INSTITUTE AND FACULTY OF ACTUARIES

SUMMARY

February 2016

CA2: Model Documentation, Analysis and Reporting

Paper 2

Josie's Jamboree financial projections

Objective

Our client, Sally, is the owner of Josie's Jamboree ("JJ's"). JJ's is a children's playgroup where an age dependent fee is charged for children to attend classes and costs are incurred in its running.

Currently Sally runs the children's playgroup as a standalone business. She has been running it for a number of years and would like to project forward her profits, allowing for the anticipated expansion of the child population over the next 10 years. Sally is considering expanding her business by allowing others to buy franchises and set up their own JJ's playgroups in return for an upfront fee and an ongoing return of a percentage of their profits.

The purpose of this project is to calculate the profits Sally can expect to receive under the existing business model and allowing for the introduction of franchises. Sally would like to aim to achieve annual profits of at least $150,000 within the next ten years and would like to know when she would need to start selling franchises to meet that target.

Data

Sally has supplied the following data:

- The current population of children, split by age group, at JJ's.
- The anticipated starting population of children for a JJ's franchise.
- The decrements for new starters and leavers.
- The factor to apply to the adjustment formula for new starters, under the existing business and for a franchise.
- The costs associated with running the business. Some costs are fixed, some are semi-variable and some are variable.
- The fees per child per class for each age group.
- The franchise charges which comprise an upfront fixed cost, and an annual proportion of profits charged.

In addition it is also noted that government data indicates that inflation has been 0% for several years.

The data looks reasonable in so far as:

- the expected new starters reflect the same pattern as the existing population i.e. more younger children than older.

- the leavers decrements appear reasonable with all children age 4 leaving, which is required as no children over 5 are allowed at the centre.

- the fees are all within a small range of one another.

Assumptions

- The data provided by Sally is correct.

- Children are expected to join and leave on average half way through the year.

- The leavers decrements apply equally to existing members as they do to new joiners.

- The age of the children is expected to change at the start of the financial year.

- Children are expected to attend 52 classes a year.

- The maximum age a child can attend a class is 4.

- Inflation is assumed to be 0% for the next 10 years.

- Children are assumed to start and leave in whole numbers, therefore new starters are rounded up to whole numbers and leavers are rounded down to whole numbers.

- Profits are not affected by taxation.

- **There are no costs associated with providing the franchise opportunities.**

- **The opening of franchises are independent of one another. Each additional franchise will not affect the running of any existing businesses.**

- **Any franchise opened starts operation at the beginning of one of Sally's financial year.**

- **The decrements provided (and formulaic adjustments proposed) are suitable for the projection of the population.**

- **The decrements and charges are independent of sex.**

- **The movement of children (starting and leaving) are independent of one another.**

- **Sally is able to sell franchises whenever she chooses to.**

- **The change to the starting decrements is appropriate given the proposed change to the class fees.**

Method

Existing business

Number of children

The existing child population is projected forward by allowing for the starters and leavers decrements.

The year 1 beginning of year population is provided by Sally.

Each year new children join JJ's. Sally provided a decrement table to reflect the number of new starters at each age. This number is adjusted by a factor calculated using the cumulative normal distribution function, found using the following formula:

$$\text{Adjustment} = \Phi\left(\frac{\ln(n)}{\text{fac}}\right)$$

where n is the year of the projection, and fac is a predefined factor. This factor is 2 for the existing business scenario.

The number of leavers in the year is a proportion of the population and is found as follows:

Number of leavers = (number at BoY + 0.5 × number of starters) × proportion of population in decrement table

The population at the start of the following year can then be found by taking the children at the start of the year plus the new starters minus the leavers, and ageing them by a year.

Financial projections

Financial projections are made on a financial year basis.

Each year the income is found by taking the average number of children present in the centre over the course of that year and multiplying it by the appropriate fee for the age of the child for each of the 52 weeks of the year.

The outgoings consist of three elements. The fixed costs are constant over the ten years of the projections. The semi variable cost is dependent on the number of children present, with a cost being incurred for every 40 children. The number of times 40 can be divided into the population is found and rounded up, and then multiplied by the semi variable cost. The total variable cost is found by taking the average number of children for the year and multiplying it by the cost per child per month. The total outgoings are found by adding together the three costs.

Finally, the profit is found by taking the difference between the total income and the total outgoings.

