(52,183 – 32,435) = $19,748
Tax on this at 9.15% = $19,748 x 0.0915 = $1,806.94

Hence total Ontario tax = $(1,962.32 + 1,806.94) **= $3,769.26**

<u>Hence total tax revenues produced</u> = $(9558.30 + 3,769.28) **<u>= $ 13,327.56</u>**

<u>Comparing the above two examples, the difference between tax revenue produced, based on full versus under-employment = $10,634.69, each year.</u>

These examples are shown in the chart on the next page.



FEDERAL INCOME TAX PAYABLE
2003 - PERSONAL

POINT	INCOME $	TAX $
A	7,756	0
B	39,939	5,149.28
C	72,174	12,229.98
D	112,404	22,632.58
E	157,756	35,786.66

Note: from D to E and beyond, the marginal tax rate was 29% for 2003

ONTARIO TAX PAYABLE
2003 – PERSONAL

POINT	INCOME $	TAX $
F	7,817	0
G	40,252	1,962.32
H	72,688	4,930.21
J	157,817	14,430.61

Note: from H to J and beyond, the marginal tax rate was 16.16% for 2003

1 CASE 1 - EXAMPLE OF UNDER-EMPLOYMENT – $10 PER HOUR
2 CASE 2 - EXAMPLE OF FULL EMPLOYMENT - $30 PER HOUR.

These examples ignore other taxes that the persons involved will pay, collected in other ways. These include, among others, P.S.T., G.S.T., gasoline tax and alcohol taxes on some purchases.

The amount likely to be lost to the tax base resulting from a high tech worker being restricted to doing menial work, for whatever reason(s), is now obvious.

Hence any regulations or attitudes which act, by intent or default, to restrict a high tech worker in this manner, serve merely to restrict the tax revenue production potential. Therefore such regulations and attitudes are counter-productive.

4. CONCLUSIONS

1. The mathematics of job-hunting, financial control and tax revenue production have been explored.
2. An attempt has been made to analyse the effects of uneven success probability distribution within a group of 800 job applicants applying for one job.
3. The sense of security and control, or lack of security and total lack of control, felt by different job hunters have been analysed in terms of mathematical probabilities and job search success statistics for the individual.
4. In the case of people who are persistently successful, there is a lack of interest in or awareness of the underlying cause and effect relationships involving the mathematics of probability and chance as applied to job hunting.
5. In the case of people who are persistently un-successful, based on the analysis presented, no amount of competence on their part is likely to get them back to work - without attention by the rest of society to its own attitudes and the conditions necessary for creating jobs in the numbers required.
6. In particular, apart from other issues, society as a whole must pay attention to the group classed as "Not in the Labour Force". Other documents are available concerning the importance and size of the problem.
7. The above is critically important for the tax base.

APPENDIX 1

Probability of landing a job within "n" applications if the probability of any one application being successful is 1/N

In this analysis, we assume that an unbroken series of un-successful applications is followed by a successful one.

If 1 application is made, the probability of success, $\mathbf{P_{S1}}$, is clearly **1/N**

If 2 applications are made, the first one must fail and the second one must succeed.
For this case, the probability that the first will fail is:-

$$\mathbf{P_{F1} = (N-1)/N}$$

The probability that the second will succeed is:-

$$\mathbf{P_S = 1/N}$$

For our assumed model of what will happen, both these events must happen, in other words the probability of success in not more than 2 applications is:-

$$\mathbf{P_{S2} = P_S \, . \, P_{F1} = (1/N) \, . \, (N-1)/N}$$

If 3 applications are made, the first two must fail and the third must succeed. The probability of the first two failing is:-

$$\mathbf{P_{F2} = \{ (N-1)/N \}^2}$$

The probability that the third will succeed is:-

$$\mathbf{P_S = 1/N}$$

For our assumed model of what will happen, all these events must happen, in other words the probability of success in not more than 3 applications is:-

$$\mathbf{P_{S3} = P_S \, . \, P_{F2} = 1/N \, . \, \{ (N-1)/N \}^2}$$

In general, $\mathbf{P_{Sx} = P_S \, . \, P_{Fx} = 1/N \, . \, \{ (N-1)/N \}^{(x-1)}}$ **- equation (1)**

