Abstract

Calculates and prints successive lines of Pascal’s triangle.

\[
\begin{array}{cccccc}
  (f + s)^5 & 1f^4s^0 & 4f^3s^1 & 6f^2s^2 & 4f^1s^3 & 1f^0s^4 \\
  (f + s)^5 & 1f^5s^0 & 5f^4s^1 & 10f^3s^2 & 10f^2s^3 & 5f^1s^4 \\
  (f + s)^5 & 1f^5s^0 & 5f^4s^1 & 10f^3s^2 & 10f^2s^3 & 5f^1s^4 \\
\end{array}
\]

and also will typeset the following proof

\[
7! = 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1
\]

\[
\begin{align*}
\binom{n}{r} &= \frac{n!}{(n-r)! \cdot r!} = \frac{n!}{(n-r)! \cdot (n-(n-r))!} = \binom{n}{n-r} \\
\binom{n-1}{r-1} + \binom{n-1}{r} &= \frac{(n-1)!}{(r-1)! \cdot [(n-1) - (r-1)]!} + \frac{1}{r! \cdot [(n-1) - r]!} \\
&= \frac{(n-1)!}{(r-1)! \cdot (n-r)!} \cdot \frac{1}{r! \cdot [(n-1) - r]!} \\
&= \frac{(n-1)! \cdot r + (n-r)}{r!(n-r)!} \\
&= \frac{n!}{r! \cdot (n-r)!} = \binom{n}{r}
\end{align*}
\]

\
\begin{align*}
\frac{r}{r! \cdot (n-r)!} &= \frac{1}{(r-1)! \cdot (n-r)!} = \frac{1}{(r+1)! \cdot (n+1)! \cdot (n+1)-(r+1)!} \\
&= \frac{(n+1)!}{r! \cdot (n-r)!} = \frac{n!}{r! \cdot (n-r)!} = (n+1) \cdot \binom{n}{r}
\end{align*}

1 Introduction

A very simple package with simple usage. Putting ‘binomexp’ (which is also typed exactly the same way than {\{binomexp\}} inside of the argumentative input of the \usepackage commands enables the user to do two extra things.

*This document corresponds to binomexp v1.0, dated 2007/01/07.
• print any successive rows of Pascal’s triangle which will fit on the page up
until the power as 31, at which point \LaTeX runs out of brain power.

• Use a piece of code which Morten Høgholm wrote which allows the cells
inside of an array or a tabular to be repeated in a similar way than those
may be repeated inside of the initial description of said array or tabular.

2 Usage

Binomexp ought to load ifthen and calc by itself. If you have already loaded these
packages using \usepackage{calc,ifthen} unload these therefore. You must
then use the command as \makeatletter so to get the command names with the
symbol as @ inside of those to function.

\begin{verbatim}
\binomexp@putpascal \{\langle number as lower power\rangle\} \{\langle number as higher power\rangle\} \{\langle symbol as first variable\rangle\} \{\langle symbol as second variable\rangle\} \{\langle symbol again as first variable\rangle\} \{\langle symbol again as second variable\rangle\}
\binomexp@putpascal \{7\} \{9\} \{f\} \{x\} \{f\} \{x\}
\binomexp@putpascal\{\langle number as row variable\rangle\} \{\langle number as column variable\rangle\}
\end{verbatim}

will typset the rows as 7, 8, and 9 of Pascal’s triangle. The first column will have \(f + x\)^power. The reason why
you have to input the symbol again is because the user might like to use a \texttt{\cdot}
or whatever in the other columns except the first column. And that’s it really.

\begin{verbatim}
\binomexp@proof \{\langle number as row variable\rangle\} \{\langle number as column variable\rangle\}
\end{verbatim}

will typset the mathematical proof of Pascal’s triangle, which is based upon the ob-
servation that the co-efficient is equal with the number of possible combinations
of the column variable out of the row variable.

3 How I wrote it.

\begin{verbatim}
1 \RequirePackage{calc,ifthen}
Morten Høgholm wrote the following code.
2 \newcommand\binomexp@replicate[2]{%\
3 \ifnum#1>\z@ \expandafter\@firstofone
4 \else
5 \expandafter\@gobble
6 \fi
7 \{#2\expandafter\binomexp@replicate\expandafter{\number\numexpr#1-1\relax}{#2}\}%
8 }\
\end{verbatim}

Morten’s code allows the following.
\begin{verbatim}
begin{document}
makeatletter
begin{tabular}{|*{6}{|c|}|}
something1 \binomexp@replicate{4}{& something2}Blah\&stuff\\ 
something1 \binomexp@replicate{4}{& something2}Blah\&stuff\\ 
end{tabular}
end{document}
\end{verbatim}
You can invoke Morten’s code either by loading the \usepackage{binomexp} within the preamble, and then by putting \makeatletter, or by including the following code somewhere (perhaps a preamble).