Franchise modelling

Projecting the child population

The same calculations were undertaken as for the existing business's projections with a few minor adjustments.

- The population at the beginning of year 1 of the franchise is adjusted to reflect the anticipated franchise starting population provided by Sally.

- The factor used in the cumulative normal distribution function adjustment to the starters decrements, is updated to be 5, the factor provided by Sally.

Financial projections

The same calculations were undertaken as for the existing business's projections, but with the following adjustments applied:

- The income is calculated based on the updated child projections.

- A start-up fee is added to the outgoings.

- The charges are then calculated based on the difference between the income and total outgoings (including the start up fee). This charge is a percentage of the profit, with a minimum of $250 applied.

- A profit after charges is then calculated by deducting from the previous profits the franchise charge.

Business results

The profits from Sally's own centre and the charges she received from the franchises are combined to determine the overall income Sally receives from her proposed business model. In years 1 to 4 the profits are only those from her centre. It is assumed Sally will sell one franchise a year from the beginning of year 5, hence the income in year 5 is the profits from her centre, plus a fixed fee and a proportion of the first franchise's profits. In year 6 there is the charge on the second year of the first franchises profits and then the fixed fee and the annual charge from the second franchise sold etc.

Target

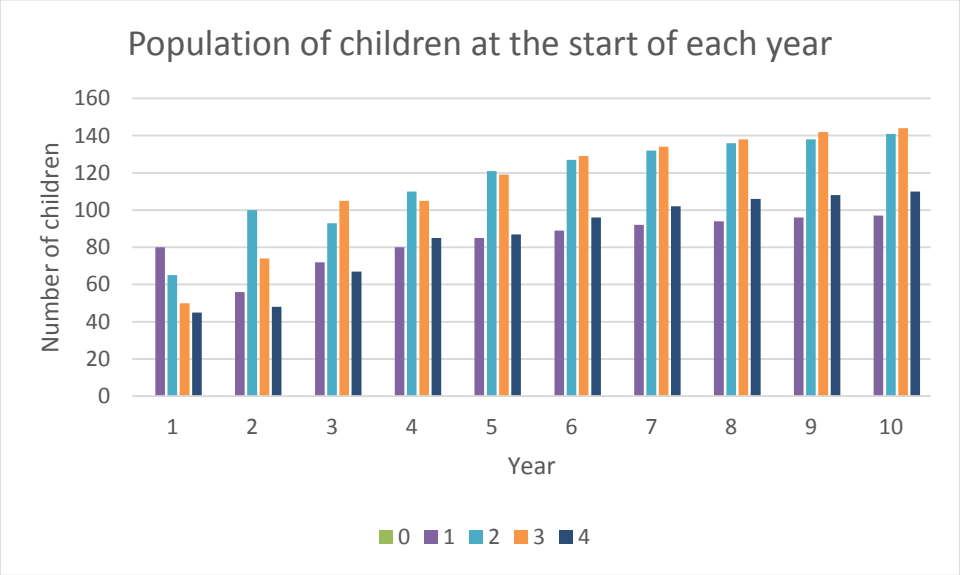
Sally is aiming to reach an annual profit figure of at least $150,000 by the end of year 10. She thinks selling more franchises should make this possible. This model incorporates selling two franchises a year with the starting point determined by a parameter. In order to determine the year in which Sally needs to start selling the franchises the parameter is adjusted using trial and error until the profits are over $150,000.

Results

Existing business

Under the existing business (i.e. the base scenario) the total number of children expected at the beginning of the tenth year is 492.

The evolution of the child population over the ten years can be seen in the following graph:



- It can be seen that the beginning of year in most circumstances the population increases year on year. This is because, overall, the number of children joining the centre is greater than the number of children leaving.

- It can be seen that there are no children age 0 at the beginning of any year. This is because the children are assumed to age in line with the financial years.

- It can be seen that more young children start with the number of children starting reducing with age.

- It can be seen that there are no children over age 4. This is because the centre does not allow children age 5 to join the classes.

- It can be seen that the population grows quicker in the early years and slower towards the end of the projections. This is as a result of the adjustment factor applied to the starter's decrements. The factor follows the same pattern.

When these population projections are applied to the financials the profits in year 10 reach $57,591.