In practice, out of **"n"** job applications, success may happen on any one of the first, second, third ... **n** th applications, so that the overall probability of success is:-

$\mathbf{P_S = \sum P_{Sx}}$ where $\mathbf{x = 1 \text{ to } n}$

Comparing this with equation 1 above, we see that we have to find the sum to "n" terms of a geometric progression of the standard form $\mathbf{(a, ar, ar^2, ar^3 .....ar^{n-1}),}$ in which:-

first term, $\mathbf{a = 1/N}$
common ratio, $\mathbf{r = (N-1)/N}$

This is given by $\mathbf{S_n = a(1-r^n)/ (1-r) = P_S = \sum P_{Sx}}$
When we substitute the expressions for "**a**" and "**r**" , this reduces to:-

$\mathbf{P_S = 1- \{(N-1)/N\}^n}$ **- equation (2)**

Alternative form of equation (2)

We might want to know the number of applications, **n** , needed for a given success probability **P_S**. Rearranging equation (2) we get:-

$1- P_S = \{(N-1)/N\}^n$, so that **$\log(1- P_S) = n \log\{(N-1)/N\}$**

and **$n = \log(1- P_S) / \log\{(N-1)/N\}$** **- equation (2a)**

Example

Based on a survey of employers, they get 800 job applications for every position advertised. In such an environment, what is the probability that you will get a job:-

(a) after 100 applications?
(b) after 800 applications?

Solutions:-

For case (a), there is a 1/800 chance of any one job application succeeding, so that **N = 800.** If you do 100 applications then **n = 100,** so that

$$P_S = 1- \{(800-1)/800\}^{100} \qquad \text{- equation (2)}$$
$$= 1- 0.88243 = \underline{0.1177}$$

Hence in this environment the chance of success after 100 applications is only 11.77%

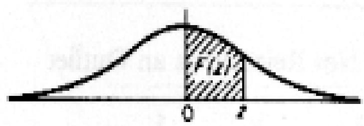
For case (b), there is a 1/800 chance of any one job application succeeding, so that **N = 800.** If you do 800 applications then **n = 800,** so that

$$P_S = 1- \{(800-1)/800\}^{800} \qquad \text{- equation (2)}$$
$$= 1- 0.3676 = \underline{0.6324}$$

Hence in this environment - a 1/800 chance of success in any one application - the chance of success after 800 applications is only 63.24%. It is obvious from the form of equation (2) that it does NOT follow that "N" job applications will guarantee success, in an environment where the chance of success with any one application is 1/N.