\makeatletter
\newcommand\binomexp@replicate[2]{%  
  \ifnum#1>\z@ \expandafter\@firstofone \else \expandafter\@gobble \fi  
  {#2}\expandafter\binomexp@replicate\expandafter{\number\numexpr#1-1\relax}{#2}  
} \makeatother

\binomexp@call the \newcommand as \binomexp@call makes things nice and pretty within a cell  
\binomexp@up the \newcommand as \binomexp@up is by the power of the series which ascends  
\binomexp@down the \newcommand as \binomexp@down is by the power of the series which descends  
\binomexp@columns an array of so many columns  
\binomexp@power \( (f + s)^{\text{power}} \)  
\binomexp@pascalstart the next 3 counters are used within the \binomexp@putpascal command  
\binomexp@pascalstop  
\binomexp@emptytimes  
\binomexp@variable1 the following 3 counters are used within the process of calculation as \binomexp@printpascal  
\binomexp@variable2  
\binomexp@answervar  
\binomexp@sub to calculate the coefficients of the Pascal’s triangle  
\binomexp@printpascal to calculate the coefficients of the Pascal’s triangle
TRANSFER PART set counter as binomexp@sub to 1
42 \setcounter{binomexp@sub}{2}
create a loop which shall get the binomexp@y values and put those into the appropriate binomexp@x values. Also export the y values by this same corresponding power into a length called binomexp@morten\roman{power}\export\roman{binomexp@sub}
43 \whiledo{\number\value{binomexp@power}+1>\value{binomexp@sub}}{
44 \setcounter{binomexp@answervar}{\number\numexpr\csname binomexp@y\roman{binomexp@sub}\endcsname\relax}
45 \expandafter\edef\csname binomexp@x\roman{binomexp@sub}\endcsname\relax{\number\value{binomexp@answervar}}
46 \addtocounter{binomexp@sub}{1}
47 }
Here is how I exported the values to the table.
48 \expandafter\edef\csname binomexp@morten\roman{binomexp@power}\export\roman{binomexp@sub}\endcsname\relax{\number\value{binomexp@answervar}}
51 \addtocounter{binomexp@sub}{1}
52 }
53 \setcounter{binomexp@variable1}{\numexpr\number\value{binomexp@power}+1\relax}
54 \expandafter\edef\csname binomexp@morten\roman{binomexp@power}\export\roman{binomexp@variable1}\endcsname\relax{\number\value{binomexp@answervar}}
56 \expandafter\edef\csname binomexp@morten\roman{binomexp@power}\export\roman{binomexp@variable1}\endcsname\relax{\number\value{binomexp@answervar}}
To see what is happening add the following lines at this place.
\begin{verbatim}
power is \number\value{binomexp@power}\par
\setcounter{binomexp@variable2}{1}
\whiledo{\value{binomexp@variable2}<\numexpr\number{\value{binomexp@power}}+2\relax}{
binomexp@morten\roman{binomexp@power}\export\roman{binomexp@variable2}\is\csname binomexp@morten\roman{binomexp@power}\export\roman{binomexp@variable2}\endcsname\relax\par\addtocounter{binomexp@variable2}{1}}
\end{verbatim}

\binomexp@putpascal set binomexp@xi as 1
\begin{verbatim}
binomexp@xi never alters
\end{verbatim}
set an eventuality for binomexp@xi by the power as zero

we’ll need to start power as zero by the way `binomexp@printpascal` is transfigured.

we’ll need to start power as zero by the way `binomexp@printpascal` is transfigured.

wrap the chipolatas in stringy bacon.

now calculate all the co-efficients.

work out the number of columns

now the table

repeat the number of rows so many times

prime the binomexp@up gun and cock.

prime the binomexp@down gun and cock.

add one more row for luck

This command prints a mathematical proof of the Pascals’s triangle based upon obervation.

\binomexp@proof
\begin{eqnarray*}
\binom{#1}{#2} &=& \frac{#1!}{(#1-#2)!(#1-(#1-#2))!} = \binom{#1}{#1-#2} \\
\binom{#1}{#2} + \binom{#1}{#2} &=& \frac{(#1 - 1)!}{(#2 - 1)!(#1 - #2)!} + \\
&=& (#1 - 1)\cdot\left(\frac{1}{(#2 - 1)!(#1 - #2)!} + \frac{1}{#2!(#1 - #2)!}\right) \\
&=& \frac{#1!}{#2!(#1 - #2)!} = \binom{#1}{#2} \\
\end{eqnarray*}

\frac{#2}{#2!(#1-#2)!} = \frac{1}{(#2-1)!(#1-#2)!}
\hspace*{5em} \text{because} \hspace*{5em} \\
\frac{6}{6!(#1-#2)!} = \frac{1}{5!(#1-#2)!}
\begin{eqnarray*}
(#2 + 1)\cdot \binom{#1 + 1}{#2 + 1} &=& (#2 + 1)\cdot \frac{(#1 + 1)!}{((#2 + 1)!\cdot ((#1 + 1) - (#2 + 1))!} \\
&=& (#2 + 1)\cdot \frac{(#1 + 1)!}{(#2 + 1)!\cdot (#1 - #2)!} \\
&=& (#1 + 1)\cdot \frac{#1!}{#2!(#1 - #2)!} = (#1 + 1)\cdot \binom{#1}{#2} \\
\end{eqnarray*}

\textbf{Index}

Numbers written in italic refer to the page where the corresponding entry is described; numbers underlined refer to the code line of the definition; numbers in roman refer to the code lines where the entry is used.

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\textbf{Symbols}
\end{center}

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