Allowance for franchises

Adjusting the child projections to reflect the expectations of a franchise gives rise to the following number of children signed up in the first 10 years of a franchise's operation:

Year	1	2	3	4	5	6	7	8	9	10
Number of children	132	225	286	324	343	356	364	372	379	386

Updating the financial projections for these child projections and the costs associated with running a franchise gives rise to the following profits over the course of a franchise's first 10 years of operation:

Year	1	2	3	4	5	6	7	8	9	10
Profit after charges	- 3,368	14,386	23,397	24,904	30,490	25,379	28,274	30,830	33,230	34,982

The profits in the first year are negative, mainly as a result of the upfront fee of $10,000 associated with buying the franchise opportunity is assumed to occur at the beginning of year 1. The initial profits are much lower than those that Sally achieves in the existing JJ's business as the initial population for the franchise is relatively small and therefore the income achieved from class fees is low.

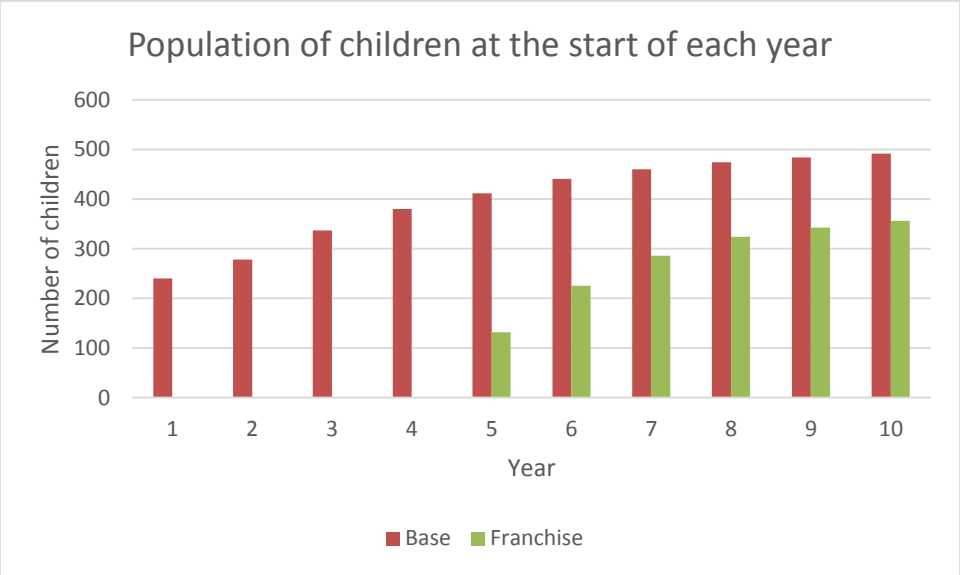
The profits for a franchise are lower in year 10, than for the existing playgroup as there are fewer children assumed to be within a franchises population. This means that the income and therefore profits are lower.

Business results

Once the profits from Sally's business and the franchises are combined profits of $97,480 are achieved in year 10.

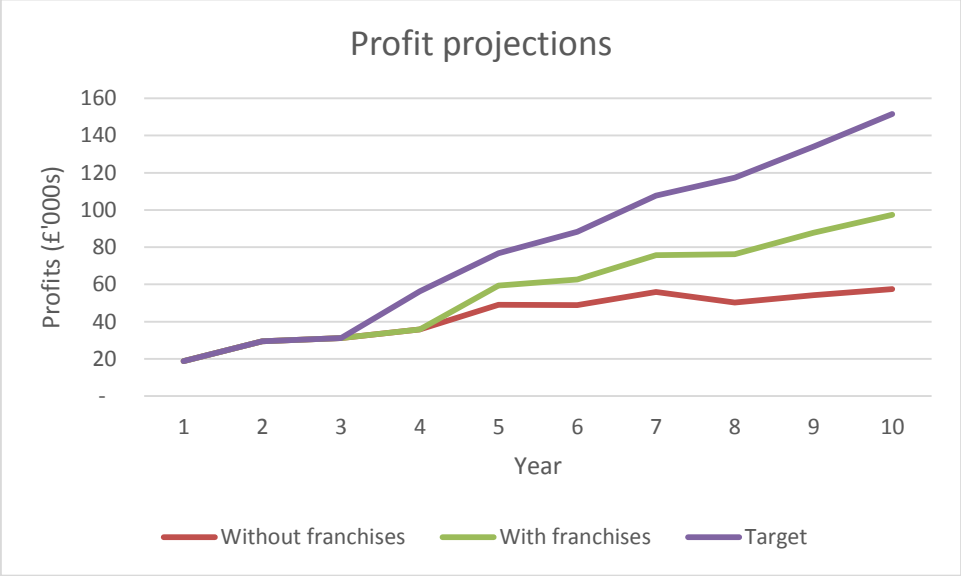
In order to reach annual profits of at least $150,000 in year 10, Sally would need to start selling two franchises a year from year 4. If she were to do this profits of $151,506 are achieved.