APPENDIX 2
Normal probability distribution

TABLE A-4



Areas under the Normal Curve

$$F(z) = \int_0^z \frac{1}{\sqrt{2\pi}} e^{-z^2/2}\, dz$$

Z	*.00*	*.01*	*.02*	*.03*	*.04*	*.05*	*.06*	*.07*	*.08*	*.09*
.0	**.0000**	**.0040**	**.0080**	**.0120**	**.0159**	**.0199**	**.0239**	**.0279**	**.0319**	**.0359**
.1	**.0398**	**.0438**	**.0478**	**.0517**	**.0557**	**.0596**	**.0636**	**.0675**	**.0714**	**.0753**
.2	**.0793**	**.0832**	**.0871**	**.0910**	**.0948**	**.0987**	**.1026**	**.1064**	**.1103**	**.1141**
.3	**.1179**	**.1217**	**.1255**	**.1293**	**.1331**	**.1368**	**.1406**	**.1443**	**.1480**	**.1517**
.4	**.1554**	**.1591**	**.1628**	**.1664**	**.1700**	**.1736**	**.1772**	**.1808**	**.1844**	**.1879**
.5	**.1915**	**.1950**	**.1985**	**.2019**	**.2054**	**.2088**	**.2123**	**.2157**	**.2190**	**.2224**
.6	**.2257**	**.2291**	**.2324**	**.2357**	**.2389**	**.2422**	**.2454**	**.2486**	**.2518**	**.2549**
.7	**.2580**	**.2611**	**.2642**	**.2673**	**.2704**	**.2734**	**.2764**	**.2794**	**.2823**	**.2852**
.8	**.2881**	**.2910**	**.2939**	**.2967**	**.2995**	**.3023**	**.3051**	**.3078**	**.3106**	**.3133**
.9	**.3159**	**.3186**	**.3212**	**.3238**	**.3264**	**.3289**	**.3315**	**.3340**	**.3365**	**.3389**
1.0	**.3413**	**.3438**	**.3461**	**.3485**	**.3508**	**.3531**	**.3554**	**.3577**	**.3599**	**.3621**
1.1	**.3643**	**.3665**	**.3686**	**.3708**	**.3729**	**.3749**	**.3770**	**.3790**	**.3810**	**.3830**
1.2	**.3849**	**.3869**	**.3888**	**.3907**	**.3925**	**.3944**	**.3962**	**.3980**	**.3997**	**.4015**
1.3	**.4032**	**.4049**	**.4066**	**.4082**	**.4099**	**.4115**	**.4131**	**.4147**	**.4162**	**.4177**
1.4	**.4192**	**.4207**	**.4222**	**.4236**	**.4251**	**.4265**	**.4279**	**.4292**	**.4306**	**.4319**
1.5	**.4332**	**.4345**	**.4357**	**.4370**	**.4382**	**.4394**	**.4406**	**.4418**	**.4430**	**.4441**
1.6	**.4452**	**.4463**	**.4474**	**.4485**	**.4495**	**.4505**	**.4515**	**.4525**	**.4535**	**.4545**
1.7	**.4554**	**.4564**	**.4573**	**.4582**	**.4591**	**.4599**	**.4608**	**.4616**	**.4625**	**.4633**
1.8	**.4641**	**.4649**	**.4656**	**.4664**	**.4671**	**.4678**	**.4686**	**.4693**	**.4699**	**.4706**
1.9	**.4713**	**.4719**	**.4726**	**.4732**	**.4738**	**.4744**	**.4750**	**.4756**	**.4762**	**.4767**
2.0	**.4772**	**.4778**	**.4783**	**.4788**	**.4793**	**.4798**	**.4803**	**.4808**	**.4812**	**.4817**
2.1	**.4821**	**.4826**	**.4830**	**.4834**	**.4838**	**.4842**	**.4846**	**.4850**	**.4854**	**.4857**
2.2	**.4861**	**.4865**	**.4868**	**.4871**	**.4875**	**.4878**	**.4881**	**.4884**	**.4887**	**.4890**
2.3	**.4893**	**.4896**	**.4898**	**.4901**	**.4904**	**.4906**	**.4909**	**.4911**	**.4913**	**.4916**
2.4	**.4918**	**.4920**	**.4922**	**.4925**	**.4927**	**.4929**	**.4931**	**.4932**	**.4934**	**.4936**
2.5	**.4938**	**.4940**	**.4941**	**.4943**	**.4945**	**.4946**	**.4948**	**.4949**	**.4951**	**.4952**
2.6	**.4953**	**.4955**	**.4956**	**.4957**	**.4959**	**.4960**	**.4961**	**.4962**	**.4963**	**.4964**
2.7	**.4965**	**.4966**	**.4967**	**.4968**	**.4969**	**.4970**	**.4971**	**.4972**	**.4973**	**.4974**
2.8	**.4974**	**.4975**	**.4976**	**.4977**	**.4977**	**.4978**	**.4979**	**.4980**	**.4980**	**.4981**
2.9	**.4981**	**.4982**	**.4983**	**.4983**	**.4984**	**.4984**	**.4985**	**.4985**	**.4986**	**.4986**
3.0	**.4987**	**.4987**	**.4987**	**.4988**	**.4988**	**.4989**	**.4989**	**.4989**	**.4990**	**.4990**
3.1	**.4990**	**.4991**	**.4991**	**.4991**	**.4992**	**.4992**	**.4992**	**.4992**	**.4993**	**.4993**
3.2	**.4993**	**.4993**	**.4994**	**.4994**	**.4994**	**.4994**	**.4994**	**.4995**	**.4995**	**.4995**
3.3	**.4995**	**.4995**	**.4996**	**.4996**	**.4996**	**.4996**	**.4996**	**.4996**	**.4996**	**.4997**
3.4	**.4997**	**.4997**	**.4997**	**.4997**	**.4997**	**.4997**	**.4997**	**.4997**	**.4998**	**.4998**
4.0	**.499968**									
5.0	**.4999997**									

Source: "Basic Statistical Methods for Scientists and Engineers", 2nd Edition. John B. Kennedy, Adam M. Neville. Published by: Thomas Y. Crowell Company Inc., 1976.

