Automating DNA Extraction

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DNA Extraction Automation Analysis

- Current GenomeTrakr Labs
  → each perform between 500 – 1000 DNA extractions annually

- Assessment based on these 2 sample numbers.
Comparisons between performing:

- Manual extraction,
- 1 QIAcube,
- 2 QIAcubes,
- 1 QIAsymphony.
QIAcube and QIAsymphony Comparison

COST AND TIME
Cost Analysis

QIAcube
($20,727.00)

QIAsymphony
($102,443.00)

Sunk Cost
→ The cost that has already been incurred and cannot be recovered.
Cost analysis

Total Cost =

Fixed Costs → stay the same regardless of the amount of production

Example: Utilities, Employee salaries

Variable Costs → change depending on the amount of production

Example: Production materials

For our comparisons, we will let utilities and employee salaries (fixed costs) be the same so our equation becomes:

Total Cost = Variable Cost
Materials Used in Production

<table>
<thead>
<tr>
<th>Item</th>
<th>CAT#</th>
<th>Cost/Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNeasy Blood &amp; Tissue Kit (250)</td>
<td>69506</td>
<td>$700.00</td>
</tr>
</tbody>
</table>
## Materials Used in Production

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<tr>
<td>Filter Tips, 200ul (1024)</td>
<td>990332</td>
<td>$97.80</td>
</tr>
<tr>
<td>Filter Tips, 1000ul (1024)</td>
<td>990352</td>
<td>$98.70</td>
</tr>
<tr>
<td>QIAamp DNA mini QIAcube Kit (240)</td>
<td>51326</td>
<td>$795.00</td>
</tr>
</tbody>
</table>

*Includes rotor adaptors, proteinase k, and buffers*
## Materials Used in Production

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<tr>
<td>Filter Tips, 1500ul (1024)</td>
<td>997024</td>
<td>$123.00</td>
</tr>
<tr>
<td>Elution Microtubules CL (24 x 96)</td>
<td>19588</td>
<td>$588.00</td>
</tr>
<tr>
<td>Sample-Prep Cartridges (8-well) (336)</td>
<td>997002</td>
<td>$137.00</td>
</tr>
<tr>
<td>8-rod covers (144)</td>
<td>997004</td>
<td>$96.50</td>
</tr>
<tr>
<td>QIAsymphony DSP Virus/Pathogen Mini Kit (192)</td>
<td>937036</td>
<td>$1,035.00</td>
</tr>
</tbody>
</table>
Total Material Cost vs Extraction Method

- Manual QIAcube QIAsymphony
- 500 Samples
- 1000 Samples

- $1,000.00
- $2,000.00
- $3,000.00
- $4,000.00
- $5,000.00
- $6,000.00
- $7,000.00
- $8,000.00
- $9,000.00
Cost/Unit vs Extraction Method

- Manual QIAcube QIAsymphony

$-$ 1.00 2.00 3.00 4.00 5.00 6.00 7.00 8.00 9.00 10.00

500 Samples
1000 Samples

Manual QIAcube QIAsymphony
Material Cost/DNA vs # of DNAs to Extract

- **QIAcube**
  - $y = 234.18x^{-0.504}$

- **QIAsymphony**
  - $y = 95.055x^{-0.478}$

- **Manual**
  - $y = 51.063x^{-0.421}$

**Graph Details:**
- Material Cost/DNA range: $5.00 to $50.00
- # of DNAs to Extract range: 0 to 1200
- Graph shows cost-effective DNA extraction for different numbers of samples.
Estimated Cost/Unit

<table>
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<th>Cost/Unit</th>
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<tr>
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<td>$51.063x^{-0.421}$</td>
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<tr>
<td>QIAsymphony</td>
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- These equations show *estimated* costs/unit, not exact.
- QIAsymphony cost/unit will never reach \( \rightarrow \) equal cost with the QIAcube cost/unit.
- Manual cost/unit will equal the QIAcube cost/unit at approximately 50,000 DNAs!
QIAcube and QIAsymphony Comparison

COST AND TIME
Hourly Production Rate

Hourly Production Rate = \( \frac{\text{# of Produced Units}}{\text{# of Production Hours/day}} \)

For our purposes:
- “produced units” are **DNAs** and
- “production hours/day” is **8 hours**
Instrument Sample Prep Times

- **QIAcube**
  - Lysis done during run (on-instrument)
  - Total Sample/Machine Prep Time
  - (1 run of 12): \(~40\ \text{minutes}\)

- **QIAsymphony**
  - Has a 45 minute extra lysis step, regardless of species (lysis off-instrument)
  - Total Sample/Machine Prep Time
  - (1 batch of 24): \(~1\text{hr 45 minutes}\)
  - (96 samples): \(~3\text{hrs 30 minutes}\)
**Instrument Run Times**

**QIAcube**
- Full run of 12 samples → **75 minutes**

**QIAsymphony**
- Batch of 24 samples → **55 min**
- Full run of 96 samples → **3hrs and 40 min**
Units Produced vs Hours
(1 QIAcube, 1 QIAsymphony - without prep in between runs)

<table>
<thead>
<tr>
<th></th>
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<th>1 QIAcube</th>
<th>1 QIAsymphony</th>
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<td>Hourly Production Rate</td>
<td>7.5 DNAs/hr</td>
<td>6 DNAs/hr</td>
<td>12 DNAs/hr</td>
</tr>
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Units Produced vs Hours

(1 QIAcube, 1 QIAsymphony - with prep in between Runs)

Manual 1 QIAcube 1 QIAsymphony

Hourly Production Rate

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Units Produced vs Hours
(2 QIAcubes, 1 QIAsymphony - with prep in between Runs)

<table>
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<th>2 QIAcubes</th>
<th>1 QIAsymphony</th>
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<tr>
<td>Hourly Production Rate</td>
<td>7.5 DNAs/hr</td>
<td>15 DNAs/hr</td>
<td>12 DNAs/hr</td>
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Units/Day vs Number of Days (All Methods)

- QIAcube
- QIASymphony
- 2 QIAcubes
- Manually

500 DNA Goal
1000 DNA Goal
Conclusions -1

QIAsymphony →

• made with high throughput production in mind

• up to consumer to make the decision to buy

• cost to run is around double the QIAcube’s cost to run

• this cost never goes lower than the QIAcube’s cost to run
Conclusions -2

Choice of QIAsymphony:
→ if needing a large amount of samples extracted in a short period of time (e.g. work week)

→ for production greater than 144 DNAs daily output

If time is not a factor:
→ manual extraction or QIAcube should always be chosen.
Conclusions -3

One disadvantage is that

the QIAsymphony has more materials that are consumed (6 vs 3) at different rates,

therefore, if not careful,

materials could run out before performing the following run.
Any Questions?