The evolution of the children's population under the two different scenarios can be seen in the following chart:



- The base scenario increases at a quicker rate. This is because it has the more favourable starter decrement table and has a lower factor within the adjustment distribution formula.

The financial projections under the three scenarios are shown in the following graph:



- The target line exceeds $150,000 in year 10, demonstrating that Sally's aim is achieved.

- The profits achieved in the without franchises and with franchises scenarios are the same for the first four years. This is because franchises are first sold in year 5, therefore up until that point both scenarios only have the profits from the existing business.

- The profit projections aren't smooth in any of the scenarios. This is due to the semi-variable costs. Every time the population reaches another 40 children the costs jump up.

- The target projections appear smoother as two franchises are being sold from an early stage. This dampens the impact of the semi-variable costs as the jumps will be at different times for the different businesses.

- The "with franchises" and "target" profits diverge from the "without franchise" scenario as from the point at which franchises are assumed to be sold additional ones are sold each year. This means that there are multiple businesses bringing in profits, with additional profit streams added each year.

- The franchise scenarios are always going to produce profits equal to or greater than the without franchise scenario as they all have the profits from the existing business and then the franchise scenarios have additional income. The impact of the franchises is always positive, as it is assumed there are no costs associated with offering franchise opportunities and there is a minimum annual charge of $250.

- The actual, real, profits achieved will depend on:

  – the actual evolution of the child population.
  – actual costs incurred.
  – the impact of taxation on the business.
  – the impact of inflation.

  therefore the profits achieved could be lower or higher than those modelled.

Conclusions

- The child population is expected to grow year on year under the two scenarios proposed.
- Selling franchises has the potential to substantially increase profits.
- Achieving profits of $150,000 in year 10 is possible if two franchises are sold each year from year 4.
- The results are heavily dependent upon the actual evolution of the child populations and the success rate of selling franchises.

Next steps

- Validate the information provided by Sally, in particular the starting population.
- Consider different decrement rates, for example a different number of children starting each year or a different number of children leaving each year.
- Find decrements from other sources, for example ask for data from other well established playgroup businesses with more years' experience.
- Obtain historic population data from JJ's and perform an experience investigation in order to validate the decrements being used.
- Model dependencies e.g. friendship groups/siblings may be more likely to join or leave at the same time.
- Allow for decrements which change over time.
- Verify the suitability of the distribution used to adjust the starting decrements.
- Use a different distribution to model the changes to the starting decrement.
- Obtain more detailed information regarding age of children and allow for this more accurately within the model.

- Confirm whether the timing of children joining or leaving is uniform of whether the timing can be more accurately reflected in the model. Are there any trends which could be more accurately reflected?

- Model variable costs that change with the number of children (economies of scale).

- Allow children not to turn up to a weekly class, or for children to come more frequently than weekly.

- Sensitivity test variable costs – how sensitive are profits to these costs.

- Sensitivity test the class fees – how sensitive are profits to this income.

- Enhance the model to allow for the interaction between number of children and the class fees (higher fees gives rise to lower numbers?).

- Model stochastic population evolution – a range of financial outcomes can be modelled to give best and worst case scenarios.

- Confirm demand for franchises and therefore whether the projections are realistic.

- Sensitivity test the results based on when franchises are first sold.

- Confirm whether any additional costs are experienced as a result of selling franchises.

- Allow for the impact of inflation in the financial projections.

- If necessary enhance the model to allow for monthly cash flows.

- Allow for a shock event. For example, model a sudden increase or drop in the number of children.

- Sensitivity test semi-variable costs – how sensitive are profits to these costs.

- Back test the model using real life data either from JJ's or another well established children's playgroup.

- Update the model as time progresses to allow for actual experience.

- Allow for the impact of taxation (if relevant) in the financial projections.

- Restate the future profits in today's prices.

- Obtain a peer review of the work performed.

END OF SUMMARY