APPENDIX 3

Ratios reported of job seekers to positions open – examples

Ratio	Source	Remarks
300 to 800	http://groups.yahoo.com/group/OttawaHiTech/message/329	From Paul Swinwood, President of SHRC
Up to 5,000	http://groups.yahoo.com/group/OttawaHiTech/message/663	Federal government
1000	http://groups.yahoo.com/group/OttawaHiTech/message/794	Federal government (DND)
1000	http://groups.yahoo.com/group/OttawaHiTech/message/797	Ditto – example involved 1000 applicants, of whom 265 selected to write exam, of whom 75 interviewed, of whom 25 put on eligibility list for between 4 and 15 positions depending on funding (note: 15 minus 4 equals 11 possible “pink elephant” situations for some unlucky persons involved)
***N/s	http://groups.yahoo.com/group/OttawaHiTech/message/2754	***Refer to OSPE letter to the P.M. dated March 18th 2004 – effects of immigration policy
500+	http://groups.yahoo.com/group/OttawaHiTech/message/3774	Local (Ottawa) engineering co: 500 applicants in one week quoted by the co.’s HR dept.
1,470	mail@a-better-chance.org - e-mail to author Monday, May 09, 2005 3:28 PM	Local (Ottawa) agency helping immigrants.
111 (approx.)	http://groups.yahoo.com/group/OttawaHiTech/message/5459	Bangalore, India – 1 million applicants for 9,000 jobs

******* This letter, from the Ontario Society of Professional Engineers to the Prime Minister of Canada, The Right Honourable Paul Martin, is in APPENDIX 4**.** See in particular their remarks concerning the years 2001 and 2002.

APPENDIX 4

O.S.P.E.: Effect of mis-functioning immigration policy

ONTARIO SOCIETY OF PROFESSIONAL ENGINEERS

March 18, 2004

The Right Honourable Paul Martin
Prime Minister of Canada
Office of the Prime Minister
80 Wellington Street
Ottawa, K1A 0A2

Dear Prime Minister Martin:

We listened with interest to your "town hall" meeting on CBC's *The National* on the evening of February 4, 2004, and commend you for your desire to listen to and address the concerns of Canadians from all walks of life.

One of the statements you made in responding to a question from an internationally-trained doctor was of particular interest. You indicated that his particular dilemma – being unable to find a residency space so he can get a licence to practise medicine – was not restricted to doctors. You explained that this challenge is being faced by other professions as well, and engineers were specifically mentioned.

The Ontario Society of Professional Engineers (OSPE) is the advocacy body for engineers in Ontario. Our organization agrees that internationally-trained professionals deserve respect and fair evaluation of their credentials and experience. Indeed, the engineering profession in Ontario is exemplary in this regard. According to our regulator, Professional Engineers Ontario (PEO), over 60% of internationally-trained applicants in Ontario receive credential recognition sufficient for licensure without the need to write a single technical examination – something few, if any, regulated professions can claim.

Prospective immigrants can even have their credentials reviewed and approved by Professional Engineers Ontario **prior to immigration**. Once their credentials are accepted, applicants are granted a Provisional Licence to practise while they gather the required 12 months of Canadian experience. The Canadian experience year is a minimal and necessary requirement for the protection of the public, to ensure that all licensees are aware of the laws, codes, standards and business norms applicable to their professional practice here in Canada.

Why, then, do we continue to hear about recent-immigrant engineers driving taxicabs, or working in other similar jobs that do not make proper use of their skills and experience?

The answer is simple: supply and demand.

Taking the year 2001 as an example, about 10,225 internationally educated engineers settled in Toronto alone – **a number greater than Canada's entire graduating class of engineers combined,** in a city with only 17% of Canada's jobs! According to data from Citizenship and Immigration Canada, engineers represent 70-80% of all the regulated professionals immigrating to Canada. This was before the 2002 reforms to the *Canadian Immigrant and Refugee Protection Ac*t, which removed any notion of demand-matching controls for immigration. Combined with a jump in university engineering enrollments to take care of the "double cohort" in Ontario, the IRPA changes ensure that the supply of engineers will likely continue to outstrip demand for the foreseeable future.

One potential solution to this growing problem in our profession is to provide incentives to businesses to hire recent engineering graduates and recent immigrants registered in the Engineering Internship Training Program of PEO, so that they can gain the most valuable type of experience: that which is gained on the job, under the direct supervision of experienced, licensed professional engineers. Without adequate access to entry-level opportunities, the crisis of under-utilization in our profession will not improve, and the potential of our immigrants and graduates will continue to be wasted.

The Ontario Society of Professional Engineers is currently working with the Canadian Council of Professional Engineers (CCPE), the national organization of the 12 provincial and territorial associations that regulate the practice of engineering in Canada, to address these issues. Paul Martin, P.Eng., a member of our Board of Directors, is a member of CCPE’s *From Consideration to Integration* Project Task Force. The goal of the Task Force is to help international engineering graduates integrate as quickly and efficiently as possible into the engineering profession in Canada as licensed professional engineers.

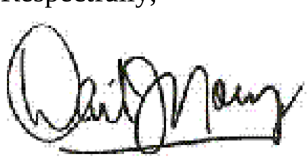
Another approach would involve aligning the goal of providing employment opportunities for Canada's engineers – key innovators in the Canadian economy – with the Federal Government's Innovation Strategy. Properly targeted and coordinated investment on the part of all three levels of our government would yield maximum benefit for Canada's economy.

Immigration enriches our country culturally and other ways too numerous to mention, but we **must** be honest with prospective immigrants to Canada about their job prospects and professional/regulatory requirements **before they choose to come** .

Uncontrolled supply to our profession is also unjust to the thousands of students who are turned away yearly from entry into Canadian engineering programs, and to the approximately 9,000 young women and men who graduate from those programs annually. The voice of this segment of our profession is not heard in the media as clearly as it should be, and the universities, which profit from their unregulated tuition fees, are less than receptive to their plight.

The Ontario Society of Professional Engineers believes that all levels of government have a responsibility to ensure that each individual can reach his or her full human potential by playing an active role in society. OSPE will continue to advocate for the interests of the 66,000 licensed professional engineers in Ontario, as well as those seeking licensure. We're committed to supporting and encouraging the interests of engineers and engineering students, wherever they received their education. We view the potential over-supply, under-employment and under-utilization of professional engineers as some of the most serious issues facing our membership, and look forward to working with your government in our efforts to address them.

Respectfully,



Daniel J. Young, M. Eng, P. Eng.
President and Chair, OSPE
200429

EXAMPLE 1.

If you have held 5 jobs including the one you have now, as follows:-

Job no.	No. of applications made before getting it, X_i	X_i^2
1	10	100
2	15	225
3	5	25
4	20	400
5	12	144
	$\sum X_i = 62$	$\sum X_i^2 = 894$

The average, $\mu = \sum X_i/n = 62/5 = 12.4$

So that the standard deviation, $\sigma = \sqrt{[\sum(X_i - \mu)^2] / n}$

Alternatively, $\sigma = n^{-1}\sqrt{\{ n\sum X_i^2 - (\sum X_i)^2\}}$

In this example, $n = 5$, $\sum X_i^2 = 894$ and $(\sum X_i)^2 = 62^2 = 3844$, giving $\sigma = 5.004$.

We now look at the normal probability distribution curve, shown in **Appendix 2 (p.22),** which tells us what fraction of all possible values can be expected to lie between **0** and "+**z**" standard deviations from the average. The area under this curve, widely known and used in statistics, is given by:-

$$F(z) = \int_0^z \frac{1}{\sqrt{2\pi}} e^{-\frac{z^2}{2}} dz$$

We don't need to concern ourselves here with the evaluation of this integral, because tables such as the one shown are widely available giving values of **F(z)** versus **z.** It tells us the probability that, based on previous experience, any future value of **X,** the number of applications needed, will lie between **0** and **+z** standard deviations from the average.

What we are actually interested in is the "never-exceed" probability, P_{ne}, that **X** will not exceed a certain value in the future. By inspection, if the chosen value of **X** exceeds the average μ, this is then given by:-

$P_{ne} = 0.5 + F(z)$ ...... **equation (3)**

If the chosen value of **X** equals the average μ then **z = 0, F(z) = 0** and

$P_{ne} = 0.5$ ...... **equation (4)**

If the chosen value of **X** is less than the average μ then

$P_{ne} = 0.5 - F(z)$ ...... **equation (5)**

The number of standard deviations from the mean ("**z**-score") is given by:-
$z = (X - \mu) / \sigma$

Example

Based on experience with jobs 1 to 5 above, that you got in the past, what is the probability that you will not need to do more than 20 job applications when you apply for a job in the future?

Solution:-

For this experience, we have seen above that $\mu =$ **12.4** and **$\sigma = 5.004$.**

The worst case was with job no 4, where you had to make 20 applications in order to get it, so you might think – quite reasonably – that you would not have to make more than 20 in the future. In fact, as we will now see, this is not quite true - so we want to know the probability that it **will** be true.

For this case, **$X = 20$** so that **$z = (X - \mu) / \sigma$**
$= (20 - 12.4) / 5.004$, so that **$z = 1.5188$**
From the table in **Appendix 2 (p.22),** we find that for **$z = 1.52$** then **$F(z) = 0.4357$**

So from equation (3), because $X > \mu$:-

$$P_{ne} = 0.5 + F(z)$$

$$P_{ne} = 0.5 + 0.4357$$

So $$P_{ne} = 0.9357$$

EXAMPLE 2

Time expected to be necessary on job hunting activities, to get a job.

Job no.	**No. of applications made before getting it, X_i**	**Initial Applications**	**No. of Interviews**
1	**10**	**10**	**3**
2	**15**	**15**	**2**
3	**5**	**5**	**3**
4	**20**	**20**	**4**
5	**12**	**12**	**3**

Nearly all hiring decisions are made after only one interview as opposed to 2, so the effect of second interviews on the time needed to get a job will be ignored in this example.

The actual time needed to compose an application and send it out will vary according to the job in question; the same comment applies to an interview. For this example we will assume the following averages which are considered realistic:-

Initial application: 1 hour
Interview: 4 hours

In addition to this, we will need to spend some time researching each company we approach, plus follow-up at different stages of the application. Again, the actual times spent at each stage will vary for each company. For this example we will assume the following averages:-

R: Research: 1 hour per company

Follow-up:-

F1: After sending out the application, prior to interview: 1 hour per company
F2: After interview: 1 hour per company

We will use the abbreviations **R**, **F1**, **F2**, in the table below. Based on the foregoing assumptions about times, we now get:- (times in hours)

Job no.	**No. of applications made before getting it, X_i**	**Initial Applications**	**No. of Interviews**
1	**10**	**10**	**3**
2	**15**	**15**	**2**
3	**5**	**5**	**3**
4	**20**	**20**	**4**
5	**12**	**12**	**3**

Job no.	**R**	**Times-apps.**	**F1**	**Times – Interviews**	**F2**	**Total Hours**
1	**10**	**10**	**10**	**12**	**3**	**45**
2	**15**	**15**	**15**	**8**	**2**	**55**
3	**5**	**5**	**5**	**12**	**3**	**30**
4	**20**	**20**	**20**	**16**	**4**	**80**
5	**12**	**12**	**12**	**12**	**3**	**51**

So in this case we spent a total of 45 hours doing job applications and other activities in order to land job no. 1, 55 hours to land job no. 2, etc.

We now analyse these times spent in exactly the same way as for the numbers of applications, in **Example 1**, as follows:-

Job no.	**Total Hours, t_{di}**	$t_{di}^{\ 2}$
1	**45**	**2025**
2	**55**	**3025**
3	**30**	**900**
4	**80**	**6400**
5	**51**	**2601**
	$\sum t_{di} = 261$	$\sum t_{di}^{\ 2} = 14951$

The average, $\mu = \sum t_{di} / n = 261/5 = 52.2$

So that the standard deviation, $\sigma = \sqrt{[\sum (t_{di} - \mu)^2] / n}$

Alternatively, $\sigma = n^{-1}\sqrt{\{ n\sum t_{di}^{\ 2} - (\sum t_{di})^2 \}}$

In this example, $n = 5$, $\sum t_{di}^{\ 2} = 14951$ and $(\sum t_{di})^2 = 261^2 = 68121$, giving $\sigma = 16.290.$

We see that the worst case was again with job no 4, where we spent 80 hours on the various activities necessary to getting it. What is the probability that this won't be exceeded in the future, when we apply for a job? We use the normal probability distribution curve, as before, as follows:-

For this case, the time delay $t_d = 80$ so that $z = (t_d - \mu) / \sigma$
$= (80 - 52.2) / 16.290,$ so that $z = 1.7066$

From the table in **Appendix 2 (p.22),** we find that for $z = 1.71$ then $F(z) = 0.4564$

So from equation (3):- $P_{n\,e} = 0.5 + F(z)$

We find that $P_{n\,e} = 0.5 + 0.4564$

So $P_{n\,e} = 0.9564$

So we conclude, from previous experience, that the probability that you won't need to spend more than 85 hours on applying for your next job is 95.64%. This, as for the number of applications (not more than 20, with a confidence level of 93.57%), might seem fine, based on previous experience.

EXAMPLE 2A

Alternative method – time to get a job.

If you have a general idea of the total time spent on all the activities connected with getting a job, but no detailed records for every stage with every employer approached, you might proceed as shown below.

In **Example 2**, the total was 261 hours to get 5 jobs, 62 job applications were needed giving an average of 12.4 applications per job.

Then average time per application $\mathbf{t_a = 261/62 = 4.03}$ hours

The confidence level was **0.9567** that not more than 20 applications would result in a job, and you consider this to be satisfactory from previous experience.

You now want to know the time to get a job if the chance of any one application succeeding is **1/800,** for the same probability of success.

Solution

From **equation 2(a) :-**

$$\mathbf{n = \log(1-P_s)/ \log\{(N - 1)/N\}}\ ,$$

where **n** = no. of applications required
and $\mathbf{P_s}$ **= required** probability of success after ‘’**n**’’ applications, in this example **0.9567**
and **1/N =** probability of any one application being successful, in this case **1/800**

Using logs to base 10 this gives :-

$$\mathbf{n = \log(1-0.9567)/ \log\{(800 - 1)/800\} = -1.3635 / -0.0005432 = 2510}$$

The time needed then is :-

$$\mathbf{t_d = t_a.n = 4.03 \times 2510 = 10{,}116}\ \text{hours}$$

This is actually a pessimistic prediction because in a bad market, less time will be spent on interviews relative to everything else, so the average time per application will be less. On the other hand, it is still useful in terms of indicating which course of action will or will not be worthwhile, when considering many kinds of jobs in difficult economic times.

EXAMPLE 3

The time spent on research, composing applications and pre-interview follow-up have increased by a factor of 8, relative to **Example 2**, for the same number of interviews and one acceptable job offer. When times were good, the experience record of this person was:-

Job no.	**R**	**Times-apps.**	**F1**	**Times – Interviews**	**F2**	**Total Hours**
1	**10**	**10**	**10**	**12**	**3**	**45**
2	**15**	**15**	**15**	**8**	**2**	**55**
3	**5**	**5**	**5**	**12**	**3**	**30**
4	**20**	**20**	**20**	**16**	**4**	**80**
5	**12**	**12**	**12**	**12**	**3**	**51**

Since times are now bad and expected to remain so for a long time, for 5 jobs that this person might get in the future then the following future experience might occur:-

Job no.	**R**	**Times-apps.**	**F1**	**Times – Interviews**	**F2**	**Total Hours**
1	**80**	**80**	**80**	**12**	**3**	**255**
2	**120**	**120**	**120**	**8**	**2**	**370**
3	**40**	**40**	**40**	**12**	**3**	**155**
4	**160**	**160**	**160**	**16**	**4**	**500**
5	**96**	**96**	**96**	**12**	**3**	**303**

The times in columns 2 to 4 inclusive are all increased by a factor of 8, whilst the times spent on interviews and post-interview follow-up remain the same. So now we get:-

Job no.	**Total Hours, t_{di}**	**t_{di}^2**
1	**255**	**65025**
2	**370**	**136900**
3	**155**	**24025**
4	**500**	**250000**
5	**303**	**91809**
	$\sum t_{di} = 1583$	**$\sum t_{di}^2 = 567759$**

The average, $\mu = \sum t_{di} / n = 1583/5 = 316.6$

So that the standard deviation, $\sigma = \sqrt{[\sum(t_{di} - \mu)^2] / n}$

Alternatively, $\sigma = n^{-1}\sqrt{\{n\sum t_{di}^2 - (\sum t_{di})^2\}}$

In this example, $n = 5$, $\sum t_{di}^2 = 567759$ and $(\sum t_{di})^2 = 1583^2 = 2505889$, giving $\sigma = 115.40$

We see that the worst case will be with job no 4, where we will spend 500 hours on the various activities necessary to getting it. What is the probability that this won't be exceeded, when we apply for any job? We use the normal probability distribution curve, as before, as follows:-

For this case, $\mathbf{t_d = 500}$ so that $\mathbf{z = (t_d - \mu) / \sigma}$

$$= (500 - 316.6) / 115.40, \text{ so that } z = 1.5892$$

From the table in **Appendix 2 (p.22),** we find that for **z = 1.59** then **F(z) = 0.4441**

So from equation (3):- $\mathbf{P_{n\,e} = 0.5 + F(z)}$

We find that $\mathbf{P_{n\,e} = 0.5 + 0.4441}$

So $\mathbf{P_{n\,e} = 0.9441}$

So we conclude, from previous experience, that the probability that you won't need to spend more than 500 hours (12.5 weeks based on 40 hours per week of effort) on applying for a job in these bad times is 94.41%, in other words $\mathbf{t_d}$ will not exceed 500 hours with a confidence level of 94.41%,. This might be a cause for complaint when the worst wait for a job, from previous experience gained in better times, was about 2 weeks (85 hours of effort).

If we wanted the same $\mathbf{P_{n\,e}}$ as before, **0.9567** , then **F(z) = 0.4567, z = 1.71** so that

$\mathbf{t_d = \mu + 1.71\,\sigma = 316.6 + 1.71 \times 115.40,}$

so that $\mathbf{t_d = 513.9}$ hours – 12.9 weeks based on 40 hours per week of effort - little different and probably no cause for concern.

EXAMPLE 4.

Job market 85 times worse than in **Example 2**

Future job hunting experience in this 85 times worse market would then be :-

Job no.	R	Times-apps.	F1	Times – Interviews	F2	Total Hours
1	**850**	**850**	**850**	**12**	**3**	**2565**
2	**1275**	**1275**	**1275**	**8**	**2**	**3835**
3	**425**	**425**	**425**	**12**	**3**	**1290**
4	**1700**	**1700**	**1700**	**16**	**4**	**5120**
5	**1020**	**1020**	**1020**	**12**	**3**	**3075**

The times in columns 2 to 4 inclusive are all increased by a factor of 85, whilst the times spent on interviews and post-interview follow-up remain the same. So now we get:-

Job no.	Total Hours, t_{di}	$t_{di}^{\ 2}$
1	**2565**	**6579225**
2	**3835**	**14707225**
3	**1290**	**1664100**
4	**5120**	**226214400**
5	**3075**	**9455625**
	$\sum t_{di} = 15885$	$\sum t_{di}^{\ 2} = 58620575$

The average, $\mu = \sum t_{di} / n = 15885/5 = 3177$

So that the standard deviation, $\sigma = \sqrt{\ } [\sum(t_{di} - \mu)^2] / n$

Alternatively, $\sigma = n^{-1}\sqrt{\{ n\sum t_{di}^{\ 2} - (\sum t_{di})^2\}}$

In this example, $n = 5$, $\sum t_{di}^{\ 2} = 58620575$ and $(\sum t_{di})^2 = 15885^2 = 252333225$,
giving $\sigma = 1277.02$

Based on previous experience in better times, a success probability of **0.9567** was considered satisfactory.

Hence $F(z) = 0.4567$ and $z = 1.71$ as before (see also **Appendix 2 (p.22)**) so that

$t_d = \mu + 1.71\ \sigma$
$= 3177 + 1.71 \times 1277.02 = 5360.7$ hours.

This is 134 weeks of effort based on 40 hours per week – over 2 ½ years.